



Narooma Wharf Upgrade

Review of Environmental Factors

Transport for NSW

Narooma Wharf Upgrade

Review of Environmental Factors

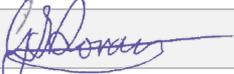
Transport for NSW | April 2022

Prepared by GHD and Transport for NSW

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Approval and authorisation

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Dated:	01/04/22

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Executive summary

The proposal

Transport for NSW is proposing to upgrade Narooma Wharf, located at Bluewater Drive, Narooma. The existing wharf is in a deteriorated condition and in need of an upgrade. The Proposal includes the removal of the existing Wharf at Narooma and reconstruction of a new wharf in the same location.

Key features of the proposal include:

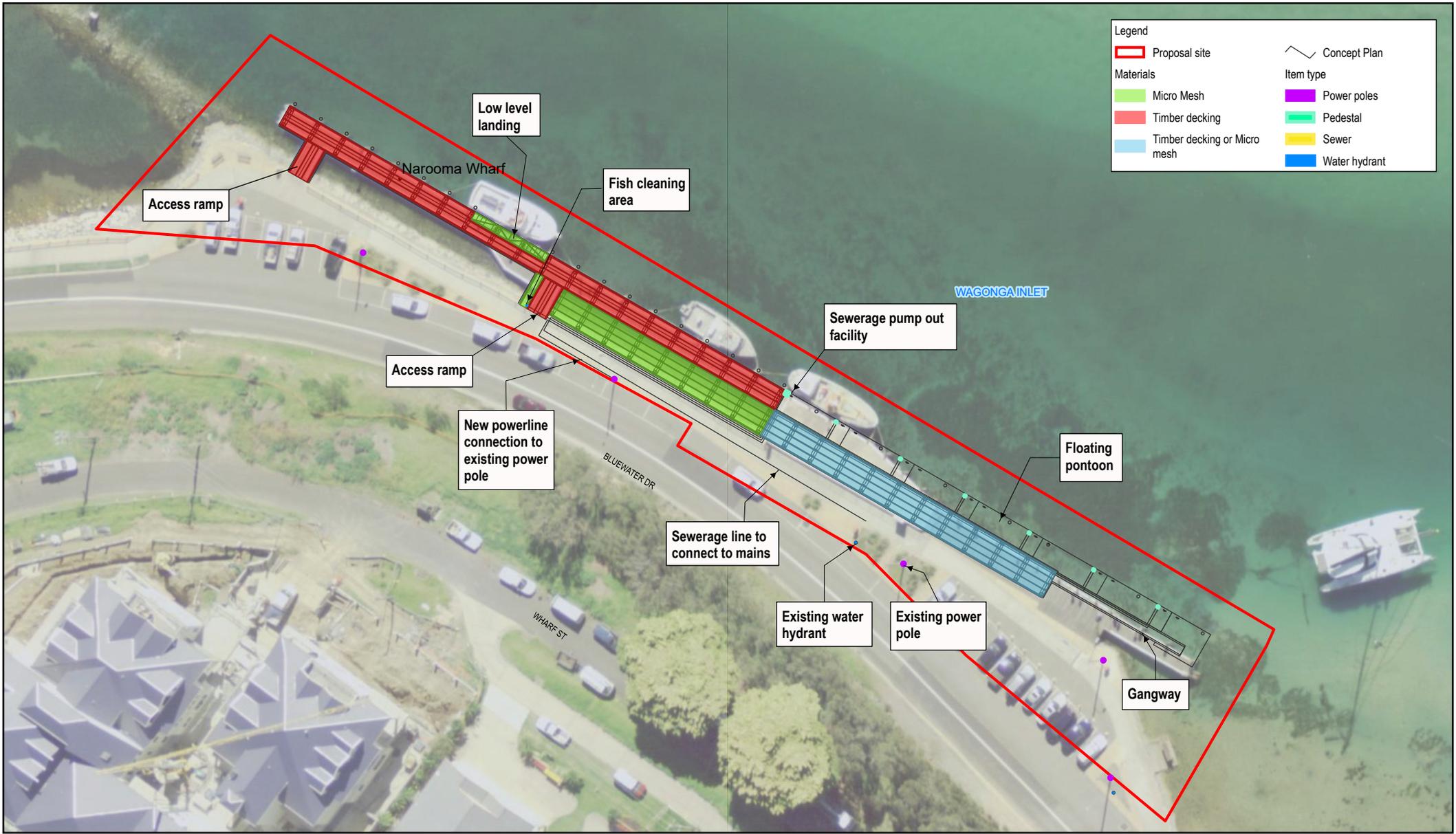
- staged demolition and removal of the existing wharf, commencing with the eastern section, including the removal of the:
 - wharf deck and furniture
 - timber and concrete piles
 - utilities
- construction of a new main wharf, 77 metres long by four metres wide, that is fixed and connected to the shore via walkways and infill micromesh
- construction of a new 66 metre long by four-metre-wide floating pontoon, that is connected to a shore-side platform via a gangway with a landing platform
- installation of a ten metre long lower-level landing, halfway along the main fixed wharf, with stairs connecting the landing to the main wharf and shore level
- installation of berthing and mooring infrastructure and wharf furniture, such as fenders, bollards, safety ladders, rails and lighting
- ancillary wharf services such as a new sewage pump-out facility and sewer connection, upgraded firefighting and power and water service pedestals
- upgrade or repair of the seawall adjacent to the pontoon and placement of rock revetment along a 24-metre section, if required.

An overview of the proposal is shown in Figure E.1.

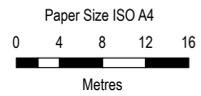
Construction of the proposal would occur over two stages to ensure that the wharf would remain operational during the construction period. Construction is expected to commence in mid-2022 and would take around four months to complete. Construction work may not be continuous as it would rely on delivery schedules. If road transport is not possible, some prefabricated wharf components would be delivered to the site on barges.

Need for the proposal

The structural integrity of the wharf has been assessed as being in a poor condition due to the age and deteriorated state of the concrete deck. Furthermore, passengers currently experience difficulty boarding boats safely during high and low tides. The wharf platform is fixed and its level does not change with the tides, making it difficult for passengers to access the boats.



Legend	
	Proposal site
	Concept Plan
Materials	
	Micro Mesh
	Timber decking
	Timber decking or Micro mesh
Item type	
	Power poles
	Pedestal
	Sewer
	Water hydrant



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56

Transport for NSW
 Narooma Wharf
 Upgrade REF

Project No. 12554705
 Revision No. 1
 Date 1/02/2022

Key features of the proposal

FIGURE E1

Proposal objectives

The objectives of the proposal are to:

- improve safety and structural integrity of the wharf
- upgrade access and operational safety for vessels
- make the wharf more accessible to those with mobility impairments and parents/carers with prams
- provide on-shore services for commercial vessels to improve environmental and business outcomes.

Options considered

The following options were considered for the upgrade of Narooma Wharf:

- Option 1 – The ‘do nothing’ option would involve no upgrade of the existing wharf. The existing wharf would not meet its intended recreational and commercial use and would continue to degrade.
- Option 2 – This option would include a gangway and floating pontoon on the eastern end of the wharf.
- Option 3 – This option would be similar to option 2 but would have a gangway and floating pontoon at the centre of the wharf connected to the fixed wharf section.
- Option 4 – This option would have a longer pontoon section compared to options 2 and 3, with a shorter fixed section.

Option 1 was discounted as it would not meet the objectives of the proposal. Both options 2 and 3 would fulfil the proposal’s strategic needs and objectives. However, Option 3 would require a major reconstruction of the existing seawall.

Options 2, 3 and 4 were found to have varying impacts on seagrasses. Option 2 was selected as the preferred option as it involved the least amount of dredging compared to options 3 and 4 and would only require potential minor works on the seawall.

Option 2 was identified as the preferred design.

Statutory and planning framework

The proposed facility is a wharf or boating facility, within the meaning of the State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP). Section 2.79(4) of the Transport and Infrastructure SEPP, permits development for the purpose of wharf or boating facilities to be carried out by or on behalf of a public authority, without development consent on any land (other than land reserved under the *National Parks and Wildlife Act 1974* (NPW Act)). The proposal is not located on land reserved under the NPW Act.

The proposal is for a boating facility and is to be carried out by Transport for NSW and can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from council is not required.

The proposal is within Special Purpose Zone (SPZ) of Batemans Marine Park, as declared under the *Marine Estate Management Act 2014*. The SPZ contains objectives “to cater for special facilities and features in the zone such as slipways, breakwaters, berthing facilities and shipwrecks” as well as to provide for the management of biological diversity, habitat, ecological processes, and natural and cultural features in the zone, where phenomena, sites or items warrant such special management” within the Marine Park. The REF assesses the consistency of the proposal with the objectives of the SPZ in which the proposal occurs.

Community and stakeholder consultation

Under the Transport and Infrastructure SEPP, consultation is required with local councils or public authorities in certain circumstances, including where Council-managed infrastructure is affected. Preliminary consultation has been undertaken with Eurobodalla Shire Council and the Department of Primary Industries – Fisheries.

Key issues raised during consultation included management strategies to minimise impacts on protected marine fauna species and seagrasses, Aboriginal native title, security fencing, potential for impacts on water quality, utility adjustments, parking and future growth in commercial wharf facilities in the local area.

Consultation with the community and stakeholders would continue throughout the construction phase.

Environment impacts

The main environmental impacts of the proposal, the safeguards and management measures to address the main impacts are summarised below.

Land surface and water quality

The removal of existing piles and installing new piles would result in the removal of about 1000 cubic metres of material from the seabed. Therefore, handling of major volumes of sediments would not be required. Marine sediment quality of the construction footprint shows contaminant levels to be below relevant guideline levels, with the exception of zinc at one location. The sediments were also not found to be acid sulphate soils or potential acid sulphate soils.

The sediment has a high proportion of fine to medium grained sand, varying amounts of gravel and very low proportion of fines. Suspended sediment may disperse during the construction activities. Considering the particle size distribution of sediments, dispersion would be localised and expected to dissipate rapidly. Implementation of safeguards including a silt boom and curtain around the construction area for the duration of the work would minimise the potential for sediment dispersion.

The construction contractor would prepare and implement a Soil and Water Management Plan to mitigate the risks associated with sedimentation, soil erosion and water pollution. This would include an Unexpected Finds Procedure for encountering contamination or acid sulphate soils and a Spill Management Plan.

Landside work would be limited to trenching to connect a new sewage pipeline from the wharf to Council’s existing sewer network. The Soil and Water Management Plan would include erosion and sediment control plans to minimise erosion and sediment in accordance with *Managing Urban Stormwater, Soils and Construction Guidelines* (the Blue Book).

Once operational, the proposal would reduce the risk to water quality by introducing a new sewage pump-out facility. There would be negligible impacts to the land surface and marine sediments during operation.

Biodiversity

Potential impacts on biodiversity during construction would occur from direct and indirect impacts associated with dredging, the removal and installation of about 67 new piles and the movement and anchoring of construction vessels and barges.

Seagrasses within the proposal site include large dense beds of *Posidonia australis*, *Zostera muelleri* and *Halophila ovalis*. Macroalgae beds also occur. The existing seagrasses and macroalgae beds are not considered threatened species and mostly occur outside the area of direct disturbance.

The proposal would directly impact about 63 square metres of marine vegetation, comprising 25 square metres of seagrasses and 38 square metres of macroalgae. Indirect impacts to marine vegetation would occur from shading and smothering from sediment dispersed during dredging and other construction activities. As benthic communities are already established in near-shore areas prone to high turbidity following rainfall events, it is likely that they would be resilient to short-term increases in suspended solids, subsequent burial and loss of light. With the implementation of a silt boom and curtain, the Soil and Water Management Plan and other mitigation measures described in the REF, the potential impacts on biodiversity are considered low to moderate and short-term.

Transport for NSW will be required to seek other permits and approvals prior to construction. A permit to harm vegetation under Section 205 of the *Fisheries Management Act 1994* (FM Act) will be required in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (2013 Update). As part of this process, Transport for NSW would consult with NSW DPI (Fisheries) during detailed design about suitable offsetting for the proposal to achieve a no net loss of habitat.

Slow-moving or semi-sedentary fauna species, if present during construction, would likely be lost if directly disturbed. This may include syngnathids (such as sea horses, sea dragons and pipefish). Before construction, the construction contractor would be required to identify the presence of syngnathids. A Seahorse Relocation Plan has been prepared as part of this REF (Appendix H) to manage the relocation of any seahorses identified during construction.

Impacts to terrestrial vegetation would be negligible as most areas contain mown grass.

Potential impacts to biodiversity during operation of the upgraded wharf are not expected to be different to the existing condition.

The proposal is not likely to significantly impact threatened terrestrial or aquatic species, populations or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation 2016* (BC Act) or the FM Act and therefore a Species Impact Statement is not required.

The proposal is also not likely to significantly impact threatened species, populations, ecological communities or migratory species within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A referral to the Australian Department of the Agriculture, Water and the Environment (DAWE) is therefore not required for biodiversity matters.

Noise and vibration

Demolition and construction of the new wharf would generate noise during standard construction hours. No construction work would be undertaken outside of standard construction hours. The nearest sensitive receivers are located about 40 metres from the proposal site. The construction noise and vibration impact assessment undertaken for the proposal concluded the following:

- Construction noise levels are predicted to exceed noise management levels for standard construction hours for all construction stages at nearby residential receivers. Noise management levels at the nearest residential area would be exceeded by about 29 dB(A).
- Vibratory intensive works likely to generate the most vibration includes impact piling rig and concrete breaking. The plant would be used for short periods of time and would not operate constantly for the duration of the construction period. Equipment would be used within safe working distances to avoid potential damage to structures and buildings. There is potential for human comfort vibration impacts should impact piling methods be used rather than bored piling methods.

The assessment represented a 'worst case' scenario where noise levels are estimated based on the loudest two pieces of equipment operating simultaneously in a worst-case location. It is expected that construction noise levels would generally be less than those estimated in the REF.

A Construction Noise and Vibration Management Plan would be prepared in accordance with the Transport for NSW Construction Noise and Vibration Guideline (Roads and Maritime, 2016) and implemented during construction. The Management Plan would include respite periods when undertaking high impact noise work, community consultation requirements and management measures that would be adopted to minimise noise impacts.

Noise generated from the operational phase of the proposal is expected to be similar to existing conditions. There would be no expected increases in operational noise from the proposal.

Traffic, transport and access

Access to the wharf would be maintained during construction to minimise impacts to existing users. Construction would be staged in a suitable and safe manner so that existing wharf users are able to berth, board or disembark passengers. Community consultation would be carried out prior to and during construction to keep the community informed on which sections of the wharf could be used and which sections are marked as exclusion zones for construction purposes. Pedestrian fencing, wayfinding and other navigational signage would be implemented to maintain safe access and use of the wharf (landside and waterside).

About ten parking bays at the wharf would be impacted during construction for use as a site compound, loading and unloading area and workforce parking. This would be temporary and re-instated following construction. Construction material would be delivered by both road and barge. Deliveries would have a short-term temporary impact on road traffic when oversized loads of material are being transported to the proposal site. Delivery of oversized loads would also occur via barge to minimise impacts on the local road network and reduce safety risk when unloading large equipment near overhead powerlines.

The movement of traffic would be managed through the construction contractor's Road Traffic Control Plan and a Construction Marine Traffic Management Plan.

Non-Aboriginal heritage

The location of the Narooma wharf (item no. 2106) is listed as a maritime heritage site by NSW Heritage but is not listed on the State Heritage Register. The location once supported the town's timber wharf built in 1894, which was then replaced with a new wharf in 1902. The listing also describes the stone retaining walls fronting along the Wogonga River entrance having been constructed from local slate and completed in 1922. Separate to this maritime heritage listing, is the locally significant Wharf pylon, located west of the proposal site (item no. 1184), which is listed under the Eurobodalla Local Environment Plan 2012 (LEP). There are no items within the proposed footprint of disturbance listed on the Shipwreck Register.

Construction activities would have the potential to uncover maritime archaeological deposits associated with former wharf structures. Any unexpected heritage finds would be managed through Transport for NSW's Unexpected Finds Procedure. Safe working distances would be established to minimise the risk of vibration impacts on the local LEP listed Wharf pylon. Transport for NSW would consult with NSW Heritage during detailed design of the proposal with reference to the wharf location being listed on the maritime heritage register.

Further information regarding these main impacts and other minor impacts is provided in chapter 6 of the REF.

Justification and conclusion

This REF has been prepared having regard to sections 111 and 112 of the EP&A Act, and section 171 of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation), to ensure that Transport for NSW takes into account to the fullest extent possible, all matters affecting or likely to affect the environment as a result of the proposal.

The detailed design of the proposal would also be designed taking into account the principles of ecologically sustainable development (ESD).

Should the proposal proceed, any potential associated adverse impacts would be appropriately managed in accordance with the mitigation measures outlined in this REF. This would ensure the proposal is delivered to maximise benefit to the community and minimise any adverse impacts on the environment.

In considering the overall potential impacts and proposed mitigation measures outlined in this REF, the proposal is unlikely to significantly affect the environment including critical habitat or threatened species, populations, ecological communities or their habitats.

Display of the review of environmental factors

This REF is on display for comment between 28 April and 18 May 2022. You can access the documents in the following ways:

Internet

The documents are available as pdf files on the Transport for NSW website at <https://roads-waterways.transport.nsw.gov.au/maritime/projects/naroomawharf/index.html>.

Printed copies

The documents can be viewed at the following locations:

- 33 James Craig Road, Rozelle NSW 2039
- Narooma Library, Field Street Narooma.

Copies by request

- email to: NaroomaWharf@transport.nsw.gov.au
- phone: 1800 962 033.

Staffed displays

Both at Narooma Sports and Leisure Centre, 100 Bluewater Drive, Narooma

Thursday 28 April 6-8pm and Saturday 30 April 2-4pm.

How can I make a submission

To make a submission about this proposal, please send your written comments to:

By post: Narooma Wharf Project, 33 James Craig Road, Rozelle, NSW 2039

Submissions must be received by 5pm on 18 May 2022. Submissions will be managed in accordance with the Transport for NSW Privacy Statement which can be found at: <https://www.transport.nsw.gov.au/about-us/transport-privacy>.

What happens next

Transport for NSW will collate and consider the submissions received during public display of the REF.

After this consideration, Transport for NSW will determine whether or not the proposal should proceed as proposed and will inform the community and stakeholders of this decision.

If the proposal is determined to proceed, Transport for NSW will continue to consult with the community and stakeholders prior to and during construction.

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Appendix I Stage 2 Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) assessment

1 Introduction

This chapter introduces the proposal and provides the context of the environmental assessment. The proposal objectives and development history are outlined and the purpose of the report provided.

1.1 Proposal identification

Transport for NSW is proposing to upgrade Narooma Wharf (the proposal). The proposal is located on the northern side of Bluewater Drive, Wagonga Inlet, in the Eurobodalla Shire Council local government area (LGA).

The wharf (the proposal site) is currently used by tour boat operators, commercial fishing operators, as well as the local community and tourists. A public walkway and kerbside parking are located along the southern side of the proposal site.

Figure 1.1 and Figure 1.2 show the regional and local settings of the proposal site.

The existing wharf is a fixed structure that is subject to a two-metre tidal range. This affects safe access to vessels during high and low tides and limits the wharf's utilisation. The proposal includes the replacement of the existing wharf with a new wharf of similar size and position, with improved amenity and access for water-side and land-side users.

The key features of the proposal include:

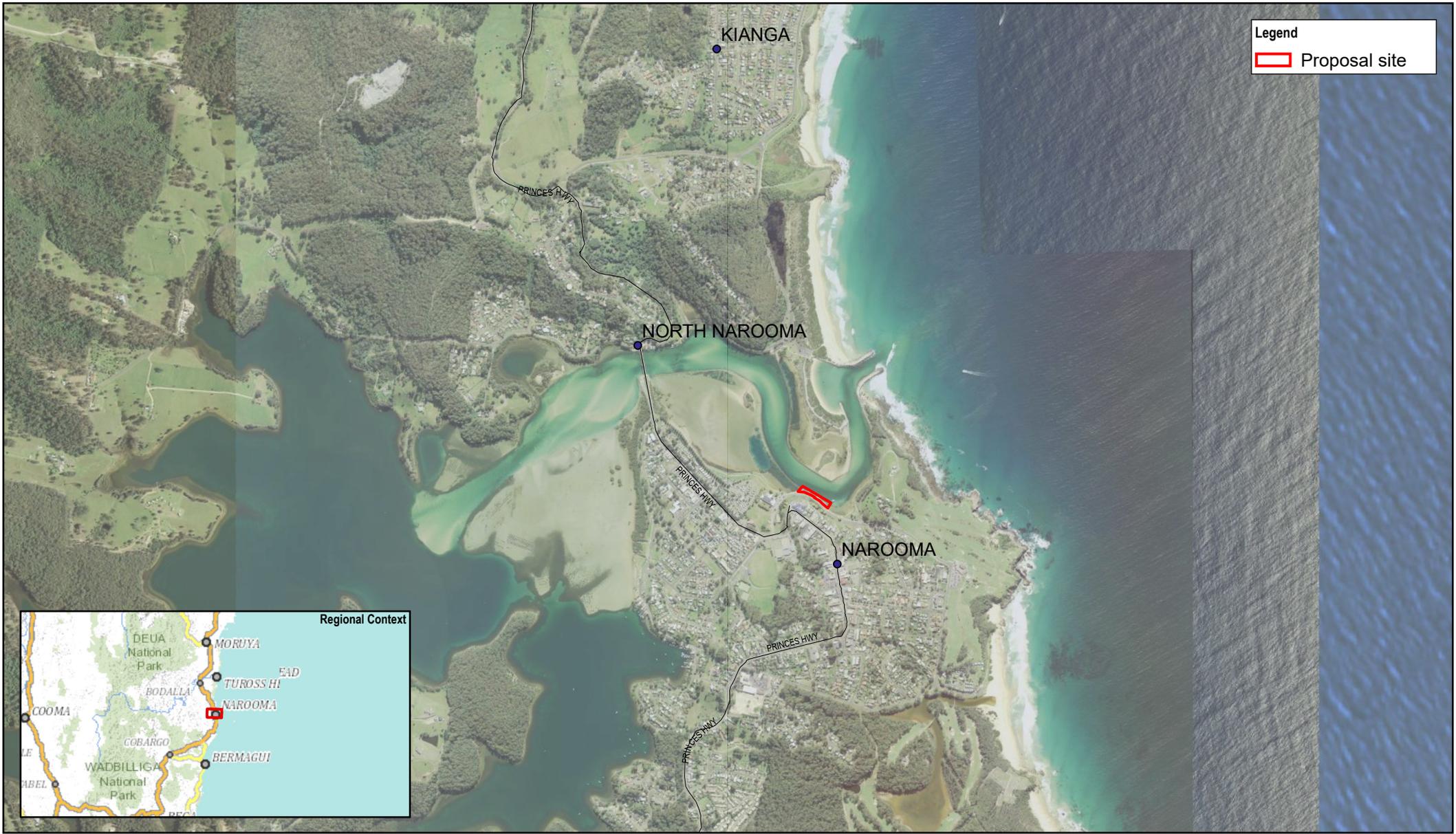
- demolition and removal of the existing wharf
- installation of a new continuous wharf structure including:
- a new 66 metre long floating pontoon with a gangway connection on the eastern side
- construction of a 77 metre long fixed wharf section on the western side
- installation of berthing and mooring infrastructure and wharf furniture such as fenders, bollards, safety ladders, rails and lighting
- ancillary wharf services such as a new sewage pump-out facility and sewer connection, upgraded firefighting and power and water service pedestals
- upgrade or repair of the seawall adjacent to the pontoon and placement of the rock revetment along a 24 metre section.

The proposed works would be staged to ensure that the wharf would remain operational during the construction period.

The proposal would provide safer access to the wharf for vessels and passengers, and improved access for passengers in accordance with the *Disability Discrimination Act 1992*.

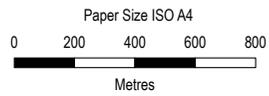
The key features of the proposal are shown in Figure 1.3. Chapter 3 describes the proposal in more detail.

The proposal would be constructed over a four-month period in mid-2022.



Legend
 Proposal site

Regional Context



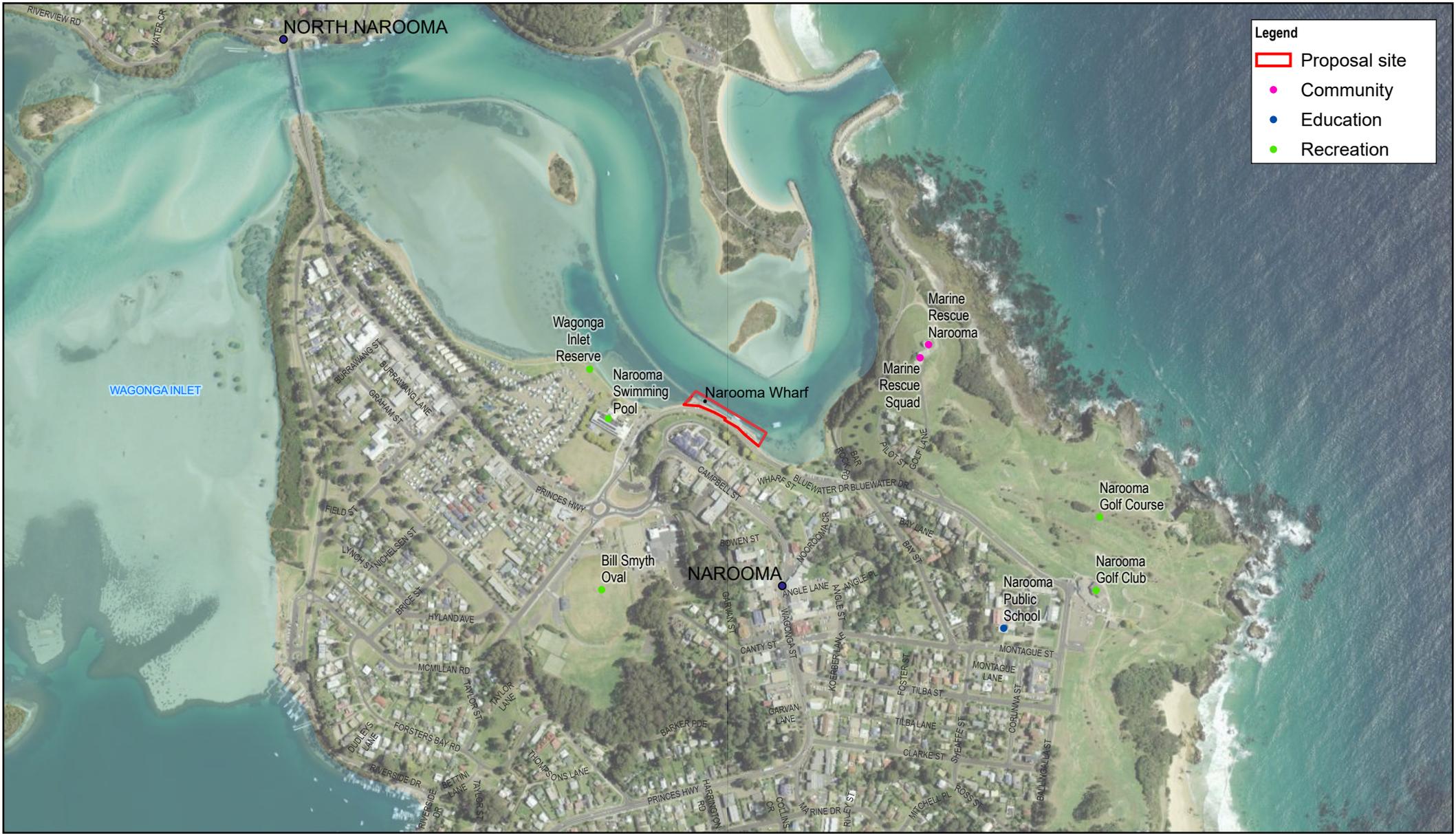
Transport for NSW
 Narooma Wharf
 Upgrade REF

Project No. 12554705
 Revision No. 0
 Date 23/09/2021

Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56

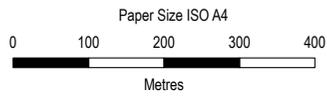
Regional setting

FIGURE 1-1



Legend

- Proposal site
- Community
- Education
- Recreation



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

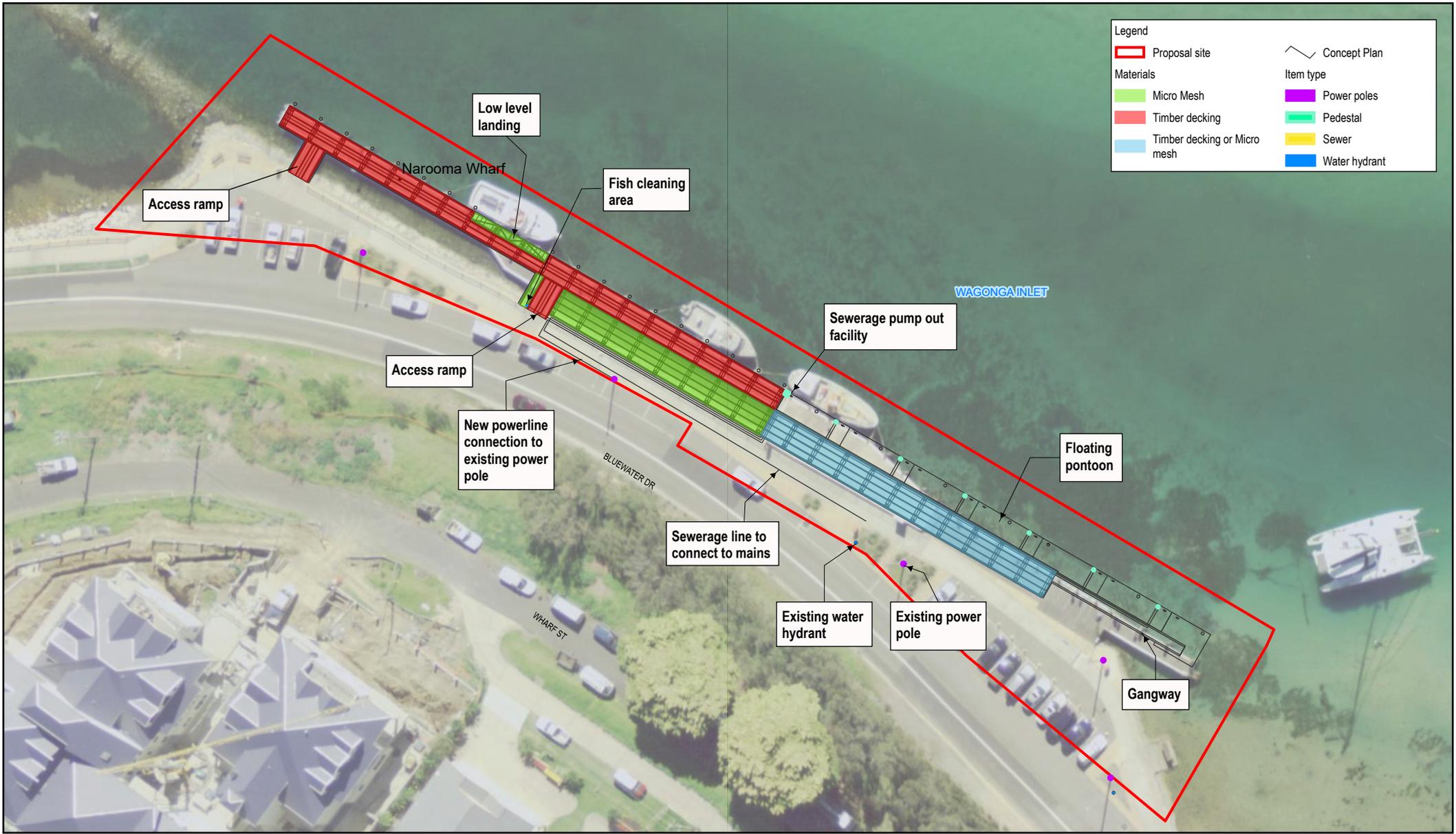


**Transport for NSW
Narooma Wharf
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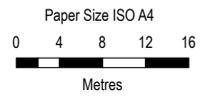
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Proposal site and locality

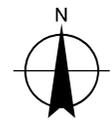
FIGURE 1-2



Legend	
	Proposal site
	Concept Plan
Materials	
	Micro Mesh
	Timber decking
	Timber decking or Micro mesh
Item type	
	Power poles
	Pedestal
	Sewer
	Water hydrant



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Transport for NSW
 Narooma Wharf
 Upgrade REF

Project No. 12554705
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 Date 1/02/2022

Key features of the proposal

FIGURE 1-3

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by GHD on behalf of Transport for NSW. For the purposes of these works, Transport for NSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed work and assessment of associated environmental impacts has been undertaken in the context of section 171 of the Environmental Planning and Assessment Regulation 2021, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (DUAP, 1995/1996), and the *Marinas and Related Facilities EIS Guideline* (DUAP, 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the REF helps to fulfil the requirements of section 5.5 of the EP&A Act including that Transport for NSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act
- the significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report
- the potential for the proposal to significantly impact any matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of Agriculture, Water and Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2 Need and options considered

This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and the selection of the preferred option for the proposal.

2.1 Strategic need for the proposal

The Maritime Infrastructure Delivery Office (MIDO) is a joint initiative between Transport for NSW, Maritime and the Department of Planning and Environment (DPE) to improve the coordination and delivery of coastal and boating infrastructure programs and projects across NSW that support recreational boating, fishing, tourism and a range of other commercial activities.

MIDO facilitates the centralised planning and delivery of maritime infrastructure and dredging services including coastal and boating infrastructure programs.

Crown Lands oversees and maintains a wide range of maritime assets including coastal harbours. This work is mostly implemented through MIDO via major projects, which are categorised as environmental projects, infrastructure projects or regional ports.

2.1.1 Coastal Infrastructure Program

The NSW Government's Coastal Infrastructure Program (2015-2019), delivered by Crown Lands and now MIDO, was developed with the key objective to help rebuild and repair key maritime assets to prolong service life and avoid critical failure. The Program is in its delivery phase which includes rebuilding and repairing key maritime assets to prolong service life and avoid critical failures. The replacement of Narooma Wharf was initiated as part of this Program.

2.1.2 NSW Regional Ports Strategy

The strategy was developed to help guide the investment, operations and growth of regional ports and infrastructure over a 10 year timeframe. Its aims are to promote regional economic growth to 2027 and it is informed by existing corporate and government strategic plans.

Narooma is one of the 25 regional ports identified by Crown Lands in the *NSW Regional Ports Strategy 2016/17*.

2.1.3 Wagonga Inlet Estuary Management Study and Plan

The *Wagonga Inlet Estuary Management Study and Plan 2001* identified a need to extend Narooma Wharf and provide boat pump-out facilities.

A review of the Study and Plan in 2010 identified the action as a priority and of high importance.

A new Coastal Estuary Management Plan is currently being prepared for Wagonga Inlet.

2.1.4 Supporting NSW strategies and policies

The proposal is also supported under the policies, goals, objectives and targets of several other strategic NSW and Eurobodalla Shire Council planning documents as summarised in Table 2.1.

Table 2.1 Other supporting strategies and policies

Strategy / Policy	Description
<p>State Infrastructure Strategy 2018- 2038 (INSW, 2018)</p>	<p>The strategy identifies the NSW Government's infrastructure vision for the state over the next 20 years, across all sectors. It is supported by the <i>Future Transport Strategy 2056</i>.</p> <p>Narooma is listed as one of NSW's 29 ports and coastal harbours in the Future Transport Strategy 2056. The proposal will support the long-term strategy covering wharf access and berthing needs.</p>
<p>NSW Maritime Infrastructure Plan 2019-2024</p>	<p>The <i>NSW Maritime Infrastructure Plan 2019-2024</i> operates in parallel with the Coastal Infrastructure Program and NSW Regional Ports Strategy. The Plan focuses on supporting and enhancing safe and sustainable boating for the public and industry in the areas that will deliver the greatest benefits, while continuing to support local projects to meet the needs of boaters across the State.</p> <p>Although Narooma Wharf is not listed as a strategically significant location in the plan, the proposal would improve access for recreational and commercial users. It is therefore consistent with the objectives of the Maritime Infrastructure Plan.</p>
<p>Disability Inclusion Action Plan 2018-2022 (TfNSW, 2017)</p>	<p>The <i>Disability Inclusion Action Plan 2018–2022</i> is Transport for NSW's plan for delivering high quality services to all customers including those with disability, including compliance with the disability standards.</p> <p>The proposal would provide improved access for all users in accordance with the Commonwealth <i>Disability Discrimination Act 1992</i> (DDA) and would therefore contribute towards meeting the aims of this plan.</p>
<p>The Disability Standards for Accessible Public Transport (DSAPT, 2002)</p>	<p><i>The Disability Standards for Accessible Public Transport</i> (DSAPT, 2002) (as amended) are a set of legally enforceable standards authorised under the DDA for the purpose of removing discrimination 'as far as possible' against people with disabilities.</p> <p>The proposal would provide improved access to the wharf in line with the DDA requirements.</p>
<p>Eurobodalla Community Strategic Plan 2017</p>	<p>This plan provides a 20-year strategic direction for the LGA identifying outcomes and strategies for the future. The proposal is aligned with the following objectives from the plan:</p> <ul style="list-style-type: none"> • strong communities, desirable lifestyle • ensure activities, facilities and services meet changing community needs.

Strategy / Policy	Description
<p><i>South East and Tablelands Regional Plan 2036</i></p>	<p>The South East and Tablelands Regional Plan 2036 is the NSW Government's strategy for guiding land use planning decisions for the South East and Tablelands Region for the next 20 years. Although Narooma Wharf is not listed specifically in the plan, the proposal would improve access for recreational and commercial users. The proposal is, therefore, aligned with the following action from the plan:</p> <ul style="list-style-type: none"> • continue to implement actions and prioritise investment in boating infrastructure as identified in relevant regional boating plans to improve boating safety, boat storage and waterway access, including better launching facilities for marine-based tourism.

2.2 Existing infrastructure

Narooma Wharf is a timber and concrete wharf, about 143 metres long located off Bluewater Drive. Its concrete midsection is about 21 metres long and is connected to a 45 metre long timber section at the eastern end, and a 77 metre long timber section at the western end. The wharf is supported by timber and concrete piles, and there is a concrete seawall supporting part of the structure.

The concrete and eastern timber sections abut the foreshore footpath and kerbside area, with level access along the timber section. There are steps down to the water level at the eastern extent. The concrete midsection is raised by about half a metre above the footpath level. The western timber section is offset from the shoreline by up to three metres and is connected to the shore via three timber foot bridges spaces about 20 metres apart (see Photo 2.1 to 2.3).

There is kerbside car parking and ancillary services including public seating, a stopping bay opposite the wharf, a public park about 100 metres along Bluewater Drive, a fish cleaning table, underground services including water supply, and overhead power lines beside the wharf.

Table 2.2 provides a list of the existing wharf infrastructure.



Photo 2.1 Narooma Wharf facing east showing raised concrete midsection that steps down to the timber deck



Photo 2.2 Narooma Wharf facing west showing the separation of the timber deck to the shoreline and two footbridges providing connection to the footpath



Photo 2.3 Narooma Wharf from footpath and kerbside showing the raised concrete midsection stepping down to the eastern section of the timber deck

Table 2.2 Existing wharf infrastructure

Element	Description
Existing infrastructure	<p>The existing wharf comprises:</p> <ul style="list-style-type: none"> • a 143 metre long concrete and timber wharf supported on piles and level with the footpath • access to water level at the eastern end of the wharf • waste oil collection and storage.
Operation	<p>Wharf operations include:</p> <ul style="list-style-type: none"> • commercial, charter, recreational and visitor vessels operate from the wharf daily • berthing and unloading • community use for private boats, recreation and fishing.

Element	Description
Ancillary facilities	<p>Ancillary facilities provided at the wharf include:</p> <ul style="list-style-type: none"> • seating areas near the western end of wharf • Rotary Park about 100 metres east of the site along Bluewater drive • sewer and water mains about 100 metres east of the site • 29 on-street car parking spaces next to the wharf • stopping bay 30 metre length on Bluewater Road opposite the wharf • the nearest wharf to Narooma Wharf is at Apex Park, on the opposite side of Wagonga Inlet close to the Marine Rescue facility.
Land ownership (as State / Local Government owned assets)	<p>Land/asset maintained by Transport for NSW includes:</p> <ul style="list-style-type: none"> • harbour bed • existing wharf structure. <p>Land/asset maintained by Eurobodalla Shire Council includes:</p> <ul style="list-style-type: none"> • road and footpath in the foreshore area • water supply and sewer main.
Other	<p>The existing wharf does not offer the following:</p> <ul style="list-style-type: none"> • sewage pump-out • fuel supply.

Due to the age and degradation of the concrete section, the structural integrity of the wharf has been assessed as being in a poor condition and it cannot meet the requirements for recreational and commercial use. Photo 2.4 shows an example of the degraded concrete components.

The concrete section is intended to allow vehicle access to service commercial vessels. However, the current wharf design is not suitable for such operations to be carried out safely. During high and low tides, passengers experience difficulty in safely boarding and accessing boats as the wharf platform is fixed.

No sewage pump-out facility is currently available at the wharf to support local tour boat operators. The current permitted disposal method is for tour boats to empty their blackwater tanks at the 12 NM territorial limit.



Photo 2.4 Example of degraded concrete structural elements under Narooma Wharf and constructed seawall

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal are to:

- improve safety and structural integrity of the wharf
- upgrade access and operational safety for vessels
- make the wharf more accessible to those with mobility impairments and parents/carers with prams
- provide on-shore services for commercial vessels to improve environmental and business outcomes.

2.3.2 Development criteria

The primary design objective of the proposal is to provide a new wharf facility that can berth up to 10 vessels, with vessel length ranging from 6 to 30 metres.

Other development criteria for the proposal include:

- ensuring that the proposal can meet ongoing commercial and private vessel needs for operational access and onshore services
- provide safe, reliable, DDA compliance so far as practicable and non-slip pedestrian access
- accommodate access for small trucks and emergency vehicles up to 10 tonnes
- provide life rings, safety equipment and fire-fighting services
- durable to exposed elements to withstand stresses and forces induced by berthing, wind, wave action and propellor wash
- ensure that access to the wharf can be maintained during construction
- be of environmentally sustainable design.

2.3.3 Urban design objectives

Urban design objectives for the proposal include:

- integrate the wharf within its local area, taking into consideration the nature of the site, local context and the surrounding biodiversity
- create a high quality, secure and positive addition to the public domain.

2.4 Alternatives and options considered

This section discusses the alternatives to the proposal and options that were considered. As the proposal is to replace the existing wharf in situ, other locations were not considered for the proposal.

2.4.1 Methodology for selection of the preferred option

The method by which Transport for NSW developed options for replacing the wharf considered:

- existing and future passenger use and service demand
- engineering design requirements and current structural integrity
- visitor safety
- environmental constraints
- build cost
- accessibility offered.

2.4.2 Identified options

The following three options were considered for the upgrade of Narooma Wharf:

- Option 1 – The ‘do nothing’ option would involve no upgrade of the existing wharf. The existing wharf would not meet its intended recreational and commercial use and would continue to degrade.
- Option 2 – This option would include a gangway and floating pontoon on the eastern end of the wharf.

- Option 3 – This option would be similar to option 2 but would have a gangway and floating pontoon at the centre of the wharf connected to the fixed wharf section.
- Option 4 – This option would be similar to option 3 with a longer pontoon section and a shorter fixed section. This option did not meet all the stakeholders needs for loading/unloading vessels from a stable platform.

2.4.3 Analysis of options

An analysis of the identified options is provided below.

Option 1 (do nothing)

Not upgrading the wharf would have:

- increased safety risks for vessels and passengers with continued concrete degradation and weathering of timber sections
- continued difficult passenger access at high and low tides
- tour boat operators would continue to dispose of sewage and wastewater at the 12 NM limit before returning to the wharf.

Option 1 was discounted as it would not meet the proposal objectives or strategic needs described in section 2.1.

Option 2 (eastern gangway)

Placing the pontoon landing at the eastern end of the wharf may result in impacts on seagrasses at the landing area. Dredging would be required to ensure that the new wharf pontoon on the eastern end floats at the lowest astronomical tide. This option may require minor repairs to the sea wall. However, less dredging would be required along the seawall length compared to options 3 and 4.

Option 2 may have a higher impact on mapped seagrasses compared to the other options.

A photomontage of option 2 is provided in Figure 2.1.

Option 3 (central gangway)

Option 3 would require a major sea-wall reconstruction and a greater volume of marine sediment to be dredged (compared to option 2) along the centre of the seawall to keep the pontoon section afloat during low tide. Dredging would be easier at this location as the operation could take place from shore rather than a construction barge or pontoon.

Option 3 would less likely result in the direct loss of seagrasses compared to option 2 and would be the preferred option for marine ecology.

A photomontage of option 3 is provided in Figure 2.2.

Option 4 (longer pontoon section)

This design option would require more dredging to accommodate the longer pontoon. This option was discounted after consultation with wharf users as the longer pontoon would not provide the required stable access for the loading and unloading of vessels.



Figure 2.1 Photomontage of option 2 (eastern gangway) looking south



Figure 2.2 Photomontage of option 3 (central gangway) looking south

2.5 Preferred option

Option 2 (gangway to the east) was selected as the preferred option. Option 2 would fulfil the proposal's strategic needs, objectives and development criteria and would not require full reconstruction of the sea wall. Option 3 was discounted as it did not meet the loading and unloading requirements of all wharf users.

Transport for NSW will complete a detailed assessment of the seawall's condition after the concrete section is demolished, and the wall can be accessed safely.

For the purpose of this REF, the potential for impacts from option 2 on seagrasses was used to ensure worst case impacts on marine ecology were considered.

A description of the proposal is provided in chapter 3.

3 Description of the proposal

This chapter describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

3.1 The proposal

The proposal to upgrade Narooma Wharf would include:

- staged demolition and removal of the existing wharf commencing with the eastern section. This would include the staged removal of the:
 - wharf deck and furniture
 - timber and concrete piles
 - utilities
- construction of a new main wharf, 77 metres long by four metres wide that is fixed and connected to the shore via walkways and infill micromesh
- construction of a new 66 metre long by four metre wide floating pontoon that is connected to a shore-side platform via a gangway with a landing platform
- installation of a ten metre long lower-level landing, halfway along the main fixed wharf, with stairs connecting the landing to the main wharf and shore level
- installation of berthing and mooring infrastructure and wharf furniture such as fenders, bollards, safety ladders, rails and lighting
- ancillary wharf services such as a new sewage pump-out facility and sewer connection, upgraded firefighting and power and water service pedestals
- upgrade of the seawall adjacent to the pontoon and placement of rock revetment along a 24-metre section, if required.

The features of the proposed upgrade to Narooma Wharf are shown in Figure 1.3.

3.2 Design

3.2.1 Design criteria

To achieve the proposal objectives and development criteria, the concept design for the Narooma Wharf Upgrade has applied the following design codes and standards:

- AS1170.0:2002 – Structural Design Actions – General Principles
- AS1170.1:2002 – Structural Design Actions – Permanent, Imposed and Other Actions
- AS1428-2010 – Design for Access
- AS1657:2018 – Fixed Platforms, Walkways, Stairways and Ladders
- AS2159:2009 – Piling - design and installation
- AS2239:2003 – Galvanic (sacrificial) Anodes for Cathodic Protection

- AS/NZS2312:2002 – Guide to The Protection Of Structural Steel Against Atmospheric Corrosion By The Use Of Protective Coatings
- AS3600:2018 – Concrete Structures
- AS3962:2020 – Marina Design
- AS4100:1998 – Steel Structures
- AS/NZS4617:2019 – Steel for the Reinforcement of Concrete
- AS4997:2005 – Guidelines for the Design of Maritime Structures
- AS5100:2017 – Bridge Design
- AS/NZS1158.3.1:2020 – Lighting for roads and public spaces pedestrian area (Category P)
- NSW Maritime Engineering Standards and Guidelines
- National Construction Code Series (Building Code of Australia)
- Coastal Engineering Manual (USACE, 2008)
- Shore Protection Manual (USACE, 1984)
- Disability Standards for Accessible Public Transport 2002.

3.2.2 Engineering and design constraints

Table 3.1 lists the main constraints shaping the proposal and describes how they have been addressed in the construction methodology or concept design.

Table 3.1 Engineering and design constraints

Constraint	Concept design provision
Ongoing access for working and commercial vessels	Staged construction to allow for continued operation of the wharf at all times.
Tidal limits for sea floor access	Dredging would be undertaken at low tide.
Sensitive marine environment with protected aquatic vegetation and marine fauna	Minimal dredging is proposed (less than 1000 m ³). Dredging would be undertaken at low tide.
Local heritage items	Works area is off set from local heritage items. Use exclusion zone if necessary.
Potential acid sulphate soils and contamination	Geotechnical and contamination assessment would include analysis for potential acid sulphate soils and contamination.
Safe access for vessels at high and low tide	Accommodate low tide access levels via pontoon and low-level fixed wharf areas. Dredging would be undertaken beneath the proposed pontoon area for safe operation during full loading and low tide conditions.
Safe access to vessels from wharf at high and low tide	Incorporate gangway ramp for permanent access to pontoon level.

3.2.3 Major design features

The new wharf would be located in the same location as the existing wharf and would be approximately 143 metres long overall. The new wharf is proposed to be no wider than the current fixed wharf. The major design features of the new wharf (for option 2 “gangway east”) are described below.

Main wharf and lower-level landing

A new main wharf would be built to replace the existing fixed concrete wharf. The new main wharf would be built in the same location with its deck fixed at the same level as the existing footpath. It would be 77 metres long and 3 metres wide and connected to the shore via infill micromesh walkways. The main wharf would be built using timber decking and micro-mesh materials.

The main wharf would require about 40 steel piles to support the wharf deck with a 5 Kpa capacity. Submerged and upper sections of steel piles will be protected from corrosion by having a protective coating system applied such as a HDPE liner. The main wharf would remain able to berth boats and other vessels accommodating vessel lengths between 6 metres to 30 metres.

A lower-level landing would be installed halfway along the main fixed wharf with the main purpose of landing is to load/unload vessels on low water. The landing would be about ten metres long, fixed and with stairs connecting it to the main wharf and shore level. The lower-landing would require about two steel piles and the deck would be built using a fabricated steel module with mini mesh treads and landing to achieve a deck capacity of 5 Kpa. The lower landing would be able to berth boats and other vessels accommodating vessel lengths between 6 metres to 30 metres.

Floating pontoon

The floating pontoon would be built using engineered foam covered with concrete. It will be 66 metres long and four metres wide. The floating pontoon will rise and fall with the tide making it easier for passengers to board and disembark from boats and other vessels and improve safety for passengers.

The pontoon would have safety handrails installed and these would be constructed in steel. The gangway that connects the pontoon to the shore-side platform would be built using reinforced concrete and fibre reinforced plastics and be located either east-facing or centre-facing (refer to section 2.5).

The pontoon would be held in place by steel piles lined with HDPE and with a white fibreglass bird cap. The number of piles required for the floating pontoon would be about seven. The shore side platform and gangway would include a stainless-steel safety handrail. The berthing line for the pontoon section would be in line with the fixed main wharf.

Berthing and mooring infrastructure

Fender piles will be installed along the main wharf and lower level landing with a rubbing strip and white fibreglass bird cap. About 18 steel fender piles would be installed spaced at four metre intervals.

Safety ladders will be installed at 60 metre intervals along the length of the wharf and be constructed of stainless steel.

Safety rails will be installed, where required, and will be galvanised steel.

Existing lighting to the wharf would remain unchanged. No additional lighting is proposed.

Six mooring cleets will be installed along the length of the floating pontoon to assist with berthing.

Other wharf furniture which will be provided includes a fish cleaning table next to the central access ramp.

Wharf services and utilities

An upgrade to existing wharf services and utilities would be undertaken to provide a new sewage pump-out system for vessels. This would include a single unit placed on the berthing area in the centre of the main fixed wharf. This unit would be connected to the main sewerage network and maintained by Council.

Electrical supply to the new wharf for lighting and for the new sewage pump-out system would be installed from the main grid. Light, power and water pedestals would be installed at six locations along the length of the floating pontoon.

A water hydrant would be installed near the eastern floating pontoon and set back behind the pedestrian path. A water stop valve would be located next to the central ramp access.

Seawall (rock revetment)

The current condition of the seawall will not be fully known until the demolition works have been completed. Where the need for repairs are identified, these would be undertaken as required. The repairs could include installation of additional rock armour, concreting patches, or potentially major repair work such as sheet piling repairs.

A photomontage of option 2 is provided in Figure 2.1.

3.3 Construction activities

3.3.1 Work methodology

For the wharf to remain operational at all times, construction would be staged as follows:

- Stage 1 would include the demolition of the concrete and eastern timber sections of the wharf and the construction and commissioning of the floating pontoon.
- Stage 2 would include the demolition of the western timber section of the wharf and the construction and commissioning of the new fixed wharf.
- Any need for seawall reconstruction at the wharf would be confirmed after an inspection and again after demolition.

The proposed construction activities for the proposal are summarised in Table 3.2 and further described in the subsections below. The construction methodology would be further developed during detailed design by the nominated Contractor in consultation with Transport for NSW.

Table 3.2 Indicative construction staging for key activities

Stage	Activities
<p>Site establishment and enabling works</p>	<p>Site establishment would include:</p> <p>Land-side work:</p> <ul style="list-style-type: none"> • establishment of temporary site compound (installation of fencing, site office, amenities, plant/material storage area etc.) • establishment of environmental controls and traffic controls (including for vehicles, boats and other vessels and pedestrians) in accordance with the construction environmental management plan (CEMP) • remove and relocate utility services as needed <p>Water-side work:</p> <ul style="list-style-type: none"> • establishment of a construction work area using floating booms and buoys to delineate the area and provide a physical boundary which boats and vessels would not be permitted to cross for safety reasons • environmental controls would be established in accordance with the CEMP.
<p>Stage 1 - Demolition and removal of eastern side of wharf and construction of new section</p>	<p>Stage 1 work would include:</p> <ul style="list-style-type: none"> • demolition of the concrete section • demolition of the eastern timber section and full removal of existing piles. If full removal is not possible, piles would be cut off below the seabed. • dredging along eastern shoreline with a long reach excavator or barge mounted excavator • potential seawall reconstruction • bore seven piles for the new floating pontoon section and gangway landings. Piles would be installed using the torque head method. This involves piles being screwed into place and then hammered to set them into final position. • offsite construction of the floating pontoon and transport to site • installation of the floating pontoon, gangway, wharf furniture and service pedestals, including sewage pump out • commissioning of services, utilities, and opening of stage 1.

Stage	Activities
Stage 2 - Demolition of western side of wharf and construction of new section	Stage 2 would include: <ul style="list-style-type: none"> • demolition of western timber section and removal of existing piles • installation of steel piles. Piles would be installed using the torque head method. It is not expected that impact driving of piles would be required. • installation of precast concrete headstocks • pour grout connections • installation of the steel sub-framing • installation of the timber decking • installation of wharf furniture and utility connections • commissioning of services, utilities and opening of stage 2.
Decommissioning of temporary facilities and site demobilisation	Decommissioning works would include: <ul style="list-style-type: none"> • removal of temporary facilities • repair of any damage to public walkway • removal of environmental controls • completion of site clean-up and tidying works.

3.3.2 Construction hours and duration

The proposed works would be estimated to begin in mid-2022 and are expected to take four months to complete.

The majority of works required for the proposal would be undertaken during standard construction hours, which are as follows:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturdays
- no work on Sundays or public holidays.

No out of hours works are expected to be required.

The demolition of the concrete wharf would be undertaken during standard hours, using pneumatic hammers and other concrete breaking tools, and is estimated to take between three to four weeks to complete.

3.3.3 Plant and equipment

The plant and equipment on site would vary depending on the construction activity and would generally include:

- excavator-mounted hydraulic concrete breaker
- powered hand tools (including concrete and floor saws, chainsaws, concrete breakers and angle grinders)
- barge-mounted plant
- light vehicles
- hiab cranes
- heavy bump trucks
- low-loader heavy truck
- piling equipment (excavator with torque head and hydraulic excavator with pile helmet)
- barge/boat and towing vessel
- portable compressors and generators.

3.3.4 Earthworks

The proposal would require the dredging of up to 1000 cubic metres of marine sediment to ensure that the pontoon continues to float on the lowest astronomical tides. Piling would also be required for the new pontoon section and gangway landings. Where possible, dredging would be carried out from the shore using a long-reach excavator, or from a barge mounted excavator.

The dredged material would be loaded into skip bins for licenced disposal or reuse, depending on waste classification.

The extent and location of proposed dredging is shown in Figure 3.1.

Trenching would also be required along Bluewater Drive for the installation of a sewer pipeline. Trench dimensions would be about 0.4 metres wide and 0.8 metres deep.

Any excavated material that cannot be reused would be waste classified prior to transport and disposal off site at appropriate licensed facility.

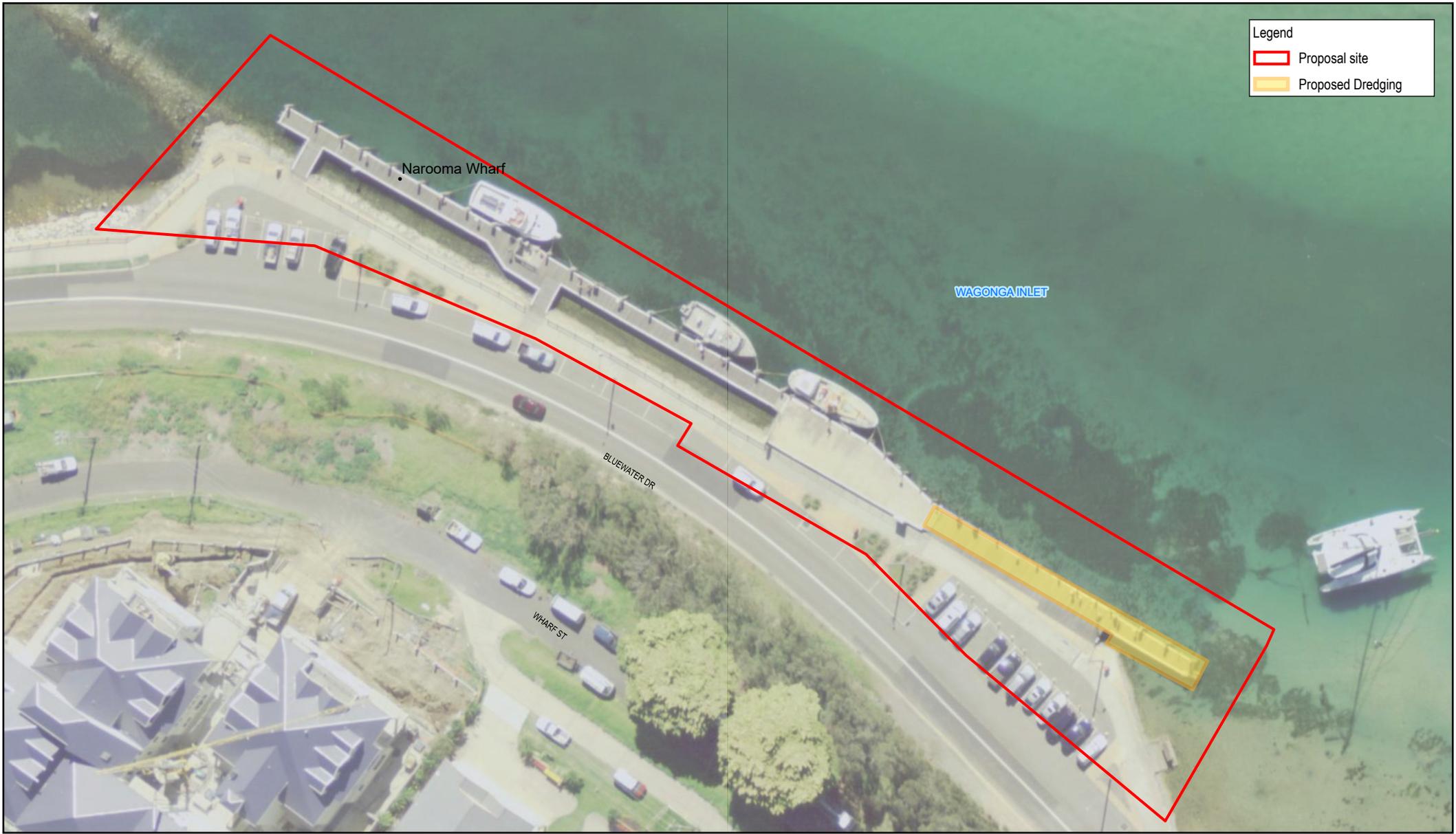
3.3.5 Source and quantity of materials

The source and quantity of materials would be determined during the detailed design phase of the proposal and would consider the requirements of the Transport for NSW *Sustainable Design Guidelines – Version 4.0* (TfNSW, 2019). Materials would be sourced from local suppliers where practicable. Reuse of existing and recycled materials would be undertaken where practicable.

All waste generated during the project will be managed following the approved Contractor's waste management plan and disposed of at a licenced waste facility if reuse and recycling options are not available. Main sources of waste would be from the demolition of existing wharf and structures:

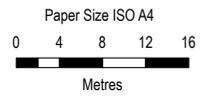
- about 75 cubic metres (m³) or 170 tonnes of concrete material from the main wharf
- about 140 m³ of timber from the eastern and western wharf decks.

Dredged material (approximate 1000 cubic metres) would be tested and classified in accordance with the NSW EPA's *Waste Classifications Guidelines* (November 2014) to determine feasible disposal options.

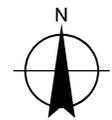


Legend

- Proposal site
- Proposed Dredging



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



**Transport for NSW
 Narooma Wharf
 Replacement REF**

Project No. **12554705**
 Revision No. **0**
 Date **1/02/2022**

Proposed dredging

FIGURE 3-1

3.3.6 Traffic management and access

Most of the construction plant, equipment, material and personnel would travel to site by the public road network. There will be some construction traffic and delivery of materials by barge or boat from other nearby locations.

It is anticipated that construction barges would be delivered to a nearby boat ramp by road (such as Apex Park or another nominated ramp) where a crane would be used to unload the pontoons into the water for towing to the worksite. Overhead power lines in the vicinity of the wharf would limit access for crane activity at the wharf without road closure.

Where major components are scheduled for delivery at the wharf or via a suitable boat ramp access, additional traffic management solutions and access would be required.

Way-finding and other measures for safe pedestrian movement, and passenger onboarding and disembarking during construction would be required.

Boating and vessel use of the wharf would be limited to berthing areas that are not impacted by construction and remain safe to use. Information to boating and vessel operators would be provided during construction and clear delineation of water-side works would be undertaken to maintain safe navigation to and from the wharf.

Maritime and road traffic and transport impacts associated with the proposal are assessed in section 6.8 of this REF.

3.4 Ancillary facilities

A temporary construction compound would be required to accommodate a site office, amenities, laydown and storage area for materials. Up to seven car parking spaces would be used for the compound and loading/unloading area (refer to Figure 3.2). Impacts associated with utilising these areas have been considered in the environmental impact assessment in chapter 6 of this REF.

3.5 Public utility adjustment

A sewer connection would be required as part of the proposed sewage pump-out facility. The proposed connection would involve installing a 160 - 200 metre long pipeline with a nominal diameter of 100 millimetres along Bluewater Drive. Trench dimensions would be about 0.4 metres wide and 0.8 metres deep. The proposed location of the sewer pipeline is shown on Figure 3.2.

Electrical supply for the services pedestal on the floating pontoon will be provided by connecting into the existing power pole located behind the existing pedestrian path (refer to Figure 3.2). Similarly, water services will be connected to existing scheme water from a proposed new stop valve located next to the central access ramp. There are no other proposed adjustments to public utilities outside of the proposal site. The proposal has been designed to avoid the relocation of services where feasible. In the event that works would be required outside the proposal site, further assessment would be undertaken. The appropriate utility providers would be consulted during the detailed design phase.



Legend

Loading/Unloading area	Sewerage connection impact area
Site compound	Pumpout
Fixed wharf	Sewer pumpout connection
Proposed pontoon wharf	Concept Plan
Proposal site	
Proposed sewer alignment	

Paper Size ISO A4
 0 4 8 12 16
 Metres



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56

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Proposed utility alignment

FIGURE 3-2

3.6 Property acquisition

Transport for NSW does not propose to acquire any property as part of the proposal. The proposal site is located on Crown land that is subject to a registered Native Title Claim application made by the South /Coast People (NC2017/003). Transport for NSW has issued section 24K notifications to Claimants as required under the *Native Title Act 1993*.

The temporary ancillary facilities and utility connections would be located on Blue Water Drive which is owned and managed by Eurobodalla Shire Council.

4 Statutory planning framework

This chapter provides the statutory and planning framework for the proposal and considers the provisions of relevant state environmental planning policies, local environmental plans and other legislation.

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Transport and Infrastructure) 2021

In March 2022, the State Environmental Planning Policies (SEPPs) were updated. The former State Environmental Planning Policy (Infrastructure) was incorporated into the State Environmental Planning Policy (Transport and Infrastructure) 2021. Chapter 2 of the SEPP aims to facilitate the effective delivery of infrastructure across the State.

Section 2.79(4) of the Transport and Infrastructure SEPP permits development for the purpose of wharf or boating facilities to be carried out on any land, by or on behalf of a public authority without consent. However, such development may only be carried out on land reserved under the *National Parks and Wildlife Act 1974* if the development is authorised by or under that Act.

As the proposal is for the purposes of a boating facility and is to be carried out by Transport for NSW, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Development consent from council is not required. The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974*.

It is noted the Transport and Infrastructure SEPP prevails over all other environmental planning instruments except where State Environmental Planning Policy (Planning Systems) 2021 and State Environmental Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP) applies. The proposal does not require consideration under the Planning Systems SEPP. The proposal is located within a mapped 'coastal environmental area' and 'coastal use area'. Further consideration of this SEPP is provided further below.

Part 2.2 of the Transport and Infrastructure SEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by the Transport and Infrastructure SEPP (where applicable), is discussed in Section 5 of this REF.

State Environmental Planning Policy (Planning Systems) 2021

The Planning Systems SEPP identifies development that is State significant infrastructure and critical State significant infrastructure.

Section 2.13(1) of the Planning Systems SEPP declares development to be State significant infrastructure if the development is, by the operation of a State environmental planning policy, permissible without development consent and the development is specified in Schedule 3 of the SEPP.

Schedule 3 specifies that development for the purpose of port and wharf facilities or boating facilities (not including marinas) by or on behalf of a public authority that has a capital investment value of more than \$30 million is State significant infrastructure.

The proposal has a capital investment value of less than \$30 million so does not become State significant infrastructure as declared by the Planning Systems SEPP.

State Environmental Planning Policy (Resilience and Hazards) 2021

The Resilience and Hazards SEPP aims to manage risk and build resilience related to hazards. Development controls related to hazardous development and the approach to coastal management areas are included.

Chapter 2 of the SEPP outlines the management of development and protection of environmental assets within the coastal zone. This Chapter gives effect to the objectives of the *Coastal Management Act 2016* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone. The coastal zone is comprised of four coastal management areas:

- coastal wetlands and littoral rainforest area
- coastal vulnerability area
- coastal environment area
- coastal use area.

The proposal is located within land mapped as ‘coastal environment area’ and ‘coastal use area’ under the Resilience and Hazards SEPP. The proposal is not located on any land mapped as coastal wetlands, littoral rainforest or coastal vulnerability area under the Resilience and Hazards SEPP.

Chapter 2, sections 2.10 and 2.11 of the Resilience and Hazards SEPP outline specific assessment criteria to be applied when assessing developments that require consent that fall within the ‘coastal environment area’ and ‘coastal use area’, respectively.

As the proposal does not require development consent under the provision of the Transport and Infrastructure SEPP, section 2.10 of the Resilience and Hazards SEPP does not apply. Notwithstanding, the proposal is not considered likely to have any impact on coastal environmental values.

4.1.2 Local Environmental Plan

Eurobodalla Local Environmental Plan 2012

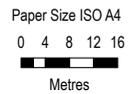
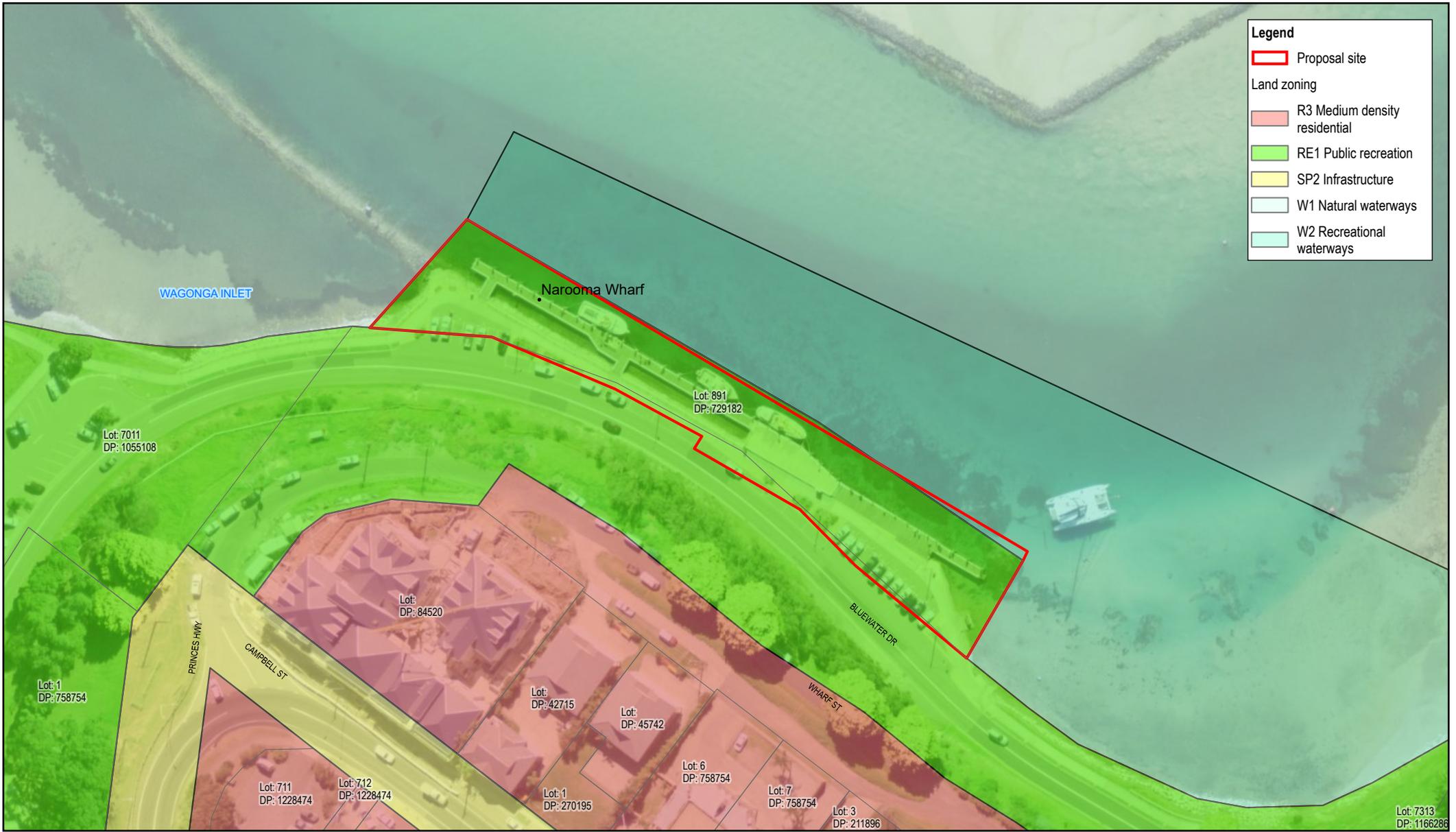
The proposal is located within the Eurobodalla LGA. The *Eurobodalla Local Environmental Plan 2012* (Eurobodalla LEP) is the governing environmental planning instrument for the Eurobodalla LGA, including Narooma.

The provisions of the Transport and Infrastructure SEPP mean that local environmental plans (LEPs) do not apply. However, during the preparation of this REF, the provisions of the Eurobodalla LGA were considered.

Table 4.1 summarises the relevant aspects of the Eurobodalla LEP applicable to the proposal. Figure 4.1 shows the relevant section of the zoning map from the Eurobodalla LEP, with the indicative location of the proposal.

Table 4.1 Relevant provisions of the Eurobodalla LEP

Provision description	Relevance to the Proposal
<p>Zoning: RE1 Public Recreation and W2 Recreational Waterways</p>	<p>The proposal is located on land zoned as RE1 Public Recreation and W2 Recreational Waterways.</p> <p>The land use objectives within the RE1 zone include:</p> <ul style="list-style-type: none"> • to enable land to be used for public open space or recreational purposes • to provide a range of recreational settings and activities and compatible land uses • to protect and enhance the natural environment for recreational purposes • to conserve the scenic and environmental resources of the land including the protection of environmental assets such as remnant vegetation, waterways and wetlands, and habitats for threatened species, populations and communities. <p>The land use objectives within the W2 zone include:</p> <ul style="list-style-type: none"> • to protect the ecological, scenic and recreation values of recreational waterways • to allow for water-based recreation and related uses • to provide for sustainable fishing industries and recreational fishing. <p>The proposal is consistent with the objectives of the zone as the land would be continued to be used for public recreational use. The proposal would also enhance and protect the natural environment and seek to protect environmental assets through the provisions of safeguards and management measures identified in this REF.</p>
<p>Clause 5.10 – Heritage Conservation</p>	<p>The proposal site is mapped as a heritage item of local significance under the Eurobodalla LEP. An email dated 30 August 2021 from Eurobodalla Shire Council confirmed that the heritage listing applies only to the Wharf Pylon located about 29 metres west of the current wharf and does not apply to the whole site. The location of Narooma wharf is also listed on the NSW Maritime Heritage Register. Impacts to heritage are discussed in sections 6.9 and 6.10.</p>
<p>Clause 5.12 – Infrastructure development and use of existing buildings of the Crown</p>	<p>The LEP does not restrict or prohibit the carrying out of development by, or on behalf of a public authority, that is permitted with or without consent, or is exempt development under the Transport and Infrastructure SEPP.</p>



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



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Upgrade REF

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Land zoning

FIGURE 4-1

4.2 Other relevant NSW legislation

4.2.1 Marine Estate Management Act 2014

In NSW, marine parks are declared and managed under the *Marine Estate Management Act 2014* by NSW Department of Primary Industries. The proposal site is located within Batemans Marine Park, which is located on the NSW south coast between Murramarang Beach near Bawley Point in the north and the entrance to Wallaga Lake at Murunna Point in the south.

The Batemans Marine Park management rules are addressed in Part 7 of the *Marine Estate Management (Management Rules) Regulation 1999* and include a description of the zoning plan for the Marine Park.

The proposal site is located within the Narooma Wharf special purpose zone (SPZ) (refer to Figure 4.2). Clause 7.13 of the *Marine Estate Management (Management Rules) Regulation 1999* notes that the object of the Narooma Wharf special purpose zone is to provide for foreshore and maritime facilities and infrastructure. The SPZ contains objectives “to cater for special facilities and features in the zone such as slipways, breakwaters, berthing facilities and shipwrecks” as well as to provide for the management of biological diversity, habitat, ecological processes, and natural and cultural features in the zone, where phenomena, sites or items warrant such special management” within the Marine Park.

Infrastructure development is permissible within the Narooma Wharf SPZ subject to permits being obtained for construction and demolition works in accordance with clause 1.22(2) of the *Marine Estate Management (Management Rules) Regulation 1999*. This is described in further detail below. The permit application must be supported by a Construction Environmental Management Plan, site environmental plan, environmental work method statement, environmental risk assessment and erosion and sediment control plan.

NSW Department of Primary Industries’ *NSW Mainland Marine Park Network – Draft Management Plan 2021 – 2031* (July 2021) applies to the Batemans Marine Park. The Draft Management Plan was released on 1 November 2021 for public comment closing on 31 January 2022. The Plan identifies the community and cultural values for five mainland marine parks, including priority threats to these values, objectives and actions to achieve the goals of the management plan. The proposal to replace the existing Narooma Wharf is consistent with the following key infrastructure actions stated in the Draft Management Plan:

- Action 1.3a: Support implementation of best-practice rock revetment, seawall and breakwater design to maximise community access and environmental values.
- Action 5.1a: work with local stakeholders to map and improve the network of formal boat and watercraft launching, fish cleaning, boat storage and boat maintenance facilities in marine parks to facilitate access for powered and unpowered watercraft and ensure facilities best meet local needs.
- Action 5.4c: Ensure access and opportunity for disabled and elderly people in marine parks.

The REF safeguards listed in section 7.2 identify the measures that will be implemented to minimise impacts on community, cultural and environmental values of the marine park.



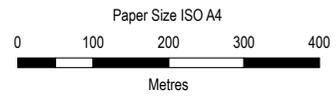
MILL BAY
SPECIAL
PURPOSE ZONE

No spearfishing
east of bridge

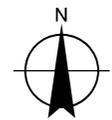
WAGONGA HEAD HABITAT
PROTECTION
ZONE (RESTRICTED) No
collecting plants or
invertebrates by
hand (including
lobster and abalone)

NAROOMA WHARF
SPECIAL
PURPOSE ZONE

FORSTERS
BAY SPECIAL
PURPOSE ZONE



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Transport for NSW
Narooma Wharf
Upgrade REF

Batmans Marine
Park Zoning

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FIGURE 4-2

Permit requirements

A permit is required for infrastructure development within Batemans Marine Park special purpose zones. Transport for NSW (and/or the construction contractor) would be required to obtain a permit from the Marine Estate Management Authority under Part 2 of the *Marine Estate Management Regulation 2017*.

When considering the permit application, the Department of Primary Industries would be required to consider the application against the criteria outlined in clause 9 of the *Marine Estate Management Regulation 2017*. These criteria are in Table 4.2.

Table 4.2 Assessment criteria for the Marine Park permit

Assessment criteria	Consistency of the REF proposal
(a) the objects of the Act	<p>The proposal meets these objectives including the proposal's contribution to the cultural, social and recreational use of the marine estate, and its ongoing function for regional economic opportunities.</p> <p>It is not considered to contravene the objectives of the adjacent habitat protection zone as it would not result in substantial impacts on the biological diversity of the zone or substantial impacts to heritage due to the relatively small-scale nature of the works, and the proposed protection measures.</p> <p>The proposal is consistent with the principles of ecologically sustainable development.</p>
(b) the purposes of marine parks and aquatic reserves (as specified in Sections 22 and 33 of the Act respectively)	<p>The proposal is intended to support the purposes of marine parks via the objectives including:</p> <ul style="list-style-type: none"> The proposal is not considered to impact on the primary purpose of a Marine Park which is to conserve biological diversity. This is because the proposal would only impact on a small area of vegetation which is located within the Marine Park and therefore is not considered to reduce the diversity within the marine park. Further detail is provided in section 6.7.
(c) the objects of the zone in which the activity is proposed to be carried out	<p>The proposal meets the objects of the special purpose zone, which is to provide for foreshore and maritime facilities and infrastructure.</p>
(d) the activities that are permissible in the zone in which the activity is proposed to be carried out (as specified in the relevant management rules)	<p>The proposal is for the purpose of public safety as the existing wharf is showing signs of deterioration and is considered a safety risk to wharf users. This is consistent with the uses for which consent may be given (and a permit obtained) within the special purpose zone, under clauses 1.22(2) of <i>Marine Estate Management (Management Rules) Regulation 1999</i>.</p>

Assessment criteria	Consistency of the REF proposal
<p>(e) any operational plan for the marine park adopted by the Marine Parks Authority pursuant to section 25 (4) of the <i>Marine Parks Act 1997</i> (before its repeal) that continues to have effect because of clause 5 of Schedule 2 to the <i>Marine Estate Management Act 2014</i></p>	<p>The 2010 Batemans Marine Park Operational Plan states, ‘special purpose zones have been established to provide for activities including coastal infrastructure development’.</p> <p>Due to the small-scale nature of the proposal, it is considered consistent with the management actions outlines in the plan as it would not involve any substantial impacts on biological diversity within the marine park and in the adjacent habitat protection zone.</p>
<p>(f) any management plan for the marine park or aquatic reserve</p>	<p>Pilot work has started using a new approach to marine park management planning for the Batemans Marine Park by the NSW Marine Estate. The 2010 Batemans Marine Park Operational Plan is considered to be the management plan for this Marine Park.</p>
<p>(g) any threatened species or other protected flora or fauna under the <i>Fisheries Management Act 1994</i>, the <i>National Parks and Wildlife Act 1974</i> or the <i>Threatened Species Conservation Act 1995</i> that may be affected by the proposed activity</p>	<p>Impacts on threatened species or other protected flora and fauna are discussed further in section 6.7.</p>
<p>(h) the form of transport to be used to gain access to the zone in, on or from which the activity is proposed to be carried out, having regard to the adequacy of facilities for parking, mooring and landing vehicles, vessels and aircraft, and for loading and unloading them</p>	<p>Construction site access and traffic is described in section 6.8.</p>
<p>(i) the type of equipment to be used in connection with the proposed activity</p>	<p>Construction equipment is described in section 3.3.3.</p>
<p>(j) the arrangements that have been made for the prevention, mitigation and making good of any damage to the marine park or aquatic reserve arising from the proposed activity</p>	<p>Safeguards and management measures are provided in Chapter 7 to prevent and mitigate any potential impacts to the marine park arising from the proposal.</p>
<p>(k) such other requirements as the relevant Ministers consider appropriate to the proposed activity</p>	<p>Not applicable</p>

Considerations of the consent authority

Under Section 55(3) of the *Marine Estate Management Act 2014*, prior to determining a granting approval to carry out an activity under Part 5 Division 5.1 of the EP&A Act within a marine park, the determining authority must consider the following:

- if there are management rules for the marine park or aquatic reserve, the purposes of the zone within which the area concerned is situated as specified in those management rules
- the permissible uses of the area concerned under the regulations or those management rules
- if a management plan for the marine park or aquatic reserve has been made, the objectives of the marine park or aquatic reserve
- any relevant marine park or aquatic reserve notifications.

