Roads & Maritime

Nowra Bridge
Soil and Water Assessment

August 2018

Roads and Maritime Services

Nowra Bridge Project
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Prepared by SMEC Australia Pty Ltd and Roads and Maritime Services.

Document controls

Document status

Document status	Date	Prepared by	Reviewed by
First draft	16/03/2018	Alexander Williams	Daniel Saunders
Final	17/08/2018	Alexander Williams	Daniel Saunders

Executive summary

NSW Roads and Maritime Services (Roads and Maritime) together with SMEC Australia Pty Ltd (SMEC) have prepared this Soil and Water Assessment for the proposed construction of a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal). The proposal would include the upgrade of the Princes Highway near the bridge, as well as key intersection upgrades and modifications to the local road network. The proposal would improve access to Nowra and the surrounding areas, improve access for larger trucks, and reduce traffic delays. The proposal extends for about 1.6 kilometres along the existing Princes Highway in the Shoalhaven local government area (LGA).

This report documents the existing soil and water environment and identifies the potential impacts that the proposal may have on soil and water environments. It addresses both construction and operational phases of the proposal and identifies soil and water management measures appropriate for mitigating the potential environmental impacts. Management measures have considered the requirements of relevant guidelines, policy and legislation so that soil and water environment impacts are minimised.

This technical report supports the proposal's Review of Environment Factors (REF) and provides guidance for the following environmental aspects associated with construction and operation of the proposal:

- Erosion and sedimentation
- Surface water quality
- Groundwater resource
- Acid sulfate soils
- Contaminated land and hazardous materials (including asbestos).

For each aspect, mitigation measures have been recommended to minimise the soil and water impacts of the proposal. Mitigation measures that may be incorporated into the proposal are summarised below. Following implementation of mitigation measures, it is not anticipated that any residual impacts will remain because of the proposal.

Construction phase

Erosion and sedimentation

Mitigation and management of sedimentation and erosion impacts during construction would be in accordance with the strategies recommended in the Blue Book (Soils and Construction 2004 and 2008). At this stage, a high erosion risk has been determined in accordance with the Roads and Maritime Erosion and Sedimentation Management Procedure (RTA Procedure PN 143P). The assigned risk is due to proximity to water bodies. Standard erosion control measures defined in *Managing Urban Stormwater – Soil and Construction* (Landcom, 2004) are considered adequate for construction over land works planning.

Erosion and sediment control measures would be implemented for the exposed soil areas during the construction stage that include construction sediment basins, catch and diversion drains, stabilisation of exposed faces, and local controls such as sediment fences, check dams, windrows, sumps. Instream and over water sediment control measures would be specifically tailored to the flow characteristics of the Shoalhaven River and Bomaderry Creek, and would include protections such as turbidity booms and/or temporary coffer dam/caissons.

Surface water

The NSW Government has not formally adopted water quality objectives for the Shoalhaven River catchment. However, the impacts of the proposal have been assessed against typical NSW water quality objectives for estuaries, including the protection of aquatic ecosystems, visual amenity, secondary contact recreation, primary contact recreation and aquatic foods (cooked). The impacts of the proposal have been determined with reference to trigger values for each indicator relevant to these water quality objectives. These trigger values are consistent with the equivalent environmental values in the ANZECC 2000 Guidelines. This assessment has concluded that there is unlikely to be a significant change within the Shoalhaven River or Bomaderry Creek.

Surface water quality impacts would be managed through the implementation of a Soil and Water Management Plan as part of the Construction Environmental Management Plan. Water quality monitoring within Bomaderry Creek and Shoalhaven River would be carried out to assess and demonstrate the effectiveness of management measures.

Groundwater

Groundwater has the potential to interact with the proposal through inflows into piling columns, cuttings and excavations. If the inflow is significant, dewatering may be required and/or ongoing drainage and disposal measures may need to be implemented. It is likely any dewatering and / or ongoing inflows which impact the local groundwater system would require consideration of potential impacts and licensing in consultation with the Department of Primary Industries.

Acid sulfate soils

Mitigation of acid sulfate soils impacts would be carried out during detailed design and construction stages. Avoidance of ground disturbance would be adopted where possible during detailed design. A further assessment involving soil sampling and testing would be carried out during additional geotechnical investigations in areas where ground disturbance is expected. An Acid Sulfate Soils Management Plan (ASSMP) would detail the site-specific requirements and or locations for handling, treatment and disposal of acid sulfate soils during construction stage.

Contaminated land and hazardous materials

Contaminated land impacts would undergo further assessment involving soil sampling and testing to confirm the nature, degree and preliminary extent of contaminated soils and or pavements. Eight areas of environmental concern have been identified within the proposal study area, five which have a moderate to high potential for encountering soil contamination. There is low potential for groundwater contaminants (if any) to be encountered because of expected construction activities associated with the proposal. Hazardous material surveys are also recommended within the existing southbound bridge, within structures proposed for demolition and at buried utilities and service pits to identify and control risks of exposure.

Operational phase

A separate operational water quality assessment has been prepared to consider potential water quality impacts on receiving waterways during operation.

Operational impacts associated with soil and water aspects such as contamination, acid sulfate soils, groundwater and management of hazardous substances are not considered significant and can be effectively minimised through additional investigation, the development and implementation of appropriate management practices.

Further assessment

Further assessment and reporting is recommended during detailed design and construction stages as outlined below:

- Phase 2 Contamination Assessment targeting identified Areas of Environmental Concern
- Hazardous materials assessment (targeting the existing southbound bridge, structures identified for demolition, buried utility and service pits).
- Groundwater dewatering strategy
- Management plans to form part of the Construction Environmental Management Plan including:
  - Acid Sulfate Soils Management Plan
  - Hazardous Materials Management Plan
  - Waste and Energy Management Plan.

Where more than minor changes occur, consultation with Roads and Maritime would determine if any additional environmental impact assessment is required.

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Glossary of terms

Definitions

Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (OEH 2014).
Indirect impact	Where an event or circumstance is a direct consequence of the action (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1: 250,000 (OEH 2014).
Mitigation	Action to reduce the severity of an impact (OEH 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Population	All the individuals that interbreed within a given area.
Proposal area/ Proposal site	The area of land that is directly impacted on by a proposed Major Proposal that is under the EP&A Act, including access roads, and areas used to store construction materials (OEH 2014).
Study area	The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly (OEH 2014).
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.

Acronym	
AEC	Areas of environmental concern
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASRIS	Australian Soil Resource Information System
ASSMAC	Acid Sulfate Soils Management Advisory Committee
ASS	Acid sulfate soil
AS/NZS	Australian Standards/New Zealand Standards
bgl	below ground level
CEMP	Construction Environmental Management Plan
CLM Act	*Contaminated Land Management Act 1997*
CLMP	Contaminated Land Management Plan
DP&E	Department of Planning and Environment
DPI	Department of Primary Industries
EPA	NSW Environment Protection Authority
EPL	Environment protection licence
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Federal)
ESCMP	Erosion and Sediment Control Management Plan
FM Act	*Fisheries Management Act 1994*
GDE	Groundwater dependent ecosystem
LS	Slope Length
NWQMS	National Water Quality Management Strategy
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
OEH	Office of Environment and Heritage
PASS	Potential acid sulfate soils
PEI	Preliminary Environmental Investigation
Phase 1	Phase 1 contamination assessment
POEO Act	*Protection of the Environment Operations Act 1997*
PSC	Professional Services Contract
REF	Review of Environmental Factors

Acronym	
RRT Act	*Dangerous Goods (Road and Rail Transport) Act 2008*
Roads and Maritime	Roads and Maritime Services
RUSLE	Revised Universal Soil Loss Equation
SEPP	State Environmental Planning Policy
SC Act	*Soil Conservation Act 1938*
SLC	Soil Loss Class
SWMP	Soil and Water Management Plan
TECs	Threatened Ecological Communities
TSC Act	*Threatened Species Conservation Act 1995*
WM Act	*Water Management Act 2000*

1 Introduction

1.1 Background

NSW Roads and Maritime Services (Roads and Maritime) together with SMEC Australia Pty Ltd (SMEC) have prepared this Soil and Water assessment for the proposed construction of a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal). The location of the proposal is shown in Figure 1-1.

Previous studies, relevant to this assessment, have been commissioned by Roads and Maritime for the proposal including:

- *Nowra Bridge Project. Preliminary Environmental Investigation* (AECOM 2014)
- *Nowra Truss Bridge. Draft Phase 1 Conservation Management Plan* (Artefact, June 2015)

The Preliminary Environmental Investigation (PEI) identified potential environmental constraints and opportunities that may influence the development of design options for an alternative crossing of the Shoalhaven River at Nowra. The analysis focused on a broad study area that covers all of Options 1 to 5, given more refined alignments or engineering design requirements are still being developed.

Following the PEI, a concept design has been developed for the proposal and has informed preparation of this assessment.

1.2 The proposal

Key features of the proposal include:

- Construction of a new bridge to the west (upstream) of the existing bridge crossings over the Shoalhaven River including:
  - Four northbound lanes including a dedicated left turn only lane from Bridge Road to Illaroo Road
  - A 3.5 metre wide shared use path on the western side of the bridge connecting the Illaroo Road intersection to the Bridge Road intersection
- Widening of the existing bridge over Bomaderry Creek
- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic
- Removal of vehicular traffic and closure of the existing southbound bridge to undertake investigation, rehabilitation and repurposing work for adaptive reuse following opening of the new northbound bridge. As part of the proposal, shared paths and maintenance access would be constructed up to the existing southbound bridge and work to prevent unauthorised access would also be carried out. The rehabilitation and repurposing of the existing southbound bridge for adaptive reuse would be subject to a separate consultation and assessment process to this REF
- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to about 75 metres north of the Moss Street intersection
- Widening of Illaroo Road over a distance of about 270 metres
- Upgrading of the Princes Highway and Illaroo Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Illaroo Road

  - Three dedicated right turn lanes and one dedicated left turn lane from Illaroo Road to Princes Highway
  - An acceleration and merge lane for northbound traffic turning into Illaroo Road from Princes Highway
- Upgrading of the Princes Highway and Bridge Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Bridge Road
  - One left turn lane from Bridge Road to the Princes Highway
- Local road adjustments including:
  - Closing the access between Pleasant Way and Princes Highway
  - Restricting turning movements at the intersection of Bridge Road and Scenic Drive
  - Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection
- Provision of pedestrian facilities at all intersections
- Dedicated off road shared paths and footpaths along the length of the proposal.
- Urban design and social amenity improvements, and landscaping including foreshore pedestrian links to the existing southbound bridge
- Relocation and/or protection of utility services
- Drainage and water quality management infrastructure along the road corridor
- Property works including acquisition, demolition, and adjustments to accesses
- Temporary ancillary facilities during construction including site offices, construction compounds, and stockpile sites.

Following completion of all construction activities, northbound and southbound traffic would be transferred to the new bridge and existing concrete bridge respectively. Temporary fencing would be installed at the northern and southern ends of the existing southbound bridge to prevent access to the former traffic lanes pending finalisation of investigations and design development for the adaptive reuse of the bridge deck area for use by pedestrians and cyclists. This would be carried out as a separate activity to the current proposal. The existing walkway attached to the bridge in the early 1980s would remain available for use by pedestrians to continue to provide access in the interim.

Roads and Maritime is intending to deliver the new bridge through a 'Design and Construct' procurement strategy. To maintain flexibility regarding the final bridge form, the assessment addresses the following two options:

- Box girder, constant depth (incrementally launched bridge)
- Pre-cast concrete beam (Super-T).

Key features of the proposal including the construction boundary and proposed ancillary sites for construction are shown in Figure 1-2.

Figure 1-1 Regional location of the proposal

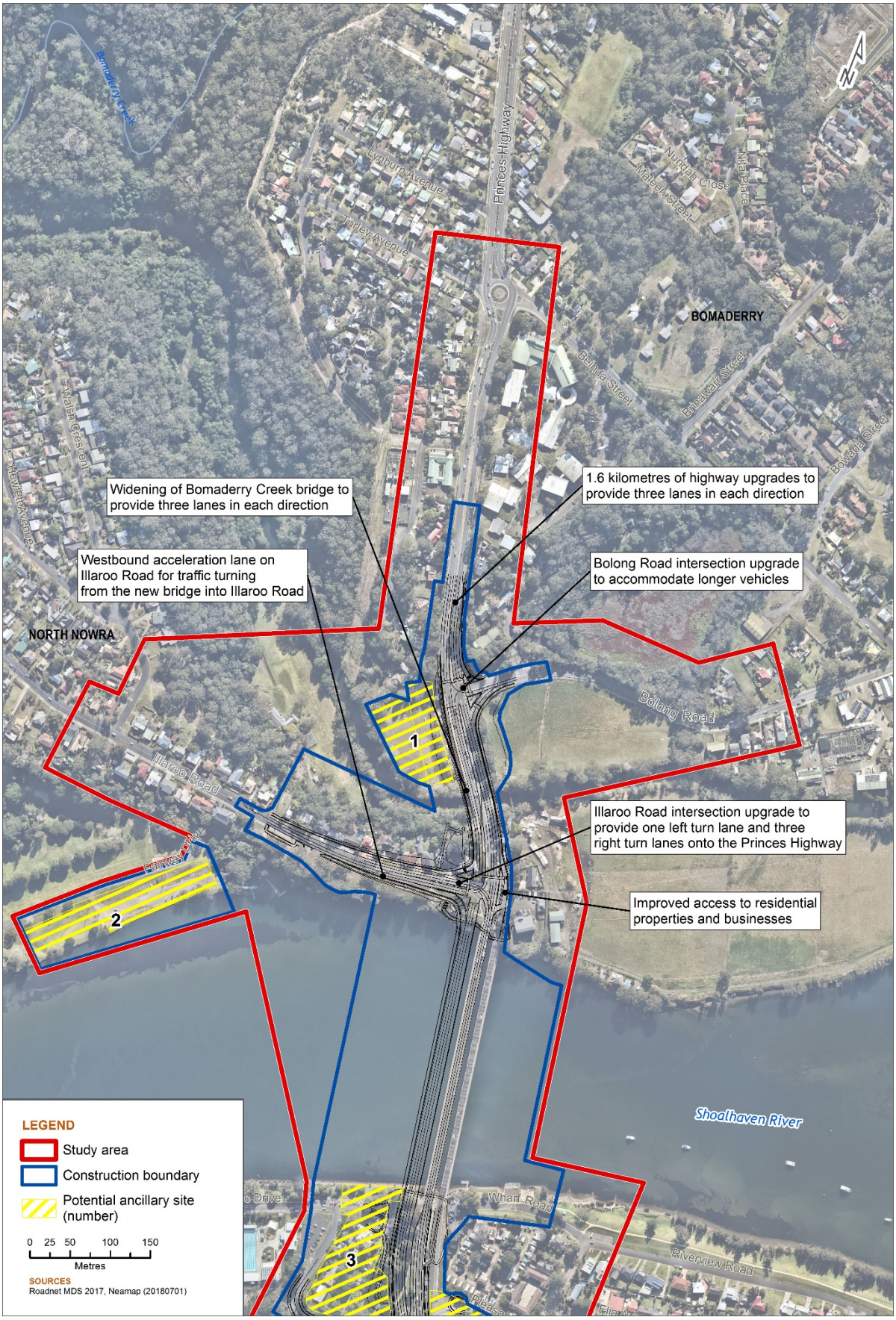

Figure 1-2 Key features of the proposal – north

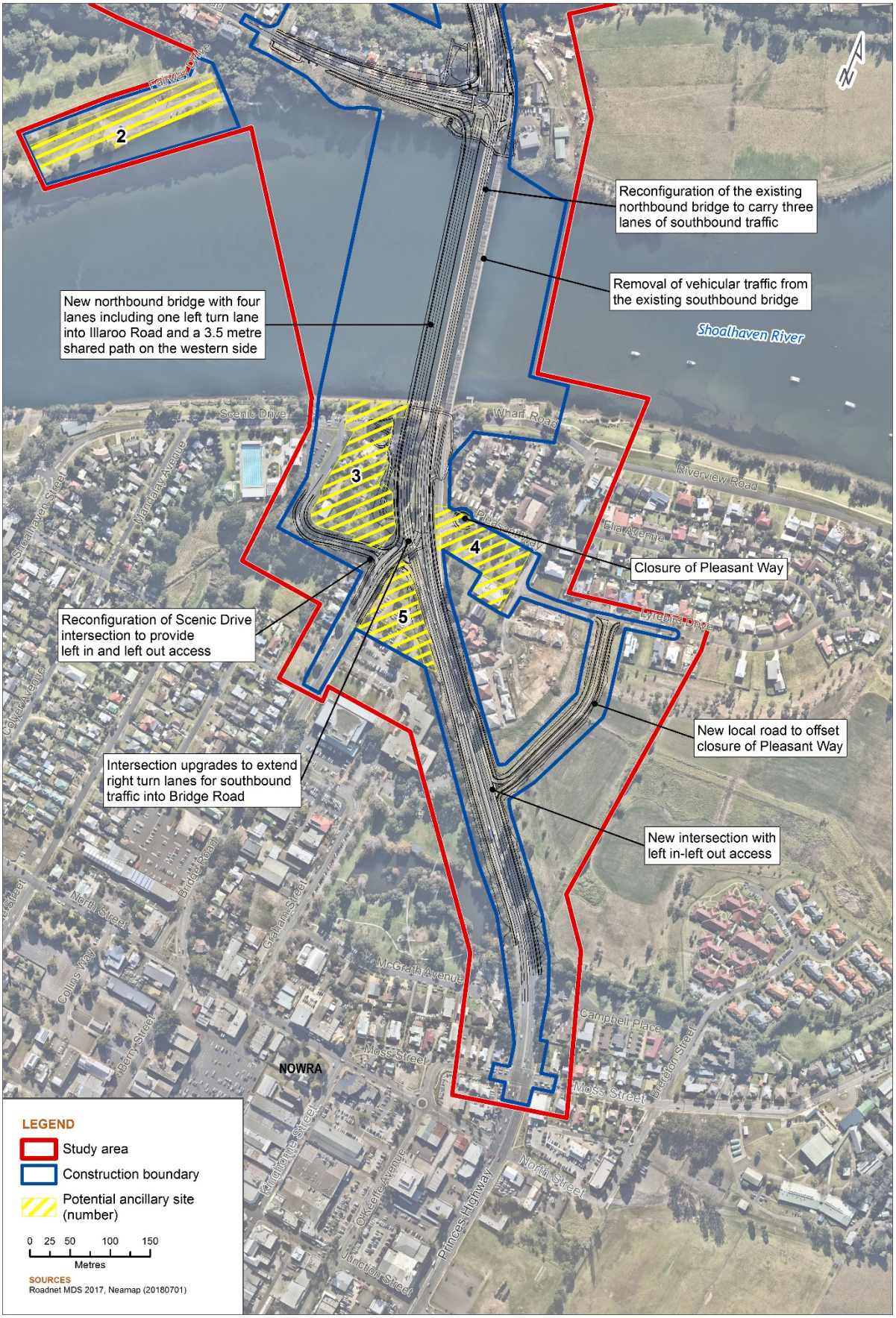

Figure 1-3 Key features of the proposal – south

1.3 Purpose of this report

This assessment documents the existing soil and water environment and identifies potential impacts that the proposal may have on soil and water environments. It focusses principally on the construction phase but also considers potential operational impacts related to sedimentation and erosion risk, acid sulfate soils (ASS), and contaminated land and hazardous materials. Consideration of operational water quality impacts is provided in a separate report. Management measures to mitigate identified and potential environmental impacts have been developed in accordance with relevant guidelines, policy and legislation so that soil and water environment impacts are minimised.

1.4 Legislative context

A Review of Environmental Factors (REF) has been prepared to satisfy Roads and Maritime's obligations under section 111 of the EP&A Act to 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity' and section 112 in making decisions on the likely significance of any environmental impacts. This soil and water assessment forms part of the REF being prepared for the Nowra Bridge proposal, and assesses the soil and water impacts of the proposal to meet the requirements of the EP&A Act.

Legislation relating to soil and water management has been considered in the context of the proposal and is discussed below.

1.4.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) sets the framework for environment protection during the construction and operation of a development or during the undertaking of an activity. The POEO Act consolidates key pollution statutes relating to air, water and noise pollution and environmental offences, and establishes a duty to notify either the Environment Protection Authority (EPA) or the local council where incidents are likely to cause material harm to the environment.

Under the Protection of the Environment Operations (Waste) Regulation 2017 (Waste Regulation) the EPA may grant permission for a waste to be used for a specified purpose, subject to strict conditions. This usually applies where it can be demonstrated that a specific type of waste can safely be used for another purpose, rather than being disposed of in accordance with the Waste Regulation. Under the Waste Regulation, the EPA would issue two separate documents: a resource recovery order and a resource recovery exemption.

There are several resource recovery orders and resource recovery exemptions currently in force which may be used by anyone in NSW, without seeking approval from the EPA, provided the waste generators, processors and consumers fully comply with the conditions. Where possible the proposal would seek to reuse waste in accordance with the current resource recovery orders and exemptions. A full list of these is provide on the EPA website[1].

Those of likely or potential relevance to the proposal include:

- Excavated natural material
- Excavated public road material

[1] https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/resource-recovery-framework/current-orders-and-exemption

- Mulch
- Reclaimed asphalt pavement.

1.4.2 Soil Conservation Act 1938

The *Soil Conservation Act 1938* (SC Act) provides for the conservation of soil resources and farm water resources and for the mitigation of erosion. The Act allows the Minister to declare an area protected area if it is:

- Land within a catchment area with a slope of greater than 18 degrees from the horizontal
- Land which is within 20 metres of the bed or bank of a river or lake, or
- Land that is environmentally sensitive or affected or liable to be affected by soil erosion, siltation or land degradation.

The proposal study area contains portions of land that meet one or more of the above criteria, principally associated with construction activities that would occur along the banks of the Shoalhaven River and Bomaderry Creek, and have potential for soil erosion. Risks would be effectively mitigated through implementation of appropriate sedimentation and erosion controls.

1.4.3 Dangerous Goods (Road and Rail Transport) Act 2008

The purpose of the *Dangerous Goods (Road and Rail Transport) Act 2008* (RRT Act) is to regulate the transport of dangerous goods by road and rail to promote public safety and protect property and the environment.

The fuels used in the construction phase are classified as dangerous goods by the Australian Dangerous Goods Code and would require transport to ancillary sites and construction plant by road. The RRT Act would require both the vehicle transporting dangerous goods and the driver of the vehicle to be licensed under the RRT Act.

1.4.4 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the protection of river and lakeside land in NSW and aims to provide for the sustainable management of the water resources throughout NSW. It identifies provisions relating to 'controlled activities' which includes (among other definitions) the carrying out of any activity that affects the quantity or flow of water in a water source or affects land fronting a waterway.

In accordance with clause 39A(1) of the Water Management (General) Regulation 2004, Roads and Maritime, as a public authority, is permitted to undertake works within 40 metres of a watercourse without the need to obtain a permit under the WM Act. A notification of the activity would need to be provided to WaterNSW at least 30 days before the activity commences.

If groundwater extraction is required for the proposal, an aquifer interference approval would be required for the work under section 91F of the WM Act. The NSW Aquifer Interference Policy was released in September 2012. Under the policy, and the associated WM Act, an aquifer is a geological structure or formation that is permeated with water or is capable of being permeated with water. Groundwater is defined as all water that occurs beneath the ground surface in the saturated zone. For the policy, the term 'aquifer' has the same meaning as groundwater system.

The WM Act defines an aquifer interference activity as the:

- Penetration of an aquifer

- Interference with water in an aquifer
- Obstruction of the flow of water in an aquifer
- Taking of water from an aquifer while carrying out mining or any other activity prescribed by the regulations
- Disposal of water taken from an aquifer while carrying out mining or any other activity prescribed by the regulations.

The requirement to seek a water license under the WM Act would be determined in consultation with the WaterNSW during detailed design. A license would be required, unless an exemption applies or water is being taken under a basic landholder right, where any act by a person carrying out an aquifer interference activity causes the:

- Removal of water from a water source
- Movement of water from one part of an aquifer to another part of an aquifer
- Movement of water from one water source to another water source, such as from an aquifer to an adjacent aquifer, an aquifer to a river/lake, or from a river/lake to an aquifer.

As part of a licence application, WaterNSW would assess the potential impacts of the aquifer interference activity against the minimal impact considerations, as well as any specific rules in a relevant water sharing plan. There are two levels of minimal impact considerations.

The Policy divides groundwater sources into 'highly productive' and 'less productive'. Highly productive groundwater is defined as a source that is declared in the Regulations and:

- Have total dissolved solids less than 1500 mg/L
- Contain water supply works that can yield water at a rate greater than five litres per second.

Highly productive groundwater sources are grouped into:

- Alluvial
- Coastal sands
- Porous rock
- Great Artesian Basin - Eastern Recharge and Southern Recharge
- Great Artesian Basin - Surat, Warrego and Central
- Other porous rock
- Fractured rock.

Less productive groundwater sources are grouped as:

- Alluvial
- Porous rock
- Fractured rock.

The groundwater source in the study area is regarded as the 'less productive' alluvial or porous rock source. Further information would be available from geotechnical investigations generated through detailed design, and would inform development of the soil and water management plan that would be prepared as part of the Construction Environmental Management Plan (CEMP).

To support consultation with WaterNSW, the scale and nature of extracting water from a less productive groundwater source, the potential direct and indirect impacts, and the management of potential impacts must be known. Bridge construction methodologies in the Shoalhaven floodplain

and further understanding of hydrogeological conditions (groundwater yield and quality) would inform the scale, nature and management of groundwater extraction (refer also Section 3.1.3).

1.4.5 Contaminated Land Management Act 1997

The Environment Protection Authority (EPA) regulates the investigation and clean-up of contaminated land to prevent pollution and safeguard community wellbeing. The *Contaminated Land Management Act 1997* (CLM Act) establishes the processes for investigating and, where appropriate, remediating contaminated land and contaminated groundwater. Section 60 of the CLM Act imposes a duty for proponents to report to the EPA if land contamination poses significant risk of harm. The CLM Act also regulates the provision of Investigation Orders (Section 17) and Remediation Orders (Section 23). SEPP 55 – Remediation of Land provides for the implementation of the CLM Act through the planning and environmental assessment process. The purpose of these Guidelines is to establish 'best practice' for managing land contamination through the planning and development control process. The Guidelines explain what needs to be done to show that planning functions have been carried out in good faith. The guidelines cannot provide a definitive answer in all cases, so planning authorities will also need to exercise their judgement.

Roads and Maritime must demonstrate appropriate management of contaminated land during the acquisition, management and divestment of property. The proposal would present a risk of potentially contaminated land being encountered during construction activity. In accordance with Section 60 of the Act, if contamination is identified which poses significant risk of harm, reporting to the EPA must occur.

1.4.6 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) provides for the protection of threatened fish and marine vegetation and is administered by the Department of Primary Industries (DPI). The FM Act works with the *Biodiversity Conservation Act 2016* and aims to conserve, develop and share fishery resources and conserve marine species, habitats and diversity.

The proposal contains works within waterways (Shoalhaven River and Bomaderry Creek) and therefore the FM Act must be considered to preserve water quality within the downstream waterways and protecting any threatened aquatic species and their habitats. These potential impacts associated with the proposal have been assessed in the separate biodiversity assessment.

1.4.7 SEPP 55 - Remediation of Land

SEPP 55 applies to the whole of NSW and relates to reducing risk of harm to human health or other aspects of the environment. The SEPP applies to development requiring development consent under Part 4 of the EP&A Act. As such, it is not specifically relevant to this proposal, however, the assessment being carried out for the proposal is consistent with the objectives of the SEPP.

1.5 NSW Water Quality Objectives

The NSW water quality objectives (WQOs) are the agreed environmental values and long-term goals for NSW's surface waters. These set out:

- The community's values and uses for the State's rivers, creeks, estuaries and lakes
- A range of water quality indicators to facilitate assessment of whether the current condition of waterways supports those values and uses.

The WQOs are consistent with the agreed national framework for assessing water quality as set out in the ANZECC 2000 Guidelines. The ANZECC 2000 Guidelines provide an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values (including human uses). The WQOs provide environmental values for NSW waters and the ANZECC 2000 Guidelines provide the technical guidance to assess the water quality needed to protect those values. At this point in time WQOs for the Shoalhaven River have not been developed.

In 2003, the former Healthy Rivers Commission (HRC) issued a report following up on public inquiries into river and lake health in coastal NSW carried out from the mid-1990s. The report provides further discussion on earlier HRC recommendations focussed on the following principles for integrated and accountable catchment and river management:

- Rivers as productive assets
- Whole-system management
- Whole-of-government approach
- Accountability for actions
- Effective river health planning
- Adaptive management
- Government-community partnerships.

The proposal is supportive of these management principles.

The NSW Government has not formally adopted water quality objectives for the Shoalhaven River catchment. However, the impacts of the proposal have been assessed against typical NSW water quality objectives for estuaries, including the protection of aquatic ecosystems, visual amenity, secondary contact recreation, primary contact recreation and aquatic foods (cooked). The impacts of the proposal have been determined with reference to trigger values for each indicator relevant to these water quality objectives. These trigger values are consistent with the equivalent environmental values in the ANZECC 2000 Guidelines.

1.6 Standards and guidelines

1.6.1 Construction phase

The following guidelines are relevant to the management of land degradation and water pollution for road construction in NSW:

- Environmental Direction: Management of Tannins from Vegetation Mulch (Roads and Maritime Services, 2012)
- Erosion and Sediment Management Procedure (Roads and Traffic Authority, 2009)
- Guide to Road Design – Section 3.6 (Austroads, 2013)
- Guideline for Construction Water Quality Monitoring (Roads and Traffic Authority, 2003)
- Guideline for the Management of Contamination (Roads and Maritime Services, 2012).
- Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze (Roads and Traffic Authority, 2005)
- Managing Urban Stormwater - Soils and Construction, Volume 1, 4th Edition (Landcom, 2004)
- Managing Urban Stormwater - Volume 2D Main Road Construction (DECCW, 2008)

- NSW Acid Sulfate Soils Management Advisory Committee, Acid Sulfate Soils Assessment Guidelines (ASSMAC,1998)
- Stockpile Site Management Guideline (Roads and Maritime Services, 2011)
- Storing and handling liquids: Environmental Protection – Participants Manual' (DECC, 2007)
- Technical Guideline: Environmental Management of Construction Site Dewatering (Roads and Maritime Services, 2011)
- Technical Guideline: Temporary Stormwater Drainage for Road Construction (Roads and Maritime Services, 2011)
- Roads and Maritime Erosion and Sedimentation Management Procedure (RTA Procedure PN 143P).
- Water sensitive urban design guideline: Applying water sensitive urban design principals to NSW transport projects (Roads and Maritime, 2016)

These guidelines have been used to identify appropriate procedures and controls to mitigate potential soil and water impacts associated with the construction phase of the proposal.

1.6.2 Operational phase

Consideration of impacts on soil and water associated with operation of the proposal focusses on sedimentation and erosion risk, ASS, and contaminated land and hazardous materials.

Consideration of operational impacts on water quality is provided in the separate operational water quality assessment.

2 Existing environment

The study area is located within the Sydney Basin Bioregion and occurs entirely within the Shoalhaven Alluvial Plain Mitchell landscape (V3), in the Illawarra IBRA subregion, and within the Nowra and Shoalhaven Local Land Services areas.

Most of the study area comprises undulating landforms associated with the Shoalhaven River and floodplain and Bomaderry Creek. Low to medium density residential development generally occurs along the length of the study area along the existing road alignment.

The study area is predominantly cleared of native vegetation with current land uses including residential and commercial properties, public open space, boat ramps and the Shoalhaven River. Terrestrial habitats in the study area have been modified by past and current infrastructure, however there is a small stand of bushland located on the north-western bank forming part of the boat ramp and a park.

The study area includes the Shoalhaven River, which in this location is a tidal river located about 15 kilometres upstream from the river estuary at Shoalhaven Heads. The Shoalhaven River provides a variety of habitat including mud flats, seagrass, mangroves, and estuarine, many of which may be used by threatened species. As such, the river is considered to provide key fish habitat as defined by the NSW DPI Fisheries, and in accordance with criteria outlined in the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013), the river is classified as a Type 1 highly sensitive key fish habitat and Class 1 major fish habitat.

2.1 Landform, geology and soils

2.1.1 Regional geology

The study area is mapped as occurring on the Nowra Sandstone and undifferentiated formation by the1:100,000 Geological Series Sheet for Kiama.

Nowra Sandstone comprises medium to coarse grained quartz sandstones, minor siltstones and conglomerate beds. The formation belongs to the Shoalhaven Group and is characterised by moderately to gently undulating rises to undulating low hills, with local relief greater than 40 metres, ground surface slopes of greater than five per cent, broad ridges and crests with long, very gently inclined slopes, deeply incised channels and benched sandstone outcrops adjacent to drainage lines. The subsurface soil in this group is likely to be moderately deep, stony, low permeability and highly susceptible to erosion.

Undifferentiated formation comprises alluvium, gravel, sand, silt and clay. This formation occurs in on both the northern and southern banks of the Shoalhaven River crossing, as well as the crossing of Bomaderry Creek.

Figure 2-1 presents the proposal study area in relation to the regional geology.

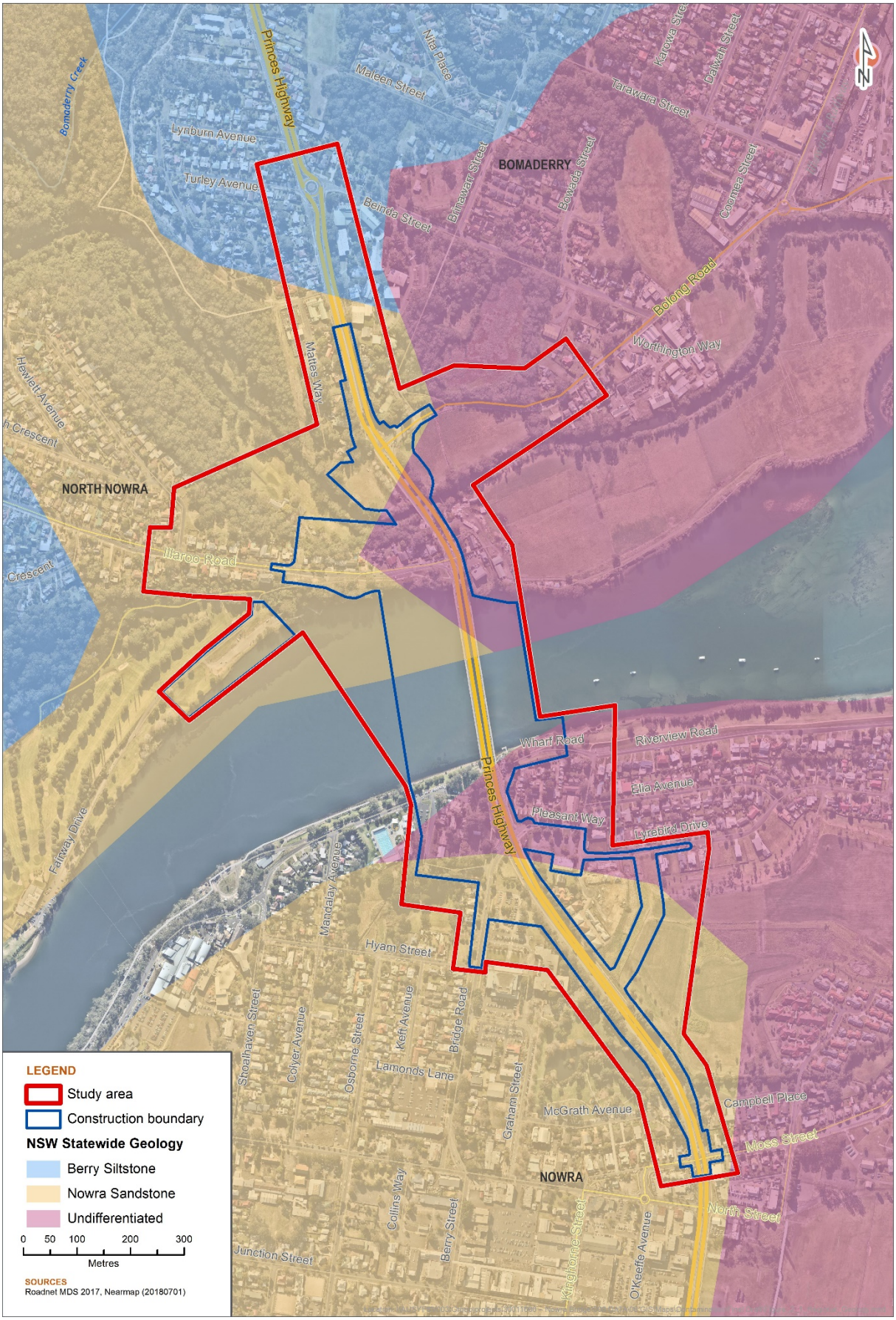

Figure 2-1 Geological mapping for the study area

2.1.2 Soil landscapes

The study area is mapped as occurring on the Shoalhaven and Nowra Soil Landscapes by the Soil Landscapes of the Kiama 1:100 000 Sheet (Hazelton, 1992). The Shoalhaven soil landscape occurs mainly throughout the northern parts of the study area, with the Nowra soil landscape occurring through both the northern and southern parts of the study area.

The Shoalhaven landscape is a level to gently undulating with present river bed and banks, active floodplain with levees and backwater swamps on alluvium. It includes the flat to undulating terrace surfaces of the Shoalhaven River:

- The soils are moderately deep to Prairie Soils that occur on levees. Red earths and Yellow and Red Podzolic Soils occur on terraces. Alluvial Soils and Gleyed Podzolic Soils occur on the floodplain
- Limitations include flood hazard, seasonal waterlogging, permanently high watertable, hard setting, acid sulfate potential, strongly acid and sodicity.

The Nowra soil landscape contains moderately to gently undulating rises to low hills on Nowra Sandstone. Benched sandstone outcrops occur adjacent to drainage lines. Vegetation in the landscape is extensive to moderately cleared tall open-forest:

- Soils are moderately deep Brown Podzolic Soils that occur on crests and upper slopes. Soloths and/or Yellow Earths occur midslope and Yellow Podzolic Soils occur on lower slopes and drainage lines.
- Limitations include run-on, rock outcrop, shallow soil, stoniness, hard setting, sodicity, low permeability and low wet bearing strength.

Figure 2-2 presents the proposal study area in relation to mapped soil landscapes.

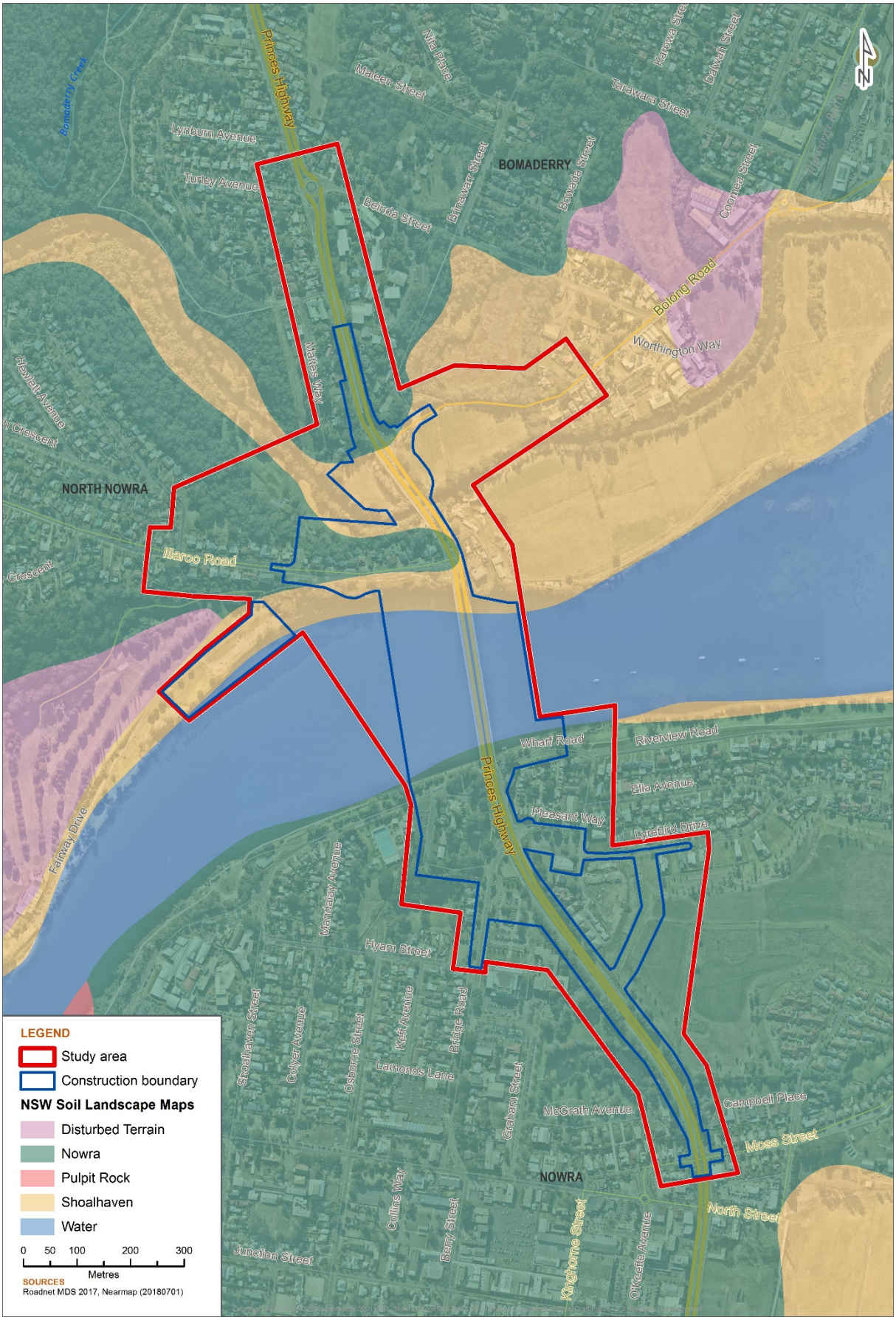

Figure 2-2 Soil landscape mapping within the study area

2.1.3 Landform zones

The proposal study area has an elevation between five metres and 25 metres Australian Height Datum (AHD) excluding Bomaderry Creek and Shoalhaven River waterways. Landforms have been previously modified because of establishing the existing Princes Highway/Nowra Bridge road corridor. The constructed road corridor is typically level, in contrast to the undulating shape and form of the Bomaderry Creek and Shoalhaven River valleys.

Two major drainage features are noted within the study area:

- **Bomaderry Creek:** this area includes about 45 metres span over Bomaderry Creek.
- **Shoalhaven River:** this area includes about 370 metres span over Shoalhaven River

Considering the topography, four main landform areas are noted within the proposal construction boundary which are described below.

- **Northern (north of Bomaderry Creek**) This area is characterised with the existing road alignment being mainly 'filled' and elevated with respect to low lying flood plains. A relatively smaller section of 'cutting' within Nowra sandstone is north west of the Bolong Road Intersection. A constructed earthen fill embankment (ranging from five to 15 metres in height) maintains an existing road level to Bomaderry Creek Bridge.
- **Central Northern (between Bomaderry Creek and Shoalhaven River)** This area is characterised with the existing road alignment being mainly 'cutting' to the side of a ridgeline within Nowra sandstone. Localised 'filling' is noted beneath Bomaderry Creek Bridge southern abutment and Illaroo Road. A 'cutting' within sandstone is beneath Nowra Bridge northern abutment.
- **Central Southern** (**between Shoalhaven River and Bridge Road Intersection)** This area is characterised with the existing road alignment being mainly 'filled' and elevated with respect to undifferentiated formation comprising of alluvium, gravel, sand, silt and clay. Localised filling is noted across the road corridor to maintain a level intersection at Bridge Road.
- **Southern (south of Bridge Road Intersection)** This area is characterised with the existing road alignment being mainly 'cutting' within the Nowra sandstone. Localised filling is noted beneath road corridor adjacent to low lying areas comprising of alluvium, gravel, sand, silt and clay.

2.2 Acid sulfate soils

The New South Wales Natural Resource Atlas (OEH 2013) shows the study area being mapped as follows:

- A high probability of ASS within sediments is mapped in the Shoalhaven River and Bomaderry Creek
- A high probability of ASS (occurring at elevations between 1-2 metres AHD) is mapped in the northern zone within the low lying floodplain
- A low probability of ASS (occurring at elevations between two to more than four metres AHD) is mapped within central northern, central southern and southern zones.

Figure 2-3 shows mapped ASS in the proposal study area.

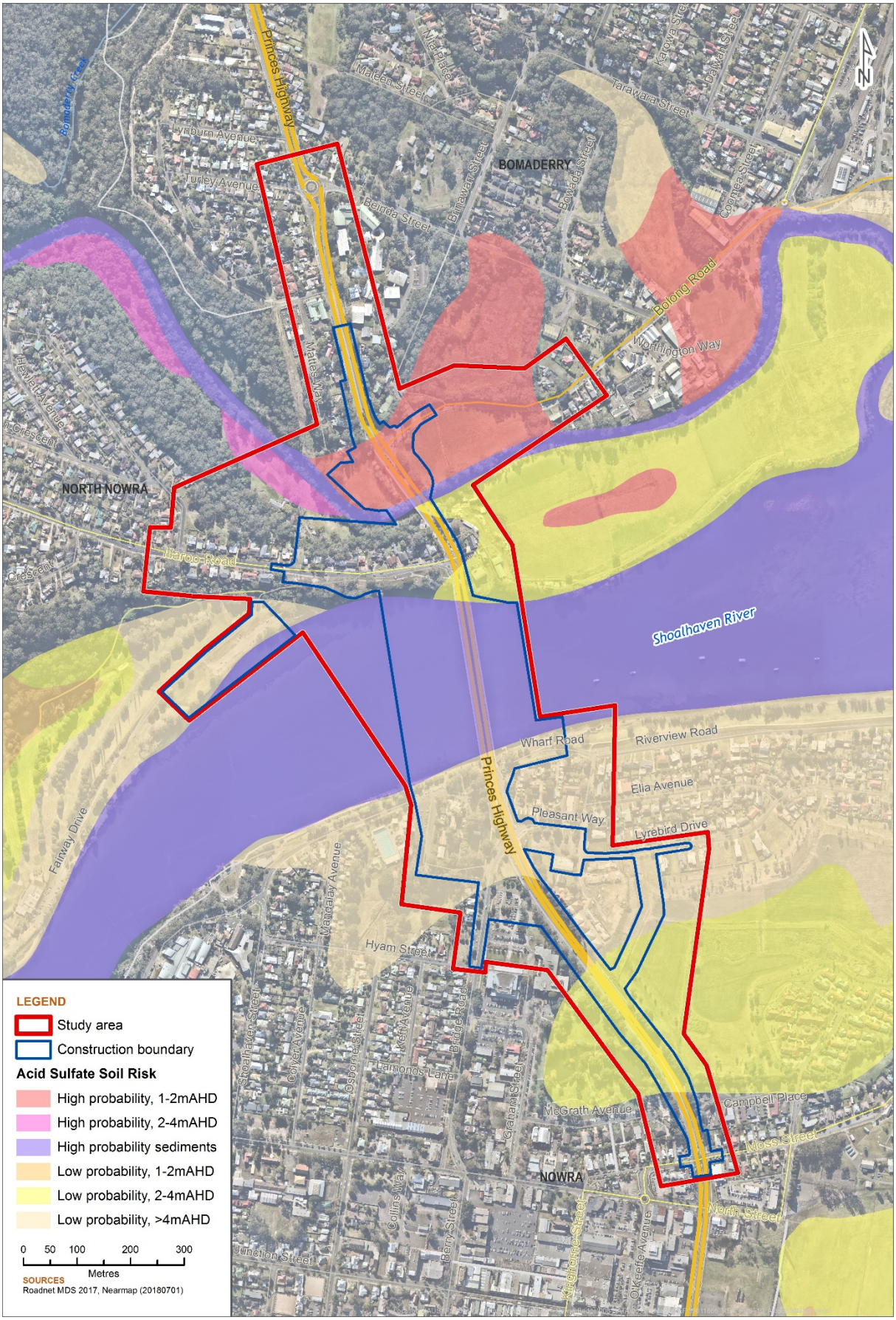

Figure 2-3 Acid sulfate soil probability mapping within the study area

2.3 Contaminated land

A Phase 1 contamination assessment report has been prepared for the proposal which is included **Appendix A**. The report has been prepared in accordance with relevant matters specified in *Guidelines for Consultants Reporting on Contaminated Sites* (Office of Environment and Heritage, 2011). A summary of the report is provided below.

Historical site information suggests the study area has comprised residential and agricultural land use since prior to 1949. A former gasworks facility (now regulated by NSW EPA) was in operation in the early 1900s located about 300 metres west of the study area. Two major changes to the existing road alignment occurred include Bolong Road intersection upgrade (circa 1960) and Princes Highway widening at northern and southern approaches and second road bridge across Shoalhaven River (circa 1980). Some former residential structures appear to have been removed to accommodate the Princes Highway construction south of the bridge. Agricultural land was progressively redeveloped for residential and commercial land use as present.

2.3.1 Areas of environmental concern

Eight potential areas of environmental concern (AEC) and potentially contamination sources were identified within the study area including:

- AEC 1 – Bomaderry substation
- AEC 2 – Agricultural paddocks, road verges, pubic open space (parks) and localised residential garden areas
- AEC 3 – Fill materials
- AEC 4 – Former and current structures
- AEC 5 – Existing southbound bridge
- AEC 6 – Acid sulfate soils and sediments
- AEC 7 – Former gas works, including down-gradient impacted areas within Harry Sawkins Park
- AEC 8 – Road pavement (coal tar) and buried utility conduits and service pits (potentially containing asbestos).

Figure 2-4 and Figure 2-5 present the eight AECs within the proposal study area. At a preliminary level, a moderate to high potential for soil contamination is assessed to be present within the various identified AECs.

Potential contaminants of concern within soils include:

- Total recoverable hydrocarbons (TRH)
- Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)
- Polycyclic aromatic hydrocarbons (PAH)
- Phenols
- Organophosphorus (OPP) and Organochlorine Pesticides (OCP)
- Polychlorinated biphenyls (PCBs)
- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc)
- Asbestos containing materials (ACM), associated with asphalt pavements constructed prior to 1987 and utility conduits and service pits across the proposal area
- Ammonia and cyanide (potentially in groundwater)
- Hazardous materials (lead paint, asbestos/synthetic mineral fibres).

While not strictly contamination, ASS parameters have been identified within relevant AECs.

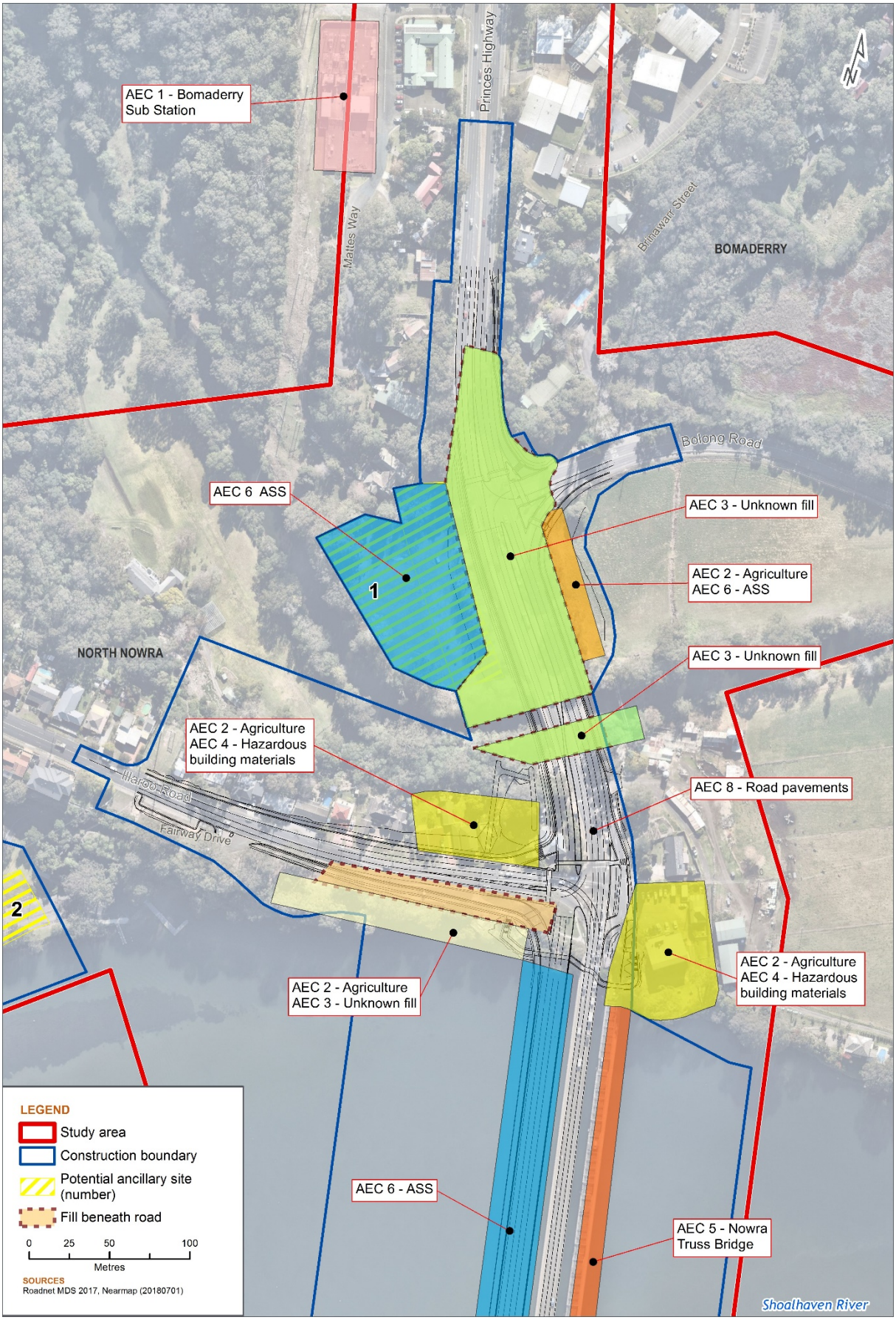

Figure 2-4 Areas of environmental concern – north

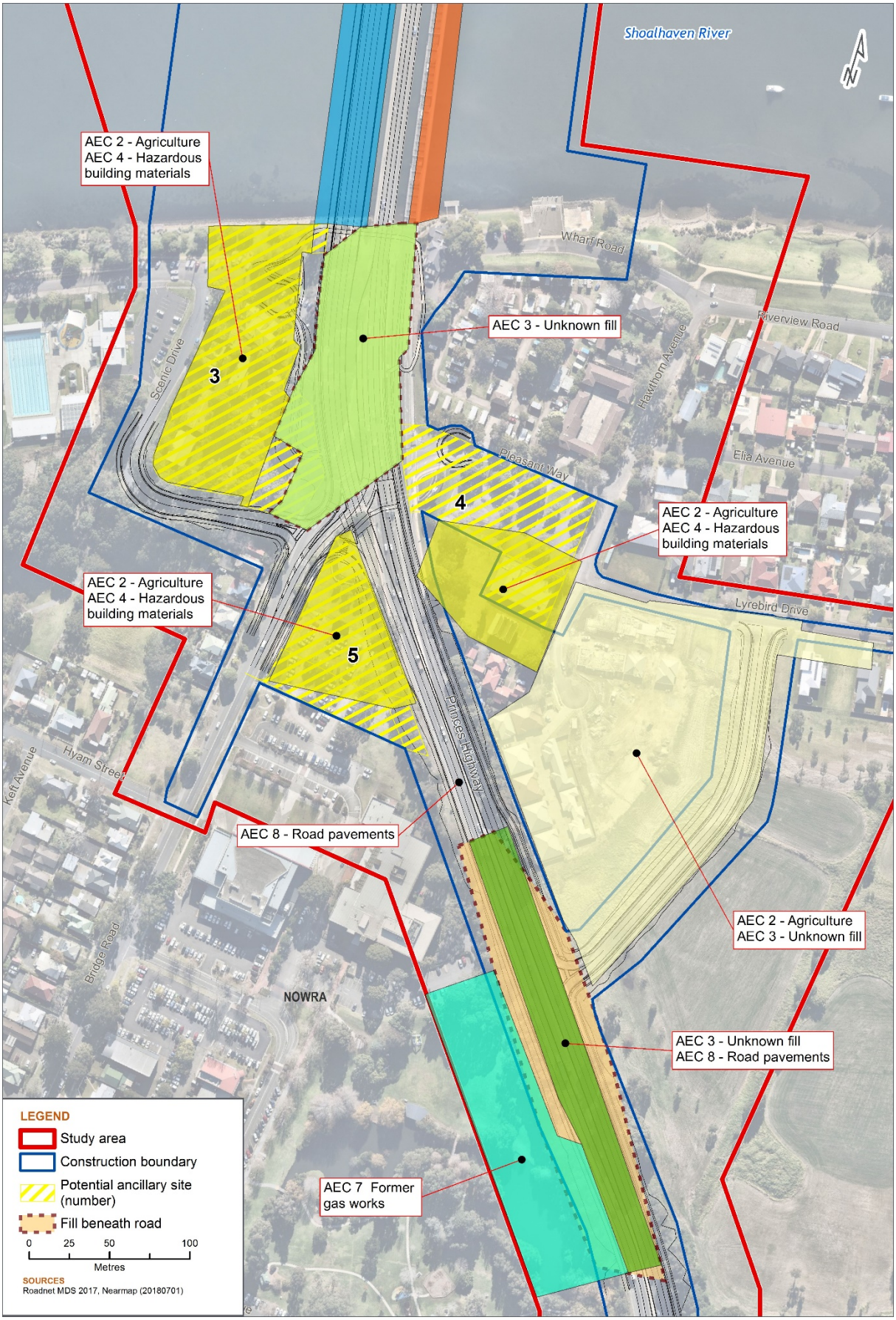

Figure 2-5 Areas of environmental concern – south

2.3.2 Preliminary risk assessment

Table 2-1 provides the risk summary criteria developed to assess the AECs. An assessment of the risk of impact for each AEC from construction of the proposal was carried out based on the likely scale of contaminating activities, proximity to construction/operational footprint and expected construction activities. It should be noted that although the risk ranking system categorises the various AECs as 'high' to 'low' risk, this does not indicate that contamination has or has not occurred but instead highlights the need that further assessment may be required. Further data would give greater confidence on these risk levels.

