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Addendum to Cawthron Report 3921: Marine ecological effects from the establishment of a temporary barge load-out berth at Akaroa

As part of the Akaroa Wharf rebuild, it is proposed that a temporary barge load-out facility be established adjacent to the Akaroa public boat ramp in Akaroa Inlet to allow for the transfer of construction materials to the wharf site (e.g. steel piles, precast headstock and deck panels). The barge berth and loading ramp is to be located on the south side of the existing boat ramp structure (Figure 1).

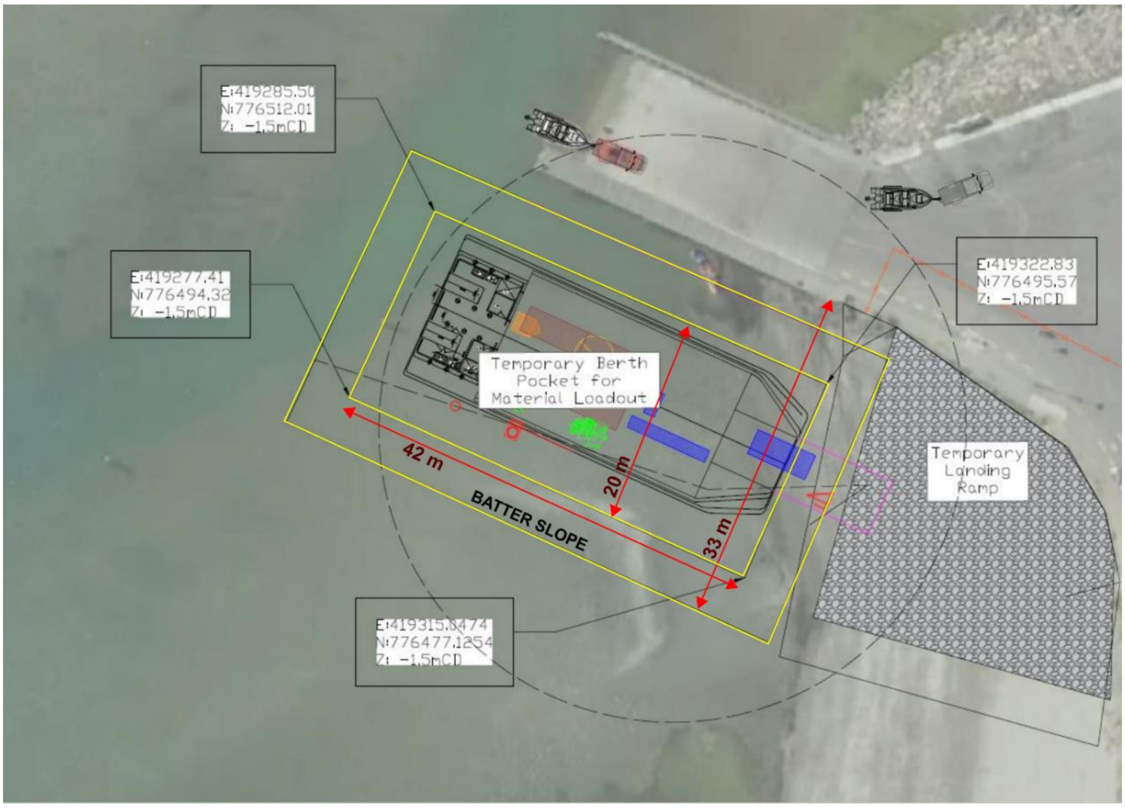

Figure 1. Plan of proposed barge load-out facility adjacent to Akaroa public boat ramp with approximate dimensions overlaid. Source: Enviser Ltd.

Proposed activity

The dimensions of the preliminary design for the barge loading berth illustrated in Figure 1 allow for a 20 m-wide berth pocket offset from the ramp structure by 8 m. This would be bounded by a 4.5 m batter slope (1.5H:1V to existing seabed). The area of excavation of the berth pocket would be up to 1,500 m^2, across mostly intertidal sediment habitat, and would extend approximately 30 m south of the existing ramp structure.

The nature of the temporary landing ramp on the beach above the berth pocket has not been specified. It is assumed that this will take the form of modular crane matting to provide a secure surface for loading vehicles and to provide protection to the beach substrate.

The depth to which the berth pocket will be dredged will not exceed 1.5 m. Access will be constrained by the approach depths in the existing channel to the ramp, so barge movements will be dictated to some extent by tidal state. Allowing for a 2–6-hour tidal window each day for barge access results in the need to excavate approximately 1,500 m^3 of sediment from the berth. It is understood that this material would be 'side-cast', deposited southwest of the dredge area, forming a temporary mound that would be used to fill in the berth pocket at the end of the project. The area required for the temporary placement of this material has not been established.

Scope of assessment

This assessment is limited to consideration of benthic marine ecological resources and communities in the immediate vicinity of the project footprint within the context of ecological function of the wider Akaroa Harbour system. While it does not directly consider avian fauna, the likely relevance of food-web relationships to shorebird populations is recognised.