An assessment of the proposal against the above consideration forms part of the assessment criteria for the Marine Park permit. Table 4.2 demonstrates how the proposal meets the above considerations.

4.2.2 Other relevant NSW legislation

Table 4.3 lists the NSW legislation relevant to the proposal or the land on which the proposal would be built.

Table 4.3 Other relevant NSW legislation

Legislation and application	Relevance to proposal and further requirements
<p>National Parks and Wildlife Act 1974: provides for the protection of Aboriginal heritage values, national parks and ecological values. Makes it an offence to harm Aboriginal objects, places or sites without permission.</p>	<p>A Stage 2 Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) assessment confirmed that the proposal would avoid impacts to known Aboriginal heritage items (Appendix I). An Aboriginal heritage impact permit (AHIP) is not required for the proposal. Further detail is provided in section 6.9.</p>
<p>Heritage Act 1977: provides for the protection of conservation of buildings, works, maritime heritage (wrecks), archaeological relics and places of heritage value through their listing on various State and local registers. Makes it an offence to harm any non-Aboriginal heritage values without permission.</p>	<p>The proposal site is mapped as a heritage item of local significance under the Eurobodalla LEP. An email dated 30 August 2021 from Eurobodalla Shire Council confirmed that the heritage listing applies only to the Wharf Pylon located about 29 metres west of the current wharf and does not apply to the whole site. The location of the Narooma Wharf is listed on the maritime heritage register identifying the location of former wharf structures, however no curtilage is defined. Further consultation will be undertaken with NSW Heritage to identify any notification or permitting requirements. Impacts to heritage are discussed in sections 6.9 and 6.10</p>

Legislation and application	Relevance to proposal and further requirements
<p>Roads Act 1993: provides for the construction and maintenance of public roads. Requires consent to dig up, erect a structure or carry out work in, on or over a road.</p>	<p>Section 138 of the Roads Act requires consent from the relevant road authority for the carrying out of work in, on or over a public road. However, clause 5(1) in Schedule 2 of the Roads Act states that public authorities do not require consent for works on unclassified roads.</p> <p>The proposal would involve the establishment of temporary structures and the installation of a sewer on Bluewater Drive which is a local road under the control of Eurobodalla Shire Council. Consent under the Roads Act is not required. However, a Road Occupancy Licence would be obtained for any works on the road.</p>
<p>Fisheries Management Act 1994 (FM Act): provides for the protection of fishery resources and values for current and future generations. Makes it an offence to harm fisheries and resources without an appropriate assessment, inclusion of safeguards and/or the appropriate permissions to carry out certain work.</p>	<p>As discussed in section 3.3, dredging would be required to ensure that the new floating pontoon floats on the lowest astronomical tides.. Therefore, notification to the Minister for Agriculture and Western NSW is required prior to any dredging or reclamation work under section 199 of the FM Act.</p> <p>Under Part 7 of the FM Act, a permit is required if the proposal involves harm to marine vegetation including mangroves, seagrasses, macroalgae or any other marine vegetation declared by the regulations to be marine vegetation.</p> <p>The aquatic ecology assessment (refer section 6.7) concluded that the proposal would trigger the need for a permit to impact on seagrasses.</p>
<p>Biodiversity Conservation Act 2016: provides for a strategic approach to conservation in NSW. It includes provisions for risk based assessment of native plant and animal impacts, including a Biodiversity Assessment Method (BAM) to assess the impact of actions on threatened species, threatened ecological communities and their habitats.</p>	<p>Under the BC Act, an assessment of significance must be completed to determine the significance of impacts to threatened species, populations and/or communities or their habitat.</p> <p>No significant impacts are expected on any threatened species, populations or communities within the proposal site.</p>

Legislation and application	Relevance to proposal and further requirements
<p>Protection of the Environment Operations Act 1997: focuses on environmental protection and provisions for the reduction of water, noise and air pollutions and the storage, treatment and disposal of waste. Introduces licensing provisions for scheduled activities that are of a nature and scale that have potential to cause environmental pollution. Also includes measures to limit pollution and manage waste.</p>	<p>The proposal would not involve undertaking or carrying out a scheduled activity. If standard controls set out in Transport for NSW guidelines and quality assurance specification are implemented and monitored, there is unlikely to be any material water, noise or air pollution impact (refer to chapter 7).</p> <p>Appropriate waste management controls would be introduced to classify, store, transport, and dispose of all construction and work generated waste.</p>
<p>Marine Pollution Act 2012: sets out provisions to prevent pollution in the marine environment.</p>	<p>The proposal is unlikely to result in any oil, noxious liquid, pollutant, sewage or garbage discharge as controlled under this Act, providing relevant standard controls are implemented and monitored (refer to chapter 7).</p>
<p>Marine Safety Act 1998 and Marine Safety Regulation 2016: sets out the requirements for marine safety and the roles of the Harbour Master and marine pilots. Includes provisions relating to marine and navigational safety including: collision prevention, spill limits, no-wash zones, shipping operations, and controls on reckless, dangerous or negligent navigation.</p>	<p>The proposal is located in navigable water under the terms of the Act and would restrict its used by the public. It is therefore subject to licensing under the terms of Section 97 of the <i>Marine Safety Regulation 2016</i>. An aquatic licence would be required from Transport of NSW (maritime division) under Section 97(1). Navigational exclusion zones would be installed while the work is taking place. This would include updating the Port Authority of NSW.</p>
<p>Contaminated Land Management Act 1997: Must report to EPA if contaminated land is encountered during the works that meets the duty to report contamination requirements under Section 60 of this Act Aims to establish a process for investigating and (where appropriate) remediating land that the EPA considers to be contaminated significantly enough to require regulation under Division 2 of Part 3. The Act aims to set out accountabilities for managing contamination if the EPA considers the contamination is significant enough to require regulation under Division 2 of Part 3.</p>	<p>The proposal would involve dredging of potentially contaminated marine sediments. Further details are provided in section 6.1.</p>

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed 'actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land'. These are considered in Appendix B and chapter 6 of the REF.

The assessment of the proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of Agriculture, Water and Environment under the EPBC Act.

4.3.2 Disability Discrimination Act 1992

The *Disability Discrimination Act 1992* (DDA) is the Commonwealth legislation that seeks to provide equity for people with disabilities. The main objects of the DDA include the elimination, as far as possible, of discrimination against persons on the grounds of disability in relation to access to premises and the provision of facilities and services. The proposal has been designed to respond to the requirements of this Act.

Disability Standards for Accessible Public Transport (DSAPT) 2002

The *Disability Standards for Accessible Public Transport 2002* (DSAPT), made under the DDA, prescribes minimum standards of accessibility in relation to both public transport buildings and conveyances to remove discrimination from public transport services. The proposal has been designed to respond to the development standards identified under the DSAPT.

4.3.3 Native Title Act 1993

A large portion of the south coast extending from Port Hacking to Eden, including the waters of the Batemans Marine Park is subject to a Native Title claim (Tribunal file no. NC2017/003) made by the South Coast People. The claim was made in 2017 and remains an active application but is undetermined. Transport for NSW has issued section 24K notifications to Claimants as required under the Native Title Act.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a boating facility and is being carried out by or on behalf of a public authority. Under section 2.79(4) of the Transport and Infrastructure SEPP, the proposal is permissible without consent. The proposal is not State significant infrastructure and is subject to environmental impact assessment under Part 5 Division 5.1 of the EP&A Act.

Accordingly, Transport for NSW is the determining authority for the proposal, with this REF fulfilling the obligation under section 5.5 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 the activity'.

5 Consultation

This chapter discusses the consultation undertaken to date for the proposal and the consultation proposed for the future.

5.1 Consultation strategy

A Community and Stakeholder Engagement Plan (CSEP) has been prepared for the Proposal and is summarised below. The plan:

- outlines the desired outcome of communication and stakeholder engagement
- describes the approach to communication, consultation and community engagement
- provides information on the outcome of the consultation and engagement activities for the Proposal.

The CSEP has been developed to be consistent with guidance provided in the Transport for NSW Stakeholder Engagement toolkit and the International Association for Public Participation (IAP2) Spectrum for Public Participation.

The community engagement objectives are to:

- provide clear information on when we are seeking feedback
- communicate the current design (footprint, moorings, berth size, physical position, etc.)
- provide the community and stakeholders with regular and targeted information to build awareness and knowledge about the Proposal
- encourage participation from the community and stakeholders in the engagement process to help identify a preferred option for the proposed upgrade
- ensure community and stakeholder feedback is considered at all stages of the Proposal
- ensure that community and stakeholder enquiries about the project are managed and resolved effectively
- identify and mitigate stakeholder and community issues early to avoid delays to the overall program.

5.2 Community involvement

A community information session would be planned for Narooma.

The purpose of the information session would be to gain community feedback to help Transport for NSW understand community views about the proposed replacement of existing wharf facilities. It would also assist Transport for NSW to further develop and refine the design. Transport for NSW has received feedback from local businesses and this is summarised below.

Table 5.1 Summary of issues raised by the community

Group	Issue raised	Response/where addressed in REF
Residents	None	None
Local Business	Access to vessels for all abilities	Installation of a pontoon, removal of the redundant tuna wharf
	Lower-level landing is too short	Increase size of lower-level landing
	Access for staging tours, i.e., changing into dive equipment, snorkelling gear and wetsuits.	Increase in staging areas i.e. mesh infill for changing
Others as required	Loading area for craning equipment onto barges and boats	Increased capacity on the deck i.e. 10 tonne limit

5.3 Aboriginal community involvement

Aboriginal heritage impacts have been considered under the four-stage Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI, Roads and Maritime, 2011). The PACHCI process is outlined in Table 5.1.

Table 5.1 Summary of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial Transport for NSW assessment to determine whether a proposal is likely to affect Aboriginal cultural heritage.
Stage 2	Site survey and further assessment to determine whether a proposal requires Part 6 approval from the NSW Heritage under the <i>National Parks and Wildlife Act 1974</i> .
Stage 3	If a Part 6 approval is required, formal consultation and preparation of a cultural heritage assessment report with involvement of the Aboriginal community.
Stage 4	Implement environmental impact assessment recommendations.

A Stage 1 assessment was completed by Transport for NSW against the PACHCI and identified the need to progress to a Stage 2 PACHCI assessment. Stage 2 of the PACHCI process was completed by On Site Cultural Heritage Management Pty Ltd in June 2021 for the proposal and confirmed that there is unlikely to be any impact on Aboriginal cultural heritage (refer to section 6.9) and an Aboriginal heritage impact permit (AHIP) under the *National Parks and Wildlife Act 1974* is not required.

Consultation with a representative of the South Coast NSW Aboriginal Elders was undertaken and arranged by Transport for NSW's Aboriginal Cultural Heritage Officer. An Aboriginal stakeholder cultural heritage survey report was completed with the South

Coast NSW Aboriginal Elder and concluded that the proposal would not affect any significant known or potential Aboriginal cultural heritage features.

5.4 Transport and Infrastructure SEPP consultation

Under the provisions of Part 2.2 of the Transport and Infrastructure SEPP, Transport for NSW is required to notify local councils and other relevant Government agencies where development has the potential to impact on assets or environmental values managed by these authorities. These issues are identified through the checklist included in Appendix C. In the case of the proposal, it triggers the notification requirements under sections 2.10, 2.11 and 2.12 of the Transport and Infrastructure SEPP for the following reasons:

- would involve connection to a council owned sewerage system
- would involve a connection to a council owned water supply
- would involve the installation of a temporary structure on, or the enclosing of, a public place
- would involve excavation of a road or adjacent footpath
- would involve temporary footpath closures along Bluewater Drive
- has a potential impact on local heritage items within the proposal site (assessed as minor)
- the proposed work is adjacent to an aquatic reserve or a marine park declared under the *Marine Estate Management Act 2014*.

Eurobodalla Shire Council and the Department of Primary Industries – Fisheries have been consulted about the proposal as per the requirements of section 2.10 and 2.12 of the Transport and Infrastructure SEPP. Appendix C contains a consultation checklist that documents how the Transport and Infrastructure SEPP consultation requirements have been considered.

Issues that have been raised as a result of this consultation are outlined in Table 5.2.

Table 5.2 Issues raised through the Transport and Infrastructure SEPP consultation

Agency	Issue raised	Response/where addressed in REF
Eurobodalla Shire Council	Use of security fencing and potential for fencing to restrict public use of the wharf	Pedestrian movements and access are described in section 3.3.6. The potential impacts on access and public use are discussed in sections 6.8 and 6.11.
	Future wharf expansion	This proposal involves the replacement of existing wharf infrastructure. Potential future expansion of the wharf is outside the scope of this proposal. Transport for NSW will consult Council if future expansion of the wharf is planned.
	Refuelling of boats and potential for spills	The potential impacts on water quality are described in section 6.3.

Agency	Issue raised	Response/where addressed in REF
	Water and sewer services to the wharf, proposed route and construction methods	Services and utilities are discussed in sections 3.3 and 3.5.
	Parking issues, particularly during loading and unloading operations.	Potential impacts on parking are described in section 6.8.
	Stakeholder engagement is recommended with wharf users and other key stakeholders	Stakeholder consultation undertaken and planned for the proposal is described in section 5.
DPI – Fisheries	Consistency of the proposal with the requirements of the Marine Estate Management Act 2014 (MEM Act), Marine Estate Management Regulation 2009 and Marine Estate Management (Management Rules) Regulation 1999 and the objectives of the relevant Special Purpose Zone of Batemans Maine Park.	Consistency of the proposal with key legislation is described in sections 4.1 and 4.2.
	Support for including a pump out facility at the wharf.	Noted
	Habitat for protected species of Black Cod, Australia and New Zealand Fur Seals, and sting rays which are protected in the Marine Park.	Potential impacts on protected species are discussed in section 6.7.
	Potential habitat for Syngnathidae species (sea horses).	The presence and potential habitat for sea horses is discussed in section 6.7.
	Presence of seagrass <i>Posidonia australis</i> and the need for the final design to avoid, minimise and then mitigate potential impacts through measures such as meshed decking material.	Potential impacts and measures to avoid, minimise and mitigate such impacts on <i>Posidonia australis</i> is discussed in section 6.7.
	<p>The Review of Environmental Factors must include:</p> <ul style="list-style-type: none"> • field surveys to confirm or dismiss presence of protected species • relocation strategies for Black Cod and/or Syngnathidae species (if appropriate) • extent of sea grass, potential impact of expanding footprint of wharf and strategies to minimise harm to this habitat 	Refer to section 6.7 for a detailed assessment on aquatic ecology.

Agency	Issue raised	Response/where addressed in REF
	<ul style="list-style-type: none"> strategies to minimise impact on seals. 	
	<p>Information to be available to DPI-Fisheries for further consultation on the design, including design, materials and construction method:</p> <ul style="list-style-type: none"> final design materials (concrete, replacing like for like, mesh decking) construction methods (piling, concrete pours) demolition methods, especially removal of existing piles waste management and removal associated works such as dredging. 	<p>Consultation with stakeholders, including DPI-Fisheries, will be ongoing through the design development of the proposal. DPI-Fisheries will be consulted on the preferred concept design and during detailed design.</p>
	<p>Permitting and approval requirements under the <i>Marine Estate Management (Management Rules) Regulation 1999</i> and the Fisheries Management Act prior to demolition and construction commencing.</p>	<p>Permitting and approval requirements for the proposal are listed in section 7.3.</p>
	<p>Native title claim over waters of Batemans Marine Park.</p>	<p>Transport for NSW has issued notifications to Claimants as required under the Native Title Act. No responses have been received.</p>

5.5 Government agency and stakeholder involvement

Consultation with Council through the requirements of the Transport and Infrastructure SEPP has been undertaken. Stakeholder engagement has also occurred to inform design development as summarised in section 5.2 and section 5.4.

5.6 Ongoing or future consultation

The REF would be made available on the Transport for NSW website for comment between 28 April and 18 May 2022. The project team would keep the community, Council and other key stakeholders informed of the process, identify any further issues as they arise, and develop additional mitigation measures to minimise the impacts of the proposal. The interaction with the community would be undertaken in accordance with the Construction Contractor's Community Liaison Plan to be developed before construction starts.

6 Environmental assessment

This chapter of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of the factors specified in the guidelines *Is an EIS required?* (DUAP, 1995/1996) as required under section 171 of the *Environmental Planning and Assessment Regulation 2021* and the *Marinas and Related Facilities EIS Guideline* (DUAP, 1996). The factors specified in section 171 of the *Environmental Planning and Assessment Regulation 2021* are also considered in Appendix B.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Land surface

6.1.1 Methodology

The land surface assessment involved a review of available resources and a qualitative desk-based assessment on potential impacts on soils, geology and topography. The following resources were used to define physical characteristics of the environment:

- Australian Soil Resource Information System (ASRIS) National Acid Sulphate Soil database
- Sydney 1:100,000 Geological Series Sheet 9130 (Herbert C., 1983)
- NSW Planning Portal
- NSW eSPADE and SEED
- NSW EPA contaminated land register.

6.1.2 Existing environment

Land based

Geology and soils

The area surrounding the wharf is underlain by Ordovician sedimentary rocks and volcanic rocks. The wharf is located on the shoreline of the Wagonga Inlet, which is classified as a Holocene Estuary Channel and comprised of marine sand, silt, clay shell and gravel (OnSite, 2021).

Contamination

There are no notices issued by the NSW EPA under the *Contaminated Land Management Act 1997* within the proposal site. There are three former notices related to a site located about 330 metres south-west of the proposal site.

The land-based side of the proposal site is located on reclaimed land and may be subject to contamination from historical origins of the reclaimed material.

Inspection of the existing wharf structure indicates no potential for hazardous materials to be encountered during demolition work. Inspection of the existing wharf structure indicates no potential for hazardous materials to be encountered during demolition work.

Acid sulphate soils

Acid sulphate soil occurs in areas rich in iron sulphide. These soils generate sulphuric acid if exposed to the air (oxygen). The acid is an issue as well as causing the mobilisation of metals (e.g. aluminium, iron, manganese) which may lead to a detrimental environmental impact. Acid sulphate soils can also decrease the amount of dissolved oxygen in surface waters, leading to eutrophic conditions and fish kills.

A review of the ASRIS National Acid Sulphate Soil database indicated that there is an extremely high probability of occurrence of acid sulphate soils within the proposal site (landside).

Water based

Contamination

There is potential for contamination to occur within the marine sediments from historical surrounding land uses and boating operations at the wharf. Marine sediments around wharves are typically characterised with the following potential contaminants of concern:

- heavy metals, nutrients, pesticides and herbicides (for example organochlorine pesticides and polychlorinated Biphenyls (PCBs)), polycyclic aromatic hydrocarbons (PAHS) accumulated in marine sediment over time from stormwater derived from residential and agricultural catchments
- Tributyltin from antifouling paints commonly used in the past.

Contamination testing of marine sediments was undertaken during engineering geotechnical investigations (Advisian, 2022) to inform a Sediment Quality Assessment (Appendix D). Surface seabed sediments were tested to maximum depth of one metre from six locations across the proposed construction footprint. The assessment findings were:

- Sediments are predominantly fine to medium grained sand (52 – 95%), with a very low proportion of fines (i.e. clay and silt) (0 – 3%), and with varying amounts of larger grained material (i.e. gravel) (3 - 36%).
- Concentrations of Nitrate as N were detected in all samples and ranged from 0.10 mg/kg to 0.30 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for nutrients in sediments.
- No sediment test results exceeded the ANZG (2018) DGVs or NAGD (2009) screening levels for any metal apart from zinc. One sample had a concentration of 266 mg/kg that exceeded the ANZG (2018) and NAGD (2009) guideline value of 200 mg/kg (the 95%UCL of 241 mg/kg exceeded the NAGD (2009) guideline, but the median value of 30.30 mg/kg did not exceed the ANZG (2018) guideline).
- The concentration of organotin compounds (monobutyltin (MBT), dibutyltin (DBT) and tributyltin (TBT)) in all samples tested were below guideline levels.
- A wide range of other organics, including pesticides and hydrocarbons, were tested for in the sediments and no ANZG (2018), NSW EPA (2014) or and NAGD (2009) guideline exceedances were detected.
- Under the NSW Waste Classification Guidelines, the sediment would be considered as General Solid Waste.

Acid sulphate soils

A review of the ASRIS National Acid Sulphate Soil database indicated that there is an extremely high probability of occurrence of acid sulphate soils within the proposal site (marine side). Analytical testing of sediments for the Sediment Quality Assessment (Advisian 2022) confirmed the sediments are not Actual Acid Sulphate Soils (ASS) or Potential Acid Sulphate Soils (PASS).

6.1.3 Potential impacts

Construction

Land based

Soil disturbance

The proposed work on land would be limited to minor trenching for the installation of the sewer pipeline along Bluewater Drive. Only minimal excavations of existing road/footpath surfaces would be required which would minimise overall soil disturbances and potential for erosion and sedimentation. Trenching and soil disturbance through reclaimed soils may uncover contaminated material.

Contamination

Soil disturbing activities such as landside surface trenching for utilities can expose or mobilise contaminants (should they be present) which may be harmful to the environment, workers and the community. This includes exposure of acid sulphate soils that would initiate oxidation, lowering of soil pH and mobilisation of bound heavy metals into the environment. Accidental spills from construction plant and improper storage of hazardous materials could also lead to soil contamination. Contaminants may also enter Wagonga Inlet and contaminate water when working close to water from erosion and accidental spills.

Potential impacts would be mitigated through the appropriate management of the storage of such materials, and inclusion of spill kits as noted in section 6.1.4.

Acid sulfate soils

Excavation activities may result in the exposure of acid sulphate soils to oxygen with the potential to generate acidic leachate. Without appropriate mitigation, exposed acid sulphate soils could impact on water quality (including pH levels and mobility of any soil-bound metals) and the health of the adjacent sensitive marine environment. Trenching activities are expected to generate minor quantities of excavated material and trenches are not expected to remain open for extended periods of time.

Any potential acid sulphate soils, should they occur, would be managed in accordance with the safeguards detailed in section 6.1.4.

Flooding

Localized flooding from significant rain events may result in an increased risk of erosion and sedimentation from the land-based work. Additionally, any plant, equipment and materials used during construction may enter the Wagonga Inlet and be swept downstream, potentially resulting in pollution from diesel or other potentially hazardous materials. Equipment and material stored within the construction compound may also enter the inlet.

Flooding risks would be managed with the implementation of safeguards in section 6.1.4, including implementing appropriate actions in the event of a flood warning, to prevent any additional impacts.

Water based

Potential impacts during construction would primarily be associated with seafloor disturbance and transport of sediment from the construction area into the surrounding waterway. Tidal mixing, local currents and wave action would all influence the likelihood and extent of sediment dispersal.

Activities such as pile removal, dredging, piling, seawall upgrades (if required), anchoring of barges and propellor wash would have the potential to destabilise marine sediments, causing turbidity. Increased turbidity may cause a short-term reduction in light penetration in the immediate area around the work and deposition of marine sediment in nearby areas.

Coarser sediments would settle out of suspension almost immediately while finer sediments could mobilise over a greater area as they would remain buoyant in the water column.

Disturbance of sediments would be minimised through the work methodology, including progressing the work in sections which would allow sediments to settle between works and undertaking certain construction activities, such as dredging, during low tide.

The proposal would result in the exposure of underlying marine sediments. The potential to disturb any contaminated marine sediments and/or acid sulphate soils is low as sediment testing has shown contaminants of concern are below guideline values, except for zinc at one location. Given the high proportion of sand and gravel and low proportion of fines and strong tidal currents, any dispersed sediment is expected to be localised and to dissipate quickly (Advisian, 2022). These physical characteristics and negligible concentrations of contaminants, indicate potential impacts from sediment disturbance are likely to be negligible.

Potential impacts on water quality are discussed further in section 6.3. Potential impacts from the exposure of contaminated marine sediments and acid sulphate soils would be managed with the implementation of safeguards provided in section 6.1.4.

Operation

The proposal would not alter existing land-based infrastructure, and no operational impacts to the land surface or marine sediments are anticipated during operation of the proposal.

6.1.4 Safeguards and management measures

Table 6.1 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.1.3.

Table 6.1 Land surface safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
<p>Soil and water</p>	<p>A Soil and Water Management Plan (SWMP) would be prepared and implemented as part of the CEMP.</p> <p>The SWMP would identify all reasonably foreseeable risks relating to soil erosion, sediment dispersion and water pollution and describe how these risks would be addressed during construction.</p> <p>Erosion and sediment control measures are to be implemented and maintained (in accordance with the Landcom/Department of Housing <i>Managing Urban Stormwater, Soils and Construction Guidelines</i> (the Blue Book)) to:</p> <ul style="list-style-type: none"> • prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • reduce water velocity and capture sediment on site • minimise the amount of material transported from site to surrounding 	<p>Contractor</p>	<p>Pre-construction</p>	<p>Standard safeguard</p>

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>waters and pavement surfaces</p> <ul style="list-style-type: none"> divert clean water around the site. <p>Additionally, sediment controls are to be implemented and maintained for the marine environment when dredging and undertaking marine-side construction work.</p>			
Erosion and sedimentation	<p>Silt curtain/s are to be installed prior to and around the area of works that may disturb the seabed.</p> <p>Silt curtains are to be installed, monitored and maintained as needed to contain any sediment.</p>	Contractor	Pre-construction	Additional safeguard
Erosion and sedimentation	<p>Select and regularly check baseline sites around the construction area to confirm impacts are not migrating out of the construction zone.</p>	Contractor	Pre-construction and Construction	Additional safeguard
Erosion and sedimentation	<p>Dredging to take place at low tide only and during stable weather and wave conditions.</p>	Contractor	Construction	Additional safeguard
Erosion and scour	<p>Positioning of barges, drilling and pile driving should occur during standard construction hours and calm conditions to prevent excessive scouring and minimise any safety risks.</p>	Contractor	Construction	Additional safeguard
Erosion and scour	<p>Construction marine vessel speeds will be kept to the posted limit and will be 4 knots during construction</p>	Contractor	Construction	Additional safeguard
Acid sulphate soils	<p>Potential or actual acid sulphate soils are to be managed in accordance with the Transport for NSW Guidelines for the Management of Acid</p>	Contractor	Construction	Standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	Sulphate Materials 2005 and a Construction Acid Sulphate Management Plan. The Plan is to include procedures for testing, material classification, treatment and disposal.			
Acid sulphate soils	Minimise the disturbance and exposure of sediment and/or the underlying soils to oxygen.	Contractor	Construction	Additional safeguard
Contaminated land	<p>If contaminated soils and sediments are encountered, prepare and implement a Contaminated Land Management Plan.</p> <p>Any unexpected finds of contamination are to be managed in accordance with an Unexpected Finds Procedure outlined in the Contaminated Land Management Plan.</p> <p>The procedure will include actions to cease work and to consult with the Transport for NSW Environment Manager and/or EPA.</p>	Contractor	Construction	Additional safeguard

Other safeguards and management measures that would address hydrological impacts are identified in sections 6.2.4 and 6.3.4.

6.2 Hydrology

6.2.1 Methodology

The following resources were used to define hydrological characteristics of the aquatic environment:

- Narooma wharf replacement: Aquatic ecology assessment (Biosis, 2021)
- Wagonga Inlet Estuary Management Study – Review 2010, Eurobodalla Shire Council 2010
- Wagonga Inlet, Kianga and Dalmeny Flood Study: Wagonga Inlet flood mapping Eurobodalla Shire Council 2016
- NSW Planning Portal.

The assessment considered the impacts associated with tidal movements, currents and waves.

6.2.2 Existing environment

Wagonga inlet has a relatively small, steep catchment with low freshwater inflows. It is a drowned river valley estuary extending about nine kilometres upstream and permanently open to the ocean. The inlet features wide sand bars and a narrower channel that is used for navigation. The wharf is about 800 metres upstream from the bar entrance. Around the wharf, the aquatic environment experiences tidal flushing and the salinity is similar to sea water (ESC, 2010).

The inlet is a central location for primary and secondary contact activities such as swimming, kayaking, boating and fishing, as well as foreshore activities. The area around the wharf experiences high on-water traffic from commercial and recreational waterway users either passing by or mooring at the wharf. The inlet supports an oyster industry, tour operators, tourist accommodation and waterfront restaurants. (ESC, 2010)

Existing impacts to the hydrological environment due to vessel traffic and the wharf include:

- boat wash from moored and passing vessels
- diffuse runoff from adjacent roads and walkways
- stormwater inputs below the wharf (Biosis, 2021).

Tides

The proposal is located on the southern side of Wagonga Inlet. Water levels of the inlet around the proposal site are subject to ocean tides and would be considered to experience the same timing.

Currents

The strongest currents in the proposal site are tidally influenced and occur in the main channel of Wagonga Inlet. Currents at the site are also driven by floods. The proposal site is located between the main channel and the shore. The ebb and flood currents of the inlet, located 300 metres downstream of the wharf, have been recorded to be between 1.49 m/s for flood tidal velocity and 1.79 m/s for an ebb tidal velocity (MHL 1986 in Advisian 2021). Currents are likely to influence the aquatic conditions at the site.

A gradient in the tidal current can be expected across the proposal site, from the stronger tidal current within the main channel to slower current or calm water at the shoreline edge of the proposal footprint.

Local currents may also arise from passing vessels and localised flows at stormwater outlets. Wind shear may also generate stronger currents around the proposal site.

Waves

The proposal site is exposed to open water to the north, east and west. Wind waves, wake from vessels and refracted ocean swell are the most likely source of wave activity at the site.

Flooding

The proposal is not located within a designated flood prone area denoted by the LEP. A flood study of the area identified a 1% AEP flood level at the Narooma Wharf of about 2.0 m AHD (WMAWater 2016 in Advisian 2021).

6.2.3 Potential impacts

Construction

The proposal to construct a new replacement wharf with a similar sized wharf combined with seawall repairs (if required), is unlikely to have a significant impact on tidal mixing, local currents, or wave action around the proposal site. Construction activities are temporary and will be staged so that sections of the existing wharf can remain operational over the expected construction duration of four months.

Tides

Potential impacts would be reduced by undertaking work during calm conditions and low tide when there would be the least water movement around the wharf.

Dredging works specifically would take place at low tide for the greatest efficiency and to reduce the likelihood of sediment transport and off-site impacts to surrounding areas.

The presence of few construction vessels would not impact tidal movements in the local area.

Currents

The proposal site may be vulnerable to underwater scour and sediment transfer off site due to local currents or stormwater flows. The scale and nature of construction activities are not expected to impact on local currents. Dredging and removal of about 1000 cubic metres at the eastern section of the wharf would deepen the area to ensure the floating pontoon is effective and meets the vessel size design criteria. Increasing the water depth in this area would likely result in a very minor change to local currents.

The presence of few construction vessels would unlikely result in changes to local currents. Existing currents and flows in the surrounding area are expected to be largely unaffected.

Waves

There may be short-term and minor localised impacts to wave action around the wharf during construction where construction barges are moored and when dredging is taking place. These equipment items would largely remain stationary in a set location for a period of time and then progressively moved as the work front shifts along the section of wharf being built. Marine vessels used for construction would travel at slow speeds limited to 4 knots and trafficking to and from the construction site would be minimal. As a result, vessel movement and the potential to create wave action negatively impacting on the shoreline is considered unlikely.

The potential impacts during construction would be limited and temporary, and insufficient to cause any dynamic changes in current speed, wave characteristics, saline/freshwater mixing or flushing.

Operation

The operational wharf is not considered likely to create any additional impact on local currents, tidal movement, or wave action in the vicinity of the wharf that would be significantly different from the existing structure. The scale and nature of the replacement wharf is similar to the existing.

Tides

The proposal is not anticipated to affect or be affected by tidal activity. The floating pontoon will rise and fall with the tidal water level when in operation enabling safer use of the wharf.

Currents

No significant impacts from sedimentation during the wharf's operation are anticipated.

Under the proposal, new piles would replace the older piles however the overall configuration would be similar to the existing. As water flows around these structures there is the potential to create local scour and erosion during settlement and consolidation of disturbed sediments around the piles and dredged areas.

Local sediment conditions would adjust over time, however the initial period of settlement and consolidation may be slightly prolonged with the ongoing necessary use of the wharf.

Waves

The operation of the wharf is not considered likely to have an impact on local wave activity.

Flooding

The Proposal has been designed to withstand a 1 in 100 year ARI flood event, and ensure the safe closure of the wharf in higher flood conditions. The height of piles enables the floating pontoon to rise and fall with flood levels, and safely disconnect from the shore bridge.

Transport for NSW would undertake inspections of wharves after flood events. This would continue during operation of the proposal. No significant impacts from flooding are anticipated during operation of the proposal.

6.2.4 Safeguards and management measures

Construction and operation of the wharf is not considered likely to create any additional impact on local currents, tidal movement, or wave action in the vicinity of the wharf that would be significantly different from the existing structure. Safeguards and management measures targeting erosion and sediment control are included in Table 6.1.

6.3 Water quality

6.3.1 Methodology

The following resources were used to assess water quality in the study area:

- *Narooma wharf replacement: Aquatic ecology assessment* (Biosis, 2021)
- *Wagonga Inlet Estuary Management Study – Review 2010* (Eurobodalla Shire Council, 2010).

The assessment considered the impacts associated with construction and operation of the wharf.

6.3.2 Existing environment

Wagonga inlet is permanently open to the ocean and the proposal site is about 800 metres upstream from the ocean bar entrance. Around the wharf the aquatic environment is defined by tidal flushing and the salinity is similar to sea water. The estuary catchment area is small and receives relatively low freshwater inflows (ESC, 2010).

The inlet and wharf surrounds are a central location for primary and secondary contact activities, and fishing. It is a highly visible site in the local community. Local activities that directly or indirectly depend on good water quality in the estuary include an oyster industry, tour operators, tourist accommodation and waterfront restaurants (ESC, 2010). ESC conducts water quality monitoring in upstream sites around the inlet.

6.3.3 Potential impacts

Construction

The greatest potential for impacts to water quality from the proposal are during the construction phase. Impacts are associated with activities of:

- wharf demolition
- dredging
- seawall reconstruction (if required)
- constructing the new wharf, including bored piling
- movement and anchoring of plant and equipment in the waterway.

There are also land-based risks from uncontrolled spills and dredge spoil management.

Water quality in the proposal site has the potential to be affected by:

- sediment disturbance and transport and into nearby sensitive areas
- potential contamination entrained with sediments being transported or dispersed into nearby areas
- liquid spills or leaks from plant and equipment operating in the water and on land, such as hydrocarbons and drilling fluid.

Without mitigation measures, the most likely impacts would be:

- visual impact of sediment plumes in the water column from higher turbidity

- sediment smothering aquatic vegetation, benthic fauna or impacting on oyster leases
- aquatic flora or fauna affected by smothering or uptake of potential pollutants or contaminants from spills
- aquatic flora or fauna (including oysters) affected by smothering or uptake of potential pollutants or contaminants from dispersion of contaminated sediment, if present.

The potential impacts on aquatic flora and fauna from water quality during the construction phase are discussed in detail in section 6.7.

Operation

The proposal is not considered to present ongoing operational risks to water quality. The proposal would result in a reduced risk of water pollution by introducing a new sewage pump-out facility. This sewage system would be a closed system with negligible risk for leaks and overflows as the system would be connected to Council's existing main sewerage network. Installing the system would provide an overall benefit to water quality in the marine environment as it removes the need for vessel operator to discharge blackwater at the 12 NM limit.

6.3.4 Safeguards and management measures

Table 6.2 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.3.3. Other relevant safeguards and measures for minimising impacts on water quality are also listed in Table 6.1.

Table 6.2 Water quality safeguards and management measures for water quality

Impact	Environmental safeguards	Responsibility	Timing	Reference
Water quality	There is to be no release of dirty water into drainage lines and/or waterways.	Contractor	Construction	Standard safeguard
Water quality	Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) is to be undertaken on a regular basis to identify any potential spills or deficient silt curtains or erosion and sediment controls.	Contractor	Construction	Standard safeguard
Water quality	Vessels (including barges) are only to be used at suitable tides when no less than 600 mm clearance is available between the underside of the vessel	Contractor	Construction	Standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	and the bed of the waterway.			
Water quality	<p>A spill kit is to be available on site and accessible at all times. The spill kit must be appropriately sized for the volume of substances at the work site. Spill kits for construction barges must be specific for working within the marine environment.</p> <p>All workers will be advised of the location of the spill kit and trained in its use.</p> <p>Ensure all liquids in use on site are securely stored, handled and disposed of to prevent spills or leaks.</p>	Contractor	Construction	Standard safeguard
Water quality	<p>Ensure all on-water plant and equipment is adequately maintained and regularly inspected for fluid leaks.</p> <p>Prior to use at the site and/or entry into the waterway, machinery should be appropriately cleaned, degreased and serviced.</p>	Contractor	Pre-construction and construction	Standard safeguard
Water quality	Ensure that the CEMP includes procedures for safe materials storage, handling, use and incident response plans for the proposed works.	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Water quality	Prepare an Environmental Work Method Statement for dredging activities that identifies the sequence of the activity, potential impacts and management controls. The EWMS must also address the handling and management of dredge spoil.	Contractor	Construction	Additional safeguard
Water quality	Capture and store any waste drilling fluids for appropriate on-shore disposal according to legislative requirements. Ensure that all liquids including fuel and other liquids used on barges during construction are securely contained.	Contractor	Construction	Additional safeguard
Water quality	Vessel speeds will be limited to 4 knots to minimize turbidity being generated from propellor wash.	Contractor	Construction	Additional safeguard

6.4 Waste management

6.4.1 Methodology

The assessment considered the impacts associated with:

- resource use and materials management during construction
- waste generation, management and disposal during construction
- the proposal's ability to respond to waste management and resource conservation plans, policies and guidelines.

The basis of assessment was to consider the hierarchy of avoiding waste generation and primary resource use in favour of reduction, reuse and recycling, consistent with the NSW *Waste Avoidance and Resource Recovery Act 2001* (WARR Act).

6.4.2 Existing environment

Public waste bins are provided at the existing wharf and are managed as part of the wharf operations. There is potential for litter to enter the Wagonga Inlet from existing wharf activities.

Recreational fishing and some limited commercial fishing is permitted from the existing wharf.

Montague Island tours, fishing, diving, snorkelling and whale watching charter boats board patrons from the proposal site. Currently, no sewage pump-out facilities are available at the wharf.

In terms of resource use, the wharf has required ongoing maintenance, repair and upgrade over time. This has required the use of small quantities of replacement materials such as timber, concrete and metal.

6.4.3 Potential impacts

Construction

Waste management

Construction activities would generate various waste streams that would need to be managed and disposed of. Potential wastes include:

- waste fuels, oils, liquids and chemicals
- packaging wastes such as cardboard, timber, paper and plastic
- general garbage and sewage from the temporary compound
- potential for acid sulfate soils in the marine environment (refer to section 6.1.2)
- potential for contaminated soils and sediment (refer to section 6.1.2)
- various building material wastes (including metals, timbers, plastics and concrete)
- earthworks spoil
- asphalt and concrete
- general waste, including food, litter and other wastes generated by the construction workers.

Landside ancillary facilities would be contained within the site compound, and include a portable toilet, and small shipping container/shed. Minimal storage of materials is anticipated but may include precast materials and some plant and equipment. Where feasible, materials would be barged, including fuels, oils and other required liquids which would be stored in bunded containers. All waste removed from the proposal footprint would be transferred by a licenced contractor to a licenced receiving facility.

Any excavated material would be reused where suitable or classified before being disposed to an appropriately licenced facility in accordance with *Waste Classification Guidelines: Part 1 Classifying Waste* (EPA 2014). Where necessary, this would include sampling and analysis.

Resource use

Transport for NSW adopts a resource reduction strategy based on using:

- alternative low-energy, high recycled content materials where they are cost and performance competitive and comparable in environmental performance
- locally sourced materials, noting that most of the materials needed to build the proposal are widely available and typically in abundant supply in the local market
- alternative forms of material sourcing to reduce the distances or methods travelled to supply materials.

Operation

One of the objectives of the proposal is to improve the accessibility of the wharf for patrons. The proposal may lead to an increase in patronage as a result of improved access and generally improving the wharf. As a result, increased waste may be generated but incidences of littering are not expected to increase given that waste management is likely to improve with the installation of new garbage receptacles, a new sewage pump-facility for charter boats and improved facilities.

6.4.4 Safeguards and management measures

Table 6.3 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.4.3.

Table 6.3 Waste management safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Waste	A Waste Management Plan (WMP) will be prepared in accordance with the WARR Act. A WMP is to be prepared as part of the CEMP. The WMP will include the following: <ul style="list-style-type: none">• measures to avoid and minimise waste associated with the proposal• classification of waste and management options (re-use, recycles, stockpile, disposal)	Contractor	Pre-construction / Construction	Standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> • statutory approvals required for managing both on and off-site waste, or, application of any relevant resource recovery exemptions • procedures for storage, transport and disposal • monitoring, record keeping and reporting. 			
Waste	Waste management, littering and general construction site tidiness will be monitored during routine site inspections.	Contractor	Construction	Additional safeguard
Waste	All waste will be classified in accordance with the EPA's <i>Waste Classification Guidelines: Part 1 Classifying Waste</i> (EPA, 2014) prior to being disposed of at a licensed waste facility.	Contractor	Construction	Additional safeguard
Waste	Timber and other components of the existing wharf, deck and piles must be reused and/or recycled if feasible.	Contractor	Construction	Additional safeguard
Waste	Waste material must not be left on site once work has been completed.	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Resource use	Recycled, durable, and low embodied energy products will be considered to reduce primary resource demand in instances where the materials are cost and performance competitive and comparable in environmental performance (e.g. where quality control specifications allow).	Transport for NSW	Detailed design	Additional safeguard
Sustainability	During construction, the construction contractor is to monitor waste and recycling quantities using <i>Transport for NSW Waste Data Collection Workbook – DMS-FT-436</i> to support compulsory requirement 4 of the <i>Transport for NSW Sustainable Design Guidelines version 4.0</i> .	Contractor	Construction	Additional safeguard

6.5 Noise and vibration

6.5.1 Methodology

The proposal has the potential to affect the community due to noise and vibration during its construction. The following methodology has been implemented to assess the potential impacts. A simple assessment has been undertaken with reference to the *Construction Noise and Vibration Guideline* (TfNSW, 2016) to identify potential construction noise and vibration impacts, including the following key tasks:

- identification of sensitive receivers within the study area
- estimating appropriate rating background levels (RBLs) for residences using the guidance provided in the CNVG and establishing construction noise management levels (NML) for residential and non-residential receivers
- a simple assessment of the potential noise impacts using the RMS construction noise estimator tool
- identifying potential construction vibration impacts based on typical safe working distances from vibration intensive plant
- providing reasonable and feasible mitigation measures to reduce potential impacts.

6.5.2 Existing environment

Sensitive receivers

Noise and vibration sensitive receivers are defined based on the type of occupancy and the activities performed in the land use. Sensitive receivers surrounding the proposal site have been categorised into Noise catchment areas (NCAs) for the construction noise assessment.

The locations of each NCA are outlined in Table 6.4 and shown on Figure 6.1.

Table 6.4 Noise catchment areas

NCA	Location and description	Approximate distance to proposal (m)
NCA1	Residential and commercial properties located south of the proposal on Wharf Street and Princes Highway	40
NCA2	Residential properties located to the southeast of the proposal on Narooma Crescent	130
NCA3	Residential properties located east of the proposal on Pilot Street	230
NCA4	Narooma swimming centre located at Lot 7011 Bluewater Dr, Narooma NSW 2546, south east of the proposal	130



Figure 6.1 Noise catchment areas

Construction methodology

The construction period is expected to be four months beginning mid-2022, and follow the methodology outlined in section 3.3.

All works are expected to be undertaken during the recommended standard construction hours as outlined in the *Interim Construction Noise Guideline (ICNG)* (DECC, 2009), being:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- no work on Sundays or Public Holidays.

Construction works include site establishment, demolition of the existing wharf and construction of the replacement wharf.

A simple assessment was carried out for two indicative construction scenarios. Sensitive receivers with a direct line-of-sight were grouped into NCAs and worst-case noise levels for each NCA have been calculated. Additionally, a distanced-based assessment has been provided for sensitive receivers that are shielded from the works by other buildings. Table 6.4 outlines the modelled scenarios and includes the activity sound power level for each.

Table 6.5 Modelled construction scenarios

Scenario	Equipment	Modelled activity sound power level, $L_{Aeq(15min)}$ dBA
Site establishment and decommission	<ul style="list-style-type: none"> • hiab crane • low-loader heavy truck • petrol Generator • work Boat "Outboard" • work utility vehicles 	109
Site demolition and construction	<ul style="list-style-type: none"> • excavator with torque head • hydraulic excavator mounted concrete breaker and pile helmet • hand operated concrete beaker • heavy dump trucks • petrol chainsaws • angle grinders handheld electric powered drills and wrench • floor saw 	122

Noise environment

The existing noise environment is expected to consist of local road traffic, natural sounds such as wind, birds and ocean processes and maritime noise. The rating background level (RBL) is estimated to be consistent with a typical suburban residential area, being 40 dBA. As such, the residential Noise Management Level (NML) during standard construction hours has been determined to be 50 dBA (RBL + 10 dBA).

The noise management levels for all sensitive receivers are outlined in Table 6.6.

Table 6.6 Noise management levels during standard hours

Receiver type	Examples nearest the proposal	Period	Noise Management Level L_{Aeq} (15minute), dBA (external)
Residences	Residential properties located along Wharf Street	Standard hours	Noise affected – 50 Highly noise affected – 75
Commercial premises	Restaurants and other commercial premises located on Princes Highway	When in use	70
Places of Worship	The Catholic Archdiocese of Canberra and Goulburn located on Canty Street	When in use	55
Active recreation areas	Narooma swimming centre located on Bluewater Drive	When in use	65
Passive recreation areas	Rotary Park located on Bar Rock Road	When in use	60

6.5.3 Potential impacts

Construction noise

Predicted noise levels at each NCA are presented in Table 6.7 and Table 6.8 for site establishment and decommission and demolition and construction works, respectively. Full results from the Construction Noise Estimator are provided in Appendix E.

Residential receivers within all NCAs are predicted to receive noise levels above the NML during site establishment and decommission, while residences within NCA1 are expected to receive noise levels that are moderately intrusive.

During site demolition and construction works, all residential receivers are predicted to receive noise levels that are moderately intrusive (20 to 30 dBA above the RBL). Residential receivers in NCA1 are likely to experience noise levels above the highly noise affected level of 75 dBA. Additional mitigation is recommended for all residential receivers during this work. Commercial receivers within NCA1 and NCA4 are expected to receive noise levels above the NML, however no additional mitigation for these receivers is recommended.

Standard and additional mitigation and management measures are outlined in section 6.5.4 and would be implemented in order to reduce the noise impact to the surrounding community.

Table 6.9 provides mitigation distances for receivers shielded from the construction works (no direct line-of-sight to the construction footprint including residences on Bowen Street).

Table 6.7 Site establishment and decommission results

NCA	Receiver type	Distance to proposal, m	NML, dBA	Predicted Noise Level, dBA	Additional mitigation measures
NCA1	Residential	40	50	66	N, V
NCA1	Commercial	40	70	66	-
NCA2	Residential	130	50	57	-
NCA3	Residential	230	50	51	-
NCA4	Active recreation	130	65	57	-

Notes: Refer to Appendix C1 of the CNVG for a detailed description of the additional mitigation measures: "N": Notification. "V": Verification

Table 6.8 Site demolition and construction results

NCA	Receiver type	Distance to proposal, m	NML, (dBA)	Predicted Noise Level, dBA	Additional mitigation measures
NCA1	Residential	40	50	79	N, V, PC, RO
NCA1	Non-residential	40	70	79	-
NCA2	Residential	130	50	70	N, V
NCA3	Residential	230	50	64	N, V
NCA4	Active recreation	130	65	70	-

Notes: Refer to Appendix C1 of the CNVG for a detailed description of the additional mitigation measures: "N": Notification. "V": Verification. "PC": Phone Calls. "RO": Respite Offer

Table 6.9 Affected distances (in metres) for shielded receivers

Receiver type	NML (dBA)	Site establishment and decommission	Site demolition and construction
Residential	50	75	255
Commercial premises	70	5	30
Places of worship	55	40	165
Active recreation areas	65	10	60
Passive recreation areas	60	25	105

Construction vibration

Vibration intensive works are expected throughout the duration of the construction period of the proposal. The most vibration intensive activities associated with the works is anticipated to be the use of hydraulic hammers and concrete breakers.

Recommended minimum working distances have been sourced from Table 2 of the CNVG for these activities and are as follows:

- cosmetic damage to standard structures: 22 metres
- human comfort impacts at sensitive receivers: 73 metres.

No residential properties have been identified within the cosmetic damage minimum working distances. However, the residences directly to the south of the construction works may experience human comfort vibration impacts during these works.

Operation

Noise from vessel movements during the operation of the wharf is not expected to change as a result of the proposal and as such, any change in the noise levels during operation would be negligible. The timing and frequency of marine vessel use is also expected to be consistent with the existing conditions.

A sewage pump system is proposed to be included at the wharf. The noise generating equipment associated with the system is proposed to be enclosed and will be designed to comply with the relevant noise emission guidelines during detailed design.

6.5.4 Safeguards and management measures

Table 6.10 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.5.3. This includes standard mitigation measures for Transport for NSW projects (Appendix B of the CNVG) to be implemented as part of the CEMP, where feasible and reasonable.

A description of the additional mitigation measures that are recommended are provided in section 7.

Table 6.10 Noise and vibration safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction noise and vibration	<p>A Construction Noise and Vibration Management Plan (CNVMP) will be prepared and incorporated into the CEMP, including:</p> <ul style="list-style-type: none"> • reasonable and feasible noise control measures to reduce impacts at sensitive receivers • identification of the sensitive receivers in the study area 	Contractor	Pre-construction	Standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> • details of the construction hours and construction works • the standard mitigation measures to be implemented (Appendix B of CNVG) • the additional mitigation measures to be implemented (refer to Table 6.7 and Table 6.8). 			
Construction noise and vibration	<ul style="list-style-type: none"> • Staged notifications delivered to sensitive receivers at least 7 days prior to commencement of relevant works in each stage of construction. Notifications will describe all upcoming construction activities. • Prior to demolition and construction works, notify residences that they may be highly noise affected. • The notifications will include the timing and nature of the works, as well as the expected noise levels, duration and impacts prior to construction works • Provide contact details to affected receivers for noise complaints and enquiries regarding construction works 	TfNSW	Pre-construction / Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction noise	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating noise with special audible characteristics and/or vibration levels should be scheduled during less sensitive time periods and undertaken within safe working distances.	Contractor	During construction	Additional safeguard
Construction noise	Noise with special audible characteristics and vibration generating activities (including jack and rock hammering and rock breaking) may only be carried out in continuous blocks, not exceeding four hours each, with a minimum respite period of one hour between each block.	Contractor	During construction	Additional safeguard
Construction noise and vibration	All employees, contractors and subcontractors are to receive an environmental induction	Contractor	Pre - construction	Additional safeguard
Construction noise	A noise monitoring program should be carried out for the duration of works in accordance with the Construction Noise and Vibration Management Plan. This should include noise monitoring at the nearest receiver within NCA1 for the noisiest activities during demolition and construction.	Contractor	During construction	Additional safeguard
Construction noise and vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable (i.e. bored	Contractor	During construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	piling/ torque head method instead of impact piling).			
Construction noise and vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.	Contractor	Pre – construction / Construction	Additional safeguard
Construction noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site, including delivery vehicles.	Contractor	During construction	Additional safeguard

6.6 Landscape character and visual impact

6.6.1 Existing environment

The wharf is situated on the shoreline of the Wagonga Inlet, which forms part of the Batemans Marine Park and flows east to the Wagonga Head.

The existing wharf is a fixed concrete and timber wharf structure accessed through Bluewater Drive and adjoins to a public walkway and kerbside parking.

The surrounding area east, west and south of the wharf is comprised of residential development including residential flat buildings and detached dwellings, and recreational land uses including the Nata Oval, Narooma Swimming Centre, Edwin Street Park, and Rotary Park. The Wagonga Inlet, Bar Beach South, Australia Rock and Wagonga Head is located north of the wharf. Most of these recreational areas have a direct line of sight to the wharf.

The wharf is located about four metres above sea level and is located at the base of a hill with an elevation of about 12 metres above sea level. Multi-level residential dwellings are located on the hill behind the wharf, and residences south, south-east and east of the wharf generally have a direct line of sight to the wharf. However, mature vegetation to the south and east of the wharf provide some visual screening between residences and the wharf.

6.6.2 Potential impacts

Construction

Landscape character and visual impacts during construction are expected due to the following construction components:

- presence of equipment, barges and piling equipment around the wharf
- removal of part of the existing wharf structure and construction of a new wharf

- temporary compound site to include site sheds, amenities shed and storage containers for tools and materials
- minor excavation during the demolition of the existing wharf, and for shoreline earthworks and trenching.

The proposal would have a temporary visual impact on users of the wharf, public walkway, recreational areas and those driving past the wharf via Bluewater Drive. The proposal would also have a temporary visual impact on residences south and south-east of the wharf. However, small pockets of established vegetation on the north-western slopes of the hill, south of the wharf, is anticipated to provide some visual screening between residences and the wharf, but not all. The topography of the area and other development will also provide a screen or visual barrier to the wharf. It is expected that any visual impacts would be greater for residences south-east of the wharf where there is less vegetation to provide visual screening.

Overall, the potential visual impacts of construction activities are considered to be minor as the works would be temporary and short-term. Impacts would be reduced with the mitigation measures outlined in Table 6.11.

Operation

The proposal has been designed to be as similar to the existing wharf structure as possible and therefore is not expected to result in visual impacts to the surrounding area.

6.6.3 Safeguards and management measures

Table 6.11 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.6.2.

Table 6.11 Landscape character and visual impact safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Landscape and visual	Hoarding will be erected around the construction compound where possible, to reduce visibility.	Contractor	Construction	Additional safeguard

6.7 Biodiversity

6.7.1 Methodology

The assessment of potential biodiversity impacts is based on the following recent study which included field survey of the Narooma Wharf area:

- *Narooma Wharf Replacement: Aquatic ecology assessment. Final Report* (Biosis, 2021).

In addition to Biosis (2021), a desktop assessment was undertaken to identify and collate existing information on the known or predicted environmental values within the proposal site. The following key information was reviewed:

- DAWE Protected Matters Search Tool for matters protected by the EPBC Act
- NSW Environment, Energy and Science (EES) BioNet Atlas of NSW Wildlife, for entities listed under the BC Act
- NSW Department of Primary Industries (DPI) Spatial Data Portal for FM Act listed threatened species, populations, and communities, and estuarine macrophyte mapping
- Atlas of Living Australia Spatial Portal tool
- high resolution aerial imagery of the proposal site.

The implications for proposed construction and operational activities were assessed in relation to EPBC Act, FM Act and BC Act.

6.7.2 Existing environment

Terrestrial

The terrestrial environment within the proposal site is very limited, highly modified by the provision of the existing wharf, footpath and car parking areas. The proposal site consists of four small, landscaped areas adjacent to roadside parking, no larger than six square metres each (refer to Figure 1.3). On the opposite side of Bluewater Drive and the wharf, lies an embankment of dense trees that provide a vegetated buffer between Bluewater Drive and Wharf Street residents (Figure 1.3). Landscaped areas and vegetation within road verges are maintained by Eurobodalla Shire Council.

Aquatic

Marine vegetation

Seagrasses are highly productive marine habitats that play a critical role for ecosystem function, are habitat forming macrophytes, and are sensitive to impacts from coastal development if not appropriately managed. Australia is home to substantial seagrass meadows, with an estimated 51,000 square kilometres of seagrass along its coastline, with 159 square kilometres of that occurring in NSW (OEH, 2017). Seagrasses are protected under the Fisheries Management Act 1994 (FM Act) from harm, including cutting, pulling, destroying, poisoning, digging up, removing, injuring, preventing light or otherwise causing harm to seagrass of NSW.

The following seagrasses have been mapped within the proposal site (DPI, 2021; Biosis, 2021):

- Large dense beds of *Posidonia australis* covering an area of 102.17 square metres primarily concentrated at the eastern end of the existing wharf from the midpoint due east (refer to Photo 6.1). *P. australis* is listed as a Threatened Ecological Community (TEC) under the EPBC Act for the Hawkesbury-Manning Bioregion, which ends just south of Wollongong, outside of the project footprint. As such, the *P. australis* community within the project footprint is not a TEC.
- Smaller beds of *Zostera muelleri* (26.84 square metres) (refer to Photo 6.2) and *Halophila ovalis* (2.71 square metres) (refer to Photo 6.3) occurring in mixed beds with *P. australis*. A mono-species bed of *Z. muelleri* occurs at the most eastern point of the existing wharf.



Photo 6.1 *Posidonia australis* bed adjacent to the eastern end of the wharf (Biosis, 2021).



Photo 6.2 *Zostera muelleri* bed (foreground) adjacent to the eastern end of the wharf (Biosis, 2021).



Photo 6.3 Mixed bed of *Posidonia australis* (top) and *Halophila ovalis* (bottom) adjacent to the wharf (Biosis, 2021).

Large areas of macroalgae beds mostly comprised of *Sargassum* sp., have also been mapped within the proposal site. The macroalgae beds often occurred amongst the seagrass beds, predominantly in the deeper water surrounding the wharf. Small patches of macroalgae, including *Hormosira banksii*, were present along the entire length of the wharf.

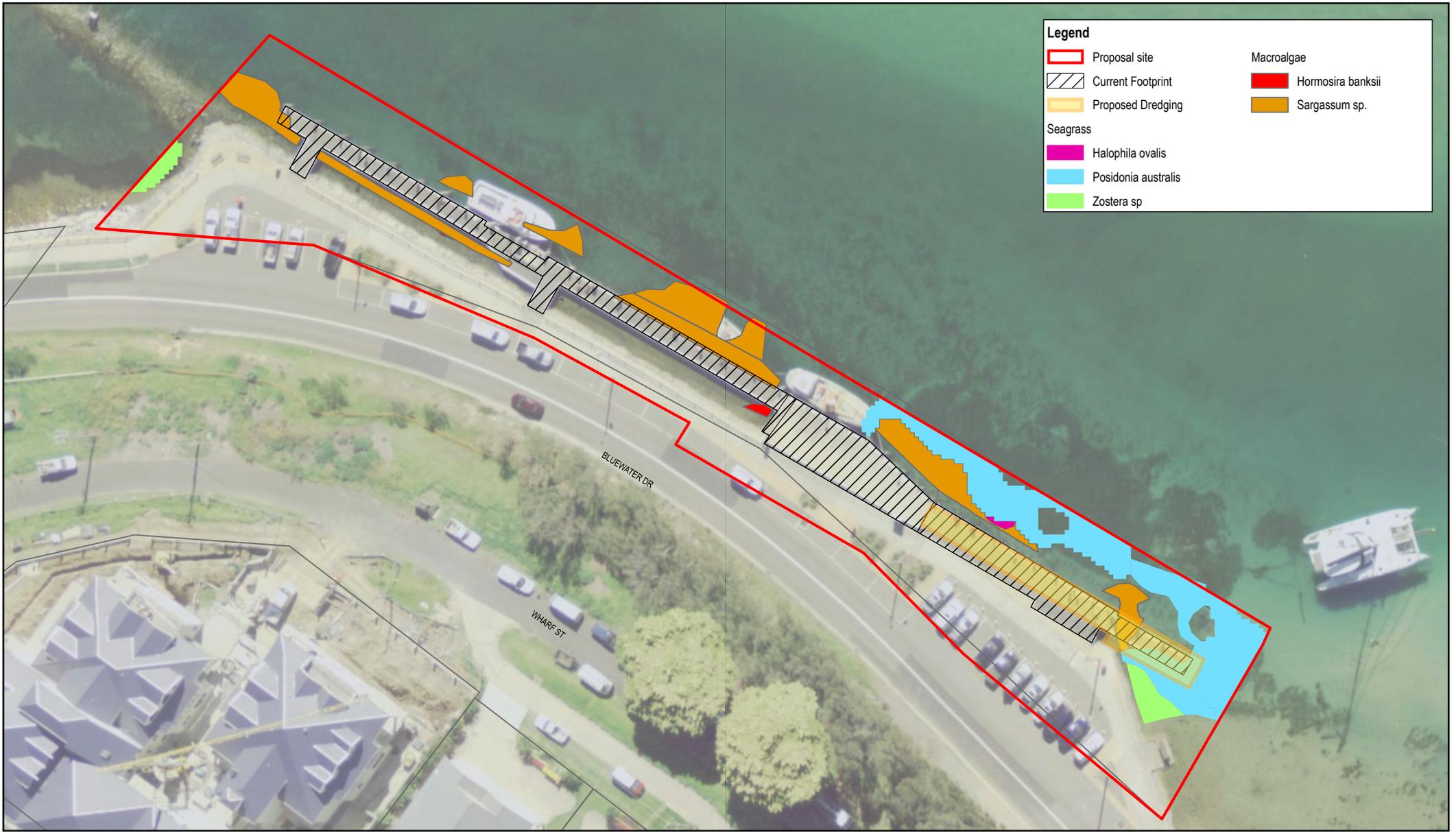
Seagrass and macroalgae beds were found immediately surrounding the majority of the wharf, with these beds most prevalent in the shallower eastern end (refer to Figure 6.2). These features were typically absent in heavily shaded areas beneath the wharf and long-term moored vessels. No seagrasses were recorded below the wharf; one large macroalgae bed (*Sargassum* sp.) was recorded below the wharf in the central section as shown in Figure 6.2 (Biosis, 2021). The remaining substrate did not support any marine plants, likely due to the existing shading from the vessels and infrastructure.

Table 6.12 provides a summary of seagrass and macroalgae habitat within the proposal site. Seagrass mapping is provided in Figure 6.2.

Table 6.12 Areas of seagrass and macroalgae habitat within the proposal site

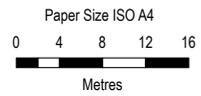
Species	Proposal site footprint area (m ²)	Pontoon footprint proposed works area (m ²)
Seagrass		
<i>Halophila ovalis</i>	2.71	2.56
<i>Zostera muelleri</i>	17.47	0
<i>Posidonia australis</i>	242.41	22.66
Macroalgae		
<i>Hormosira banksii</i>	4.25	0
<i>Sargassum sp.</i>	298.93	38.04

The sediment underlying the proposal site is primarily coarse grain sands, with sporadic boulders and shell material. The high habitat condition of the seagrass and macroalgae marine vegetation present produces suitable habitat for a range of small or juvenile fish species, as well as foraging habitat for larger aquatic species and shorebirds (Biosis, 2021).

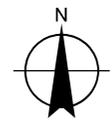


Legend

Proposal site	Macroalgae
Current Footprint	Hormosira banksii
Proposed Dredging	Sargassum sp.
Seagrass	
Halophila ovalis	
Posidonia australis	
Zostera sp	



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



**Transport for NSW
 Narooma Wharf
 Upgrade REF**

Project No. **12554705**
 Revision No. **0**
 Date **2/02/2022**

Aquatic vegetation

FIGURE 6-2

Habitat within the existing wharf alignment

The existing wharf piles were found to provide habitat for a range of aquatic species, supporting a dense growth of barnacles and oysters below the mean high-water mark. Below this the piles support extensive cunjevoi (*Pyura* sp.) beds. The interstitial spaces of the *Pyura* sp. community on these surfaces provides habitat for a range of fish species. The area where the wharf adjoins the foreshore provides significant habitat for barnacles and oysters with boulders and introduced built features providing additional complex habitat for marine fauna (Biosis, 2021).

Beneath the existing wharf the substrate is comprised of mixed rock ranging from pebbles through to boulders, interspersed occasionally by open sand expanses. These mixed rock habitats provide potential shelter and foraging habitat for a range of marine biota such as octopus, crabs, and small-bodied and juvenile fish. Water depth increases at the western end of the existing wharf where the substrate also shifts to predominately sand. At the eastern end of the wharf there is a section of unconsolidated sand; this aligns with the proposed pontoon wharf footprint (Figure 6.2) (Biosis, 2021) (refer to Photo 6.4 to Photo 6.8).

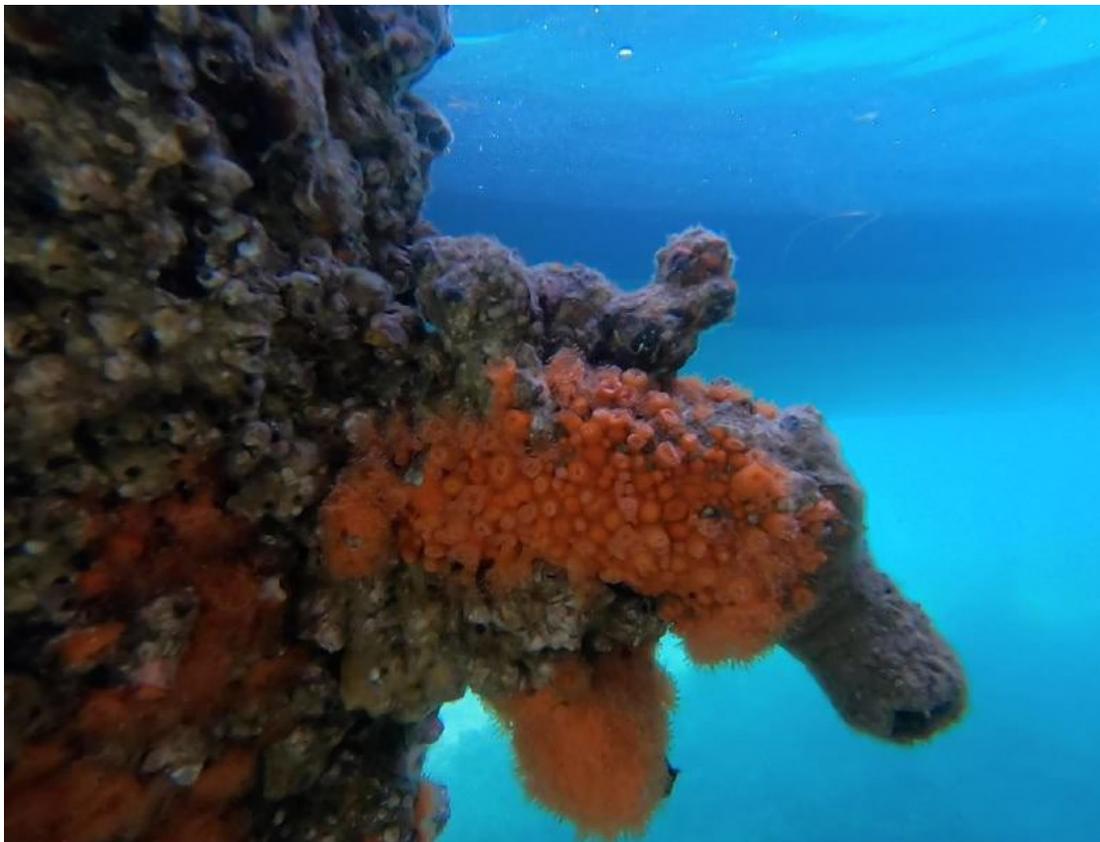


Photo 6.4 Example of marine growth on existing wharf structures supporting complex habitat (Biosis, 2021).



Photo 6.5 Boulders and built features below the existing wharf adjoining the foreshore (Biosis, 2021)



Photo 6.6 Macroalgae bed located below the centre of the existing wharf (Biosis, 2021)



Photo 6.7 Typical mixed rock substrate below the existing wharf (Biosis, 2021)

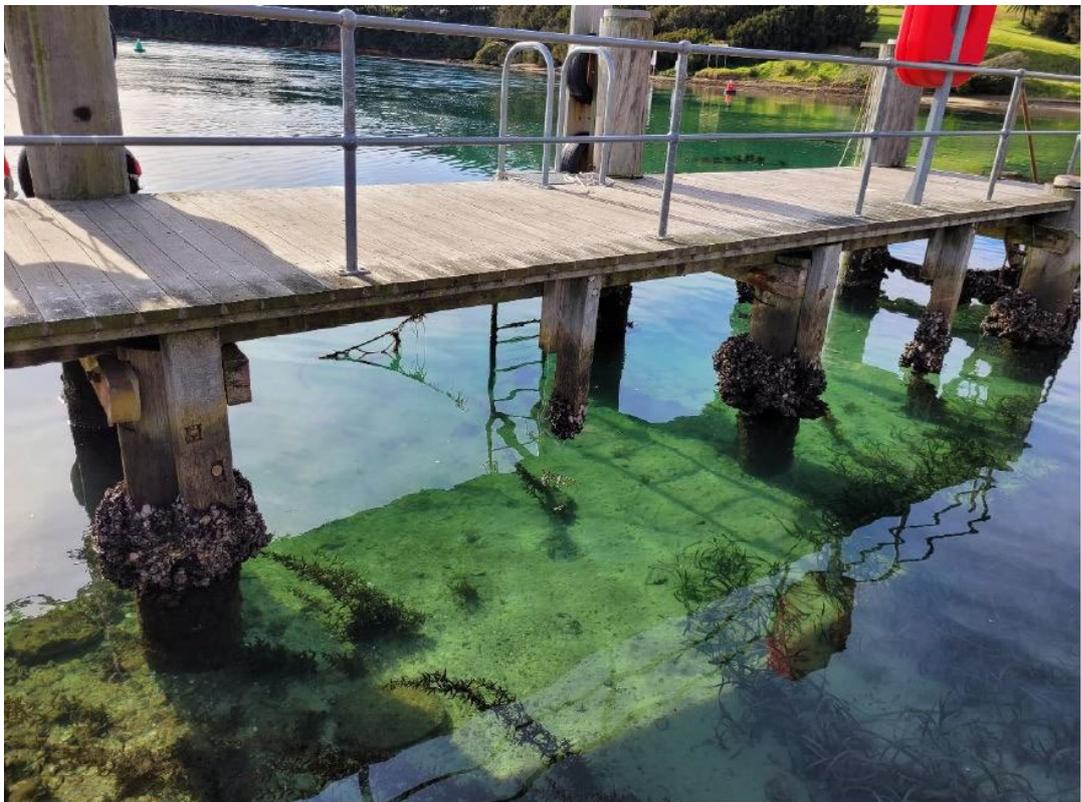


Photo 6.8 Section of unconsolidated sand substrate below the eastern end of the existing wharf (Biosis, 2021)

Near-shore habitats within the existing wharf alignment

In shallow waters on the landward side of the wharf, small patches of the macroalgae *Hormosira banksii* were present along the seawall complex totalling approximately 4.25 square metres, with patches of *Pyura* sp. also present along the seawall. The shoreline of the proposal site is highly modified. Habitats present include cobble and boulder sized rocky substrates. These habitats support complex habitats for crabs, periwinkles and molluscs (Biosis, 2021) (refer to Photo 6.9 and Photo 6.10).



Photo 6.9 Modified near shore environments with the macroalgae *Hormosira banksii* at the centre of the existing wharf (Biosis, 2021)



Photo 6.10 *Hydatina physis* observed in near shore rocky substrate below the existing wharf (Biosis, 2021)

Some existing impacts and sources of disturbance to aquatic habitats and aquatic biota were observed during the site inspection undertaken by Biosis (2021). These include:

- shading from the existing wharf structure and associated moored vessels
- boat wash from moored and passing vessels
- recreational fishing from the wharf
- adjacent roads and walkways
- stormwater outlet below the wharf.

Threatened species

No threatened or protected fish species were identified during the site inspection undertaken by Biosis (2021). Threatened species relevant to the proposal site are listed in Appendix F.

Desktop searches were undertaken by Biosis (2021) and confirmed by GHD in this report. These searches identified eight threatened flora species, 55 threatened bird species, 20 threatened mammal species and 13 threatened fauna species recorded (EES, 2020) or predicted to occur (Commonwealth of Australia, 2020) within five kilometres of the proposal site. Those species considered most likely to have habitat within the proposal site or considered likely to occur based on the desktop research are detailed in the following section. Given the scope and type of works as well as the habitats present, terrestrial species, mammals, pelagic or marine birds are considered unlikely to occur or to be impacted by the works and are not discussed further in this report.

Those species considered most likely to have habitat within the proposal site based on the desktop research are identified in Appendix F. An assessment of the habitat values of the proposal site is provided for each threatened species identified as having the potential to occur. The potential for impacts for these species are discussed in Appendix G.

6.7.3 Potential impacts

Marine ecosystems in the proposal site would be subject to potential direct and indirect impacts from the proposal. These have been assessed for both the construction and operation phases. Control measures are recommended to mitigate or minimize potential impacts.

An assessment of significance of threatened species that are likely to occur within the study area is provided in Appendix G.

Construction

Terrestrial

Terrestrial disturbance would be limited to a narrow trench about 180 metres long between the proposal site and the nearest suitable sewer and water connection for utilities upgrade associated with the proposal. Trenching would pass near two street trees and mown landscaped grass, next to Bluewater Drive. Trenching is not expected to result in the direct loss of existing vegetation.

Aquatic

Marine vegetation and benthic fauna

Construction activities for the proposal would result in direct and indirect impacts to marine vegetation (seagrass and macroalgae beds) and associated benthic fauna through:

- movement and anchoring construction barges within the waterway
- demolition and removal of the old wharf
- physical removal of old piles
- seawall repairs (if required)
- dredging
- drilling and installing new piles
- constructing the new wharf.

Seagrass and macroalgae beds have been mapped in Figure 6.2; this delineates areas within the proposal site that will be subject to direct disturbance. The majority of mapped marine vegetation is located outside of the footprint of direct disturbance.

It is expected that 63.26 square metres of marine vegetation, comprising 25.22 square metres of seagrasses, and 38.04 square metres of macroalgae will be directly disturbed during construction. Impacts to seagrass beds can be minimised by ensuring that only the fringes of these areas would be disturbed, and following the controls described in Table 6.17.

Slow-moving or semi-sedentary fauna species located on the seabed at the time of construction works are likely to be lost if directly disturbed; this may include syngnathids (such as sea horses and pipefish). Keeping works out of seagrass beds as far as practicable would result in better biodiversity outcomes as benthic species would recolonise impacted areas under a long-term recruitment process (Hamer and Mills, 2015).

A permit would need to be obtained from NSW DPI Fisheries under clause 205 of the FM Act to undertake construction works due to the anticipated impact on the seagrass beds. Refer to section 6.7.5 for more details. Indirect disturbance to marine vegetation adjacent to the proposal site may also arise during construction via generation of turbid plumes which can cause shading and smothering from sediment deposition. An increase in turbidity can affect the feeding and respiratory apparatus of filter-feeding organisms such as sponges, ascidians (e.g. sea squirts) and oysters (Airoldi, 2003; Maldonado et al., 2008).

These indirect impacts are expected to cease following the completion of construction activities. Construction is anticipated to take four months, with completion anticipated by November 2022. As seagrasses are known to be tolerant of periods of high turbidity, the short-term and localised turbidity from construction activities are unlikely to result in adverse impact to the species (Biosis, 2021). As benthic communities are already established in near-shore areas prone to high turbidity following rainfall events, it is likely that they will be resilient to short-term increases in suspended solids and subsequent burial and loss of light resulting associated with construction activities. These impacts can be considered low to moderate and short-term after management controls are in place.

Land-based works also have the potential to impact upon marine vegetation. Potential impact pathways include uncontrolled spills and inappropriate management of dredged material. Without appropriate management impacts could include an increased footprint of disturbance beyond the proposal site, resulting in flow on effects to the region's biodiversity.

Refer to Table 6.1 for management controls to minimise the impact of sediment disturbance and turbidity.

Marine fauna

Mobile species at the site include species such as fish, turtles and seals. Turtles and seals are considered transient species and are unlikely to be resident to the study area. If present, the species are likely only transiting through and potentially opportunistically foraging.

Construction impacts would be most likely to affect fish in the study area and proposal site. An increase in turbidity from suspended sediment has the potential to affect the feeding ability of fish including potential gill damage (de Robertis et al., 2003; Au et al., 2004; Wong et al., 2013).

There may be temporary impacts on turtles and seals as a result of habitat disturbances and underwater construction noise. It is likely that any animals in the area would move away from the proposal site during works.

Table 6.17 describes management controls to mitigate the potential for these impacts on mobile species in the study area. Table 6.1 describes sediment controls for water quality.

Marine pests and invasive species

The use of boats and barges may increase the risk of the establishment of non-indigenous species including invasive species in Wagonga Inlet. Risks would increase if these boats came from outside the harbour and/or have been previously used in infested areas and have not been adequately checked and cleaned.

Table 6.11 describes measures to reduce the risk of introducing pest species.

Operation

Marine vegetation

The proposed wharf upgrade has the potential to shade the seabed, limiting the growth of the seagrass below. However, this impact is likely to be minor considering the presence of the existing wharf structure. The current footprint area of the wharf is 547 square metres with the proposed wharf footprint to be approximately 875 square metres representing a net increase of approximately 328 square metres, including the mesh infill proposed along the fixed wharf. The depth at which the seagrass is located (around 0.8 metres below the proposed wharf upgrade section on the eastern end level at lowest astronomical tide), the use of mesh for the deck of the wharf to let light through and the north westerly orientation of the walkway will minimise the potential for impact to marine vegetation.

The wharf upgrade is to include the addition of a new pontoon wharf facility on the eastern end (Figure 6.2) overlapping with some seagrass and macroalgae beds which predominantly occur outside of the proposal site where potential shading from wharf structures is expected to be minimal. The mapped areas of seagrass and macroalgae that will be impacted by shading from the new wharf infrastructure are provided in Table 6.13 and Table 6.15.

The new piles to be installed as part of the proposed wharf upgrade are likely to become colonised by invertebrates and algal growth leading to a restoration of habitat that is removed during construction activities.

Table 6.13 Seagrass and macroalgae to be impacted indirectly from shading within the proposal site

Seagrass impact area (m ²)	Macroalgae impact area (m ²)	Total impact area (m ²)
237.37	265.14	502.51

Benthic fauna species

After works have been completed, further disturbance to benthic communities is not anticipated. The disturbed areas will likely be recolonised with comparable benthic communities to those previously established.

