Appendix 17

Erosion and Sediment Control Effects Assessment

Eastern Busway

EB3 Commercial and EB4 Link Road

Erosion and Sediment Control Effects Assessment

Document Number: EB-RP-3C4L-PL-000008

Eastern Busway

Quality Information

Document Number: EB-RP-3C4L-PL-000008

Document History and Status			
Rev	**Date**	**Author**	**Status**
A	12.07.2023	Campbell Stewart	Final

Document Approval					
Rev	**Action**	**Name**	**Position**	**Date**	**Signature**
A	Reviewed by	Michael Parsonson	Environmental Consultant	12.07.2023	On file
B	Reviewed by	Roger McDonald	Alliance Principal Planner	27.07.2023	On file
1	Approved by	Jarrod Snowsill	Alliance RMA Planning Lead	31.08.2023	On file

Table of Contents

Figures

Tables

List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AEE	Assessment of Effects on the Environment
AUP(OP)	Auckland Unitary Plan (Operative in Part) (Updated 20 July 2023)
BMP	Best Management Practice
BPO	Best Practicable Option
CEMP	Construction Environmental Management Plan
CMA	Coastal Marine Area
CWD	Clean Water Diversion
DEB	Decanting Earth Bund
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3C	Eastern Busway 3 Commercial (Gossamer Drive to Botany)
EB3R	Eastern Busway 3 Residential (Pakuranga Highway to Gossamer Drive)
EB4L	Eastern Busway 4 Link Road (link between Tī Rākau Drive and Te Irirangi Drive)
EBA	Eastern Busway Alliance
ESCP	Erosion and Sediment Control Plan
GD05	Auckland Council Guideline Document 2016/005 Erosion and Sediment Control Guideline for Land Disturbing Activities in the Auckland Region
HNZPT	Heritage New Zealand Pouhere Taonga
HNZPTA	Heritage New Zealand Pouhere Taonga Act 2014
km	Kilometre(s)
m	Metre(s)
m^2	Square Metre(s)
m^3	Cubic Metre(s)
MCA	Multi Criteria Analysis
NES - CS	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
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
SSESCP	Site Specific Erosion and Sediment Control Plan

Executive Summary

The purpose of this Erosion and Sediment Control Effects Assessment is to provide an assessment of the potential erosion and sediment effects of the Eastern Busway 3 Commercial (EB3C) and Eastern Busway 4 Link Road (EB4L) sections of the Eastern Busway Project (the Project).

Key elements of the proposed EB3C works include the construction of two bridges (Bridges A and B), noise wall and retaining walls, stormwater drainage, and a cycleway. The EB3C bridge structures, associated reclamation and works associated with new and upgraded stormwater outfalls require works in the coastal marine area (CMA).

EB4L footprint traverses Guys Reserve and Whaka Maumahara Reserve and includes road widening at the intersection of Te Irirangi and Town Centre Drive. The proposed works include construction of a bridge structure (Bridge C), retaining walls, associated stormwater drainage, and a new walking and cycling pathway.

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).

The overall earthworks footprint and volumes are considered low and correspondingly a reduced risk of erosion during rainfall. In addition, the works will comprise areas of reworking existing developed land (paved and buildings) such that subgrades exposed may be non-erodible hardfill. Overall, works will be staged to minimise areas exposed to erosion at any one time.

The management of construction water proposed for the EB3C and EB4L aspects of the Project will be in accordance with current best practice, be successfully implemented and will provide certainty in mitigating any actual and potential adverse effects. This conclusion is based on a review of the existing design information, and experience from other similar and adjacent roading projects in Auckland.

The conclusions of the assessment have taken account of potential effects on terrestrial and coastal aquatic environments associated with diversion and discharge of treated sediment-laden runoff during construction.

It is concluded that the proposed works methodology will minimise actual and potential adverse construction effects to an acceptable and negligible level.

1 Introduction

1.1 Overview of 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 (Bridges A & B) for buses across Pakuranga Creek
- 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 the Botany Town Centre, including a link road through Guys and Whaka Maumahara Reserves to Te Irirangi Drive/Town Centre Drive intersection **(this Assessment)**.

The overall Project is shown in Figure 1-1 below.

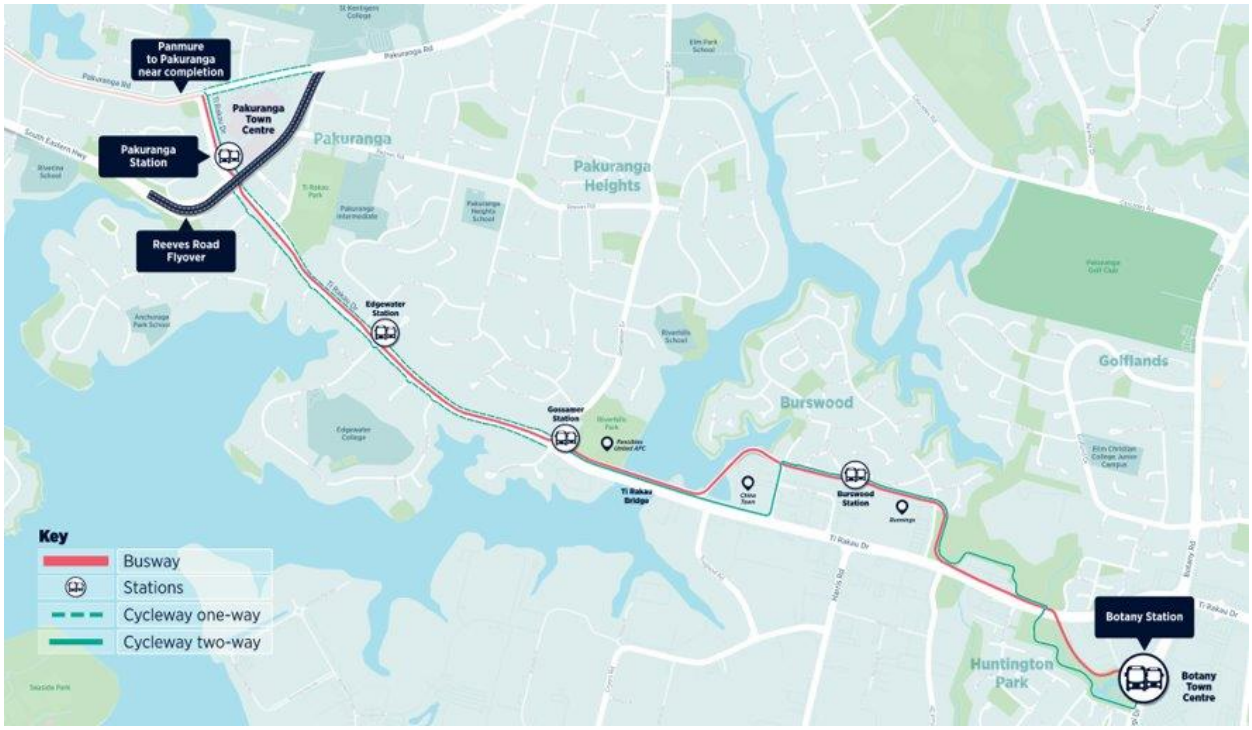


Figure 1-1 Project alignment

1.2 Project Objectives

The Project objectives are:

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. These descriptions consist of the construction and operation of both EB3C and EB4L packages, with further details provided in the Assessment of Effects on the Environment (AEE) and Notices of Requirement (NoRs). A full set of proposed plans is attached to the AEE.

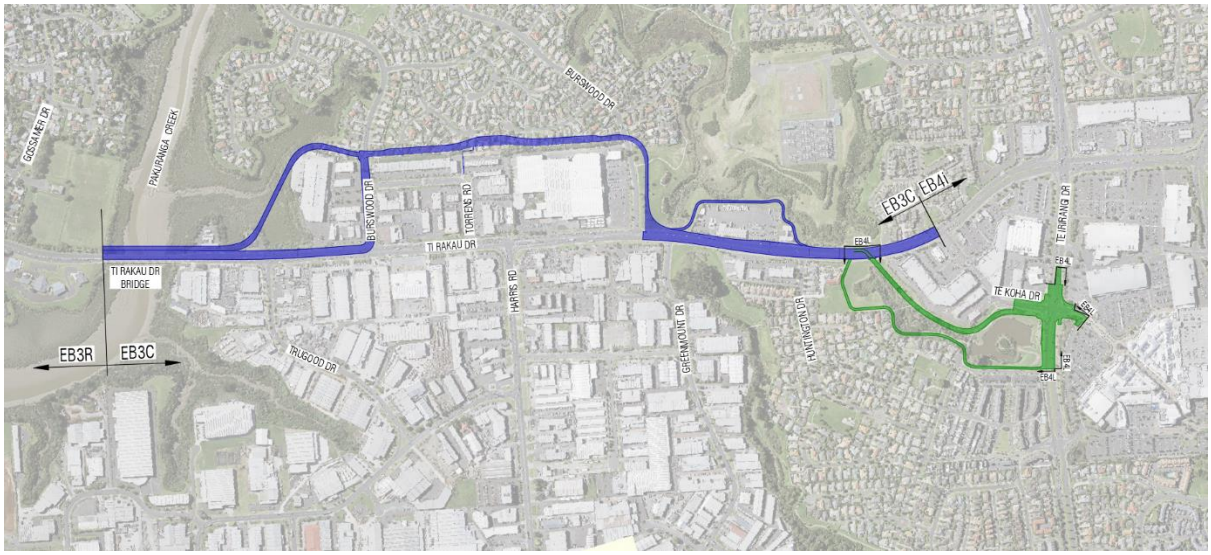


Figure 2-1 Eastern Busway 3 Commercial and 4 Link Road Project Extent

2.1 Eastern Busway 3 Commercial

The EB3C works will involve the establishment of an 'off-line' busway, cycleway and associated stormwater upgrades. These works will take place within existing road reserves, Council reserves[1] and privately held land. The extent of works for EB3C runs between Riverhills Park (i.e. adjacent to the terminus of EB3R) in the west to Guys Reserve in the east, through the suburbs of Burswood and East Tāmaki.

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) including abutments[2] 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 coastal reclamation. In parallel, a retaining wall will be constructed to the eastern side of the embankment. Following this, the busway runs between the commercial area and residential area north of Tī Rākau Drive, crossing several residential sites. The busway also crosses Burswood Drive twice, with raised signalised crossings established to control both the busway and road traffic.

[1] Including Burswood Esplanade Reserve and Bard Place Reserve

[2] The western abutment and associated scour protection was included in the EB3R consenting package. This application includes the eastern abutment.

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 2-2 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 viaduct 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.