Existing environment

The shoreline environment is similar to others in the wider extent of Akaroa Inlet but appears significantly modified by the presence of the ramp structure, with an accumulation of finer sediments in a broad beach. The high-tide shoreline has been stabilised against erosion with introduced boulders, and these have been further secured with cement where they support the ramp approaches. Historical aerial photographs show the extent of sand build-up on the ramp's southern side to be variable. The wider shoreline area supports patches of intertidal seagrass (*Nanozostera muelleri*), although these are absent from the beach directly adjacent to the southern side of the ramp. The shallow offshore area appears dominated by fairly uniform sediments, possibly with a greater silt content than those present intertidally. A marked and maintained channel access to the ramp cuts through this area from the southwest (Figure 2).

Survey methods

The survey sought to characterise the habitats and communities of the intertidal area in the vicinity of the proposed project. Although it was the intention to extend the survey into the shallow subtidal zone using underwater video, this was impossible due to very poor water clarity adjacent to the beach. Hence, such assessment had to rely on other existing knowledge of these habitats locally (e.g. aerial photographs and survey information pertaining to nearby areas).

General observations of the site were made during the survey. The intertidal area was characterised by running a series of five 40 m transects across the area to be disturbed (Figure 2). The physical habitat and conspicuous communities and biota along each transect was recorded and representative photographs taken at 5 m intervals.

Sediment communities were sampled using 13 cm-diameter infauna cores. Three cores were collected from within the lower part of the tidal profile (Figure 2). The area that could be sampled was further restricted by the physical nature of the substrate. Over most of the area, this comprised a mixture of sand, pebble and shell. Only within approximately 15 m of the ramp was the sand profile uniform enough to insert a core sampler. At each of these three stations, surficial sediments (top 5 cm) were sub-sampled from four replicate 6 cm cores to analyse for grain-size distribution, organic carbon and indicative trace metals. A single sample composited from the three stations was analysed for semi-volatile organic compounds (SVOCs).

A small trowel was used to haphazardly sample across the lower tidal zone of the survey site for the presence of bivalve shellfish populations within the sediment profile.

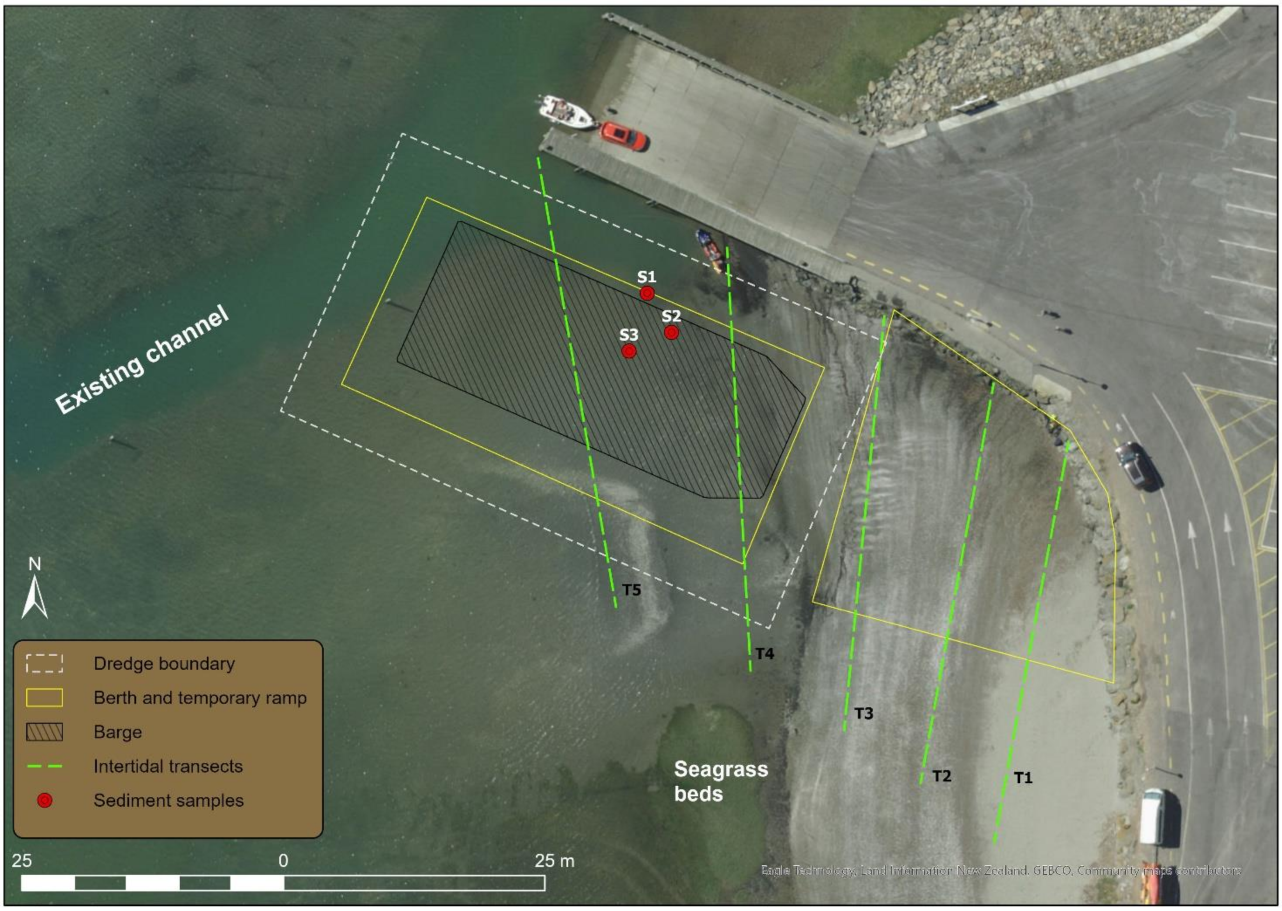

Figure 2. Overview of survey elements in the vicinity of the proposed temporary barge loading facility. NZ Imagery: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors.