By following the recommended management measures in Table 6.14 impacts to benthic communities are not expected to have an adverse impact upon the wider adjacent communities as migration and recolonization of the disturbed footprint from these adjacent habitats is predicted to occur over time post construction.

Marine fauna

There is no expected difference in impacts to mobile marine fauna species between the existing wharf and the proposed wharf after construction is complete.

Routine use

The addition of the proposed pontoon wharf and low-tide access is likely to foster a gradual increase in wharf use for recreational activities such as fishing and kayaking and for smaller boats. There is potential for increased litter entering the Wagonga Inlet and the Batemans Bay Marine Park, and disturbance of the marine habitat at the proposal site. These additional potential impacts are expected to be minor and can be further minimised through the implementation of safeguards.

Conclusion on significance of impacts

A detailed assessment of significance for conservation significant species likely to occur in the study area has been undertaken pursuant to the requirements under the EPBC Act and the FM Act. This is provided in Appendix G.

With the application of mitigation measures detailed in Table 6.14, the proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the *Fisheries Management Act 1994* and the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Government DAWE is not required for biodiversity matters.

6.7.4 Safeguards and management measures

Table 6.14 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.7.3.

Table 6.14 Biodiversity safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	<p>Notify DPI (Fisheries) in accordance with Clause 199 of the FM Act.</p> <p>Obtain a permit under Clause 205 of the FM Act to address harm to seagrass and macroalgae.</p>	Transport for NSW / Contractor	Detailed design/ Preconstruction	Additional safeguard
Biodiversity – aquatic habitats	<p>A Marine Ecology Management Plan (MEMP) would be prepared as part of the CEMP. This would include, but not be limited to, measures relating to the following activities to minimise the impact to marine habitat:</p> <ul style="list-style-type: none"> • low impact barge positioning to prevent propeller scouring and thrust wash onto sensitive habitats • minimise footprint and establish no-go zones in sensitive habitats • accidental waste/material overboard response (e.g. construction materials dropped into the harbour) • biological hygiene (e.g. prevent spread of noxious species on and off the site) • aquatic fauna management. 	Contractor	Preconstruction /construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity – aquatic habitats	Minimise construction works and movements in identified seagrass meadows, and clearly define and limit the activity if it is unavoidable.	Transport for NSW / Contractor	Preconstruction / construction	Additional safeguard
Benthic community disturbance and threatened aquatic fauna species and habitat	<p>Undertake seabed construction work outside of the seahorse breeding season, between September to February. Where this is not possible, implement the Seahorse Relocation Plan at least 1 month prior to the start of the breeding season.</p> <p>Conduct a visual inspection of the works area before starting work on the wharf with specific attention for protected mobile fauna such as seahorses and sea dragons (i.e. <i>Syngnathids</i>). If present, these are to be relocated to adjacent habitats by a qualified person, outside the zone of influence of the construction works, where feasible in accordance with the Seahorse Relocation Plan provided in Appendix H.</p>	Contractor	Preconstruction /construction	Additional safeguard
Smothering and reduced light penetration	<p>Ensure that the Erosion and Sediment Control Plan is followed to prevent sediment transport beyond the silt curtain and into Wagonga Inlet.</p> <p>Limit the movement or re-anchoring of construction barges to reduce the potential disturbance of sediments to as low as reasonably possible. Minimise or eliminate the use of anchors and seabed contact from on-water plant and equipment.</p> <p>Avoid the use of propellers in shallow areas where possible to limit sediment</p>	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>disturbances and damage to macroalgae.</p> <p>Carry out in-water construction works using control methods appropriate to the sediment characteristics in disturbed areas.</p>			
Smothering and reduced light penetration	<p>Ensure that the proposed wharf design offers maximum light penetration to the seabed to minimise impacts to macroalgal and seagrass growth.</p>	Transport for NSW	Detailed design	Additional safeguard
Landscape amenity and tree protection	<p>Trenching is to avoid direct impact to tree root zones, where possible. Allocate exclusion areas for root protection during trenching works.</p> <p>Replace any vegetation removed as part of the works with a similar plant and in accordance with Landscaping Plans.</p>	Contractor	Construction	Additional safeguard
Piling construction noise impacts on aquatic fauna	<p>Follow the standard operational procedures below to manage the impact of underwater construction noise from piling activities, on marine fauna (DPTI, 2012):</p> <ul style="list-style-type: none"> • Pre-start procedure – A suitably trained crew member is to observe the site and surroundings from the wharf for the presence of marine mammals for at least 30 minutes before beginning the soft start procedure (see next step). • An acoustic harassment/deterrent device could be sounded prior to the 	Contractor	Preconstruction /construction	Additional safeguard

	<p>commencement of any underwater activity to provide the opportunity for sensitive marine fauna, such as seals, to relocate temporarily if hauling out nearby.</p> <ul style="list-style-type: none"> • Soft start procedure – If marine mammals have not been sighted within or are unlikely to enter the shutdown zone during the pre-start procedure, the soft start procedure may commence in which the piling impact energy is gradually increased over a 10-minute period. The soft start procedure should also be used after long breaks of more than 30 minutes in piling activity. Visual observations of marine mammals within the safety zones should be maintained by trained crew throughout soft starts. The soft start procedure may alert marine mammals to the presence of the piling rig and enable animals to move away to distances where injury is unlikely. • Normal operation procedure – If marine mammals have not been sighted within or are not likely to enter observation zone during the soft start procedure, 			
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Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>piling may start at full impact energy. Trained crew should continuously undertake visual observations during piling activities and shut-down periods.</p> <ul style="list-style-type: none"> • After long breaks in piling activity or when visual observations ceased or were hampered by poor visibility, the pre-start procedure should be used. Low visibility operations may proceed provided that no more than three shut-downs occurred during the preceding 24 hour period. • Stand-by operations procedure – If a marine mammal is sighted within the observation zone during the soft start or normal operation procedures, the operator of the piling rig should be placed on standby to shut down the piling rig. An additional trained crew member should continuously monitor the marine mammal in sight. • Shut-down procedure – If a marine mammal is sighted within or about to enter the construction zone, the piling activity should be stopped immediately. If a shut-down procedure occurred and marine 			

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<p>mammals have been observed to move outside the shut-down zone, or 30 minutes have lapsed since the last marine mammal sighting, then piling activities should recommence using the soft start procedure. If marine mammals are detected the shut-down zone during poor visibility, operations should stop until visibility improves.</p> <p>Where possible, timing of the works will be outside of the breeding months (summer months) for the Australian Fur Seal and New Zealand Fur Seal to alleviate any noise related stress the species may experience.</p> <p>Refer to the <i>Australian Guidelines for Whale and Dolphin Watching</i> (DoEE, 2017) for sea-faring activities for the works.</p>			
<p>Pest introduction and proliferation</p>	<p>The following controls and processes should be employed when possible, in order to mitigate or eliminate the risk of introducing pests:</p> <ul style="list-style-type: none"> • Vessels and construction barges will be locally sourced (within NSW waters) to complete the construction works, where possible. 	<p>Contractor</p>	<p>Preconstruction /construction</p>	<p>Additional safeguard</p>

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> A Marine Pest Species Management Plan will be prepared and implemented in accordance with the National System for the Prevention and Management of Marine Pest Incursions (National System) and NSW requirements for IMP identification and management. If an IMP is identified or suspected, then the contractor will notify the NSW Department of Primary Industries Aquatic Biosecurity Unit immediately (within 24 hours) hotline on (02) 4916 3877. 			
Pest control	Ensure that the use of on-water plant and equipment is adequately checked and cleaned to prevent the spread of invasive and non-indigenous species	Contractor	Preconstruction /construction	Additional safeguard
Marine fauna interaction	<p>The following controls may be adopted and should be executed when possible to mitigate or eliminate the risk of collision between vessels and marine fauna:</p> <ul style="list-style-type: none"> Operations of vessels will be commensurate with Part 8 of the EPBC Regulations (Interacting with Cetaceans and Whale Watching). 	Contractor	Preconstruction /construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> The <i>Australian Guidelines for Whale and Dolphin Watching</i> (DoEE, 2017) for sea-faring activities will be implemented across the entire project. 			
Threatened aquatic flora and fauna species and habitat	If unexpected threatened fauna or flora species are discovered, stop works immediately and follow the <i>Roads and Maritime Services Unexpected Threatened Species Find Procedure in the Roads and Maritime Services Biodiversity Guidelines 2011 – Guide 1</i> (Pre-clearing process).	Contractor	Preconstruction /construction	Additional safeguard
Marine habitats, aquatic fauna and water quality	<p>Detailed design is to consider including:</p> <ul style="list-style-type: none"> waste disposal bins at the wharf to minimise the potential for litter to enter Wagonga inlet signage to encourage wharf users to dispose of waste appropriately and keep Batemans Bay Marine Park litter free. 	Transport for NSW	Detailed design	Additional safeguard
Biodiversity offsets	Consult with NSW Department of Industries on final direct and indirect impacts of the detailed design and required offset and compensation requirements in accordance with the <i>Policy and Guidelines for Fish Habitat Conservation and Management</i> (2013 Update).	Transport for NSW	Detailed design	Additional safeguard

6.7.5 Potential offsetting obligations

The proposal is likely to directly impact upon seagrass and macroalgae beds on the eastern side proposal site. In accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management (2013 Update)*, a permit to harm vegetation under Section 205 of the FM Act is required to be obtained prior to works commencing.

As part of ordinary permit conditions of consent, NSW DPI enforces a no net loss habitat policy that may require proponents to conduct habitat rehabilitation and/or provide compensation for its direct impacts on marine habitats. A monetary bond may be kept by DPI to ensure that works are completed in accordance with stipulated permit conditions. DPI calculates habitat compensation on a minimum 2:1 basis for all key fish habitat to capture the indirect impacts of the proposal. A greater compensation ratio may be required where opportunities for compensation are not available in the immediate vicinity of, or the type of habitat that has been lost.

The calculated area of seagrass impact is that which is likely to be subject to direct impacts from the construction works and secondary shading impacts as a result of the widening of the existing wharf and installation of a pontoon wharf on the eastern end.

As per Table 6.15, the minimum offset burden for the proposal arising from the direct impact to seagrass and macroalgae includes a total area of 63.26 square metres. This area covers the direct impacts from the proposal.

Table 6.15 Seagrass and macroalgae species to be directly and indirectly impacted resulting from the construction works within the proposal site

Species	Total direct impact area per species (m ²)	Total indirect impact per species (m ²)
Seagrass		
<i>Halophila ovalis</i>	2.56	0.15
<i>Zostera muelleri</i>	0	17.47
<i>Posidonia australis</i>	22.66	219.55
Macroalgae		
<i>Hormosira banksii</i>	0	4.25
<i>Sargassum</i> sp.	38.04	260.89

Transport for NSW would consult with NSW DPI on compensation during detailed design. Consultation would address:

- detailed design's final direct and indirect impacts, updating the information in Table 6.15
- requirement to offset and compensate for indirect impacts
- compensation rates
- offsetting options including the potential for a seagrass relocation program.

6.8 Traffic, transport and access

6.8.1 Methodology

A qualitative assessment of transport, traffic and access was performed and considers the following:

- desktop assessment of existing transport infrastructure and services near the proposal
- evaluation of construction and operation impacts to maritime and landside transport.

6.8.2 Existing environment

Land transport

Road network

The road network within the vicinity of the wharf is characterised by residential streets with on-street and off-street parking.

Narooma Wharf is accessed from Bluewater Drive as shown in Photo 6.11. Bluewater Drive is a local road managed by Eurobodalla Shire Council. Bluewater Drive connects to the Princes Highway (A1) to the east and connects with other local roads including Wharf Street, Bay Street and Ballingalla Street to the west (refer to Figure 1.2).

Bluewater Drive has one lane in each direction and it has a signed speed of 40 kilometres per hour. There is street lighting along parts of the road around the wharf area.



Photo 6.11 Bluewater Drive adjacent to the Proposal site

Active transport and public transport

A pedestrian footpath is provided on the water side of Bluewater Drive. No dedicated cycle facilities are provided. The footpath links the parking areas with the wharf, as shown in Photo 6.12 and Photo 2.3.

Bus stops are available on the Princes Highway. The nearest bus stop (Stop ID: 254633) services the 866 route and is around 300 metres from the proposal site. The 866 bus has 16 stops departing from Bodalla Public School Narooma, Potato Point Road and ending in 179 Old Highway.

Parking

There is public street parking adjacent to the wharf. This comprises 19 angled spaces, and 14 parallel spaces. Parking spaces can be seen in Photo 6.12. There are no time restrictions or parking fees for using these facilities.

In addition to this, there is further public parking available off Bluewater Drive at Batemans Marine Park around 200 metres east, and at Edwin Street Park, around 100 metres west of the proposal site.



Photo 6.12: Parking spaces and pedestrian footpath

Water transport

The wharf is currently used by tour boat operators, commercial fishing operators, as well as the local community and tourists. Regular charter boats provide recreational activities such as diving and whale watching trips. Photo 2.3 shows the mooring facilities of the wharf.

The wharf provides moorings for up to nine boats to a maximum length of around 25 metres. There are no time restrictions for moorings at this wharf.

6.8.3 Potential impacts

Construction

Land transport

Road network

Construction vehicles would access the proposal site via Bluewater Drive. It is anticipated that most materials and equipment required for land-based elements of the proposal would be delivered by road. Construction vehicle movements and access arrangements which may occasionally interrupt traffic flow on the local road network during delivery and removal of materials and plant.

Overhead power lines in the vicinity of Narooma Wharf would limit access for crane activity at the wharf and may require road closures. It is anticipated therefore, that the new pontoon would be delivered to a nearby boat ramp (such as Apex Park or another nominated ramp) where there is suitable access for a crane to unload the structure into the water for towing to the worksite.

Where major components are scheduled for delivery at the wharf or via a suitable boat ramp access, additional traffic management solutions and access would be required.

Active transport and public transport

There would be no disruption to the bus network or impact to bus stops.

A section of the existing pedestrian footpath is located between the work site and the laydown area and compound site. A temporary diversion to the pedestrian footpath would be required to manage public safety during some construction and loading/unloading activities.

The footpath east of the proposal site would be impacted during utility works. A sewer connection would be required as part of the proposed sewage pump-out facility located at the wharf. The connection is anticipated to be a 160 - 200 metre long underground connection run to the existing sewerage main heading east. The sewer will be located under the existing footpath and join with an existing connection located beneath Bluewater Drive. The location is shown on Figure 3.2.

A temporary diversion to the footpath would be needed to manage public safety during these construction works.

Parking

Land side works would require space for a site compound and loading/unloading area. The location of these are shown on Figure 1.3. These would be established in the carpark area adjacent to the proposal site. This would require the temporary loss of three angled spaces for the compound site and four parallel spaces would be required for a loading/unloading area.

In addition, construction workers may require up to three parking spaces near the proposal site.

These activities would reduce the availability of parking spaces close to the wharf. There are several other carparks within 200 metres of the site that could accommodate vehicles from visitors to the wharf. In addition, as half the wharf would be unavailable for public use during construction it is anticipated there would also be a reduction in visitors to the site.

Water transport

A small maritime exclusion zone may be required around the water side construction footprint during construction to prevent commercial and recreational traffic entering the area.

Where feasible, materials and equipment for water based elements of the proposal would be shipped (barged) into and out of the area to limit any impact on the surrounding traffic network. This would provide the best method to build the marine components. The amount of materials shipped to site, over being delivered by road, would be confirmed during detailed design.

Construction of the proposal would result in up to 8-10 vessels travelling between an off-site loading facility and the wharf each day. As half the wharf would be unavailable for public use during construction it is anticipated there would also be a reduction in vessels using this site and therefore the minor increase in vessel movements for construction activities is not considered to be significant in the context of the wharf.

The construction works would result in temporary impacts to commercial and recreational users of the wharf due to the partial closure of the wharf. Charter boats and private vessels would continue to have access to half the wharf during construction, minimising disruption to water transport.

Operation

Land transport

Operation of the proposal would have negligible impact on the surrounding road network, parking or public transport.

Minor improvements to pedestrian footpaths in and around the proposal site would be carried out through incorporating a gangway ramp for permanent access to pontoon level. The proposed design incorporates improved access in accordance with the *Disability Discrimination Act 1992*.

Water transport

The size and capacity of the design would accommodate a similar type and volume of vessels as the existing wharf. On this basis, there would not be a significant change in water transport resulting from the proposal.

6.8.4 Safeguards and management measures

Table 6.16 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.8.3.

Table 6.16 Traffic, transport and access safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Land transport, parking and access	<p>A Traffic Management Plan (TMP) will be prepared and will include the following:</p> <ul style="list-style-type: none"> • A safe and alternative pedestrian and cyclist access to be maintained with consideration to temporary security fencing and wayfinding being implemented for each construction stage • designated parking for construction workforce that minimises impacts on public car parking spaces at the wharf • maintaining current local traffic movements along Bluewater Drive • A Road Traffic Control Plan in accordance with the '<i>Traffic control at work sites manual</i>' (RTA, 2010a) and Australian Standard 1742.3 <i>Manual of uniform control devices</i> for any planned traffic disruptions or road occupancy of Bluewater Drive. 	Contractor	Pre-construction/ construction	Standard safeguard
Water transport	<p>A Construction Marine Traffic Management Plan (CMTMP) will be prepared and implemented. The CMTMP will identify:</p> <ul style="list-style-type: none"> • navigational safety requirements for all construction vessels and water-based equipment 	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> • a response plan for implementation including 24-hour contact details, management and communication protocols for enquiries, complaints and emergencies • retrieve any material associated with the construction of the development that enters the water to prevent the obstruction of vessel movements. 			
Water transport	Where possible, current vessel movements and public access to the waterway and foreshore area are to be maintained during works. Any disturbance is to be minimised as much as practicable.	Contractor	Construction	Additional safeguard
Water transport	<p>Commercial, recreational operators, private services and the community that use the existing wharf will be advised of:</p> <ul style="list-style-type: none"> • the commencement of construction, well in advance of work starting including the location of the compound site and temporary loss of car parking bays • any changes to pedestrian routes to safely access the wharf • the partial wharf closure at least two weeks prior to closure. 	Transport for NSW	Pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Water transport	<p>A navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area.</p> <p>This zone will be clearly defined to communicate access for other water users.</p>	Contractor	Pre-construction /construction	Additional safeguard

6.9 Aboriginal cultural heritage

6.9.1 Methodology

A Stage 2 Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) has been carried out and is provided in Appendix I. This section summarises the proposal's Aboriginal heritage impacts.

An archaeological pedestrian survey was conducted of the shoreline area extending to the south and north of the proposal site on 26 May 2021. This was attended by a representative of the South Coast NSW Aboriginal Elders.

This assessment was carried out with reference to the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010) and has included:

- review of relevant landscape context to understand the potential of the land to have been occupied by Aboriginal people and leave material traces behind reflecting that occupation
- review of the non-Aboriginal history of the proposal site
- an Aboriginal Heritage Information Management System (AHIMS) database search to identify previously recorded sites within or within proximity to the proposal site
- review of AHIMS site cards and relevant archaeological reports to provide archaeological context for the assessment of the proposal site.

6.9.2 Existing environment

The proposal site falls within the boundaries of the Wagonga Local Aboriginal Land Council and within the boundaries of the Yuin Aboriginal people.

The search area for the assessment was a square, four square kilometres in area and centred on the wharf.

No Aboriginal objects, potential archaeological deposits (PADs) or sensitive landforms were identified as part of this archaeological survey. The terrestrial part of the proposal site has been demonstrated to be reclaimed land and is assessed as highly disturbed.

A search of the AHIMS database identified Site 62-7-0089 being located close to the western end of the wharf within the proposal site. No trace of AHIMS Site 62-7-0089 could be located within the proposal site when the area was inspected as part of the archaeological pedestrian survey. Interpretation of the original site recordings as part of this assessment suggest that AHIMS Site 62-7-0089, if indeed still extant, is located south of the Narooma Wharf proposal site and on the north-western fringe of Rotary Park adjoining Blue Water Drive.

6.9.3 Potential impacts

No Aboriginal objects, PADs or sensitive landforms were identified as part of this archaeological survey. The terrestrial part of the proposal site has been demonstrated to be reclaimed land and is assessed as highly disturbed.

No trace of AHIMS Site 62-7-0089 could be located within the proposal site as part of this investigation. The fact that the entire proposal site has also been demonstrably assessed as reclaimed land resulting from historical successive disturbance adds considerable weight and confidence to this reinterpretation.

The survey did not locate any Aboriginal sites or objects and the likelihood of PADs was assessed as negligible to nil. The proposal site was assessed as having no archaeological significance.

Aboriginal consultation concluded that the proposal would not affect any significant known or potential Aboriginal cultural heritage features.

The proposed replacement of the Narooma Wharf is therefore assessed as having a negligible or nil potential to impact on Aboriginal sites and objects protected under the *National Parks and Wildlife Act 1977*.

6.9.4 Safeguards and management measures

Table 6.17 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.9.3.

Table 6.17 Aboriginal cultural heritage safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage	If Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and the Transport for NSW Aboriginal cultural heritage officer and regional environment manager contacted immediately. Steps in the Transport for NSW Standard Management Procedure: Unexpected Heritage Items must be followed.	Contractor	Construction	Standard safeguard.

6.10 Non-Aboriginal heritage

6.10.1 Methodology

A search of the following heritage databases was undertaken for the proposal site on 16 August 2021:

- National Heritage List
- Commonwealth Heritage List
- NSW State Heritage Register
- Marine Heritage Register
- Eurobodalla LEP.

Other heritage items in the vicinity of the proposal are listed in Table 6.18.

Table 6.18 Other heritage items in the vicinity of the proposal

Item name	Listing	Distance
Light from Montague Island Lighthouse	LEP (Item no. I256)	200 metres south west
Narooma Soldiers Memorial School of Arts	I185	150 metres south
Court House	I186	160 metres south
War memorial clock	I195	200 metres south
Shop	I286	220 metres south
Pilot Wharf and boatshed	I183	125 metres north east

6.10.2 Existing environment

The desktop searches identified no items on the Commonwealth, National or State Heritage Register within the proposal site or immediate surrounds.

The following heritage items were identified within or adjacent to the proposal site:

- Wharf Pylon, listed under the Eurobodalla LEP (Item no. I184)
- Narooma wharf is listed under the Maritime Heritage Register (item 2106).

The listing for 'Wharf Pylon' under the Eurobodalla LEP identifies Lot 891 DP 729182 as part of the heritage listing. This includes the existing wharf within the proposal site. Correspondence with Eurobodalla Shire Council (email dated 30 August 2021) has confirmed that the heritage listing applies only to a historical pylon located to the west of the proposal site.

The location of the Narooma wharf (item no. 2106) is listed as a maritime heritage site by NSW Heritage but is not listed on the State Heritage Register. The location once supported the town's timber wharf built in 1894, which was later reconstructed in 1902 together with a pilot station located high on a nearby hill, on the southern side of the entrance. The stone training walls fronting the Wogonga River entrance were constructed from local slate mined near the entrance and was completed in 1922. The listing provides a co-ordinate location to the listing, however no curtilage is defined

6.10.3 Potential impacts

Construction

The proposal would be confined to the proposal site identified in Figure 3.1. Eurobodalla Shire Council have confirmed that the proposal is not located within the curtilage of the local heritage item of (Wharf Pylon Item no. 1184), however it is located directly to the west of the proposal site. There is potential for indirect impacts such as vibration on the Wharf Pylon during construction (located about 29 metres to the west of the proposal site). These impacts would be minimised through the implementation of appropriate safeguards such as selecting low vibration equipment to ensure safe working distances can be achieved.

Construction activities would have the potential to uncover maritime archaeological deposits associated with the former Narooma wharf structures of 1894 and 1902. The current Narooma Wharf has not retained any former elements of the old wharf structures.

Operation

There would be no risks to non-Aboriginal heritage from the operation of the proposal.

6.10.4 Safeguards and management measures

Table 6.19 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.10.3.

Table 6.19 Non-Aboriginal cultural heritage safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal Heritage	If unexpected heritage items are uncovered during the works, all works must cease in the vicinity of the material/find and the steps in the Transport for NSW's <i>Standard Management Procedure: Unexpected Heritage Items</i> must be followed. Transport for NSW Senior Environment Specialist – Heritage must be contacted immediately.	Contractor	Construction	Standard safeguard
Maritime heritage	Consult with NSW Heritage to notify of the proposal to replace the Narooma Wharf, the location to which is listed on the maritime heritage register. Consultation will also identify any additional design or permit	Transport for NSW	Detailed design	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	requirements prior to construction.			
Local heritage	Construction activities near to the local heritage item, Wharf Pylon Item no. 1184, must be within safe working distances for cosmetic damage identified in the <i>Construction Noise and Vibration Guideline</i> (RMS 2016). If safe working distances cannot be achieved with standard equipment, then low vibration equipment should be selected.	Contractor	Construction	Additional safeguard

6.11 Other impacts

6.11.1 Existing environment and potential impacts

Environmental factor	Existing environment	Potential impacts
<p>Air quality</p>	<p>The existing air quality is primarily influenced by emissions from motor vehicles and residential activities. Air quality is also influenced by the prevailing weather and climatic conditions, bushfires and other natural factors such as pollen.</p>	<p>During the construction of the proposal temporary impacts on air quality may arise from:</p> <ul style="list-style-type: none"> • minor generation of particles and dust from general construction work (e.g. concrete cutting and breaking) • minor emissions (primarily diesel exhaust) from plant and machinery • minor emissions from construction traffic and water vessels. <p>These impacts are expected to be short-term, low intensity and be able to be managed through identified safeguard and management measures.</p> <p>The proposal is not anticipated to change the volume of water vessels or land vehicles accessing the site, and maintenance activities would be similar to the existing wharf operations. No additional impacts to air quality are expected from the operation of the proposal.</p>
<p>Climate change and greenhouse gas</p>	<p>In October 2009 the NSW government released its <i>NSW Sea Level Rise Policy</i> (DECCW, 2009a). The policy provided sea level rise planning benchmarks as follows:</p> <ul style="list-style-type: none"> • 40 centimetres by 2050 • 90 centimetres by 2100. <p>On 8 September 2012, the State government withdrew these benchmarks in order to provide more flexibility in considering local conditions when determining future hazards. Responsibility</p>	<p>Climatic factors would not constrain construction of the proposal except during adverse weather conditions such as prolonged heavy rain or high winds which may occur during the construction period. These may delay the completion of construction.</p> <p>Construction would contribute to climate change through the generation of greenhouse gases from construction activities. A temporary increase in greenhouse gas emissions, primarily carbon dioxide, would be expected during construction of the proposal due to exhaust emissions from construction machinery and vehicles transporting materials and personnel to and from the site. These impacts are anticipated to be minor however given the small scale and temporary nature of construction.</p>

Environmental factor	Existing environment	Potential impacts
	<p>for adopting sea level rise projections for use in planning was transferred back to local government.</p>	<p>The proposal is not anticipated to change the volume of water vessels or land vehicles accessing the site, and maintenance activities would be similar to the existing wharf operations. No additional impacts to climate change or greenhouse gas emissions are expected from the operation of the proposal.</p> <p>The proposal has minimised its exposure to climate change risks by including clearances of existing tides, storm surge, sea and wave action whilst also considering projected sea level rise over the next 50 years. The pontoon was designed to account for projections of sea level rise.</p>
<p>Hazards and risk</p>	<p>The existing wharf is a fixed structure that is subject to a two-metre tidal range. This affects safe access to vessels during high and low tides and limits the wharf's utilisation.</p>	<p>The following hazards and risks would be associated with the proposal during construction:</p> <ul style="list-style-type: none"> • construction materials, wastes and/or other objects have the potential to fall from the land based construction area into the water causing water pollution and risk to human health • construction materials, waste and/or objects have the potential to fall from the construction barge or other construction vessels into the water causing water pollution and risk to human health • physical injury to public due to various hazards and risks associated with the construction activities (e.g. construction vehicle movements) • physical injury to public due to various hazards and risks associated with the construction activities. <p>The proposal includes the replacement of the existing wharf with a new wharf of similar size and position, with improved amenity and access for water-side and land-side users. The proposed design would provide safer and regular access to the wharf for vessels and passengers. The proposed design incorporates improved</p>

Environmental factor	Existing environment	Potential impacts
		access in accordance with the <i>Disability Discrimination Act 1992</i> .
Socio-economic	The wharf is currently used by tour boat operators, commercial fishing operators, as well as the local community and tourists. A public walkway and kerbside parking are located along the southern side of the proposal site.	<p>There would be some disruption to local community during construction from the additional traffic movements and restrictions to part of the wharf, parking and the pedestrian footpath. These disruptions would be managed by standard safeguard measures and would be short term.</p> <p>During operation of the proposal similar facilities would be available to the community with the benefit of improved access and utility connections.</p>

6.11.2 Safeguards and management measures

Table 6.20 lists the safeguards and management measures that would be implemented to minimise impacts identified in section 6.11.1. Other relevant safeguards for minimising water quality impacts are also relevant and are listed in Table 6.2.

Table 6.20 Other impacts safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Air quality	<p>Air quality during construction will be considered and addressed within the CEMP and would include methods to manage work during strong winds or other adverse weather conditions as required. As a minimum, the following measures will be included:</p> <ul style="list-style-type: none"> • covering all loaded trucks and vessels • machinery to be turned off rather than left to idle when not in use • water to be used for dust suppression during concrete breaking and saw cutting • maintenance of all vehicles, including trucks and vessels entering and leaving the site in accordance with the manufacturers specifications to comply with all relevant legislation • maintenance of all plant and equipment to ensure good operating conditions and exhaust emissions comply with the <i>Protection of the Environment Operations Act 1997</i> • maintaining the work site in a condition that minimises fugitive emissions such as minor dust 	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> appropriate sediment and erosion controls for any exposed earth or stockpiled waste. 			
Hazard and risk	<p>Construction areas will be kept tidy, objects tied down to prevent falling into the water and land-based work areas fenced.</p> <p>Weather conditions will be actively monitored. In the event of adverse weather, wet-weather preparedness measures will be implemented including construction areas being made safe, erodible material stabilised, equipment tied down, moorings and anchors checked to ensure construction barges and vessels can withstand the expected weather conditions.</p>	Contractor	Construction	Additional safeguard
Hazard and risk	Refuelling of land based plant and equipment is to occur in impervious bunded areas located a minimum of 50 metres from drainage lines or waterways.	Contractor	Construction	Core safeguard
Hazard and risk	Refuelling of marine plant and equipment and storage of hazardous materials on barges is to occur within a double-bunded area.	Contractor	Construction	Core safeguard
Hazard and risk	<p>If an incident (e.g. spill) occurs, the Transport for NSW Environmental Incident Classification and Reporting Procedure is to be followed and the Transport for NSW Contract Manager notified as soon as practicable.</p> <p>Incidents will be reported to other agencies, where required, to comply with the requirements of the <i>Protection of the Environment Operations Act 1997</i>.</p>	Contractor	Construction	Core safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Hazard and risk	Emergency contacts will be kept in an easily accessible location on vehicles, vessels, plant and site office. All workers will be advised of these contact details and procedures.	Contractor	Construction	Core safeguard
Socio-economic	<p>A Communications and Stakeholder Engagement Plan will be prepared to provide timely and accurate information to wharf users, surrounding sensitive receivers, businesses, stakeholders and the local community of:</p> <ul style="list-style-type: none"> • Construction activities well in advance of construction starting. • Project updates to the progress in construction including the stage construction program. Wharf users will be notified and informed on which sections of the wharf will be opened or closed for public use. • Any disruptions to local road traffic. • Contact name and telephone number for enquiries or for making a complaint. <p>A webpage and free-call number will be established for enquiries and will remain active for the duration of construction. All enquiries and complaints will be tracked and acknowledged within 24 hours of being received.</p>	Transport for NSW and Construction Contractor	Construction	Additional safeguard

6.12 Cumulative impacts

6.12.1 Proposal site

The Narooma Wharf is located within the suburb of Narooma, in the Eurobodalla LGA. A search of the following databases was completed to identify any projects which might result in cumulative impacts with the proposal:

- Department of Planning, Industry and Environment – Major projects
- Southern Regional Planning Panel Development and Planning Register
- Eurobodalla Shire Council development application register.

Projects identified on the above registers that may impact on the proposal have been identified in Table 6.21.

6.12.2 Other projects and developments

Potential impacts from the construction and operation of identified past, present and future projects are summarised in Table 6.21.

In addition, other minor residential alterations and development applications have been identified. No significant construction related traffic would be generated for these projects outside of light vehicles travelling to the site and minor deliveries of equipment and materials.

Table 6.21 Past, present and future projects

Project	Construction impacts	Operational impacts
117 Campbell Street, Narooma Lot 1 DP 1071860 Construction of a residential flat building containing seven units	Potential impacts to traffic with a minor increase in construction vehicles and light vehicles for the construction activities. Potential noise impacts for the surrounding area.	No operational impacts are anticipated.

6.12.3 Potential impacts

Environmental factor	Construction	Operation
Traffic and transport	Minor increase in construction vehicles and light traffic.	No operational impacts are anticipated.
Traffic and transport	Negligible impact on parking for patrons of the Food Market who park along Bluewater Drive.	No operational impacts are anticipated.
Noise	Minor increase in noise for residential dwellings within the immediate vicinity of the proposal site and residential flat development.	No operational impacts are anticipated.

Environmental factor	Construction	Operation
Noise	Potential minor and temporary increase in noise for patrons of the Food Market.	No operational impacts are anticipated.

6.12.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative construction impacts	<p>Construction will include notification prior to the start of the works.</p> <p>Updates on any delays or changes to the construction period will also be communicated.</p>	Transport for NSW	Pre-construction / Construction	Additional safeguard

7 Environmental management

This chapter describes how the proposal will be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided. A summary of site-specific environmental safeguards is provided and the licence and/or approval requirements required prior to construction are also listed.

7.1 Environmental management plans

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the Transport for NSW Environment Officer prior to the commencement of any on-site works. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed work on the surrounding environment. The safeguards and management measures are summarised in Table 7.1.

Table 7.1 Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing
GEN1	General - minimise environmental impacts during construction	<p>A CEMP will be prepared and submitted for review and endorsement of the Transport for NSW Environment Manager prior to commencement of the activity.</p> <p>As a minimum, the CEMP will address the following:</p> <ul style="list-style-type: none"> • any requirements associated with statutory approvals • details of how the project will implement the identified safeguards outlined in the REF • issue-specific environmental management plans • roles and responsibilities • communication requirements • induction and training requirements • procedures for monitoring and evaluating environmental performance, and for corrective action • reporting requirements and record-keeping 	Contractor / Transport for NSW Project Manager	Pre-construction/ detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> • procedures for emergency and incident management • procedures for audit and review. <p>The endorsed CEMP will be implemented during the undertaking of the activity.</p>		
GEN2	General - notification	All businesses, residential properties and other key stakeholders (e.g. schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Contractor/ Transport for NSW project manager	Pre-construction
GEN3	General – environmental awareness	<p>All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings.</p> <p>Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include:</p> <ul style="list-style-type: none"> • dredging and water quality impacts • marine ecology and Batemans Marine Park • spill response procedures • adjoining residential areas requiring particular noise management measures • managing complaints and enquiries during construction. 	Contractor/ Transport for NSW project manager	Pre-construction/ construction

No.	Impact	Environmental safeguards	Responsibility	Timing
SW1	Soil and water	<p>A Soil and Water Management Plan (SWMP) would be prepared and implemented as part of the CEMP.</p> <p>The SWMP would identify all reasonably foreseeable risks relating to soil erosion, sediment dispersion and water pollution and describe how these risks would be addressed during construction.</p> <p>Erosion and sediment control measures are to be implemented and maintained (in accordance with the Landcom/Department of Housing <i>Managing Urban Stormwater, Soils and Construction Guidelines</i> (the Blue Book)) to:</p> <ul style="list-style-type: none"> • prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • reduce water velocity and capture sediment on site • minimise the amount of material transported from site to surrounding waters and pavement surfaces • divert clean water around the site. <p>Additionally, sediment controls are to be implemented and maintained for the marine environment when dredging and undertaking marine-side construction work.</p>	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
SW2	Erosion and sedimentation	Silt curtain/s are to be installed prior to and around the area of works that may disturb the seabed. Silt curtains are to be installed, monitored and maintained as needed to contain any sediment.	Contractor	Pre-construction
SW3	Erosion and sedimentation	Select and regularly check baseline sites around the construction area to confirm impacts are not migrating out of the construction zone.	Contractor	Pre-construction and Construction
SW4	Erosion and sedimentation	Dredging to take place at low tide only and during stable weather and wave conditions.	Contractor	Construction
SW5	Erosion and scour	Positioning of barges, drilling and pile driving should occur during standard construction hours and calm conditions to prevent excessive scouring and minimise any safety risks.	Contractor	Construction
SW6	Erosion and scour	Construction marine vessel speeds will be kept to the posted limit and will be 4 knots during construction	Contractor	Construction
SW7	Acid sulphate soils	Potential or actual acid sulphate soils are to be managed in accordance with the Transport for NSW Guidelines for the Management of Acid Sulphate Materials 2005 and a Construction Acid Sulphate Management Plan. The Plan is to include procedures for testing, material classification, treatment and disposal.	Contractor	Construction
SW8	Acid sulphate soils	Minimise the disturbance and exposure of sediment and/or the underlying soils to oxygen.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
SW9	Contaminated land	<p>If contaminated soils and sediments are encountered, prepare and implement a Contaminated Land Management Plan.</p> <p>Any unexpected finds of contamination are to be managed in accordance with an Unexpected Finds Procedure outlined in the Contaminated Land Management Plan.</p> <p>The procedure will include actions to cease work and to consult with the Transport for NSW Environment Manager and/or EPA.</p>	Contractor	Construction
WQ1	Water quality	There is to be no release of dirty water into drainage lines and/or waterways.	Contractor	Construction
WQ2	Water quality	Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) is to be undertaken on a regular basis to identify any potential spills or deficient silt curtains or erosion and sediment controls.	Contractor	Construction
WQ3	Water quality	Vessels (including barges) are only to be used at suitable tides when no less than 600 mm clearance is available between the underside of the vessel and the bed of the waterway.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
WQ4	Water quality	<p>A spill kit is to be available on site and accessible at all times. The spill kit must be appropriately sized for the volume of substances at the work site. Spill kits for construction barges must be specific for working within the marine environment.</p> <p>All workers will be advised of the location of the spill kit and trained in its use.</p> <p>Ensure all liquids in use on site are securely stored, handled and disposed of to prevent spills or leaks.</p>	Contractor	Construction
WQ5	Water quality	<p>Ensure all on-water plant and equipment is adequately maintained and regularly inspected for fluid leaks.</p> <p>Prior to use at the site and / or entry into the waterway, machinery should be appropriately cleaned, degreased and serviced</p>	Contractor	Pre-construction and construction
WQ6	Water quality	<p>Ensure that the CEMP includes procedures for safe materials storage, handling, use and incident response plans for the proposed works.</p>	Contractor	Construction
WQ7	Water quality	<p>Prepare an Environmental Work Method Statement for dredging activities that identifies the sequence of the activity, potential impacts and management controls. The EWMS must also address the handling and management of dredge spoil.</p>	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
WQ8	Water quality	<p>Capture and store any waste drilling fluids for appropriate on-shore disposal according to legislative requirements</p> <p>Ensure that all liquids including fuel and other liquids used on barges during construction are securely contained.</p>	Contractor	Construction
WQ9	Water quality	Vessel speeds will be limited to 4 knots to minimize turbidity being generated from propellor wash.	Contractor	Construction
W1	Waste	<p>A Waste Management Plan (WMP) will be prepared in accordance with the WARR Act. A WMP is to be prepared as part of the CEMP. The WMP will include the following:</p> <ul style="list-style-type: none"> • measures to avoid and minimise waste associated with the proposal • Classification of waste and management options (re-use, recycles, stockpile, disposal). • statutory approvals required for managing both on and off-site waste, or, application of any relevant resource recovery exemptions. • procedures for storage, transport and disposal. • monitoring, record keeping and reporting. 	Contractor	Pre-construction/ Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
W2	Waste	Waste management, littering and general construction site tidiness will be monitored during routine site inspections.	Contractor	Construction
W3	Waste	All waste will be classified in accordance with the EPA's <i>Waste Classification Guidelines: Part 1 Classifying Waste</i> (EPA, 2014) prior to being disposed of at a licensed waste facility.	Contractor	Construction
W4	Waste	Timber and other components of the existing wharf, deck and piles must be reused and/or recycled if feasible.	Contractor	Construction
W5	Waste	Waste material must not be left on site once work has been completed.	Contractor	Construction
W6	Resource use	Recycled, durable, and low embodied energy products will be considered to reduce primary resource demand in instances where the materials are cost and performance competitive and comparable in environmental performance (e.g. where quality control specifications allow)	Transport for NSW	Detailed design
W7	Sustainability	During construction, the construction contractor is to monitor waste and recycling quantities using Transport for NSW <i>Waste Data Collection Workbook – DMS-FT-436</i> to support compulsory requirement 4 of the <i>Transport for NSW Sustainable Design Guidelines version 4.0</i> .	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
NV1	Construction noise and vibration	<p>A Construction Noise and Vibration Management Plan (CNVMP) will be prepared and incorporated into the CEMP, including:</p> <ul style="list-style-type: none"> • reasonable and feasible noise control measures to reduce impacts at sensitive receivers • identification of the sensitive receivers in the study area • details of the construction hours and construction works • the Standard mitigation measures to be implemented (Appendix B of CNVG) • the additional mitigation measures to be implemented (refer to Table 6.7 and Table 6.8). 	Contractor	Pre-construction
NV2	Construction noise and vibration	<ul style="list-style-type: none"> • Staged notifications delivered to sensitive receivers at least 7 days prior to commencement of relevant works in each stage of construction. Notifications will describe all upcoming construction activities. • Prior to demolition and construction works, notify residences that they may be highly noise affected. 	Contractor	Pre-construction/ Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> The notifications will include the timing and nature of the works, as well as the expected noise levels, duration and impacts prior to construction works. Provide contact details to affected receivers for noise complaints and enquiries regarding construction works. 		
NV3	Construction noise	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating noise with special audible characteristics and/or vibration levels should be scheduled during less sensitive time periods and undertaken within safe working distances.	Contractor	During construction
NV4	Construction noise	Noise with special audible characteristics and vibration generating activities (including jack and rock hammering and rock breaking) may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.	Contractor	During construction
NV5	Construction noise and vibration	All employees, contractors and subcontractors are to receive an environmental induction	Contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
NV6	Construction noise	A noise monitoring program should be carried out for the duration of works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions. This should include noise monitoring at the nearest receiver within NCA1 during demolition/construction as a minimum.	Contractor	During construction
NV7	Construction noise and vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable (i.e. bored piling/ torque head method instead of impact piling).	Contractor	During construction
NV8	Construction noise and vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.	Contractor	Pre-construction/ Construction
NV9	Construction noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.	Contractor	During construction
LV1	Landscape and visual	Hoarding will be erected around the construction compound where possible, to reduce visibility.	Contractor	Construction
B1	Biodiversity	Notify DPI (Fisheries) in accordance with clause 199 of the Fisheries Management Act. Apply for & receive permit under clause 205 of the Fisheries Management Act to address harm to seagrass and macroalgae.	Transport for NSW / Contractor	Detailed design/ Pre construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B2	Biodiversity – aquatic habitats	<p>A Marine Ecology Management Plan (MEMP) will be prepared as part of the CEMP. This would include, but not be limited to, measures relating to the following activities to minimise the impact to marine habitat:</p> <ul style="list-style-type: none"> • low impact barge positioning to prevent propeller scouring and thrust wash onto sensitive habitats • minimise footprint and establish no-go zones in sensitive habitats • accidental waste/material overboard response (e.g. construction materials dropped into the harbour) • biological hygiene (e.g. prevent spread of noxious species on and off the site). • aquatic fauna management 	Contractor	Pre-construction /construction
B3	Biodiversity – aquatic habitats	Minimise construction works and movements in identified seagrass meadows, and clearly define and limit the activity if it is unavoidable.	Transport for NSW / Contractor	Pre-construction/ construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B4	Benthic community disturbance and threatened aquatic fauna species and habitat	<p>Undertake seabed construction work outside of the seahorse breeding season, between September to February. Where this is not possible, implement the Seahorse Relocation Plan at least 1 month prior to the start of the breeding season.</p> <p>Conduct a visual inspection of the works area before commencing works on the wharf with specific attention for protected mobile fauna such as seahorses and sea dragons (i.e. <i>Syngnathids</i>). If present, these are to be relocated to adjacent habitats by a qualified person, outside the zone of influence of the construction works, where feasible.</p>	Contractor	Pre-construction /construction
B5	Smothering and reduced light penetration	<p>Ensure that the Erosion and Sediment Control Plan is followed to prevent sediment transport beyond the silt curtain and into Wagonga Inlet.</p> <p>Limit the movement or re-anchoring of construction barges to reduce the potential disturbance of sediments to as low as reasonably possible.</p> <p>Minimise or eliminate the use of anchors and seabed contact from on-water plant and equipment.</p> <p>Avoid the use of propellers in shallow areas where possible to limit sediment disturbances and damage to macroalgae.</p> <p>Carry out in-water construction works using control methods appropriate to the sediment characteristics in disturbed areas.</p>	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B6	Smothering and reduced light penetration	Ensure that the proposed wharf design offers maximum light penetration to the seabed to minimise impacts to macroalgal and seagrass growth.	Transport for NSW	Detailed design
B7	Landscape amenity and tree protection	<p>Trenching is to avoid direct impact to tree root zones, where possible. Allocate exclusion areas for root protection during trenching works.</p> <p>Replace any vegetation removed as part of the works with a similar plant and in accordance with Landscaping Plans.</p>	Contractor	Construction
B8	Piling construction noise impacts on aquatic fauna	<p>Follow the standard operational procedures below to manage the impact of underwater construction noise from piling activities, on marine fauna (DPTI, 2012):</p> <ul style="list-style-type: none"> • Pre-start procedure – A suitably trained crew member is to observe the site and surroundings from the wharf for the presence of marine mammals for at least 30 minutes before beginning the soft start procedure (see next step). • An acoustic harassment/deterrent device could be sounded prior to the commencement of any underwater activity to provide the opportunity for sensitive marine fauna, such as seals, to relocate temporarily if hauling out nearby. 	Contractor	Pre-construction /construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> <li>• Soft start procedure – If marine mammals have not been sighted within or are unlikely to enter the shutdown zone during the pre-start procedure, the soft start procedure may commence in which the piling impact energy is gradually increased over a 10-minute period. The soft start procedure should also be used after long breaks of more than 30 minutes in piling activity. Visual observations of marine mammals within the safety zones should be maintained by trained crew throughout soft starts. The soft start procedure may alert marine mammals to the presence of the piling rig and enable animals to move away to distances where injury is unlikely. <li>• Normal operation procedure – If marine mammals have not been sighted within or are not likely to enter observation zone during the soft start procedure, piling may start at full impact energy. Trained crew should continuously undertake visual observations during piling activities and shut-down periods. <li>• After long breaks in piling activity or when 		

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>visual observations ceased or were hampered by poor visibility, the pre-start procedure should be used. Low visibility operations may proceed provided that no more than three shut-downs occurred during the preceding 24 hour period.</p> <ul style="list-style-type: none"> • Stand-by operations procedure – If a marine mammal is sighted within the observation zone during the soft start or normal operation procedures, the operator of the piling rig should be placed on standby to shut down the piling rig. An additional trained crew member should continuously monitor the marine mammal in sight. • Shut-down procedure – If a marine mammal is sighted within or about to enter the construction zone, the piling activity should be stopped immediately. If a shut-down procedure occurred and marine mammals have been observed to move outside the shut-down zone, or 30 minutes have lapsed since the last marine mammal sighting, then piling activities should recommence using the soft start procedure. If marine mammals are 		

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>detected the shut-down zone during poor visibility, operations should stop until visibility improves.</p> <p>Where possible, timing of the works will be outside of the breeding months (summer months) for the Australian Fur Seal and New Zealand Fur Seal to alleviate any noise related stress the species may experience.</p> <p>Refer to the Australian Guidelines for Whale and Dolphin Watching (DoEE, 2017) for sea-faring activities for the works.</p>		
B9	Pest introduction and proliferation	<p>The following controls and processes should be employed when possible, in order to mitigate or eliminate the risk of introducing pests:</p> <ul style="list-style-type: none"> • Vessels and construction barges will be locally sourced (within NSW waters) to complete the construction works, where possible. • A Marine Pest Species Management Plan will be prepared and implemented in accordance with the National System for the Prevention and Management of Marine Pest Incursions (National System) and NSW requirements for IMP identification and management. If an IMP is identified or suspected, then the contractor will notify the NSW Department of Primary Industries 	Contractor	Pre-construction /construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		Aquatic Biosecurity Unit immediately (within 24 hours) hotline on (02) 4916 3877.		
B10	Pest control	Ensure that the use of on-water plant and equipment is adequately checked and cleaned to prevent the spread of invasive and non-indigenous species	Contractor	Pre-construction /construction
B11	Marine fauna interaction	<p>The following controls may be adopted and should be executed when possible to mitigate or eliminate the risk of collision between vessels and marine fauna:</p> <ul style="list-style-type: none"> operations of vessels will be commensurate with Part 8 of the EPBC Regulations (Interacting with Cetaceans and Whale Watching). <p>The Australian Guidelines for Whale and Dolphin Watching (DoEE, 2017) for sea-faring activities will be implemented across the entire project.</p>	Contractor	Pre-construction /construction
B12	Threatened aquatic flora and fauna species and habitat	If unexpected threatened fauna or flora species are discovered, stop works immediately and follow the Roads and Maritime Services <i>Unexpected Threatened Species Find Procedure in the Roads and Maritime Services Biodiversity Guidelines 2011 – Guide 1</i> (Pre-clearing process).	Contractor	Pre-construction /construction

No.	Impact	Environmental safeguards	Responsibility	Timing
B13	Threatened aquatic fauna species and habitat	Undertake a survey of existing wharf piles for the presence of seahorses before the start of construction. If seahorses are observed, implement the Seahorse Relocation Plan (Appendix H) before the start of construction. Relocation will require a permit under Section 37 of the FM Act.	Contractor	Pre-construction/c onstruction
B14	Marine habitats, aquatic fauna and water quality	Detailed design is to consider including: <ul style="list-style-type: none"> waste disposal bins at the wharf to minimise the potential for litter to enter Wagonga inlet. signage to encourage wharf users to dispose of waste appropriately and keep Batemans Bay Marine Park litter free. 	Transport for NSW	Detailed design
B15	Biodiversity offsets	Consult with NSW Department of Industries on final direct and indirect impacts of the detailed design and required offset and compensation requirements in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (2013 Update).	Transport for NSW	Detailed design
T1	Land transport, parking and access	A Traffic Management Plan (TMP) will be prepared and will include the following: <ul style="list-style-type: none"> a safe and alternative pedestrian and cyclist access to be maintained with consideration to temporary security fencing and wayfinding being 	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>implemented for each construction stage.</p> <ul style="list-style-type: none"> designated parking for construction workforce that minimises impacts on public car parking spaces at the wharf. maintaining current local traffic movements along Bluewater Drive. a Road Traffic Control Plan in accordance with the 'Traffic control at work sites manual' (RTA, 2010a) and Australian Standard 1742.3 Manual of uniform control devices for any planned traffic disruptions or road occupancy of Bluewater Drive. 		
T2	Land transport	A Road Traffic Control Plan will be prepared and implemented in accordance with the ' <i>Traffic control at work sites manual</i> ' (RTA, 2010a) and Australian Standard 1742.3 <i>Manual of uniform control devices</i> for any planned traffic disruptions or road occupancy of Bluewater Drive.	Contractor	Pre-construction /construction
T3	Water transport	<p>A Construction Marine Traffic Management Plan (CMTMP) will be prepared and implemented. The CMTMP will identify:</p> <ul style="list-style-type: none"> navigational safety requirements for all construction vessels and water-based equipment 	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> • a response plan for implementation including 24-hour contact details, management and communication protocols for enquiries, complaints and emergencies. • retrieve any material associated with the construction of the development that enters the water to prevent the obstruction of vessel movements 		
T4	Water transport	Where possible, current vessel movements and public access to the waterway and foreshore area are to be maintained during works. Any disturbance is to be minimised as much as practicable.	Contractor	Construction
T5	Water transport	<p>Commercial, recreational operators, private services and the community that use the existing wharf will be advised of:</p> <ul style="list-style-type: none"> • the commencement of construction, well in advance of work starting including the location of the compound site and temporary loss of car parking bays • any changes to pedestrian routes to safely access the wharf. <p>The partial wharf closure at least two weeks prior to closure</p>	Transport for NSW	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
T6	Water transport	<p>A navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area.</p> <p>This zone will be clearly defined to communicate access for other water users.</p>	Contractor	Pre-construction /construction
AH1	Aboriginal heritage	<p>If Aboriginal heritage items are uncovered during the works, all works in the vicinity of the find must cease and the Transport for NSW Aboriginal cultural heritage officer and regional environment manager contacted immediately. Steps in the Transport for NSW Standard Management Procedure: Unexpected Heritage Items must be followed.</p>	Contractor	Construction
H1	Non-Aboriginal Heritage	<p>If unexpected heritage items are uncovered during the works, all works must cease in the vicinity of the material/find and the steps in the Transport for NSW's <i>Standard Management Procedure: Unexpected Heritage Items</i> must be followed. Transport for NSW Senior Environment Specialist – Heritage must be contacted immediately.</p>	Contractor	Construction
H2	Maritime heritage	<p>Consult with NSW Heritage to notify of the proposal to replace the Narooma Wharf, the location to which is listed on the maritime heritage register. Consultation will also identify any additional design or permit requirements prior to construction.</p>	Transport for NSW	Detailed design

No.	Impact	Environmental safeguards	Responsibility	Timing
H3	Local heritage	Construction activities near to the local heritage item, Wharf Pylon Item no. I184, must be within safe working distances for cosmetic damage identified in the Construction Noise and Vibration Guideline (RMS 2016). If safe working distances cannot be achieved with standard equipment, then low vibration equipment should be selected.	Contractor	Construction
AQ1	Air quality	<p>Air quality during construction will be considered and addressed within the CEMP and would include methods to manage work during strong winds or other adverse weather conditions as required. As a minimum, the following measures will be included:</p> <ul style="list-style-type: none"> • covering all loaded trucks and vessels • machinery to be turned off rather than left to idle when not in use • water to be used for dust suppression during concrete breaking and saw cutting • maintenance of all vehicles, including trucks and vessels entering and leaving the site in accordance with the manufacturers specifications to comply with all relevant legislation • maintenance of all plant and equipment to ensure good operating conditions 	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<p>and exhaust emissions comply with the <i>Protection of the Environment Operations Act 1997</i></p> <ul style="list-style-type: none"> maintaining the work site in a condition that minimises fugitive emissions such as minor dust. <p>Appropriate sediment and erosion controls for any exposed earth or stockpiled waste.</p>		
HZ1	Hazard and risk	<p>Construction areas will be kept tidy, objects tied down to prevent falling into the water and land-based work areas fenced.</p> <p>Weather conditions will be actively monitored. In the event of adverse weather, wet-weather preparedness measures will be implemented including construction areas being made safe, erodible material stabilised, equipment tied down, moorings and anchors checked to ensure construction barges and vessels can withstand the expected weather conditions.</p>	Contractor	Construction
HZ2	Hazard and risk	Refuelling of land based plant and equipment is to occur in impervious bunded areas located a minimum of 50 metres from drainage lines or waterways.	Contractor	Construction
HZ3	Hazard and risk	Refuelling of marine plant and equipment and storage of hazardous materials on barges is to occur within a double-bunded area.	Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
HZ4	Hazard and risk	<p>If an incident (e.g. spill) occurs, the Transport for NSW Environmental Incident Classification and Reporting Procedure is to be followed and the Transport for NSW Contract Manager notified as soon as practicable.</p> <p>Incidents will be reported to other agencies, where required, to comply with the requirements of the <i>Protection of the Environment Operations Act 1997</i>.</p>	Contractor	Construction
HZ5	Hazard and risk	Emergency contacts will be kept in an easily accessible location on vehicles, vessels, plant and site office. All workers will be advised of these contact details and procedures.	Contractor	Construction
SE1	Socio-economic	<p>A Communications and Stakeholder Engagement Plan will be prepared to provide timely and accurate information to wharf users, surrounding sensitive receivers, businesses, stakeholders and the local community of:</p> <ul style="list-style-type: none"> • construction activities well in advance of construction starting. • project updates to the progress in construction including the stage construction program. Wharf users will be notified and informed on which sections of the wharf will be opened or closed for public use. • any disruptions to local road traffic. 	Transport for NSW and Construction Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
		<ul style="list-style-type: none"> contact name and telephone number for enquiries or for making a complaint. <p>A webpage and free-call number will be established for enquiries and will remain active for the duration of construction. All enquiries and complaints will be tracked and acknowledged within 24 hours of being received.</p>		
C1	Cumulative construction impacts	<p>Construction will include notification prior to the start of the works.</p> <p>Updates on any delays or changes to the construction period will also be communicated.</p>	Transport for NSW	Pre-construction/ Construction

7.3 Licensing and approvals

Table 7.2 Summary of licensing and approvals required

Instrument	Requirement	Timing
<i>Fisheries Management Act 1994 (s199)</i>	Notification to the Minister for Agriculture and Western NSW prior to any dredging or reclamation work.	A minimum of 28 days prior to the start of work.
<i>Fisheries Management Act 1994 (Part 7 and s205)</i>	Agreement on proposed offsets. Permit to harm marine vegetation from the Minister for Agriculture and Western NSW.	Detailed design/ prior to start of the activity.
<i>Fisheries Management Act 1994 (s37)</i>	Permit for the relocation of seahorses	Prior to start of the activity.
<i>Heritage Act 1977</i>	The location of the Narooma Wharf is listed on the maritime heritage register identifying historical wharves in that location. However no curtilage is defined. Consultation will be undertaken with NSW Heritage to identify any notification or permitting requirements.	Detailed design/ prior to start of the activity.

Instrument	Requirement	Timing
<i>Marine Estate Management (Management Rules) Regulation 1999</i> (clause 1.22(2))	Permit for construction and demolition works. Permit application must be supported by a Construction Environmental Management Plan, site environmental plan, environmental work method statement, environmental risk assessment and erosion and sediment control plan.	Prior to start of the activity.
<i>Marine Estate Management Regulation 2017</i> (Part 2)	Permit for infrastructure development within Batemans Marine Park special purpose zones from the Marine Estate Management Authority	Prior to start of the activity.
<i>Roads Act 1993</i>	Road occupancy licence if any construction work is to occupy and impact the operation of Bluewater Drive.	Prior to start of the activity.
<i>Marine Safety Regulation 2016</i> (section 97(1))	Aquatic licence would be required from Transport of NSW (maritime division) under section 97(1) for navigational exclusion zones installed while construction work is taking place.	Prior to start of the activity.

8 Justification and conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2021.

8.1 Justification

The proposal forms part of the delivery program with MIDO, whose objectives are to plan and deliver maritime infrastructure and dredging services including coastal and boating infrastructure programs. These objectives also take in the former maritime-related functions of DPIE, Crown Lands.

Narooma wharf is one of the 25 regional ports identified by Crown Lands in the *NSW Regional Ports Strategy 2016/17*, developed to promote regional economic growth and informed by existing corporate and government strategic plans.

In these capacities, initial justification for the proposal was provided through an assessment of the existing wharf, which was identified as requiring upgrading in order to:

- improve safety and structural integrity of the wharf
- upgrade access and operational safety for vessels
- improve access for less mobile and disabled passengers
- provide on-shore services for commercial vessels to improve environmental and business outcomes.

Consideration of alternatives and options was then carried out. The preferred design of the proposal selected to best achieve the objectives outlined in section 2.3, which included meeting the project objectives by providing improvements for access and safety, utility, and passenger access and amenity. The design efficacy was determined by comparison to the option of doing nothing and other options outlined in section 2.4.

Potential environmental and social impacts resulting from construction and operation of the proposal have been minimised through the safeguards and management measures outlined in chapter 7.

The remainder of this chapter provides justification through considering the impacts and benefits of the proposal.

8.2 Objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	Through the assessment in chapter 6, it has been identified that the proposal would not have a significant impact on any natural or artificial resources. The proposal will result in community benefits through facilitation of a safe and reliable public wharf in Narooma for the next 50 years.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in sections 8.2.1 to 8.2.4 below.
1.3(c) To promote the orderly and economic use and development of land.	The proposal includes continuation of the use of the proposal location as a public wharf.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the proposal.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	An aquatic ecology assessment is included in section 6.7. The assessment concluded that the proposal would not result in a significant impact on aquatic ecology. No terrestrial vegetation is proposed to be removed as part of the proposal.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal would not impact on Aboriginal or non-Aboriginal heritage items.

Object	Comment
1.3(g) To promote good design and amenity of the built environment.	The proposal has been designed to be consistent with the urban design objectives identified in section 2.3.3.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	No buildings are proposed or affected as part of this proposal.
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Consultation with the relevant government agencies is detailed in sections 5.4 and 5.5.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	This REF will be available to the community. Targeted consultation with the community and stakeholders would continue to occur throughout detailed design and construction.

8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

This principle was considered during wharf upgrade options development (refer to chapter 2). The precautionary principle has guided the assessment of environmental impacts for this EIS and the development of mitigation measures.

Through the assessment of the potential impacts of the proposal in chapter 6, it has been demonstrated that threats of serious or irreversible environmental damage do not exist for the proposal.

To account for the subjectivity of professional judgement applied in environmental assessment and modelling uncertainty, worst-case assumptions have nonetheless been incorporated into the assessment, including the following:

- best available technical information, environmental standards and mitigation measures have been used and/or proposed to minimise environmental risks
- specialist studies for heritage, hydrology, and ecology were incorporated to provide a detailed understanding of the existing environment.
- specialist assessments of noise and vibration, landscape character and visual impact have been completed
- the worst-case assumption of all noise generating construction equipment operating at a location closest to the nearest of the sensitive receivers.
- assessment of impacts and including safeguards for impacts which are exceptionally unlikely to happen such as major spills
- recommending monitoring during construction to verify and validate results, and allow modification of safeguards and mitigation controls accordingly.

Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

To achieve intergenerational equity, the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

An Aboriginal cultural heritage assessment, including consultation with the local Aboriginal community, was carried out during the environmental assessment phase to avoid or minimise the potential for irreparable damage to occur to Aboriginal cultural heritage during the construction.

The proposal would result in benefit to the community through improvements to vessel and passenger amenity, safety and overall user experience of the wharf for the next 50 years.

No potential impacts to future generations would be generated by the proposal.

Conservation of biological diversity and ecological integrity

The proposed wharf design and construction methodology was selected to minimise impacts to the marine environment and seabed as far as practicable. This included:

- establishing site selection criteria for construction phase facilities and activities that include minimising seagrass and aquatic vegetation clearance
- considering the cultural significance of the remaining areas of native vegetation and native fauna to the local Aboriginal community through a Heritage assessment.

Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

As part of the proposal, environmental issues were considered as key matters in the economic and financial feasibility assessments for the project, and its design and proposed construction methodology recognises the value of the project to the community in terms of improved safety and long term use.

8.3 Conclusion

The proposed upgrade of Narooma Wharf is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (where relevant) of conservation agreements and plans of management under the NPW Act, stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts in the marine environment. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The appropriate permits would also be sought. The proposal would also improve safety for wharf users, improved passenger and vessel access, and provide access for people with a disability. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Department of Agriculture, Water and Environment is not required.

9 Certification

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.



Jenny McKinney

Technical Director – Environment

GHD

Date: 1/04/2022

I have examined this review of environmental factors and accept it on behalf of Transport for NSW.



Gareth Doran

Manager Programs, Infrastructure Programs (South)

Maritime Infrastructure Delivery Office – Maritime Greater

Sydney Date: 01/04/22

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Terms and acronyms used in this REF

Term / Acronym	Description
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
AS	Australian Standard
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
Benthic	Relating to, or occurring at the bottom of a body of water
CEMP	Construction environmental management plan
CSEP	Community and Stakeholder Engagement Plan
DAWE	Australian Department of the Agriculture, Water and the Environment
DDA	<i>Disability Discrimination Act 1992 (Cth)</i>
DPI	Department of Primary Industries
DSAPT	<i>The Disability Standards for Accessible Public Transport (1992)</i>
EES	NSW Environment, Energy and Science
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i> . Provides the legislative framework for land use planning and development assessment in NSW.
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i> . Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased.
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
Gangway	A landing used by passengers to board or exit ships/vessels.
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local government area
MIDO	Maritime Infrastructure Delivery Office
MNES	Matters of national environmental significance under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> .

NCA	Noise catchment area
NM	Nautical miles
NML	Noise management level
NPW Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential archaeological deposit
Piles	Foundations used to support marine structures and offshore platforms.
Pontoon	A floating structure serving as a dock.
Proposal site	The area directly impacted by proposed works, including the installation and removal of structures.
RBL	Rating background level
REF	Review of environmental factors
Roads and Maritime	NSW Roads and Maritime Services now part of Transport for NSW
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SPZ	Special Purpose Zone
SWMP	Soil and Water Management Plan
TfNSW	Transport for New South Wales
Transport and Infrastructure SEPP	State Environmental Planning Policy (Transport and Infrastructure) 2021
Wharf	A landing place or pier where ships may tie up and load or unload.
WMP	Water Management Plan

Appendix A

Proposal drawings

NAROOMA EUROBODALLA BLUEWATER DRIVE WHARF REPLACEMENT FOR TRANSPORT NSW (CONCEPT DESIGN)

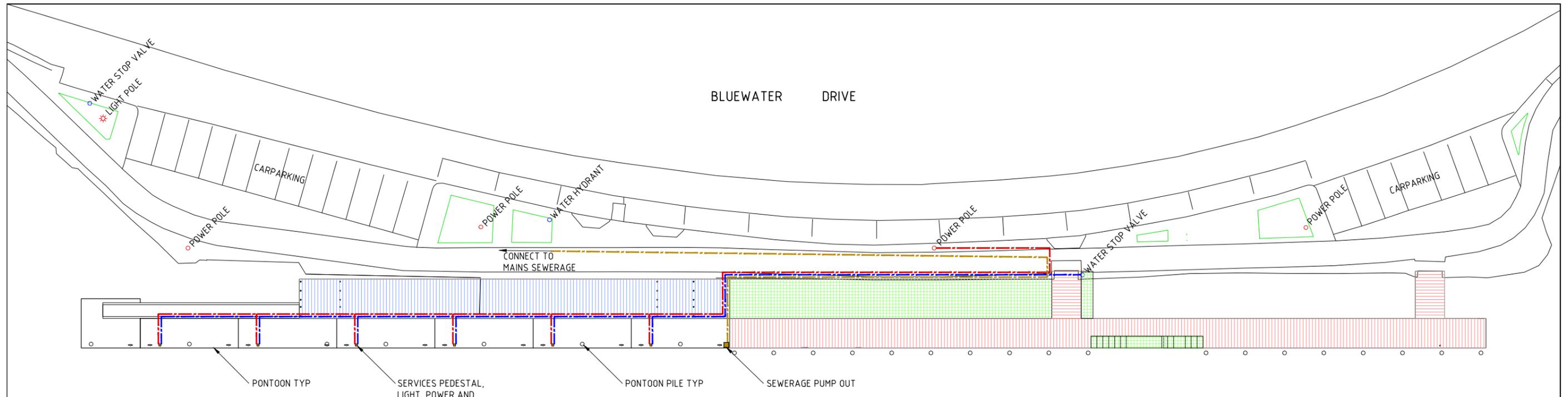


LOCALITY PLAN
NTS

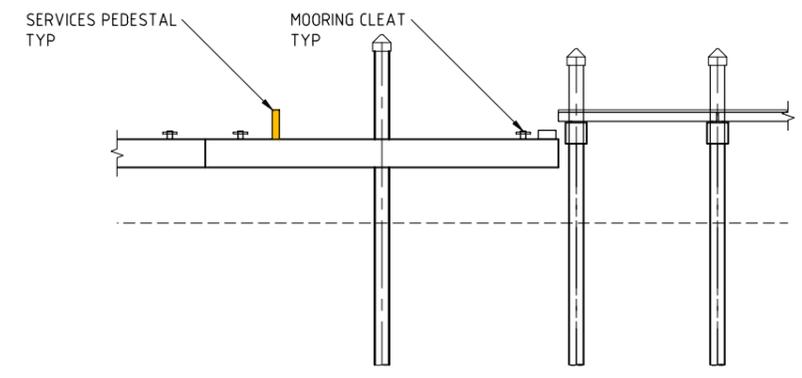
DRAWING LIST

DRAWING NUMBER	DRAWING TITLE
311015-00219-MA-DSK-0001	PROPOSED WHARF COVER SHEET, LOCALITY PLAN AND DRAWING LIST
311015-00219-MA-DSK-0002	PROPOSED WHARF PLAN AND SECTIONS
311015-00219-MA-DSK-0003	PROPOSED WHARF SERVICES PLAN AND VIEWS

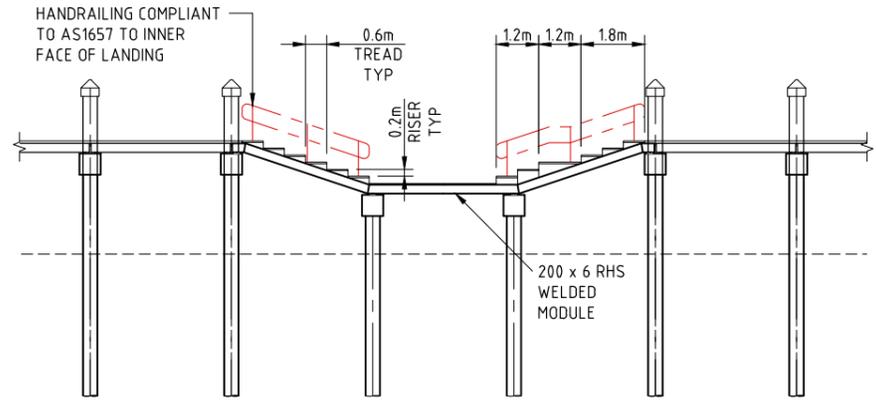
										A1 SHEET SCALE	ENGINEERING AND PERMIT STAMPS (As Required)	CUSTOMER				
										 Copyright © Worley Services Pty Ltd ABN 61 001 279 812	<div style="border: 1px solid red; padding: 5px; text-align: center; color: red;"> INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION </div>	 Transport for NSW		NAROOMA EUROBODALLA BLUEWATER DRIVE WHARF REPLACEMENT CONCEPT DESIGN PROPOSED WHARF COVER SHEET, LOCALITY PLAN AND DRAWING LIST		
REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REFERENCE DRAWING No	REFERENCE DRAWING TITLE		311015-00219	<small>*This drawing is prepared solely for the use of the contractual customer of Advisian and Advisian assumes no liability to any other party for any representations contained in this drawing.*</small>	DRG No	311015-00219-MA-DSK-0001	REV



PROPOSED SERVICES PLAN
1:200

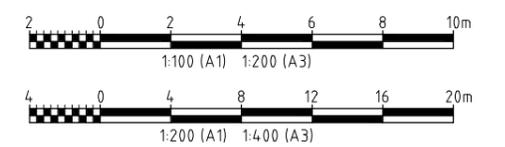


PONTON/JETTY VIEW
1:100



LOW LEVEL LANDING VIEW
1:100

- LEGEND:**
- ELECTRICAL SERVICE
 - WATER SERVICE
 - SEWERAGE SERVICE



										A1 SHEET SCALE	ENGINEERING AND PERMIT STAMPS (As Required)		CUSTOMER		 NAROOMA EUROBODALLA BLUEWATER DRIVE WHARF REPLACEMENT CONCEPT DESIGN PROPOSED WHARF SERVICES PLAN AND VIEWS	
										 Copyright © Worley Services Pty Ltd ABN 61 001 279 812 ADVISIAN PROJECT No.	INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		 Transport for NSW			
REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REFERENCE DRAWING No	REFERENCE DRAWING TITLE					311015-00219	<small>*This drawing is prepared solely for the use of the contractual customer of Advisian and Advisian assumes no liability to any other party for any representations contained in this drawing.*</small>

Appendix B

Consideration of section 171 factors, matters of National Environmental Significance and Commonwealth land

Section 171 factors for consideration

In addition to the requirements of the *Is an EIS required?* (DUAP, 1995/1996) guideline and the *Marinas and Related Facilities EIS Guideline* (DUAP, 1996) as detailed in the REF, the following factors, listed in section 171, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
a) Any environmental impact on a community? Construction noise has the potential to impact the community.	Temporary and minor
b) Any transformation of a locality?	Nil
c) Any environmental impact on the ecosystems of the locality? Minor direct loss of seagrass due to dredging and deepening of the berth area for the floating pontoon.	Minor direct loss
d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? During construction there will be reduced amenity and recreational activity due to sections of the wharf being closed off, for safety reasons, and physical presence of construction barges and equipment. Construction staging will allow for other sections of the wharf to remain operational to minimise impacts to the boating community.	Temporary and minor
e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? The proposal is to replace the existing Narooma Wharf with a similar wharf facility. No significant heritage values will be impacted.	Nil
f) Any impact on the habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>)? Seagrass habitat will be impacted and this is protected under the Fisheries Management Act. No habitat protected under the Biodiversity Conservation Act will be impacted.	Minor direct loss
g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? Potential to impact on seahorses, should they occur. A Seahorse Relocation Plan is provided as part of this REF.	Minor and temporary
h) Any long-term effects on the environment?	Nil

Factor	Impact
<p>i) Any degradation of the quality of the environment?</p> <p>Construction activities, including dredging, has the potential to result in reduced water quality conditions. Proposed mitigation measures and implementation of a silt curtain will minimise sediment dispersion.</p>	<p>Temporary and minor</p>
<p>j) Any risk to the safety of the environment?</p> <p>The proposal improves the wharf facilities to reduce risks to the safety of the environment, including the provision of a water supply for fire fighting, a sewage pump out facility to manage wastewater and replacing an aging wharf facility.</p>	<p>Nil</p>
<p>k) Any reduction in the range of beneficial uses of the environment?</p> <p>The proposal improves the wharf facilities to replace an aging marine asset.</p>	<p>Nil</p>
<p>l) Any pollution of the environment?</p> <p>The REF describes several mitigation measures that will be implemented to avoid and minimise the potential for pollution of the environment. These will be implemented during construction and operation.</p>	<p>Nil</p>
<p>m) Any environmental problems associated with the disposal of waste?</p> <p>The proposal will result in general building wastes from replacing the existing wharf. A small volume of dredge spoil will be produced and this will be tested and waste classified prior to disposal to an approved and licenced facility.</p>	<p>Nil</p>
<p>n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?</p> <p>The proposal is a small-scale proposal unlikely to result in increased demand or shortage of resources.</p>	<p>Nil</p>
<p>o) Any cumulative environmental effect with other existing or likely future activities?</p> <p>Refer to section 6.12 of the REF.</p>	<p>Nil</p>
<p>p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?</p> <p>Refer to section 6.2 of the REF.</p>	<p>Temporary and minor</p>
<p>q) Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1.</p> <p>Refer to section 2.1.4 of the REF.</p>	<p>Temporary and minor</p>
<p>r) Other relevant environmental factors</p>	<p>In considering the potential impacts of this proposal all relevant</p>

Factor	Impact
	environmental factors have been considered, refer to Chapter 6 of this assessment.

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on the Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of Agriculture, Water and Environment.

Factor	Impact
a) Any impact on a World Heritage property?	Nil
b) Any impact on a National Heritage place?	Nil
c) Any impact on a wetland of international importance?	Nil
d) Any impact on a listed threatened species or communities?	Temporary and indirect. Unlikely to significantly impact EPBC listed threatened species, populations or ecological communities.
e) Any impacts on listed migratory species?	Nil
f) Any impact on a Commonwealth marine area?	Nil
g) Does the proposal involve a nuclear action (including uranium mining)?	No
h) Additionally, any impact (direct or indirect) on the environment of Commonwealth land?	Nil

Appendix C

Statutory consultation checklists

Transport and Infrastructure SEPP

Certain development types

Development type	Description	Yes/No	If 'yes' consult with	section
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No		Section 2.110
Bus Depots	Does the project propose a bus depot?	No		Section 2.110
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No		Section 2.110

Development within the Coastal Zone

Issue	Description	Yes/No/NA	If 'yes' consult with	Section
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	No		Section 2.14

Note: See interactive map here: <https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management>. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program

Council related infrastructure or services

Issue	Potential impact	Yes/No	If 'yes' consult with	Section
Stormwater	Is the work likely to have a <i>substantial</i> impact on the stormwater management services which are provided by council?	No		Section 2.10(1)(a)
Traffic	Is the work likely to generate traffic to an extent that will <i>strain</i> the capacity of the existing road system in a local government area?	No		Section 2.10(1)(b)
Sewerage system	Will the work involve connection to a council owned sewerage system? If so, will this connection have a <i>substantial</i> impact on the capacity of any part of the system?	Yes the proposal would involve a new connection to the sewer network. However, this is unlikely to have a <i>substantial</i> impact on the capacity of the system.	Eurobodalla Shire Council	Section 2.10(1)(c)
Water usage	Would the work involve connection to a council owned water supply system? If so, would this require the use of a <i>substantial</i> volume of water?	No		Section 2.10(1)(d)

Issue	Potential impact	Yes/No	If 'yes' consult with	Section
Temporary structures	Would the work involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, would this cause more than a <i>minor</i> or <i>inconsequential</i> disruption to pedestrian or vehicular flow?	Yes, the temporary compound and stockpile area would temporarily impact on on-street car parking spaces. The impact is likely to be minor.	Eurobodalla Shire Council	Section 2.10(1)(e)
Road & footpath excavation	Would the work involve more than <i>minor</i> or <i>inconsequential</i> excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Excavation is proposed however this is considered to be minor or inconsequential	Eurobodalla Shire Council	Section 2.10(1)(f)

Local heritage items

Issue	Potential impact	Yes/No	If 'yes' consult with	Section
Local heritage	<p>Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the proposal site for the work? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than <i>minor</i> or <i>inconsequential</i>?</p>	<p>There are two local heritage items in the proposal site.</p> <p>A single Wharf Pylon, west of the current wharf, listed under the Euroboda Ila LEP 2012.</p> <p>This item will not be directly impacted.</p>	<p>Eurobodalla Shire Council</p>	<p>Section 2.11</p>

Flood liable land

Issue	Potential impact	Yes/No	If 'yes' consult with	Section
Flood liable land	Is the work located on flood liable land? If so, would the work change flood patterns to more than a <i>minor</i> extent?	No		Section 2.12
Flood liable land	Is the work located on flood liable land? (to any extent). If so, does the work comprise more than minor alterations or additions to, or the demolition of, a building, emergency work or routine maintenance	No		Section 2.13

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled *Floodplain Development Manual: the management of flood liable land* published by the New South Wales Government.

