Wellington to Hutt Valley Walking and Cycling Path

Ecological Values and Assessment of Effects
Prepared for NZTA

4 March 2015

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Use and Reliance

CONTENTS

1.0 Introduction

Boffa Miskell Ltd has been engaged to conduct an ecological assessment for New Zealand Transport Agency (NZTA) of the coastal edge and associated terrestrial area along the Wellington to Petone inner harbour coastline to as to be able to assess the potential ecological effects of the construction and operation of a shared use walking and cycling path (WaCP) to connect Lower Hutt with Wellington City at Ngauranga. The assessment has involved examination of two potential alignments for this link. They are:

- Option 1) Between State Highway 2 (SH2) and the current railway line (‘*between transport corridors’’*), with a very small northern area of coastal reclamation; and
- Option 2) between the current rail corridor and the shore (‘*coastal side of rail corridor*’), and will include the reclamation of up to 30m of intertidal and sub-tidal sea bed.

The ecological assessment of Option 1, between transport corridors, required assessment of terrestrial flora and habitat in the main, whereas assessment of Option 2 involved survey of the terrestrial flora and habitat on the coastal side of the rail corridor and of the intertidal and subtidal environment extending 30m seaward of the existing sea wall.

2.0 Methodology

The methods for all aspects involved researching existing data sources and then collecting on site information on the presence of flora and fauna, both terrestrial and marine that is spatially within or near the proposed works required to construct the cycle and walkway.

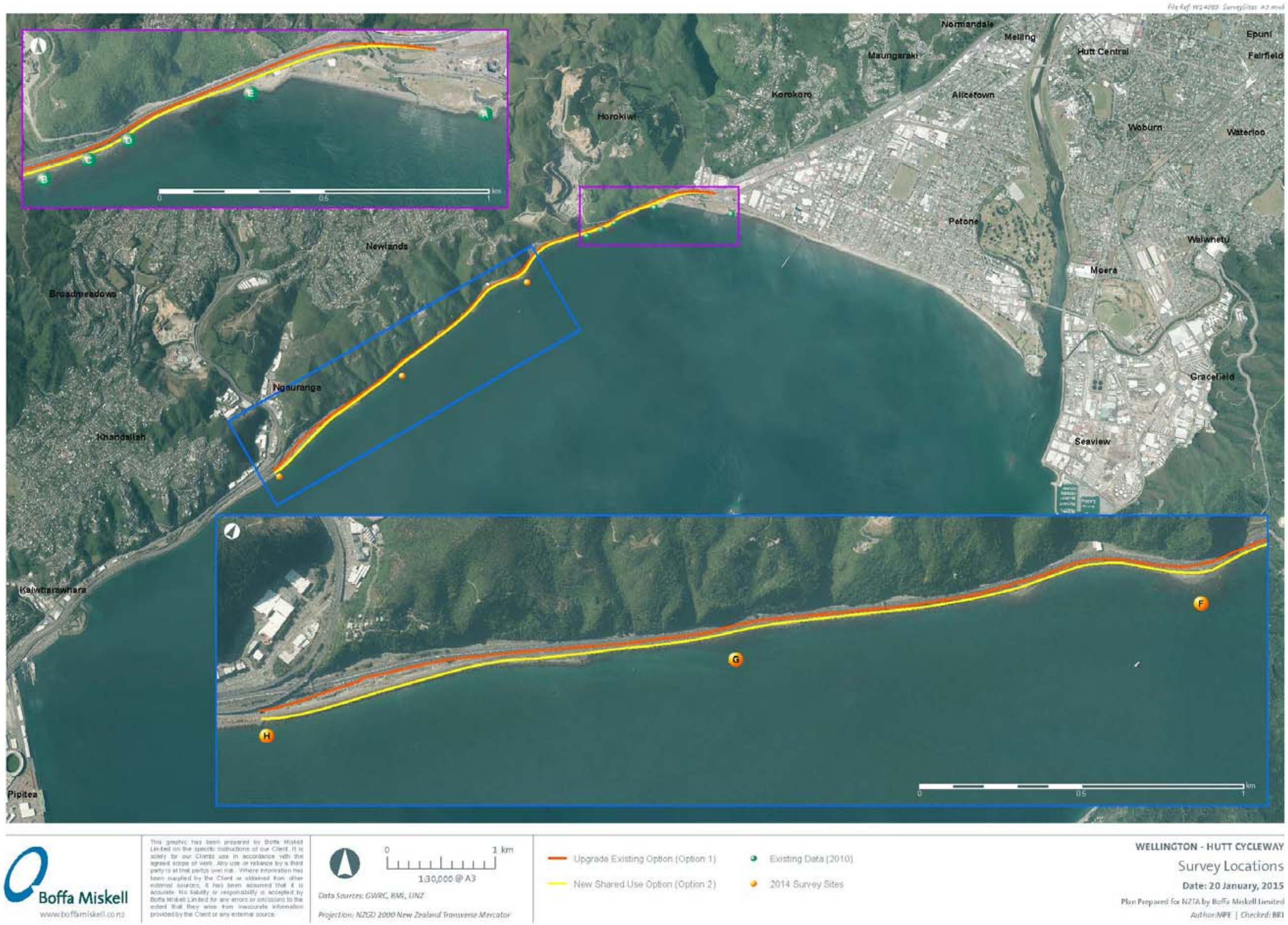
Using that information we then established the significance (using the RPS “significance criteria were appropriate) and ecological values of the communities present. For the marine systems there are no statutory methods and our approach follows a “values” test system not dissimilar to the terrestrial test. The marine values assessment focused on the presence of taxa or communities of particular value or sensitivity.

We then tested the effects of the proposed actions on those values and taxa and assessed if the effects of the proposal are likely to have an adverse effect and if so what magnitude of effect.

We note as part of the existing information available for this assessment that we were able to draw on avifauna data provided by GWRC, and (with permission) marine data gathered by Boffa Miskell for an assessment of effects for the expansion of Horokiwi Quarry.

Vegetation, avifauna and marine assessments were carried out on the 28/10/2014 and the 5th November, 2014. The proposed routes and marine survey site locations are shown in Figure 1.

The methodologies used are described in the following sections.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Melling
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Waterloo
Petone
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Newlands
Moera
Broadmeadows
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0
1 km
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Data Sources: GWRC, BML, LINZ
Projection: NZGD 2000 New Zealand Transverse Mercator
Upgrade Existing Option (Option 1)
New Shared Use Option (Option 2)
Existing Data (2010)
2014 Survey Sites
WELLINGTON - HUTT CYCLEWAY
Survey Locations
Date: 20 January, 2015
Plan Prepared for NZTA by Boffa Miskell Limited
Author: MPE | Checked: BRI

2.1 Terrestrial Vegetation and Habitat

To assess the current vegetation along the alignment, the entire length of the proposed cycleway was walked from north to south and the between rail and SH2 section was walked south to north. The nature of the vegetation did not warrant the use of set transects, or RECCE plots, or other quantitative plant abundance or diversity measures[1]. The method relies on spatial observation of the presence of terrestrial vegetation. Every species observed was identified, whether, native, weed or part of amenity planting and recorded. The findings of this survey, were checked against their Department of Conservation Threat Status (Townsend et.al. 2008, de Lange et al 2013).

The values ("significance" in terms of RMA section 6(c)) were assessed against GWRC Regional Policy Statement 22 and can be found in the results section and data in the appendices.

2.2 Avifauna

Information was gathered on the avifauna values (habitat and species) present within the project and wider area through a combined desktop and field approach.

Robertson (1992) reported on avifauna data collected from 17 sections around the Wellington harbour over two 2-year periods (1975-77 and 1986-88). Each section of coastline was walked or cycled once a month during each 2-year period. All birds seaward of the high-tide line were recorded. The data from section (7) between Horokiwi and Ngauranga was compiled.

Data from the Ornithological Society of New Zealand's atlas (Robertson et al. 2007) was collated from the 10 km x 10 km grid square (266, 599) which encompass the section of coastline between Horokiwi and Ngauranga, as well the terrestrial and marine habitat either side of the coastline. The primary and secondary habitats for each of the species recorded within this grid square was obtained from Heather & Robertson (2000), along with each species' New Zealand threat status according to Robertson et al. (2013).

By identifying the habitat preferences of the species recorded in the OSNZ data, we are able to better determine which of those species recorded may utilise the project area. Furthermore, this provides a more focused species list relevant to the project and which assists with on-site investigations.

Information was also obtained from New Zealand eBird database regarding species recorded opportunistically along the Horokiwi and Ngauranga coastline during 2013 and 2014 (courtesy of Nikki McArthur, GWRC).

Lastly, a roaming species inventory was compiled while undertaking the vegetation surveys and the marine surveys. All avifauna species seen or heard were recorded, along with any sign of breeding or roosting (e.g. accumulation of guano or nesting material).

2.3 Intertidal Field Investigations

Two areas of marine habitat we assessed and are different in terms of their structure and species composition:

[1] Note the "habitat" present was also considered in such a poor condition that invertebrate or lizard surveys were not considered as being required.

1. the soft substrate benthos (or low-tide beaches); and
2. the rocky shore.

The methods used to survey each of these is described in the sections below, and a summary of the habitat type surveyed at each of the sample sites is provided in Table 1.

Table 1: Summary of marine survey sites and year sampled (refer to Figure 1 for site locations)

SURVEY SITE	INTERTIDAL SOFT	INTERTIDAL ROCKY	SUBTIDAL
A	2009/10	N/A	2009/10*
B	2009/10	N/A	2009/10*
C	2009/10	N/A	2009/10*
D	2009/10	N/A	2009/10*
E	2009/10	N/A	2009/10*
F	2014	2014	2014
G	2014	2014	2014
H	N/A	2014	2014

* Visual inspection conducted in 2014 to confirm 2009/10 results remained valid (refer to Section 2.4).

2.3.1 Soft Shore intertidal Assessments

Sampling and assessment of this zone was carried out on Wednesday the 5/11/14 during rainy/cloudy then fine weather conditions, on either side of the low tide (9:48am).

Firstly the entire length of the coastal works were walked to establish the uniformity of this habitat and to determine where representative sampling should be undertaken. At sites F and G (Figure 1) the following sampling was undertaken:

- To assess infaunal (below substrate surface) invertebrate abundance and diversity a sediment core was collected from each site using a 13 cm diameter × 10 cm deep PVC tube. The tube was manually driven into the sediment, with assistance of a trowel to work around rocks, and the contents bagged. Samples were then sieved through a 0.5 mm mesh and the retained material was carefully placed into a labelled plastic container and preserved in 60-70% ethanol. Invertebrates were extracted and identified later in a laboratory.
- To survey epifaunal invertebrates (surface dwelling organisms) and macroalgae, a 0.50 m x 0.50 m quadrat was haphazardly placed at each site approximately 0.5 m from where cores were collected. All macroinvertebrates within the quadrat were identified and counted. Percentage cover of macroalgal cover was also estimated.
- A surface sediment (top 2 cm) sample was collected at both sites for contaminants (copper, lead, zinc, high molecular weight polycyclic aromatic hydrocarbons (HMW PAHs), and total organic carbon (TOC) and sediment grain size analyses.

2.3.2 Intertidal Rocky Shore Survey

Three survey sites were considered sufficient to reflect the habitat variably along the coastal area potentially affected by the project. During +/- 1 hour of low tide, the ecology of the intertidal rocky /rip rap shore at three survey sites F, G and H was assessed (Figure 1 and Table 1). That assessment involved the placement of a quadrat (0.25m^2) above low water on the rocky shore. This quadrat was then used to survey the habitat features, within which the following parameters were recorded:

- Percentage cover of sessile organisms
- Number of mobile organisms
- Substrate type
- Percentage cover of algae
- Number/percentage of cracks in the rocks surveyed

In addition, a 0.1m^2 quadrat was placed in the bottom left corner of the 0.25m^2 quadrat for quantitative survey. In this smaller quadrat, all epifaunal individuals observed were counted. Photos of these rocky shore sites can viewed in the Appendices.