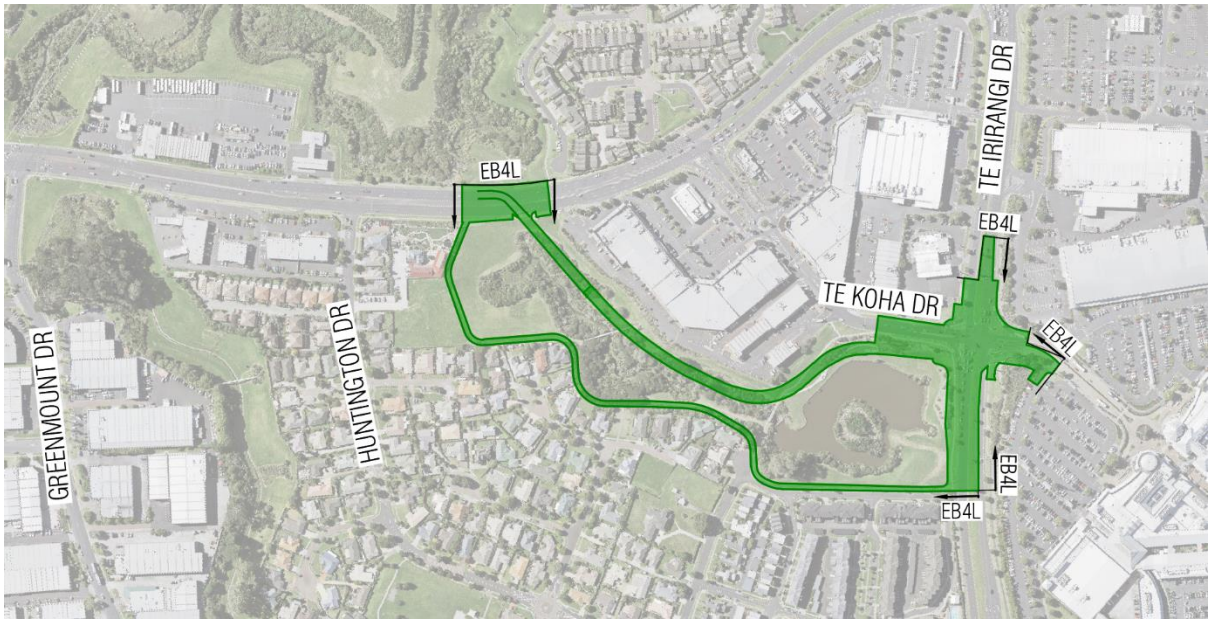


Figure 2-3 Eastern Busway 4 Link Road Project Area

3 Specialist Assessment

Chapter Summary
The Project construction elements that are relevant to this assessment are: ¶ *Earthworks* ¶ *Reworking of existing hardstand areas* ¶ *Structures* ¶ *Stormwater outfalls including stream and coastal outfalls and erosion protection* ¶ *Coastal works including bridges, retaining walls, temporary staging, temporary platforms and reclamation* ¶ *Trenching and drainage* ¶ *Service relocation* ¶ *Laydown areas and site compounds* *The works will be undertaken in accordance with industry best-practice methods and design guidelines, Project-wide management plans and site-specific management plans that will be developed and certified as works progress.*

3.1 Assessment Content

This ESC Effects Assessment provides the assessment of the land disturbing activities and accompanying erosion and sediment control and effects associated with the construction of the EB3C and EB4L sections of the Project.

Its purpose is to inform the AEE relating to the NoRs, and the consents required under the Auckland Unitary Plan (Operative in Part) (AUP(OP)) (regional consents) and the National Environment Standards, for EB3C and EB4L and to identify the ways in which any adverse effects will be appropriately managed.

This Assessment has been undertaken in accordance with Auckland Council Guideline Document 2016/005 *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region* (GD05). It addresses the following activities that occur across the EB3C and EB4L sections:

- Establishment of the erosion and sediment controls
- General earthworks and trenching activities associated with drainage and services
- Land disturbance associated with the construction of structures
- Coastal works associated with new and upgraded stormwater outfalls, temporary construction staging platforms, temporary and permanent structures and associated reclamation
- Stream works associated with new and upgraded stormwater outfalls
- Final landscaping and stabilisation.

3.2 Specific Project Elements

3.2.1 Earthworks

The works areas are separated into two project stages, EB3C and EB4L.

EB3C

EB3C earthwork operations include approximately 15,000 m^3 of cut and approximately 17,550 m^3 of fill, across approximately 2.5 ha within a total Project area of approximately 10 ha. The works are to occur on a generally flat grade based on existing site contours. There are minor areas of grade around

the back of China Town and the reserve area between Burswood Ave and the Howick and Eastern bus depot.

The construction methodology will involve the trimming and widening of berms, the excavation and formation of a new carriageway including the construction of bridge abutments and a bus station, the removal of the central medians, minor cutting of batters, placement of fill and associated drainage, structure placement, stream and coastal works.

The trimming and widening of berms, the removal of the central mediums, and minor drainage and services trenching operations, will be a cut and rapid cover operation. This will ensure that any exposed areas are minimised at any given time. This is a typical and accepted method for these types of projects and as such there is experience, and success, with undertaking these types of works on similar projects throughout Auckland.

Portions of the works (on Tī Rākau Drive and Burswood Intersections) are civil operations that do not require earthworks. These works primarily involve milling and resurfacing of the existing road surfaces. Approximately 4,650 m^3 of milling is to be undertaken.

For the other areas of more traditional cut to fill earthworks, including the formation of the new busway alignments, the bridge abutments, the embankment, establishment of the Burswood bus station footprint and the construction of the cycleway, cut material will be excavated and removed directly off site. The imported fill material will be primarily aggregate (regarded as a stabilised product), ensuring exposed areas are minimised at any given time.

The estimated earthwork areas and volumes are detailed in **Table 3-1** below[3][4].

Table 3-1 Earthworks Area and Volumes EB3C

Area	Cut Material m^3	Fill Material m^3	Earthworks Area m^2	Estimated Earthworks Duration
Bridge A to Bridge B (including works for 4m^2 reclamation)	**2,600**	**250**	**7,100**	**2-3 weeks**
Bridge B Northern Abutment (note the abutment fill includes an area of coastal reclamation, refer to section 3.2.2 below)	**Negligible**	**11,000**	**2,000**	**3-4 weeks (noted staged works)**
Burswood Drive Busway (CH30670 – CH30788)	**1,400**	**300**	**9,100**	**2-3 weeks**

[3] Note: Within the tables, estimated earthworks duration includes the cut and earth fill programmed timeframes. The imported aggregate filling operations (aggregate defined as a stabilised product in GD05) have not been included in the estimated earthwork durations as that involves the placement of non-erodible material. In some instances, the days will be continuous, in others they will be staged. They have been provided to give context in regard to the duration of earthworks.

[4] The volumes include the works necessary for reclamation and stormwater upgrades inside and outside the CMA. Specific calculations of volumes will be provided during detailed design.

Burswood Bus Station	**5,000**	**800**	**1,600**	**2-3 weeks**
Burswood Reserve Busway	**6,000**	**200**	**5,200**	**3-4 weeks**
Service relocations and installations	**Negligible**	**Negligible**	**Negligible**	**Trenching operations sequenced through project**
MSE Wall Construction	**Negligible**	**5,000**	**Negligible**	**Operations sequenced through project**
Milling Volumes	**4,650**	**NA**		
Total	**15,000 (excluding milling)**	**17,550**	**25,000**	

[Source: Construction Methodology]

The Project includes a wide range of small earthworks activities that will be based on a "cut and cover" methodology (progressive stabilisation such that sediment control is not required), but in some cases supplemented by traditional ESC measures (e.g. clean water diversions and sediment retention devices). These approaches are consistent with GD05.

The areas of relatively "larger" earthworks volumes (larger within the context of this project) described above will involve a cut to waste methodology with the filling operations, and the use of aggregate as the fill material, ensuring exposed areas are minimised at any given time.

A driver of the staged and progressive approach to construction is the nature of the Project, working with limited construction space and with many sections adjacent to a live road network.

The indicative staging for EB3C generally involves:

- Bridge A and Bridge B will be constructed concurrently with two separate teams
- Construction of the Burswood section of the busway, Burswood Bus Station and section through the Burswood Esplanade Reserve busway (offline)
- Tī Rākau Drive works to be tightly staged works (milling, resealing, services etc) dictated by traffic management requirements.

Due to the generally gentle slopes of the area and the staged nature of the works incorporating progressive stabilisation, the risk of untreated sediment discharges is low. Notwithstanding this, in terms of the proposed works, the potentially higher risk areas and activities are identified as:

- Those works required immediately adjacent to the CMA of the Pakuranga Creek (associated with the new and upgraded stormwater outfall structures on the northern side of Tī Rākau Drive) which are in the Sediment Control Protection Area (SCPA)[5].
- Any works 100m either side of the Pakuranga Creek which is in the SCPA.

[5] Sediment Control Protection Area under the AUP: OP is an area within 100m of the CMA or within 50m of a watercourse or wetland of 1000m^2 or greater.

- Pumping of any sediment laden water from excavations.
- The activities associated with the CMA operations, (including bridge structures and associated temporary staging, retaining walls, the stormwater outfalls, the reclamation works and the temporary occupation working platforms).

EB4L

EB4L earthwork operations includes approximately 1,150m^3 of cut to fill over the EB4L project footprint of approximately 0.9ha. In addition, approximately 21,330m^3 of hardfill is proposed to construct retaining walls, the site yards and site access with an additional construction footprint of approximately 1.5ha. The works are to occur on generally flat to sloping existing site contours through Guys Reserve and Whaka Maumahara Reserve.

The earthworks are predominantly a fill operation either side of the proposed Guys Reserve Bridge (Bridge C) to form the new busway. Any cut material will be excavated and removed directly off site. The imported fill material will be primarily aggregate (regarded as a stabilised product), ensuring exposed (erodible) areas are minimised at any given time. The fill operation primarily occurs at the northern end of the works area just south of Tī Rākau Drive and is associated with the retaining wall structure. A small quantity of earthworks are required to form the footpath and cycle path located through Guys Reserve and Whaka Maumahara Reserve.

To facilitate the construction of EB4L and Bridge C, a temporary access track will be required to provide personnel and machinery with access to the site. The access track will likely involve the construction of a temporary embankment and some retaining walls constructed from imported hardfill. The exact design of which will be determined through detailed planning and is subject to feasibility assessments. Once the link road is completed, the temporary works will be removed from above ground level, and the affected area will be remediated.

The tie-in with Tī Rākau Drive and Te Irirangi Drive / Town Centre Drive Intersection works are hard fill and surfacing operations that require only minor earthworks. The works will include marking a pedestrian crossing, lane marking, new kerb alignment and pavement widening (which will require removal of a portion of landscaping). These works primarily involve milling and resurfacing of the existing road surfaces.

The estimated earthwork areas and volumes are detailed **in Table 3-2** below.

Table 3-2 Earthworks Area and Volumes EB4L

Area	Cut Material m^3	Fill Material m^3
Busway	**200**	**2,960**
Shared pathway and retaining walls along the southern and western boundaries of Guys Reserve and Whaka Maumahara Reserve	**200**	**620**
Temporary Access Embankment	**0**	**17,000**
Temporary construction laydown areas	**500**	**500**

Te Irirangi Drive/Town Centre Drive intersection improvement works	**250**	**250**
Total	**1,150**	**21,330**

The indicative staging for EB4L generally involves:

- Earthworks and the construction of the retaining wall will be completed first. This will provide access and working area for the construction of Bridge C
- Construction of Bridge C through Guys Reserve and Whaka Maumahara Reserve
- Tī Rākau Drive and Te Irirangi Drive / Town Centre Drive Intersection tie-in works to be tightly staged (milling, resealing, services etc) dictated by traffic management requirements.

Due to the relatively small area of earthworks proposed and the staged nature of the works incorporating progressive stabilisation, the risk of untreated sediment discharges is low. Notwithstanding this, the potentially higher risk areas and activities within the extent of works are identified as:

- Those works required immediately adjacent to the watercourse within Guys Reserve which are in the SCPA.
- Pumping of any sediment laden water from (piling) excavations.

3.2.2 Coastal Works

The proposed coastal works comprise temporary and permanent occupation of the CMA, (including permanent reclamation), installation of temporary and permanent structures, and works associated with new and upgraded coastal stormwater outfalls. The proposed coastal works are all associated with EB3C.

Coastal Works – Structures

The proposed structures comprise Bridge A and Bridge B. Both bridge structures will have temporary staging (temporary bridge platforms) installed to facilitate the construction of the main structures.