Public authorities other than councils

Issue	Potential impact	Yes/No	If 'yes' consult with	Section
National parks and reserves	Is the work adjacent to a national park or nature reserve, or other area reserved under the <i>National Parks and Wildlife Act 1974</i> , or on land acquired under that Act?	No		Section 2.15(2)(a)
National parks and reserves	Is the work on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No		Section 2.15(2)(b)
Artificial light	Would the work increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the	No		Section 2.15(2)(d)

Issue	Potential impact	Yes/No	If 'yes' consult with	Section
	dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)			
Defence communications buffer land	Is the work on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.	No		Section 2.15(2)(e)
Mine subsidence land	Is the work on land in a mine subsidence district within the meaning of the <i>Mine Subsidence Compensation Act 1961</i> ?	No		Section 2.15(2)(f)

Appendix D

Sediment Quality Assessment



Narooma Wharf Replacement Sediment Quality Assessment

Final Report

Transport for NSW

1 March 2022

311015-00219

Advisian
Worley Group

[advisian.com](https://www.advisian.com)

Disclaimer

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PROJECT 311015-00219: Narooma Wharf Replacement Sediment Quality Assessment - Final Report

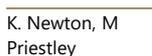
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B	Draft submitted for client review	 K. Newton	TfNSW		1/3/22		
O	Final submitted to client	 K. Newton		 L. Freeman	1/3/22		

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Acronyms and abbreviations

Acronym/abbreviation	Definition
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality
ASS	Acid sulphate soils
BTEXN	Benzene, toluene, ethylbenzene, xylene and naphthalene
CoA	Commonwealth of Australia
COC	Contaminants of concern
CT	Contaminant threshold
DBT	Dibutyltin
DGV	Default guideline value
MBT	Monobutyltin
NAGD	National Assessment Guidelines for Dredging
NO _x	Nitrogen oxides
NSW DPI	NSW Department of Primary Industries
NSW EPA	New South Wales Environment Protection Authority
OC	Organochlorine pesticides
OP	Organophosphate pesticides
PAH	Polynuclear aromatic hydrocarbons
PASS	Potential acid sulphate soils
PCB	Polychlorinated biphenyls
POEO Act 1997	Protection of the Environment Operations Act 1997
PSD	Particle size distribution
SCC	Specific contaminant concentration
SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulphur
TBT	Tributyltin
TCLP	Toxicity characteristics leaching procedure
TfNSW	Transport for New South Wales
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
VENM	Virgin excavated natural material

Executive summary

Transport for New South Wales (TfNSW) engaged Advisian to undertake a sediment quality assessment for the proposed replacement of the Narooma Wharf, New South Wales (NSW). The proposed works will include disturbance of the local seabed through demolition of the existing wharf, piling for the new wharf and general construction vessel related activities.

This sediment quality assessment was undertaken to assess the physical and chemical properties of surface marine sediments within the proposed works area to determine any potential environmental risks from remobilisation during wharf demolition and construction activities. The assessment was undertaken in general accordance with the sampling and analysis requirements of the National Assessment Guidelines for Dredging (NAGD; CoA 2009), the Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018), the NSW Environment Protection Authority (NSW EPA) Waste Classification Guidelines (2014) and the NSW Acid Sulphate Soil Assessment Guidelines (Ahern et al. 1998), as considered applicable to the site and the proposed activity.

Surface sediments (to a maximum depth of 1m, or to refusal) from six locations within the proposed works area, spread along the length of the existing wharf, were sampled by divers using a hand held vibrocore, or push core, on the 20th January 2022. Samples were analysed at a National Association of Testing Authorities (NATA) accredited laboratory, ALS Environmental, for a range of physical and chemical contaminants of potential concern.

A summary of the sediment quality results is as follows:

- The samples were similar in their Particle Size Distribution (PSD) and were reported as being predominantly fine to medium grained sand (52 – 95%), with a very low proportion of fines (i.e. clay and silt) (0 – 3%), and with varying amounts of larger grained material (i.e. gravel) (3 – 36%). The sample N1 had the lowest proportion of gravel and was located at the eastern end of the wharf where increased protection results in significantly less scouring of the seabed surface by the strong tidal currents (noted by divers).
- All samples returned concentrations of Nitrite as N below the laboratory LOR of 0.10 mg/kg. Concentrations of Nitrate as N were detected in all samples and ranged from 0.10 mg/kg to 0.30 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for nutrients in sediments.
- Field screening and Suspension Peroxide Oxidation Combined Acidity and Sulphur (SPOCAS) testing confirmed that the sediments are not Actual Acid Sulphate Soils (ASS) or Potential Acid Sulphate Soils (PASS).
- Many of the metals tested for returned concentrations below the laboratory LORs. For those which did not there were no exceedances of the ANZG (2018) DGVs or NAGD (2009) screening levels for any metal apart from zinc, where one sample had a concentration of 266 mg/kg that exceeded the ANZG (2018) and NAGD (2009) guideline value of 200 mg/kg (note that the 95%UCL for all samples of 241 mg/kg exceeded the NAGD (2009) guideline, but the median value of 30.30 mg/kg did not exceed the ANZG (2018) guideline).
- The concentration of organotin compounds (monobutyltin (MBT), dibutyltin (DBT) and tributyltin (TBT)) in all samples tested were below their respective laboratory LORs and no

guideline exceedances were detected. No 95% Upper Confidence Levels (UCLs) were run for organotin compounds.

- A wide range of other organics, including pesticides and hydrocarbons, were tested for in the sediments collected. For all samples, concentrations of the organics listed below were below the respective laboratory LORs. No ANZG (2018) or NSW EPA (2014) guideline exceedances were detected.
 - Polychlorinated Biphenyls (PCBs) (as Aroclors).
 - BTEXN (Benzene, Toluene, Ethylbenzene, meta- & para-Xylene, ortho-Xylene, Total Xylenes, Sum of BTEX, Naphthalene).
 - Triazine pesticides.
 - Toxaphene (insecticide).
 - Organophosphorus (OP) Pesticides.
 - Organochlorine (OC) Pesticides.
 - Carbamate Pesticides.
 - Phenoxyacetic Acid Herbicides.
- The following three groups of organics had samples with detections above the laboratory LOR. All detections were below the relevant ANZG (2018), NSW EPA (2014) and NAGD (2009) guideline values.
 - Total Petroleum Hydrocarbons (C15 - C28 Fraction, C29 – C36 Fraction and C10 - C36 Fraction (sum)).
 - Total Recoverable Hydrocarbons (>C16 - C34 Fraction, >C34 - C40 Fraction and >C10 - C40 Fraction (sum)).
 - Polyaromatic Hydrocarbons (naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b+j) fluoranthene, benzo(k)fluoranthene, benzo(e)pyrene, benzo(a)pyrene, benzo(g,h,i)perylene, indeno(1.2.3.cd)pyrene, sum of PAHs).

Under the NSW Waste Classification Guidelines, the sediment would be considered as General Solid Waste, in particular, Virgin Excavated Natural Material (VENM). Disturbance of surface sediments during wharf demolition and piling activities may generate localised and small turbid plumes which are expected to dissipate very rapidly due to the relatively high proportion of sand and gravel, the very low proportion of fines and the strong tidal currents in this area.

Overall, disturbance of these surface sediments adjacent to Narooma Wharf during construction is not expected to create any significant environmental or ecological risk to the local marine environment.

1 Introduction

1.1 Proposal Locality

Transport for New South Wales (TfNSW) is proposing to replace the Narooma Wharf, located in Narooma on the far south coast of New South Wales (NSW), within the Eurobodalla Shire Local Government Area (LGA). The shores of Narooma extend around the Wagonga Inlet which enters to the ocean through two breakwaters at Wagonga Head (Figure 1-1). The area is an estuarine port, with the primary operators being commercial fishing, fishing charters and tourism (Montague Island Tours).



Figure 1-1 Location of the Narooma Wharf.

1.2 Background

The Narooma Wharf, located close to the inlet mouth, has a current capacity for up to 10 vessels. The wharf has had various additions over time with the eastern concrete section added in the 1970s. The concrete section comprises reinforced concrete piles, beams, precast concrete decking and a precast concrete topping slab. The eastern timber section was added some time later comprising timber piles and decking. At the western end of the wharf a traditional timber piled structure was added in the 1980s. The wharf is in a dilapidated state with operational issues due to the structures load limitations, access height issues during high and low tide and a lack of essential services, such as a sewage pump out facility, for wharf users. Images of the existing wharf are shown in Figure 1-2.



Figure 1-2 Images of the existing wharf.

1.3 Proposed Narooma Wharf Replacement

The primary objective of the proposal is to design a new wharf facility to allow for the berthing of up to 10 vessels (vessel length ranging from 12 m to 24.9 m). The new wharf facility would comprise both fixed and floating components to connect, improve and increase the wharf area.

Advisian have been appointed by TfNSW to prepare both the concept and detailed design for the new facility. Two concept options were proposed in the Narooma Wharf Concept Design Report (Advisian 2022) and subsequently reviewed.

The option to be taken forward to detailed design was Option 2 – Gangway Placed East (Figure 1-3). In summary this option consists of a:

- 66 m long floating pontoon.
- 77 m long fixed wharf structure.
- Gangway extending down from the fixed structure to the pontoon on the eastern end of the wharf.
- Steel circular hollow section (CHS) piles.
- Precast concrete headstocks.
- Timber decking or suitable agreed alternative.
- Sewage pump out facility.
- Service pedestals (power and water).
- Hydrants, fire hose reels, extinguishers.
- Lighting.
- Ladders and life buoys.
- Fibre reinforced plastic (FRP) grating to fill between wharf and land.
- Rock revetment.
- Installation of fenders and bollards.
- Sewage pump proposed to be located at the western end of the floating pontoon.



Figure 1-3 Concept Option 2 – Eastern Gangway.

1.4 Sediment Quality Assessment

A sediment quality assessment was undertaken for the proposed activity to determine the physical and chemical properties of sediments within the proposed works area, to assess the potential environmental and ecological impacts of the proposed demolition of the existing Narooma wharf and construction activities for the new wharf.

The sediment quality assessment was designed and undertaken in general accordance with the sampling and analysis requirements of the National Assessment Guidelines for Dredging (NAGD; CoA 2009), the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018), the NSW Environment Protection Authority (NSW EPA) Waste Classification Guidelines (2014) and the NSW Acid Sulphate Soil Assessment Guidelines (Ahern et al. 1998), as considered applicable to the site and the proposed activity.

1.4.1 Objectives

The objectives of the sediment quality assessment were to determine the nature of marine sediment (i.e. physical properties, acid sulphate generating capacity and potential contamination) within the proposed works footprint and compare the data to relevant sediment quality and waste classification guidelines, as previously identified, in order to:

1. Identify any contaminants of concern (COC), exceedances of sediment quality guidelines (e.g. ANZG 2018 and NAGD 2009) and classify the material in accordance with the NSW EPA Waste Classification Guidelines (NSW EPA 2014).
2. Identify any potential impacts of remobilisation of sediments and potential contaminants during demolition and construction related disturbance of the seabed on the local aquatic environment.
3. Inform a NSW Department of Primary Industries (NSW DPI) Section 199 Notification (required to reclaim i.e. piling) for the proposed activity.

2 Sampling and Sediment Quality Guidelines

The following sediment quality guidelines were considered in the design of the Narooma Wharf Sediment Quality Assessment. Note that at the time of designing the sediment sampling and analysis plan, consideration was being given to potential dredging at the site, to a possible depth of 1 m alongside the wharf. It was also expected that bedrock would occur at around 1 m in this area, hence the planned sediment sampling depth was limited to 1 m (or to refusal).

2.1 National Assessment Guidelines for Dredging (CoA 2009)

The international agreement relating to the dumping of wastes and other matter in Australian waters, including dredged material, is called the London Protocol. Australia implements its obligations under the London Protocol through the Commonwealth Environment Protection (Sea Dumping) Act 1981 (the Sea Dumping Act). Through the Sea Dumping Act, the Australian Government assesses proposals to load and dump wastes and other matter at sea, permits acceptable activities, and places conditions of approval, to mitigate and manage environmental impacts.

The NAGD (CoA 2009) set out the framework for the environmental impact assessment and permitting of the ocean disposal of dredged material. Under Table 6 of the NAGD (CoA 2009) a minimum of six sampling locations is required for any volume of material to be dredged <10,000 m³ (refer to Table 6, NAGD CoA 2009). This was the case for the potential dredge volume initially being considered for the Narooma Wharf Replacement (which has since been decided against).

Table 2 of the NAGD (2009) provides screening levels for COC which should be assessed (if considered potentially relevant to the site of interest). For substances not listed in Table 2, the NAGD states that the procedures set out in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) should be referred to. Available NAGD screening levels are provided in the raw data tables in **Appendix A**.

2.2 Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) provide toxicant Default Guideline Values (DGVs) for sediment quality. The sediment DGVs indicate the concentrations below which there is a low risk of unacceptable effects occurring, and should be used, with other lines of evidence, to protect aquatic ecosystems.

ANZG (2018) also provides upper guideline values (GV-high), which provide an indication of concentrations at which toxicity-related adverse effects may already be expected to occur. As such, these GV-high values should only be used as an indicator of potential high-level toxicity problems, not as a guideline value to ensure protection of ecosystems. Available ANZG DGVs are provided in the raw data tables in **Appendix A**.

2.3 NSW EPA Waste Classification Guidelines

The NSW EPA Waste Classification Guidelines (NSW EPA 2014) cover the classification of wastes into groups that pose similar risks to the environment and human health as defined in Clause 49 of Schedule 1 of the Protection of the Environment Operations Act 1997 (POEO Act).

Waste classification of the sediment was undertaken based on the physical and chemical assessment of the material. In order to classify the waste, the maximum possible levels of contaminants in the waste must not exceed the Specific Contaminant Concentration (SCC) and/or toxicity characteristics leaching procedure (TCLP) test values for that classification. The SCC test acts as an initial screening test for the classification of a waste. Based on SCC alone, the test value for each contaminant must be less than or equal to the contaminant threshold (CT) value specified for that contaminant in Table 1 of the guideline. This will determine whether the waste is classified as general solid waste or restricted solid waste.

Available NSW EPA Waste Classification Guidelines are provided in the raw data tables in **Appendix A**.

2.4 Acid Sulphate Soil Guidelines

If there is the potential for oxidation of sediments to occur (e.g. if dredging / excavation of sediments and disposal above the low tide level or land based disposal of sediments is to be considered) testing of sediments for the presence of Potential Acid Sulphate Soils (PASS) and Actual Acid Sulphate Soils (ASS) is required. This is to ensure that any runoff from sediment dewatering is correctly managed, sediments are correctly treated (e.g. by liming) and/or that appropriate disposal locations or waste facilities are selected.

The NSW Acid Sulphate Assessment Manual (Ahern et al. 1998) recommends a minimum number of four (4) "boreholes" for assessment areas that are up to 1 ha (10,000 m²). As the proposed works area is less than 1 ha, four locations were tested for ASS.

Ahern et al. (1998) states that the depth of investigation should usually be at least one (1) metre beyond the depth of the proposed excavation. However, in this location bedrock was expected at 1 m, so this influenced the depth of sampling undertaken. In addition, as no dredging or excavation of sediments will be required for the proposal there is no risk of ASS impacts, so sampling to 1 m (or to refusal) was considered sufficient.

Under the guidelines samples should be collected for every soil layer or every half (0.5) metre. The depth of the sample within the layer must be recorded, along with the upper and lower horizon depths. Where distinct soil layers or horizons occur in the soil profile, sampling intervals should be adjusted to take account of these horizons.

In the case of the guidance for ocean disposal of dredged materials (NAGD 2009), due to the extensive volume and pH buffering capacity provided by seawater, the disposal of sediments classified as containing ASS in the open marine environment is unlikely to significantly alter the acidity and release of quantities of metal(loid)s to the extent that water quality guideline values are exceeded in the water column.

3 Sampling and Analysis

3.1 Sampling Design and Rationale

A general sediment Sampling and Analysis Plan (SAP) was prepared and submitted to TfNSW prior to undertaking the sediment quality assessment. The SAP was based on the area of proposed works, the proposed volume of dredging (as identified at that time) of <math> < 10,000 \text{ m}^3 </math>, the proposed depth of dredging required (i.e. a maximum of 1 m at which depth bedrock was expected) and the sampling and analysis requirements of the relevant sediment guidelines listed below (as described in Section 2):

- Australia and New Zealand Guidelines for Marine and Freshwater Quality – Default Sediment Quality Guidelines (ANZG 2018).
- National Assessment Guidelines for Dredging (NAGD) (CoA 2009).
- NSW EPA Waste Classification Guidelines Part 1: Classifying Waste (NSW EPA 2014).
- NSW Acid Sulfate Soils Assessment Guidelines (Ahern et al. 1998).

The potential contaminants of concern (COC) selected for testing were based on a suite of analytes that are typically measured in equivalent coastal locations and those required to be tested under the guidelines listed above (where considered to be applicable to the site). The parameters tested, as well as those parameters not considered to be relevant (and not tested for), are listed in Section 3.7.

3.2 Sample Locations and Numbers

The six sampling locations within the proposed dredge area are shown in Figure 3-1. Consistent with the recommendations of the NAGD (CoA 2009) for small dredging projects, up to 50,000 m³, the entire dredge area was treated as a single site with random sample locations selected within it. At each location, a single sediment core was collected, with a target depth of 1m. For a number of locations refusal was met at a very shallow depth due to a large amount of rock and shell material and little surface sediments being available, especially at the western end of the wharf where a rock platform extended off the seawall and scouring by strong tidal currents was significant. The entire core was treated as a single sample for testing unless a visible stratigraphy was noted.

Samples from all six locations were photographed, logged and tested for physical properties and selected contaminants as listed under the NAGD (CoA 2009), ANZG (2018) and NSW EPA (2014) as outlined in Sections 3.6 and 3.7. Acid sulphate soil assessment, in general accordance with the NSW ASS Guidelines (Ahern et al. 1998), was also undertaken for four of the locations, being location 2, 3, 4 and 5 (refer to Figure 3-1) (noting that dredging or excavation of sediments is not required for the proposed wharf replacement).



Figure 3-1 Sediment sampling locations adjacent to Narooma Wharf.

General notes for each sampling location including date, time, core depth achieved, samples taken, testing undertaken and any additional general field notes are provided in Table 3-1.

Table 3-1 Sample location notes.

Sample Location	Date	Core Depth (below seabed)	Subsamples Taken	Sample Names	Lab Testing	Notes
N1	20/1/22	1m	0-0.6m 0.6-1.0m	N1a N1b (hold)	NAGD PSD	Vibrocore method (with diver). Core taken in sand patch between seagrass. Sand with penetration to 1m achieved. Darker sand layer from 0.6-1m (was not tested due to findings of clean sand above).
N2	20/1/22	0.5m	0-0.3m 0.3-0.5m	N2a N2b (hold)	NAGD ASS/PASS PSD	Vibrocore method (with diver). Core taken in sand patch between seagrass. Lots of shell rubble and small rocks. Clay layer reached at 0.3m and refusal reached at 0.5m.
N3	20/1/22	0.2m	0-0.2m	N3	NAGD	Vibrocore method (with diver).

Sample Location	Date	Core Depth (below seabed)	Subsamples Taken	Sample Names	Lab Testing	Notes
					ASS/PASS PSD	Refusal reached quickly. Multiple cores attempted at location with similar result. Lots of rock rubble and seagrass present.
N4	20/1/22	0.3m	0-0.3m	N4	NAGD ASS/PASS PSD	Diver coring method (hand core). High level of shell and rock rubble off rock shelf. Refusal reached early.
N5	20/1/22	0.3m	0-0.3m	N5	NAGD ASS/PASS PSD	Diver coring method (hand core). High level of shell and rock rubble off rock shelf. Refusal reached early.
N6	20/1/22	0.3m	0-0.3m	N6	NAGD PSD	Diver coring method (hand core). High level of shell and rock rubble off rock shelf. Refusal reached early.

3.3 Timing

Sediment sampling was undertaken on the 20th January 2022. Conditions were generally fine and sunny, with light-moderate winds and scattered showers.

3.4 Sample Collection and Processing

3.4.1 Collection

McLennans Diving Service (MDS) were engaged to provide commercial divers to undertake the sediment vibrocoring for the project and an Advisian marine scientist oversaw the work and undertook all processing and subsampling of samples.

A small sampling vessel was supplied by MDS from which the surface supply diving equipment was run. The sediment cores were collected using an electric P3 vibrocorer using 100 mm diameter aluminium core tubes. A hand coring method was adopted at some sites where use of the vibrocore was not possible due to the high shell and rock rubble. A sub-sampling area was set up on Narooma Wharf.

Images of sampling being undertaken are provided in Figure 3-2.



Figure 3-2 Images of divers collecting sediments at Narooma Wharf.

3.4.2 Processing

Once the sediment core was obtained it was brought to the surface and taken to the designated subsampling area onshore. Cores were cut open by MDS staff along one side using a small angle grinder, before core logging and sample processing by Advisian.

Field logging and photographs of all core samples were undertaken. Core logs and photos are provided in **Appendix B**. Once samples were logged and photographed, each sample horizon was fully homogenised (in glass mixing bowls) using a stainless steel spoon. Samples were then transferred into sterile pre-labelled laboratory supplied jars / bags with zero headspace. Samples were immediately placed in a closed esky on ice and transported the same day to the laboratory for analysis.

3.5 Sample Horizons

The sampling depths achieved, and analyses undertaken for each site are presented in Table 3-1 and Sections 3.6 and 3.7.

3.6 Geotechnical Information

Basic geotechnical information was collected in the field and all sediment cores were photographed and logged. For each sample general geotechnical information was recorded including the major and minor sediment types, sediment colour, odour etc. This information along with core photos is provided in **Appendix B**.

3.7 Laboratory Testing

Laboratory analysis was undertaken by the NATA accredited laboratory ALS Environmental. All original laboratory reports are provided in **Appendix C**.

3.7.1 Screening Level Assessment

The parameters tested were based on the potential for contamination at the site. Laboratory LORs were selected to ensure they were below the relevant guidelines. Samples from locations 1 to 6 were analysed for the following analytes:

- Total organic carbon (TOC).
- Particle size distribution (PSD).
- Moisture content.
- Trace metals/metalloids (Aluminium, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Tin, Thallium, Vanadium, Zinc).
- Total petroleum hydrocarbons (TPH) (C6 - C9 Fraction, C10 - C14 Fraction, C15 - C28 Fraction, C29 - C36 Fraction, C10 - C36 Fraction (sum)).
- Total recoverable hydrocarbons (TRH) (C6 - C10 Fraction, C6 - C10 Fraction minus BTEX (F1)).
- Total recoverable hydrocarbons - NEPM 2013 Fractions (>C10 - C16 Fraction, >C16 - C34 Fraction, >C34 - C40 Fraction, >C10 - C40 Fraction (sum), >C10 - C16 Fraction minus Naphthalene (F2)).
- BTEXN (Benzene, Toluene, Ethylbenzene, meta- & para-Xylene, ortho-Xylene, Total Xylenes, Sum of BTEX, Naphthalene).
- Organotins (Monobutyltin – MBT, Dibutyltin – DBT, Tributyltin - TBT).
- Pesticides (Organophosphorus pesticides (OPs) (Ultra-trace), Organochlorine pesticides (OCs), Carbamate pesticides and Phenoxyacetic acid herbicides).
- Polychlorinated biphenyls (PCBs) (as Aroclors).
- Polycyclic aromatic hydrocarbons (PAHs).

Subsamples that were collected but did not require immediate testing due to depth were held frozen at the laboratory in case any additional testing was warranted (i.e. in the case of high concentrations in the upper horizons).

Acid sulphate soils (ASS) testing was undertaken at four locations (2, 3, 4 and 5). Tests included:

- Acid sulphate soils: pH (field screen).
- Suspension Peroxide Oxidation Combined Acidity and Sulphur (SPOCAS) testing.

There are a number of parameters which are listed under the NAGD (CoA 2009) and NSW EPA Guidelines that were not considered to be of concern for the site and so were excluded from testing including:

- Radionuclides (gross beta/alpha activity in soils).
- Methyl mercury.

- Cyanide, bromide, chloride, fluoride.
- Hexavalent and trivalent chromium.
- Sulfate.
- Phenols.
- Volatile organic compounds (VOCs).

All original laboratory reports are provided in **Appendix C**.

3.7.2 Laboratory Methods

A summary of the laboratory methods adopted by ALS is provided in Table 3-2.

Table 3-2 Laboratory methods adopted.

Contaminants	Acid Sulphate Soils
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES	EA002: pH 1:5 (Soils)
EG005(ED093)T: Total Metals by ICP-AES	EA003 :pH (field/fox)
EG020-SD: Total Metals in Sediments by ICPMS	EA029-A: pH Measurements
EG035T: Total Recoverable Mercury by FIMS	EA029-B: Acidity Trail
EK057G: Nitrite as N by Discrete Analyser	EA029-C: Sulfur Trail
EK058G: Nitrate as N by Discrete Analyser	EA029-D: Calcium Values
EK059G: Nitrite plus Nitrate as N (NO _x) by Discrete Analyser	EA029-E: Magnesium Values
EP003: Total Organic Carbon (TOC) in Soil	EA029-F: Excess Acid Neutralising Capacity
EP068C: Triazines	EA029-H: Acid Base Accounting
EP069: Toxaphene	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons	
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons	
EP080-SD: BTEXN	
EP090: Organotin Compounds	
EP130A: Organophosphorus Pesticides (Ultra-trace)	
EP131A: Organochlorine Pesticides	
EP131B: Polychlorinated Biphenyls (as Aroclors)	
EP132B: Polynuclear Aromatic Hydrocarbons	
EP201: Carbamate Pesticides by LCMS	
EP202A: Phenoxyacetic Acid Herbicides by LCMS	
	Particle Size Analysis
	EA150: Particle Sizing
	EA150: Soil Classification based on Particle Size

3.8 Quality Control

Quality control during field sampling was ensured by:

- Using suitably qualified environmental staff experienced in sediment sampling, field supervision and sediment logging.
- Chain of Custody forms identifying the sampler, nature of the sample, collection date and time, analyses to be performed and sample preservation method.
- Using survey vessels that was thoroughly inspected and washed down.
- Staff wearing sterile nitrile gloves during subsampling which were changed between samples.
- Subsampling undertaken on clean plastic tarps.
- Samples being contained in appropriately cleaned, pre-treated and labelled sample containers (supplied by the laboratory).
- Samples being kept cool (4°C) after sampling and during transport, stored in eskies with ice.
- Transportation of samples under Chain of Custody documentation.
- All sampling equipment, including the vibracore, hand cores, mixing bowls, spoons etc. was decontaminated between sampling locations via a decontamination procedure involving a wash with ambient seawater and Decon 90 and successive rinsing with fresh seawater.

Laboratory quality control was met through:

- Samples were submitted to a National Association of Testing Authorities (NATA) accredited laboratory (ALS Environmental) capable of meeting the required practical quantitation limits.
- Internal laboratory QA/QC procedures included laboratory blanks, matrix spikes, surrogates and replicate analysis was undertaken and reported.
- Sample holding times were within the prescribed times as set out in Appendix 7 of the NAGD.

3.9 Data Analysis

Contaminant levels in sediments were determined by the laboratory, tabulated and compared against the relevant guideline screening levels (i.e. ANZG 2018, NAGD 2009 and NSW EPA 2014) to determine any guidelines exceedances and to determine if further testing was required (e.g. elutriate, bioavailability and/or toxicity assessment). Considering the results received, this additional testing was not required for any sample or analyte.

3.9.1 Comparison to ANZG (2018)

Raw data were compared to the ANZG (2018) DGVs for sediments where they were available (these are provided in the raw data tables in **Appendix A**).

3.9.2 Comparison to NAGD (CoA 2009)

Comparison against the NAGD (CoA 2009) involves the comparison of screening levels with the upper 95% confidence level (95% UCL) of the mean. For the purposes of calculation of 95% UCLs, values that are below the laboratory LOR were set to one-half of the LOR in accordance with NAGD recommendations. Results for PAHs were normalised to 1% Total Organic Carbon (TOC) where the recorded value was within the range of 0.2-10%. If TOC values were outside this range, then the highest or lowest of the 0.2-10% range was adopted as appropriate. Minimum, maximum, mean, medians, standard deviations and 95% UCLs were calculated for each sample except for contaminant groups where all samples were below the LOR for a given parameter (these were not analysed).

The method used to calculate the 95% UCLs was based on the methods recommended in Appendix A of the NAGD (P38, Comparison of Data to Screening Levels). Normality of datasets was determined using Shapiro-Wilks test in ProUCL Version 4 (4.1.00) (software developed by the US EPA). Datasets were determined as being normal, log-normal, gamma or non-parametric in their distributions. Given the small sample size (n=6), the datasets were analysed assuming non-parametric distribution using the Chebyshev UCL method (ITRC, 2012) which is most appropriate for small sample sizes (i.e. sample size <20) datasets.

Output from this analysis is provided in **Appendix D**.

3.9.3 NSW EPA Waste Classification Guidelines (2014)

Classification of the sediments in accordance with the NSW EPA Waste Classification Guidelines (NSW EPA 2014) was undertaken. A summary of findings is below (based on the knowledge of the material and the laboratory results in Section 4).

1. **Is the waste special waste?** – The waste does not constitute any pre-classified special waste as listed under the NSW EPA Waste Classification Guidelines.
2. **Is the waste liquid waste?** – The waste is not liquid waste.
3. **Is the waste pre-classified?** – Based on Items 1, 2, 4 and 5, the waste can be classed as non-putrescible general solid waste, specifically, virgin excavated natural material (VENM). VENM is natural material such as clay, gravel, sand, soil or rock fines that has been excavated from areas that are not contaminated as a result of industrial, commercial, mining or agricultural activities and does not contain sulfidic ores or soils or any other waste.
4. **Does the waste possess hazardous characteristics?** – The waste does not constitute hazardous waste under any classes or divisions of the *Transport of Dangerous Goods Code*.
5. **Determining a waste's classification using chemical assessment** – Although the waste was not expected to contain any chemicals of concern, sampling and testing for a range of potential contaminants was undertaken to confirm this (refer to Section 4). This testing was also required to compare the characteristics of sediments to the ANZG (2018) and NAGD (CoA 2009) guidelines.

4 Results

4.1 Physical Characteristics

General physical characteristics of sediments collected from each location are presented in the core logs in **Appendix B**. Photographs of each sample are also included within **Appendix B**. Samples were typically recorded to be medium grained sands, many with a high proportion of gravel (rock and shell material), which were brown with some grey/black in colour. The samples had no odour other than that of natural marine material.

4.2 Particle Size Analysis

Particle size analysis was undertaken for each sediment sample. Figure 4-1 shows the composition of sediments by size class (12 size classes are included ranging from +75 µm to +75.0 mm). Figure 4-2 shows the soil classification (clay, silt, sand, gravel or cobbles) for each sample.

The samples were similar in their PSD and were reported as being predominantly fine to medium grained sand (52 – 95%), with a very low proportion of fines (i.e. clay and silt) (0 – 3%), and with varying amounts of larger grained material (i.e. gravel) (3 - 36%). The sample N1 had the lowest proportion of gravel and was located at the eastern end of the wharf where increased protection results in significantly less scouring of the seabed surface by the strong tidal currents (noted by divers).

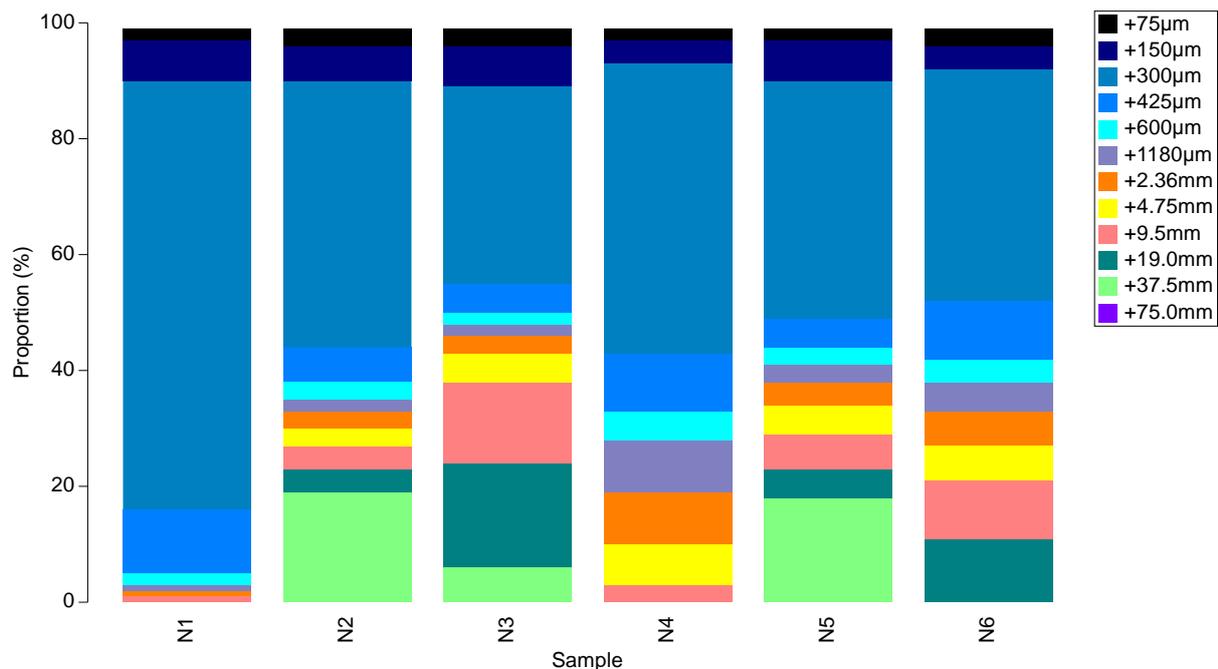


Figure 4-1 Particle size distribution.

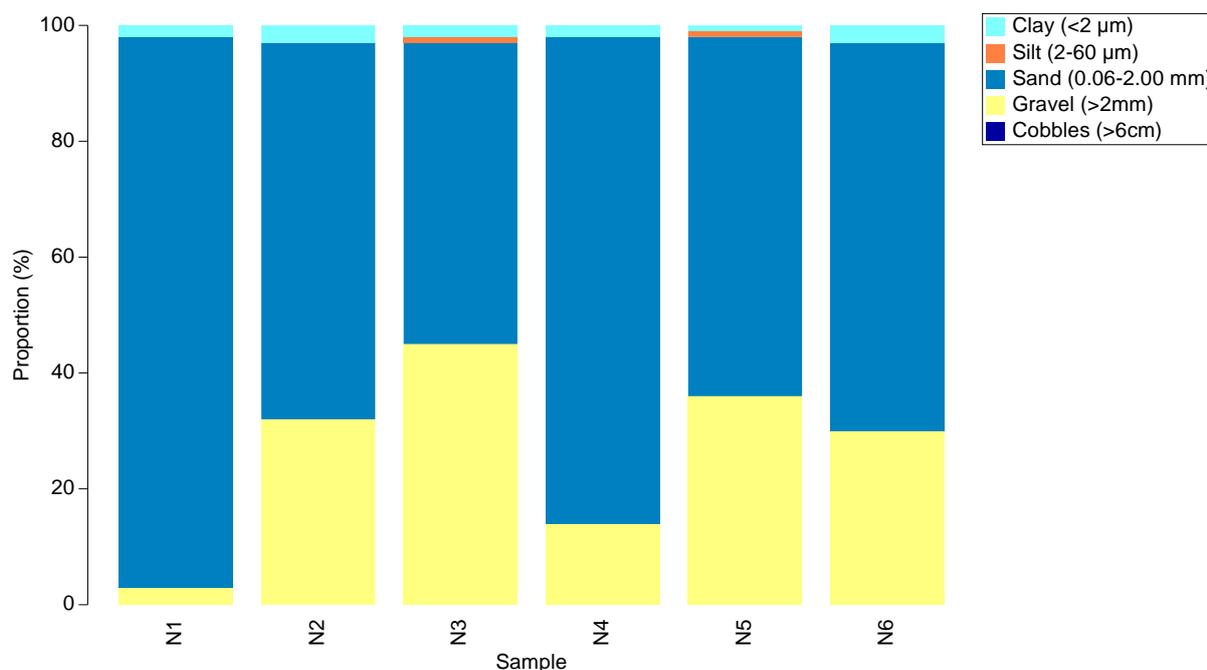


Figure 4-2 Soil classification.

4.3 Contaminants

Contaminant levels in sediments were compared against the ANZG sediment DGVs (2018), the NAGD screening level concentrations (CoA 2009) and the NSW EPA Waste Classification Guidelines (NSW EPA 2014). All raw data are tabulated in **Appendix A** and photographs and logs of sediments are provided in **Appendix B**. Chain of Custody documentation together with original laboratory results are provided in **Appendix C**.

4.3.1 Nutrients

The following nutrients were tested for:

- Nitrite as N.
- Nitrate as N.
- Nitrite plus Nitrate as N (NO_x).

All samples returned concentrations of Nitrite as N below the laboratory LOR of 0.10 mg/kg. Concentrations of Nitrate as N were detected in all samples and ranged from 0.10 mg/kg to 0.30 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for nutrients in sediments.

Table 4-1 Summary statistics and 95% UCLs for nutrients.

Analyte	Units	Level of Reporting	ANZG DGV/ NAGD SV	Mean	Min	Max	Median	STDEV	95%UCL
Nitrate as N	mg/kg	0.1	-	0.18	0.10	0.30	0.15	0.10	0.36
Nitrate and Nitrites as N	mg/kg	0.1	-	0.18	0.10	0.30	0.15	0.10	0.36

4.3.2 Total Organic Carbon

Total organic carbon (TOC) was tested in sediments with raw results provided in **Appendix A** with summary statistics, including 95% UCLs, in Table 4-2. Concentrations of TOC were low in all samples and ranged from just 0.15% to 0.27%. There are no ANZG (2018), NAGD (2009) or NSW EPA (2014) guidelines for TOC.

Table 4-2 Summary statistics and 95% UCLs for total organic carbon.

Analyte	Units	Level of Reporting	NAGD SV	Mean	Min	Max	Median	STDEV	95%UCL
Total Organic Carbon	%	0.02	-	0.21	0.15	0.27	0.21	0.05	0.29

4.3.3 Acid Sulphate Soils

4.3.3.1 Screening Tests

The acid sulphate soil screening test results are provided in Table 4-3 and summarised as follows, with all raw data provided in **Appendix A**.

- The field pH (F) results varied from 8.4 to 8.8 indicating no actual acidity, with values representative of typical marine influenced samples.
- The pH (Fox) results varied from 8.8 to 9.0. Values of pH (Fox) <3 are indicative of sediments with a strong potential to generate acid. These sediments are not considered to have a strong potential to generate acid.
- The reaction rate was 'moderate' (2) for all samples. Reaction rates range from 'slight' (1) to 'extreme' (4).
- Field screening tests confirmed that sediments within all substrata tested were not actual acid sulphate soils (AASS) or potential acid sulphate soils (PASS).

Table 4-3 Acid sulphate soil screening test results (pH (F) and pH (Fox)).

	N1	N2	N3	N4	N5	N6
EA002: pH 1:5 (Soils)						
pH Value	8.4	8.8	8.7	8.8	8.7	8.6
EA003 :pH (field/fox)						
pH (F)	-	9.0	8.9	9.0	8.8	-
pH (Fox)	-	6.7	6.5	6.5	6.4	-
Reaction Rate	-	2	2	2	2	-
EA029-A: pH Measurements						
pH KCl (23A)	-	9.3	9.5	9.7	9.7	-
pH OX (23B)	-	8.9	8.8	8.8	8.6	-

* ASS: EA003 (NATA Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 – Extreme.

4.3.3.2 SPOCAS

The acid sulphate soil potential was also assessed using the SPOCAS analysis suite. The SPOCAS suite and acid sulphate soil assessment method was adopted from Ahern et al (1998). The results of the SPOCAS suite testing are summarised in Table 4-4 with full results shown in **Appendix A**.

All sediments had low organic content and were predominately sand with a small proportion of fines (<2%). All samples tested were above the action criteria for oxidizable sulphur (0.3%) listed in Ahern et al. (1998) for coarse soil type (≤5 % clay content). All samples were below the action criteria for acid trail listed in Ahern et al. (1998).

Table 4-4 Summary of SPOCAS results.

	N2	N3	N4	N5
Clay content %	3	2	2	1
% Sulphur Equivalent	0.103	0.070	0.051	0.068
Mol H+ / tonne	<2	<2	<2	<2
PASS	No	No	No	No

4.3.4 Metals

The following metals were tested for in sediments, with results as indicated. Raw data are provided in **Appendix B** with summary statistics, including 95% UCLs, in Table 4-5.

- Aluminium – concentrations ranged from 780 mg/kg to 4,550 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for aluminium.
- Antimony – all samples had concentrations below the laboratory LOR of 0.5 mg/kg. No ANZG (2018) or NAGD (2009) exceedances were detected.
- Arsenic – concentrations ranged from 3.95 mg/kg to 6.81 mg/kg. No ANZG (2018) or NAGD (2009) exceedances were detected.
- Barium – concentrations ranged from 5.00 mg/kg to 20.00 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for barium.
- Beryllium – all samples had concentrations below the laboratory LOR of 1 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for beryllium.
- Cadmium – all samples had concentrations below the laboratory LOR of 0.1 mg/kg. No ANZG (2018) or NAGD (2009) exceedances were detected.
- Chromium – concentrations ranged from 4.40 mg/kg to 22.80 mg/kg. No ANZG (2018) or NAGD (2009) guideline exceedances were detected.
- Cobalt – concentrations ranged from 0.60 mg/kg to 33.60 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for cobalt.
- Copper – concentrations ranged from 1.40 mg/kg to 15.10 mg/kg. No ANZG (2018) or NAGD (2009) exceedances were detected.
- Iron – concentrations ranged from 2,060 mg/kg to 12,900 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for iron.
- Lead – concentrations ranged from 1.20 mg/kg to 6.40 mg/kg. No ANZG (2018) or NAGD (2009) guideline exceedances were detected for lead.
- Manganese – concentrations ranged from 11.0 mg/kg to 118.0 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for manganese.
- Molybdenum – all samples had concentrations below the laboratory LOR of 2 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for molybdenum.
- Nickel – concentrations ranged from 1.40 mg/kg to 14.40 mg/kg. No ANZG (2018) or NAGD (2009) exceedances were detected for nickel.
- Selenium – concentrations ranged from 0.30 mg/kg to 0.70 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for selenium.
- Silver – all samples had concentrations below the laboratory LOR of 0.1 mg/kg apart from one which was on the LOR. No ANZG (2018) or NAGD (2009) guideline exceedances were detected.
- Thallium – all samples had concentrations below the laboratory LOR of 5 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for thallium.
- Tin – all samples had concentrations below the laboratory LOR of 5 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for tin (excluding TBT as tin).

- Vanadium – concentrations ranged from below the laboratory LOR of 4.70 mg/kg to 22.40 mg/kg. There are no ANZG (2018) or NAGD (2009) guidelines for vanadium.
- Zinc – concentrations ranged from 4.0 mg/kg to 266 mg/kg. There was one sample with a concentration of 266 mg/kg that exceeded the ANZG (2018) and NAGD (2009) guideline value of 200 mg/kg. The 95%UCL of 241 mg/kg exceeded the NAGD (2009) guideline. However, the median value of 30.30 mg/kg did not exceed the ANZG (2018) guideline.

Table 4-5 Summary statistics and 95% UCLs for metals.

Analyte	Units	Level of Reporting	ANZG/ NAGD GV	Mean	Min	Max	Median	STDEV	95%UCL
Aluminum	mg/kg	50	-	2707	780	4550	2595	1346	5102
Arsenic	mg/kg	1	20	5.23	3.95	6.81	5.15	0.92	6.87
Barium	mg/kg	10	-	10.83	5.00	20.00	10.00	4.92	19.58
Cobalt	mg/kg	0.5	-	9.27	4.40	22.80	6.20	6.94	21.62
Chromium	mg/kg	1	80	8.87	0.60	33.60	4.70	12.29	30.74
Copper	mg/kg	1	65	7.22	1.40	15.10	6.60	4.88	15.9
Iron	mg/kg	50	-	8633	2060	12900	9265	3757	15320
Lead	mg/kg	1	50	4.52	1.20	6.40	5.15	1.89	7.87
Manganese	mg/kg	10	-	42.2	11.0	118.0	27.0	39.3	112.2
Nickel	mg/kg	1	21	7.22	1.40	14.40	5.90	4.54	15.3
Selenium	mg/kg	0.1	-	0.55	0.30	0.70	0.55	0.15	0.82
Vanadium	mg/kg	2	-	12.33	4.70	22.40	10.60	6.42	23.75
Zinc	mg/kg	1	200	62.50	4.00	266.00	30.30	100.31	241

* Only analytes that had detections above limit of reporting are summarised. NA = not applicable due to all values below limit of reporting. Exceedances of relevant guidelines are shown in bold.

4.3.5 Organotins

The concentration of organotin compounds (monobutyltin (MBT), dibutyltin (DBT) and tributyltin (TBT)) in all samples tested were below their respective laboratory LORs of 0.1 µgSn/kg or 0.5 µgSn/kg. No samples exceeded the ANZG (2018) or NAGD (2009) guideline for TBT of 9 µgSn/kg. Raw data are provided in **Appendix A**.

4.3.6 Other Organics

A wide range of other organics, including pesticides and hydrocarbons, were tested for in the sediments collected. For all samples, concentrations of the organics listed below were below the

respective laboratory LORs. No ANZG (2018) or NSW EPA (2014) guideline exceedances were detected. No 95% URLs were run for these parameters and no NAGD (2009) guidelines were exceeded. The full list of analytes tested under each of the general groups below, as well as the raw lab results, are provided in **Appendix A** with summary statistics, including 95% UCLs, in Table 4-6.

- Polychlorinated Biphenyls (PCBs) (as Aroclors).
- BTEXN (Benzene, Toluene, Ethylbenzene, meta- & para-Xylene, ortho-Xylene, Total Xylenes, Sum of BTEX, Naphthalene).
- Triazine pesticides.
- Toxaphene (insecticide).
- Organophosphorus (OP) Pesticides.
- Organochlorine (OC) Pesticides.
- Carbamate Pesticides.
- Phenoxyacetic Acid Herbicides.

The following three groups had samples with detections above the laboratory LOR. All detections were below the relevant ANZG (2018), NSW EPA (2014) and NAGD (2009) guideline values. The full list of analytes tested under each of the general groups below, as well as the raw lab results, are provided in **Appendix A**.

- Total Petroleum Hydrocarbons (C15 - C28 Fraction, C29 – C36 Fraction and C10 - C36 Fraction (sum)).
- Total Recoverable Hydrocarbons (>C16 - C34 Fraction, >C34 - C40 Fraction and >C10 - C40 Fraction (sum)).
- Polyaromatic Hydrocarbons (naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b+j) fluoranthene, benzo(k)fluoranthene, benzo(e)pyrene, benzo(a)pyrene, benzo(g,h,i)perylene, indeno(1.2.3.cd)pyrene, sum of PAHs).

Table 4-6 Summary statistics and 95% UCLs for organics.

Analyte	Units	LOR	ANZG DGV	NAGD SV	Mean	Min	Max	Median	STDEV	95% UCL
C15-C28 Fraction	mg/kg	3	-	-	27	11	40	28	11	46.0
C29-C36 Fraction	mg/kg	5	-	-	14	11	20	11	4	21.8
C10-C36 Fraction	mg/kg	3	-	-	39	11	60	41	17	67.9
C16-C34 Fraction	mg/kg	3	-	-	34	14	50	36	13	56.2

Analyte	Units	LOR	ANZG DGV	NAGD SV	Mean	Min	Max	Median	STDEV	95% UCL
C34-C40 Fraction	mg/kg	5	-	-	11	8	15	9	3	16.9
C10-C40 Fraction (sum)	mg/kg	3	280	-	43	14	65	46	17	73.5
Total PAHs (sum)¹	µg/kg	4	10,000	50,000	357	2	1746	108	685	1576

* Only analytes that had detections above limit of reporting (LOR) are summarised. 1 = The concentration of total PAHs was normalized to TOC as per ANZG (2018).

5 Conclusions

The sediment quality assessment has confirmed that sediments adjacent to the Narooma Wharf are clean marine sands with a high level of shell and rock rubble. Refusal was reached relatively quickly along the length of the wharf, owing to a high proportion of rock/shell or a clay layer.

There were no exceedances of the ANZG (2018) DGVs or NAGD (2009) screening levels for any organics (including organotins). There were no exceedances of the ANZG (2018) DGVs or NAGD (2009) screening levels for any metal apart from zinc, where one sample had a concentration of 266 mg/kg that exceeded the ANZG (2018) and NAGD (2009) guideline value of 200 mg/kg (the 95%UCL of 241 mg/kg exceeded the NAGD (2009) guideline but the median value of 30.30 mg/kg did not exceed the ANZG (2018) guideline). The levels of zinc found in sediments may result from the breakdown of 'sacrificial anodes' made of zinc which are placed on vessels to protect the hulls. Zinc coating is used as an efficient solution for corrosion prevention and cathodic protection.

Under the NSW Waste Classification Guidelines, the sediment would be considered as General Solid Waste, in particular, Virgin Excavated Natural Material (VENM). Testing has also confirmed that the sediment adjacent to Narooma Wharf is not actual acid sulphate soil (AASS) or potential acid sulphate soil (PASS). In any case, no dredging or excavation of sediment is proposed so no impacts associated with ASS would be expected from the proposed works.

An assessment of the physical parameters of the sediment has shown the samples were similar in their PSD and were reported as being predominantly fine to medium grained sand (52 - 95%), with a very low proportion of fines (i.e. clay and silt) (0 - 3%), and with varying amounts of larger grained material (i.e. gravel) (3 - 36%). Disturbance of surface sediments during wharf demolition and piling activities may generate localised and small turbid plumes which are expected to dissipate very rapidly due to the relatively high proportion of sand and gravel, the very low proportion of fines and the strong tidal currents in this area. However, measures should be taken to prevent the spread of resuspended material outside of the immediate works zone, especially considering the abundance of seagrass (including *Posidonia*) in the local area.

Overall, disturbance of these surface sediments adjacent to Narooma Wharf during construction is not expected to create any significant environmental or ecological risk to the local marine environment.

6 References

Ahern C R, Stone, Y, and Blunden B (1998). Acid Sulphate Soils Assessment Guidelines Published by the Acid Sulphate Soil Management Advisory Committee, Wollongbar, NSW, Australia. ANZG 2018.

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018). Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.

Commonwealth of Australia (2009). National Assessment Guidelines for Dredging, Commonwealth of Australia, Canberra.

Commonwealth of Australia (1981). Sea Dumping Act, Commonwealth of Australia, Canberra.

NSW EPA (2014). Waste Classification Guidelines Part 1: Classifying waste. NSW EPA.

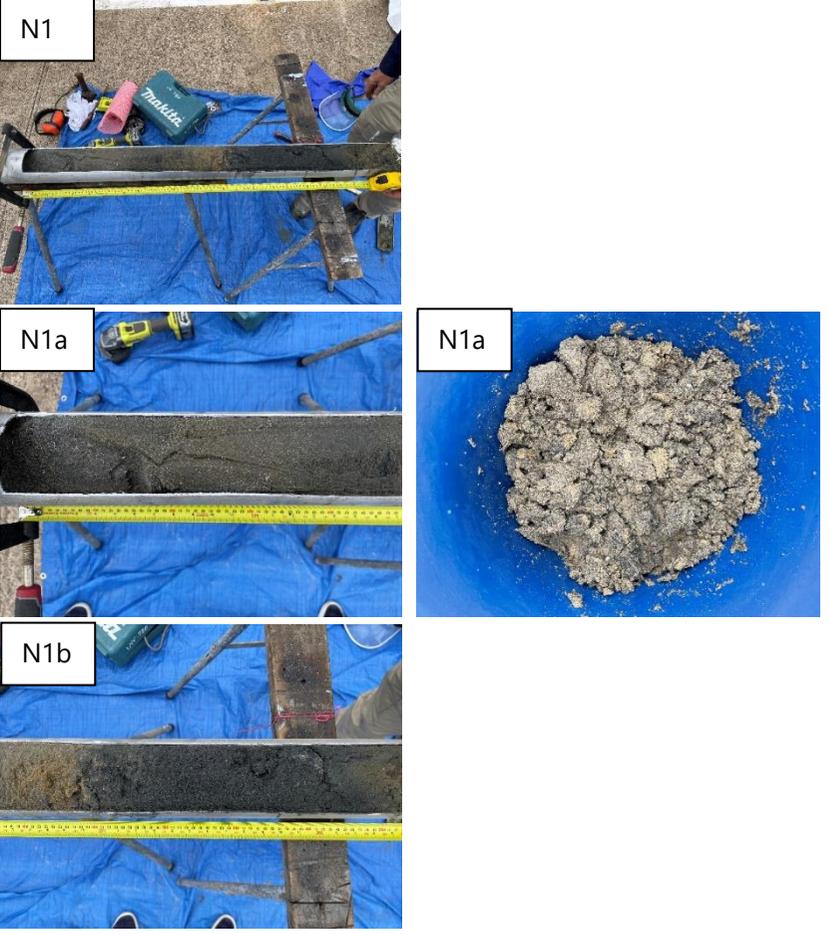
Simpson, SL, Mosley, L, Batley, GE and Shand, P (2018), National Acid sulphate soils guidance: Guidelines for the dredging of acid sulphate soil sediments and associated dredge spoil management, Department of Agriculture and Water Resources, Canberra, ACT. CC BY 4.0.



Appendix A
Summary of Lab Results and Statistical
Analysis

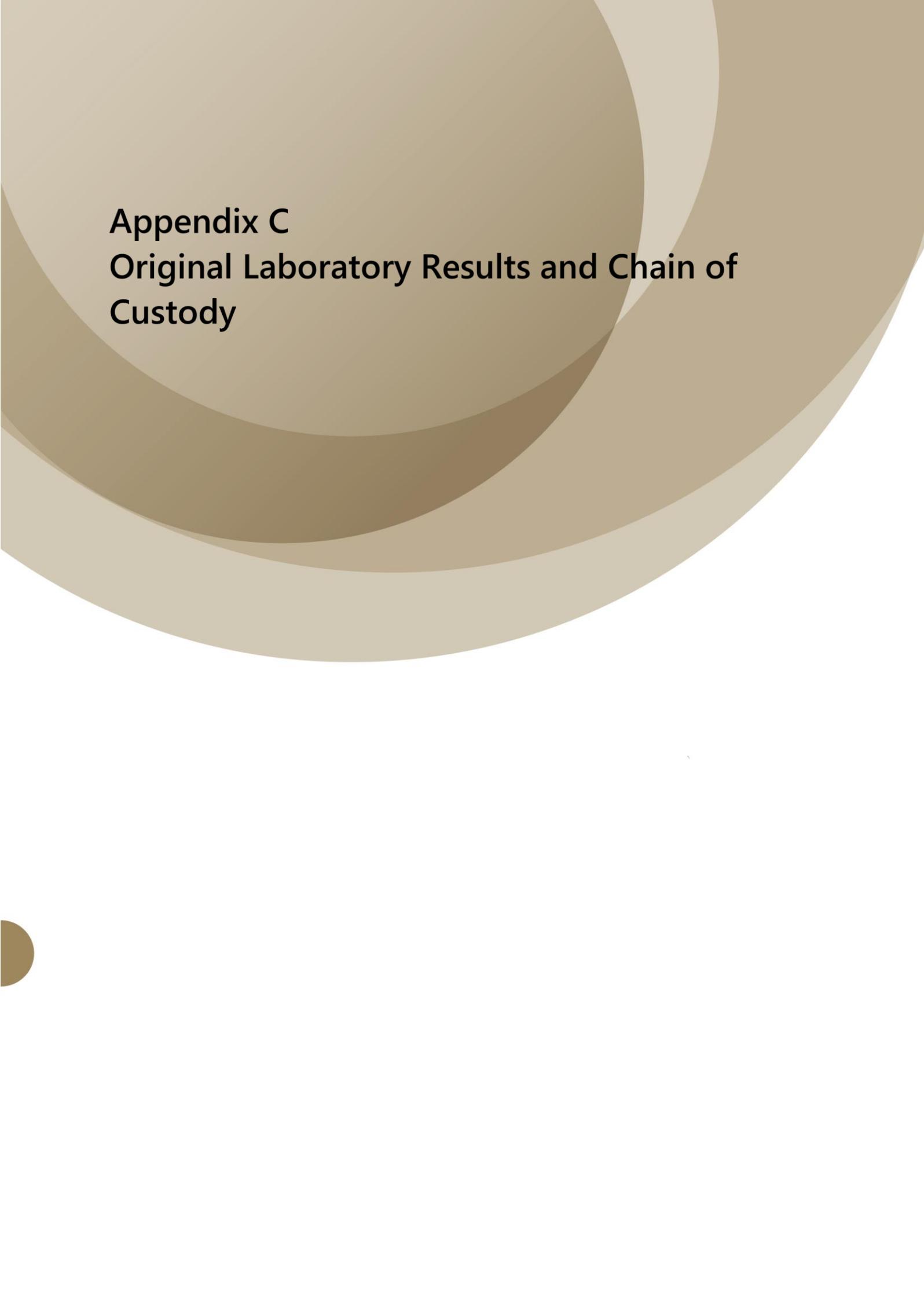
			Narooma						Guidelines	
			20/01/2022	20/01/2022	20/01/2022	20/01/2022	20/01/2022	20/01/2022	ANZG DGV (2018)	NAGD Screening (2009)
			Sample Date:	20/01/2022	20/01/2022	20/01/2022	20/01/2022	20/01/2022		
			Sample Name:	N1	N2	N3	N4	N5	N6	
			Depth (m):	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	
Analyte grouping/Analyte	Unit	Limit of reporting								
EA002: pH 1:5 (Soils)										
pH Value	pH Unit	0.1	8.4	8.8	8.7	8.8	8.7	8.6		
EA003 :pH (field/fox)										
pH (F)	pH Unit	0.1	--	9.0	8.9	9.0	8.8	--		
pH (Fox)	pH Unit	0.1	--	6.7	6.5	6.5	6.5	--		
Reaction Rate	Reaction Unit	1	--	2	2	2	2	--		
EA029-A: pH Measurements										
pH KCl (23A)	pH Unit	0.1	--	9.3	9.5	9.7	9.7	--		
pH OX (23B)	pH Unit	0.1	--	8.9	8.8	8.8	8.6	--		
EA029-B: Acidity Trail										
Titratable Actual Acidity (23F)	mole H+ / t	2	--	<2	<2	<2	<2	--		
Titratable Peroxide Acidity (23G)	mole H+ / t	2	--	<2	<2	<2	<2	--		
Titratable Sulfidic Acidity (23H)	mole H+ / t	2	--	<2	<2	<2	<2	--		
sulfidic - Titratable Actual Acidity (s-23F)	% pyrite S	0.02	--	<0.020	<0.020	<0.020	<0.020	--		
sulfidic - Titratable Peroxide Acidity (s-23G)	% pyrite S	0.02	--	<0.020	<0.020	<0.020	<0.020	--		
sulfidic - Titratable Sulfidic Acidity (s-23H)	% pyrite S	0.02	--	<0.020	<0.020	<0.020	<0.020	--		
EA029-C: Sulfur Trail										
KCl Extractable Sulfur (23Ce)	% S	0.02	----	0.057	0.043	0.046	0.042	----		
Peroxide Sulfur (23De)	% S	0.02	----	0.160	0.113	0.097	0.110	----		
Peroxide Oxidisable Sulfur (23E)	% S	0.02	----	0.103	0.070	0.051	0.068	----		
acidity - Peroxide Oxidisable Sulfur (a-23E)	mole H+ / t	10	----	64	44	32	43	----		
EA029-D: Calcium Values										
KCl Extractable Calcium (23Wh)	% Ca	0.02	----	0.171	0.182	0.188	0.173	----		
Peroxide Calcium (23Wb)	% Ca	0.02	----	2.69	7.43	6.98	8.67	----		
Acid Reacted Calcium (23X)	% Ca	0.02	----	2.52	7.25	6.80	8.50	----		
acidity - Acid Reacted Calcium (a-23X)	mole H+ / t	10	----	1260	3620	3390	4240	----		
sulfidic - Acid Reacted Calcium (s-23X)	% S	0.02	----	2.02	5.80	5.44	6.80	----		
EA029-E: Magnesium Values										
KCl Extractable Magnesium (23Sm)	% Mg	0.02	----	0.043	0.040	0.045	0.043	----		
Peroxide Magnesium (23Tm)	% Mg	0.02	----	0.110	0.224	0.201	0.191	----		
Acid Reacted Magnesium (23U)	% Mg	0.02	----	0.067	0.184	0.155	0.148	----		
Acidity - Acid Reacted Magnesium (a-23U)	mole H+ / t	10	----	55	151	128	122	----		
sulfidic - Acid Reacted Magnesium (s-23U)	% S	0.02	----	0.089	0.242	0.205	0.196	----		
EA029-F: Excess Acid Neutralising Capacity										
Excess Acid Neutralising Capacity (23Q)	% CaCO3	0.02	----	6.16	17.9	17.9	20.1	----		
acidity - Excess Acid Neutralising Capacity (a-23Q)	mole H+ / t	10	----	1230	3580	3570	4010	----		
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	% S	0.02	----	1.97	5.74	5.72	6.42	----		
EA029-H: Acid Base Accounting										
ANC Fineness Factor		0.5	----	1.5	1.5	1.5	1.5	----		
Net Acidity (sulfur units)	% S	0.02	----	<0.02	<0.02	<0.02	<0.02	----		
Net Acidity (acidity units)	mole H+ / t	10	----	<10	<10	<10	<10	----		
Liming Rate	kg CaCO3/t	1	----	<1	<1	<1	<1	----		
Net Acidity excluding ANC (sulfur units)	% S	0.02	----	0.10	0.07	0.05	0.07	----		
Net Acidity excluding ANC (acidity units)	mole H+ / t	10	----	64	44	32	43	----		
Liming Rate excluding ANC	kg CaCO3/t	1	----	5	3	2	3	----		
EA055: Moisture Content (Dried @ 105-110°C)										
Moisture Content	%	1	22.2	29.0	24.3	22.2	22.4	27.9		
EA150: Particle Sizing										
+75µm	%	1	98	97	97	98	98	97		
+150µm	%	1	91	91	90	94	91	93		
+300µm	%	1	17	45	56	44	50	53		
+425µm	%	1	6	39	51	34	45	43		
+600µm	%	1	4	36	49	29	42	39		
+1180µm	%	1	3	34	47	20	39	34		
+2.36mm	%	1	2	31	44	11	35	28		
+4.75mm	%	1	2	28	39	4	30	22		
+9.5mm	%	1	<1	24	25	<1	24	12		
+19.0mm	%	1	<1	20	7	<1	19	<1		
+37.5mm	%	1	<1	<1	<1	<1	<1	<1		
+75.0mm	%	1	<1	<1	<1	<1	<1	<1		
EA150: Soil Classification based on Particle Size										
Clay (<2 µm)	%	1	2	3	2	2	1	3		
Silt (2-60 µm)	%	1	<1	<1	1	<1	1	<1		
Sand (0.06-2.00 mm)	%	1	95	65	52	84	62	67		
Gravel (>2mm)	%	1	3	32	45	14	36	30		
Cobbles (>6cm)	%	1	<1	<1	<1	<1	<1	<1		
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES										
Aluminium	mg/kg	50	780	3810	4550	2790	1910	2400		
Iron	mg/kg	50	2060	10900	12900	7410	8330	10200		
EG005(ED093)T: Total Metals by ICP-AES										
Barium	mg/kg	10	<10	10	10	10	10	20		
Beryllium	mg/kg	1	<1	<1	<1	<1	<1	<1		
Molybdenum	mg/kg	2	<2	<2	<2	<2	<2	<2		
Tin	mg/kg	5	<5	<5	<5	<5	<5	<5		
Thallium	mg/kg	5	<5	<5	<5	<5	<5	<5		
EG020-SD: Total Metals in Sediments by ICPMS										
Antimony	mg/kg	0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2.00	2.00
Arsenic	mg/kg	1	3.95	6.81	5.04	5.36	4.94	5.25	20.00	20.00
Cadmium	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.50	1.50
Chromium	mg/kg	1	4.4	22.8	10.4	6.7	5.7	5.6	80.00	80.00
Copper	mg/kg	1	1.4	8.0	15.1	9.8	5.2	3.8	65.00	65.00
Cobalt	mg/kg	0.5	0.6	33.6	6.5	5.6	3.8	3.1		
Lead	mg/kg	1	1.2	5.2	6.4	5.7	3.5	5.1	50.00	50.00
Manganese	mg/kg	10	11	118	50	28	26	20		
Nickel	mg/kg	1	1.4	14.4	10.4	6.4	5.3	5.4	21.00	21.00
Selenium	mg/kg	0.1	0.3	0.5	0.7	0.7	0.6	0.5		

Appendix B Core Logs and Photos

Sample Location	Date	Core Depth (below seabed)	Subsamples Taken	Sample Names	Notes	Photos and Description
N1	20/1/22	1m	0-0.6m 0.6-1.0m	N1a N1b (hold)	<p>Vibrocore method (with diver). Core taken in sand patch between seagrass.</p> <p>Sand with penetration to 1m achieved.</p> <p>Darker sand layer from 0.6-1m (was not tested due to findings of clean sand above).</p>	 <p>N1a – Sand. Fine to Medium Grained. Brown with some Grey, Black. Moderate Grading. Moist. No odour.</p> <p>N1b - Sand. Fine to Medium Grained. Grey/Black with some Brown. Moderate Grading. Moist. No odour.</p>

Sample Location	Date	Core Depth (below seabed)	Subsamples Taken	Sample Names	Notes	Photos and Description
N2	20/1/22	0.5m	0-0.3m 0.3-0.5m	N2a N2b (hold)	<p>Vibrocore method (with diver). Core taken in sand patch between seagrass.</p> <p>Lots of shell rubble and small rocks. Clay layer reached at 0.3m and refusal reached at 0.5m.</p>	 <p>N2</p>  <p>N2a</p>  <p>N2b</p> <p>N2a – Sand and Clay, Gravel. Brown with some Black and Grey. Moderate Grading. Moist. No odour. N2b – Clay. Fine. Brown with some Grey and Black. Well Graded. Moist. No odour.</p>
N3	20/1/22	0.2m	0-0.2m	N3	<p>Vibrocore method (with diver). Refusal reached quickly. Multiple cores attempted at location with similar result. Lots of rock rubble and seagrass present.</p>	 <p>N3</p> <p>Sand and Gravel. Brown with some Grey, Black. Poor Grading. Moist. No odour.</p>

Sample Location	Date	Core Depth (below seabed)	Subsamples Taken	Sample Names	Notes	Photos and Description
N4	20/1/22	0.3m	0-0.3m	N4	Diver coring method (hand core). High level of shell and rock rubble off rock shelf. Refusal reached early.	 <p>Sand and Clay, Silt and Gravel. Brown with some Grey and Black. Poor Grading. Moist. No odour.</p>
N5	20/1/22	0.3m	0-0.3m	N5	Diver coring method (hand core). High level of shell and rock rubble off rock shelf. Refusal reached early.	 <p>Sand and Silt, Gravel. Brown with some Grey. Moist. No odour.</p>
N6	20/1/22	0.3m	0-0.3m	N6	Diver coring method (hand core). High level of shell and rock rubble off rock shelf. Refusal reached early.	 <p>Sand and Gravel. Brown with some Grey, Black and Yellow. Moderate Grading. Moist.</p>



Appendix C
Original Laboratory Results and Chain of
Custody



CHAIN OF CUSTODY

ALS Laboratory - please tick →

DUCKLAKE 21 Burns Road, Pascoe SA 5095
Ph: 08 8350 0800 E: adelaide@alsglobal.com
GREGGARS 2 Bth Street, Sturt GLD 4033
Ph: 07 3200 7221 E: samp@sturt@alsglobal.com
DELUSTONE 48 Callendar Drive, Chirn QLD 4650
Ph: 07 7471 5000 E: gordon@alsglobal.com

DIAMOND 70 Hassler Road, Kennerly QLD 4740
Ph: 07 4944 0177 E: mackay@alsglobal.com
DRIELBOURNE 24 Werrall Road, Springs VIC 3171
Ph: 03 8610 9600 E: samples@spring@alsglobal.com
DUNDEE 123 Sydney Road, Madaya NSW 2350
Ph: 02 6372 6735 E: madaya@alsglobal.com
DUNEDIN 277-289 Woodcock Road, Smithfield NSW 2164
Ph: 02 8784 4555 E: samples_syd@alsglobal.com
DUNEDIN 15/16 44.5 Dorrin Court, Dorrin QLD 4415
Ph: 07 4795 0500 E: samples_dun@alsglobal.com
DUNEDIN 69 Kenney Street, Wollongong NSW 2500
Ph: 02 4223 3128 E: wollongong@alsglobal.com

CLIENT: **Advisian Pty Ltd** TURNAROUND REQUIREMENTS: Standard TAT (last due date): 5 days Non Standard or urgent TAT (last due date):

OFFICE: **Newcastle** PROJECT NO: **311015-0219** ALS QUOTE NO.: **SY09121 V2**

ORDER NUMBER: **NA** PURCHASE ORDER NO.: **NA** COUNTRY OF ORIGIN: **Australia**

PROJECT MANAGER: **Katie Newton** CONTRACT PH: **0425 325 410** RELINQUISHED BY: **Katie Newton** DATE/TIME: **20/1/22**

SAMPLER: **Katie Newton** SAMPLER MOBILE: **0425 325 410** EDD FORMAT (or default): **Yes** RECEIVED BY: **[Signature]** DATE/TIME: **20/1/22 1530**

COC Emailed to ALS? **Yes** Email Reports to: **katie.newton@advisian.com** Email Invoice to (will default to PMI if no other addresses are listed): **K. Newton**

COC SEQUENCE NUMBER (Circle)	RECEIVED BY	DATE/TIME
1	[Signature]	20/1/22 1530
2	[Signature]	20/1/22 1530
3	[Signature]	20/1/22 1530
4	[Signature]	20/1/22 1530
5	[Signature]	20/1/22 1530
6	[Signature]	20/1/22 1530
7	[Signature]	20/1/22 1530

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: **Marine Sediments. Please FREEZE and HOLD ALL REMAINING SAMPLE from each jar in case of potential future analysis.**

LAB ID	SAMPLE ID	DATE / TIME	MATRIX	CONTAINER INFORMATION (refer to codes below)	TOTAL BOTTLES	ANALYSIS REQUIRED INCLUDING SUTES (NB: Sute Codes must be listed to attract suite price) When Metals are required, specify Total (unfiltered bottle required) or Dissolved (dissolved bottle required)	Additional Information Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	N1	20/01/2022	S	1 x plastic bag, 3 x jar	4	EA150H EP003 EA055-103 EN020D EA003 EN020PR EA029 SD-03	
	N2	20/01/2022	S	2 x plastic bag, 3 x jar	5	X X X X X X X	
	N3	20/01/2022	S	2 x plastic bag, 3 x jar	5	X X X X X X X	
	N4	20/01/2022	S	2 x plastic bag, 3 x jar	5	X X X X X X X	
	N5	20/01/2022	S	2 x plastic bag, 3 x jar	5	X X X X X X X	
	N6	20/01/2022	S	1 x plastic bag, 3 x jar	4	X X X X	
	N25 - HOP	4	S	1 bag + 2 jar	3		
	N16 - HOP	4	S	11	3		
TOTAL					28		

Water Container Codes: P = Unpreserved Plastic; N = Nitro Preserved Plastic; DRG = Nitro Preserved CRG; SH = Sodium Hydroxide/CRG Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airtight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisphosphate Preserved; VS = VOA Vial Sulfuric Preserved; AV - Airtight Unpreserved Vial; SG = Sulfuric Preserved Amber Glass; H = HCl Preserved Plastic; HS = HCl Preserved Specimen bottle; SP = Sulfuric Preserved Plastic; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottle; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulfuric Soils; B = Unpreserved Bag; LI = Lungs Incubation Preserved Bottles; STI = Sterile Sodium Trisulfate Preserved Bottles.

Environmental Division
Wollongong
Work Order Reference
EW2200300



Printed on 12/01/2022



CHAIN OF CUSTODY

ALS Laboratory, please refer to →

DATE/LABOUR: 21 Burma Road, Potts Point NSW 1585
Ph: 02 9559 0890 E: sales@als.com.au
LABORATORY: 2 BVA Street, Darling QLD 4033
Ph: 07 3243 7222 E: samples@als.com.au
DGLABSTONE 46 Callammond Drive, Callon QLD 4690
Ph: 07 7471 5550 E: galestone@als.com.au

DUNDEE 76 Harbour Road, Mackay QLD 4740
Ph: 07 4644 0177 E: mackay@als.com.au
DUNDEE SOURCE 24 Westall Road, Springvale VIC 3171
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DUNDEE 128 Sydney Road, Mangrove NSW 2250
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DUNDEE 10 Road Way, Malaga WA 6150
Ph: 08 9208 7556 E: samples@als.com.au

DUNDEE 27-289 Woodpark Road, Shellharbour NSW 2514
Ph: 02 9784 4555 E: samples@als.com.au
DUNDEE 14-15 Derrin Court, Baulk Hills NSW 2148
Ph: 07 4795 0900 E: samples@als.com.au
DUNDEE 99 Kenny Street, Wagga Wagga NSW 2650
Ph: 02 4223 3125 E: wagga@als.com.au

CLIENT: Advisian Pty Ltd

OFFICE: Newcastle

PROJECT: Narooma Wharf Upgrade

ORDER NUMBER: NA PURCHASE ORDER NO.: NA

PROJECT MANAGER: Katie Newton

SAMPLER: Katie Newton

COC Emailed to ALS? Yes

Email Reports to: katie.newton@advisian.com

Email Invoice to (will default to PM if no other addresses are listed): K. Newton

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Marine Sediments, Please FREEZE and HOLD ALL REMAINING SAMPLE from each Jar in case of potential future analysis.

TURNOAROUND REQUIREMENTS: (Standard TAT may be longer for some tests)
 Standard TAT (last due date):
 Non Standard or urgent TAT (last due date):

5 days

FOR LABORATORY USE ONLY (Circle)

Coldbody Seal Intact? Yes No N/A

Free Ice / Frozen Ice Trunks present upon receipt? Yes No N/A

Random Sample Temperature on Receipt: 0-7 °C

Other comment:

RELINQUISHED BY: Katie Newton

DATE/TIME: 20/1/22

RECEIVED BY: [Signature]

DATE/TIME: 20/1/22 1530

RELINQUISHED BY:

DATE/TIME:

RECEIVED BY:

DATE/TIME:

LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	ANALYSIS REQUIRED INCLUDING SUITES (NB, Suite Codes must be listed to attract suite price)	Additional Information
	N1	20/01/2022	S	1 x plastic bag, 3 x Jar	4	EG005T(solids) SD-02 EPO80-SD EP071-SD EP090(solids) EN34 EA002 EK058G (solids)	
	N2	20/01/2022	S	2 x plastic bag, 3 x Jar	5		
	N3	20/01/2022	S	2 x plastic bag, 3 x Jar	5		
	N4	20/01/2022	S	2 x plastic bag, 3 x Jar	5		
	N5	20/01/2022	S	2 x plastic bag, 3 x Jar	5		
	N6	20/01/2022	S	1 x plastic bag, 3 x Jar	4		
TOTAL							

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cl Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airtight Unpreserved Plastic; V = VOA Vial HCl Preserved; VA = VOA Vial Sodium Disulphate Preserved; VS = VOA Vial Sulphur Preserved; AV = Airtight Unpreserved Vial; SG = Sulphur Preserved Amber Glass; H = HCl Preserved Plastic; HS = HCl Preserved Speciation bottle; GP = Gullonic Preserved Plastic; F = Formaldhyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottle; ST = Sterile Sealer; ASS = Plastic Bag for Acid Sulphate Solids; B = Unpreserved Bag; LI = Lugsis Iodine Preserved Bottle; STT = Sterile Sodium Thiosulfate Preserved Bottle.