Results

Field observations

The (undated) aerial photograph used in Figure 2 was found to be reasonably aligned with field observations. The principal difference was that sand had built up against the southern side of the ramp structure to the extent that it was exposed at low tide at the ramp's easternmost point. The clean-swept nature of the beach above the mid-tide level and visible wave-mediated striations (Appendix 1 images A and B) suggest the mobility of these sediments. The presence of other features, including seagrass patches, was approximately as depicted in Figure 2.

Transects

Descriptions of substrates, habitats and communities along the five transects are listed in Table 1 and representative photographs are presented in Appendix 1. The intertidal survey area was dominated by sediment substrate. In the upper part of the tidal profile (transects T1–T3), this took the form of accumulated fine sand with scattered surficial shell and pebble detritus. This transitioned in the lower part of the profile to fine silty sands. Low-shore sediments were embedded with variable quantities of pebble, shell and cobble material, increasing southwards from the ramp structure.

No conspicuous biota was observed in the sand habitats of the upper four transects of the survey area (T1–T4). Even along T5, biota was represented by no more than isolated vestigial clumps or strands of red and green algae attached to occasional cobbles and the larger pebble material. Furthermore, there were no conspicuous burrow or siphon holes in the substrate.

The only substantial hard substrate habitat was that associated with the boat ramp structure and some facing material armouring the very top of the beach. This comprised rock riprap in the high shore, changing to rock / concrete composites towards the mid-shore, and finally vertical concrete surfaces and some additional timber piling in the low shore. These supported communities and species fairly typical of such substrates in the wider Akaroa Harbour area (Table 1, Appendix 1).

Seagrass

Intertidal seagrass beds are a notable feature of the wider area of Childrens Bay, north of the ramp. Patches were also observed south of the boat ramp (see Appendix 2), but these did not extend northward as far as the survey transects. The smallest low-density seagrass patches began no more than 10 m south of the proposed southern edge of the berth pocket batter slope, with dense well-established beds from 25 m south. While the existence of seagrass subtidally at the site was not investigated directly, all evidence (including aerial photos and from other surveys) suggests that beds are limited to the intertidal zone within the wider Akaroa Harbour.

Historical satellite (GoogleEarth™) imagery suggests that the distribution of seagrass south of the ramp has been relatively stable over the past decade. Beds have possibly been prevented from establishing closer to the ramp structure by the greater mobility of sediments accumulated there.

Presence of bivalve shellfish

There was evidence of cockles (*Austrovenus stutchburyi*) in the form of scattered relict shell material. However, spot checks throughout the area uncovered only occasional live individuals, and no sediment-dwelling shellfish beds were present that could be characterised by a density value.

Sediment samples

As noted, due to the limited spatial distribution of homogeneous sand substrates, the three sediment core samples collected came from a relatively small area of the beach low-tide zone within 20 m of the boat ramp structure. As such, they can be regarded as pseudo-replicates. The three stations yielded core samples of a similar nature, with fine grey sands changing to visibly darker sediments below an apparent redox potential discontinuity (aRPD) at approximately 4–5 cm depth (Figure 3).

Sediments from all three stations were dominated by very fine and fine sands, with some gravel-sized material (Figure 4). Total organic carbon (TOC) was uniformly quite low at 0.1–0.5%.

Table 1. Details of substrate and conspicuous biota identified along each of the five intertidal transects.

Transect	Hard substrate (north end wave protection and ramp structure)		Sediment substrate	
	Substrate	**Biota**	**Substrate**	**Biota**
T1 (High zone)	Rock riprap, some rough concrete	Clusters of *Xenostrobus pulex*. Sparse *Austrolittorina* sp. (*A. cincta* and *A. antipodum*). *Haustrum scobina* and *Diloma aethiops*. Barnacles (*Chamaesipho columna*) beneath overhangs	Fine sand. Sporadic shell, pebbles	No conspicuous biota
T2 (High / mid zones)	Rock riprap, some rough concrete	Limpets (*Cellana denticulata*), *A. cincta*, *A. antipodum*, *C. columna*, *H. scobina*, *D. aethiops*	Fine sand. Sporadic shell, pebbles	No conspicuous biota
T3 (Mid zone)	Rock / concrete wall	Narrow zone of dense tubeworms (*Spirobranchus cariniferus*)	Fine sand. Drift seagrass, terrestrial vegetation detritus. Scattered shell detritus (*Maoricolpus* sp., *Austrovenus stutchburyi*, other bivalves)	No conspicuous biota
T4 (Mid / low zones)	Vertical concrete wall, wooden pilings	Zone of blue mussels (*Mytilus galloprovincialis*) with chitons (*Sypharochiton pelliserpentis*) adjacent above, along with *C. denticulata*, *D. aethiops* and *H. scobina*. *S. cariniferus* now sparse. *Ulva* sp. and fine red alga on piles	Fine sand (softer, waterlogged), scattered shell and woody debris. Small embedded boulders at south end	No conspicuous biota on transect but small clumps of seagrass established 5–10 m to the south
T5 (Low zone)	Wooden pilings	Mussels (*M. galloprovincialis* but also some *Aulacomya maoriana* and *Perna canaliculus*). Barnacles (*Austrominius modestus*), limpets (*Siphonaria* sp.), cushion stars (*Patiriella regularis*). *Undaria pinnatifida*, *Ulva* sp., *Gelidium* sp. and other small red algae. Encrusting bryozoan (*Watersipora subtorquata*), colonial ascidians (*Didemnum* sp., *Applidium* sp.)	Fine silty sand at north end, becoming embedded with shell and pebble material towards the south (from 20 m)	No conspicuous epifauna Scraps of algae occasionally attached to pebble / shell fragments (*Polysiphonia* sp., *Ulva lactuca*). *Cladostephus spongiosus* as drift