2.4 Subtidal

A total of 8 sites (A-H) were visited by scientific divers on SCUBA, on 28/10/14 between 8.00am and 2.30pm. Visibility at survey was limited partly due to rain the previous day. Given that five (A-E) of the sites had previously been surveyed in 2009/10, the divers only carried out visual assessments in 2014 in order to determine if there were significant changes to ecological condition (refer to Table 1).

At the three new sites (F-H), divers collected sample material from 15m and 30m distances from the rocky shore edge during the 2014 survey, as per the following methodologies:

2.4.1 Physical Habitat Description:

Observations of the surficial sediment type(s), depth, abundance and diversity of algae, epifauna, and overall condition were made.

2.4.2 Epifauna

A 0.25 m^2 quadrat was surveyed at each site, approximately 0.5 m from where cores were taken. All organisms occurring within the quadrats were identified to species level and enumerated. Macroalgal cover was estimated on the basis that a 5 x 5 cm area equates to 1% cover.

2.4.3 Infauna

A sediment core was collected from each site using 13 cm diameter × 10 cm deep PVC tube. Each tube had a tapered leading edge to facilitate penetration, with the top end capped. The cap had a small hole (10 mm diameter) to allow water to escape as the tube was driven into the sediment.

Individual tubes were manually driven into the sediment, removed with core intact, the contents bagged, and then placed on ice. Samples were sieved through a 0.5 mm mesh and the retained material was removed, placed into a labelled plastic container and preserved in 70% ethanol and for later identification in the laboratory.

2.4.4 Sediment

Surface sediment (top 2–3cm) was collected using a modified garden trowel, samples were approximately 0.5 m to 1 m from the location of the infauna cores. Samples were placed on ice and later sent to laboratories for the analysis of copper, lead, zinc, high molecular weight polycyclic aromatic hydrocarbons and total organic carbon and sediment grain size. The concentration of PAHs was normalised to 1% TOC.

The values returned will be compared against the Concentrations of copper, lead, zinc and high molecular weight polycyclic aromatic hydrocarbons (HMW-PAHs) can be compared against Auckland Councils (AC) Environmental Response Criteria (ERC) (ARC, 2004), and the Australian and New Zealand Environment and Conservation Council (ANZECC, 2000) Interim Sediment Quality Guidelines (ISQG). Table 2 below provides the trigger and threshold limits for both the AC ERC and ISQG. AC ERC thresholds were developed based on ANZECC (2000) ISQG and other internationally recognised sediment quality guidelines. Contaminant concentrations in the green range indicate that the biology of the site is unlikely to be impacted, whereas the amber range indicates possible impact and the red range indicates probable impact.

Table 2: Sediment contaminant guidelines values

CONTAMINANT	AC ERC Green	AC ERC Amber	AC ERC Red	ISQG-Low	ISQG-High
Copper	<19	19-34	>34	65	270
Lead	<30	30-50	>50	50	220
Zinc	<124	124-150	>150	200	410
HMW-PAHs	<0.66	0.66-1.7	>1.7	1.7	9.6

3.0 Results: Ecological Condition, Significance and Value

3.1 Terrestrial Vegetation

The vegetation found within the alignment area[2] consisted of both exotic and native coastal species, with a dominance towards exotics. Native vegetation was generally found within areas of amenity roadside plantings, wilding along the road edges and where small peninsulas provided sufficiently sized platforms between the sea and the railway. None of the native species detected are recorded as “Threatened” or “At Risk” in the DOC Threat Classification System (de Lange et al, 2013), or are regionally notable. Exotic species were found throughout the area, particularly scattered through the gravel and the sealed paths along the alignment.

[2] Note: vegetation species list is in Appendix 2

3.1.1 Between the road and rail corridor

The vegetation on the western (coastal) side of the tracks is comprised of both naturally occurring and planted species. A total of 48 species were identified and of these 48 species, 35 were exotic and 13 were native species. None are “Threatened” or “At Risk” (Appendix 2). The plants in this area are generally amenity focused and have little in the way of habitat value, are fragmented, limited in size and area and intactness and include species not “appropriate” in an ecological sense to the area (e.g. karo and pohutukawa).

The majority of the vegetation between the road and rail area is found within roadside amenity plantings, with one small area near the Kaiwharawhara overpass, one narrow strip opposite the Horokiwi Road intersection and five areas associated with the Korokoro Gateway Park near the Wellington Water Ski Clubhouse. Here several coastal shrubs and secondary forest species have been planted (*Pittosporum* and *Olearia*). Nine native species in total have been planted consisting of coastal shrubs and secondary forest species such as *Olearia* and *Pittosporum*, other woody exotic species has invaded such as broom and gorse. Two of the native species here, pohutukawa and karo are not native to the region, and therefore are seen as ecologically inappropriate.

Outside of the amenity plantings most of the sealed and gravelled area between the road and railway has been regularly sprayed with herbicide, preventing most invading perennial seedlings from establishing. However a few taupata, flax and pohutukawa have become established in some places, particularly at the southern end of the proposed cycle route.

3.1.2 Westward of the rail corridor

Thirty Seven species, of which 8 were native and 29 were exotic were recorded between the existing railway line and the high tide mark (refer to Appendix 2). The majority of these were found at the Wellington end of the cycle way where land area was slightly greater. The natives were common, opportunistic, coastal, species of disturbed soils and land (e.g. taupata, tauhinu, flax, scrub pohuehue, shining spleenwort, shore convolvulus, native shore spinach, and leather leaf fern). There were no large areas of vegetation and no “intact native habitats” with most vegetation being scattered weeds or small clusters of herbs and weeds about small clusters of flax.

None of the native species are recorded as “Threatened” or “At Risk” (de Lange et al, 2013), or are regionally notable.

3.2 Significance

To assess the ecological significance of this vegetation, the GWRC Regional Policy Statement for the Wellington Region (2013) was used. There are a set of criteria at Policy 22 which are to be used to identify indigenous ecosystems and habitats with significant indigenous biodiversity values. The feature can be considered significant where one or more of the following criteria are meet:

(a) Representativeness: high representativeness values are given to particular ecosystems and habitats that were once typical and commonplace in a district or in the region, and:

(b) Are no longer commonplace (less than about 30% remaining); or (ii) are poorly represented in existing protected areas (less than about 20% legally protected).

  (i) Rarity: the ecosystem or habitat has biological physical features that are scarce or threatened in a local, regional or national context. This can include individual species, rare and distinctive biological communities and physical features that are unusual or rare.

(c) Diversity: the ecosystem or habitat has a natural diversity of ecological units, ecosystems, species and physical features within an area.

(d) Ecological context of an area: the ecosystem or habitat:

  (i) Enhances connectivity or otherwise buffers representative, rare or diverse indigenous ecosystems and habitats; or

  (ii) provides seasonal or core habitat for protected or threatened indigenous species.

(e) Tangata whenua values: the ecosystem or habitat contains characteristics of special spiritual, historical or cultural significance to tangata whenua, identified in accordance with tikanga Maori.

3.2.1 Significance West of the Rail corridor to the Mean High Tide

In terms of the vegetation found between the Rail and Road corridors, no individual or cluster or grouping of vegetation present represents a once typical and commonplace type of wellington inner harbour coastal edge. In that regard it follows that there is no representation of a historic but now under represented (<30%) type and nor is there a type present that might otherwise be found under represented in the protected areas of the district. (Assessment: VERY LOW)

There are no “scarce”, rare, Threatened or At Risk taxa within the transport corridors. There are also no distinctive biological communities and physical features that are unusual or rare. (Assessment: VERY LOW)

It follows too that there is no particular diversity of indigenous species (8), or habitats or features. (Assessment: VERY LOW)

In regard to ecological context, the vegetation present offers little or no connectivity value and cannot be seen as a stepping stone, or transitional add, it has no buffering role, being between two transport corridors, and it provides no seasonal or core habitat for protected or threatened indigenous species. (Assessment: VERY LOW)

The vegetation and features in general and at specific locations between the Road and Rail corridors cannot in any way be found to be ecologically significant.

3.2.2 Significance between the rail and road corridor

While there is a greater quantity of vegetation and larger clusters, and more “unplanted” vegetation than between the transport corridors, the clusters of vegetation are still predominantly weedy and do not, as an assemblage, represent a natural coastal community type. Only the flax along some areas where it is in greatest abundance (which remains a low abundance) could be said, with the small number of taupata, fern etc., also present to approximate a coastal flaxland community. However, these areas are on such disturbed media with such an abundance of weeds and such limited abundance of the natives, other than the flax, that we do not liken the assemblage to a natural or historic community. Again the test for representative fails at the first hurdle which is the presence of a representative assemblage. (Assessment: VERYLOW)

There were no scarce, Threatened or At Risk species recorded. We do not that some value is attached to shore spinach, but that value is no ecological but cultural. (Assessment: VERY LOW)

With only thirteen native species and small clusters of vegetation and no sequence of habitat, the feature as a whole or in its various parts cannot be said to be diverse, or have a diversity of indigenous habitats or ecosystems. (Assessment: VERY LOW)

In regard to the Ecological Context criteria, most of the area as a whole is bare ground, highly unlikely to enhance connectivity between the sea and coastal forest escarpments east, or along the coast. Neither does it buffer any other (better) habitat. Some of the larger flax clusters, may provide nesting sites for little blue penguin. The little blue penguin is an “at Risk” species and so not threatened, but it is a protected species under the Wildlife Act. During the breeding season little blue penguins utilise the lower, constructed, rocky coastal edge (in the crevices) but may also climb above to where flax cover exists, and they may nest under this vegetation. No penguins were recorded in the surveys. (Assessment: LOW)

Despite this potential use of the flax by penguins, most of the nesting is likely to occur in the non-vegetated rocky shore and the crevices there in, and we do not consider the potential sufficient to cause us to check this criterion.

The wider vegetation and terrestrial habitat along the foreshore, west of the rail corridor, as a whole or in areas, is not ecologically significant.

3.3 Terrestrial Value

Ecological value is different from "significance". An area may not be significant but will still likely have a range of values.

Following significance a "values" judgement was made using the following table (Table 3). This table can be used to assess both the species and vegetation habitat values.

Table 3: Description of Measures of Ecological/Conservation Values for Species, Vegetation Communities & Habitats

ECOLOGICAL/ CONSERVATION VALUE	SPECIES	TERRESTRIAL VEGETATION AND HABITAT (using the significance criteria)
Very High	Threatened (Nationally Critical, Nationally Endangered, Nationally Vulnerable)	Rates High for all or most of the four assessment criteria (Section 3.2 above). Likely to be nationally important and recognised as such.
High	At Risk (Declining, Recovering, Relict, Nationally Uncommon)	Rates High for at least one of the assessment criteria and moderate for the majority of the others. Likely to be regionally important and recognised as such.
Medium	Native - Not Threatened	Rates Moderate for the majority of assessment criteria. Important at the level of the Ecological District.
Low	Introduced	Rates Low to Nil for all assessment criteria. Limited ecological value other than as local habitat for tolerant native species.

In terms of column one, species, the terrestrial vegetation observed along the route falls into the Low Ecological Conservation Value range due to the absence of Threatened and At Risk species. This is despite there being some native species, because the dominant vegetation is exotic (weedy). Had the number of native species been more than the exotic or the areas of native vegetation (abundance) been greater than the exotic, the feature as a whole may have risen to "medium". There may be some value in the coastal flax as nesting sites for little blue penguin, but at this stage that is speculative only, and likely of minor value next to the rocky crevices. Avifauna taxa and habitat are assessed separately below. In terms of the second column, and its reference to the outcomes of the significance criteria the "Values" present are at best low.

3.4 Avifauna

Avifauna species data obtained from the Robertson (1992), OSNZ atlas data and eBird are summarised in the Table 4 below, along with species observed whilst carrying out the site walk over on the 5th November 2014. Due to the focus of Robertson (1992) and eBird data being collected along and adjacent to the project area and over 2 year periods (1975-77, 1986-88 and 2013-14), this provides the most representative list of the avifauna utilising the site. Both data sets recorded Threatened (pied shag, Caspian tern, red-billed gull) and At Risk (little shag, NZ pied oystercatcher, little blue penguin, variable oystercatcher, white-fronted tern and fluttering shearwater) species along the Horokiwi to Ngauranga coastline.