CERTIFICATE OF ANALYSIS

Work Order : **EW2200300**
Client : **ADVISIAN PTY LTD**
Contact : **MS KATIE NEWTON**
Address : **8-14 TELFORD STREET**
NEWCASTLE EAST NSW, AUSTRALIA 2300
Telephone : **----**
Project : **Narooma Wharf Upgrade**
Order number : **----**
C-O-C number : **----**
Sampler : **Client, KATIE NEWTON**
Site : **----**
Quote number : **SY/091/21 v2**
No. of samples received : **8**
No. of samples analysed : **6**

Page : 1 of 20
Laboratory : Environmental Division NSW South Coast
Contact : Aneta Prosaroski
Address : 1/19 Ralph Black Dr, North Wollongong 2500 NSW Australia
Telephone : 02 42253125
Date Samples Received : 20-Jan-2022 15:57
Date Analysis Commenced : 24-Jan-2022
Issue Date : 08-Feb-2022 10:01



Accreditation No. 825
 Accredited for compliance with
 ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
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Vincent Emerton-Bell	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP090-Organotin: Sample 'N2' shows poor matrix spike recovery for MBT due to matrix interference.
- EP202: Poor matrix spike recovery for particular compounds due to matrix interferences. Confirmed by re preparation and re analysis.
- **Analytical work for this work order will be conducted at ALS Sydney.**
- EA150H: Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1 2006 was not requested by the client. Typical sediment SPD values used for calculations and consequently NATA endorsement does not apply to hydrometer results.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP068: Where reported, Total OCP is the sum of the reported concentrations of all Organochlorine Pesticides at or above LOR.
- EP080-SD: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP131A: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5
- EP131B : Particular samples required dilution prior to extraction due to matrix interferences. LOR values have been adjusted accordingly.
- ASS: EA029 (SPOCAS): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m³ in-situ soil, multiply reported results x wet bulk density of soil in t/m³.
- ASS: EA003 (NATA Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N1	N2	N3	N4	N5
Sampling date / time				20-Jan-2022 00:00					
Compound	CAS Number	LOR	Unit	EW2200300-001	EW2200300-002	EW2200300-003	EW2200300-004	EW2200300-005	
				Result	Result	Result	Result	Result	
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit	8.4	8.8	8.7	8.8	8.7	
EA003 :pH (field/fox)									
pH (F)	----	0.1	pH Unit	----	9.0	8.9	9.0	8.8	
pH (Fox)	----	0.1	pH Unit	----	6.7	6.5	6.5	6.5	
Reaction Rate	----	1	Reaction Unit	----	2	2	2	2	
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit	----	9.3	9.5	9.7	9.7	
pH OX (23B)	----	0.1	pH Unit	----	8.9	8.8	8.8	8.6	
EA029-B: Acidity Trail									
Titrateable Actual Acidity (23F)	----	2	mole H+ / t	----	<2	<2	<2	<2	
Titrateable Peroxide Acidity (23G)	----	2	mole H+ / t	----	<2	<2	<2	<2	
Titrateable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	<2	<2	<2	<2	
sulfidic - Titrateable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	<0.020	<0.020	<0.020	<0.020	
sulfidic - Titrateable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	<0.020	<0.020	<0.020	<0.020	
sulfidic - Titrateable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	<0.020	<0.020	<0.020	<0.020	
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	0.057	0.043	0.046	0.042	
Peroxide Sulfur (23De)	----	0.020	% S	----	0.160	0.113	0.097	0.110	
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	0.103	0.070	0.051	0.068	
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	64	44	32	43	
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	0.171	0.182	0.188	0.173	
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	2.69	7.43	6.98	8.67	
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	2.52	7.25	6.80	8.50	
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	1260	3620	3390	4240	
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	2.02	5.80	5.44	6.80	
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	0.043	0.040	0.045	0.043	
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	0.110	0.224	0.201	0.191	
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	0.067	0.184	0.155	0.148	
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	55	151	128	122	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N1	N2	N3	N4	N5
Sampling date / time				20-Jan-2022 00:00					
Compound	CAS Number	LOR	Unit	EW2200300-001	EW2200300-002	EW2200300-003	EW2200300-004	EW2200300-005	
				Result	Result	Result	Result	Result	
EA029-E: Magnesium Values - Continued									
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	0.089	0.242	0.205	0.196	
EA029-F: Excess Acid Neutralising Capacity									
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	----	6.16	17.9	17.9	20.1	
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	----	1230	3580	3570	4010	
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	----	1.97	5.74	5.72	6.42	
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-	----	1.5	1.5	1.5	1.5	
Net Acidity (sulfur units)	----	0.02	% S	----	<0.02	<0.02	<0.02	<0.02	
Net Acidity (acidity units)	----	10	mole H+ / t	----	<10	<10	<10	<10	
Liming Rate	----	1	kg CaCO3/t	----	<1	<1	<1	<1	
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	0.10	0.07	0.05	0.07	
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	64	44	32	43	
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	5	3	2	3	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	22.2	29.0	24.3	22.2	22.4	
EA150: Particle Sizing									
+75µm	----	1	%	98	97	97	98	98	
+150µm	----	1	%	91	91	90	94	91	
+300µm	----	1	%	17	45	56	44	50	
+425µm	----	1	%	6	39	51	34	45	
+600µm	----	1	%	4	36	49	29	42	
+1180µm	----	1	%	3	34	47	20	39	
+2.36mm	----	1	%	2	31	44	11	35	
+4.75mm	----	1	%	2	28	39	4	30	
+9.5mm	----	1	%	<1	24	25	<1	24	
+19.0mm	----	1	%	<1	20	7	<1	19	
+37.5mm	----	1	%	<1	<1	<1	<1	<1	
+75.0mm	----	1	%	<1	<1	<1	<1	<1	
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%	2	3	2	2	1	
Silt (2-60 µm)	----	1	%	<1	<1	1	<1	1	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N1	N2	N3	N4	N5
Sampling date / time					20-Jan-2022 00:00				
Compound	CAS Number	LOR	Unit		EW2200300-001	EW2200300-002	EW2200300-003	EW2200300-004	EW2200300-005
					Result	Result	Result	Result	Result
EA150: Soil Classification based on Particle Size - Continued									
Sand (0.06-2.00 mm)	----	1	%		95	65	52	84	62
Gravel (>2mm)	----	1	%		3	32	45	14	36
Cobbles (>6cm)	----	1	%		<1	<1	<1	<1	<1
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		780	3810	4550	2790	1910
Iron	7439-89-6	50	mg/kg		2060	10900	12900	7410	8330
EG005(ED093)T: Total Metals by ICP-AES									
Barium	7440-39-3	10	mg/kg		<10	10	10	10	10
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<2	<2	<2
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	<5
Thallium	7440-28-0	5	mg/kg		<5	<5	<5	<5	<5
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg		3.95	6.81	5.04	5.36	4.94
Cadmium	7440-43-9	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg		4.4	22.8	10.4	6.7	5.7
Copper	7440-50-8	1.0	mg/kg		1.4	8.0	15.1	9.8	5.2
Cobalt	7440-48-4	0.5	mg/kg		0.6	33.6	6.5	5.6	3.8
Lead	7439-92-1	1.0	mg/kg		1.2	5.2	6.4	5.7	3.5
Manganese	7439-96-5	10	mg/kg		11	118	50	28	26
Nickel	7440-02-0	1.0	mg/kg		1.4	14.4	10.4	6.4	5.3
Selenium	7782-49-2	0.1	mg/kg		0.3	0.5	0.7	0.7	0.6
Silver	7440-22-4	0.1	mg/kg		0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	7440-62-2	2.0	mg/kg		4.7	17.3	22.4	10.9	8.4
Zinc	7440-66-6	1.0	mg/kg		4.0	30.9	30.7	266	29.9
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg		0.3	0.1	0.1	0.1	0.3
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		0.3	0.1	0.1	0.1	0.3



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N1	N2	N3	N4	N5
Sampling date / time				20-Jan-2022 00:00					
Compound	CAS Number	LOR	Unit	EW2200300-001	EW2200300-002	EW2200300-003	EW2200300-004	EW2200300-005	
				Result	Result	Result	Result	Result	
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%	0.15	0.20	0.22	0.16	0.26	
EP068C: Triazines									
Atrazine	1912-24-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	
Simazine	122-34-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	
EP069: Toxaphene									
Toxaphene	8001-35-2	2	mg/kg	<2	<2	<2	<2	<2	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	3	mg/kg	<6	<6	<6	<6	<6	
>C16 - C34 Fraction	----	3	mg/kg	35	42	50	14	26	
>C34 - C40 Fraction	----	5	mg/kg	8	9	15	<6	9	
>C10 - C40 Fraction (sum)	----	3	mg/kg	43	51	65	14	35	
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<6	<6	<6	<6	<6	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C10 - C14 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C15 - C28 Fraction	----	3	mg/kg	29	36	40	11	20	
C29 - C36 Fraction	----	5	mg/kg	11	11	20	<6	11	
^ C10 - C36 Fraction (sum)	----	3	mg/kg	40	47	60	11	31	
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons									
C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	<3	<3	<3	
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	<3.0	<3.0	<3.0	<3.0	<3.0	
EP080-SD: BTEXN									
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	<1	<1	<1	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N1	N2	N3	N4	N5
Sampling date / time					20-Jan-2022 00:00				
Compound	CAS Number	LOR	Unit	EW2200300-001	EW2200300-002	EW2200300-003	EW2200300-004	EW2200300-005	
				Result	Result	Result	Result	Result	
EP090: Organotin Compounds - Continued									
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	<1	<1	<1	
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	<0.5	
EP130A: Organophosphorus Pesticides (Ultra-trace)									
Bromophos-ethyl	4824-78-6	10	µg/kg	<10	<10	<10	<10	<10	
Carbophenothion	786-19-6	10	µg/kg	<10	<10	<10	<10	<10	
Chlorfenvinphos (E)	18708-86-6	10.0	µg/kg	<10.0	<10.0	<10.0	<10.0	<10.0	
Chlorfenvinphos (Z)	18708-87-7	10	µg/kg	<10	<10	<10	<10	<10	
Chlorpyrifos	2921-88-2	10	µg/kg	<10	<10	<10	<10	<10	
Chlorpyrifos-methyl	5598-13-0	10	µg/kg	<10	<10	<10	<10	<10	
Demeton-S-methyl	919-86-8	10	µg/kg	<10	<10	<10	<10	<10	
Diazinon	333-41-5	10	µg/kg	<10	<10	<10	<10	<10	
Dichlorvos	62-73-7	10	µg/kg	<10	<10	<10	<10	<10	
Dimethoate	60-51-5	10	µg/kg	<10	<10	<10	<10	<10	
Ethion	563-12-2	10	µg/kg	<10	<10	<10	<10	<10	
Fenamiphos	22224-92-6	10	µg/kg	<10	<10	<10	<10	<10	
Fenthion	55-38-9	10	µg/kg	<10	<10	<10	<10	<10	
Malathion	121-75-5	10	µg/kg	<10	<10	<10	<10	<10	
Azinphos Methyl	86-50-0	10	µg/kg	<10	<10	<10	<10	<10	
Monocrotophos	6923-22-4	10	µg/kg	<10	<10	<10	<10	<10	
Parathion	56-38-2	10	µg/kg	<10	<10	<10	<10	<10	
Parathion-methyl	298-00-0	10	µg/kg	<10	<10	<10	<10	<10	
Pirimphos-ethyl	23505-41-1	10	µg/kg	<10	<10	<10	<10	<10	
Prothiofos	34643-46-4	10	µg/kg	<10	<10	<10	<10	<10	
EP131A: Organochlorine Pesticides									
Aldrin	309-00-2	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
alpha-BHC	319-84-6	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
beta-BHC	319-85-7	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
delta-BHC	319-86-8	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
4.4`-DDD	72-54-8	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
4.4`-DDE	72-55-9	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
4.4`-DDT	50-29-3	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Dieldrin	60-57-1	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
alpha-Endosulfan	959-98-8	0.50	µg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N1	N2	N3	N4	N5
Sampling date / time					20-Jan-2022 00:00				
Compound	CAS Number	LOR	Unit		EW2200300-001	EW2200300-002	EW2200300-003	EW2200300-004	EW2200300-005
					Result	Result	Result	Result	Result
EP131A: Organochlorine Pesticides - Continued									
beta-Endosulfan	33213-65-9	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Endosulfan sulfate	1031-07-8	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
^ Endosulfan (sum)	115-29-7	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Endrin	72-20-8	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Endrin aldehyde	7421-93-4	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Endrin ketone	53494-70-5	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Heptachlor	76-44-8	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Heptachlor epoxide	1024-57-3	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
Hexachlorobenzene (HCB)	118-74-1	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
gamma-BHC	58-89-9	0.25	µg/kg		<0.25	<0.25	<0.25	<0.25	<0.25
Methoxychlor	72-43-5	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
cis-Chlordane	5103-71-9	0.25	µg/kg		<0.25	<0.25	<0.25	<0.25	<0.25
trans-Chlordane	5103-74-2	0.25	µg/kg		<0.25	<0.25	<0.25	<0.25	<0.25
^ Total Chlordane (sum)	----	0.25	µg/kg		<0.25	<0.25	<0.25	<0.25	<0.25
Oxychlordane	27304-13-8	0.50	µg/kg		<0.50	<0.50	<0.50	<0.50	<0.50
EP131B: Polychlorinated Biphenyls (as Aroclors)									
^ Total Polychlorinated biphenyls	----	5.0	µg/kg		<15.6	<15.6	<15.6	<15.6	<15.6
Aroclor 1016	12674-11-2	5.0	µg/kg		<15.6	<15.6	<15.6	<15.6	<15.6
Aroclor 1221	11104-28-2	5.0	µg/kg		<15.6	<15.6	<15.6	<15.6	<15.6
Aroclor 1232	11141-16-5	5.0	µg/kg		<15.6	<15.6	<15.6	<15.6	<15.6
Aroclor 1242	53469-21-9	5.0	µg/kg		<15.6	<15.6	<15.6	<15.6	<15.6
Aroclor 1248	12672-29-6	5.0	µg/kg		<15.6	<15.6	<15.6	<15.6	<15.6
Aroclor 1254	11097-69-1	5.0	µg/kg		<15.6	<15.6	<15.6	<15.6	<15.6
Aroclor 1260	11096-82-5	5.0	µg/kg		<15.6	<15.6	<15.6	<15.6	<15.6
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg		<5	<5	6	<5	<5
2-Methylnaphthalene	91-57-6	5	µg/kg		<5	<5	<5	<5	<5
Acenaphthylene	208-96-8	4	µg/kg		<4	<4	<4	<4	6
Acenaphthene	83-32-9	4	µg/kg		<4	<4	<4	<4	5
Fluorene	86-73-7	4	µg/kg		<4	<4	<4	<4	9
Phenanthrene	85-01-8	4	µg/kg		<4	<4	<4	4	90
Anthracene	120-12-7	4	µg/kg		<4	<4	<4	<4	9
Fluoranthene	206-44-0	4	µg/kg		<4	<4	4	11	135
Pyrene	129-00-0	4	µg/kg		<4	<4	<4	7	79



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N1	N2	N3	N4	N5
Sampling date / time				20-Jan-2022 00:00					
Compound	CAS Number	LOR	Unit	EW2200300-001	EW2200300-002	EW2200300-003	EW2200300-004	EW2200300-005	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	<4	4	31	
Chrysene	218-01-9	4	µg/kg	<4	<4	<4	4	29	
Benzo(b+)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	<4	4	24	
Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	<4	<4	8	
Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	<4	<4	10	
Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	<4	<4	10	
Perylene	198-55-0	4	µg/kg	<4	<4	<4	<4	<4	
Benzo(g,h,i)perylene	191-24-2	4	µg/kg	<4	<4	<4	<4	4	
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	<4	<4	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	<4	<4	5	
Coronene	191-07-1	5	µg/kg	<5	<5	<5	<5	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	10	34	454	
EP201: Carbamate Pesticides by LCMS									
Oxamyl	23135-22-0	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Methomyl	16752-77-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
3-Hydroxy Carbofuran	16655-82-6	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Aldicarb	116-06-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Bendiocarb	22781-23-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Thiodicarb	59669-26-0	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Carbofuran	1563-66-2	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Carbaryl	63-25-2	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Methiocarb	2032-65-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
EP202A: Phenoxyacetic Acid Herbicides by LCMS									
4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
2,4-DB	94-82-6	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Dicamba	1918-00-9	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Mecoprop	93-65-2	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
MCPA	94-74-6	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
2,4-DP	120-36-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
2,4-D	94-75-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Triclopyr	55335-06-3	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
2,4,5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
2,4,5-T	93-76-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
MCPB	94-81-5	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N1	N2	N3	N4	N5
Sampling date / time				20-Jan-2022 00:00					
Compound	CAS Number	LOR	Unit	EW2200300-001	EW2200300-002	EW2200300-003	EW2200300-004	EW2200300-005	
				Result	Result	Result	Result	Result	
EP202A: Phenoxyacetic Acid Herbicides by LCMS - Continued									
Picloram	1918-02-1	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Clopyralid	1702-17-6	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%	104	102	99.5	102	104	
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%	83.6	81.4	80.3	95.0	104	
EP069: Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%	120	129	112	121	112	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	92.6	110	102	97.1	92.4	
Toluene-D8	2037-26-5	0.2	%	78.7	93.4	88.6	87.8	82.1	
4-Bromofluorobenzene	460-00-4	0.2	%	88.6	101	96.6	94.9	90.6	
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%	54.2	65.9	63.4	54.0	90.9	
EP130S: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	10	%	62.0	40.8	56.5	74.5	43.0	
EP131S: OC Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.50	%	58.1	41.3	45.8	71.8	43.9	
EP131T: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.5	%	65.6	46.9	68.8	96.9	62.5	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	82.0	87.0	79.4	81.9	81.9	
Anthracene-d10	1719-06-8	10	%	107	112	91.7	98.1	100.0	
4-Terphenyl-d14	1718-51-0	10	%	82.2	91.7	84.5	80.0	80.7	
EP201S: Carbamate Surrogate									
4-Bromo-3,5-dimethylphenyl-N-methylcarbamate	672-99-1	0.02	%	80.0	76.6	96.8	96.9	93.0	
EP202S: Phenoxyacetic Acid Herbicide Surrogate									
2,4-Dichlorophenyl Acetic Acid	19719-28-9	0.02	%	53.0	47.4	48.0	53.3	59.9	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Sample ID		N6	----	----	----	----
		Sampling date / time		20-Jan-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EW2200300-006	-----	-----	-----	-----
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.6	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	27.9	----	----	----	----
EA150: Particle Sizing								
+75µm	----	1	%	97	----	----	----	----
+150µm	----	1	%	93	----	----	----	----
+300µm	----	1	%	53	----	----	----	----
+425µm	----	1	%	43	----	----	----	----
+600µm	----	1	%	39	----	----	----	----
+1180µm	----	1	%	34	----	----	----	----
+2.36mm	----	1	%	28	----	----	----	----
+4.75mm	----	1	%	22	----	----	----	----
+9.5mm	----	1	%	12	----	----	----	----
+19.0mm	----	1	%	<1	----	----	----	----
+37.5mm	----	1	%	<1	----	----	----	----
+75.0mm	----	1	%	<1	----	----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	3	----	----	----	----
Silt (2-60 µm)	----	1	%	<1	----	----	----	----
Sand (0.06-2.00 mm)	----	1	%	67	----	----	----	----
Gravel (>2mm)	----	1	%	30	----	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----	----
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2400	----	----	----	----
Iron	7439-89-6	50	mg/kg	10200	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Barium	7440-39-3	10	mg/kg	20	----	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	----	----	----
Tin	7440-31-5	5	mg/kg	<5	----	----	----	----
Thallium	7440-28-0	5	mg/kg	<5	----	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	----	----	----	----
Arsenic	7440-38-2	1.00	mg/kg	5.25	----	----	----	----



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N6	----	----	----	----
Sampling date / time				20-Jan-2022 00:00	----	----	----	----	----
Compound	CAS Number	LOR	Unit	EW2200300-006	-----	-----	-----	-----	-----
				Result	----	----	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Cadmium	7440-43-9	0.1	mg/kg	<0.1	----	----	----	----	----
Chromium	7440-47-3	1.0	mg/kg	5.6	----	----	----	----	----
Copper	7440-50-8	1.0	mg/kg	3.8	----	----	----	----	----
Cobalt	7440-48-4	0.5	mg/kg	3.1	----	----	----	----	----
Lead	7439-92-1	1.0	mg/kg	5.1	----	----	----	----	----
Manganese	7439-96-5	10	mg/kg	20	----	----	----	----	----
Nickel	7440-02-0	1.0	mg/kg	5.4	----	----	----	----	----
Selenium	7782-49-2	0.1	mg/kg	0.5	----	----	----	----	----
Silver	7440-22-4	0.1	mg/kg	<0.1	----	----	----	----	----
Vanadium	7440-62-2	2.0	mg/kg	10.3	----	----	----	----	----
Zinc	7440-66-6	1.0	mg/kg	13.5	----	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg	<0.01	----	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	----	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	0.2	----	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.2	----	----	----	----	----
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%	0.27	----	----	----	----	----
EP068C: Triazines									
Atrazine	1912-24-9	0.05	mg/kg	<0.05	----	----	----	----	----
Simazine	122-34-9	0.05	mg/kg	<0.05	----	----	----	----	----
EP069: Toxaphene									
Toxaphene	8001-35-2	2	mg/kg	<2	----	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	3	mg/kg	<6	----	----	----	----	----
>C16 - C34 Fraction	----	3	mg/kg	36	----	----	----	----	----
>C34 - C40 Fraction	----	5	mg/kg	13	----	----	----	----	----
>C10 - C40 Fraction (sum)	----	3	mg/kg	49	----	----	----	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<6	----	----	----	----	----
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N6	----	----	----	----
Sampling date / time				20-Jan-2022 00:00	----	----	----	----	
Compound	CAS Number	LOR	Unit	EW2200300-006	-----	-----	-----	-----	
				Result	----	----	----	----	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons - Continued									
C6 - C9 Fraction	----	3	mg/kg	<3	----	----	----	----	
C10 - C14 Fraction	----	3	mg/kg	<3	----	----	----	----	
C15 - C28 Fraction	----	3	mg/kg	27	----	----	----	----	
C29 - C36 Fraction	----	5	mg/kg	15	----	----	----	----	
^ C10 - C36 Fraction (sum)	----	3	mg/kg	42	----	----	----	----	
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons									
C6 - C10 Fraction	C6_C10	3	mg/kg	<3	----	----	----	----	
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	<3.0	----	----	----	----	
EP080-SD: BTEXN									
Benzene	71-43-2	0.2	mg/kg	<0.2	----	----	----	----	
Toluene	108-88-3	0.2	mg/kg	<0.2	----	----	----	----	
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	----	----	----	----	
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	----	----	----	----	
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	----	----	----	----	
^ Total Xylenes	----	0.5	mg/kg	<0.5	----	----	----	----	
^ Sum of BTEX	----	0.2	mg/kg	<0.2	----	----	----	----	
Naphthalene	91-20-3	0.2	mg/kg	<0.2	----	----	----	----	
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg	<1	----	----	----	----	
Dibutyltin	1002-53-5	1	µgSn/kg	<1	----	----	----	----	
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	----	----	----	----	
EP130A: Organophosphorus Pesticides (Ultra-trace)									
Bromophos-ethyl	4824-78-6	10	µg/kg	<10	----	----	----	----	
Carbophenothion	786-19-6	10	µg/kg	<10	----	----	----	----	
Chlorfenvinphos (E)	18708-86-6	10.0	µg/kg	<10.0	----	----	----	----	
Chlorfenvinphos (Z)	18708-87-7	10	µg/kg	<10	----	----	----	----	
Chlorpyrifos	2921-88-2	10	µg/kg	<10	----	----	----	----	
Chlorpyrifos-methyl	5598-13-0	10	µg/kg	<10	----	----	----	----	
Demeton-S-methyl	919-86-8	10	µg/kg	<10	----	----	----	----	
Diazinon	333-41-5	10	µg/kg	<10	----	----	----	----	
Dichlorvos	62-73-7	10	µg/kg	<10	----	----	----	----	
Dimethoate	60-51-5	10	µg/kg	<10	----	----	----	----	
Ethion	563-12-2	10	µg/kg	<10	----	----	----	----	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N6	---	---	---	---
Sampling date / time				20-Jan-2022 00:00	---	---	---	---	---
Compound	CAS Number	LOR	Unit	EW2200300-006	-----	-----	-----	-----	-----
				Result	---	---	---	---	---
EP130A: Organophosphorus Pesticides (Ultra-trace) - Continued									
Fenamiphos	22224-92-6	10	µg/kg	<10	---	---	---	---	---
Fenthion	55-38-9	10	µg/kg	<10	---	---	---	---	---
Malathion	121-75-5	10	µg/kg	<10	---	---	---	---	---
Azinphos Methyl	86-50-0	10	µg/kg	<10	---	---	---	---	---
Monocrotophos	6923-22-4	10	µg/kg	<10	---	---	---	---	---
Parathion	56-38-2	10	µg/kg	<10	---	---	---	---	---
Parathion-methyl	298-00-0	10	µg/kg	<10	---	---	---	---	---
Pirimphos-ethyl	23505-41-1	10	µg/kg	<10	---	---	---	---	---
Prothiofos	34643-46-4	10	µg/kg	<10	---	---	---	---	---
EP131A: Organochlorine Pesticides									
Aldrin	309-00-2	0.50	µg/kg	<0.50	---	---	---	---	---
alpha-BHC	319-84-6	0.50	µg/kg	<0.50	---	---	---	---	---
beta-BHC	319-85-7	0.50	µg/kg	<0.50	---	---	---	---	---
delta-BHC	319-86-8	0.50	µg/kg	<0.50	---	---	---	---	---
4,4'-DDD	72-54-8	0.50	µg/kg	<0.50	---	---	---	---	---
4,4'-DDE	72-55-9	0.50	µg/kg	<0.50	---	---	---	---	---
4,4'-DDT	50-29-3	0.50	µg/kg	<0.50	---	---	---	---	---
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.50	µg/kg	<0.50	---	---	---	---	---
Dieldrin	60-57-1	0.50	µg/kg	<0.50	---	---	---	---	---
alpha-Endosulfan	959-98-8	0.50	µg/kg	<0.50	---	---	---	---	---
beta-Endosulfan	33213-65-9	0.50	µg/kg	<0.50	---	---	---	---	---
Endosulfan sulfate	1031-07-8	0.50	µg/kg	<0.50	---	---	---	---	---
^ Endosulfan (sum)	115-29-7	0.50	µg/kg	<0.50	---	---	---	---	---
Endrin	72-20-8	0.50	µg/kg	<0.50	---	---	---	---	---
Endrin aldehyde	7421-93-4	0.50	µg/kg	<0.50	---	---	---	---	---
Endrin ketone	53494-70-5	0.50	µg/kg	<0.50	---	---	---	---	---
Heptachlor	76-44-8	0.50	µg/kg	<0.50	---	---	---	---	---
Heptachlor epoxide	1024-57-3	0.50	µg/kg	<0.50	---	---	---	---	---
Hexachlorobenzene (HCB)	118-74-1	0.50	µg/kg	<0.50	---	---	---	---	---
gamma-BHC	58-89-9	0.25	µg/kg	<0.25	---	---	---	---	---
Methoxychlor	72-43-5	0.50	µg/kg	<0.50	---	---	---	---	---
cis-Chlordane	5103-71-9	0.25	µg/kg	<0.25	---	---	---	---	---
trans-Chlordane	5103-74-2	0.25	µg/kg	<0.25	---	---	---	---	---
^ Total Chlordane (sum)	---	0.25	µg/kg	<0.25	---	---	---	---	---



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N6	----	----	----	----
Sampling date / time				20-Jan-2022 00:00	----	----	----	----	
Compound	CAS Number	LOR	Unit	EW2200300-006	-----	-----	-----	-----	
				Result	----	----	----	----	
EP131A: Organochlorine Pesticides - Continued									
Oxychlorane	27304-13-8	0.50	µg/kg	<0.50	----	----	----	----	
EP131B: Polychlorinated Biphenyls (as Aroclors)									
^ Total Polychlorinated biphenyls	----	5.0	µg/kg	<15.6	----	----	----	----	
Aroclor 1016	12674-11-2	5.0	µg/kg	<15.6	----	----	----	----	
Aroclor 1221	11104-28-2	5.0	µg/kg	<15.6	----	----	----	----	
Aroclor 1232	11141-16-5	5.0	µg/kg	<15.6	----	----	----	----	
Aroclor 1242	53469-21-9	5.0	µg/kg	<15.6	----	----	----	----	
Aroclor 1248	12672-29-6	5.0	µg/kg	<15.6	----	----	----	----	
Aroclor 1254	11097-69-1	5.0	µg/kg	<15.6	----	----	----	----	
Aroclor 1260	11096-82-5	5.0	µg/kg	<15.6	----	----	----	----	
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg	<5	----	----	----	----	
2-Methylnaphthalene	91-57-6	5	µg/kg	<5	----	----	----	----	
Acenaphthylene	208-96-8	4	µg/kg	<4	----	----	----	----	
Acenaphthene	83-32-9	4	µg/kg	<4	----	----	----	----	
Fluorene	86-73-7	4	µg/kg	<4	----	----	----	----	
Phenanthrene	85-01-8	4	µg/kg	<4	----	----	----	----	
Anthracene	120-12-7	4	µg/kg	<4	----	----	----	----	
Fluoranthene	206-44-0	4	µg/kg	5	----	----	----	----	
Pyrene	129-00-0	4	µg/kg	<4	----	----	----	----	
Benz(a)anthracene	56-55-3	4	µg/kg	5	----	----	----	----	
Chrysene	218-01-9	4	µg/kg	17	----	----	----	----	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	10	----	----	----	----	
Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	----	----	----	----	
Benzo(e)pyrene	192-97-2	4	µg/kg	5	----	----	----	----	
Benzo(a)pyrene	50-32-8	4	µg/kg	5	----	----	----	----	
Perylene	198-55-0	4	µg/kg	<4	----	----	----	----	
Benzo(g,h,i)perylene	191-24-2	4	µg/kg	<4	----	----	----	----	
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	----	----	----	----	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	----	----	----	----	
Coronene	191-07-1	5	µg/kg	<5	----	----	----	----	
^ Sum of PAHs	----	4	µg/kg	47	----	----	----	----	
EP201: Carbamate Pesticides by LCMS									
Oxamyl	23135-22-0	0.02	mg/kg	<0.02	----	----	----	----	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	N6	----	----	----	----
Sampling date / time				20-Jan-2022 00:00	----	----	----	----	
Compound	CAS Number	LOR	Unit	EW2200300-006	-----	-----	-----	-----	
				Result	----	----	----	----	
EP201: Carbamate Pesticides by LCMS - Continued									
Methomyl	16752-77-5	0.02	mg/kg	<0.02	----	----	----	----	
3-Hydroxy Carbofuran	16655-82-6	0.02	mg/kg	<0.02	----	----	----	----	
Aldicarb	116-06-3	0.02	mg/kg	<0.02	----	----	----	----	
Bendiocarb	22781-23-3	0.02	mg/kg	<0.02	----	----	----	----	
Thiodicarb	59669-26-0	0.02	mg/kg	<0.02	----	----	----	----	
Carbofuran	1563-66-2	0.02	mg/kg	<0.02	----	----	----	----	
Carbaryl	63-25-2	0.02	mg/kg	<0.02	----	----	----	----	
Methiocarb	2032-65-7	0.02	mg/kg	<0.02	----	----	----	----	
EP202A: Phenoxyacetic Acid Herbicides by LCMS									
4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	----	----	----	----	
2,4-DB	94-82-6	0.02	mg/kg	<0.02	----	----	----	----	
Dicamba	1918-00-9	0.02	mg/kg	<0.02	----	----	----	----	
Mecoprop	93-65-2	0.02	mg/kg	<0.02	----	----	----	----	
MCPA	94-74-6	0.02	mg/kg	<0.02	----	----	----	----	
2,4-DP	120-36-5	0.02	mg/kg	<0.02	----	----	----	----	
2,4-D	94-75-7	0.02	mg/kg	<0.02	----	----	----	----	
Triclopyr	55335-06-3	0.02	mg/kg	<0.02	----	----	----	----	
2,4,5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	----	----	----	----	
2,4,5-T	93-76-5	0.02	mg/kg	<0.02	----	----	----	----	
MCPB	94-81-5	0.02	mg/kg	<0.02	----	----	----	----	
Picloram	1918-02-1	0.02	mg/kg	<0.02	----	----	----	----	
Clopyralid	1702-17-6	0.02	mg/kg	<0.02	----	----	----	----	
Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	----	----	----	----	
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%	116	----	----	----	----	
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%	88.0	----	----	----	----	
EP069: Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%	125	----	----	----	----	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	94.6	----	----	----	----	
Toluene-D8	2037-26-5	0.2	%	83.4	----	----	----	----	
4-Bromofluorobenzene	460-00-4	0.2	%	90.4	----	----	----	----	
EP090S: Organotin Surrogate									



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	N6	----	----	----	----
Sampling date / time			20-Jan-2022 00:00	----	----	----	----	
Compound	CAS Number	LOR	Unit	EW2200300-006	-----	-----	-----	-----
				Result	----	----	----	----
EP090S: Organotin Surrogate - Continued								
Tripopyltin	----	0.5	%	75.4	----	----	----	----
EP130S: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	10	%	51.9	----	----	----	----
EP131S: OC Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.50	%	53.3	----	----	----	----
EP131T: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.5	%	68.8	----	----	----	----
EP132T: Base/Neutral Extractable Surrogates								
2-Fluorobiphenyl	321-60-8	10	%	81.2	----	----	----	----
Anthracene-d10	1719-06-8	10	%	107	----	----	----	----
4-Terphenyl-d14	1718-51-0	10	%	89.7	----	----	----	----
EP201S: Carbamate Surrogate								
4-Bromo-3,5-dimethylphenyl-N-methylcarbamate	672-99-1	0.02	%	104	----	----	----	----
EP202S: Phenoxyacetic Acid Herbicide Surrogate								
2,4-Dichlorophenyl Acetic Acid	19719-28-9	0.02	%	51.6	----	----	----	----



Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	49	147
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	35	143
EP069: Surrogate			
Decachlorobiphenyl	2051-24-3	70	130
EP080-SD: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	67	137
Toluene-D8	2037-26-5	74	134
4-Bromofluorobenzene	460-00-4	73	137
EP090S: Organotin Surrogate			
Tripropyltin	----	35	130
EP130S: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	14	102
EP131S: OC Pesticide Surrogate			
Dibromo-DDE	21655-73-2	10	119
EP131T: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	10	106
EP132T: Base/Neutral Extractable Surrogates			
2-Fluorobiphenyl	321-60-8	55	135
Anthracene-d10	1719-06-8	70	136
4-Terphenyl-d14	1718-51-0	57	127
EP201S: Carbamate Surrogate			
4-Bromo-3,5-dimethylphenyl-N-methylcarbamate	672-99-1	59	137
EP202S: Phenoxyacetic Acid Herbicide Surrogate			
2,4-Dichlorophenyl Acetic Acid	19719-28-9	45	139

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EP003: Total Organic Carbon (TOC) in Soil

(SOIL) EP090: Organotin Compounds

(SOIL) EP090S: Organotin Surrogate

(SOIL) EA003 :pH (field/fox)

(SOIL) EA029-D: Calcium Values

(SOIL) EA029-E: Magnesium Values

(SOIL) EA029-F: Excess Acid Neutralising Capacity

(SOIL) EA029-H: Acid Base Accounting

(SOIL) EA029-G: Retained Acidity

(SOIL) EA029-A: pH Measurements

(SOIL) EA029-C: Sulfur Trail

(SOIL) EA029-B: Acidity Trail

Analysis conducted by ALS Melbourne, NATA accreditation no. 825, site no. 13778 (Chemistry).

(SOIL) EP069: Toxaphene

(SOIL) EP069: Surrogate

Analysis conducted by ALS Newcastle, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(SOIL) EA150: Soil Classification based on Particle Size

(SOIL) EA150: Particle Sizing

Analysis conducted by ALS Sydney, NATA accreditation no. 825, site no. 10911 (Chemistry) 14913 (Biology).

(SOIL) EP130A: Organophosphorus Pesticides (Ultra-trace)

(SOIL) EP130S: Organophosphorus Pesticide Surrogate

(SOIL) EP131B: Polychlorinated Biphenyls (as Aroclors)

(SOIL) EP131T: PCB Surrogate

(SOIL) EA055: Moisture Content (Dried @ 105-110°C)

(SOIL) EA002: pH 1:5 (Soils)

(SOIL) EG005(ED093)T: Total Metals by ICP-AES

(SOIL) EK058G: Nitrate as N by Discrete Analyser

(SOIL) EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser

(SOIL) EK057G: Nitrite as N by Discrete Analyser

(SOIL) EP202A: Phenoxyacetic Acid Herbicides by LCMS

(SOIL) EP202S: Phenoxyacetic Acid Herbicide Surrogate

(SOIL) EP201: Carbamate Pesticides by LCMS

(SOIL) EP201S: Carbamate Surrogate

(SOIL) EP068C: Triazines

(SOIL) EP068T: Organophosphorus Pesticide Surrogate

(SOIL) EP068S: Organochlorine Pesticide Surrogate

(SOIL) EP080-SD: BTEXN

(SOIL) EP080-SD / EP071-SD: Total Petroleum Hydrocarbons



(SOIL) EP080-SD / EP071-SD: Total Recoverable Hydrocarbons
(SOIL) EP080-SD: TPH(V)/BTEX Surrogates
(SOIL) EG035T: Total Recoverable Mercury by FIMS
(SOIL) EG005(ED093)-SD: Total Metals in Sediments by ICP-AES
(SOIL) EG020-SD: Total Metals in Sediments by ICPMS
(SOIL) EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions
(SOIL) EP132B: Polynuclear Aromatic Hydrocarbons
(SOIL) EP132T: Base/Neutral Extractable Surrogates
(SOIL) EP131A: Organochlorine Pesticides
(SOIL) EP131S: OC Pesticide Surrogate

Certificate of Analysis

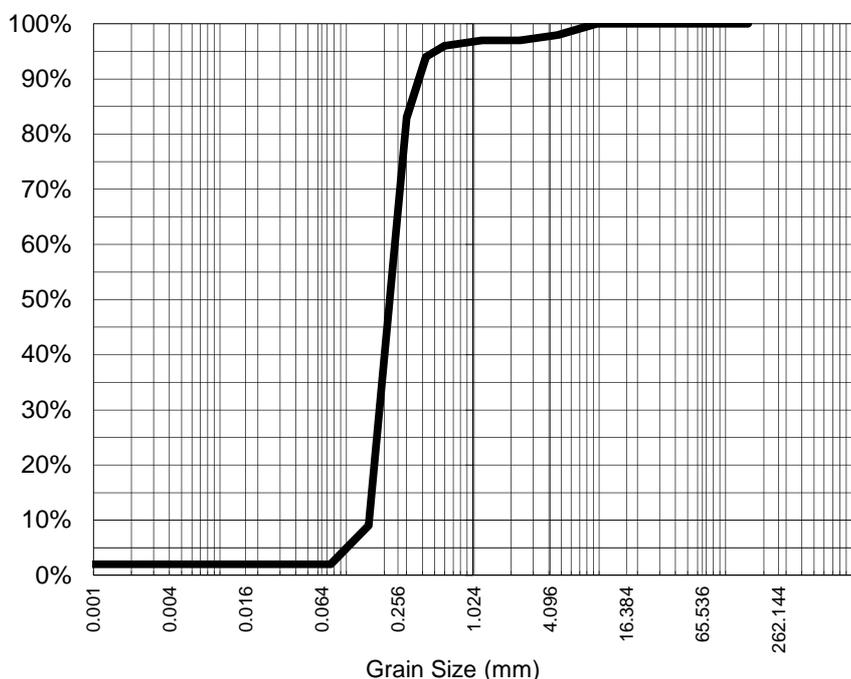


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ALS Environmental
Newcastle, NSW

CLIENT: KATIE NEWTON **DATE REPORTED:** 27-Jan-2022
COMPANY: ADVISIAN PTY LTD **DATE RECEIVED:** 20-Jan-2022
ADDRESS: 8-14 Telford Street **REPORT NO:** EW2200300-001 / PSD
Newcastle East
Nsw, Australia
PROJECT: Narooma Wharf Upgrade **SAMPLE ID:** N1

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	98%
2.36	97%
1.18	97%
0.600	96%
0.425	94%
0.300	83%
0.150	9%
0.075	2%
Particle Size (microns)	
37	2%
26	2%
18	2%
13	2%
9	2%
7	2%
5	2%
3	2%
1	2%

Median Particle Size (mm)*	0.233
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Analysis Notes

Samples analysed as received.

* Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Analysed: 24-Jan-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, GRAVEL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) #N/A

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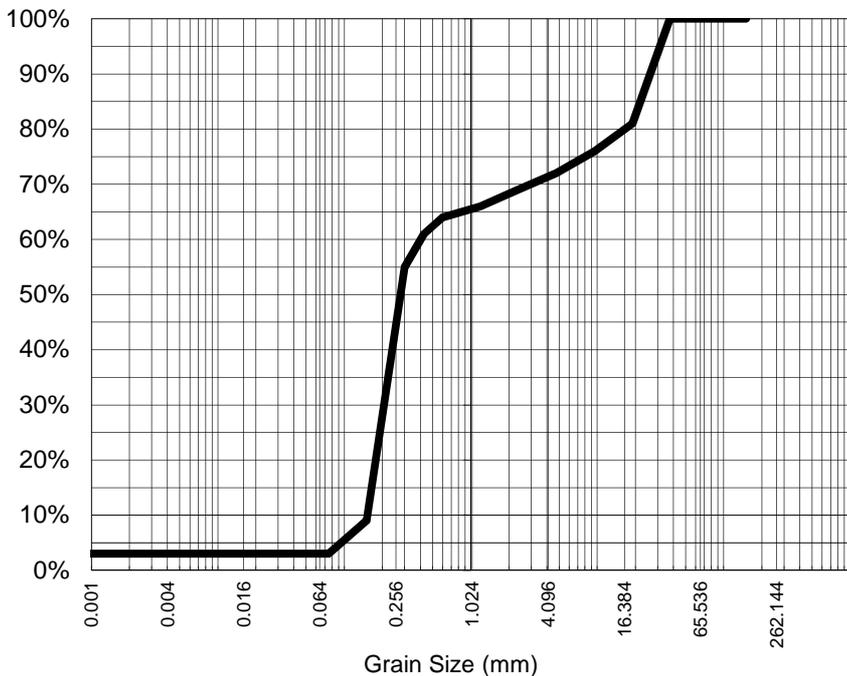
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ADDRESS: 8-14 Telford Street **REPORT NO:** EW2200300-002 / PSD
 Newcastle East
 Nsw, Australia
PROJECT: Narooma Wharf Upgrade **SAMPLE ID:** N2

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	81%
9.50	76%
4.75	72%
2.36	69%
1.18	66%
0.600	64%
0.425	61%
0.300	55%
0.150	9%
0.075	3%
Particle Size (microns)	
37	3%
26	3%
18	3%
13	3%
9	3%
7	3%
5	3%
3	3%
1	3%

Analysis Notes

Samples analysed as received.

* Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Median Particle Size (mm)*	0.284
----------------------------	-------

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Analysed: 24-Jan-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, GRAVEL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) #N/A



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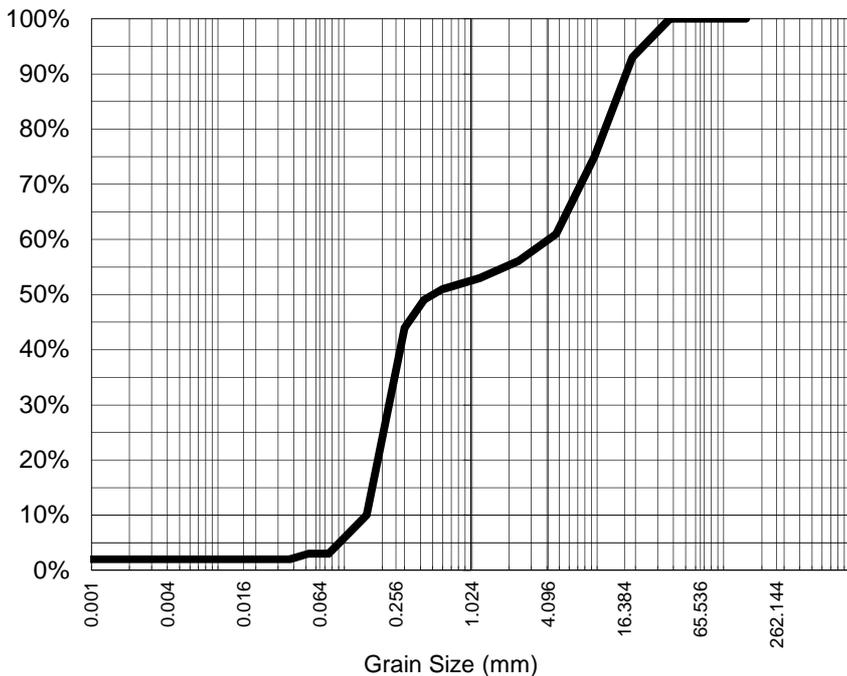
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Newcastle East
Nsw, Australia
PROJECT: Narooma Wharf Upgrade **SAMPLE ID:** N3

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	93%
9.50	75%
4.75	61%
2.36	56%
1.18	53%
0.600	51%
0.425	49%
0.300	44%
0.150	10%
0.075	3%
Particle Size (microns)	
37	2%
26	2%
18	2%
13	2%
9	2%
7	2%
5	2%
3	2%
1	2%

Analysis Notes

Samples analysed as received.

* Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Median Particle Size (mm)*	0.513
----------------------------	-------

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Analysed: 24-Jan-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, GRAVEL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) #N/A

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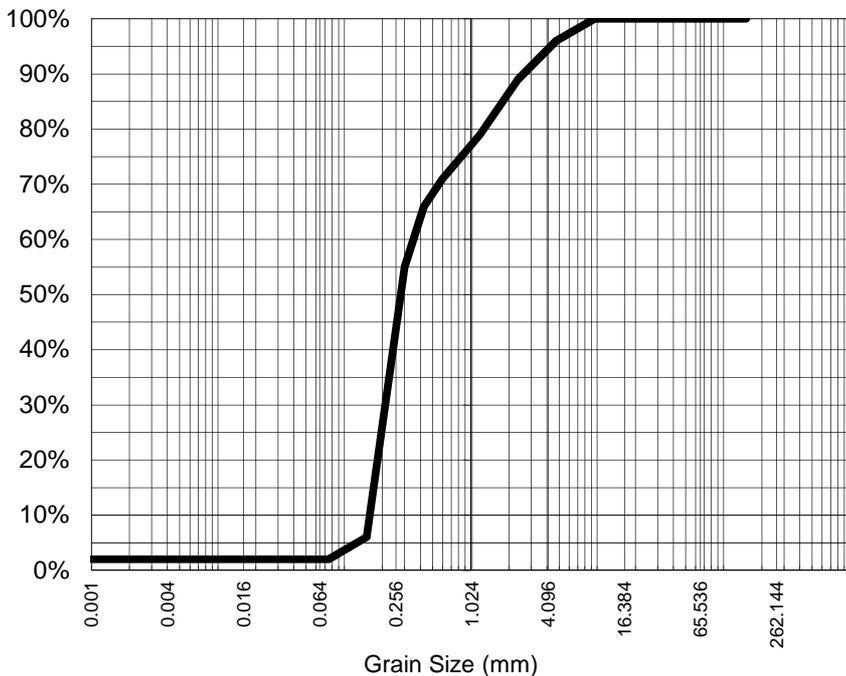
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 Newcastle East
 Nsw, Australia
PROJECT: Narooma Wharf Upgrade **SAMPLE ID:** N4

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	96%
2.36	89%
1.18	79%
0.600	71%
0.425	66%
0.300	55%
0.150	6%
0.075	2%
Particle Size (microns)	
37	2%
26	2%
18	2%
13	2%
9	2%
7	2%
5	2%
3	2%
1	2%

Analysis Notes

Samples analysed as received.

* Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Median Particle Size (mm)*	0.285
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Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Analysed: 24-Jan-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, GRAVEL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) #N/A

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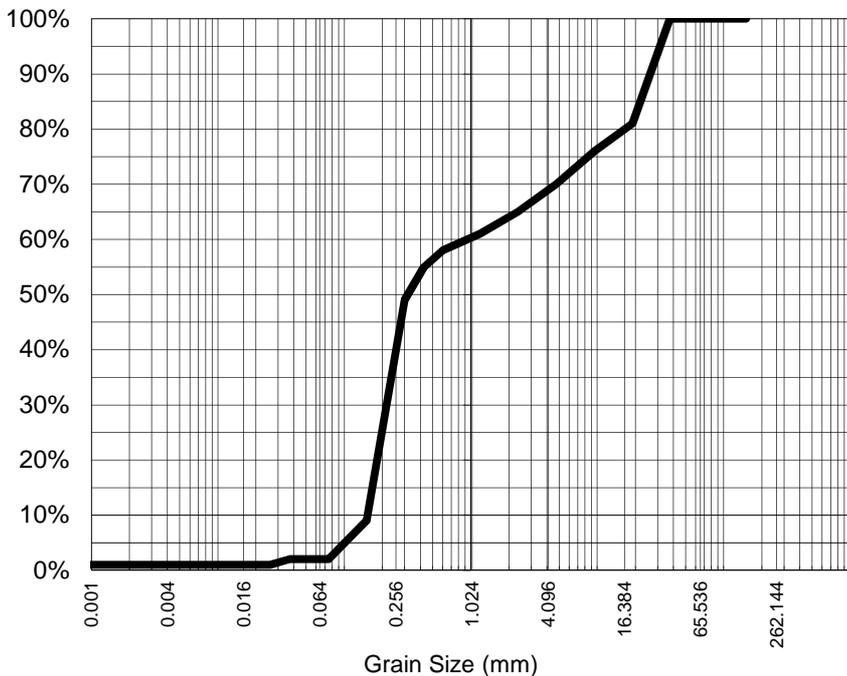
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COMPANY: ADVISIAN PTY LTD **DATE RECEIVED:** 20-Jan-2022
ADDRESS: 8-14 Telford Street **REPORT NO:** EW2200300-005 / PSD
Newcastle East
Nsw, Australia
PROJECT: Narooma Wharf Upgrade **SAMPLE ID:** N5

Particle Size Distribution



Particle Size (mm)	% Passing
37.5	100%
19.0	81%
9.50	76%
4.75	70%
2.36	65%
1.18	61%
0.600	58%
0.425	55%
0.300	49%
0.150	9%
0.075	2%
Particle Size (microns)	
37	2%
26	1%
18	1%
13	1%
9	1%
7	1%
5	1%
3	1%
1	1%

Analysis Notes

Samples analysed as received.

* Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Median Particle Size (mm)*	0.321
----------------------------	-------

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Analysed: 24-Jan-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, GRAVEL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) #N/A

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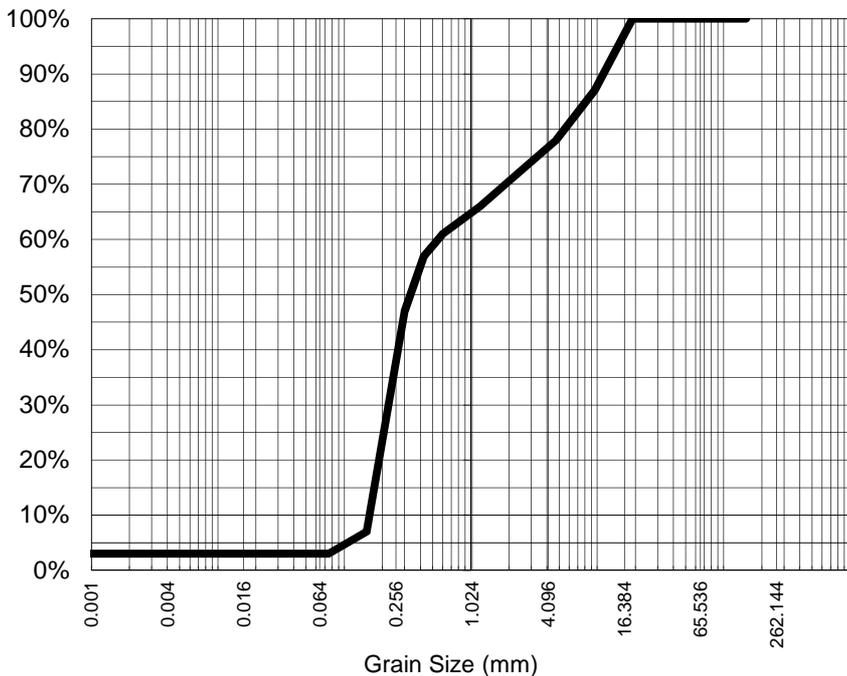
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COMPANY: ADVISIAN PTY LTD **DATE RECEIVED:** 20-Jan-2022
ADDRESS: 8-14 Telford Street **REPORT NO:** EW2200300-006 / PSD
Newcastle East
Nsw, Australia
PROJECT: Narooma Wharf Upgrade **SAMPLE ID:** N6

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	87%
4.75	78%
2.36	72%
1.18	66%
0.600	61%
0.425	57%
0.300	47%
0.150	7%
0.075	3%
Particle Size (microns)	
37	3%
26	3%
18	3%
13	3%
9	3%
7	3%
5	3%
3	3%
1	3%

Analysis Notes

Samples analysed as received.

* Soil Particle Density required for Hydrometer analysis according to AS 1289.3.5.1—2006 was not requested by the client. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Median Particle Size (mm)*	0.338
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Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Analysed: 24-Jan-22

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, GRAVEL, FINES

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) #N/A

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.



Vincent Emerton-bell
Laboratory Analyst
Authorised Signatory

QUALITY CONTROL REPORT

Work Order	: EW2200300	Page	: 1 of 18
Client	: ADVISIAN PTY LTD	Laboratory	: Environmental Division NSW South Coast
Contact	: MS KATIE NEWTON	Contact	: Aneta Prosaroski
Address	: 8-14 TELFORD STREET NEWCASTLE EAST NSW, AUSTRALIA 2300	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 NSW Australia
Telephone	: ----	Telephone	: 02 42253125
Project	: Narooma Wharf Upgrade	Date Samples Received	: 20-Jan-2022
Order number	: ----	Date Analysis Commenced	: 24-Jan-2022
C-O-C number	: ----	Issue Date	: 08-Feb-2022
Sampler	: Client, KATIE NEWTON		
Site	: ----		
Quote number	: SY/091/21 v2		
No. of samples received	: 8		
No. of samples analysed	: 6		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Edwandy Fadjjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Franco Lentini	LCMS Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Nancy Wang	2IC Organic Chemist	Melbourne Organics, Springvale, VIC
Thomas Donovan	Senior Organic Chemist - PFAS	Brisbane Organics, Stafford, QLD
Vincent Emerton-Bell	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QC Lot: 4135254)									
EW2200300-001	N1	EG005-SD: Aluminium	7429-90-5	50	mg/kg	780	740	5.3	0% - 50%
		EG005-SD: Iron	7439-89-6	50	mg/kg	2060	2040	0.8	0% - 20%
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 4135252)									
EW2200300-001	N1	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	<10	<10	0.0	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Thallium	7440-28-0	5	mg/kg	<5	<5	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 4135253)									
EW2200300-001	N1	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.0	No Limit
EA002: pH 1:5 (Soils) (QC Lot: 4135249)									
EW2200300-004	N4	EA002: pH Value	----	0.1	pH Unit	8.8	8.8	0.0	0% - 20%
ES2202066-011	Anonymous	EA002: pH Value	----	0.1	pH Unit	6.2	5.9	3.8	0% - 20%
EA003 :pH (field/fox) (QC Lot: 4143020)									
EW2200275-011	Anonymous	EA003: pH (F)	----	0.1	pH Unit	7.3	7.4	0.0	0% - 20%
		EA003: pH (Fox)	----	0.1	pH Unit	3.8	4.0	3.6	0% - 20%
EA029-A: pH Measurements (QC Lot: 4140580)									
EW2200300-002	N2	EA029: pH KCl (23A)	----	0.1	pH Unit	9.3	9.4	0.0	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	8.9	8.9	0.0	0% - 20%
ME2200128-005	Anonymous	EA029: pH KCl (23A)	----	0.1	pH Unit	5.6	5.5	0.0	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	6.3	6.3	0.0	0% - 20%
EA029-B: Acidity Trail (QC Lot: 4140580)									
EW2200300-002	N2	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA029-B: Acidity Trail (QC Lot: 4140580) - continued									
EW2200300-002	N2	EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.0	No Limit
ME2200128-005	Anonymous	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	7	8	14.5	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	6	6	0.0	No Limit
EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.0	No Limit		
EA029-C: Sulfur Trail (QC Lot: 4140580)									
EW2200300-002	N2	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	0.057	0.055	4.4	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	0.160	0.177	9.9	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	0.103	0.122	16.9	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	64	76	16.9	No Limit
ME2200128-005	Anonymous	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-D: Calcium Values (QC Lot: 4140580)									
EW2200300-002	N2	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.171	0.169	1.5	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	2.69	2.97	9.6	0% - 20%
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	2.52	2.80	10.4	0% - 20%
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	2.02	2.24	10.4	0% - 20%
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	1260	1400	10.4	0% - 20%
ME2200128-005	Anonymous	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.125	0.119	4.8	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	0.130	0.128	1.9	No Limit
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-E: Magnesium Values (QC Lot: 4140580)									
EW2200300-002	N2	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	0.043	0.042	0.0	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.110	0.131	17.2	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA029-E: Magnesium Values (QC Lot: 4140580) - continued									
EW2200300-002	N2	EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	0.067	0.089	27.6	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	0.089	0.117	27.6	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	55	73	27.6	No Limit
ME2200128-005	Anonymous	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	0.024	0.021	12.5	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.024	0.021	11.4	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-F: Excess Acid Neutralising Capacity (QC Lot: 4140580)									
EW2200300-002	N2	EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	6.16	6.15	0.2	0% - 20%
		EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	1.97	1.97	0.2	0% - 20%
		EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	1230	1230	0.2	0% - 20%
EA029-H: Acid Base Accounting (QC Lot: 4140580)									
EW2200300-002	N2	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.0	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.10	0.12	16.9	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	5	6	0.0	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	64	76	16.9	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	10	mole H+ / t	64	76	16.9	No Limit
ME2200128-005	Anonymous	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.0	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 4135257)									
ES2202066-026	Anonymous	EA055: Moisture Content	----	0.1	%	12.5	11.1	11.3	0% - 50%
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 4135255)									
EW2200300-001	N1	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
		EG020-SD: Selenium	7782-49-2	0.1	mg/kg	0.3	0.2	0.0	No Limit
		EG020-SD: Silver	7440-22-4	0.1	mg/kg	0.1	0.1	0.0	No Limit
		EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	<0.50	0.0	No Limit



Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 4135255) - continued									
EW2200300-001	N1	EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	0.6	<0.5	19.6	No Limit
		EG020-SD: Arsenic	7440-38-2	1	mg/kg	3.95	4.17	5.4	No Limit
		EG020-SD: Chromium	7440-47-3	1	mg/kg	4.4	4.5	3.9	No Limit
		EG020-SD: Copper	7440-50-8	1	mg/kg	1.4	1.9	31.9	No Limit
		EG020-SD: Lead	7439-92-1	1	mg/kg	1.2	1.1	0.0	No Limit
		EG020-SD: Nickel	7440-02-0	1	mg/kg	1.4	1.2	9.4	No Limit
		EG020-SD: Zinc	7440-66-6	1	mg/kg	4.0	4.2	4.0	No Limit
		EG020-SD: Manganese	7439-96-5	10	mg/kg	11	11	0.0	No Limit
		EG020-SD: Vanadium	7440-62-2	2	mg/kg	4.7	5.0	4.9	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 4135247)									
ES2202066-011	Anonymous	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.5	<0.5	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 4135250)									
ES2202066-011	Anonymous	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	8.4	8.5	0.0	0% - 50%
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 4143332)									
EW2200300-006	N6	EP003: Total Organic Carbon	----	0.02	%	0.27	0.27	0.0	0% - 50%
EB2137472-001	Anonymous	EP003: Total Organic Carbon	----	0.02	%	0.29	0.28	6.7	0% - 50%
EP068C: Triazines (QC Lot: 4134613)									
ES2201531-014	Anonymous	EP068: Atrazine	1912-24-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Simazine	122-34-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
EP069: Toxaphene (QC Lot: 4147871)									
EW2200300-001	N1	EP069: Toxaphene	8001-35-2	2	mg/kg	<2	<2	0.0	No Limit
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 4132104)									
EW2200300-001	N1	EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	<3	0.0	No Limit
		EP071-SD: C15 - C28 Fraction	----	3	mg/kg	29	32	9.3	No Limit
		EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	40	44	9.5	No Limit
		EP071-SD: C29 - C36 Fraction	----	5	mg/kg	11	12	0.0	No Limit
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 4134153)									
EW2200300-001	N1	EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	<3	0.0	No Limit
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QC Lot: 4132104)									
EW2200300-001	N1	EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<6	<6	0.0	No Limit
		EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	35	39	9.5	No Limit
		EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	43	48	11.0	No Limit
		EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	8	9	0.0	No Limit
EP080-SD: BTEXN (QC Lot: 4134153)									
EW2200300-001	N1	EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	0.0	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP080-SD: BTEXN (QC Lot: 4134153) - continued									
EW2200300-001	N1	EP080-SD: meta- & para-Xylene	108-38-3	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
			106-42-3						
		EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EP090: Organotin Compounds (QC Lot: 4139408)									
EW2200300-001	N1	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.0	No Limit
		EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	0.0	No Limit
		EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	0.0	No Limit
EP130A: Organophosphorus Pesticides (Ultra-trace) (QC Lot: 4132032)									
EW2200300-001	N1	EP130: Bromophos-ethyl	4824-78-6	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Carbophenothion	786-19-6	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Chlorfenvinphos (E)	18708-86-6	10	µg/kg	<10.0	<10.0	0.0	No Limit
		EP130: Chlorfenvinphos (Z)	18708-87-7	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Chlorpyrifos	2921-88-2	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Chlorpyrifos-methyl	5598-13-0	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Demeton-S-methyl	919-86-8	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Diazinon	333-41-5	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Dichlorvos	62-73-7	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Dimethoate	60-51-5	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Ethion	563-12-2	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Fenamiphos	22224-92-6	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Fenthion	55-38-9	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Malathion	121-75-5	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Azinphos Methyl	86-50-0	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Monocrotophos	6923-22-4	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Parathion	56-38-2	10	µg/kg	<10	<10	0.0	No Limit
		EP130: Parathion-methyl	298-00-0	10	µg/kg	<10	<10	0.0	No Limit
EP130: Pirimphos-ethyl	23505-41-1	10	µg/kg	<10	<10	0.0	No Limit		
EP130: Prothiofos	34643-46-4	10	µg/kg	<10	<10	0.0	No Limit		
EP131A: Organochlorine Pesticides (QC Lot: 4132034)									
EW2200300-001	N1	EP131A: gamma-BHC	58-89-9	0.25	µg/kg	<0.25	<0.25	0.0	No Limit
		EP131A: cis-Chlordane	5103-71-9	0.25	µg/kg	<0.25	<0.25	0.0	No Limit
		EP131A: trans-Chlordane	5103-74-2	0.25	µg/kg	<0.25	<0.25	0.0	No Limit
		EP131A: Total Chlordane (sum)	----	0.25	µg/kg	<0.25	<0.25	0.0	No Limit
		EP131A: Aldrin	309-00-2	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: alpha-BHC	319-84-6	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: beta-BHC	319-85-7	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: delta-BHC	319-86-8	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: 4,4'-DDD	72-54-8	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: 4,4'-DDE	72-55-9	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: 4,4'-DDT	50-29-3	0.5	µg/kg	<0.50	<0.50	0.0	No Limit



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP131A: Organochlorine Pesticides (QC Lot: 4132034) - continued									
EW2200300-001	N1	EP131A: Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Dieldrin	60-57-1	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: alpha-Endosulfan	959-98-8	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: beta-Endosulfan	33213-65-9	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Endosulfan sulfate	1031-07-8	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Endosulfan (sum)	115-29-7	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Endrin	72-20-8	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Endrin aldehyde	7421-93-4	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Endrin ketone	53494-70-5	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Heptachlor	76-44-8	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Heptachlor epoxide	1024-57-3	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
		EP131A: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/kg	<0.50	<0.50	0.0	No Limit
EP131A: Methoxychlor	72-43-5	0.5	µg/kg	<0.50	<0.50	0.0	No Limit		
EP131B: Polychlorinated Biphenyls (as Aroclors) (QC Lot: 4132033)									
EW2200300-001	N1	EP131B: Total Polychlorinated biphenyls	----	5	µg/kg	<15.6	<15.6	0.0	No Limit
		EP131B: Aroclor 1016	12674-11-2	5	µg/kg	<15.6	<15.6	0.0	No Limit
		EP131B: Aroclor 1221	11104-28-2	5	µg/kg	<15.6	<15.6	0.0	No Limit
		EP131B: Aroclor 1232	11141-16-5	5	µg/kg	<15.6	<15.6	0.0	No Limit
		EP131B: Aroclor 1242	53469-21-9	5	µg/kg	<15.6	<15.6	0.0	No Limit
		EP131B: Aroclor 1248	12672-29-6	5	µg/kg	<15.6	<15.6	0.0	No Limit
		EP131B: Aroclor 1254	11097-69-1	5	µg/kg	<15.6	<15.6	0.0	No Limit
		EP131B: Aroclor 1260	11096-82-5	5	µg/kg	<15.6	<15.6	0.0	No Limit
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 4132019)									
EW2200300-002	N2	EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(b+j)fluoranthene	205-99-2	4	µg/kg	<4	4	0.0	No Limit
		EP132B-SD: Benzo(k)fluoranthene	205-82-3	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	<4	0.0	No Limit
EP132B-SD: Benzo(g,h,i)perylene	191-24-2	4	µg/kg	<4	<4	0.0	No Limit		



Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 4132019) - continued									
EW2200300-002	N2	EP132B-SD: Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	0.0	No Limit
		EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	4	0.0	No Limit
		EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	<5	0.0	No Limit
		EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	0.0	No Limit
		EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	<5	0.0	No Limit
EP201: Carbamate Pesticides by LCMS (QC Lot: 4138995)									
ES2201966-001	Anonymous	EP201: Oxamyl	23135-22-0	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Methomyl	16752-77-5	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: 3-Hydroxy Carbofuran	16655-82-6	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Aldicarb	116-06-3	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Bendiocarb	22781-23-3	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Thiodicarb	59669-26-0	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Carbofuran	1563-66-2	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Carbaryl	63-25-2	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
EW2200300-006	N6	EP201: Oxamyl	23135-22-0	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Methomyl	16752-77-5	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: 3-Hydroxy Carbofuran	16655-82-6	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Aldicarb	116-06-3	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Bendiocarb	22781-23-3	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Thiodicarb	59669-26-0	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Carbofuran	1563-66-2	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP201: Carbaryl	63-25-2	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
EB2201250-001	Anonymous	EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: 2,4-DB	94-82-6	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: MCPA	94-74-6	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: 2,4-DP	120-36-5	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: 2,4-D	94-75-7	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: 2,4,5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: 2,4,5-T	93-76-5	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: MCPB	94-81-5	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: Picloram	1918-02-1	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
		EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.04	<0.04	0.0	No Limit
EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.04	<0.04	0.0	No Limit		



Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QC Lot: 4133758) - continued									
EW2200300-003	N3	EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: 2,4-DB	94-82-6	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: MCPA	94-74-6	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: 2,4-DP	120-36-5	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: 2,4-D	94-75-7	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: 2,4,5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: 2,4,5-T	93-76-5	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: MCPB	94-81-5	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: Picloram	1918-02-1	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.02	<0.02	0.0	No Limit
		EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	<0.02	0.0	No Limit



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Acceptable Limits (%)	
						LCS	Low	High	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QCLot: 4135254)									
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	15910 mg/kg	98.8	88.2	136	
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	33227 mg/kg	99.8	70.0	109	
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 4135252)									
EG005T: Barium	7440-39-3	10	mg/kg	<10	90.5 mg/kg	100	65.0	136	
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	0.5 mg/kg	103	70.0	130	
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	2.3 mg/kg	81.3	77.0	119	
EG005T: Tin	7440-31-5	5	mg/kg	<5	----	----	----	----	
EG005T: Thallium	7440-28-0	5	mg/kg	<5	----	----	----	----	
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 4135253)									
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	0.073 mg/kg	97.3	72.0	116	
EA029-A: pH Measurements (QCLot: 4140580)									
EA029: pH KCl (23A)	----	0.1	pH Unit	<0.1	4.4 pH Unit	98.7	70.0	130	
EA029: pH OX (23B)	----	0.1	pH Unit	<0.1	4.2 pH Unit	110	70.0	130	
EA029-B: Acidity Trail (QCLot: 4140580)									
EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	19 mole H+ / t	87.9	70.0	130	
EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	27.5 mole H+ / t	86.1	70.0	130	
EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	----	----	----	----	
EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	----	----	----	----	
EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	----	----	----	----	
EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	----	----	----	----	
EA029-C: Sulfur Trail (QCLot: 4140580)									
EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	0.03595 % S	118	70.0	130	
EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	0.14405 % S	103	70.0	130	
EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	----	----	----	----	
EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----	
EA029-D: Calcium Values (QCLot: 4140580)									
EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.020	0.22443 % Ca	113	70.0	130	
EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.020	0.22637 % Ca	112	70.0	130	
EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	----	----	----	----	
EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----	
EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	----	----	----	----	
EA029-E: Magnesium Values (QCLot: 4140580)									
EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.020	0.20621 % Mg	107	70.0	130	



Sub-Matrix: SOIL

Method Blank (MB) Report				Laboratory Control Spike (LCS) Report					
				Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%)		Low	High
Method: Compound	CAS Number	LOR	Unit	Result					
EA029-E: Magnesium Values (QCLot: 4140580) - continued									
EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.020	0.23199 % Mg	106	70.0	130	
EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	----	----	----	----	
EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----	
EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	----	----	----	----	
EA029-F: Excess Acid Neutralising Capacity (QCLot: 4140580)									
EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	<0.020	----	----	----	----	
EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	<10	----	----	----	----	
EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	<0.020	----	----	----	----	
EA029-H: Acid Base Accounting (QCLot: 4140580)									
EA029: ANC Fineness Factor	----	0.5	-	<0.5	----	----	----	----	
EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----	
EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----	
EA029: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----	
EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	----	----	----	
EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	----	----	----	
EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	----	----	----	
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 4135255)									
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	----	----	----	----	
EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	98 mg/kg	112	80.0	139	
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	0.74 mg/kg	108	83.0	127	
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	15.4 mg/kg	127	73.0	130	
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	48 mg/kg	95.1	76.0	130	
EG020-SD: Cobalt	7440-48-4	0.5	mg/kg	<0.5	9.8 mg/kg	102	81.0	130	
EG020-SD: Lead	7439-92-1	1	mg/kg	<1.0	50 mg/kg	109	74.0	130	
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	482 mg/kg	119	76.0	130	
EG020-SD: Nickel	7440-02-0	1	mg/kg	<1.0	12.4 mg/kg	115	83.0	130	
EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	1.25 mg/kg	93.0	71.0	130	
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	----	----	----	----	
EG020-SD: Vanadium	7440-62-2	2	mg/kg	<2.0	42 mg/kg	121	84.0	131	
EG020-SD: Zinc	7440-66-6	1	mg/kg	<1.0	115 mg/kg	105	82.0	137	
EK057G: Nitrite as N by Discrete Analyser (QCLot: 4135247)									
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	103	85.0	111	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 4135250)									
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	101	88.0	118	
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 4143332)									
EP003: Total Organic Carbon	----	0.02	%	<0.02	0.54 %	102	80.0	120	
				<0.02	25.5 %	98.7	80.0	120	



Sub-Matrix: SOIL

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
				Result	Spike	Spike Recovery (%)	Acceptable Limits (%)	
					Concentration	LCS	Low	High
EP068C: Triazines (QCLot: 4134613)								
EP068: Atrazine	1912-24-9	0.05	mg/kg	<0.05	0.5 mg/kg	92.4	68.0	116
EP068: Simazine	122-34-9	0.05	mg/kg	<0.05	0.5 mg/kg	94.8	69.0	113
EP069: Toxaphene (QCLot: 4147871)								
EP069: Toxaphene	8001-35-2	2	mg/kg	<2	10 mg/kg	110	64.0	132
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 4132104)								
EP071-SD: C10 - C14 Fraction	----	3	mg/kg	<3	5 mg/kg	89.0	78.0	118
EP071-SD: C15 - C28 Fraction	----	3	mg/kg	<3	7.5 mg/kg	109	84.0	118
EP071-SD: C29 - C36 Fraction	----	5	mg/kg	<5	5 mg/kg	106	73.0	119
EP071-SD: C10 - C36 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 4134153)								
EP080-SD: C6 - C9 Fraction	----	3	mg/kg	<3	6.2 mg/kg	78.1	61.0	133
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons (QCLot: 4132104)								
EP071-SD: >C10 - C16 Fraction	----	3	mg/kg	<3	6.25 mg/kg	107	70.0	130
EP071-SD: >C16 - C34 Fraction	----	3	mg/kg	<3	8.75 mg/kg	108	74.0	138
EP071-SD: >C34 - C40 Fraction	----	5	mg/kg	<5	3.75 mg/kg	104	63.0	131
EP071-SD: >C10 - C40 Fraction (sum)	----	3	mg/kg	<3	----	----	----	----
EP080-SD: BTEXN (QCLot: 4134153)								
EP080-SD: Benzene	71-43-2	0.2	mg/kg	<0.2	0.2 mg/kg	107	66.0	122
EP080-SD: Toluene	108-88-3	0.2	mg/kg	<0.2	0.2 mg/kg	94.8	70.0	130
EP080-SD: Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	0.2 mg/kg	96.5	66.0	126
EP080-SD: meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	0.4 mg/kg	97.7	59.0	129
EP080-SD: ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	0.2 mg/kg	98.4	66.0	126
EP090: Organotin Compounds (QCLot: 4139408)								
EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	1.25 µgSn/kg	96.5	36.0	128
EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	1.25 µgSn/kg	76.2	42.0	132
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	65.8	52.0	139
EP130A: Organophosphorus Pesticides (Ultra-trace) (QCLot: 4132032)								
EP130: Bromophos-ethyl	4824-78-6	10	µg/kg	<10	50 µg/kg	79.6	49.0	117
EP130: Carbophenothion	786-19-6	10	µg/kg	<10	50 µg/kg	85.0	54.0	104
EP130: Chlorfenvinphos (E)	18708-86-6	10	µg/kg	<10.0	5 µg/kg	84.5	48.0	156
EP130: Chlorfenvinphos (Z)	18708-87-7	10	µg/kg	<10	50 µg/kg	86.7	53.0	119
EP130: Chlorpyrifos	2921-88-2	10	µg/kg	<10	50 µg/kg	79.5	54.0	112
EP130: Chlorpyrifos-methyl	5598-13-0	10	µg/kg	<10	50 µg/kg	79.9	52.0	108
EP130: Demeton-S-methyl	919-86-8	10	µg/kg	<10	50 µg/kg	81.8	51.0	109
EP130: Diazinon	333-41-5	10	µg/kg	<10	50 µg/kg	80.2	57.0	121
EP130: Dichlorvos	62-73-7	10	µg/kg	<10	50 µg/kg	77.1	48.0	104
EP130: Dimethoate	60-51-5	10	µg/kg	<10	50 µg/kg	93.2	52.0	120



Sub-Matrix: SOIL

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Acceptable Limits (%)	
					Concentration	LCS	Low	High	
EP130A: Organophosphorus Pesticides (Ultra-trace) (QCLot: 4132032) - continued									
EP130: Ethion	563-12-2	10	µg/kg	<10	50 µg/kg	81.7	51.0	121	
EP130: Fenamiphos	22224-92-6	10	µg/kg	<10	50 µg/kg	81.7	50.0	120	
EP130: Fenthion	55-38-9	10	µg/kg	<10	50 µg/kg	79.3	48.0	112	
EP130: Malathion	121-75-5	10	µg/kg	<10	50 µg/kg	82.8	51.0	121	
EP130: Azinphos Methyl	86-50-0	10	µg/kg	<10	50 µg/kg	85.8	45.0	127	
EP130: Monocrotophos	6923-22-4	10	µg/kg	<10	50 µg/kg	76.6	48.0	128	
EP130: Parathion	56-38-2	10	µg/kg	<10	50 µg/kg	79.3	49.0	125	
EP130: Parathion-methyl	298-00-0	10	µg/kg	<10	50 µg/kg	94.3	51.0	119	
EP130: Pirimphos-ethyl	23505-41-1	10	µg/kg	<10	50 µg/kg	80.4	48.0	120	
EP130: Prothiofos	34643-46-4	10	µg/kg	<10	50 µg/kg	80.4	51.0	117	
EP131A: Organochlorine Pesticides (QCLot: 4132034)									
EP131A: Aldrin	309-00-2	0.5	µg/kg	<0.50	5 µg/kg	81.3	38.0	139	
EP131A: alpha-BHC	319-84-6	0.5	µg/kg	<0.50	5 µg/kg	85.0	17.6	136	
EP131A: beta-BHC	319-85-7	0.5	µg/kg	<0.50	5 µg/kg	83.4	30.5	131	
EP131A: delta-BHC	319-86-8	0.5	µg/kg	<0.50	5 µg/kg	90.1	37.0	140	
EP131A: 4,4'-DDD	72-54-8	0.5	µg/kg	<0.50	5 µg/kg	119	25.9	141	
EP131A: 4,4'-DDE	72-55-9	0.5	µg/kg	<0.50	5 µg/kg	62.4	35.0	129	
EP131A: 4,4'-DDT	50-29-3	0.5	µg/kg	<0.50	5 µg/kg	85.0	23.4	138	
EP131A: Sum of DDD + DDE + DDT	72-54-8/72-5-9/50-2	0.5	µg/kg	<0.50	----	----	----	----	
EP131A: Dieldrin	60-57-1	0.5	µg/kg	<0.50	5 µg/kg	101	30.2	140	
EP131A: alpha-Endosulfan	959-98-8	0.5	µg/kg	<0.50	5 µg/kg	96.9	38.0	140	
EP131A: beta-Endosulfan	33213-65-9	0.5	µg/kg	<0.50	5 µg/kg	99.5	32.0	152	
EP131A: Endosulfan sulfate	1031-07-8	0.5	µg/kg	<0.50	5 µg/kg	62.4	36.0	155	
EP131A: Endosulfan (sum)	115-29-7	0.5	µg/kg	<0.50	----	----	----	----	
EP131A: Endrin	72-20-8	0.5	µg/kg	<0.50	5 µg/kg	81.2	25.8	158	
EP131A: Endrin aldehyde	7421-93-4	0.5	µg/kg	<0.50	5 µg/kg	91.5	20.1	118	
EP131A: Endrin ketone	53494-70-5	0.5	µg/kg	<0.50	5 µg/kg	108	13.4	135	
EP131A: Heptachlor	76-44-8	0.5	µg/kg	<0.50	5 µg/kg	102	39.0	155	
EP131A: Heptachlor epoxide	1024-57-3	0.5	µg/kg	<0.50	5 µg/kg	93.3	34.0	148	
EP131A: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/kg	<0.50	5 µg/kg	77.5	26.1	152	
EP131A: gamma-BHC	58-89-9	0.25	µg/kg	<0.25	5 µg/kg	87.4	31.2	137	
EP131A: Methoxychlor	72-43-5	0.5	µg/kg	<0.50	5 µg/kg	80.8	36.0	152	
EP131A: cis-Chlordane	5103-71-9	0.25	µg/kg	<0.25	5 µg/kg	103	36.0	142	
EP131A: trans-Chlordane	5103-74-2	0.25	µg/kg	<0.25	5 µg/kg	92.9	29.5	138	
EP131A: Total Chlordane (sum)	----	0.25	µg/kg	<0.25	----	----	----	----	
EP131B: Polychlorinated Biphenyls (as Aroclors) (QCLot: 4132033)									
EP131B: Total Polychlorinated biphenyls	----	5	µg/kg	<5.0	50 µg/kg	83.4	45.0	115	
EP131B: Aroclor 1016	12674-11-2	5	µg/kg	<5.0	----	----	----	----	



Sub-Matrix: SOIL

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Acceptable Limits (%)	
					Concentration	LCS	Low	High	
EP131B: Polychlorinated Biphenyls (as Aroclors) (QCLot: 4132033) - continued									
EP131B: Aroclor 1221	11104-28-2	5	µg/kg	<5.0	----	----	----	----	
EP131B: Aroclor 1232	11141-16-5	5	µg/kg	<5.0	----	----	----	----	
EP131B: Aroclor 1242	53469-21-9	5	µg/kg	<5.0	----	----	----	----	
EP131B: Aroclor 1248	12672-29-6	5	µg/kg	<5.0	----	----	----	----	
EP131B: Aroclor 1254	11097-69-1	5	µg/kg	<5.0	50 µg/kg	83.4	45.0	115	
EP131B: Aroclor 1260	11096-82-5	5	µg/kg	<5.0	----	----	----	----	
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 4132019)									
EP132B-SD: Naphthalene	91-20-3	5	µg/kg	<5	25 µg/kg	85.5	63.0	129	
EP132B-SD: 2-Methylnaphthalene	91-57-6	5	µg/kg	<5	25 µg/kg	98.0	64.0	128	
EP132B-SD: Acenaphthylene	208-96-8	4	µg/kg	<4	25 µg/kg	83.1	65.0	129	
EP132B-SD: Acenaphthene	83-32-9	4	µg/kg	<4	25 µg/kg	83.9	68.0	132	
EP132B-SD: Fluorene	86-73-7	4	µg/kg	<4	25 µg/kg	85.0	68.0	124	
EP132B-SD: Phenanthrene	85-01-8	4	µg/kg	<4	25 µg/kg	88.0	64.0	134	
EP132B-SD: Anthracene	120-12-7	4	µg/kg	<4	25 µg/kg	89.1	65.0	131	
EP132B-SD: Fluoranthene	206-44-0	4	µg/kg	<4	25 µg/kg	87.7	64.0	130	
EP132B-SD: Pyrene	129-00-0	4	µg/kg	<4	25 µg/kg	86.1	67.0	133	
EP132B-SD: Benz(a)anthracene	56-55-3	4	µg/kg	<4	25 µg/kg	92.9	62.0	130	
EP132B-SD: Chrysene	218-01-9	4	µg/kg	<4	25 µg/kg	89.5	65.0	133	
EP132B-SD: Benzo(b+j)fluoranthene	205-99-2	4	µg/kg	<4	25 µg/kg	93.0	68.0	120	
	205-82-3								
EP132B-SD: Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	25 µg/kg	80.1	61.0	133	
EP132B-SD: Benzo(e)pyrene	192-97-2	4	µg/kg	<4	25 µg/kg	82.1	63.0	127	
EP132B-SD: Benzo(a)pyrene	50-32-8	4	µg/kg	<4	25 µg/kg	86.7	66.0	118	
EP132B-SD: Perylene	198-55-0	4	µg/kg	<4	25 µg/kg	87.0	69.0	119	
EP132B-SD: Benzo(g,h,i)perylene	191-24-2	4	µg/kg	<4	25 µg/kg	84.5	66.0	120	
EP132B-SD: Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	25 µg/kg	84.5	64.0	122	
EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	25 µg/kg	85.8	64.0	120	
EP132B-SD: Coronene	191-07-1	5	µg/kg	<5	25 µg/kg	83.3	68.0	136	
EP132B-SD: Sum of PAHs	----	4	µg/kg	<4	----	----	----	----	
EP201: Carbamate Pesticides by LCMS (QCLot: 4138995)									
EP201: Oxamyl	23135-22-0	0.02	mg/kg	<0.02	0.04 mg/kg	118	73.8	122	
EP201: Methomyl	16752-77-5	0.02	mg/kg	<0.02	0.04 mg/kg	105	74.9	129	
EP201: 3-Hydroxy Carbofuran	16655-82-6	0.02	mg/kg	<0.02	0.04 mg/kg	116	79.5	131	
EP201: Aldicarb	116-06-3	0.02	mg/kg	<0.02	0.04 mg/kg	109	82.2	138	
EP201: Bendiocarb	22781-23-3	0.02	mg/kg	<0.02	0.04 mg/kg	120	76.4	138	
EP201: Thiodicarb	59669-26-0	0.02	mg/kg	<0.02	0.04 mg/kg	126	75.9	129	
EP201: Carbofuran	1563-66-2	0.02	mg/kg	<0.02	0.04 mg/kg	124	78.2	128	
EP201: Carbaryl	63-25-2	0.02	mg/kg	<0.02	0.04 mg/kg	112	66.0	124	
EP201: Methiocarb	2032-65-7	0.02	mg/kg	<0.02	0.04 mg/kg	122	70.2	144	