Bridge A is a 180 m long structure located parallel and immediately to the north of the existing Tī Rākau Drive Bridge. The temporary staging will be located on the north side of the new structure.

Bridge B is a 108 m long structure, aligned in a north south orientation from just north of Tī Rākau Drive, passing to the west of the Chinatown site and landing behind the Chinatown building. The temporary staging will be located on the north-western side of the new structure.

The temporary staging is required to provide a working platform for bridge piling and bridge structure works. The installation of the temporary staging structures will be launching from the land. Casings are driven into the substrate followed by the installation of cross heads and longitudinal beams to brace the casing together. Staging decks are then placed on the cross heads typically 9 m x 9 m in size. The process is then repeated. As each stage deck is installed, the plant will work off the completed section, until the staging is installed. All the work is undertaken above the CMA on the staging decks. While temporary staging piles will penetrate the bed of the CMA, no machinery will operate on the seabed.

The permanent bridge structures will be constructed from reinforced in-situ and precast concrete components. In-situ decks will be poured on top of precast concrete girders, supported on formed in-situ concrete piers and columns, which will be positioned above reinforced bored and poured concrete piles.

The permanent structure piling operations will be undertaken from the staging decks. The piling method to be adopted for the installation of the permanent piles is a bored cast in-situ reinforced concrete pile, utilising permanent steel casings. No drilling fluids are required.

The material excavated from the pile casings is to be directly removed off site. Any dewatering of the pile excavations will be managed via treatment containers / tanks or a lamella, with the ability to include chemical treatment to enhance settlement and sediment retention. The treated water will then discharge to the stormwater network.

The basic construction process is as follows:

1. Install set-out 'gate' from temporary staging platform on the casing and then pitch and vibrate permanent steel casing to refusal
2. Switch vibro-hammer to drop-hammer and strike the casings to the design set
3. Install boring shaft to the rig and bore out the earth material from within the permanent casing and down to the pile toe depth. Spoil will be disposed of into a large skip located on the staging for removal off site
4. Clean pile toe and Geotechnical Engineer to confirm acceptability of foundation material
5. Install the reinforcement cage and embedded items to the design position
6. Install tremie pipe to pile toe and commence concrete placement operations
7. Remove latent water (in contact with top of concrete) prior to concrete reaching top of casing, and complete concrete placement (note, that the liner is kept approx. 300-500 mm higher than the design top-of-pile to accommodate any remaining latent water or concrete over-pour). The liner and pile are only cut back to design level after concrete has reached its set.

Each bridge abutment requires associated ground improvement works and permanent rock armouring benching works. The works within the CMA will be timed to occur when the tide is below the works area. The work sites will be isolated by bunding or silt fences. Approximately 30m^2 of CMA will be occupied by the Bridge A eastern abutment (including scour protection). A small working platform (approximately 50 m^2) will be established to support construction. Geotextile will be placed and covered with aggregate. The working platform will be removed once these works are complete.

Coastal Works - Reclamation

Two areas of reclamation are required for the busway alignment. The first area of reclamation will provide the additional footprint required for the busway connecting the two promontories, on the northern side of Tī Rākau Drive (refer to Figure 3-1 below). In addition, small areas of temporary occupation are required at the location of the permanent reclamation and the stormwater outfalls to provide working platforms to complete the works, refer to Figure 3-1 below.

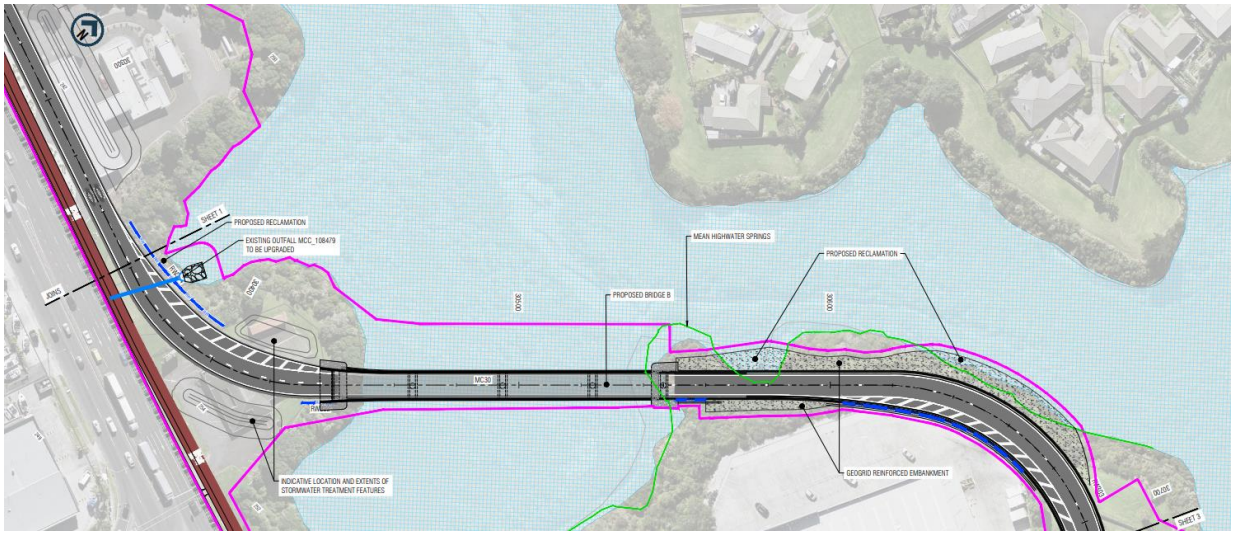


Figure 3-1 Location of Reclamation

The footprint of this permanent reclamation is approximately 4m^2. Approximately 4m^3 of clean granular material will be required to construct the reclamation.

Construction of the reclamation will be undertaken progressively in sections approximately 1m in height working from the existing promontories until the final platform footprint is achieved.

The following step by step methodology will be employed to construct this reclamation:

1. All works will be undertaken "in the dry" (to occur when the tide is below the works area)
2. Works will commence on the outgoing tide as soon as the area is "dry"
3. Mangroves within the footprint will be cleared by hand above ground level
4. A geotextile underlay will be rolled over the seabed with clean granular fill then being placed over the geotextile
5. The placement and compaction of the clean granular strips will commence from the land to the design height.

All works within the CMA will be timed to occur when the tide is below the works area to allow the works to be undertaken "in the dry". The sheet piles will remain in place until the retaining wall works have been constructed and completed, providing coastal protection for the new reclamation. The sheet piles will be removed once these works are complete.

The construction of the temporary occupation works platform is as above. The temporary occupation extends several meters past the permanent footprint to create a working space, over approximately 70 m^2. The temporary platform will be removed once these works are complete.

The second area of reclamation will provide for the Bridge B northern abutment and embankment, (refer to Figure 3-1 below). The CMA footprint of the Bridge B embankment is approximately 549m^2. Approximately 1,600m^3 of clean granular material will be required to construct the reclamation.

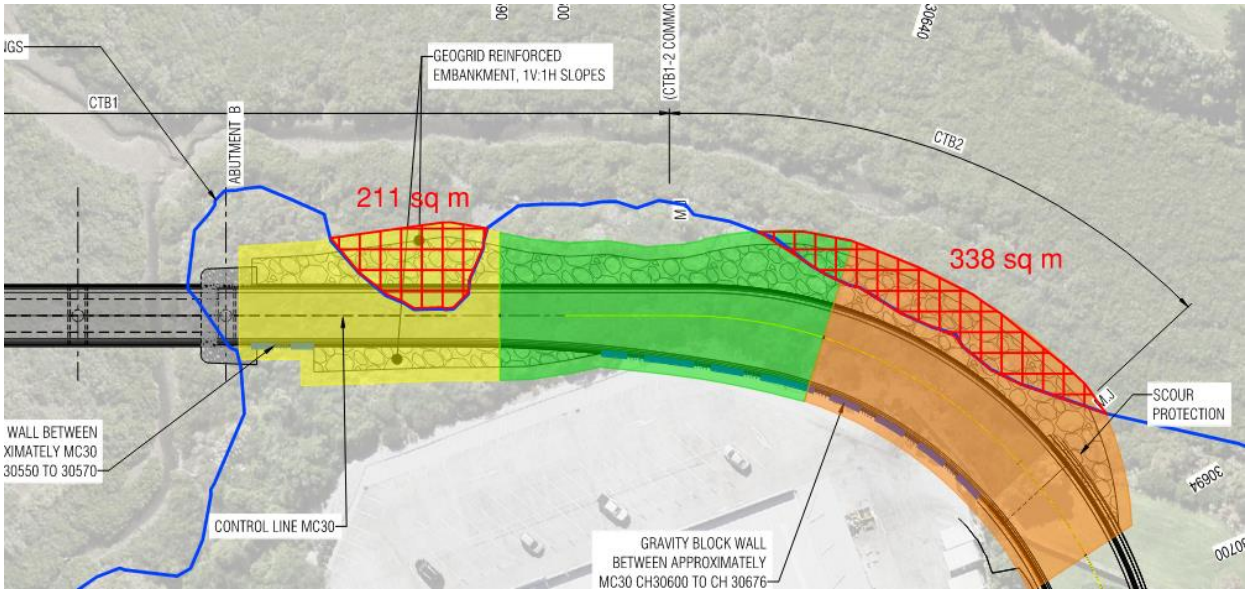


Figure 3-2 Location of Bridge B Northern Abutment Reclamation

The coastal reclamation will be staged until clear of the tide. Once clear of the tide, operations (general filling, preloading, ground improvements including wok drainage) will be able to continue "in the dry" as a standard "land based" civil operation.

The work sites will be isolated by a coffer dam, constructed either from rock rip rap wrapped in geotextile or a silt fence and bunding, the bunding will be constructed from the marine mud wrapped in geotextile constructed within the silt fence. Both options were successfully used during the Causeway Motorway reclamation works, operations undertaken within the highly sensitive Motu Manwa-Pollen Island Marine Reserve. Once the coffer dams are installed all works are within the dams. The SSESCP's will confirm which option will be used following detailed site surveys and investigations.

The following general step by step methodology will be employed to construct the embankment:

1. All works will be undertaken "in the dry" (to occur when the tide is below the works area)
2. Works will commence on the outgoing tide as soon as the area is "dry"
3. Mangroves within the footprint will be cleared by hand above ground level
4. The coffer dams to be constructed. Once constructed clean granular fill will be placed within coffer dam to create a working platform to complete the required ground improvements works and construct the fill embankment and abutment.

All works within the CMA will be timed to occur when the tide is below the works area to allow the works to be undertaken "in the dry". The coffer dam will remain in place until the reclamation and civil works have been constructed and completed, providing coastal protection for the new reclamation. The coffer dam will be removed once these works are complete.

Coastal Works – Stormwater outfalls

Four new stormwater outfalls are to be installed. Two are new outfalls and two are an upgrade of existing outfalls, located off Tī Rākau Drive, and one-off Burswood Drive. Note, there are three other new stormwater outfalls located in EB3C, located on the northwest of Tī Rākau Drive, to be installed that are not CMA works. The indicative pipe sizes of the four coastal pipes are 225mmØ, 900mmØ, 900mmØ and 450mmØ.

The extent of works at each pipe location will comprise:

- Installation of tracks into the outfall sites, using cut and cover methodology. Cover will comprise geotextile and aggregate surfacing and geotextile cover of cut batters
- Clearance of vegetation from the works footprint
- Excavation of unsuitable substrate, trenching and placement of final pipe sections and pre-cast concrete wingwall outfall structures (craned in from land)
- Excavation of unsuitable substrate and placement of geotextile and rock riprap beyond the outfall.