In summary, Robertson (1992) describes the rocky shore between Horokiwi and Ngauranga as mainly being used by small shags and variable oystercatchers. This appears to still be the case based on the eBird data and observations made during the site visit.

The value of the project site as habitat for avifauna will vary according to what function it provides for individual species i.e. foraging, nesting or roosting habitat. The project site and adjacent marine environment is likely to provide roosting and foraging opportunity for the majority of species, of which there are other such habitats within the wider Wellington Harbour. However, the Boffa Miskell survey of the project area identified the presence of a variable oystercatcher nest under a flax as well as a possible little blue penguin burrow within the coastal rock rip-rap (no bird was seen). Both variable oystercatcher and little blue penguin are classified as At Risk species (Robertson et al. 2013).

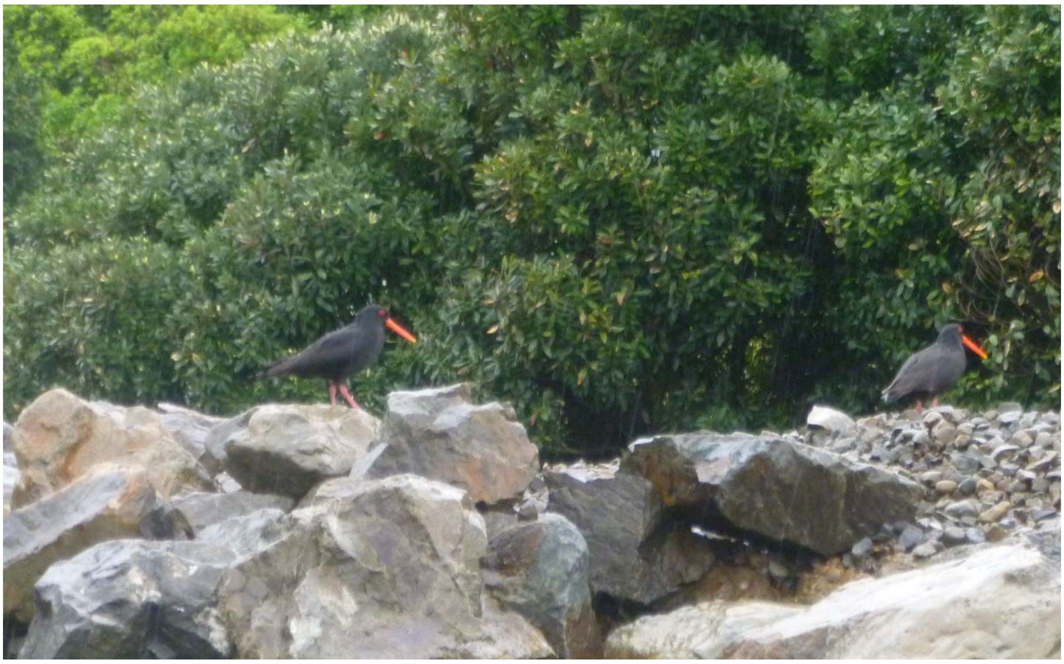


Table 4: Summary of avifauna species recorded in the OSNZ atlas data, eBird and BML survey along the Horokiwi to Ngauranga coastline and wider environment.

SPECIES - Robertson et al. 2007		CONSERVATION STATUS - Robertson et al. 2013			HABITAT								SOURCE			
					Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	OSNZ (266, 599)	Robertson (1992)	eBird	BML site visit
Bellbird	*Anthornis m. melanura*	Endemic	Not Threatened	Not Threatened									x			
Bush falcon	*Falco novaeseelandiae "bush"*	Endemic	Threatened	Nationally Vulnerable[DP St]									x			
Kereru	*Hemiphaga novaeseelandiae*	Endemic	Not Threatened	Not Threatened[CD Inc]									x			
Long-tailed cuckoo	*Eudynamys taitensis*	Endemic	At Risk	Naturally Uncommon[De DP]									x			
Morepork	*Ninox n. novaeseelandiae*	Native	Not Threatened	Not Threatened									x			
North Island fantail	*Rhipidura fuliginosa placabilis*	Native	Not Threatened	Not Threatened[EF]									x			
North Island rifleman	*Acanthisitta chloris*	Endemic	At Risk	Declining[DP]									x			
Red-crowned parakeet	*Cyanoramphus n. novaezelandiae*	Endemic	At Risk	Relict									x			
Shining cuckoo	*Chrysococcyx l. lucidus*	Native	Not Threatened	Not Threatened[DP]									x			
Tui	*Prosthemadera n. novaeseelandiae*	Endemic	Not Threatened	Not Threatened[OL St]									x			
Blackbird	*Turdus merula*	Introduced	Introduced	Introduced & Naturalised[SO]									x		x	
California quail	*Callipepla californica*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Eastern rosella	*Platycercus eximius*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Grey warbler	*Gerygone igata*	Endemic	Not Threatened	Not Threatened									x			
Silvereye	*Zosterops lateralis lateralis*	Native	Not Threatened	Not Threatened[SO]									x			
Canada goose	*Branta canadensis*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Chaffinch	*Fringilla coelebs*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Dunnock	*Prunella modularis*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Goldfinch	*Carduelis carduelis*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Greenfinch	*Carduelis chloris*	Introduced	Introduced	Introduced & Naturalised[SO]									x			

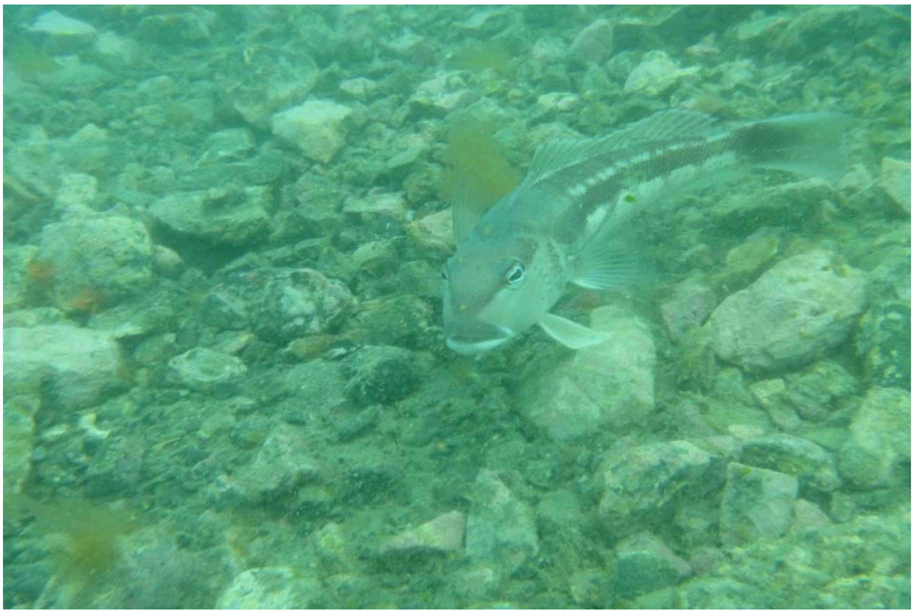
SPECIES - Robertson et al. 2007		CONSERVATION STATUS - Robertson et al. 2013			HABITAT								SOURCE			
					Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	OSNZ (266, 599)	Robertson (1992)	eBird	BML site visit
House sparrow	*Passer domesticus*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Magpie	*Gymnorhina tibicen*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
NZ pipit	*Anthus n. novaeseelandiae*	Native	At Risk	Declining									x			
Redpoll	*Carduelis flammea*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Skylark	*Alauda arvensis*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Song thrush	*Turdus philomelos*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Spur-winged plover	*Vanellus miles novaehollandiae*	Native	Not Threatened	Not Threatened[SO]									x	x	x	
Starling	*Sturnus vulgaris*	Introduced	Introduced	Introduced & Naturalised[SO]									x		x	
Swamp harrier	*Circus approximans*	Native	Not Threatened	Not Threatened[SO]									x			
Welcome swallow	*Hirundo n. neoxena*	Native	Not Threatened	Not Threatened[Inc SO]									x		x	
Yellowhammer	*Emberiza citrinella*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Black shag	*Phalacrocorax carbo novaehollandiae*	Native	At Risk	Naturally Uncommon[SO Sp]									x	x		
Black swan	*Cygnus atratus*	Native	Not Threatened	Not Threatened[SO]									x		x	
Black-billed gull	*Larus bulleri*	Endemic	Threatened	Nationally Critical[RF]									x			
Feral goose	*Anser anser*	Introduced	Introduced	Introduced & Naturalised[SO]									x			
Grey duck	*Anas s. superciliosa*	Native	Threatened	Nationally Critical[SO]									x			
Grey teal	*Anas gracilis*	Native	Not Threatened	Not Threatened[Inc SO]									x			
Kingfisher	*Todiramphus sanctus vagans*	Native	Not Threatened	Not Threatened									x			
Little black shag	*Phalacrocorax sulcirostris*	Native	At Risk	Naturally Uncommon[RR]									x	x	x	
Little shag	*Phalacrocorax melanoleucos brevirostris*	Native	Not Threatened	Not Threatened[Inc]									x	x	x	
Mallard	*Anas platyrhynchos*	Introduced	Introduced	Introduced & Naturalised[SO]									x		x	
NZ pied oystercatcher	*Haematopus finschi*	Endemic	At Risk	Declining									x		x	
NZ shoveler	*Anas rhynchotis variegata*	Native	Not Threatened	Not Threatened									x			
Paradise shelduck	*Tadorna variegata*	Endemic	Not Threatened	Not Threatened									x			
Pied shag	*Phalacrocorax varius varius*	Endemic	Threatened	Nationally Vulnerable									x	x	x	

SPECIES - Robertson et al. 2007		CONSERVATION STATUS - Robertson et al. 2013			HABITAT								SOURCE			
					Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	OSNZ (266, 599)	Robertson (1992)	eBird	BML site visit
Pied stilt	*Himantopus h. leucocephalus*	Native	At Risk	Declining[SO]									x			
Pukeko	*Porphyrio m. melanotus*	Native	Not Threatened	Not Threatened[Inc SO]									x			
Black-backed gull	*Larus d. dominicanus*	Native	Not Threatened	Not Threatened[SO]									x	x	x	x
Caspian tern	*Hydroprogne caspia*	Native	Threatened	Nationally Vulnerable[SO Sp]									x		x	
Eastern bar-tailed godwit	*Limosa lapponica baueri*	Native	At Risk	Declining[TO]									x			
Red-billed gull	*Larus novaehollandiae scopulinus*	Native	Threatened	Nationally Vulnerable									x	x	x	
Reef heron	*Egretta sacra sacra*	Native	Threatened	Nationally Endangered[DP SO Sp St]									x			
Royal spoonbill	*Platalea regia*	Native	At Risk	Naturally Uncommon[Inc RR SO Sp]									x			
Spotted shag	*Stictocarbo p. punctatus*	Endemic	Not Threatened	Not Threatened									x		x	
Variable oystercatcher	*Haematopus unicolor*	Endemic	At Risk	Recovering[Inc]									x	x	x	x
White-faced heron	*Egretta novaehollandiae*	Native	Not Threatened	Not Threatened[SO]									x			
White-fronted tern	*Sterna s. striata*	Native	At Risk	Declining[DP]									x	x	x	
Australasian gannet	*Morus serrator*	Native	Not Threatened	Not Threatened[De Inc SO]									x		x	
Common diving petrel	*Pelecanoides urinatrix urinatrix*	Native	At Risk	Relict[RR Inc SO]									x			
Fluttering shearwater	*Puffinus gavia*	Endemic	At Risk	Relict[RR]									x	x	x	
Northern blue penguin	*Eudyptula minor iredalei*	Native	At Risk	Declining[DP EF]									x		x	
Sooty shearwater	*Puffinus griseus*	Native	At Risk	Declining[SO]									x	x		
Rock pigeon	*Columba livia*	Introduced	Introduced	Introduced & Naturalised[SO]									x			

3.5 Marine intertidal and Subtidal existing environment

The following results are from assessments carried out on the subtidal and intertidal zones on 28 October and 5 November, 2014. These results and subsequent assigned values will only require consideration if the option to reclaim land beyond the current coastal edge is chosen (Option 2).