Table 2-1 Risk summary criteria for AECs

Risk ranking	AEC risk assessment criteria
Low	Low potential of residual soil and/or groundwater contamination to exist within the extent of the proposal footprint. Low probability of engaging any potential contaminated land associated with identified AEC due to extent of proposed works.
Moderate	Moderate potential of residual soil and/or groundwater contamination to exist within the proposal footprint. Contaminated soil and / or groundwater associated with identified AEC may be engaged due to the extent of the proposed works.
High	High potential of some level of residual soil and/or groundwater contamination to exist within the extent proposal footprint. Contaminated soil and / or groundwater associated with identified AEC are likely to be engaged due to the extent of the proposed works. Further investigations recommended.

A summary of the AECs which have been identified as having a moderate to high potential for contamination is as follows:

- AEC 3 – Fill of unknown origin and quality appears to have been placed widespread throughout the existing road alignment with a moderate potential for soil contamination. Fill embankments were observed at various depths, typically deepest near the approach to existing bridge structures and within the northern and central southern zones adjacent to low lying floodplains.
- AEC 4 – Former and current structures has also been identified as moderate to high potential for soil contamination given the age of existing or former residential properties (circa 1960s) within the alignment. There is a potential for residual localised contaminated soil may be encountered during demolition works. Residential properties potentially contain surface soil or uncontrolled fill impacted by asbestos, domestic waste and other hazardous materials.
- AEC 5 – There is a high potential for lead-based paint having been used (circa 1980s) during historic maintenance of the existing southbound bridge. This has since been removed however residual lead paint would remain in difficult to access parts of the structure. A low potential for soil contamination residues is considered within near surface soils beneath/surrounding these features.
- AEC 6 – There is a high potential for acid sulfate soils north of the Bomaderry Creek crossing (east and west of the Princes Highway) where the Bolong Road intersection meets with the Princes Highway and for sediments within the Shoalhaven River and Bomaderry Creek. Low potential remains within the majority of the southern portion of the proposal.
- AEC 8 – The existing road pavements within the study area have a medium to high potential to contain coal tar, noting this was common practice prior to 1987. The main highway easement has a moderate to high potential of asbestos containing materials in road assets like service

conduits and communication pits, noting that construction materials containing asbestos were still used until 1986.

There are no known previous investigations that undertook groundwater sampling within the proposal area. At a preliminary level, a moderate potential for groundwater contamination is assessed within two areas of environmental concern; AEC 1 Bomaderry substation (localised impacts) and/or AEC 7 Former gas works including Harry Sawkins Park (more widespread). Groundwater contamination at these locations within/adjacent to the study area is considered to have a low potential to impact the proposal based on the proximity to actual construction/operational extent of the proposal and the low likelihood for engaging groundwater. A low potential for widespread groundwater contamination is assessed in remaining AECs.

2.4 Hydrology and water quality

2.4.1 Catchment areas

The proposal is situated in the Shoalhaven River Basin, within the Shoalhaven Estuary subcatchment, on the NSW south coast. The Shoalhaven River catchment has a total area of 7300 square kilometres and drains eastward to the Pacific Ocean at Shoalhaven Heads. Major tributaries include Mongarlowe, Corang, Endrick and Kangaroo Rivers. The proposal is located within the large coastal floodplain where the Shoalhaven River enters the Pacific Ocean at Shoalhaven Heads.

Land use in the Shoalhaven Estuary subcatchment primarily consists of grazing (28 per cent), private conservation (34 per cent), and other public usage (17 per cent), and an urban land use (six per cent) associated with Nowra, Bomaderry and Braidwood. Urban land use consists of transport corridors for road and rail and residential, commercial and industrial areas.

The proposal contains two main drainage features; the Shoalhaven River and Bomaderry Creek. The Bomaderry Creek and Shoalhaven River bank topography ranges from steep embankment slopes, including cliffs, west of the proposal within the Nowra soil landscape, with relatively shallow slopes east of the proposal within the floodplain areas. This creek and river topography potentially results in high velocity flows and erosion in the upper reaches. In the lower reaches flow velocities are lower and the water spreads out over low lying land and the floodplain.

For the purpose of developing the preliminary erosion and sediment control plan (Appendix B), the proposal construction boundary has been separated into seven main catchments for Bomaderry Creek and Shoalhaven River (refer Figure 2-6).

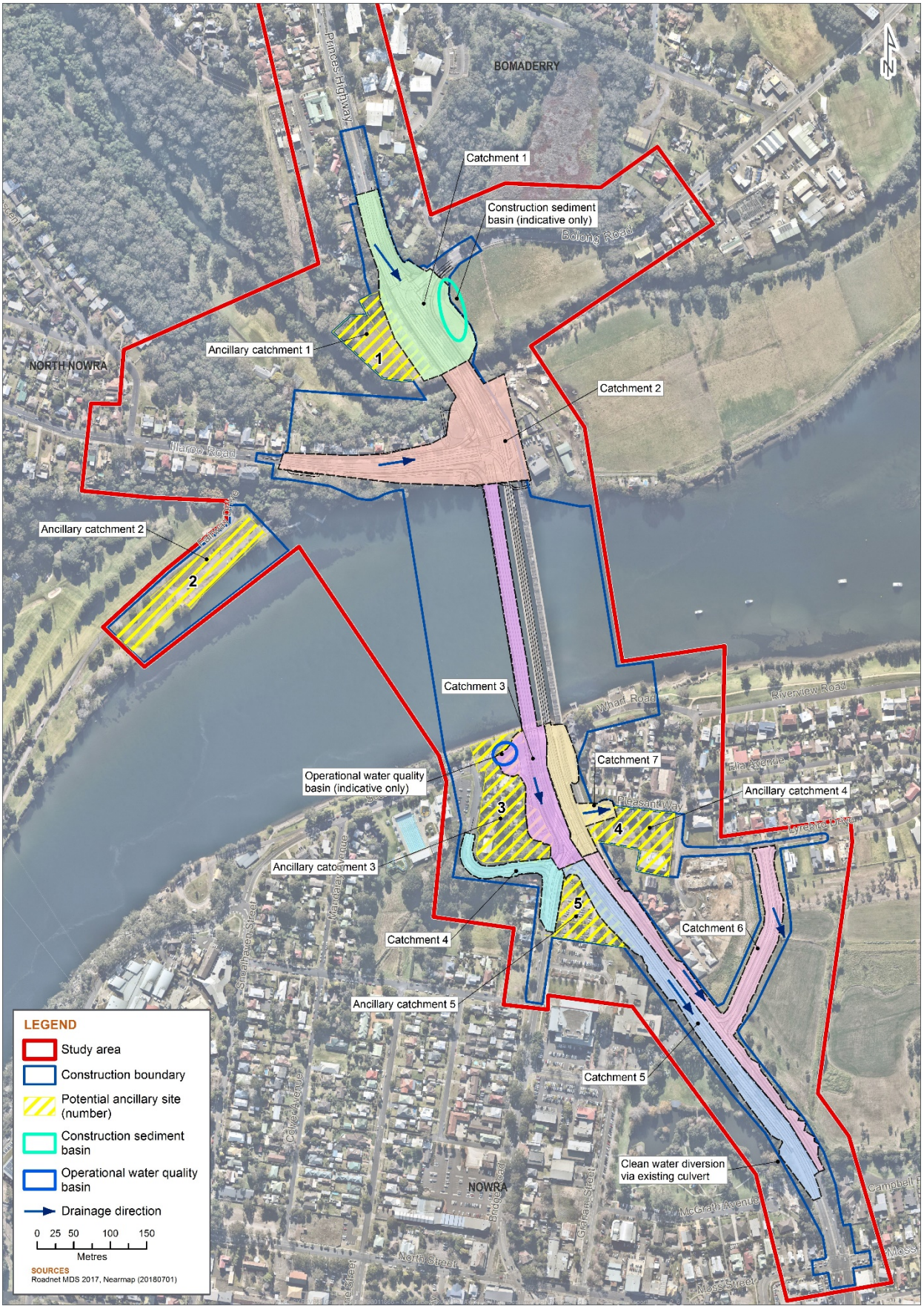

Figure 2-6 Construction area catchments

2.4.2 Surface water and sediment quality

Published monitoring data

Historic water quality information for the Shoalhaven River and Bomaderry Creek within the study area was sourced from the following:

- Shoalhaven City Council (SCC, 2018)
- Estuary health report card (OEH, 2011)
- Sydney Catchment Authority (SCA, 2011) '*State of the Science – Catchment Impacts*' report
- NSW Government, Department of Primary Industries, Office of Water, Realtime data (NSW DPI, 2018).

The Shoalhaven City Council water quality monitoring data provides water quality index rating, dissolved oxygen, faecal coliform, total phosphorus, and total nitrogen concentrations for data collected between 2000 to 2012. There were two monitoring locations in the study area, one at the mouth of Bomaderry Creek, and the other in the Shoalhaven River close to the Nowra bridge.

The summary below of historic water quality was taken from the closest Shoalhaven City Council Shoalhaven River monitoring site. From the information, water quality within the Shoalhaven River near the proposal area is likely to be represented by:

- Good to excellent water quality index rating
- Dissolved oxygen levels (per cent saturation) ranging between 70 and 110 (good)
- Faecal coliform counts generally below relevant ANZECC (2000) swimming guideline levels
- Phosphorus levels below ANZECC (2000) guidelines
- Total nitrogen levels below ANZECC (2000) guidelines.

No historic turbidity data was found for the Shoalhaven River. The estuary health report card provides a 'B' rating (good) for turbidity at a location just to the east of the site. A 2011 Sydney Catchment Authority '*State of the Science – Catchment Impacts*' report claims that none of the rivers surveyed regularly exceeded the relevant ANZECC Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) turbidity threshold of 25 NTU. An exception was for single event suspended sediment concentration of 200 mg/L in the Wollondilly, Nattai and Shoalhaven Rivers, presumably during high flow events (SCA, 2011).

From the Council information available, water quality within Bomaderry Creek is likely to be represented by:

- Medium to good water quality index
- Dissolved oxygen levels (per cent saturation) of about 140 (poor)
- Faecal coliform counts above ANZECC (2000) swimming guideline levels
- Phosphorus levels below ANZECC (2000) guidelines
- Total nitrogen levels below ANZECC (2000) guidelines.

The above summary is based on the most recent monitoring data available (2012). The complete dataset available (2000 to 2012) suggests that there have been significant improvements in water quality in the Shoalhaven River from about 2010 onwards as all indicators improved from this time.

A review of the NOW Realtime data identified two river gauging station upstream of the proposal; Station 215016 located within Bomaderry Creek at Bomaderry, about 2.7 kilometres northwest and Station 215430 within Shoalhaven River at Grady Park, about 13 kilometres west. Continuous daily

monitoring of water level occurs at both these locations. A summary of available monitoring data is provided in the following table.

Table 2-2 Summary of river gauging station data

Gauging station	Data available	Period of record	Summary
Station 215016 Bomaderry Creek at Bomaderry	• Water level • Rainfall • Flow	2003 to 2018	• Water level ranges between -0.1metres and 3.8metres AHD (maximum recorded) within Bomaderry Creek.
Station 215430 within Shoalhaven River at Grady Park	• Water level • Electrical conductivity • Water temperature	2013 to 2018	• Water level ranges between -1metre and 18metres AHD (maximum recorded) within Shoalhaven River. • EC typically varies up to 1,500 µs/cm (with occasional up to 80,000 µs/cm) at 25ºC

Additional monitoring data

Monitoring data obtained during surveys for the proposal indicate that water quality within the Shoalhaven River was good. Temperature showed little variation within and between sites, with values typically ranging between 24.0 °C and 24.8 °C. Surface dissolved oxygen concentrations ranged between 6.5 mg L^{-1} and 13.0 mg L^{-1}, which represents an approximate per cent saturation range of 60 to 130 per cent. Note that dissolved oxygen levels are influenced by salinity and water depth, and the lower measurements observed during field surveys were taken at low tide. Dissolved oxygen concentrations generally declined with increasing depth, which is likely a function of decreasing temperature and increasing pressure with depth influencing dissolved oxygen concentrations. Dissolved oxygen concentrations were higher at sites where recordings were taken at high tide, and at sites close to extensive seagrass beds.

Both pH and oxidative reduction potential (ORP) were recorded at all sites; however, without appropriate reference data, little can be interpreted from these values. In general, pH was neutral at all sites. Noticeably, the Bomaderry Creek site displayed lower pH than all Shoalhaven River sites. Turbidity concentrations at Shoalhaven River sites ranged between 0.1 nephelometric turbidity unit (NTU) and 1.7 NTU suggesting that turbidity is generally good. Turbidity in Bomaderry Creek was higher, ranging between 1.7 and 2.7 NTU.

Water samples were collected at four sites along the proposed bridge alignment. Analytical results indicated that metals (arsenic, cadmium, chromium, copper, nickel, lead, zinc, mercury), TPH, TRH, BTEX, TN, COD, and BOD, were all below analytical detection limits (and therefore ANZECC guidelines). Ammonia concentrations ranged between 4 µg N L^{-1} and 8 µg N L^{-1}, and nitrate concentrations were all below 10 µg N L^{-1}. Total phosphorus concentrations ranged between 5 µg P L^{-1} and 10 µg P L^{-1}, and reactive phosphorus was 10 µg P L^{-1} or below. With the exception of reactive phosphorus, these values are all below the ANZECC (2000) guidelines, which for ammonia for estuaries is 15 µg N L^{-1}; for nitrate is 15 µg N L^{-1}; for total phosphorus is 30 µg P L^{-1}, and for reactive phosphorus is 5 µg P L^{-1}.

Sediment samples were collected at four sites along the proposed bridge alignment. Sediment particle size distribution indicates that the southern, shallower portion of the river is dominated by sand, while the deeper channel on the northern riverbank is dominated by fine particles. Metals and

metalloids, PAH, TPH, BTEX were all below ANZECC (2000) sediment quality guidelines. **Table 2-3** includes a summary of sediment physical and chemical attributes.

Note that the water and sediment sample data presented in this report is indicative only. The data is representative of one sampling event and does not account for spatial and temporal variations, or replication. A construction and operational water and sediment quality management plan is being prepared for the proposal, which will detail the appropriate sampling regime (including appropriate temporal and spatial scales, replication, and quality assurance).

Available data suggests that water and sediment quality of the Shoalhaven River is generally good, with little influence from urbanised pollution, and some influence from weather events (e.g., floods) which may cause temporary fluctuations.

Table 2-3 Sediment physical and chemical attributes

Parameter / Site	SB-01	SB-02	NB-02	NB-01	Guideline*
Soil classification					
Per cent fines (< 75 µm)	2	<1	1	77	N/A
Per cent sand (>75 µm)	95	94	99	23	N/A
Per cent sand (>75 µm)	95	94	99	23	N/A
Per cent cobbles (> 6 cm)	<1	<1	<1	<1	N/A
Per cent moisture	44.9	30.0	64.8	35.7	N/A
pH	7.6	7.8	7.9	7.6	N/A
Per cent organic matter	1.8	<0.5	5.6	<0.5	N/A
Per cent total organic carbon	1.0	<0.5	3.2	<0.5	N/A
Metals / Metalloids (mg/kg)					
Arsenic	<5	<5	11	<5	20-70^
Cadmium	<1	<1	<1	<1	1.5-10^
Chromium	7	6	20	8	80-370^
Copper	<5	<5	24	<5	65-270^
Lead	6	<5	20	8	50-220^
Nickel	8	7	17	10	21-52^
Zinc	27	20	77	28	200-410^

Parameter / Site	SB-01	SB-02	NB-02	NB-01	Guideline*
Mercury	<0.1	<0.1	<0.1	<0.1	0.15-1^
Petroleum hydrocarbons / Derivatives					
Total PAH	<0.5	<0.5	<0.8	<0.5	4000-45000^
TPH	<10	<10	<10	<10	N/A
BTEX	<0.2	<0.2	<0.2	<0.2	N/A

*ANZECC / ARMCANZ Interim Sediment Quality Guidelines (ISQG)

^ISQG-Low (trigger value) to ISQG-High

2.4.3 Groundwater

A search of the NSW Department of Primary Industries, Office of Water, All Groundwater Map (accessed online 15/02/2018) indicated six registered groundwater bores in proximity to the proposal area. Groundwater bores were located outside the proposal construction/operational footprint, apparently associated with groundwater monitoring at Bomaderry electrical substation and a Former Nowra Gasworks site. Limited information was available on groundwater table depth.

3 Assessment of impacts

3.1 Construction

The proposal would be predominantly constructed within the existing road corridor, incorporating the existing A1 Princes Highway alignments and adjoining local road connections. A new link road connecting Lyrebird Drive with Princes Highway would be constructed. Bridge work would be undertaken within Bomaderry Creek and the Shoalhaven River. Road construction would involve traffic diversions and potentially some temporary road crossovers, subject to construction staging. Ancillary sites as detailed in Figure 1-2 may be required to assist in the construction of the proposal and would be predominantly used for material stockpiling, office accommodation and site compounds.

General construction activities that have the potential to impact on soil and water quality include:

- Pavement removal
- Excavation and filling for the new Princes highway alignment
- Shoalhaven River and Bomaderry Creek bridge work including bridge abutments and instream work
- Sediment basin and other erosion controls
- Removal of riparian vegetation
- Underground service relocation
- Culvert construction and stabilisation
- Ancillary site preparation and operation
- Generation of building and construction waste
- Importing, handling, stockpiling and transporting material resources
- General waste generation from compounds.

3.1.1 Sedimentation and erosion impacts

A Preliminary Erosion and Sediment Management Report has been prepared for the proposal which is included as Appendix B. This includes a a Preliminary Erosion and Sediment Assessment. Erosion assessment was carried out in general accordance with the Erosion and Sediment Management Procedure (Roads and Maritime, RTA Procedure PN143P). A summary of these assessments plans is provided below.

Construction of the proposal has the potential to impact on water quality due to erosion and sedimentation, particularly while working under / over water and during heavy rainfall events. Common areas which would present an elevated risk of soil erosion and resulting environmental impacts include areas of concentrated flows and locations where surface gradients and slope lengths combine to increase the erosive potential of stormwater runoff.

During the construction phase these locations would typically include:

- Bridge abutments and piers over land or water
- Road embankments and cut faces
- Haul road and lay down yard boundaries
- Works on the northern bank

- Culverts and drainage outlets.

These activities would result in exposure of soils and subsoils, creating an elevated risk of soil erosion. Eroded soils and sediments have the potential to be transported by water runoff and wind to nearby waterways and sensitive receiving environments. This would result in degradation of receiving water quality and settlement of eroded sediments on the beds of streams, floodplains and wetlands, with associated adverse impacts on aquatic flora and fauna, and human water uses.

The potential impact from excessive sedimentation and erosion on receiving surface waters include:

- Loss of slope stability of channel banks due to accelerated erosion leading to channel siltation and degraded channel morphology
- River water quality degradation because of increased sedimentation of downstream sections of Bomaderry Creek and other waterways/drainage lines discharging to Shoalhaven River, which may result in direct impacts such as reduction in light penetration (limiting the growth of macrophytes), clogging fish gills, alter stream geomorphology, smother benthic organisms and reduce visibility for fish
- Increased levels of turbidity, nutrients, metals and other pollutants, transported via sediment reducing overall water quality in Shoalhaven River.

The potential for soil erosion and consequent impacts on water quality would vary across the proposal area depending on the following key risk factors:

- Soil erodibility
- Scale of earthworks
- Proportion of road batter area relative to the road catchment size
- Road gradient.

At this stage, a high erosion risk has been determined in accordance with the Roads and Maritime Erosion and Sedimentation Management Procedure (RTA Procedure PN 143P). The assigned risk is due to proximity to water bodies and standard erosion control measures defined in Managing Urban Stormwater – Soil and Construction (Landcom, 2004) are considered adequate for construction over land works planning.

Erosion and sediment control measures would be implemented for the exposed soil areas during the construction stage and could include:

- Construction sediment basins (refer Appendix B)
- Catch and diversion drains
- Stabilisation of exposed faces
- Other local controls such as sediment fences, check dams, windrows, sumps.

Instream and over water sediment control measures would be specifically tailored to the flow characteristics of the Shoalhaven River and Bomaderry Creek, and would include appropriate protections such as turbidity booms and/or temporary coffer dams/caissons.

Further to the above, a previous Geotechnical Interpretive Report (SMEC, 2017a) recommended the cutting and embankment slope design needs to consider measures to control erosion and natural weathering of materials. Erosion mitigation measures that may be considered include:

- Water interceptor drains on top of cut and fill batters where land falls towards the road alignment
- Installation of erosion control measures during construction, particularly around downstream ends of stockpiles, and diversion of upslope runoff around stockpiles

- Locate stockpiles in well drained and generally level areas
- Limiting batter slopes of stockpiles to 1V:2H for heights up to 2.5 metres and constructing them in accordance with project specific Roads and Maritime QA Specification R44
- Regular grading of the surface at the end of each day to achieve a well-drained road
- Formation during construction
- Slope vegetation and landscape design.

3.1.2 Surface water

The potential for general impacts on surface water quality would depend on many factors. Primarily impacts would be dependent on the nature, extent and magnitude of construction activities and their interaction with the natural environment. Risks of acute water quality impacts during construction are primarily in relation to spills or leaks of fuels / oils and other machinery liquids such as radiator coolants which could arise from negligence, accident or deliberate sabotage.

Runoff or discharge from ancillary sites may impact water quality where the following activities are undertaken:

- Soil and mulch stockpiling
- Vehicle wash down areas
- Vehicle refuelling areas
- High frequency of vehicle movements
- Fuel, chemical, material storage and stockpile areas
- Office compounds.

The potential impacts associated with use of ancillary sites include:

- Increased levels of litter from construction activities polluting downstream watercourses
- Introduction of contamination into groundwater
- Tannin leachate from clearing, mulching and stockpiling (if any) impacting biological oxygen demand in receiving water
- Major impacts to various sensitive receiving environments through accidental release of water pollutants during construction due to fuel storage and leaks and inappropriate storage of material stockpiles
- Loss of terrestrial and aquatic species
- Damage to aquatic, riparian and terrestrial environments
- Effects on the suitability of downstream waterways for recreational uses (such as swimming).

To manage potential impacts during construction phase, baseline and construction surface water quality monitoring should be carried out upstream and downstream areas of Bomaderry Creek and Shoalhaven River.

3.1.3 Assessment of construction water quality impacts against water quality objectives

Consideration of the impacts on water quality with reference to water quality parameters relevant to the construction phase of the proposal are provided in Table 3-1. The table includes relevant indicators for the water quality objectives of protection of aquatic ecosystems, visual amenity, secondary contact recreation, primary contact recreation and aquatic foods (cooked).

Table 3-1 Assessment of construction water quality impacts against water quality objectives

Parameter	Guideline	Comment	Potential impact
pH	7.0-8.5 (for aquatic ecosystem protection) 5.0-9.0 (for primary contact recreation).	pH is a measure of the acidity or alkalinity of water and has a scale from 0 (extremely acidic) to 7 (neutral), through to 14 (extremely alkaline).	The proposed construction sediment basin discharge limits are expected to be generally consistent with the guideline values for this indicator but noting that range allowed for pH in the 'Blue Book' is 6.5 - 8.5. Discharges would be generally consistent with the pH of natural stormwater runoff of fresh water into the Shoalhaven River.
Salinity	No guideline value for estuaries	Salinity or electrical conductivity (EC) measures the total concentration of inorganic ions (salts) in the water. Sodium is typically associated with salinity however sodic soils are not necessarily saline. Excess amounts of sodium can adversely impact soil structure, making plant growth difficult and have toxic impact on freshwater species.	None expected in view of the existing salinity of the receiving waters.

Parameter	Guideline	Comment	Potential impact
Turbidity	0.5–10 NTU (for aquatic ecosystem protection)	Turbidity is the presence of suspended particulate and colloidal matter consisting of suspended clay, silt, phytoplankton and detritus measured by a technique called nephelometry, which measures the fraction of light scattered at right angles to the light path of water. Increased turbidity can reduce light penetration through the water column and therefore reduce the level of photosynthetic activity.	Turbidity/total suspended solids (TSS) is the principal pollutant of concern associated with road construction projects. Turbidity can increase as a result of increases of sediment load from catchment erosion. Increased sediment loading and increased turbidity, can increase the potential for the transport of contaminants bound to sediment particles. Elevated levels of nutrients such as phosphorous and nitrogen are also found in road runoff and can contribute to the accelerated growth of nuisance aquatic plants and cause a reduction in the levels of dissolved oxygen. Nutrients are usually associated with the fine suspended sediment in the runoff. No historic turbidity data was found for the Shoalhaven River. The estuary health report card provides a 'B' rating (good) for turbidity at a location just to the east of the site. It is expected that the proposal would have only minimal impact with regard to this indicator as any impacts above the upper value limit would be generally short-term in nature, would be similar to the existing turbidity levels, and only experienced for the duration of construction. where exposed soils are at risk of being mobilised in a rain event exceeding the designed rainfall criteria. A number of mitigation measures typically implemented for road construction projects would also be implemented, such as those detailed in the Preliminary Sediment and Erosion Control Management Plan (refer Appendix B). Discharges from sediment basins would be managed to meet the recommended 50 mg/L standard as specified in the Blue Book.

Parameter	Guideline	Comment	Potential impact
Temperature	Iterative (for aquatic ecosystem protection). 15–35°C (for primary contact recreation).	Aquatic ecosystem function is very closely regulated by temperature. Temperature changes can occur naturally as part of normal diurnal and seasonal cycles, or as a consequence of human activities.	The water temperature in the construction sediment basins is not expected to be significantly different from the Shoalhaven River or Bomaderry Creek as the basin depths would be relatively shallow (maximum of 2 m). Cold water pollution is not expected in bodies of water less than 15 m deep. No impacts are expected.
Dissolved oxygen	90–110% (for aquatic ecosystem protection)	Dissolved oxygen concentration in a waterbody is highly dependent on temperature, salinity, biological activity (microbial, primary production) and the rate of transfer from the atmosphere. Excessive nutrients could stimulate plant growth which could affect the dynamics of the aquatic ecosystem. Eutrophication occurs when excessive plant growth deprives the water column of oxygen thereby killing other forms of aquatic biota. The growth of algae is also stimulated by excessive nutrients and may result in a build-up of toxins in the water column.	No significant change is expected as a result of the proposed construction sediment basin discharge limits provided sediment is appropriately managed to limit changes to salinity and nutrients (microbial activity).

Parameter	Guideline	Comment	Potential impact
Total nitrogen (TN)	300 µg/L	Excessive nitrogen could stimulate plant growth which could affect the dynamics of the aquatic ecosystem (e.g. eutrophication, algae and macrophytes). Most nitrogen in surface soils is immobilised, bound as organic nitrogen associated with vegetative matter. A small proportion is steadily converted to inorganic forms such as nitrate compounds that can be released to soil water.	MUSIC modelling indicates an average existing TN concentration of around 1150 µg/L for the existing catchment. The majority of TN is expected to be available in topsoil. Road construction programming typically involves the clearing of vegetation and stripping of topsoil as one of the first activities, with the subsoils only exposed for the majority of the construction period. Local controls are provided for topsoil stockpiles (e.g. cover crops, bunds) and excess run-off from disturbed topsoil areas would be captured by construction sediment basins with expected reductions in TN associated with retention, settlement and removal of deposited sediment. TN is further reduced by the flocculation of remaining colloidal material prior to discharge. Elevated levels of nutrients such as nitrogen can be found in construction surface water runoff and can contribute to the accelerated growth of nuisance aquatic plants and cause a reduction in the levels of dissolved oxygen. Nutrients are usually associated with the fine suspended sediment in the runoff. Discharges from sediment basins would be managed to meet the recommended 50 mg/L standard as specified in the Blue Book, and in turn would manage TN such that no material change in receiving water quality would be anticipated.

Parameter	Guideline	Comment	Potential impact
Total phosphorus (TP)	30 µg/L	Excessive phosphorus could stimulate plant growth which could affect the dynamics of the aquatic ecosystem. Eutrophication occurs when excessive plant growth deprives the water column of oxygen thereby killing other forms of aquatic biota. The growth of algae is also stimulated by excessive nutrients and may result in a build-up of toxins in the water column. The availability of inorganic phosphorus from soil is largely controlled by pH. Maximum phosphate availability occurs in the pH range of 6.0 - 7.0. Soil pH is around 7.0 for soils in the proposal study area.	MUSIC modelling indicated an average daily TP concentration around 200 µg/L for the existing catchment. As with TN, the majority of TP is expected to be available in topsoil with up to 85-90% would be attached to soil particles. The comments made above in regard to implementation of the controls noted and the consequent expected reductions in TN associated with retention, settlement and removal of deposited sediment would also apply for TP. Elevated levels of nutrients such as phosphorus can be found in construction surface water runoff and can contribute to the accelerated growth of nuisance aquatic plants and cause a reduction in the levels of dissolved oxygen. Nutrients are usually associated with the fine suspended sediment in the runoff. Discharges from sediment basins would be managed to meet the recommended 50 mg/L standard as specified in the Blue Book, and in turn would manage TP such that no material change in receiving water quality would be anticipated.
Chlorophyll-α	4 µg/L	Chlorophyll α concentration is often used as a general indicator of the algal biomass in a waterbody. Some algae also produce toxins that can be of public health concern when they are found in high concentrations and can cause aesthetic problems such as green scums and bad odours, and can result in decreased levels of dissolved oxygen in the water body.	None expected, basins would be managed to avoid/restrict aquatic plant and algae growth, and chlorophyll α is therefore not expected to be present in construction sediment basin discharges.

* ANZECC 2000 Guideline for Southeast Australia slightly disturbed ecosystems, estuaries

3.1.4 Groundwater

There are a number of major cuttings along the proposal, except for a deep cut widening to the into the ridgeline in the central northern area between Bomaderry Creek and Bolong Road. Large groundwater inflows are unlikely to be encountered during earthworks. Relatively minor groundwater ingress is expected during piling for the bridges over Bomaderry Creek and Shoalhaven River.

Groundwater has the potential to interact with the proposal through inflows into piling columns, cuttings and excavations. If the inflow is significant, dewatering may be required and/or ongoing drainage and disposal measures may need to be implemented.

The need for dewatering with regard to piling activities would be dependent on the methodology adopted noting there are some construction options that would require dewatering. The methodology for piling has yet to be finalised; as such the requirement to dewater for piling cannot be ruled out.

3.1.5 Acid sulfate soil

There is potential for ASS/PASS to be encountered during construction. Disturbance of PASS is most likely to occur during construction activities associated with the bridges over Shoalhaven River and Bomaderry Creek including construction of bridge piles, bridge abutments and excavation for drainage structures.

The handling and management of ASS material including excavation, loading, transportation and storage and stockpiling has the potential to generate acid leachate runoff if not properly managed. Generally, ASS may also be impacted in other areas of the proposal during excavation and dewatering activities. Disturbance or poor management of ASS has the potential to result in generation of low pH waters (surface and groundwater) which may in turn cause impacts relating to the following:

- Sulphuric acid generation leading to heavy metal leaching both of which have terrestrial and aquatic ecological impacts, including fish disease, kills, loss of food resource, reduced fish migration and recruitment potential, disturbance to water plant communities and secondary effects on water quality, and potential human health risks
- Reduced land and soil conditions, potentially inhibiting growth of vegetation and land productivity, agricultural impacts and land quality degradation
- Soil structure degradation and loss (including infrastructure instability)
- Loss of infrastructure integrity (i.e. corrosion).

3.1.6 Contaminated land and hazardous materials

Any existing contamination present within the soils or groundwater underlying the proposal study area and associated ancillary facilities has the potential to be exposed or disturbed by construction activities. The highest risk activities would be excavation, earthworks and demolition.

The risk of disturbing any existing contamination would be highest at proposed road cuttings. At road embankment sites, by contrast, the proposal is unlikely to increase the risks associated with any site contamination and the placement of fill would also act as a barrier to future exposure and disturbance of contamination.

The risk of disturbing any existing hazardous materials would be highest near the existing southbound bridge, structures proposed for demolition, and relocation/adjustment of buried utility conduits and service pits. As previously noted, AEC 8 (Road pavement) is regarded as having potential for the occurrence of coal tar and asbestos. The Phase 1 assessment (refer Appendix A) includes a recommendation to carry out a Phase 2 assessment involving soil and groundwater sampling program for locations within identified AECs for potential contaminants of concern to confirm the presence/absence of contamination.

There is the potential for existing contaminated land to be disturbed by construction activities. The proposal requires ancillary sites to be temporarily occupied for the purposes of construction. These ancillary sites provide individual contamination risk profiles that should be assessed prior to occupation to establish benchmark conditions for the site.

Areas of environmental concern identified in Section 2.3 have the potential to impact on general construction activities associated with the proposal including the following activities:

- Excavation
- Pavement removal
- Building demolition
- Underground service relocation
- Generation of construction waste
- Ancillary site preparation and operation
- Use of fuel and chemicals during construction
- Importing, handling, stockpiling and transporting material resources.

Potential environmental impacts associated with the proposed works include:

- Increasing waste volumes from excavated (potentially contaminated) materials
- Movement of contaminated sediments via surface runoff into stormwater systems
- Adverse effects on human health (construction personnel, public pedestrians or nearby residential/commercial land use communities)
- Surface water runoff from identified AECs may potentially impact groundwater and surface water quality, and if not appropriately managed, potential pollutants in fill or near surface soils may reach perched groundwater or surface water bodies.

There is low potential for groundwater contaminants (if any) to be encountered because of expected construction activities associated with the proposal (refer to Section 3.1.3).

3.2 Operation

3.2.1 Sedimentation and erosion impacts

The proposal has a low potential for sedimentation and erosion impacts during operational phase. The road and footpath areas would be paved and any disturbed areas (such as embankments and road verges) would be revegetated and stabilised.

3.2.2 Acid sulfate soils

The proposal has a low potential for acid sulfate soils impacts during operational phase. There would be no change to the watertable in the areas identified as areas containing ASS. Therefore, no further ASS/ PASS risk is likely once the road is operational.

3.2.3 Contaminated land and hazardous materials

The proposal has a low potential for contaminated land impacts during operation, subject to the outcomes of the Phase 2 investigation recommended in the Phase 1 assessment report.

Accidental spillage of hazardous materials or dangerous goods, without satisfactory means of containment, the spills could pass rapidly into the drainage system and impact downstream ecosystems. Operational water quality treatment measures can also provide spill containment to mitigate risks and this is further discussed in the Operational Water Quality Assessment.

Major spills of chemicals or petrol are generally the result of traffic incidents. The likelihood of a potential spill of hazardous substances would be reduced because of the proposal and improved road design standards.

4 Management of impacts

4.1 Avoidance and minimisation

The key principle regarding managing soil and water impacts for road development and associated impact on human and the environment is that the planning and construction of roads should, in order of consideration, endeavour to:

- Avoid and minimise impact first
- Mitigate impact where avoidance is not possible
- Treatment/remedial measures where residual impacts are unacceptable.

The construction footprint has been delineated with careful consideration of the design's direct footprint, where possible minimising impact on properties, drainage, utility work and all environmental factors. The proposal has been designed so that it follows the existing road corridor alignment. Soil and water constraints will be considered throughout the design process.

4.2 Mitigation measures

A range of mitigation measures are presented in Table 4-1 and would be implemented during detailed design, prior to construction, during construction and during post construction phases of the proposal. These measures have been developed to mitigate the potential impacts of the proposal on soils and water environment (including erosion and sedimentation, surface water, groundwater, acid sulfate soils, contaminated land and hazardous materials) and their environmental significance, that occur in the study area.

Table 4-1 Mitigation measures

Impact	Mitigation measures	Responsibility	Timing
Sedimentation and erosion	During detailed design, the potential impacts associated with the bridge construction and operation would be further considered to minimise the likelihood of bank instability and scouring, flow alteration and potential increased risk of flooding. The design and construction methodologies should, wherever possible, minimise direct and indirect impacts to riparian vegetation, and implement best practice water sensitive urban design (WSUD) measures to provide dissipation of flows and prevent gross pollutants and contaminants entering the study area's waterways. WSUD measures are designed to provide treatment of nutrients and suspended solids prior to discharge to the existing receiving environment.	Designer	Detailed Design

Impact	Mitigation measures	Responsibility	Timing
Sedimentation and erosion	A soil and water management plan (SWMP) will be developed for the proposal as part of the Construction Environmental Management Plan (CEMP). The SWMP will be developed by a suitably qualified and experienced soil conservationist or Roads and Maritime certified practitioner in erosion control in accordance with the principles and practices detailed in Volume 1 Managing Urban Stormwater: Soils and Construction (Landcom, 2004) and Volume 2: Main Road construction (OEH 2009). The SWMP would contain as a minimum the following elements: • Site specific Erosion and Sedimentation Control Plans (ESCPs), including detailed consideration of staging and management at ancillary sites, in accordance with the Blue Book • Identification of site conditions or construction activities that could potentially result in erosion and associated sediment runoff • Methods to minimise potential adverse impacts of construction activities on the water quality within surrounding waterways • Details of measures to minimise any adverse impacts of sedimentation on the surrounding environment • Details of measures to minimise soil erosion caused by all construction works including clearing, grubbing and earthworks • Details of measures to make site personnel aware of the requirements of the SWMP by providing information within induction, toolbox and training sessions • Details of the roles and responsibilities of personnel responsible for implementing the SWMP • Details of measures for the inspection and maintenance of construction phase water treatment devices and structures • Details of water quality monitoring • Detailed construction methodology and environmental work method statement for the proposed bridge works and creek realignment within Shoalhaven River and Bomaderry Creek to minimise the potential for bank instability, scour, flooding and other adverse impacts of construction activities on the water quality. • The SWMP will be reviewed by a soil conservationist on the Roads and Maritime list of Registered Contractors for Erosion, Sedimentation and Soil Conservation Consultancy Services. The SWMP will then be revised to address the outcomes of the review.	Works Contractor	Detailed Design / Pre-construction

Impact	Mitigation measures	Responsibility	Timing
Surface water	Surface water quality monitoring will be undertaken to establish baseline water quality so that any impacts from the proposal construction phase can be identified and addressed. Sampling locations and monitoring methodology will be determined as part of the SWMP but as a minimum would be undertaken upstream and downstream of creek crossings and in accordance with the Guideline for Construction Water Quality Monitoring (Roads and Maritime, 2003).	Designer / Works Contractor	Detailed Design / Pre-construction
Surface water	Bulk storage of fuels or chemicals should be located greater than 100 metres from any watercourse. In constrained areas where criteria cannot be achieved, additional risk assessment and additional mitigation measures may need to be considered and implemented to manage risk to sensitive receivers to an acceptable level.	Works Contractor	Construction
Surface water	Vehicles and machinery will be properly maintained to minimise the risk of fuel/oil leaks.	Works Contractor	Construction
Surface water	An Emergency Spill Plan will be developed and incorporated in the CEMP. This will include measures to avoid spillages of fuels, chemicals, and fluids into any waterways.	Works Contractor	Pre-construction
Surface water	The storage, handling and use of hazardous materials will be undertaken in accordance with the *Occupational Health and Safety Act 2000* and WorkCover's Storage and Handling of Dangerous Goods Code of Practice (WorkCover, 2005).	Works Contractor	Construction
Surface water	To inform geotechnical design, surface water within Bomaderry Creek and Shoalhaven River and groundwater within the adjacent river embankment, will be sampled and tested for geotechnical aggressively parameters (including chloride, sulfate, pH and resistivity) to assess potential impacts of saline water on proposal bridge pile infrastructure.	Designer	Detailed Design
Groundwater	A groundwater dewatering strategy will be prepared outlining appropriate construction methodologies to minimise lowering of the water table during construction activities. The need for this strategy will be informed by the geotechnical investigations for the proposal (which at the time of preparation of this report had not commenced). This will specifically focus on areas of the proposal likely to be impacted by any activities by which the water table is likely to be lowered including: • Groundwater dependent ecosystem • Acid sulfate soils • Contaminated land	Designer	Detailed Design

Impact	Mitigation measures	Responsibility	Timing
Groundwater	If any dewatering or other activities which will impact the local groundwater system are proposed, consultation with the DPI will be undertaken to determine the requirements for water extraction licenses and approvals.	Designer / Works Contractor	Detailed Design / Pre-construction
Acid sulfate soils	During detailed design, the preferred management strategy for PASS/ASS is to avoid its disturbance wherever possible. Where disturbance of PASS/ASS is unavoidable, preferred design strategies are: • Minimisation of disturbance which may include avoiding/ minimising impact on areas with high levels of sulphides, limiting disturbances so that only shallow disturbances occur and minimising groundwater fluctuations. • Neutralisation with lime • Hydraulic separation of sulfides from the sediment either on its own or in conjunction with dredging • Strategic reburial (re-interment) where material can be permanently placed in anaerobic conditions, for example covered by water and compacted soil to keep it wet and free of oxygen. Other management measures may be considered during construction stage but must not pose unacceptably high risks.	Designer / Works Contractor	Detailed Design / Pre-construction
Acid sulfate soils	During geotechnical investigations, soil sampling and testing for ASS parameters will be carried out in areas of proposed ground disturbance where there is a low to high probability of encountering PASS/ASS. These include: • Bomaderry Creek and Shoalhaven River sediments • Low lying floodplains (northern and southern) • Alluvial and estuarine soils alongside river embankments This assessment of the presence/absence of PASS/ASS will be made with respect to the NSW Acid Sulfate Soils Assessment Guidelines (ASSMAC,1998).	Designer	Detailed Design

Impact	Mitigation measures	Responsibility	Timing
Acid sulfate soils	An Acid Sulfate Soils Management Plan (ASSMP) will be prepared to identify procedures for mitigation and management of known PASS/ASS areas during construction stage. The ASSMP will include details on: • Identification of specific areas where PASS/ASS are required to be managed • Determine liming rates for neutralisation of PASS/ASS within each area • Details on appropriate construction staging and methods used in relation to PASS/ASS on site • Specific mitigation measures to prevent disturbance of and/or acid generation from PASS/ASS to manage and control environmental issues • Procedures for handling, treatment (including acid neutralisation), containment and disposal of PASS/ASS associated with proposed excavation activities at the site. Additional testing will be required during construction to determine liming rates relevant to each area of ASS that would be disturbed. The plan will be prepared in general accordance with NSW Acid Sulfate Soils Assessment Guidelines (ASSMAC,1998) and Queensland Acid Sulfate Soil Technical Manuel (Ahern et al, 2014).	Designer / Works Contractor	Detailed Design / Pre-construction
Contaminated land and hazardous materials	A Phase 2 Contamination Assessment involving soil sampling and testing will be carried out to assess the nature, degree and preliminary extent of contamination within soil and/or road pavements (i.e. AEC 8). A Sampling, Analysis and Quality plan (SAQP) would be prepared outlining the sampling and laboratory testing which will be carried out targeting within the identified Areas of Environmental Concern that are likely to be impacted by the proposal. The Phase 2 assessment would be carried out in general accordance with: • National Environment Protection (Assessment of Site Contamination) Measure 1999 • NSW EPA Sampling Design Guidelines • NSW EPA Guidelines for Consultants Reporting on Contaminated Sites. Subject to the findings of the Phase 2 Contamination Assessment, a Remedial Action Plan (RAP) and/or construction Contaminated Land Management Plan would be prepared to manage known contamination exposure risks (if any).	Designer	Detailed Design

Impact	Mitigation measures	Responsibility	Timing
Contaminated land and hazardous materials	A Hazardous Materials (HAZMAT) Survey would be carried out to assess the potential for lead-based paints and/or asbestos containing materials including: • The existing southbound bridge • Structures identified for demolition • Known buried utilities and service pits. A Hazmat Register would identify the location of all known or suspected hazardous materials. Risk assessments will be carried out to quantify and control potential exposure to human and ecological receptors during construction.	Designer	Detailed Design
Contaminated land and hazardous materials	A Hazardous Materials Management Plan applying to known areas of asbestos contamination / other hazardous materials will be developed in accordance with the Roads and Maritime Procedure Asbestos Related Work No. 066P25 (RMS, 2013).	Designer / Works Contractor	Detailed Design / Pre-construction
Contaminated land and hazardous materials	Any works requiring asbestos removal will be carried out in accordance with an Asbestos Removal Control Plan prepared in accordance with the relevant published guidelines and codes of practice: • Code of Practice. How to safely remove asbestos in the workplace (SafeWork NSW, 2016a) • Code of Practice. How to manage and control asbestos in the workplace (SafeWork NSW, 2016b) • Roads and Maritime Procedure Asbestos Related Work No. 066P25 (RMS, 2013). Prior to works, notifications to SafeWork NSW will be carried out by the appropriate licenced asbestos removal contractor. At the completion of the asbestos removal, clearance certificates will be issued to the contractor confirming the effectiveness of asbestos removal.	Works Contractor	Construction

Impact	Mitigation measures	Responsibility	Timing
Contaminated land and hazardous materials	An unexpected finds protocol will be employed if previously unidentified asbestos contamination is discovered during construction. Work in the affected area would cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of the asbestos contamination. The level of reporting must be appropriate for the identified contamination in accordance with Guidelines for Consultants Reporting on Contaminated Sites (OEH, 2011), any relevant SafeWork NSW codes of practice and include the proposed methodology for the remediation of the asbestos contamination. Works may only recommence upon receipt of a validation report from a suitably qualified contamination specialist that the remediation activities have been undertaken in accordance with the investigation report and remediation methodology.	Works Contractor	Construction
Contaminated land and hazardous materials	A Material Reuse Management Plan (MRMP) will provide further details to construction contractor on how to optimise waste minimisation opportunities through procedures for material handling, stockpiling, onsite and offsite reuse area, and waste disposal. Likely waste types would be addressed including: • General solid waste • Virgin excavated natural material (VENM) / Excavated Natural Materials (ENM) • Hazardous materials (including Asbestos containing materials, lead-based paints) • ASS • Asphalt pavements (incl. potential coal tar) The MRMP and WEMP will also include environmental management measures to manage cross contamination, waste segregation and/or unexpected finds protocols, and provide details sampling and testing requirements to confirm waste classifications.	Designer / Works Contractor	Detailed Design / Pre-construction

5 Conclusion

5.1 Conclusions

This proposal comprises major road construction works. During construction, there is potential for the works to increase the levels of pollutants in downstream waterways, particularly through activities such as pile construction, vegetation clearance, topsoil stripping and cut and fill earthworks. During operation, increased impervious areas and formalised drainage systems have the potential to concentrate flows and increase levels of pollutants discharging via stormwater drainage into Shoalhaven River. The assessment concluded that mitigation measures for both construction and operation would be required. These controls would be part of a multi-faceted approach that would also include procedural controls, site management controls and monitoring.

Construction phase

Mitigation and management of sedimentation and erosion impacts during construction would be in accordance with the strategies recommended in the Blue Book (Soils and Construction 2004 and 2008). At this stage, a high erosion risk has been determined in accordance with the Roads and Maritime Erosion and Sedimentation Management Procedure (RTA Procedure PN 143P). The assigned risk is due to proximity to water bodies and standard erosion control measures defined in *Managing Urban Stormwater – Soil and Construction* (Landcom, 2004) are considered adequate for construction over land works planning.

The NSW Government has not formally adopted water quality objectives for the Shoalhaven River catchment. However, the impacts of the proposal have been assessed against typical NSW water quality objectives for estuaries, including the protection of aquatic ecosystems, visual amenity, secondary contact recreation, primary contact recreation and aquatic foods (cooked). The impacts of the proposal have been determined with reference to trigger values for each indicator relevant to these water quality objectives. These trigger values are consistent with the equivalent environmental values in the ANZECC 2000 Guidelines. This assessment has concluded that there is unlikely to be a significant change within the Shoalhaven River or Bomaderry Creek.

Erosion and sediment control measures would be proposed for the exposed soil areas during the construction stage that include construction sediment basins, catch and diversion drains, stabilisation of exposed faces, and local controls such as sediment fences, check dams, windrows, sumps. Instream and over water sediment control measures would be specifically tailored to the flow characteristics of the Shoalhaven River and Bomaderry Creek, and will include protections such as turbidity booms and/or temporary coffer dams/caissons.

Surface water quality impacts during construction would be managed through the implementation of a Soil and Water Management Plan. Water quality monitoring within Bomaderry Creek and Shoalhaven River would be carried out to assess and demonstrate the effectiveness of management measures.

Groundwater has the potential to interact with the proposal through inflows into piling columns, cuttings and excavations. If the inflow is significant, dewatering may be required and/or ongoing drainage and disposal measures may need to be implemented. It is likely any dewatering and / or ongoing inflows which impact the local groundwater system would require consideration of potential impacts and licensing in consultation with the DPI.

Mitigation of ASS impacts would be carried out during detailed design and construction stages. Avoidance of ground disturbance will be adopted where possible during detailed design. A further

assessment involving soil sampling and testing will be carried out during additional geotechnical investigations in areas where ground disturbance is expected. An Acid Sulfate Soils Management Plan (ASSMP) would detail the site-specific requirements for handling, treatment and disposal of ASS during construction stage.

Contaminated land impacts would undergo further assessment involving soil sampling and testing to confirm the nature, degree and preliminary extent of contaminated soils and or pavements. Eight areas of environmental concern have been identified within the proposal study area, noting five which have a moderate to high potential for encountering soil contamination. There is low potential for groundwater contaminants (if any) to be encountered because of expected construction activities associated with the proposal. Hazardous material surveys are also recommended within the existing southbound bridge, within structures proposed for demolition and at buried utilities and service pits to identify and control risks of exposure.

5.2 Further assessment

Further assessment and reporting is recommended during detailed design and early construction stage as outlined below:

- Phase 2 Contamination Assessment (targeting soils and pavements)
- Hazardous materials assessment (targeting existing southbound bridge, structures identified for demolition, buried utility and service pits).
- Groundwater dewatering strategy
- Management plans to form part of the Construction Environmental Management Plan including:
  - Acid Sulfate Soils Management Plan
  - Hazardous Materials Management Plan
  - Waste and Energy Management Plan.

Where more than minor changes occur, consultation with the Roads and Maritime would determine whether any additional environmental impact assessment would be required.

6 References

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Appendix A – Phase 1 Contamination Assessment

Member of the Surbana Jurong Group

Phase 1 Contamination Assessment

Nowra Bridge Project

August 2018

DOCUMENT CONTROL

Title	Phase 1 Contamination Assessment, Nowra Bridge Project
Project Ref	30011666

Details of Revisions

Rev	Date	Prepared by	Reviewed by	Approved for Issue by
Draft Rev01	20/2/2018	Steven Shaw and Alex Williams	Alex Williams and Daniel Saunders	Chris Masters
Final Draft	30/4/2018	Steven Shaw	Daniel Saunders	Chris Masters
Final	20/8/2018	Steven Shaw	Daniel Saunders	Chris Masters

Issue Register

Distribution List	Date Issued	Number of Copies
Roads and Maritime Services	20/8/2018	1 electronic
SMEC Project Folder	20/8/2018	1 electronic
SMEC Library	20/8/2018	1 electronic

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ABBREVIATIONS & ACRONYMS

Abbreviation / Acronym	Description
ACM	Asbestos containing material
AEC	Area of environmental concern
ASS	Acid sulfate soils
BTEX	Benzene, toluene, ethylbenzene and xylenes
CoC	Contaminants of Concern
EPA	Environment Protection Authority
EPL	Environment Protection Licence
m	Metres
m bgl	Metres below ground level
OCP	Organochlorine pesticides
OPP	Organophosphorus pesticides
NEPC	National Environment Protection Council
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
POEO Act	Protection of the Environment Operations Act
TRH	Total recoverable hydrocarbons

IMPORTANT NOTICE

This report is confidential and is provided solely for the purposes of providing additional information in relation to potential contamination associated with the proposed Nowra Bridge redevelopment, Nowra NSW. This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited (SMEC) and Roads and Maritime Services under which SMEC undertook to perform a specific and limited task. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes. The report is limited to the scope defined in Section 1.3.

This report must be read as a whole. Any subsequent report must be read in conjunction with this report. In conducting this assessment, reliance has been placed on data and information provided by other consultants.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

SMEC accepts no responsibility for inaccuracies contained in the information provided by other consultants. The findings of this report are based on the data collected during the stated investigation period. SMEC performed the fieldwork in a manner consistent with the normal level of care and expertise exercised by members of the contaminated land management profession. The findings of the report are based on information obtained and site observations made at the time of the assessment. These conditions may change with time and space.

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EXECUTIVE SUMMARY

SMEC Australia Pty Ltd (SMEC) was engaged by Road and Maritime Services (RMS) to carry out a Phase 1 contamination assessment for the proposed upgrade of Nowra bridge located at Nowra, NSW 2565 (the proposal).

This Phase 1 contamination assessment is required to inform the Environmental Assessment (EA) for the proposal. This report presents findings from desktop investigations and a site inspection undertaken across the proposal in 29 January 2018.