All works within the CMA will be timed to occur when the tide is below the works area. The work sites will be isolated by bunding or silt fences.

A small working platform (approximately 100 m^2) will be established at each outfall. Geotextile will be placed and covered with aggregate. The working platform will be removed once these works are complete.

3.2.3 Stream works

There is one new and two upgraded stormwater outfalls located in EB3C, on the northwest of Tī Rākau Drive. The three outfalls are within the riparian margins of Pakuranga Creek. The erosion protection rock riprap outfalls are expected to extend into the stream bed. This will be determined during detailed design. The indicative pipe sizes of the three pipes are 525mmØ, 300mmØ and 525mmØ.

A fourth new stormwater outfall is located in Guys Reserve, EB4L. The outfall is within the riparian margin of the Pakuranga Creek within Guys Reserve. The erosion protection rock riprap outfall is expected to extend into the stream bed. This will be determined during detailed design. The indicative pipe size of is a 375mmØ.

The extent of works at each pipe location will comprise:

- Installation of tracks into the outfall sites, using cut and cover methodology. Cover will comprise geotextile and aggregate surfacing and geotextile cover of cut batters
- Clearance of vegetation from the works footprint
- Excavation of unsuitable substrate, trenching and placement of final pipe sections and pre-cast concrete wingwall outfall structures
- Excavation of unsuitable substrate and placement of geotextile and rock riprap beyond the outfall.

Any works within the streambed will be undertaken in the dry. The work area will be isolated by bunding or silt fences.

3.2.4 Services Relocations

EB3C traverses a highly modified urban environment and as a result there are numerous network utilities within and crossing the alignment. These services range from major arterial networks to local reticulation services. Examples of these services include:

- High voltage transmission lines
- High pressure gas transmission pipelines
- Bulk water supply and wastewater infrastructure
- Fibre optic communication cables and telephone lines
- Electricity and gas distribution.

The relocation of the services will be staged and sequenced working in consultation with the utility providers. The majority of the work is located within existing road reserve or land to be vested as road reserve. Where trenching or land disturbance is required, the works will generally be a cut and cover operation. For the larger trenching operations, the works will be undertaken in accordance with the trenching and drainage works described below.

3.2.5 Trenching and Drainage

The trenching operations will be staged and will comprise of a cut to waste trenching excavation, civil works and a stabilised backfill.

Dewatering, from the trenching operations will be managed via treatment containers / tanks or a lamella with the ability to include chemical treatment to enhance settlement and sediment retention. The treated water will then discharge to the stormwater network.

3.2.6 Structures

Bridge A and Bridge B are discussed above in Section 3.2.2.

A noise wall, located along the Burswood Busway section and fourteen separate retaining wall structures will be installed along the project alignment.

EB4L requires the construction of 90 m of retaining wall and a 350 m long bridge (Bridge C).

A retaining wall will be constructed along the west embankment of the busway, approximately 90m in length from Tī Rākau Drive and with a maximum height of 3.5 m. This is a fill retaining wall. Note the majority of the fill operation associated with EB4L is the aggregate backfill behind the retaining wall. Refer to Figure 3-2 below.

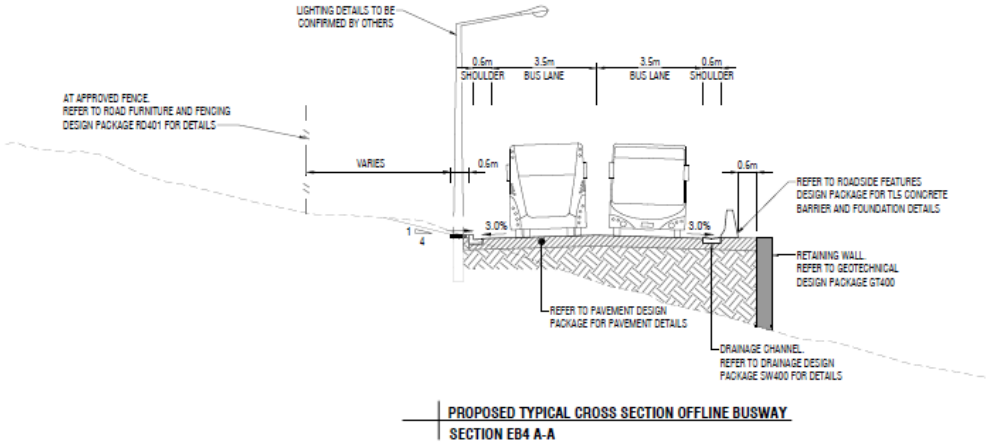


Figure 3-2 Typical Cross Section

Bridge C in EB4L will likely be a super T structure, with two abutments (each abutment has two piles), 14 piers/piles (with a total 18 piles) and approximately 350 m long.

Temporary access will be installed to facilitate the construction of the main structure and specifically the piers. The temporary access is required to provide a working platform for bridge piling and bridge structure works.

The access track will be constructed for the length of the bridge structure. The access structure will be constructed from hardfill and will be used as the working platform for the construction operations.

The permanent bridge structures will be constructed from reinforced in-situ and precast concrete components. In-situ decks will be poured on top of precast concrete girders, supported on formed in-situ concrete piers and columns, which will be positioned above reinforced bored and poured concrete piles.

The permanent structure piling operations will be undertaken from the access track. The piling method to be adopted for the installation of the permanent piles is a bored cast in-situ reinforced concrete pile, utilising permanent steel casings. No drilling fluids are required.

The material excavated from the pile casings is to be directly removed off site. Any dewatering of the pile excavations will be managed via treatment containers / tanks or a lamella, with the ability to include chemical treatment to enhance settlement and sediment retention. The treated water will then discharge to the stormwater network.

3.2.7 Construction Laydown Yards, Compounds and Satellite Offices

A main laydown yard has been consented and established at 169/171 Pakuranga Road with a designated stockpile area, which will predominantly serve the material and aggregate for the Project and provide temporary storage of the site disposal before hauling off-site. The establishment of this yard is not specifically part of this assessment given its prior approval under a separate resource consent.

Specific satellite laydown yards for EB3C will be established at Burswood Reserve and 242 Tī Rākau Drive. A laydown area and transfer station will be established at Burswood Reserve (refer to Figure 3-3 below).

The other satellite laydown yard at 242 Tī Rākau Drive for the bridge structure operations and all relevant works will also be constructed with the demolition of the Mobil service station. The hardstand area of the station will be used for the duration of the works, (refer to Figure 3-4 below).

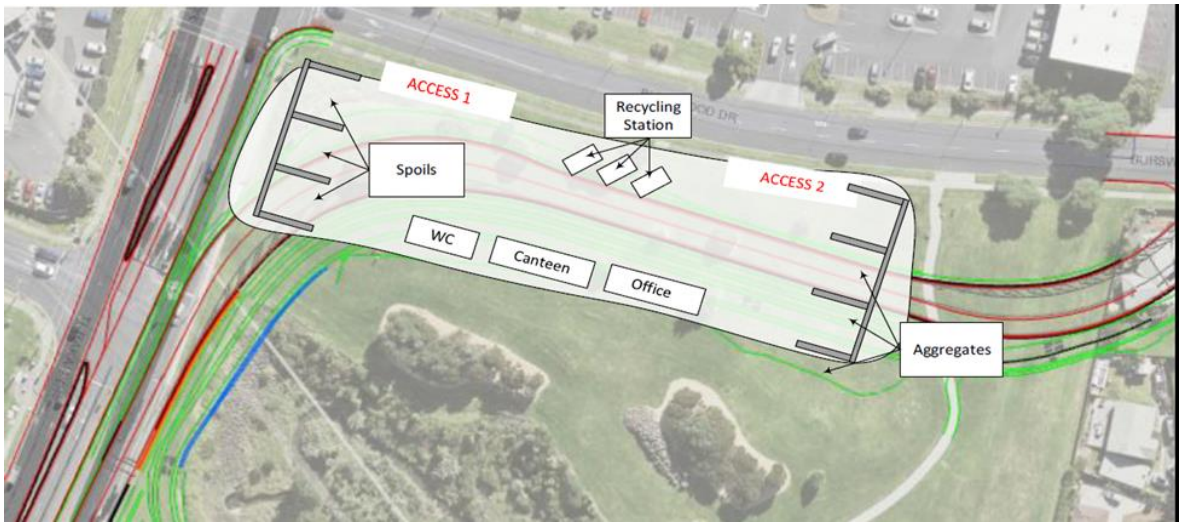


Figure 3-3 Location of Burswood Reserve Laydown

Figure 3-4 Location of Tī Rākau Drive Yard

For EB4L two satellite laydown yards will be established. The main yard is at the northern extent of the works area off Tī Rākau Drive, (refer to Figure 3-5 below) with the second yard in Whaka Maumahara Reserve between the existing stormwater pond and Te Irirangi Drive (refer to Figure 3-6 below).