Figure 3. Representative sediment core samples (Station S3; see Figure 2) showing colour variation down the profile.

Trace metal concentrations were all well below low-risk trigger levels (ANZG 2018 default guideline values [DGV]; Figure 4). Of the 73 compounds in the SVOC suite of organic contaminants, only the polycyclic aromatic hydrocarbons (PAHs) fluorene and pyrene were detected marginally above the analytical detection limit (ADL; see Appendix 3). Substituting ADL for non-detects, the sum of PAHs was less than 1.8 mg/kg, well below the corresponding DGV of 10 mg/kg. Overall, the sediment analyses did not indicate the presence of ecologically significant levels of contamination.

Infauna communities

Infauna communities (i.e. those living in the sediment) at the three sample stations were quite sparse, with just 27 taxa identified overall. Of these, 12 were polychaetes and three were amphipods. Molluscs were represented by five bivalve taxa and three gastropods. Additionally, there were cumaceans, nemerteans, nematodes and a sipunculid.

By abundance, the samples were dominated by the capitellid polychaete *Heteromastus filiformis* (mean 26 per core) and cumaceans (mean 11 per core). The polychaete *Magelona dakini* and phoxocephalid amphipods were also consistently present in lower numbers. Six juvenile cockles (*A. stutchburyi*) were present, spread across the three samples.

Overall abundances and taxa richness were comparable to those of shallow offshore areas of Akaroa Inlet (Sneddon and Morrisey 2025 [in prep.]), with the latter averaging just 14 per core. Neither were the Shannon–Weiner diversity or Pielou’s evenness indices particularly elevated (Figure 5), reflecting the somewhat limited sediment community.

