Appendix 28

Marine Ecology and Coastal Avifauna Effects Assessment

Eastern Busway

EB3 Commercial and EB4 Link Road

Marine Ecology and Coastal Avifauna Effects Assessment

Document Number: EB-RP-3C4L-PL-000011

Eastern Busway

Quality Information

Document Number: EB-RP-3C4L-PL-000011

Document History and Status			
Rev	**Date**	**Author**	**Status**
A	07.07.2023	Dr Sharon De Luca Karin Sievwright	Final

Document Approval					
Rev	**Action**	**Name**	**Position**	**Date**	**Signature**
A	Reviewed by	Dr Leigh Bull	External Technical Review	07.07.2023	On file
B	Reviewed by	Roger McDonald	Alliance Principal Planner	18.08.2023	On file
1	Approved by	Jarrod Snowsill	Alliance RMA Planning Lead	31.08.2023	On file

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List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AC	Auckland Council
ANZG	Australia and New Zealand Guidelines for Freshwater and Marine Water Quality
AEE	Assessment of Effects on the Environment
AUP(OP)	Auckland Unitary Plan (Operative in Part) (Updated 20 July 2023)
BHM	Benthic Health Model
BPO	Best Practicable Option
CEMP	Construction Environmental Management Plan
CMA	Coastal Marine Area
DGV	Default Guideline Value
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3C	Eastern Busway 3 Commercial (Pakuranga Creek to Botany)
EB3R	Eastern Busway 3 Residential (SEART to Pakuranga Creek)
EB4L	Eastern Busway 4 Link Road (link between Tī Rākau Drive and Te Irirangi Drive)
EBA	Eastern Busway Alliance
EIANZ	Environment Institute of Australia and New Zealand
GV	Guideline Value
km	Kilometre(s)
m	Metre(s)
m^2	Square Metre(s)
m^3	Cubic Metre(s)
NDC	Network Discharge Consent
NES - FW	Resource Management (National Environmental Standards for Freshwater) Regulations 2020
NPS - FM	National Policy Statement for Freshwater Management 2020
NZCPS	New Zealand Coastal Policy Statement 2010
NoR	Notice of Requirement
RTN	Rapid Transit Network
RRF	Reeves Road Flyover
RMA	Resource Management Act 1991
WQI	Water Quality Index
ZOI	Zone of Influence

Executive Summary

This report describes the assessment of effects on marine and coastal avifauna ecological values associated with the operation and construction of Eastern Busway 3 Commercial (EB3C). There are no works in Eastern Busway 4 Link Road (EB4L) that are in or adjacent to the Coastal Marine Area (CMA). Therefore, this report does not include further assessment of EB4L.

Its purpose is to inform the Assessment of Effects on the Environment (AEE) relating to the Notices of Requirement (NoR), and required regional consents and consents required under National Environmental Standards for Freshwater (NES-FW) and identify the ways in which any adverse effects can be mitigated.

The Eastern Busway Project (the Project) is a package of works focusing on promoting an integrated, multi-modal transport system to support population and economic growth in southeast Auckland. This involves the provision of a greater number of improved public transport choices and aims to enhance the safety, quality and attractiveness of public transport and walking and cycling environments. The Project will be delivered in several stages.

This Assessment addresses EB3C – which commences at Tī Rākau Drive, adjacent to Riverhills Park, and ends at Tī Rākau Drive, opposite Guys Reserve.

Key elements of the proposed EB3C works package include the construction of two bridges (Bridge A and Bridge B), a new bus station (Burswood Bus Station), a noise wall and retaining walls, stormwater drainage, and a cycleway. The EB3C bridge structures, new and upgraded stormwater outfalls and areas of reclamation require works in the CMA.

This marine ecology and coastal avifauna assessment addresses:

- Estuarine/marine sites identified for bridge infrastructure across the Tāmaki River (Bridge A) and within tributaries of Pakuranga Creek for a bridge adjacent to/near the Chinatown retail business (Bridge B)
- Estuarine/marine sites identified for works associated with stormwater outfalls (including permanent and temporary occupation of the CMA for construction of new and upgraded outfall structures (including riprap) and associated habitat disturbance, remobilisation of sediment bound contaminants, vegetation (exotic and native) removal)
- Coastal avifauna use of proposed stormwater discharge sites
- Quality of stormwater to be discharged with respect to effects on marine ecological values and coastal avifauna.

Standard estuarine survey methods were used for assessing marine ecological values– benthic infauna and epifauna, sediment grain size and sediment stormwater contaminant samples were collected, and coastal vegetation and habitat modification was assessed.

An avifauna literature review was conducted, and site visits were undertaken to assess coastal avifauna habitat. Targeted surveys for banded rail were also conducted as this cryptic, At Risk (Declining) species forages in mangrove forests.

Environment Institute of Australia and New Zealand (EIANZ) guidelines were used (modified for marine ecology) to assess the ecological values, magnitude of effects and level of effects.

Marine Ecology

There are minimal direct effects on marine ecological values (apart from temporary and permanent occupation and saline vegetation loss) on the CMA.

The construction of EB3C's two bridges (Bridge A and B) will involve 821m^2 (191m^2 (Bridge A) and 621m^2 (Bridge B)[1] permanent occupation of the CMA and 45 m^2 (23m^2 and 22m^2 for Bridge A and Bridge B respectively) temporary occupation of the CMA for bridge staging, which is a small proportion of the abundant coastal mangrove wetland habitat within the Pakuranga Creek[2]. Within the calculation for permanent occupation of Bridge A is 147m^2 of scour protection which is yet to be confirmed if it is required. At detailed design, the Requiring Authority will undertake flood modelling to confirm if scour protection around the piles of Tī Rākau Drive Bridge (Bridge A) is required. In the event, that flood modelling demonstrates that scour protection is not required, the requiring authority is not required to implement it.

Vegetation clearance for the permanent Bridges and temporary staging structures in the CMA will be 67m^2 for Bridge A and 643m^2 for Bridge B giving a total of 710m^2.

The retaining wall (RW304) will require 4m^2 of permanent occupation, 70m^2 of temporary occupation and 70m^2 of vegetation removal.[2]

In the CMA, two new stormwater outfalls[3] will be constructed, plus two existing outfalls will be upgraded (MCC-108479, 01A-1, 09-1 and MCC 108409). The four stormwater outfalls[4] are located in mangrove habitat within the Zone of Influence (ZOI). The total area of CMA that is predicted to be adversely affected by temporary and permanent occupation for stormwater outfalls/structures is 400m^2 and 100m^2, respectively, which is a small proportion of the abundant coastal wetland habitat within the Pakuranga Creek. Removal of vegetation (including mangroves) is required for the proposed works associated with these outfalls in the CMA due to temporary and permanent occupation of CMA for construction (total of 400m^2 for construction reducing to 100m^2 (25m^2 each) permanent footprint for the outfall structures)[5].

Survey of the CMA stormwater receiving environment revealed Low ecological values, with common benthic invertebrate infauna taxa, few epifaunal invertebrates, dominance of silt and clay sediment, elevated stormwater contaminants at some sites (e.g. most sites surveyed for sediment contaminants revealed concentrations of zinc above Default Guideline Value (DGV) (Australian and New Zealand Governments, 2018)), and coastal edge and riparian vegetation that is largely dominated by exotic weed species, minimal native vegetation present and relatively modified environment. The marine ecological values for EB3C are Low at all four stormwater outfalls.

The Contaminant Load Model (CLM) indicates that the Project will lead to an overall reduction in EB3C for copper, zinc and TPH at most sites. However, of the outfalls discharging directly to the CMA, the CLM indicates that outfall MCC_108479 is predicted to have an increase in TSS (around 17%), whereas copper, zinc and TPH are predicted to increase by 1-2% at this location (Stormwater Assessment[6], see Table 2).

[1] This includes 549m^2 of reclamation, 8m^2 of piles and 64m^2 of rip rap

[2] Table 4, Construction Methodology and attached in Appendix 2.

[3] MCC-108479 is effectively a new outfall construction, as the old outfall will be demolished and removed and a new outfall will be constructed.

[4] This includes two new stormwater outfalls, and upgrades to two existing stormwater outfalls.

[5] Table 4, Construction Methodology and attached in Appendix 2.

[6] Contaminant Load Model (CLM) approach is being confirmed.

The magnitude (

Table 5) of construction effects (i.e. permanent and temporary occupation of the CMA, vegetation loss within the CMA) on marine ecological values is assessed as Low. For marine ecology (ecological values are low), the low magnitude of effects results in low overall level of effects.

Cumulative effects of construction are assessed as a Moderate magnitude of effect (due to the accumulation of small effects across the EB3C works area/ZOI). However, with low ecological values, the level of effect (

Table 6) remains low overall. Mitigation of cumulative effects on marine ecological values from construction effects is recommended (whilst not strictly required by the EIANZ assessment guidelines).

Coastal Avifauna

Mangroves (generally and at the ZOI) provide foraging habitat (but not breeding or roosting habitat) for coastal avifauna, potentially including At Risk native species.

Native coastal avifauna ecological values present, or potentially present, in the EB3C ZOI range from Low to High. The High ecological value relates to the potential presence of banded rail, an At Risk (Declining) species that forages in mangroves. Banded rail were not observed during the site investigations, however, based on the habitat available in the ZOI and the wider distribution of banded rail in the bays and estuarine wetlands of the Manukau and Waitemata Harbours, they could occasionally forage in the ZOI.

Potential construction and operational effects on coastal avifauna include loss of foraging habitat, habitat disturbance and displacement, impacts on foraging ability and food supply and cumulative effects. With the exception of cumulative effects, the magnitudes of effect of construction and operation on coastal avifauna ecological values are assessed as Negligible (*Having negligible effect on the known population or range of the element / feature*). The magnitude of effect of cumulative construction effects are assessed as Low (*Having a minor effect on the known population or range of the element / feature*). Negligible to Low magnitudes of effect on Low to High value species result in Very Low to Low overall levels of effect. Mitigation of cumulative effects on coastal avifauna ecological from construction effects is recommended (whilst not strictly required by the EIANZ assessment guidelines).

Conclusion and Recommendations

Mitigation is not required for any of the Very Low and Low levels of adverse effects detected (on the assumption that the proposed Erosion and Sediment Control Plan and the proposed Stormwater Treatment approach are implemented in accordance with conditions). However, it is our assessment that the cumulative effects of construction on marine ecological values (a Moderate magnitude of effect) and coastal avifauna values (Low magnitude) should be mitigated even though the EIANZ assessment guidelines, indicate the overall level of effect in this situation would be Low. We recommend rubbish and debris in the CMA adjacent to EB3C is removed (and repeated annually for three years post construction) and pest plants are controlled and replaced with native vegetation along the coastal fringe of EB3C that are suitable for banded rail to nest in (continuing annually for three years post construction) (see section 7.0 and Figure 20).

1 Introduction

1.1 Overview of the Eastern Busway Project

The Eastern Busway Project (the Project) is a package of works focusing on promoting an integrated, multi-modal transport system to support population and economic growth in southeast Auckland. This involves the provision of a greater number of improved public transport choices and aims to enhance the safety, quality and attractiveness of public transport and walking and cycling environments. The Project includes:

- 5 km of two-lane busway
- Two new bridges for buses across Pakuranga Creek (Bridge A and Bridge B)
- A new bridge for buses crossing Guys Reserve and Whaka Maumahara Reserve (Bridge C)
- Improved active mode infrastructure (walking and cycling) along the length of the busway
- Three intermediate bus stations
- Two major interchange bus stations.

The Project forms part of the previous Auckland Manukau Eastern Transport Initiative (AMETI) programme (the programme) which includes a dedicated busway and bus stations between Panmure, Pakuranga and Botany town centres. The dedicated busway will provide an efficient rapid transit network (RTN) service between the town centres, while local bus networks will continue to provide more direct local connections within the town centre areas. The Project also includes new walking and cycling facilities, as well as modifications and improvements to the road network.

The programme includes the following works which do not form part of the Eastern Busway Project:

- Panmure Bus and Rail Station and construction of Te Horeta Road (completed)
- Eastern Busway 1 (EB1) – Panmure to Pakuranga (completed).

The Eastern Busway Project consists of the following packages:

- Early Works Consents – William Roberts Road (WRR) extension from Reeves Road to Tī Rākau Drive (LUC60401706); and Project Construction Yard at 169 – 173 Pakuranga Road (LUC60403744).
- Eastern Busway 2 (EB2) – Pakuranga Town Centre, including the Reeves Road Flyover (RRF) and Pakuranga Bus Station.
- Eastern Busway 3 Residential (EB3R) – Tī Rākau Drive from the South-Eastern Arterial (SEART) to Pakuranga Creek, including Edgewater and Gossamer Intermediate Bus Stations.
- Eastern Busway 3 Commercial (EB3C) – which commences from Riverhills Park along Tī Rākau Drive to Botany, including two new bridges, and an offline bus route through Burswood **(this Assessment).**
- Eastern Busway 4 Link Road (EB4L) – Guys Reserve to Botany Town Centre including a link road through Guys Reserve and Whaka Maumahara Reserve to Te Irirangi Drive/Town Centre Drive Intersection (as there are no works within or adjacent to the CMA in EB4L, it is not considered further in this assessment).

The overall Project alignment is shown in Figure 1 below.

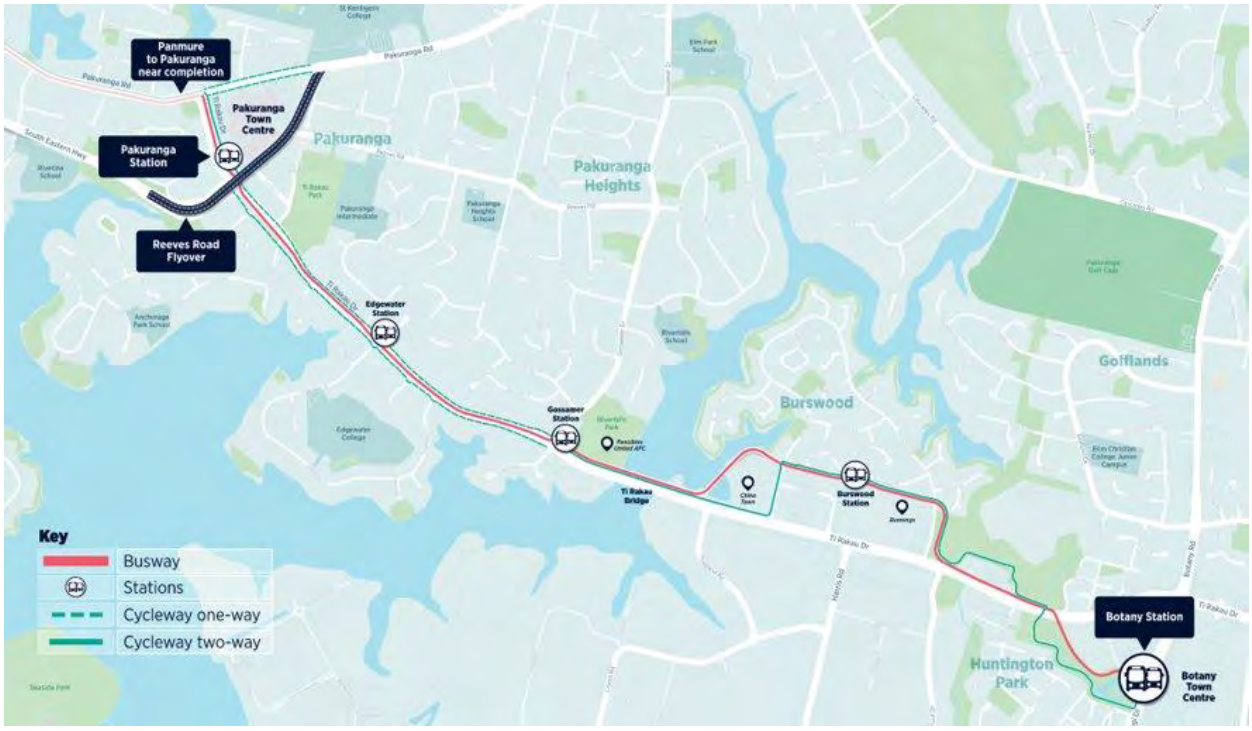

Figure 1: Project alignment

1.2 Project Objectives

1. Provide a multimodal transport corridor that connects Pakuranga and Botany to the wider network and increases choice of transport options.
2. Provide transport infrastructure that integrates with existing land use and supports a quality, compact urban form.
3. Contribute to accessibility and place shaping by providing better transport connections between, within, and to the town centres.
4. Provide transport infrastructure that improves linkages, journey time and reliability of the public transport network.
5. Provide transport infrastructure that is safe for everyone.
6. "Provide or Safeguard future" transport infrastructure at (or in the vicinity of) Botany Town Centre to support the development of strategic public transport connection to Auckland Airport.

2 Proposal Description

The following sections provide a brief description of both EB3C and EB4L (Figure 2 and Figure 3). As previously indicated, works associated with EB4L will not generate effects on the CMA. However, as that conclusion was informed by the nature of proposed works and location of EB4L, for completeness a description of that stage of the Project is included below.