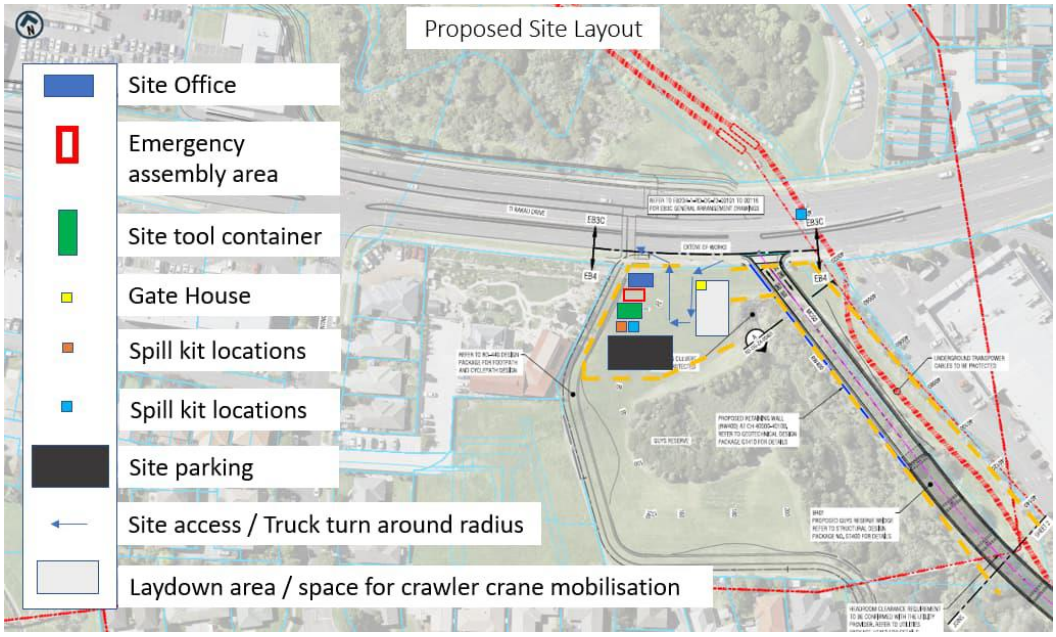


Figure 3-5 Location of EB4L main Tī Rākau Drive Yard

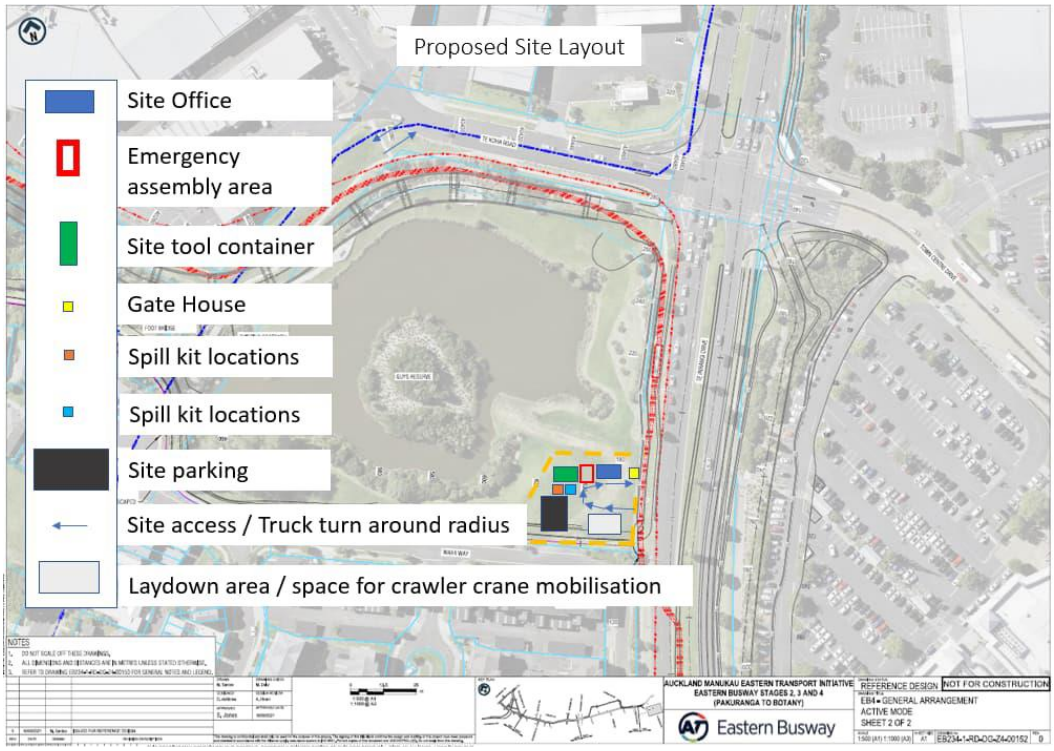


Figure 3-6 Location of EB4L Te Irirangi Drive Yard

For further descriptions of the construction compounds and satellite offices, refer to the Construction Methodology.

3.2.8 Construction Programme

The EB3C and EB4L works are planned for a 3-year construction programme, with EB3C and EB4L works occurring concurrently with the EB2 and EB3R works. More detail in regard to the estimated program can be found in the Construction Methodology. The approximate timeframes are as follows:

- EB3C: 3-year construction programme commencing approximately late 2024 through to 2027.

- EB4L: 2-year construction programme commencing approximately late 2024 through to 2027[6].

Earthworks operations will be staged throughout this period and cumulatively will occur over a significantly shorter timeframe as indicated in Tables 3.1 and Section 3.2.1 above.

3.3 Construction Water Management

3.3.1 Guideline Implementation

As noted, GD05 will be the minimum ESC standard applied for all earthworks undertaken during EB3C and EB4L. All ESC measures will be in place and operational before any site works for any specific area are undertaken.

All ESC measures will need to be retained and maintained in good working order until all site works (earthwork and coastal work activities) within that area have been completed and the site stabilised to minimise erosion and any untreated discharges of sediment from the site.

The construction methodology will involve the trimming and widening of berms, the excavation and formation of new carriageway, removal of the central median, minor cutting of batters, placement of fill and the undertaking of associated drainage, coastal works and structure placement. The trimming and widening of berms and the removal of the central median will be a cut and rapid cover operation ensuring exposed areas are minimised at any given time. This is a typical and accepted method for these types of projects and as such there is experience, and success, with undertaking these types of works on similar projects throughout the Auckland roading and motorway network.

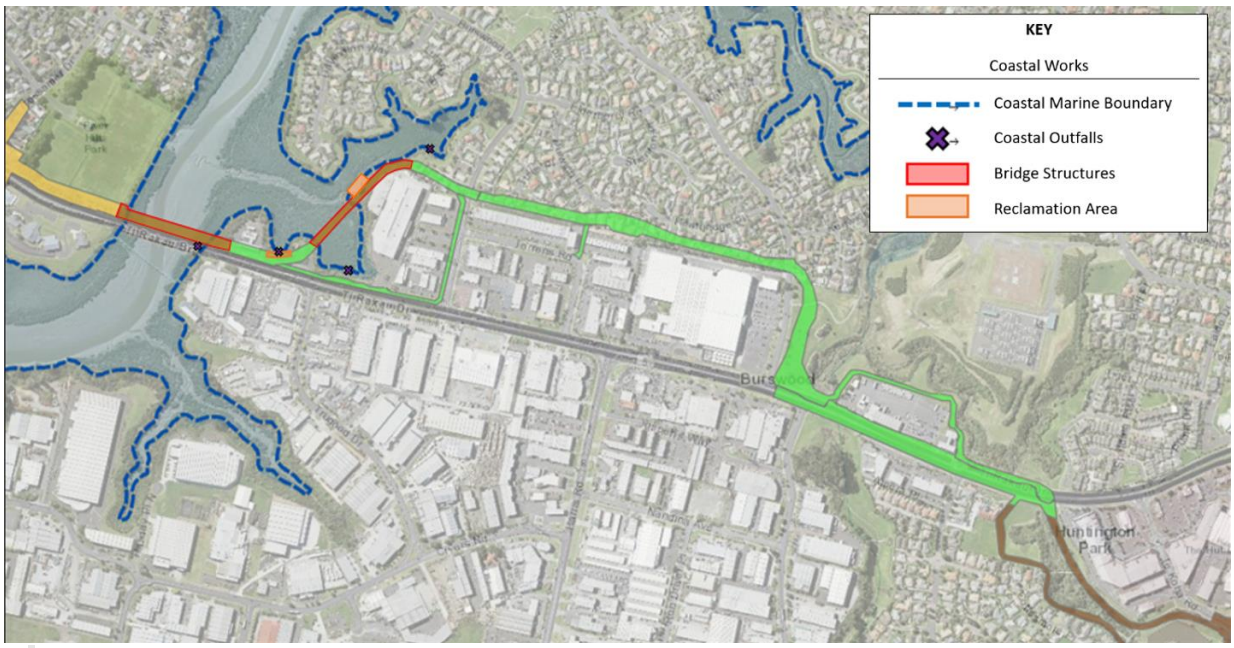
For the other areas of more traditional cut to fill earthworks including the formation of the new busway, generally the Burswood Bus Station section, the Burswood Reserve section, and the cycleway, cut material will be excavated and removed directly off site. The fill material will be primarily aggregate, ensuring exposed areas are minimised at any given time.

EB3C includes a wide range of small activities, and a “cut and cover” approach for earthworks will be implemented in addition to the traditional erosion and sediment control measures. Sections of the work area includes working on hardstand and/or hard fill locations and as such, an estimate of sediment yield is not warranted, as the corresponding risk of adverse sediment discharge is considered low.

While the Project is assessed as having an overall low risk of untreated sediment discharge, on a relative basis the potentially higher risk areas and activities within EB3C are identified as:

- Those works required immediately adjacent to the CMA of the Pakuranga Creek (associated with the new and upgraded stormwater outfall structures on the northern side of Tī Rākau Drive) which are in the SCPA
- Any works 100m either side of the Pakuranga Creek which is in the SCPA
- Pumping of any sediment laden water from excavations
- The activities associated with the CMA operations (the bridge structures and associated temporary staging, retaining walls, the new/upgraded stormwater outfalls and the reclamation works).

[6] Depending on securing funding.



¶

Figure 3-7 below indicates the locations of the coastal outfalls, structures and reclamations and the CMA boundary of Pakuranga Creek.

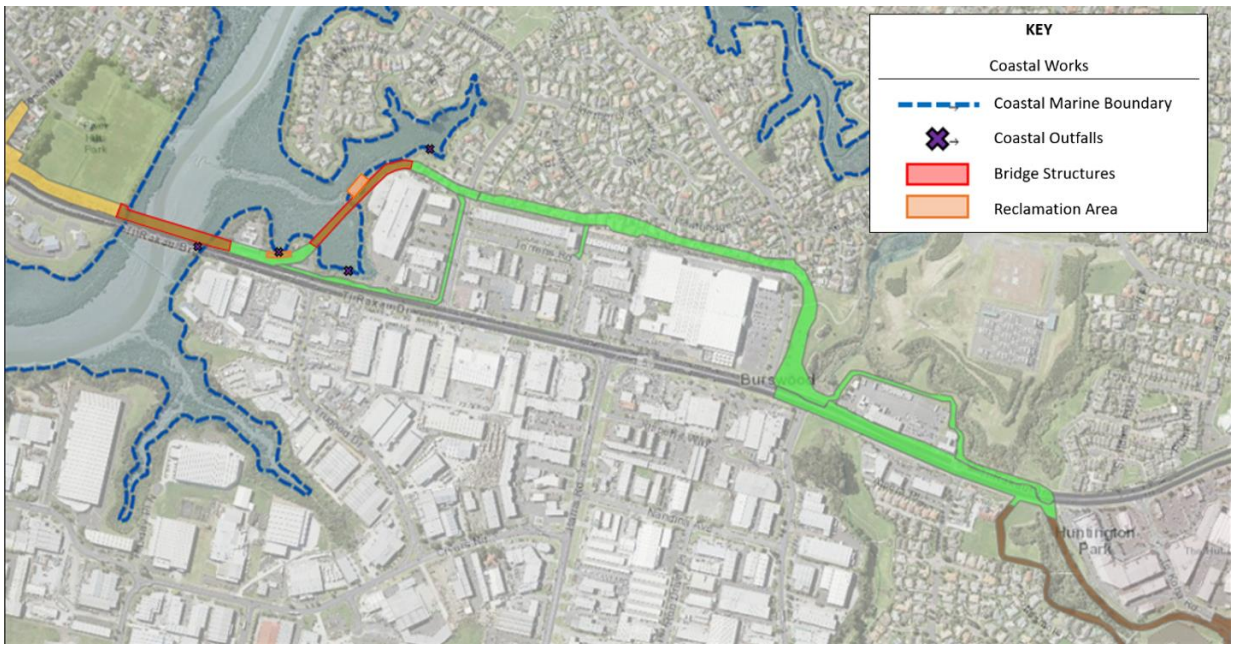


Figure 3-7 Location of Coastal Works (EB3C)

The duration and timing of works will be managed as far as practical to minimise disturbed soils exposed to heavy rainfall. A total construction programme of approximately 32-36 months is estimated, with approximately 12-15 weeks of earthworks programmed throughout that construction period (excluding trenching operations).

The use of hardfill (aggregate) for the earthwork areas will ensure that the majority of the site is stabilised at any one time. This is used as a key risk reduction methodology and is consistent with the principle of progressive stabilisation.

The coastal works present the highest relative risk. These works will be managed to minimise the risk of sediment generation and discharge to the marine receiving environment through staging, use of material (hardfill), isolating the works from tidal inundation, and progressive stabilisation.

The construction of the bridges will be carried out through temporary staging. No plant will physically work in the CMA. The pile excavation operations will be within casings that isolate disturbance from the surrounding environment. The excavated material will be loaded directly into skips or trucks and removed off site.

The reclamations and works to establish the temporary occupation working platforms as referred to in section 3.2.2, will be staged and will use stabilised material. The mangroves will be removed by hand and then geotextile will be placed over the area. During low tidal stages, clean aggregate will be placed to build up the platform.

EB4L includes a bridge and retaining wall. The construction of the bridge will be carried out on a temporary access track. No plant will physically work in the stormwater pond or wetted areas of the watercourse.

The earthworks fill operation in behind the retaining wall will use hard fill (aggregate). This will ensure that the majority of the site is stabilised at any one time. This is used as a key risk reduction methodology and is consistent with the principle of progressive stabilisation.