Sub-Matrix: SOIL

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Acceptable Limits (%)	
						LCS	Low	High
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 4133758)								
EP202: 4-Chlorophenoxy acetic acid	122-88-3	0.02	mg/kg	<0.02	0.1 mg/kg	69.9	54.4	128
EP202: 2,4-DB	94-82-6	0.02	mg/kg	<0.02	0.1 mg/kg	85.6	45.5	130
EP202: Dicamba	1918-00-9	0.02	mg/kg	<0.02	0.1 mg/kg	66.6	51.7	135
EP202: Mecoprop	93-65-2	0.02	mg/kg	<0.02	0.1 mg/kg	81.7	60.0	130
EP202: MCPA	94-74-6	0.02	mg/kg	<0.02	0.1 mg/kg	74.2	56.8	131
EP202: 2,4-DP	120-36-5	0.02	mg/kg	<0.02	0.1 mg/kg	78.5	50.0	141
EP202: 2,4-D	94-75-7	0.02	mg/kg	<0.02	0.1 mg/kg	73.0	68.5	131
EP202: Triclopyr	55335-06-3	0.02	mg/kg	<0.02	0.1 mg/kg	79.9	50.8	141
EP202: 2,4,5-TP (Silvex)	93-72-1	0.02	mg/kg	<0.02	0.1 mg/kg	72.8	40.8	126
EP202: 2,4,5-T	93-76-5	0.02	mg/kg	<0.02	0.1 mg/kg	84.1	57.4	139
EP202: MCPB	94-81-5	0.02	mg/kg	<0.02	0.1 mg/kg	78.9	38.9	137
EP202: Picloram	1918-02-1	0.02	mg/kg	<0.02	0.1 mg/kg	71.4	48.7	129
EP202: Clopyralid	1702-17-6	0.02	mg/kg	<0.02	0.1 mg/kg	55.3	49.4	106
EP202: Fluroxypyr	69377-81-7	0.02	mg/kg	<0.02	0.1 mg/kg	61.8	53.2	128

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: SOIL

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery(%)	Acceptable Limits (%)	
					MS	Low	High
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 4135253)							
EW2200300-001	N1	EG035T-LL: Mercury	7439-97-6	0.05 mg/kg	94.4	70.0	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 4135255)							
EW2200300-001	N1	EG020-SD: Arsenic	7440-38-2	50 mg/kg	94.2	70.0	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	94.9	70.0	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	96.0	70.0	130
		EG020-SD: Copper	7440-50-8	250 mg/kg	86.9	70.0	130
		EG020-SD: Lead	7439-92-1	250 mg/kg	90.0	70.0	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	96.3	70.0	130
		EG020-SD: Zinc	7440-66-6	250 mg/kg	92.0	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 4135247)							
ES2202066-011	Anonymous	EK057G: Nitrite as N (Sol.)	14797-65-0	25 mg/kg	112	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 4135250)							
ES2202066-011	Anonymous	EK059G: Nitrite + Nitrate as N (Sol.)	----	25 mg/kg	112	70.0	130
EP069: Toxaphene (QCLot: 4147871)							



Sub-Matrix: SOIL

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP069: Toxaphene (QCLot: 4147871) - continued							
EW2200300-002	N2	EP069: Toxaphene	8001-35-2	10 mg/kg	91.5	54.2	138
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 4132104)							
EW2200300-001	N1	EP071-SD: C10 - C14 Fraction	----	14 mg/kg	81.7	70.0	130
		EP071-SD: C15 - C28 Fraction	----	59 mg/kg	86.8	70.0	130
		EP071-SD: C29 - C36 Fraction	----	42 mg/kg	86.3	70.0	130
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 4134153)							
EW2200300-001	N1	EP080-SD: C6 - C9 Fraction	----	6.5 mg/kg	89.3	70.0	130
EP080-SD: BTEXN (QCLot: 4134153)							
EW2200300-001	N1	EP080-SD: Benzene	71-43-2	0.5 mg/kg	84.7	70.0	130
		EP080-SD: Toluene	108-88-3	0.5 mg/kg	77.2	70.0	130
		EP080-SD: Ethylbenzene	100-41-4	0.5 mg/kg	81.0	70.0	130
		EP080-SD: meta- & para-Xylene	108-38-3	0.5 mg/kg	81.8	70.0	130
		EP080-SD: ortho-Xylene	95-47-6	0.5 mg/kg	83.4	70.0	130
EP090: Organotin Compounds (QCLot: 4139408)							
EW2200300-004	N4	EP090: Monobutyltin	78763-54-9	1.25 µgSn/kg	# 15.2	20.0	130
		EP090: Dibutyltin	1002-53-5	1.25 µgSn/kg	42.9	20.0	130
		EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	76.8	20.0	130
EP130A: Organophosphorus Pesticides (Ultra-trace) (QCLot: 4132032)							
EW2200300-001	N1	EP130: Bromophos-ethyl	4824-78-6	50 µg/kg	66.6	36.0	144
		EP130: Carbophenothion	786-19-6	50 µg/kg	60.2	38.0	120
		EP130: Chlorfenvinphos (E)	18708-86-6	5 µg/kg	79.8	49.0	157
		EP130: Chlorfenvinphos (Z)	18708-87-7	50 µg/kg	76.0	53.0	145
		EP130: Chlorpyrifos	2921-88-2	50 µg/kg	69.4	60.0	140
		EP130: Chlorpyrifos-methyl	5598-13-0	50 µg/kg	65.6	56.0	126
		EP130: Demeton-S-methyl	919-86-8	50 µg/kg	51.9	9.70	148
		EP130: Diazinon	333-41-5	50 µg/kg	67.0	60.0	122
		EP130: Dichlorvos	62-73-7	50 µg/kg	54.4	33.0	123
		EP130: Dimethoate	60-51-5	50 µg/kg	73.9	36.0	142
		EP130: Ethion	563-12-2	50 µg/kg	68.0	48.0	136
		EP130: Fenamiphos	22224-92-6	50 µg/kg	71.1	42.0	136
		EP130: Fenthion	55-38-9	50 µg/kg	65.7	35.0	131
		EP130: Malathion	121-75-5	50 µg/kg	67.1	55.0	141
		EP130: Azinphos Methyl	86-50-0	50 µg/kg	50.9	23.5	132
		EP130: Monocrotophos	6923-22-4	50 µg/kg	45.7	35.0	153
		EP130: Parathion	56-38-2	50 µg/kg	59.0	57.0	147
		EP130: Parathion-methyl	298-00-0	50 µg/kg	83.3	48.0	140
		EP130: Pirimphos-ethyl	23505-41-1	50 µg/kg	63.9	45.0	137



Sub-Matrix: SOIL

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP130A: Organophosphorus Pesticides (Ultra-trace) (QCLot: 4132032) - continued							
EW2200300-001	N1	EP130: Prothiofos	34643-46-4	50 µg/kg	64.7	51.0	137
EP131A: Organochlorine Pesticides (QCLot: 4132034)							
EW2200300-001	N1	EP131A: Aldrin	309-00-2	5 µg/kg	59.8	23.4	153
		EP131A: alpha-BHC	319-84-6	5 µg/kg	42.1	17.6	156
		EP131A: beta-BHC	319-85-7	5 µg/kg	38.7	24.9	153
		EP131A: delta-BHC	319-86-8	5 µg/kg	43.0	25.2	147
		EP131A: 4.4'-DDD	72-54-8	5 µg/kg	40.9	25.9	150
		EP131A: 4.4'-DDE	72-55-9	5 µg/kg	43.5	31.2	125
		EP131A: 4.4'-DDT	50-29-3	5 µg/kg	52.4	23.4	163
		EP131A: Dieldrin	60-57-1	5 µg/kg	44.8	30.2	140
		EP131A: alpha-Endosulfan	959-98-8	5 µg/kg	41.9	28.8	135
		EP131A: beta-Endosulfan	33213-65-9	5 µg/kg	40.4	22.6	141
		EP131A: Endosulfan sulfate	1031-07-8	5 µg/kg	71.6	16.1	156
		EP131A: Endrin	72-20-8	5 µg/kg	88.7	17.7	162
		EP131A: Endrin aldehyde	7421-93-4	5 µg/kg	37.9	20.1	116
		EP131A: Endrin ketone	53494-70-5	5 µg/kg	44.2	13.4	151
		EP131A: Heptachlor	76-44-8	5 µg/kg	57.6	23.8	170
		EP131A: Heptachlor epoxide	1024-57-3	5 µg/kg	35.4	28.3	140
		EP131A: Hexachlorobenzene (HCB)	118-74-1	5 µg/kg	44.4	17.7	144
		EP131A: gamma-BHC	58-89-9	5 µg/kg	42.1	21.8	158
EP131A: Methoxychlor	72-43-5	5 µg/kg	70.4	24.4	158		
EP131A: cis-Chlordane	5103-71-9	5 µg/kg	46.6	27.3	139		
EP131A: trans-Chlordane	5103-74-2	5 µg/kg	43.6	29.5	138		
EP131B: Polychlorinated Biphenyls (as Aroclors) (QCLot: 4132033)							
EW2200300-001	N1	EP131B: Total Polychlorinated biphenyls	----	50 µg/kg	79.1	44.0	136
		EP131B: Aroclor 1254	11097-69-1	50 µg/kg	79.1	44.0	136
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 4132019)							
EW2200300-002	N2	EP132B-SD: Naphthalene	91-20-3	25 µg/kg	97.4	70.0	130
		EP132B-SD: 2-Methylnaphthalene	91-57-6	25 µg/kg	99.5	70.0	130
		EP132B-SD: Acenaphthylene	208-96-8	25 µg/kg	98.4	70.0	130
		EP132B-SD: Acenaphthene	83-32-9	25 µg/kg	92.9	70.0	130
		EP132B-SD: Fluorene	86-73-7	25 µg/kg	97.1	70.0	130
		EP132B-SD: Phenanthrene	85-01-8	25 µg/kg	87.5	70.0	130
		EP132B-SD: Anthracene	120-12-7	25 µg/kg	103	70.0	130
		EP132B-SD: Fluoranthene	206-44-0	25 µg/kg	97.5	70.0	130
		EP132B-SD: Pyrene	129-00-0	25 µg/kg	92.5	70.0	130
		EP132B-SD: Benz(a)anthracene	56-55-3	25 µg/kg	107	70.0	130
		EP132B-SD: Chrysene	218-01-9	25 µg/kg	97.4	70.0	130



Sub-Matrix: SOIL

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 4132019) - continued							
EW2200300-002	N2	EP132B-SD: Benzo(b+j)fluoranthene	205-99-2	25 µg/kg	95.0	70.0	130
			205-82-3				
		EP132B-SD: Benzo(k)fluoranthene	207-08-9	25 µg/kg	83.6	70.0	130
		EP132B-SD: Benzo(e)pyrene	192-97-2	25 µg/kg	84.9	70.0	130
		EP132B-SD: Benzo(a)pyrene	50-32-8	25 µg/kg	96.4	70.0	130
		EP132B-SD: Perylene	198-55-0	25 µg/kg	94.6	70.0	130
		EP132B-SD: Benzo(g,h,i)perylene	191-24-2	25 µg/kg	93.5	70.0	130
		EP132B-SD: Dibenz(a,h)anthracene	53-70-3	25 µg/kg	91.2	70.0	130
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	92.7	70.0	130
		EP132B-SD: Coronene	191-07-1	25 µg/kg	92.9	70.0	130
EP201: Carbamate Pesticides by LCMS (QCLot: 4138995)							
ES2201966-001	Anonymous	EP201: Oxamyl	23135-22-0	0.04 mg/kg	138	74.0	152
		EP201: Methomyl	16752-77-5	0.04 mg/kg	106	75.0	145
		EP201: 3-Hydroxy Carbofuran	16655-82-6	0.04 mg/kg	135	80.0	146
		EP201: Aldicarb	116-06-3	0.04 mg/kg	122	82.0	138
		EP201: Bendiocarb	22781-23-3	0.04 mg/kg	132	76.0	142
		EP201: Thiodicarb	59669-26-0	0.04 mg/kg	130	76.0	148
		EP201: Carbofuran	1563-66-2	0.04 mg/kg	127	78.0	140
		EP201: Carbaryl	63-25-2	0.04 mg/kg	131	63.0	139
		EP201: Methiocarb	2032-65-7	0.04 mg/kg	125	70.0	144
EP202A: Phenoxyacetic Acid Herbicides by LCMS (QCLot: 4133758)							
EB2201250-001	Anonymous	EP202: Mecoprop	93-65-2	0.1 mg/kg	# 52.9	60.0	140
		EP202: MCPA	94-74-6	0.1 mg/kg	# 33.7	57.0	143
		EP202: 2.4-D	94-75-7	0.1 mg/kg	# 37.3	68.0	139
		EP202: Triclopyr	55335-06-3	0.1 mg/kg	# 42.9	51.0	145
		EP202: 2.4.5-T	93-76-5	0.1 mg/kg	# 40.0	57.0	142
		EP202: Picloram	1918-02-1	0.1 mg/kg	82.4	49.0	138
		EP202: Clopyralid	1702-17-6	0.1 mg/kg	# 14.0	49.0	149

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EW2200300	Page	: 1 of 12
Client	: ADVISIAN PTY LTD	Laboratory	: Environmental Division NSW South Coast
Contact	: MS KATIE NEWTON	Telephone	: 02 42253125
Project	: Narooma Wharf Upgrade	Date Samples Received	: 20-Jan-2022
Site	: ----	Issue Date	: 08-Feb-2022
Sampler	: Client, KATIE NEWTON	No. of samples received	: 8
Order number	: ----	No. of samples analysed	: 6

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- **NO** Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers exist - please see following pages for full details.



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EP090: Organotin Compounds	EW2200300--004	N4	Monobutyltin	78763-54-9	15.2 %	20.0-130%	Recovery less than lower data quality objective
EP202A: Phenoxyacetic Acid Herbicides by LCMS	EB2201250--001	Anonymous	Mecoprop	93-65-2	52.9 %	60.0-140%	Recovery less than lower data quality objective
EP202A: Phenoxyacetic Acid Herbicides by LCMS	EB2201250--001	Anonymous	MCPA	94-74-6	33.7 %	57.0-143%	Recovery less than lower data quality objective
EP202A: Phenoxyacetic Acid Herbicides by LCMS	EB2201250--001	Anonymous	2,4-D	94-75-7	37.3 %	68.0-139%	Recovery less than lower data quality objective
EP202A: Phenoxyacetic Acid Herbicides by LCMS	EB2201250--001	Anonymous	Triclopyr	55335-06-3	42.9 %	51.0-145%	Recovery less than lower data quality objective
EP202A: Phenoxyacetic Acid Herbicides by LCMS	EB2201250--001	Anonymous	2,4,5-T	93-76-5	40.0 %	57.0-142%	Recovery less than lower data quality objective
EP202A: Phenoxyacetic Acid Herbicides by LCMS	EB2201250--001	Anonymous	Clopyralid	1702-17-6	14.0 %	49.0-149%	Recovery less than lower data quality objective

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
Moisture Content	1	12	8.33	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Total Metals by ICP-AES	0	6	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
Container / Client Sample ID(s)							



Matrix: SOIL

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA002: pH 1:5 (Soils)								
Soil Glass Jar - Unpreserved (EA002) N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	27-Jan-2022	✓	25-Jan-2022	25-Jan-2022	✓	
EA003 :pH (field/fox)								
Snap Lock Bag - frozen on receipt at ALS (EA003) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	
EA029-A: pH Measurements								
Snap Lock Bag - frozen on receipt at ALS (EA029) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	
EA029-B: Acidity Trail								
Snap Lock Bag - frozen on receipt at ALS (EA029) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	
EA029-C: Sulfur Trail								
Snap Lock Bag - frozen on receipt at ALS (EA029) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	
EA029-D: Calcium Values								
Snap Lock Bag - frozen on receipt at ALS (EA029) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	
EA029-E: Magnesium Values								
Snap Lock Bag - frozen on receipt at ALS (EA029) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	
EA029-F: Excess Acid Neutralising Capacity								
Snap Lock Bag - frozen on receipt at ALS (EA029) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	
EA029-G: Retained Acidity								
Snap Lock Bag - frozen on receipt at ALS (EA029) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	
EA029-H: Acid Base Accounting								
Snap Lock Bag - frozen on receipt at ALS (EA029) N2, N3, N4, N5	20-Jan-2022	28-Jan-2022	15-Oct-2024	✓	28-Jan-2022	28-Apr-2022	✓	



Matrix: SOIL

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055) N1, N2, N3, N4, N5, N6	20-Jan-2022	----	----	----	24-Jan-2022	03-Feb-2022	✓	
EA150: Particle Sizing								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) N1, N2, N3, N4, N5, N6	20-Jan-2022	----	----	----	27-Jan-2022	19-Jul-2022	✓	
EA150: Soil Classification based on Particle Size								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) N1, N2, N3, N4, N5, N6	20-Jan-2022	----	----	----	27-Jan-2022	19-Jul-2022	✓	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Soil Glass Jar - Unpreserved (EG005-SD) N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	19-Jul-2022	✓	25-Jan-2022	19-Jul-2022	✓	
EG005(ED093)T: Total Metals by ICP-AES								
Soil Glass Jar - Unpreserved (EG005T) N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	19-Jul-2022	✓	25-Jan-2022	19-Jul-2022	✓	
EG020-SD: Total Metals in Sediments by ICPMS								
Soil Glass Jar - Unpreserved (EG020-SD) N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	19-Jul-2022	✓	25-Jan-2022	19-Jul-2022	✓	
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T-LL) N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	17-Feb-2022	✓	27-Jan-2022	17-Feb-2022	✓	
EK057G: Nitrite as N by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK057G) N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	27-Jan-2022	✓	25-Jan-2022	26-Jan-2022	✓	



Matrix: SOIL

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK059G)								
N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	17-Feb-2022	✓	25-Jan-2022	26-Jan-2022	✓	
EP003: Total Organic Carbon (TOC) in Soil								
Soil Glass Jar - Unpreserved (EP003)								
N1, N2, N3, N4, N5, N6	20-Jan-2022	28-Jan-2022	17-Feb-2022	✓	28-Jan-2022	17-Feb-2022	✓	
EP068C: Triazines								
Soil Glass Jar - Unpreserved (EP068)								
N1, N2, N3, N4, N5, N6	20-Jan-2022	25-Jan-2022	03-Feb-2022	✓	27-Jan-2022	06-Mar-2022	✓	
EP069: Toxaphene								
Soil Glass Jar - Unpreserved (EP069)								
N1, N2, N3, N4, N5, N6	20-Jan-2022	01-Feb-2022	03-Feb-2022	✓	01-Feb-2022	13-Mar-2022	✓	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Soil Glass Jar - Unpreserved (EP071-SD)								
N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	03-Feb-2022	✓	25-Jan-2022	05-Mar-2022	✓	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
Soil Glass Jar - Unpreserved (EP071-SD)								
N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	03-Feb-2022	✓	25-Jan-2022	05-Mar-2022	✓	
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons								
Soil Glass Jar - Unpreserved (EP080-SD)								
N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	03-Feb-2022	✓	25-Jan-2022	03-Feb-2022	✓	
EP080-SD: BTEXN								
Soil Glass Jar - Unpreserved (EP080-SD)								
N1, N2, N3, N4, N5, N6	20-Jan-2022	24-Jan-2022	03-Feb-2022	✓	25-Jan-2022	03-Feb-2022	✓	



Matrix: **SOIL**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EP090: Organotin Compounds								
Soil Glass Jar - Unpreserved (EP090) N1, N3, N5, N2, N4, N6	20-Jan-2022	27-Jan-2022	03-Feb-2022	✓	28-Jan-2022	08-Mar-2022	✓	
EP130A: Organophosphorus Pesticides (Ultra-trace)								
Soil Glass Jar - Unpreserved (EP130) N1, N3, N5, N2, N4, N6	20-Jan-2022	24-Jan-2022	03-Feb-2022	✓	31-Jan-2022	05-Mar-2022	✓	
EP131A: Organochlorine Pesticides								
Soil Glass Jar - Unpreserved (EP131A) N1, N3, N5, N2, N4, N6	20-Jan-2022	24-Jan-2022	03-Feb-2022	✓	31-Jan-2022	05-Mar-2022	✓	
EP131B: Polychlorinated Biphenyls (as Aroclors)								
Soil Glass Jar - Unpreserved (EP131B) N1, N3, N5, N2, N4, N6	20-Jan-2022	24-Jan-2022	03-Feb-2022	✓	31-Jan-2022	05-Mar-2022	✓	
EP132B: Polynuclear Aromatic Hydrocarbons								
Soil Glass Jar - Unpreserved (EP132B-SD) N1, N3, N5, N2, N4, N6	20-Jan-2022	24-Jan-2022	03-Feb-2022	✓	28-Jan-2022	05-Mar-2022	✓	
EP201: Carbamate Pesticides by LCMS								
Soil Glass Jar - Unpreserved (EP201) N1, N3, N5, N2, N4, N6	20-Jan-2022	27-Jan-2022	03-Feb-2022	✓	27-Jan-2022	08-Mar-2022	✓	
EP202A: Phenoxyacetic Acid Herbicides by LCMS								
Soil Glass Jar - Unpreserved (EP202) N1, N3, N5, N2, N4, N6	20-Jan-2022	25-Jan-2022	03-Feb-2022	✓	25-Jan-2022	06-Mar-2022	✓	



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Reaular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Carbamate Pesticides by LCMS	EP201	2	11	18.18	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	1	12	8.33	10.00	✖	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	8	12.50	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	8	12.50	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Organophosphorus Pesticides (Ultra-trace)	EP130	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
PCB's (Ultra-trace)	EP131B	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	10	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	13	15.38	10.00	✔	NEPM 2013 B3 & ALS QC Standard
pH field/fox	EA003	1	7	14.29	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	2	14	14.29	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	2	12	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	11	18.18	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Toxaphene by GCMS	EP069	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatle Fraction	EP071-SD	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	6	16.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Carbamate Pesticides by LCMS	EP201	1	11	9.09	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	8	12.50	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	8	12.50	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Organophosphorus Pesticides (Ultra-trace)	EP130	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
PCB's (Ultra-trace)	EP131B	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	10	10.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	14	7.14	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Matrix: **SOIL** Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Reular	Actual	Expected	Evaluation	
Analytical Methods							
Laboratory Control Samples (LCS) - Continued							
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	12	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Toxaphene by GCMS	EP069	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Carbamate Pesticides by LCMS	EP201	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Organophosphorus Pesticides (Ultra-trace)	EP130	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PCB's (Ultra-trace)	EP131B	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	10	10.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	12	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Toxaphene by GCMS	EP069	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Carbamate Pesticides by LCMS	EP201	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Organophosphorus Pesticides (Ultra-trace)	EP130	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
Analytical Methods							
Matrix Spikes (MS) - Continued							
PAHs in Sediments by GCMS(SIM)	EP132B-SD	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
PCB's (Ultra-trace)	EP131B	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	10	10.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	1	14	7.14	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	0	6	0.00	5.00	✖	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Toxaphene by GCMS	EP069	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	1	6	16.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
pH field/fox	EA003	SOIL	In house: Referenced to Ahern et al 1998 - determined on a 1:5 soil/water extract designed to simulate field measured pH and pH after the extract has been oxidised with peroxide.
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	SOIL	In house: Referenced to Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3
Total Fe and Al in Sediments by ICPAES	EG005-SD	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3). LORs per NODG
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Total Metals in Sediments by ICPMS	EG020-SD	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector. Analyte list and LORs per NODG.
Total Mercury by FIMS (Low Level)	EG035T-LL	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Nitrite as N - Soluble by Discrete Analyser	EK057G	SOIL	In house: Referenced to APHA 4500-NO ₃ - B. Nitrite in a water extract is determined by direct colourimetry by Discrete Analyser.
Nitrate as N - Soluble by Discrete Analyser	EK058G	SOIL	In house: Referenced to APHA 4500-NO ₃ - F. Nitrate in the 1:5 soil:water extract is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results.
Nitrite and Nitrate as N (NO _x)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NO _x -N) and nitrate (NO ₃ -N) by calculation, Combined oxidised Nitrogen (NO ₂ +NO ₃) in a water extract is determined by direct colourimetry by Discrete Analyser.



Analytical Methods	Method	Matrix	Method Descriptions
Total Organic Carbon	EP003	SOIL	In house C-IR17. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO ₂) is automatically measured by infra-red detector.
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270 Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM Schedule B(3).
Toxaphene by GCMS	EP069	SOIL	In house: Referenced to USEPA 8276. Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM Schedule B(3).
TPH - Semivolatile Fraction	EP071-SD	SOIL	In house: Referenced to USEPA SW 846 - 8270. Extracts are analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX in Sediments	EP080-SD	SOIL	In house: Referenced to USEPA SW 846 - 8260 Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve.
Organotin Analysis	EP090	SOIL	In house: Referenced to USEPA SW 846 - 8270 Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quantified against an established calibration curve.
Organophosphorus Pesticides (Ultra-trace)	EP130	SOIL	In house: Referenced to USEPA Method 3640 (GPC cleanup), 8141 (GC/FPD - Capillary Column) This technique is compliant with NEPM Schedule B(3)
Organochlorine Pesticides (Ultra-trace)	EP131A	SOIL	In house: Referenced to USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/μECD/μECD) This technique is compliant with NEPM Schedule B(3)
PCB's (Ultra-trace)	EP131B	SOIL	In house: Referenced to USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/μECD/μECD) This technique is compliant with NEPM Schedule B(3)
PAHs in Sediments by GCMS(SIM)	EP132B-SD	SOIL	In house: Referenced to USEPA 8270 GCMS Capillary column, SIM mode using large volume programmed temperature vaporisation injection.
Carbamate Pesticides by LCMS	EP201	SOIL	In house: Referenced to USEPA Method 8318 LCMS (ES in positive mode). Residues of carbamates are extracted from soil samples using acetonitrile. The extract is evaporated to near dryness and the residues are dissolved in HPLC mobile phase prior to instrumental analysis.
Phenoxyacetic Acid Herbicides (LCMS - Standard DL)	EP202	SOIL	In house: LCMS (Electrospray in negative mode). Residues of acid herbicides are extracted from soil samples under the alkaline condition. An aliquot of the alkaline aqueous phase is taken and acidified before a SPE cleanup. After eluting off from the SPE cartridge, residues of acid herbicides are dissolved in HPLC mobile phase prior to instrument analysis.

Preparation Methods	Method	Matrix	Method Descriptions
Drying only	EN020D	SOIL	In house
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.



Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Extraction for Carbamates in Soils	EP201-PR	SOIL	In house: Referenced to USEPA Method 8318
Extraction for Phenoxy Acid Herbicides in Soils.	EP202-PR	SOIL	In-House: Alkaline extract followed by SPE clean up of acidified portion of the sample extract.
Dry and Pulverise (up to 100g)	GEO30	SOIL	#
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na ₂ SO ₄ and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Tumbler Extraction of Solids (Option A - Concentrating)	ORG17A	SOIL	In house: Mechanical agitation (tumbler). 20g of sample, Na ₂ SO ₄ and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Tumbler Extraction of Solids/ Sample Cleanup	ORG17A-UTP	SOIL	In house: Mechanical agitation (tumbler). 20g of sample, Na ₂ SO ₄ and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. Samples are extracted, concentrated (by KD) and exchanged into an appropriate solvent for GPC and florisil cleanup as required.
Tumbler Extraction of Solids for LVI (Non-concentrating)	ORG17D	SOIL	In house: 10g of sample, Na ₂ SO ₄ and surrogate are extracted with 50mL 1:1 DCM/Acetone by end over end tumbling. An aliquot is concentrated by nitrogen blowdown to a reduced volume for analysis if required.
Organotin Sample Preparation	ORG35	SOIL	In house: 20g sample is spiked with surrogate and leached in a methanol:acetic acid:UHP water mix and vacuum filtered. Reagents and solvents are added to the sample and the mixture tumbled. The butyltin compounds are simultaneously derivatised and extracted. The extract is further extracted with petroleum ether. The resultant extracts are combined and concentrated for analysis.



Appendix D
95% UCLs

Nonparametric UCL Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation ProUCL 5.115/02/2022 3:05:22 PM
 From File data.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Aluminium

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	780	Mean	2707
Maximum	4550	Median	2595
SD	1346	Std. Error of Mean	549.6
			-
			0.009
Coefficient of Variation	0.497	Skewness	74
		SD of logged Data	
Mean of logged Data	7.767		0.626

Note: Sample size is small (e.g., <10), if data are collected using ISM approach

you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3814	95% Adjusted-CLT UCL (Chen-1995)	3608

		95% Modified-t UCL (Johnson-1978)	3814
Nonparametric Distribution Free UCLs			
95% CLT UCL	3611	95% Jackknife UCL	3814
95% Standard Bootstrap UCL	3521	95% Bootstrap-t UCL	3960
95% Hall's Bootstrap UCL	4111	95% Percentile Bootstrap UCL	3547
95% BCA Bootstrap UCL	3528		
90% Chebyshev(Mean, Sd) UCL	4356	95% Chebyshev(Mean, Sd) UCL	5102
97.5% Chebyshev(Mean, Sd) UCL	6139	99% Chebyshev(Mean, Sd) UCL	8175
Suggested UCL to Use			
Data appear Normal, May want to try Normal Distribution			
<p>Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.</p>			
<p>Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.</p>			

Iron			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	2060	Mean	8633
Maximum	12900	Median	9265
SD	3757	Std. Error of Mean	1534
Coefficient of Variation	0.435	Skewness	-1.09

Mean of logged Data	8.927	SD of logged Data	0.665
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Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
 Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics
 Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
		95% Adjusted-CLT UCL	1042
95% Student's-t UCL	11724	(Chen-1995)	7
		95% Modified-t UCL	1161
		(Johnson-1978)	1

Nonparametric Distribution Free UCLs

95% CLT UCL	11157	95% Jackknife UCL	1172
95% Standard Bootstrap UCL	11033	95% Bootstrap-t UCL	4
95% Hall's Bootstrap UCL	10583	95% Percentile Bootstrap UCL	1102
95% BCA Bootstrap UCL	10477	95% Chebyshev(Mean, Sd) UCL	5
90% Chebyshev(Mean, Sd) UCL	13235	99% Chebyshev(Mean, Sd) UCL	1077
97.5% Chebyshev(Mean, Sd) UCL	18213		3
			1532
			0
			2389
			6

Suggested UCL to Use
 Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Barium

General Statistics

Total Number of Observations	6	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	5	Mean	10.83
Maximum	20	Median	10
SD	4.916	Std. Error of Mean	2.007
Coefficient of Variation	0.454	Skewness	1.438
Mean of logged Data	2.303	SD of logged Data	0.438

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL

Statistics

Data appear Approximate Lognormal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.88	95% Adjusted-CLT UCL (Chen-1995)	15.39
		95% Modified-t UCL (Johnson-1978)	15.07

Nonparametric Distribution Free UCLs

95% CLT UCL	14.13	95% Jackknife UCL	14.88
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A

95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	16.85	95% Chebyshev(Mean, Sd) UCL	19.58
97.5% Chebyshev(Mean, Sd) UCL	23.37	99% Chebyshev(Mean, Sd) UCL	30.8

Suggested UCL to Use
Data appear Approximate Lognormal, May want to try Lognormal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	3.95	Mean	5.225
Maximum	6.81	Median	5.145
SD	0.924	Std. Error of Mean	0.377
Coefficient of Variation	0.177	Skewness	0.715
Mean of logged Data	1.641	SD of logged Data	0.175

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics
Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.985	95% Adjusted-CLT UCL (Chen-1995)	5.963
		95% Modified-t UCL (Johnson-1978)	6.004

Nonparametric Distribution Free UCLs

95% CLT UCL	5.846	95% Jackknife UCL	5.985
95% Standard Bootstrap UCL	5.79	95% Bootstrap-t UCL	6.108
95% Hall's Bootstrap UCL	6.818	95% Percentile Bootstrap UCL	5.807
95% BCA Bootstrap UCL	5.943		
90% Chebyshev(Mean, Sd) UCL	6.357	95% Chebyshev(Mean, Sd) UCL	6.87
97.5% Chebyshev(Mean, Sd) UCL	7.582	99% Chebyshev(Mean, Sd) UCL	8.98

Suggested UCL to Use
Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	4.4	Mean	9.267
Maximum	22.8	Median	6.2

SD	6.941	Std. Error of Mean	2.834
Coefficient of Variation	0.749	Skewness	2.022
Mean of logged Data	2.053	SD of logged Data	0.599

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL

Statistics

Data appear Approximate Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.98	95% Adjusted-CLT UCL (Chen-1995)	16.43
		95% Modified-t UCL (Johnson-1978)	15.37

Nonparametric Distribution Free UCLs

95% CLT UCL	13.93	95% Jackknife UCL	14.98
95% Standard Bootstrap UCL	13.55	95% Bootstrap-t UCL	39.43
95% Hall's Bootstrap UCL	42.58	95% Percentile Bootstrap UCL	14.2
95% BCA Bootstrap UCL	15.8		
90% Chebyshev(Mean, Sd) UCL	17.77	95% Chebyshev(Mean, Sd) UCL	21.62
97.5% Chebyshev(Mean, Sd) UCL	26.96	99% Chebyshev(Mean, Sd) UCL	37.46

Suggested UCL to Use

Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	1.4	Mean	7.217
Maximum	15.1	Median	6.6
SD	4.879	Std. Error of Mean	1.992
Coefficient of Variation	0.676	Skewness	0.679
Mean of logged Data	1.733	SD of logged Data	0.837

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL

Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	11.23	95% Adjusted-CLT UCL (Chen-1995)	11.08
		95% Modified-t UCL (Johnson-1978)	11.32

Nonparametric Distribution Free UCLs

95% CLT UCL	10.49	95% Jackknife UCL	11.23
95% Standard Bootstrap UCL	10.2	95% Bootstrap-t UCL	12.58

95% Hall's Bootstrap UCL	12.66	95% Percentile Bootstrap UCL	10.38
95% BCA Bootstrap UCL	10.92		
90% Chebyshev(Mean, Sd) UCL	13.19	95% Chebyshev(Mean, Sd) UCL	15.9
97.5% Chebyshev(Mean, Sd) UCL	19.65	99% Chebyshev(Mean, Sd) UCL	27.03

Suggested UCL to Use
Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Cobalt			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.6	Mean	8.867
Maximum	33.6	Median	4.7
SD	12.29	Std. Error of Mean	5.018
Coefficient of Variation	1.386	Skewness	2.294
		SD of logged Data	1.3

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics
Data appear Gamma Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	18.98	95% Adjusted-CLT UCL (Chen-1995)	22.14
		95% Modified-t UCL (Johnson-1978)	19.76

Nonparametric Distribution Free UCLs

95% CLT UCL	17.12	95% Jackknife UCL	18.98
95% Standard Bootstrap UCL	16.24	95% Bootstrap-t UCL	49.79
95% Hall's Bootstrap UCL	60.06	95% Percentile Bootstrap UCL	18.05
95% BCA Bootstrap UCL	19.33		
90% Chebyshev(Mean, Sd) UCL	23.92	95% Chebyshev(Mean, Sd) UCL	30.74
97.5% Chebyshev(Mean, Sd) UCL	40.2	99% Chebyshev(Mean, Sd) UCL	58.79

Suggested UCL to Use

Data appear Gamma, May want to try Gamma Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	1.2	Mean	4.517
Maximum	6.4	Median	5.15

SD	1.886	Std. Error of Mean	0.77
Coefficient of Variation	0.418	Skewness	1.282
Mean of logged Data	1.385	SD of logged Data	0.623

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics
Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.068	95% Adjusted-CLT UCL (Chen-1995)	5.353
		95% Modified-t UCL (Johnson-1978)	6.001

Nonparametric Distribution Free UCLs

95% CLT UCL	5.783	95% Jackknife UCL	6.068
95% Standard Bootstrap UCL	5.673	95% Bootstrap-t UCL	5.691
95% Hall's Bootstrap UCL	5.376	95% Percentile Bootstrap UCL	5.617
95% BCA Bootstrap UCL	5.517		
90% Chebyshev(Mean, Sd) UCL	6.827	95% Chebyshev(Mean, Sd) UCL	7.873
97.5% Chebyshev(Mean, Sd) UCL	9.325	99% Chebyshev(Mean, Sd) UCL	12.18

Suggested UCL to Use
Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Manganese

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	11	Mean	42.17
Maximum	118	Median	27
SD	39.34	Std. Error of Mean	16.06
Coefficient of Variation	0.933	Skewness	1.914
Mean of logged Data	3.444	SD of logged Data	0.815

Note: Sample size is small (e.g., <10), if data are collected using ISM approach

you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL

Statistics

Data appear Approximate Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	74.53	95% Adjusted-CLT UCL (Chen-1995)	81.99
		95% Modified-t UCL (Johnson-1978)	76.62

Nonparametric Distribution Free UCLs

95% CLT UCL	68.58	95% Jackknife UCL	74.53
95% Standard Bootstrap UCL	66.92	95% Bootstrap-t UCL	156
95% Hall's Bootstrap UCL	226	95% Percentile Bootstrap UCL	70.33
95% BCA Bootstrap UCL	75.33		
90% Chebyshev(Mean, Sd) UCL	90.34	95% Chebyshev(Mean, Sd) UCL	112.2
97.5% Chebyshev(Mean, Sd) UCL	142.5	99% Chebyshev(Mean, Sd) UCL	202
Suggested UCL to Use			
Data appear Normal, May want to try Normal Distribution			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Nickel			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	1.4	Mean	7.217
Maximum	14.4	Median	5.9
SD	4.543	Std. Error of Mean	1.855
Coefficient of Variation	0.63	Skewness	0.616
Mean of logged Data	1.759	SD of logged Data	0.801
Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options.			

Nonparametric Distribution Free UCL

Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	10.95	95% Adjusted-CLT UCL (Chen-1995)	10.77
		95% Modified-t UCL (Johnson-1978)	11.03

Nonparametric Distribution Free UCLs

95% CLT UCL	10.27	95% Jackknife UCL	10.95
95% Standard Bootstrap UCL	10.01	95% Bootstrap-t UCL	13.49
95% Hall's Bootstrap UCL	42.32	95% Percentile Bootstrap UCL	10.05
95% BCA Bootstrap UCL	10.07		
90% Chebyshev(Mean, Sd) UCL	12.78	95% Chebyshev(Mean, Sd) UCL	15.3
97.5% Chebyshev(Mean, Sd) UCL	18.8	99% Chebyshev(Mean, Sd) UCL	25.67

Suggested UCL to Use

Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

General Statistics

Total Number of Observations	6	Number of Distinct Observations	4
		Number of Missing Observations	0

Minimum	0.3	Mean	0.55
		Medi	
Maximum	0.7	an	0.55
		Std. Error of	0.061
SD	0.152	Mean	9
			-
Coefficient of Variation	0.276	Skewness	0.774
		SD of logged	
Mean of logged Data	-0.636	Data	0.316

Note: Sample size is small (e.g., <10), if data are collected using ISM approach

you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL

Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
		95% Adjusted-CLT UCL	
95% Student's-t UCL	0.675	(Chen-1995)	0.631
		95% Modified-t UCL (Johnson-1978)	0.671

Nonparametric Distribution Free UCLs

95% CLT UCL	0.652	95% Jackknife UCL	0.675
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.736	95% Chebyshev(Mean, Sd) UCL	0.82
97.5% Chebyshev(Mean, Sd) UCL	0.937	99% Chebyshev(Mean, Sd) UCL	1.166

Suggested UCL to Use

Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Vanadium

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	4.7	Mean	12.33
Maximum	22.4	Median	10.6
SD	6.418	Std. Error of Mean	2.62
Coefficient of Variation	0.52	Skewness	0.71
Mean of logged Data	2.393	SD of logged Data	0.55

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	17.61	95% Adjusted-CLT UCL (Chen-1995)	17.45

		95% Modified-t UCL (Johnson-1978)	17.74
Nonparametric Distribution Free UCLs			
95% CLT UCL	16.64	95% Jackknife UCL	17.61
95% Standard Bootstrap UCL	16.22	95% Bootstrap-t UCL	22.18
95% Hall's Bootstrap UCL	60	95% Percentile Bootstrap UCL	16.35
95% BCA Bootstrap UCL	16.77		
90% Chebyshev(Mean, Sd) UCL	20.19	95% Chebyshev(Mean, Sd) UCL	23.75
97.5% Chebyshev(Mean, Sd) UCL	28.7	99% Chebyshev(Mean, Sd) UCL	38.4
Suggested UCL to Use			
Data appear Normal, May want to try Normal Distribution			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Zinc			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	4	Mean	62.5
Maximum	266	Medi an	30.3
SD	100.3	Std. Error of Mean	40.95
Coefficient of Variation	1.605	Skewness	2.381
Mean of logged Data	3.304	SD of logged Data	1.371
Note: Sample size is small (e.g., <10), if data are collected using ISM approach			

you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL

Statistics

Data appear Approximate Gamma Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
		95% Adjusted-CLT UCL	
95% Student's-t UCL	145	(Chen-1995)	172.4
		95% Modified-t UCL	
		(Johnson-1978)	151.7

Nonparametric Distribution Free UCLs

		95%	
95% CLT UCL	129.9	Jackknife UCL	145
95% Standard Bootstrap UCL	123.1	95% Bootstrap-t UCL	560.3
95% Hall's Bootstrap UCL	656	95% Percentile Bootstrap UCL	139.8
95% BCA Bootstrap UCL	148.3		
90% Chebyshev(Mean, Sd) UCL	185.4	95% Chebyshev(Mean, Sd) UCL	241
97.5% Chebyshev(Mean, Sd) UCL	318.2	99% Chebyshev(Mean, Sd) UCL	470

Suggested UCL to Use

Data appear Approximate Gamma, May want to try Gamma Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Nitrate as N (Sol.)

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.1	Mean	0.183
Maximum	0.3	Median	0.15
SD	0.0983	Std. Error of Mean	0.040
Coefficient of Variation	0.536	Skewness	1
Mean of logged Data	-1.821	SD of logged Data	0.456
			0.548
<p>Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options.</p>			
<p>Nonparametric Distribution Free UCL Statistics</p>			
<p>Data appear Approximate Normal Distributed at 5% Significance Level</p>			
<p>Assuming Normal Distribution</p>			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.264	95% Adjusted-CLT UCL (Chen-1995)	0.257
		95% Modified-t UCL (Johnson-1978)	0.265
<p>Nonparametric Distribution Free UCLs</p>			
95% CLT UCL	0.249	95% Jackknife UCL	0.264
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.304	95% Chebyshev(Mean, Sd) UCL	0.358
97.5% Chebyshev(Mean, Sd) UCL	0.434	99% Chebyshev(Mean, Sd) UCL	0.583

Suggested UCL to Use

Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Nitrite + Nitrate as N (Sol.)

General Statistics

Total Number of Observations	6	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.1	Mean	0.183
Maximum	0.3	Median	0.15
SD	0.0983	Std. Error of Mean	0.040
Coefficient of Variation	0.536	Skewness	1
Mean of logged Data	-1.821	SD of logged Data	0.456
			0.548

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL

Statistics

Data appear Approximate Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.264	95% Adjusted-CLT UCL (Chen-1995)	0.257

		95% Modified-t UCL (Johnson-1978)	0.265
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.249	95% Jackknife UCL	0.264
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.304	95% Chebyshev(Mean, Sd) UCL	0.358
97.5% Chebyshev(Mean, Sd) UCL	0.434	99% Chebyshev(Mean, Sd) UCL	0.583
Suggested UCL to Use			
Data appear Normal, May want to try Normal Distribution			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Total Organic Carbon			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.15	Mean	0.21
Maximum	0.27	Medi an	0.21
SD	0.0498	Std. Error of Mean	0.020 3
Coefficient of Variation	0.237	Skewness	1.25E -15
Mean of logged Data	-1.585	SD of logged Data	0.244

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics
Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL	
95% Student's-t UCL	0.251	(Chen-1995)	0.243
		95% Modified-t UCL (Johnson-1978)	0.251

Nonparametric Distribution Free UCLs

		95%	
95% CLT UCL	0.243	Jackknife UCL	0.251
95% Standard Bootstrap UCL	0.24	95% Bootstrap-t UCL	0.259
95% Hall's Bootstrap UCL	0.25	95% Percentile Bootstrap UCL	0.242
95% BCA Bootstrap UCL	0.238		
90% Chebyshev(Mean, Sd) UCL	0.271	95% Chebyshev(Mean, Sd) UCL	0.299
97.5% Chebyshev(Mean, Sd) UCL	0.337	99% Chebyshev(Mean, Sd) UCL	0.412

Suggested UCL to Use

Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Nonparametric UCL Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation ProUCL 5.116/02/2022 8:13:59 PM
 From File data.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

C15 - C28 Fraction normalised

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	11	Mean	27.17
Maximum	40	Medi an	28
SD	10.57	Std. Error of Mean	4.316
			-
Coefficient of Variation	0.389	Skewness	0.453
		SD of logged Data	0.47

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
 Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35.86	95% Adjusted-CLT UCL (Chen-1995)	33.41

		95% Modified-t UCL (Johnson-1978)	35.73
Nonparametric Distribution Free UCLs			
95% CLT UCL	34.27	95% Jackknife UCL	35.86
95% Standard Bootstrap UCL	33.64	95% Bootstrap-t UCL	35.1
95% Hall's Bootstrap UCL	33.68	95% Percentile Bootstrap UCL	33.5
95% BCA Bootstrap UCL	32.67		
90% Chebyshev(Mean, Sd) UCL	40.11	95% Chebyshev(Mean, Sd) UCL	45.98
97.5% Chebyshev(Mean, Sd) UCL	54.12	99% Chebyshev(Mean, Sd) UCL	70.11
Suggested UCL to Use			
Data appear Normal, May want to try Normal Distribution			
<p>Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.</p>			
<p>Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.</p>			
C29 - C36 Fraction normalised			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3	Mean	11.83
Maximum	20	Median	11
SD	5.601	Std. Error of Mean	2.286

Coefficient of Variation	0.473	Skewness	-
		SD of logged	0.196
Mean of logged Data	2.333	Data	0.651

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics
Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
		95% Adjusted-CLT UCL	
95% Student's-t UCL	16.44	(Chen-1995)	15.4
		95% Modified-t UCL	
		(Johnson-1978)	16.41

Nonparametric Distribution Free UCLs

95% CLT UCL	15.59	95% Jackknife UCL	16.44
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	18.69	95% Chebyshev(Mean, Sd) UCL	21.8
97.5% Chebyshev(Mean, Sd) UCL	26.11	99% Chebyshev(Mean, Sd) UCL	34.58

Suggested UCL to Use

Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

C10 - C36 Fraction (sum) normalised

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	11	Mean	38.5
Maximum	60	Median	41
SD	16.5	Std. Error of Mean	6.737
			-
Coefficient of Variation	0.429	Skewness	0.709
		SD of logged Data	0.597

Note: Sample size is small (e.g., <10), if data are collected using ISM approach

you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	52.07	95% Adjusted-CLT UCL (Chen-1995)	47.5
		95% Modified-t UCL (Johnson-1978)	51.75

Nonparametric Distribution Free UCLs

95% CLT UCL	49.58	95% Jackknife UCL	52.07
95% Standard Bootstrap UCL	48.52	95% Bootstrap-t UCL	49.28
95% Hall's Bootstrap UCL	48.63	95% Percentile Bootstrap UCL	48.17
95% BCA Bootstrap UCL	47		
90% Chebyshev(Mean, Sd) UCL	58.71	95% Chebyshev(Mean, Sd) UCL	67.86
97.5% Chebyshev(Mean, Sd) UCL	80.57	99% Chebyshev(Mean, Sd) UCL	105.5

Suggested UCL to Use
 Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

>C16 - C34 Fraction normalised

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	14	Mean	33.83
Maximum	50	Medi an	35.5
SD	12.56	Std. Error of Mean	5.128
Coefficient of Variation	0.371	Skewness	-0.53
Mean of logged Data	3.448	SD of logged Data	0.452

Note: Sample size is small (e.g., <10), if data are collected using ISM approach

you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL

Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
		95% Adjusted-CLT UCL	
95% Student's-t UCL	44.17	(Chen-1995)	41.08
		95% Modified-t UCL	
		(Johnson-1978)	43.98

Nonparametric Distribution Free UCLs

		95%	
95% CLT UCL	42.27	Jackknife UCL	44.17
95% Standard Bootstrap UCL	41.61	95% Bootstrap-t UCL	42.95
95% Hall's Bootstrap UCL	41.9	95% Percentile Bootstrap UCL	41.33
95% BCA Bootstrap UCL	41		
90% Chebyshev(Mean, Sd) UCL	49.22	95% Chebyshev(Mean, Sd) UCL	56.18
97.5% Chebyshev(Mean, Sd) UCL	65.86	99% Chebyshev(Mean, Sd) UCL	84.85

Suggested UCL to Use

Data appear Normal, May want to try Normal Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

>C34 - C40 Fraction normalised

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	3	Mean	9.5
Maximum	15	Median	9
SD	4.183	Std. Error of Mean	1.708
			-
Coefficient of Variation	0.44	Skewness	0.283
		SD of logged Data	0.565

Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options.

Nonparametric Distribution Free UCL Statistics

Data appear Normal Distributed at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12.94	95% Adjusted-CLT UCL (Chen-1995)	12.1
		95% Modified-t UCL (Johnson-1978)	12.91

Nonparametric Distribution Free UCLs

95% CLT UCL	12.31	95% Jackknife UCL	12.94
95% Standard Bootstrap UCL	12.15	95% Bootstrap-t UCL	13.23
95% Hall's Bootstrap UCL	13.99	95% Percentile Bootstrap UCL	12
95% BCA Bootstrap UCL	11.67		

90% Chebyshev(Mean, Sd) UCL	14.62	95% Chebyshev(Mean, Sd) UCL	16.94
97.5% Chebyshev(Mean, Sd) UCL	20.17	99% Chebyshev(Mean, Sd) UCL	26.49
Suggested UCL to Use			
Data appear Normal, May want to try Normal Distribution			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.			

>C10 - C40 Fraction (sum) normalised			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	14	Mean	42.83
Maximum	65	Median	46
SD	17.26	Std. Error of Mean	7.045
			-
Coefficient of Variation	0.403	Skewness	0.746
		SD of logged Data	0.54
Mean of logged Data	3.659		
Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options.			

Nonparametric Distribution Free UCL
 Statistics
 Data appear Normal Distributed at 5%
 Significance Level

Assuming Normal
 Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	57.03	95% Adjusted-CLT UCL (Chen-1995)	52.13
		95% Modified-t UCL (Johnson-1978)	56.67

Nonparametric Distribution Free
 UCLs

95% CLT UCL	54.42	95% Jackknife UCL	57.03
95% Standard Bootstrap UCL	53.38	95% Bootstrap-t UCL	53.97
95% Hall's Bootstrap UCL	52.95	95% Percentile Bootstrap UCL	52.67
95% BCA Bootstrap UCL	51.33		
90% Chebyshev(Mean, Sd) UCL	63.97	95% Chebyshev(Mean, Sd) UCL	73.54
97.5% Chebyshev(Mean, Sd) UCL	86.83	99% Chebyshev(Mean, Sd) UCL	112.9

Suggested UCL to Use
 Data appear Normal, May want to try Normal
 Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Sum of PAHs normalised

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	2	Mean	356.6
		Median	107.7
Maximum	1746	Standard Error of Mean	279.7
SD	685.2	Skewness	2.379
Coefficient of Variation	1.921	SD of logged Data	2.697
Mean of logged Data	3.827		
<p>Note: Sample size is small (e.g., <10), if data are collected using ISM approach you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options.</p>			
Nonparametric Distribution Free UCL Statistics			
Data appear Gamma Distributed at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
		95% Adjusted-CLT UCL (Chen-1995)	1107
95% Student's-t UCL	920.3	95% Modified-t UCL (Johnson-1978)	965.5
Nonparametric Distribution Free UCLs			
95% CLT UCL	816.7	95% Jackknife UCL	920.3
95% Standard Bootstrap UCL	770.5	95% Bootstrap-t UCL	3559
95% Hall's Bootstrap UCL	3479	95% Percentile Bootstrap UCL	881.3
95% BCA Bootstrap UCL	958.8		
90% Chebyshev(Mean, Sd) UCL	1196	95% Chebyshev(Mean, Sd) UCL	1576
97.5% Chebyshev(Mean, Sd) UCL	2103	99% Chebyshev(Mean, Sd) UCL	3140

Suggested UCL to Use

Data appear Gamma, May want to try Gamma Distribution

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix E

Noise assessment results

Distanced Based Assessment (Construction Scenario)

Please pick from drop-down list in orange cells

Noise area category			R1
RBL or LAs	Day	40	
Background level (dB(A))	Evening	35	
	Night	30	
	Day	50	
L _{Aeq} (15minute)	Day (OOHW)	45	
Noise Management Level (dB(A))	Evening	40	
	Night	35	
Scenario	Structural demolition		
Is there line of sight to receiver?	No (behind rows of buildings)		

Abbreviation	Measure
N	Notification (letterbox drop or equivalent)
SN	Specific notifications
PC	Phone calls
IB	Individual briefings
RO	Respite offer
R1	Respite period 1
R2	Respite period 2
DR	Duration respite
AA	Alternative accommodation
V	Verification

Note that spot check verification of noise levels and individual briefings are not required for projects with less than 3 weeks impact duration

Residential receiver		L _{Aeq} (15minute) noise level above background (L _{Aeq})												L _{Aeq} (15minute) 75 dB(A) or greater (Highly affected)			Sleep disturbance (Less 65 dB(A))
		≤ 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)						
		Noticable			Clearly audible			Moderately intrusive			Highly intrusive						
Affected distance (m)		Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Measures	Within distance (m)	Mitigation level (dB(A))	Affected distance (m)
Undeveloped green fields, rural areas with isolated dwellings	Day	215															
	Day (OOHW)	310															
	Evening	450															
	Night	655	35	N, R1, DR	215	50	N, R1, DR	95	60	N	25	70	N, PC, RO	20	75	65	
Highly Affected	20			N, R2, DR	450	40	N, PC, SN, R2, DR	215	50	AA, N, PC, SN, R2, DR	95	60	N, PC, RO	20	75		
Developed settlements (urban and suburban) or over water	Day	255															
	Day (OOHW)	390															
	Evening	585															
	Night	865	35	N, R2, DR	255	50	N, R1, DR	105	60	N	30	70	N, PC, RO	20	75	75	
Highly Affected	20			N, R1, DR	390	45	N, R1, DR	165	55	N, R1, DR, PC, SN	60	65	N, PC, RO	20	75		
				N, R2, DR	585	40	N, PC, SN, R2, DR	255	50	AA, N, PC, SN, R2, DR	105	60	N, PC, RO	20	75		

Non-residential receiver		L _{Aeq} (15minute) noise level above NML											
		<10 dB(A)			10 to 20 dB(A)			L _{Aeq} (15minute) 75 dB(A) or greater (Highly affected)					
Standard hours		Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	145		N	50	65	N, PC, RO	20	75			
	Day	65	50					N, PC, RO	20	75			
Hospital wards and operating theatres	Day	55	145		N	50	65	N, PC, RO	20	75			
	Day	65	50					N, PC, RO	20	75			
Place of worship	Day	55	145		N	50	65	N, PC, RO	20	75			
	Day	65	50					N, PC, RO	20	75			
Active recreation	Day	60	95		N	25	70	N, PC, RO	20	75			
	Day	60	95					N, PC, RO	20	75			
Industrial premise	Day	75	20					N, PC, RO	20	75			
	Day	75	20					N, PC, RO	20	75			
Offices, retail outlets	Day	70	25					N, PC, RO	20	75			
	Day	70	25					N, PC, RO	20	75			

Non-residential receiver		L _{Aeq} (15minute) noise level above NML											
		< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
OOHW		Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	50		N, R1, DR	25	70	N, R1, DR	11	80	N, R1, DR, PC, SN	4	90
	Night	65	50		N, R2, NR	25	70	N, PC, SN, R2, DR	11	80	AA, N, PC, SN, R2, DR	4	90
Place of worship	Evening	55	145		N, R1, DR	95	60	N, R1, DR	25	70	N, R1, DR, PC, SN	11	80
	Night	55	145		N, R2, NR	95	60	N, PC, SN, R2, DR	25	70	AA, N, PC, SN, R2, DR	11	80
Active recreation	Evening	65	50		N, R1, DR	25	70	N, R1, DR	11	80	N, R1, DR, PC, SN	4	90
	Evening	60	95		N, R1, DR	50	65	N, R1, DR	20	75	N, R1, DR, PC, SN	6	85
Industrial premise	Evening	75	20		N, R1, DR	11	80	N, R1, DR	4	90	N, R1, DR, PC, SN	1	100
	Night	75	20		N, R2, NR	11	80	N, PC, SN, R2, DR	4	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	25		N, R1, DR	20	75	N, R1, DR	6	85	N, R1, DR, PC, SN	2	95
	Night	70	25		N, R2, NR	20	75	N, PC, SN, R2, DR	6	85	AA, N, PC, SN, R2, DR	2	95

Non-residential receiver		L _{Aeq} (15minute) noise level above NML											
		<10 dB(A)			10 to 20 dB(A)			L _{Aeq} (15minute) 75 dB(A) or greater (Highly affected)					
Standard hours		Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Classroom at schools and other educational institutions	Day	55	165		N	60	65	N, PC, RO	20	75			
	Day	65	60					N, PC, RO	20	75			
Hospital wards and operating theatres	Day	55	165		N	60	65	N, PC, RO	20	75			
	Day	65	60					N, PC, RO	20	75			
Place of worship	Day	55	165		N	60	65	N, PC, RO	20	75			
	Day	65	60					N, PC, RO	20	75			
Active recreation	Day	60	105		N	30	70	N, PC, RO	20	75			
	Day	60	105					N, PC, RO	20	75			
Industrial premise	Day	75	20					N, PC, RO	20	75			
	Day	75	20					N, PC, RO	20	75			
Offices, retail outlets	Day	70	30					N, PC, RO	20	75			
	Day	70	30					N, PC, RO	20	75			

Non-residential receiver		L _{Aeq} (15minute) noise level above NML											
		< 5 dB(A)			5 to 15 dB(A)			15 to 25 dB(A)			> 25 dB(A)		
OOHW		Period	NML	Affected distance (m)	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))	Measure	Within distance (m)	Mitigation level (dB(A))
Hospital wards and operating theatres	Evening	65	60		N, R1, DR	30	70	N, R1, DR	11	80	N, R1, DR, PC, SN	4	90
	Night	65	60		N, R2, NR	30	70	N, PC, SN, R2, DR	11	80	AA, N, PC, SN, R2, DR	4	90
Place of worship	Evening	55	165		N, R1, DR	105	60	N, R1, DR	30	70	N, R1, DR, PC, SN	11	80
	Night	55	165		N, R2, NR	105	60	N, PC, SN, R2, DR	30	70	AA, N, PC, SN, R2, DR	11	80
Active recreation	Evening	65	60		N, R1, DR	30	70	N, R1, DR	11	80	N, R1, DR, PC, SN	4	90
	Evening	60	105		N, R1, DR	60	65	N, R1, DR	20	75	N, R1, DR, PC, SN	6	85
Industrial premise	Evening	75	20		N, R1, DR	11	80	N, R1, DR	4	90	N, R1, DR, PC, SN	1	100
	Night	75	20		N, R2, NR	11	80	N, PC, SN, R2, DR	4	90	AA, N, PC, SN, R2, DR	1	100
Offices, retail outlets	Evening	70	30		N, R1, DR	20	75	N, R1, DR	6	85	N, R1, DR, PC, SN	2	95
	Night	70	30		N, R2, NR	20	75	N, PC, SN, R2, DR	6	85	AA, N, PC, SN, R2, DR	2	95

Construction Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Narooma Wharf Replacement REF
Scenario name	Site Demolition
Receiver address	NCA1
Select area ground type	Water
Select type of background noise level input	Representative Noise Environment

Noise area category		Representative Noise Environment	User Input
		R1	
RBL or LA90 Background level (dB(A))	Day	40	
	Evening	35	
	Night	30	
LAeq(15minute) Noise mangement level (dB(A))	Day	50	
	Day (OOHW)	45	
	Evening	40	
	Night	35	

Representative distance (m)	40
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Scenario	SWL LAeq (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Structural demolition	122	Yes	0	40	79

Total SPL LAeq(15minute) (dBA)	79
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		Residential receiver	Non-residential receivers						
			Classroom at schools and other educational institutions	Hospital wards and operating theatres	Place of worship	Active recreation	Passive recreation	Industrial premise	Offices, retail outlets
Noise Management Level (dB(A))	Standard hours	50	55	65	55	65	60	75	70
	Day (OOHW)	45	55	65	55	65	60	75	70
	OOHW Period 1	40		65	55	65	60	75	70
	OOHW Period 2	35		65	55			75	70
Level above background (dB(A))	Standard hours	39							
	Day (OOHW)	39							
	OOHW Period 1	44							
	OOHW Period 2	49							
Level above NML (dB(A))	Standard hours	29	24	14	24	14	19	4	9
	Day (OOHW)	34	24	14	24	14	19	4	9
	OOHW Period 1	39		14	24	14	19	4	9
	OOHW Period 2	44		14	24			4	9
Additional mitigation measures	Standard Hours	N, V, PC, RO	N, V, PC, RO	N, V, PC, RO	N, V, PC, RO	N, V, PC, RO	N, V, PC, RO	N, V, PC, RO	N, V, PC, RO
	Day (OOHW)	V, IB, N, R1, DR, PC, SN	V,N, R1, DR	N, R1, DR	V,N, R1, DR	N, R1, DR	V,N, R1, DR	-	N, R1, DR
	OOHW Period 1	V, IB, N, R1, DR, PC, SN		N, R1, DR	V,N, R1, DR	N, R1, DR	V,N, R1, DR	-	N, R1, DR
	OOHW Period 2	AA, V, IB, N, PC, SN, R2, DR		V, N, R2, DR	V, IB, N, PC, SN, R2, DR			N	V, N, R2, DR

Construction Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Narooma Wharf Replacement REF
Scenario name	Site Demolition
Receiver address	NCA2
Select area ground type	Water
Select type of background noise level input	Representative Noise Environment

Noise area category		Representative Noise Environment	User Input
		R1	
RBL or LA90 Background level (dB(A))	Day	40	
	Evening	35	
	Night	30	
LAeq(15minute) Noise mangement level (dB(A))	Day	50	
	Day (OOHW)	45	
	Evening	40	
	Night	35	

Representative distance (m)	130
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Scenario	SWL LAeq (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Structural demolition	122	Yes	0	130	70

Total SPL LAeq(15minute) (dBA)	70
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		Residential receiver	Non-residential receivers						
			Classroom at schools and other educational institutions	Hospital wards and operating theatres	Place of worship	Active recreation	Passive recreation	Industrial premise	Offices, retail outlets
Noise Management Level (dB(A))	Standard hours	50	55	65	55	65	60	75	70
	Day (OOHW)	45	55	65	55	65	60	75	70
	OOHW Period 1	40		65	55	65	60	75	70
	OOHW Period 2	35		65	55			75	70
Level above background (dB(A))	Standard hours	30							
	Day (OOHW)	30							
	OOHW Period 1	35							
	OOHW Period 2	40							
Level above NML (dB(A))	Standard hours	20	15	5	15	5	10		0
	Day (OOHW)	25	15	5	15	5	10		0
	OOHW Period 1	30		5	15	5	10		0
	OOHW Period 2	35		5	15				0
Additional mitigation measures	Standard Hours	N, V	N, V	-	N, V	-	N, V	-	-
	Day (OOHW)	V, IB, N, R1, DR, PC, SN	V,N, R1, DR	N, R1, DR	V,N, R1, DR	N, R1, DR	N, R1, DR	-	-
	OOHW Period 1	V, IB, N, R1, DR, PC, SN		N, R1, DR	V,N, R1, DR	N, R1, DR	N, R1, DR	-	-
	OOHW Period 2	AA, V, IB, N, PC, SN, R2, DR		V, N, R2, DR	V, IB, N, PC, SN, R2, DR			-	-

Construction Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Narooma Wharf Replacement REF
Scenario name	Site Demolition
Receiver address	NCA3
Select area ground type	Water
Select type of background noise level input	Representative Noise Environment

Noise area category		Representative Noise Environment	User Input
		R1	
RBL or LA90 Background level (dB(A))	Day	40	
	Evening	35	
	Night	30	
LAeq(15minute) Noise mangement level (dB(A))	Day	50	
	Day (OOHW)	45	
	Evening	40	
	Night	35	

Representative distance (m)	230
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Scenario	SWL LAeq (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Structural demolition	122	Yes	0	230	64

Total SPL LAeq(15minute) (dBA)	64
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		Residential receiver	Non-residential receivers						
			Classroom at schools and other educational institutions	Hospital wards and operating theatres	Place of worship	Active recreation	Passive recreation	Industrial premise	Offices, retail outlets
Noise Management Level (dB(A))	Standard hours	50	55	65	55	65	60	75	70
	Day (OOHW)	45	55	65	55	65	60	75	70
	OOHW Period 1	40		65	55	65	60	75	70
	OOHW Period 2	35		65	55	65	60	75	70
Level above background (dB(A))	Standard hours	24							
	Day (OOHW)	24							
	OOHW Period 1	29							
	OOHW Period 2	34							
Level above NML (dB(A))	Standard hours	14	9		9		4		
	Day (OOHW)	19	9		9		4		
	OOHW Period 1	24			9		4		
	OOHW Period 2	29			9				
Additional mitigation measures	Standard Hours	N, V	-	-	-	-	-	-	-
	Day (OOHW)	V, N, R1, DR	N, R1, DR	-	N, R1, DR	-	-	-	-
	OOHW Period 1	V, N, R1, DR		-	N, R1, DR	-	-	-	-
	OOHW Period 2	AA, V, IB, N, PC, SN, R2, DR		-	V, N, R2, DR	-	-	-	-

Construction Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Narooma Wharf Replacement REF
Scenario name	Site Demolition
Receiver address	NCA4
Select area ground type	Water
Select type of background noise level input	Representative Noise Environment

Noise area category		Representative Noise Environment	User Input
		R1	
RBL or LA90 Background level (dB(A))	Day	40	
	Evening	35	
	Night	30	
LAeq(15minute) Noise mangement level (dB(A))	Day	50	
	Day (OOHW)	45	
	Evening	40	
	Night	35	

Representative distance (m)	130
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Scenario	SWL LAeq (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Structural demolition	122	Yes	0	130	70

Total SPL LAeq(15minute) (dBA)	70
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		Residential receiver	Non-residential receivers						
			Classroom at schools and other educational institutions	Hospital wards and operating theatres	Place of worship	Active recreation	Passive recreation	Industrial premise	Offices, retail outlets
Noise Management Level (dB(A))	Standard hours	50	55	65	55	65	60	75	70
	Day (OOHW)	45	55	65	55	65	60	75	70
	OOHW Period 1	40		65	55	65	60	75	70
	OOHW Period 2	35		65	55			75	70
Level above background (dB(A))	Standard hours	30							
	Day (OOHW)	30							
	OOHW Period 1	35							
	OOHW Period 2	40							
Level above NML (dB(A))	Standard hours	20	15	5	15	5	10		0
	Day (OOHW)	25	15	5	15	5	10		0
	OOHW Period 1	30		5	15	5	10		0
	OOHW Period 2	35		5	15				0
Additional mitigation measures	Standard Hours	N, V	N, V	-	N, V	-	N, V	-	-
	Day (OOHW)	V, IB, N, R1, DR, PC, SN	V,N, R1, DR	N, R1, DR	V,N, R1, DR	N, R1, DR	N, R1, DR	-	-
	OOHW Period 1	V, IB, N, R1, DR, PC, SN		N, R1, DR	V,N, R1, DR	N, R1, DR	N, R1, DR	-	-
	OOHW Period 2	AA, V, IB, N, PC, SN, R2, DR		V, N, R2, DR	V, IB, N, PC, SN, R2, DR			-	-

Construction Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Narooma Wharf Replacement REF
Scenario name	Site Establishment & Decommission
Receiver address	NCA1
Select area ground type	Water
Select type of background noise level input	Representative Noise Environment

Noise area category		Representative Noise Environment	User Input
		R1	
RBL or LA90 Background level (dB(A))	Day	40	
	Evening	35	
	Night	30	
LAeq(15minute) Noise mangement level (dB(A))	Day	50	
	Day (OOHW)	45	
	Evening	40	
	Night	35	

Representative distance (m)	40
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Scenario	SWL LAeq (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Site establishment	109	Yes	0	40	66

Total SPL LAeq(15minute) (dBA)	66
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		Residential receiver	Non-residential receivers						
			Classroom at schools and other educational institutions	Hospital wards and operating theatres	Place of worship	Active recreation	Passive recreation	Industrial premise	Offices, retail outlets
Noise Management Level (dB(A))	Standard hours	50	55	65	55	65	60	75	70
	Day (OOHW)	45	55	65	55	65	60	75	70
	OOHW Period 1	40		65	55	65	60	75	70
	OOHW Period 2	35		65	55			75	70
Level above background (dB(A))	Standard hours	26							
	Day (OOHW)	26							
	OOHW Period 1	31							
	OOHW Period 2	36							
Level above NML (dB(A))	Standard hours	16	11	1	11	1	6		
	Day (OOHW)	21	11	1	11	1	6		
	OOHW Period 1	26		1	11	1	6		
	OOHW Period 2	31		1	11				
Additional mitigation measures	Standard Hours	N, V	N, V	-	N, V	-	-	-	-
	Day (OOHW)	V, N, R1, DR	N, R1, DR	-	N, R1, DR	-	N, R1, DR	-	-
	OOHW Period 1	V, IB, N, R1, DR, PC, SN		-	N, R1, DR	-	N, R1, DR	-	-
	OOHW Period 2	AA, V, IB, N, PC, SN, R2, DR		N	V, N, R2, DR			-	-

Construction Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Narooma Wharf Replacement REF
Scenario name	Site Establishment & Decommission
Receiver address	NCA2
Select area ground type	Water
Select type of background noise level input	Representative Noise Environment

Noise area category		Representative Noise Environment	User Input
		R1	
RBL or LA90 Background level (dB(A))	Day	40	
	Evening	35	
	Night	30	
LAeq(15minute) Noise mangement level (dB(A))	Day	50	
	Day (OOHW)	45	
	Evening	40	
	Night	35	

Representative distance (m) 130

Scenario	SWL LAeq (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Site establishment	109	Yes	0	130	57

Total SPL LAeq(15minute) (dBA) 57

		Residential receiver	Non-residential receivers						
			Classroom at schools and other educational institutions	Hospital wards and operating theatres	Place of worship	Active recreation	Passive recreation	Industrial premise	Offices, retail outlets
Noise Management Level (dB(A))	Standard hours	50	55	65	55	65	60	75	70
	Day (OOHW)	45	55	65	55	65	60	75	70
	OOHW Period 1	40		65	55	65	60	75	70
	OOHW Period 2	35		65	55			75	70
Level above background (dB(A))	Standard hours	17							
	Day (OOHW)	17							
	OOHW Period 1	22							
	OOHW Period 2	27							
Level above NML (dB(A))	Standard hours	7	2		2				
	Day (OOHW)	12	2		2				
	OOHW Period 1	17			2				
	OOHW Period 2	22			2				
Additional mitigation measures	Standard Hours	-	-	-	-	-	-	-	-
	Day (OOHW)	N, R1, DR	-	-	-	-	-	-	-
	OOHW Period 1	V, N, R1, DR	-	-	-	-	-	-	-
	OOHW Period 2	V, IB, N, PC, SN, R2, DR	-	-	N	-	-	-	-

Construction Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Narooma Wharf Replacement REF
Scenario name	Site Establishment & Decommission
Receiver address	NCA3
Select area ground type	Water
Select type of background noise level input	Representative Noise Environment

Noise area category		Representative Noise Environment	User Input
		R1	
RBL or LA90 Background level (dB(A))	Day	40	
	Evening	35	
	Night	30	
LAeq(15minute) Noise mangement level (dB(A))	Day	50	
	Day (OOHW)	45	
	Evening	40	
	Night	35	

Representative distance (m) 230

Scenario	SWL LAeq (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Site establishment	109	Yes	0	230	51

Total SPL LAeq(15minute) (dBA) 51

		Residential receiver	Non-residential receivers						
			Classroom at schools and other educational institutions	Hospital wards and operating theatres	Place of worship	Active recreation	Passive recreation	Industrial premise	Offices, retail outlets
Noise Management Level (dB(A))	Standard hours	50	55	65	55	65	60	75	70
	Day (OOHW)	45	55	65	55	65	60	75	70
	OOHW Period 1	40		65	55	65	60	75	70
	OOHW Period 2	35		65	55			75	70
Level above background (dB(A))	Standard hours	11							
	Day (OOHW)	11							
	OOHW Period 1	16							
	OOHW Period 2	21							
Level above NML (dB(A))	Standard hours	1							
	Day (OOHW)	6							
	OOHW Period 1	11							
	OOHW Period 2	16							
Additional mitigation measures	Standard Hours	-	-	-	-	-	-	-	-
	Day (OOHW)	N, R1, DR	-	-	-	-	-	-	-
	OOHW Period 1	N, R1, DR	-	-	-	-	-	-	-
	OOHW Period 2	V, IB, N, PC, SN, R2, DR	-	-	-	-	-	-	-

Construction Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Project name	Narooma Wharf Replacement REF
Scenario name	Site Establishment & Decommission
Receiver address	NCA4
Select area ground type	Water
Select type of background noise level input	Representative Noise Environment

Noise area category		Representative Noise Environment	User Input
		R1	
RBL or LA90 Background level (dB(A))	Day	40	
	Evening	35	
	Night	30	
LAeq(15minute) Noise magement level (dB(A))	Day	50	
	Day (OOHW)	45	
	Evening	40	
	Night	35	

Representative distance (m) 130

Scenario	SWL LAeq (dB(A))	Is there line of sight to receiver?	Shielding correction (dB(A))	Distance used in calculation (m)	Contribution SPL (dB(A))
Site establishment	109	Yes	0	130	57

Total SPL LAeq(15minute) (dBA) 57

		Residential receiver	Non-residential receivers						
			Classroom at schools and other educational institutions	Hospital wards and operating theatres	Place of worship	Active recreation	Passive recreation	Industrial premise	Offices, retail outlets
Noise Management Level (dB(A))	Standard hours	50	55	65	55	65	60	75	70
	Day (OOHW)	45	55	65	55	65	60	75	70
	OOHW Period 1	40		65	55	65	60	75	70
	OOHW Period 2	35		65	55			75	70
Level above background (dB(A))	Standard hours	17							
	Day (OOHW)	17							
	OOHW Period 1	22							
	OOHW Period 2	27							
Level above NML (dB(A))	Standard hours	7	2		2				
	Day (OOHW)	12	2		2				
	OOHW Period 1	17			2				
	OOHW Period 2	22			2				
Additional mitigation measures	Standard Hours	-	-	-	-	-	-	-	-
	Day (OOHW)	N, R1, DR	-	-	-	-	-	-	-
	OOHW Period 1	V, N, R1, DR	-	-	-	-	-	-	-
	OOHW Period 2	V, IB, N, PC, SN, R2, DR	-	-	N	-	-	-	-

Appendix F

Biodiversity likelihood of occurrence table

Likelihood of occurrence of Narooma Wharf environmental values

Species name	EPBC Act	BC Act	FM Act	Habitat requirements	Likelihood of occurrence
Marine flora					
Fish					
<p><i>Carcharias taurus</i> Grey nurse shark</p>	CE		CE	<p>This species is regularly reported around south-east Australia in primarily subtropical to cool temperate waters. They commonly reside around rocky reefs and islands, sandy seabed gutters, rocky caves and sometimes surf zones and shallow bays along the coast of NSW and southern Queensland (QLD).</p>	<p>May occur</p> <p>The most suitable habitats for this species are absent within the proposal site. However, this species is expected to occur elsewhere in the locality and may move through the proposal site (Biosis 2021). However, due to the mobility of the species it is not anticipated that the works will result in any disturbance for the species.</p>
<p><i>Epinephelus daemeli</i> Black rockcod</p>	V		V	<p>The species is found throughout the southwest Pacific, from southern QLD to northern waters of the Bass Strait. Juveniles inhabit estuarine systems while larger specimens are found around rocky reefs and shelves. Black rockcod demonstrate high site fidelity, with individuals of the species often occupying an individual cave for most of their adult life (DoEE, 2019).</p>	<p>Likely to occur</p> <p>The Black rockcod is known to occur within Batemans Marine Park and has been described as being observed within the Wagonga Inlet.</p> <p>Adult and juvenile Black rockcod individuals may occur within the proposal site due to the absence of suitable habitats (Biosis 2021), including habitat that the species is known to inhabit such as deep rocky crevices and ledges which are absent in the proposal site.</p>

Species name	EPBC Act	BC Act	FM Act	Habitat requirements	Likelihood of occurrence
Marine flora					
Reptiles					
<i>Caretta caretta</i> Loggerhead turtle	E, Mig	E		<p>Widely distributed throughout Australian coastal and offshore zones, suitable habitat includes coral reefs, rocky reefs, seagrass beds and inshore embayment's (DoEE 2019).</p> <p>Female turtles recorded from nesting sites in south east QLD, have been observed in Australian waters off Northern Territory (NT), QLD and NSW (Limpus, 2008). In NSW, Loggerhead turtles have been recorded feeding as far south as Jervis Bay and Sydney.</p>	<p>Likely occur</p> <p>These species are expected to occur within the locality and may pass through the proposal site on occasion.</p> <p>Indirect impacts to these species may result due to the direct impacts to the seagrass beds as a result of the wharf upgrade. These species may be sensitive to underwater noise and vibration impacts during construction works, however proposed works are anticipated to be small scale, temporary and highly localised.</p>
<i>Chelonia mydas</i> Green turtle	V, Mig	V		<p>Species is distributed throughout Australian coastal warm temperate to tropical seas. Nesting occurs throughout northern Australia between December and February (DES, 2019). Following hatching, neonate and juvenile turtles remain in pelagic and offshore waters until they reach approximately 30 to 40 cm carapace length (DoEE, 2019).</p> <p>Adults are commonly encountered in seagrass beds and in proximity to macroalgal benthic habitats.</p>	
<i>Dermochelys coriacea</i> Leatherback turtle	E, Mig	E		<p>Circum-globally distributed in warm temperate to tropical seas for pelagic foraging. Foraging is common at high latitudes in the Southern Pacific Ocean. The species occurs in open ocean basins, making landfall to nest at known locations.</p>	
<i>Eretmochelys imbricata</i> Hawksbill turtle	V, Mig			<p>Nesting for this species occurs in far north QLD, NT and WA between December and February with individuals migrating up to 2400 kilometres between foraging areas and nesting beaches (DES, 2019). Juvenile turtles remain in pelagic and offshore waters for the first five to ten years, drifting on ocean currents.</p>	
<i>Natator depressus</i> Flatback Turtle	V			<p>Feeding grounds are mostly over the Australian continental shelf, extending as far south as the Tropic of Capricorn, and off eastern Indonesian waters.</p> <p>Migration is usually restricted to the continental shelf although there are numerous records of the species in waters off the continental shelf.</p>	

Species name	EPBC Act	BC Act	FM Act	Habitat requirements	Likelihood of occurrence
Marine flora					
Mammals					
<i>Arctocephalus forsteri</i> New Zealand fur-seal		V		Occurs in Australian coastal waters and offshore islands of South and Western Australia as well as southern Tasmania (IUCN, 2018). Small populations are also present along the southern NSW coast, particularly on Montague Island but also other isolated areas to north of Sydney (NSW OEH, 2018b).	Likely to occur These species are expected to occur within the locality and may pass through the proposal site on occasion. Impacts to these species are not anticipated as direct impacts to their habitats are to be avoided (Biosis, 2021). These species may be sensitive to underwater noise and vibration impacts during construction works, however proposed works are anticipated to be small scale, temporary and highly localised. Given the population at Montague Island, it is possible that the species
<i>Arctocephalus pusillus doriferus</i> Australian fur-seal		V		Preference for rocky parts of islands and foraging occurs in oceanic waters of the continental shelf. There are 10 established breeding colonies, all restricted to the Bass Strait with six occurring in VIC and four in Tasmania. In NSW the species can be found at Montague Island (DoEE, 2018).	
Birds					
<i>Haematopus fuliginosus</i> Sooty oystercatcher		V		This species is distributed along the entire coastline of Australia, including offshore islands, but most common in the Bass Strait. Small populations of the species are known to be distributed along the NSW coastline. This species habitat preferences include rocky headlands, shorelines and exposed reefs, foraging on exposed rock or coral at low tide in search of limpets and mussels (NSW, 2017)	Likely to occur These species are expected to occur in the locality, with a number recorded in the area surrounding the proposal site during the site inspection (Biosis, 2021).
<i>Haematopus longirostris</i> Pied oystercatcher		E		Pied Oystercatchers can be found scattered along the entire Australian coastline, although most common around in coastal Tasmania and Victoria. This species inhabits intertidal mud and sand flats, wetlands and coastal beaches where it feeds on bivalves, worms and crustaceans. Nests are shallow scrapes in the sand though will occasionally nest amongst salt marshes and grassy areas.	
<i>Haliaeetus leucogaster</i> White-bellied sea-eagle		V		Species is distributed along the entire coastline (including offshore islands) of mainland Australia and Tasmania. Distribution also extends inland along larger waterways, particularly in eastern Australia. Prefers coastal and terrestrial wetlands in tropical and temperate of mainland Australia and its offshore islands. Must contain large areas of open water (DoEE, 2019).	May occur These species may fly over the proposal site on occasion during dispersal or foraging activity (Biosis, 2021).