These descriptions consist of the construction and operation of both EB3C and EB4L packages, with further details provided in the AEE and NoRs. A full set of proposed plans is attached to the AEE.

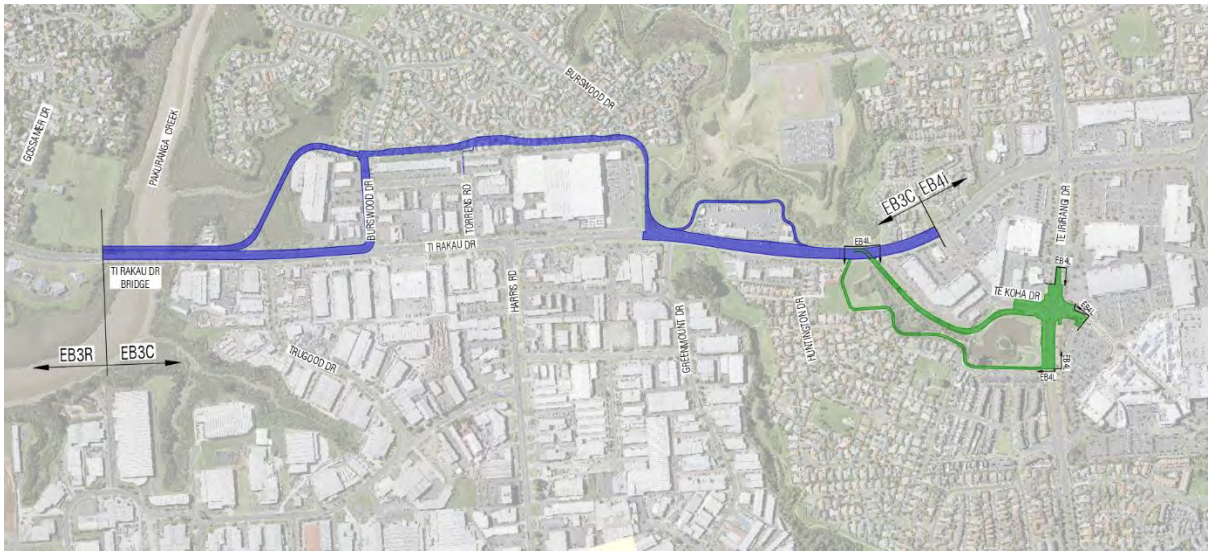

Figure 2: Eastern Busway 3 Commercial and 4 Link Road Project Extent

2.1 Eastern Busway 3 Commercial

The proposed EB3C works involve the establishment of an 'off-line' busway, cycleway and associated stormwater upgrades. The proposed works will take place within existing road reserves, Council reserves[7] and privately held land within the proposed works footprint. The extent of works for EB3C runs between Riverhills Park (i.e. adjacent to the terminus of the earlier EB3R package) in the west to Guys Reserve in the east, through the suburbs of Burswood and East Tāmaki (Figure 3).

The EB3C project (Zone Of Influence / ZOI) sits within the AUP (OP) marine sites of significance (SEA-M245b) which is regarded by AC as the best example of mangrove habitat in the Tāmaki Estuary. The busway will be largely off-line (i.e. outside the current Tī Rākau Drive corridor), first crossing Pakuranga Creek by way of a new two-lane bridge (Bridge A) with abutments[8] and scour protection. It will then cross a coastal headland at 242 Tī Rākau Drive (a Mobil branded service station), and then an embayment within which a retaining wall, and a 4m^2 coastal reclamation will be constructed. The busway will cross a second headland at 254 Tī Rākau Drive (currently occupied by a pet store), before crossing a mangrove filled bay to the west of 262 Tī Rākau Drive (the 'Chinatown' retail business) via a second bridge (Bridge B). Bridge B will include two abutments with scour protection. Bridge B will require construction of a reinforced embankment at its northern end which includes imported fill, rip rap and permanent wick drains, and 549m^2 of coastal reclamation. In parallel, a retaining wall will be constructed to the eastern side of the embankment. Following this, the busway will run between the

[7] Including Burswood Esplanade Reserve and Bard Place Reserve

[8] The western abutment and associated scour protection was included in the EB3R consenting package

commercial area and residential area north of Tī Rākau Drive, crossing several residential sites. The busway will also cross Burswood Drive twice, with raised signalised crossings established to control both the busway and road traffic.

A new 'intermediate' style bus station will be established at Burswood, before the busway then crosses over Burswood Esplanade Reserve and onto a widened Tī Rākau Drive (by the Howick and Eastern bus depot). The busway will then run beside the eastbound lanes of Tī Rākau Drive, before crossing over Tī Rākau Drive to connect with EB4L at Guys Reserve.

The busway will include a new cycleway, which will largely run parallel to the busway for most of this section of the Project. The exceptions to this include Bridge B, between 254 Tī Rākau Drive and Burswood Esplanade (west) – for this section the cycleway will continue along Tī Rākau Drive before turning into Burswood Drive West, as well as where the cycleway runs behind the Howick and Eastern bus depot.

Other works included in EB3C are the relocation of existing utility services, the provision of new or upgraded stormwater infrastructure and open space upgrades. Stormwater works will involve new outfalls discharging to Pakuranga Creek (and its tributaries) and rain gardens.

Lastly, EB3C involves the establishment of two laydown areas, one at 242 Tī Rākau Drive and the other within the boundaries of Burswood Esplanade Reserve. Both laydown areas are located on land that will be occupied by the Project upon its completion.

Figure 3: Eastern Busway 3 Commercial Project Area

2.2 Eastern Busway 4 Link Road

The EB4L works will involve the establishment of an 'off-line' dedicated two-way busway, shared pathway and stormwater upgrades. These works will take place in Guys Reserve, Whaka Maumahara Reserve, existing road reserve and Botany Town Centre land for the intersection improvements on Town Centre Drive.

EB4L commences south of Tī Rākau Drive, crossing through Guys Reserve, Whaka Maumahara Reserve and ending at the intersection of Te Irirangi Drive/Town Centre Drive.

The works will primarily involve the construction of a new two-way busway corridor which will run along the eastern side of Guys Reserve and Whaka Maumahara Reserve to provide access for bus services between Pakuranga and Botany. The two-way busway is designed to integrate with EB3C and be a continuation of the EB3C busway.

This section of the busway will feature a bridge (Bridge C) approximately 350m long. This bridge is needed due to the sloping topography of the Reserves.

The busway will then connect to Te Irirangi Drive, following alterations to the existing Te Irirangi Drive/Town Centre Drive intersection.

A shared pathway and minor retaining walls will also be constructed along the southern and western boundaries of Guys Reserve and Whaka Maumahara Reserve. The shared pathway will connect to existing walkways and will terminate at Te Irirangi Drive.

A new shared pathway and retaining wall will also be constructed along the western boundary of Te Irirangi Drive and is partially located within the Whaka Maumahara Reserve.

A new stormwater outfall (including riprap) will be constructed within Guys Reserve. The outfall will discharge stormwater over scour protection prior to its entry into a tributary of Pakuranga Creek. Additionally, a new stormwater connection will be constructed in Whaka Maumahara Reserve, adjacent to Te Irirangi Drive. This new connection will discharge via an existing outfall into the existing stormwater pond within the Reserve.

A construction laydown area will also be established within Guys Reserve, adjacent to Tī Rākau Drive and 47C Huntington Drive. A second laydown area will be established in Whaka Maumahara Reserve, between the existing stormwater pond and Te Irirangi Drive. Construction access will also be gained from Te Koha Road beside VTNZ's vehicle inspection premise located at 451 Tī Rākau Drive.

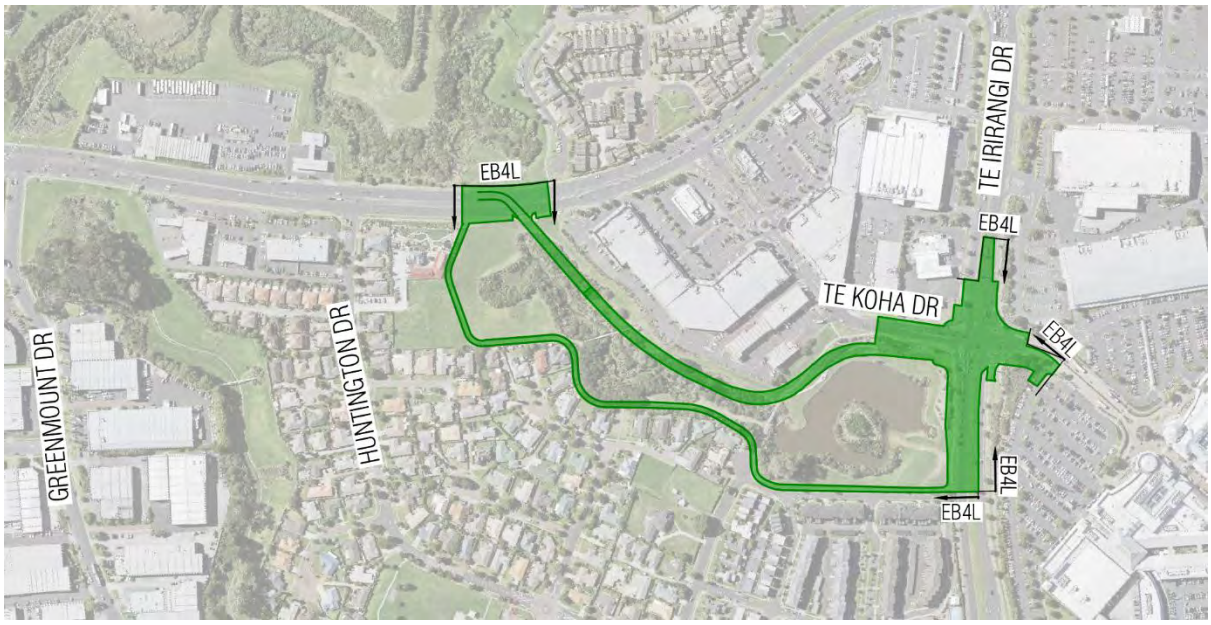

Figure 4: Eastern Busway 4 Link Road Project Area

3 Specialist Assessment

Chapter Summary
The potential effects on marine ecology and coastal avifauna values in EB3C relate to the temporary and permanent occupation of the CMA (including reclamation) to construct two bridges, a retaining wall (requiring reclamation), construction of, and upgrades to, stormwater outfalls and discharge dissipation structures, vegetation removal and shading, and loss and disturbance of foraging habitat for coastal avifauna, impacts on avifauna foraging ability and food supply, and cumulative effects.

3.1 Assessment Content

This report describes the assessment of marine ecology and coastal avifauna effects associated with the operation and construction of the EB3C section of the Project. As previously indicated, the scope of this assessment also covers EB4L. However, there are no works in EB4L that are in or adjacent to the CMA, and therefore works associated with EB4L will not generate effects on the CMA.

The purpose of this assessment is to inform the AEE relating to the NoRs, and required regional consents and consents required under National Environmental Standards and identify the ways in which any adverse effects will be mitigated.

This marine ecology and coastal avifauna assessment assesses:

- Estuarine/marine sites identified for bridge structures (including permanent and temporary occupation in the CMA) crossing Pakuranga Creek (Figure 5)
- Estuarine/marine sites identified for stormwater outfalls (including permanent and temporary occupation of the CMA for construction of new and upgraded outfall structures (including riprap) and associated habitat disturbance (Figure 6)
- Estuarine/marine sites identified for reclamation
- Remobilisation of sediment-bound contaminants
- Vegetation (exotic and native) removal and shading
- Coastal avifauna use (breeding, foraging, roosting) of the proposed stormwater discharge locations, and temporary and permanent occupation locations within the CMA for the bridge structures
- Quality of stormwater to be discharged with reference to the effects on marine and coastal avifauna ecological values.

Note that this assessment is not restricted to the project footprint but instead is an assessment of the EB3C Zone of Influence (ZOI). The EIANZ guidelines define the ZOI as “all land, water bodies and receiving environments that could be potentially impacted by the Project. It includes the Project Site and any environments beyond the Project Site where ‘indirect effects’ such as discharges may extend”. For this Project the ZOI is the mangrove edge given that stormwater contaminants typically accumulate at / around outfalls in fine organic / muddy sediments and decrease in contamination from the discharge point. The ZOI is not expected to extend beyond open channels and other coastal / estuarine habitats.

Further, it is noted that marine mammals are not included in this assessment. We understand the marine mammals are rarely (if at all) detected in the Pakuranga Creek as it is not preferred marine mammal habitat, especially as far upstream in the mangrove lined estuary as the EB3C project is located.

3.2 Specific Project Elements

The potential effects on marine ecology and coastal avifauna values in EB3C relate to the construction of temporary bridge staging platforms and piles, permanent bridge structures (including an embankment), a retaining wall (and associated reclamation), stormwater outfalls and discharge dissipation structures (i.e. riprap), vegetation removal and shading, remobilisation of contaminants in sediment during earthworks or vegetation removal, contaminant discharges associated with the operation of stormwater outfalls, temporary and permanent occupation of the CMA, loss and disturbance of foraging habitat for coastal avifauna, impacts on avifauna foraging ability and food supply, and cumulative effects.

Figure 5: Estuarine sampling locations and significant ecological areas (SEAs)

Figure 6: Stormwater outfall locations

3.3 Proposed Construction Methodology for works in the CMA

3.3.1 Bridge A

To construct a new bridge across Pakuranga Creek temporary staging will be required to access the permanent bridge. The temporary staging will include a platform which will sit above the CMA and 360m^2 of mangroves. Temporary staging piles will occupy 23m^2 of benthic habitat. Installation of the piles will be driven piles. The construction method states that once the bridge is complete every effort will be made to remove the temporary piles. If the temporary piles cannot be removed from the marine benthos they will be cut off below ground/benthos level.

Permanent bridge piles will occupy 14m^2 of benthic habitat while pile scour protection for Bridge A (if required by hydrodynamic modelling) will permanently occupy approximately 147m^2 of benthic habitat. The eastern abutment will occupy 30m^2 of the benthic habitat. This totals 191m^2 of permanent occupation of the CMA.

The area of intertidal mangrove vegetation removal in the CMA for the temporary staging piles is expected to be 10m^2 in addition to 7m^2 for permanent occupation of bridge piles. Intertidal mangrove removal is not required for bridge pile scour protection. Mangrove removal for the construction of the eastern abutment is approximately 50m^2. This totals 67m^2 of vegetation removal from within the CMA.

3.3.2 Bridge B

To construct a new bridge in the estuary adjacent to Chinatown retail business temporary staging in the CMA will be required to access the permanent bridge. The temporary staging will include a platform which will sit above the CMA and 800m^2 of mangroves. Temporary staging piles will occupy/disturb 22m^2 of predominantly intertidal mangrove habitat. Installation of the piles will be driven piles. The construction method states that once the bridge is complete every effort will be made to remove the temporary piles. If the temporary piles cannot be removed from the marine benthos they will be cut off below ground/benthos level.

Permanent bridge B piles will occupy 8m^2 of benthic habitat, rip rap for Abutment B will occupy 64m^2 of benthic habitat and a reinforced embankment at its northern end which includes imported fill, rip rap and permanent wick drains includes 549m^2 of coastal reclamation. This totals 621m^2 of permanent occupation of the CMA.

The area of intertidal mangrove vegetation removal in the CMA for the temporary staging piles is expected to be 22m^2 and 8m^2 for the permanent piles. The abutment at the northern end of the bridge will require mangrove removal of 64m^2 and the coastal reclamation 549m^2 of mangrove removal. This totals 643m^2 of vegetation removal from within the CMA.

3.3.3 Construction of permanent retaining wall (RW304)

The retaining wall and associated reclamation will involve the permanent loss of 4m^2 of the CMA. Approximately 70m^2 of mangrove vegetation will be removed/disturbed to enable construction of the retaining wall (70m^2 includes the 4m^2 of permanent occupation).

3.3.4 Erosion and Sediment Control

It is proposed that silt fencing will surround all vegetation removal and earthworks in the CMA (in accordance with the recommendations from the Erosion and Sediment Control Effects Assessment).

3.3.5 Stormwater Outlets and Discharges

Figure 6 shows the location of the proposed stormwater outfall locations. Two new outfalls (01A-1, 09-1) and will be constructed and existing outfalls MCC-108479 and MCC 108409 will be upgraded. Permanent intertidal mangrove vegetation removal/occupation of the CMA will be approximately 25m^2 per outfall, which totals 100m^2. To construct the outfalls, temporary occupation and vegetation removal for the four outfalls will be 400m^2 (Stormwater Assessment Report).

Stormwater discharge for the four SW outfalls located in/adjacent to the CMA will result in reduced or negligible increases in concentrations of zinc and copper in the discharges, apart from MC-108479 which will result in a 17% increase in Total Suspended Solids (TSS) and 2% increases in copper and zinc concentration (see Table 2) (Stormwater Assessment Report[9]).