The implementation of a monitoring programme (as per section 3.5.3 of this report) supports the emphasis of good site management of exposed areas and the operation and maintenance of ESC. In addition, chemical treatment in accordance with the Chemical Treatment Management Plan, where appropriate, will allow for improved treatment efficiencies of detention devices.

3.4 Management Plans

3.4.1 Project Erosion and Sediment Control Plan

As illustrated in Figure 3-8, the Project ESC will be delivered through a cascade of management plans to ensure consistent outcomes and to achieve a high standard of environment management.

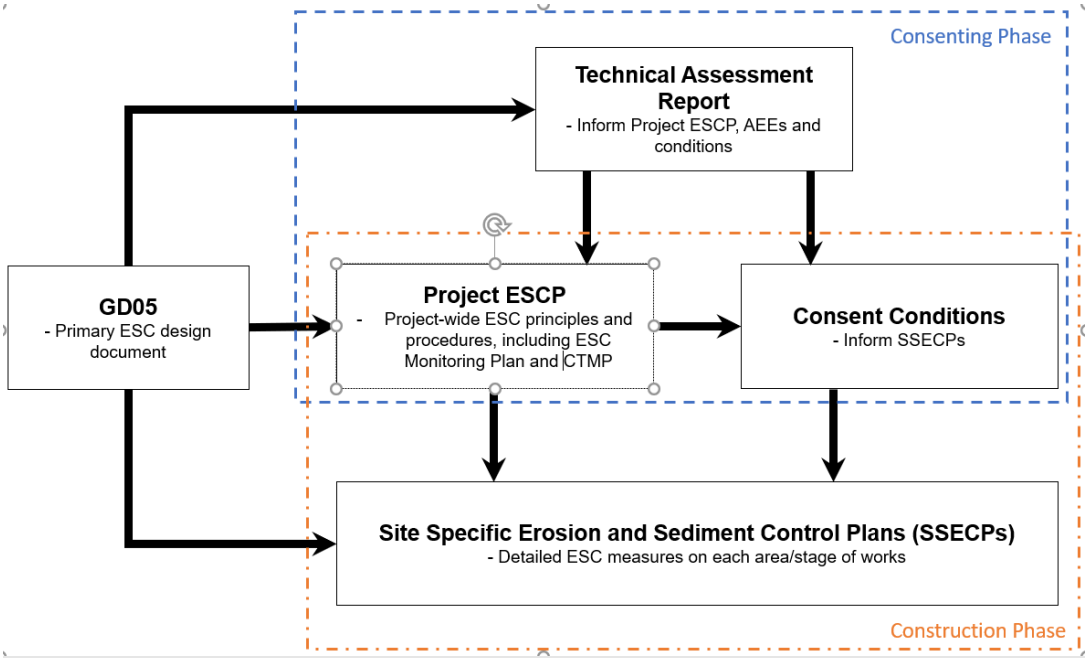


Figure 3-8 ESC Management Plan Hierarchy

A Project Erosion and Sediment Control Plan (Project ESCP) has been prepared for the current EB2 / EB3R works. The Project ESCP provides the overarching principles and design standards that will be implemented for the design construction, monitoring and maintenance of the ESC measures during the Project and has been written to provide for the greater EB project. The Project ESCP will apply to the EB3C / EB4L works and is required by the consent conditions.

In conjunction with conditions and GD05, the Project ESCP will guide the development of Site-Specific Erosion and Sediment Control Plans (SSESCPs) for each area of work.

3.4.2 Site Specific Erosion and Sediment Control Plans

SSESCPs are detailed erosion and sediment control plans which will be submitted for specific work areas, or activities, within EB3C and EB4L. SSESCPs are required by the consent conditions and will be consistent with the principles of this ESC Report and GD05. They will be developed prior to the commencement of work in that area or that specific activity, and will provide the detailed design, specific erosion and sediment control measure location, staging and sequencing of works for the specific location or activities.

The implementation of SSESCPs will enable the construction teams to have ongoing input into the ESC design prior to and during construction, subject to compliance with the design and implementation standards specified in this report, and consent conditions when those are confirmed.

The SSESCPs will be short and succinct technical plans and will include:

- Contour information
- ESC measures for the works being undertaken within a particular construction area including supporting sizing calculation and drawings
- Chemical treatment design and dosing details (including bench test results) when required
- Catchment boundaries of works and devices installed
- Location of the work
- Details of construction methods
- Design criteria, typical and site-specific details of erosion and sediment control.

3.5 Site Management

3.5.1 Management Procedures

Management of construction water will seek to achieve the following objectives:

- Minimise the potential for sediment generation and sediment yield[7] by maximising the effectiveness of ESC measures
- Take all reasonable steps to avoid or minimise potential adverse effects on freshwater and marine environments within or beyond the EB3C and EB4L work boundaries, with particular regard to reducing opportunities for sediment generation and discharge of non-sediment contaminants.

The following principles will apply and will be reflected in the SSESCPs prior to construction activities commencing:

[7] The amount of sediment discharged from the site during the works.

1. ESC construction water management measures will, where practicable, be undertaken and implemented with a hierarchy and priority order as follows:
    - Erosion control will be provided for in all circumstances by minimising sediment generation through a range of structural (physical measures) and non-structural (methodologies and construction staging – use of hardfill) erosion control measures
    - Sediment control will be implemented to treat sediment laden discharges.
2. Construction water management measures will be confirmed in the SSESCPs. All erosion and sediment controls will meet the minimum criteria of GD05 and the Project ESCP (refer to Section 3.4 above).
3. Progressive and rapid stabilisation, both temporary and permanent, of disturbed areas using mulch, aggregate and geotextiles will be on-going during the construction phase. Temporary stabilisation will apply particularly with respect to stockpiles (temporary only), ground improvement locations where topsoil is removed, concentrated flow paths and batter establishment. Stabilisation is designed for both erosion control and dust minimisation and will be progressively implemented, and will adopt the following protocols:
    - No areas of works should be stripped of vegetation unless they are to be subject to works within a 14-day period of the area being stripped. If areas are stripped and exposed to erosion and works are not to occur for at least 14 days, then temporary stabilisation will be implemented
    - Progressive stabilisation is to be implemented across EB3C and EB4L. Setting timeframes for areas to be open before stabilisation is required and will be established within the 14-day period. Stabilisation methodologies will be based on GD05 and will include mulch, geotextile, and hard fill
    - Trenching activities will be staged and undertaken in a progressive manner. Excavated material will be cut to waste. All backfill material will be aggregate
    - Preparation of earthworks areas when heavy rain is forecast to minimise erosion, through stabilisation and the installation of GD05 erosion control measures.
4. Minimising activities that could exacerbate erosion, and avoidance of activities such as stockpiling of material in flow paths.
5. All T-bar decanting earth bunds (DEBs) will be fitted with a mechanism to control (or cease) outflow during dewatering pumping activities to these structures if required. This mechanism could take the form of a manual decant pulley system or plug. When pumping to a DEB, pumping will be such that pump volumes will only be to the same level as that able to be fully captured within the retention structure and discharged out the designed decant structure.
6. Coastal works and works in the vicinity of the CMA will be undertaken in a manner that recognises the higher risk of this activity, from a sediment generation and discharge perspective, and the sensitivity of the receiving environments. Works within the CMA will be undertaken outside of tidal inundation periods and / or will be bunded to isolate the works areas from tidal encroachment and / or protected via the use of silt fences.

3.5.2 As-built Certification

All ESC measures installed on site will be inspected and certified as compliant with the relevant SSESCP and GD05 prior to earthworks commencing in that area. The as-built certification will be submitted to

Auckland Council. Any variation between the design and the measures on site will be rectified or justified prior to works commencing.

3.5.3 Monitoring

Comprehensive ESC monitoring will be undertaken for the duration of the earthworks. This will ensure that ESC measures operate with maximum efficiency and will allow for continuous improvement in response to monitoring feedback. This is outlined in Section 7 of the Project ESCP.

Proactive monitoring will occur as part of implementation as a way of assessing the effectiveness of the methodologies and treatment and allowing for improvements/modifications as the works continue, including regular site walkovers and inspection of construction water management devices and the downstream environment prior to, during and post rainfall.

3.5.4 Training

Awareness and skills are essential to ensure consistent outcomes. All staff will be provided with environmental awareness training. Staff responsible for the construction and maintenance of environmental controls will be trained in those specific areas. Awareness training will also be required for all sub-contractors to ensure that controls are maintained operational at all times, or that damage is immediately reported if it occurs.

3.6 Design of Erosion and Sediment Control Devices

The control devices to be applied to EB3C and EB4L are summarised below.

3.6.1 Erosion Control – Construction Staging and Sequencing

The extent of exposed soil and length of time that an area is exposed directly influences the sediment yield leaving a particular area. Earthworks and construction activities will be staged and sequenced across the project. Open earthworks areas will be progressively stabilised to reduce the potential for erosion to occur.

The use of hardfill supports this approach.

3.6.2 Erosion Control - Cut and Cover: Stabilisation

Stabilisation will be undertaken with three key purposes:

- To assist with the reduction of overall disturbed areas of earth
- To minimise the open area extents to assist with a reduction in sediment generation and subsequent yield
- To minimise the open area extents to assist with a reduction in dust generation.

Due to the overall nature of the proposed works, which includes provision for a stabilised hard fill surface as soon as possible to allow for civil works to commence (resurfacing, drainage, curbing and traffic barriers etc.), it is proposed to utilise a “cut and cover” erosion and sediment control methodology wherever possible and practical, in accordance with Section G3.1.2 of GD05.

This method promotes progressively undertaking construction works, stripping topsoil and any unsuitable subsoils (to achieve suitable ground conditions) and then immediately backfilling with aggregate to the final required level. In addition to the aggregate, progressively and rapidly stabilising

exposed areas will occur with measures including (but not limited to) straw mulch, pavement, geotextile cloth and vegetation establishment. This methodology will be used through the central median works, drainage activities and areas of limited shoulder widening.

For areas not filled with hardfill, mulching will typically be applied to slopes of less than 10 degrees, with alternatives such as geotextile or polymers considered as required.

Photo 1: Rapid stabilisation, cut and cover (geotextiles and aggregate) used on the Albany Highway project

3.6.3 Erosion Control – Clean water Control

Clean water diversions (CWDs) are diversion channels or bunds which provide for the controlled conveyance of runoff from the wider catchment. CWDs will be used on EB3C and EB4L to prevent runoff from the undisturbed catchment above the works from entering the construction area to ensure the works are sufficiently protected from flows from the natural catchment outside of the work area wherever practicable.

This will specifically be in the form of retaining the kerb and existing drainage as long as possible or in the form of Hotmix bunds which will be installed and utilised for diversion of flows from existing road surfaces. In accordance with GD05, the Hotmix bunds will be approximately 150mm to avoid flooding of the existing road network.

Photo 2: Hotmix Bund used to divert existing road runoff and separate works area, used on the North-Western Motorway.

3.6.4 Erosion Control – Stabilised Construction Entrance Way

Stabilised construction entrance ways are either a sealed entrance or a stabilised pad of aggregate placed on a filter cloth base and are located where construction traffic will enter or exit a construction site. Stabilised construction entranceways help to prevent site entry and exit points from becoming a source of sediment and also help to reduce dust generation and disturbance along public roads.

No vehicles will be allowed to leave the construction site unless tyres are clean, so that construction vehicles will not contribute to sediment deposition on public road surfaces outside the works area. These are to be designed in accordance with GD05.