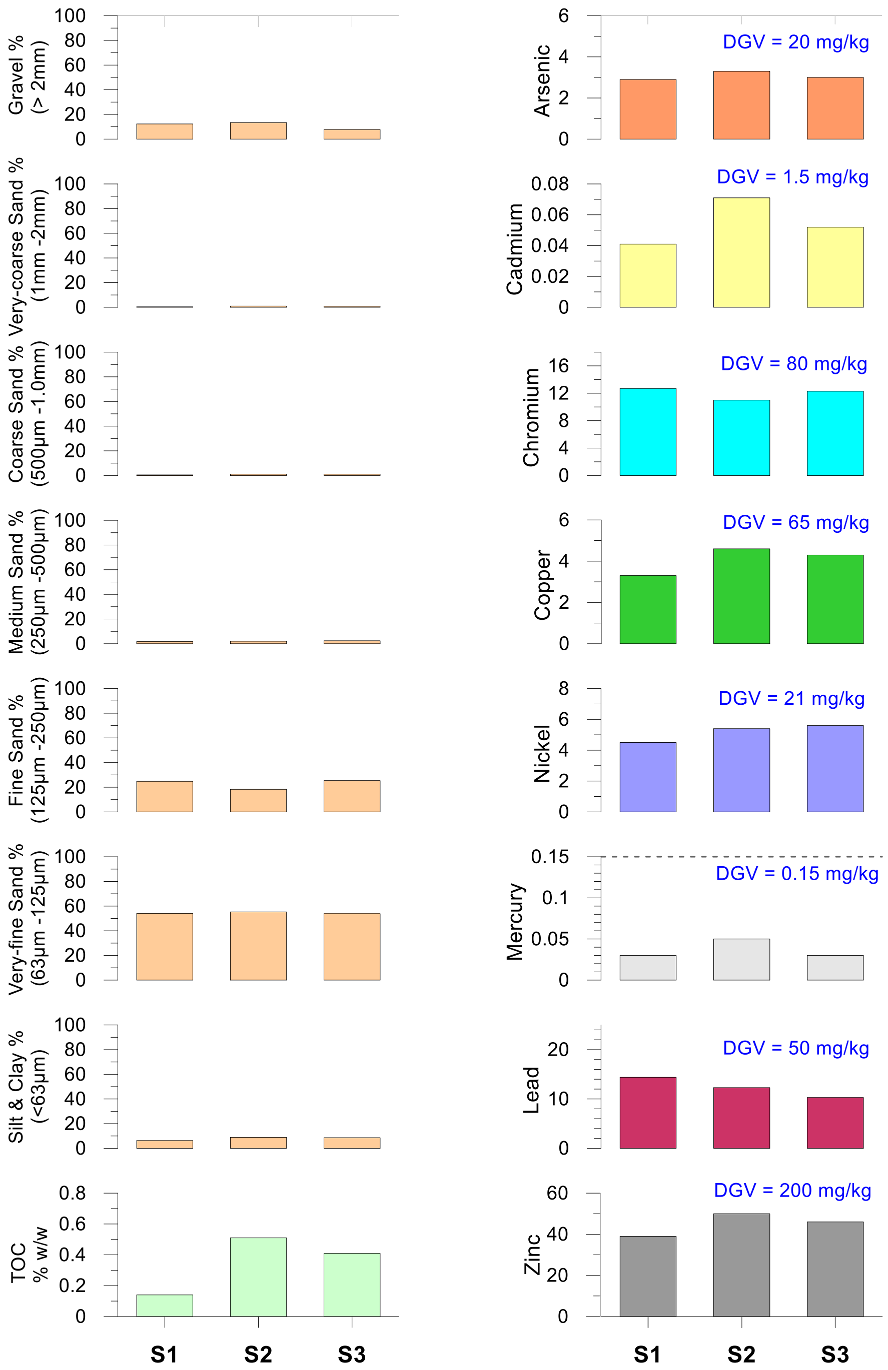

Figure 4. Sediment physicochemical data for the three samples collected from the low-tide area of the proposed barge berth pocket. Left column: Grain-size distribution and total organic carbon (TOC). Right column: Sediment trace metal concentrations (mg/kg dry weight). ANZG (2018) default guideline trigger values included for reference.

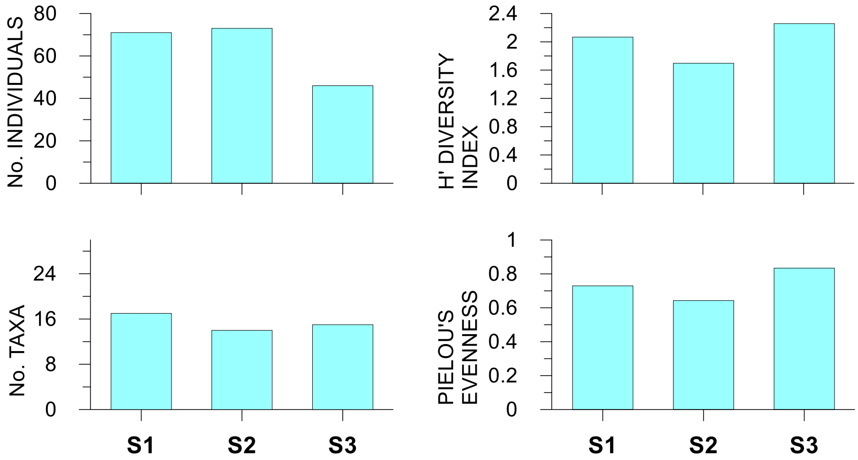

Figure 5. Standard indices of infaunal community structure for the three core samples collected from the low-tide area of the proposed barge berth pocket.

Assessment of impact of proposed activities on coastal ecology

Communities and habitats

The area surveyed has already been significantly modified by shoreline developments and structures, the key feature of the site being the public boat ramp. This has altered sediment transport and deposition so that there is a discernible gradient in substrate moving south from the structure. The high-shore boundary of much of the inlet's eastern shoreline has been stabilised by introduced rock and concrete substrates. No natural hard substrates were identified within the intertidal area of the project footprint.

The shallow subtidal area just offshore has been altered by the establishment of a dedicated channel to the boat ramp. Neither low-tide aerial photographs such as the one in Figure 2 nor limited multi-beam coverage (Mundy 2020) suggest the presence of significant hard substrate or conspicuous biogenic features close offshore. It is likely that subtidal seabed sediment communities in this shallow offshore area effectively mirror those in similar depths nearby (such as those covered by Sneddon and Morrisey [2023] off Drummonds Wharf).

No marine invertebrates listed as Threatened or At Risk under the New Zealand Threat Classification System (NZTCS; Funnell et al. 2023) were recorded from the survey. Of macroalgae, a small beach-cast clump of the brown alga *Cladostephus spongiosus* (At Risk: Naturally Uncommon [Nelson et al. 2019]) was identified, but no attached specimens were observed within the vicinity.

The key ecological features of the site are the beds of seagrass on the adjacent intertidal area to the south. These are habitats of recognised ecological importance (Nordlund et al. 2016) and their extent has decreased nationally over decades (Inglis 2003; Park 2016). Seagrass is listed as At Risk: Declining in the NZTCS (de Lange et al. 2018).

Potential effects of proposed activities

It is assumed that most excavation work for the berth would be via back-hoe accessed at low tide from shore, although some work may proceed via barge-mounted excavator. In either case, direct disturbance of seabed habitat is unlikely to extend more than a few metres beyond the berth footprint or within its shallow-water approaches.

During excavation, all sediment communities existing within the outer boundary of the berth construction footprint would be lost. However, the richness and complexity of these communities is generally very limited and is considered to reflect those of the wider intertidal area of the inlet and other sandy intertidal areas of Akaroa Harbour. The nature of these communities is such that they would likely re-establish quite rapidly following physical reconstitution of the site at the end of the project. Although edible shellfish occur at the site, these are not at a density that represents a harvestable resource.

