23 Marine ecology

Overview

The Project does not involve any direct effects on marine ecological values, as the proposed Expressway alignment occurs at some distance from marine environments. However, potential indirect effects may occur as a result of sediment and contaminant release during construction and through stormwater runoff during operation, to streams and rivers that discharge to the marine environment.

There are three marine receiving environments with the potential to be adversely affected by the Project. These are the:

- Wharemauku Stream Mouth;
- Waikanae Estuary; and
- Waimeha Stream Mouth.

The mouths of the Wharemauku and Waimeha Streams are dynamic, high energy environments on the open coast. In contrast, the Waikanae Estuary is sheltered, calm and influenced by freshwater. All three marine habitats are considered to have high ecological values (as described within Technical Report 26, Volume 3).

Construction of the Project will result in increased levels of sediment entering the marine environment via streams, with potential impacts on habitats, vegetation and species reliant on these waterbodies. However, the predicted increase of discharge into the marine environment during construction is considered to be negligible (i.e. not able to be measured) above levels of discharge that are currently occurring. A comprehensive CEMP, contained in Volume 4, is proposed to be implemented which will minimise risks associated with potential spills of contaminants or the release of contaminants by disturbing contaminated soils. As a result, the risks of contaminant discharges associated with the construction of the Project on marine environmental values can be avoided, or managed so that effects are negligible. Overall, the effects of Project construction on marine ecological values will be negligible.

Once the Project is in operation, and the proposed Expressway is in use, treated stormwater runoff will discharge to the marine environment via streams or the Waikane River. When modelled against the current situation, the only catchments to show an increase in contaminant loads are the Wharemauku and Waimeha stream catchments. Due to the high energy receiving environments, however, contaminants will dilute and disperse which makes deposition and accumulation of contaminants highly unlikely. Accordingly, the operational effects of the Project on the marine environment will be negligible.

23.1 Introduction

This Chapter presents the findings of investigations undertaken to determine the potential effects of the proposed Expressway on marine ecology.

Information about marine ecology was obtained from desktop studies and marine ecological field investigations downstream of the proposed Expressway alignment. Once a baseline of marine ecology had been determined (refer to Technical Report 31, Volume 3), the impacts of construction and operation of the Project were assessed (refer to Technical Report 26, Volume 3).

It is noted that the Project ecologists worked closely with the Project design team to avoid adverse ecological effects where practicable. Where avoidance was not practicable, ecological mitigation has been proposed to mitigate those adverse effects.

The following Technical Reports (Volume 3) and Management Plans (Volume 4) have been cross referenced within this Chapter:

- Assessment of Operational Air Quality Effects (Technical Report 13)
- Assessment of Hydrology and Stormwater Effects (Technical Report 22)
- Contaminant Load Assessment (Technical Report 25)
- Ecological Impact Assessment (Technical Report 26)
- Avifauna Studies – Descriptions and Values (Technical Report 29)
- Marine Habitat and Species – Description and Values (Technical Report 31)
- Erosion and Sediment Control Plan (Appendix H of the CEMP)

23.2 Ecological investigations and modelling

The identification of the potential effects of the Project on marine ecology required the assessment of the composition and values of the existing marine ecosystems. This relied on two complementary methods:

- Desktop studies of available and relevant data and information on the ecological values (invertebrates, fish, sediment grain size, sediment quality and water quality) of the estuarine environments downstream of the proposed Expressway alignment were collated from a large number of sources; and

- Field surveys consisting of intertidal[176] surveys of infaunal[177] and epifaunal[178] invertebrates, sediment grain size, sediment quality, depth of oxygenation of sediment and macroalgal[179] cover were undertaken at the mouths of streams that are likely to receive both construction sediment and operational phase stormwater from the proposed Expressway. Because of the size of the Waikanae River estuary, two sites were sampled, one to the North and one to the South.

The description of the existing marine ecology given in this Chapter includes a brief overview of the investigations undertaken. Further details on the sources and methods used and the findings of the field survey investigations are contained in Technical Report 31, Volume 3.

23.3 Existing marine ecosystems characteristics

Three marine receiving environments have been identified as being potentially affected by construction and operational phase discharges to streams/rivers from the Project. These receiving environments are the:

- Wharemauku Stream mouth;
- Waikanae Estuary; and
- Waimeha Stream mouth (which is also the receiving environment for the Ngarara Stream which joins the Waimeha Stream just before it enters to sea at Waikanae Beach).

The Designation overlays or effects negligible portions of the Whareroa Stream catchment (in the northeast corner of Queen Elizabeth Park) and the Hadfield/Kowhai Stream catchment (north of Peka Peka). On this basis, the Whareroa and Hadfield/Kowhai Stream mouths are not considered to be sufficiently at risk of downstream disturbance and further detailed assessments were not considered necessary in these locations.

The physical and biological characteristics of the relevant marine environments are described in this section. Aspects described include:

- Morphology;
- Sediment characteristics;

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[176] 'Intertidal' refers to the area between high and low tide.

[177] 'Infauna' are benthic animals that live in the substrates of the ocean floor, especially in a soft sea bottom. Infauna usually construct tubes or burrows and are commonly found in deeper and subtidal waters. 'Benthic' refers to flora and fauna (benthos) living on the bottom of a body of water (stream or sea).

[178] 'Epifauna' are benthic animals that live on the surface of a substrate, such as rocks, pilings, marine vegetation, or the sea or lake floor itself. Epifauna may attach themselves to such surfaces or range freely over them, as by crawling or swimming.

[179] Macroalgae are large-celled, photosynthetic algae.

- Water quality; and
- Habitat and species.

23.3.1 Wharemauku estuary

The Wharemauku Stream originates behind in the hills east of Raumati and Paraparaumu, and flows through the Paraparaumu town centre discharging into the sea via the open sandy coast of Raumati Beach. The main tributary is Drain 7, a channelised stream that flows through the low lying interdunal areas of Raumati and Raumati South.

Land use within the 1203 ha catchment includes pastoral and residential, with some land remaining in scrub and forest.

The Wharemauku Stream differs from the Waimeha Stream and Waikanae River in that the lower reaches of the stream are modified through channelisation, artificial embankments (wooden walls) and the relatively large proportion of the catchment which is urbanised. These features have constrained and altered the natural path of the stream, impeding the natural migration paths of several fish species.

The Wharemauku Stream mouth is a shallow, small tidal estuary that is approximately 3 to 5m wide. The margins of the stream mouth are highly modified with sea walls and houses located on the foredunes.

23.3.1.1 Sediment characteristics

Surface sediment grain size at the Wharemauku Stream mouth is dominated by fine sand (>70%). Approximately 95-99% of the sediment is within the medium to very fine sand range. The presence of silt and clay is negligible (<2%).

Contaminant concentrations (copper, lead, zinc and HMW PAHs[180]) are significantly below guideline values[181] (refer to Technical Report 31, Volume 3).

23.3.1.2 Water quality

Land use activities and land cover types in the catchment as discussed have resulted in poor stream water quality conditions primarily relating to elevated concentrations of faecal contaminants and nitrogen.

Water quality assessments undertaken as part of this Project (Technical Report 24, Volume 3) determined that the recorded levels of dissolved zinc and aluminium may be exerting a toxic effect on

[180] High molecular weight polycyclic aromatic hydrocarbons

[181] 'Guideline values' include the Auckland Regional Council (ARC) Environmental Response Criteria (ERC) and the Australian and New Zealand Environment and Conservation Council (ANZECC) Interim Sediment Quality Guidelines (ISQG).

freshwater organisms in the Wharemauku Stream. However, the Wharemauku Stream mouth is well flushed and is unlikely to suffer adverse effects from poor stream water quality.

23.3.1.3 Habitat and species

The Wharemauku Stream mouth is a high energy environment, with exposed sandy beaches, which are typically characterised by low abundance and diversity of intertidal marine invertebrates and macroalgae settlement. In addition, no known sensitive invertebrate species were detected.

Estuarine habitat diversity is low given the historic and ongoing modifications and the lack of salt marsh vegetation and tidal flats.

23.3.2 Waikanae estuary

The Waikanae River originates from the western base of the Tararua Ranges where the habitat is largely native bush. As the River flows towards the coast, it passes through the Reikorangi Basin where a number of major tributaries feed into the River. As the River nears the coast it runs through the urban areas of Waikanae and Otaihanga, feeding into the Waikanae Estuary and mixing with tidal seawater.

The Waikanae Estuary is a tidal river mouth estuary and covers approximately 80 ha. The Estuary is approximately 1.5km long, 40-50m wide with an average water depth ranging between 1 to 3m.

23.3.2.1 Sediment characteristics

Surface sediment grain size in the Waikanae Estuary is dominated by fine sand (>70%). Approximately 95-99% of the sediment is within the medium to very fine sand range. The presence of silt and clay is negligible (<2%).

The sediment collected from the Waikanae River Estuary North site during the field investigation survey had the highest contaminant concentrations of zinc (47 mg/kg dw), lead (9.3 mg/kg dw) and copper levels (7.4 mg/kg dw), all of which are significantly below guideline values (refer to Technical Report 31, Volume 3). The other estuarine environments surveyed have similar levels of these contaminants.

23.3.2.2 Water quality

The Waikanae River has good water quality, reflecting the large proportion of forest cover and low intensity pastoral land use in the 13,400 hectare catchment.

Water quality in the Waikanae Estuary is influenced by the large urban areas surrounding the estuary and the discharge of treated wastewater via the Mazengarb Drain, which enters the Waikanae River just upstream of the estuary.

23.3.2.3 Habitat and species

The Waikanae Estuary is relatively more sheltered than the other stream estuaries downstream of the proposed Expressway, and is influenced by the greater volumes of freshwater. As such, though not

found during the field investigation survey, epifauna such as mud crabs and small gastropods are likely to be present. The Estuary is unsuitable for macroalgae settlement due to the influence of freshwater and periodic high velocity flows during storm events.

The Waikanae Estuary contains a variety of habitats, including tidal mudflats, vegetated sand flats, sand dunes, two tidal lagoons and salt marsh. The intertidal sand flats (comprising 50% of the estuary) provide important habitat for native fish, as well as a feeding resource for a variety of resident and migratory (national and international) bird species.

For these reasons, the estuary environment is considered to be of high ecological value, and in 1978, DOC gazetted the estuary as the Waikanae Estuary Scientific Reserve which is managed by DOC.

The intertidal area within the Waikanae Estuary below mean high water spring is within the Kāpiti Marine Reserve, which was established in 1992. The Marine Reserve links the Waikanae Estuary Scientific Reserve with the Kāpiti Island Nature Reserve. The Marine Reserve incorporates a distribution overlap of species of cool temperature southern waters and warm temperate northern waters resulting in a mixture of northern and southern species. The Reserve is also unique as it contains four distinct habitat zones in close proximity. The habitat zone identified around the Waikanae River mouth is characterised as partly sheltered shallow sand habitat.

23.3.3 Waimeha Stream mouth

Waimeha Stream is a small, spring-fed stream originating from the outskirts of the Waikanae township, flowing down to enter the sea via the sandy coastline at Waikanae Beach. The small stream catchment drains a primarily residential area. Just upstream from the estuary, the Ngarara Stream joins the Waimeha. The Ngarara Stream catchment area consists mainly of pastureland and interdunal wetlands.

The mouth of the Waimeha Stream has been highly modified, and has been channelised. Originally, the Stream flowed south parallel to the beach to the mouth of the Waikanae River; however, in 1920, the Stream was re-directed to discharge across the beach to provide another white-baiting stream. A string of small lakes occupy where the Stream once ran and the old stream bed is now an artificial estuary.

The Waimeha Stream exits to a narrow (5-10 m) and shallow (0.5 m) tidal stream mouth. The Waimeha Stream mouth is a popular site for recreational activities.

23.3.3.1 Sediment characteristics

The Waimeha Stream mouth has the highest surface sediment grain size of all three marine areas, dominated by fine sand (84%). Approximately 95-99% of the sediment is within the medium to very fine sand range. Silt and clay are negligible (<2%).

Contaminant concentrations (copper, lead, zinc and HMW PAHs) were below guideline values (refer to Technical Report 31, Volume 3).

23.3.3.2 Water quality

Water quality from previous studies showed characteristics of typical lowland rural waterways influenced by agricultural run-off (elevated nutrient levels and low toxicant concentrations).

23.3.3.3 Habitat and species

The Waimeha Stream mouth is a high energy environment, with an exposed sandy beach, which is typically characterised by low abundance and diversity of intertidal marine invertebrates and macroalgae settlement. No known sensitive invertebrate species were detected.

Stream mouth habitat diversity is low due to upstream modifications, regular modification of the beach channel (in order to protect coastal residential property from erosion), lack of salt marsh vegetation, and high abundance of weeds.

The sand-flats are a feeding area for coastal and shore birds including black-backed and red-billed gulls, Caspian terns and pied stilts. The relative close proximity to the Waikanae Estuary suggests that a number of other species are likely to visit the stream mouth periodically.

23.4 Existing ecological values

Overall, the Wharemauku and Waimeha Stream mouths and the marine habitat of the Waikanae Estuary are considered to have high ecological values[182].

High ecological values are attributed to marine receiving environments with the following characteristics:

- Benthic invertebrate community typically highly diverse with high species richness;
- Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and mud;
- Marine sediments typically comprise <50% smaller grain sizes;
- Depth of oxygenated surface sediment typically >1.0 cm;
- Contaminant concentrations in surface sediment rarely exceed low effects threshold concentrations; and
- Habitat largely unmodified.

[182] Table 5 within Technical Report 26, Volume 3 lists the characteristics which have been used to assess the predominant ecological values of parts of the marine environment within the Project area, based on a weight of evidence approach.

Table 23.1: Ecological characteristics common to the Waimeha and Wharemauku Stream mouths and the Waikanae Estuary

	Ecological characteristics of Waimeha and Wharemauku Stream mouths	Ecological characteristics of the Waikanae Estuary
Sediment Grain Size	Dominated by fine sand grain size.	Dominated by fine sand grain size.
Sediment Quality	Contaminant concentrations in sediment significantly below guideline values.	Contaminant concentrations in sediment significantly below guideline values
Redox Discontinuity Layer[183]	No anoxic[184] sediment discernable.	Depth of anoxic sediment on average 2-4 cm.
Surface Macroalgae	No macroalgae present.	No macroalgae present.
Epifauna	No epifauna present.	No epifauna present.
Infaunal Invertebrates	Low diversity and abundance of invertebrates, which is typical and expected in the mobile sands of an exposed beach and does not reflect a degraded habitat in this case. Shannon Wiener Diversity below 0.4.	Invertebrate assemblage dominated by a high abundance of amphipods and gastropods. Shannon Wiener Diversity just below 1.
Sensitive Invertebrates	No known sensitive invertebrate species detected.	Sensitive invertebrate species detected e.g. pipi.
Habitat Modification	Modified habitat.	Largely unmodified habitat.

23.5 Assessment of effects on marine ecology

23.5.1 Assessment overview

It is not anticipated that there would be any direct effects on marine ecological values due to construction or operation of the Project, as the proposed Expressway alignment occurs at some distance from marine environments.

However, potential indirect effects may occur due to the discharge of runoff, during both construction and operation phases, to streams and rivers that discharge to the marine environment. Thus, in developing the methodology to investigate the marine ecology associated with the Project and surrounding area, the following potential effects were considered:

- Discharge of sediment-laden water to estuaries and open beaches;
- Discharge of road runoff contaminants via streams and rivers to the estuaries and open beaches; and

[183] The transition layer between oxygen-rich and oxygen-poor layers is called the 'redox discontinuity layer'

[184] Anoxic means oxygen-depleted.

- Impact on food resources for birds and fish within the Waikanae Estuary and the Wharemauku and Waimeha Stream mouths as a result of Project earthworks within the catchment area.

23.5.2 Assessment of construction effects on marine ecology

The indirect effects from construction on marine ecology have the potential to include:

- Impact on streams, wetlands and estuarine habitats through discharge of construction contaminants (oil, cement, lubricants) from stores or vehicles; and
- Impact on streams, wetlands and estuarine habitats and species through increased turbidity and blanketing of stream bed by sediment generated by construction activities.

23.5.2.1 Discharge of construction contaminants

The Project team considered the risks associated with spills of contaminants such as chemicals, fuel, and oil during construction and the release of contaminants by disturbing contaminated soils. These risks will be addressed by the measures identified within the CEMP in Volume 4. The CEMP describes standard methodologies and management that will avoid or minimise these risks. It includes management conditions that address spill minimisation, protocols for managing accidental discharges, planning of bunded storage areas, and refuelling sites.

Overall, with good construction environmental management, these risks can be avoided, or managed so that effects are negligible. On this basis, no additional mitigation is required.

23.5.2.2 Discharge of construction sediment

Sediment discharge into waterways can be an issue during the construction phase, when fine soils from areas of open ground associated with earthworks can be carried into waterways during rain events. Once the earthworks are completed and stabilised, sediment should not reach the waterways, except perhaps in extreme rain events or if ground cover is again disturbed. The proposed management of these potential effects is outlined in the ESCP (Appendix H of the CEMP, Volume 4).

Effects on marine ecology can occur from both suspended sediment and from sediment deposited on the seabed (benthos). Broadly, the magnitude of effect will relate to the concentration of suspended sediment and depth of deposition of sediment, in addition to the duration of exposure.

The field work carried out (Technical Report 31, Volume 3) found that the Waimeha and Wharemauku Stream mouths are high energy, exposed sandy beaches, which are typically characterised by low abundance and diversity of intertidal marine invertebrates. In comparison, the Waikanae River Estuary North and South sites are relatively more sheltered and are influenced by freshwater more than the Waimeha and Wharemauku sites. Typically, there is greater risk of adverse effects where discharges occur into sheltered, calm marine habitats, such as harbours and estuaries, as opposed to exposed, high energy habitats.

A range of measures are proposed for the management of erosion, and the capture and treatment of sediment during construction. Treatment devices will be designed with a target of 70% for on-site

capture of sediment from erosion on site, and 75% efficiency for stormwater pond treatment (refer to the ESCP Appendix H of the CEMP, Volume 4).

The 'pre-earthworks' or baseline sediment yields and the additional contribution predicted to result from the earthworks footprint is presented in Table 23.2[185]. The figures in the table are based on the two month duration of open earthworks areas for each stage of the works (refer to Chapter 8 of this AEE for details of staging). The figures represent the 'worst-case' as progressive stabilisation will occur.

Standard methodologies to ensure these discharge levels are achieved are outlined within the Contaminant Load Assessment (Technical Report 25, Volume 3) and the ESCP (Appendix H of the CEMP, Volume 4).

Table 23.2: Predicted sediment generation by catchment (pre and during construction)

DESCRIPTION	Baseline Sediment Whole Catchment (tonnes)	Total Contribution by Construction (tonnes) *	% Increase over baseline
Whareroa catchment	18.17	0.58	2.6%
Wharemauku catchment	38.02	4.50	9.5%
Waikanae catchment	644.72	3.96	0.4%
Waimeha catchment	2.37	0.77	25.3%
Ngarara catchment[186]	50.56	6.83	9.8%

* Predicted sediment generated over 2 month construction period.

The risk of adverse effects arising from the discharge of sediment, based on Table 23.2, has been considered for each of these habitats.

Sediment discharged to the Wharemauku Stream over a two-month period during construction is estimated to increase by 9.5% above the baseline (refer to Table 23.2). The stream discharges to the high energy open coast at Raumati Beach, where significant flushing and dilution of discharges occurs. As such, it is anticipated that the predicted increase in sediment discharge to the stream during rainfall events occurring when earthworks are open in this catchment will have negligible effects on the marine ecological values at this site.

The Waikanae Estuary is a tidal river mouth estuary that has high ecological values. The predicted increase in sediment discharge to the river/estuary over a two month period during open earthworks in the catchment is 0.4%. The baseline sediment discharge in this catchment over this period is relatively high at approximately 650 tonnes. Even though the Waikanae Estuary is a more sheltered low energy environment, the adverse effects on estuarine/marine ecological values resulting from the predicted increase of sediment (4.5 tonnes) are considered to be negligible (i.e. not able to be measured) above this baseline.

[185] Full details can be found in 'Appendix G1 USLE Calculation M2PP Pre Earthworks' & 'Appendix G5 - USLE Calculation M2PP during Earthworks' within the CEMP, Volume 4.

[186] Just upstream from the Waihema Stream Mouth, the Ngarara Stream joins the Waimeha Stream.

The Waimeha Stream discharges to the high energy open coast via a relatively narrow and shallow stream mouth. Sediment discharged to the Waimeha Stream is predicted to increase by 25% from 2.37 tonnes to 3.14 tonnes over a two month period during open earthworks in the catchment. Whilst the percentage increase is large, the actual volume of sediment is low. The discharge point is approximately 1.5 km upstream of the stream mouth, and sediment is expected to be carried to the open coast during rainfall events. At the open coast, sediment will be rapidly diluted and dispersed subtidally[187], with negligible effects on marine ecological values.

Whilst the Whareroa Stream mouth was not assessed as part of this Project due to the low potential for adverse effects, we consider that an increase of 2.6% in sediment discharged to the stream mouth would have negligible effects on marine ecological values due to the rapid dilution and dispersion of sediment provided by the ultimate receiving environment of the Tasman Sea.

Table 23.3: Assessment of the Magnitude of Effects of Sediment Discharge on the Marine Habitat During Construction (without mitigation)

Description	Ecological Value	Description of effect	Assessment of Impact Magnitude
Estuaries, stream and river mouths			
Whareroa Stream mouth	High	Sediment discharge (0.6 tonnes) to small, unmodified river mouth	Negligible
Wharemauku Stream mouth	High	Sediment discharge (4.5 tonnes) to small, highly modified river mouth	Negligible
Waikanae Estuary	High	Sediment discharge (3.9 tonnes) to very large, high value estuary	Negligible
Waimeha Stream mouth	High	Sediment discharge (6.8 tonnes) to large, somewhat modified river mouth	Negligible

This summary concludes that the magnitude of effects from construction on the high ecological values of the marine ecology is considered negligible[188].

23.5.3 Operational effects on marine ecology

During the operational phase of the Project, treated stormwater runoff from the proposed Expressway will discharge to the marine environments via streams or the Waikanae River. As with any stormwater discharge, there is the potential for cumulative effects in the long term arising from the accumulation of contaminants contained in discharges.

[187] 'Subtidal' refers to the area below water at low tide.

[188] Negligible in this context means a very slight change from baseline condition; change barely distinguishable, approximating to the "no change" situation.

The Project design has incorporated a mix of stormwater treatment swales along the length of the Alignment and a number of larger treatment wetlands. These devices are expected to perform so that the levels of contaminants in stormwater discharging to streams and the stream mouths and estuaries will not increase. The Assessment of Hydrology and Stormwater Effects (Technical Report 22 Volume 3) outlines these mechanisms and treatment efficiencies in more detail.

The Contaminant Load Assessment (Technical Report 25, Volume 3) modelled a number of scenarios to predict the potential contribution of contaminants (sediment, zinc, copper and TPH) from the operation of the proposed Expressway, in 2031. When compared to the current situation, contaminant loads within the Wharemauku and Waimeha stream catchments were the only catchments within the Project that showed an increase. Given that these streams discharge to the high energy open coast, deposition and accumulation of contaminants in the Wharemauku and Waimeha Stream mouths is highly unlikely. This is evidenced by the existing very low concentrations of contaminants in surface sediment at both these stream mouths.

Based on the results of contaminant modelling, the effects of stormwater runoff to estuarine systems will be negligible. This is as a result of the re-distribution of traffic from existing SH1 (from which untreated stormwater discharges directly to many of the same streams discussed in this Chapter) to the proposed Expressway and the increase in stormwater runoff treatment proposed as part of the Project design.

23.5.4 Summary of effects

This assessment considered the discharge of construction phase sediment and contaminants and operational phase stormwater to estuaries and stream mouths. Negligible adverse effects on stream, estuarine and marine ecological values are predicted to occur during both the construction and operational phases of the Project.

Overall, the biodiversity and ecological values of the marine environment can be maintained in the long-term. No additional mitigation is considered necessary.