3.6.5 Sediment Control - Decanting Earth Bund

Decanting earth bunds (DEBs) are sediment retention devices where ponding of sediment-laden runoff can occur. DEBs provide time for suspended solids to settle out before the runoff is discharged to the receiving environment. The DEBs will be designed and installed in accordance with GD05. The key design criteria are set out below:

- DEBs will have a minimum storage volume sized at a ratio of 2% of the contributing catchment area with a maximum contributing area not exceeding 0.3 ha, and an ideal length to width ratio of 3:1, but not exceeding 5:1
- All spillways from the DEBs will be constructed to a minimum 2m wide by 250mm in depth
- DEBs will be fitted with T-floating decants with a mechanism to control outflow such as a manual decant pulley system to be used during pumping activities to these structures.

3.6.6 Sediment Control - Chemical Treatment

To maximise their efficiency, DEBs will receive chemical treatment to increase the settlement rate and retention of suspended solids from construction runoff. All DEBs will be chemically treated with a flocculant appropriate for the soil type and discharge location in a particular construction area. This will be based on bench testing of soils using a range of flocculants to be undertaken during the SSESCP development, which will include details of the flocculant type, dosing rate and floc system catchment

tray area to be applied at specific locations. A Chemical Treatment Management Plan has been prepared and is appended to the Project ESCP.

3.6.7 Sediment Control – Silt Fences and Super Silt Fences

Silt fences and super silt fences are fabric fences reinforced with stakes and netting backing. They provide a physical barrier to flows leaving the area of earthworks.

The placement of silt fences and super silt fences will be based upon the criteria contained within GD05.

Photo 3: Silt Fences used to treat construction water, used on the North-Western Motorway.

3.6.8 Sediment Control - Pumping activities

Wherever possible, gravity flow into the various sediment retention measures will be used in preference to pumping. However, it may not always be possible to achieve gravity flow to sediment control devices during construction. Trenching is an activity that will be undertaken during the Project that may require dewatering by pumping.

If pumping is required, pumped water will be discharged to a DEB or other treatment container. Water from the containment devices (DEB or treatment container) will not be discharged to the environment until the impounded water has a visual clarity of at least 100mm. That is consistent with GD05.

As noted, DEB decants will have a means to suspend the T-bar decants or plug the outlet to prevent discharge while pumped water settles.

The pumping rates and volumes to DEBs or treatment containers will be controlled so that the total pump volume can be fully captured within the retention structure.

Pumping may also be required for other activities such as bridge construction where pumping of sediment laden water may be required during foundation / piling construction. Pumping flows to a sediment retention structure ensures that any sediment laden flows are discharged to a treatment device prior to discharge to the receiving environment.

A Chemical Treatment Management Plan and Dewatering Procedures are included in the Project ESCP. All pumping and dewatering operations will be in accordance with the Project ESCP.

3.6.9 Coastal Works

Coastal works will include the construction of Bridge A and Bridge B with the associated reclamation, retaining walls, temporary staging and structures, and permanent structures.

Specific SSESCPs will be prepared for these operations that will allow the works to be undertaken in the dry, working around the tides and the use of stabilised material, coffer dams and casings for the bridge piers.

The construction of the bridges will be carried out through temporary staging. No plant will physically work on the seabed. The pile excavation operations will be within casings that isolate disturbance from the surrounding environment. The excavated material will be loaded directly into skips and removed off site.

The reclamation and temporary occupation works will be staged and will use stabilised material. The mangroves will be removed by hand and then geotextile will be placed over the area. Once the tide has receded below the works area, clean aggregate will be placed to build up the reclamation or temporary work platform. This methodology was successfully used during the Causeway Motorway reclamation works, operations undertaken within the highly sensitive Motu Manwa-Pollen Island Marine Reserve.

The installation of two new and two upgraded stormwater outfalls will occur within the CMA. A specific SSESCP will be prepared for those operations that will allow the works to be undertaken in the dry, working around the tides, and the use of coffer dams, silt fences and diversions to divert any upper catchment water.

Stabilised access will be constructed to allow the works to be completed as required. The stabilised access tracks will be completed as cut and cover operations. Geotextile will be placed over the grass, with aggregate placed over the geotextile. Any dirty water created during the operations will be contained and pumped to a containment device (DEB or treatment container) for treatment in accordance the Project's Chemical Treatment Management Plan and Dewatering Procedures.

3.6.10 Stream Works

The installation of one new stormwater outfall and two existing stormwater outfalls will be upgraded within the riparian margins of Pakuranga Creek, EB3C. A fourth stormwater outfall will occur in Guys Reserve, EB4L. A specific SSESCP will be prepared for those operations that will allow the works to be undertaken in the dry, with the use of coffer dams, silt fences and diversions to divert any upper catchment water.

Stabilised access will be constructed to allow the works to be completed as required. The stabilised access tracks will be completed as cut and cover operations. Geotextile will be placed over the grass, with aggregate placed over the geotextile. Any dirty water created during the operations will be contained and pumped to a containment device (DEB or treatment container) for treatment in accordance with the Project Chemical Treatment Management Plan and Dewatering Procedures, included in the Project ESCP.

The EB4L retaining wall and bridge construction will be immediately adjacent to the Pakuranga Creek, in Guys and Whaka Maumahara Reserves. The retaining wall works will be clear of the creek, and the construction of Bridge C will be carried out on a temporary access track, all clear of the creek. No plant will physically work in the stormwater pond or creek. Silt fences will be installed below the area of works to provide a physical barrier and protection for the Pakuranga Creek within the Guys and Whaka Maumahara Reserves.

3.6.11 Dust Control

Dust will be managed onsite in accordance with GD05. This includes the use of water trucks to dampen exposed soil areas and stockpiled materials if they eventuate (although stockpiles are not expected).

The limited area of land disturbance works for EB3C and EB4L and the areas of "cut and cover" methodology proposed will further minimise the likelihood of a dust nuisance.

Stockpiles will be located within the transfer compound areas and controlled by bunding and silt fences. Cut material will initially be loaded onto a 6-wheeler truck and taken to the transfer yard where the material will be transferred onto truck and trailer units for removal off project. Material may be temporarily stockpiled until there is enough material to fill a truck and trailer unit for removal.

Material to be removed off site (cut to waste) will be taken to authorised facilities. All material will be tested as required to ensure compliance with the authorised facilities acceptance criteria and conditions.

3.7 Reasons for Consent

Consent matters are set out in the AEE. Reasons for consent are under the AUP(OP), Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES FW) and the Resource Management (National Environmental Standards for Assessing and Managing Contaminants) Regulations 2011. Consent matters relevant to this assessment relate to land disturbance, land disturbance in proximity to streams and wetlands~~,~~ stream works and land disturbance within the CMA.

4 Methodology and Analysis

Chapter Summary
This assessment is based on: ¶ *The Project design drawings and engineering details* ¶ *Other specialist assessments* ¶ *Relevant design guideline* ¶ *Site walk-over* ¶ *Statutory assessment instruments.*

4.1 Assessment Methodology

This report follows an overall Best Management Practice (BMP) approach to the construction activities which combines GD05 as the minimum design standard with appropriate staging and other controls, based on the characteristics of EB3C and EB4L and the receiving environment.

The existing environment as outlined within Section 5 of this report was characterised through the following:

- Assessment of existing datasets and information available from numerous sources including the Council
- Project technical reports
- Site inspection of the alignment in general
- It is framed within the relevant AUP (OP) matters of discretion, objectives and policies, and the relevant provisions of the NES - FW.

4.2 Site Walk-Over

Site inspections have been undertaken on several occasions to assess different aspects of the Project through October and November 2021.

4.3 Design Guidelines

GD05 is the relevant ESC design guideline. The construction management principles and methodologies described in this report are based on, and consistent with, that guideline.

5 Existing Environment

The immediate receiving environment of EB3C consists of the coastal environment of the Pakuranga Creek and the road corridor of Tī Rākau Drive, including the intersections with Burswood Drive. The wider area includes the local commercial area, as well as residential dwellings to the north of the commercial area.

EB4L is within the Guys Reserve and the Whaka Maumahara stormwater reserve. To the north of the alignment is the commercial precinct of the Botany Hub.

As discussed in further detail in the AEE, the topography within and immediately surrounding EB3C and EB4L is generally flat to gently undulating.

The western end of the EB3C project area is dominated by Pakuranga Creek, while the eastern end by the Burswood reserve.

The majority of the works will be undertaken across sites that comprise residential property or existing at grade road carriageway. Commercial and residential properties bound the middle sections of the combined EB3C and EB4L project footprint.

Stormwater is serviced by reticulation and by overland flow paths that drain back via Tī Rākau Drive and the Burswood reserve to the Pakuranga Creek. The Pakuranga Creek is tidal at the location of the stormwater reticulation outfalls. The EB4L outfall works site is within the Guys Reserve. The Whaka Maumahara stormwater pond discharges to the Pakuranga Creek through Guys Reserve beneath Tī Rākau Drive, to Bard Place Reserve.

6 Assessment of Potential Construction Water Effects

Chapter Summary
Overall, the potential risk of an elevated sediment yield is low. The works comprise a mix of earthworks that expose erodible soil and reworking of existing non-erodible surfaces. The works areas have generally low gradients, which further reduces the potential for sediment generation during rainfall. The works will be staged such that the exposed areas are minimised at any one time and works areas will be progressively stabilised. *The stream works are minor in nature associated with new and the upgrade of existing stormwater outfalls. The construction activities can be isolated from the receiving environment through the installation of coffer dams or bunds to isolate the works area, and weather windows.* *The coastal works present the highest relative risk. But again, those works will be managed to acceptably minimise the risk of sediment generation and discharge to the marine receiving environment through the use of temporary staging (for the bridge structures) to allow the structures works to be undertaken above the CMA, the staging of the works, isolating the works from tidal inundation, and progressive stabilisation. Reclamation works will be undertaken using a proven staged methodology within tide cycles ensuring that the works are undertaken in the dry using stabilised materials.* *If undertaken in accordance with the methodology described in this report and consistent with the Project ESCP, , it is anticipated that the works will have low adverse effects on the receiving environment.*

Overall, it is considered that the potential risk of an elevated sediment yield from the EB3C and EB4L works is low. This is primarily due to the low gradient[8] of the majority of the Project area across EB3C and EB4L, the relatively small area of exposed soil that will occur as distinct from exposed hardfill, and the staged nature of the works incorporating progressive stabilisation. A driver of this staged and progressive approach to the earthworks is the nature of working in and around and adjacent to a live road network and developed urban and commercial environment with limited space.

Notwithstanding the above, EB3C and EB4L works have the potential to result in some temporary changes to water quality during the construction phase as a result of the discharge of sediment from earthworks during rain events, from dewatering activities and the discharge of other construction related contaminants (such as oils, fuels, and cement).

The assessment of these potential water quality effects is based on the GD05 BMP principles, and the specific erosion and sediment control measures assessed as appropriate for the project.

Managing site sediment risk is a combination of:

- The competency and performance of the construction team
- Timing and duration of works
- The quality construction, operation and maintenance of the ESC measures and other site management procedures and practices.

The SSESCPs will ensure ongoing construction team input into site management and will allow for flexibility with the specific ESC implementation. These SSESCPs will provide the detailed design, specific ESC locations, and the staging and sequencing of works for that location or activity. Each SSESCP will be developed prior to works commencing in the specific locations applicable to the SSESCP.

[8] Slope gradient and slope length are significant factors in erosion potential and sediment generation during rainfall.

6.1 Erosion and Sediment Control Onsite Implementation

SSESCPs will be developed prior to the commencement of work and provide the detailed design, specific erosion and sediment control measure location, staging and sequencing of works for the specific location or activity.

Primarily the erosion and sediment controls are based around cut and cover methodologies, use of silt fences in locations where suitable, and the installation of DEBs where space provides.

In addition, clean water diversions (existing curbs and hotmix bunds) will be utilised along the sections of the alignment for the purpose of minimising dirty water catchment areas and keeping “offsite water” away from the earthwork activity.

EB3C and EB4L has waste cut material that is to be removed off site. This cut material will initially be cut to waste and removed to the transfer laydown yard at Burswood reserve before being transported directly off site or to the main Project site transfer (169 - 171 Pakuranga Road) compound for temporary stockpiling to then be reloaded onto a truck and trailer for removal off site to an appropriate facility.

Coastal and stream works will have specific SSESCPs developed based around isolating the works area and using methodologies to ensure that the works are “undertaken in the dry”. The specific reclamation methodology ensures all works will be timed to occur when the tide is below the works area and will be isolated by bunding or silt fences, a proven methodology undertaken successfully in highly sensitive receiving environments.

6.2 Eastern Busway 3 Commercial

As previously described in this Assessment, the EB3C works will comprise:

- Reworking of existing road and hard-stand areas
- Disturbance of soil and construction with hardfill, including formation of new busway, bus station, road widening and cycleway using hardfill
- Services installation via trenching
- Coastal works associated with permanent and temporary bridge structures, retaining walls, and reclamation
- Coastal outfall construction and upgrades.

6.2.1 Existing road and hardstand areas

These works present a very low risk of sediment generation and discharge as erodible soils will not be exposed and these works areas have very low gradient. Where necessary, additional protection will be installed such as filter protection around live catch pits and measures to ensure that runoff is not directed towards private property in a manner that will cause nuisance or harm. Overall, the potential adverse effects of these works are very low.

6.2.2 Disturbance of soil and construction with hardfill

Areas beyond existing road and hardstand will need to be excavated prior to placement of hardfill base. Generally, these will be progressively stabilised but in addition, sediment control will be provided as described in Section 0 above and in accordance with required measures included in the

Project ESCP, and as detailed in the relevant SSESCP as required by conditions. These works areas have a low gradient and individually, each works area is not extensive. The potential for sediment generation is relatively low and with ESC mitigation, the potential for adverse sediment effects off site is very low.

6.2.3 Services installation / Trenching

Trenching will be staged and isolated from surrounding works. If required, dewatering will be undertaken in accordance with required measures included in the Project ESCP and the relevant SSESCP as required by conditions. Water pumped from trenches will not be discharged from the site unless it meets a minimum standard of 100 mm visual clarity, in accordance with the Project ESCP. Alternative options will be available via tankering water off-site in the event that the clarity standard cannot be met. Experience in similar projects suggests that the 100mm standard will be able to be met.

Consequently, service installation, including trenching, can be managed to ensure that any residual discharge of sediment from the works is minimised to an acceptable level and offsite effects are negligible.

6.2.4 Coastal Works

EB3C requires works within the CMA, the works being reclamation, temporary occupation to create working platforms and the construction of permanent bridge structures requiring the installation of temporary staging during the construction phase.

The works will be isolated from the coastal environment through the use of pile casings, coffer dams and working outside tidal inundation. Fill will comprise non-erodible hardfill. All subsequent construction works will be undertaken outside or above the CMA but will not require direct contact with the CMA.

Best practice site management measures will be adopted to contain and prevent any spill of concrete, debris or other material from the working surfaces.

The proposed construction methodologies, for the reclamation, temporary occupation platforms and the piling operations, have been successfully used in the highly sensitive marine environment of the Motu Manawa Marine Reserve during the North-Western Motorway project. The reclamation and temporary occupation platform methodology was then successfully repeated for the Onehunga Foreshore Restoration project. The reclamation and piling methodologies are now considered standard best practice and have been successfully implemented on recent large bridge builds in sensitive marine environments, including bridge construction at Matakohe and Taipa in Northland.

EB3C also requires works within the CMA for the installation of two new and two upgraded stormwater outfalls. The construction activities can be isolated from the receiving environment through the installation of coffer dams or bunds to isolate the works area, and within tide and weather windows. These works will also require tracking into the site. That will be managed by progressive stabilisation with aggregate and geotextile such that the access is immediately protected from erosion.

The ecological impacts of the works, including the area required for reclamation and rip rap erosion protection beyond the pipe outlet and wingwall, has been assessed by others, refer to the Marine Ecology and Coastal Avifauna Effects Assessment.

In terms of potential sediment effects, the works will be undertaken using best practice techniques including isolating the worksites with coffer dams or bunds and works timed to occur when the tide is below the works area.

Given the proven and successful implementation of these methodologies within various other projects, they can be successfully implemented for the EB3C works.

Overall, the coastal works will be managed in a way that ensures that potential adverse water quality effects associated with land disturbance are appropriately minimised.

6.2.5 Stream Works

EB3C requires works within the riparian margins and stream works for the upgrade of two existing outfalls and the installation of a new stormwater outfall. The construction activities can be isolated from the receiving environment through the installation of coffer dams or bunds to isolate the works area, and weather windows.

These works will also require tracking into the site. That will be managed by progressive stabilisation with aggregate and geotextile such that the access is immediately protected from erosion.

The ecological impacts of the works, including the area required for reclamation and rip rap erosion protection beyond the pipe outlet and wingwall, is assessed by others, refer to the Terrestrial and Freshwater Ecological Effects Assessment.

In terms of potential sediment effects, the works will be undertaken using best practice techniques including isolating the worksite with coffer dams or bunds and in fine weather windows.

Given the proven and successful implementation of these methodologies within various other projects, they can be successfully implemented for the EB3C works.

Overall, the stream works will be managed in a way that ensures that potential adverse water quality effects associated with land disturbance are appropriately minimised.

6.3 Eastern Busway 4 Link Road

As previously described in this Assessment, the EB4L works will comprise:

- Reworking of existing road and hard-stand areas
- Disturbance of soil and construction with hardfill, including formation of new busway and walking path cycleway and temporary access using hardfill
- Services installation via trenching
- Works associated with structures, retaining wall and a bridge.

6.3.1 Existing road and hardstand areas

These works present a very low risk of sediment generation and discharge as erodible soils will not be exposed and these works areas have very low gradient. Where necessary, additional protection will be installed such as filter protection around live catch pits and measures to ensure that runoff is not directed towards private property in a manner that will cause nuisance or harm. Overall, the potential adverse effects of these works are very low.

6.3.2 Disturbance of soil and construction with hardfill

Areas beyond existing road and hardstand will need to be excavated prior to placement of hardfill base. These will be progressively stabilised but in addition, sediment control will be provided as described in Section 0 above and in the Project ESCP, and as detailed in the relevant SSESCP. The fill operations are associated with the establishment of temporary access and the retaining wall structure. The works area has a low gradient and is not extensive. The potential for sediment generation is relatively low and with ESC mitigation, the potential for adverse sediment effects off site is very low.

6.3.3 Stream Works

EB4L requires works immediately adjacent to the Pakuranga Creek within Guys Reserve and Whaka Maumahara Reserve. No specific works associated with road alignment are required in the watercourse. The construction activities can be isolated from the receiving environment through the installation of silt fencing and other erosion and sediment control.

The earthworks adjacent to the creek will include the use of hardfill. This will ensure that the area is managed by progressive stabilisation with aggregate.

One stormwater outfall requires works within the riparian margin and stream works. The construction activities can be isolated from the receiving environment through the installation of coffer dams or bunds to isolate the works area, and weather windows.

These works will also require tracking into the site. That will be managed by progressive stabilisation with aggregate and geotextile such that the access is immediately protected from erosion.

The ecological impacts of the works are assessed by others, refer to the Terrestrial and Freshwater Ecological Effects Assessment. In terms of potential sediment effects, the works will be undertaken using proven ESC techniques.

Given the proven and successful implementation of these methodologies within various other projects, they can be successfully implemented for the EB4L works.

Overall, the works will be managed in a way that ensures that potential adverse water quality effects are appropriately minimised.

6.4 Cumulative Effects

The risk of adverse sediment-related effects of the EB3C and EB4L works is assessed as being low. Consequently, the cumulative effects are also assessed as low, even when considered in conjunction with the EB2 and EB3R works, which are assessed as low. As noted earlier, the extent of works that will result in open ground that is vulnerable to erosion is relatively small compared to the scale of the project. Those works can be managed such that they present a low risk of untreated sediment discharge and a low risk of unacceptable off-site effects on water quality and ecology. The coastal works and works in and adjacent to streams can be carefully managed and staged to achieve an equally low impact on the downstream environment.

This conclusion includes consideration of potential adverse sediment-related effects on coastal values. The management of runoff will appropriately minimise sediment discharges to and within those environments.

7 Mitigation

Overall, it is concluded that the construction ESC and water management proposed for EB3C and EB4L is in accordance with current best practice, can be successfully implemented and provides certainty in mitigating any actual and potential adverse effects.

It is recommended that the following key elements from this assessment form part of the mitigation measures for the construction works:

- All earthworks and land disturbance activities should be undertaken in general accordance with this report, including the specific measures in the Project Erosion and Sediment Control Plan and SSESCP's.
- The approach to managing ESC and construction water discharges will be confirmed by the construction team prior to works commencing through the preparation (and certification by Council) of SSESCPs for specific activities of EB3C and EB4L.
- SSESCPs will include the following information:
    - Contour information
    - ESC measures for the works being undertaken within a particular construction area
    - Chemical treatment design and details
    - Catchment boundaries of works and devices installed
    - Location of the work
    - Details of construction methods
    - Design criteria, typical and site-specific details of erosion and sediment control
    - Design details for managing the treatment, disposal and/or discharge of contaminants (e.g., concrete wash water).
- A Chemical Treatment Management Plan should be prepared and submitted to Council prior to the commencement of works to confirm the chemical treatment set up and include all relevant batch dosing information as part of dewatering operations.
- Any DEBs constructed should be chemically treated in accordance with the Chemical Treatment Management Plan.
- Prior to any coastal works commencing on the site, a final construction methodology should be included within the relevant SSESCP. Details to be provided should include, but should not be limited to timing, staging, and sequencing of coastal works, and the erosion sediment control measures to be employed to mitigate the effects on the receiving environment.
- Prior to any stream works commencing on the site, a final construction methodology should be included within the relevant SSESCP. Details to be provided should include, but should not be limited to timing, staging, and sequencing of stream works, and the erosion sediment control measures to be employed to mitigate the effects on the receiving environment.
- Any exposed areas should be subject to a 14-day stabilisation period. If areas are stripped and exposed to erosion, and works are not to occur within a 14-day period, then temporary stabilisation will need to occur. Stabilisation methodologies will need to be based on proven options and will include mulch, geotextile and hard fill.

Through the implementation of the recommended key mitigation measures above, any ESC construction water discharges will be subject to best practice management and proven management conditions, which will enable any potential effects from EB3C and EB4L to be appropriately managed.

8 Recommendations and Conclusions

It is recommended that the earth, coastal and stream works associated with EB3C and EB4L implement the mitigation listed in Section 7 above. That represents construction industry best-practice, provides certainty in outcomes, and can be successfully implemented within these footprints. These conclusions are based on site visits, a review of the existing design information, and experience from other similar and adjacent roading projects in Auckland.

Site-specific erosion and sediment control plans will allow ESC details to be confirmed concurrently with detailed design for each stage or area of works. These will be prepared by the project contractor and will be implemented in accordance with the Project ESCP and GD05.

Ongoing monitoring, maintenance, and adaptation of the ESC measures for the duration of works will ensure that the works achieve the anticipated environmental outcomes i.e., that the potential adverse sediment-related effects of the works will be temporary and can be appropriately managed.