Site photographs and habitat descriptions, including depth, algal cover, substrate type and epifaunal presence observations were taken and the raw data is in Appendix 4.



3.6 Infaunal Macro-Invertebrate Community Structure

3.6.1 Taxa Richness

A total of 65 infaunal taxa were recorded from all sites and all sample locations. Number of taxa ranged from 3 to 28 taxa (noting there were no intertidal samples collected from the H location). More taxa were detected subtidally compared to intertidally (Figure 2).

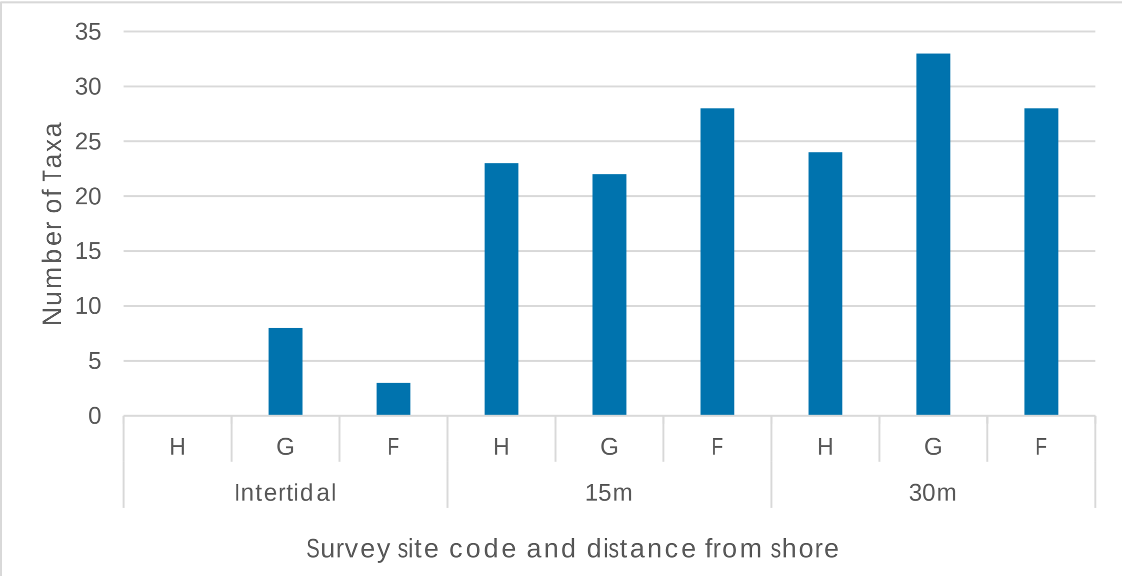


Figure 2: Taxa richness of infauna

3.6.2 Abundance

The abundance of macroinvertebrates found in the intertidal zone was comparatively low (0-14 (average 9)). This increased at 15m from the shore to an average of 194 and 150 at 30m. Figure 3 illustrates that one sample (site G) in the 15m set of data had a particular large number of individuals (353 individuals, primarily bristleworms) skewing the average from what is perceivably a slight trend of increasing abundance with distance from the rocky cost (intertidal).

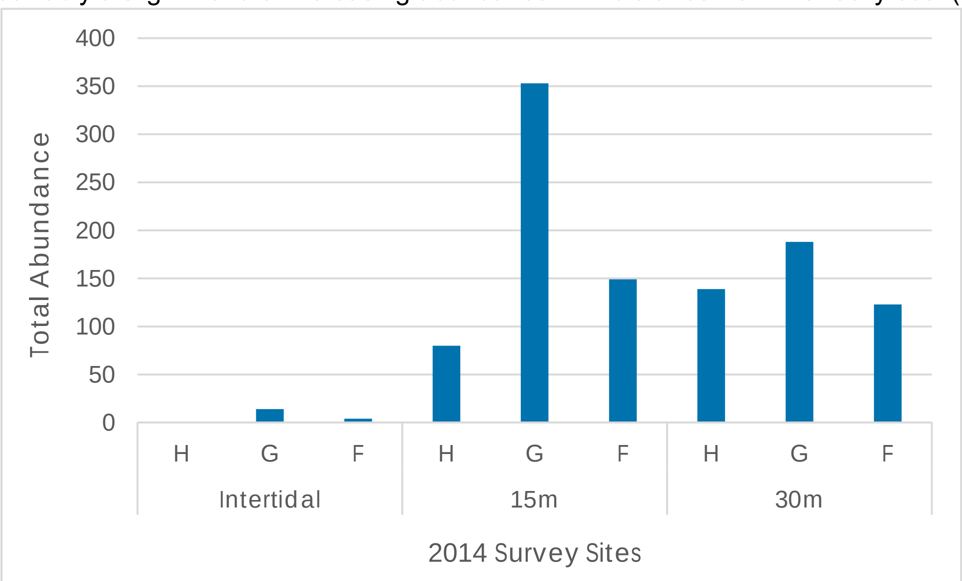


Figure 3: Abundance of infaunal invertebrates

3.6.3 Diversity

The Shannon–Wiener index is a measure of diversity that takes into account both richness of taxa and their individual abundances (evenness). The diversity of infauna generally increases with distance from the shore (Table 5).

Table 5: Shannon-Wiener Diversity

	Intertidal		15m			30m		
	G	F	H	G	F	H	G	F
Diversity Index	1.8	1.0	2.4	1.3	2.3	2.7	2.9	2.5

3.6.4 Community Composition

At the intertidal Site F, only 4 individuals in total were recorded, and 2 of these individuals were unidentified amphipods.

The polychaeta group dominate all of the communities present in terms of taxa richness, with 24 taxa, followed by bivalves (10 taxa), and gastropods (8). Polychaete worms also dominate the abundance of individuals, comprising 820 individuals of a total of 1050. The following polychaete worms were the most abundant: *Barantolla lepte,* Dorvilleidae, and Spirorbidae. Figure 4 shows the proportion of each main group at each sample location and clearly illustrates the dominance of polychaete worms at all sites other than intertidal site F where Amphipods dominate the community.

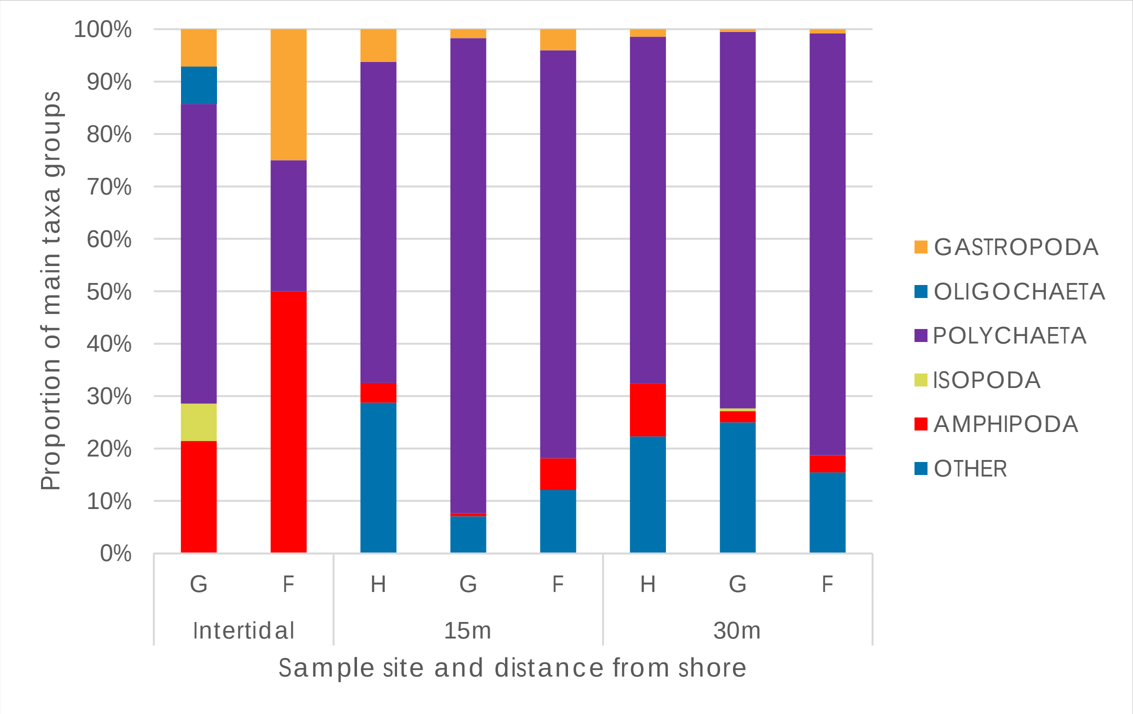


Figure 4: Proportional abundances of taxa groups.

3.7 Epifauna & Flora

Subtidal epifaunal communities at rocky reef/cobble and boulder sites A-E (Figure 1) were surveyed in 2009/2010 along transects from 10m to 30m from the shore.

In 2014, the subtidal dive team qualitatively assessed these sites, concluding that there was no appreciable change in habitat or condition over the last 4 years, and the species identified in 2009/2010 were still present. Photos from 2014 and 2009/2010 and site descriptions are in Appendix 3.

Typically only 1 or 2 taxa were recorded. The highest diversity of taxa was per quadrat was observed at Site C (Figure 5) at 10 and 20m water depth, although the differences are unlikely to be statistically significantly different.

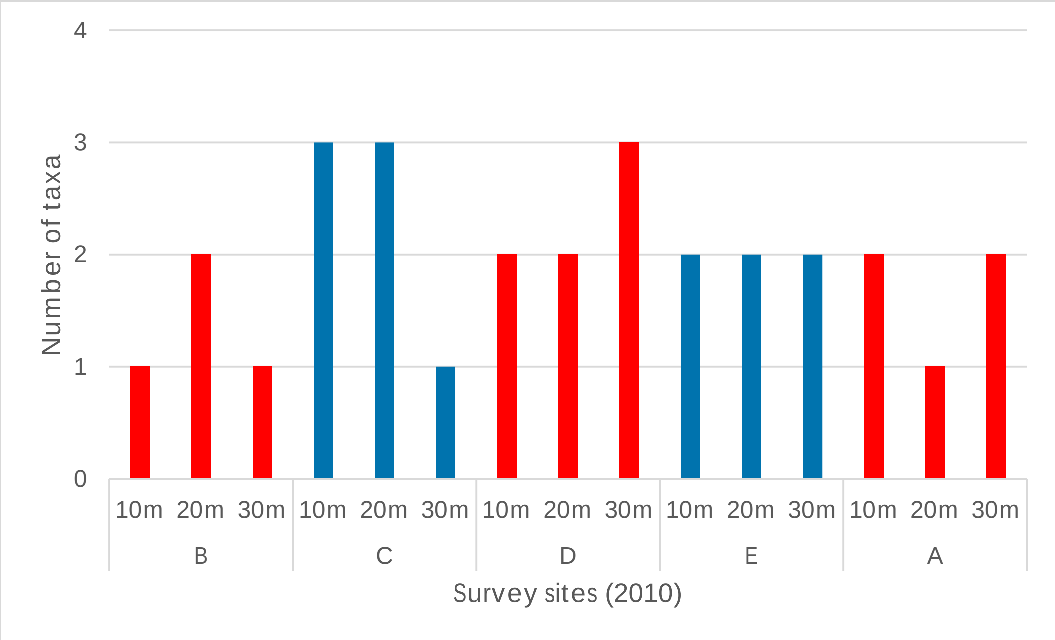


Figure 5: Number of taxa per sample in the 2009/2010 survey. (Note, sites are place in order from southern most site (B) to northern most (A).

The highest abundance of macroinvertebrates was found at Site B, at 30m (Figure 6). There was no clear pattern of abundance by site or distance. The dominant epifaunal organisms found across all samples were gastropods.

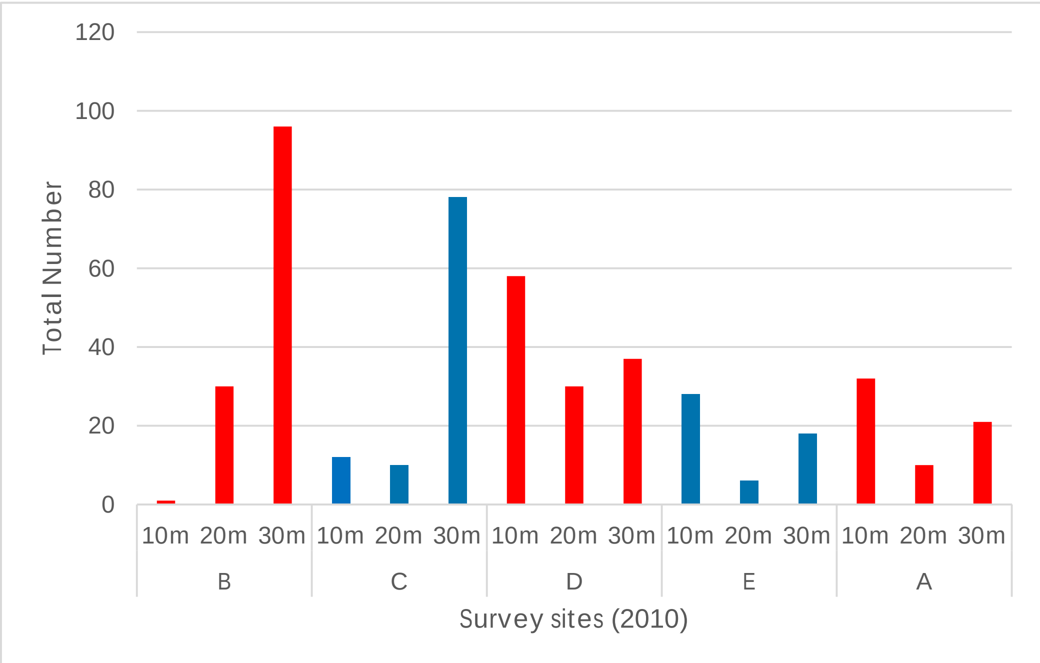


Figure 6: Total number of invertebrates per sample in the 2009/2010 survey. (Note, sites are place in order from southern most site (B) to northern most (A)

There were no intertidal macroalgae detected (Table 6). There were four common surface adhering subtidal macroalgae, but only Coralline was abundant (Table 6). Coralline algae (a pinkish encrusting algae of benthic hard surfaces) play an important role in the diet of sea urchins, limpets, and chitons.

Table 6: Flora recorded from survey quadrates at intertidal and sub-tidal sites. A = Abundant, L = low, T = trace

Plants	GI	FI	H15	G15	F15	H30	G30	F30
Coralline (encrusting)				A	A		A	A
Gracilaria sp.			T		T			T
Polysiphonia sp.						L		
Hildenbradia kerguelensis					L			L

3.8 Rocky Shore Community

The intertidal rocky shore in this area comprises a modified structure, built to support the current transport corridor. The seawall is a combination of rip-rap, comprising of clean-fill large size construction waste (bricks, concrete and other rubble), and more natural large boulders. There is a larger proportion of rubble at the northern Hutt Valley end, and the more suitable natural greywacke boulders have been used at the Ngauranga southern section of the sea wall. There is a concrete section of sea wall through the central region, where the transport corridor is a narrower. The abundance of algae and macroinvertebrates is highest at the southern survey site (H).

Within the rock quadrats were varying number of cracks and crevices. These spaces influenced the number of mussels present, but no other organisms.

Observations of algal cover are presented in Table 7, and observations of organisms and substrate by site are presented in

Table 8. The greatest abundance of flora and fauna was found at the most southern site (H), closest to Ngauranga (Table 9).

Table 7: Algae present within the 0.25m² quadrat

Site Name	Percentage algae cover in transect	Unidentified green turfing algae	*Ulva lactuca* (Sea lettuce)	*Carpophyllum maschalocarpum* (Flapjack)
Site E	0	0	0	0
Site F	10%	10%	0	0
Site G	40%	5%	0	0
Site H	22%	5%	2%	15%

Table 8: Visual Observations within a 0.25m² quadrat

Site Name	Percentage sessile organisms	Percentage mobile organisms	Substrate type
Site E	10%	5%	Construction Rubble
Site F	15%	5%	Conglomerate rock
Site G	30%	15%	Rock (greywacke)
Site H	50%	30%	Rock (greywacke)

Table 9: Abundance of surface organisms

Site Name	*Chaemaesipho columna* (barnacle)	*Limnoperla pulex* (little black mussel)	*Cellana Ornata* (ornate limpet)	*Patelloida corticata* (encrusted limpet)	Unidentified whelk sp
Site E	157	21	0	0	0
Site F	0	34	0	0	1
Site G	97	0	3	1	0
Site H	>400	15	2	0	0

3.9 Sediment Quality

3.9.1 Sediment Grain Size

The low proportion of very fine silts and sand within the study area is indicative of the high energy nature of the Wellington Harbour, which is prone to high wind events throughout the year. Sediment at all sites, excluding Site H at 30m, is dominated by grain sizes between coarse sand and coarse gravel (Figure 7). Sediment at Site H at 30m predominantly comprised fine and medium sand. Some silt and clay was also present at that site (Figure 7).

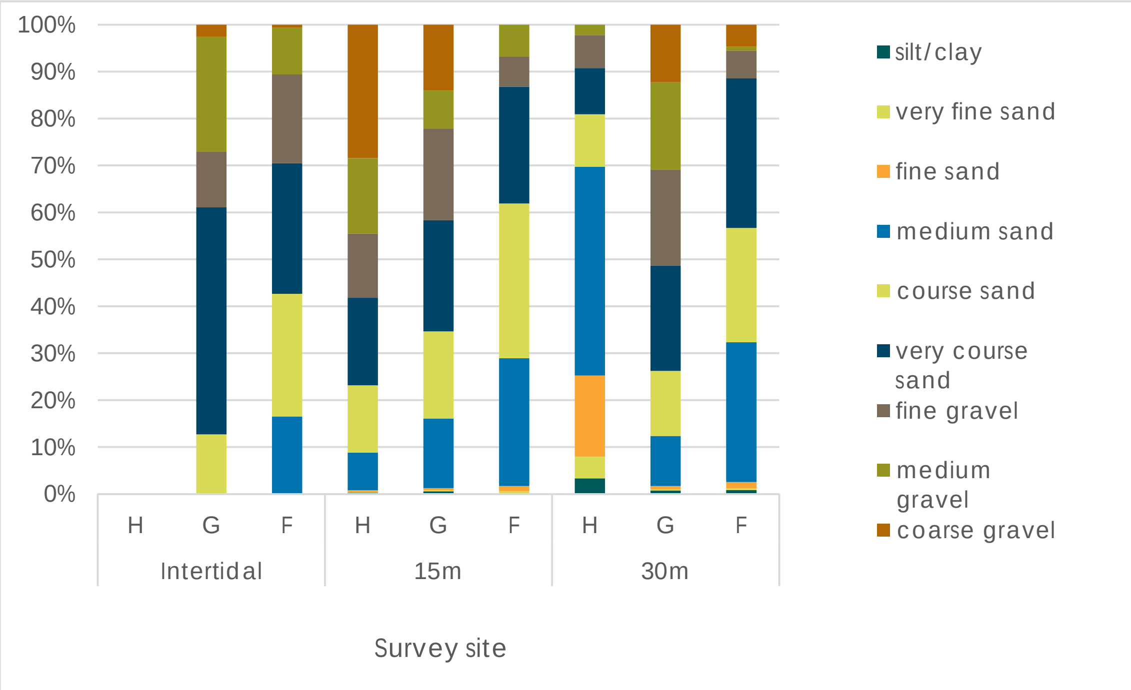


Figure 7: Proportion of grain size of material <2mm.

3.9.2 Sediment Contaminants

Contaminant concentrations tested for were low in all samples (Table 10). The concentration of total recoverable copper at all sites was below the ERC amber threshold indicating low contaminant concentrations. Lead was detected at concentrations within the amber range at sites G and H at 30m. Zinc was above red threshold concentrations at site H, but still below the ISQG low guideline value. PAHs were above the amber threshold at three sites (Table 10).

Table 10: Sediment contaminant concentration (mg/kg) (analysis in total sediment and 63µm fraction).

	H – 15m	H - 30m	G-Intertidal	G – 15m	G – 30m	F-intertidal	F-15m	F-30m
Total Recoverable Copper	17.1	18.7	13.9	21	16.5	17.5	19.1	16.4
Total Recoverable Lead	26	43	15.3	25	36	15	25	19.1
Total Recoverable Zinc	174	170	59	85	87	86	78	80
Polycyclic Aromatic Hydrocarbons Trace	0.136	1.397	0.096	0.056	0.791	0.099	0.653	0.085

3.10 Summary of Current Intertidal and Subtidal Findings

There is little published literature describing intertidal and subtidal biology of Wellington Harbour. The area is not included in the Regional Policy Statement nor identified in the Regional Coastal Plan appendices as an "Area of Important Conservation Value" (Appendix 3, Map 2).

The marine ecological values area summarised as follows:

- Low to medium diversity and abundance of macroinvertebrates in intertidal and subtidal samples;
- The most abundant macroinvertebrate group present was polychaete worms;
- There was nothing remarkable about the benthic flora or the structure or complexity of the habitats themselves;
- The sediment grain size reflected the high energy hydrodynamic environment;
- Zinc, lead and PAHs were detected above threshold concentrations at some sites.

3.11 Intertidal and Sub-tidal Values

There is no standard evaluation protocol or national guidance to "Value" intertidal or subtidal systems. To enable us to interpret the results we have looked at the coastal environment under the following criteria:

- Habitat (intertidal and subtidal)
- Species (intertidal and subtidal)
- Condition/Degree of Modification (intertidal and subtidal)

To assess the marine ecological value we have developed a matrix to enable us to estimate value from Low to Very High. If there is an absence of data, then we can also specify (Table 11).

Table 11: Assessment of Marine Ecological Value

Assessment of marine ecological value										
	Intertidal					Subtidal				
	Low	Medium	High	Very High	No Data	Low	Medium	High	Very High	No Data
HABITAT										
Important habitat for rare or threatened species for at least part of their life cycle (e.g. foraging, breeding, spawning, migration routes etc.)			√			√				
High habitat diversity (including natural sequences and ecotones), important species (e.g. biogenic habitat forming species), connectivity between different habitat types		√					√			
Quantity of habitat - NZ wide, biographical region, area of interest, site etc.	√					√				
SPECIES										
A population of rare or threatened species present (NZ DOC Threat Classification Lists)	√					√				
Species diversity (broken down into invertebrates, fish, birds, plants, mammals). Diversity indices can be used as a measure where appropriate e.g. Shannon-Wiener for invertebrates	√						√			
Absence of exotic/introduced invasive species				√					√	
CONDITION / DEGREE OF MODIFICATION										
Degree of modification to coastal processes and physical environmental factors	√						√			
Water quality – contaminants, physic-chemical characteristics etc.		√					√			
Sediment quality - contaminants, grain size, anoxia etc.			√					√		
Degree of sedimentation			√					√		
Degree of current modification e.g. reclamation, structures	√						√			
Sum of classes	5	2	3	1		4	4	2	1	
Result	Low					Medium				

3.11.1 Habitat

The marine environment along the Wellington to Hutt Valley foreshore is highly modified by reclamation and stormwater discharge points. In addition, debris is present along the shore. Option 2 of the proposed project impinges on an intertidal man-made rocky shore (primarily comprising rock rip rap) and intertidal and subtidal soft (gravel) shore. The habitat types present provide for both sessile species (on the rocks and firmer bed) and mobile species. The subtidal habitats are less modified than the intertidal foreshore and also support a higher diversity of species and habitat types.

The intertidal area provides seasonal breeding habitat for at least one, and possibly two "*At Risk*" avifauna species (see avifauna assessment above).

At a regional scale, these habitat types are well represent in Wellington, in an unmodified form, with particularly good examples nationally protected e.g. Red Rocks and Sinclair Head Scientific Reserves and Taputeranga Marine Reserve.

3.11.2 Species

There were no rare or special marine species detected during the survey, although the subtidal habitats had greater species richness than the intertidal sites. The species requiring most consideration for this project are the "At Risk" avifauna which utilise the intertidal area and rocky shore seasonally. The degree to which these species are affected will depend on the timing and extent of the works. We note that these species are not limited to this area of the coast.

We correspondingly assessed this parameter as "low" subtidal, low intertidal outside of the breeding season and "medium" (based on the presence of two "At Risk" coastal bird species) during the breeding season.

3.11.3 Condition / Modification

As stated previously, the intertidal habitat is a highly modified environment, with the shoreline mostly constructed of concrete rubble and similar materials. The subtidal habitat is less modified. These areas are subject to stormwater from the state highway and Horokiwi quarry, which introduce sediment and/or contaminants to the coast during rainfall events. However, wave action generally prevents sediment build up or contaminant accumulation at the immediate coast line.

We have assessed this section as of "medium-high" value for the subtidal and "low-medium" value for the intertidal area.

3.11.4 Over all values

The assessment of effects treats each wider habitat as a whole and we have complied the values of the intertidal and subtidal areas into single value for each habitat based on numerical dominance i.e. low ecological values in the intertidal habitat and medium ecological values in the subtidal habitat (Table 10).

4.0 Summary of Ecological Values

Assessment of ecological significance is a necessary test under the Resource Management Act 1991. For this assessment, ecological values / significance have been assigned to individual species as well as features / habitat.

4.1 Terrestrial Values – Either Route Option

In terms of terrestrial vegetation, no feature, site of as a whole was assessed as being significant. There were no species recorded which are "At Risk", or "threatened" or registered as of Regional importance.

Following the "values" allocation set out above, no feature or site ranked greater than a "**Low** value".

4.2 Avifauna Values – Route Option 1 and / or 2

Whilst this is an extensively modified coastal environment, the rocky outcrops (natural and constructed shore/zone) are used by a number of coastal birds, mainly gulls, shags and variable oystercatcher. Of the 19 birds recorded within the eBird data, three are classified as Threatened and six as At Risk species (Robertson et al, 2013). The conservation status of these birds, and the confirmed breeding there of at least one *At Risk* species (variable oystercatcher), translates to this area having a "**high**" ecological value <u>when occupied or used by these birds</u>. However, during the non-breeding season when these birds are not dependent on the area (and similar feeding and roosting habitat is available elsewhere in the harbour), the ecological value would be adjusted to **medium**.

4.3 Marine Values – Route Option 1 and / or 2

Over all we rank the intertidal marine ecological values as **low** and subtidal marine ecological values as **medium.** However, we recognise that the intertidal area, when "*At Risk*" coastal birds are breeding at this site, has high values. In addition, in terms of condition, while parts of the intertidal habitat are a man-made, it remains in relatively good condition. Ecological value however, is less governed by condition than by the species present and the diversity of species and habitats. Condition is a measure of function and sustainability and while that adds to the overall ecological value we consider that it is of secondary importance.

5.0 Assessment of Effects on the Existing Environment

The potential direct and indirect adverse ecological effects associated with the proposal have been considered in this assessment involve the following.

Option 1 and Option 2:

- Clearance or disturbance of vegetation

- Loss of habitat for Threatened and At Risk avifauna
- Loss of marine habitat (rocky intertidal shore and subtidal zone) and loss of macroinvertebrates which currently occupy these zones
- Disturbance to wildlife (noise and displacement construction operational)
- Construction phase earthworks sediment discharge
- Operational phase stormwater discharge

The following matrices (from Regini 2002 and developed by Boffa Miskell through the Transmission Gully evaluation phase for consenting) have been used to determine the level of ecological effect associated with the WaCP proposal. This significance of effect Table 13 was determined by considering the magnitude of the ecological effect (Table 12) in association with the ecological values. For ease of reading of the assessment of the level of significance of the potential adverse effect, Table 14 presents a summary following the text in section 5.2.

Table 12: Effects Magnitude Decision Matrix (modified from Regini (2002))

Magnitude	Description
Very High	Total loss or very major alteration to key elements/features of the baseline conditions such that the post development character/composition/attributes will be fundamentally changed and may be lost from the site altogether
High	Major loss or major alteration to key elements/features of the baseline (pre development) conditions such that post development character/ composition/ attributes will be fundamentally changed.
Medium	Loss or alteration to one or more key elements/features of the baseline condition such that post development character/composition/attributes of baseline will be partially changed.
Low	Minor shift away from baseline conditions. Change arising from the loss/ alteration will be discernible buy underlying character/composition/attributes of the baseline condition will be similar to pre-development circumstances/ patterns.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the “no change” situation.

Table 13: Significance of Effect Matrix (modified from Regini (2002)).

Magnitude		ECOLOGICAL / CONSERVATION VALUE			
		Very High	High	Medium	Low
	Very High	Very High	Very High	Medium	Low
	High	Very High	Very High	Medium	Low
	Medium	Very High	High	Low	Very Low
	Low	Medium	Medium	Low	Very Low
	Negligible	Low	Low	Very Low	Very Low

5.1 Option 1 – between the transport corridors

Terrestrial vegetation and habitat. We assessed the whole area and each feature as having low value (with low indigenous representation, low intactness, high weed dominance and no “*At Risk*” or “Threatened Species”).

The potential adverse effect of construction works, we believe to be likely to have a high magnitude of effect, but we also acknowledge that there is likely to be the potential to avoid or remedy some of those effects to existing amenity and planted areas.

A **low value** and **high effect** results in a **low level of significance** of the adverse effect.

Avian Bird species that use the wider site are limited to exotic "urban" species. The Little Penguin and variable oyster catchers which utilise seasonally the foreshore do not use the Option 1 area *between the transport corridors). Here in the terrestrial section of Option 1 there is negligible value and negligible impact and the effect is for all intense purposes zero.

There is only a very minor marine aspect of Option 1. We understand this to be a small northern area of reclamation perhaps 2-3m into the inter-tidal zone. As will be discussed below, this zone is valued: **Low** while the magnitude of effect will be **Low** giving a significance rating of the effect of **very low**.

5.2 Option 2 – coastal side of rail corridor

This option will include the reclamation of up to 30m (extent as yet determined) of intertidal and sub-tidal sea bed as well as the rocky foreshore and disturbance to the coastal terrestrial vegetation.

Terrestrial vegetation and habitat, while marginally better on the western side of the rail is still (for similar reasons) assessed as being **low**. The construction works, as with Option 1, may avoid or affect only parts of the indigenous vegetation, but we assess the likelihood of the magnitude of effect as being **high**. This again results in a **low significance** of adverse effect.

To the **avian** species that utilise the rocky foreshore during breeding season (Little penguin and oyster catchers and potentially others) the value is **High** (in the breeding season) while the magnitude of effect would be **Very High**, causing the significance of adverse effect to be **Very High** (in the breeding season).

Outside of the breeding season the value to the **avian** taxa is **Low** and the effects **Very High** making the significance of the effect **Low** (but temporary).

The **intertidal marine** habitat has a **low** overall ecological value (coastal birds aside) and the effect of reclamation to this area will be initially be **Very High** (we assume complete burial by new infill material). The significance of that level of effect on those values will be **Low** (this assumes such works will be carried out outside of the breeding season of the noted bird species).

There is a secondary effect in that expansion of land out 30m into the harbour will remove the narrow intertidal sand flat habitat, replacing it with a more expansive rocky "vertical" substrate.

For the **marine subtidal** areas, the values are the **Medium** and combined with an effect magnitude of **Very High** results in an adverse effect of **Medium** significance.

The permanent habitat loss in the marine subtidal environment will require mitigation. Generally low level effects, those of low or below significance, do not require particular mitigation or offsetting. Some remedial actions however, are appropriate and return of forms of habitat affected will occur.

In the case of the "*At Risk*" coastal birds, which if affected during the breeding season, would constitute a High significance of effect, there should be a requirement to avoid such effects and to ensure that the project also does not remove the opportunity for these birds to continue to breed in the area post-construction.

5.2.1 Level of Effects Summary Table

Table 14: Summary Table of the Significance of potential adverse effects.

Option	Zone	Value	Magnitude of effect (without mitigation)	Level of significance of adverse effect
1	terrestrial	Low	High	Low
	Avian	Low	High	Low
	Intertidal	Low	Low	Very Low
2	Terrestrial	Low	High	Low
	Avian	Seasonally High / else Low	Very High	Very High (if at breeding) / else Low
	Intertidal	Low	Very High	Low
	Sub tidal	Moderate / Medium	Very High	Medium

In terms of the RMA; those adverse effects which have a “significance” of more than low (i.e. medium and above) are effects considered to be “more than minor”. Effects low and below are those deemed to be “less than minor”. Effects that are less than minor are those typically not considered to require ecological mitigation.

6.0 Avoidance, Remedy and Mitigation

6.1 Option 1 – between the transport corridors

In terms of ecological adverse effect, Option 1 is the least adverse option for the ecology in that it results in very little direct disturbance to the inter-tidal rocky foreshore habitats and no effect to the sub-tidal zone. Its affects to the terrestrial habitat are very low (near negligible) and any works here would have no real effect on the local ecology (i.e. “less than minor”).

6.2 Option 2 – coastal side of rail corridor

While the ecological adverse effects relating to Option 2 are greater than Option 1, the effects are not so significant and adverse that “avoidance” of the effects (other than to nesting coastal birds) of reclamation should be considered as required or even preferred. Considerable gains can be had to the local ecology in undertaking Option 2.

The adverse effects of Option 2, being largely reclamation (and minor terrestrial vegetation removal) would have a range of temporary adverse effects. We state this on the understanding that the values today are a product of historic reclamation and creation of the hard rocky foreshore.

The proposed works could result in the same or similar rocky foreshore, however, the small areas of intertidal (daily exposed) substrate for much of the length (although not in the southern section) of the project would be lost. This area we have determined as having no "key" resource value and to be of relatively simple and of limited species occupation. It would be replaced by a rocky (hard) reclamation edge and could equally provide creviced permanent hard substrate for the same range of rocky shore species currently present but in a bigger expanse (more habitat). The species found at the intertidal zone now would remain represented in the subtidal habitat that would persist outside of the reclamation.

The permanent loss of subtidal habitat due to the construction of the reclamation is an adverse effect of medium significance that requires mitigation or an offset. Given the nature of the reclamation up to 30m of subtidal area will become land, there is no method with which to reduce or minimise the effect and no method with which to mitigate in a like for like manor the effect. While the loss has been recognised here as a medium significant effect it must be kept in context as a very small part of a much wider habitat and resource and the loss has no material bearing on the local subtidal ecology. That said we consider an offset in the form of betterment of the resultant foreshore an opportunity that should be undertaken. This (in keeping with suggestions above) would see areas of the foreshore revegetated in native local coastal species in extent and composition that mimic a natural condition and while also being amenity return a flavour of the historic rocky foreshore vegetation habitat.

Construction could also potentially have a more than minor impact on breeding coastal birds. Construction, in the absence of consideration of these birds, could disturb and/or destroy nests, eggs and chicks. It is unlikely to affect adults other than their displacement and stress of losing nests. However, those adverse effects are largely avoidable.

While we have stated before that the adverse effects relate to construction in the breeding season, more accurately it is construction in the breeding season where nesting is occurring. Adverse effects are therefore spatial and temporal. Birds do not nest along the entire foreshore or in great density. There are only a few pairs of a few species breeding seasonally. A pre-construction survey (under taken by a suitably qualified ornithologist) will identify and locate the nesting pairs (typically starting between August and October). Once located those specific areas should be cordoned off and works avoid those particular locations until the nesting and fledging of young has been completed (again confirmed by the ornithologist). This may only mean several specific sites (survey dependent) cannot be constructed generally between August and February (inclusive). In this way, the potentially more than minor adverse effects can be avoided.

Where reclamation was to occur an important aspect for remedy of the ecological adverse effect would be the new foreshore rocky construction material used and the structure of its placement and final form. In essence the values today (though low) are in the various non-uniform natural rock edges creating a large surface area with many cervices or varying size, frequently inundated, but also crevices and spaces between hard substrate which is above high tide in which little penguin create their nests seasonally.

The foreshore edge development needs to also consider areas that have limited public access close to the edge and appropriately vegetated where oyster catches (and little penguins) can rise above the rocky shore to also nest. Flax clusters may be ideal for such activities. The cycle path could therefore veer away from the rock edge from time to time to create these more isolated edges and revegetation could focus on sheltering native species suitable to assist nesting.

Where the rocky shore edge is constructed from appropriate materials and of a form that mimics a rocky coastal shore and with suitable revegetation on at least the foreshore, the, at most low-to medium, adverse ecological effects can be remedied, in time.

There is every opportunity here to develop a set of habitats and values of much greater value than those of the current. This is especially so in terms of the terrestrial vegetation.

7.0 Conclusion and Recommendations

Construction and operation of the project in the Option 1 location, between the transport corridors, has negligible ecological effects and does not require avoidance, remedy or mitigation for those adverse effects.

In consideration of Option 2, expansion into the coastal marine area, the terrestrial and intertidal marine values present are low and of a common, modified and ubiquitous nature. However, the values in the subtidal habitat are medium and the effect of loss a medium significant effect ("more than minor"). Permanent loss of subtidal habitat requires mitigation or an offset.

There are also a number of "at risk" coastal birds present and using the habitat; mostly for roosting, with at least one species breeding. When these birds are present values are higher and effects of construction or improper rocky shore construction (i.e. a vertical smooth sea wall) could be (in the absence of processes to avoid effects) "more than minor".

7.1 We recommend:

- Avoid effects on breeding coastal birds by: carrying out a pre-construction survey searching for birds breeding within the construction area, cordoning off any breeding areas and construction stopped until birds fledged, or work outside the breeding season (i.e. non-breeding period generally March-July);
- Ensure the re-creation of a rocky edge and fore shore with natural materials suitable for the sessile and mobile marine species present, and which enable nesting of the coastal breeding species generally present (i.e. rock crevices above high tide);
- Revegetation the foreshore in areas for coasting bird breeding shelter but which also reflect the natural indigenous vegetation of the Wellington Coast (use robust coastal species such as ngaio, taupata, harakeke, pohuehue and native sea spinach);
- Move the cycle and pedestrian path around some of these vegetation areas to reduce interaction with potential breeding sites;
- Develop "mitigation" to offset the permanent habitat loss in the subtidal marine environment. We suggest the most practical way is to ensure areas of the new foreshore and rocky edges are appropriately revegetated with native coastal species in quantities that at least mimic natural vegetation sequences and which can provide coastal breeding bird refugia.

8.0 References

ANZECC (2000) Interim Sediment Quality Guideline (ISQG) High contaminant threshold concentrations or Auckland Regional Council's Environmental Response Criteria Red contaminant threshold concentrations (Auckland Regional Council, 2004).

De Lange, P. J., J. R. Rolfe, P. D. Champion, S. P. Courtney, P. B. Heenan, J. W. Barkla, E. K. Cameron, D. A. Norton, and R. A. Hitchmough. (2013). *Conservation Status of New Zealand Indigenous Vascular Plants, 2012*. New Zealand Threat Classification Series. Wellington: Department of Conservation, August 2013.

Greater Wellington Regional Council. *Regional Policy Statement for the Wellington Region*. Wellington: Greater Wellington Regional Council, April 2013

LINZ, 2014. Tide Table, 2014. http://www.linz.govt.nz/docs/hydro/tidal-info/tide-tables/maj-ports/pdf/Wellington%20 2014.pdf

McEwen (1987). Ewen, W. M. (1987). *New Zealand Biological Resources Centre Publication Number 5 sheet 3.* New Zealand: Ecological Regions and Districts of New Zealand. Department of Conservation.

Regini, K. (2002). *Guidelines for ecological impact assessment: Amended pilot*. Institute of Ecology and Environmental Management (IEEM).

Robertson, H.A. (1992). Trends in the numbers and distribution of coastal birds in Wellington Harbour. *Notornis 39: 263-289.*

Robertson, C. J. R., Hyvonen, P., Fraser, M. J., & Pickard, C. J. (2007). *Atlas of bird distribution in New Zealand: 1999-2004*. Wellington: Ornithological Society of New Zealand.

Robertson, H.A.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; O'Donnell, C.J.F.; Powlesland, R.G.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2013: Conservation status of New Zealand birds, 2012. *New Zealand Threat Classification Series 4.* Department of Conservation, Wellington. 22 p

Rowden, A.A.; Berkenbuisch, K.; Brewin, P.E.; Dalen, J.; Neill, K.F.; Nelson, W.A.; Oliver, M.D.; Probert, P.K.; Schwarz, A-M.; Sui, P.H.; Sutherland, D. (2012) A review of the marine soft-sediment assemblages of New Zealand. *NZ Aquatic Environment and Biodiversity Report No. 96.* 165 p

Snelgrove, P.V.R. (1998). The biodiversity of macrofaunal organisms in marine sediments. *Biodiversity and Conservation 7*: 1123–1132.

Appendix 1: Site Photos

Photo 1 Variable Oystercatcher observed near nest

Photo 2 Oystercatcher egg under flax

Photo 3 Potential Little Blue Penguin

Photo 4: example of typical coastal edge vegetation and rubble

Photo 5: Historic reclamation rubble edge (near central).

Photo 6: Southern end intertidal beach

Photo 7: Rock stack in sub-tidal edge

Photo 8: North end amenity planting between corridors

Photo 9: Typical between corridor condition of vegetation / habitat

Photo 10: Between corridors, planted walkway section.

Appendix 2: Terrestrial Vegetation List

Option 1 - Between transport corridors			
Scientific	Common	Status	Habit
Brassica rapa	Wild turnip	exotic	herb
Senecio skirrhodon	Gravel groundsel	exotic	herb
Anagallis arvensis	Pimpernel	exotic	herb
Plantago lanceolata	Narrow leaved plantain	exotic	herb
Plantago coronopus	Buck's horn plantain	exotic	herb
Phormium cookianum	Mountain flax	not threatened	monocot
Cymbalaria muralis	Ivy-leaved toadflax	exotic	herb
Mulenbeckia complexa	Scrub pohuehue	not threatened	shrub
Asplenium oblonifolium	Shining spleenwort	not threatened	fern
Coprosma repens	Taupata	not threatened	shrub
Allium triquetrum	Onion weed	exotic	herb
Aphanes inexspectata	Piert parsley	exotic	herb
Arctotheca calendula	Cape weed	exotic	herb
Calystegia soldanella	Shore convolvulus	not threatened	scrambling subshrub
Poa cita	Silver tussock	not threatened	grass
Circium vulgare	Scotch thistle	exotic	herb
Crepis capillaris	Hawksbeard	exotic	herb
Cytisus scoparius	Broom	exotic	shrub
Dactylis glomerata	Cocksfoot	exotic	grass
Holcus lanatus	Yorkshire fog	exotic	grass
Ehrharta erecta	Veldt grass	exotic	grass
Euphorbia peplus	Milkweed	exotic	herb
Epilobium spp.	-		herb
Galium propinquum	Cleavers	exotic	herb
Ulex europaeus	Gorse	exotic	herb
Solanum nigrum	Black nightshade	exotic	herb
Rumex obtusifolius	Broad-leaved dock	exotic	herb
Trifolium repens	White clover	exotic	herb
Conyza sumatrensis	Broad-leaved fleabane	exotic	herb
Sonchus asper	Prickly sow thistle	exotic	herb
Geranium molle	Doves foot cranesbill	exotic	herb
Hebe stricta	Koromiko	not threatened	shrub

Option 1 - Between transport corridors			
Scientific	**Common**	**Status**	**Habit**
Lupinus arboreus	Tree lupin	exotic	shrub
Microsorum pustulatum	Hounds tongue fern	not threatened	fern
Briza maxima	Large quaking grass	exotic	grass
Cyperus eragrostis	Umbrella sedge	exotic	sedge
Clematis forsteri	Forster's clematis	not threatened	climber
Agapanthus praecox subsp. orientalis	Agapanthus	exotic	monocot herbs
Rytidosperma unarede	Bristle grass	not threatened	grass
Pyrrosia eleagnifolia	Leather leaf fern	not threatened	fern
Juniperus spp	Conifer	exotic	shrub
Polystichum vestitum	Prickly shield fern	not threatened	fern
Trifolium dubium	Suckling clover	exotic	herb
Cortaderia selloana	Pampas	exotic	grass
Ozothamnus leptophyllus	Tauhinu	not threatened	shrub
Clematis vitalba	Old man's beard	exotic	climber
Atriplex prostrata	Orache	exotic	herb
Malva dendromorpha	Tree mallow	exotic	herb

Planting near Kaiwharawhara overpass			
Scientific	**Common**	**Status**	**Habit**
Phormium cookianum	Mountain flax	not threatened	monocotyledonous herb
Pittosporum crassifolium	Karo	native invasive	tree
Muelhenbeckia complexa	Scrub pohuehue	not threatened	shrub
Coprosma repens	Taupata	not threatened	shrub
Cytisus scoparius	Broom	exotic	shrub
Metrosideous excelcum	Pohutukawa	native invasive	tree
Psedopanex arboreous	Five finger	not threatened	tree
Leptospermum scoparium	Manuka	not threatened	shrub
Oleria tenuafolium	Tree daisy	not threatened	shrub
Cordyline australis	Ti kouka	not threatened	monocotyledonous tree

Option 2 - Between Rail and Coast			
Scientific	Common	Status	Habit
Brassica rapa	Wild turnip	exotic	herb
Senecio skirrhodon	Gravel groundsel	exotic	herb
Anagallis arvensis	Pimpernel	exotic	herb
Plantago lanceolata	Narrow leaved plantain	exotic	herb
Plantago coronopus	Buck's horn plantain	exotic	herb
Phormium cookianum	Mountain flax	not threatened	monocot
Pseudognaphalium luteoalbum	-	not threatened	herb
Cymbalaria muralis	Ivy-leaved toadflax	exotic	herb
Mulenbeckia complexa	Scrub pohuehue	not threatened	shrub
Asplenium oblonifolium	Shining spleenwort	not threatened	fern
Coprosma repens	Taupata	not threatened	shrub
Aphanes inexspectata	Piert parsley	exotic	herb
Arctotheca calendula	Cape weed	exotic	herb
Calystegia soldanella	Shore convolvulus	not threatened	scrambling subshrub
Circium vulgare	Scotch thistle	not threatened	herb
Crepis capillaris	Hawksbeard	exotic	herb
Cytisus scoparius	Broom	exotic	shrub
Dactylis glomerata	Cocksfoot	exotic	grass
Holcus lanatus	Yorkshire fog	exotic	grass
Ehrharta erecta	Veldt grass	exotic	grass
Euphorbia peplus	Milkweed	exotic	herb
Epilobium spp.	-		herb
Gamochaeta purpurea	Cudweed	exotic	herb
Galium propinquum	Cleavers	exotic	herb
Ulex europaeus	Gorse	exotic	herb
Tetragoinia implexicoma	Native spinach	not threatened	scrambling subshrub
Solanum nigrum	Black nightshade	exotic	herb
Rumex obtusifolius	Broad-leaved dock	exotic	herb
Trifolium repens	White clover	exotic	herb
Conyza sumatrensis	Broad-leaved fleabane	exotic	herb
Sonchus asper	Prickly sow thistle	exotic	herb
Geranium molle	Doves foot cranesbill	exotic	herb
lupinus arboreus	Tree lupin	exotic	shrub
Cyperus eragrostis	Umbrella sedge	exotic	sedge
Atriplex prostrata	Orache	exotic	herb
Malva dendromorpha	Tree mallow	exotic	herb

Appendix 3: Marine Survey Photos & Physical Habitat Description

Site Name and Description

Intertidal - Site G 2014

- Large and diverse sediment size – Sand/ gravels and cobbles with occasional boulders
- No crab holes
- No epifauna

Intertidal - Site F 2014

- Surficial sediment compact and firm – course sand with occasional cobbles
- No crab holes
- No epifauna

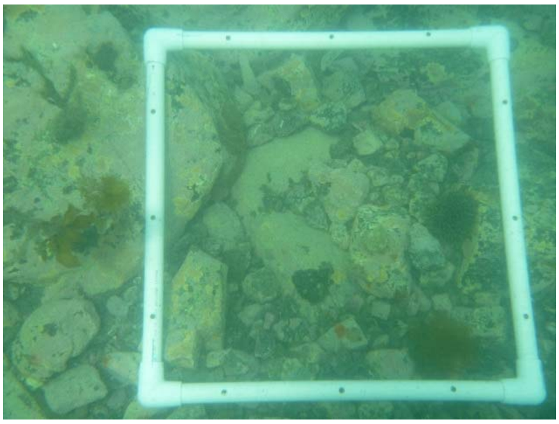
Subtidal – Site H 15m 2014

- Course sand and gravel substrate.
- Occasional *Perna canalicula* (green lipped mussel)
- Depth 2.8m
- Algal cover 30-45% - equal and patchy comprising of *Codium sp.*, *Macrocystis pyrifera*
- Occasional triplefin.

Site Name and Description

Subtidal – Site H 30m 2014

- Sand and gravel substrate
- Depth – 6.6m deep - 30 degree slope
- Occasional *Ulva* and filamentous algae and hydroids
- Occasional triplefin.
- Abundant tube worms



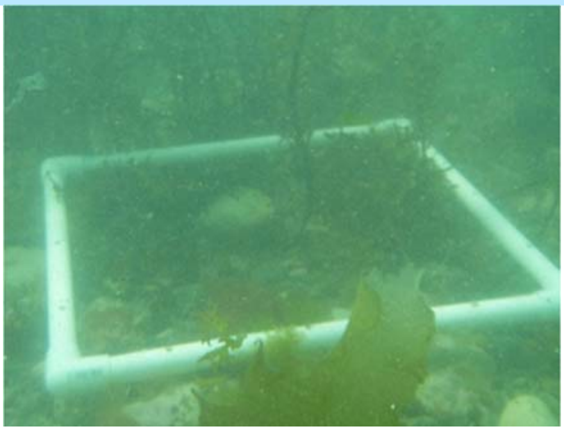
Subtidal – Site G 15m 2014

- Cobble/boulder substrate
- Occasional mussels
- Depth 1.6m
- Algal cover – *Carpophyllum* sp. and *Macrocystis* sp.
- Fish diversity noted to be increasing with increasing distance from shore

Subtidal – Site G 30m 2014

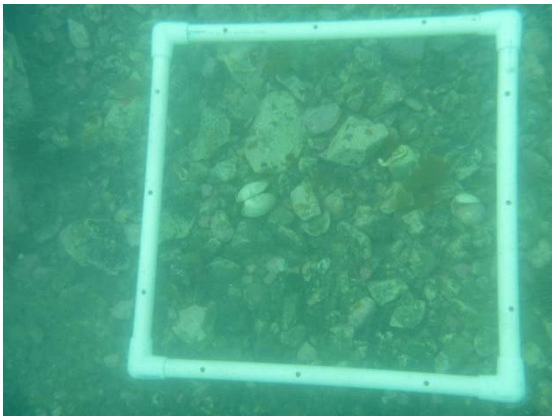
- Cobble substrate with occasional boulder
- Depth – 3m
- Occasional *Ulva* and filamentous algae
- Occasional triplefin and blue cod
- Macroinvertebrates include: *Turbo smaragdus* (cats eye), *Coscinasterias muricata* (11 arm starfish), sea squirt, tube worm.

Site Name and Description



Subtidal – Site F 15m 2014

- Foreshore rock boulders – Boulder (0.5 m average) with cobble substrate
- Depth 1.6m
- Algae Cover - 40% - mixed *Carpophyllum* sp., *Macrocystis* sp., *Undaria pinnatifida*, and *Ulva* (5-10%)



Subtidal – Site F 30m 2014

- Mixed cobble, boulder, sand substrate
- Depth – 2.6m
- 30% *Carpophyllum* sp. dominant
- Occasional triplefin and blue cod
- Macroinvertebrates include: *Turbo smaragdus* (cats eyes), and whelks.
- *P. canalicula* (green lipped mussel) present on boulders

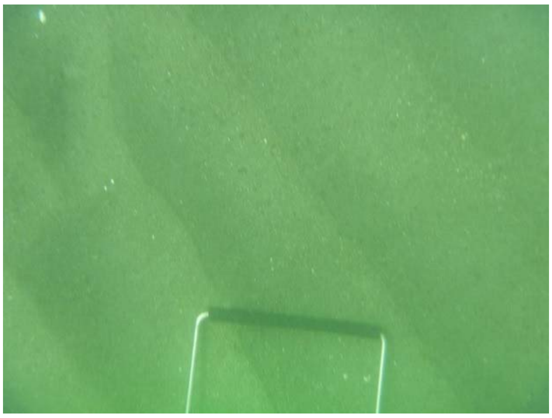
Subtidal – Site C 15m 2014

- Sand and cobble substrate with and boulders
- Depth 1.6m
- Algae cover – 70% *Carpophyllum* sp., (5-10%), red filamentous algae

Site Name and Description

Subtidal – Site C 30m 2014

- Sandy substrate with boulders
- Depth – 2.6m
- Algal cover 85% - 70% *Carpophyllum* sp., 10% Ulva and red filamentous algae present
- Abundant *P. canalicula* (green lipped mussel) present on boulders



Subtidal – Site E 15m 2014

- Sand and occasional small cobble
- Depth – 1.5m
- No algae
- Occasional *Patiriella regularis* (cushion star) observed
- Large sting ray observed

Subtidal – Site E 15m 2014

- Substrate sand with mixed size boulders 30–50cm diameter
- Depth – 2.8m
- Algal cover 85% - 70% *Carpophyllum* sp., 10% *Ulva* and red filamentous algae
- Abundant *P. canalicula* (green lipped mussel) present on boulders

Site Name and Description

Subtidal – Site A 15m 2014

- Substrate small cobble – 6-7cm diameter
- Depth – 1 m
- Algae – occasional – green turf
- Abundant Austrovenus stutchburyi (cockle)
- Limited visibility c. 0.5m

No Image taken as visibility limited

Subtidal – Site A 30m 2014

- Substrate sand with sparse cobbles and boulders
- Depth – 1 m
- Algae – *Ulva* 15% -20%, red spindly, filamentous, 20%, green turf algae 20%,
- Abundant *P. canalicula* (green lipped mussel) present on boulders

Appendix 4: Invertebrates detected in soft sediment core samples

			Intertidal		Subtidal					
		Distance from shore	**0 m**	**0 m**	**15 m**	**15 m**	**15 m**	**30 m**	**30 m**	**30 m**
		Site Name	**G**	**F**	**H**	**G**	**F**	**H**	**G**	**F**
General Group	**Taxa**	**Common Name**								
Anthozoa	*Edwardsia sp.*	Burrowing anemone			3		1	10		
Nemertea	*Nemertea*	Proboscis worms							3	1
Polyplacophora	*Chiton glaucus*	Green Chiton					2			1
Polyplacophora	*Ischnochiton maorianus*	Variable Chiton- Active Chiton				15	4		2	1
Polyplacophora	*Leptochiton inquinatus*	Chiton								3
Gastropoda	*Gastropoda (micro snails)*	Unidentified gastropod				2				
Gastropoda	*Buccinulum vittatum*								1	
Gastropoda	*Caecum digitulum*		1		5		1			
Gastropoda	*Diloma arida*							1		
Gastropoda	*Micrelenchus sp.*					2				1
Gastropoda	*Notoacmea sp.*	Limpet					5			
Gastropoda	*Turbo smaragdus*	Cat's Eye (Ataata)		1		2				
Gastropoda	*Turbonilla sp.*	Small spiral shell						1		
Bivalvia	*Corbula zelandica*							2	7	2
Bivalvia	*Gari stangeri*				3			1		
Bivalvia	*Leptomya retiaria retiaria*				2					
Bivalvia	*Melliteryx parva*				1				1	1
Bivalvia	*Nucula hartvigiana*	Nut Shell					1		4	1
Bivalvia	*Ruditapes largillierti*	Thick lipped biscuit shell			2	1	1	8	1	
Bivalvia	*Scintillona zelandica*				4	1				
Bivalvia	*Tawera spissa*	Morning Star					1	5	3	1
Bivalvia	*Tellinota edgari*	Wedge shell				1			2	1
Bivalvia	*Varinucula gallinacea*								1	
Oligochaeta	*Oligochaeta*	Oligochaete worms	1							
Polychaeta: Spionidae	*Aonides trifida*					4	5			
Polychaeta: Spionidae	*Boccardia sp.*	Polychaete worm							2	
Polychaeta: Spionidae	*Prionospio sp.*	Polychaete worm			1					
Polychaeta: Spionidae	*Scolecolepides benhami*				1					
Polychaeta: Spionidae	*Spio sp.*								1	
Polychaeta: Capitellidae	*Barantolla lepte*				33	11	34	28	5	13
Polychaeta: Capitellidae	*Notomastus zeylanicus*				2					1
Polychaeta: Opheliidae	*Armandia maculata*	Polychaete worm			1	1				
Polychaeta: Phyllodocidae	*Phyllodocidae*	Paddle worms				1		1	1	
Polychaeta: Polynoidae	*Polynoidae*	Scale worms						1		

			Intertidal		Subtidal					
		Distance from shore	0 m	0 m	15 m	15 m	15 m	30 m	30 m	30 m
		Site Name	G	F	H	G	F	H	G	F
General Group	**Taxa**	**Common Name**								
Polychaeta: Hesionidae	*Hesionidae*	Polychaete Worm			2			1	1	1
Polychaeta: Syllidae	*Syllidae*	Polychaete worm			2	9	1	5	13	6
Polychaeta: Syllidae	*Sphaerosyllis sp.*	Polychaete worm			1	3	1	6	11	1
Polychaeta: Nereidae	*Nereidae* (juvenile)	Rag worms	1				4		1	1
Polychaeta: Nereidae	*Platynereis australis*						1			
Polychaeta: Glyceridae	*Glyceridae*	Polychaete worm	5	1	3		1	1		17
Polychaeta: Lumbrineridae	*Lumbrineridae*	Polychaete worm	1					8	6	9
Polychaeta: Dorvilleidae	*Dorvilleidae*	Polychaete worm			3	23	2	12	17	7
Polychaeta: Oweniidae	*Owenia petersenae*	Polychaete				9	16	17	9	5
Polychaeta: Cirratulidae	*Cirratulidae*	Polychaete worm				1	1		3	
Polychaeta: Terebellidae	*Terebellidae*	Polychaete worm	1			2			7	
Polychaeta: Sabellidae	*Sabellidae*	Umbrella worms						2		
Polychaeta: Sabellidae	*Euchone pallida*	Fan worm						10	7	1
Polychaeta: Spirorbinae	*Spirorbidae*	Polychaete spiral tube				256	50		51	37
Isopoda	*Anthuridea*	Isopod							1	
Isopoda	*Eurylana cookii*		1							
Amphipoda	*Corophiidae*	Amphipod (family)						1		
Amphipoda	*Lysianassidae*	Amphipod (family)			2		2			2
Amphipoda	*Phoxocephalidae*	Amphipod (family)						2		
Amphipoda	*Amphipoda Unid.*	Amphipod	3	2	1	2	7	11	4	2
Decapoda	*Liocarcinus corrugatus*				1					
Decapoda	*Plagusia sp.*	Crab					1			
Ostracoda	*Diasterope grisea*	Ostracod			5		1			1
Ostracoda	*Neonesidea sp.*	Ostracod							1	
Cirripedia	*Austrominius modestus*	Estuarine Barnacle					1			
Phoronida	*Phoronus sp.*	Horseshoe worms							3	
Bryozoa	*Bryozoa (encrusting)*				1	4	2	1	8	
Echinoidea	*Evechinus chloroticus (spat)*	Common Sea Urchin (Kina)					1			
Asteroidea	*Patiriella regularis*	Cushion Star					1		2	4
Ophiuroidea	*Ophiuroidea*	Brittle stars				1			7	1
Holothuroidea	*Trochodota dendyi*	Sea cucumber			1	2	1	4	2	1