The scope of works for this Phase 1 contamination assessment included:

- A desktop review including review of:
  - Available published information relating to the site including geological, soil landscape, topographical, and/or land use maps
  - Review of previous environmental reports
  - Historical aerial photographs (1949 to 2017)
  - NSW Environmental Protection Authority (EPA) contaminated land and Protection of the Environment and Operations Act (POEO Act) licence online databases
  - Search of nearby registered groundwater bores
  - Publicly available Shoalhaven City Council information relevant to the proposal
- A site walkover by an experienced environmental engineer/scientist to identify potentially contaminating activities or previous land uses
- A report presenting the findings of the preliminary assessment including:
  - Site history information gained during the desktop study and site walkover
  - Identification of potential areas of environmental Concern (AECs)
  - Preliminary assessment of the likelihood for contamination and/or acid sulfate soils/sediments at the site and provide recommendations for further assessment

Key findings of the Phase 1 contamination assessment are summarised below:

- The former Nowra Gasworks operated between the early 1900s and 1960s. The site (including Harry Sawkins Park which abuts the southern project boundary) was formally declared a contaminated site by the NSW EPA
- Eight potential AEC and potential contamination sources were identified onsite including (refer to Figure 4-1 and 4-2):
  - AEC 1 – Bomaderry sub Station
  - AEC 2 – Agricultural paddocks, road verges, pubic open space (parks) and localised residential garden areas
  - AEC 3 – Fill materials
  - AEC 4 – Former and current structures
  - AEC 5 – Nowra Truss Bridge
  - AEC 6 – Acid Sulfate Soils and Sediments
  - AEC 7 – Former gas works including Harry Sawkins Park
  - AEC 8 – Road pavement (coal tar) and buried utility conduits and service pits (asbestos).

A summary of the AECs which have been identified as having a medium to high potential for contamination to be encountered during proposal construction is as follows:

- AEC 2 - Agricultural activities in the study area have a medium, potential for contamination based on extended history of agricultural land use (prior to 1949), including possible application of pesticides (widespread). Localised application of herbicides is possible, however widespread application is less likely based on normal agricultural practices
- AEC 3 - Fill of unknown origin and quality appears to have been placed widespread throughout the existing road alignment with a medium potential for soil contamination. Fill embankments were observed at various depths, typically deepest near the approach to existing bridge structures and within the northern and central southern zones adjacent to low lying floodplains
- AEC 4 - Former and current structures has also been identified as medium to high potential for soil contamination given the age of existing or former residential properties (circa 1960s) within the alignment. There is a potential for residual localised contaminated soil may be encountered during demolition works. Residential properties potentially contain surface soil or uncontrolled fill impacted by asbestos, domestic waste and other hazardous materials
- AEC 5 - There is a high potential for Lead-based paints having been used (circa 1980s) during historic maintenance of the Nowra truss bridge. A low potential for soil contamination residues is considered within near surface soils beneath/surrounding these features
- AEC 6 - There is a high potential for acid sulfate soils north of the Bomaderry Creek crossing (east and west of the Princes Highway) where the Bolong Road intersection meets with the Princes Highway and for sediments within the Shoalhaven River
- AEC 8 - The existing road pavements within the study area have a medium to high potential to contain coal tar, noting this was common practice prior to 1987. The main highway easement has a medium to high potential of asbestos containing materials in road assets like service conduits and communication pits, noting that construction materials containing asbestos were still used until 1986

There are no known previous investigations that undertook groundwater sampling within the Proposal area. At a preliminary level, a medium potential for groundwater contamination is assessed within two areas of environmental concern; AEC 1 Bomaderry substation (localised impacts) and/or AEC 7 Former gas works including Harry Sawkins Park (more widespread). Groundwater contamination at these locations within/adjacent to the study area are considered to have a low potential to impact the proposal based on the proximity to actual construction/operational extent of the proposal and the low likelihood for engaging groundwater. A low potential for widespread groundwater contamination is assessed in remaining AECs.

SMEC recommends a detailed site investigation be conducted within AEC 2, AEC 3, AEC 4, AEC 5, AEC 6 and AEC 8 consisting of a soil sampling programme within areas of environmental concern and testing for potential contaminants of concern to confirm the presence/absence of contamination. Groundwater sampling may not be required within AEC1 and AEC7 considering a low potential for exposure during proposal construction activities.

SMEC consider a suitable approach would be to undertake judgemental sampling pattern targeting the individual AECs identified with laboratory testing for potential contaminants of concern could be implemented during the geotechnical drilling program for the proposal. Further assessments should be carried out in accordance with the NEPM (2013).

Subject to the results of further investigations, SMEC recommended that an Unexpected Finds Plan be prepared for the construction phase works, to manage the potential for unexpected finds of contaminated materials.

Acid sulfate soils risks should be further assessed and management measures documented within an Acid Sulfate Soils Management Plan.

1. INTRODUCTION

1.1 General

SMEC Australia Pty Ltd (SMEC) was engaged by Road and Maritime Services (Roads and Maritime) to carry out a Phase 1 contamination assessment for the proposed upgrade of Nowra bridge located at Nowra, NSW 2565 (the proposal).

SMEC understands that a Phase 1 contamination assessment is required to inform the Environmental Assessment (EA) for the proposal.

The proposal covers about 1.6 kilometres of the Princes Highway at Nowra (and various intersection upgrades) from 150 metres north of Bolong Road on the northern approach to the bridge at Bomaderry to 75 metres north of the Moss Street intersection at Nowra on the southern approach to the bridge. The proposal is located within the Shoalhaven City Council local government area (LGA). The Shoalhaven City Council Local Environment Plan (LEP) (2014) identifies the following various land uses as being impacted by the proposal:

- R2 – Low Density Residential
- SP2 – Infrastructure
- B4 – Mixed Use
- RE1 – Public Recreation

The proposal locality and study area are presented in Figure 1-1.

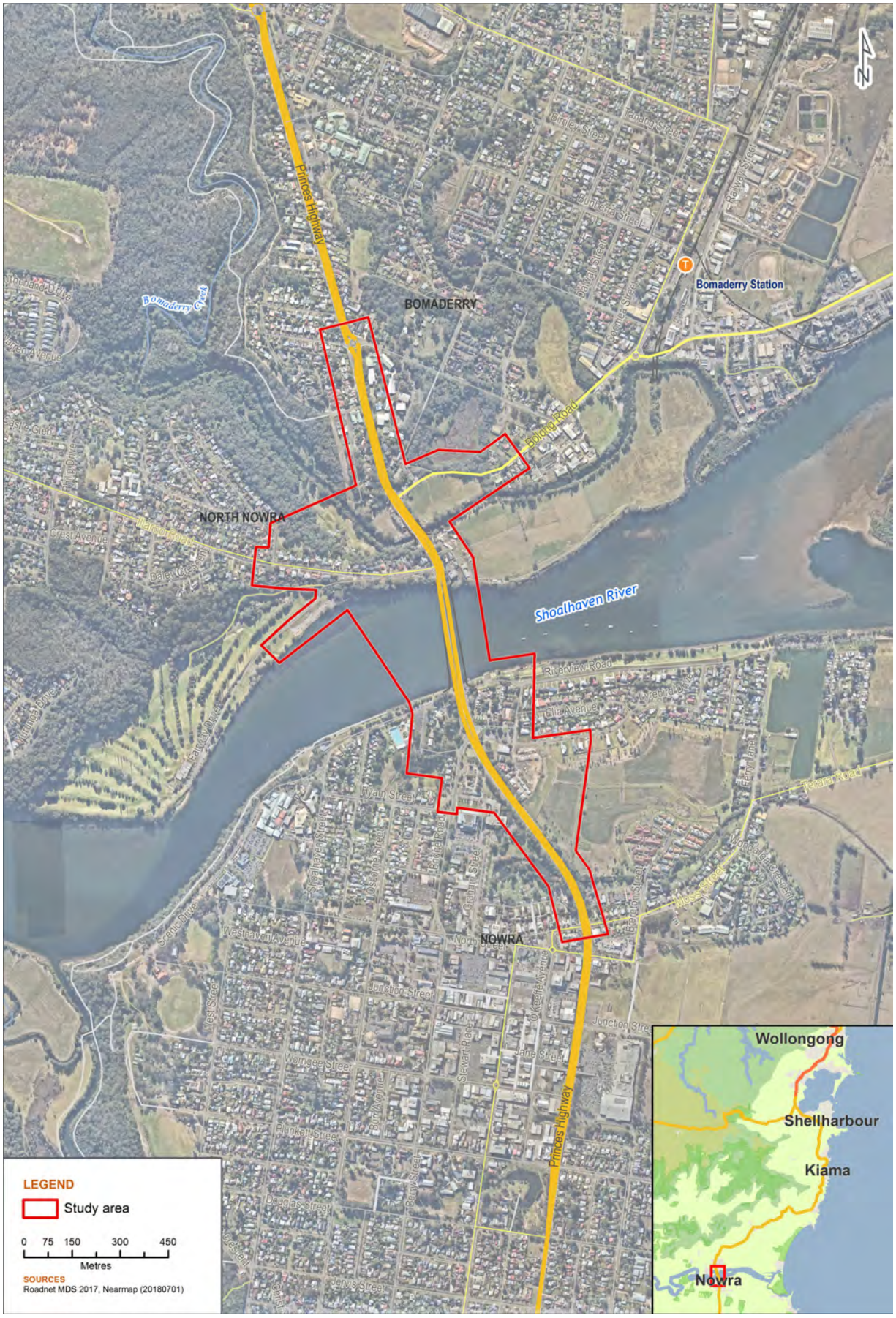


Figure 1-1 Proposal locality and study area

1.2 The proposal

Roads and Maritime Services NSW (Roads and Maritime) proposes to construct a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal). The proposal includes the construction of a new four lane bridge to the west (upstream) of the existing bridge crossings and the removal of vehicular traffic from the existing southbound bridge. The proposal would also include the upgrade of about 1.6 kilometres of the Princes Highway in the vicinity of the bridge, as well as providing key intersection upgrades and modifications to the local road network. The proposal would improve access to Nowra and the surrounding areas, improve southbound access for large freight vehicles, and improve traffic flows.

Key features of the proposal include:

- Construction of a new bridge to the west (upstream) of the existing bridge crossings over the Shoalhaven River including:
  - Four northbound lanes including a dedicated left turn only lane from Bridge Road to Illaroo Road
  - A 3.5 metre wide shared use path on the western side of the bridge connecting the Illaroo Road intersection to the Bridge Road intersection
- Widening of the existing bridge over Bomaderry Creek
- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic
- Removal of vehicular traffic and closure of the existing southbound bridge to undertake investigation, rehabilitation and repurposing work for adaptive reuse following opening of the new northbound bridge. As part of the proposal, shared paths and maintenance access would be constructed up to the existing southbound bridge and work to prevent unauthorised access would also be carried out. The rehabilitation and repurposing of the existing southbound bridge for adaptive reuse would be subject to a separate consultation and assessment process to this REF
- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to about 75 metres north of the Moss Street intersection
- Widening of Illaroo Road over a distance of about 270 metres
- Upgrading of the Princes Highway and Illaroo Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Illaroo Road
  - Three dedicated right turn lanes and one dedicated left turn lane from Illaroo Road to Princes Highway
  - An acceleration and merge lane for northbound traffic turning into Illaroo Road from Princes Highway
- Upgrading of the Princes Highway and Bridge Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Bridge Road
  - One left turn lane from Bridge Road to the Princes Highway
- Local road adjustments including:
  - Closing the access between Pleasant Way and Princes Highway
  - Restricting turning movements at the intersection of Bridge Road and Scenic Drive
  - Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection
- Provision of pedestrian facilities at all intersections

- Dedicated off road shared paths and footpaths along the length of the proposal.
- Urban design and social amenity improvements, and landscaping including foreshore pedestrian links to the existing southbound bridge
- Relocation and/or protection of utility services
- Drainage and water quality management infrastructure along the road corridor
- Property works including acquisition, demolition, and adjustments to accesses
- Temporary ancillary facilities during construction including site offices, construction compounds, and stockpile sites.

The proposed road design, construction boundary and construction compounds are shown in Figure 1-2 and Figure 1-3.

1.3 Objectives and scope of works

The objectives of this Phase 1 contamination assessment are to:

- Assess the potential for contamination to be present within the proposal area
- Assess if contamination potentially poses a risk to human health or the environment and/or has the potential to preclude development of the site
- Provide recommendations on the need for further investigations and/or management based on preliminary findings
- Prepare a Phase 1 contamination assessment in accordance with the requirements of relevant NSW EPA Guidelines, and SEPP 55 remediation of land, planning guidelines.

This Phase 1 was prepared to fulfil the requirements of Nowra Bridge Project Stage 1 Contamination Assessment, Appendix R of the PSC Brief – Professional Services Contract, Description of services Concept Design and Environmental Assessment, Nowra Bridge, Contract Number: 14.2571.1372, Issue 1.0 (dated 24 October 2014).

The scope of works for this Phase 1 contamination assessment included:

- A desktop review including review of:
  - Available published information relating to the site including geological, soil landscape, topographical, and/or land use maps
  - Review of previous environmental reports
  - Historical aerial photographs (1949 to 2017)
  - NSW Environment Protection Authority (EPA) contaminated land and POEO licence online databases
  - Search of nearby registered groundwater bores
  - Publicly available Shoalhaven City Council information relevant to the site.
- A site walkover by an experienced environmental engineer/scientist to identify potentially contaminating activities or previous land uses
- A report presenting the findings of the preliminary assessment including:
  - Site history information gained during the desktop study and site walkover
  - Identification of potential areas of environmental concern (AECs).

Preliminary assessment of the likelihood for contamination and/or acid sulfate soils (ASS)/sediments at the site and provide recommendations for further assessment

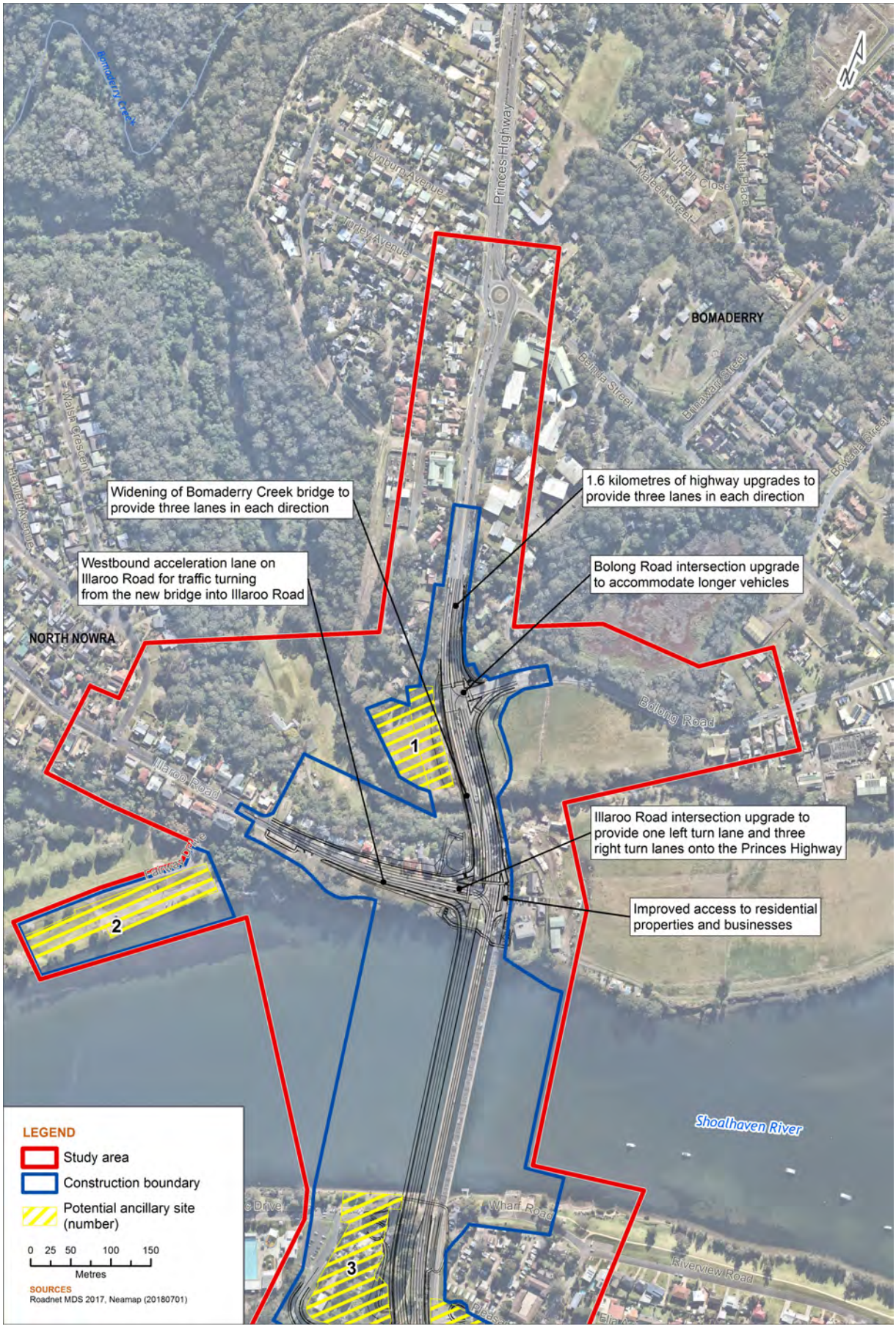


Figure 1-2 Key features of the proposal north of Shoalhaven River

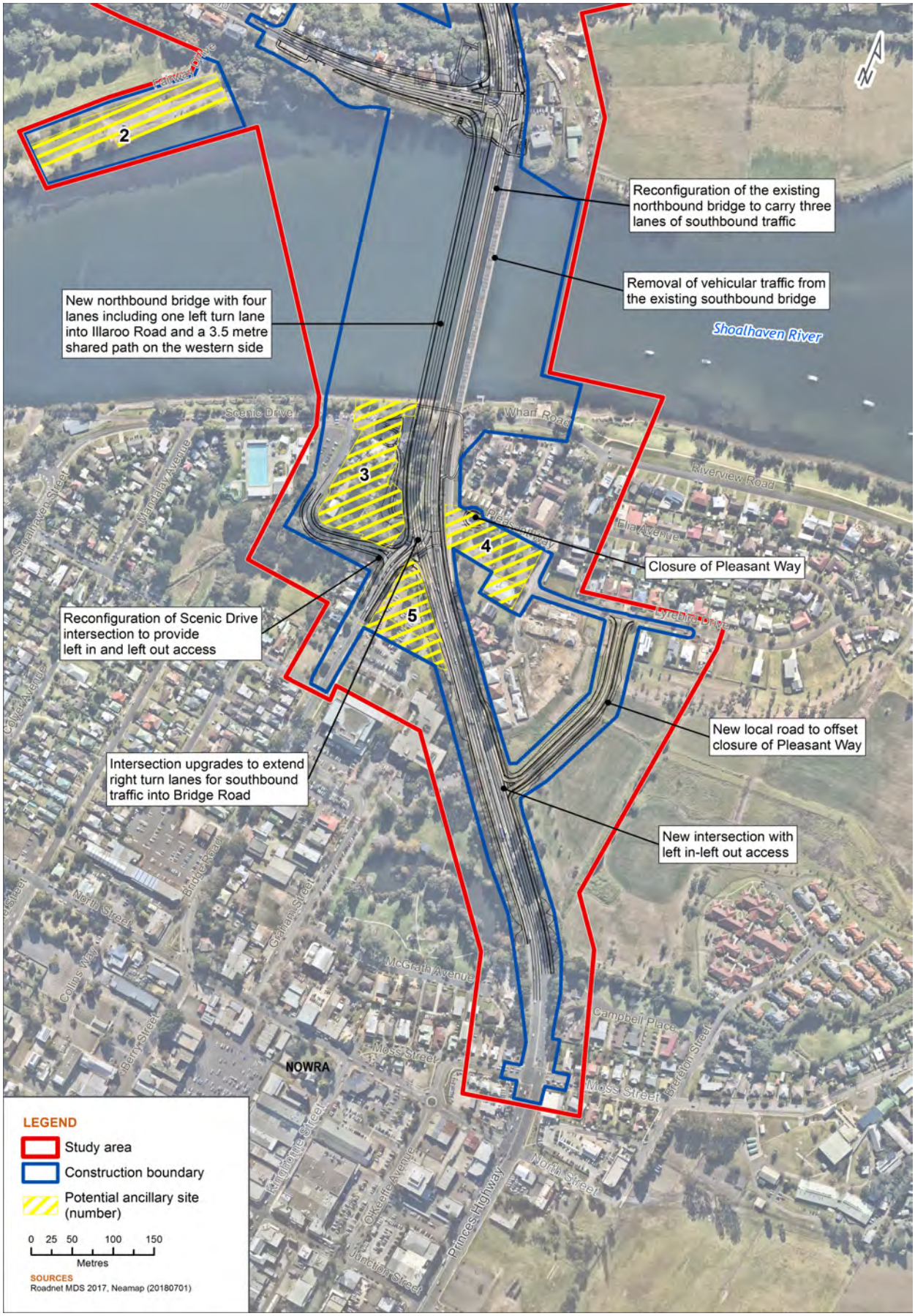


Figure 1-3 Key features of the proposal south of Shoalhaven River

1.4 Published guidelines and framework

The assessment has been undertaken in general accordance with applicable legislation and guidelines including:

- Acid Sulfate Soils Assessment Guidelines, NSW Acid Sulfate Soils Management Advisory Committee August 1998
- Guideline for the management of contamination, Roads and Maritime Services 2013
- National Environment Protection Council, National Environmental Protection (Assessment of Site Contamination) Measure, 2013
- NSW EPA, Contaminated Sites – Guidelines for Consultants Reporting on Contaminated Sites, 1997
- State Environmental Planning Policy No.55 - Contaminated Land, 1998.

2. SITE INFORMATION

2.1 Site description and zoning

The proposal is located at Nowra, NSW and within the Shoalhaven City Council LGA. The Shoalhaven LEP (2014) identifies the following land uses as being impacted by the proposal:

- B4 – Mixed Use
- R2 – Low Density Residential
- RE1 – Public Recreation
- SP2 – Infrastructure.

The proposal includes the addition of a new bridge to the west of the existing bridge, upgrades to about 1.6 kilometres of the Princes Highway from 150 metres north of Bolong Road to 75 metres north of the Moss Street intersection at Nowra and a number of intersection upgrades at Bolong Road, Illaroo Road, Bridge Road and Scenic Drive.

2.2 Surrounding land use

North of the Shoalhaven River

- North – Public open space (Bomaderry Creek), low density residential, Commercial (TAFE NSW Nowra, Shoalhaven Community College)
- West– Low density residential and public open space (North Nowra Rotary Park)
- East – Commercial (Perfect Catch Seafoods) and farm/agricultural grazing open paddock.

South of the Shoalhaven River

- East – Public open space, commercial and low density residential
- West – Public open space, commercial (caravan Park) and low density residential
- South – commercial and public open space.

2.3 Topography and landforms

The topographic setting of the proposal area is oriented with a north-south slope before levelling out to the south. The topography drops from a high of about 25 metres at the northern extent of the proposal to nine metres at Bomaderry Creek. The topography from Bomaderry Creek to southern extent of the proposal footprint remains relatively flat with minor undulations.

2.4 Vegetation

Established trees (predominantly >5 metres in height), shrubs and landscaped areas align the majority of the proposal boundary. It expected that the majority will need to be removed to facilitate the construction of the proposal.

2.5 Regional geology

Reference to the 1:100,000 Geological Series Sheet for Kiama shows the proposal to be underlain by several formations.

The proposal is predominantly underlain by Nowra Sandstone comprising of medium to coarse grained quartz sandstones, minor siltstones and conglomerate beds. The formation belongs to the Shoalhaven Group and is characterised by moderately to gently undulating rises to undulating low hills, with local relief greater than 40 metres, ground surface slopes of greater than five per cent, broad ridges and crests with long, very gently inclined slopes, deeply incised channels and benched sandstone outcrops adjacent to drainage lines. The subsurface soil in this group is likely to be moderately deep, stony, low permeability and highly susceptible to erosion.

The proposal is also underlain by an undifferentiated formation comprising of alluvium, gravel, sand, silt and clay. This formation occurs in on both the northern and southern banks of the Shoalhaven River crossing, as well as the crossing of Bomaderry Creek.

Figure 2-1 presents the proposal study area in relation to the regional geology.

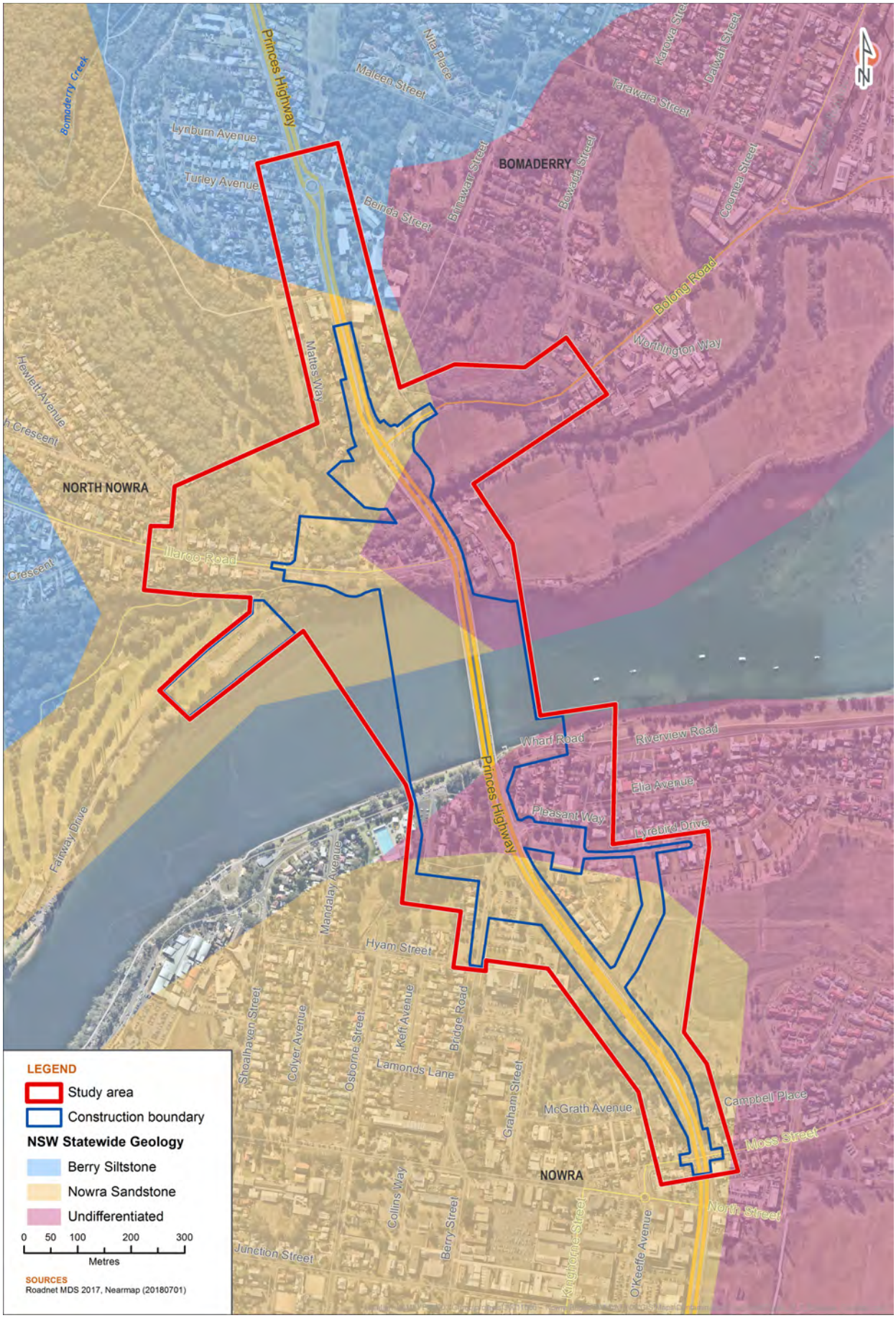


Figure 2-1 Regional geology

2.6 Regional lithology

Reference to the NSW Office of Environment and Heritage eSPADE NSW Soil and Land Information Map (viewed 20.12.17) indicates that the proposal site is situated predominantly within Nowra with the chance of some Shoalhaven soils on the northern side of the bridge.

Nowra soils

- Original landscape consists of moderately to gently undulating rises to undulating low hills on sandstone on the coastal plain
- The range of soil types that may be encountered include yellowish brown sands and gravelly yellowish brown clayey sand as topsoils and mottled light clay and dark olive sandy clays as subsoils
- The soil limitations are:
  - Topsoils - high permeability, low available water-holding capacity and sodicity
  - Subsoils - hard setting, low permeability, low wet bearing strength, sodicity and strongly acid.

Shoalhaven soils

- Original landscape consists of level to gently undulating active floodplains with small levees, minor depressions and backwater swamps on coastal floodplains
- The range of soil types that may be encountered include brownish black fine sandy loams as topsoils and brown/yellow sandy clays and reddish brown clays as subsoils
- The soil limitations are:
  - Topsoils – hardsetting, very high organic matter, low available water-holding capacity and sodicity and strongly acid
  - Subsoils – acid sulfate potential, low permeability, low wet bearing strength, low available water-holding capacity, sodicity and strongly acid.

Figure 2-2 presents the proposal study area in relation to the regional lithology.

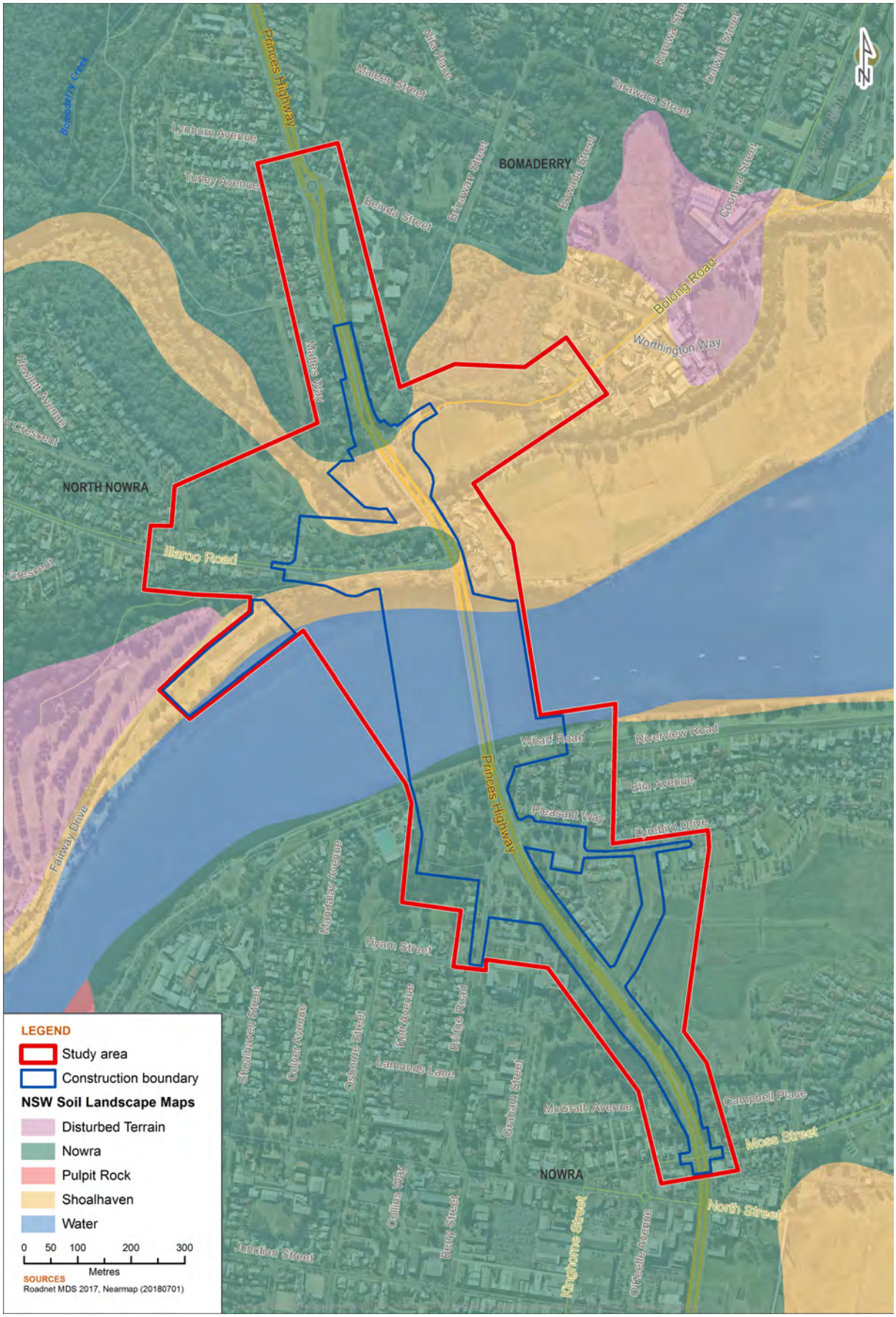


Figure 2-2 Regional lithology

2.7 Hydrology and hydrogeology

The proposal area can be considered a relatively flat floodplain landscape with a small elevation change to the north of 25 metres beyond Bomaderry Creek to the northern extent of the proposal. The remainder of the proposal footprints elevation ranges from nine meters at Bomaderry Creek to five metres at southern extent of the proposal.

Drainage from the proposal site is expected to flow offsite via roadside drainage lines to the east and west of the present road alignment. A permanent creek (Bomaderry Creek) is located within the proposal footprint about 150 meters to the north of the main water body the Shoalhaven River. Bomaderry Creek is a tributary of the Shoalhaven River with its confluence located about 800 metres east of the proposal.

SMEC completed a preliminary search of the Department of Water and Energy Online Database to identify registered groundwater bores within the vicinity of the site. The search indicated there are six registered boreholes registered under the database within a one kilometre radius of the site. Details of the bores are provided in Table 2.1.

The locations of the registered bores are shown in Figure 2-3.

Figure 2-3 Registered groundwater bore locations

Table 2-1 Summary of registered groundwater bores

Borehole ID	Standing Water Level (m bgl)	Comments
GW109969	Not recorded	Borehole is located about 550m north west of the northern river bank. The borehole is 15.2m deep. The purpose of the bore is unknown but given its special location it's reasonable to assume that it may be a groundwater monitoring well at Bomaderry Substation.
GW109970	1.33	Borehole is located about 550m north west of the northern river bank. The borehole is 1.8m deep. The purpose of the bore is unknown but given its special location it's reasonable to assume that it may be a groundwater monitoring well at Bomaderry Substation.
GW101695	Not recorded	Borehole is located about 520m south west of the southern river bank. The borehole is 15.2m deep. The purpose of the bore is unknown.
GW109973	Not recorded	Borehole is located about 650m south west of the southern river bank. The borehole is 15.2m deep. Given the location it is reasonable to assume that the bore is related to the former gas works site.
GW109971	Not recorded	Borehole is located about 650m south west of the southern river bank. The borehole is 15.2m deep. Given the location it is reasonable to assume that the bore is related to the former gas works site.
GW109972	Not recorded	Borehole is located about 650m south west of the southern river bank. The borehole is 15.2m deep. Given the location it is reasonable to assume that the bore is related to the former gas works site.

2.8 Acid sulfate soil risk

ASS are acidic soil horizons (layers) resulting from the aeration of soil materials rich in iron sulfides. ASS generally occur within the following locations:

- Marine or estuarine sediments deposited during the Holocene period
- Soils over five metres above sea level
- Marine or estuarine settings/environments.

As mapped by the New South Wales Natural Resource Atlas (OEH, 2013) there is a low risk of ASS (one to two metres and two to two metres) existing within the southern section of the proposal area and area immediately north east and north west of the bridge.

A high probability is mapped north of the Bomaderry Creek crossing (east and west of the Princes Highway) where the Bolong Road intersection meets with the Princes Highway.

In addition, there is a high risk of acid sulfate sediments within the Shoalhaven River. Figure 2-4 presents the proposal study area in relation to the mapped ASS.

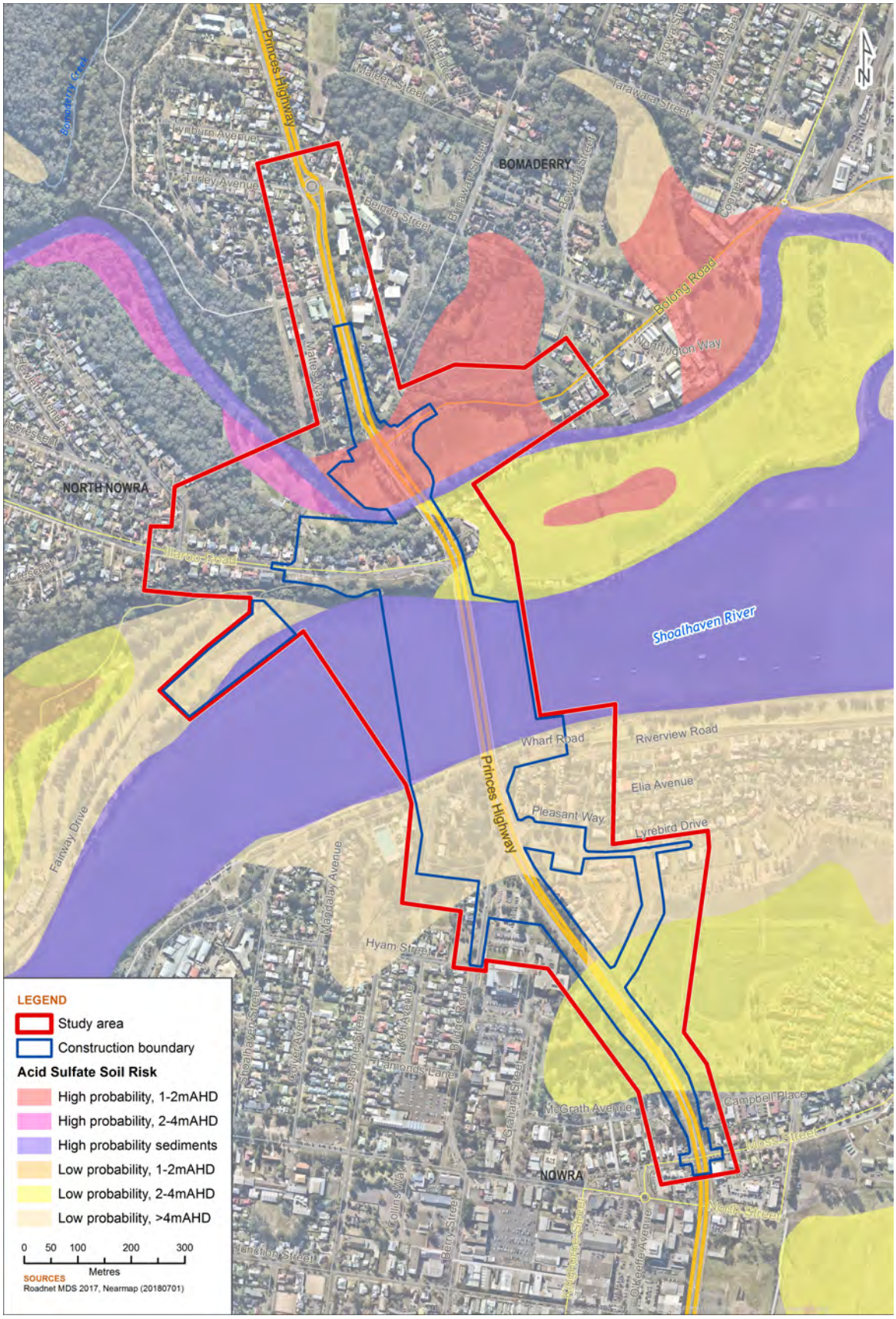


Figure 2-4 Acid sulfate soils

3. SITE HISTORY AND OBSERVATIONS

3.1 General

Site history information was reviewed in the following information sources:

- Review of historical aerial photography (1949, 1961, 1974, 1997, 1984 and 2017). We note that aerial photography prior to this period was not viewed
- A search of NSW EPA Contaminated Land and POEO licence records
- Publicly available Shoalhaven City Council records
- Review of existing literature relating to the proposal
- Site inspection.

3.2 Aerial photography

Historic aerial photos reviewed during this study are presented in Figures 3-1 to 3-6.

Major proposal features and surrounding proposal conditions are summarised in Table 3.1.

Table 3-1 Historical aerial photo review

Year	Proposal Description and Surrounding Area
Aerial Photo 1949 B/W	**North of Shoalhaven River:** The 1949 photo indicates that development (assumed to be low density residential properties) immediately north of Illaroo Road. Small structures and agricultural land are visible immediately east of the bridge. Agricultural land (open paddock) occupies the area between Bomaderry Creek and Bolong Road. Bolong Road itself joins the Princes Highway about 100m further north than the present intersection. The area north of Bolong Road is forested with the exception of Princes Highway. **South of Shoalhaven River:** Other than some a few small structures adjacent to Bridge Road, agricultural land (open paddock) occupies the area to the east of the Princes Highway. Structures are visible at the intersection of Bridge and Hyam streets and along North and Moss streets to the south of the proposal. Although not easily identifiable from the image it is known that Shoalhaven Council operated a gasworks from the early 1900s to the late 1960s at Bridge Road and Lamonds Lane, about 200m south east of the proposal site.
Aerial Photo 1961 B/W	**North of Shoalhaven River:** The 1961 photo indicates that there is minimal change compared with the 1949 image other than the addition of some farm structures immediately to the east. The Bolong Road intersection with the Princes Highway is now in its present position. There has been some clearance and development of the land immediately north of the old Bolong Road intersection and Walsh Crescent and additional residential structures have been constructed **South of Shoalhaven River:** There has been development of the land immediately east of the bridge (assumed to be the present day caravan park). The area boarded by Scenic Drive has been developed with many of the present day structures visible. West of Scenic Drive has also been developed with the original Nowra Aquatic Park visible structures on the eastern side of Darkes Road are no longer present. There is minimal change compared with the 1949 image further south.
Aerial Photo 1974 B/W	**North of Shoalhaven River:** The 1974 photo indicates that there is minimal change compared with the 1961 image other than the addition of a structure on the north east river bank adjacent to the bridge (present day Perfect Catch Seafoods and takeaway building) and some additional farm structures to the north.

Year	Proposal Description and Surrounding Area
	South of Shoalhaven River: There has been minimal change compared to the previous image other than some residential development around Lyrebird Drive, Elia Avenue and Riverview Road. West of Scenic Drive has also been additional development of Nowra Aquatic Park.
Aerial Photo 1979 B/W	**North of Shoalhaven River:** The 1979 photo indicates that there is minimal change compared with the 1974 image other than some scaring is evident between Bomaderry Creek and Bolong Road on the eastern side of Princes Highway. The additional northbound bridge to the west of the original bridge is under construction. **South of Shoalhaven River:** There appears to be a works compound located at the south west river bank (at the end of Scenic Drive). There is minimal change evident within the wider area other than more residential development around Lyrebird Drive, Elia Avenue and Riverview Road and the addition of the Pleasant Way River Lodge complex to the south east corner of the caravan park.
Aerial Photo 1984 B/W	**North of Shoalhaven River:** Minimal change compared with the 1979 image. The additional northbound bridge to the west of the original bridge has been completed. **South of Shoalhaven River:** The works compound located at the south west river bank has been cleared and the Princes Highway to the south has been developed and now follows its present day alignment. There is minimal evident change to the wider area other than more residential development around Lyrebird Drive, Elia Avenue and Riverview Road.
Aerial Photo 2017 Colour	**North of Shoalhaven River:** Minimal obvious change compared to the 1984 image other than road widening along the Princes Highway and additional farm structures and a residential structure immediately north east of the bridge. Some development has occurred north of the study area (TAFE NSW Nowra and Shoalhaven Community College). **South of Shoalhaven River:** The Nowra aquatic centre has been further developed. Clearing of some structures has occurred at the corner of Hyam and Bridge streets and the area between Bridge Street and the Princes Highway to allow development of the Shoalhaven City Council offices, Shoalhaven Entertainment Centre and car parking areas. The IRT Greenwell Gardens Care Centre has also been developed south east of the proposal The area formally occupied by the gas works has been redeveloped and now contains Nowra Fire Station and commercial buildings (Hardware store) and car parking facilities.

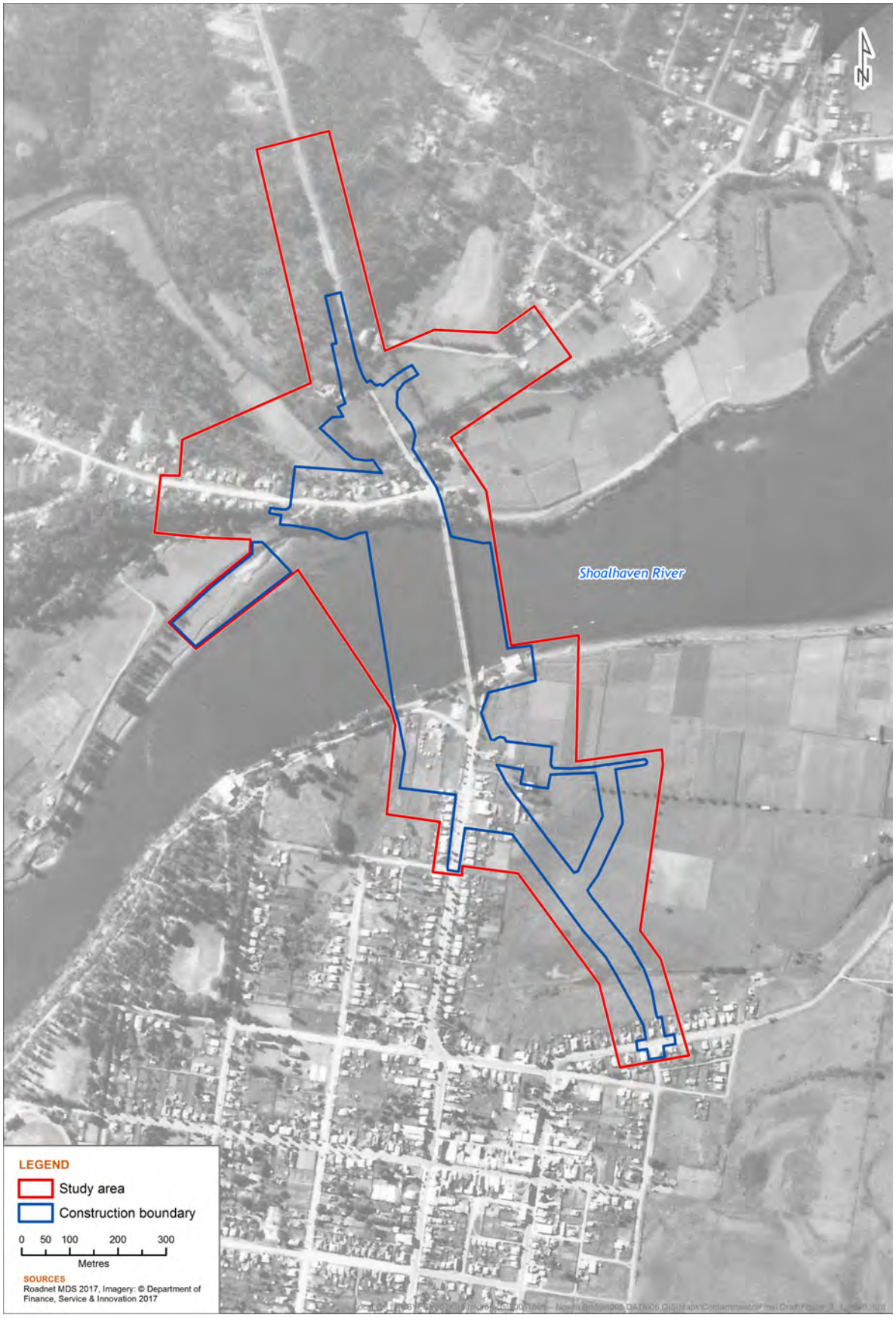


Figure 3-1 Historical aerial photo (1949)

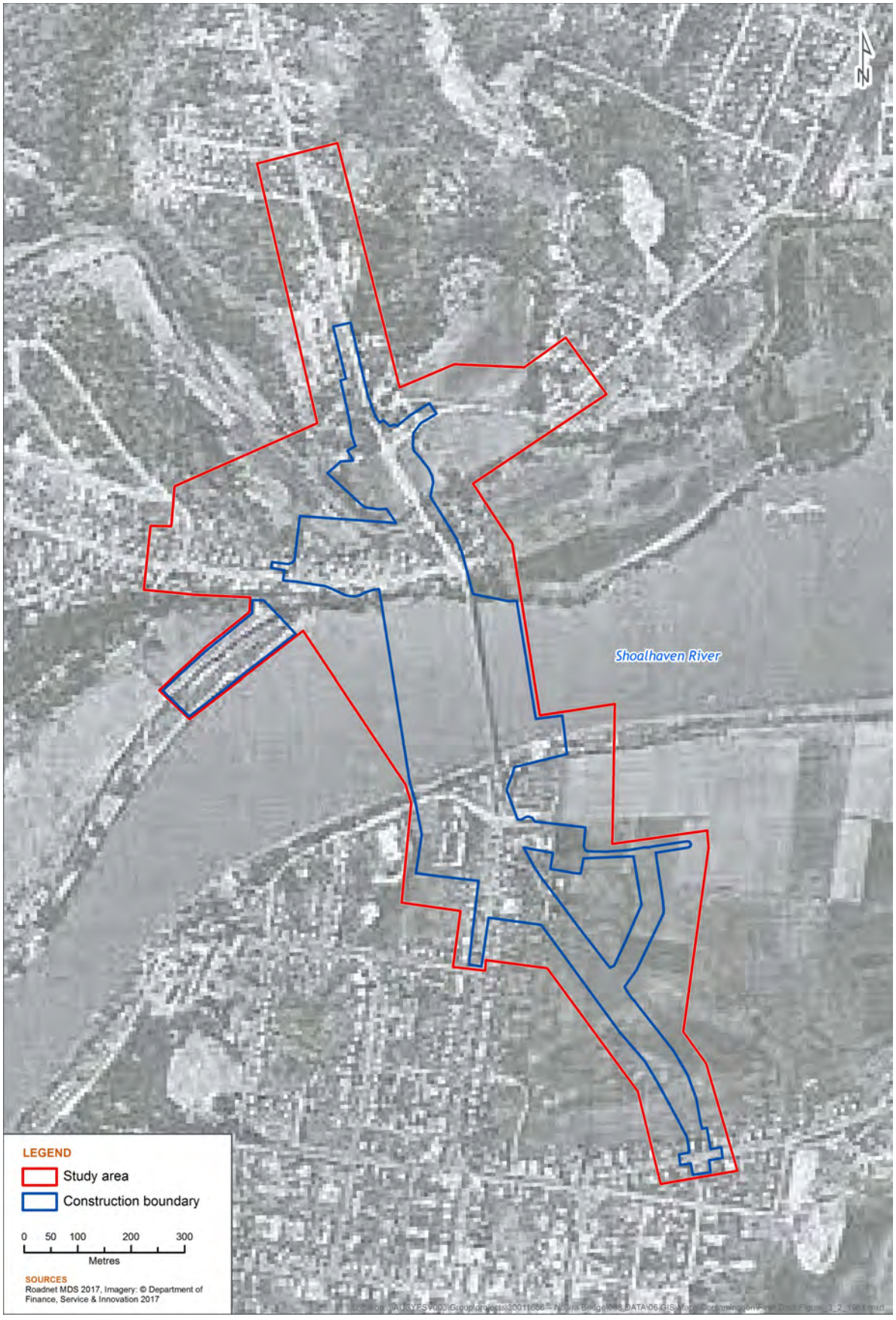


Figure 3-2 Historical aerial photo (1961)

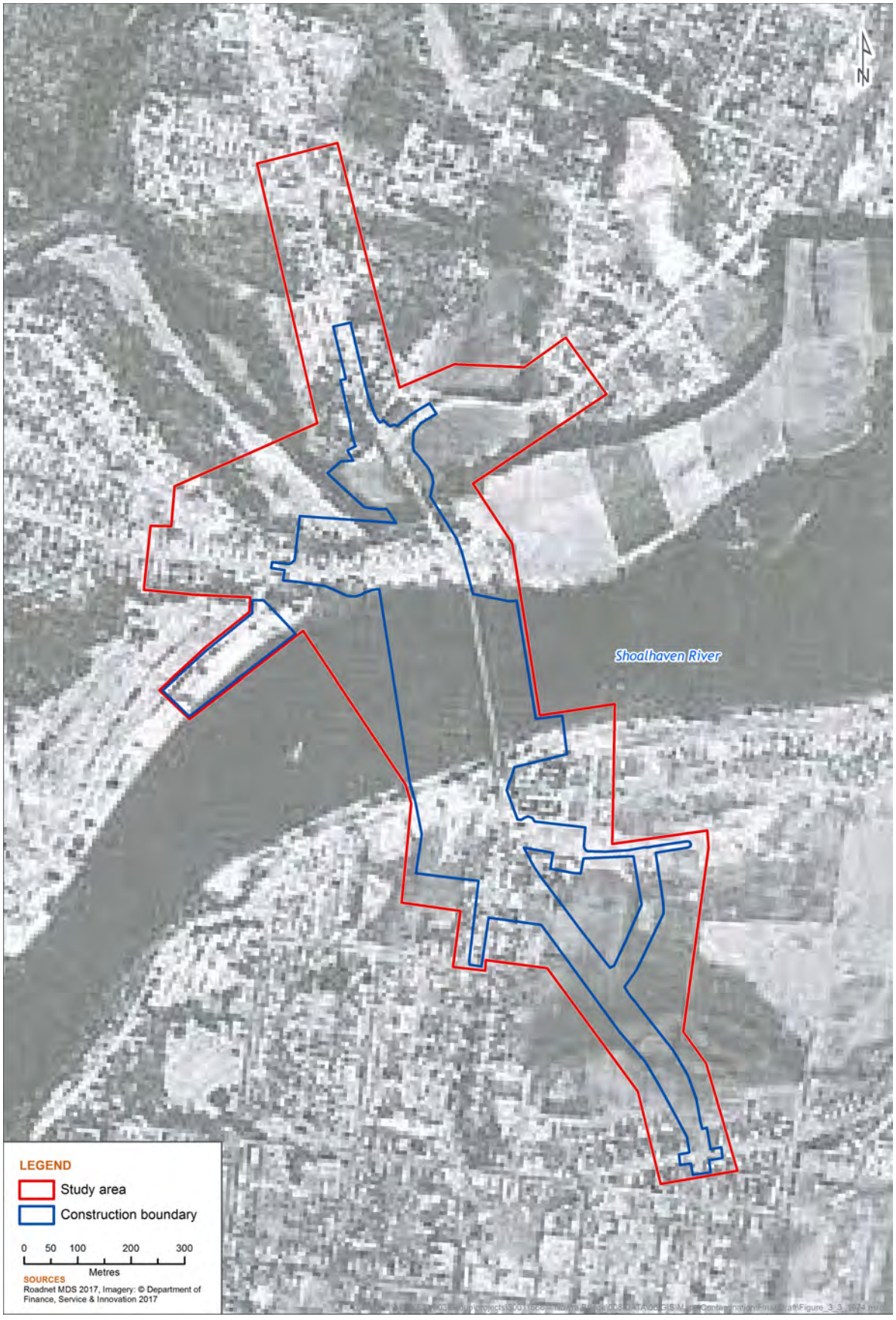


Figure 3-3 Historical aerial photo (1974)

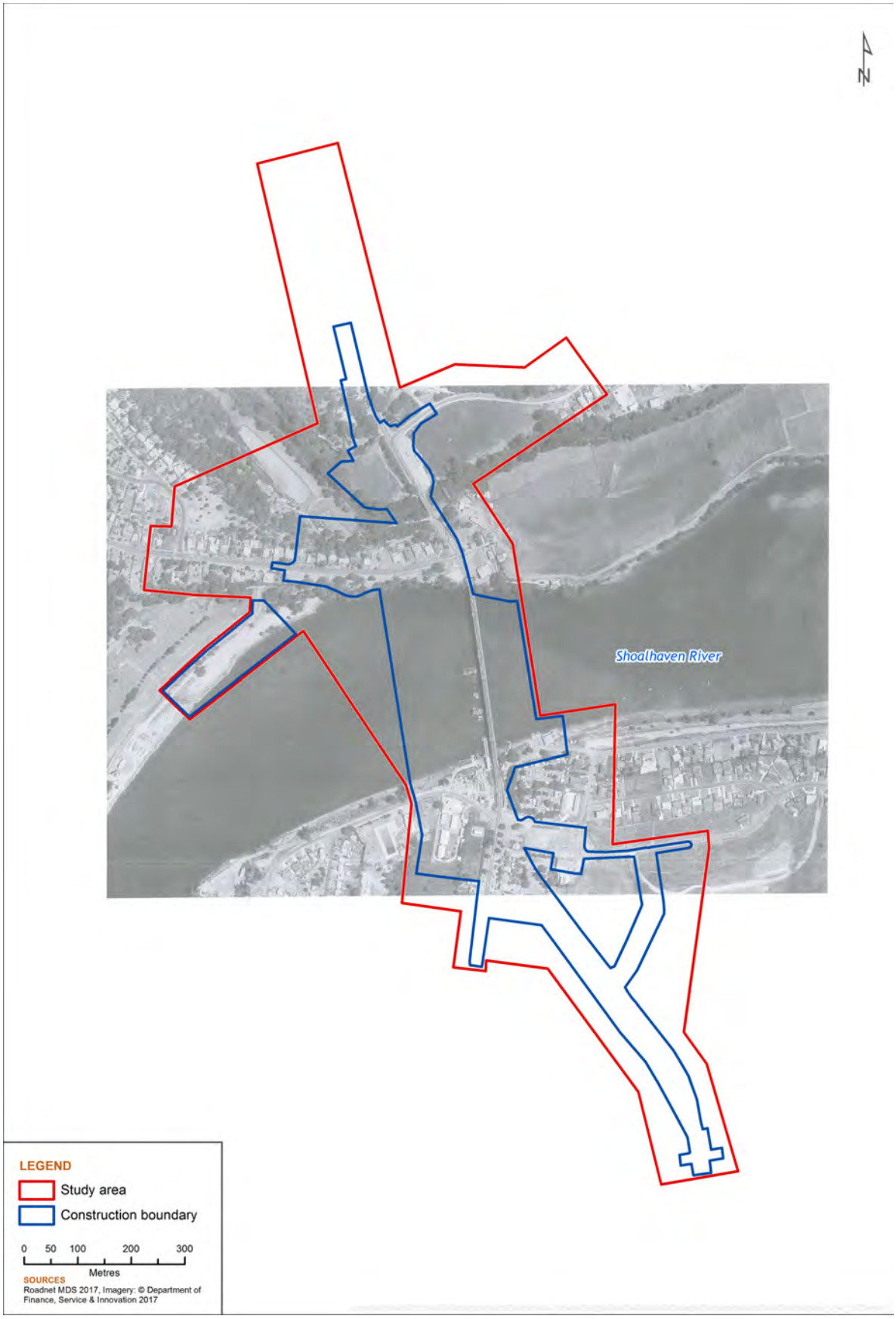


Figure 3-4 Historical aerial photo (1979)

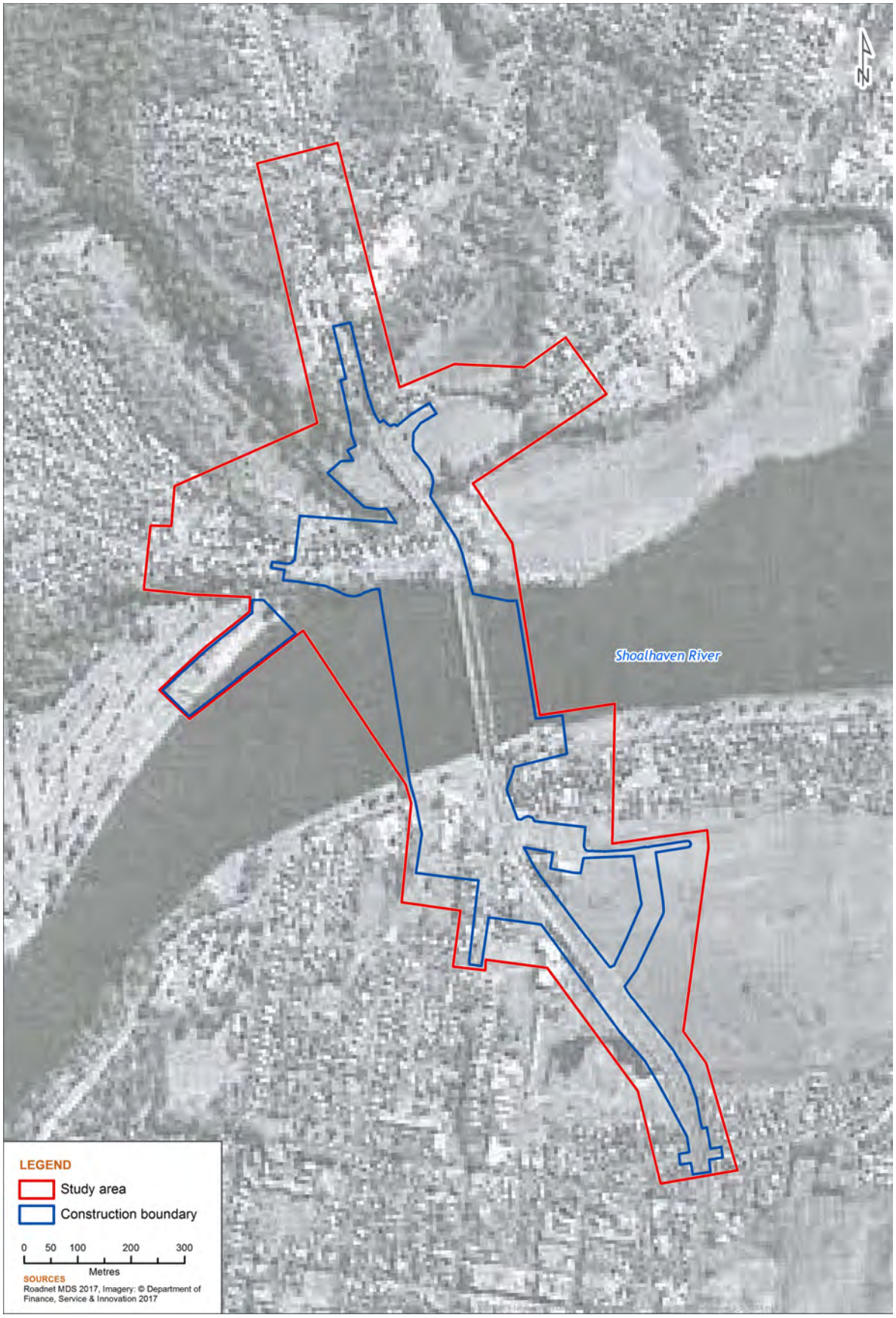


Figure 3-5 Historical aerial photo (1984)

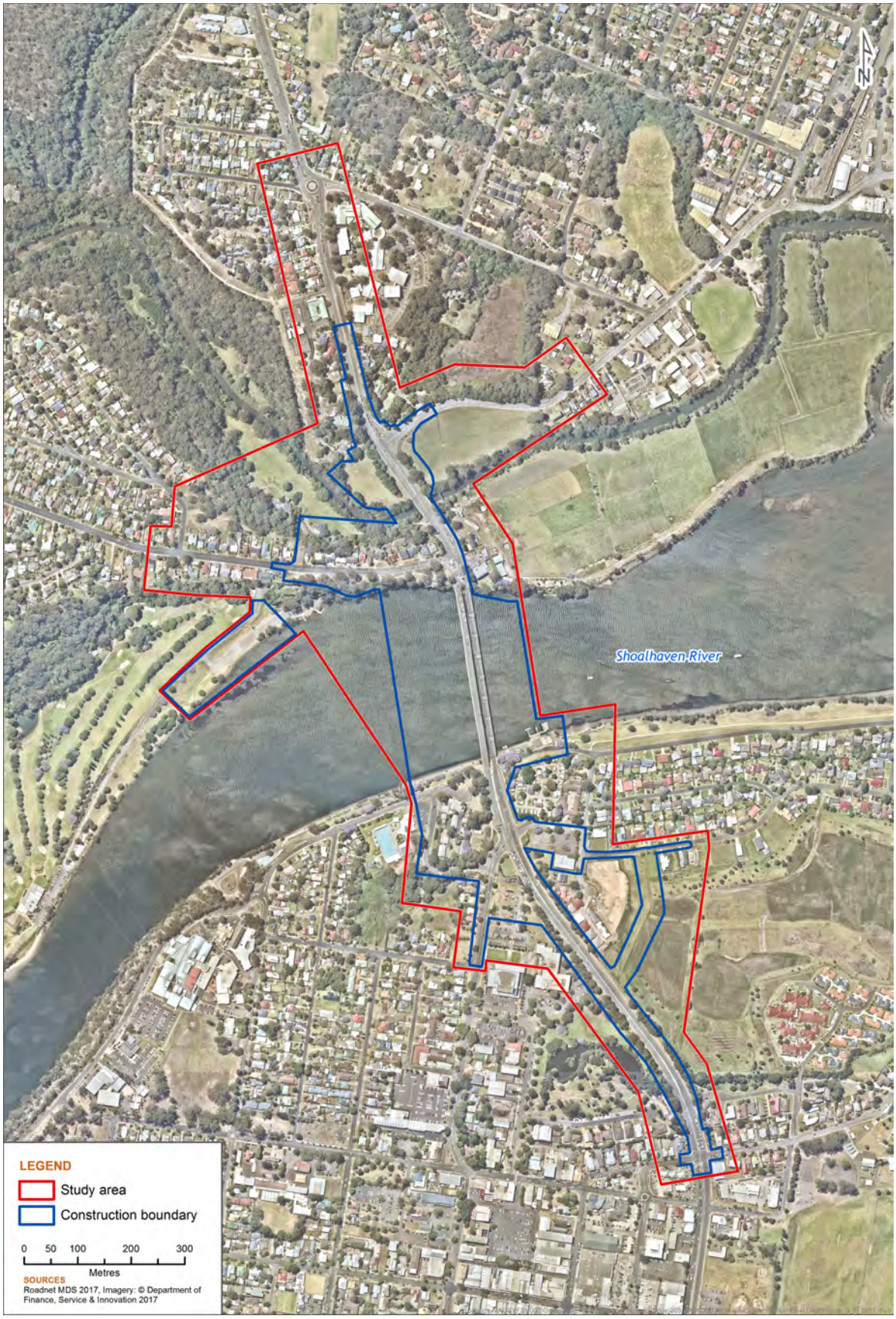


Figure 3-6 Historical aerial photo (2017)

3.3 Shoalhaven City Council Records

The following publicly available information was reviewed:

- Environmental Investigation Surrounding the Former Gas Works Site in Bridge Road Nowra (Fact Sheet 1, January 2012 and Fact sheet 2 October 2012), Shoalhaven City Council.

The fact sheets provide a high level summary of the environmental soil and groundwater investigation conducted at the site. The investigated site covered the former Gas Works site, residential and commercial properties and Harry Sawkins Park which abuts the southern end of the proposal boundary. The site was historically declared a contaminated site by the NSW EPA as detailed in section 3.4.1.

3.4 NSW Environment Protection Authority (EPA) public record

3.4.1 Contaminated Land Search

A search of the NSW EPA Contaminated Land records on 7 November 2017 showed that there were no notified sites or management notices within the area of the proposal.

The closest notified sites are identified below:

Former gasworks site

- Former Gasworks site, Lamonds Lane and Bridge Road, Nowra (Lot 3 DP868373 and Lot 1 DP702802) is located about 300 metres southwest of the southern extent of the proposal. The site has two current Notices (21066 issued 04/01/2005, and 26086 issued 11 May 2006)
- The notices relate to soils and groundwater that the EPA has found to be contaminated with a range of contaminants, including:
  - Polycyclic aromatic hydrocarbons (PAHs), including benzo(a)pyrene
  - Total petroleum hydrocarbons (TPHs) (C6 – C36)
  - Benzene, toluene, ethylbenzene and xylene (BTEX)
  - Phenol
  - Cyanide
  - Copper
  - Lead
  - Zinc
  - Ammonia
  - Coal tar is also present in surface soils.

Mobil Service Station

- Mobil Service Station, Kalandar Street, Nowra (Lot 3 DP542656) is located about 2 kilometres southeast of southern extent of the proposal. The site has 6 former notices (21108 issued 26/02/2009 and repealed 28 June 2017, 26113 issued 29/06/2009 and completed 28 June 2017, 20134437 which was 26113 as amended and issued on 05/11/2013, 20174409 issued 28 June 2017, 201717-7-02 issued 28 June 2017 and GN410 issued 8 August 2016)
- The notices relate to soils that the EPA has found to be contaminated with BTEX and TPH. The groundwater has been contaminated by Phase Separated Hydrocarbons which has migrated offsite. Given the site is located about two kilometres southeast of southern extent of the proposal it is not considered that the site would impact the proposal.

A summary of the NSW EPA Contaminated Land records search results is provided in **Appendix A**.

3.4.2 Protection of the Environment and Operations Act Database Search

A search of the NSW EPA Protection of the Environment Operations environmental protection license (EPL) registers was conducted on 20 December 2017. Table 3.2 identified the licences for sites within one kilometre of the proposal.

Table 3-2 Summary of POEO licenses identified within 1 kilometre of the proposal

Licence No.	Name	Location	Type	Status	Activity
3787	ELSIE EDITH BRYCE	Gwandalan Park - 474 PRINCES HIGHWAY, NOWRA, NSW 2541	POEO licence	Surrendered	Irrigated Agriculture
1027428	ELSIE EDITH BRYCE	Gwandalan Park - 474 PRINCES HIGHWAY, NOWRA, NSW 2541	s.58 Licence Variation	Issued	Irrigated Agriculture
21029	ROADS AND MARITIME SERVICES	Princes Highway, BOMADERRY, NSW 2541	POEO licence	Pending	Road Construction

Other licences may exist for sites in a wider area (more than one kilometre) of the immediate proposal, however due to the location and distance of the sites from the proposal, it is anticipated that none of those sites will have an impact on the proposed proposal. A summary of the POEO Database search is provided in **Appendix A.**

3.5 Review of existing literature

The following previous environmental reports were available for review at the proposal. Reference has been made to relevant findings of the previous investigations.

3.5.1 Nowra Truss Bridge, Draft Phase 1 Conservation Management Plan (Artefact, June 2015)

Artefact Heritage prepared a Phase 1 Conservation Management Plan for the original Nowra truss bridge (existing southbound bridge) that was constructed in 1881. The following relevant information was noted with respect to this Phase 1 contamination assessment:

- The underdeck and other metalwork are painted in standard DMR grey
- It is understood that current painted surface dates from around 1981
- It is likely that the current paint incorporates a lead-based paint undercoat
- Potential for utility conduits to be made from asbestos containing materials.

3.5.2 Nowra Bridge Project, Preliminary Environmental Investigation (PEI) (AECOM, April 2014)

AECOM conducted a Preliminary Environmental Investigation (PEI) for the Nowra bridge proposal. The PEI consisted of assessing five different broad options for an alternate crossing of the Shoalhaven River at Nowra. Option 1 of the report subsequently became the preferred option. Numerous locations within the wider area of the proposal were identified in relation to potential contamination, however, the following areas relevant to this Phase 1 contamination assessment were identified:

- Former Nowra Gas Works located at the corner of Bridge Road and Lamonds Lane. The site is located up gradient about 300 metres west of the southern end of study area. Potential contaminants identified include TPH, BTEX, PAHs, phenols, ammonia, cyanide and heavy metals
- Harry Sawkins Park located to the south of Shoalhaven City Council Administration Centre and immediately up gradient of southern end of the study area. Potential contaminants identified include TPH, BTEX, PAHs, phenols, ammonia, cyanide and heavy metals
- Bomaderry Substation locked at Mattes Way. The site is located up gradient and within the north-western portion of the study area. Potential contaminants identified include TPH, PCBs and heavy metals
- Shoalhaven Truss Bridge. Potential contaminants identified include - lead based paint systems
- Agricultural areas to the north east and south east of the river. Potential contaminants identified include OCPs and OPPs (herbicides and pesticides)
- Residential, commercial and recreational land use areas to the north-west and south of the bridge where legacy issues of uncontrolled imported fill, hazardous building materials such as asbestos, lead paint and herbicides and pesticides. Potential contaminants identified include TPH, BTEX, PAHs, PCB, OCPs, OPPs, metals and asbestos.

3.6 Site history summary

North of Shoalhaven River

Based on a review of aerial photography, residential development on the northern side of Illaroo Road and agricultural land use development east of Princes Highway occurred prior to 1949. Between 1949 and 1961 the intersection of Bolong Road and Princes Highway was diverted about 100 metres south. Widening of the Princes Highway occurred (post 1979) following the construction of a second northbound bridge. Other than the addition of some farm outbuildings and a commercial and residential building to the east, increased residential development to the west and some development north of the study area there has been minimal major change to the area north of the bridge.

South of Shoalhaven River

Although not easily identifiable from the aerial imagery it is known that Shoalhaven Council operated a gasworks from the early 1900s to the late 1960s at Bridge Road and Lamonds Lane. The site, which includes Harry Sawkins Park, abuts the southern extent of the proposal footprint and has previously been declared a remediation site by NSW EPA.

Bridge Road and the area further south were developed with mixture of residential/commercial structures prior to 1949. Open agricultural paddock occupied the area east of Bridge Road. Post 1949 the area east of Bridge Road has been developed to the north (caravan park and residential structures) and to the south (IRT Greenwell Gardens Care Centre). Between 1979 and 1984 the second (northbound) bridge to the west was constructed and Princes Highway to the south was constructed. Around this time the area between Bridge Road and the Princes Highway was redeveloped with some structures being removed to allow development of the Shoalhaven City Council offices, Entertainment Centre and car parking facilities.

3.7 Site observations

A site inspection was carried out by a senior environmental engineer on Monday 29 January 2018. The scope included a site walkover across public footpath areas within of the proposal alignment. The purpose of this inspection was to make observations of the ground surface conditions within areas of

expected disturbance within the construction boundary and/or potential ancillary sites in order to inform the Soil and Water Assessment.

Figure 3-7 and 3-8 show the relevant site features observed and the location of photographs taken.

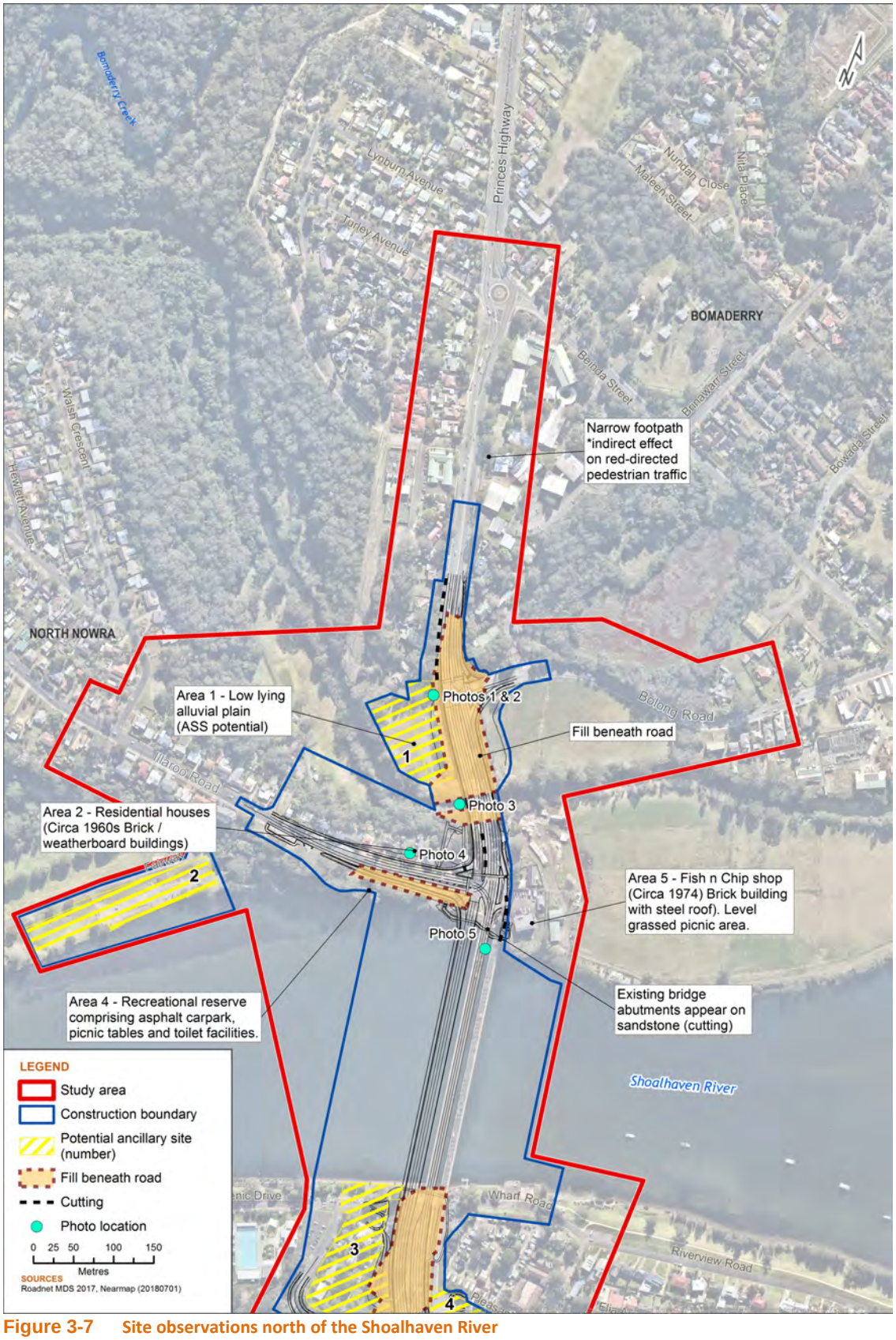


Figure 3-7 Site observations north of the Shoalhaven River

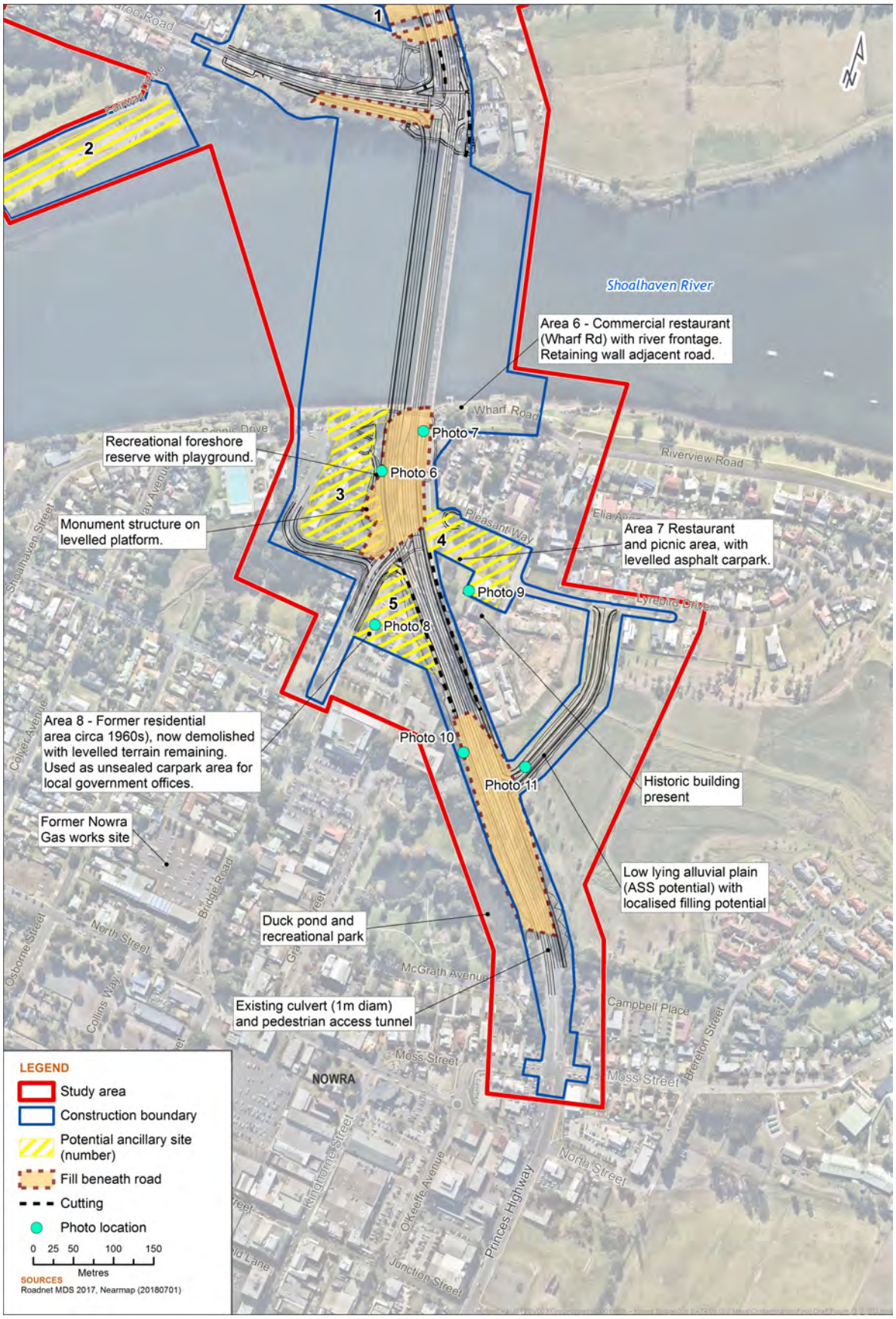


Figure 3-8 Site observations south of the Shoalhaven River

The following observations were noted with corresponding site photographs presented in Table 3.3.

North of the Shoalhaven River

- Drainage from the northern portion of the proposal is expected to flow north or south towards Bomaderry Creek
- The road traverses the undulating natural landscape across alluvial plains and through sandstone. Widespread 'filling' appears within the road corridor from the intersection with Bolong Road and Bomaderry Creek (Photo 1). Fragments of brick, concrete and trace fibre cement fragments (suspected to comprise asbestos containing material) were noted on the ground surface (Photos 2 and 2a)
- Localised earthen fill embankments were also observed on the south and north bridge abutments on Bomaderry Creek (Photo 3), and south of Illaroo Road. (Photo 4). There appears to be 'Cutting' into the natural landscape between Bomaderry Creek and Shoalhaven Rivers
- The existing Shoalhaven bridge abutments appear to be constructed within 'cutting' on sandstone (Photo 5)
- Area 1 – Private residential land comprising vacant grassed paddock on low lying alluvial plains. Potential ASS are mapped within this area
- Area 2 – Residential houses (circa 1960s) appear comprising mainly brick/weatherboard, and ceramic/steel roofing. Houses appear to have been renovated/updated. Construction of houses appears to be at natural grade, elevated with respect to Illaroo road
- Area 4 - Recreational reserve comprising asphalt carpark, picnic tables and toilet facilities.
- Area 5 – A commercial fish and chip shop (Perfect Catch Seafood) (circa 1979) operates comprising a brick/concrete block building with steel roof. A levelled grassed picnic area adjoins the Shoalhaven River embankment.

South of the Shoalhaven River

- Drainage from the southern portion of the proposal appears to discharge flow north-west or south. Drainage appears to flow parallel to road corridor along roadside batter drains towards culverts. A cylindrical culvert (diameter 1 metre) was observed to bisect the Princes Highway immediately south of the site, alongside a box-shaped pedestrian underpass tunnel
- The road traversed the undulating natural landscape across low lying alluvial plains and through sandstone cuttings. Widespread deep 'filling' within the road corridor appears from the southern bridge abutment to the intersection with Bridge Road (Photo 6). Filling appears in the south of the site, where the road is elevated adjacent to low lying alluvial plain (east) and the recreational park (west) (Photo 10). The proposed connection road bisects a portion of low lying agricultural land, with dense grass cover and what appears to be some localised fill mounds (Photo 11)
- Area 6 – Commercial restaurant comprising brick building and steel roofing, and with a river frontage and fishing pontoon. This area is lower in elevation to the road, with a lattice style retaining wall supporting fill material along the road corridor (Photo 7)
- Area 7 – Noted to be within a former residential area (circa 1960s), with house structure now demolished. The site currently comprises a commercial restaurant (Nowra Steakhouse) (Circa 1979), grassed picnic area, and levelled areas comprising asphalt/gravel carpark (Photo 9)
- Property within the south-east appears to be a historic building (at least prior to 1961)
- Area 8 – Noted to be within a former residential area (circa 1960s), with house structures now demolished with levelled terrain remaining. Some traces of demolition rubble (brick, concrete,

metal pipe) evident at ground surface (Photos 8 and 8a). The areas appear vacant and used as unsealed carpark area for local government office precinct to the south.

Limited observations of the ground surface were made across the proposal due to large portions comprising paved road areas, densely grassed/vegetated areas. Furthermore, no private properties (including private residential dwellings and commercial premises) were accessed/inspected during this walkover. Preliminary site observations may be confirmed during future stages of ground and site investigations.

Table 3-3 Site observations and photos

Site Inspection Photos - Conducted Monday 29 January 2018	
Photo 1: Widespread 'filling' appears within the road corridor from the intersection with Bolong Road and Bomaderry Creek	Photo 2 and 2a: Trace fibre cement fragments (suspected to comprise asbestos containing material) were noted on the ground surface near footpath
	 
Photo 3: Fill embankments were also observed on the south and north bridge abutments on Bomaderry Creek	Photo 4: Fill embankment south of Illaroo Road
	
Photo 5: Existing Shoalhaven bridge abutments appear to be constructed within 'cutting' on sandstone	Photo 6: Widespread deep 'filling' within the road corridor appears from the southern bridge abutment to the intersection with Bridge road

Site Inspection Photos - Conducted Monday 29 January 2018	
	
Photo 7: Lattice style retaining wall supporting fill material along the road corridor	Photo 8 and 8a: Some traces of demolition rubble (brick, concrete, metal pipe) evident at ground surface
	
Photo 9: Levelled areas comprising asphalt/gravel carpark	Photo 10: The road is elevated adjacent to low lying alluvial plain with respect to Harry Sawkins Park (west)
	

Site Inspection Photos - Conducted Monday 29 January 2018

Photo 11: The connection road bisects a portion of low lying agricultural land, with dense grass cover and what appears to be some localised fill mounds

4. POTENTIAL AREAS OF ENVIRONMENTAL CONCERN

4.1 Potential sources of contamination

Based on site history and observations made during the site inspection, the following activities have been identified as potential onsite sources for site contamination:

- Importation/placement of fill of unknown quality and origin
- Weathering and/or ineffective demolition of hazardous building materials within vicinity of present or former structures
- Localised application of herbicides or pesticides in garden areas, agricultural areas, parks and road verges for weed and pest control
- TPH, BTEX, PAHs, Phenols, Ammonia, Cyanide and Heavy Metals associated with the former gas works site (including Harry Sawkins Park)
- TPH, PCBs and heavy metals associated with Bomaderry Substation
- Coal tars within road pavements.

4.2 Potential Areas of Environmental Concern and Contaminants of Concern

Eight potential areas of environmental concern (AECs) and associated contaminants of concern (CoCs) were identified within the study area including:

- AEC 1 - Bomaderry sub Station
- AEC 2 - Agricultural paddocks, road verges, pubic open space (parks) and localised residential garden areas
- AEC 3 - Fill materials
- AEC 4 - Former and current structures
- AEC 5 - Nowra Truss Bridge
- AEC 6 - ASS and/or sediments
- AEC 7 - Former gas works, including down-gradient impacted areas within Harry Sawkins Park
- AEC 8 - Road pavement (coal tar) and buried utility conduits and service pits (asbestos).

A preliminary assessment of the likelihood for contamination to be present within each AEC was based on desktop information, site observations and experience on similar sites.

The locations of the identified AECs are shown in Figure 4-1 and Figure 4-2.

Figure 4-1 AECs north of the Shoalhaven River

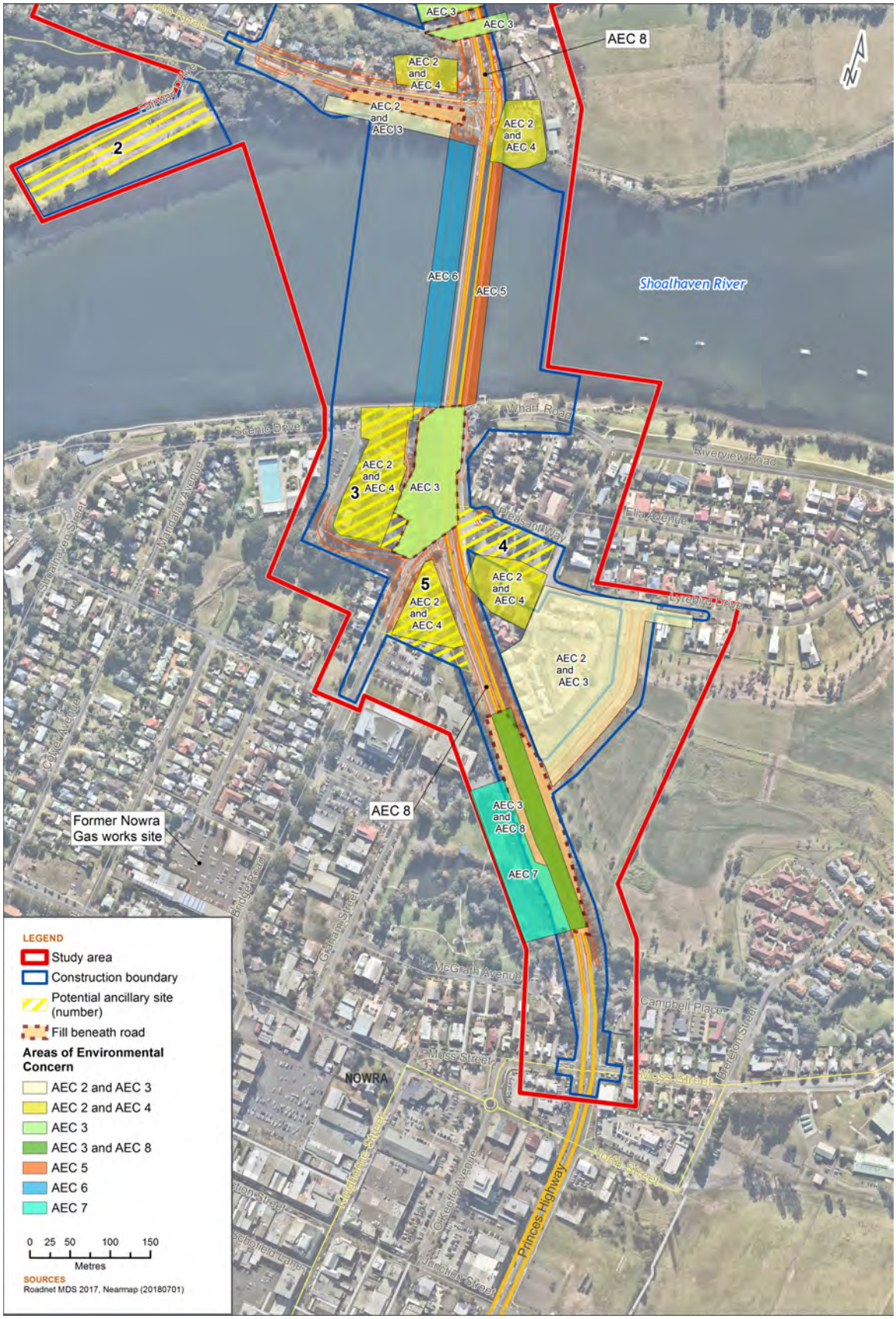


Figure 4-2 AECs south of the Shoalhaven River

5. SITE CHARACTERISATION

5.1 Risk assessment criteria

This section discusses the potential presence of contamination based on observations made during the site inspection conducted on 29 January 2018, historical observations from aerial photography and a review of relevant information previous reports and how this might affect human health and / or the environment and proposed works. It does not assess contamination that should be dealt with in relation to unexpected finds, offsite disposal or site management for which, further assessment in AECs may be required.

A level of low, medium or high risk from a contamination perspective has been based on qualitative judgment from observations made during the site inspection, information obtained during the desktop review and the extent of the proposed works for the Proposal area. Table 5-1 provides the risk summary criteria developed to assess the AECs.

Table 5-1 Risk summary criteria for AECs

Risk Summary	AEC Risk Assessment Criteria
Low	Low potential of residual soil and/or groundwater contamination to exist within the extent of the proposal footprint. Low probability of engaging any potential contaminated land associated with identified AEC due to extent of proposed works.
Medium	Medium potential of residual soil and/or groundwater contamination to exist within the proposal footprint. Contaminated soil and / or groundwater associated with identified AEC may be engaged due to the extent of the proposed works.
High	High potential of some level of residual soil and/or groundwater contamination to exist within the extent proposal footprint. Contaminated soil and / or groundwater associated with identified AEC are likely to be engaged due to the extent of the proposed works. Further investigations recommended.

It should be noted that whilst the risk ranking system categorises an AEC as 'high' to 'low' risk, this does not indicate that contamination has or has not occurred but instead highlights that further assessment may be required. Additional data obtained during future waste classification sampling events or unexpected find sampling events would give greater confidence on these risk levels.

5.2 AEC potential impact on construction

The identified AEC's have the potential to impact on general construction activities associated with the proposal including:

- Excavation
- Pavement removal
- Building demolition
- Underground service relocation
- Generation of construction waste

- Ancillary site preparation and operation
- Importing, handling, stockpiling and transporting material resources.

Potential environmental impacts associated with the proposed works include:

- Increasing waste volumes from excavated (potentially contaminated) materials
- Movement of contaminated sediments via surface runoff into stormwater systems
- Adverse effects on human health (construction personnel, travelling public or nearby communities).

Runoff from identified AECs may potentially impact water quality, and if not appropriately managed, potential pollutants in fill or near surface soils may reach perched groundwater or surface water bodies.

Table 5-2 identifies the AECs, risk classification in terms of potential exposure routes and potential COCs. The locations of AEC1 to AEC8 are presented in Figure 4-1 and 4-2.

Table 5-2 Summary of risks associated with AECs

AEC No.	Potential AEC	Risk Class	Potential COC	Potential Source	Potential Exposure Route
1	Bomaderry Sub Station	Low	TPH, PCBs and Heavy Metals	Substation operations. Potential soil (localised) and groundwater contamination	Engagement of groundwater during construction
2	Agricultural paddocks, road verges, pubic open space (parks) and localised residential garden areas	Low	OCP and OPP pesticides and herbicides	Application of pesticides and herbicides in agricultural paddocks, road verges, pubic open space and localised garden areas	Excavation during construction
3	Fill of unknown quality around Bomaderry Creek Bridge abutments and south of Illaroo Road	Medium	Metals, PAHs, TPH, BTEX, PCB, OCP, OPP, Phenols, asbestos	Importation of shallow fill of unknown quality and origin Near surface soil media potentially affected	Excavation works could potentially expose soil impacted by uncontrolled fill.
4	Weathering and/or ineffective demolition of hazardous building materials within	Medium to High	Asbestos, synthetic mineral fibres (SMF), lead paint, galvanised iron (zinc), Polychlorinated biphenyls (PCB)	Hazardous building materials were commonly used in residential structures prior to the 1970s and 1980s. Subject to weathering in place or ineffective demolition	Excavation during construction.

AEC No.	Potential AEC	Risk Class	Potential COC	Potential Source	Potential Exposure Route
	vicinity of present and former building structures			practices, these materials have the potential to impact near surface soils	
5	Nowra Truss Bridge	Medium to High	Lead and asbestos	Paint system on the bridge dates from around 1981 and therefore it is likely the current paint system contains a lead undercoat. Utilities conduits or services pits may contain asbestos containing materials	Construction activities
6	Acid sulfate soils and sediments	Low to High	ASS	There is a low risk of acid sulfate soils (1-2m and 2-4m) existing within the southern section of the proposal area and area immediately north east and north west of the bridge. A high probability is mapped north of the Bomaderry Creek crossing and for sediments within the Shoalhaven River	Excavation during construction.
7	Former gas works including Harry Sawkins Park	Low to Medium	TPH, BTEX, PAHs, Phenols, Ammonia, Cyanide and Heavy Metals	Soil and groundwater contamination as a result of the historic Nowra gas works site located about 300m up-gradient of the proposal	Excavation during construction.
8	Road Pavement (coal tar) and buried utility conduits and services pits (asbestos) throughout proposal area	Medium to High	PAHs, Phenols, Benzo-a-pyrene and asbestos	Historical use of coal tar in sections of road pavement constructed prior to 1987 Historical use of asbestos containing materials products	Excavation during construction.

5.3 Additional assessment of soil and groundwater contamination

SMEC recommends detailed site investigation be conducted within AEC2, AEC3, AEC4, AEC5, AEC6 and AEC8 consisting of a soil sampling programme within areas of environmental concern and testing for potential contaminants of concern to confirm the presence/absence of contamination. Groundwater sampling may not be required within AEC1 and AEC7 considering a low potential for exposure during proposal construction activities.

A summary of the AECs which have been identified as having a medium to high potential for contamination is as follows:

- AEC 3 – Fill of unknown origin and quality appears to have been placed widespread throughout the existing road alignment with a medium potential for soil contamination. Fill embankments were observed at various depths, typically deepest near the approach to existing bridge structures and within the northern and central southern zones adjacent to low lying floodplains
- AEC 4 – Former and current structures has also been identified as medium to high potential for soil contamination given the age of existing or former residential properties (circa 1960s) within the alignment. There is a potential for residual localised contaminated soil may be encountered during demolition works. Residential properties potentially contain surface soil or uncontrolled fill impacted by asbestos, domestic waste and other hazardous materials
- AEC 5 – There is a high potential for lead-based paints having been used (circa 1980s) during historic maintenance of the Nowra truss bridge (existing southbound bridge). A low potential for soil contamination residues is considered within near surface soils beneath/surrounding these features
- AEC 6 – There is a high potential for ASS north of the Bomaderry Creek crossing (east and west of the Princes Highway) where the Bolong Road intersection meets with the Princes Highway and for sediments within the Shoalhaven River
- AEC 8 – The existing road pavements within the study area have a medium to high potential to contain coal tar, noting this was common practice prior to 1987. The main highway easement has a medium to high potential of asbestos containing materials in road assets like service conduits and communication pits, noting that construction materials containing asbestos were still used until 1986.

There are no known previous investigations that undertook groundwater sampling within the proposal area. At a preliminary level, a medium potential for groundwater contamination is assessed within two AECs; AEC 1 Bomaderry substation (localised impacts) and/or AEC 6 Former Gas Works including Harry Sawkins Park (more widespread). Groundwater contamination at these locations within/adjacent to the study area are considered to have a low potential to impact the proposal based on the proximity to actual construction/operational extent of the proposal and the low likelihood for engaging groundwater. A low potential for widespread groundwater contamination is assessed in remaining AECs.

6. CONCEPTUAL SITE MODEL

6.1 General

This preliminary conceptual site model (CSM) is made up of:

- CoCs
- Receptors that could be exposed to the CoCs
- The exposure pathways between the CoCs and the receptors.

The preliminary CSM has been based on site and historical information (Sections 2 and 3) and a preliminary understanding of the proposed development at concept stage (Section 1.2). A further refined CSM may be considered upon more detailed understanding of the proposed development subsequent to this assessment.

6.2 Potential sources of contamination

On the basis of our assessment the potential sources of contamination within each of the identified AECs are listed below:

AEC 1 – Bomaderry sub Station

- Mobilisation of potential soil contamination in to groundwater

AEC 2 - Agricultural paddocks, road verges, pubic open space (parks) and localised residential garden areas

- Application of pesticides and herbicides for weed and pest suppression

AEC 3 - Fill materials

- Unknown quality and origin of fill materials used within sections of the study area

AEC 4 - Former and current structures

- Ineffective removal and/or weathering of hazardous materials (possibly also including services conduits)

AEC 5 - Nowra Truss Bridge

- Lead paint systems historically used on Truss Bridge

AEC 6 - Acid Sulfate Soils and Sediments

- High probability of ASS mapped north of the Bomaderry Creek crossing and for sediments within the Shoalhaven River

AEC 7 - Former Gas Works including Harry Sawkins Park

- The site was historically declared a contaminated site by the NSW EPA. Harry Sawkins Park abuts the southern end of the proposal boundary

AEC 8 - Road Pavement (coal tar) and buried utility conduits and services pits (Asbestos)

- Asphalts or subsurface layers (constructed prior to 1987) containing coal tar and buried utility conduits and services pits may have used products containing asbestos containing throughout the proposal area.

6.3 Potential contaminants of concern

Based on the desktop review and field observations, potential CoC have been assessed as either primary or secondary as outlined below included:

- Heavy metals
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Total Petroleum Hydrocarbons (TPH). Conservatively these may be initially assessed as Total Recoverable Hydrocarbons (TRH)
- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Organochlorine pesticides (OCPs)
- Organophosphorus Pesticides (OPPs)
- Polychlorinated biphenyls (PCBs)
- Phenols
- Ammonia
- Cyanide
- Synthetic Mineral Fibres (SMF)
- Asbestos
- Lead paint
- ASS and Sediments.

6.4 Potential receptors

Based on the environmental setting, the potential receptors comprise:

Human receptors

- Site users
- Construction workers in civil works programs
- Intrusive maintenance workers within the site (i.e. maintenance of buried services)
- Future short-term construction workers associated with the proposed development.

Ecological receptors

- Flora and fauna within Bomaderry Creek and the Shoalhaven River.

6.5 Exposure pathways

The pathways of exposure consist of:

- A transport mechanism; and
- A route of exposure.

At this stage of the investigation, it is likely that the exposure pathways include:

- Disturbance of shallow soil and groundwater contamination and exposure by ingestion, dermal contact or inhalation
- Air transport of particulates (dust) or vapour intrusion/ground emissions of volatiles and exposure by inhalation.

6.6 Persistence in the environment

The potential contaminants of concern identified which have a relatively high degree of persistence in the environment are:

- OCPs and OPPs
- Metals
- Asbestos
- Some PAHs
- Longer chain hydrocarbons (i.e. >C29).

6.7 Potential source-pathway-receptor linkages

Potential source-pathway-receptor linkages are where potential contamination (if any) has been identified for the site. Soil and/or groundwater contamination has the potential for adverse impact on human health and the environment for the site via these exposure pathways.

Human Receptors

Workers involved ground disturbance during earthworks could potentially have exposure. Construction workers are therefore likely to have a complete exposure pathway. Following construction, the future maintenance workers at the site are considered to have incomplete or no exposure pathways if contamination remains either remains inaccessible beneath sealed areas or is removed during proposal works. Limited interaction during intrusive construction works remains possible during site redevelopment.

Ecological Receptors

Aquatic organisms within Bomaderry Creek and the Shoalhaven River could potentially be adversely effected during disturbance of ASS and sediments and have a complete exposure pathway if not managed correctly. Potential diverse effects to the water bodies include:

- **Deoxygenation** - Although unlikely, oxidation of sulfidic materials consumes oxygen and in severe cases may remove all oxygen from the water column
- **Release of metals and metalloids** – Oxidation of sulfidic materials may lead to heavy metals (such as cadmium and lead) and metalloids (such as arsenic) becoming more available in the environment.

7. DISCUSSION

7.1 Identification of key environmental risks

The key environmental risks are identified as follows:

1. Bomaderry substation – Evidence suggests (installation of groundwater monitoring bores) that some form of environmental groundwater investigation has occurred at the site. The site is located about 50 metres northwest of the construction work area but within the wider study area. Groundwater was recorded at 1.33 metres below ground level in one of the bores installed at the site. A preliminary understanding of expected construction activities in the northern section of the proposal suggest a low potential that contaminated groundwater may be engaged during construction activities
2. Agricultural paddocks, road verges, pubic open space (parks) and localised residential garden areas – pesticides and herbicides may have been applied for weed and pest suppression throughout the proposal area along road verges and in localised areas (parks, domestic gardens) and agricultural paddocks especially in-between Bolong Road and Bomaderry Creek and south of Lyrebird Drive. Areas where construction activities are proposed should be further assessed
3. Widespread 'filling' was identified within the road corridor from the intersection with Bolong road and Bomaderry Creek. A single fibre cement fragment (suspected to comprise asbestos containing material) was noted on the exposed soil surface in this area. Localised earthen fill embankments were also observed on the south and north bridge abutments on Bomaderry Creek (Area 1), south of Illaroo Road (Area 4) and suspected within localised fill mounds in the agricultural paddock south of Lyrebird Drive. The areas should be further assessed where construction activities may engage fill materials
4. The area to the north and east of Illaroo Road (Areas 2 and 5), the proposed construction compounds area boarded by Scenic Drive and south east of Bridge Road (Area 7) presently contain structures that in some cases will require demolition. There is a high probability (given the assumed age) that the structures contain hazardous building materials such as asbestos, lead paints, SMF, PCBs etc. In addition, the area in-between Bridge Road and Princes Highway (Area 8) was formally a residential area and as such the potential exists that hazardous materials may still be present in subsoils as a result of ineffective demolition works
5. The paint systems presently covering Nowra Truss Bridge (existing southbound bridge) are suspected to contain lead
6. A high probability for ASS has been identified for the area north of the Bomaderry Creek crossing [east (Area 1) and west of the Princes Highway] and within the sediments of the Shoalhaven River. A low risk of ASS is identified for the remainder of the proposal area
7. The southern end of the proposal boundary abuts Harry Sawkins Park. The park (and former gas works) was historically declared a contaminated site by the NSW EPA. The Princes Highway at this location is elevated about five metres and proposal construction works are unlikely to engage soils from the park. However, the potential remains for contaminated soils or groundwater to be encountered at the southern end of the proposal
8. Coal tar and asbestos containing materials may be encountered in asphalts pavements constructed prior to 1987 and utility conduits and service pits throughout the proposal footprint.

7.2 Proposed safeguards and management measures

7.2.1 Contaminated land

Additional soil and groundwater sampling investigations will provide a greater conceptual understanding of the identified AECs. A construction Contaminated Land Management Plan (CLMP) supporting the construction environment management plan should be developed to assist with compliance with the *Contaminated Land Management Act 1997* and relevant EPA guidelines in relation to disturbance or treatment of potentially contaminated land. The CLMP would detail the following:

- Procedure for identifying contamination by monitoring for:
  - Discolouration or staining of soil
  - Bare soil patches both on-site, and off-site next to the site boundary
  - Visible signs of plant stress
  - Presence of drums or other waste material
  - Presence of stockpiles or fill material
  - Soil vapour risk
  - Odours
- Identification of locations of known or potential contamination and preparation of a map showing these locations (expanding upon the AECs identified in Figures 4-1 and 4-2)
- Identification of rehabilitation, classification, transport and disposal requirements of any contaminated land or materials within the construction footprint
- General contamination management measures including:
  - Waste classification and reuse procedures
  - In the event that indications of contamination are encountered (known and unexpected, including odorous or visual indicators), work in the immediate area will immediately cease until a contamination assessment can be prepared to advise on the need for remediation or other action, as deemed appropriate
  - Investigate potentially contaminated land to determine the concentration and type of contaminants and the extent of contamination
  - Protect the environment by implementing control measures to divert surface runoff away from any identified contaminated land
  - Capture and manage any surface runoff impacted by exposure to confirmed contaminated land where offsite mobilisation of contaminants is a risk
  - Assess the requirement to notify relevant authorities, including the EPA
  - Manage the remediation and subsequent validation of the contaminated land, including any certification required
- If coal tar is encountered, then it would be managed in accordance with Roads and Maritime's Technical Direction #21 and would be disposed of to a facility licensed to accept such material.

Excavated material that is not suitable for on-site reuse or recycling, such as contaminated material would be transported to a site that may legally accept that material for reuse or disposal. Soils leaving the site should be waste classified so that correct resource recovery and or off-site disposal occurs.

The provisions of the current EPA resource recovery orders and resource recovery exemptions would be applied where material (e.g. virgin excavated natural material, excavated public road material or recovered aggregate) meets the waste criteria for reuse within the road corridor by the proposal.

7.2.2 Groundwater

Groundwater encountered during the construction of the proposal would be managed and disposed of in accordance with NSW EPA requirements, including the Waste Classification Guidelines (NSW EPA, 2014).

Requirements for the management and disposal of groundwater waste should be included in the Construction Soil and Water Quality Management Plan to manage surface and groundwater impacts during construction.

7.2.3 Asbestos management

An Asbestos Management Plan should be developed in accordance with the Road and Maritime Procedure Asbestos Related Work No. 066P25 (RMS, 2013). If previously unidentified asbestos contamination is discovered during construction, work in the affected area would cease immediately, and an investigation must be undertaken and report prepared to determine the nature, extent and degree of the asbestos contamination. The level of reporting must be appropriate for the identified contamination in accordance with Guidelines for Consultants Reporting on Contaminated Sites (OEH, 2011), any relevant WorkCover Guidelines and include the proposed methodology for the remediation of the asbestos contamination. Remediation activities must not take place until receipt of the investigation report by an occupational health professional.

Works may only recommence upon receipt of a validation report from a suitably qualified contamination specialist that the remediation activities have been undertaken in accordance with the investigation report and remediation methodology.

7.2.4 Acid sulfate soil

The preferred management strategy for potential acid sulphate soils (PASS)/ASS is to avoid its disturbance wherever possible. Where disturbance of PASS/ASS is unavoidable, preferred design strategies are:

- Minimisation of disturbance which may include avoiding/ minimising impact on areas with high levels of sulphides, limiting disturbances so that only shallow disturbances occur and minimising groundwater fluctuations
- Neutralisation with lime
- Hydraulic separation of sulfides from the sediment either on its own or in conjunction with dredging
- Strategic reburial (re-interment) where material can be permanently placed in anaerobic conditions, for example covered by water and compacted soil to keep it wet and free of oxygen.

Other design management measures may be considered but must not pose unacceptably high risks. Additional testing would be required during construction to determine liming rates relevant to each area of ASS that would be disturbed.

7.3 Recommendations for additional work

Given the identified AECs SMEC recommends the following additional work be conducted:

1. An environmental Sampling and Analysis Quality Plan (SAQP) should be developed to target the identified AECs. The SAQP would help to define the vertical and lateral extent of any potential soil and groundwater contamination present within the AECs (if any). It is considered that the SAQP could be implemented during the geotechnical drilling program for the proposal.
2. Hazardous materials assessments (Hazmat) should be conducted on the Nowra truss bridge and all structures proposed for demolition as part of the proposal. Hazmat assessments will help define the nature and extent of any hazardous materials (asbestos, lead paints, SMF, PCBs etc.) within the structures and define appropriate management measures prior to demolition
3. An Acid Sulfate Soils Management Plan should be developed for the proposal to mitigate any potential adverse effect during construction activities.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

North of Bridge

A site history review revealed that north of the bridge residential development on the northern side of Illaroo Road and agricultural land use development east of Princes Highway occurred prior to 1949. Between 1949 and 1961 the intersection of Bolong Road and Princes Highway was diverted about 100 metres south. A site inspection identified widespread filling' within the road corridor from the intersection with Bolong road and Bomaderry Creek and fragments of brick, concrete and trace fibrocement fragments (suspected to comprise asbestos containing material) were noted on the ground surface. Widening of the Princes Highway occurred (post 1979) following the construction of a second northbound bridge. Other than the addition of some farm outbuildings and a commercial and residential building to the east, increased residential development to the west and some development north of the study area there has been minimal major change to the area north of the bridge.

South of Bridge

Bridge Road and the area further south were developed with mixture of residential/commercial structures prior to 1949. Open agricultural paddock occupied the area east of Bridge Road. Post 1949 the area east of Bridge Road was developed to the north (caravan park and residential structures), to the south (IRT Greenwell Gardens Care Centre) and to the west (residential/commercial including Nowra Aquatic Centre). Between 1979 and 1984 the second (northbound) bridge to the west was constructed and the Princes Highway to the south was constructed. Around this time the area between Bridge Road and the Princes Highway was redeveloped with some structures being removed to allow development of the Shoalhaven City Council offices, Entertainment Centre and car parking facilities. The former Nowra Gasworks operated between the early 1900's and 1960s. The site (including Harry Sawkins Park which abuts the southern proposal boundary) were historically declared a contaminated site by the NSW EPA.

A total of eight AECs and potentially contamination sources were identified throughout the proposal footprint including:

- AEC 1 - Bomaderry sub Station
- AEC 2 - Agricultural paddocks, road verges, pubic open space (parks) and localised residential garden areas
- AEC 3 - Fill materials
- AEC 4 - Former and current structures
- AEC 5 - Nowra Truss Bridge
- AEC 6 - ASS and Sediments
- AEC 7 - Former gas works including Harry Sawkins Park
- AEC 8 - Road pavement (coal tar).

SMEC considers there is a low to high potential for soil contamination to be present within the various identified AECs (refer to Table 5-2). If present, potential contaminants of concern associated with these AECs are most likely to be found within or near surface soils and shallow fill at the locations of each AEC.

The recorded groundwater depth is 1.33 metres below ground level in GW109970 which is located in the northwest of the proposal area. Given the geographical location of the proposal, groundwater levels area expected to be high. As such the potential for exists for groundwater to be engaged during construction activities. At this stage the groundwater quality is unknown.

8.2 Recommendations

SMEC recommends the following:

Hazardous materials assessments (Hazmat) should be conducted on the Nowra truss bridge (existing southbound bridge) and all structures proposed for demolition as part of the proposal. Hazmat assessments will help define the nature and extent of any hazardous materials (asbestos, lead paints, SMF, PCBs etc.) within the structures and define appropriate management measures prior to demolition.

A Phase 2 environmental site investigation consisting of a soil and groundwater sampling program should be conducted within identified AECs for potential contaminants of concern to confirm the presence/absence of contamination. SMEC consider a suitable approach would be to undertake judgemental sampling pattern targeting the individual AECs identified with laboratory testing for the potential contaminants of concern identified within Section 6. It is considered that the sampling programme could be implemented during the geotechnical drilling program for the proposal. Any additional assessment (if required) should be carried out in accordance with the NEPM (2013).

Subject to the results of further investigations, SMEC recommends that an Acid Sulfate Soils Management Plan be developed for the proposal to mitigate any potential adverse effect during construction activities and an unexpected finds plan be prepared for inclusion in a construction management plan, to manage potential for unexpected finds of contaminated materials.

9. REFERENCES

National Environment Protection (Assessment of Site Contamination) Measure (NEMP) 1999, Amendment 2013.

NSW EPA, Contaminated Sites – Guidelines for Consultants Reporting on Contaminated Sites, 1997.

NSW EPA (website) Contaminated Land Record of Notices URL: http://www.epa.nsw.gov.au/prclmapp/searchregister.aspx accessed 20/12/17

NSW EPA (website) POEO Public Register URL: http://www.epa.nsw.gov.au/prpoeo/index.htm accessed 20/12/17

NSW Office of Environment and Heritage eSPADE NSW Soil and Land Information Map URL: http://www.environment.nsw.gov.au/eSpade2WebApp# accessed 20/12/17

State Environmental Planning Policy No.55 – Remediation of Land, 1998.

Shoalhaven City Council LEP (2014) URL: http://maps2.shoalhaven.nsw.gov.au/slep2014/ accessed 18/12/2017

APPENDIX A: NSW EPA DATABASE SEARCHES

Home Contaminated land Record of notices

Search results

Your search for:LGA: Shoalhaven City Council

Matched 9 notices relating to 2 sites.

Search Again

Refine Search

Suburb	Address	Site Name	Notices related to this site
NOWRA	Lamonds LANE	Former gasworks	2 current and 1 former
NOWRA EAST	Lot 3 Kalandar STREET	Mobil Service Station	6 former

Page 1 of 1

20 December 2017

For business and industry ()

For local government ()

Contact us

131 555 (tel:131555)

Online (http://www.epa.nsw.gov.au/about-us/contact-us/feedback/feedback-form)

info@epa.nsw.gov.au (mailto:info@epa.nsw.gov.au)

EPA Office Locations (http://www.epa.nsw.gov.au/about-us/contact-us/locations)

Environment Protection Authority

Declaration of remediation site

(Section 21 of the Contaminated Land Management Act 1997)

Declaration Number 21066; Area Number 3191

The Environment Protection Authority (EPA) declares the following land to be a remediation site under the Contaminated Land Management Act 1997 ("the Act"):

1. Land to which this declaration applies ("the site")

The site to which this declaration relates is described as:

- Lot 3 in DP 868373 Lamonds Lane, Nowra, NSW; and
- Lot 1 in DP 702802 Bridge Road, Nowra, NSW;

in the local government area of Shoalhaven.

A drawing showing the areas within the site that require remediation is attached.

2. Nature of contamination affecting the site:

The EPA has found that the site is contaminated with the following substances ("the contaminants") derived from previous gasworks operations including:

- Coal tar;
- Polycyclic aromatic hydrocarbons (PAHs), including benzo(a)pyrene;
- Total petroleum hydrocarbons (TPHs);
- Benzene, toluene, ethylbenzene and xylene (BTEX);
- Phenol;
- Cyanide;
- Copper;
- Lead;
- Zinc; and
- Ammonia.

3. Nature of harm that the contaminants may cause:

The EPA has considered the matters in s.9 of the Act and for the following reasons has determined that the site is contaminated in such a way as to present a significant risk of harm to human health and the environment. The issues of concern are as follows:

- The site soils are contaminated with polycyclic aromatic hydrocarbons (PAHs) including benzo(a) pyrene, total petroleum hydrocarbons (TPHs) including benzene, and cyanide at concentrations exceeding relevant health based investigation levels for 'commercial/industrial' land use. Coal tar is also present in surface soils. There is the potential for site workers to be exposed to the contamination under current industrial/commercial use of the site.

- Groundwater at the site is contaminated with PAHs, benzene, toluene, ethylbenzene, xylene (BTEX), phenol, cyanide, copper, lead, zinc and ammonia at concentrations exceeding the trigger values for 95% protection of freshwater ecosystems listed in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZECC and ARMCANZ, 2000*. Contaminated groundwater may migrate off-site and ultimately impact on the Shoalhaven River.

4. Further action under the Act

The making of this declaration does not prevent the carrying out of a voluntary remediation of the site and any person may submit a voluntary remediation proposal for the site to the EPA. If the proposal satisfies the requirements of s.26 of the Act, the EPA may agree not to issue a remediation order to the person or persons bringing the proposal.

5. Submissions invited

The public may make written submissions to the EPA on:

- Whether the EPA should issue a remediation order in relation to the site; or
- Any other matter concerning the site.

Submissions should be made in writing to:

Director Contaminated Sites
Department of Environment and Conservation
PO Box A290
SYDNEY SOUTH NSW 1232

or faxed to 02 9995 5930

by not later than 17 February 2005

NIALL JOHNSTON
A/Director Contaminated Sites
Department of Environment and Conservation

Date: 4 January 2005

Attachment: Drawing showing the areas within the site that require remediation.
Site map

NOTE:

Remediation order may follow

If remediation of the site or part of the site is required, the EPA may issue a remediation order under s.23 of the Act.

Variation/Revocation

This declaration may be varied by subsequent declarations. It remains in force until it is otherwise revoked. A declaration may only be revoked when the EPA does not have reasonable grounds to believe that land is contaminated in such as way as to present a significant risk of harm (s.44 of the Act).

Information recorded by the EPA

Section 58 of the Contaminated Land Management Act 1997 requires the EPA to maintain a public record. A copy of this remediation declaration will be included in the public record.

Information recorded by councils

Section 59 of the Act requires the EPA to give a copy of this declaration to the relevant local council. The council is then required to note on its planning certificate issued pursuant to s.149 (2) of the Environmental Planning and Assessment Act that the land is currently within a remediation site. The EPA is required to notify council as soon as practicable when the declaration is no longer in force and the notation on the s.149 (2) certificate is no longer required.

Relationship to other regulatory instrument

This declaration does not affect the provisions of any relevant environmental planning instruments which apply to the land or provisions of any other environmental protection legislation administered by the EPA.

Environment Protection Authority (EPA)

AGREEMENT NOT TO ISSUE ORDER DURING COMPLIANCE WITH A VOLUNTARY PROPOSAL

(Section 26 of the Contaminated Land Management Act 1997)

Agreement No.: 26086

Agreement Date: 11 May 2006

Area No.: 3191

This agreement relates to the attached proposal, which comprises three Parts: Part 1 – Preliminary Details; Part 2 – Undertakings; and Part 3 – Performance Schedule.

Proponent: Shoalhaven City Council

Site: Former Nowra Gasworks site comprising Lot 3 DP868373 Lamonds Lane and Lot 1 DP702802 Bridge Road Nowra NSW.

Proposal Date: 7 April 2006

1. The EPA is satisfied that the terms of the proposal are appropriate.
2. The EPA notes for the purposes of section 26 of the *Contaminated Land Management Act 1997* (CLM Act) that the proponent has undertaken in writing to the EPA not to recover contributions under Part 3, Division 6 of the CLM Act in respect of implementation of the proposal.
3. The EPA agrees, in accordance with the provisions of Part 3 of the CLM Act, that it will not issue a remediation order against the proponent if and for so long as the proposal is complied with.
4. The EPA may issue a remediation order against the proponent in accordance with the CLM Act if the EPA is not satisfied that the proposal is being or has been complied with.
5. The EPA is not prevented by this agreement from making a remediation order against persons (whether or not they were originally parties to the proposal and including public authorities) other than the proponent.
6. The EPA is not prevented by this agreement from exercising its powers under the *Protection of the Environment Operations Act 1997* in relation to activities conducted in association with or under the proposal.
7. Each component of the proposal, as described in the proposal is to be completed by the date specified in the proposal. Failure to satisfactorily complete any component by the due date for that component may be taken as a failure to carry out the terms of the proposal for the purposes of section 27 of the CLM Act.
8. This agreement takes effect on the "Agreement Date" specified above and continues in effect subject to satisfactory performance and progress with implementation of the proposal.

Signed: N Johnston 11/5/2006

Niall Johnston
Acting Manager Contaminated Sites
Department of Environment and Conservation (NSW)

VOLUNTARY REMEDIATION PROPOSAL UNDER CONTAMINATED LAND MANAGEMENT ACT 1997

Part 1- Preliminary Details

1. Proponent's Details

(a) Name and contact details-

Shoalhaven City Council
PO Box 42
Nowra NSW 2541

Ph (Direct) (02) 4429 3276
Fax (02) 4429 3175

(b) Who the EPA should contact with technical enquiries about the proposal

Employer/Company: Earth2Water Pty Ltd
Type of business: Environmental and Groundwater Consulting
Phone (business): (02) 4234 0829
Fax: (02) 4234 0152
Email: earthh2o@tpg.com.au

2. Site to which proposal applies

The site to which the proposal applies ("the site") is:

The former gasworks site is located at Lamonds Lane, Nowra, NSW.

The site is identified as Lot 3 DP868373 (former Shoal Gas Depot) and Lot 1 DP702802 (former Pioneer Bus Garage plot) and is approximately 0.7 ha in area.

3. The contamination

Soil and groundwater at the site are contaminated with substances in such a way as to present a significant risk of harm. The substances of concern ("the contaminants") include:

- Coal tar
- PAHs (including BaP and napthalene)
- TPH/BTEX
- Phenol
- Cyanide
- Copper
- Lead
- Zinc
- Ammonia

4. The remediation proposal

The remediation proposal ("the proposal") comprises:

a) the information set out above;
b) the actions, works and other components are set out in the following documents:

1997	*Stage 1, Site Environmental Assessment Report, Nowra Gasworks* - GHD
1997	*Contamination Investigation, Nowra Gasworks* - Douglas and Partners,
1997	*Contamination Assessment Report, Nowra Gasworks.* –Golder & Associates
1997	*Stage 2 Contamination Investigation, Nowra Gasworks* - Golder & Associates
2001	*(Draft Final) Remediation Action Plan, former Shoal Gasworks and Pioneer Bus Depot, Nowra.* – Golder & Associates
2001	Council appoint Site Auditor (Chris Jewell) to review site assessment and RAP by Golder & Associates
2002	*Site Investigation at Gas Works Site, Lamonds Lane, Nowra.* - Golder & Associates.
2002	*Statement of Heritage Impact for Nowra Gasworks* – E Higginbotham
2005	*Groundwater fate and transport modelling assessment for Nowra Gasworks.* – Golders & Associates Pty Ltd.
2005	*Final Remediation Action Plan (RAP) for Nowra Gasworks.* - Golder & Associates Pty Ltd.

c) the undertakings set out in Part 2 of this document; and
d) the performance schedule set out in Part 3 of this document (attached)

Signed by the proponent

Part 2

Undertakings Included in Voluntary Remediation Proposal

Explanatory Note:
Before the EPA can agree with one or more parties to a voluntary investigation or remediation proposal not to issue orders against them under section 17 or 23 of the Contaminated Land Management Act 1997, it has a statutory obligation to satisfy itself that the terms of the proposal submitted to it under section 19 or 26 are appropriate. In addition to including an appropriate investigation or remedial action plan, to be acceptable to the EPA a proposal must include the undertakings set out below. These undertakings are important. They must be complied with in order for the EPA to be satisfied that the terms of the proposal have been carried out.

THE PROPOSAL INCLUDES THE FOLLOWING UNDERTAKINGS:

General

1. All activities carried out in connection with the proposal including sampling and preparation of associated reports ("the activities") will be carried out in accordance with applicable provisions of *State Environmental Planning Policy 55 – Remediation of Land* and any requirements imposed under it in relation to the works.
2. All matters listed as relevant to a remediation action plan by the EPA's *Guidelines for Consultants Reporting on Contaminated Sites* (1997) will be taken into account in the carrying out of the activities.
3. All the activities will be carried out consistently with guidelines made or approved under section 105 of the CLM Act.
   (See http://www.environment.nsw.gov.au/clm/guidelines.htm)
4. All the activities will be carried out in compliance with applicable NSW environmental legislation, and in particular:
   i) All the activities, including:
      (1) the processing, handling, movement and storage of materials and substances used to carry out the activities; and
      (2) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activities

      will be carried out in a competent manner;
   ii) All plant and equipment installed at the site or used in connection with the activities:
      (1) will be maintained in a proper and efficient condition; and
      (2) will be operated in a proper and efficient manner.
5. All the activities at the site will be carried out in a manner that prevents or minimises the emission of dust, odour and noise from the site.
6. Waste generated or stored at the site will be assessed, classified and managed in accordance with the EPA's *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes.*

   (See http://www.environment.nsw.gov.au/waste/envguidlns/index.htm)
7. All hazardous, industrial, Group A or controlled waste generated by the activities at the site and which is to be transported from the site will be tracked in accordance with the *Protection of the Environment (Waste) Regulation 1999* and any licence under the *Protection of the Environment Operations Act 1997* in relation to the

activities.

(See http://www.environment.nsw.gov.au/waste/wastetracking.htm)

8. The proponent will, and acknowledges that the EPA may, make all documents and information relating to the activities available to the public free of charge.

9. The proponent will:

   i) prior to the implementation of the proposal provide for the EPA's approval a strategy for communicating about that implementation, particularly the actual remediation works, with members of the public who are likely to have a real interest in or be affected by that implementation and

   ii) implement the strategy as approved by the EPA.

Monitoring, Record Keeping & Reporting

10. At least until the EPA has notified the proponent that the EPA no longer considers that the contamination poses a significant risk of harm, record and retain all monitoring data and information and provide this record to the EPA at any reasonable time if so requested by the EPA and as specifically provided under the proposal.

    [Note: Specific details of monitoring and data reporting requirements, requirements for progress reports, etc are to be set out in the performance schedule in Part 3 of this document.]

11. The EPA will be informed in writing within 7 days of the proponent becoming aware of information or data indicating a material change in conditions at the site or in its surrounding environment which could adversely affect the prospects of successful investigation or remediation of the site or result in harm to the environment.

12. The EPA will be informed in writing within 7 days of the proponent becoming aware of any failure, either by the proponent or any other person, to comply with any component or aspect of the proposal.

13. The EPA will be informed in writing as soon as practicable of any notification by the proponent, its employees or its agents to an appropriate regulatory authority other than the EPA of any pollution incident at the site within the meaning of the *Protection of the Environment Operations Act 1997*.

    (See http://www.environment.nsw.gov.au/licensing/dutytonotify.htm)

Performance Schedule

14. The performance schedule which is in Part 3 of this document will be adhered to.

Signed by the proponent

Part 3

Performance Schedule

Explanatory Notes:

The performance schedule required must provide a clear and concise list of:

- *key milestones and dates by which they are to be achieved and*
- *the objectives and principal features of the investigation or remedial action plan.*

The performance schedule is very important because it provides a concise set of performance indicators which will be used, along with an evaluation of compliance with the undertakings in Part 2 of this document, to assess whether or not the terms of the proposal have been carried out.

To be acceptable to the EPA, the performance schedule ***must*** *include precise, measurable and time-bounded performance indicators. Where it is appropriate for the investigation or remediation to be done in stages, performance measures for each stage must be provided, and approval for later stages will be dependent on the completion and/or performance of earlier stages being demonstrated to the EPA's satisfaction.*

The performance schedule should adhere to the structure set out in the following table.

PART 3 - PERFORMANCE SCHEDULE The schedule should concisely set out:
1. Objectives of the proposal
2. Principal features of the proposal a. Capital works b. Remediation and/or Investigation c. Monitoring
3. Reporting requirements and timeframes for submission of reports
4. Key milestones for investigation or remediation activities

PERFORMANCE SCHEDULE

1. Objectives of the proposal

The objective of the proposal is to remediate the site to address the "significant risk of harm" (CLM Act, 1997) and allow continued commercial/industrial use of the site (eg. car park). This will be achieved by implementing the Remedial Action Plan by Golders (December 2005) endorsed and signed-off by Council's independent site auditor (Chris Jewell) at completion of the remedial and validation works.

2. Principal features of the proposal

The remedial works and monitoring program will be implemented according to the RAP and interim advice approved by the site auditor.

The remediation of onsite coal tar, tar well and grossly impacted soil is designed to remove the primary contaminant source causing contaminant migration via groundwater transport. As a result of soil remediation, the groundwater contamination plume will be gradually stabilised (not expanding) and naturally attenuated (over time) within the shallow and deep aquifers. Natural attenuation of groundwater contamination will be enhanced with the removal of the contaminant source, and eliminating (or at least minimising) rainfall recharge (via hardstand paving and kerb and guttering) causing decreased hydraulic gradients and leaching at the site (i.e. slowing down the groundwater velocity).

The principal features of the proposal are summarised below:

a. Capital works

P1. Construction management, establishment and site preparation

P2. Site investigation and pre demolition assessment regarding heritage advice

P3. Demolition of existing buildings and former gas works infrastructure

P4. Storm water drainage and diversion works.

P5. Installation of a site capping layer and backfilling to meet car park design.

P6. Car park construction.

b. Remediation

P7. Removal of tar well and associated contaminated soil.

P8. Removal of underground petroleum storage system and associated contaminated soil.

P9. Investigation, characterisation, excavation and stockpiling of contaminated soil

P10. Disposal of contaminated soil to an approved landfill.

P11. Treatment and immobilisation of contaminated soil that is not suitable for direct disposal to landfill.

P12. Capping of areas where contaminated soil is suitable to remain on site with subsoil and topsoil.

P13. Water management and treatment and disposal of contaminated water/perched groundwater.

P14. Validation of remediated areas and fill to be used on site.

P15. Auditor Sign-off.

c. Monitoring

P16. Installation of additional groundwater monitoring wells to delineate the groundwater plume and facilitate monitoring and effect of natural attenuation.

P17. Implementation of groundwater monitoring programs to assess water quality trends and natural attenuation over time (yrs).

P18. Groundwater fate and transport modelling.

3. Reporting requirements and timeframe for submission of reports

Documents to be provided to the DEC in regards to the VRP will include a remediation and validation report by Golder Associated Pty Ltd and a site audit statement by Chris Jewell & Associates Pty Ltd.
The EPA will be provided with the following reports by the deadlines specified below:

Report	*Deadline*
R1. Validation Report	December 2006
R2. Site Audit Statement	December 2006

Key milestones for investigation, remediation and other actions

The program of work for the gasworks remediation is summarised in Gnant Chart.

All works set out in the proposal will be completed by the deadlines specified below:

Works	*Deadline*
T1. Finalise RAP and Technical Specification for contract works	March 2006
T2. Engagement of Remediation Contractor	June 2006
T3. Trial remedial investigation works and demolition works	September 2006
T4. Remediation works (tanks, impacted soil, tar well)	October 2006
T5. Validation sampling	November 2006
T6. Commence car park construction	November 2006
T7. Auditor sign off	February 2007

It is envisaged that ongoing groundwater monitoring will be undertaken for approximately 3 years after completion of remedial works to demonstrate effects of monitored natural attenuation.

NSW Site Auditor Scheme
SITE AUDIT STATEMENT

Department of Environment & Climate Change NSW

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the* Contaminated Land Management Act 1997 *on 26 March 2009. For more information about completing this form, go to Part IV.

PART I: Site audit identification

Site audit statement no. SA153

This site audit is a **statutory audit**/~~non-statutory audit~~* within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details (as accredited under the *Contaminated Land Management Act 1997*)

Name: Christopher Jewell Company: C. M. Jewell & Associates Pty Ltd

Address: 1/13 Kalinda Road

BULLABURRA NSW Postcode: 2784

Phone: 02 4759 3251 Fax: 02 4759 3257

Site details

Address: Lamonds Lane,

NOWRA NSW Postcode: 2541

Property description *(attach a list if several properties are included in the site audit)*

The site is identified as Lot 3 in DP868373 and Lot 1 in DP702802, in the Parish of Nowra, County of St Vincent.

Local Government Area: Shoalhaven City Council

Area of site: 8221 m² Current zoning: Business 3 (g)

To the best of my knowledge, the site **is**/~~is not~~* the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

~~Declaration/Order~~/**Agreement**/~~Proposal/Notice~~* **no(s)** Voluntary Remediation Agreement No. 26086, finalised on 11 May 2006.

****Strike out as appropriate***

Site audit commissioned by

Name: Mr G. A. Napper

Company: Shoalhaven City Council

Address: Bridge Road, Nowra, NSW 2541

Phone: 02 4429 3111 ***Fax***: 02 4422 1816

Name and phone number of contact person (if different from above)

Mr David Wagstaff, Shoalhaven City Council, 02 4429 3540

Purpose of site audit

☑ A. To determine land use suitability *(please specify intended use[s])*

Car Park

~~**OR**~~

☐ ~~B(i) To determine the nature and extent of contamination, and/or~~

☐ ~~B(ii) To determine the appropriateness of an **investigation/remedial action/management plan***, and/or~~

☐ ~~B(iii) To determine if the land can be made suitable for a particular use or uses by implementation of a specified **remedial action plan/management plan*** *(please specify intended use[s])*~~

.....

Information sources for site audit

Consultancy(ies) which conducted the site investigation(s) and/or remediation

Earth2Water Pty Ltd
Golder Associates Pty Ltd
GHD Pty Ltd
Douglas Partners Pty Ltd

Title(s) of report(s) reviewed:

1. Site Validation Report, Nowra Gasworks, prepared by GHD Pty Ltd (ref. 21/15913/129831), dated October 2008
2. Groundwater Monitoring (MNA Wells – R2) at the Former Gasworks, prepared by Earth2Water Pty Ltd (ref: E2W-077 L001), dated February 2008
3. Tar Pit Excavation Validation, Nowra Gasworks, prepared by GHD Pty Ltd (ref. 21/15913/134246), dated 10 September 2007
4. Waste Classification – Stockpile EB, Nowra Gasworks, prepared by GHD Pty Ltd (ref. 21/15913/133860), dated 24 August 2007
5. Waste Classification – Stockpile H, Nowra Gasworks, prepared by GHD Pty Ltd (ref. 21/15913/133856), dated 24 August 2007

****Strike out as appropriate***

6. Tar Pit – Base Validation Samples, Nowra Gasworks, prepared by GHD Pty Ltd (ref. 21/15913/133802), dated 22 August 2007
7. Interim Advice – Contamination Status of Retort Building and Gasometer Sediment, Nowra Gasworks, prepared by GHD Pty Ltd (ref. 2115913), dated 10 August 2007
8. Waste Classification of Stockpile, Nowra Gasworks, prepared by GHD Pty Ltd (ref. 21/15913/130085), dated 30 July 2007
9. Background Air Quality Monitoring, Nowra Gasworks, prepared by GHD Pty Ltd (ref. 21/15913/128976), dated 28 June 2007
10. Remediation Action Plan, Former Shoal Gas Works and Pioneer Bus Depot, Nowra, prepared by Golder Associates Pty Ltd (ref. 03623115/021), dated March 2006
11. Remediation Action Plan, Former Shoal Gas Works and Pioneer Bus Depot, Nowra, prepared by Golder Associates Pty Ltd (ref. 01623039/024), December 2005
12. Remediation Action Plan, Former Shoal Gas Works and Pioneer Bus Depot, Nowra, prepared by Golder Associates Pty Ltd (ref. 01623039/024), dated May 2005
13. Groundwater Fate and Transport Assessment at Gas Works Site, Lamonds Lane, Nowra, prepared by Golder Associates Pty Ltd (ref. 03623115/007), dated January 2004
14. Draft Site Investigation at Gas Works Site, Lamonds Lane, Nowra, prepared by Golder Associates Pty Ltd (ref. 01623039/015), dated April 2002
15. Draft Remediation Action Plan, Former Shoal Gas Works and Pioneer Bus Depot, Nowra, prepared by Golder Associates Pty Ltd (ref. 01623039/07), dated September 2001
16. Contamination Investigation, Nowra Gasworks, Nowra NSW, prepared by Golder Associates Pty Ltd (ref. 97623095.I), dated June 1997
17. Site Environmental Assessment, Shoal Gas, Nowra and Kiama, prepared by GHD Pty Ltd (ref. 211/024515/00), dated March 1997
18. Report on Contamination Assessment, Lot 2 DP626211 Bridge Road, Nowra, prepared by Douglas Partners Pty Ltd (ref. 23215), dated 14 February 1997

Other information reviewed (including previous site audit reports and statements relating to the site):

- Regional geological and topographic mapping
- Regional hydrogeological data

Site audit report

Title: Lamonds Lane, Nowra

Report no. J0741.12R-rev0 Date: 1 March 2010

Strike out as appropriate

PART II: Auditor's findings

Please complete either Section A or Section B, **not** both. *(Strike out the irrelevant section.)*

Use Section A where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land use(s).

Use Section B where the audit is to determine the nature and extent of contamination and/or the appropriateness of an investigation or remedial action or management plan and/or whether the site can be made suitable for a specified land use or uses subject to the successful implementation of a remedial action or management plan.

Section A

☑ **I certify that, in my opinion, the site is SUITABLE for the following use(s)** *(tick all appropriate uses and strike out those not applicable)*:

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
- ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~
- ☐ ~~Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
- ☐ ~~Day care centre, preschool, primary school~~
- ☐ ~~Residential with minimal opportunity for soil access, including units~~
- ☐ ~~Secondary school~~
- ☐ ~~Park, recreational open space, playing field~~
- ☐ ~~Commercial/industrial~~
- ☑ Other (please specify): Car Park

subject to compliance with the following environmental management plan *(insert title, date and author of plan)* **in light of contamination remaining on the site:**

Site Environmental Management Plan, Former Nowra Gasworks, Lamonds Lane, Nowra, prepared by C. M. Jewell & Associates Pty Ltd (ref. J0741.14R-rev1), dated 1 March 2010

OR

☐ ~~**I certify that, in my opinion, the site is NOT SUITABLE for any use due to the risk of harm from contamination.**~~

Overall comments

1. A building remains on the site, and contamination is present beneath it. Although the contamination appears to be limited to semi-volatile and non-volatile hydrocarbon compounds – and the combined risk of vapour generation and the accumulation of any such vapours within the building is therefore considered to be low – I have approved the associated land only for use as a car park, subject to the implementation of the specified Environmental Management Plan (EMP). Any use of the building that involves occupation (as opposed to short-term visits, maintenance work, etc.) will first require investigation to assess whether the building is suitable for the intended use.

2. Ongoing monitoring of groundwater (i.e. monitored natural attenuation - MNA) is required, and in the event that an assessment of the (quarterly) results indicates that the validity of continuing to adopt MNA as the preferred remedial option for contaminated groundwater is no longer valid, an appropriate alternative remedial option should be developed.
3. In addition to implementing the EMP that is required for the site I recommend that Shoalhaven City Council (Council) appropriately documents the likely presence of soil and groundwater contamination beneath Bridge Road and that in the event subsurface works are conducted along Bridge Road in the vicinity of the site, appropriate actions are implemented. Therefore, Section 6.1 (Preparation of Site and Work Specific Plans), Section 6.3 (Unexpected Finds) and Section 6.4 (Health and Safety), in particular, of the EMP should also apply to Bridge Road.
4. I recommend that the owners of the Home Hardware property should be informed that:
    - Soil contamination remains along the southern boundary of the former gasworks site and that potentially, soil contamination is present on the Home Hardware property.
    - Any subsurface works conducted on the Home Hardware property in the future, should be conducted in accordance with the EMP that has been developed for the former gasworks site.

    Furthermore, I recommend that:

    - Council appropriately documents the potential presence of soil contamination on the Home Hardware property.
    - In the event Council becomes aware that subsurface works are to be conducted on the Home Hardware property, it ensures that appropriate actions are implemented.

    Therefore, Section 6.1, Section 6.3 and Section 6.4, in particular, of the EMP should also apply to the Home Hardware property.
5. Any soil that is removed from the site should be appropriately classified in accordance with the Waste Classification Guidelines (DECC, July 2009).
6. Any soil to be imported to the site (including topsoil) should first be assessed as being suitable for use on the site.
7. Given demonstrated local contamination issues, and because groundwater quality may change with time, groundwater should not be extracted from the site for any purpose without appropriate assessment.

Section B

Purpose of the plan[1] which is the subject of the audit .....

.....

I certify that, in my opinion:

☐ **the nature and extent of the contamination HAS/HAS NOT* been appropriately determined**

AND/OR

☐ **the investigation/remedial action plan/management plan* IS/IS NOT* appropriate for the purpose stated above**

AND/OR

☐ **the site CAN BE MADE SUITABLE for the following uses** *(tick all appropriate uses and strike out those not applicable)*:

- ☐ Residential, including substantial vegetable garden and poultry
- ☐ Residential, including substantial vegetable garden, excluding poultry
- ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ Day care centre, preschool, primary school
- ☐ Residential with minimal opportunity for soil access, including units
- ☐ Secondary school
- ☐ Park, recreational open space, playing field
- ☐ Commercial/industrial
- ☐ Other *(please specify)* .....

if the site is remediated/managed* in accordance with the following remedial action plan/management plan* *(insert title, date and author of plan)*

.....

.....

.....

.....

subject to compliance with the following condition(s):

.....

.....

.....

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

* ***Strike out as appropriate***

~~Overall comments~~

PART III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority under the *Contaminated Land Management Act 1997* (Accreditation No. 9810).

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed ..... Date 2 March 2010

PART IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remedial action or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use(s) of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A or Section B of Part II, **not** both.

In **Section A** the auditor may conclude that the land is *suitable* for a specified use(s) OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further remediation or investigation of the site was needed to render the site fit for the specified use(s). Any **condition** imposed should be limited to implementation of an environmental management plan to help ensure the site remains safe for the specified use(s). The plan should be legally enforceable: for example a requirement of a notice under the *Contaminated Land Management Act 1997* (CLM Act) or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of the *Environmental Planning and Assessment Act 1979*.

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

In **Section B** the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or whether land can be made suitable for a particular land use or uses upon implementation of a remedial action or management plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

In **Part III** the auditor certifies his/her standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to:

Department of Environment and Climate Change (NSW)
Contaminated Sites Section
PO Box A290, SYDNEY SOUTH NSW 1232
Fax: (02) 9995 5930

AND

the **local council** for the land which is the subject of the audit.

Note: On 28 June 2017, the Environment Protection Authority issued notice No. 20174409 to end this declaration.

Environment Protection Authority

Declaration of remediation site

(Section 21 of the Contaminated Land Management Act 1997)

Declaration Number 21108 / Area Number 3240

The Environment Protection Authority (EPA) declares the following land to be a remediation site under the Contaminated Land Management Act 1997 ("the Act").

1. Land to which this declaration applies ("the site")

The site includes the land, road and footpaths listed below;

- All of Lot 3 Kalandar Street Nowra (Lot 3 DP 542656) (known as Mobil Service Station, Nowra East), and those parts of:
- Kalandar Street Nowra; and
- the footpaths adjoining Kalandar Street.

which fall within the area bounded by the thick black line marked on the attached map by NSW Lands 2004 entitled **Figure 1: Declared Area.**

The site is in the Parish of Nowra.

2. Nature of contamination affecting the site:

The EPA has found that the site and nearby areas are contaminated with the following substances ("the contaminants"):

- Benzene, Toluene, Ethylbenzene and Xylene (BTEX)
- Petroleum Hydrocarbons (TPH)

3. Nature of harm that the contaminants may cause:

The EPA has considered the matters in s.9 of the Act and for the following reasons has determined that the site is contaminated in such a way as to present a significant risk of harm to human health and the environment:

- groundwater has been degraded by petroleum hydrocarbon contamination at concentrations exceeding relevant guideline values. Groundwater is also contaminated with phase separated hydrocarbons;
- the contaminants include benzene (a known human carcinogen) and are toxic to humans and aquatic ecosystems;
- the hydrocarbon contaminated groundwater has migrated off the site and may continue to migrate offsite towards residential areas; and
- workers may be accidentally exposed to vapours that may accumulate in excavations and service utilities.

4. Further action under the Act

The making of this declaration does not prevent the carrying out of a voluntary remediation of the site and any person may submit a voluntary remediation proposal for the site to the EPA. If the proposal satisfies the requirements of s.26 of the Act, the EPA may agree not to issue a remediation order to the person or persons bringing the proposal.

5. Submissions invited

The public may make written submissions to the EPA on:

- Whether the EPA should issue a remediation order in relation to the site; or
- Any other matter concerning the site.

Submissions should be made in writing to:

Manager Contaminated Sites
Department of Environment and Climate Change
PO Box A290
SYDNEY SOUTH NSW 1232

or faxed to 02 9995 5930

by not later than: 3 April 2009

NIALL JOHNSTON
Manager Contaminated Sites
Department of Environment and Climate Change

Date: 26 February 2009

NOTE:

Remediation order may follow

If remediation of the site or part of the site is required, the EPA may issue a remediation order under s.23 of the Act.

Variation/Revocation

This declaration may be varied by subsequent declarations. It remains in force until it is otherwise revoked. A declaration may only be revoked when the EPA does not have reasonable grounds to believe that land is contaminated in such a way as to present a significant risk of harm (s.44 of the Act).

Information recorded by the EPA

Section 58 of the Contaminated Land Management Act 1997 requires the EPA to maintain a public record. A copy of this remediation declaration will be included in the public record.

Information recorded by councils

Section 59 of the Act requires the EPA to give a copy of this declaration to the relevant local council. The council is then required to note on its planning certificate issued pursuant to s.149 (2) of the Environmental Planning and Assessment Act that the land is currently within a remediation site. The EPA is required to notify council as soon as practicable when the declaration is no longer in force and the notation on the s.149 (2) certificate is no longer required.

Relationship to other regulatory instrument

This declaration does not affect the provisions of any relevant environmental planning instruments which apply to the land or provisions of any other environmental protection legislation administered by the EPA.

Environment Protection Authority (EPA)

AGREEMENT NOT TO ISSUE ORDER DURING COMPLIANCE WITH A VOLUNTARY PROPOSAL

(Section 26 of the Contaminated Land Management Act 1997)

Agreement No.: 26113

Agreement Date: 29/6/2009

Area No.: 3240

This agreement relates to the attached proposal, which comprises three Parts: Part 1 – Preliminary Details; Part 2 – Undertakings; and Part 3 – Performance Schedule.

Proponent: **Mobil Oil Australia Pty Ltd ACN 004 052 984**

Site: **Lot 3 in Deposited Plan 542656 - (Lot 3, Kalandar Street, Nowra East) and those parts of Kalandar Street, Nowra East and the footpaths adjoining Kalandar Street.**

Proposal Date: **6 May 2009**

1. The EPA is satisfied that the terms of the proposal are appropriate.
2. The EPA notes for the purposes of section 26 of the *Contaminated Land Management Act 1997* (CLM Act) that the proponent has undertaken in writing to the EPA not to recover contributions under Part 3, Division 6 of the CLM Act in respect of implementation of the proposal.
3. The EPA agrees, in accordance with the provisions of Part 3 of the CLM Act, that it will not issue a remediation order against the proponent if and for so long as the proposal is complied with.
4. The EPA may issue a remediation order against the proponent in accordance with the CLM Act if the EPA is not satisfied that the proposal is being or has been complied with.
5. The EPA is not prevented by this agreement from making a remediation order against persons (whether or not they were originally parties to the proposal and including public authorities) other than the proponent.
6. The EPA is not prevented by this agreement from exercising its powers under the *Protection of the Environment Operations Act 1997* in relation to activities conducted in association with or under the proposal.
7. Each component of the proposal, as described in the proposal is to be completed by the date specified in the proposal. Failure to satisfactorily complete any component by the due date for that component may be taken as a failure to carry out the terms of the proposal for the purposes of section 27 of the CLM Act.
8. This agreement takes effect on the "Agreement Date" specified above and continues in effect subject to satisfactory performance and progress with implementation of the proposal.

Signed:

NIALL JOHNSTON
Manager Contaminated Sites
Department of Environment and Climate Change (NSW)

VOLUNTARY REMEDIATION* PROPOSAL UNDER CONTAMINATED LAND MANAGEMENT ACT 1997

Part 1

Preliminary Details

1. Proponent's Details

(a) Name and contact details

Mobil Oil Australia Pty Ltd
ACN/ABN: 004 052 984

Phone: 03 9270 3333
Postal address: 12 Riverside Quay, Southbank, Victoria
Postcode: 3006

(b) Who the EPA should contact with technical enquiries about the proposal

Employer/Company: Mobil Oil Australia Pty Ltd
Type of business: Remediation
Phone (business): 03 9286 5390
Fax: 03 9286 5233

2. Site to which proposal applies

The site(s) to which the proposal applies ("the site") are:

- All of Lot 3 Kalandar Street East Nowra (Lot 3 DP542656) NSW (known as formerly Mobil-owned Service Station, East Nowra), and those parts of;
- Kalandar Street East Nowra, to the North and Northeast of the service station;
- The footpaths adjoining Kalandar Street East Nowra, to the North and Northeast of the service station.

3. The contamination

Soil and/or groundwater and/or surface water at the site are contaminated with substances in such a way as to present a significant risk of harm. The substances of concern ("the contaminants") include:

- Total Petroleum Hydrocarbons (TPH) C_6 to C_{36}
- Benzene, Toluene, Ethyl-benzene, Xylenes (BTEX)

4. The remediation* proposal

The remediation* proposal ("the proposal") comprises:

a) the information set out above;
b) the actions, works and other components set out in the following documents:

Remediation Action Plan Mobil Service Station (NO0278), Lot # 3, Kalandar Street, East Nowra, NSW, 2541, dated 5 March 2007, by Coffey Environments Pty Ltd.

c) the undertakings set out in Part 2 of this document; and
d) the performance schedule set out in Part 3 of this document.

Proponent's signature:

Signed by the proponent 6 May 2009

Part 2

Undertakings Included in Voluntary Remediation* Proposal

Explanatory Note:
Before the EPA can agree with one or more parties to a voluntary investigation or remediation proposal not to issue orders against them under section 17 or 23 of the Contaminated Land Management Act 1997, it has a statutory obligation to satisfy itself that the terms of the proposal submitted to it under section 19 or 26 are appropriate. In addition to including an appropriate investigation or remedial action plan, to be acceptable to the EPA a proposal must include the undertakings set out below. These undertakings are important. They must be complied with in order for the EPA to be satisfied that the terms of the proposal have been carried out.

THE PROPOSAL INCLUDES THE FOLLOWING UNDERTAKINGS:

General

1. All activities carried out in connection with the proposal including sampling and preparation of associated reports ("the activities") will be carried out in accordance with applicable provisions of *State Environmental Planning Policy 55 – Remediation of Land* and any requirements imposed under it in relation to the works.
2. All matters listed as relevant to a remediation action plan by the EPA's *Guidelines for Consultants Reporting on Contaminated Sites* (1997) will be taken into account in the carrying out of the activities.
3. All the activities will be carried out consistently with guidelines made or approved under section 105 of the CLM Act.
   (See http://www.environment.nsw.gov.au/clm/guidelines.htm)
4. All the activities will be carried out in compliance with applicable NSW environmental legislation, and in particular:
   i) All the activities, including:
      (1) the processing, handling, movement and storage of materials and substances used to carry out the activities; and
      (2) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activities

      will be carried out in a competent manner;
   ii) All plant and equipment installed at the site or used in connection with the activities:
      (1) will be maintained in a proper and efficient condition; and
      (2) will be operated in a proper and efficient manner.
5. All the activities at the site will be carried out in a manner that prevents or minimises the emission of dust, odour and noise from the site.
6. Waste generated or stored at the site will be assessed, classified and managed in accordance with the EPA's *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes.*

   (See http://www.environment.nsw.gov.au/waste/envguidlns/index.htm)

7. All hazardous, industrial, Group A or controlled waste generated by the activities at the site and which is to be transported from the site will be tracked in accordance with the *Protection of the Environment (Waste) Regulation 2005* and any licence under the *Protection of the Environment Operations Act 1997* in relation to the activities.

   (See http://www.environment.nsw.gov.au/waste/wastetracking.htm)

8. The proponent will, and acknowledges that the EPA may, make all documents and information relating to the activities available to the public free of charge.

9. The proponent will:

   i) prior to the implementation of the proposal provide for the EPA's approval a strategy for communicating about that implementation, particularly the actual remediation works, with members of the public who are likely to have a real interest in or be affected by that implementation and

   ii) implement the strategy, as approved by the EPA.

Monitoring, Record Keeping & Reporting

10. At least until the EPA has notified the proponent that the EPA no longer considers that the contamination poses a significant risk of harm, record and retain all monitoring data and information and provide this record to the EPA at any reasonable time if so requested by the EPA and as specifically provided under the proposal.

    [Note: Specific details of monitoring and data reporting requirements, requirements for progress reports, etc are to be set out in the performance schedule in Part 3 of this document.]

11. The EPA will be informed in writing within 7 days of the proponent becoming aware of information or data indicating a material change in conditions at the site or in its surrounding environment which could adversely affect the prospects of successful investigation or remediation of the site or result in harm to the environment.

12. The EPA will be informed in writing within 7 days of the proponent becoming aware of any failure, either by the proponent or any other person, to comply with any component or aspect of the proposal.

13. The EPA will be informed in writing as soon as practicable of any notification by the proponent, its employees or its agents to an appropriate regulatory authority other than the EPA of any pollution incident at the site within the meaning of the *Protection of the Environment Operations Act 1997*.

    (See http://www.environment.nsw.gov.au/licensing/dutytonotify.htm)

Performance Schedule

14. The performance schedule which is in Part 3 of this document will be adhered to.

Proponent's signature:

Signed by the proponent 6 May 2009

Part 3

Performance Schedule

1. Objectives of the proposal

The main objective of the proposal is to implement the most efficient technology to remove the identified groundwater impacts to a level such that they no longer pose a significant risk of harm to human health and the environment. This will be achieved through the principle features described in the following sections:

2. Principal features of the proposal

Stage 1 – Primary Source Removal and Investigations *(Completed)*

Stage 1 of the VRP includes the following:

- Removal of all former underground tanks and secondary sources (grossly contaminated soil associated with the fuel infrastructure); and
- Off site investigations, including off site drilling / sampling and installation and sampling of 3 soil vapour bores.

Stage 2 - Detailed design of the appropriate remediation system *(Completed)*

- Technical review of the site data, including but not limited to site geological / hydro-geological conditions, historical groundwater impacts trends, and assessment of previous remediation efforts;
- A site visit to evaluate available infrastructure, remediation system location, vapour discharge points, etc;
- Detailed design of the remediation system, utilising the most appropriate technology best suited to the site hydro-geological conditions. The detailed design will also include the proposed trenching and extraction well layout that provides the best plume coverage;
- Review of remediation system for compliance with Mobil's procedures and protocols;
- Preparation of a site management plan including contingency plan, and a system operation and monitoring manual for the designed remediation system; and
- The completion of a Risk Assessment which will be undertaken to define quantifiable Remediation Goals which will be directly linked to risks posed to human health and environment. The Risk Assessment shall be endorsed by an Auditor.

Stage 3 - System Infrastructure Installation *(Completed)*

- Liaison with Shoalhaven City Council to obtain the necessary development applications and permits required for the installation of the remediation system and associated piping run trenches;

- Installation of extraction wells to be located on-site and in the footpath along Kalandar Street;

- Installation of the extraction well piping run network trenches;

- Collection of groundwater samples prior to commencing installation of the remediation system in order to establish a hydrocarbon impact baseline; and

- Installation and commissioning of the remediation system.

Stage 4 – Remediation System Operation and Groundwater Monitoring Program

- Noise monitoring of the remediation system, which includes specific testing of system components, background testing and testing at the site boundaries of neighbouring properties, and implementation of sound attenuation measures recommended by specialised noise consultants;

- Operation of the remediation system and monitoring of influent and effluent hydrocarbon concentrations, via a volatile organic compound (VOC) screen using a Photo-Ionisation Detector (PID) and a Lower Explosive Level (LEL) meter. The remediation system will be operated by Mobil until influent VOC concentrations are 10% of their original values or until asymptotic conditions are reached, whichever comes first;

- Six monthly review of pumping data, separate phase petroleum hydrocarbon recovery and monitoring data to determine the need to adjust/modify the pumping scheme to maximise the recovery of separate phase hydrocarbon and minimise any migration of impacted groundwater from the source site. This will be reported six monthly during operation of the system.

- Six monthly groundwater sampling of targeted wells to assess the status of the groundwater plume during the period of remediation system operation;

- The remediation system will then be mothballed for a 2 to 3 month period to monitor if there is any rebound of hydrocarbon impacts post system operation. If the groundwater concentrations show significant rebound the system will be restarted and operated for another 3 to 6 months, dependant on the level of rebound;

- Undertake three groundwater sampling rounds post the operation of the remediation to show that natural attenuation is occurring within the plume and trending down towards the levels determined in the Risk Assessment; and

- Engage an Auditor to review completed Remediation work to ensure that the above remediation goals outlined in the Risk Assessment have been met.

Stage 5 – Additional Investigations and Soil Vapour Bore Monitoring

- Additional drilling investigation to further assess the nature and delineate the extent of groundwater hydrocarbon contamination across Kalandar Street to the North and adjacent the site towards the East;

- Installation of additional soil vapour bores targeting surrounding residential properties, to assess the potential for health risks to residents, associated with hydrocarbon vapour inhalation;

- Six monthly sampling of both existing and new soil vapour bores, consistent with EPA methodology, during the period of remediation system operation. This may also include monitoring hydrocarbon vapour concentrations within selected residential dwellings using Summa Canisters (if required).

3. Reporting requirements and timeframe for submission of reports

The EPA will be provided with the following reports by the deadlines specified below:

Report	*Deadline*
R1. Underground Tank Removal Report	Completed March 2007
R2. Pilot Test Report	Completed August 2007
R3. Remedial Action Plan	Completed August 2007
R4. Off Site Investigation Report following the completion of works set out in the Coffey letter to EPA dated 27 February 2007, referred to in P1.	Completed December 2007
R5. Remediation System Installation and Commissioning Report (including System design).	Completed November 2008
R6. Quantitative Risk Assessment Report (SSTL's)	Within 10 weeks of completion of works (refer to Section 4)
R7. Six Monthly Remediation System Performance Review, Soil Vapour Bore Testing and Groundwater Monitoring Event Report. R7a. Additional Investigation Reports	Within 10 weeks of completion of works (refer to Section 4) Within 10 weeks of completion of works (refer to Section 4)
R8. Quarterly Post Mothball GME Report.	Within 10 weeks of completion of works (refer to Section 4)
R9. Remediation Validation Report.	Within 10 weeks of completion of works (refer to Section 4)

4. Key milestones for investigation, remediation and other actions

All works set out in the proposal will be completed by the deadlines specified below:

Works	*Report Type*	*Estimated Works Completion Date*
Underground Tank Removal	R1	Completed 2006
Pilot Test	R2	Completed 2005
Remedial Action Plan	R3	Completed 2007
Post Phase 2 ESA – Off Site Drilling	R4	Completed 2007
Remediation System Construction and Installation of Pipe Work and Extraction Wells	NA	Completed 2006
Remediation System Commissioning	R5	Completed September 2007
Remediation System Performance Review and Groundwater Monitoring Event	R7	Completed July 2008
Extension of Remediation System across Kalandar Street	NA	Completed November 2008
Remediation System Performance Review and Groundwater Monitoring Event	R7	Completed February 2009
Soil Bore Vapour Sampling, Well Gauging & Letter Drop	Letter	Completed March 2009
Notification Letters to Third Party Utility Companies	NA	Completed April 2009
Noise Monitoring and Noise Attenuation Upgrade	NA	May 2009
Risk Assessment (SSTL's)	R6	August 2009
Remediation System Performance Review, Soil Vapour Bore Testing and Groundwater Monitoring Event	R7	August 2009
Remediation System Performance Review, Soil Vapour Bore Testing and GME	R7	February 2010
Additional Investigations (Off site)	R7a	February 2010
Remediation System Performance Review, Soil Vapour Bore Testing and GME	R7	August 2010
Remediation System Performance Review, Soil Vapour Bore Testing and GME	R7	February 2011
Remediation System Performance Review, Soil Vapour Bore Testing and GME	R7	August 2011
Remediation System Performance Review, Soil Vapour Bore Testing and GME	R7	February 2012
Remediation System Performance Review, Soil Vapour Bore Testing and GME	R7	August 2012
Remediation System Mothballing	NA	August 2012
Post Mothball Groundwater Monitoring Event	R8	November 2012
Post Mothball Groundwater Monitoring Event	R8	March 2013
Post Mothball Groundwater Monitoring Event	R8	June 2013
Site Remediation Validation	R9	September 2013

Environment Protection Authority

Notice to cease approval of Voluntary Management Proposal

(Section 17(7) of the *Contaminated Land Management Act 1997*)

Notice Number 201717-7-02; Area Number 3240

Background

The land to which this notice applies was declared as "significantly contaminated land" (declaration No. 21108) on 26 February 2009 by the Environment Protection Authority (EPA) and has been the subject of an EPA approved voluntary remediation agreement (VRA - Agreement No. 26113 issued on 29 June 2009) which was amended by Mobil Oil Australia (the proponent) and approved by the EPA (Approval No. 20134437).

Land to which this notice applies

Description	Address
Mobil East Nowra	Lot 3 Kalandar Street, Nowra East, NSW (Lot 3 in DP 542656)

Completion of approved VMP

The proponent carried out management actions under the VRA approved by the EPA on 29 June 2009 (Approval No. 26113) and amended voluntary management proposal (Notice No. 20134437). The management actions under the VMP have been completed and the documentation has been made available to the EPA. Pursuant to section 17(7) of the CLM Act, this proposal ceases to be an approved VMP as the EPA is satisfied that the terms of the proposal have been carried out.

[Signed]

DAVID GATHERCOLE
A/Director Contaminated Land Management
Environment Protection Authority

Date: 28 June 2017

NOTE:
Information recorded by the EPA
Section 58 of the CLM Act requires the EPA to maintain a public record. A copy of this notice will be included in the public record.

Information recorded by councils
Section 59 of the CLM Act requires the EPA to give a copy of this notice to the relevant local council. The council may then make appropriate consequential modifications to the planning certificate issued in relation to the land to which this notice applies pursuant to s149 of the *Environmental Planning and Assessment Act 1979*.

Relationship to other regulatory instrument

This repeal notice does not affect the provisions of any relevant environmental planning instruments which apply to the land or provisions of any other environmental protection legislation administered by the EPA.

Previous regulatory instrument

As of 1 July 2009, all current declarations of investigation area and declarations of remediation site are taken to be declarations of significantly contaminated land, all current investigation orders and remediation orders are taken to be management orders and all current agreed voluntary investigation proposals and agreed voluntary remediation proposals are taken to be approved voluntary management proposals.

Environment Protection Authority

Notice to amend notice of approval of voluntary management proposal

(Section 44 of the Contaminated Land Management Act 1997)

Notice Number 20134437; Area Number 3240

Background

The land to which this notice applies, was declared as "significantly contaminated land" (declaration No. 21108) by the Environment Protection Authority (EPA) and is the subject of an EPA-approved voluntary management proposal (approval No. 26113). The proponent proposes to carry out management actions under the approved proposal. The proponent has requested that the schedule of management actions be amended.

Amendment of approved VMP

Having reviewed the management actions, the EPA is satisfied that the schedule of management actions can be amended.

Land to which this notice applies

Description	Address
Lot 3 in DP542656	Lot 3 Kalandar Street, Nowra East

Pursuant to section 44 of the CLM Act, voluntary management proposal No. 26113, approval date 29 June 2009 is amended as follows;

4. Key milestones for investigation, remediation and other actions

All works set out in the proposal will be completed by the deadlines specified below:

Works	Report Type	Completion Date
Install additional groundwater wells and soil vapour bores	R7a	December 2013
Additional on and offsite assessment	R7a	December 2013
Multiphase Extraction pilot test	R2	December 2013
Multiphase Extraction event	R8	December 2013
Multiphase Extraction remediation performance review, Soil vapour bore sampling and GME	R7	January 2014
Revise Human Health Risk Assessment	R6	February 2014
Multiphase Extraction performance review, Soil vapour bore sampling and GME	R7	April 2014
Multiphase Extraction performance review, Soil vapour bore sampling and GME	R7	July 2014
Multiphase Extraction performance review, Soil vapour bore sampling and GME	R7	October 2014
Post Mothball GME	R8	November 2014
Post Mothball GME	R8	January 2015
Post Mothball GME	R8	March 2015
Site Remediation Validation	R9	December 2015

[Signed] 5 November 2013

NIALL JOHNSTON
Manager Contaminated Sites
Environment Protection Authority

NOTE:

Information recorded by the EPA

Section 58 of the CLM Act requires the EPA to maintain a public record. A copy of this notice will be included in the public record.

Information recorded by councils

Section 59 of the CLM Act requires the EPA to give a copy of this notice to the relevant local council. The council may then make appropriate consequential modifications to the planning certificate issued in relation to the land to which this notice applies pursuant to s149 of the *Environmental Planning and Assessment Act 1979*.

Relationship to other regulatory instrument

This repeal notice does not affect the provisions of any relevant environmental planning instruments which apply to the land or provisions of any other environmental protection legislation administered by the EPA.

Previous regulatory instrument

As of 1 July 2009, all current declarations of investigation area and declarations of remediation site are taken to be declarations of significantly contaminated land, all current investigation orders and remediation orders are taken to be management orders and all current agreed voluntary investigation proposals and agreed voluntary remediation proposals are taken to be approved voluntary management proposals.

Environment Protection Authority

Notice to repeal significantly contaminated land declaration

(Section 44 of the Contaminated Land Management Act 1997)

Notice Number 20174409; Area Number 3240

Background

The land to which this notice applies, was declared as "significantly contaminated land" (declaration No. 21108 in Area 3240) issued by the Environment Protection Authority (EPA). Required investigations have been completed and results have been provided to the EPA.

Repeal

Having reviewed the results of the management actions and Site Audit Statement, the EPA is satisfied that it no longer has reason to believe that contamination of the land to which this notice applies is significant enough to warrant regulation under the *Contaminated Land Management Act 1997* (CLM Act).

Pursuant to section 44 of the CLM Act, declaration of significantly contaminated land No. 21108 dated 26 February 2009, gazetted on 6 March 2009, ceases to be in force on the date on which this notice is signed.

Land to which this notice applies

Description	Address
Mobil East Nowra	Lot 3 Kalandar Street, East Nowra, NSW (Lot 3 in DP 542656)

[Signed]

DAVID GATHERCOLE
A/Director Contaminated Land Management
Environment Protection Authority

Date: 28 June 2017

NOTE:

Information recorded by the EPA

Section 58 of the CLM Act requires the EPA to maintain a public record. A copy of this notice will be included in the public record.

Information recorded by councils

Section 59 of the CLM Act requires the EPA to give a copy of this notice to the relevant local council. The council may then make appropriate consequential modifications to the planning certificate issued in relation to the land to which this notice applies pursuant to s149 of the *Environmental Planning and Assessment Act 1979*.

Relationship to other regulatory instrument

This repeal notice does not affect the provisions of any relevant environmental planning instruments which apply to the land or provisions of any other environmental protection legislation administered by the EPA.

Previous regulatory instrument

As of 1 July 2009, all current declarations of investigation area and declarations of remediation site are taken to be declarations of significantly contaminated land, all current investigation orders and remediation orders are taken to be

management orders and all current agreed voluntary investigation proposals and agreed voluntary remediation proposals are taken to be approved voluntary management proposals.

NSW Site Auditor Scheme
SITE AUDIT STATEMENT

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the* Contaminated Land Management Act 1997 *on 31st October 2012. For more information about completing this form, go to Part IV.

PART I: Site audit identification

Site audit statement no. GN 410

This site audit is a **statutory audit~~/non-statutory audit~~*** within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details (as accredited under the *Contaminated Land Management Act 1997*)

Name:	Graeme Nyland	Company:	Ramboll Environ Australia Pty Ltd
Address:	Level 3, 100 Pacific Highway (PO Box 560)		
	North Sydney NSW	Postcode:	2060
Phone:	02 9954 8100	Fax:	02 9954 8150

Site details

Address: Lot 3 Kalandar Street, Nowra East NSW

Postcode: 2541

Property description *(attach a list if several properties are included in the site audit)*

Lot 3 DP 542656 (see attachment at the end of Part I of the statement)

Local Government Area: Shoalhaven City Council

Area of site (e.g. hectares): 1,682 m^2 Current zoning: B1 Neighbourhood Centre

To the best of my knowledge, the site **is~~/is not~~*** the subject of a declaration, order, agreement or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

Declaration/~~Order~~/Agreement~~/Proposal/Notice~~* no(s):

Declaration of Remediation Site, dated 26 February 2009, No. 21108, Area 3240

Voluntary Remediation Agreement, dated 29 June 2009, Agreement No. 26113, Area No. 3240

Notice to amend notice of approval of voluntary management proposal, dated 5 November 2013, Notice Number 20134437, Area No. 3240

Strike out as appropriate

Site audit commissioned by

Name: [redacted] Company: Mobil Oil Australia Pty Ltd

Address: 12 Riverside Quay, Southbank, VIC

Postcode: 3006

Phone: [redacted] Fax: [redacted]

Name and phone number of contact person (if different from above)

[redacted]

Purpose of site audit

☐ ~~A. To determine land use suitability *(please specify intended use[s])*~~

~~**OR**~~

☑ B(i) To determine the nature and extent of contamination, ~~and/or~~

☐ ~~B(ii) To determine the appropriateness of an **investigation/remedial action/management plan***~~, and/or~~

☐ ~~B(iii) To determine if the land can be made suitable for a particular use or uses by implementation of a specified **remedial action plan/management plan*** *(please specify intended use[s])*~~

.....

Information sources for site audit

Consultancy(ies) which conducted the site investigation(s) and/or remediation

- IT Environmental (Australia) Pty Ltd (IT)
- Coffey Environments Pty Ltd (Coffey)
- Environmental Strategies Pty Ltd (ES)

Title(s) of report(s) reviewed:

- 'Phase I Environmental Site Assessment, Mobil East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra NSW 2541', 16 June 2004, IT (Australia) Pty Ltd (IT) (2004a)
- 'Phase 2 Environmental Site Assessment, Mobil East Nowra Service Station (NO0278), Lot 3, Kalandar Street, East Nowra NSW 2541', 1 July 2004, IT
- 'Post Phase 2 Environmental Site Assessment, Mobil East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra NSW 2541', 12 October 2004, IT
- 'Tank Excavation Assessment Report, Lot 3, Kalandar Street, East Nowra NSW', 8 January 2007, Coffey
- 'Remediation Action Plan, Mobil Service Station (NO0278), Lot 3 Kalandar Street, East Nowra NSW 2541', 5 March 2007, IT
- 'Post Phase 2 Environmental Site Assessment, Mobil East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra, NSW 2541', 8 April 2008, Coffey

Strike out as appropriate

- ‘Remediation System Commissioning Report, Mobil East Nowra Service Station (NO0278), Lot 3, Kalandar Street, East Nowra, New South Wales’, 28 November 2008, Coffey
- ‘Interim Groundwater Monitoring Report, former East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra NSW 2541’, 23 January 2009, Coffey
- ‘Mobil East Nowra Service Station (NO0278), Soil Vapour Assessment’, 11 May 2009, Coffey
- ‘Six-Monthly Groundwater Monitoring Event, Mobil Branded East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra, NSW 2541’, 13 July 2009, Coffey
- ‘Six-monthly Groundwater and Soil Vapour Monitoring Event, and Remediation System Performance Review, Mobil Branded East Nowra Service Station (NO0278), Lot Kalandar Street, East Nowra, NSW 2541’, 16 November 2009, Coffey
- ‘Health Risk Assessment, Mobil East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra, New South Wales’, 8 April 2010, Coffey
- ‘Interim Groundwater Monitoring Event and Remediation System Performance Review, Mobil East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra, NSW 2541’, 14 May 2010, Coffey
- ‘Interim Groundwater Monitoring Event & Remediation System Performance Review, Mobil East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra, NSW 2541’, 16 June 2011, Coffey
- ‘Interim Groundwater Monitoring Event & Remediation System Performance Review, Mobil East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra, NSW 2541’, 24 June 2011, Coffey
- ‘Additional PP2 ESA, Groundwater Monitoring Event & Remediation System Performance Review, Mobil Nowra Service Station (NO0278), Lot 3 Kalandar Road, East Nowra NSW 2580’, 5 December 2011, Coffey
- ‘Groundwater Monitoring Report, Former Mobil East Nowra Service Station, Lot 3 Kalandar Street, East Nowra, NSW’, November 2012, ES
- ‘Groundwater Monitoring Report, Former Mobil East Nowra Service Station, Lot 3 Kalandar Street, East Nowra, NSW’, January 2013, ES
- ‘Soil Vapour Monitoring Event - Mobil East Nowra Service Station (Site ID: NO0278), Lot 3 Kalandar Road, East Nowra, NSW’, 29 April 2013, ES
- ‘Groundwater Monitoring Report, Former Mobil East Nowra Service Station, Lot 3 Kalandar Street, East Nowra, NSW’, June 2013, ES
- ‘Proposed Works Plan Targeted Site Investigations Former Mobil East Nowra Service Station – Lot 3 Kalandar Street, East Nowra- SAQP’, 10 October 2013, ES
- ‘Groundwater Monitoring Report, Former Mobil East Nowra Service Station (NO0278), Lot 3 Kalandar Street, East Nowra, NSW’, December 2013, ES
- ‘Pumping Test Report, Former Mobil East Nowra Service Station – Lot 3 Kalandar Street, East Nowra, NSW’, December 2013, ES
- ‘Soil Vapour Monitoring Point Installation Report, Former Mobil East Nowra Service Station, Lot 3, Kalandar Road, East Nowra, NSW’, December 2013, ES
- ‘Multi-Phase Extraction (MPE) Pilot Trial Assessment of Onsite MPE and Insitu Extraction Well Network’, 6 December 2013, ES
- ‘Multiphase Extraction Event Letter Report’, 9 December 2013, ES
- ‘Light Non Aqueous Phase Liquid (LNAPL) Baildown Assessment, Former Mobil East Nowra Service Station – Lot 3 Kalandar Street, East Nowra, NSW’, 9 December 2013, ES

Strike out as appropriate

- ‘Delineation Well Installation Report, Mobil East Nowra Service Station, Lot 3, Kalandar Road, East Nowra, NSW’, December 2013, ES
- ‘Soil Vapour Monitoring Event – Former Mobil East Nowra Service Station (Site ID: NO0278), Lot 3 Kalandar Street, East Nowra, NSW’, 8 January 2014, ES
- ‘Groundwater Monitoring Report, Former Mobil East Nowra Service Station (NO0278), Lot 3, Kalandar Street, East Nowra, NSW’, April 2014, ES
- ‘Human Health Risk Assessment, Former Mobil East Nowra Service Station NO0278, Lot 3 Kalandar Street, East Nowra, NSW’, April 2014, ES
- ‘Groundwater Monitoring Report, Former Mobil East Nowra Service Station NO0278, Lot 3 Kalandar Street, East Nowra, NSW’, July 2014, ES
- ‘Soil Vapour Monitoring Event – Former Mobil East Nowra Service Station (Site ID: NO0278), Lot 3 Kalandar Street, East Nowra, NSW’, 30 May 2014, ES
- ‘Groundwater Monitoring Report, Former Mobil East Nowra Service Station NO0278, Lot 3 Kalandar Street, East Nowra, NSW’, October 2014, ES
- ‘Soil Vapour Monitoring Event – Former Mobil East Nowra Service Station (Site ID: NO0278), Lot 3 Kalandar Street, East Nowra, NSW’, 8 October 2014, ES
- ‘Site Remediation Validation Report, Former Mobil East Nowra Service Station, Lot 3 Kalandar Street, East Nowra, NSW’, 30 May 2016, ES

Other information reviewed (including previous site audit reports and statements relating to the site)

N/A

Site audit report

Title: Site Audit Report – Mobil East Nowra Service Station

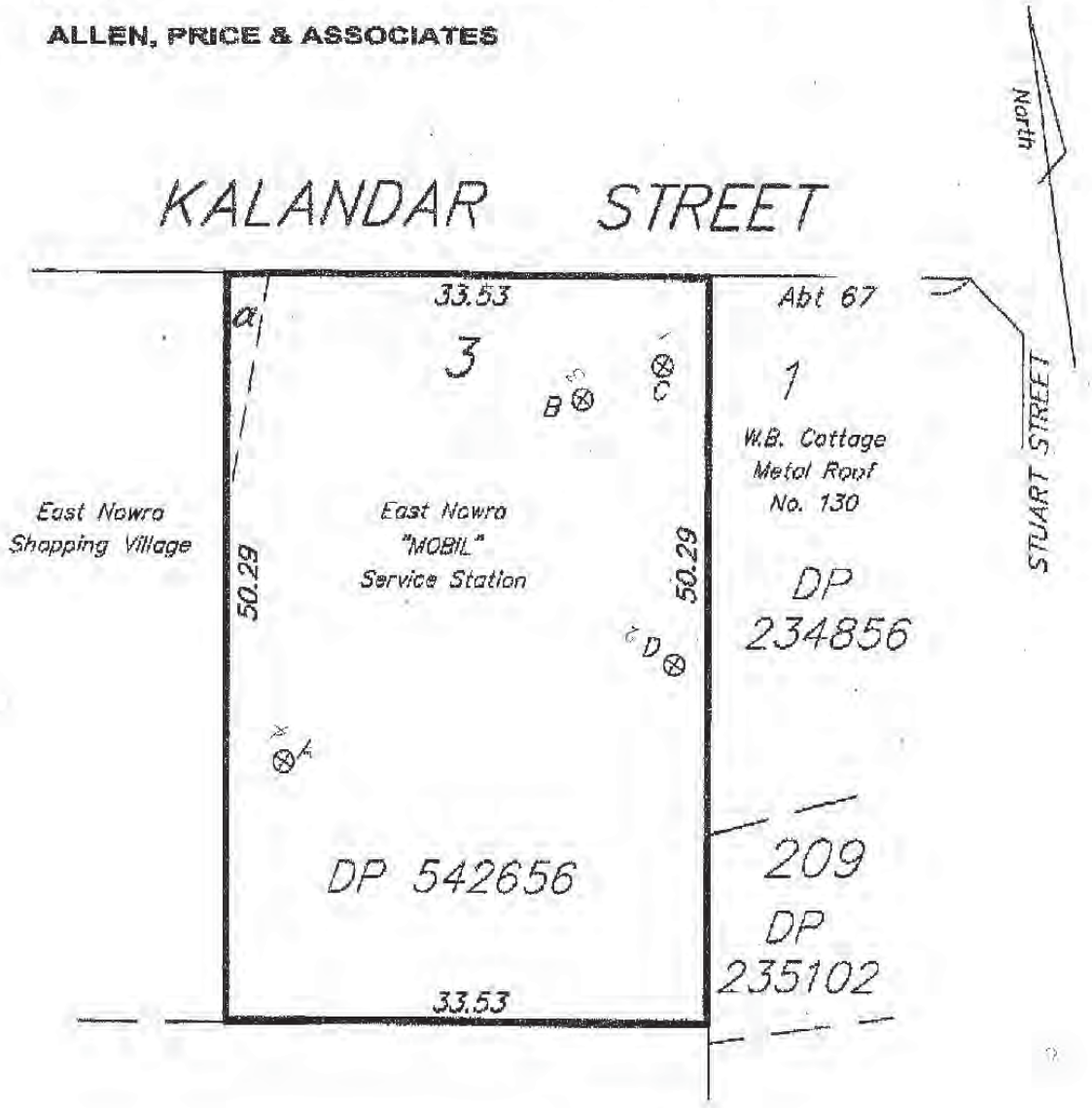
Report no. GN 410 (Ramboll Environ Ref: AS121074)

Date: August 2016

Strike out as appropriate

28/05/2004 16:51 ALLEN PRICE & ASSOCIATES, NOWRA → 95022105 NO.317 002

ALLEN, PRICE & ASSOCIATES



Levels taken on top of inside casing (top PVC pipe) are related to Australian Height Datum (AHD)
Origin PM 23614
RL 15.587 AHD

⊗A Denotes monitoring well. (see ISG coordinate table)

ISG COORDINATES			
WELL	EASTING	NORTHING	RL
A	264172.63	1137734.29	20.305
B	264196.79	1137755.16	19.195
C	264202.59	1137756.46	18.910
D	264200.29	1137736.50	19.605

a Right of Carriageway vide M845281

Sketch to accompany my report reference 42279 of even date.

A. Isaac Date 27.5.04

Registered Surveyor
for ALLEN,PRICE & ASSOCIATES

Liability is limited by the Professional Surveyors Scheme approved under the Professional Standards Act 1994 (NSW)
COVER OF EXCELLENCE

Strike out as appropriate

PART II: Auditor's findings

Please complete either Section A or Section B, **not** both. *(Strike out the irrelevant section.)*

Use Section A where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land use(s).

Use Section B where the audit is to determine the nature and extent of contamination and/or the appropriateness of an investigation or remedial action or management plan and/or whether the site can be made suitable for a specified land use or uses subject to the successful implementation of a remedial action or management plan.

~~Section A~~

- ❑ **I certify that, in my opinion, the site is SUITABLE for the following use(s)** *(tick all appropriate uses and strike out those not applicable)*:
  - ❑ Residential, including substantial vegetable garden and poultry
  - ❑ Residential, including substantial vegetable garden, excluding poultry
  - ❑ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
  - ❑ Day care centre, preschool, primary school
  - ❑ Residential with minimal opportunity for soil access, including units
  - ❑ Secondary school
  - ❑ Park, recreational open space, playing field
  - ❑ Commercial/industrial
  - ❑ Other *(please specify)* ……

subject to compliance with the following environmental management plan *(insert title, date and author of plan)* **in light of contamination remaining on the site:**

OR

- ❑ **I certify that, in my opinion, the site is NOT SUITABLE for any use due to the risk of harm from contamination.**

Overall comments:

Section B

Purpose of the plan[1] which is the subject of the audit is to demonstrate compliance with an approved voluntary remediation agreement that required the removal of contamination so that it no longer presents a significant risk of harm to human health and the environment.

I certify that, in my opinion:

☑ **the nature and extent of the contamination HAS/~~HAS NOT~~* been appropriately determined**

AND/OR

☑ **the investigation/~~remedial action plan/management plan~~* IS/~~IS NOT~~* appropriate for the purpose stated above**

~~AND/OR~~

☐ **~~the site CAN BE MADE SUITABLE for the following uses~~** *~~(tick all appropriate uses and strike out those not applicable):~~*

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
- ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~
- ☐ ~~Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
- ☐ ~~Day care centre, preschool, primary school~~
- ☐ ~~Residential with minimal opportunity for soil access, including units~~
- ☐ ~~Secondary school~~
- ☐ ~~Park, recreational open space, playing field~~
- ☐ ~~Commercial/industrial~~
- ☐ ~~Other *(please specify)* ……~~

~~if the site is remediated/managed* in accordance with the following remedial action plan/management plan*~~ *~~(insert title, date and author of plan)~~*

~~…~~

~~subject to compliance with the following condition(s):~~

~~…~~

[1] For simplicity, this statement uses the term ‘plan’ to refer to both plans and reports.

**** Strike out as appropriate***

Overall comments

The service station and downgradient Kalandar Street are the subject of a Declaration of Remediation Site and an approved Voluntary Remediation Agreement (VRA). Groundwater at the site was contaminated with petroleum hydrocarbons, which had migrated onto Kalandar Street and adjacent residential and commercial properties.

The source of the contamination was a leaking product line in the bowser area. The product line and all underground storage tanks and associated pipes and bowsers were removed from the site in 2006 and replaced with new infrastructure. Remediation of the site and northern side of Kalandar Street was undertaken between 2005 and 2013 by short-term multi-phase extraction events and operation of a multi-phase vapour extraction system.

The site is the subject of a Declaration of a Remediation Site due to phase separated hydrocarbons (PSH) and dissolved petroleum hydrocarbons in groundwater migrating off the site, which may migrate to residential areas. Groundwater monitoring undertaken between 2004 and 2014 identified a reduction in the apparent thickness and extent of PSH, with no PSH identified in the last monitoring round. The lateral extent and concentration of dissolved phase contaminants has also reduced in wells located within the plume and at the leading edge of the plume. Concentrations exceeded the residential human health criteria for vapour intrusion in wells located on the northern side of Kalandar Street, however soil vapour monitoring did not identify concentrations above the human health vapour intrusion criteria and were typically less than the detection limit. The risk to residents from petroleum vapour intrusion is therefore considered to be low.

The closest down gradient ecological receptor is approximately 550 m to the north of the site. Residual contamination is not considered to be a risk to down gradient ecological receptors given wells located approximately 90 m to the north of the site in Young Avenue and Duchess Close have not had detectable concentrations of petroleum hydrocarbon in the last five monitoring rounds and the plume is considered to be retracting.

The objective of the VMP was *"…to remove the identified groundwater impacts to a level such that they no longer pose a significant risk of harm to human health and the environment"*. The objective of the VMP is considered to have been met.

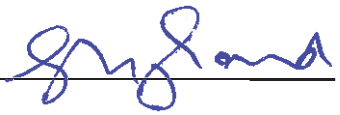
PART III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority under the *Contaminated Land Management Act 1997* (Accreditation No. 9808).

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed  Date 8/8/2016

PART IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remedial action or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use(s) of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A or Section B of Part II, **not** both.

In **Section A** the auditor may conclude that the land is *suitable* for a specified use(s) OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further remediation or investigation of the site was needed to render the site fit for the specified use(s). Any **condition** imposed should be limited to implementation of an environmental management plan to help ensure the site remains safe for the specified use(s). The plan should be legally enforceable: for example a requirement of a notice under the *Contaminated Land Management Act 1997* (CLM Act) or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of the *Environmental Planning and Assessment Act 1979*.

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

In **Section B** the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or whether land can be made suitable for a particular land use or uses upon implementation of a remedial action or management plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

In **Part III** the auditor certifies his/her standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to:

EPA (NSW)
Contaminated Sites Section
PO Box A290, SYDNEY SOUTH NSW 1232
nswauditors@epa.nsw.gov.au

AND

the **local council** for the land which is the subject of the audit.

Application summary

Search Again Return to Previous Page

Summary Application No: 21029

Applicant:	**ROADS AND MARITIME SERVICES** **Trading as:** RMS
Premises:	Berry to Bomaderry Upgrade Princes Highway, BOMADERRY, NSW, 2541 **LGA:** SHOALHAVEN **Catchment:** Shoalhaven
Application type:	New licence
Application status:	Pending
Activity type:	Road construction Crushing, grinding or separating Land-based extractive activity
Received:	03 Nov 2017
Pollution incident management plan:	No

Section 55 Protection of the Environment Operations Act 1997

Environment Protection Licence

Licence - 3787

Department of **Environment & Climate Change** NSW

Licence Details	
Number:	3787
Anniversary Date:	30-June
Review Due Date:	13-Jun-2008

Licensee

BRYCE; LESLIE WILLIAM ROBERT
"GWANDALAN PARK" 476 PRINCES HIGHWAY
NOWRA NSW 2541

Licence Type

Premises

Premises

"GWANDALAN PARK"
474 PRINCES HIGHWAY
NOWRA NSW 2541

Non Scheduled Activity

Irrigated Agriculture

Fee Based Activity	**Scale**
Other Activities (94)	0 - All

Region

South - Queanbeyan
Suite 4, Robert Lowe Building, 30 Lowe Street
QUEANBEYAN NSW 2620
Phone: 02 6122 3100
Fax: 02 6299 3525

PO Box 622 QUEANBEYAN
NSW 2620

Environment Protection Licence

Licence - 3787

Department of **Environment & Climate Change** NSW

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act); and
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

The EPA publication "A Guide to Licensing" contains information about how to calculate your licence fees.

The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

BRYCE; LESLIE WILLIAM ROBERT
"GWANDALAN PARK" 476 PRINCES HIGHWAY
NOWRA NSW 2541
BRYCE; ELSIE EDITH
"GWANDALAN", 476 PRINCES HIGHWAY
NOWRA NSW 2541

subject to the conditions which follow.

1 Administrative conditions

A1 What the licence authorises and regulates

A1.1 This licence regulates water pollution resulting from the activity/ies specified below carried out at the premises specified in A2.

Irrigated Agriculture

A1.2 Not applicable.

A1.3 Not applicable.

A2 Premises to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
"GWANDALAN PARK"
474 PRINCES HIGHWAY
NOWRA
NSW
2541
LOT 1 DP 610330 AND LOTS 21 & 22 DP 856086

A3 Other activities

A3.1 Not applicable.

A4 Information supplied to the EPA

A4.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
(a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
(b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

2 Discharges to air and water and applications to land

P1 Location of monitoring/discharge points and areas

P1.1 Not applicable.

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

P1.3 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

Water and land

EPA identification no.	Type of monitoring point	Type of discharge point	Description of location
1		Discharge to utilisation area	Utilisation area identified as paddocks 1 - 15 on the drawing titled "Gwandalan Park" submitted to the EPA with the Licence Information Form dated 25/10/2000
2	Discharge to utilsation area. Effluent quality monitoring	Discharge to utilsation area. Effluent quality monitoring	Gate valve on pipeline on paddock number 10 - 11, labelled "Line from ACF" drawing titled "Gwandalan Park" submitted to the EPA with the Licence Information Form dated 25/10/2000
3	Discharge to utilisation area. Effluent quality monitoring.	Discharge to utilisation area. Effluent quality monitoring.	Gate valve on pipeline from the Minad premises lablled "Line from Minad" drawing titled "Gwandalan Park" submitted to the EPA with the Licence Information Form dated 25/10/2000

3 Limit conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must

comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Load limits

L2.1 Not applicable.

L2.2 Not applicable.

L3 Concentration limits

L3.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L3.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L3.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.

Water and Land

POINT 3

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile Concentration Limit
Biochemical oxygen demand	kilograms per hectare				25

L4 Volume and mass limits

L4.1 Not applicable.

L5 Waste

L5.1 Not applicable.

L6 Noise Limits

L6.1 Not applicable.

L7 Potentially offensive odour

L7.1 The licensee must not cause or permit the emission of offensive odour beyond the boundary of the premises.

Note: Section 129 of the Protection of the Environment Operations Act 1997, provides that the licensee must not cause or permit the emission of any offensive odour from the premises but provides a defence if the emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.

4 Operating conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.

This includes:
(a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
(b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
(a) must be maintained in a proper and efficient condition; and
(b) must be operated in a proper and efficient manner.

O3 Management of utilisation area

O3.1 The quantity of effluent/solids applied to the utilisation area must not exceed the capacity of the area to effectively utilise the effluent/solids.

For the purpose of this condition, 'effectively utilise' includes the use of the effluent/solids for pasture or crop production, as well as the ability of the soil to absorb the nutrient, salt, hydraulic load and organic material.

O4 Effluent application

O4.1 Spray from effluent application must not drift beyond the boundary of the premises.

O4.2 Irrigation lines and equipment must be flushed immediately following the cessation of irrigating effluent from Minad Pty Ltd.

5 Monitoring and recording conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
(a) in a legible form, or in a form that can readily be reduced to a legible form;
(b) kept for at least 4 years after the monitoring or event to which they relate took place; and
(c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
(a) the date(s) on which the sample was taken;
(b) the time(s) at which the sample was collected;
(c) the point at which the sample was taken; and
(d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 Not applicable.

M3 Testing methods - concentration limits

M3.1 Not applicable.

M3.2 Not applicable.

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:
(a) the date and time of the complaint;

(b) the method by which the complaint was made;
(c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
(d) the nature of the complaint;
(e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
(f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 Conditions M5.1 and M5.2 do not apply until 3 months after:
(a) the date of the issue of this licence or
(b) if this licence is a replacement licence within the meaning of the Protection of the Environment Operations (Savings and Transitional) Regulation 1998, the date on which a copy of the licence was served on the licensee under clause 10 of that regulation.

M6 Requirement to monitor volume or mass

M6.1 Not applicable.

6 Reporting conditions

R1 Annual return documents

What documents must an Annual Return contain?

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
(a) a Statement of Compliance; and
(b) a Monitoring and Complaints Summary.

A copy of the form in which the Annual Return must be supplied to the EPA accompanies this licence. Before the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

Period covered by Annual Return

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee:
(a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
(b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
(a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
(b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

Deadline for Annual Return

R1.5 The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

Notification where actual load can not be calculated

R1.6 Not applicable.

Licensee must retain copy of Annual Return

R1.7 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

Certifying of Statement of Compliance and signing of Monitoring and Complaints Summary

R1.8 Within the Annual Return, the Statement of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
(a) the licence holder; or
(b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R1.9 A person who has been given written approval to certify a certificate of compliance under a licence

issued under the Pollution Control Act 1970 is taken to be approved for the purpose of this condition until the date of first review of this licence.

R2 Notification of environmental harm

Note: The licensee or its employees must notify the EPA of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R2.1 Notifications must be made by telephoning the EPA's Pollution Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
(a) where this licence applies to premises, an event has occurred at the premises; or
(b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
(a) the cause, time and duration of the event;
(b) the type, volume and concentration of every pollutant discharged as a result of the event;
(c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
(d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
(e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
(f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
(g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

General conditions

G1 Copy of licence kept at the premises

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

Pollution studies and reduction programs

U1.1 Not applicable.

Special conditions

E1.1 Not applicable.

Dictionary

General Dictionary

In this licence, unless the contrary is indicated, the terms below have the following meanings:

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998

Environment Protection Licence

Licence - 3787

AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 1998.
flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
industrial waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
inert waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997

MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 months. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
reprocessing of waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
treatment of waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste code	Means the waste codes listed in Appendix 5 of the EPA document A Guide to Licensing Part B.
waste type	Means Group A, Group B, Group C, inert, solid, industrial or hazardous waste

Environment Protection Licence

Licence - 3787

Department of Environment & Climate Change NSW

Ms Nadia Kanhoush

Environment Protection Authority

(By Delegation)

Date of this edition - 04-Dec-2007

End Notes

1	Licence transferred through application 141139, approved on 17-Apr-2002, which came into effect on 17-Apr-2002.
2	Licence varied by notice 1027428, issued on 13-Jun-2003, which came into effect on 08-Jul-2003.
3	Licence varied by change to DEC Region allocation, issued on 02-Mar-2006, which came into effect on 02-Mar-2006.
4	Licence varied by correction to DEC file number, issued on 08-Mar-2007, which came into effect on 08-Mar-2007.
5	This licence was surrendered subject to conditions by notice 1080812 on 03-Dec-2007.

Environment Protection Licence - Protection of the Environment Operations Act 1997

Licence Variation

Section 58(5) Protection of the Environment Operations Act 1997

BRYCE; ELSIE EDITH,

Trading as L.W.R. & E.E & J.W & C.G. BRYCE,

"GWANDALAN", 476 PRINCES HIGHWAY,

NOWRA NSW 2541

STANDARD POST

Attention: Mr. JOHN BRYCE

BRYCE; LESLIE WILLIAM ROBERT ,

Trading as L.W.R&E.E & J.W&C.G BRYCE ,

"GWANDALAN PARK" 476 PRINCES HIGHWAY,

NOWRA NSW 2541

STANDARD POST

Attention: Mr. JOHN BRYCE

Notice Number 1027428

File Number 280633

Date 13-Jun-2003

NOTICE OF VARIATION OF LICENCE 3787

BACKGROUND

A. BRYCE; LESLIE WILLIAM ROBERT t/as L.W.R&E.E & J.W&C.G BRYCE ("the licensee") is the holder of environment protection licence 3787 for Non Scheduled Activity - Water Pollution ("the licence") under the Protection of the Environment Operations Act 1997 ("the POEO Act").

B. Licence varied as an outcome of the licence review conducted by the EPA as required under s 78 of the POEO Act 1997.

Licence Variation

Section 58(5) Protection of the Environment Operations Act 1997

VARIATION OF LICENCE 3787

1. By this notice the EPA varies licence 3787 as set out in the Appendix. *(for licenses with a lot of changes and where the whole licence document will be in the appendix:* The Appendix is a copy of the licence marked with the variations that are made to it by this notice. *(for licences with a small number of changes where only the conditions will be printed:* The Appendix is a copy of the provisions of the licence which are varied by this notice, marked with the variations that are made to them.

2. The variations to the licence are indicated in the following way:

   - if a strike through mark appears through any word or other text (eg. ~~Solids or~~) this indicates that the word or other text is deleted from the licence by this notice; and

   - if a double underline appears under any word or other text (eg. must be treated) this indicates that the word or other text is added to the licence by this notice.

3. Except, as provided by s84(2) of the POEO Act, the variations to the licence by this notice begin to operate at the expiry of the period of 21 days from when you get notice of the variations, unless another date is specified in this notice.

4. Note: Section 84(2) provides that a variation to a licence does not operate until

   - the expiry of the period of 21 days after notice of the decision to vary the licence is given to the licensee, or

   - if an appeal against the decision is lodged, until the Land and Environment Court determines the appeal, or

   - the licensee notifies the EPA in writing that no appeal is to be made against the decision to vary the licence,

   whichever first occurs.

5. This notice is issued under section 58(5) of the Protection of the Environment Operations Act 1997.

. . . . . .

Mr William Dove
Head Regional Operations Unit
South Coast
(by Delegation)

INFORMATION ABOUT THIS NOTICE

- Section 287 of the Act enables appeals to be made in connection with decisions about a licence application within 21 days after notice of the decision is given to the applicant.

- Details provided in this notice will be available on the EPA's Public Register in accordance with section 308 of the Protection of the Environment Operations Act 1997.

Licence Variation

Section 58(5) Protection of the Environment Operations Act 1997

Environment Protection Authority

Environment Protection Licence

Section 55 Protection of the Environment Operations Act 1997

- **Licence number: 3787**
- **File number: 280633**
- **Licence Anniversary Date: 30-June**
- **Review date not later than 01-Jul-2002**

Licence Type
Premises

Licensee
BRYCE; LESLIE WILLIAM ROBERT
"GWANDALAN PARK" 476 PRINCES HIGHWAY
NOWRA NSW 2541

Licensed Premises
"GWANDALAN PARK"
474 PRINCES HIGHWAY
NOWRA NSW 2541

Fee Based Activity	Scale
Other Activities (94)	0 - All

EPA Region
South Coast
Level 3, NSW Govt Offices, 84 Crown Street
WOLLONGONG NSW 2500
Phone: 02 ~~4226 8100~~4224 4100
Fax: 02 ~~4227 2348~~4224 4110
PO Box 513 WOLLONGONG EAST
NSW 2520

Information about this licence

Dictionary

The licence contains a dictionary, which defines terms used in the licence. It is found at the end of the licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- Ensure persons associated with you comply with this licence, as set out in section 64 of the Act.
- Control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act).
- Report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Transfer of licence

Transfer of the licence to another person may be requested by the licensee using the form for this purpose available from the EPA.

Variation of licence conditions

Variations to the conditions of this licence may be requested by the licensee using the form for this purpose available from the EPA. The EPA may also vary a licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 3 years after the issue of the licence, as

set out in Part 3.6 of the Act. You will receive advance notice of the licence review. For licences held immediately before 1 July 1999, the first review will take place before 1 July 2002.

Fees and annual return to be sent to the EPA

The licence requires you to forward to the EPA an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints).

The Annual Return must be submitted within 60 days after the end of each reporting period. Where a licence is transferred, surrendered or revoked, a special reporting period applies.

For each licence fee period you must pay:
- an administrative fee; and
- a load-based fee (if applicable).

Usually the licence fee period is the same as the reporting period.

See condition R1 and the accompanying form regarding the Annual Return requirements.

The EPA publication "A Guide to Licensing" contains information about how to calculate your licence fees.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications
- licence conditions and variations
- statements of compliance

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

Licence anniversary date

30-June

This licence is issued to

BRYCE; LESLIE WILLIAM ROBERT
"GWANDALAN PARK" 476 PRINCES HIGHWAY
NOWRA NSW 2541
BRYCE; ELSIE EDITH
"GWANDALAN", 476 PRINCES HIGHWAY
NOWRA NSW 2541

subject to the conditions which follow:

1 Administrative conditions

A1 What the licence authorises and regulates

A1.1 This licence regulates water pollution resulting from the activity/ies specified below carried out at the premises specified in A2.

Irrigated Agriculture

A1.2 Not applicable.

A1.3 Not applicable.

A2 Premises to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
"GWANDALAN PARK"
474 PRINCES HIGHWAY
NOWRA
NSW
2541
~~LOT 1 &2 DP601330 LOT 11 DP617492~~LOT 1 DP 610330 AND LOTS 21 & 22 DP 856086

A3 Other activities

A3.1 Not applicable.

A4 Information supplied to the EPA

A4.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
(a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998 and
(b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

2 Discharges to air and water and applications to land

P1 Location of monitoring/discharge points and areas

P1.1 Not applicable.

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

P1.3 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

Water and land

EPA identi-fication no.	Type of monitoring point	Type of discharge point	Description of location
1		Discharge to utilisation area	Utilisation area ~~being LOTS~~identified as paddocks 1 ~~& 2 DP601330 and LOT 11 DP617492, identified as the shaded area 15~~ on the drawing titled ~~'Map Showing Location of Discharge Points'~~"Gwandalan Park" submitted to the EPA with the Licence Information Form dated 25/10/2000
2	Discharge to utilsation area. Effluent quality monitoring	Discharge to utilsation area. Effluent quality monitoring	Gate valve on pipeline on paddock number 10 - 11, labelled "Line from ACF" drawing titled "Gwandalan Park" submitted to the EPA with the Licence Information Form dated 25/10/2000
3	Discharge to utilisation area. Effluent quality monitoring.	Discharge to utilisation area. Effluent quality monitoring.	Gate valve on pipeline from the Minad premises labled "Line from Minad" drawing titled "Gwandalan Park" submitted to the EPA with the Licence Information Form dated 25/10/2000

3 Limit conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Load limits

L2.1 Not applicable.

L2.2 Not applicable.

L3 Concentration limits

L3.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

L3.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L3.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.

Water and Land

POINT 13

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile Concentration Limit
Oil and GreaseBiochemical oxygen demand	mg/LKg/hectare	-	-	-	1025
Total Suspended Solids	mg/L	-	-	-	100
Biochemical Oxygen Demand	mg/L	-	-	-	100

For the purposes of the table above, the concentration limits apply to the effluent from Australian Cooperative Foods Limited.

L3.4 The licensee is not taken to have exceeded a concentration limit for Total Suspended Solids specified in L3.3 for discharge to Point 1 if the effluent irrigated is excess mixed liquor suspended solids from Australian Cooperative Foods Limited.

L3.5 The effluent from Minad Pty Ltd must not be applied to Point 1 at an organic loading rate greater than 25kg of Biochemical Oxygen Demand per hectare.

L4 Volume and mass limits

~~L4.1 For each discharge point or utilisation area specified below (by a point number), the volume/mass of:~~

~~liquids discharged to water; or;~~

~~solids or liquids applied to the area;~~

~~must not exceed the volume/mass limit specified for that discharge point or area.~~

~~Point~~	~~Unit of measure~~	~~Volume/Mass Limit~~
~~1~~	~~kL/day~~	~~300~~

~~L4.1 Not applicable.~~

L5 Waste

L5.1 Not applicable.

L6 Noise Limits

L6.1 Not applicable.

L7 Potentially offensive odour

L7.1 The licensee must not cause or permit the emission of offensive odour beyond the boundary of the premises.

Note: Section 129 of the Protection of the Environment Operations Act 1997, provides that the licensee must not cause or permit the emission of any offensive odour from the premises but provides a defence if the emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.

4 Operating conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.

This includes:
(a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and

(b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
(a) must be maintained in a proper and efficient condition; and
(b) must be operated in a proper and efficient manner.

O3 Management of utilisation area

O3.1 The quantity of effluent/solids applied to the utilisation area must not exceed the capacity of the area to effectively utilise the effluent/solids.

For the purpose of this condition, 'effectively utilise' includes the use of the effluent/solids for pasture or crop production, as well as the ability of the soil to absorb the nutrient, salt, hydraulic load and organic material.

O4 Effluent application

O4.1 Spray from effluent application must not drift beyond the boundary of the premises.

O4.2 Irrigation lines and equipment must be flushed immediately following the cessation of irrigating effluent from Minad Pty Ltd.

5 Monitoring and recording conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
(a) in a legible form, or in a form that can readily be reduced to a legible form;
(b) kept for at least 4 years after the monitoring or event to which they relate took place; and
(c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:

(a) the date(s) on which the sample was taken;
(b) the time(s) at which the sample was collected;
(c) the point at which the sample was taken; and
(d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 Not applicable.

M3 Testing methods - concentration limits

M3.1 Not applicable.

M3.2 Not applicable.

M4 Recording of pollution complaints

M4.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M4.2 The record must include details of the following:

(a) the date and time of the complaint;
(b) the method by which the complaint was made;
(c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
(d) the nature of the complaint;
(e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
(f) if no action was taken by the licensee, the reasons why no action was taken.

M4.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M4.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M5 Telephone complaints line

M5.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M5.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M5.3 Conditions M5.1 and M5.2 do not apply until 3 months after:
(a)the date of the issue of this licence or

(b) if this licence is a replacement licence within the meaning of the Protection of the Environment Operations (Savings and Transitional) Regulation 1998, the date on which a copy of the licence was served on the licensee under clause 10 of that regulation.

M6 Requirement to monitor volume or mass

M6.1 Not applicable.

6 Reporting conditions

R1 Annual return documents

What documents must an Annual Return contain?

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
(a) a Statement of Compliance; and
(b) a Monitoring and Complaints Summary.
A copy of the form in which the Annual Return must be supplied to the EPA accompanies this licence. Before the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

Period covered by Annual Return

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee,
(a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
(b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on
(a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
(b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

Deadline for Annual Return

R1.5 The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

Notification where actual load can not be calculated

R1.6 Not applicable.

Licensee must retain copy of Annual Return

R1.7 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

Certifying of Statement of Compliance and Signing of Monitoring and Complaints Summary

R1.8 Within the Annual Return, the Statement of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
(a) the licence holder; or
(b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R1.9 A person who has been given written approval to certify a certificate of compliance under a licence issued under the Pollution Control Act 1970 is taken to be approved for the purpose of this condition until the date of first review of this licence.

R2 Notification of environmental harm

Note: The licensee or its employees must notify the EPA of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R2.1 Notifications must be made by telephoning the EPA's Pollution Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
(a) where this licence applies to premises, an event has occurred at the premises; or
(b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:

(a) the cause, time and duration of the event;
(b) the type, volume and concentration of every pollutant discharged as a result of the event;
(c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event; and
(d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
(e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
(f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event;
(g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

General conditions

G1 Copy of licence kept at the premises

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

Pollution studies and reduction programs

U1.1 Not applicable.

Special conditions

E1.1 Not applicable.

Dictionary

General Dictionary

In this licence, unless the contrary is indicated, the terms below have the following meanings:

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
BOD	Means biochemical oxygen demand
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 1998.
flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
industrial waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

	1997
inert waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder described at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 1998
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 months. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
reprocessing of waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
treatment of waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TSP	Means total suspended particles
TSS	Means total suspended solids
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997

waste code	Means the waste codes listed in Appendix 5 of the EPA document A Guide to Licensing Part B.
waste type	Means Group A, Group B, Group C, inert, solid, industrial or hazardous waste

Ms Nadia Kanhoush

~~Licence Review Team Leader~~
Principal Air Program Officer

(By Delegation)

Date of this edition - 17-Apr-2002

End Notes

1	Licence transferred through application 141139, approved on 17-Apr-2002, which came into effect on 17-Apr-2002.

Appendix B – Erosion and Sediment Control Management Plan

SMEC

Member of the Surbana Jurong Group

Nowra Bridge Project

Preliminary Erosion and Sediment Management Report

Prepared for: Roads and Maritime Services

Reference No: NBR-EN-REP-04

August 2018

Document/Report Control Form

File Location Name:	Preliminary Erosion and Sediment Management Report
Project Name:	Nowra Bridge Project
Project Number:	30011666
Revision Number:	R4

Revision History

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
R0	20/02/2018	Luke Jenkins / Alex Williams	Daniel Saunders	Chris Masters
R1	04/05/2018	Luke Jenkins / Alex Williams	John Wright	Chris Masters
R2	12/06/2018	Luke Jenkins / Alex Williams	John Wright / Daniel Saunders	Chris Masters
R3	06/07/2018	Luke Jenkins / Eladio Perez	Daniel Saunders / Eladio Perez	Chris Masters
R4	17/08/2018	Luke Jenkins / Eladio Perez	Daniel Saunders / Eladio Perez	Chris Masters

Issue Register

Distribution List	Date Issued	Number of Copies
Roads and Maritime Services	21/08/2018	One PDF
SMEC Technical Principal - Chris Masters	21/08/2018	One PDF
Office Library (North Sydney Office)	21/08/2018	One PDF
SMEC Project File	21/08/2018	One PDF

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ABBREVIATIONS/ GLOSSARY

Abbreviation/Acronym	Description
AEC	Area of environmental concern
AHD	Australian Height Datum
AS/NZS	Australian Standards/New Zealand Standards
ASS	Acid Sulfate Soil
CEMP	Construction Environmental Management Plan
Cv	Runoff Coefficient
LS	Slope Length
PESCMP	Primary Erosion and Sediment Control Management Plan
PESCP	Progressive Erosion Sediment Control Plan
PESMR	Preliminary Erosion and Sediment Management Report
PSC	Professional Services Contract
REF	Review of Environmental Factors
Roads and Maritime	Roads and Maritime Services
RUSLE	Revised Universal Soil Loss Equation
SLC	Soil Loss Class
SMEC	Snowy Mountains Engineering Corporation
Stn.	Station
SWMP	Soil and Water Manageemnt Plan

1. INTRODUCTION

SMEC Australia Pty Ltd (SMEC) was engaged by Road and Maritime Services (Roads and Maritime) to carry out a preliminary Erosion and Sediment Management Report for the proposed upgrade of Nowra Bridge located at Nowra, NSW 2565 (the proposal).

SMEC understands that a Preliminary Erosion and Sediment Management Report (PESMR) is required to inform the Environmental Assessment (EA) for the proposal. This PESMR is based on the current stage of concept design (80% concept design) and includes review of potential erosion and sediment control considerations for the proposed construction phase.

The project locality and study area are presented in Figure 1**.**

1.1 Purpose

The purpose of this report is to:

- Develop a concept for major erosion and sediment control measures such as up-gradient stormwater diversions, cross-drainage, and sediment basins
- Assess constraints to the installation and operation of major erosion and sediment controls during construction in accordance with Volumes 1 and 2D of the NSW Blue Book (Landcom, 2004 and DECC, 2008)
- Identify methods to eliminate, substitute or manage potential erosion and sediment control hazards during construction.

1.2 Key features

Roads and Maritime Services NSW (Roads and Maritime) proposes to construct a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal). The proposal includes the construction of a new four lane bridge to the west (upstream) of the existing bridge crossings and the removal of vehicular traffic from the existing southbound bridge. The proposal would also include the upgrade of about 1.6 kilometres of the Princes Highway near the bridge, as well as providing key intersection upgrades and modifications to the local road network. The proposal would improve access to Nowra and the surrounding areas, improve southbound access for large freight vehicles, and improve traffic flows.

Key features of the proposal include:

- Construction of a new bridge to the west (upstream) of the existing bridge crossings over the Shoalhaven River including:
  - Four northbound lanes including a dedicated left turn only lane from Bridge Road to Illaroo Road
  - A 3.5 metre wide shared use path on the western side of the bridge connecting the Illaroo Road intersection to the Bridge Road intersection
- Widening of the existing bridge over Bomaderry Creek
- Minor lane adjustments on the existing northbound bridge to convert it to three lanes of southbound traffic
- Removal of vehicular traffic and closure of the existing southbound bridge to undertake investigation, rehabilitation and repurposing work for adaptive reuse following opening of the new northbound bridge. As part of the proposal, shared paths and maintenance access would be constructed up to the existing southbound bridge and work to prevent unauthorised access would also be carried out. The

rehabilitation and repurposing of the existing southbound bridge for adaptive reuse would be subject to a separate consultation and assessment process to this REF

- Upgrading of the Princes Highway to provide three northbound and three southbound lanes from the Bolong Road intersection through to about 75 metres north of the Moss Street intersection
- Widening of Illaroo Road over a distance of about 270 metres
- Upgrading of the Princes Highway and Illaroo Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Illaroo Road
  - Three dedicated right turn lanes and one dedicated left turn lane from Illaroo Road to Princes Highway
  - An acceleration and merge lane for northbound traffic turning into Illaroo Road from Princes Highway
- Upgrading of the Princes Highway and Bridge Road intersection to provide:
  - Two southbound right turn lanes from the Princes Highway into Bridge Road
  - One left turn lane from Bridge Road to the Princes Highway
- Local road adjustments including:
  - Closing the access between Pleasant Way and Princes Highway
  - Restricting turning movements at the intersection of Bridge Road and Scenic Drive
  - Construction of a new local road connecting Lyrebird Drive to the Princes Highway about 300 metres south of the existing Pleasant Way intersection
- Provision of pedestrian facilities at all intersections
- Dedicated off road shared paths and footpaths along the length of the proposal
- Urban design and social amenity improvements, and landscaping including foreshore pedestrian links to the existing southbound bridge
- Relocation and/or protection of utility services
- Drainage and water quality management infrastructure along the road corridor
- Property works including acquisition, demolition, and adjustments to accesses
- Temporary ancillary facilities during construction including site offices, construction compounds, and stockpile sites.

Figure 1 Proposal location

1.3 Methodology

In preparing this PESMR the following has been completed:

- Preparation of a Preliminary Erosion and Sedimentation Assessment (PESA) Technical Note in accordance with RTA Procedure PN 143P (Appendix B2). This assessment determined the proposal as being potentially high risk, requiring consideration of additional erosion and sedimentation controls in the concept phase, the engagement of a soil conservation consultant, and preparation of this PESMR.
- Review of the proposal area including the operational footprint, construction footprint, and ancillary sites (Figure 2)
- Review of existing drainage patterns that would impact on the construction area
- Review of concept drainage drawings and road design to determine if any inherent design issues might impact on constructability and effective implementation of controls
- Review of land available during construction to determine is space constraints were likely to impact the effective implementation of controls
- A site inspection was undertaken on 29th January 2018 by Alex Williams, a senior environmental engineer with SMEC. Alex took note of:
  - Filled areas below the road surface
  - Location of foreshore and open reserves
  - Areas of potential acid sulfate soils (ASS)
  - Locations of existing culverts and retaining walls

1.4 Published guidelines and framework

The assessment has been undertaken in with reference to applicable legislation and guidelines including:

- Road and Maritime, Water Policy, 1997
- RTA Code of Practice for Water Management, 1999
- Road and Maritime Technical Guideline, Temporary stormwater drainage for road construction, December 2011
- Erosion and Sedimentation Management Procedure, RTA Procedures PN143P, 2008
- Managing urban stormwater: soils and construction Volume 1, Landcom, 2004 (the 'Blue Book')
- Managing urban stormwater: soils and construction Volume 2D, Main road construction, Department of Environment and Climate Change, NSW, 2008.

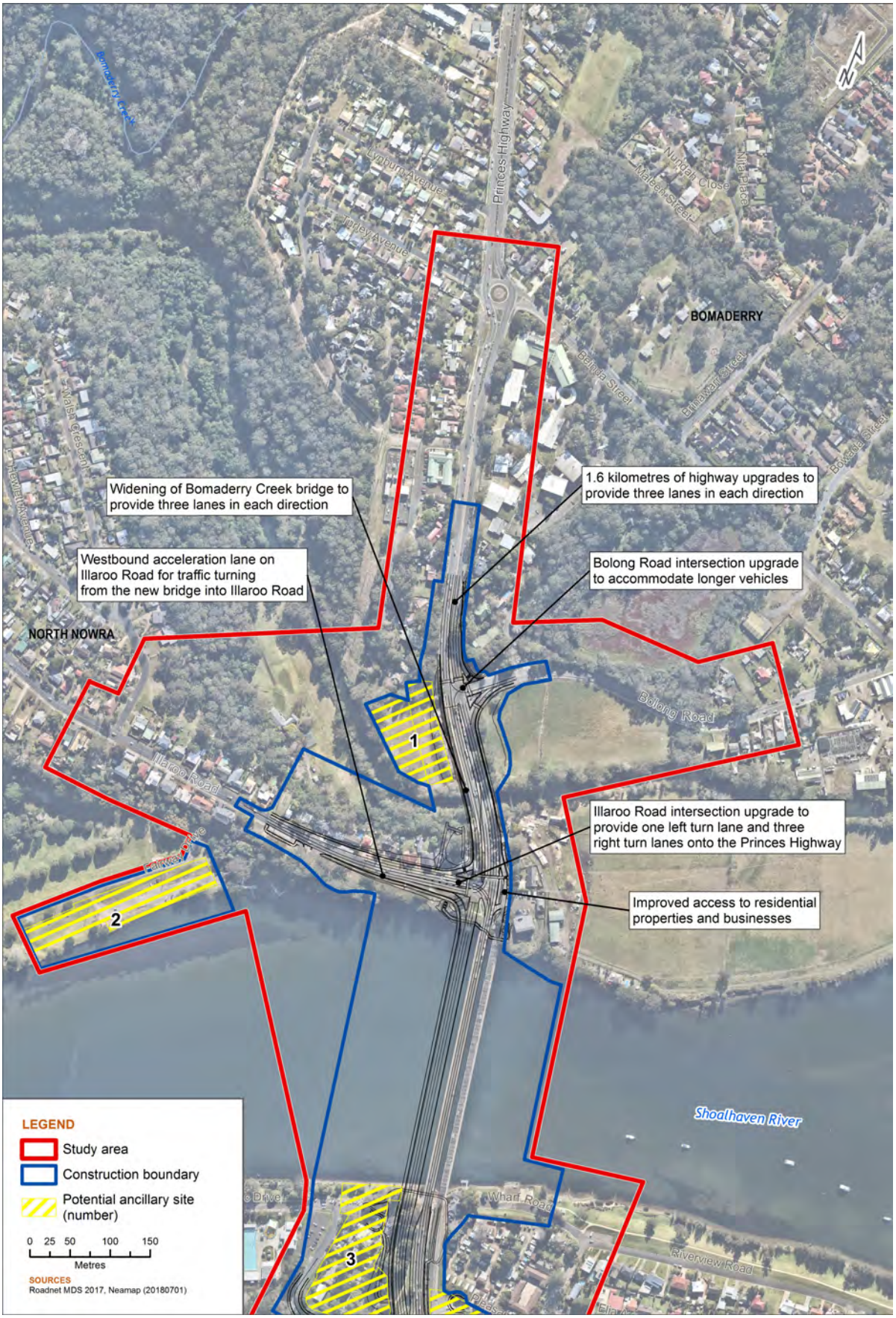

Figure 2 Proposal footprint – north

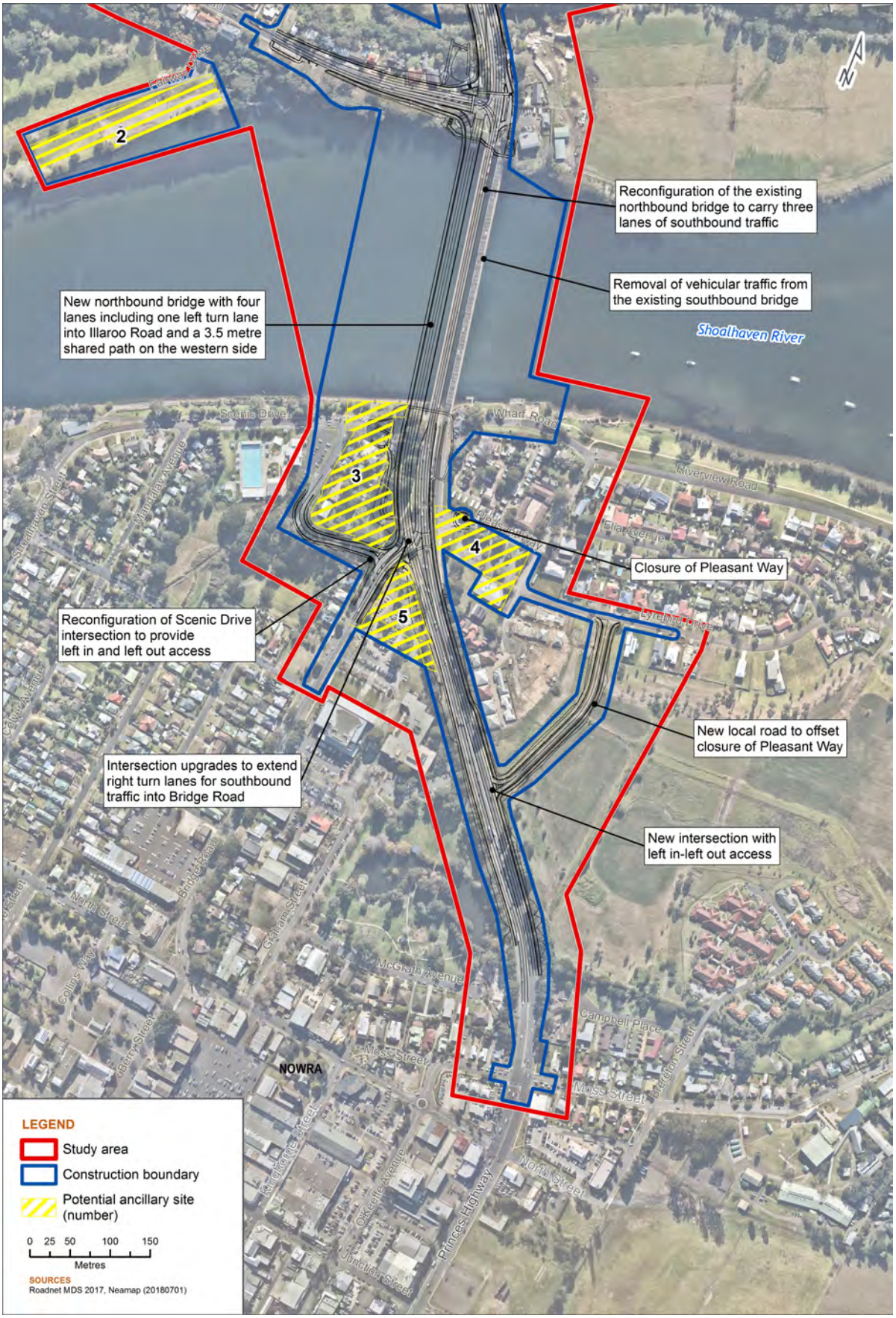

Figure 3 Proposal footprint – south

2. EXISTING ENVIRONMENT

SMEC carried out a review of several environmental aspects which have the potential to impact on erosion and sediment considerations in the design and construction stages. Relevant information has been summarised within the following sections including:

- Climate
- Soil landscapes
- Topography and drainage, focussing on the contributing catchments
- Surrounding land uses
- Receiving water quality
- Tides
- Erosion and hazard areas
- Environmentally sensitive areas.

2.1 Climate

Table 1 provides a summary of climate data available on the Bureau of Meteorology (BoM) website for Nowra RAN Air Station AWS (Station 068072). Monthly average rainfall statistics are also shown in Figure 3. Rainfall occurs throughout the year with a slight summer dominance. Temperatures are warm to mild. As a coastal area, winds can be strong at any time of year. Prevailing summer winds are from the north-east, and from the south-east in winter.

Table 1 Monthly climate averages for Nowra RAN Air Station AWS (BoM station 068072), February 2018

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Rainfall (mm)	63.2	133.1	115.0	66.2	51.0	118.8	61.1	69.7	42.0	64.6	70.1	76.6	901.5
Mean no. of days with >1mm	7.6	9.3	9.4	7.6	5.2	7.3	5.5	5.2	6.2	6.8	8.4	7.7	86.2
Mean max temp (ºC)	27.7	26.3	25.2	22.7	19.6	16.9	16.6	18.2	21.1	23.2	24.7	26.1	22.4
Mean min temp (ºC)	16.6	16.7	15.1	12.3	9.2	7.8	6.6	6.8	8.8	10.6	13.5	14.9	11.6
Mean 3pm wind speed (km/h)	21.4	19.5	19.2	18.1	16.7	16.7	18.2	21.8	22.9	21.7	21.3	22.0	20.0

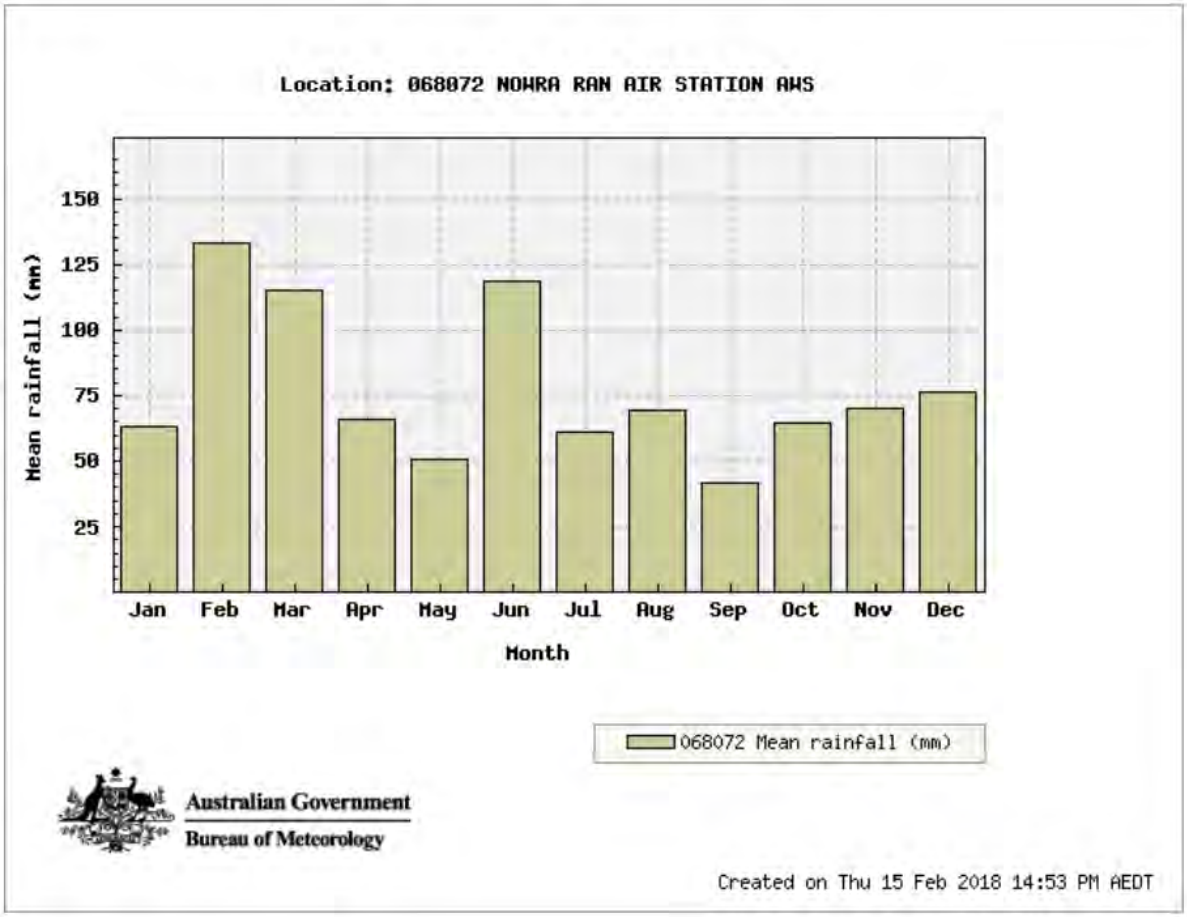

Figure 4 Mean monthly rainfall for Nowra (Bureau of Meteorology, February 2018)

2.2 Soil landscapes

Figure 4 shows two main soil landscapes have been identified within the proposal area from the Soil Landscapes of the Kiama 1:100 000 Sheet (Hazelton, P.A. 1992). The Shoalhaven soil landscape occurs mainly throughout the northern parts of the study area, with the Nowra occurring through both the northern and southern parts of the study area.

- Nowra (no) – The Nowra group comprises medium to coarse-grained quartz sandstones which contain rounded pebbles scattered throughout the beds. The landscape is moderately to gently undulating rises to undulating low hills with relief less than 40 metres and slopes below five per cent. Broad ridges and crests with long, very gently inclined slopes, broad drainage areas with deeply incised channels can be present. Benched sandstone outcrops occur adjacent to drainage lines. Most of the lands have been extensively to moderately cleared with stands of tall open-forest. Erodibility for the topsoil is generally low, but for the subsoils the erodibility is high. Moderate rill erosion can occur on batters. Erosion hazard for non-concentrated flows is moderate to high. The calculated soil loss for the first 12 months of urban development ranges up to 20 t/ha for topsoils and 60 t/ha for exposed subsoils. The erosion hazard for concentrated flows is low to moderate.
- Shoalhaven (sf) – The Shoalhaven Group is made up of alluvium gravel, sand, silt and clay derived mainly from sandstone and shale overlying buried estuarine sediments. The erodibility of the topsoil is low, while the erodibility of the subsoils is high. Level to gently undulating floodplains. Relief <5 m and slopes <3%. Broad active floodplains 6–10 km wide with minor levees <l m and occasional back plain swamps. Scattered flat to gently undulating narrow terraces with relief <2 m. Completely cleared except for

scattered decorative paperbark (*Melaleuca decora*), swamp oak (*Casuarina glauca*), Illawarra flame tree (*Brachychiton acerifolium*) on terraces and various reeds in swamps. Erosion hazard for non-concentrated flows is slight. The calculated soil loss for the first 12 months of urban development ranges up to 10 t/ha for topsoils and 10 t/ha for exposed subsoils. The erosion hazard for concentrated flows is low.

Acid sulfate soils are acidic soil horizons (layers) resulting from the aeration of soil materials rich in iron sulfides. Acid sulfate soils generally occur within the following locations:

- Marine or estuarine sediments deposited during the Holocene period
- Soils >5 metres above sea level
- Marine or estuarine settings/environments.

Figure 5 shows the acid sulfate soils mapping within the proposal area as shown on NSW Office of Environment and Heritage (NSW OEH). There is a high probability of acid sulfate soils (elevation of 1-2m Australian Height Datum (AHD)) mapped north of the Bomaderry Creek crossing (east and west of the Princes Highway) where the Bolong Road intersection meets with the Princes Highway. In addition, there is a high probability of acid sulfate sediments within the Shoalhaven River. There is a low probability of acid sulfate soils (elevations of 1-2m AHD and 2-4m AHD) existing within the southern section of the proposal area and area immediately north east and north west of the bridge.

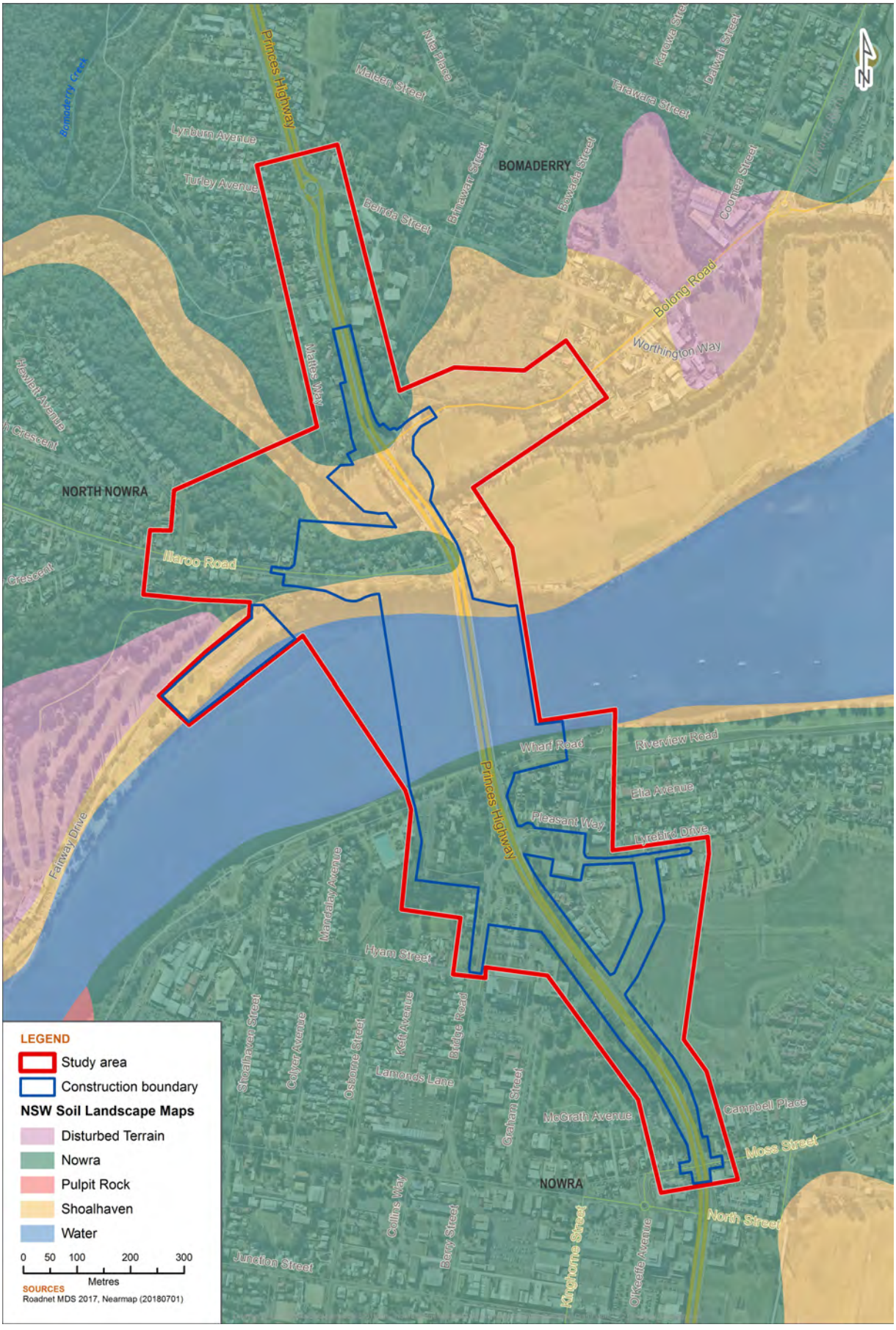

Figure 5 Soil landscape mapping

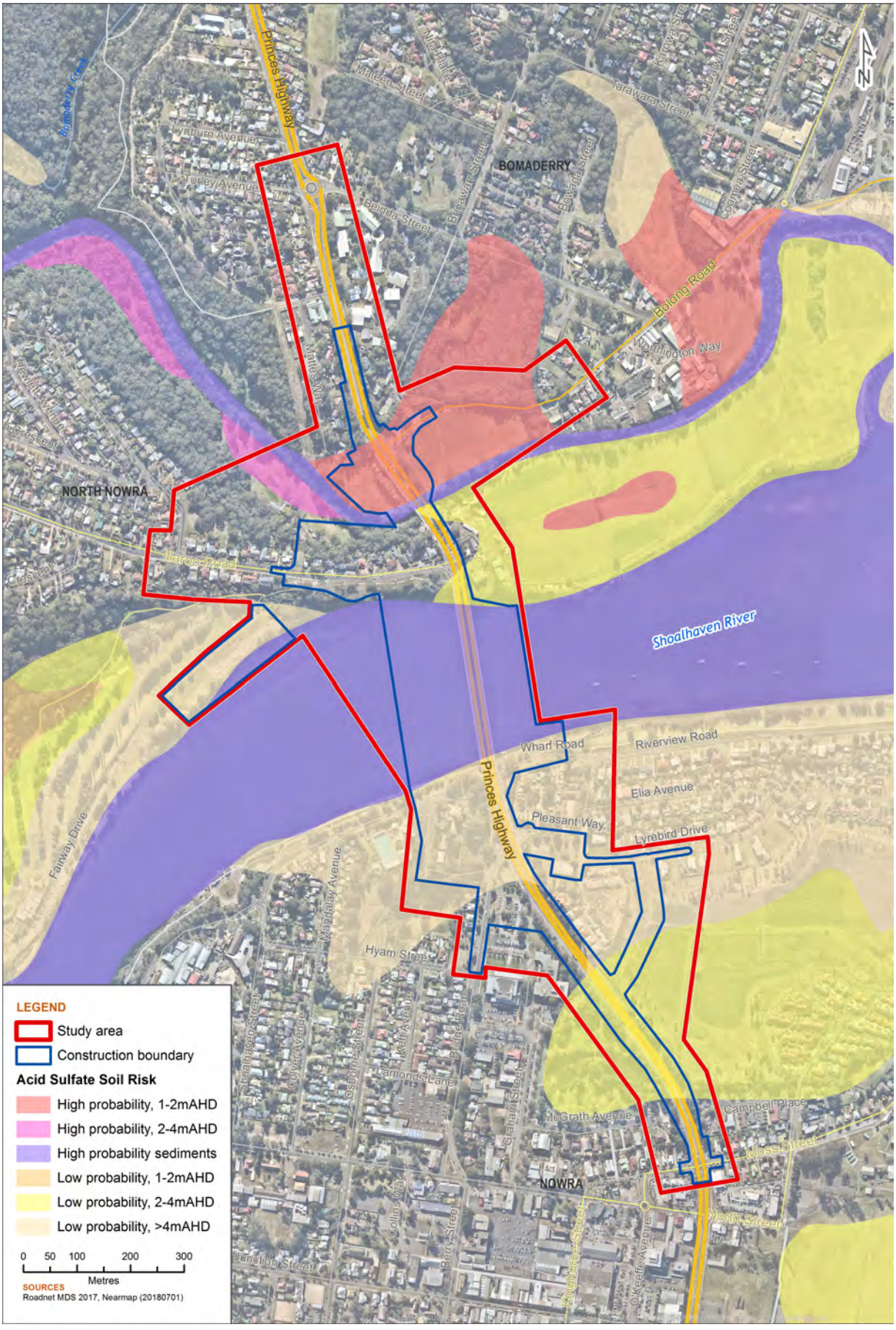

Figure 6 Acid sulfate soil risk mapping

2.3 Topography and drainage

SMEC carried out review of topographic mapping and the Nowra Bridge 80% Concept Drainage Design, Sheets SM-2301 to SM-2308.

The two figures below show the proposal construction footprint within the context of the existing topography. Major existing features such as existing culverts, surrounding drainage lines and watercourses are also shown. Following existing contours, the inferred 'construction water' drainage pathways within the proposal construction footprint are shown. Inferred 'clean water' drainage pathways in surrounding areas of the proposal are also shown.

The proposal area is elevated above a relatively flat floodplain landscape within the Shoalhaven River catchment. The existing road level experiences minor changes in elevation range from five metres AHD at southern extent of the proposal to nine metres AHD at Bomaderry Creek, before increasing in elevation up to 25 metres AHD north of Bolong Road intersection.

Drainage from within the proposal construction footprint is expected to flow offsite via roadside drainage lines running parallel alongside the east and west of the present road alignment. Stormwater drainage is expected to flow north or south discharging to the identified main water courses across intercepted by the proposal alignment; namely, Bomaderry Creek, the Shoalhaven River and an unnamed tributary which discharges from Harry Sawkins Park duck pond (west) is present flowing beneath the Princes Highway.

Stormwater drainage from upstream of the proposal is expected to follow natural or man-made surface contours discharging towards Bomaderry Creek or Shoalhaven River. Urban stormwater runoff is expected to be intercepted by the existing stormwater network and diverted through / bypassing the proposal. Surrounding topography typically falls away from the proposal, noting exceptions north of Bolong Road intersection, south of Bridge Road intersection. In relatively few cases, the small upgradient catchments are expected to contribute a minor stormwater 'run-on' into the proposal construction footprint.

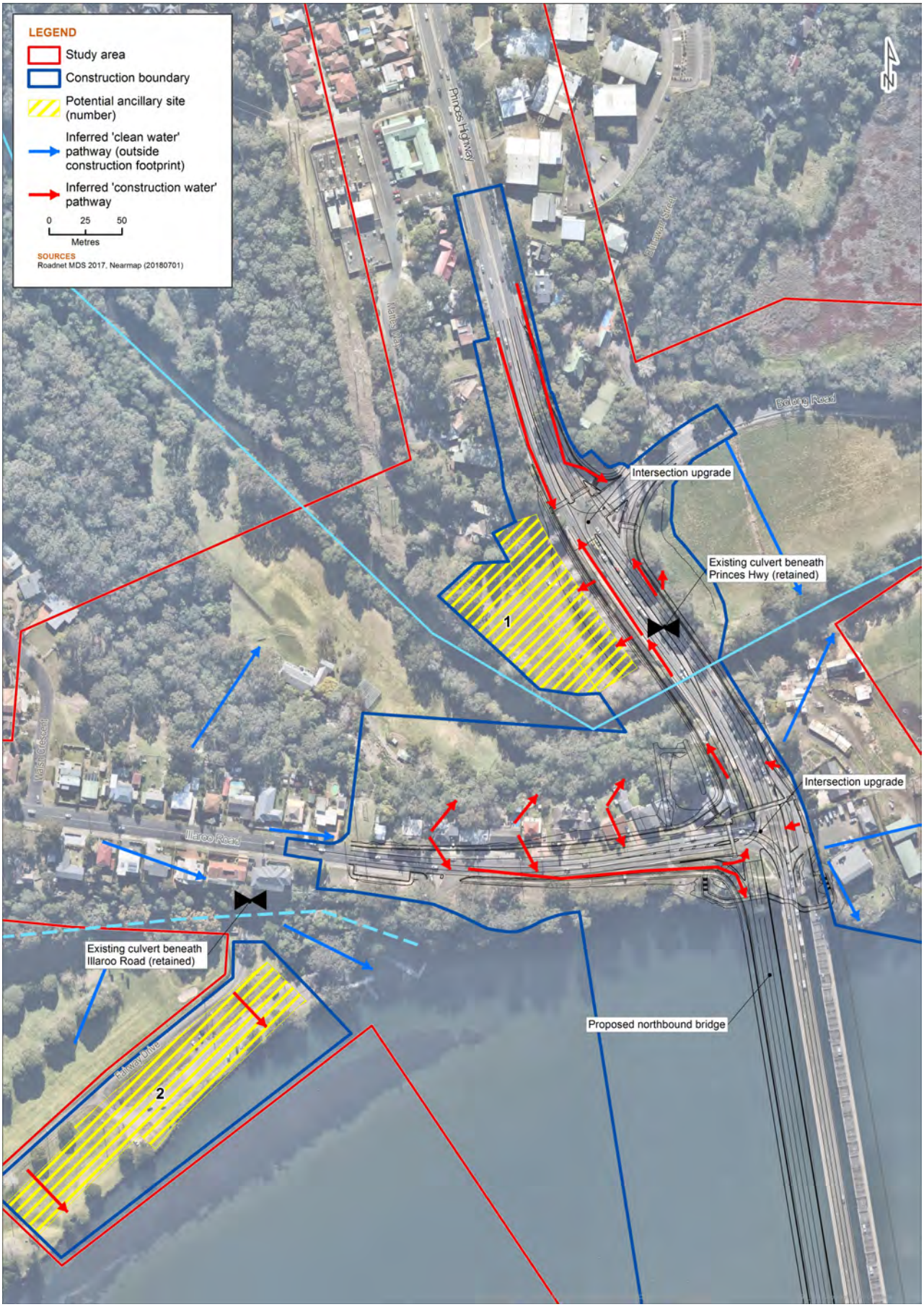

Figure 7 Topography and drainage – north

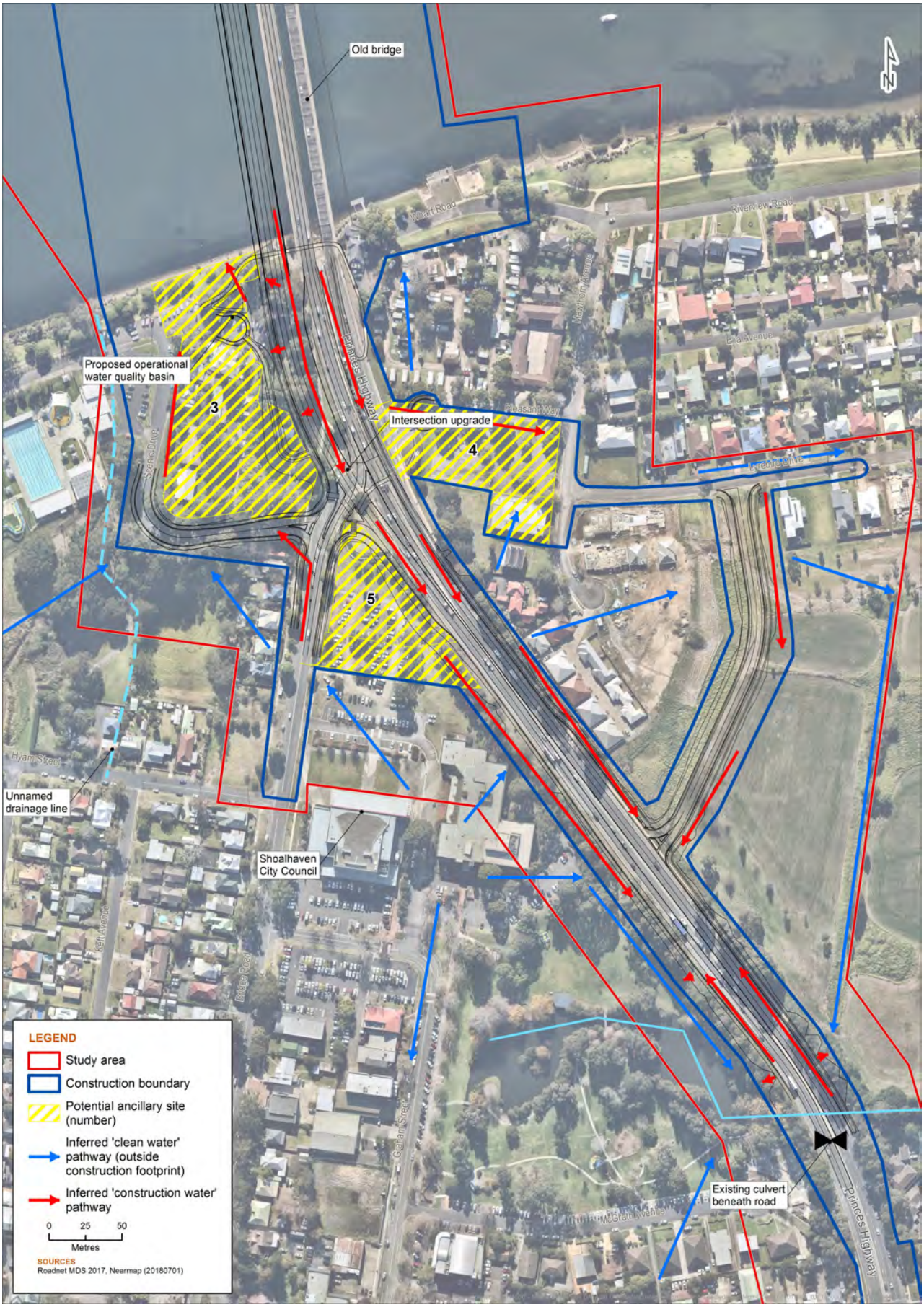

Figure 8 Topography and drainage – south

2.4 Land use and availability

The following is considered relevant with respect to current land use and availability:

- The proposal is located within the Shoalhaven City Council Local Government Area (LGA). The Shoalhaven City Council LEP (2014) identifies the following land zoning within the proposal construction footprint:
  - R2 - Low Density Residential
  - SP2 - Infrastructure
  - B4 - Mixed Use
  - RE1 - Public Recreation
- To the north of Shoalhaven River, the proposal construction footprint is currently bound by residential dwellings on the northern side of Illaroo Road, with rural industrial properties on the western side of the Princes Highway and Illarroo Road intersection. The remaining areas are vacant land associated with rural agricultural land uses. From a review of the local topography, surface water from the rural properties would flow to either Bomaderry Creek or the Shoalhaven River
- To the south of the Shoalhaven River, the adjoining lands are mainly vacant grassed areas with landscaping associated with surrounding commercial, recreational or agricultural (grazing pasture) land use. In some areas, residential/commercial properties are adjacent the proposal construction footprint at Bridge Road, Scenic Drive, east of Princes Highway and on the western side of Scenic Drive
- Near the southern extent, the proposal construction footprint adjoins Harry Sawkins Park. This area has previously been declared a remediation site by NSW EPA and has undergone contamination assessment due to former gasworks operations in Lamonds Lane, Nowra. Due to its proximity with the construction footprint, there are likely to be some restrictions on the adjoining land use within this area. Further details are included within the Phase 1 Contamination Assessment (ref: SMEC 2018).

2.5 Receiving water quality and water quality objectives

A review of receiving water quality data was carried out as part of the Operational Water Quality Assessment (ref: SMEC, dated 6 June 2018). In summary, surface water quality within the Shoalhaven River near the proposal is likely to be represented by good to excellent water quality index rating. The remaining water courses (namely Bomaderry Creek and unnamed tributary) are considered tributaries to the Shoalhaven River, it is considered that similar quality standards would apply.

The below summary of historic water quality was taken from the closest Shoalhaven City Council Shoalhaven River monitoring site, which indicates that water quality within the Shoalhaven River near the site is likely to be represented by:

- Good to excellent water quality index rating
- Dissolved oxygen levels (per cent saturation) ranging between 70 and 110 (good)
- Faecal coliform counts generally below relevant ANZECC 2000 Guidelines for swimming
- Phosphorus levels below ANZECC 2000 Guidelines
- Total nitrogen levels below ANZECC 2000 Guidelines.

The following summary of historic water quality was taken from the Shoalhaven City Council Bomaderry Creek monitoring, which indicates that water quality within Bomaderry Creek, near the confluence with the Shoalhaven River is likely to be represented by:

- Medium to good water quality index

- Dissolved oxygen levels (per cent saturation) of about 140 (poor)
- Faecal coliform counts above ANZECC 2000 Guidelines for swimming
- Phosphorus levels below ANZECC 2000 Guidelines
- Total nitrogen levels below ANZECC 2000 Guidelines.

The NSW Government has not formally adopted water quality objectives for the Shoalhaven River catchment. However, the impacts of the proposal have been assessed against typical NSW water quality objectives for estuaries, including the protection of aquatic ecosystems, visual amenity, secondary contact recreation, primary contact recreation and aquatic foods (cooked). The impacts of the proposal have been determined with reference to trigger values for each indicator relevant to these water quality objectives. These trigger values are consistent with the equivalent environmental values in the ANZECC 2000 Guidelines. It is recommended that construction water quality management follow that imposed by Landcom (2004) discussed below.

Taking into consideration the historical water quality for both Bomaderry Creek and Shoalhaven River as stated above, the Blue Book (Landcom, 2004) suggests that water discharged from construction sites should not contain more than 50mg/L of suspended sediment. Although this concentration exceeds the recommended release criteria for stormwater flows into lowland seawater systems under ANZECC guidelines, a more stringent water quality requirement is not recommended because:

- The construction period is expected to be relatively short-term so long term impacts are unlikely
- The immediate receiving environment is saline, meaning that any sediment would rapidly settle
- A more stringent water quality requirement would add to the cost of site dewatering and most likely couldn't be achieved within a reasonable timeframe using flocculants.

As such, it is recommended that the water quality standard in Table 2 below be adopted for any site dewatering.

Table 2 Recommended water quality standard for site dewatering

Parameter	Recommended standard during construction
Total suspended solids (TSS)	50 mg/L
pH	6.5 – 8.5
Oil and grease	None visible

Source: Managing Urban Stormwater Soils and Construction Vol 2D Main road construction (DECC, 2008)

2.6 Tides and floods

A review of the tidal influence on the Shoalhaven River at Nowra Bridge has shown that times have been adjusted by 140 min for low tide and 130 min for high tide to the official tide times for Sydney. These interpolations are from tide times converted from the tide forecasts provided by the BoM for standard ports, and data from the Australian National Tide Tables (ANTT) and other marine agencies.

Over the period reviewed, tide heights ranged between 0.23 metres AHD for low and 2.08 metres AHD for high tide. Tidal inundation is not expected for most of the proposal area which is at elevation of five metres AHD, however consideration, of tidal influences of king and neep tide cycles on construction watercraft movements and construction planning, should be given as required.

A flooding and hydrology technical paper by Arup was completed in June 2018 and this report summarises flooding and hydrology for the proposal.

2.7 Erosion and hazard areas

In accordance with Section 4.4.2 of the Blue Book, areas which pose a 'high' erosion hazard are those which have a Soil Loss Class (SLC) of 5. This equates to a calculated soil loss of greater than 500 (tonnes / hectare / year). Soil loss equations for construction catchments have been provided in Section 4 of this report.

Common areas which would present a high risk of soil erosion and resulting environmental impacts include areas of concentrated flows and locations where surface gradients and slope lengths combine to increase the erosive potential of stormwater runoff. During the construction phase these locations would typically include:

- Bridge abutments (northern and southern river banks) and piers within river sediments
- Unstabilised laydown yards and access/haul roads
- Road embankments and cut faces
- Culverts and drainage outlets

2.8 Environmentally sensitive receiving areas

Figure 7 shows the environmentally sensitive receiving areas with the potential for direct impact from proposal. These includes areas of seagrass and mangroves within the Shoalhaven River and on the river banks.

To ensure the protection of these areas, construction water which has been treated using erosion and sediment controls must meet the water quality requirements prior to discharge into Shoalhaven River or associated tributaries such as Bomaderry Creek.

Refer to Section 5.3 for further details on water quality requirements.

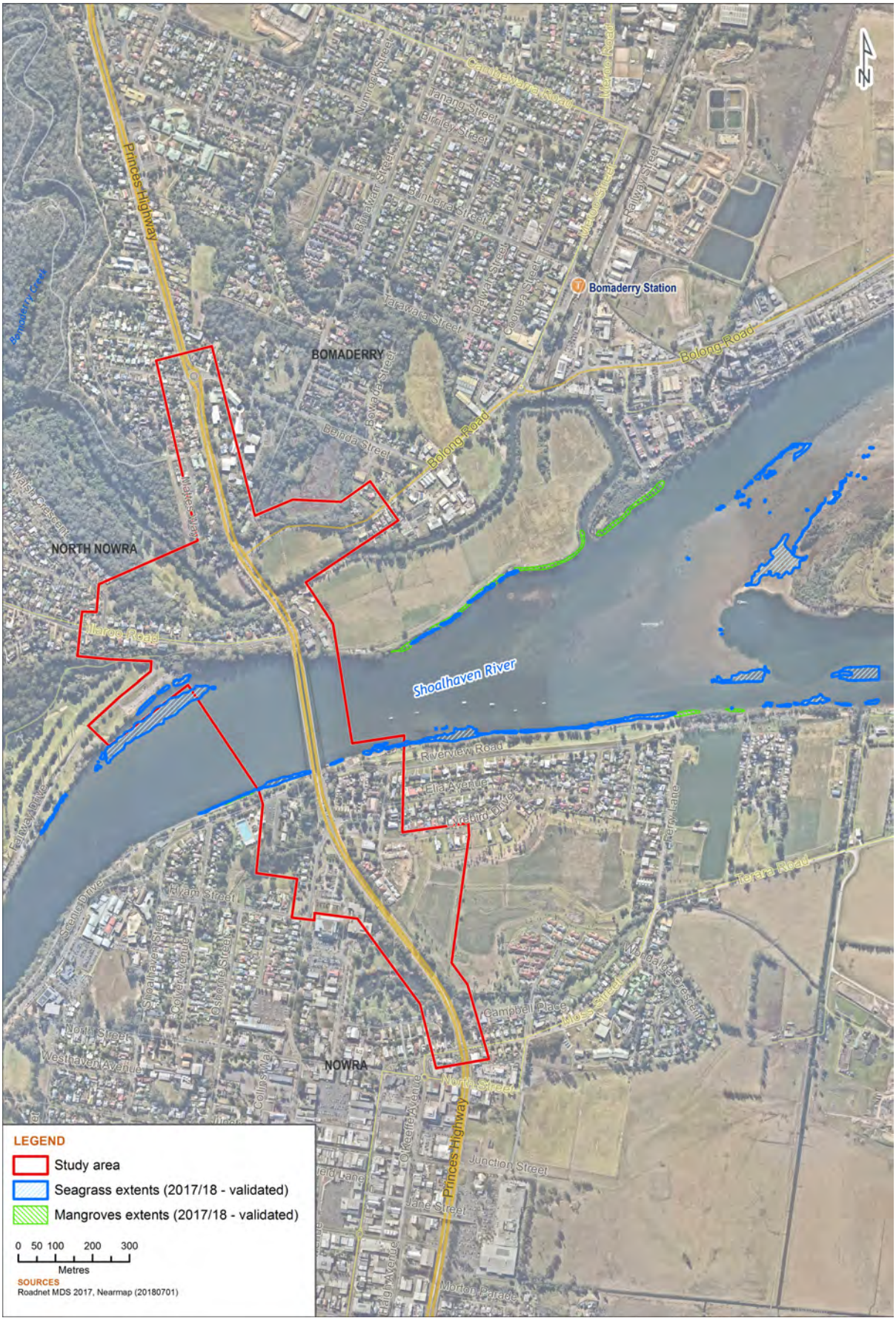

Figure 9 Environmentally sensitive areas

3. DESIGN CRITERIA AND ASSUMPTIONS

3.1 General

The PESMR and the associated calculations and drawings have been prepared based on the 80% Concept Drainage Design undertaken by ARUP (dated 10/3/2018). As the proposal is still in the concept design phase, this report is based on available information at the time of writing. Provisions should be made which allow erosion and sediment control measures to be adapted and specified as the proposal matures.

3.2 Existing and proposed drainage design

A review was carried out of the current 80% concept design drawings, namely, Nowra Bridge Drainage 80% Concept Design, Sheets SM-2301 to SM-2308. The relevant features were noted:

- Two existing culverts which pass beneath the Princes Highway (Chainages 76900 and 78160) will be retained and/or upgraded by extension in length and headwall.
- Upgrades to the existing stormwater drain network are proposed through the addition of several new pits and stormwater drains. Drainage discharge points are located east and west of the Princes Highway with stabilised outlets
- Two operational water quality treatment facilities are proposed, including:
  - Drainage swale west of the highway and to the south of Bomaderry Creek (Chainage 77040) – The drainage swale is designed to receive stormwater discharging from the Illaroo Road stormwater network and the new Nowra Bridge deck (northern half).
  - Basin west of the Princes Highway and just south of the river (Chainage 77500) – The basin is designed to receive stormwater discharging from the operational stormwater management pits within the Bridge Road intersection and the new Nowra Bridge deck (southern half).

At this preliminary stage, the following opportunities are considered:

- Existing stormwater culverts would be utilised to maintain up-gradient 'clean water' flows through the site during the construction phase within the construction footprint. Stabilised inlets/outlets would be implemented to prevent scour wherever water channel diversions are used
- The opportunity for co-location of operational water quality structures with temporary construction sediment basins is worth consideration. The basin at Chainage 77500 is noted to be near the Shoalhaven River. A construction sediment basin located in similar location may represent an unnecessary elevated risk on the nearby receiving water quality. Alternative positions further away from the river should also be considered where land availability permits
- Existing stormwater drainage network would be functioning during construction phase until proposed stormwater drainage is operational. The use of operational structures during construction is yet to be determined based on construction staging. Early installation of upgraded drainage features may improve flexibility in management 'clean water' and 'construction water' flows from the site.

3.3 Design parameters

In accordance with the Blue Book, Table 2 details the design parameters which have been used to estimate the RUSLE for each identified construction catchment of the proposal. Additional criteria from the water quality objectives for the proposal where the design of sediment basins may be required has also been included.

Table 3 Construction catchment assessment parameters

Parameter	Value	'Blue Book' Reference (Landcom, 2004)
Sediment Type	Nowra (F) Shoalhaven (F)	Table C22 Kiama Soil Landscapes in Appendix C of the Blue Book
Soil Hydrological Group	Nowra (C) Shoalhaven (F)	Table C22 Kiama Soil Landscapes in Appendix C of the Blue Book
Volumetric Runoff Coefficient	Nowra (0.51 moderate to high) Shoalhaven (0.51 moderate to high)	Table F2 in Appendix F of the Blue Book
Rainfall Data	5 day / 80th percentile / 32.2 mm	Table 6.3(a) Kiama
Rainfall Erosivity (R factor)	5,750	Appendix B, Map 11: Rainfall Erosivity of the Wollongong 1: 250,000 topographic Sheet
Soil Erodibility (K factor)	Nowra (0.047) Shoalhaven (0.039)	Table C22 Kiama Soil Landscapes in Appendix C of the Blue Book
Slope %	Steepest catchment = <6%	Dept. Conservation & Land Management Soil Landscapes of the Kiama 1:100 000 Sheet
Erosion Control Practice (P factor)	1.3 (compacted and smooth)	Appendix A Table A2 of the Blue Book
Ground Cover and Management Factor (C factor)	1	Appendix A Section A6 of the Blue Book

3.3.1 Slope length and gradient factor

The slope length and gradients have been measured using each designated flow path length. The values have been used to calculate the LS factor using Table A1 of the Blue Book.

3.3.2 Erosion control practice factor

A default P factor of 1.3 has been adopted. This reflects a worst-case scenario 'compacted and smooth' surface condition of the site.

3.3.3 Ground cover and management factor

A default C factor of 1 has been adopted. This reflects a worst-case scenario cover factor where topsoil has been stripped.

4. CATCHMENT ASSESSMENT

4.1 Construction catchments

Figure 10 shows construction catchments that have been identified for the proposal in accordance with the proposed 80% concept design and stormwater design. Each construction catchment has been assessed in principle with Blue Book and using the Revised Universal Soil Loss Equation (RUSLE) to assess the need for likely sediment basin locations. A description of construction catchments and expected surface water flow behaviour is outlined below.

The site catchments are shown in Figure 10 in an overall plan. A close up image of the catchments with drainage lines and topography indicating potential surface flows is shown in Figure 11, Figure 12, and Figure 13.

North of the river

A review of the topography and stormwater designs have indicated two catchments and two ancillary sites on the northern side of Shoalhaven River:

- Catchment 1 – Existing Princes Highway and Bolong Road Intersection north of Bomaderry Creek:
  - No ridge lines are identified within the catchment for possible sub-divisions
  - Current calculations from a worst case RUSLE calculation indicates that a sediment basin is required. However, as much of catchment 1 is already hardstand with minimal clearing required. The soil loss in the catchment may be less than calculated. It should be noted that these are over estimated calculations
  - Clean water flowing down gradient from the north (to the south) on the Princes Highway can be diverted into the existing stormwater culverts or diverted around the construction areas. While water flowing within the construction footprint will also flow to the south collecting at the Bolong Road intersection
  - The road surface from Bomaderry Creek slopes to the north, with surface water travelling from the south to the north, collecting at the Bolong Road intersection
  - The local topography indicates that the Bolong Road intersection is potentially a collection point for on-site brown surface water
  - From a review of the topographic map and drainage designs, the sediment basin is recommended to be placed on the south-eastern corner of the Princes Highway / Bolong Road intersection. Topography indicates the neighbouring fields as an area low point that staged construction waters from the Princes Highway could be gravity fed too.
- Catchment 2 – Existing Princes Highway and Illarroo Road between Bomaderry Creek and the Shoalhaven River:
  - The Illaroo Road gradient runs down gradient from west to east, while the Princes Highway itself is relatively flat
  - Surface water to the west and upgradient of the construction site (clean water) on Illaroo Road is able to be diverted within the existing stormwater system
  - Surface water from roads would flow into a combination of existing stormwater system
  - Surface water from earthworks (i.e. newly cut and filled areas) (dirty water) would need to be captured prior to draining into Bomaderry Creek.

- Ancillary Site 1:
  - The ancillary site is proposed to be located in the area on the northern bank of Bomaderry Creek and opposite the Bolong Road intersection.
  - Current calculations from a worst-case RUSLE calculation indicates that a sediment basin would be required, however, water could be adequately managed within road cuttings and via standard mitigation measures
  - The embankments of the road easement and the Bomaderry Creek river bank have increased the slope gradient across the site.
  - The centre of the proposed location is flat indicating that soil loss in the catchment may be less than calculated. It should be noted that these are over estimated calculations.
  - The centre of the land appears to be predominantly flat with an elevated river bank resulting in land sloping generally to the north away from Bomaderry Creek.
  - It is expected that surface waters falling onto the site would flow away from Bomaderry Creek flowing to north and north-westerly direction.
- Ancillary Site 2:
  - Ancillary site 2 is located on the northern bank of the Shoalhaven River.
  - The site is predominantly flat and comprises an existing gravel hardstand carpark and adjacent grassed area
  - The site gently slopes to the south towards Shoalhaven River with surface waters expected to follow this pathway.
  - There is a natural drainage line within the grassed area.

South of the river

Five catchments and three ancillary sites have been identified south of the Shoalhaven River:

- Catchment 3 - Proposed Princes Highway bridge decking over the Shoalhaven River draining to the south joining the intersection with Bridge Road and Pleasant Way, and proposed engineered batters and drainage system:
  - Once constructed, surface water originating on the southern half of the bridge deck would travel south off the deck in the newly constructed north bound Princes Highway and into drainage infrastructure (curb and guttering) at the Bridge Road and Pleasant Way intersection.
  - The migration of offsite derived clean or dirty water onto Catchment 3 is not possible due to the staging of the bridge construction and due to the topography of the proposed Princes Highway.
  - Surface water falling onto the engineered batters on the western edge of the new north bound Princes Highway will drain directly off the batter, potentially offsite to the west.
- Catchment 4 - Existing road surfaces of Scenic Drive and Bridge Road:
  - Catchment 4 is bound to the east by the Princes Highway median curb and guttering.
  - Surface water originating from the intersection will be collected by existing and / or proposed drainage infrastructure.
  - Surface water originating from further downgradient will flow down Bridge Road and Scenic Drive.
  - The potential does exist for construction surface waters to flow offsite through the southern end of Bridge Road

  - Surface water from earthworks/resurfacing areas would drain towards the unnamed drainage line adjacent to Scenic Drive

- Catchment 5 - Western side of the existing Princes Highway south of Bridge Road intersection:
  - Surface water from roads would be captured via the existing stormwater system
  - Surface water along construction areas would flow via the existing drainage line south towards the duck ponds of Harry Sawkins Park
- Catchment 6 – Eastern side of Princes Highway and new Lyrebird Drive connection:
  - Surface waters during earthworks construction would flow towards the intersection and be diverted south via the existing drainage lines adjacent to Princes Highway
- Catchment 7 – Existing Princes Highway and Pleasant Way intersection:
  - Catchment 7 is bound to the west by the Princes Highway median curb and guttering.
  - Surface waters would flow into the existing stormwater system
- Ancillary Site 3:
  - Site is the largest of the ancillary sites located to the west of the Princes Highway between Scenic Drive and Shoalhaven River
  - The site is gently undulating with topographic maps indicating a slight rise in the centre of the site, with a depression close to Scenic Drive and a drop away towards the Shoalhaven River
  - At its current grade, surface water across much of the site would collect in the south west corner adjacent to Scenic Drive
  - The only surface waters to drain towards Shoalhaven River are those north of the Scenic Drive cul de sac. This area is also well vegetated
- Ancillary Site 4:
  - The site is located immediately to the south of Pleasant Way and currently consists of a gravel and hardstand car park
  - Site 4 itself is almost flat with an incline off site to the south and east up to the Princes Highway
  - Surface water from off site to the north would flow on to the ancillary site
  - Up-gradient waters from the Princes Highway and Pleasant Way are captured within the current stormwater network
- Ancillary Site 5:
  - The site is located within the southern corner of the Princes Highway and Scenic Drive intersection
  - Site 5 is elevated with slopes falling to the east towards Princes Highway, and the north and west onto Bridge Road
  - Currently the site is free of buildings, largely grassed with a gravel car park and access road
  - No off-site surface water is likely to migrate across the site. No steep slope are noted on the site, however surface waters originating on-site would travel off-site to the east, north and west

The design of construction catchments followed a best practice management approach in accordance with the Blue Book which included the following considerations:

- A maximum value / worst case scenario for construction and ancillary sites has been adopted for design input data. However, the actual soil loss risk is potentially significantly less as the proposed construction methodology results in staged excavation of roads and installation of curb and guttering. Resulting in

much of the catchment remaining as bitumen hardstand with connections to existing drainage maintained

- Where industry standard practice is to adopt an 80 metre slope, where possible, slope lengths were calculated as the distance from the origin of overland flow along its flow path to the location of either concentrated flow or deposition
- Where required (e.g. intersections) catchments were sized to be inclusive of all sub stages to improve efficiency of control implementation
- Review of catchment sizing would be required at detailed design to reflect available lands due to acquisitions and construction staging. Up-gradient urban stormwater catchments, such as the northern section of the Princes Highway, may also need to be considered in some events where clean water diversion controls are being temporarily or permanently impacted.

4.2 Construction catchment sizing

Construction catchment sizing is based on the proposed construction footprint at 80% concept design stage. Catchments sizes account for the expected ground engaging activities including bulk earthworks, erosion and sediment structures, frequent haul roads, piling platforms, road resurfacing, utilities upgrades, earthworks, proposal engineered elements (bridges, drainage culverts and retaining walls) and the property acquisition schedules. Catchment sizes are described in Table 4. The placement of construction sediment basins has been considered throughout the design process.

The following limitations are noted regarding construction catchment sizing:

- The concept design has not specified types of ground engaging activities that would occur in some areas of the construction footprint (i.e. ancillary sites, property acquisitions, existing paved carparks and access roads). These areas have been excluded from construction catchment sizing noting reduced erosion potential is expected in these areas
- Ancillary sites have potential to be used for various activities such as construction compounds, bulk material stockpiling, equipment laydown and mobile plant, equipment or vehicle storage. A limited potential for earthworks is expected in these areas. It is assumed that existing hardstand pavements or provision of stabilised gravel fill are maintained for most of these areas.
- The concept design has not specified construction staging at this point. Several design inputs, construction methodology and property acquisitions would be required to undertake revised calculations in accordance with the Blue Book during construction planning
- Stormwater catchments of the existing operating Nowra Bridges (i.e. existing northbound and southbound carriageways) have not been assessed. Best practice management principles are assumed to apply to resurfacing activities undertaken on these bridges

Sizing of construction catchments would need to be further refined once construction staging planning is underway. There are potentially larger up-gradient stormwater catchments that may need to be considered during higher erosion risk activities like redirecting live stormwater assets, changes to pavement drainage or when bridge deck surface water is connected to site water quality controls.