The principal mechanism by which berth construction activities may affect the coastal marine environment outside the project footprint is by the propagation of sediment plumes. The site is not known for tidal currents and any transport of plumes is likely to be dominated by wind and wave effects. While some resuspension of benthic sediment will occur when working below the tide level, this will mostly remain localised and, based on observations, is considered unlikely to much exceed that from natural wave-resuspension events at points beyond 50 m from the source of disturbance. Since excavation would likely proceed as a series of discrete events, there is little potential for continuous exposure of adjacent habitats to high-concentration plumes. Moreover, even where limited transport of these plumes may occur, sediment analysis indicates that the material suspended will not be a significant source of chemical contaminants to nearshore habitats. Nonetheless, maximising the proportion of excavation carried out during low tide will minimise the generation and propagation of plumes.

Although the hard substrate communities of the existing boat ramp structures will not be directly disturbed by project activities, their close proximity means that they may be exposed to suspended sediment levels exceeding the range that is currently typical. However, the limited duration and scale of project works is unlikely to result in an ecologically significant change in community composition, and whatever small shifts that do occur are expected to be temporary.

Protection of seagrass

The presence of seagrass triggers the following Policy 11 criteria of the New Zealand Coastal Policy Statement to:

(a) avoid adverse effects of activities on

- (i) indigenous taxa that are listed as Threatened or At Risk in the NZTCS lists.
- (iii) indigenous ecosystems and vegetation types that are nationally threatened in the coastal environment or are naturally rare

(b) avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on:

- (i) areas of predominantly indigenous vegetation in the coastal environment
- (iii) indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification (with ‘eelgrass’ [i.e. seagrass] referred to specifically).

Although the seagrass beds do not extend into the footprint of the proposed excavation, their proximity is notable, especially if material excavated from the berth is to be deposited on its southern side or if construction plant is required to access or cross this area. While there may be sufficient space to accommodate the temporary stockpile of material without impinging upon the main beds, there would be concern that erosion by wave action would transport this material southwards, bringing about a smothering impact. The risk of such an effect could potentially be mitigated via careful placement of the deposit and the use of containment measures such as silt fencing. Extended into the low shore, silt fencing would also provide a measure of protection against the longshore transport of sediment plumes, but care would be needed to avoid alteration of existing sediment transport processes. Fencing or other containment of the stockpile would need to remain in place until the barge berth was disestablished at the end of the wharf rebuild project, and some monitoring may be required. Given the likely short duration of excavation activity, light attenuation by sediment plumes is less likely to significantly affect these beds.

Barge operation

The barge operation will be temporary and potential benthic effects will be constrained spatially to the immediate area of the berth pocket and its approaches. However, there is potential for some seabed disturbance as the barge negotiates the shallows near the site (regardless of how the barge is propelled – towed vs powered). Nonetheless, there are several mitigating factors:

- The substantial capacity of barge transport of materials to the wharf site means that the number of barge movements – already constrained by tidal state – would be limited.
- The approach to the berth is already modified, being the channel to the existing boat ramp, and is already disturbed to an extent by ramp traffic.
- All evidence suggests that the nearshore subtidal habitat is an extension of that occurring in similar depths in the wider Akaroa Inlet.

Together, these aspects suggest that any disturbance effects will be minor, localised and temporary. Recovery following disestablishment of the loading facility is likely to be relatively rapid (months).

Conclusions

- The area directly disturbed by construction of the temporary barge berth does not support any taxa or communities of special scientific or conservation interest.
- While all communities within the project footprint would be lost, their re-establishment following project completion is expected to be rapid.
- Barge operation during the reconstruction of Akaroa Wharf is unlikely to result in benthic impacts that are more than minor and localised to the immediate area.
- Healthy beds of seagrass – a species and habitat of national conservation importance - occur adjacent to the project site. Their proximity is such that protection of these (from potential sediment impacts) will need to be a focus of construction plans, particularly in regard to placement and stability of excavated material.

I trust that this letter addresses all concerns with potential marine ecological effects from the proposed barge load-out berth project and that its rationale and recommendations are clear. Please do not hesitate to contact me should you have any comments or queries.

Yours sincerely

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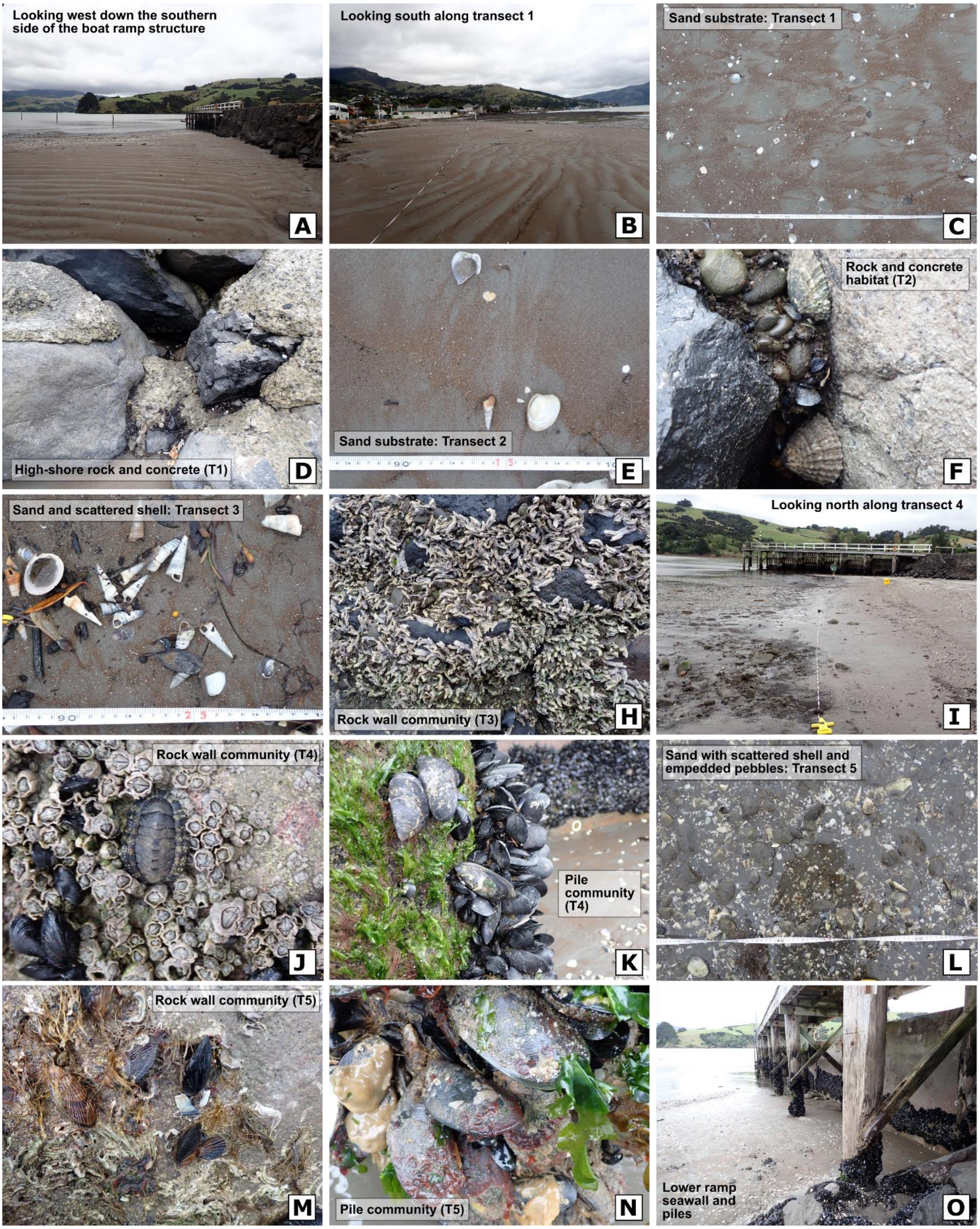
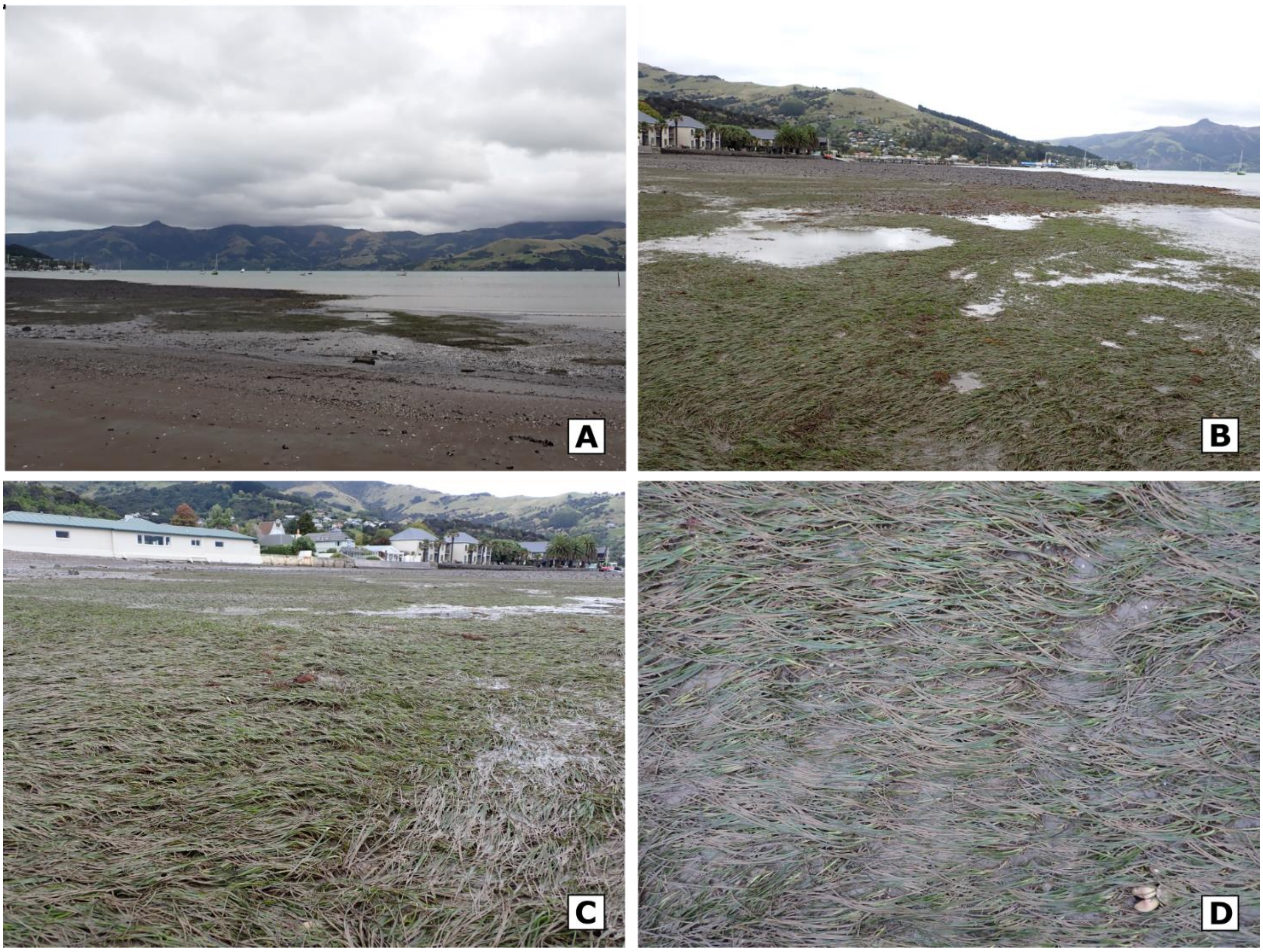
Appendices

Appendix 1. Representative photographs of substrates and habitats within the survey area



Appendix 2. Views of the intertidal seagrass beds adjacent to the southern boundary of the project site



Appendix 3. Semi-volatile organic compounds (SVOCs) in sediment samples

Concentrations mg/kg dry weight. Shaded cells designate a result below the analytical detection limit.

COMPOUND	mg/kg
Haloethers	
Bis(2-chloroethoxy) methane	< 0.10
Bis(2-chloroethyl)ether	< 0.10
Bis(2-chloroisopropyl)ether	< 0.10
4-Bromophenyl phenyl ether	< 0.10
4-Chlorophenyl phenyl ether	< 0.10
Nitrogen containing compounds	
N-Nitrosodiphenylamine + Diphenylamine	< 0.14
2,4-Dinitrotoluene	< 0.2
2,6-Dinitrotoluene	< 0.2
Nitrobenzene	< 0.10
N-Nitrosodi-n-propylamine	< 0.14
Organochlorine pesticides (OCPs)	
Aldrin	< 0.10
alpha-BHC	< 0.10
beta-BHC	< 0.10
delta-BHC	< 0.10
gamma-BHC (Lindane)	< 0.10
4,4'-DDD	< 0.10
4,4'-DDE	< 0.10
4,4'-DDT	< 0.2
Dieldrin	< 0.10
Endosulfan I	< 0.2
Endosulfan II	< 0.5
Endosulfan sulphate	< 0.2
Endrin	< 0.14
Endrin ketone	< 0.2
Heptachlor	< 0.10
Heptachlor epoxide	< 0.10
Hexachlorobenzene	< 0.10
Polycyclic aromatic hydrocarbons (PAHs)	
Acenaphthene	< 0.10
Acenaphthylene	< 0.10
Anthracene	< 0.10
Benzo[a]anthracene	< 0.10
Benzo[a]pyrene (BAP)	< 0.10
Benzo[b]fluoranthene + Benzo[j]fluoranthene	< 0.10
Benzo[g,h,i]perylene	< 0.10
Benzo[k]fluoranthene	< 0.10
1&2-Chloronaphthalene	< 0.10
Chrysene	< 0.10

COMPOUND	mg/kg
Dibenzo[a,h]anthracene	< 0.10
Fluoranthene	0.11
Fluorene	< 0.10
Indeno(1,2,3-c,d)pyrene	< 0.10
2-Methylnaphthalene	< 0.10
Naphthalene	< 0.10
Phenanthrene	< 0.10
Pyrene	0.11
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	< 0.25
Benzo[a]pyrene Toxic Equivalence (TEF)	< 0.25
Phenols	
4-Chloro-3-methylphenol	< 0.5
2-Chlorophenol	< 0.2
2,4-Dichlorophenol	< 0.2
2,4-Dimethylphenol	< 0.4
3 & 4-Methylphenol (m- + p-cresol)	< 0.4
2-Methylphenol (o-cresol)	< 0.2
2-Nitrophenol	< 0.4
Pentachlorophenol (PCP)	< 6
Phenol	< 0.2
2,4,5-Trichlorophenol	< 0.2
2,4,6-Trichlorophenol	< 0.2
Plasticisers	
Bis(2-ethylhexyl)phthalate	< 0.5
Butylbenzylphthalate	< 0.2
Di(2-ethylhexyl)adipate	< 0.2
Diethylphthalate	< 0.2
Dimethylphthalate	< 0.2
Di-n-butylphthalate	< 0.2
Di-n-octylphthalate	< 0.2
Other halogenated compounds	
1,2-Dichlorobenzene	< 0.14
1,3-Dichlorobenzene	< 0.14
1,4-Dichlorobenzene	< 0.14
Hexachlorobutadiene	< 0.14
Hexachloroethane	< 0.14
1,2,4-Trichlorobenzene	< 0.10
Other SVOCs	
Benzyl alcohol	< 1.0
Carbazole	< 0.10
Dibenzofuran	< 0.10
Isophorone	< 0.10

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