Species name	EPBC Act	BC Act	FM Act	Habitat requirements	Likelihood of occurrence
Marine flora					
<i>Pandion cristatus</i> Eastern osprey		V		The eastern osprey is a medium sized, fish-eating raptor found along most of the Australian coastline, excluding only Tasmania and Victoria. They are common along the east coast, especially on rocky shorelines, islands, reefs and estuaries and known to occasionally range inland along rivers. This species preys upon fish and nests are usually within 1 kilometre of the sea.	
<i>Sternula albifrons</i> Little tern	Mig	E		Small, marine tern. Occurring along most of Australia's coastline from Broome in north-west WA, across north Australia and down to Adelaide in south Australia. Breeding colonies in QLD have not been used recently, it more commonly breeds along the NSW coastline (Garnett and Crowley 2000). Nonbreeding range of this subpopulation is poorly known (DoEE, 2019). They forage and nest in sheltered coastal environments such as estuaries, river mouths, bays and harbours.	May occur As these species are able to occupy terrestrial habitats and are highly mobile they are able to move away from any disturbances associated with the proposed works (Biosis, 2021).
<i>Sternula nereis nereis</i> Fairy tern	V			This species occurs along the coast of Tasmania, South Australia, Victoria and Western Australia. A population in NSW was historically known to occur, however it is unknown whether the bird occurs in NSW still. This species prefers sandy beaches that are well sheltered, spits and banks (DoEE, 2019).	

Note: EPBC Act – Environment Protection and Biodiversity Act 1999, BC Act – Biodiversity Conservation Act 2016, FM Act – Fisheries Management Act 1994. CE – critically endangered, E – endangered, V – vulnerable, Mig – migratory.

Appendix G

Biodiversity assessment of significance

1. Assessment of significance

This section provides an assessment of significance, pursuant to the requirements under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Fisheries Management Act 1994* (FM Act) and provides a concluding statement as to whether additional assessment, offsetting or approval is required, to address risk of significant impact upon protected marine fauna and flora.

1.1 EPBC Act

Six marine species listed under the EPBC Act are considered as **likely to occur** within the study area. These include:

- Black Rock Cod (*Epinephelus daemeli*) (Vulnerable)
- Loggerhead Turtle (*Caretta caretta*) (Endangered, Migratory)
- Green Turtle (*Chelonia mydas*) (Vulnerable, Migratory)
- Leatherback Turtle (*Dermochelys coriacea*) (Endangered, Migratory)
- Hawksbill Turtle (*Eretmochelys imbricata*) (Vulnerable, Migratory)
- Flatback Turtle (*Natator depressus*) (Vulnerable)
- White's Seahorse (*Hippocampus whitei*) (Endangered)

These species were assessed under the EPBC Act Significant Impact Assessment Criteria, assuming all mitigation measures detailed in section 7 of the REF are implemented. The assessment found that the proposed works will not have a significant impact on these species, with the implementation of mitigation measures.

Posidonia australis is listed as a Threatened Ecological Community under the EPBC Act for the Manning-Hawkesbury Bioregion. This covers major estuarine systems from Forster to Port Hacking. The Wagonga Inlet is part of the Batemans Shelf Bioregion, approximately 300 km south of the border of the Manning-Hawkesbury Bioregion. Therefore, the *Posidonia australis* meadows located within the inlet, including those in the impact area are not considered to be part of the Threatened Ecological Community.

1.1.1 EPBC Act Listed Endangered Species

Species: Endangered marine turtles Loggerhead Turtle, Leatherback Turtle	Assessment under the EPBC Act Significance Criteria
An action is likely to have significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to the long-term decrease in the size of a population	The study area is not close to any known breeding grounds for the species. The proposed works are unlikely to lead to the long term decrease in the size of a population.
Reduce the area of occupancy of the species	Given the transient nature of the species, the localised works are unlikely to impact on the occupancy area for the species. If present, the species is likely to transit through between food sources. The proposed works are short term in nature and overall, there will be no reduction to the area of occupancy for the species.
Fragment an existing population into two or more populations	Works are limited to a small footprint close to the shore and as such will not impede passage in the inlet. Therefore, fragmentation of the turtle population is unlikely to occur due to the proposed works.

Species: Endangered marine turtles Loggerhead Turtle, Leatherback Turtle	Assessment under the EPBC Act Significance Criteria
Adversely affect habitat critical to the survival of a species	The proposed works will not adversely affect habitat critical to the survival of the species. The study area is not close to any known breeding grounds for this species. Care should be taken to avoid direct impact to seagrass meadows not planned for removal, eg accidental impacts, as a result of the works.
Disrupt the breeding cycle of a population	No breeding grounds are located in the study area. These species migrate along most of the Australian coastline where they forage for sponges and seagrasses on coral reefs, rocky reefs and inshore embayments. This species may forage for seagrasses in the study area opportunistically. As the works are not located near a breeding area and alternative feeding areas are located nearby the study area within the inlet, it is not anticipated that the proposed works will impact on the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	<p>The proposed works will not result in significant modification, destruction, removal, isolation or a reduction in the availability and quality of habitat to the extent that the species is likely to decline. Potential localized short-term impacts include, but are considered unlikely:</p> <ul style="list-style-type: none"> – Behavioural avoidance of the area during the proposed works – Potential exposure to pollutants that arise as a consequence of the proposed works
Result in invasive species that are harmful to a critically endangered or endangered species become established in the endangered or critically endangered species' habitat	Environmental management measures implemented are in conjunction with accepted international and domestic practice with risk of introduction of invasive species to as low as reasonably practicable. The proposed works will not result in any invasive species that are harmful to these species becoming established in the species habitat.
Introduce disease that may cause the species to decline, or	The proposed works will not result in the introduction of disease that may cause a species to decline. Environmental management measures implemented are in conjunction with accepted international and domestic practice with risk of introduction of disease to as low as reasonably practicable.
Interfere with the recovery of the species	<p>The Department of Environment and Energy has a 'Recovery Plan for Marine Turtles in Australia' for 2017 – 2027, including the following immediate actions enacted by the Plan:</p> <ul style="list-style-type: none"> – Maintaining and improving efficacy of legal and management protections – Adaptively manage turtle stocks to reduce risk and build resilience to climate change and variability – Reduce the impacts from marine debris – Minimise chemical and terrestrial discharge – Minimise light pollution – Reduce international and domestic fisheries bycatch – Reduce impacts from terrestrial predation – Address international take within and outside Australia's jurisdiction – Address impacts of coastal development/infrastructure and dredging and trawling – Maintain and improve sustainable Indigenous management of marine turtles <p>The proposed works will not contravene any actions of the Plan and therefore will not interfere with the recovery of the species.</p>
Statement of impact:	The proposed works will NOT have a significant impact on the species.

Species: White's Seahorse and other Syngnathids Endangered	Assessment under the EPBC Act Significance Criteria
An action is likely to have significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to the long-term decrease in the size of a population	<p>Unmitigated, the proposed works would have the potential to lead to long-term decrease in the size of an important population, namely the White's Seahorse endemic to NSW and QLD.</p> <p>While not detected during the general marine survey, there is suitable habitat on site for the species, including the <i>Posidonia australis</i> seagrass immediately adjacent to the wharf. It is not uncommon to not detect the species due to their cryptic nature, without a targeted approach to survey specifically for the species. It is presumed that the species is present at Narooma Wharf.</p> <p>Through the implementation of proposed mitigation measures, it is not anticipated that the works will result in a long-term decline in the population of this species or group. All individuals will be located, as identified through a pre-clearance survey and relocated to an appropriate relocation site as agreed between TfNSW and DPI. Following the works, if the use of seahorse hotels is implemented, individuals could potentially be moved back to Narooma Wharf at the discretion of DPI recommendations.</p>
Reduce the area of occupancy of the species	<p>Unmitigated, the proposed works will impact the population and have the potential to place the population at risk of long term decline due to the species high site fidelity behaviours.</p> <p>Through the implementation of the proposed mitigation measures, new habitat (through the use of seahorse hotels) will be created. A number of piles will be removed as part of the works and new piles reinstated. Until the new piles are fouled, there will be a temporary loss of habitat in the works area should the seahorses be relocated back to the works site.</p> <p>Use of seahorse hotels will create artificial habitat for seahorses to mitigate reduced habitat areas as a result of the proposed works (Simpson et al, 2020)¹.</p>
Fragment an existing population into two or more populations	<p>Unmitigated, the proposed works have the potential to fragment the existing population.</p> <p>With the mitigation measure in place, the works are not anticipated to result in fragmentation of the population. While the works will directly impact seagrasses, the seahorses will be relocated prior to any works commencing to ensure that no fragmentation, nor impact, is realised.</p>
Adversely affect habitat critical to the survival of a species	<p>Unmitigated, the proposed works have the potential to adversely affect habitat critical for the survival of the family, as discussed above.</p> <p>With the mitigation measures in place, the works will still result in some habitat loss via the removal of piles. There will be new piles installed and until they recruit fouling, will result in temporary habitat loss. This may be mitigated through consideration and implementation of artificial habitat (seahorse hotels) to which the seahorses can be relocated. A Seahorse Relocation Plan has been prepared for the works.</p>
Disrupt the breeding cycle of a population	<p>The proposed works have the potential to disrupt the breeding cycle of a number of species in the Syngnathids family, given some species brood all year. Relocation is likely to be stressful and may result in a reduction in breeding behaviours and intensity and therefore impact the success of a breeding cycle. The relocation will take place prior to breeding season by at least 1 month to reduce the risk of disruption to the breeding cycle as low as reasonably practicable. Further, all individuals will be relocated to the same relocation site to ensure that monogamous pairs are not separated.</p>

¹ Simpson, M., Coleman, R., Morris, R., Harasti, D. Seahorse Hotels: Use of Artificial Habitats to Support Populations of the Endangered White's Seahorse *Hippocampus whitei*. Journal of Marine Environmental Research (157). <https://doi.org/10.1016/j.marenvres.2019.104861>

Species: White's Seahorse and other Syngnathids Endangered	Assessment under the EPBC Act Significance Criteria
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed works will remove available quality of habitat for syngnathids. This is not anticipated to translate into a decline in the reduction of the species population, given that all individuals will be relocated to a site beyond project influence.
Result in invasive species that are harmful to a critically endangered or endangered species become established in the endangered or critically endangered species' habitat	The proposed works will not result in any invasive species that are harmful to these species becoming established in the species habitat. Environmental management measures implemented are in conjunction with accepted international and domestic practice with risk of introduction of invasive species to as low as reasonably practicable.
Introduce disease that may cause the species to decline, or	The proposed works will not result in the introduction of disease that may cause a species to decline. Environmental management measures implemented are in conjunction with accepted international and domestic practice with risk of introduction of disease to as low as reasonably practicable.
Interfere with the recovery of the species	The proposed works will not interfere with the recovery of the species.
Statement of impact:	The proposed works will NOT have a significant impact on the species.

1.1.2 EPBC Act Listed Vulnerable Species

Species: Marine turtles Vulnerable Green Turtle, Flatback Turtle and Hawksbill Turtle	Assessment under the EPBC Act Significance Criteria
An action is likely to have significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to the long-term decrease in the size of an important population of a species	<p>The Department of Environment and Energy has a 'Recovery Plan for Marine Turtles in Australia' for 2017 – 2027, including the following immediate actions enacted by the Plan:</p> <ul style="list-style-type: none"> – Maintaining and improving efficacy of legal and management protections – Adaptively manage turtle stocks to reduce risk and build resilience to climate change and variability – Reduce the impacts from marine debris – Minimise chemical and terrestrial discharge – Minimise light pollution – Reduce international and domestic fisheries bycatch – Reduce impacts from terrestrial predation – Address international take within and outside Australia's jurisdiction – Address impacts of coastal development/infrastructure and dredging and trawling – Maintain and improve sustainable Indigenous management of marine turtles <p>The proposed works will not contravene any actions of the Plan and therefore will not interfere with the recovery of the species and will not lead to the long term decrease of the size of the population.</p>
Reduce the area of occupancy of an important population	Given the transient nature of the species, the localised works are unlikely to impact on the occupancy area for the species. If present, the species is likely to transit through between food sources. The proposed works are short term in nature and overall, there will be no reduction to the area of occupancy for the species.

Species: Marine turtles Vulnerable Green Turtle, Flatback Turtle and Hawksbill Turtle	Assessment under the EPBC Act Significance Criteria
Fragment an existing important population into two or more populations	Fragmentation of the turtles population is unlikely to occur due to the proposed works.
Adversely affect habitat critical to the survival of a species	The proposed works will not adversely affect habitat critical to the survival of the species. The study area is not close to any known breeding grounds for this species. Care should be taken to avoid direct impact to seagrass meadows.
Disrupt the breeding cycle of an important population	No breeding grounds are located in the study area. Multiple species locally migrate along most of the Australian coastline where it forages for sponges and seagrasses on coral reefs, rocky reefs and inshore embayment. This species may forage for seagrasses in the study area opportunistically. As the works are not located near a breeding area and feeding areas are located nearby the study area, it is not anticipated that the proposed works will impact on the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed works will not result in significant modification, destruction, removal, isolation or a reduction in the availability and quality of habitat to the extent that the species is likely to decline. Potential localized short term impacts include, but are considered unlikely: <ul style="list-style-type: none"> - Collision with marine equipment during the proposed works - Behavioural avoidance of the area during the proposed works - Potential exposure to pollutants that arise as a consequence of the proposed works
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed works will not result in any invasive species that are harmful to these species becoming established in the species habitat. Environmental management measures implemented are in conjunction with accepted international and domestic practice with risk of introduction of invasive species to as low as reasonably practicable.
Introduce disease that may cause the species to decline, or	The proposed works will not result in the introduction of disease that may cause a species to decline. Environmental management measures implemented are in conjunction with accepted international and domestic practice with risk of introduction of disease to as low as reasonably practicable.
Interfere substantially with the recovery of the species	The proposed works will not interfere with the recovery of the species.
Statement of impact:	The proposed works will NOT have a significant impact on the species.

Species: Black Rock Cod Vulnerable	Assessment under the EPBC Act Significance Criteria
An action is likely to have significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to the long-term decrease in the size of an important population of a species	The proposed works will not result in the removal of, or damage to, any rocky reef habitat and therefore it is considered unlikely that the proposed works will result in long term decrease in the size of the species population. The preferred habitat of the Black Rockcod inhabits caves, gutters and crevices which are not present in the study area (DPI, 2022) ² .
Reduce the area of occupancy of an important population	The proposed works will not result in the removal or damage of any rocky reef habitat and therefore it is unlikely that the proposed works will reduce the area of occupancy of the species population.

² DPI (2022). Threatened Species Lists: Black Rock Cod. New South Wales Government. Available from: <https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current/vulnerable-species2/black-rockcod#:~:text=Habitat,in%20coastal%20rockpools%20and%20estuaries.>

Species: Black Rock Cod Vulnerable	Assessment under the EPBC Act Significance Criteria
Fragment an existing important population into two or more populations	The works are located on the banks of the inlet and will not interfere with fish passage. The species is also highly territorial and do not live in groups permanently. Therefore, it is not anticipated that the works will result in isolation of two or more populations. .
Adversely affect habitat critical to the survival of a species	The proposed works do not involve any alteration of the species preferred habitat (rocky reef). It is unlikely that the proposed works will significantly adversely affect critical habitat of the Black Rock cod.
Disrupt the breeding cycle of an important population	Given the short term nature of the proposed works, it is not anticipated that the works will result in a disruption to the breeding cycle of the Black Rock cod.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Rocky reef habitat will not be altered as part of the proposed works and it is unlikely that the proposed works will result in significant modification, removal, isolation or a decrease in the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed works will not result in any invasive species that are harmful to these species becoming established in the species habitat. Environmental management measures implemented are in conjunction with accepted international and domestic practice with risk of introduction of invasive species to as low as reasonably practicable.
Introduce disease that may cause the species to decline, or	The proposed works will not result in the introduction of disease that may cause a vulnerable species to decline. Environmental management measures implemented are in conjunction with accepted international and domestic practice with risk of introduction of disease to as low as reasonably practicable.
Interfere substantially with the recovery of the species	The proposed works will not interfere with the recovery of the species.
Statement of impact:	The proposed works will NOT have a significant impact on the species.

1.2 Fisheries Management Act

Two marine species listed under the FM Act were considered **likely to occur** within the study area, being the Black Rock Cod (*Epinephelus daemeli*) (Vulnerable) and White's Seahorse (*Hippocampus whitei*) (Endangered).

These species were assessed under Section 220ZZ of the FM Act, assuming all mitigation measured recommended in Section 7 of the REF would be implemented. The assessment found that the works are not anticipated to result in a significant impact to these species.

Consultation should be undertaken with NSW DPI as soon as reasonably practicable to affirm this assessment and proposed mitigation measures are sufficient to reduce the risk of harm to the marine environment to as low as reasonably practicable. Guidance should also be sought on how to implement the seahorse hotels and relocation strategy for the species, including a review of the relocation plan.

The following permits will be required from the DPI under the FM Act:

- Section 37 Permit for the taking or possession of fish or marine vegetation that would otherwise be unlawful under the FM Act. This permit is required for the relocation works for the White's Seahorse.
- Part 7 Permit for the minor excavator based dredging works proposed at the wharf.
- Section 205 Permit will also be required to harm marine vegetation. Harm refers to the gathering, cutting, pulling up, destroying, poisoning, digging up, removal, injury to, prevention of light or otherwise any harm to marine vegetation in whole, or part.

1.2.1 Fisheries Management Act Listed Endangered Species

Species: White's Seahorse Endangered	Assessment under the FM Act Significance Criteria
<p>The following is to be taken into account for the purposes of determining under this division whether a proposed development or activity is likely to significantly affect threatened species, populations or ecological communities (unless it is carried out in a critical habitat)</p>	
<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>White's Seahorse show high site fidelity, including to a micro-habitat scale (i.e. to a certain holdfast). Removal of habitat (i.e. seagrass) presents a significant risk to the life cycle of the species. Breeding season for the species occurs between September to February. Removing seagrass in the non-breeding season (March – August) can potentially reduce some of the risk.</p> <p>Litter mortality is high (at approximately 95 %), with males producing ~100 – 150 young per litter and can give birth up to 8 times per breeding season (September to February). However, with high mortality rates, the species recovery process can be slow. Young dispersal is low as the species is not associated with rafting (attaching to a floating object for dispersal) at a juvenile stage and is therefore highly likely to remain at its birth place.</p> <p>Given the high site fidelity, removing seagrass may present unacceptable risk to the species. Relocating the species may alleviate some of the risk to the local population and therefore make the risk not significant.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that contributes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Not applicable</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction or</p> <p>ii) is likely to be substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>Not applicable</p>

Species: White's Seahorse Endangered	Assessment under the FM Act Significance Criteria
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i) The extent to which habitat is likely to be removed or modified as a result of the action proposed,</p> <p>and</p> <p>ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii) The importance of the habitat to be removed, modified, fragmented, or isolated to the long-term survival of the species, population or ecological community in the locality</p>	<p>The proposed works include the removal of the species habitat. The species is highly correlated with seagrass beds. Given the high site fidelity behaviour of the species, the removal of seagrass will fragment the local population without mitigation measures.</p> <p>The relocation works of the Seahorse population (if present) will ensure that there is no fragmentation of the population as all individuals will be relocated to the same receiver site to maintain monogamous pairings.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>The works will have a direct impact on preferred habitat for the species via the direct removal of seagrass habitat, however this will be offset by the creating of artificial habitat at a receiver site that the seahorse population will be relocated to.</p> <p>While <i>Posidonia australis</i> is preferred and natural habitat significant for the survival of the species, it is not listed as Critical Habitat on the Register of Critical Habitat under the EPBC.</p>
<p>f) Whether the action proposed is consistent with a Priorities Action Statement</p>	<p>The proposed action is inconsistent with the Priorities Action Statement for the species, including habitat protection and rehabilitation priorities.</p> <p>However, the works will be offset in part by the implementation of a Relocation Plan for the seahorse population to be managed in collaboration with DPI.</p>
<p>g) Whether the action proposed constitutes or is part of a key threatening process, or is likely to result in the operation of, or increase the impact of, a key threatening process</p>	<p>The proposed action is not part of a key threatening process listed under the FM Act.</p>
<p>Statement of impact:</p>	<p>The proposed works will NOT have a significant impact on the species, provided that the proposed mitigation measures are implemented in their entirety.</p>

1.2.2 Fisheries Management Act Listed Vulnerable Species

Species: Black Rock Cod Vulnerable	Assessment under the FM Act Significance Criteria
<p>The following is to be taken into account for the purposes of determining under this division whether a proposed development or activity is likely to significantly affect threatened species, populations or ecological communities (unless it is carried out in a critical habitat)</p>	
<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>. While minimal suitable habitat does exist in the study area, the proposed works will not likely impact the species and its habitat. The proposed works are not anticipated to result in adverse effects on the life cycle of the species, such that the local population of the species is likely to be placed at risk of extinction</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that contributes the endangered population such that a viable local</p>	<p>Not applicable</p>

Species: Black Rock Cod Vulnerable	Assessment under the FM Act Significance Criteria
population of the species is likely to be placed at risk of extinction	
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction or</p> <p>ii) is likely to be substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	Not applicable
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i) The extent to which habitat is likely to be removed or modified as a result of the action proposed,</p> <p>and</p> <p>ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii) The importance of the habitat to be removed, modified, fragmented, or isolated to the long-term survival of the species, population or ecological community in the locality</p>	<p>The study area has minimal opportunities for refuge for the black rock cod within the immediate footprint of the works extent. The habitat is unlikely to become fragmented as a result of the proposed works.</p> <p>The proposed works are not anticipated to result in habitat fragmentation. There are no rock ledges and overhands within the study area. There are crevices between the rocks with very limited vertical habitat complexity. No species was identified through the general survey (Biosis). While there is suitable habitat, the habitat for the species is limited within the study area.</p> <p>There is no fish passage limitations created from the works as the works study area is limited to the banks of the inlet and immediate surrounds.</p>
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No critical habitat is present in the study area according to the Register of Critical Habitat of the EPBC Act, or areas of Outstanding Biodiversity Value. The proposed works are unlikely to present a risk to the habitat of the species given the lack of habitat within the study area.
f) Whether the action proposed is consistent with a Priorities Action Statement	The action proposed is consistent with Priorities Action Statement for the species.
g) Whether the action proposed constitutes or is part of a key threatening process, or is likely to result in the operation of, or increase the impact of, a key threatening process	The proposed action is not part of a key threatening process listed under the FM Act.
Statement of impact:	The proposed works will NOT have a significant impact on the species.

1.3 Biodiversity Conservation Act

Four species listed under the BC Act are considered **likely to occur** within the study area, these include:

- New Zealand Fur-seal (*Arctocephalus forsteri*) (Vulnerable)
- Australian Fur Seal (*Arctocephalus pusillus doriferus*) (Vulnerable)
- Sooty Oystercatcher (*Haematopus fuliginosus*) (Vulnerable)
- Pied Oystercatcher (*Haematopus longirostris*) (Endangered)

1.3.1 BC Act Listed Endangered Species

Species: Pied Oystercatcher Endangered	Assessment under the BC Act Significance Criteria
<p>a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	<p>Given the works are water based, it is not anticipated that the works will result in an adverse effect on the life cycle of the Pied Oystercatcher.</p> <p>The species nests on sandy beaches from August to January with a high level of site fidelity. The species also inhabits mud and sand flats, and are likely to transit the study area towards the sand flats to the west of Narooma Wharf. Narooma Wharf does not constitute breeding habitat for the species and therefore will not disrupt the lifecycle. There are no mud or sand flats within the study area.</p>
<p>b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <p>i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,</p>	<p>Not applicable.</p>
<p>c) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</p> <p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality</p>	<p>The existing wharf may offer temporary refuge points (i.e. such as pylons, railing etc) for the species during periods of feeding or travel. The construction works will only temporarily remove these refuge points and are expected to be reinstated following the construction of the new wharf.</p> <p>It is unlikely that the works will result in habitat fragmentation and unlikely that the works will result in long term habitat removal for the Pied Oystercatcher.</p>
<p>d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>	<p>No areas of outstanding biodiversity value exist within the study area, or surrounds.</p>
<p>e) Whether the proposed development or activity constitutes or is part of a key threatening process or is likely to increase the impact of, a key threatening process</p>	<p>The works will result in the small scale removal of native vegetation in the form of seagrass meadows. The removal of seagrasses results in a reduced area of habitat for the species prey and potentially may result in less species capable of inhabiting that area, due to a potential reduction of habitat for small fish and crustaceans that inhabit seagrass meadows. This may have an indirect impact on the Pied Oystercatcher.</p> <p>The removal of native vegetation (indirectly via seagrass removal) is not listed as a threatening process for the species.</p>
<p>Statement of impact:</p>	<p>The proposed works will NOT have a significant impact on the species.</p>

1.3.2 BC Act Listed Vulnerable Species

Species: Sooty Oystercatcher Vulnerable	Assessment under the BC Act Significance Criteria
<p>a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle</p>	<p>Given the works are water based, it is not anticipated that the works will result in an adverse effect on the life cycle of the Sooty Oystercatcher.</p>

Species: Sooty Oystercatcher Vulnerable	Assessment under the BC Act Significance Criteria
of the species such that a viable local population of the species is likely to be placed at risk of extinction.	The species nests on sandy beaches from August to January with a high level of site fidelity. The species also inhabits mud and sand flats, and are likely to transit the study area towards the sand flats to the west of Narooma Wharf. Narooma Wharf does not constitute breeding habitat for the species and therefore will not disrupt the lifecycle. There are no sandy beaches in the study area.
<p>b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <p>i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,</p>	Not applicable.
<p>c) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</p> <p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality</p>	<p>The existing wharf may offer temporary refuge points (i.e. such as pylons, railing etc) for the species during periods of feeding or travel. The construction works will only temporarily remove these refuge points and are expected to be reinstated following the construction of the new wharf.</p> <p>It is unlikely that the works will result in habitat fragmentation and unlikely that the works will result in long term habitat removal for the Sooty Oystercatcher.</p>
d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)	No areas of outstanding biodiversity value exist within the study area, or surrounds.
e) Whether the proposed development or activity constitutes or is part of a key threatening process or is likely to increase the impact of, a key threatening process	The works will result in the small scale removal of native vegetation in the form of seagrass meadows. The removal of seagrasses results in a reduced area of habitat and potentially may result in less species capable of inhabiting that area. This may have an indirect impact on the Sooty Oystercatcher.
Statement of impact:	The proposed works will NOT have a significant impact on the species.

Species: Australian Fur Seal, New Zealand Fur Seal Vulnerable	Assessment under the BC Act Significance Criteria
<p>a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	<p>Both the Australian and New Zealand Fur Seals inhabit coastal waters, with the Australian Fur Seal favouring rocky islands with flat, open terrain. The New Zealand Fur Seal prefers notably more complex terrains of rocky islands, complete with boulders (DELWP, 2018³).</p> <p>The Australian Fur Seal is known to inhabit Montague Island offshore from Narooma, which is an identified breeding location for the species. There are also reports of non-breeding New Zealand Fur Seal at Montague Island. Numbers of both seals</p>

³ DELWP (2018). Our Wildlife Fact Sheet: Australian Fur Seal. Victorian Government.

Species: Australian Fur Seal, New Zealand Fur Seal Vulnerable	Assessment under the BC Act Significance Criteria
	<p>peak on Montague Island in September and October (Shaughnessy et al, 2001)⁴.</p> <p>Australian Fur Seals breed in summer months, with pups born from late October to late December. Females will spend their gestation period at sea, coming ashore to birth before mating again 6 – 10 days later (Australian Museum, 2020).</p> <p>Given the nature, scale and location of the works, it is not anticipated that the works will result in a significant impact to the life cycle of either species. Montague Island is located approximately 10 km from Narooma.</p>
<p>b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <p>i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,</p>	<p>Not applicable.</p>
<p>c) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</p> <p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality</p>	<p>The Australian and New Zealand Fur Seals are likely to inhabit the breakwaters at the inlet entrance, due to their complex rocky habitat presenting an ideal haul out area.</p> <p>The habitat offered by the wharf is likely not favourable to the species and if present, the species is likely only transiting and using the wharf as a temporary refuge. The Narooma Wharf does not form core habitat for either species.</p> <p>The removal of seagrass may reduce the available habitat for Australian and New Zealand Fur Seals prey (bony fish, cephalopods, crustaceans) and therefore may indirectly impact the food web for the species. However, both species are more likely to forage in oceanic waters and this indirect impact is expected to be minor to coastal foraging in the immediate vicinity. Further to this, there is alternative seagrass meadows within the greater inlet system.</p>
<p>d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>	<p>No areas of outstanding biodiversity value exist within the study area, or surrounds.</p>
<p>e) Whether the proposed development or activity constitutes or is part of a key threatening process or is likely to increase the impact of, a key threatening process</p>	<p>The works will result in the small scale removal of native vegetation in the form of seagrass meadows. The removal of seagrasses results in a reduced area of habitat, which reduces prey available for seal species. As such, this action may result in less foraging availability for seals within the local area</p>
<p>Statement of impact:</p>	<p>The proposed works will NOT have a significant impact on the species.</p>

1.4 Conclusion on significance of impacts

With the implementation of the mitigation measures detailed in Section 7 of the REF, it is not anticipated that a significant impact to threatened species is likely to occur. With the implementation of a DPI approved seahorse relocation plan, and use of seahorse hotels at the relocation site, impacts to seahorses will be minimised. There will be a loss of some seagrass habitat within the study area. The Seahorse Relocation

⁴ Shaughnessy, P., Briggs, S., Constable R. (2001). Observations on Seals at Montague Island, New South Wales. *Journey of Australian Mammalogy*, 23(1)pp1-7.

Plan recommends the consideration of seahorse hotels to be located at the receiver site to compensate for habitat loss.

Engagement with DPI Fisheries and DP&E Threatened Species Unit is required to confirm approval requirements, agree to the Seahorse Relocation Plan approach and confirm the adequacy of the proposed mitigation measures for listed species.

Appendix H

Seahorse relocation plan



→ The Power of Commitment

Syngnathids Relocation Plan

Narooma Wharf Upgrade

Transport for NSW

30 March 2022



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1. Introduction

1.1 Purpose of this report

Transport for New South Wales is proposing to upgrade Narooma Wharf, located at Bluewater Drive, Narooma. The existing wharf is in a deteriorated condition and in need of upgrade.

A specialist marine habitat assessment of the Proposal area was undertaken by Biosis in 2021 to assess the habitat types and species that may be supported by that habitat. This specialist assessment informed the review of environmental factors (REF) and understanding of the risk profile of the project on the marine environment. The accompanying field assessment was general in nature and no targeted survey was undertaken. While no syngnathids were identified during the general field survey, GHD's desktop assessment (refer to Section 6.7 of the REF) indicates the wharf is likely to support a population of syngnathids, including the endangered White's Seahorse. This is based on an assessment of existing suitable habitat and feedback from the Department of Primary Industries (DPI) - Fisheries. The REF adopts a precautionary approach and assumes the presence of syngnathids. On this basis, a syngnathids relocation plan has been prepared.

In order to reduce the risk of impact of the upgrade works to syngnathids, a relocation plan is required to relocate any syngnathids identified in the Proposal area (refer to Figure 1-2 of the REF) to appropriate habitat nearby. As the group's home range is generally quite small, relocation is generally a successful mitigation measure accepted by DPI.

The purpose of this plan is to satisfy statutory obligations under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Fisheries Management Act 1994* (FM Act) for endangered species to seek permission and appropriate permits for relocation to reduce the risk of harm as low as reasonably practicable.

Specifically, this relocation plan addresses:

- brief overview of the proposed scope of works
- background on seahorse ecology
- approach to relocation including:
 - potential receiver sites
 - relocation methods
 - timing of relocation
 - permits required
 - equipment personnel
- health and safety.

This plan is to be provided in draft to DPI Fisheries to seek support and undertake consultation on the appropriateness of the approach, consistent with statutory obligations and industry leading practice.

2. Background Information

2.1 The Proposal

The proposed upgrade of Narooma Wharf includes the demolition and reconstruction of the wharf in the same location and to a similar built Proposal area to the existing wharf.

Key features of the proposal include:

- staged demolition and removal of the existing wharf commencing with the eastern section. This would include the staged removal of the:
 - wharf deck and furniture
 - timber and concrete piles
 - utilities.
- construction of a new main wharf, 77 metres long by four metres wide that is fixed and connected to the shore via walkways and infill micromesh
- construction of a new 66 metre long by four-metre-wide floating pontoon that is connected to a shore-side platform via a gangway with a landing platform
- installation of a ten metre long lower-level landing, halfway along the main fixed wharf, with stairs connecting the landing to the main wharf and shore level
- installation of berthing and mooring infrastructure and wharf furniture such as fenders, bollards, safety ladders, rails and lighting
- ancillary wharf services such as a new sewage pump-out facility and sewer connection, upgraded firefighting and power and water service pedestals upgrade of the seawall adjacent to the pontoon and placement of rock revetment along a 24 metre section, if required.

A marine ecology assessment was prepared by Biosis in 2021 for the geotechnical work, which included field surveys. For the upgrade works, GHD has applied the findings from the Biosis report and supplemented any data gaps with a desktop assessment. The assessment found that the upgrade works of Narooma Wharf have the potential to impact a number of species that may utilise the area and will directly impact seagrass within the Proposal area. These works have the potential to impact on local and transient marine fauna that utilises the area as habitat, or for foraging, refuge or similar. This includes the potential for impact to the White's Seahorse and other syngnathids that may be present in the Proposal area.

Within the Proposal area, there are large beds of *Posidonia australis* (102.17 m²), *Zostera muelleri* (26.84 m²), and *Halophila ovalis* (2.71 m²), occurring in smaller mixed beds.

Refer to the accompanying Review of Environmental Factors for further information.

2.2 Seahorse ecology

The White's Seahorse (*Hippocampus whitei*) is endemic to Australia, occurring in temperate marine waters along both the south-east and south-west coastlines of Australia. The White's Seahorse is associated with a number of habitats, including artificial habitats such as swimmer protection nets and seahorse hotels. Naturally, the species is associated with seagrasses, sponges, soft corals and algae beds up to approximately 25 metres in depth, including where these habitats occur alongside wharf structures (NSW DPI, 2019). The species' home range is quite small, between 5 to 50 m², and individuals exhibit significant fidelity to their birthplace. This site fidelity and the species' poor swimming ability makes the White's Seahorse vulnerable to development (NSW DPI, 2019).

White's Seahorse live for about six years, with the breeding season occurring from September to February (NSW DPI, 2019). Monogamous pairs often reproduce up to eight times in a breeding season, producing between 100 – 250 seahorse fry. The survival rate of fry is estimated to be less than five percent (Fisheries Scientific Committee, 2019).

2.3 Relocation approach and DPI consultation

Due to their high site fidelity, it is not uncommon for the White's Seahorse home range to be between 5 and 50 m². Relocation is therefore a commonly accepted method to manage the risk of harm to the species. Following the review of this Plan, Transport for NSW would be required to consult directly with DPI Fisheries to confirm the relocation approach is satisfactory, obtain approval on a relocation site and post monitoring requirements (if applicable).

3. Methodology

3.1 Sites

3.1.1 Work site

The seahorse population located within the Narooma Wharf project Proposal area on Wagonga Inlet is the population of interest to be relocated. While the general ecology survey did not result in any positive identifications of the species, it is not possible to rule out their presence. Bioclimatic mapping has assumed a likely occurrence of the White's Seahorse in the area. Due to their highly cryptic nature, a thorough search for the group is required in order to have confidence that risk of the project is appropriately managed.

The first step of the relocation process is to undertake a thorough assessment of the work site to delineate habitats, identify species of syngnathids and predict the total population size prior to construction. During this phase underwater photographs will be captured and reported to DPIE Threatened Species Unit and DPI Fisheries. This phase will also include mapping of adjacent habitat immediately outside the worksite at the preferred relocation site, or several relocation sites as directly by DPIE and DPI.

3.1.2 Relocation site

The White's Seahorse prefers complex habitats that provide high levels of protection and food sources. A study undertaken by Harasti *et al* (2014) determined White's Seahorses in Port Stephens preferred gorgonian habitats (*Euplexaura* sp.) (juveniles) and sponges and soft corals (*Dendronephthya australis*) (adults). Within Sydney Harbour, the species is known to prefer similar habitats to the Port Stephens population. However, due to the degraded distributions of the species natural habitats within the Harbour (sponges, soft corals and seagrass), the species is strongly associated with artificial habitats such as the swimmer protection nets on inner harbour beaches.

A study undertaken in 2019 by Simpson *et al* (2019) took 10 individuals through binary choice experiments within aquaria settings which determined a notable preference for artificial habitats over natural. The study determined the results of the habitat preference experiments to be a) Net habitat (highest preference), b) *Sargassum* sp, c) *Posidonia australis* and d) *Zostera muelleri*. These results suggest that net habitat may offer a useful conservation substitute in circumstances where natural habitat is not available, or where natural habitat can be supplemented as natural habitat declines (Simpson, 2019).

GHD recommends consideration of creating and using seahorse hotels to supplement the natural habitat given the documented affinity of complex artificial structures. This process is overseen by DPI Fisheries and consultation undertaken early in the process can ensure that the best possible ecological outcomes are achieved. It is recommended that supplementary habitat in the form of seahorse hotels be deployed, that hotels are placed in the water as soon as reasonably practicable (about one month) before the relocation works as per DPI advice, allowing maximum marine growth for the species to seek refuge in immediately upon relocation.

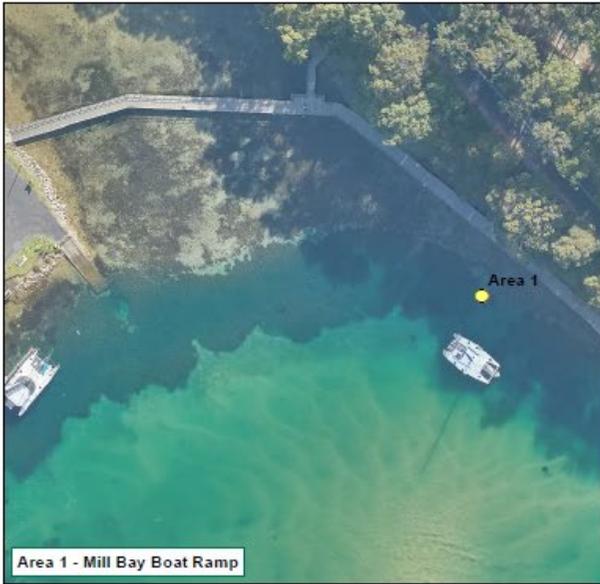
GHD has reviewed the Proposal area in detail via a desktop assessment and considered proximity to work site, protection offered by the relocation site, depth and availability of suitable and comparable habitat to the work site. The desktop assessment identified three potential relocation sites within one kilometre of the work site. A brief overview of each of these sites is provided in Table 3-1. These sites are also presented in Figure 3-1.

The preferred relocation site should be determined in consultation with DPI Fisheries. Consultation should be supported with field survey information of the potential relocation site(s). DPI Fisheries would review the recommended relocation site(s) and provide endorsement prior to confirming the final relocation site (as described in Section 3.1.1 above).

Table 3-1 Potential relocation sites

Relocation site name	Approximate location (Lat, Long)	Justification
<p>Mill Bay Boat Ramp</p> 	<p>-36.208081 150.125998</p>	<p>Mill Bay Boat Ramp was selected as a potential relocation site due to the mapped presence of <i>Posidonia sp.</i> (NSW DPI, 2000). The boat ramp is approximately 1 km upstream from the work site in the calm embayment of Mill Bay. There are piles in-situ which are supporting the boardwalk running parallel to Centenary Drive.</p> <p>On inspection of aerial imagery there appears to be a large Proposal area of seagrass that could be a suitable location for relocation and supplementary habitat placement provided by NSW DPI seahorse hotels.</p>
<p>Apex Park Pontoon</p> 	<p>-36.209179 150.128616</p>	<p>Apex Park Pontoon offers slightly deeper waters on the north-western corner of the slipway area. A large Proposal area of seagrass is visible in the aerial imagery. The seagrass genera mapped (NSW DPI, 2000) is <i>Zostera sp.</i> The Apex Park Pontoon is located approximately 700 m upstream. There are piles in-situ which support the boardwalk running parallel to Centenary Drive.</p> <p>This potential relocation site offers protection from throughfare vessel traffic and offers a similar environment to the works site.</p>

Relocation site name	Approximate location (Lat, Long)	Justification
<p>Bar Beach South</p> 	<p>Northern location (a)</p> <p>-36.209864 150.132555</p> <p>Southern location (b)</p> <p>-36.211321 150.132644</p>	<p>Bar Beach South offers two potential relocation areas. The first of which is on the existing swimmer protection net on the northern end of the beach. The second is the inner area of the groyne wall on the southern end of the beach. This option would require the addition of NSW DPI seahorse hotels. Both options are located approximately 600 m downstream near the inlet entrance.</p> <p>Swimmer net maintenance activities (e.g. seasonal removal, cleaning of net fouling etc.) should be understood prior to use of this option.</p>



Transport for NSW
Narooma Wharf
Upgrade REF

Project No. 12554705
Revision No. -
Date 1/25/2022

Relocation sites

FIGURE 3-1

© 2022 working: 12554705/REF/wharf_upgrade/12554705_2021_relocation_sites.mxd
Print Date: 25 Jan 2022 - 11:58

Data source: © OpenStreetMap (and) contributors, CC-BY-SA
© Department of Customer Service 2020. Drawn by: apj/rlr

3.2 Relocation methods

The relocation works would be undertaken with a dive vessel and team (minimum of two divers in the water), led by suitably qualified marine biologists experienced in underwater surveys and animal handling techniques. Following the initial survey of the work site and confirmation of the relocation site by DPI Fisheries, the relocation contractor would undertake a pre-clearance survey no more than 24 hours prior to the start of construction (ideally before silt curtain deployment).

Large buckets filled with seawater would be loaded onto the deck of the dive vessel. Temperature and dissolved oxygen probes would be placed in each large bucket to monitor the water conditions. It is recommended to place algae fronds with complex structures in the buckets for Syngnathids to grab onto.

The divers would undertake a thorough search of all Syngnathids within the worksite and immediate surrounds, including where the initial survey identified suitable habitat. Individuals would be captured by hand and placed in a catch bag (either a snap lock bag or fine, non-abrasive mesh bag). The species, sex, colouration, and size would be recorded for each collected individual. A photograph of each individual should also be taken. The location and depth would also be recorded for each individual. A total count of collected Syngnathids would be recorded. All recorded information would be provided to DPI Fisheries following the field work. Tagging may be required and would be discussed with DPI in advance of relocation work commencing.

At the end of each dive, all individuals would be taken to the vessel and placed in the large buckets out of their grab bags. There will be a dedicated diver on board who will monitor the seahorses and water conditions continuously.

Once all individuals are captured, the vessel would slowly proceed to the nominated relocation site. Syngnathids would be placed in catch bags from the large buckets and placed at the relocation site on appropriate habitat (i.e. sponges, seagrass, alga or on the seahorse hotel). All individuals would be relocated to the same relocation site, so as to reduce the potential for impacts to the species' breeding cycle given their strong monogamous pairing.

Periodic inspections throughout the construction works are required to ensure any Syngnathids have not relocated back to the works zone. The frequency of which is to be determined based on advice provided by DPI-Fisheries.

3.3 Timing of relocation

Construction work is proposed to be undertaken in mid-2022 with an expected four-month construction period. Construction may not be continuous during that period. It is anticipated that a silt curtain would be deployed immediately prior to construction works commencing, also in mid-2022.

The White's Seahorse breeding period is between September and February. All relocation works should be completed prior to the silt curtain deployment. An ad hoc inspection following the deployment of the silt curtain would need to be undertaken to check for any missed Syngnathids. Relocation between June to August would minimise potential impacts to the species' reproductive cycle.

3.4 Management measures

The following management measures are recommended as part of this relocation plan to minimise potential impacts on Syngnathids:

- surveys of the work site would be conducted before and after the silt curtain is deployed to ensure that all individual Syngnathids have been relocated
- relocation works would take place outside of the breeding cycle, allowing the opportunity for individuals to settle prior to the start of their breeding cycle
- relocation works should target winter months before the start of the breeding cycle and when population density of the group is lowest
- all individuals would be relocated to the same relocation site so as to not disrupt the species breeding season success, given the monogamous pairing characteristic of many Syngnathids
- three relocation sites have been recommended for NSW DPI Threatened Species Unit and Transport for NSW to consider.

- consideration should be given to supplementary use of seahorse hotels at the selected relocation site as alternative habitat should there be a natural decline or degradation of the natural environment that may occur
- relocation works would be overseen by a suitably qualified marine biologist with experience in underwater surveys and animal handling techniques
- works would be undertaken in accordance with permits (see Section 3.5) and any associated conditions.

3.5 Permits

To carry out the Syngnathids relocation works, the following permit will be required:

- Section 37 of the FM Act requires a permit for actions involving the taking and possession of fish or marine vegetation of any description.

3.6 Equipment

At a minimum, the following equipment will be required:

- dive vessel in commercial survey
- personal dive gear equipment including underwater camera with underwater light attachments
- safety equipment (i.e., alpha flag, diver below buoy, spotter on vessel)
- catch bags made of fine, non-abrasive mesh or large snap lock plastic bags and recapture net
- measuring plate with ruler
- large buckets full of seawater on the vessel, with battery operated aerators.
- seahorse hotels (if applicable).

3.7 Personnel

The relocation works must be undertaken by suitably qualified scientific or commercial divers, with experience in underwater surveys and animal handling, specifically with regards to seahorse relocation. The works must be undertaken by a suitably qualified marine biologist experience in animal handling. The relocation program would be undertaken in consultation with DPI Fisheries.

3.8 Health and safety

The contractor undertaking the relocation works is required to prepare a Job Safety Environment Analysis (JSEA) or Safe Work Method Statement (SWMS), or equivalent to the satisfaction of Transport for NSW. The plan is to ensure safety to personnel during the process of relocation works, inclusive of all task steps.

In addition, the contractor is required to provide a Dive Plan, or equivalent. The Dive Plan is to cover the tasks and duties of each person diving, the equipment used, the proposed dive times and depths, hazards of the proposed scope of works, modes of communication including to external parties and other environmental factors. The Dive Plan is to be prepared to the satisfaction of Transport for NSW.

With regards to communicating the intent to dive the works and relocation site, the contractor is to provide formal notification to Transport for NSW - and ensure the dive team includes appropriate safety precautions and flag provisions.

3.9 Reporting

A brief summary report of the relocation works is to be provided to DPI Fisheries following the relocation works. At a minimum, the summary report would include:

- details on relocation site
- details on total number of relocated animals, including details on species, sex, colouration and size recorded in the field during relocation works

- details on the success of the relocation program and discussion of deviations to the proposed work approach detailed in this plan.
- long term plan for the relocated animals (The relocation works may be decided by DPI as a temporary measure and therefore, the group and the seahorse hotels (if appropriate) would need to be moved back under a renewed relocation plan to Narooma Wharf)
- any ongoing monitoring requirements (if applicable).

4. References

Fisheries Scientific Committee (2019). Final Determination White's Seahorse: *Hippocampus whitei*.

Harasti, D., Martin-Smith, K. & Gladstone, W. (2014b). Ontogenetic and sex-based differences in habitat preferences and site fidelity of the White's seahorse *Hippocampus whitei*. *Journal of Fish Biology*, 85: 1413–1428.

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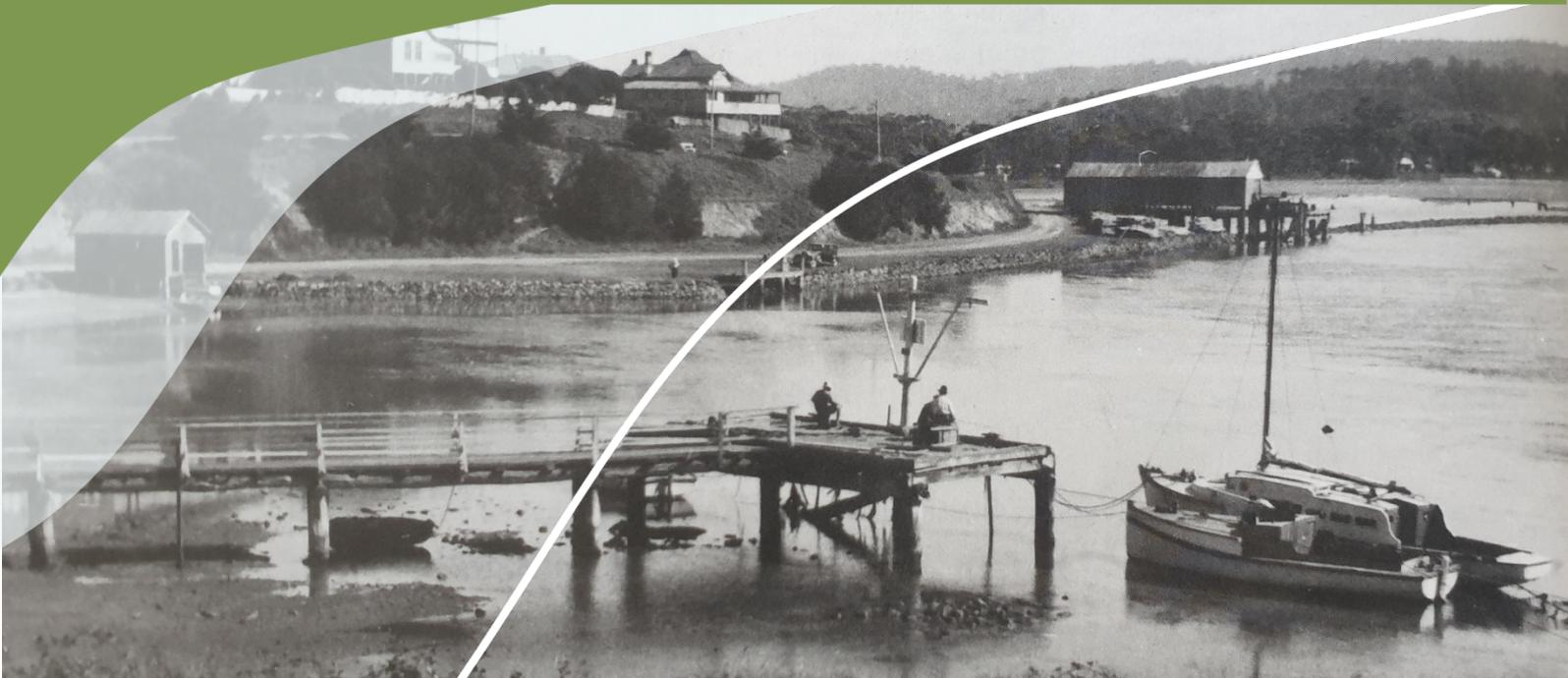
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Appendix I
Stage 2 Procedure for Aboriginal Cultural Heritage
Consultation and Investigation (PACHCI)
assessment

Stage 2 PACHCI: Aboriginal Archaeological Assessment



Narooma Wharf Replacement Eurobodalla Shire NSW

A report prepared for:
Transport for NSW

Assessment No: A095

June 2021



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Recipients are responsible for eliminating all superseded documents in their possession.

Acknowledgement of Country

On Site Cultural Heritage Management acknowledges the Traditional Custodians and Elders of this country and their connections to land, sea and community. We pay respect to the past, present and future continuation of cultural, spiritual and educational practices of Aboriginal and Torres Strait Islander peoples.

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EXECUTIVE SUMMARY

INTRODUCTION

Transport for New South Wales NSW (TfNSW) are proposing to replace the Narooma Wharf on Blue Water Drive, Wagonga Inlet.

TfNSW completed a Stage 1 assessment against the Procedure for Aboriginal and Cultural Heritage Consultation Investigation (PACHCI) as part of their project review (**Appendix 1**). The Stage 1 PACHCI identified the need to progress to a Stage 2 PACHCI assessment due to presence of a previously recorded AHIMS Site 62-7-0089 near the proposed works.

TfNSW has engaged On Site Cultural Heritage Management Pty Ltd to undertake an Aboriginal Archaeological Assessment to meet the requirements of the PACHCI (Stage 2).

SURVEY AND RESULTS

An archaeological pedestrian survey was conducted of the shoreline area extending to the south and north of the study area on 26 May 2021 by David Carriage (Bindarray) and representative of the South Coast NSW Aboriginal Elders, Gareth Doran of Transport for NSW and Gerard Niemoeller of On Site CHM.

No Aboriginal objects, Potential Archaeological Deposits (PADs) or sensitive landforms were identified as part of this archaeological survey. The terrestrial part of the study area has been demonstrated to be reclaimed land and is assessed as highly disturbed.

No trace of AHIMS Site 62-7-0089 could be located within the study area as part of this investigation.

Aboriginal consultation concluded that the proposal would not affect any significant known or potential Aboriginal cultural heritage features.

CONCLUSIONS

This assessment has determined that:

- There are no Aboriginal sites or objects within the study area.
- Previously recorded AHIMS Site 62-7-0089 is not located within the current study area. Interpretation of Sullivan's original site recordings as part of this assessment suggest that AHIMS Site 62-7-0089, if indeed still extant is located south of the Narooma Wharf study area and on the north western fringe of Rotary Park adjoining Blue Water Drive.

- The *National Parks and Wildlife Act* protects Aboriginal sites and objects. The recorded locations of Aboriginal objects are stored within the AHIMS Database for management purposes. If the recorded locations are demonstrated to be erroneous, then the erroneous location recorded in AHIMS is not protected. In this instance a review and reinterpretation of Aboriginal site recordings has determined a different location for AHIMS Site 62-7-0089 than that recorded on AHIMS.
- The study area is reclaimed land resulting from massive amounts of landscape disturbance and the likelihood of subsurface deposit / PAD is therefore assessed as negligible to nil.
- The study area has no archaeological significance.
- The proposed replacement of the Narooma Wharf will have a negligible or nil potential to impact on Aboriginal sites and objects protected under the *National Parks and Wildlife Act*.
- Aboriginal consultation concluded that the proposal would not affect any significant known or potential Aboriginal cultural heritage features.

MANAGEMENT RECOMMENDATIONS

On the basis of this assessment and the legal requirements of the *National Parks and Wildlife Act* and associated policy, it is recommended that:

1. No further assessment or action is warranted with regard to the proposed Narooma Wharf replacement and management of Aboriginal sites and objects protected under the *National Parks and Wildlife Act*.

An AHIMS Site card has been prepared for the revised location of AHIMS Site 62-7-0089 and submitted to AHIMS (**Appendix 5**).

1. INTRODUCTION

Transport for New South Wales NSW (TfNSW) are proposing to replace the Narooma Wharf on Blue Water Drive, Wagonga Inlet.

TfNSW completed a Stage 1 assessment against the Procedure for Aboriginal and Cultural Heritage Consultation Investigation (PACHCI) as part of their project review (**Appendix 1**). The Stage 1 PACHCI identified the need to progress to a Stage 2 PACHCI assessment due to presence of a previously recorded AHIMS Site 62-7-0089 near the proposed works.

TfNSW has engaged On Site Cultural Heritage Management Pty Ltd to undertake an Aboriginal Archaeological Assessment to meet the requirements of the PACHCI (Stage 2).

1.1. Narooma Wharf Replacement Proposal

According to the PACHCI Stage 1 Assessment, TfNSW is proposing to demolish the existing Narooma wharf structure and rebuild a more fit for purpose structure.

TfNSW propose to stage the works to keep tour boats operating throughout the construction period. Commencement of the work will involve removing the wharf's concrete section then progressing to the eastern side. Rebuilding the wharf begins by installing a pontoon system with a gangway connection on the eastern side.

New amenities, such as a sewerage pump-out system, possibly security gates, along with upgraded firefighting and electrical outlets are also proposed to be installed.

The proposed Wharf replacement is located approximately within the same footprint area of the existing wharf at 142m in length and nominally 3m to 4m in width. The primary proposed construction material is steel, reinforced concrete & fibre reinforced plastics for the access gangways and the walkway. Handrails will be of steel, and the pontoon system is a foam-cored concrete covering.

1.2. Personnel and Authorship

Gerard Niemoeller, Principal Heritage Consultant of On Site CHM undertook the site visit, the research component and prepared reporting for this project.

Figure 1: The Project Area – proposed Narooma Wharf replacement footprint (shown in green).



2. STUDY METHODOLOGY

The current Aboriginal Archaeological Assessment has been conducted in accordance with Stage 2 of the PACHCI, with reference to the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010) and has included:

- Review of relevant landscape context to understand the potential of the land to have been occupied by Aboriginal people and leave material traces behind reflecting that occupation.
- Review of the non-Aboriginal history of the study area
- An AHIMS database search to identify previously recorded sites within or within proximity to the study area
- Review of AHIMS Site cards and relevant archaeological reports to provide archaeological context for the assessment of the study area.
- A site assessment in partnership with the Aboriginal community to document information about the Aboriginal objects that may be present
- Assess the archaeological significance of any identified Aboriginal objects to inform the development of conservation management strategies
- Preparation of this report documenting the results of the above processes, discussing the significance of the area and formulation of management strategies.

The Code acknowledges that the review of background information relating to landscape context, previous archaeological works and discussion about regional character should be appropriate in scale and details to the study area.

The current study area is small in size and as discussed in **Section 4.0** is also highly disturbed. The review and discussion relating to these aspects is considered appropriate in nature and scale.

3. ABORIGINAL PEOPLE AND EARLY EUROPEAN HISTORY IN NAROOMA

3.1. Aboriginal people and the Eurobodalla Shire

The Narooma wharf area falls within the boundaries of the Wagonga Local Aboriginal Land Council. The study area falls within the boundaries of the Yuin Aboriginal people and more information is provided below.

The following summary is taken from the Eurobodalla Aboriginal Heritage Study (Stages 2) (Donaldson 2006:2-3).

Underlying the Eurobodalla Shire is an Aboriginal land tenure system present prior to European settlement of the area¹. Aboriginal people's links to the region, in the past as well as in the present can be described on a number of levels including tribal, sub-tribal, clan and linguistic.

The Yuin [Djuwin] tribal area extends from the Shoalhaven in the north, to the Victorian border in the south and west to the Great Dividing Range. Within the Yuin tribal area, thirteen [13] sub tribal groupings exist. The mythological basis to the Yuin tribal division is said to involve the mythical ancestor "Bundoola" who had thirteen [13] wives each representing the different tribal groups. Yuin tribal subgroups with traditional links to the region include the Walbanja, Bringa and Djirringanj².

On a more localised scale, a number of named clan groups existed within each tribal area. For instance, the *Turras* [Durras] group were recorded as occupying country to the general area to the north of the Clyde River; the *Currowan* group occupied the present day Currowan Creek area near Nelligen; the *Browley* [Broulee] group occupied land between Congo and Batemans Bay; the *Mullenderee* [Mullinderry] / *Moorooya* [Moruya] / *Duga* [Dooga] / *Gundaree* [Gunday] / *Mokondoora* [Mogendoura] group were variously recorded as occupying the Moruya and Deua River area; the *Kiyora* [Kiora] group west of Moruya; the *Burgali* [Bergalia] in the Congo and Bingi area; the *Terosse* [Tuross] group in the Tuross area; the *Bowdally* [Bodalla] group in the Bergalia and Brou Lake areas; the *Wagunga* [Wagonga] and the *Noorama* [Narooma] people were identified in the Wagonga and Tilba areas; and the *Wollaga* [Wallaga] group as occupying the Tilba, Wallaga Lake and Narooma area³.

¹ See Robinson 1844, Mathews 1902, Morris 1832, Oldrey 1842.

² See Howitt 1904 [1996]; Egloff, Peterson and Wesson [2005]. Note, the description of the Yuin tribal area can vary according to context, level of knowledge and personal orientations. Per comm Trisha Ellis 4.2.2006.

³ S Wesson 2000: 131 – 147. Per comm. John Mumbler 24.5.2006.

On a linguistic level, the Eurobodalla Shire is associated primarily with the *Dhurga* [Thoorga / Durga] language, with the *Djirringanj* language region extending into the study area in the south. These languages are dialects of a language that existed in a variety of forms including *Dhurga* [Thoorga/Durga], *Djirringanj*, *Thurumba* or *Mudthung* and *Tharawal*⁴.

3.2. Eurobodalla Aboriginal Heritage Study

The Eurobodalla Aboriginal Heritage Study was a four stage study undertaken between 2005 and 2008. The study was a partnership study between the Aboriginal Community and Local Aboriginal Land Councils, NSW Government agencies and the Eurobodalla Shire Council. The broad aim of the study was to develop a better understanding of Aboriginal cultural heritage in the Eurobodalla Shire and to develop better ways to manage, protect and acknowledge the heritage values within the local government planning framework (Donaldson 2008:14).

The study involved the collation of written resources, recording of oral histories, identification and documentation of places identified, especially those places identified through oral history and not currently afforded protection under the NPW Act and the formulation of conservation management strategies and recommendations.

The Narooma Wharf area is within an identified culturally sensitive landscape of Wagonga Inlet (Donaldson 2008: see Stage 4, Appendix 8). Donaldson (2008:40) defined culturally sensitive landscape where ‘nodes’ or clusters of interrelated places of heritage significance exist. It was recommended that these landscapes be included in a Development Control Plan (DCP) and act as a trigger within these landscapes to consider heritage values in relation to a given development.

To date this remains a recommendation and has not been adopted or furthered by the Eurobodalla Shire Council and therefore imposes no additional legal constraints or requirements on the proposed works at Narooma Wharf.

The undertaking of this assessment to consider and understand Aboriginal cultural heritage values is consistent with the management principles likely to be adopted for a culturally sensitive landscape.

Whilst there are no legal constraints arising out of the study for the current proposal TfNSW has also undertaken consultation with the Aboriginal Community to ensure their views about any identified values are considered.

⁴ Egloff, Peterson and Wesson [2005]: 17.

3.3. A Brief history of Narooma

The first European to take up land around Wagonga Inlet and the Narooma area was Francis Hunt in 1835 who established a large property on the southern side of the inlet called Wagonga Station. By 1848 the property had been sold to Thomas Forster who changed the name to 'Noorooma'. This large property was subsequently broken up into smaller landholdings following the 1861 Free Selection Act. During the early years of occupation Europeans developed the Narooma area for pastoral purposes. Following the discovery of gold on Mount Dromedary in the 1850s mining also became a feature of the area. The resulting small rush caused by the initial gold discovery served to increase the population of the area, as well as provide necessary trade and capital for further development. The Wagonga Inlet also began serving as a port for the developing township of Nerrigundah following the discovery of gold. A road was constructed between Nerrigundah and Wagonga Heads in the early 1860s and a small settlement began to develop around the Heads. Gold mining continued on a small scale within the region up until the early 1880s. During the same period the timber industry began to develop and several sawmills were established in the area (Pacey 2005:7, 17-19; Turner 1996:9, 21, 29-30).

The discovery of reef gold at Kianga in 1882 and construction of sawmill on the south head of the inlet saw expansion of the Wagonga Heads area. The small settlement at Wagonga Heads South continued to develop to service the emerging industries and a road was soon constructed linking it with Tilba Tilba. At this time there was estimated to be a population of between 50 and 100 people in the surrounding area which was enough for a post office to be established to the north of Wagonga Heads in 1883. In 1884 the Wagonga Heads South settlement began to be known as 'Noorooma', was subsequently surveyed in 1885 and proclaimed a township in 1886. By this time the wharf was receiving regular steamer traffic and at least one store was present in the town. Meanwhile the post office to the north of Wagonga Heads closed due to population decrease in the area. By 1888 the local community was calling for a new post office at 'Noorooma' and increased mail services, which were soon granted by the government. By this time 50 or 60 people lived at and around 'Noorooma' which sported a sawmill, large hotel, up to eight cottages and a public school. The growing importance of 'Noorooma' led to the construction of a road to Bodalla to the north in 1889. The spelling of the town's name to Narooma was also changed around this time due to the postal department mistakenly spelling it this way (Pacey 2005:17-19).

Following the construction of the punt across the Wagonga Inlet in 1894 Narooma began to develop quickly and with additional houses, a store, a butcher's shop, a bakery, a dance hall, a church, a School of Arts, and another hotel over the following years. In the early 1900s increasing development required the upgrading of bridges and roads in the area to cope with the growing traffic. At this time the Illawarra and South Coast Steam Navigation Company had a steamer calling bi-weekly at Narooma and Wagonga to service the timber and fishing industries of the area. With the construction and opening of the Narooma Bridge in 1931, Narooma continued to grow as a transport and tourist centre and earn a name as a popular seaside resort (Pacey 1990:20; Turner 1996:30).

4. LANDSCAPE CONTEXT

According to the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010: 8), the purpose of reviewing the landscape context is to assist in the determination or prediction of:

- the potential of the landscape, over time, to have accumulated and preserved objects
- the ways Aboriginal people have used the landscape in the past, with reference to the presence of resource areas, surfaces for art, other focal points for activities and settlement, and
- the likely distribution of the material traces of Aboriginal land use based on the above

Consideration of the landscape is essential to the definition and interpretation of Aboriginal land use across a landscape. The landscape will provide clues as to those areas of land that may have been more intensively used by Aboriginal people in the past, and also provide the context within which the material remains of past Aboriginal occupation may be preserved and detectable (DECCW 2010:8).

The landscape context should be appropriate in scale and detail relative to the study area and might include aspects relating to landscape history, description of landforms and geomorphic activity, soils, land use history and, where relevant, natural resources. The landscape context should also be proportionate in detail to the level of assessment. This Due Diligence Assessment represents a broad scale assessment to understand whether further and more detailed assessment. Accordingly, the review of the landscape context is also broad scale in nature.

The archaeological record that we seek to understand is a reflection of Aboriginal land use and tangible expressions of that occupation. The archaeological potential of a given area will commonly be influenced by major economic factors such as access to potable water, stone resources suitable for the manufacture of stone tools, natural resources providing food and other materials, shelter and suitable camping areas.

4.1. Environmental Description of the Landscape and Study Area

According to the landscape classification system described by Mitchell DECCW (2002) the subject land falls within the South East Corner Granites Bioregions and the Bega Coastal Foothills (Bfh) landscape. The Wagonga Inlet is part of the Tuross - Eden Barriers and Beaches (Teb) landscape. A description of these landscapes after Mitchell (2002) is provided below.

4.1.1. Bega Coastal Foothills (Bfh) landscape

Low hills with general slope toward the coast on Ordovician quartzite, slate, chert, and phyllite. General elevation 0 to 520m, local relief 250m. Thin stony red and red-yellow texture-contrast soils. Open forest of tall spotted gum (*Corymbia maculata*), grey ironbark (*Eucalyptus paniculata*), red bloodwood (*Corymbia gummifera*), white stringybark (*Eucalyptus globoidea*), blackbutt (*Eucalyptus pilularis*) with blady grass (*Imperata cylindrica*), bracken (*Pteridium esculentum*) and burrawang (*Macrozamia* sp.) in the understorey, shrubs limited. On headlands heaths of bushy needlewood (*Hakea sericea*), giant honey-myrtle (*Melaleuca armillaris*), coast rosemary (*Westringia fruticosa*) and dwarfed red bloodwood occur in shallow soils subject to high salt spray input and frequent fire.

4.1.2. Tuross - Eden Barriers and Beaches (Teb) landscape.

Beach, dune and lagoon complex of Quaternary quartz sands, elevation 0 to 20m. Moderate carbonate content in frontal dune transitions to simple podsols with organic pan and diffuse iron pans on the most inland dunes. Organic silty sand in lagoons and estuary. Coast spinifex (*Spinifex hirsutus*) and mat-rush (*Lomandra* sp.), at the rear of the beach, coast tea-tree (*Leptospermum laevigatum*), coast banksia (*Banksia integrifolia*) and coast wattle (*Acacia longifolia* ssp. *sophorae*) on the frontal dune, old man banksia (*Banksia serrata*), red bloodwood (*Corymbia gummifera*) on inland dunes. Swamp paperbark (*Melaleuca* sp.), swamp oak (*Casuarina glauca*) and rushes on margins of lagoons in brackish sectors giving way to common reed (*Phragmites australis*) in fresh water areas. Southern mahogany (*Eucalyptus botryoides*) and blackbutt (*Eucalyptus pilularis*) around swamp margin.

4.2. Geology of the Study Area

According to geological mapping, the adjoining land area of the project area is entirely underlain by Ordovician sedimentary rocks and volcanic rocks (Ow). Wagonga Inlet is classified as a Holocene Estuary Channel (Qhec), comprised of marine sand, silt, clay shell and gravel.

4.3. Land use history and integrity of the Study Area

The current Narooma wharf area (and study area) has been an important historical focus on Wagonga Inlet and for Narooma since at least the early 1900s.

The initial focus for historical settlement in Narooma was largely driven by the pastoralism, gold, timber and sawmilling industries. Most of these early settlements and industries in the Narooma area were largely serviced by ship and the establishment of wharves in the Wagonga Inlet played an important role in the development of the town.

There have been a number of iterations of wharves within the vicinity of the study area. The first wharf was built in the 1880s at the small bay to the south east of the study area now called Rotary Park. This wharf serviced sawmills until 1891 (See **Plate 1** and **Figure 2**) and was also used for deliveries from Sydney until 1930 when the new wharf within the current study area was built. The Rotary park wharf was then largely used by fisherman until it was demolished in 1964 (Pacey 2005:28).

Plate 1: The 1880s wharf at current Rotary Park (from Pacey 2005:28) from 1926 postcard. Note Australia Rock in background.



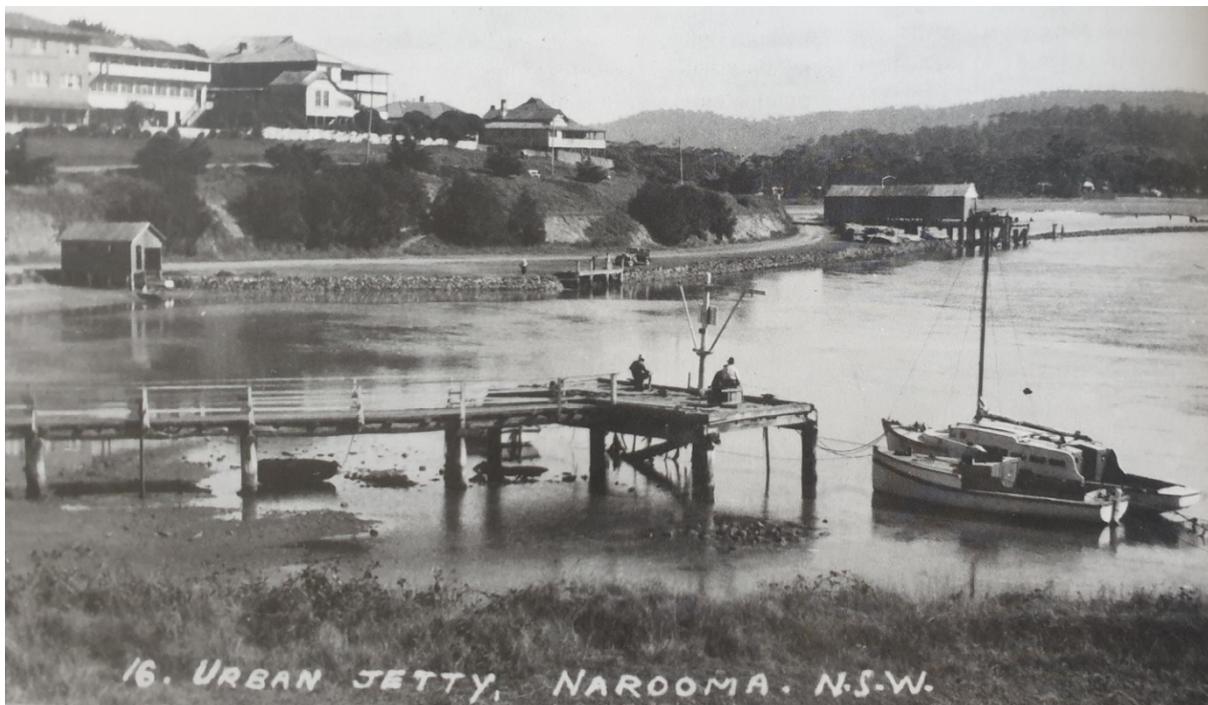
Figure 2: 1880s map showing wharf at what is now Rotary Park. Note original profile of land for current study and wharf area



The first wharf within the current study area was completed in 1930 and an extension was subsequently added in 1938 (Pacey 2005:28). **Plate 2** shows extensive cutting adjacent the wharf and early road alignment of what is now Blue Water Drive.

The fill from this cut was also likely used for land reclamation evidenced in photo by the rock armour. Additional plans from 1954 show that the level of this reclaimed land was subsequently raised and additional rock armour was instated to fortify and repair the existing armour wall and minimise erosion occurring at hightides. Plans supplied by TfNSW for the original 1930s wharf and 1954 repairs are provided at **Appendix 2**

Plate 2: Rotary Park wharf in foreground (from Pacey 2005:34). Note extensive cutting likely used for land reclamation purposes to create wharf area. The reclaimed land is shown by the rock armour wall.



Aerial photography from 1957, 1973 and 1984 at **Figures 3 to 5** shows the study area, developmental stages of the wharf and the land reclamation as distinct from the original approximate coastline as was previously shown at **Figure 2**.

Figure 3: 1957 Aerial photograph showing original wharf and land reclamation.

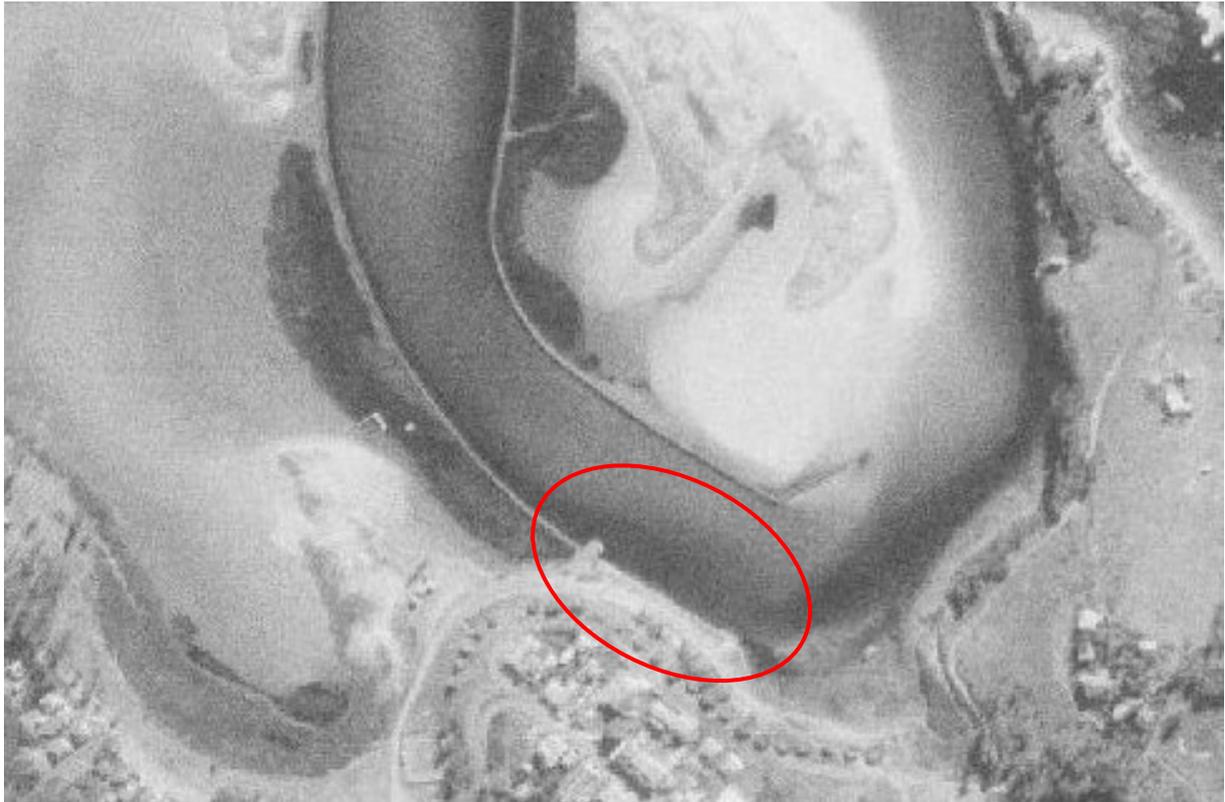


Figure 4: 1973 Aerial photograph showing original 1930s wharf and concrete wharf.



Figure 5: 1984 Aerial photograph showing current day wharf and extent of land reclamation.



4.4. General Description of the Project Area

Whilst the environmental descriptions within this section describe a macro landscape class, these descriptions do not accurately describe the contemporary micro landscape of the actual project area. As discussed above the study area is within the centre of Narooma township. The Narooma wharf area has been a focus for non-Aboriginal activities and disturbance since the late 1800s and has undergone successive maritime and roadway construction activities. This has resulted in clearing of all native vegetation, extensive cutting of the adjoining landform, staged land reclamation, widespread introduction of hard surfaces (roads and footpaths) to accommodate vehicle and pedestrian traffic and installation of services to accommodate urban and maritime needs.

On this basis the entire study area is considered to be highly disturbed and have a low level of integrity.

5. REGIONAL CHARACTER AND ARCHAEOLOGICAL BACKGROUND

5.1. Regional Character

Numerous archaeological studies have been undertaken for the NSW South Coast region for the purposes of both academic research and development assessment and are reviewed below. The below is not considered an exhaustive review but is appropriate to the small scale of this assessment and the proposed activity.

Many of the early archaeological settlement models proposed for the south coast area focussed on the discussion about seasonal variation, settlement and subsistence patterns between coastal areas and the hinterland (Poiner 1971, Attenbrow 1976, Vallance 1983).

By far the most comprehensive and contemporary academic study of the South Coast hinterland has been conducted by Boot (2002) for his Doctorate. Boot (2002) focused on the hinterland forested hills, mountains and plateaux between the coastal lowlands and tablelands. The study area extended from the Pigeon House Range and the northern rim of the Bega Valley and encompasses the catchments of three major river systems.

According to Boot (2002:315-316) previous archaeological research in the South Coast region produced hypotheses that attempted to explain Aboriginal occupation in terms of seasonality, movement and territory, antiquity of occupation, economic factors and population change. Some hypothesised that the hinterland was visited by people who spent most of the year on the coast, while others have suggested that major hinterland river valleys were occupied throughout the year and that elevated areas were visited only during warmer seasons. All suggest some form of seasonally determined occupation pattern. Other models hypothesise that subsistence patterns were influenced by short-term climate and environmental change and localised resource abundance rather than by seasonal variation (Boot 2002: 315-316). Boot (2002:316) concluded that many of the previous hypotheses relating to Aboriginal occupation of the South Coast hinterland could no longer be supported.

Instead Boot (2002:330) posited that the generalised economy model suggests that extensive sites with large assemblages will occur where significant quantities of food and other resources were available, either regularly or on single occasions. Smaller sites represent periods and locations of normal resource availability. Large sites tend to be located in optimum exploitation areas where a range of adjoining environments occur. Such places include those where rock platforms, sandy beaches and estuaries occur in association with coastal woodland or where riverine and open woodland environments occur together such as in hinterland river valleys (Boot 2002:330).