3.4 Statutory and Planning Framework

This assessment and associated impact management has been developed with consideration of the following list of relevant legislation, policy, plans and strategies:

1. Resource Management Act 1991
2. National Environmental Standards for Freshwater 2020
3. National Policy Statement for Freshwater Management 2020
4. National Policy Statement for Indigenous Biodiversity 2023
5. Auckland Unitary Plan (Operative in Part) – Chapters B8, F2, F8
6. New Zealand Coastal Policy Statement 2010
7. Hauraki Gulf Islands Marine Park Act 2000.

[9] Approach to the CLM is yet to be confirmed.

4 Methodology

Chapter Summary
Summary of key points/ findings • *Standard estuarine survey methods were used – including the collection of benthic infauna and epifauna, sediment grain size analysis and sediment stormwater contaminant samples, and assessment of coastal vegetation and habitat modification.* • *A coastal avifauna literature review was conducted, and site visits were undertaken to assess coastal avifauna habitat. Targeted surveys for banded rail were also conducted.* • *EIANZ guidelines were used (modified for marine ecology) to assess the ecological values, magnitude of effects and level of effects.*

4.1 Desktop and Field Investigations

Field surveys to assess marine and/or coastal avifauna ecological values were undertaken at low tide as follows[10]:

- Estuarine habitat assessment of sites adjacent to the abutments of the existing bridge across the Pakuranga Creek and near the proposed location of Bridge A (prior to detailed location design) (sites 3 and 4, Figure 5) were carried out on 27 June, 3 October and 6 December 2018. We have assumed that the habitats near the existing bridge abutments would be similar to those surveyed nearby in 2018.
- Sites beneath/around the proposed bridge structure (Bridge B) through the estuarine habitat adjacent to Chinatown retail business were carried out on 14 April 2021 and 29 August 2022 (sites 5-10, Figure 5).
- Stormwater outfall areas that discharge to the CMA (sites 01A-1, MCC-1085479, 09-1 and MCC-108409 on Figure 6) were assessed on 22 September 2022 and 4 October 2022 at low tide.
- Sites MCC 108481, 43-1, 53-1, and 47-3 (Figure 6) discharge to freshwater environments and are covered in the Terrestrial and Freshwater Assessment not this assessment, as outfalls are upstream of the CMA boundary (freshwater or terrestrial habitats).

Avifauna information was also obtained through existing resources, including the Ornithological Society of New Zealand (OSNZ) atlas (C. J. R. Robertson et al., 2007). While details are provided in the following sections, a summary of the marine ecology and coastal avifauna surveys undertaken, and samples collected is provided in Table 1.

4.1.1 Coastal Vegetation

Native and exotic flora present within and adjacent to each proposed construction and operational works area was noted while on site (in 2018, 2021 and 2022).

4.1.2 Benthic Invertebrate Assemblage

At each tidally influenced site (four for stormwater outfalls, and six for Bridge A and B structures) surveyed three 10cm diameter sediment cores (approximately 15cm deep) were collected, sieved through a 5mm mesh and the retained material and organisms preserved in 70% ethanol. Marine macroinvertebrates were extracted from the material, identified and counted by an independent expert taxonomist at a later date.

[10] Refer to Figure 5 for the location of structural bridge survey sites and Figure 6 for stormwater outfall sites.

Three 0.25m^2 quadrats were placed on the undisturbed benthic sediment at each site, photographed and all epifauna identified. All data were analysed using descriptive statistics and multivariate analyses.

Table 1: Survey site details

PROPOSED WORKSITE OR STORMWATER OUTFALL NUMBER DETAILS	DATE SURVEYED	VEGETATION ASSESSMENT	ESTUARINE BENTHIC INFAUNA CORES	ESTUARINE EPIFAUNA QUADRAT	SEDIMENT GRAIN SIZE	SEDIMENT SW CONTAMINANTS	AVIFAUNA BREEDING AND FORAGING HABITAT ASSESSMENT
EB3C							
Construction Works Survey Sites (Figure 5)							
Site 3	03/10/2018	Yes	3	3	Yes	Yes	Yes
Site 4	03/10/2018	Yes	3	3	Yes	Yes	Yes
Site 7	14/04/2022 & 29/08/2022	Yes	3	3	Yes	Yes	Yes
Site 8	14/04/2022 & 29/08/2022	Yes	3	3	Yes	Yes	Yes
Site 9	14/04/2022 & 29/08/2022	Yes	3	3	Yes	Yes	Yes
Site 10	14/04/2022 & 29/08/2022	Yes	3	3	Yes	Yes	Yes
New/upgraded SW Survey Sites							
01A-1 (new outfall) (Site 1, Figure 6)	22/09/2022	Yes	3	3	Yes	Yes	Yes
MCC-108479 (upgraded outfall) (Site 2, Figure 6)	22/09/2022	Yes	3	3	Yes	Yes	Yes
09-1 (new outfall) (Site 3, Figure 6)	22/09/2022	Yes	3	3	Yes	Yes	Yes
MCC 108409 (upgraded outfall) (Site 4, Figure 6)	04/10/2022	Yes	3	Yes	Yes	Yes	Yes

4.1.3 Sediment Quality and Grain Size

Two composite samples of surface (top 2cm) sediment were collected at each proposed structural site for bridges and stormwater outfall sites, with one sample from each site, being sent on ice, to Hill Laboratories for the analysis of common stormwater contaminants (copper, lead and zinc). The other sample from each site was sent, on ice, to the University of Waikato for analysis of sediment grain size distribution.

4.1.4 Coastal Avifauna

An assessment of Significant Ecological Area – Marine (SEA_M) sites for wading bird habitat within and in close proximity to the project site was conducted.

Data for the 10 km x 10 km OSNZ atlas grid square (267, 647; Robertson et al. (2007)), which encompasses the Tī Rākau Drive bridge (Bridge A) and surrounding environment (see Figure 7), was collated to provide a baseline list of species that have previously been recorded in that area. The primary and secondary habitats for each of the species recorded within this grid square were obtained from Heather & Robertson (2005), along with each species' New Zealand threat status according to Robertson et al. (2021).

Two initial site visits were conducted in October and December 2018 to the area below the existing Tī Rākau Drive bridge, an area of the Project where there is potential for coastal bird species to be present and directly affected. The site visits commenced at 8:30 am to coincide with a low tide. Climatic conditions were fine and mild, with no cloud cover.

A third site visit was conducted on 23 August 2022 to assess coastal avifauna habitat within and adjacent to bridge structural sites and proposed stormwater outfalls in the estuary next to the Chinatown retail business. The site visit commenced at 10.15 am to coincide with low tide. Climatic conditions were fine, cloudy and mild.

On all survey occasions, an assessment of avifauna habitat quality was conducted, as well as targeted surveys for mioweka, banded rail (*Gallirallus philippensis assimilis*), a cryptic marshbird classified as *At Risk – Declining* in the New Zealand Threat Classification System and identified as a "specified highly mobile fauna" in the NPS-IB. Banded rail can reside in mangrove habitat, such as that found in the riparian margins of Pakuranga Creek near the Tī Rākau Drive bridge, using the benthic habitat beneath mangroves as a foraging habitat. Targeted surveys included banded rail playback calls at six locations during the October and December 2018, and 29 August 2022 site visits. Searches for banded rail footprints in the estuarine mud within the mangrove stands were also undertaken on all occasions. In addition, a roaming inventory was collated by recording all native coastal birds seen and heard during the site visits.

All coastal avifauna site visits were undertaken by a coastal avifauna specialist[11].

Terrestrial (including land birds) and freshwater ecology (i.e. areas landward of the CMA) were not included within this assessment and are covered in the Terrestrial and Freshwater Ecological Effects Assessment.

[11]Dr Leigh Bull or Karin Sievwright.

Figure 7: OSNZ avifauna square (267, 647) location

4.2 Supporting Information

In addition to the information collected through ecological field investigations (Table 1) and desktop investigation of relevant literature and databases, this assessment has been based on the information provided in the following supporting documents and plans:

4.2.1 Stormwater Effects Assessment Report (December 2022)

The Stormwater Effects Assessment summarises the contaminant load models (CLM) and expected outcomes for discharge quality for EB3C as follows: increase in TSS (17%) and 1-2% in zinc, copper, total petroleum hydrocarbons at outfall MCC_108479, whereas outfalls 09-1 / MCC_108480 and MCC_108409 are expected to have reductions in sediment and contaminants (Table 2).

The potential effect of the construction is assessed in section 6.1.1 and the operational phase stormwater discharge quality in section 6.2.2.

Table 2: CLM for new and upgraded stormwater outfalls discharging to the CMA (updated February 2023) (Red cells indicate increases, green cells indicate decreases)

CMA SW Outfall Name	Total suspended solids (TSS)	Zinc suspended particulate and dissolved (TZn)	Copper suspended particulate and dissolved (Tcu)	TPH suspended particulate and dissolved (TTPH)	Comments
MCC_108479	17%	2%	2%	1%	Upgraded outfall. As per stormwater design drawings
01A-1	Not Modelled	Not Modelled	Not Modelled	Not Modelled	Not modelled because footpath/cycleway doesn't generate measurable contaminants
09-1 & MCC_108480	-38%	-11%	-13%	-18%	09-1 serves same catchment as MCC_108480 and is provided for flood mitigation
MCC_108409	-57%	-40%	-45%	-52%	Upgraded outfall. As per stormwater design drawings.

4.3 Ecological Assessment

The methods used to undertake this assessment are consistent with the EIANZ guidelines for undertaking ecological impact assessments (Roper-Lindsay et al., 2018), whereby ecological values are assigned (refer to Table 3 for coastal avifauna and Table 4 for marine ecology) and the magnitude of effects identified (Table 5) in order to determine the overall level of effect of the proposal (Table 6).

In New Zealand, no regional or national guidelines or criteria for the assessment of marine ecological values have been developed to date. In the absence of such guidelines, we have adopted the EIANZ guidelines (Roper-Lindsay et al., 2018) approach to assess marine ecological value (including species richness and diversity)[12]. This approach has been used and accepted in previous Board of Inquiry and Environment Court consenting processes for major infrastructure Projects[13].

The scale of the assessments are upper estuary sites of the Tāmaki River/Estuary. The marine ecological values described in this report are based on criteria that range from very low to very high (Table 4).

According to Roper-Lindsay et al. (2018), the overall level of effect can then be used to guide the extent and nature of the ecological management response required (including the need for biodiversity offsetting):

- Very high adverse effects require a net biodiversity gain[14]
- High and moderate adverse effects require no net loss of biodiversity values
- Low and very low effects are not typically of ecological concern. If effects are assessed taking impact management developed during Project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure low or very low effects.

Table 3: Criteria for assigning ecological value to species (Roper-Lindsay et al., 2018).

ECOLOGICAL VALUE	SPECIES CLASSIFICATION
NEGLIGIBLE	Exotic species, including pests, species having recreational value.
LOW	Nationally and locally common indigenous species.
MODERATE	Species listed as any other category of *At Risk* (Recovering, Relict, Naturally Uncommon) found in the ZOI for the EB3C Project either permanently or seasonally; or Locally (ED) uncommon or distinctive species.
HIGH	Species listed as *At Risk – Declining* found in the ZOI either permanently or seasonally.
VERY HIGH	*Nationally Threatened* (Nationally Critical, Nationally Endangered, Nationally Vulnerable) species found in the ZOI either permanently or seasonally.

[12] Dr De Luca is currently leading a team of marine ecologists who are drafting revisions to the EIANZ guidelines to include marine ecology.

[13] See evidence of Dr De Luca in Board of Inquiry Hearings for NZTA Projects: Pūhoi to Warkworth, Waterview Connection, Transmission Gully, Mackays to Peka Peka, East West Link and Te Ara Tupua.

[14] Though when ecological compensation is required because biodiversity offsetting is not possible, the principles of no-net-loss or net-gain do not apply (Maseyk et al., 2018).

Table 4: Criteria for assigning ecological value to marine habitats.

ECOLOGICAL VALUE	CHARACTERISTICS
VERY LOW	Benthic invertebrate community degraded with very low species richness, diversity and abundance for the habitat type
	Benthic invertebrate community dominated by organic enrichment tolerant and mud tolerant organisms with no sensitive taxa present. E.g. rated as 'Poor' using the Auckland Council (AC) Benthic Health Model (BHM) or a similar index
	Invasive, opportunistic and disturbance tolerant species highly dominant
	Marine sediments dominated by silt and clay grain sizes (>80%) or rated as 'Poor' using the AC BHM or similar index
	Surface sediment anoxic (lacking oxygen)
	Annual average sedimentation rates typically greater than 10 mm above background levels
	Elevated contaminant concentrations in surface sediment, above ANZG Default Guideline Values (DGV) effects threshold concentrations[15]
	Where shellfish are present, flesh has moderate-high contaminant concentrations present
	Water column contaminant values typically at or worse than Australia and New Zealand Guidelines for Freshwater and Marine Water Quality (ANZG) 80% species protection levels and/or scored as 'Poor' on a recognised Water Quality Index (WQI)
	Water quality degraded, with the concentration of many toxicants above effects thresholds
	Fish community depleted with very low species richness, diversity and abundance
	No *Threatened* or *At Risk* marine species present
	Native estuarine vegetation or macroalgae absent or so sparse as to provide very limited ecological value
	No *Threatened* ecosystems present
	Nuisance phytoplankton or macroalgal blooms may occur frequently over a large spatial scale
	Physical habitat extremely modified
LOW	Benthic invertebrate community degraded with low species richness, diversity and abundance for the habitat type
	Benthic invertebrate community dominated by organic enrichment tolerant and mud tolerant organisms with few/no sensitive taxa present e.g. rated as 'Marginal' using the AC BHM or similar index
	Invasive, opportunistic and/or disturbance-tolerant species dominant
	Marine sediments dominated by silt and clay grain sizes (>60%) or rated as 'Marginal' using the AC BHM or similar index
	Surface sediment predominantly anoxic (lacking oxygen)
	Annual average sedimentation rates typically less than 10 mm above background levels
	Elevated contaminant concentrations in surface sediment, above ANZG DGV effects threshold concentrations
	Where shellfish are present, flesh has low-moderate contaminant concentrations present
	Water column contaminant values typically between ANZWQG 80% and 90%species protection levels and/or scored as 'Marginal' on a recognised WQI
	Water quality compromised by some toxicants in concentrations above effects thresholds

[15] ANZG (2018) Australian and New Zealand Guidelines for Freshwater and Marine Water Quality (replaced previous ANZECC guidelines).

	Fish community depleted with low species richness, diversity and abundance
	No *Threatened* or *At Risk* marine species present
	No *Threatened* ecosystem present
	Native estuarine vegetation and/or macroalgae community provides minimal/limited habitat for native fauna.
	Nuisance phytoplankton or macroalgal blooms may occur commonly over a moderate scale
	Physical habitat highly modified
MODERATE	Benthic invertebrate community typically has moderate species richness, diversity and abundance for the habitat type
	Benthic invertebrate community has both (organic enrichment and mud) tolerant and sensitive taxa present E.g. rated as 'Fair' using the AC BHM or similar index
	Few invasive opportunistic and/or disturbance tolerant species present
	Marine sediments typically comprise less than <60% silt and clay grain sizes or rated as 'Fair' using the AC BHMmud or similar index
	Shallow depth of oxygenated surface sediment to 1-2 cm depth
	Annual average sedimentation rates typically less than 5 mm above background levels
	Contaminant concentrations in surface sediment generally below DGV
	Where shellfish are present, flesh has low contaminant concentrations present
	Water column contaminant values typically between ANZWQG 90% and 95% species protection levels and/or scored as 'Fair' on a recognised WQI
	Fish community typically has moderate species richness, diversity and abundance
	Few *Threatened* or *At Risk* marine species present
	Few *Threatened* ecosystems present
	Native estuarine vegetation and macroalgae community dominated by native species and provides moderate habitat for native fauna
	Nuisance phytoplankton or macroalgal blooms may occur sporadically over a moderate spatial scale
	Physical habitat modification limited
HIGH	Benthic invertebrate community typically has high diversity, species richness and abundance for the habitat type
	Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and mud. E.g. rated as 'Good' using the AC BHM or similar index
	Invasive opportunistic and/or disturbance tolerant species largely absent
	Marine sediments typically comprise <40% silt and clay grain sizes or rated as 'Good' using the AC BHMmud or a similar index
	Surface sediment oxygenated up to 5 cm depth
	Annual average sedimentation rates typically less than 2 mm above background levels
	Contaminant concentrations in surface sediment rarely exceed DGV concentrations
	Where shellfish are present, flesh has no contaminant concentrations present or not above laboratory detection limits

	Water column contaminant values typically between ANZWQG 95% and 99% species protection levels and/or scored as 'Good' on a recognised WQI
	Fish community typically has high diversity, species richness and abundance
	Native estuarine vegetation or macroalgae community dominated by native species and provides high quality habitat for native fauna
	Nuisance phytoplankton or macroalgal blooms may occur infrequently at a limited spatial scale
	Threatened or *At Risk* marine species present
	Threatened ecosystem types present
	Physical habitat largely unmodified
VERY HIGH	Benthic invertebrate community typically has very high diversity, species richness and abundance for the habitat type
	Benthic invertebrate community contains dominated taxa that are sensitive to organic enrichment and mud e.g. rated as 'Excellent' using the AC BHM[16] or similar index
	Invasive opportunistic and disturbance tolerant species absent[17]
	Marine sediments typically comprise < 20% silt and clay grain sizes[18] (mud) or rated as 'Excellent' using the AC BHMmud or similar index
	Surface sediment oxygenated to >5 cm depth[19] with no anoxic sediment present
	Annual average sedimentation rates typically less than 1 mm above background levels [20]
	Contaminant concentrations in surface sediment significantly below DGV
	Water column contaminant values typically at or better than ANZWQG 99% species protection level and/or scored as 'Excellent' on a recognised Water Quality Index (WQI)[21]
	Fish community typically has very high diversity, species richness and abundance[22]
	Threatened ecosystems present
	Native estuarine vegetation or macroalgae community intact and provides significant habitat for native fauna
	No evidence of nuisance phytoplankton or macroalgal blooms[19]
	Threatened or *At Risk* marine species present
	Threatened ecosystems present
	Physical habitat unmodified

[16] Hewitt, J E., Lohrer, A M and Townsend, M (2012). Health of estuarine soft-sediment habitats: continued testing and refinement of state of the environment indicators. Prepared by NIWA for Auckland Council. Auckland Council technical report, TR2012/012

[17] https://www.marinebiosecurity.org.nz/

[18] Silt and clay percentage of sediment adjusted to be consistent with BHMud Model.

[19] Robertson, B.M, Stevens, L., Robertson, B., Zeldis, J., Green, M., Madarasz-Smith, A., Plew, D., Storey, R., Oliver, M. 2016. NZ Estuary Trophic Index Screening Tool 2. Determining Monitoring Indicators and Assessing Estuary Trophic State. Prepared for Envirolink Tools Project: Estuarine Trophic Index, MBIE/NIWA Contract No: C01X1420. 68p.

[20] Townsend and Lohrer (2015). ANZECC Guidance for Estuary Sedimentation. Prepared for Ministry for the Environment by NIWA.

[21] E.g., Ingley, R (2021). Coastal and estuarine water quality state and trends in Tāmaki Makaurau / Auckland 2010-2019. State of the environment reporting. Auckland Council technical report, TR2021/02.

[22] https://www.mpi.govt.nz/legal/legislation-standards-and-reviews/fisheries-legislation/maps-of-nz-fisheries/

Table 5: Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018).

MAGNITUDE	DESCRIPTION
VERY HIGH	Total loss of, 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; AND/OR Loss of a very high proportion of the known population or range of the element / feature.
HIGH	Major loss or major alteration to key elements/ features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element / feature.
MODERATE	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element / feature.
LOW	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances/patterns; AND/OR Having a minor effect on the known population or range of the element / feature.
NEGLIGIBLE	Very slight change from existing baseline condition. Change barely distinguishable, approximating to the "no change" situation; AND/OR Having a negligible effect on the known population or range of the element / feature.

Table 6: Based on the criteria for describing the level of effect (Roper-Lindsay et al., 2018)

LEVEL OF EFFECT		ECOLOGICAL AND / OR CONSERVATION VALUE				
		Very High	High	Moderate	Low	Negligible
MAGNITUDE	Very High	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

5 Existing Environment

Chapter Summary
• *Survey of stormwater receiving sites and bridge structural element sites in the CMA revealed Low ecological values, which is common in upper estuary habitats with common benthic invertebrate infaunal taxa, few epifaunal invertebrates, dominance of silt and clay sediment, elevated stormwater contaminants at some sites (e.g. most sites surveyed for sediment contaminants revealed concentrations of zinc above DGV or GV), native saline vegetation (mangroves) and coastal edge and riparian vegetation that is largely dominated by exotic weed species with minimal native vegetation present.*
• *Native coastal avifauna ecological values range from Low to High. High ecological values could be present with (unconfirmed) At Risk banded rail potentially foraging in mangrove habitat.*

5.1 Stormwater Outfalls: Vegetation and Coastal Avifauna Habitat

The AUP(OP) (SEA-M2 45b Schedule 4) states that the mangrove areas of Pakuranga Creek are regarded as the best example of mangrove habitat in the Tāmaki Estuary.

Vegetation removal (coastal and riparian (freshwater)) within the CMA is required to install some of the bridge structures and stormwater outfalls proposed. A total of approximately 400 m^2 of coastal vegetation is anticipated to be removed for the temporary and permanent stormwater outfall works (sum of vegetation removal at outfalls 01A-1, MCC-108479, 09-1 and MCC 108409) (Table 7).

The stormwater receiving environments were assessed for coastal avifauna breeding and foraging habitat. No breeding habitat was identified, although mangrove stands were identified as providing foraging habitat (Table 7).

Coastal and riparian margins of stormwater receiving environments comprised predominantly exotic pest plant vegetation, with minimal indigenous vegetation (excluding mangroves) at most sites (Table 7). In addition, rubbish was common at many sites.

Table 7: Coastal and Riparian Vegetation and Coastal Avifauna Surveys

BRIDGE STRUCTURAL LOCATIONS / STORMWATER OUTFALL NUMBER	DATE SURVEYED	NATIVE VEGETATION PRESENT	EXOTIC VEGETATION PRESENT	AREA OF VEGETATION WITHIN CMA TO BE REMOVED (TEMPORARY AND PERMANENT)	COASTAL AVIFAUNA BREEDING HABITAT	COASTAL AVIFAUNA FORAGING HABITAT
Site 3 (see Figure 5 and Photo 1)	3/10/2018	Mangroves (manawa) (*Avicennia marina* var. *australisica*) – c. 1.5-2m tall. Some native planting on the true right bank.	Wattle *(P. lophantha*), tree privet (*L. lucidum*).		No	Yes
Site 4 (see Figure 5 and Photo 2)	3/10/2018	Mangroves (manawa) (*Avicennia marina* var. *australisica*) – c. 1.5-2m tall. Pohutukawa (*Metrosideros excelsa)*, mahoe, cabbage tree (*Cordyline australis*), saltmarsh ribbonwood *(Plagianthus divaricatus)* and glasswort (*Salicornia quinqueflora).*	Wattle *(P. lophantha*), tree privet (*L. lucidum*).		No	Yes
Site 7 (see Figure 5 and Photo 3)	29/08/2022	Mangroves (manawa) (*Avicennia marina* var. *australisica*) – c. 1.5-2m tall, surrounding bankside vegetation includes pohutukawa (c.15m tall), mahoe, cabbage tree, kanuka, red mapou, karamu, bracken, *Muelenbeckia complexa*, taupata, flax, and karo. Occasional scattered coastal plants along the estuarine/terrestrial margin e.g. saltmarsh ribbonwood, *Carex secta*, *Carex geminata*, glasswort, other finer Carex that couldn't be identified.	Gorse, pampas grass, mahoe, tree privet, Chinese privet, tuber ladder fern, climbing asparagus, blackberry, boneseed, moth plant, Eucalyptus, Convolvulus. All occasional except climbing asparagus, tuber ladder fern and Convolvulus which were rarely present. Surrounding vegetation ~8-10m in height. Ground story of herbaceous exotic weed species and exotic grasses.		No	Yes
Site 8 (see Figure 5 and Photo 4)	29/08/2022	Mangroves (manawa, *Avicennia marina* var. *australisica*) – c. 1.5-2m tall.			No	Yes

BRIDGE STRUCTURAL LOCATIONS / STORMWATER OUTFALL NUMBER	DATE SURVEYED	NATIVE VEGETATION PRESENT	EXOTIC VEGETATION PRESENT	AREA OF VEGETATION WITHIN CMA TO BE REMOVED (TEMPORARY AND PERMANENT)	COASTAL AVIFAUNA BREEDING HABITAT	COASTAL AVIFAUNA FORAGING HABITAT
Site 9 (see Figure 5 and Photo 5)	29/08/2022	Mangroves (manawa, *Avicennia marina* var. *australisica*) – c. 1.5-2m tall.			No	Yes
Site 10 (see Figure 5 and Photo 6)	29/08/2022	Mangroves (manawa, *Avicennia marina* var. *australisica*) – c. 1.5-2m tall.			No	Yes
01A-1 (new outfall) (see Figure 6 and Photo 7)	23/09/2022	Mangroves (manawa, *Avicennia marina var. australisica*), cabbage tree (*Cordyline australis*), mahoe (*Melicytus ramiflorus*)	Wattle (*P. lophantha*), tree privet (*L. lucidum*).	100m^2	No	Yes
MCC-108479 (upgraded outfall) (see Figure 6 and Photo 8)	23/09/2022	mangroves (manawa, *Avicennia marina var. australisica*), red mapou (*Myrsine australis*), mahoe (*Melicytus ramiflorus)*, bracken fern (*Pteridium esculentum*)	Tree privet (*L. lucidum*), blackberry (*Rubus fruticosus* agg.), gorse (*Ulex europaeus*), Pampas (*Cortaderia selloana*),	100 m^2	No	Yes
09-1 (new outfall) (see Figure 6 and Photo 9)	23/09/2022	Mangroves (manawa, *Avicennia marina* var. *australisica*). NB: Lots of big boulders / rock	Tree privet (*L. lucidum*), jasmine (*Parsonsia heterophylla*)	100 m^2	No	Yes
MCC- 108409 (upgraded outfall) (see Figure 6 and Photo 10)	23/09/2022	Mangroves 10m downstream of marker), saltmarsh ribbonwood/Makaka (*Plagianthus divaricatus*), kowhai (*Sophora microphylla*), *Carex secta*, flax/Harakeke, (*Phormium tenax*) slender club rush (*Isolepis cernua*). Very urban site – lots of existing rock scour protection. Hebe stricta common.	Tree privet (*L. lucidum*), pine tree (*Pinus* spp.), pampas (*Cortaderia selloana*)	100 m^2	No	Yes

BRIDGE STRUCTURAL LOCATIONS / STORMWATER OUTFALL NUMBER	DATE SURVEYED	NATIVE VEGETATION PRESENT	EXOTIC VEGETATION PRESENT	AREA OF VEGETATION WITHIN CMA TO BE REMOVED (TEMPORARY AND PERMANENT)	COASTAL AVIFAUNA BREEDING HABITAT	COASTAL AVIFAUNA FORAGING HABITAT
		Freshwater flowing beneath mangroves				

Photo 1: Site 3 adjacent to true right abutment of existing bridge across Pakuranga Creek.

Photo 2: Site 4 adjacent to true left abutment of existing bridge across Pakuranga Creek.

Photo 3: Site 7 adjacent to location of Bridge B.

Photo 4: Site 8 adjacent to location of Bridge B.

Photo 5: Site 9 adjacent to location of Bridge B.

Photo 6: Site 10 adjacent to Bridge B.

Photo 7: Adjacent to new 01A-1 SW Outfall (Figure 6).

Photo 8: Adjacent to MCC-108479 upgraded SW Outfall (Figure 6).

Photo 9: Adjacent to new 09-1 SW Outfall (Figure 6).

Photo 10: Adjacent to MCC-108409 upgraded SW Outfall (Figure 6).

5.2 Benthic Infaunal Invertebrate Community

5.2.1 Bridge Structural Elements

The benthic invertebrate assemblages at all sites were largely dominated by oligochaete worms, estuarine gastropods (*Potamopyrgus estuarinus* and *Amphibola crenata*) and amphipods (Figure 8). These are typical common species present in mangrove stands.

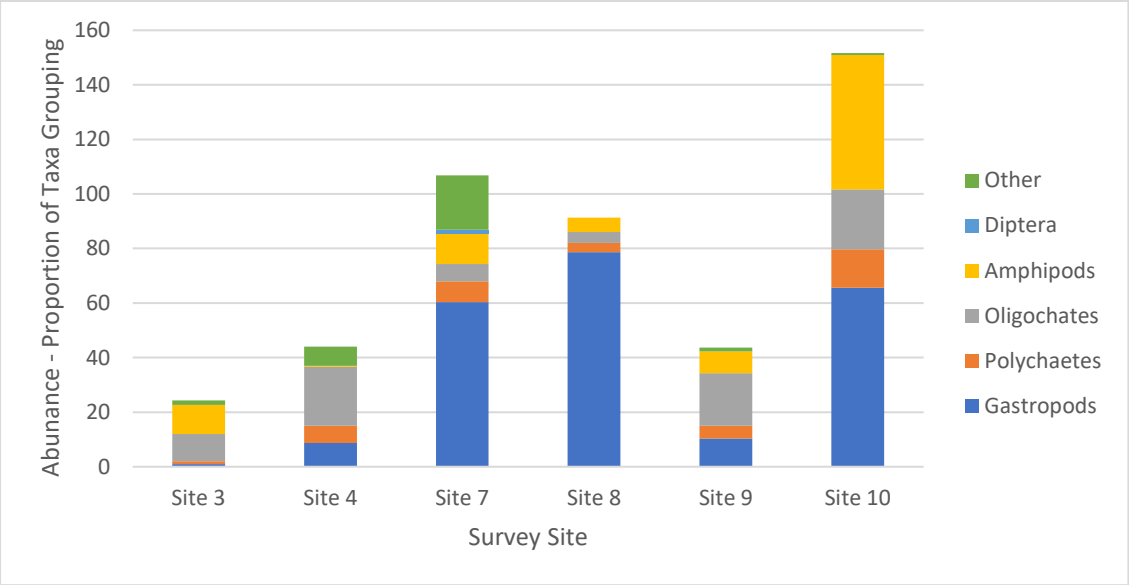

Figure 8: Proportion of main taxa groups by abundance at each structural works site (refer to Figure 5 for site locations).

Abundance of benthic invertebrates ranged between an average of approximately 20 individuals at structural works Site 3, to 150 at Site 10 (Figure 9: Average abundance of benthic invertebrates at structural works).

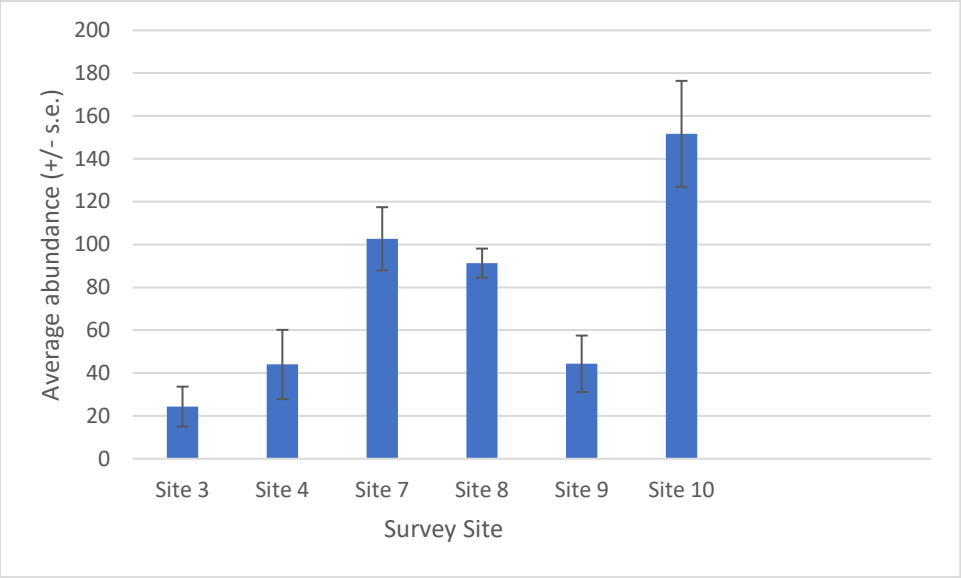

Figure 9: Average abundance of benthic invertebrates at structural works (refer to Figure 5 for site locations).

Average species richness was lowest at structural works Site 3 and highest at Site 7 (Figure 10).

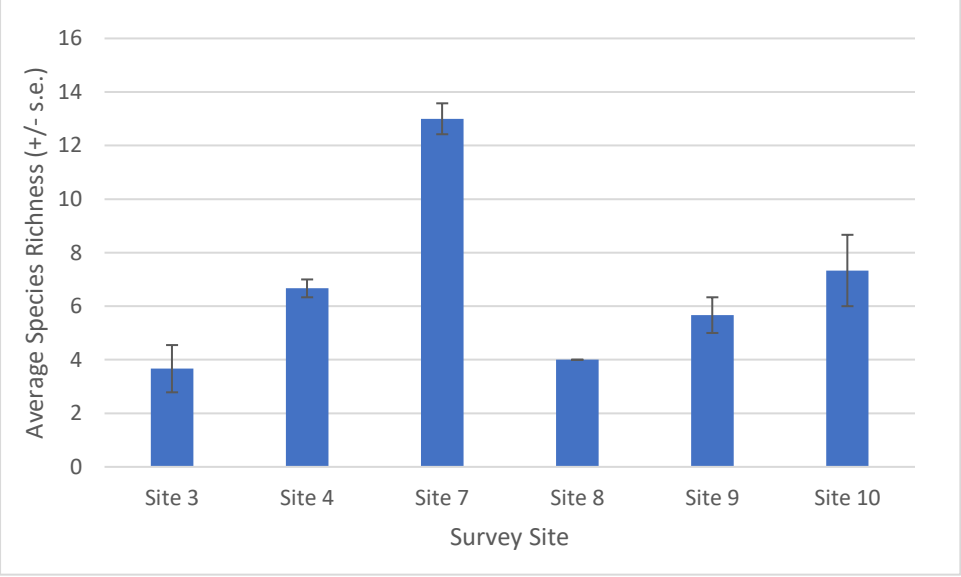

Figure 10: Average species richness of benthic invertebrates at structural works sites (refer to Figure 5 for site locations).

Average Shannon-Wiener diversity varied from low (0.4 at structural works Site 10) to moderate/high diversity (approximately 1.8 at Site 7) (Figure 11).

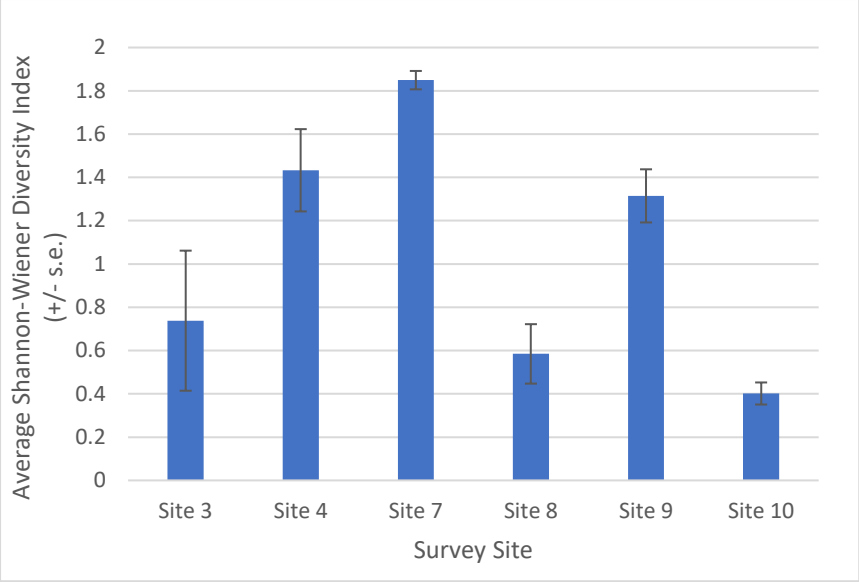

Figure 11: Average Shannon-Wiener diversity of benthic invertebrate communities at structural works sites (refer to Figure 5 for site locations).

The difference in benthic invertebrate assemblages at selected bridge structural elements sites is shown in the Multi-Dimensional Scaling (MDS) Plot[23] below (Figure 12), with most sites clustered separately, particularly Sites 7-10 (Figure 5) adjacent to the proposed location of Bridge B and the habitat adjacent to the existing bridge abutments over the Pakuranga Creek (near the proposed location of Bridge A).

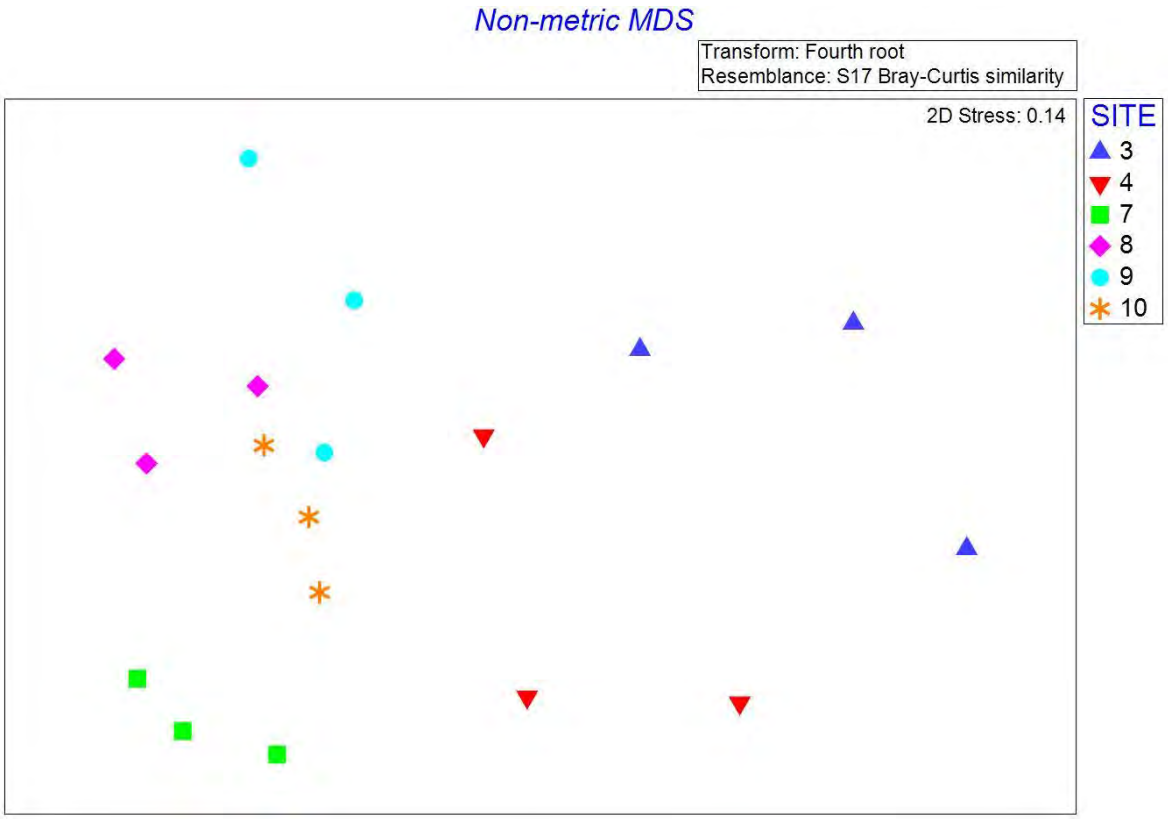

Figure 12: MDS of benthic community composition at bridge structural element sites.

[23] Using Primer E multivariate statistical software

5.2.2 Stormwater Outfall Sites

The average number of benthic invertebrate individuals ranged between approximately 50 at outfalls 01A1 and MCC-108479 (Figure 6) and approximately 150 per core at outfalls 09-1 and MCC-108409 (Figure 13). The number of taxa varied between 8 and 14 at the surveyed stormwater outfall sites (Figure 14).

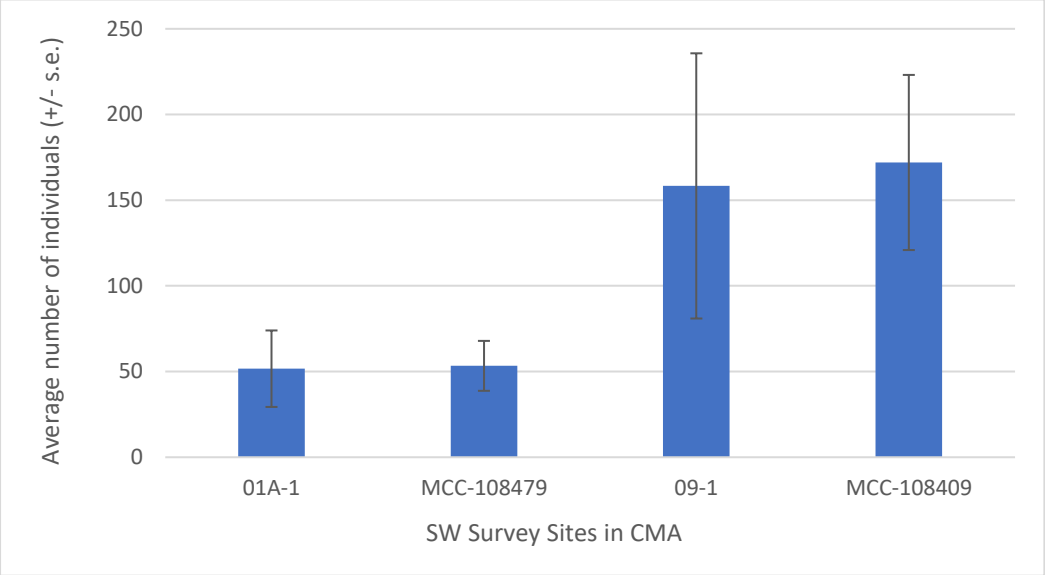

Figure 13: Average number of individuals at stormwater sites in CMA (refer to Figure 6 for site locations).

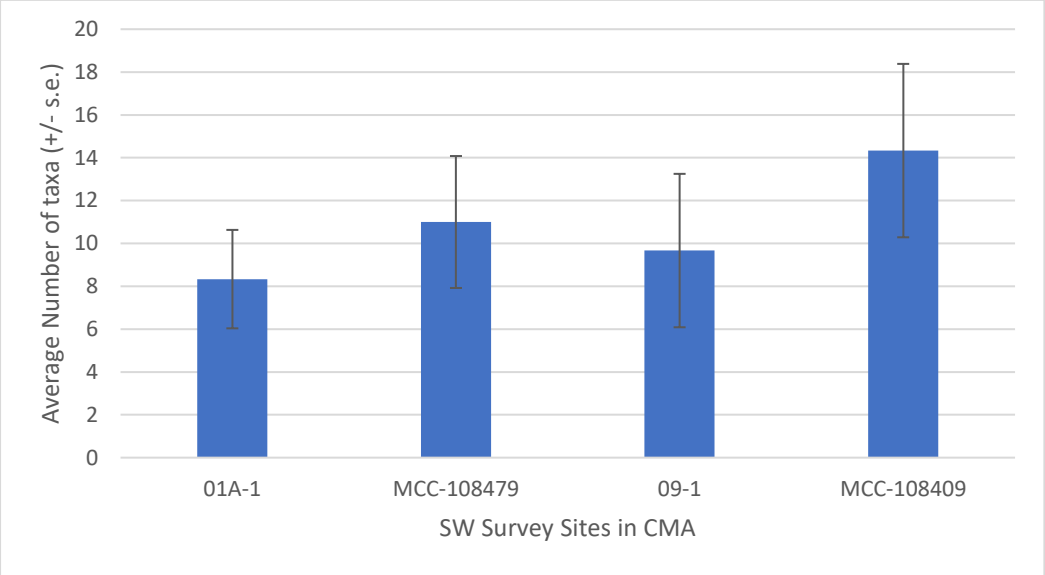

Figure 14: Average proportion of number of taxa at stormwater sites in CMA (refer to Figure 6 for site locations).

Shannon Wiener Diversity was lowest at outfall 09-1 (<1), with the other three sites having an index of around 1.5 (Figure 15). Most sites contained a range of gastropods, bivalves, amphipods and some oligochaete worms, whereas site 09-1 was dominated by oligochaete worms (Figure 16).

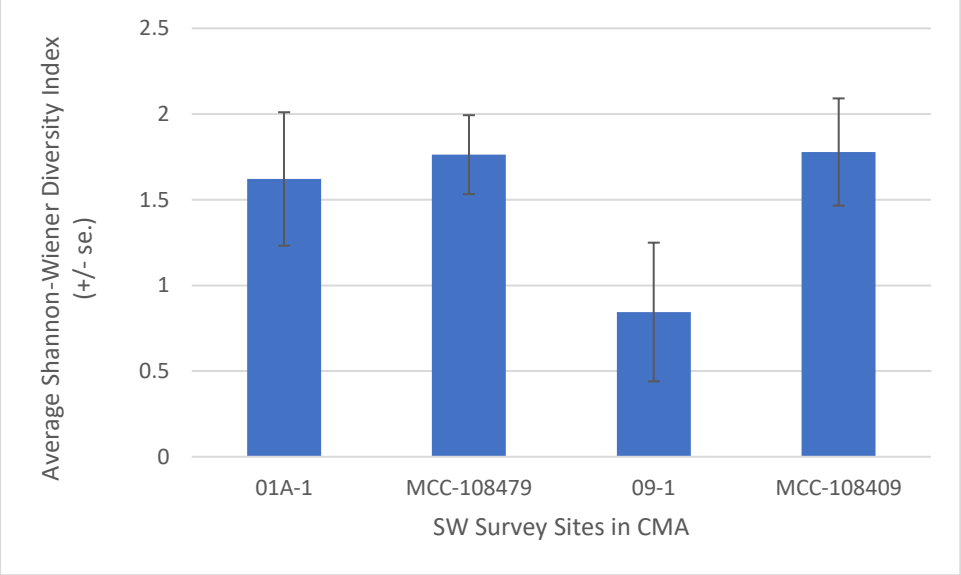

Figure 15: Average Shannon-Wiener Diversity Index at stormwater sites in CMA (refer to Figure 6 for site locations).

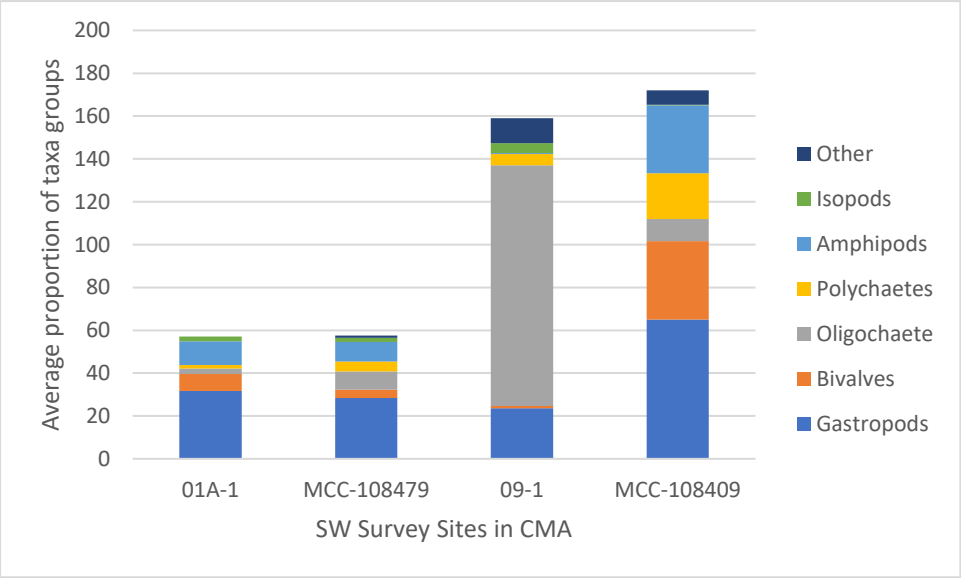

Figure 16: Average proportion of taxa groups at stormwater sites in the CMA (refer to Figure 6 for site locations).

The difference in benthic invertebrate assemblages at selected stormwater outfall sites is shown in the Multi-Dimensional Scaling (MDS) Plot[24] below (Figure 17), with no obvious pattern or grouping of samples.

[24] Using Primer E multivariate statistical software

Figure 17: MDS of benthic communities at new/upgraded stormwater outfalls (refer to Figure 6 for site locations).

5.3 Epifaunal Communities

Representative photographs of benthic habitat at surveyed Bridge structural elements (Photo 11 to Photo 16) and new/upgraded stormwater outfall sites (Photo 17 to Photo 20) are included below. Sunlight exposed sites exhibited extensive mangrove seedling and pneumatophores and some gastropods (*Potamopyrgus estuarinus*). Although not captured in the quadrat photographs collected *Amphibola crenata* (mud snail) were present at some sites along with mangrove stands.

Photo 11: Site 3 – Crab and worm holes.

Photo 12: Site 4 – Mangrove pneumatophores and Potamopyrgus estuarinus.

Photo 13: Site 7 – Mangrove pneumatophores and seedlings, and Potamopyrgus estuarinus.

Photo 14: Site 8 – Mangrove seedlings, pneumatophores and leaf litter.

Photo 15: Site 9 – Mud crab burrows, mangrove pneumatophores and seedlings.

Photo 16: Site 10 – Mud crab burrows, and mangrove pneumatophores and seedlings.

Photo 17: Adjacent to new outfall 01A-1 SW Outfall (Figure 6).

Photo 18: Adjacent to MCC-1085479-2 upgraded SW Outfall (Figure 6).

Photo 19:Adjacent to new outfall 09-1 SW Outfall (Figure 6).

Photo 20: Adjacent to new outfall 10-1 SW Outfall (Figure 6).

5.3.1 Sediment Quality and Grain Size

Surface sediment at all sites was dominated by silt and clay and had shallow depth of oxygenated sediment (Figure 18 and Figure 19). Silt and clay at all sites were >50% for structural works sites (Figure 18). For the stormwater sites, Site 01A-1 and MCC-108409 silt and clay was >50%, whereas Sites MCC-108479 and SW 09-1 comprised <30% and c.15% respectively (Figure 19). A high proportion of silt and clay is typical of upper estuarine depositional environments.

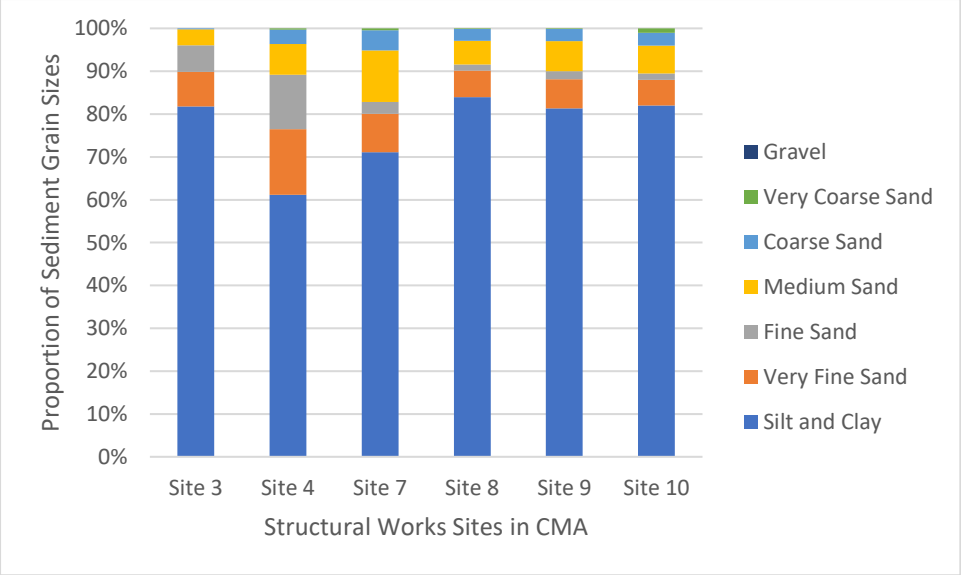

Figure 18: Proportion of sediment grain size distribution in surface sediment at structural works sites (refer to Figure 5 for site locations).

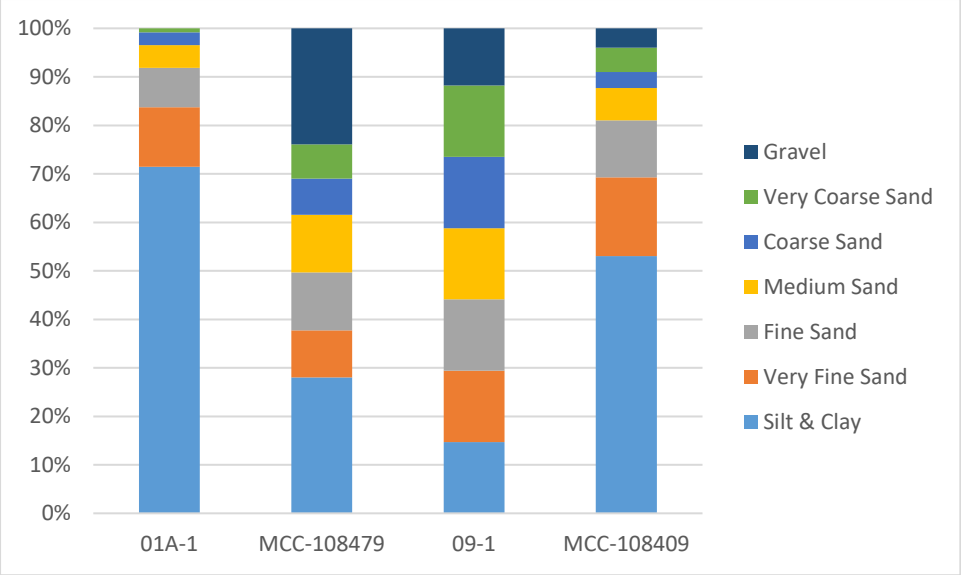

Figure 19: Proportion of sediment grain size distribution in surface sediment at stormwater outfall sites (refer to Figure 6 for site locations).

Copper was detected above DGV at structural bridge work Site 10 and stormwater outfalls MCC-108479 and 9-01 & MCC 108480 (Table 8). Lead was also found above DGV at structural bridge works Site 10. Zinc was found above the higher DGV at structural Sites 3 and 4 and stormwater Sites 01A-1 and MCC108409, and above GV at structural bridge works Site 10 and stormwater outfalls MCC-108479 and 9-01 & MCC 108480. Overall, structural bridge works Site 10 had the highest concentration of zinc at 690 mg/mg (Table 8).

Table 8: Common stormwater contaminants (metals) in surface sediment recorded at the structural bridge work sites (Figure 5) and stormwater outfall sites (Figure 6).

STORMWATER CONTAMINANTS	STRUCTURAL BRIDGE WORK SITES						STORMWATER OUTFALL SITES				GUIDELINES	
	3	4	7	8	9	10	01A-1	MCC108479	9-01 MCC 108480	MCC 108409	DGV[25]	GV[9]
Copper (mg/kg)	36	31	51	34	37	87	32	69	67	30	65	270
Lead (mg/kg)	40	31	43	36	36	51	30	30	32	24	50	220
Zinc (mg/kg)	270	210	480	220	280	690	280	490	580	220	200	410

5.4 Coastal Avifauna/Manu

Pakuranga Creek is an estuarine arm of the Tāmaki River. Tāmaki River is utilised by a range of New Zealand resident and migratory shore birds, with the mid-to-lower reaches being particularly important due to the availability of roosting and feeding areas (Kelly, 2008). The marine environment of the Tāmaki River includes Significant Ecological Areas (SEAs). SEA-M2-45b lies within the EB3C Project Footprint and ZOI and is recognised as the best example of mangrove habitat in the Tāmaki Estuary. Four other SEAs, related specifically to birds, are near EB3C but are located outside of the Project Footprint and ZOI for this Project. These SEAs have been identified for their wading bird values (Figure 5). SEA-M1-45a (Pakuranga Creek roost) is a roosting site used by hundreds of wading birds that feed within the Tāmaki River, while SEA-M2-45w1 (wading bird habitat), SEA-M2-45w2 (wading bird habitat) and SEA-M2_45c (Otahuhu Creek) provide extensive areas of feeding habitat for wading birds along the

[25] Orange cells are above the DGV guideline value, whereas red cells are above the GV guideline value (Australian and New Zealand Governments, 2018).

coastline. For the majority of wading and shorebird species utilising the Tāmaki River, this will form part of a wider network of coastal and estuarine habitats that they use depending on the time of year and tidal sequence (Dowding & Moore, 2006).

A list of all species recorded in the Ornithological Society of New Zealand (OSNZ) atlas square encompassing the existing Tī Rākau Drive bridge (Bridge A) and surrounding Project area (as shown on Figure 7) is provided in Appendix 1. This list also includes native coastal bird species observed during the site visits.

The coastal / estuarine environment within the ZOI provides, or potentially provides, primary or secondary habitat for five of the species recorded in the atlas square, one of which is classified as *At Risk* (banded rail, Table 9). The mangrove-dominated area within the ZOI does not provide foraging habitat for gulls, oystercatchers, shags, stilts, dotterels, or terns as they forage in open areas such as channels and intertidal mudflats (which have little to no vegetative cover). The dense mangrove habitat within the ZOI also does not provide roosting or nesting habitat for these species.

White-faced heron (*Not Threatened*) was the only coastal species observed within the ZOI during the site visits. Other native bird species recorded, which can be found in coastal habitats, included kingfisher, paradise shelduck and pukeko (all classified as *Not Threatened*). Black-backed gulls were also observed but beyond the Project Footprint. No shorebirds were observed during the site visits despite it being low tide on all survey occasions.

Searches were also carried out for banded rail footprints in the mangrove habitat where they would typically forage, and playback surveys were conducted to potentially illicit a response from any birds in the area. However, no banded rail footprints were located and there were no responses to the playback calls.

Table 9: Threat status of species for which the coastal / estuarine ZOI in EB3C combined provides, or potentially provides, primary or secondary habitat.

Species	Māori name	Threat status (H. A. Robertson et al., 2021)	Recorded During Site Visits (Yes / No)
Banded rail	Mioweka	At Risk – Declining	No
White-faced heron	Matuku	Not Threatened	Yes
Paradise shelduck	Putangitangi	Not Threatened	Yes
Sacred kingfisher	Kotare	Not Threatened	Yes
Pūkeko	Pūkeko	Not Threatened	Yes

5.5 Summary of Ecological Values

Assessment of ecological value is guided by the parameters in Table 3 (coastal avifauna) and Table 4 (for marine ecology).

The following contains the marine ecological criteria/parameters applicable to this Project (from Table 4), indicating overall Low ecological value, on balance, regardless of the marine environment being within AC SEA-M2 45b:

Low Ecological Values

Marine sediments dominated by silt and clay grain sizes (>60%)	✓
Surface sediment predominantly anoxic (lacking oxygen)	✓
Sediment bound contaminants are often detected DGV for copper, and DGV and GV for Zinc	✓
No Threatened or At Risk marine species present	✓
No Threatened ecosystem present	✓

Moderate Ecological Values

Native estuarine vegetation and macroalgae community dominated by native species (mangroves) and provides moderate habitat for native fauna (SEA-M2 45b)	✓
Physical habitat modification limited	✓

5.5.1 Marine Ecology

All marine environments associated with the temporary and permanent occupation of the CMA for bridge structures, CMA stormwater outfalls and the retaining wall (RW304) had an overall ecological value of Low. The basis for this determination is outlined in the following sections:

Bridge structural elements (3-10) were characterised by common benthic invertebrates (infauna and epifauna), high proportion of silt and clay in benthic sediment, somewhat modified habitats, and on average low sediment contaminant concentrations (excluding site 10).

Site 10 (Figure 5) had copper and lead concentrations exceeding DGV values, and zinc exceeding GV. Sites 3, 4, 7, 8, 9 had contaminant concentrations in sediment below DGV values (excluding zinc at sites 3 and 4 which was above DGV) (Table 8).

Overall, ecological values at all Bridge structural sites (3-10) were assessed as Low.

Stormwater outfall 01A-1 is mangrove habitat with exotic and native shrubs on the margins, moderate benthic invertebrate abundance (dominated by gastropods, bivalves and amphipods; Figure 16), moderate species richness (n=8) and moderate Shannon-Wiener diversity (>1.5; Figure 15), sediments comprising >70% silt and clay (Figure 19), the concentration of zinc above DGV (Table 8), and modified habitat. Overall, marine ecological values are assessed as Low.

Stormwater outfall MCC-108479 is a mangrove habitat with no other marine vegetation, benthic invertebrate abundance low (dominated by gastropods, bivalves and amphipods; Figure 6), species richness approximately 11, Shannon-Wiener moderate at 1.75 (Figure 15), silt and clay <20% (Figure 19), zinc above GV and copper above DGV (Table 8), less modified site compared to other outfalls. Overall, this outfall is assessed to have Low ecological values.

Outfall 09-1 is a mangrove habitat. Zinc concentration in sediment is above GV value and copper is above DGV (Table 8). Moderate benthic invertebrate abundance (dominated by gastropods, bivalves and amphipods; Figure 16), moderate species richness (>10) and moderate Shannon-Wiener diversity (<1.0; Figure 15), sediments comprising approximately 15% silt and clay (Figure 19). Riparian vegetation is mostly exotic with some native species (Table 7) and no avifauna breeding/foraging habitat. Overall, ecological values are determined to be Low.

Outfall MCC-108409 is a mangrove habitat receiving environment. Zinc concentration in sediment is above DGV value. (Table 8). Moderate benthic invertebrate abundance (dominated by gastropods, bivalves and amphipods; Figure 16), moderate species richness (<14) and moderate Shannon-Wiener diversity (1.75; Figure 15), sediments comprising >50% silt and clay (Figure 19). Riparian vegetation (mostly exotic and some native; Table 7) and no avifauna breeding/foraging habitat. Overall, Low ecological values.

Overall, loss of marine vegetation during construction (both temporary and permanent) will total 1,180m^2, including:

- 100m^2 for each of the stormwater outfalls (400m^2 in total)
- 710m^2 for the construction of bridge structures[26],
- 70m^2 for the temporary works associated with the retaining wall (RW304) supporting a 4m^2 permanent reclamation

Overall, permanent loss of marine vegetation will total 782m^2, including:

- 25m^2 for each of the stormwater outfalls (100m^2 in total)
- 678m^2 for the permanent bridge piers, embankment reclamation, and abutments[27]
- 4m^2 permanent loss for the reclamation supported by the retaining wall (RW304)

The permanent bridges will sit above approximately 1,590m^2 of marine vegetation. There is potential for shading effects from the new bridge structures as well as the temporary construction staging platforms. This is addressed in section 6 of this assessment.

5.5.2 Coastal Avifauna

The ZOI lies within SEA-M2-45b which is noted in the AUP(OP) as the best example of mangrove habitat in the Tāmaki Estuary. The ZOI is outside of, but in close proximity, to four marine SEAs identified for wading bird values. With the exception of white-faced heron (a *Not Threatened* species), no wading bird species were observed foraging or roosting in that area during site visits at low tide. However, *Threatened* and *At Risk* coastal species have been recorded in the wider marine environment (Appendix 1).

[26] This includes vegetation clearance for abutments, piles and scour protection and 549m^2 of reclamation for Bridge B and vegetation clearance associated with the temporary construction staging bridges.

[27] The calculation includes the 549m^2 reclamation for Bridge B.

No potential breeding habitat for banded rail was identified along the estuarine margins of EB3C's footprint. No banded rail birds or footprints were observed during the surveys conducted, but given their cryptic nature they could occasionally be present in the ZOI. It is likely that this species forages in the mangroves in the wider marine environment. Based on this species having an *At Risk – Declining* classification, it is assigned a High Ecological Value according to the EIANZ criteria (Table 3).

Accordingly, this assessment assumes that EB3C's ZOI does provide potential foraging habitat for native coastal avifauna species with species ecological values ranging from Low (*Not Threatened*) to High (*At Risk – Declining*).

6 Assessment of Effects on Marine Ecology and Coastal Avifauna Ecology

Chapter Summary

Potential Effects of Construction:

- *The construction of permanent bridge structures, including the establishment of temporary staging structures in the CMA and reclamation (549m^2), will generate direct effects on marine ecological values within small areas of the CMA. The key effects are associated with occupation (temporary and permanent) of the CMA (including reclamation), coastal vegetation removal and habitat disturbance. Overall, the construction-related effects are considered to have a Low overall effect level on marine ecology.*
- *There will also be temporary shading during the construction period of mangroves from the temporary staging platforms.*
- *New or upgraded stormwater outfalls are proposed within the CMA. Stormwater outfall locations are assessed as having Low ecological value overall, and the temporary construction-related occupation (400m^2 in total) has been assessed as having a Low magnitude of effect on ecological values.*
- *Removal of vegetation for some outfalls and occupation of CMA for some outfalls/dissipation structures is proposed (Figure 6).*
- *Construction of a retaining wall involving reclamation associated with Bridge A (RW304) will result in the permanent loss of 4m^2 of the CMA.*
- *Remobilisation of contaminants bound in sediment during earthworks or vegetation removal is an environmental risk that can be appropriately managed through using best practice erosion and sediment control devices including coffer dams or bunds.*
- *Loss of coastal avifauna foraging habitat (mangroves) as a result of vegetation removal for some outfalls / dissipation structures and occupation of CMA for bridge structures (Bridge A and B), is considered to have a Very Low overall level of effect on avifauna values given the small quantities of vegetation / habitat being removed relative to the vast amount of mangrove habitat present, and that will remain, in the wider area.*
- *Potential avifauna habitat disturbance and displacement during construction works is considered to have a Very Low overall level of effect on avifauna given the small and temporary nature of the works as well as the abundance of alternative, nearby habitat available for avifauna to utilise if disturbed or displaced during works for EB3C.*
- *Impacts on foraging ability and food supply due to increased sediment and remobilisation of contaminants currently bound in sediment during earthworks or vegetation removal are considered to have Very Low levels of effects on coastal avifauna values.*
- *The cumulative effects of construction activities on marine ecological values is assessed as a Moderate magnitude of effect. Combined with Low ecological values, the overall level of effect (according to the EIANZ assessment guidelines) is Low. For coastal avifauna, the cumulative effects of construction activities are assessed as a Low magnitude of effect. A Low magnitude of effect on Low-High values results in a Very Low - Low overall level of effect. Whilst not necessarily required under the EIANZ Guidelines, we recommend mitigation in the form of annual rubbish/debris removal, pest plant removal and native planting within the CMA and coastal margins of the EB3C Project area (continuing for three years post construction) (see details of locations and areas below).*

Potential Effects of Operation:

- *The bridges (A and B) will shade areas of mangrove, likely reducing the ability of the mangrove plants to fully thrive. This is considered to be a low magnitude of effect and a low level of effect.*
- *CLM indicates overall a reduction in copper, lead, zinc and TSS from new and upgraded stormwater outfalls, except for new outfall 01A-1 (which has an increase in total suspended sediment of 17% and 2% increase in other contaminants).*
- *The discharge of stormwater contaminants will reduce across the EB3C overall catchments due to treatment with gross pollutant traps and raingardens.*
- *Discharge of stormwater contaminants from EB3C to potential avifauna foraging habitat during operation is considered to have a Very Low overall level of effect on coastal avifauna.*
- *The effects of the Project operation will have Low overall level of effect on marine ecological values.*

- *In terms of marine ecology, the contribution of the Project's operation to the cumulative effects of benthic habitat loss and contaminant discharge and deposition, has a low magnitude of effect. Based on low ecological values, the level of effect on marine ecology is assessed as Low and mitigation is not required to manage the operation of EB3C contribution to cumulative effects. We do not consider mitigation is necessary for operational effects.*
- *For coastal avifauna, the contribution of the Project's operation to the cumulative effects of contaminant discharge and deposition on prey availability and contaminant body burden of prey has a Negligible magnitude of effect for all outfalls given that only a small proportion of prey items may be contaminated relative to food availability in the wider Pakuranga Creek and Tāmaki River foraging network. Based on Low to High coastal avifauna species ecological values, the potential overall level of effect of operation on coastal avifauna is assessed as Very Low and mitigation is not required for contribution to cumulative effects for EB3C.*

6.1 Effects of Construction

In our assessment of effects of construction, we have included consideration of permanent components (such as bridge structures and reclamation, new and upgraded stormwater outfalls in the CMA).

Construction of bridge structures within Pakuranga Creek and in the estuary adjacent to the Chinatown retail business (Sites 7-10; Figure 5) will occupy the CMA (temporary and permanent). Permanent occupation for the bridge piles will be 22m^2 (14m^2 for Bridge A and 8m^2 for Bridge B) (refer to Section 3.3.1 and 3.3.2). Permanent occupation for the Bridge A eastern abutment will be approximately 30m^2 and 64m^2 for the Bridge B northern abutment rip rap. Pile scour protection for Bridge A (if required by hydrodynamic modelling) will occupy approximately 147m^2 of benthic habitat. A 549m^2 reclamation is required for Bridge B. Permanent occupation for the four stormwater outfalls is 100m^2 (25m^2 per outfall). Permanent occupation for the reclamation supported by retaining wall RW3043 is 4m^2.

Temporary staging piles for Bridge A and Bridge B (estimated at 45m^2 for the staging bridges; Section 3.3.1 and 3.3.2) will be removed or cut below the surface sediment upon construction completion. Construction of the eastern abutment for Bridge A will disturb approximately 50m^2 of the CMA. A further 70m^2 of the CMA will be disturbed adjacent to the retaining wall (RW304; Section 3.3.3).

An area of 400m^2 within the CMA is required for the construction of four stormwater upgrades/new outfalls (100m^2 per outfall) (refer to Section 3.3.5).

6.1.1 Temporary Staging for Bridge Installation

Construction of temporary and permanent structures associated with the two bridges involves the loss of mangrove habitat (refer section 6.1.5) and habitat disturbance. Temporary occupation of the CMA for bridge staging will involve approximately 23m^2 and 22m^2 for Bridge A and Bridge B respectively. Upon completion of construction, removal of piles will be attempted. If this is not possible, the piles will be cut off below the benthic sediment surface. The magnitude of effect of temporary occupation of the CMA for staging for bridge installations and subsequent removal of staging piles is assessed as Low, given that the benthos will naturally rehabilitate itself over time once piles are removed. Applying the assessment approach set out in Table 6, the overall level of effect is determined to be Very Low (given the Low ecological values identified earlier in the assessment).

6.1.2 Shading of Mangroves by Temporary Bridge Staging

The area of mangroves beneath staging structures for Bridge A and Bridge B that will be temporarily shaded is 360 and 800m^2 respectively (Table 4, Construction Design Report)[28]. The shaded mangroves

[28] See 6.2.1 for shading of mangroves by permanent structures.

are likely to not thrive due to reduced light. However, the shading will be temporary, and the mangroves are expected to fully recover.

The magnitude of effect of the temporary shading of mangroves under the staging platforms associated with the construction of bridges is assessed as Low, with the level of effect being Very Low (based on Low ecological values).

6.1.3 Construction and Occupation of the CMA by Bridges A & B

The bridge piles (Bridge A and B) will disturb and permanently occupy 22m^2 of benthic habitat of the CMA. If hydrodynamic modelling indicates that scour protection of the piles is required, each pile in the CMA for Bridge A will have 6m radius of 700mm D50 riprap installed for scour protection. The total area of scour protection for Bridge A piles is estimated to be 147m^2 (if needed). Construction of an embankment for Bridge B will require reclamation of 549m^2 of the CMA.

A small area of the CMA will be permanently occupied by the scour protection for the eastern abutment of Bridge A (30m^2). Construction of the Eastern abutment will disturb approximately 50m^2.

Bridge maintenance will be informed by visual inspection approximately every two years of the top of the bridge, however bridge piers are designed to last the life of the bridge (Structures and Design Report) and do not require maintenance inspection.

The magnitude of effect of construction and permanent occupation for the bridge piles, scour protection, reclamation and the eastern abutment on the CMA is assessed as Low, with the level of effect being Very Low (based on Low ecological values).

6.1.4 Stormwater Discharge Structures

Construction of new and upgraded stormwater discharge structures and energy dissipation structures (rip rap) will involve permanent and temporary habitat loss within the CMA and habitat disturbance. Approximately 400m^2 of vegetation removal within the CMA will be required to install/modify four stormwater outfalls and dissipation structures (rip rap). The stormwater outfall structures will permanently occupy 100m^2 of the CMA (25m^2 each). The magnitude of effect of the vegetation removal for construction footprint of the new and upgraded stormwater installations in the CMA is assessed as Low, as the natural saline vegetation will re-establish the temporary clearance areas over time, with the level of effect being Very Low (based on Low ecological values).

6.1.5 Increased turbidity and remobilisation of contaminants in sediment through earthworks

Earthworks associated with the construction of new stormwater outfalls, modification of existing outfalls and vegetation removal in the ZOI may result in the remobilisation of some contaminants currently bound in receiving environment sediments. For avifauna, increased sediment loads may temporarily impact the ability of visual foragers to locate prey, and both sediment and contaminants may reduce their prey availability (fish and shellfish).

Best practice erosion and sediment control (ESC) methods will be implemented, in accordance with Auckland Council Guideline Document 2016/005 *Erosion and Sediment Control Guideline for Land Disturbing Activities in the Auckland Region* (GD05) (Erosion and Sediment Control Effects Assessment, 2022). Dirty and clean water will be separated through the use of temporary coffer dams or bunds (ESCP Assessment). Silt fences will be placed around any saline vegetation removal areas.

It is concluded that implementation of the proposed works methodology will minimise actual and potential adverse construction effects to a Negligible magnitude. As such, combining Low ecological values for marine ecology with a Negligible magnitude of effect results in a Very Low level of effect (see

Table 6). For coastal avifauna, with Low to High species values, and a Negligible magnitude of effect, the overall level of effect is determined to be Very Low.

6.1.6 Vegetation Removal within the CMA

Overall, loss of marine vegetation during construction (both temporary and permanent) will total 1,180m^2, including:

- 100m^2 for each of the stormwater outfalls (400m^2 in total),
- 710m^2 for the construction of bridge structures[29], and
- 70m^2 for the temporary works associated with the retaining wall (RW304) supporting a 4m^2 permanent reclamation.

Overall, permanent loss of marine vegetation will total 782m^2 (0.08ha):

- loss of 25m^2 for each stormwater outfall structure (100m^2 in total)[30],
- 678m^2 for the permanent bridge piers, reclamation, and abutments[31], and
- 4m^2 permanent loss for the reclamation supported by the retaining wall (RW304).

For vegetation removal, combining Low ecological values (despite recognition by AC as SEA-M2 45b) for marine ecology with a Low magnitude of effect results in a Very Low level of effect (

Table 6).

With regards to coastal avifauna, vegetation removal will result in loss of foraging habitat (primarily mangroves). Given the small area of total mangrove removal (782m^2 / 0.08 ha permanently and 1,180m^2 / 0.12 ha temporarily) relative to the large amount of coastal / marine vegetation (primarily mangrove) available in the wider Tāmaki River area (~186ha) (Kelly, 2008) and the mobile nature of the birds potentially foraging in these areas (i.e. ability to forage elsewhere upon habitat removal), it is considered that the loss of potential foraging habitat for species with ecological values ranging from Low (*Not Threatened*) to High (*At Risk – Declining*) will have a Negligible magnitude of effect on coastal avifauna potentially utilising habitat in the ZOI (

Table 5) and a Very Low overall level of effect (

Table 6).

6.1.7 Habitat Disturbance and Displacement

With respect to coastal avifauna, piling for temporary bridge staging structures and permanent bridge piles, stormwater outfall vegetation clearance and construction works may result in effective foraging habitat loss as a result of disturbance and displacement. Given the small, discrete locations of work, the temporary nature of the work, the extensive alternative areas of foraging habitat available in the wider

[29] This includes vegetation clearance for abutments, piles and scour protection and 549m^2 of reclamation for Bridge B and vegetation clearance associated with the construction staging bridges

[30] Note Mr Todd (coastal processes expert) has recommended that the 75m^2 of temporary mangrove removal per outfall in the CMA required for construction is revegetated for coastal erosion protection purposes. This is included as a condition of consent.

[31] The calculation includes the 549m^2 reclamation for Bridge B

Tāmaki River area, plus the highly mobile nature of species potentially affected (i.e. ability to move to suitable, alternative habitat if disturbed or displaced), it is considered that potential habitat disturbance and displacement during construction works will have a Negligible magnitude of effect on coastal avifauna potentially using habitat in the ZOI. A Negligible magnitude of effect on Low to High value species, results in a Very Low overall level of effect (

Table 6).

6.1.8 Cumulative Effects

The cumulative effects of temporary and permanent occupation of the CMA, vegetation removal and shading, disturbance of sediment causing remobilisation of contaminants, habitat disturbance during construction have been considered in this assessment. Cumulative effects are determined to have a Moderate magnitude of effect for construction on marine values at the context of the ZOI and a Low magnitude of effect on coastal avifauna values due to the number of temporary and permanent effects identified. However, there are large areas of available high quality mangrove habitat within the Tāmaki River (186 ha of mangrove habitat, Kelly, 2008) that are unaffected by the Proposal. A Moderate magnitude of effect on Low marine ecological values and a Low magnitude of effect on Low to High coastal avifauna values results in Low to Very Low overall levels of effect, which do not typically require mitigation (according to the EIANZ assessment guidelines). However, it is our assessment and recommendation that mitigation is required for the cumulative effects of construction on marine and coastal avifauna ecological values (see section 7.0).

The individual effects of construction on marine ecological values will directly impact relatively small proportions of the abundant saline wetland (mangrove) habitat and intertidal benthic soft sediment habitat within Pakuranga Creek and the wider Tāmaki River. However, due to the area of habitat affected by the combined construction-related effects, mitigation is recommended.

6.1.9 Summary of Ecological Effects of Construction

EB3C's construction will require works within the CMA associated with bridges and stormwater infrastructure. These works in the CMA will involve occupation of the CMA, mangrove vegetation clearance and sediment disturbance. A construction methodology has been proposed that will actively limit the potential for sediment discharge, while also minimising the ZOI. This methodology will also be captured by the measures that are required to be included in the ESCP and ssESCPs.

Overall, the marine ecological values are Low at all four stormwater outfalls in the CMA and at bridge structural elements, whereas coastal avifauna ecological values potentially range between Low and High (the latter due to the potential but unconfirmed presence of banded rail) in the ZOI. The magnitudes of effect of individual construction-related effects (including temporary occupation of the CMA, vegetation loss and shading in the CMA, coastal avifauna foraging habitat loss and disturbance / displacement) are assessed as Negligible to Low overall (

Table 5), resulting in Very Low to Low overall levels of effect on marine and coastal avifauna ecological values. According to the EIANZ guidelines, mitigation is not typically required for these low-level effects (refer to Table 10).

These effects of construction on marine ecological values individually represent relatively small proportions of the abundant mangrove habitat and intertidal benthic soft sediment habitat within Pakuranga Creek and the wider Tāmaki River, but collectively the area effected is relatively large due to the combined adverse effects of construction. The cumulative effects of temporary and permanent

occupation of the CMA, vegetation removal and shading, disturbance of sediment causing remobilisation of contaminants, habitat disturbance during construction have been considered in this assessment and determined to have a Moderate magnitude of effect on marine ecology values overall due to the number of temporary and permanent effects identified and spatial extent of the proposed works. For coastal avifauna, cumulative construction effects are assessed as having a Low magnitude of effect, less than marine ecology, as birds are highly mobile and able to utilise the extensive alternative areas of habitat that are part of their foraging network in the wider estuarine area that will be unaffected by the Project. A Moderate magnitude of effect, for cumulative effects on Low marine ecological values, and a Low magnitude of effect on Low to High coastal avifauna values results in Low to Very Low overall levels of effect, which do not typically require mitigation (according to the EIANZ assessment guidelines). However, it is our assessment and recommendation that precautionary mitigation is required for the cumulative effects of construction on marine and coastal avifauna ecological values assessed collectively (see section 7).

Considering that the level of effect on marine ecological values and coastal avifauna is assessed as Very Low to Low.

With regards to effects on banded rail (an At Risk species) potential foraging habitat cannot be avoided, given the functional need of the works to occur in the CMA; however, works in the CMA have been minimised as much as practicable and overall levels of effects of the project on banded rail are assessed as being Very Low or Low (Low for cumulative effects only).

With regards to the NPS-IB, it is considered that, in an ecological context, there will not be a meaningful loss of extent, function, occupancy or connectivity of foraging habitat for banded rail (a specified highly mobile fauna species in the NPS-IB) given the very small amount of foraging habitat that will be lost relative to that unaffected by EB3C in the wider area (i.e. the extent of habitat will effectively be maintained in an ecological context). The measures that will be implemented to mitigate cumulative construction effects (discussed in Section 7) will not replace foraging habitat for banded rail but will improve foraging habitat quality (as rubbish in some areas of CMA will be removed) and will provide some areas of potential nesting habitat for banded rail along the coastal edge of EB3C (no nesting habitat currently exists); on balance, these measures will maintain the extent of habitat available for banded rail in the EB3C area. Furthermore, injury or mortality of banded rail is not expected given that there is no banded rail nesting habitat in the EB3C ZOI and that they are highly mobile fauna capable of moving out of the ZOI if necessary, as such there will be no local population impacts on banded rail (i.e. population size will be maintained).

Table 10: Summary of construction effects of the Project for EB3C (assuming the implementation of the Erosion and Sediment Control Plan and the Construction Management Plan).

Construction Effect	Ecological Values	Magnitude of Effect	Level of Effect	Mitigation Required
Marine Ecology				
Temporary occupation of CMA by bridge staging structures	Low	Low	Very Low	Not required
Permanent occupation of CMA by bridge pile structures	Low	Low	Very Low	Not required
Occupation of CMA by stormwater structures	Low	Low	Very Low	Not required
Vegetation Removal in CMA	Low	Low	Very Low	Not required
Remobilisation of contaminants currently bound in sediment during	Low	Negligible	Very Low	Not required

Construction Effect	Ecological Values	Magnitude of Effect	Level of Effect	Mitigation Required
earthworks or vegetation removal.				
Cumulative effects	Low	Moderate	Low	Not strictly required, but highly recommended due to combined habitat areas affected.
Coastal Avifauna Ecology				
Loss of foraging habitat	Low to High value species	Negligible	Very Low	Not required
Habitat disturbance and displacement	Low to High value species	Negligible	Very Low	Not required
Impacts on foraging ability and food supply due to increased sediment and remobilisation of contaminants currently bound in sediment during earthworks or vegetation removal.	Low to High value species	Negligible	Very Low	Not required
Cumulative effects	Low to High value species	Low	Very Low - Low	Not strictly required but recommended due to combined habitat areas affected.

6.2 Effects of Operation

The primary operational potential effects for EB3C on marine ecology and coastal avifauna are shading of mangroves by bridge structures and the discharge of treated stormwater directly to the CMA. Construction effects arise from permanent occupation from bridge structural elements, reclamation, and stormwater outfalls form part of the Effects of Construction in Section 6.1 above.

6.2.1 Shading of Mangroves by Bridge Structures

The area of mangroves beneath permanent Bridges A and B that will be shaded is 830m^2 and 903m^2 respectively (Table 4, Construction Design Report). The shaded mangroves are likely to not thrive due to reduced light.

The magnitude of effect of the effect of shading of mangroves under the bridges is assessed as Low, with the level of effect being Very Low (based on Low ecological values).

6.2.2 Stormwater Quality Discharge

Figure 6 indicates the proposed stormwater discharge locations, with the Pakuranga Creek being the ultimate receiving environment. Stormwater discharges will be authorised under Healthy Water's Network Discharge Consent (NDC).

Stormwater treatment for the Project is primarily provided by way of gross pollutant traps and raingardens. Some of the existing stormwater outfalls currently receive no treatment prior to discharge (e.g. existing Tī Rākau Bridge). Discharge from the new busway bridge (Bridge A) is incorporated in the calculations of discharges from MCC_108479 (Stormwater Assessment). At many of the stormwater

discharge points, existing outfalls have been combined and include catchment areas that are not part of the Project.

CLM indicates at outfall PC_MCC_108479 a 17% increase in TSS is predicted, plus a 1-2% increase in zinc and copper, and a 1% increase whereas all other stormwater outlets that discharge to the CMA are predicted to have a decrease in TSS and contaminants (Stormwater Assessment Report).

An assessment of the current concentration of zinc in receiving environment sediment, combined with CLM zinc predictions are included in Table 8. We have identified the likely effects of the zinc from the outfalls in the marine receiving environments and determined which are likely to increase due to the increased zinc load (Table 2). The magnitude of effect on marine ecological values of the discharge of stormwater from each outlet is considered to be Low with overall Very Low level of effect.

All stormwater outfall locations in the CMA have Low marine ecological values, and a Low magnitude of effect (Table 5) with the overall level of effect on marine ecological values assessed as Very Low (Table 6).

With respect to coastal avifauna, despite treatment of stormwater, there will still be an accumulation of contaminants in sediments in CMA foraging habitat at the outfalls and within the ZOI. This may reduce prey items available to coastal avifauna. However, given the small area of foraging habitat that will be impacted relative to the large quantity of alternative foraging habitat available in the wider foraging area / network, it is considered that potential reduced prey item availability and potential prey contaminant body burden as a result of stormwater contaminants will have a Negligible magnitude of effect on coastal avifauna. A negligible magnitude of effect on Low to High value species, results in a Very Low overall level of ecological effect (Table 6).

6.2.3 Cumulative Effects of Operation

The cumulative effects of operation of EB3C on marine ecological values include permanent shading of mangroves and the discharge of treated stormwater. Stormwater discharges in the Project catchments (from numerous sources) are currently discharged to the freshwater and estuarine environments untreated, resulting in elevated zinc in sediments at most existing outfalls and receiving environments (Table 8). The treatment of stormwater for EB3C will result in an overall decreased contaminant load. However, the discharge of contaminants from urban and road stormwater throughout the Tāmaki River's wider catchment (beyond the Eastern Busway Project) occurs largely untreated.

In terms of marine ecology, the contribution of EB3C to the cumulative effects of contaminant discharge and deposition, has an average of Low magnitude of effect for all outfalls. Based on Low ecological values, the overall level of effect on marine ecology is assessed as Very Low and mitigation is not required for contribution to cumulative effects relating to operation of the project.

For coastal avifauna, the contribution of EB3C to the cumulative effects of contaminant discharge and deposition on prey availability and contaminant body burden of prey (bioaccumulation) has a Negligible magnitude of effect for all outfalls given that only a small proportion of prey items could be contaminated relative to food availability in the wider Pakuranga Creek and Tāmaki River foraging network. Based on Low to High coastal avifauna species ecological values, the overall level of effect on coastal avifauna is assessed as Very Low and mitigation is not required for contribution to cumulative effects.

6.2.4 Summary of Ecological Effects of Operation

Operation of the Project involves discharge of stormwater contaminants (treated via gross pollutant traps and raingardens) to aquatic receiving environments (freshwater to CMA or direct to CMA).

The treatment of stormwater, whilst reducing the existing contaminant concentrations discharged to the receiving environments significantly, still contributes to the accumulation of contaminants in sediments and may reduce the number of prey items and type available to coastal avifauna (Table 11). Mitigation is not required for the level of effects that have been identified, assuming the implementation of the stormwater design and treatment plan (Stormwater Assessment).

The cumulative effects of operation of EB3C are assessed as a Very Low level of effect, and we do not consider mitigation is required.

Table 11: Summary of ecological effects of operation of Project

Operational Effect	Ecological Values	Magnitude of Effect	Level of Effect	Mitigation Required
Marine Ecology				
Shading of mangroves by permanent Bridge structures	Low	Low	Very Low	Not required
Discharge of stormwater contaminants at 3 new and 1 upgraded outfall	Low	Low	Very Low	Not required
Cumulative effects of operation of the Project	Low	Low	Very Low	Not required
Coastal Avifauna Ecology				
Discharge of stormwater contaminants at all outfalls within EB3C affecting avifauna prey availability and prey contaminant body burden	Low to High	Negligible	Very Low	Not required
Cumulative effects on contaminant deposition for all outfalls affecting avifauna prey availability and prey contaminant body burden	Low to High	Negligible	Very Low	Not required

7 Mitigation

Chapter Summary
• *Minimise occupation of CMA during construction (as required by conditions).* • *Minimise removal of coastal/estuarine (wetlands) vegetation during construction.* • *Minimise coastal avifauna habitat disturbance during construction.* • *Mitigation is recommended (although not strictly required by EIANZ assessment guidelines) for the cumulative effects of the proposed construction effects on marine and coastal avifauna ecological values.* • *We have assumed the proposed stormwater design and management is implemented (Stormwater Assessment) and the proposed Erosion and Sediment Control Plan is implemented.* • *Mitigation is not required for operational effects of stormwater contaminant discharges at outfalls.*

There is an expectation that the permanent and temporary occupation of the CMA, disturbance of the CMA and vegetation removal are minimised. This approach is consistent with the proposed erosion and sediment control approach and stormwater design approach, which will be implemented in the construction and operation of EB3C in accordance with conditions.

The level of identified adverse effects (Low and Very Low) do not require mitigation according to the strict application of the EIANZ guidelines (Roper-Lindsay et al., 2018). However, we recommend mitigation should be developed to address the cumulative effects on marine and coastal avifauna ecological values from the construction phase of EB3C.

Such mitigation should comprise:

- Gather and dispose of rubbish/debris in the Pakuranga Creek within the CMA adjacent to the project (excluding private land), within an area that extends from approximately 10m above MHWS to seaward of MHWS in mangrove habitat (see Figure 20). Monitoring and repeat rubbish/debris removal should occur on an annual basis for a period of three years post construction) (approximately 1,480m^2 mangrove habitat and 5,740m^2 of coastal vegetation habitat) (see Figure 20).

- Remove/treat exotic pest vegetation species and replace with native species from the coastal margins adjacent to EB3C that are suitable for banded rail to nest in given that there is no nesting habitat currently present for them in the EB3C CMA. Removal/treatment and replacement planting to occur on an annual basis for a period of three years post construction in an area of approximately 7,600m^2 of coastal edge terrestrial vegetation; see Figure 20). Vegetation suitable for banded rail to nest in includes rushes and sedges (e.g. oioi (*Apodasmia similis*), sea rush (*Juncus krausii subsp. australiensis, Carex secta, Carex geminata*, etc.) and coastal shrubs (e.g. saltmarsh ribbonwood (*Plagianthus divaricatus*), etc.). Rushes and sedges should be planted on the coastal edge with saltmarsh ribbonwood and other suitable shrub vegetation planted further inland.

Figure 20: EB3C proposed coastal mitigation.

8 Recommendations and Conclusions

Chapter Summary
• *Minimise removal of coastal wetland habitat (mangroves and saltmarsh)* • *Mitigate the cumulative effects of construction on marine ecology and coastal avifauna (Section 7) by:* 1. *Gathering and disposal of rubbish/debris in the CMA (including repeating annually for three years post construction)* 2. *Removal/treat exotic pest vegetation species along the EB3C coastal edge and replace with native species that are suitable for banded rail to nest in (including repeating annually for three years post construction)*

No mitigation is required as only Low and Very Low levels of effects were identified for marine ecology and coastal avifauna ecology, apart from the cumulative effects of construction on marine ecology (Section 7) which do require mitigation.

To address the effects of the cumulative effects of construction of EB3C on marine ecological values and coastal avifauna, the recommendations of this Assessment are to:

- Minimise removal of coastal wetland habitat during the construction and operational stage, by complying with best practice / recommended measures.
- Mangrove Habitat - Gathering and disposal of rubbish/debris in the CMA (including repeating annually for three years post construction) (1,480 m^2, see Figure 20).
- Coastal Vegetation - Gathering and disposal of rubbish/debris in the CMA (including repeating annually for three years post construction) (5,740m^2, see Figure 20).
- Coastal Vegetation - Removal/treat exotic pest vegetation species along the EB3C coastal edge and replace with native species that are suitable for banded rail to nest in (including repeating annually for three years post construction) (5,740m^2, see Figure 20).

9 References

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Appendix 1: List of species recorded in the OSNZ Atlas Square for the EB3C Project Area

The following table lists species recorded during the site visits (3/10/18, 6/12/18 and 23/2/22) and within the OSNZ atlas for the 10 km x 10 km grid square (267, 647), which encompass the Ti Rakau Drive bridge and surrounding environment. The primary (dark green) and secondary (light green) habitats for each of the species recorded was obtained from Heather & Robertson (2005), along with each species' New Zealand threat status according to Robertson et al. (2021).

SPECIES		THREAT STATUS		Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	OSNZ square (267, 647)	Site visits
Morepork	*Ninox n. novaeseelandiae*	Not Threatened	Not Threatened									✓	
North Island fantail	*Rhipidura fuliginosa placabilis*	Not Threatened	Not Threatened[EF]									✓	
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened	Not Threatened									✓	✓
Kereru	*Hemiphaga novaeseelandiae*	Not Threatened	Not Threatened[CD Inc]									✓	
Shining cuckoo	*Chrysococcyx l. lucidus*	Not Threatened	Not Threatened[DP]									✓	
Tui	*Prosthemadera n. novaeseelandiae*	Not Threatened	Not Threatened[OL St]									✓	
Blackbird	*Turdus merula*	Introduced	Introduced & Naturalised[SO]									✓	
Eastern rosella	*Platycercus eximius*	Introduced	Introduced & Naturalised[SO]									✓	
Grey warbler	*Gerygone igata*	Not Threatened	Not Threatened									✓	
Silvereye	*Zosterops lateralis lateralis*	Not Threatened	Not Threatened[SO]									✓	
California quail	*Callipepla californica*	Introduced	Introduced & Naturalised[SO]									✓	
Pheasant	*Phasianus colchicus*	Introduced	Introduced & Naturalised[SO]									✓	
Chaffinch	*Fringilla coelebs*	Introduced	Introduced & Naturalised[SO]									✓	
Greenfinch	*Carduelis chloris*	Introduced	Introduced & Naturalised[SO]									✓	
Magpie	*Gymnorhina tibicen*	Introduced	Introduced & Naturalised[SO]									✓	
Song thrush	*Turdus philomelos*	Introduced	Introduced & Naturalised[SO]									✓	
Goldfinch	*Carduelis carduelis*	Introduced	Introduced & Naturalised[SO]									✓	
House sparrow	*Passer domesticus*	Introduced	Introduced & Naturalised[SO]									✓	
Myna	*Acridotheres tristis*	Introduced	Introduced & Naturalised[SO]									✓	
Rook	*Corvus frugilegus*	Introduced	Introduced & Naturalised[SO]									✓	
Skylark	*Alauda arvensis*	Introduced	Introduced & Naturalised[SO]									✓	
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened	Not Threatened[SO]									✓	
Starling	*Sturnus vulgaris*	Introduced	Introduced & Naturalised[SO]									✓	
Swamp harrier	*Circus approximans*	Not Threatened	Not Threatened[SO]									✓	
Welcome swallow	*Hirundo n. neoxena*	Not Threatened	Not Threatened[Inc SO]									✓	
Yellowhammer	*Emberiza citrinella*	Introduced	Introduced & Naturalised[SO]									✓	
Black shag	*Phalacrocorax carbo novaehollandiae*	At Risk	Naturally Uncommon[SO Sp]									✓	
Black swan	*Cygnus atratus*	Not Threatened	Not Threatened[SO]									✓	
Black-billed gull	*Larus bulleri*	Threatened	Nationally Critical[RF]									✓	
Grey duck	*Anas s. superciliosa*	Threatened	Nationally Critical[SO]									✓	
Little black shag	*Phalacrocorax sulcirostris*	At Risk	Naturally Uncommon[RR]									✓	
Little shag	*Phalacrocorax melanoleucos brevirostris*	Not Threatened	Not Threatened[Inc]									✓	
Mallard	*Anas platyrhynchos*	Introduced	Introduced & Naturalised[SO]									✓	

SPECIES		THREAT STATUS		Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	OSNZ square (267, 647)	Site visits
NZ pied oystercatcher	*Haematopus finschi*	At Risk	Declining									✓	
Paradise shelduck	*Tadorna variegata*	Not Threatened	Not Threatened									✓	✓
Pied shag	*Phalacrocorax varius varius*	At Risk	Recovering									✓	
Pied stilt	*Himantopus h. leucocephalus*	Not Threatened	Not Threatened									✓	
Pukeko	*Porphyrio m. melanotus*	Not Threatened	Not Threatened[Inc SO]									✓	✓
Banded dotterel	*Charadrius bicinctus bicinctus*	Threatened	Nationally Vulnerable[DP]									✓	
Banded rail	*Gallirallus philippensis assimilis*	At Risk	Declining[DP RR]										
Black-backed gull	*Larus d. dominicanus*	Not Threatened	Not Threatened[SO]									✓	✓
Caspian tern	*Hydroprogne caspia*	Threatened	Nationally Vulnerable[SO Sp]									✓	
Eastern bar-tailed godwit	*Limosa lapponica baueri*	At Risk	Declining[TO]									✓	
Lesser knot	*Calidris canutus rogersi*	Threatened	Nationally Vulnerable[TO]									✓	
Northern NZ dotterel	*Charadrius obscurus aquilonius*	At Risk	Recovering[CD Inc]									✓	
Red-billed gull	*Larus novaehollandiae scopulinus*	At Risk	Declining									✓	
Red-necked stint	*Calidris ruficollis*	Non-resident Native	Migrant[SO]									✓	
Reef heron	*Egretta sacra sacra*	Threatened	Nationally Endangered[DP SO Sp St]									✓	
Royal spoonbill	*Platalea regia*	At Risk	Naturally Uncommon[Inc RR SO Sp]									✓	
Variable oystercatcher	*Haematopus unicolor*	At Risk	Recovering[Inc]									✓	
White-faced heron	*Egretta novaehollandiae*	Not Threatened	Not Threatened[SO]									✓	✓
White-fronted tern	*Sterna s. striata*	At Risk	Declining[DP]									✓	
Wrybill	*Anarhynchus frontalis*	Threatened	Nationally Vulnerable[RR]									✓	
Australasian gannet	*Morus serrator*	Not Threatened	Not Threatened[De Inc SO]									✓	
Northern blue penguin	*Eudyptula minor iredalei*	At Risk	Declining[DP EF]									✓	
Barbary dove	*Streptopelia risoria*	Introduced	Introduced & Naturalised[SO Sp]									✓	
Rock pigeon	*Columba livia*	Introduced	Introduced & Naturalised[SO]									✓	
Spotted dove	*Streptopelia chinensis tigrina*	Introduced	Introduced & Naturalised[SO]									✓	

Appendix 2: EB3C Summary of Temporary and Permanent Works in the CMA[32]

Location	Permanent Occupation for Structures within CMA (m^2)	Temporary Occupation for Structures within CMA (m^2)	Vegetation Clearance for permanent and temporary structures within CMA (m^2)	Footprint of deck over the mangroves (m^2)
Tī Rākau Drive Bridge (Bridge A)				
Bridge A permanent piles	14 (8 piles)	0	6 (4 piles)	0
Bridge A permanent scour protection (if required)	147 (4 piles)	0	0	0
Bridge A permanent eastern abutment (including scour protection)	30	0	50	0
Footprint of permanent Bridge A deck over the existing mangroves	0	0	0	830
Bridge A temporary (during construction) staging piles	0	23	10	0
Footprint of the temporary construction staging platforms (excluding the temporary staging piles) for Bridge A over the existing mangroves	0	0	0	360
Total for Bridge A	**191**	**23**	**67**	**1190**
China Town Bridge (Bridge B)				
Bridge B permanent piles	8 (3 piles)	0	8	0

[32] Extract from the EB3C Construction Methodology

Bridge B permanent rip rap abutment B	64	0	64	0
Footprint of Permanent Bridge B deck over the existing mangroves	0	0	0	903
Bridge B temporary (during construction) staging piles	0	22	22	0
Footprint of the temporary construction staging platforms (excluding the temporary staging piles) for the Bridge B over the existing mangroves	0	0	0	800
Total for Bridge B	**72**	**22**	**94**	**1703**
Bridge B Permanent embankment (reclamation) at the northern end of 262 Tī Rākau Drive				
Area of permanent reclamation required within the CMA	549	0	549	0
Permanent retaining wall (reclamation) between 242 & 254 Tī Rākau Drive (RW304)				
Retaining wall (RW304)[33]	4	70	70	0
Stormwater Infrastructure (new or upgraded)				
New Outfall 01-A-1	25	100	100	0
Existing Outfall MCC_108479 (SAP ID 200029871)	25	100	100	0
New Outfall 09-1 MCC 108480	25	100	100	0
Existing Outfall MCC_108409	25	100	100	0

[33] Construction of the permanent retaining wall RW304 is between 242 & 254 Tī Rākau Drive

Total for Stormwater Infrastructure	100	400	400	0
Overall Total for EB3C CMA Permanent and Temporary Works	**916**	**515**	**1180**	**2893**