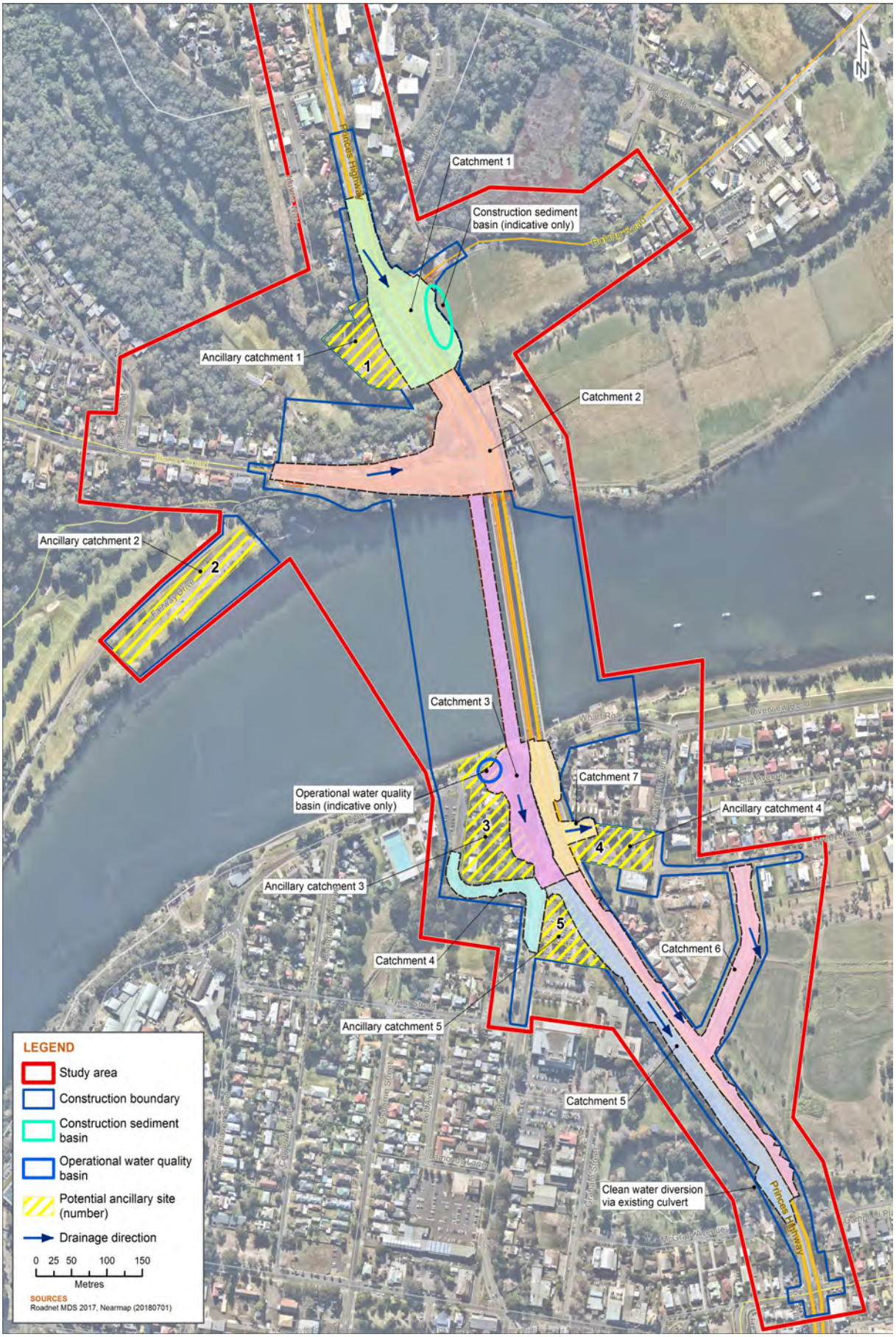

Figure 10 Construction catchments

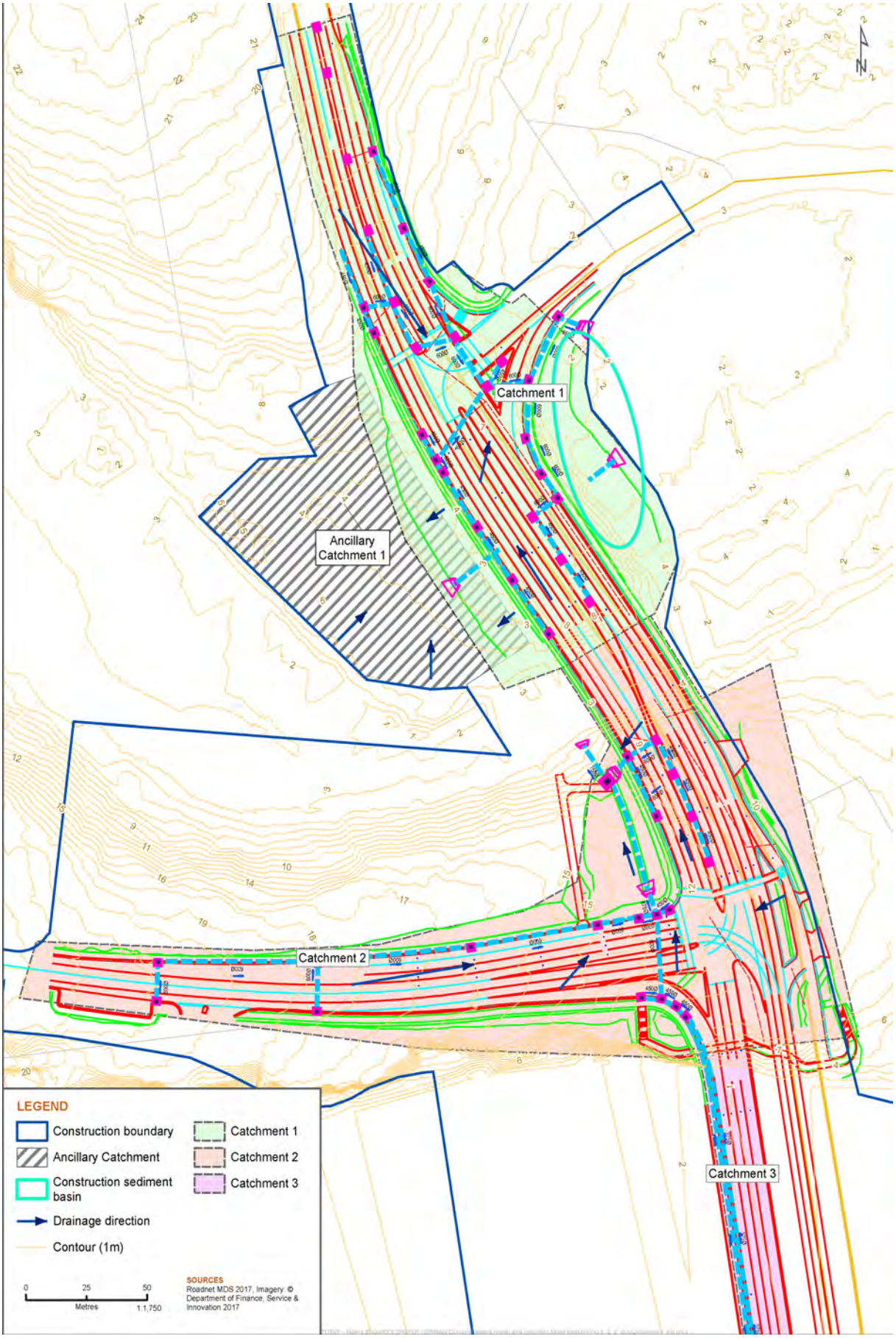

Figure 11 Construction catchments 1, 2 and 3, and Ancillary Site 1 catchment

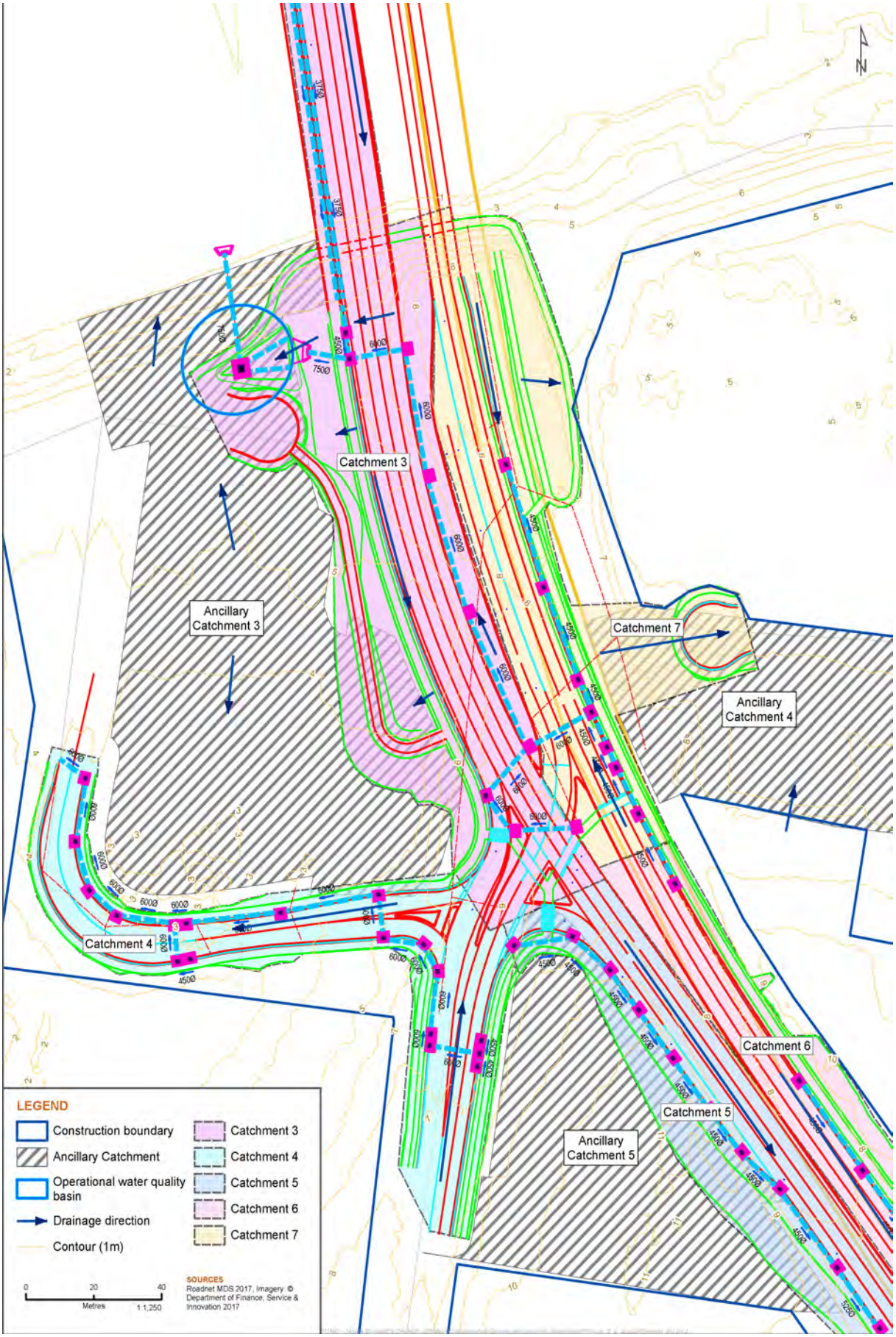

Figure 12 Construction catchments 3–7 and Ancillary Sites 3–5 catchments

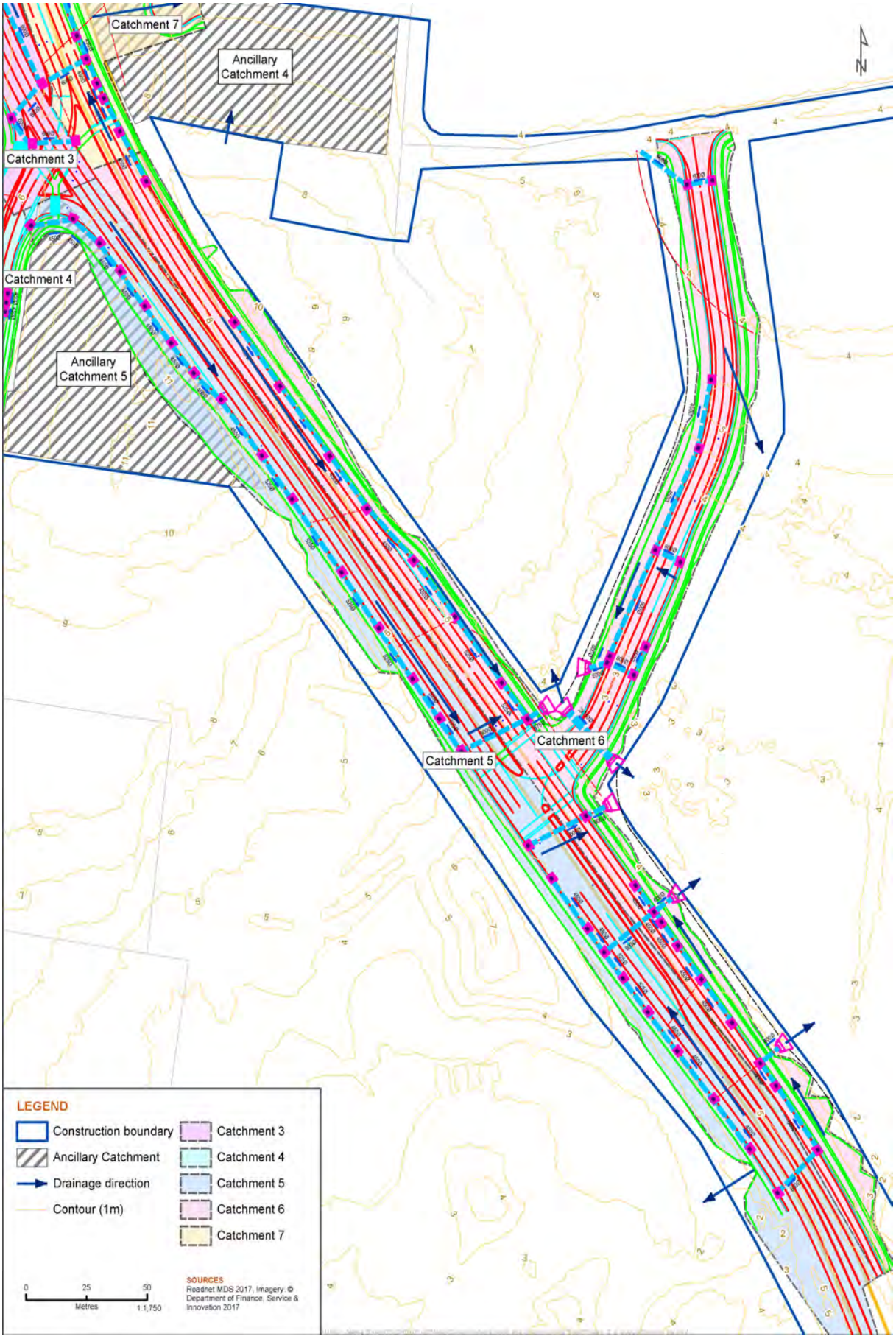

Figure 13 Construction catchments 5 and 6, and Ancillary Sites 4 and 5 catchments

4.3 Erosion risk hazard and high risk area

An evaluation of the erosion risk was made using the Revised Universal Soil Loss Equation (RUSLE) methodology. The RUSLE formula is outlined below:

A = R x K x LS x P x C

Where:

- A is computed soil loss (tonnes/hectare/year).
- R is rainfall erosivity factor
- K is soil erodibility factor
- LS is slope length and gradient factor
- P is soil conservation practice factor
- C is ground cover factor

The values identified in Table 2 have been used in the assessment of each construction catchment identified in Section 3.2 and shown on Figure 10. RUSLE calculations for each of the construction catchments are included in Appendix B1.

4.4 Soil loss results

As detailed in Section 6.3.2 (d) of the Blue Book '*the building of a sediment retention basin can be considered unnecessary'* if the computed soil loss from a catchment is less than 150 m^3 per year. For all catchments which exceed this requirement, a sediment basin is required.

Table 3 summarises the RUSLE assessment finding for each construction catchment within the proposal. The full RUSLE calculation sheets are available in Appendix B1**.** The RUSLE assessment concluded that Catchments C1 and C2 registered a soil loss of >150 m^3 per year, however additional detailed design and management of construction phasing and management of reduced slope lengths may further decrease required basin sizing. It should also be noted that C1 and C2 contain a large percentage of existing road structures, in turn reducing the volume of sediment available for transport.

Where the construction contractor chooses to vary the size of a construction catchment (e.g. through a change in construction staging) and final design and property acquisitioning, further assessment of the soil loss from the catchment should be undertaken to confirm if a sediment basin would be required in accordance with the Blue Book.

The 'Soil Loss Class' is a measure of erosion hazard that underpins the erosion control aspects of these guidelines.

Table 4 Construction catchments and RUSLE calculations

Catchment ID	Catchment size (ha)	Soil loss (m3 / y)	Soil Loss Class	Sediment basin required? (N / Y)	Erosion Hazard
C1 – Existing Princes Highway north of Bomaderry Creek	1.91	397	5	Y	Moderate
C2 – Existing Princes Highway and Illarroo Road between Bomaderry Creek and the Shoalhaven River	2.32	321	4	Y	Low - Moderate
C3 – Proposed Princes Highway bridge decking over the Shoalhaven river draining to the south and associated intersections	1.88	110	1	N	Very Low
C4 – Existing road surfaces of Scenic Drive	0.61	74	1	N	Very Low
C5 – South western edge of the existing and proposed southern tip of the Princes Highway	1.58	110	1	N	Very Low
C6 – Access Ramp joining the Princes Highway and Lyrebird Drive	2.37	32	1	N	Very Low
C7 – Existing Pleasant Way Intersection	0.33	145	2	N	Very Low
Ancillary Catchment 1	0.86	247	3	Y[1]	Low - Moderate
Ancillary Catchment 2	0.92	52	1	N	Very Low
Ancillary Catchment 3	1.26	52	1	N	Very Low
Ancillary Catchment 4	0.62	52	1	N	Very Low
Ancillary Catchment 5	0.64	52	1	N	Very Low

Table notes:

1. RUSLE rules indicate that a basin should be provided, however, standard on-site controls would achieve the same performance outcomes.
2. All catchments include paved areas (i.e. existing roads / paths with a planned overwater bridge) as such the catchments do not experience just direct soil loss and may reflect a worst-case scenario.
3. All soil loss calculations have been assessed against existing road structures. As the proposal matures and plans progress, these volumes may change.

4.5 Catchment risks

SMEC prepared a Preliminary Erosion and Sedimentation Assessment (PESA) Technical Note in accordance with RTA Procedure PN 143P (copy included in Appendix B2). This assessment considered the proposal as being potentially high risk, requiring consideration of additional erosion and sedimentation controls in the concept phase, the engagement of a soil conservation consultant, and preparation of this PESMR.

4.5.1 Catchment C1 – Existing Princes Highway north of Bomaderry Creek

The worst case RUSLE calculations undertaken for Catchment 1 indicate that a sediment basin is required (refer to Table 3). The worst case scenario has been considered as elevated soil loss potential is due to slope gradient of up to six per cent and the large catchment area associated with the raised Princes Highway. The surface waters from the raised road pavement are to be considered dirty water and managed accordingly. The primary risks to water quality within the catchment are repaving works, concrete curing and general waste. Potential soil loss may occur on the engineered batters of the elevated Princes Highway and Bolong Road.

Without appropriate management, there is a potential elevated soil loss risk during bulk earthworks activities expected as part of the widening of the Princes Highway and associated engineered batter slopes, near Bomaderry Creek and Bolong Road intersection.

It is recommended that the basin be placed in the topographic and drainage low point on the grassed land immediately to the south east of the Princes Highway - Bolong Road intersection as shown in Figure 11.

It is noted that this location is at 3-4m AHD. Should it be determined during detailed design that there is a flooding risk beyond 3-4m AHD, the construction contractor may be required to raise the basin walls to reduce the flood inundation risk.

This location is indicative only and has been recommended based on the current road and batter designs, land restrictions, drainage and topographic information. This location will be verified during the detailed design process and modified where necessary.

Proactive management measures for this catchment such as sediment fencing, mesh and geotextile filters, rock check dams should be implemented in accordance with the Blue Book recommendations. These mitigation measures are to be utilised on the engineered batters off the elevated Princes Highway.

A review of the 80% Construction Staging Strategy Report (SMEC, 2018) identifies that standard Blue Book mitigation measures have the ability to remove the necessity for a generic construction sediment basin. These include:

- Clean water diversions from the upgradient Princess Highway and or active roads will be maximised using existing drainage
- Catchments can be sub-divided into individual road cuts
- Construction zones / cut zones will be phased and minimised
- Dirty water will be managed *in situ* (within the cut) where practicable
- Sucker trucks pumping out cuts and / or *in situ* treatment is to be maximised where reasonable and feasible
- Land-based sediment controls will be required at the base of the batter slopes joining Bomaderry Creek
- Silt booms and/or curtains could be used running parallel to the Bomaderry Creek banks to catch surface runoff without restricting fish passage. Silt curtains can be installed at alternating depths and can be set for the specific creek bed depth.
- Slim high efficiency basins could be used where the preferred mitigation measures are not practicable.

4.5.2 Catchment C2 – Existing Princes Highway and Illarroo Road between Bomaderry Creek and the Shoalhaven River

The worst case RUSLE calculations undertaken for Catchment 2 indicate that a sediment basin is required (refer to Table 3). The worst case scenario has been considered as elevated soil loss potential is due to slope gradient of up to five per cent and the large catchment area associated with the raised Princes Highway and Illaroo Road. The surface waters from the raised road pavement are to be considered dirty water and managed accordingly. The primary risks to water quality within the catchment are repaving works, concrete curing and general waste. Potential soil may occur on the engineered batters of the elevated Princes Highway and Illaroo Road.

Without appropriate management, there is a potential elevated soil loss risk during bulk earthworks activities expected as part of the widening of the Princes Highway Illaroo Road intersection and associated engineered batter slopes, near the Shoalhaven River.

After consultation with RMS it was indicated that land will not be made available between Illaroo Road Bomaderry Creek to install a sediment basin. Recommendations from the soil conservationist, drainage experts and experienced site engineers, it has been determined that the basin has the potential to be placed in the topographic and drainage low point on the grassed land on the northern side of Bomaderry Creek, immediately to the south east of the Princes Highway-Bolong Road intersection as shown in Figure 11. Dirty captured on the southern side of Bomaderry Creek could then be pumped to the basin. As the requirement for a basin for Catchment 1 can be removed through *in situ* management. This location may be available for the Catchment 2 basin. Through site experience, it is possible to construct minor collection sump/s and then pump the water north via the Princes Highway bridge.

It is noted that this location is at 3-4m AHD. Should it be determined during detailed design that there is a flooding risk beyond 3-4m AHD, the construction contractor may be required to raise the basin walls to reduce the flood inundation risk.

This location, as presented in Figure 11, is indicative only and has been recommended based on the current road and batter designs, land restrictions, and drainage and topographic information. This location will be reviewed during detailed design and modified where necessary.

Recommendations from the soil conservation specialists and experienced site personnel, have indicated that the most proactive management measures for this catchment are Blue Book mitigations such as sediment fencing, mesh and geotextile filters, rock check dams, drop inlet filters and sand bags. These mitigations are to be utilised on the engineered batters off the elevated Princes Highway.

A review of the 80% Construction Staging Strategy Report (SMEC 2018) identified that standard Blue Book mitigations have the ability to remove the necessity for a generic construction sediment basin. These include:

- Clean water diversions from Illaroo Road and active lanes of the Princes Highway will be maximised using existing drainage
- Catchments can be sub-divided into individual road cuts for water collection
- Construction zones / cut zones will be phased and minimised
- Dirty water will be managed *in situ* (within the cut) where practicable
- Sucker trucks pumping out cuts and / or *in situ* treatment is to be maximised where reasonable and feasible
- Land based sediment controls will be required at the base of the batter slopes joining northern bank of the Shoalhaven River
- Silt booms and/or silt curtains could be used running parallel to the Shoalhaven River shoreline to catch surface runoff without restricting fish passage. Silt curtains can be installed at alternating depths and can

be set for the specific creek bed depth. Booms and curtains will need to be monitored on a daily basis with adjustments made during inclement water or higher than normal water flows.

- Consider the use of silt booms encompassing boat landing / mooring locations adjacent to the northern bank to capture and reduce the migration of disturbed river bed sediments. Accurate positioning of silt curtains can also be used in this instance, by only partially protruding into the river, they do not block fish passage, yet angle and capture sediment
- Slim high efficiency basins could be used where the preferred mitigation measures are not practicable.

4.5.3 Catchment C3 - Proposed Princes Highway bridge decking over the Shoalhaven River draining to the south and associated intersections

A construction basin is not required in Catchment 3 based on elevated soil loss results (refer to Table 3). A relatively lower risk soil loss hazard is noted compared to Catchment 1 and 2 due to slope gradient of two per cent.

There is however a larger catchment area associated with the existing road intersection, bridge easements and bridge deck. Runoff from these areas, though paved, would need to be considered as 'construction water' at concrete curing stages of construction noting the potential for oil and grease and general waste. Construction methodology should maintain bridge decking areas over water, as clean as reasonable and feasible. Sediment loss is also expected from required bulk earthworks associated with widening of road embankments which are noted to be near the Shoalhaven River. Construction staging during upgrade of the main intersection is likely to be subject to tight timeframes.

Proposed sediment control measures in Catchment 3 include:

- Catchments can be sub-divided into individual road cuts for water collection
- Construction zones / cut zones will be phased and minimised
- Dirty water will be managed *in situ* (within the cut) where practicable
- Sucker trucks pumping out cuts and / or *in situ* treatment is to be maximised where reasonable and feasible
- Although current road surfaces are limited within Catchment 3, additional control measures should be applied to existing stormwater pits, kerb and guttering (e.g. such as drop inlet filters, sand bags) to prevent sediment impacted surface water entering the stormwater network. Stabilised outlets should be monitored and maintained to prevent potential 'construction water' discharges to the Shoalhaven River.
- Land based sediment controls will be required at the base of the batter slopes joining southern bank of the Shoalhaven River
- Silt booms and/or silt curtains could be used running parallel to the Shoalhaven River shoreline to catch surface runoff without restricting fish passage. Silt curtains can be installed at alternating depths and can be set for the specific creek bed depth. Booms and curtains will need to be monitored on a daily basis with adjustments made during inclement water or higher than normal water flows.
- Consider the use of silt booms encompassing boat landing / mooring locations adjacent to the northern bank to capture and reduce the migration of disturbed river bed sediments. Accurate positioning of silt curtains can also be used in this instance, by only partially protruding into the River, they do not block fish passage, yet angle and capture sediment
- Slim high efficiency basins could be used where the preferred mitigation measures are not practicable.

4.5.4 Catchment C4 - Existing road surfaces of Scenic Drive and Bridge Road

Construction sediment basins are not required for catchment 4 based on soil loss results (refer to Table 3). A reduced soil loss is noted due to reduced slope gradients of 1.4 per cent and relatively smaller catchment area. Earthworks activities are expected to be limited to relatively minor cutting and filling, reshaping of batter slopes and shallow excavations (stormwater pits, kerb and guttering etc).

Recommendations from the soil conservation specialists and experienced site personnel, have indicated that the most proactive management measures for this catchment are Blue Book mitigations such as sediment fencing, mesh and geotextile filters, rock check dams.

The following erosion and sediment controls are considered for catchment 4

- Clean water diversions from the Scenic Drive, Bridge Road and Princes Highway intersection and active lanes will be maximised using existing drainage. A controlled discharge point (e.g. such as a drop inlet filter) is to be installed on at the lowest storm water pit which discharges into the unnamed drainage line
- It is noted that slope lengths would be broken up into lengths of no more than 80m between erosion controls. Catchments can be sub-divided into individual road cuts for water collection
- Construction zones / cut zones will be phased and minimised
- Dirty water will be managed *in situ* (within the cut) where practicable
- Sucker trucks pumping out cuts and / or *in situ* treatment is to be maximised where reasonable and feasible
- Sediment controls will be required at the base of the engineered batter slopes
- Slim high efficiency basins could be used where the preferred mitigation measures are not practicable.

4.5.5 Catchment C5 - Western side of the existing Princes Highway south of Bridge Road intersection

Construction sediment basins are not required for catchment 5 based on soil loss results (refer to Table 3). A reduced soil loss is noted due to reduced slope gradients of two per cent. Earthworks activities are expected to be limited to relatively minor cutting and filling, reshaping of batter slopes and shallow excavations (stormwater pits, kerb and guttering etc).

Recommendations from the soil conservation specialists and experienced site personnel, have indicated that the most proactive management measures for this catchment are Blue Book mitigations such as sediment fencing, mesh and geotextile filters, rock check dams.

The following erosion and sediment controls are considered for catchment 5:

- A controlled discharge point (e.g. such as a rock check dam, or mesh and gravel filter) is to be installed on at the down gradient drainage line adjacent to Harry Sawkins Park duck ponds. The existing drainage line from the duck pond is to be maintained as 'clean water' diversion through the site.
- Clean water diversions along the Princes Highway active lanes will be maximised using existing drainage
- It is noted that slope lengths would be broken up into lengths of no more than 80 metres between erosion controls. Catchments can be sub-divided into individual road cuts for water collection
- Construction zones / cut zones will be phased and minimised
- Dirty water will be managed *in situ* (within the cut) where practicable
- Sucker trucks pumping out cuts and / or *in situ* treatment is to be maximised where reasonable and feasible
- Sediment controls will be required at the base of the engineered batter slopes

- Slim high efficiency basins could be used where the preferred mitigation measures are not practicable.

4.5.6 Catchment C6 - Access road joining the Princes Highway and Lyrebird Drive

Construction sediment basins are not required for catchment 6 based on soil loss results (refer to Table 3). A reduced soil loss is noted due to reduced slope gradients less than one per cent. Earthworks activities are expected to include cutting and filling to form Lyrebird Drive, reshaping of batter slopes and shallow excavations (stormwater pits, kerb and guttering etc).

Recommendations from the soil conservation specialists and experienced site personnel, have indicated that the most proactive management measures for this catchment are Blue Book mitigations such as sediment fencing, mesh and geotextile filters, rock check dams.

The following erosion and sediment controls are considered for catchment 6

- Controlled discharge points are to be constructed and installed on the eastern side of the Princes Highway, primarily at the down gradient drainage line adjacent to Harry Sawkins Park duck ponds
- A controlled discharge point can also be installed in the low drainage point midway along the proposed Paper Road
- Clean water diversions along the Princes Highway active lanes will be maximised using existing drainage
- It is noted that slope lengths would be broken up into lengths of no more than 80m between erosion controls. Catchments can be sub-divided into individual road cuts for water collection
- Construction zones / cut zones will be phased and minimised
- Dirty water will be managed *in situ* (within the cut) where practicable
- Sucker trucks pumping out cuts and / or *in situ* treatment is to be maximised where reasonable and feasible
- Sediment controls will be required at the base of the engineered batter slopes
- Slim high efficiency basins could be used where the preferred mitigation measures are not practicable.

4.5.7 Catchment C7 - Pleasant Way intersection

Construction sediment basins are not required for catchment 7 based on soil loss results (refer to Table 3). A reduced soil loss is noted due to reduced slope lengths (20 metres) due to slope gradients of five per cent and relatively smaller catchment area. Earthworks activities are expected to be limited to relatively minor cutting and filling, reshaping of batter slopes and shallow excavations (stormwater pits, kerb and guttering etc).

The following erosion and sediment controls are considered for catchment 7:

- Standard controls to capture and treat 'construction water' prior to discharge off site or into the existing stormwater network (e.g. a drop inlet filter) would be utilised as discussed in Section 5.3. It is noted that slope lengths would be broken up into lengths of no more than 80 metres between erosion controls
- Clean water diversions along the Princes Highway and Pleasant Way active lanes will be maximised using existing drainage
- Construction zones / cut zones will be phased and minimised
- Dirty water will be managed *in situ* (within the cut) where practicable
- Sucker trucks pumping out cuts and / or *in situ* treatment is to be maximised where reasonable and feasible
- Sediment controls will be required at the base of the engineered batter slopes

- Slim high efficiency basins could be used where the preferred mitigation measures are not practicable.

4.5.8 Working within and over waterways

The proposal includes the construction and operation of ancillary sites such as a temporary jetty facility and the construction of permanent bridge piers within the Shoalhaven River and Bomaderry Creek.

To ensure that the water quality of the Shoalhaven River and Bomaderry Creek is not impacted, appropriate sediment controls would need to be installed prior to working in or over waterways. These would include but not be limited to the following:

- Turbidity water quality monitoring of Shoalhaven River and Bomaderry Creek carried out on a risk basis during works within/over waterways
- Sediment fences along areas of the foreshore that have been disturbed
- Silt curtains encompassing construction areas during activities disturbing or releasing river bottom sediments (e.g. piling / pier excavations) or with potential to disturb shoreline soils (e.g. Jetty)
- A combination of floating booms and silt curtains surrounding barges to ensure leaks / spills are contained.
- Selection of construction techniques that minimise the disturbance of sediments wherever there is a probability of acid sulfate soils (i.e. low lying alluvial soils and river sediments).

The following considerations with respect to tides are relevant to erosion and sediment management:

- Construction phase planning for works within/over water (i.e. barge movements) should consider when tides are at their peak high, low, dropping and rising, as well as local weather conditions.
- Tidal inundation and wave action has the potential to impact upon the construction activities along shoreline works (i.e. temporary jetty, embankment stabilisation) and works within/over water (e.g. barges)
- Tidal fluctuations should also be factored when implementing the use of temporary erosion and sediment control measures (e.g. silt curtains) and carrying out water quality monitoring (e.g. turbidity water quality monitoring).

4.6 Sediment basin location and sizing

Figure 10 and associated figures include the proposed sediment basin locations within Catchments 1 and 2. Preliminary sizing and capacity requirements are included within the RUSLE calculation in Appendix B1. The following preliminary considerations are given to the location and sizing of the construction sediment basins:

- The low-lying nature and proximity of sediment basins to the northern banks Bomaderry Creek presents the potential risk from poor construction or miss management of uncontrolled overflow or failure causing pollution of the waterway as well as the ease of maintenance and controlled treated discharge
- Construction sediment basins are proposed to be located on portions of land elevated at 3-4m AHD, to avoid the risk of flooding and/or tidal inundation from Bomaderry Creek impacting the construction sediment basin. The potential sediment basin locations for Catchment 1 and / or 2 on the south east of the Princes Highway and Bolong Road intersection is at 3-4m AHD. The walls of the basin can be increased to further limit potential flooding impacts
- Indicative sediment basin locations have been selected where the vegetation largely consist of exotic vegetation (i.e. grassed areas). They avoid areas with native vegetation, hollow-bearing trees, and the natural Spotted Gum / Blackbutt open forest located adjacent to the Bomaderry Creek banks or Shoalhaven River foreshore

- Indicative sediment basin locations are in areas where no ecological dependent surface or groundwater ecosystems have been identified
- Indicative sediment basins are located in natural depressions / low lying areas where there is a high probability of occurrence of acid sulfate soils from 1-2m below surface level (see Figure 6). As such, basin designs and / or construction techniques would involve earthworks that would avoid disturbance to acid sulfate soils where possible. For example, basin dimensions and orientation may adopt a 'wide and flat' and a 'built-up' design to achieve required capacity without requiring excavation that would disturb acid sulfate soils. Should detailed design identify the need for built up sediment basins, contractors would import clean clay fill, with appropriate lining and neutralising lime treatment, to construct basins if and where required.
- Basin sizing and construction methodologies should be confirmed during detailed design when further detail of construction staging, methodology and site specific geotechnical data is available
- Sediment basin locations would be confirmed during detailed design.

5. EROSION AND SEDIMENT CONTROL PLANNING

5.1 Key management strategies

Key management strategies for erosion and sediment control plans are to include:

- Minimising extent and duration of disturbance
- Control up-gradient 'clean' stormwater flows by diverting around, through and away from the site
- Use erosion control measures to treat 'construction water' flows to minimise onsite damage from erosion
- Use sediment control measures to minimise off site damage, unauthorised discharge and pollution of waters
- Stabilise disturbed areas quickly
- Revegetate and stabilise exposed batter slopes progressively
- Inspect and maintain control measures regularly
- Capture and treat 'construction water' via construction sediment basins prior to discharge.

5.2 Primary and progressive erosion and sediment control planning

The best practice management guidance for the construction of main roads and highways is provided in Soils and Construction Volume 2D Main Road Construction (DECC NSW, 2008) to assist in planning and implementation of appropriate controls to minimise soil erosion and control sedimentation. The purpose of the primary erosion and sediment control management plan (PESCMP) is to outline the intentions and fundamental principles that would be followed in the planning and implementation of erosion and sediment control measures for the entire proposal.

The PESCMP would contain detailed background information, risk assessment and discussion, while a series of subordinate progressive erosion and sediment control plans (PESCP) would provide up-to-date detail regarding location and installation of control measures. This preliminary erosion and sediment management report may inform the preparation of the PESCP. The staging and preparation of these reports would be detailed in the CEMP.

Several PESCPs are typically developed as the construction phases proceed, as site conditions evolve and as flow paths are changed for each catchment area and matched to risk settings. During the construction phase of the proposal, a series of PESCPs would be prepared to address all stages of the work and to provide the necessary levels of flexibility. The following steps should be undertaken prior to construction within each designated catchment area.

- A series of PESCPs should be prepared which detail the controls and management actions implemented to minimise soil and water impacts for construction staging and at specific discharge points and revised as necessary
- Site personnel charged with the responsibility for implementation of the PESCP should have appropriate knowledge and experience in erosion and sediment control management in accordance with the Blue Book Volume 1 and Volume 2D
- Where permitted by design, a diversion bank or similar should be constructed at the top of the construction activity zone or catchment to divert offsite water (clean water) around the area of disturbance

- Where required, install sediment containment measures (e.g. excavated sumps, sediment fence, sandbag traps, booms and silt curtains to treat runoff from the disturbed catchment area. Placement of these control measures is restricted to the available space within the proposal boundary and preferably outside of the active construction zone. Where space is restricted, the volume requirement of sediment containment measures may be reduced by separating the catchment into smaller subcatchments by way of diversion banks or temporary cut drains.

5.3 Standard controls

The following erosion and sediment controls are indicative of controls to be used to manage soil and water impacts during the construction of the proposal. Table 4 details the relevant section from the Soils and Construction Volume 1 (Landcom, 2004) and Volume 2D (DECC, 2008) where the drawings are detailed. Controls should be implemented where appropriate and maintained to ensure proper function.

Selection of control measures requires the following:

- Identifying the problem – erosion or sedimentation to be managed?
- Where the problem is erosion, identifying whether it is caused by raindrop impact or concentrated flow
- Where the problem is sedimentation, identifying if sediment is conveyed by sheet or concentrated flow
- Selecting the appropriate techniques depending on the identified specific nature of the problem.

Table 5 Standard erosion and sediment controls

Control	Blue Book Drawing Reference	Blue Book Page Reference
Stabilised Site Access	SD 6-14	6-48
Rock check dams	SD 5-4	5-22
Earth Bank (low flow)	SD 5-5	5-25
Sheet Flow	SD 5-2	5-18
Earth Bank (high flow)	SD 5-6	5-26
Concentrated Flow	SD 5-7	5-28
Mesh and Gravel Inlet Filter	SD 6-11	6-40
Geotextile Inlet Filter	SD 6-12	6-41
Stockpiles	SD 4-1	4-5
Rock Sediment Basin	SD 6-1	6-16
Sediment Fence	SD 6-8	6-36
Sediment Traps at drop inlets	C5	Vol 2D Appendix C, 60
Energy Dissipater	SD 5-8	5-34
Turbidity Barrier	SD 6-10	6-39

5.4 Basin water quality monitoring and discharge requirements

Environmentally sensitive receiving areas (namely Shoalhaven River and Bomaderry Creek) are present within or near the construction proposal footprint. An appropriate level of water quality monitoring of sediment basins should be undertaken prior to any discharge from site including inclement weather events. At a minimum, water quality criteria for discharges from a point source would not exceed the values provided in Table 2.

If these water quality parameters are unable to be met or are exceeded, discharge should not be permissible. Additional mitigation measures such as flocculant blocks, will need to be put in place by the construction contractor.

The contractor should adhere to best management practice in accordance with the following guidance documents:

- Roads and Maritime Services Specification G38, Soil and Water Management
- Roads and Traffic Authority (2011), Technical Guidelines, Environmental Management of Construction Site Dewatering, EMS-TG-011, issue 2 April 2011.

Consideration should also be given for water quality monitoring of Bomaderry Creek and Shoalhaven River during inclement weather to evaluate the effectiveness of sediment and erosion mitigations. Monitoring points up and down stream of the construction site, in conjunction with discharge point monitoring (if occurring) would recognise any negative impacts to the waterways.

5.5 Summary of control elements and measures

The key elements of construction phase erosion and sediment control measures are summarised below:

- Sediment basins located outside of road formation may represent construction phase sediment control opportunities at the following locations:
  - To the west of the Princes Highway opposite the intersection with Bolong Road, or alternatively further south towards Bomaderry Creek
  - To the west of the Princes Highway and north of Illaroo Road intersection
  - To the west of the Princes Highway and north of Bridge Road intersection
- A controlled discharge point (e.g. a rock check dam, or mesh and gravel filter) is to be installed within each catchment wherever ‘construction water’ is required to discharge into existing watercourses/drainage lines. The existing watercourses/drainage lines are to be maintained as ‘clean water’ diversion through the site
- Standard sediment control measures should be applied to existing stormwater pits, kerb and guttering (e.g. drop inlet filters, sand bags) to prevent sediment impacted surface water entering the existing stormwater network. Existing stormwater outlets should be monitored and maintained to prevent potential ‘construction water’ discharges to the Shoalhaven River
- Additional standard sediment control measures (e.g. such as sediment fencing, mesh and geotextile filters, rock check dams, booms and turbidity barriers/silt curtains) would be required down-gradient of the catchment on the construction boundary (especially along the foreshore areas) to ensure run off or drainage lines do not enter the Shoalhaven River or Bomaderry Creek in an uncontrolled manner.

5.6 Recommendations

It is recommended that:

- Nomination of a site environmental representative to be available on site during construction to complete self-audits, monitor the site, maintain controls, and minimise sediment and erosion on the site in accordance with the ESCP
- Preparation and implementation of a Soil and Water Management Plan (SWMP) and accompanying Primary Erosion and Sediment Control Management Plan (PESCMP)
- Preparation and implementation of a Progressive Erosion and Sediment Control Plan (PESCP) for the works which would be updated progressively throughout the construction phase. The PESCP would be prepared and updated by a Roads and Maritime registered soil conservationist in accordance with the requirements of Managing Urban Stormwater: Soils and Construction (Landcom, 2004) and Managing Urban Stormwater-Volume 2D Main Road Construction (DECC, 2008).
- The location and sizing of construction phase sediment basins or other sediment control elements are to be confirmed during the detailed design phase, and where possible, be compatible with future operational water treatment requirements.
- Sizing of detailed construction sub catchments may need to be further defined once construction staging planning is underway. There are potentially larger up-gradient stormwater catchments that may need to be considered during higher erosion risk activities like redirecting live stormwater assets, changes to pavement drainage or when bridge deck surface water is connected to site water controls.

6. REFERENCES

Australian Soil Resource Information System (http://www.asris.csiro.au/index_ie.html), viewed 18 August 2015

Bureau of Meteorology 2018, Daily Weather Observations from Nowra RAN Air Station AWS (station 068072), Bureau of Meteorology, Melbourne

Managing urban stormwater: soils and construction Volume 1, Landcom, 2004 (the 'Blue Book')

Managing urban stormwater: soils and construction Volume 2D, Main road construction, Department of Environment and Climate Change, NSW, 2008.

Roads and Maritime Services, QA Specification G38, Soil and Water Management, edition 2, February 2015

Road and Maritime Services Technical Guideline, Temporary stormwater drainage for road construction, December 2011

Roads and Maritime Services, Water Policy, 1997

Roads and Traffic Authority, Technical Guidelines, Environmental Management of Construction Site Dewatering, EMS-TG-011, issue 2 April 2011

SMEC Australia Pty Ltd, 80% Construction Staging Strategy Report. Prepared for Roads and Maritime Services, August 2018

Appendix B1
Construction RUSLE Calculations

1. Erosion Hazard and Sediment Basins

Site Name: Nowra Bridge Project

Site Location: Nowar Bridge

Precinct/Stage: 80% Design

Other Details: Assumed Soil landscape; Nowra (pg C110).

Site area	Sub-catchment or Name of Structure						Notes
	C1	C2	C3	C4	C5	C6	
Total catchment area (ha)	1.73	2.32	1.64	0.5	1.46	1.69	
Disturbed catchment area (ha)	2.3	0.15	0.52	0.13	1.33	0.3	

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	F	F	F	F	F	F	From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	F	F	F	F	F	F	Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5	5	5	See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	80	80	80	80	80	80	
x-day, y-percentile rainfall event (mm)	32.2	32.2	32.2	32.2	32.2	32.2	
Rainfall R-factor (if known)	5750	5750	5750	5750	5750	5750	Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)							

RUSLE Factors

Rainfall erosivity (*R*-factor)	5750	5750	5750	5750	5750	5750	Auto-filled from above
Soil erodibility (*K*-factor)	0.047	0.047	0.047	0.047	0.047	0.047	
Slope length (m)	80	80	80	80	80	80	
Slope gradient (%)	6	5	2	1.4	2	0.6	RUSLE LS factor calculated for a high rill/interrill ratio.
Length/gradient (*LS*-factor)	1.47	1.19	0.41	0.27	0.41	0.12	
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	12	12	12	12	12	12	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.69	0.69	0.69	0.69	0.69	0.69	See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	516	417	143	96	143	42	
Soil Loss Class	5	4	1	1	1	1	See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	397	321	110	74	110	32	Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	914	48	57	10	146	10	See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	384	515	364	111	324	375	See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	1298	563	421	121	470	385	

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

1. Erosion Hazard and Sediment Basins

Site Name: Nowra Bridge Project

Site Location: Nowra Bridge

Precinct/Stage: 80% Design

Other Details: Assumed Soil landscape; Nowra (pg C110).

Site area	Sub-catchment or Name of Structure						Notes
	C7	A1	A2	A3	A4	A5	
Total catchment area (ha)	0.67	0.86	0.92	1.26	0.62	0.64	
Disturbed catchment area (ha)	0.33	0.86	0.92	1.26	0.62	0.64	

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	F	F	F	F	F	F	From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	F	F	F	F	F	F	Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5	5	5	See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	80	80	80	80	80	80	
x-day, y-percentile rainfall event (mm)	32.2	32.2	32.2	32.2	32.2	32.2	
Rainfall R-factor (if known)	5750	5750	5750	5750	5750	5750	Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)							

RUSLE Factors

Rainfall erosivity (*R*-factor)	5750	5750	5750	5750	5750	5750	Auto-filled from above
Soil erodibility (*K*-factor)	0.047	0.047	0.047	0.047	0.047	0.047	
Slope length (m)	20	80	80	80	80	80	
Slope gradient (%)	5	4	1	1	1	1	RUSLE LS factor calculated for a high rill/interrill ratio.
Length/gradient (*LS*-factor)	0.54	0.91	0.19	0.19	0.19	0.19	
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	12	12	12	12	12	12	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.69	0.69	0.69	0.69	0.69	0.69	See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	189	321	68	68	68	68	
Soil Loss Class	2	3	1	1	1	1	See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	145	247	52	52	52	52	Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	48	212	48	66	32	33	See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	149	191	204	280	138	142	See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	197	403	252	346	170	175	

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

Appendix B2
Preliminary Erosion and Sediment Assessment Technical Note

Memorandum

Memo No.	001	Date:	12/06/2018
Revision:	R02	Prepared for:	Roads & Maritime Services
Discipline:	Environment	Originator:	Luke Jenkins
Subject:	Preliminary Erosion and Sediment Assessment Technical Note	Reviewer / Approver:	Daniel Saunders / Chris Masters

1. Introduction

This Preliminary Erosion and Sediment Assessment (PESA) has been developed to address the requirements of the Detailed Design Brief provided by Roads and Maritime Services NSW (Roads and Maritime) and as discussed in the Biodiversity Assessment Report (SMEC, 2018) for the proposed construction of a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal). This report provides findings from the Erosion Hazard Assessment derived from the Blue Book "Managing Urban Stormwater – Soil and Construction" (Landcom, 2004) and the Roads and Maritime Erosion and Sedimentation Management Procedure (RTA Procedure PN 143P). The assessment is determined by characterising the proposal against erosional risk and hazardous constraints. The Erosion Hazard Assessment is to establish if the proposal is an overall 'low' or 'high' erosional hazard and to assess the need for the appointment of a Soil Conservation Consultant to assist in the preparation of an Erosion and Sedimentation Management Report as concept design develops.

2. Issue

Roads and Maritime proposes to construct a new bridge on the A1 Princes Highway over the Shoalhaven River at Nowra (the proposal). This would include the construction of a new four lane bridge to the west (upstream) of the existing bridge crossings. The proposal would also include the upgrade of the Princes Highway near the bridge, as well as key intersection upgrades and modifications to the local road network. The proposal would improve access to Nowra and the surrounding areas, improve access for larger trucks, and reduce traffic delays.

The existing stormwater from the A1 Princes Highway and adjoining arterial roads is discharged to Shoalhaven River. As part of the construction, the hydrological and sediment regimes are proposed to be dramatically altered for the receiving water bodies near the proposal area due to vegetation clearance and increasing urbanisation which impacts on water quality. While stormwater from urban areas reduces water quality, the quality of surface runoff from within the construction footprint (lay down yards and haul roads) is impacted by the build-up of sediments, with the potential for other chemical contaminants including hydrocarbons, fuel additives and lubricants. The proposal area is characterised by relatively flat terrain and improvements to the existing stormwater network are expected as part of the proposal design.

Construction of the proposal has the potential to impact on water quality due to erosion and sedimentation, particularly during heavy rainfall events. The proposed bridge and road upgrades would include demolition, vegetation clearing and excavations. Although stormwater flows have yet to be determined, initial indications are that no stormwater would flow directly into the Shoalhaven River or tributaries prior to treatment through the implementation of safeguard measures.

Through the earthworks process, ground cover is removed exposing soil and increasing the potential for erosion and sedimentation during rainfall periods. There is a risk that the receiving water bodies (primarily Shoalhaven River) could become polluted by sediment runoff and construction waste. This is expected,

however, to be appropriately managed through the implementation of erosion and sediment safeguard control measures as required by the environmental risk assessment process.

Two landscape classifications are identified on the NSW Office of Environment and Heritage eSPADE web application across the proposal footprint. The Nowra Sandstone group is located across the southern side of the Shoalhaven River and to the west of the Princes Highway on the north. While the Shoalhaven Alluvium is located to the east of the Prices Highway on the northern banks of the Shoalhaven River.

Nowra Sandstone

Nowra Sandstone—medium- to coarse-grained quartz sandstones which contain rounded pebbles scattered throughout the beds. Moderately to gently undulating rises to undulating low hills. Relief >40 m. Slopes >5%. Broad ridges and crests with long, very gently inclined slopes, broad drainage areas with deeply incised channels. Benched sandstone outcrops adjacent to drainage lines. Extensively to moderately cleared with stands of tall open-forest.

Erodibility for the topsoil is generally low, but for the subsoils the erodibility is high. Moderate rill erosion on batters. Erosion hazard for non-concentrated flows is moderate to high. The calculated soil loss for the first 12 months of urban development ranges up to 20 t/ha for topsoils and 60 t/ha for exposed subsoils. The erosion hazard for concentrated flows is low to moderate.

Shoalhaven Alluvium

The Shoalhaven Group consists of Alluvium—gravel, sand, silt and clay derived mainly from sandstone and shale overlying buried estuarine sediments. Level to gently undulating floodplains. Relief <5 m and slopes <3%. Broad active floodplains 6–10 km wide with minor levees <l m and occasional back plain swamps. Scattered flat to gently undulating narrow terraces with relief <2 m. Completely cleared except for scattered decorative paperbark (Melaleuca decora), swamp oak (Casuarina glauca), Illawarra flame tree (Brachychiton acerifolium) on terraces and various reeds in swamps.

The erodibility of the topsoil is low, while the erodibility of the subsoils is high. Erosion hazard for non-concentrated flows is slight. The calculated soil loss for the first 12 months of urban development ranges up to 10 t/ha for topsoils and 10 t/ha for exposed subsoils. The erosion hazard for concentrated flows is low.

3. Design criteria and assumptions

The PESA is established in accordance with Appendix A of the Blue Book. Table 1 details the design parameters which have been used to identify the relevant hazard assessment for the catchments of the proposal.

Table B2.1 Construction catchment assessment parameters

Parameter	Value	Blue Book Reference
Sediment Type	Nowra (F) Shoalhaven (F)	Table C22 Kiama Soil Landscapes in Appendix C
Soil Hydrological Group	Nowra (C) Shoalhaven (C)	Table C22 Kiama Soil Landscapes in Appendix C
Volumetric Runoff Coefficient	Nowra (0.51 moderate to high) Shoalhaven (0.51 moderate to high)	Table F2 in Appendix F
Rainfall Data	5 day / 80th percentile / 32.2 mm	Table 6.3(a) Kiama

Parameter	Value	Blue Book Reference
Rainfall Erosivity (R factor)	5,750	Appendix B, Map 11: Rainfall Erosivity of the Wollongong 1: 250,000 topographic Sheet
Soil Erodibility (K factor)	Nowra (0.047) Shoalhaven (0.039)	Table C22 Kiama Soil Landscapes in Appendix C
Slope %	Steepest catchment = <6%	Dept. Conservation & Land Management Soil Landscapes of the Kiama 1:100 000 Sheet
Erosion Control Practice (P factor)	1.3 (compacted and smooth)	Appendix A Table A2
Ground Cover and Management Factor (C factor)	1	Appendix A Section A6

The geographic location of Nowra is identified in *Managing Urban Stormwater – Soil and Construction* (Landcom, 2004) as having a rainfall erosivity R-Factor of 5,750. Survey information of the proposal has yet to be provided, therefore the maximum slope potential would be based at <6% indicated in the *Department of Conservation & Land Management, Soil Landscapes of the Kiama 1:100 000 Sheet*. This equates to an LS factor of 1.19.

These two factors of R-Factor and worst-case Slope per cent when plotted on the A-Line graphic provided in Figure B2.1 of this assessment (Figure 4.6 of Managing Urban Stormwater – Soil and Construction (Landcom, 2004) as slightly below the A-Line curve. It should be noted that the worst-case slope factor has been used for the calculation. Sites below the A-line on Figure B2.1 have low potential for erosion hazards and the standard erosion control measures defined in *Managing Urban Stormwater – Soil and Construction* (Landcom, 2004) are considered adequate. Planners of such sites need not undertake the tasks outlined in the remainder of the *Blue Book* Section 4, and therefore is to be interpreted as a site of Low Erosional Risk. Section 4-10 states this A-Line plot is assuming an LS=500/1.3 (RxK) where K is 0.05 and slope length is 80 metres.

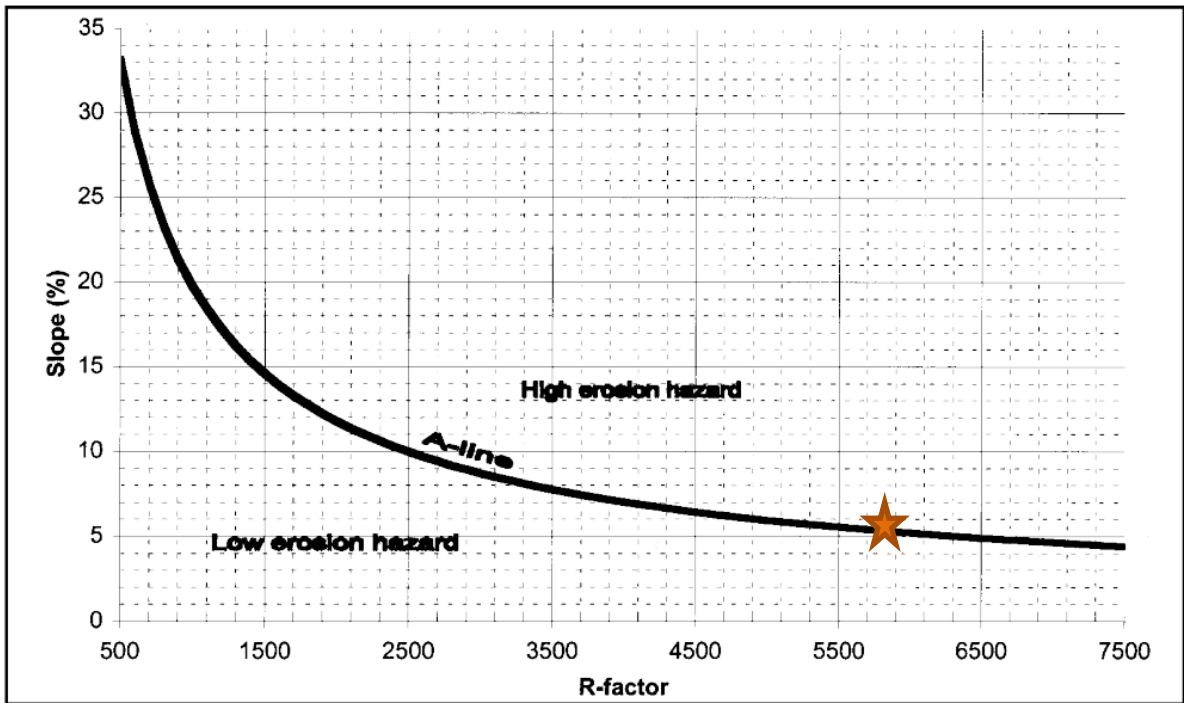

Figure B2.1 Assessment of potential erosion hazard (Landcom, 2004).

4. Results summary

Table B2.2 Preliminary Erosion and Sedimentation Assessment

Triggers	Yes / No	Comment
1. Does the complexity or size of the proposal result in it being inherently high risk as ongoing installation and maintenance of controls would require extensive coordinated resources	Yes	The proposal requires the construction of bridge piers within the Shoalhaven River. The northern abutment of the bridge would require excavation into the near vertical cliff face. The complexity of the works and proximity to the Shoalhaven River and Bomaderry Creek result in the proposed work being high risk. Works north of Bomaderry Creek and south of the Shoalhaven River would largely be conducted within the existing road corridor and developed areas. These sites are generally flat and would allow standard industry practice measures to mitigate potential areas of erosion.
2. Assess the erosion hazard of each catchment area to be disturbed for the proposed proposal using Attachment 1b. Are any of the proposed construction areas define as High Erosion Hazard?	No	Considering the steepest catchment, the slope % and R-Factor plot below the A-line. In terms of erosion hazard only, the proposal is considered a low erosion risk.
3. Are there known site constraints that limit the implementation of	Yes	Construction techniques and methodologies are currently unknown.

Triggers	Yes / No	Comment
appropriate erosion and sediment controls measures?		• The northern bank of the Shoalhaven River has a steep to vertical slope. Proposal works would involve earthworks within the bridge abutment which are likely to interact with this bank. Specific construction methodologies are required to be developed to assist in reducing impacts from erosion and sediment impacts. • Works within the Shoalhaven River have the potential to create constraints for adequate mitigation.
4. Are there identified sensitive receiving environments that would receive stormwater discharge from the construction proposal?	Yes	Sensitive receiving environments that would receive stormwater discharge from the proposal are: • Shoalhaven River (including seagrass and mangroves) • Bomaderry Creek

5. References / supporting information

- Erosion and Sedimentation Management Procedure, RTA Procedure PN 143P
- Roads and Maritime Nowra Bridge proposal description V5
- Managing Urban Stormwater – Soil and Construction Volume 1 4th Edition" (Landcom, 2004)
- NSW Department of Conservation & Land Management, Soil Landscapes of the Kiama 1:100 000 Sheet (Hazleton, P.A., 1992)
- Nowra Bridge Biodiversity Assessment (SMEC, Draft 11 January 2018)

6. Impact on other disciplines

Other design teams and specialist disciplines have the potential to be impacted by the high erosion hazards noted within this PESA including:

- Construction staging and methodology
- Structures
- Civils
- Geotechnical
- Utilities and drainage

7. Summary / recommendation

Construction of the proposal has the potential to impact on water quality due to erosion and sedimentation, particularly while working within the water and during heavy rainfall events. Common areas which would present an elevated risk of soil erosion and resulting environmental impacts include areas of concentrated flows and locations where surface gradients and slope lengths combine to increase the erosive potential of stormwater runoff. During the construction phase these locations would typically include:

- Bridge abutments and piers over land or water
- Road embankments and cut faces

- Haul road and lay down yard boundaries
- Works on the northern bank
- Culverts and drainage outlets.

The proposal site is considered to have high erosional risk and represent high potential for erosion hazards. Standard erosion control measures defined in Roads and Maritime Erosion and Sedimentation Management Procedure (RTA Procedure PN 143P) based on data from *Managing Urban Stormwater – Soil and Construction* (Landcom, 2004) are considered adequate for construction planning.

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