Boot (2002:91, 1993:327) found that the greatest density of sites tended to occur in major river valleys and on broad well watered ridgelines. Major river valleys also showed a much higher overall artefact density than other locations. Stone artefact locales (open artefact scatters and isolated artefacts represented the overwhelmingly majority of Aboriginal occupation evidence located during the study.

(Boot 2002:102-103) found that the majority (60% to 74%) of open scatters, isolated finds and artefact locations across all environmental zones occurred on ridge and spur crests or saddles, suggesting a considerable amount of subsistence activity in the hinterland occurred from these locations. River terraces also accounted for large percentages of the total artefacts recorded. River terrace sites contained more artefacts than any topographic unit other than ridge crests. Between 72% and 82% of all artefacts occur on ridge crests, river terraces, spur crests and saddles, suggesting that the river terraces were as crucial to the subsistence and habitation strategies as the ridgelines above them (Boot 2002:102-103).

Boot (2002:101) also found overwhelming environmental evidence, from at least 82% of open scatters that level locations were preferred for campsites even over slight slopes and the same was true for isolated finds (Boot 2002:101). The most intensively exploited and occupied were flat locations in major river valleys and on low altitude, broad, forested ridges (Boot 2002:119).

Knight's (1995) analysis of the 2270 sites located during ANU undergraduate field surveys between Ulladulla and Moruya found that 78% were located within the hinterland, with only 22% percent located on the coast (ocean shoreline, estuarine environments and off shore islands). Sites were more common along the ocean shoreline (60.8%) than in estuarine environments (33.9%) including lake shores, river banks and mangrove swamp. The highest proportion of sites recorded along the ocean shoreline was situated within the dunes context (47.6%), followed by those on headlands (35.7%). Knight (1995:29) suggested that the location of middens appears to be essentially governed by ecological (proximity to shellfish procurement zones) as well as topographic factors. Knight (1995:29) further suggests that there was no outstanding association with any particular coastal topographic unit and midden forming behaviour was undertaken at any topographic feature that was within close proximity to a shellfish procurement zone, noting gradient and shelter as key influences on site location.

The findings of these studies have implications for how we understand the Aboriginal archaeological landscape, predict the locations of Aboriginal occupation evidence, being the 'sites' and 'objects' that the *NSW National Parks and Wildlife Act 1974* seeks to protect.

5.2. Aboriginal Heritage Information Management System (AHIMS)

A search of the Aboriginal Heritage Information Management System or AHIMS register was undertaken for a 2 EW x 2 NS kilometre area (4 km²) encompassing the project area. **Table 1** below shows the grid coordinates for the AHIMS register search.

Table 1: Minimum and maximum grid references employed for AHIMS register search

	Minimum	Maximum
Easting	56 241000	56 243000

Northing	5987200	5989200
-----------------	---------	---------

The AHIMS Database search shows 20 Aboriginal sites have been previously recorded within this search area. All but one of these sites are recorded as open sites.

The subject land is not within, either partly or wholly an area that has been declared an Aboriginal place. The AHIMS search area and the distribution of previously recorded AHIMS sites is shown in **Figure 2**. Results of the AHIMS site register search are provided in **Appendix 3**.

According to the AHIMS register spatial information, one of these sites is located immediately adjacent the wharf area (AHIMS Site 62-7-0089). This site is recorded as a midden site and was recorded by Marjorie Sullivan as part of the Eurobodalla Shire Survey (1979). A second site (AHIMS Site 62-7-0025), is located within Rotary Park to the south east of the wharf is reported as a burial. Additional discussion about these sites is provided at **Section 5.3.1** and copies of relevant AHIMS Site cards are included at **Appendix 3**.

Information from the AHIMS search register shows that the majority of previously (75%) recorded sites are recorded as Midden Sites. Scarred trees represent the second highest proportion of previously site type (10%). A review of key studies for this area is provided below in **Section 5.3**.

Table 2: Review of site types from AHIMS register search

SITE TYPES	Number	%
Midden	15	75%
Scarred Tree	2	10%
Burial/s	1	5%
Shelter with Midden	1	5%
Stone artefact	1	5%
TOTAL	20	100.0%

Figure 6: AHIMS search area and distribution of previously recorded AHIMS sites



Figure 7: Previously recorded AHIMS sites in relation to the Narooma Wharf



5.3. Previous archaeological studies within local area

A number of archaeological surveys have been undertaken around Wagonga Inlet and resulted in the recording of previously recorded AHIMS sites discussed in **Section 5.2**.

Besides Sullivan (1979), the only other survey covering the current foreshore area was undertaken by Kerry Navin in 1997 for Eurobodalla Shire Council. This study is reviewed below to inform the current assessment.

Navin (1997) undertook a survey of proposed improvement works around both northern and southern foreshore of Wagonga Inlet. Eleven Aboriginal midden sites were located during the study with five being on the northern side of the inlet and six on the southern. All these sites were assessed to be significant in a local context as they represented a substantial portion of

the remaining Aboriginal sites around the Wagonga Inlet (See **Figures 6-8**). Along the foreshore a number of areas of archaeological potential were also identified, as well as several areas of no archaeological potential due to large scale historic land surface disturbance or landfill. This type of disturbance was found to be widespread across both sides of the inlet foreshore and included the exploitation of midden material by Europeans for lime burning, road base, and boat ramp construction (See **Figure 9**).

Navin (1997:15, Figure 3) identified Rotary Park as an area where disturbance may uncover Aboriginal artefacts. Five middens (WFM7-WFM11 / AHIMS Sites 62-7-0219 - 62-7-0223) were identified to the east of Rotary Park along the spit that forms the southern head to Wagonga Inlet (See **Figure 8**). **Figure 9** identifies the entire wharf area and the adjoining foreshore north towards the bridge as areas of gross land surface disturbance and/or landfill with no potential for Aboriginal sites.

Figure 8: Extract of Figure from Appendix II from Navin 1997:16) showing identified sites.

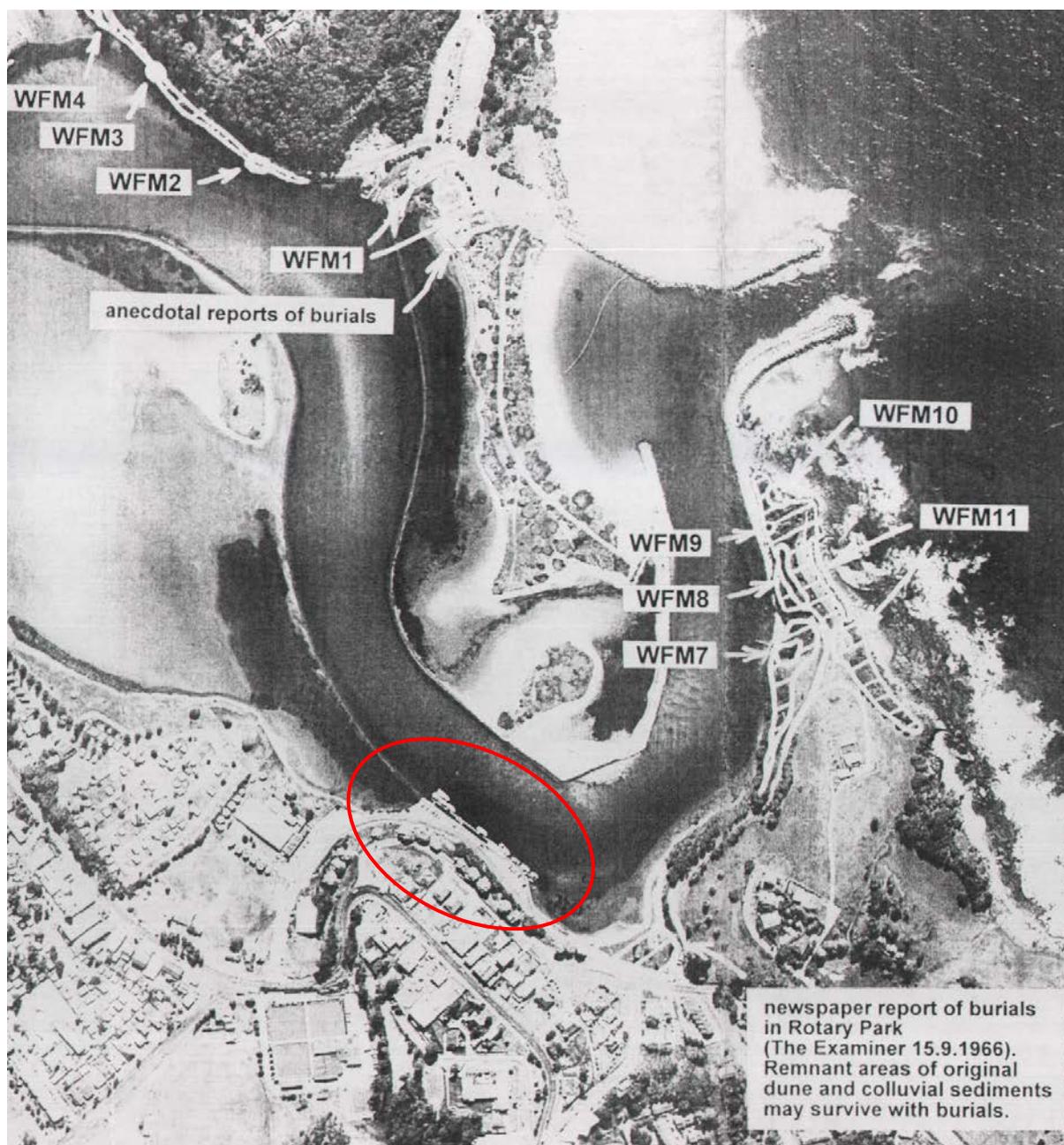
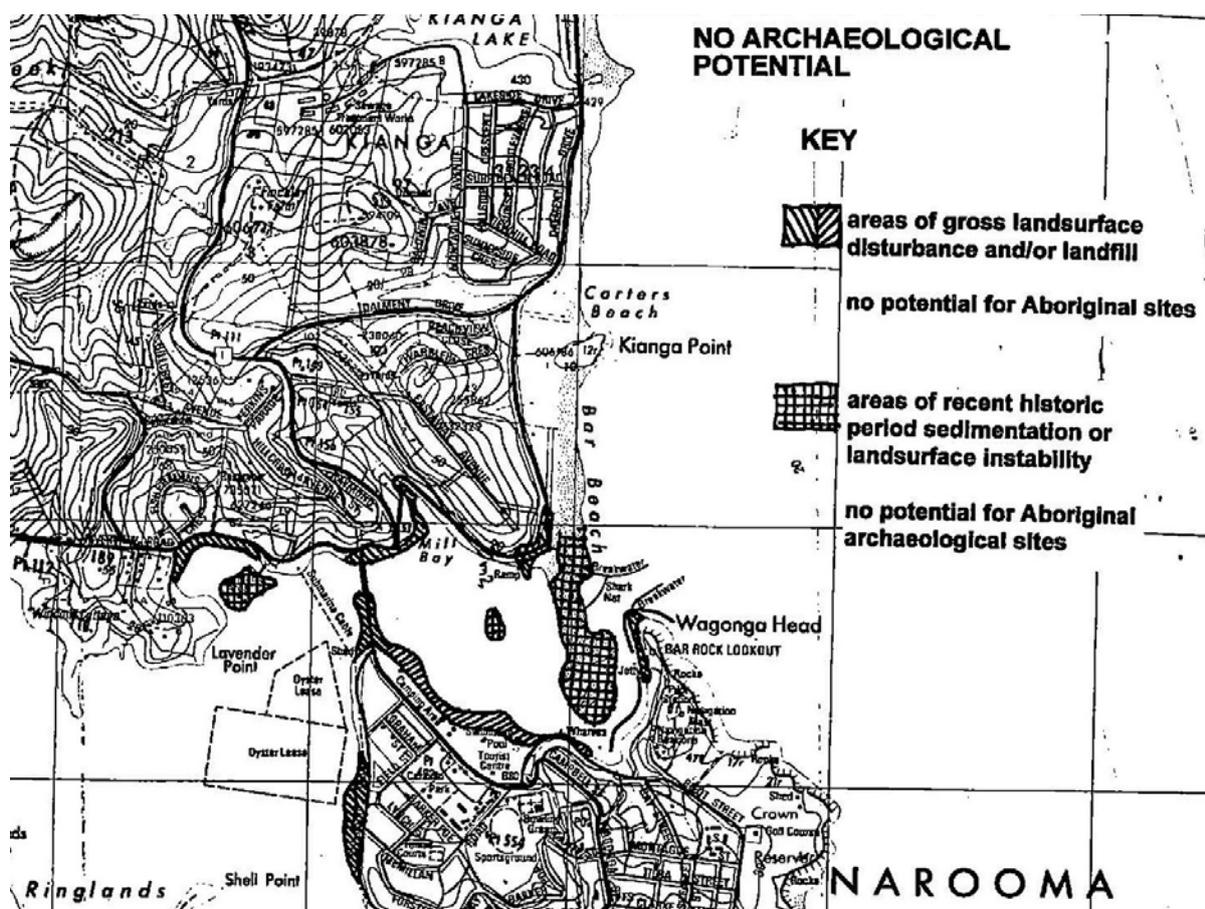


Figure 9: Extract of Figure 4 (after Navin 1997:16) showing wharf area assessment as area of gross disturbance with no potential for Aboriginal sites.



Navin (1997:7) also reviewed Sullivan's (1979) previous survey work that resulted in the recording of AHIMS Site 62-7-0089 and reported:

Sullivan recorded a number of sites in the vicinity of Narooma in the course of this survey, however minimal locational data is available for these sites.

This data is limited to dots on a large scale map in the published articles (Sullivan 1976, Sullivan & Gibney 1978) and a few words on the NPWS Aboriginal Site Cards.

The grid references for all of the Sullivan sites which occur in or near the present study area are incorrect. The references were checked on the NPWS site register computer printout, on the original site cards and were also plotted on imperial grid maps to determine if they correlated with the site names or descriptions. Short of accessing original field notes, it is difficult to determine the actual location of these sites. It is also possible that sites which plot outside of the study area are actually located within the study area.

It is not considered time-effective to pursue more detailed (correct?) locational data for Sullivan's sites. As the present study is a comprehensive survey of foreshore areas, any sites which are present in the study area should be located, and accurate map references will be generated for the sites.

Regarding NPWS Site #62-7-89 (AHIMS Site 62-7-0089) Navin (1997:9) described as 'Strat open midden, mixed cultural and charcoal, estuary/lakeshore situation. Area 250 sq. m ... condition good ... significant to type study, study before development or preserve best' (NPWS Site Card/M.Sullivan). Grid references place this site on the foreshore just east of the swimming pool (near the end of Campbell Street) however the site is described as 'Wagonga Head 28/95' indicating that the site was probably located somewhere on Wagonga Head at the southern entrance to the inlet.

It is apparent from this review that Navin (1997) did not consider the spatial location recorded for AHIMS Site 62-7-0089 as accurate.

5.3.1. Review of AHIMS Sites 62-7-0089 and 62-7-0025

The site card for AHIMS Site 62-7-0089 was produced in 1979 as part of the Eurobodalla Shire Archaeological Survey. Unfortunately, useful information from the site card for is limited. This factor was also pointed out by Navin (1997). The AHIMS Site card for 62-7-0089 (included at **Appendix 3**) describes a stratified open midden of 250 sq metres on the estuary lakeshore. Sullivan assessed the site as significant and recommended the site either be preserved or studied further before development.

There is however no registered report for this survey on AHIMS and the relevant records are a collection of individual site records (14 in Narooma). Subsequent review of the Eurobodalla Shire Archaeological Survey document held on AHIMS (Report No 692) reveals 2 records for this general area (AHIMS Site 62-7-0088 and AHIMS Site 62-7-0089). The site record for AHIMS Site 62-7-0089 describes the locality as north of rotary park, the relationship as extension S/E site but messed up by park and road construction, shoreline altered by construction of the boat harbour (at Rotary Park), the general appearance as against sealed road, surface of the deposit as very grassed so not very obvious. The size of the midden is estimated as probably 100m x 5m x 60cms deep.

For a number of reasons discussed previously above at **Section 4.3**, this does not describe the study area and reclaimed land of the wharf where grid coordinates derived from AHIMS plot this site 62-7-0089 (See **Figure 7**). The current project / wharf area has been demonstrated as reclaimed land. The review of the aerial photography (**Figures 3-5**) shows at the time of the recording (1979) the current wharf area was comprised of hard concrete surfaces and certainly not of a midden of some 250 sq metres and 60cms in depth.

AHIMS Site 62-7-0025 provides a newspaper extract from The Examiner, Moruya dating to 1966 and is recorded as two burials / Aboriginal skeletal remains within the bank of Wagonga Inlet at Rotary Park.

The AHIMS Site cards for 62-7-0025 and 62-7-0089 and corresponding Site Records from the Eurobodalla Shire Archaeological Survey for AHIMS Site 62-7-0089 are included at **Appendix 3**.

5.4. Synthesis of previous studies and predictions

Prior to undertaking any archaeological study, it is useful to assess the archaeological potential of the study area.

In this instance, the archaeological potential and predictions for the current proposal can be directly informed by the review of the landscape context, localised literature and information from the AHIMS Site cards.

Prior to European occupation the shores of Wagonga Inlet presented access to both estuarine and hinterland resources and was a focus for Aboriginal people and occupation. The presence of previously recorded midden sites nearby reflects this.

Historical review of the study area shows massive disturbance has successively occurred through the ongoing development of the wharf. The study area is considered to be comprised of reclaimed land and is considered to have no integrity and potential to contain in situ Aboriginal objects.

6. SURVEY AND RESULTS

6.1. Survey

An archaeological pedestrian survey was conducted of the shoreline area extending to the south and north of the study area on 26 May 2021 by David Carriage (Bindarray) and representative of the South Coast NSW Aboriginal Elders, Gareth Doran, Project Officer with Transport for NSW and Gerard Niemoeller, Principal of OSCHM. Particular effort was also made to relocate AHIMS Site 62-7-0089 along the entire stretch of the inlet from north of the wharf to east of Rotary Park.

The entire length of the wharf shore area is comprised of rock armour, concrete pathways and bitumised surfaces. North and south of wharf area the shoreline is similarly comprised of rock armour, thick kikuyu grass and concrete pathways obscuring detection of AHIMS Site 62-7-0089, any other Aboriginal objects and original land profiles.

General views of the study area are shown in **Plates 1-5**.

6.2. Aboriginal Stakeholder views

Participation of David Carriage (Bindarray) as a representative of the South Coast NSW Aboriginal Elders was arranged by Tabatha Cann, Aboriginal Cultural Heritage Officer with Transport for NSW. The survey followed a review of the relevant maps, AHIMS Site cards, historical photos and other project documentation describing the proposal.

Bindarray recognised the Wagonga Inlet as a significant cultural landscape feature that would have provided shell fish and fish to Aboriginal people in the past and these natural resources continue to be valued by the Aboriginal people. The adjoining land would have provided a variety of bush foods, medicines and natural resources for the production and manufacture of various functional tools and items and ceremonial ware.

Bindarray thought the study area was comprised of entirely reclaimed land and likely deriving from the cutting and benching of the adjacent road (Bluewater Drive).

Bindarray concluded that the proposal would not affect any significant known or potential Aboriginal cultural heritage features. An Aboriginal stakeholder cultural heritage survey report completed with Bindarray for the Narooma Wharf survey is included at **Appendix 4**.

6.3. Results

No Aboriginal objects, Potential Archaeological Deposits (PADs) or sensitive landforms were identified as part of this archaeological survey. The terrestrial part of the study area has been demonstrated to be reclaimed land and is assessed as highly disturbed.

No trace of AHIMS Site 62-7-0089 could be located within the study area as part of this investigation.

Aboriginal consultation concluded that the proposal would not affect any significant known or potential Aboriginal cultural heritage features.

Plate 3. Approximate recorded location of AHIMS Site 62-7-0089, looking northwest.



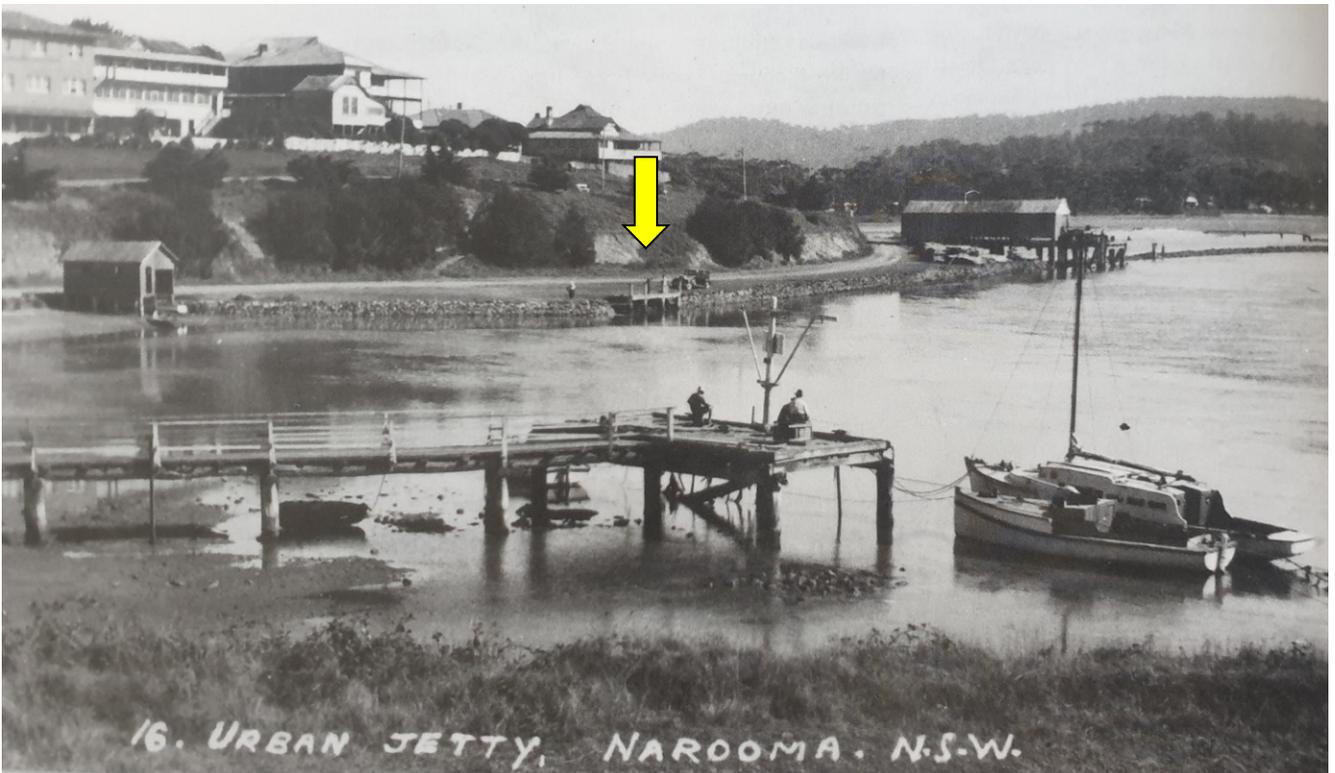
Plate 4. Approximate recorded location of AHIMS Site 62-7-0089, looking southeast.



Plate 5 Narooma wharf and comparison with early historic photo at Plate 6 and previously shown at Section 4.3. Note likely extant historic wharf also shown below at Plate 6.



Plate 6. Rotary Park wharf in foreground (from Pacey 2005:34). Note extensive cutting likely used for land reclamation purposes to create wharf area. The reclaimed land is shown by the rock armour wall.



7. DISCUSSION

Historical review shows the entire study area is reclaimed land and shows massive disturbance that has successively occurred through ongoing development of the wharf and adjoining Blue Water Drive. As such the study area has been assessed to have no integrity and potential to contain in situ Aboriginal objects.

The reclaimed land surface area of the study area is comprised of hard surfaces (concrete/bitumen) and because of successive development has clearly been so since the 1970s. This means that the 1979 recorded location of AHIMS Site 62-7-0089 as shown by AHIMS is incorrect. As previously discussed at **Section 5.3**, Navin (1997) came to a similar conclusion and asserted that the recording of AHIMS Site 62-7-0089 related to one of the five sites (WFM7 – WFM11, AHIMS Sites 62-7-0219 - 62-7-0223) recorded by Navin on the south Wagonga Head to the north east of the study area.

Subsequent interpretation as part of this assessment of Sullivan's original site recordings suggest that this midden (AHIMS Site 62-7-0089), if indeed still extant may be located south of the Narooma Wharf study area and on the north western fringe of Rotary Park adjoining Blue Water Drive (**Plate 7**). Either assertion (by On Site CHM as part of the current assessment) or by Navin (1997) means that AHIMS Site 62-7-0089 is not located within the current study area.

The fact that the entire study area has also been demonstrably assessed as reclaimed land resulting from historical successive disturbance adds considerable weight and confidence to this re-interpretation.

Aboriginal consultation concluded that the proposal would not affect any significant known or potential Aboriginal cultural heritage features.

The *National Parks and Wildlife Act* protects Aboriginal sites and objects. The recorded locations of Aboriginal objects are stored within the AHIMS Database for management purposes. If the recorded locations are demonstrated to be erroneous, then the erroneous location recorded in AHIMS is not protected. In this instance a review and reinterpretation of Aboriginal site recordings has determined a different location for AHIMS Site 62-7-0089 than that recorded on AHIMS (See **Figure 10**).

Plate 7: Rotary Park and revised location of 62-7-0089 behind rock armour wall based on Sullivan site descriptions (See Appendix 3), with southern end of wharf to the right of frame.



Figure 10: Location AHIMS Site 62-7-0089 (red) recorded on AHIMS and revised location determined by this assessment (yellow).



8. SIGNIFICANCE AND IMPACT ASSESSMENT

8.1. Archaeological Significance

The archaeological significance of a site or artefacts may be assessed according to two criteria, representativeness/rarity and research potential. These two criteria are interrelated.

- **Representativeness / Rarity** refers to the frequency of a particular site type, or an activity at a site and the similarities between site types in the study area and the wider regional context. Rare or unique site types are accorded higher archaeological significance than site types that are more common.
- **Archaeological research potential** refers to the degree to which a site can contribute data to answer specific research questions. The degree of a site's research potential is related to factors such as size, structure and content reflecting the range and frequency of activities exhibited at the site, regional frequency and the level of site integrity and preservation.

This assessment has demonstrated that previously recorded AHIMS Site 62-7-0089 is not located within the current study area. The survey conducted as part of this assessment did not locate any Aboriginal sites or objects within the study area. The study area has been assessed as reclaimed land resulting from massive amounts of landscape disturbance and the likelihood of subsurface deposit / PAD is therefore assessed as negligible to nil.

The study area is assessed as having no representative or rarity values or archaeological research potential and is therefore assessed as having no archaeological significance.

8.2. Impact Assessment

This survey did not locate any Aboriginal sites or objects and the likelihood of PAD was assessed as negligible to nil. The study area was assessed as having no archaeological significance.

The proposed replacement of the Narooma Wharf is therefore assessed as having a negligible or nil potential to impact on Aboriginal sites and objects protected under the *National Parks and Wildlife Act*.

9. CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

9.1. Conclusions

This assessment has determined that:

- There are no Aboriginal sites or objects within the study area.
- Previously recorded AHIMS Site 62-7-0089 is not located within the current study area. Interpretation of Sullivan’s original site recordings as part of this assessment suggest that AHIMS Site 62-7-0089, if indeed still extant is located south of the Narooma Wharf study area and on the north western fringe of Rotary Park adjoining Blue Water Drive.
- The *National Parks and Wildlife Act* protects Aboriginal sites and objects. The recorded locations of Aboriginal objects are stored within the AHIMS Database for management purposes. If the recorded locations are demonstrated to be erroneous, then the erroneous location recorded in AHIMS is not protected. In this instance a review and reinterpretation of Aboriginal site recordings has determined a different location for AHIMS Site 62-7-0089 than that recorded on AHIMS.
- The study area is reclaimed land resulting from massive amounts of landscape disturbance and the likelihood of subsurface deposit / PAD is therefore assessed as negligible to nil.
- The study area has no archaeological significance.
- The proposed replacement of the Narooma Wharf will have a negligible or nil potential to impact on Aboriginal sites and objects protected under the *National Parks and Wildlife Act*.
- Aboriginal consultation concluded that the proposal would not affect any significant known or potential Aboriginal cultural heritage features.

9.2. Management Recommendations

On the basis of this assessment and the legal requirements of the *National Parks and Wildlife Act* and associated policy, it is recommended that:

1. No further assessment or action is warranted with regard to the proposed Narooma Wharf replacement and management of Aboriginal sites and objects protected under the *National Parks and Wildlife Act*.

An AHIMS Site card has been prepared for the revised location of AHIMS Site 62-7-0089, as previously shown in **Figure 10**, and submitted to AHIMS (**Appendix 5**).

10. REFERENCES

Boot, P 2002, Didthul, Bhundoo, Gulaga and Wadbilliga: An archaeological study of the Aboriginals of the New South Wales south coast hinterland, PhD thesis, Australian National University, Canberra.

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Pacey, L 2016, *Narooma's Past – steamers, sawmills and salmon*, 2nd edition, Laurelle Pacey.

APPENDIX 1



Narooma Wharf Replacement

PACHCI Stage 1 Assessment

Transport for NSW

Document controls

Approval and authorisation

Title	Narooma Wharf Replacement PACHCI Stage 1 Assessment
Signed:	
Dated:	20/03/2021

Document status

Document status	Date	Prepared by	Reviewed by
Draft 1	22/03/2021	Gareth Doran	
Draft 2	31/03/2021	Gareth Doran	

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1 Item

1.1 Proposal description

Transport for New South Wales (TNSW) proposes to demolish the existing structure and rebuilt a more fit for purpose structure.

TNSW shall stage the works to keep the tour boats operating throughout the construction period; work shall begin by removing the wharf's concrete section then progressing to the eastern side. Rebuilding the wharf begins by installing a pontoon system with a gangway connection on the eastern side.

New amenities are also installed, such as a sewerage pump-out system and possibly security gates, along with upgraded firefighting and electrical outlets.

The proposed Wharf replacement is located approximately within the same footprint area of the existing wharf, "142m in length and nominally 3m to 4m in width. The primary construction material is steel, reinforced concrete & fibre reinforced plastics for the access gangways and the walkway; handrails are in steel, and the pontoon system is a foam-cored concrete covering. Concept Design details can be shown in attachment C.

The wharf is located near the rock training walls and an old pile that are a heritage item listed on the State Agency Heritage Register. And the project works are situated within the Batemans Marine Park. Work within the waterway and the tidal zone are required.

Access to the worksite would be via Bluewater drive. At this location, some car parking spaces will be temporarily removed to place site offices, secure storage containers and an area for construction equipment and materials. See Figure 2 below for the provisional site layout:

1.1 Outline Method of Works

The construction method for the proposed works;

A barge-mounted excavator is used to install the piled foundations within the waterway and tidal zone, and the drilling head spins the piles in using a torque head; the piles have cutting teeth welded to the face, the cuttings are cleared from the cutting face by pumping water through the pile. Large lifts will be needed to install the pontoons, gangways and other subframe sections. Other plant and equipment for the works could include small power tools, portable compressors/generators, chainsaws and jackhammers.

The project is planned to commence construction in mid-2022, with an expected to take four months to complete.

The basic work methodology would comprise of the following:

- Establishment of site and compound.
- Set up approved environmental controls.
- Demolition of the concrete section
- Demolition of the eastern timber concrete section
- Bore piles for the new pontoon section and gangway landings
- Installation of the pontoon, gangway and services, including sewage pump out.
- Commissioning and opening of stage 1
- Installation of environmental controls

- Demolition of western timber section
- Installation of steel piles
- Installation of precast concrete headstocks
- Pour grout connections.
- Install the steel sub-framing
- Install decking (Type to be confirmed)
- Commissioning and opening of stage 2
- Removal of environmental controls
- Disestablish and restore the site.

According to TNSW standard working hours, the hours of work are 7 am to 6 pm, Monday to Friday, and 8 am to 1 pm, Saturdays. The Contractor may seek approval to work outside these hours, which must be submitted in writing 3 weeks prior. Any work conducted outside of these hours will be managed in accordance with the RMS Environmental Noise Management Manual. It is anticipated that no road closures will be required for this work to be completed.

All waste generated during the project will be managed following the approved Contractor's waste management plan and disposed of at a licenced waste facility.

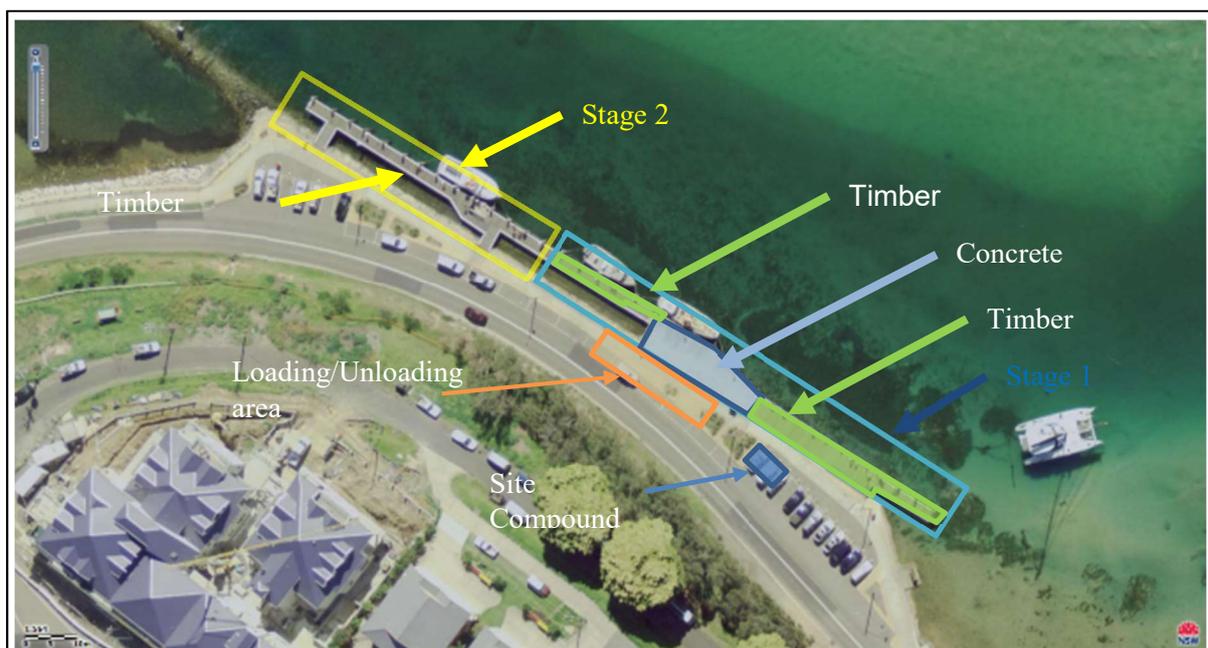


Figure 1 Proposed site layout



Figure 2 Estimated dredging areas for new installation

1.2 Detailed Methodology

The project begins by removing the services (electrical & water) after being removed and made safe. The Contractor begins on the site to demolish the concrete wharf. This task starts with jackhammering with an excavator-mounted hydraulic concrete breaker operating from the shore and powered hand tools as needed to breakout the topping concrete and grouted connections to the beams. (As the wharf is in a dilapidated condition, heavy machinery shall not be permitted to operate on top of the structure), once the topping concrete and connections are removed, the precast panels are slung on to a crane or excavator and lifted off the beams for disposal. Next, the beams are slung and removed where possible; if the beams are unstable while sited on the piles, the excavator removes them from the piles to then be slung from the ground for removal. Finally, the piles will be slung and pulled out using the excavator; a demolition-licensed contractor is needed to carry out all demolition works. The concrete demolition works will be tidal dependant meaning slinging and removal is only carried out on low water.

After the concrete wharf has been removed, the timber wharf's removal begins; the Contractor begins by manually removing the decking, ensuring the boards remain intact as much as possible as these materials still have some recycling value. Upon completion of decking boards, the beams are then removed; these beams are removed by slinging them to the excavator, which is sited on land.

Dredging along the pontoon's shoreline side is then carried out by the Contractor, and this is necessary to keep a sufficient water depth beneath the pontoon to ensure it remains floating during low water and fully loaded configuration. A 20-tonne excavator sited onshore, and where necessary, the excavator is mounted on a barge to carry out the excavation.

Historical designs have indicated that the rock foundations are near the seabed surface (>1000mm). The excavator uses a small to medium-sized excavator toothed bucket to break up and remove the rock materials; the rock is then loaded into recycling skips for legal disposal or recycling. The estimated rock to be dredged is approximately 10-70m³

1.3 Project Background

The current Narooma wharf was constructed over several decades, with the eastern concrete section been built in the 1970s, then the eastern timber section added to it sometime later. The concrete wharf has been built on reinforced concrete piles with a reinforced concrete beam structure; the decking is precast concrete panels with a concrete topping slab placed over the precast panels to provide a working surface. The reinforced concrete section is in a very dilapidated condition and not currently unable to be adequately repaired and will need to be demolished. The concrete wharf is also very high off the water, making alighting on to vessels very difficult, and therefore the wharf's utilisation is currently minimal.

The timber wharf to the east of the concrete section is a traditional timber piled structure with a timber subframe, and timber decked planking has exceeded its design life and is no longer fit for purpose. Being a fixed structure and with a 2m tidal range, four boats have been struggling to board patrons during the high and low waters safely.

The wharf's western section was added in the 1980s and is built with a traditional timber piled foundation, timber subframe, and timber decking. This area is dominated by a vast longliner fishing vessel, "the D&D" this vessel is the largest vessel to use the wharf; moreover, this vessel is serviced by light trucks which drive on to the wharf to load and unload the wharf. The current wharf design is not suitable for such operations to be carried out safely.

Currently, the four boat operators have been emptying their Blackwater tanks at the 12NM territorial limit. There is no sewage pump-out facility available at Narooma. The upgraded wharf will aim to include this amenity.

2 Map of the Study Area



Figure 1 Project Location

3 Land acquisition

None

4 Description of Current and Past Land Use

4.1 Current Use

Narooma is an estuarine port located in the South Coast region of NSW within the Wagonga Inlet. With an approximate vessel capacity of 10, port facilities include a public wharf, commercial fishing unloading and berthing, recreational and visitors berthing and a breakwater. There is also a boat ramp available nearby. There is a range of commercial businesses and food retailers operating out of the port, including fishing charters and Montague Island Tours. The primary economic activities of the port are commercial fishing and tourism.

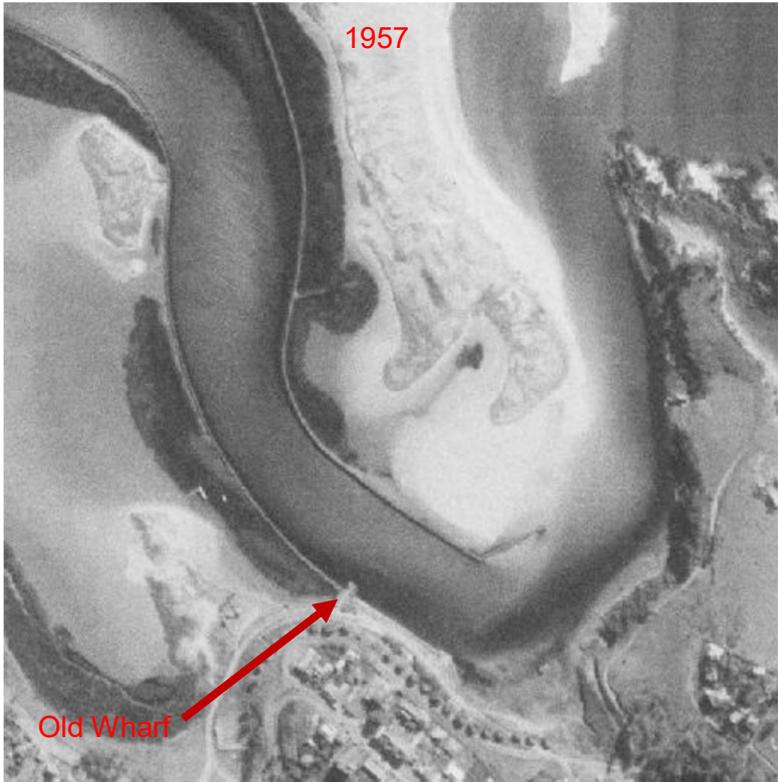
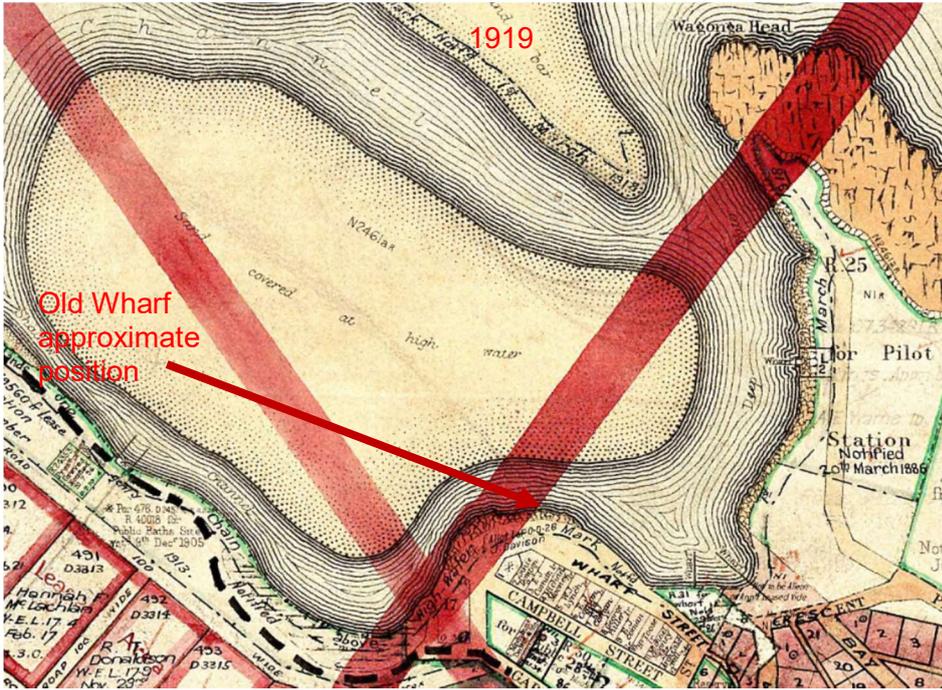
Despite the commercial activity, some essential infrastructure is not available at the port, including fuel and sewage pump-out.

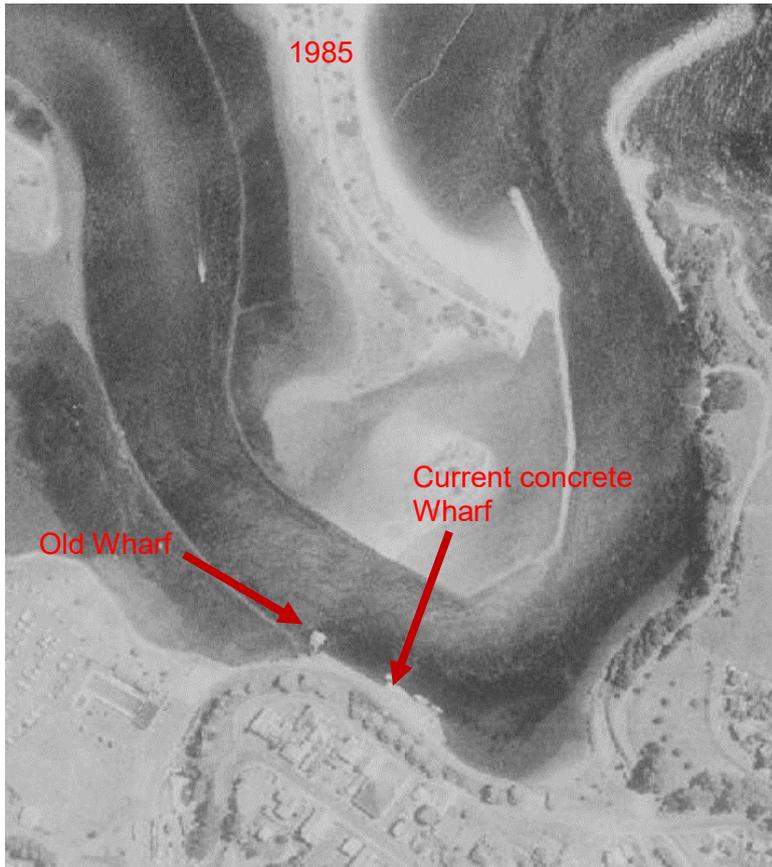


4.2 Past Use

The Narooma wharf's current site is relatively new being built in the late 1970s and extended in the preceding years; Bluewater Road and the car park are constructed on reclaimed land. There have been several other wharves near the current wharf since the late 1800s. Industries that the wharves serviced was the timber and boat building industries, and there were also coal bunkers for refuelling ships near the current wharf.

Aerial images and past maps





5 Timeframe & Milestones



List of Milestones

Milestone Task	Date
Initiation meeting conducted	June 2021
Detailed design approved	Nov 2021
Contract awarded	Jan 2022
Construction commence	Feb 2022
Handover Completion	Aug 2022

6 AHIMS Basic Search

6.1 AHIMS Search

6.1.1 AHIMS Search Result Basic Narooma

6.1.2 ExtensiveSearchReport

6.1.3 3903 "Report"

6.1.4 Site Card 62-7-0025

6.1.5 Site Card 62-7-0089

6.1.6 Site Card Mapped 62-7-0025

6.1.7 Site Card Mapped 62-7-0089

7 Heritage Searches

7.1 Native Title Register Search

7.1.1 NNTT Number: NND2020/001

7.1.2 Native Title Determination Application South Coast Claim Area

7.2 State Heritage Inventory Search

7.2.1 Rock Training Walls _ NSW Environment, Energy and Science

7.2.2 Wharf Pylon _ Heritage NSW

7.3 Australian Heritage database Search

7.3.1 Australian Heritage Database

8 Previous Heritage Assessments

- 8.1 Narooma Bridge Pedestrian Underpass Page 96-119 (Aboriginal Archaeological Assessment)**

9 Previous REFs

9.1 Narooma Bridge Pedestrian Underpass

9.2 Marine Rescue NSW Narooma

**9.3 Wagonga Inlet Entrance Channel - Options for Navigation
Management Review of Environmental Factors**

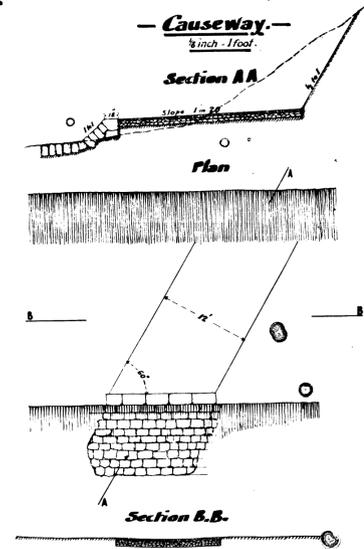
APPENDIX 2

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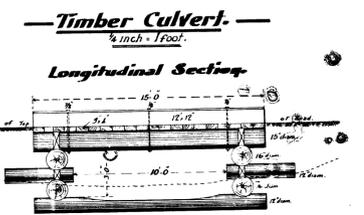
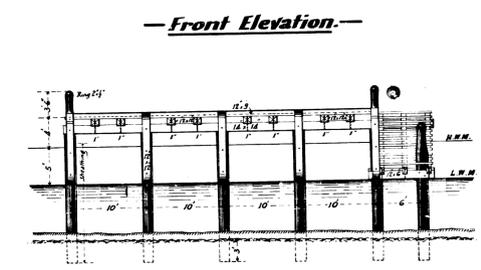
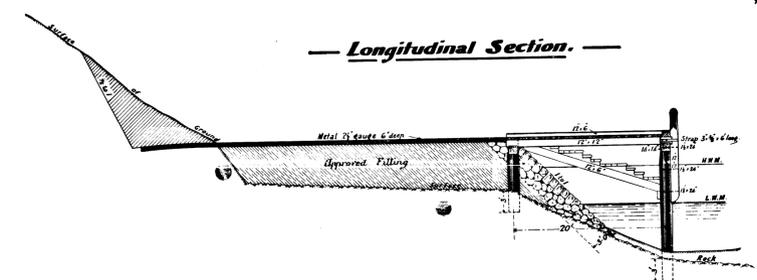
PLAN OF PROPOSED WHARF & APPROACH AT NOOROOMA, WAGONGA INLET.

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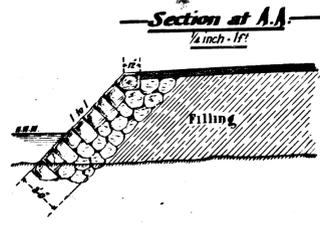
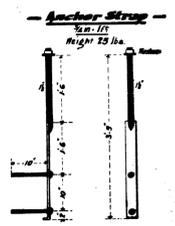
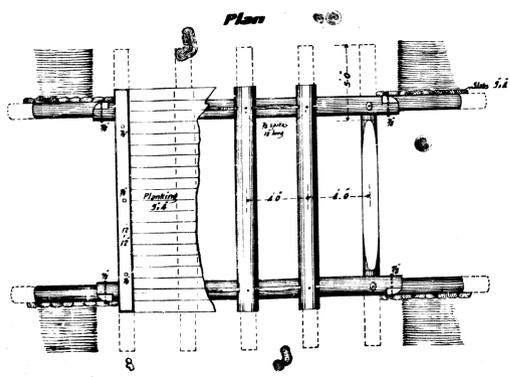
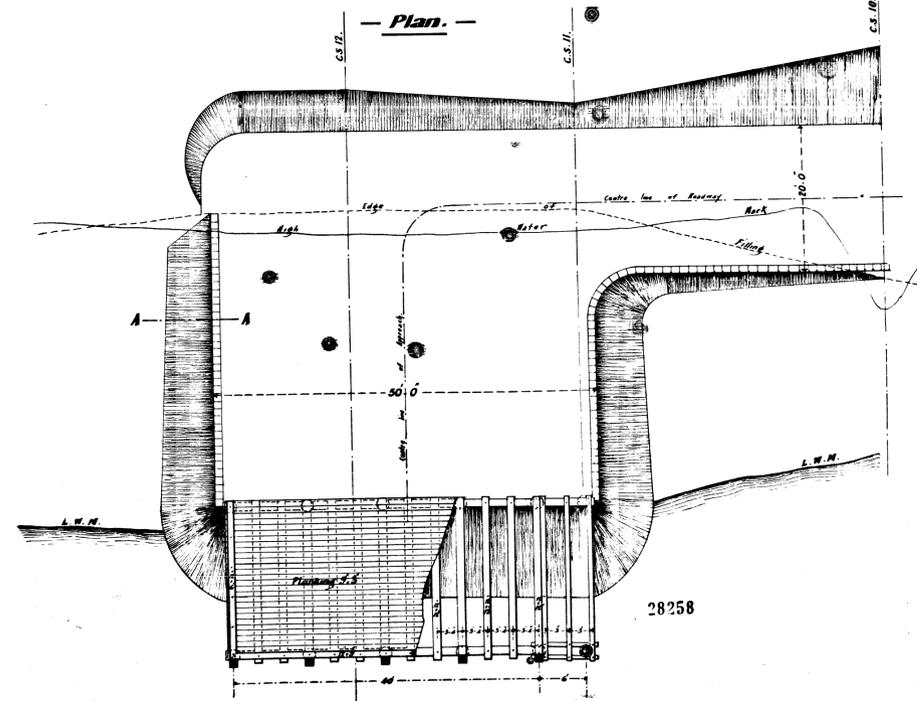
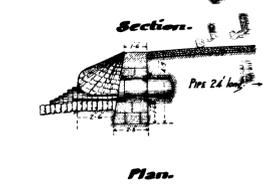
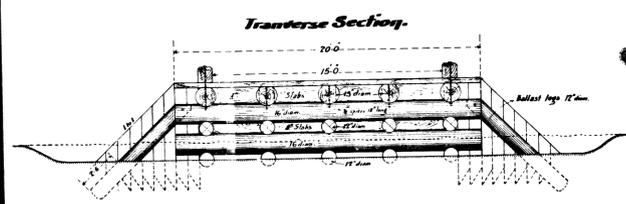
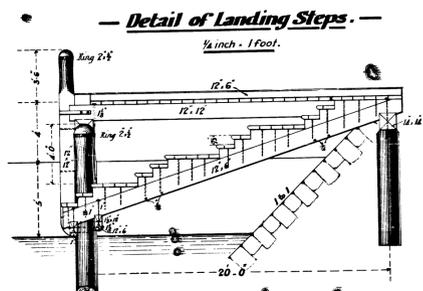
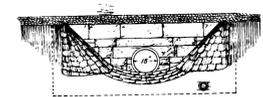
C. Barkly
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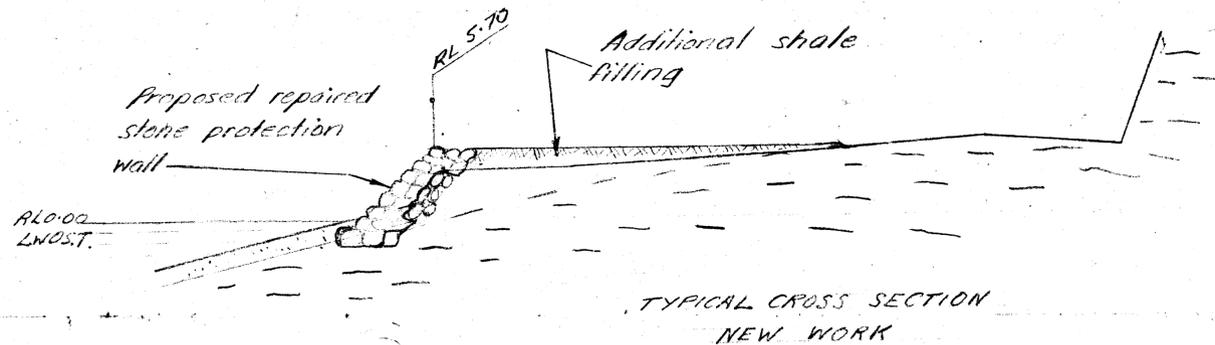
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Stone Head for Drain Pipe

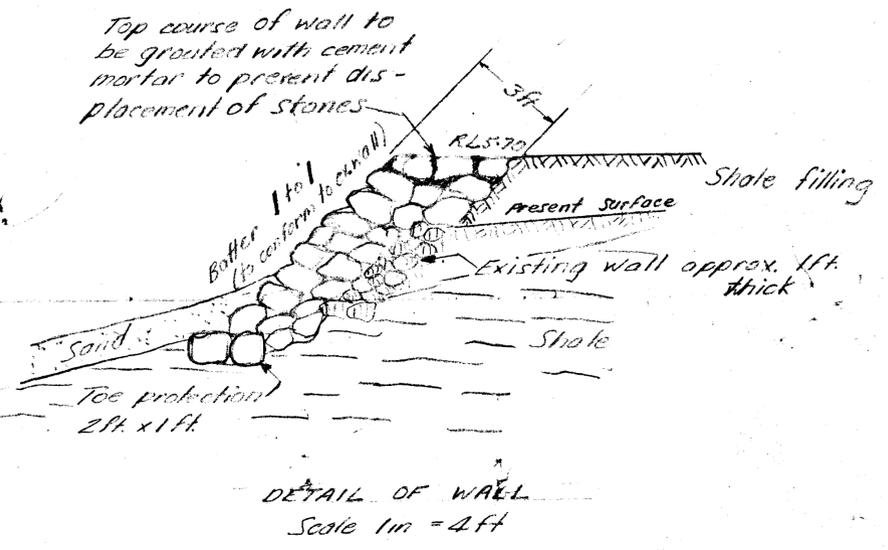


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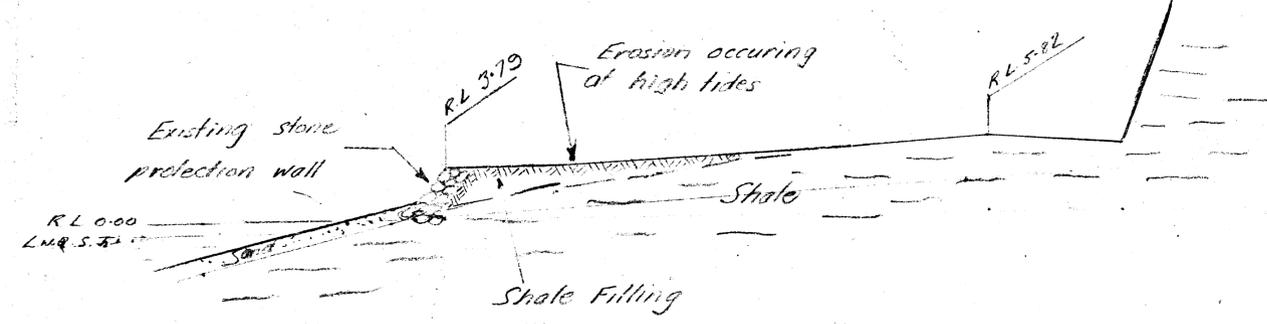


TYPICAL CROSS SECTION
NEW WORK

Note: Repaired wall to be brought
to uniform level RL 5.70



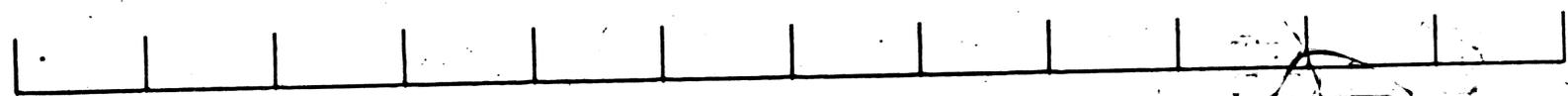
DETAIL OF WALL
Scale 1 in = 4 ft



TYPICAL CROSS SECTION
EXISTING WORK

SHIRE OF EUROBODALLA
PROPOSED REPAIRS TO EROSION WALL
AND ROADWAY
LOWER WHARF ROAD - NARDOMA
Scale (unless otherwise stated) 1 inch = 10 feet
PLAN NO. P.K.D. 220

300m.m. ON ORIGINAL SCALE



APPENDIX 3

Onsite Cultural Heritage Management - Narooma

Date: 14 May 2021

PO Box 574
Narooma New South Wales 2546
Attention: Gerard Niemoeller
Email: gerard@onsitechm.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 241000 - 243000, Northings : 5987200 - 5989200 with a Buffer of 0 meters, conducted by Gerard Niemoeller on 14 May 2021.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

20	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(http://www.nsw.gov.au/gazette\)](http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
62-7-0217	WFM 5;Wogonga Inlet; Contact	AGD	56	240950	5988810	Open site	Valid	Shell : -, Artefact : -	Midden	
62-7-0151	Narooma; Contact	AGD	56	241200	5988900	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	
62-7-0165	Boat Shed Midden Contact	AGD	56	241430	5988940	Open site	Valid	Shell : -, Artefact : -	Midden	409
62-7-0088	Wagonga Head 28/94; Contact	AGD	56	241560	5988270	Open site	Valid	Shell : -, Artefact : -	Midden	
62-7-0215	WFM 3;Wogonga Inlet; Contact	AGD	56	241570	5988950	Open site	Valid	Shell : -, Artefact : -	Midden	103554
62-7-0214	WFM 2;Wogonga Inlet; Contact	AGD	56	241690	5988850	Open site	Valid	Shell : -, Artefact : -	Midden	103554
62-7-0248	BS02 Contact	AGD	56	241880	5987710	Open site	Valid	Artefact : -		97489
62-7-0213	WFM 1;Wogonga Inlet; Contact	AGD	56	241900	5988850	Open site	Valid	Shell : -, Artefact : -	Midden	
62-7-0024	Wagonga Inlet; Contact	AGD	56	241900	5989000	Open site	Valid	Shell : -, Artefact : -	Midden	
62-7-0247	BS01 Contact	AGD	56	241910	5987690	Open site	Valid	Modified Tree (Carved or Scarred) : -		97489
62-7-0084	Wagonga Head 28/190; Contact	AGD	56	241920	5988800	Open site	Valid	Shell : -, Artefact : -	Midden	
62-7-0089	Wagonga Inlet 28/95; Contact	AGD	56	241960	5988180	Open site	Valid	Shell : -, Artefact : -	Midden	409
62-7-0221	WFM 9;Wogonga Inlet; Contact	AGD	56	242310	5988480	Open site	Valid	Shell : -, Artefact : -	Midden	
62-7-0219	WFM 7;Wogonga Inlet; Contact	AGD	56	242350	5988390	Open site	Valid	Shell : -, Artefact : -	Midden	
62-7-0220	WFM 8;Wogonga Inlet; Contact	AGD	56	242350	5988430	Open site	Valid	Shell : -, Artefact : -	Midden	
62-7-0223	WFM 11;Wogonga Inlet; Contact	AGD	56	242380	5988440	Open site	Valid	Shell : -, Artefact : -	Midden	

Report generated by AHIMS Web Service on 14/05/2021 for Gerard Niemoeller for the following area at Datum :GDA, Zone : 56, Eastings : 241000 - 243000, Northings : 5987200 - 5989200 with a Buffer of 0 meters. Additional Info : Assessment. Number of Aboriginal sites and Aboriginal objects found is 20

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.



SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports	
62-7-0090	Narooma 28/96;	AGD	56	242800	5987800	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden		
	<u>Contact</u>	<u>Recorders</u>	ASRSYS					<u>Permits</u>			
62-7-0218	WFM 6;Wogonga Inlet;	GDA	56	241360	5988322	Open site	Valid	Shell : -, Artefact : -	Midden	103461	
	<u>Contact</u>	<u>Recorders</u>	Kerry Navin,Mr.Kelvin Officer,Mr.Matthew Barber,NGH Heritage - Fyshwick						<u>Permits</u>	3926,4620	
62-7-0025	Narooma; two skeletons	GDA	56	242266	5988281	Open site	Valid	Burial : -	Burial/s	3903	
	<u>Contact</u>	<u>Recorders</u>	Moruya Examiner					<u>Permits</u>			
62-7-0222	WFM 10;Wogonga Inlet;	GDA	56	242360	5988715	Open site	Valid	Shell : -, Artefact : -	Midden	3903	
	<u>Contact</u>	<u>Recorders</u>	Kerry Navin,Mr.Kelvin Officer						<u>Permits</u>		

Report generated by AHIMS Web Service on 14/05/2021 for Gerard Niemoeller for the following area at Datum :GDA, Zone : 56, Eastings : 241000 - 243000, Northings : 5987200 - 5989200 with a Buffer of 0 meters. Additional Info : Assessment. Number of Aboriginal sites and Aboriginal objects found is 20

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62-7-0089

1. Map Name .. Bega Navopuna Navopuna 5. Site No.

2. Scale .. 1:250,000 1:100,000 1:25,000 6. Site type . OPEN

3. Grid ref 2418 9980 .. 2420 5988 .. 4196 8818 MIDDEN

4. Site name(s) .. Waganga.. Harad .. 28/95 7. Classification

8. Air photo ref

9. Cadastral

10. Land Status

11.

12. Directions for site relocation

13. Owner

Address

Attitude

14. Tenant/Manager

Address

Attitude

15. Site Description

Strat open midden, mixed cultural & charcoal, estuary / lake shore
 situation . Area - 250 sqm.

16. Reasons for investigation

17. Condition ... Good / Clear:

18. Interpretation

19. Visitation

20. Recommendations ... Significant to type study, study before development
 .. or preserve - best

X

21. Environmental description of site locality

22. Relation to other sites in locality

23. Details of artifact collections

24. Is plan or diagram of site attached? Yes/No

25. Are annotated photographs attached? Yes/No How many?

26. Other additions

27. Importance of site to Aborigines

28. Source of this information

29. Oral sources of information

30. Written references

31. Recorded by M. Sullivan

Filed by MK.

Eucbodalla Shire Survey

Address

Date

Date 8/6/79.

EUROBODALLA SHIRE
ARCHAEOLOGICAL SURVEY

COASTAL SITES

Reported by M.D.

Recorded by M.D. Aug. 79.

Locality: *Nuramin Camping Ground*

Map scale	Sheet Name	No.	Grid Ref.	Lat. °S	Long. °E
<i>1:25,000</i>	<i>Nuramin</i>	<i>8425</i> <i>IX-S</i>	<i>1619582</i>	<i>36° 13' 10"</i>	<i>150° 7' 42"</i>

Access to site: *Drive around via Rotary Park*

Precise location: *Below road & base of scrubby.*

F.U. Geology:

F.U. Geomorphology:

Facet geomorphology:

Intertidal zone adjacent to site is mainly:

Rock Sandy Silty

Details: *Boulders rather than reefs, but now obscured.*
Altered by construction of boat harbour

Are offshore reefs apparent? *yes*

Distance from source of fresh or brackish water *400 m.*

Source of water *creek (now used as drain)*

Other factors influencing shellfish ecology or site choice

Reported to be boulder concrete & buried ground.

Local shellfish species

Major *oyster, shell*

Minor *turbin anatare*

Photographs: *AJ i/26*

Comments:

ROBODALLA SHIRE
ARCHAEOLOGICAL SURVEY

SITE RECORD

Locality: N of Rotary Park, Narooma

Aspect of site: NE - N

Nature of site:

stratified
open
midden

deflated
open
midden

rock
shelter

stone
arrangement

Not. Pks records
Rotary Park supposed
to be old carbonaceous
Ground

Relationship to nearby sites: Extension to S/E side, but
mired up by bank + road construction.

Size of deposit:

length:

probably
100 m.

width:

5m (?)

depth:

60cm.

Size of shelter or rock surface:

{ width:

depth:

height:

(length:

width:

Surface of deposit

Vegetated? Very !!

Type of vegetation: Buffalo / Kikuyu type grass.

Nature of sediment

Soil/sediment overlying deposit:

Black organic sand

Sediment within deposit:

sand

Soil/sediment underlying deposit:

weathered Ordovician rocks.

Disturbance

General appearance:

Against sealed road, + v. grassed, so
not very obvious.

Height above mean high water:

2m.

Distance from mean high water:

5m.

Agent likely to cause disturbance:

People perhaps flooding

How imminent is damage?

Not terribly

Visible contents of deposit

Matrix

Sand, [no reason to be there if not for midden]

implement types

quartz flakes

stone flakes

qtz + basic volcanic + grey buff siltite (5-10%)

shell species

turbin, cypr, anadoma, mussel(?)

other fauna

odd bones Bird + mammal?/?

Photographs:

Ag 1/27, 28

Comments:

Bega 1:250,000 c. 2419.9884

The Examiner, Moruya, N.S.W., 15.9.66

"Two skeletons believed to be of Aborigines were found on Sunday in a shallow grave at Narooma.//The discovery was made by Mr Kevin Barton, of Tarcolla Place, Engadine, who was holidaying at Narooma and was fossicking for sea shells in the bank of the Wagonga River at the Rotary Park.// When he was pulling out a sea shell from the soft embankment, the head of a skeleton fell away from the sandy soil.....When Sergeant Dudley began to dig out the remains of the skeleton from the embankment he was surprised to find there were two skeletons in the one shallow grave - covered with mud oyster shells.// Sergeant Dudley said later that it was not uncommon to find skeletons in the area as it known that there were Aboriginal burial grounds both at this point and at Mystery Bay. // The coroner at Moruya.....ordered that the skeletons be forwarded to Sydney for scientific examination at Sydney University.// The skeletons are the remains of adults and Sergeant Dudley believes that they were buried there about 100 years ago.// Children uncovered a similar skeleton near Rotary Park about three years ago. Several have been recovered from the sands at Mystery Bay over a number of years. Mystery Bay was known as a battle, or corroboree place for Aborigines many years ago, as well as a burial ground."



62-7-0025

M. M. M.

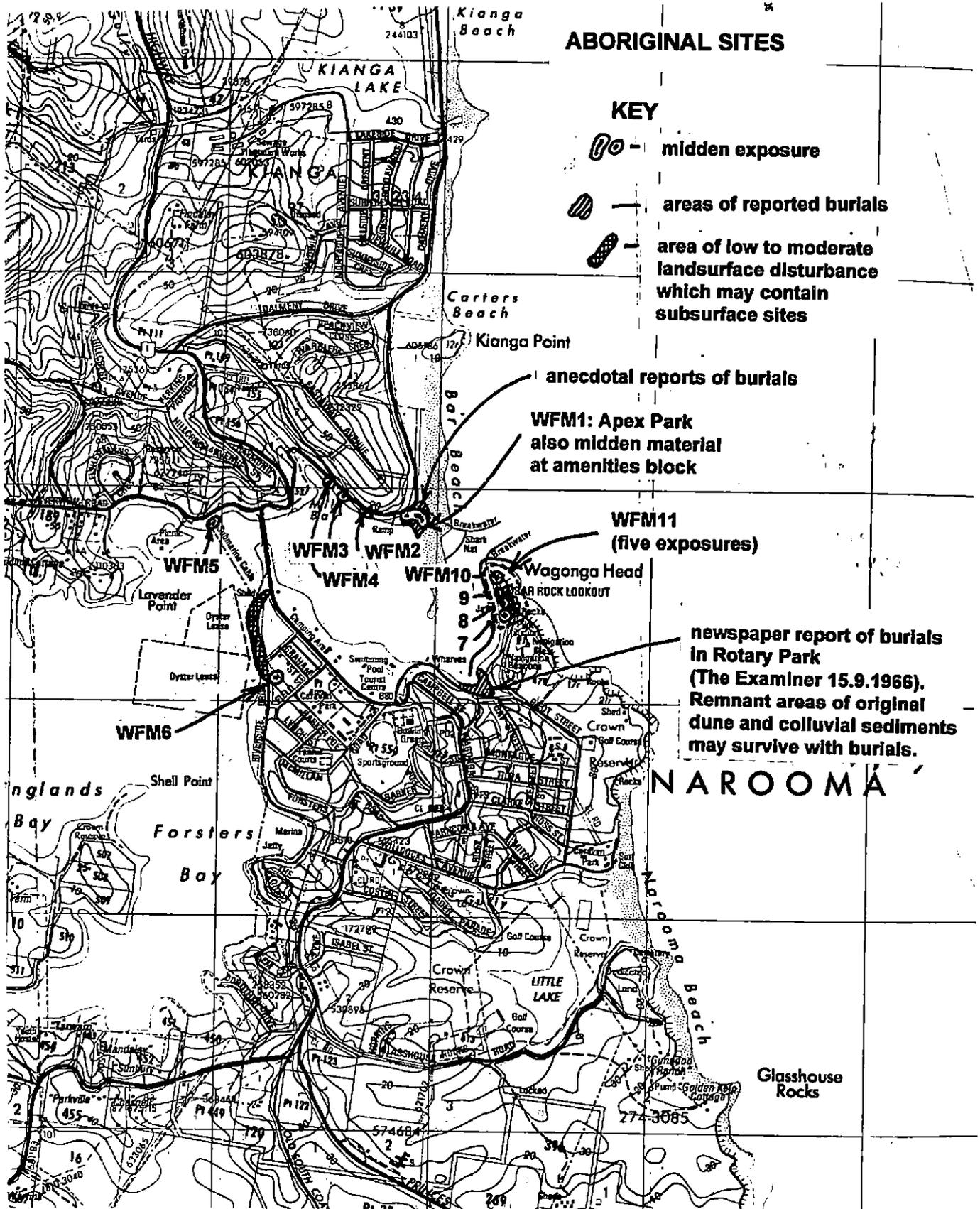


Figure 2: Location of Aboriginal Sites in study area (Narooma 1:25000 topo map)

APPENDIX 4

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NAME OF PROJECT – NAROOMA WHARF UPGRADE PROJECT

Aboriginal stakeholder cultural heritage survey report

STAGE 2 – ROADS AND MARITIME SERVICES PROCEDURE FOR
ABORIGINAL CULTURAL HERITAGE CONSULTATION AND
INVESTIGATION (RESOURCE 7)

Aboriginal stakeholder cultural heritage survey report

1. Purpose of this assessment

This assessment forms part of the Stage 2 assessment of the Transport NSW (TfNSW) *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*. Its purpose is to determine whether any features of Aboriginal cultural significance occur within the study area for this project, and whether they would be affected by the project. This assessment will be used to assist the TfNSW in determining whether further assessment and consultation is required for this project.

1



2. Project details: (provide the following information)

- a) Project title: Narooma Wharf Upgrade Project
- b) Location of study area:
- c) Name of Aboriginal site officer(s) completing this assessment:

1. David Carriage

2. _____

- d) Name of Aboriginal organisation(s) represented by this survey:

South Coast Elders Group

- e) Name of site officer(s) who undertook site survey:

1. David Carriage

2. _____

- f) Date of survey: 26 May 2021.



3. Methodology:

- a) Approximately how much of the total project area was surveyed (eg 10%-100%) and why? (Eg Certain areas were heavily disturbed, properties were inaccessible, ground visibility was poor, difficult weather conditions, etc.)

100%

- b) How was the survey undertaken? (Eg On foot, by car, individually, in groups, other? If other people were involved in the survey, please provide their names and name of their organisation, if relevant)

On foot with David Carrige, Gareth Doran (TFNSW)
and Gerald Niemoeller (OSCHM)

4. Results:



- a) Please provide a description of the area surveyed. Include a description of the total area covered, landforms, built areas, etc. Where appropriate, survey areas should be identified on a map/plan.

Primarily Nooma Wharf, and surrounds and area adjoining.

~~Much of the adjoining was determined area.~~
The road adjacent the wharf has been ~~cut~~ cut/benched into the adjoining slope.

Much/most of the adjoining area and land was determined to be highly disturbed and reclaimed land.



- c) Is it likely that any of the above features may be present in the study area, despite not being positively identified during the survey?
No. Yes. (If yes, where are they considered likely to occur?)

No - the study area is entirely reclaimed land.

- d) If known, please provide a description of the natural resources used by Aboriginal people that are, or would have been, available within the study area. Please describe the significance of these resources to past and present Aboriginal communities.

Fish, bimbolas, oysters, shellfish.
- These natural resources continue to be valued by the Aboriginal community.
- Bush foods, (killi pillis, berries), medicines would have also been present.
- Mangroves used for boomerang, and drying tomorrow grass for basket weaving and ceremonial ware. Paperbarks are medicinal plants.



- e) Please provide a description of past disturbances to the study area, if known, and how this may have affected Aboriginal cultural heritage features.

The study area is likely entirely reclaimed
land, likely deriving from the cutting off and benching
of the adjacent road.



This assessment has been completed by:

Name: David Carrige David Carrige
Provide name Provide signature

Position title: Aboriginal site Officer
Provide title

Organisation name: South Coast Elders Group
Provide name of Aboriginal organisation

On the following date: 26/05/2021
Insert date



APPENDIX 5



Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville 2220 NSW

AHIMS site ID:

Date recorded:

Site Location Information

Site name:

Easting: Northing: Coordinates must be in GDA (MGA)

Horizontal Accuracy (m):

Zone: Location method:

Recorder Information

(The person responsible for the completion and submission of this form)

Title	Surname	First name
<input type="text" value="Mr."/>	<input type="text" value="Niemoeller"/>	<input type="text" value="Gerard"/>

Organisation:

Address:

Phone: E-mail:

Site Context Information

Land Form Pattern: Land Use:

Land Form Unit: Vegetation:

Distance to Water (m): Primary Report:

How to get to the site:

Other site information:

Plotted location on AHIMS demonstrated to be erroneous. A review and reinterpretation of Aboriginal site recordings has determined a different location for AHIMS Site 62-7-0089 than that recorded on AHIMS.

Site location map



Site contents information

open/closed site:

Site condition:

Features:

1.	Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees			
					Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
1.	Shell	0	100	5				

Description:

The feature is currently not visible. Description and estimate of this feature derived from recording of Sullivan (1979) site information.

Features:

2.	Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees			
					Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
2.								

Description:

Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
3.	<input type="text"/>	<input type="text"/>	<input type="text"/>

Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
4.	<input type="text"/>	<input type="text"/>	<input type="text"/>

Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

Features:

	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)
5.	<input type="text"/>	<input type="text"/>	<input type="text"/>

Scarred Trees			
Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Description:

Other Site Info:

Plotted location on AHIMS demonstrated to be erroneous. A review and reinterpretation of Aboriginal site recordings has determined a different location for AHIMS Site 62-7-0089 than that recorded on AHIMS.

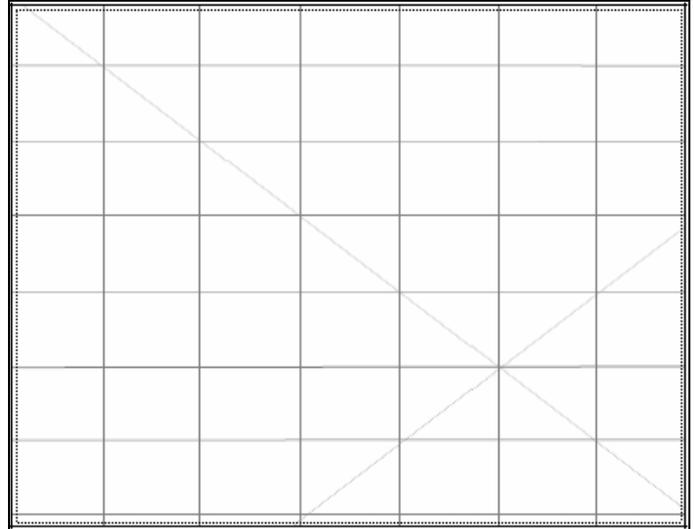
Site plan



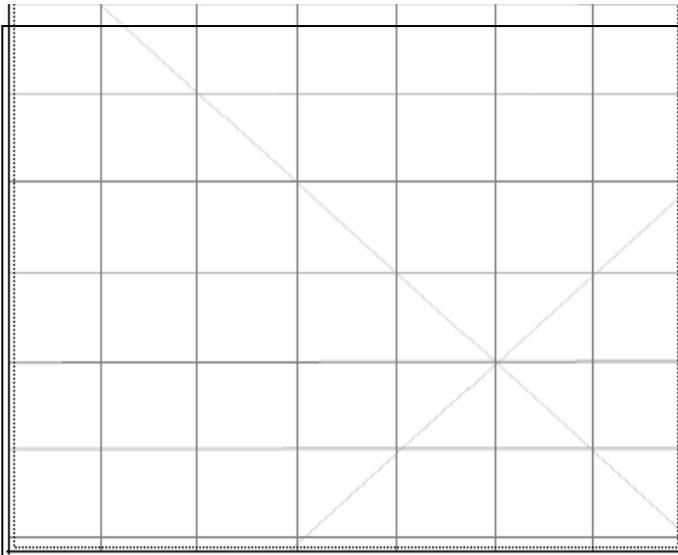
Site photographs



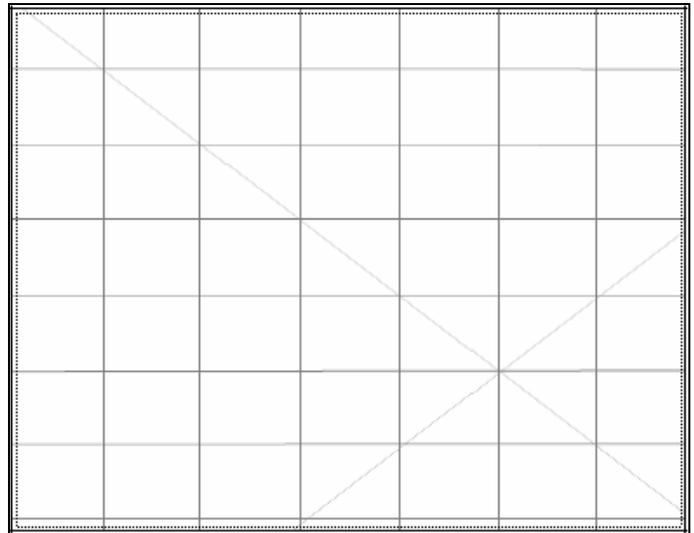
Description: Rotary Park and revised location of 62-7-0089 behind rock armour wall



Description:



Description:



Description:

Site restrictions

Do you want to Restrict this site?:

Restriction type: Gender General Location

Why is this site restricted?:

Further information contact

Title Surname First name

Organisation:

Address:

Phone: E-mail: