



DESCRIPTION OF THE PROJECT

6.0 Description of the Project

Overview

This section includes the Project Description which provides the basis for the assessment of effects on the environment in *Part G: Assessment of Effects on the Environment* of this AEE. It includes a description of design and form of the Project and how the Project will be operated once construction is complete.

6.1 Introduction

This Project description provides the basis for the assessment of effects on the environment. It includes a description of the key physical elements of the Project and how different aspects of the Project will be operated once construction is complete.

Given the integrated nature of the Project, the description provides a brief overview of the transport elements of the Project and the wider open space, water and environmental elements. This is followed by a description of the Project's physical works within each of the six sectors.

The transport elements of the Project are described in terms of the following aspects:

- The State highway environment and local roads, other transport modes;
- A summary of the key features including: major structures, interchanges, acoustic barriers;
- Traffic function; and
- Design approach.

In addition, the wider integrated elements of the Project are described in terms of the social, environmental and cultural outcomes they deliver. In particular, these relate to the:

- Open space and recreation outcomes (public access);
- Water quality outcomes (the receiving environment including the CMA); and
- Wider environmental / cultural restoration / rehabilitation outcomes.

The second part of this section provides a description of design elements specific to each of the six sectors described in *Section 6.6: Physical description – Project sectors* of this AEE. The section also highlights how this Project integrates with other transport network-related projects in the wider area in *Section 6.7* of this AEE.

The information provided in this section is indicative and is intended to provide sufficient detail on the Project to assess the actual and potential effects and to identify any necessary measures to avoid, remedy, or mitigate any adverse effects, where appropriate.

The design will be further refined, through subsequent phases of the Project. This will be undertaken within the scope of the final designation and consent conditions which will have been put in place to manage the effects on the environment. The detailed design of the Project will be reflected in the Outline Plan(s) and other documentation submitted to Auckland Council prior to construction. Further discussion on the Outline Plan process is provided in *Section 13.1.2* of this AEE.

6.2 Overview of key features

At its core, the Project seeks to provide transport outcomes to meet the Transport Agency's objectives for the Project as set out in *Section 3.3* of this AEE. In delivering these outcomes, the Project has also

sought to integrate with wider social, environmental and cultural outcomes and aspirations for the area. This integrated approach is core to the Project, but also means that some components of the Project are beyond the defined transport outcomes. As a summary, for each of the design features described, reference is made to whether these are contributing to transport, public access, water quality and/or wider environmental/cultural outcomes.

The principal design features are addressed in the sections below.

6.3 Transport environment

6.3.1 New State highway

The Project involves the establishment of a new section of State highway generally between existing SH20 and SH1. The new State highway will comprise all parts of the alignment where the primary function is State highway and will likely be gazetted as State highway on completion. This will include:

- All ramps onto and off the Neilson Street Interchange and the alignment where it passes to the north of the Onehunga Wharf;
- The Main Alignment adjacent to the Māngere Inlet foreshore;
- Viaducts over Anns Creek and the intersection with Great South Road;
- Connections from the Main Alignment to Great South Road and Sylvia Park Road and the alignment;
- Sylvia Park Road; and
- New SH1 on and off-ramps at Mt Wellington.

Where the alignment ties into local roads, these will be designated for State highway purposes as far as physical works are required. In due course the designation will be uplifted to cover the gazetted State highway, with the balance of any works becoming part of the local road network. This is described further in *Section 6.3.4* of this AEE.

The new State highway will operate as an arterial road environment, enabling local road connections, walking and cycling paths, and crossings at some intersections. The majority of the State highway will comprise two lanes in each direction with shoulders, raised median, and separated walking and cycling paths on either side.

6.3.2 SH1 alignment and capacity improvement

The Project will increase capacity on SH1 between the Mt Wellington Interchange and just south of the Princes Street Interchange by adding one additional lane in each direction on the existing motorway. The additional lanes will have adjacent shoulders and vertical retaining walls on the outer edges. The additional lanes merge from new south-facing ramps providing access between the Main Alignment and the SH1 corridor. Where the new State highway joins SH1, the southbound on-ramp will comprise two lanes that enable ramp metering, merging into a single lane prior to joining into the new auxiliary lane on SH1. The northbound off-ramp from SH1 includes an improved Mt Wellington Highway off-ramp, with the Project connection coming off this ramp. The new EWL/Great South Road/ Sylvia Park Road intersection will provide long term benefits by providing grade separating the east west connections improving reliability and future resilience for this intersection.

6.3.3 SH20 alignment

Capacity improvements on SH20 are being undertaken in 2016 as part of a wider programme of improvements along the SH20 corridor. These are described in *Section 6.7.1* of this AEE. In addition, the Project will include the following changes to the existing SH20, which are illustrated in *Plan Set 3: Road Alignment* in *Volume 2: Drawing Set*.

- A bus priority lane leading into a reconfigured off-ramp which directs bus access to a reconfigured Galway Street/Onehunga Harbour Road;
- New on-ramp from the Main Alignment comprising a bridge over SH20 and on-ramp west of the existing access from Neilson Street which remains in its current location with lanes merging between the two ramps; and
- Extended bus only on-ramp to SH20.

6.3.4 Local roads

Local roads will be altered and constructed as part of the Project. These are administered by Auckland Transport. These works are required as part of the Project to provide connectivity to the Project and to provide improved local road function. The Transport Agency designation for the Project will provide for these works to occur. The designation will be uplifted from local road areas on completion and local roads will be transferred to Auckland Transport to operate and maintain. The local roads are described in Section 6.6 of this AEE.

6.3.5 Walkways, cycleways and shared paths

The Project includes both commuter and recreational cycle paths provided along the Project alignment, and also in a north-south direction to enhance connectivity to communities in the Onehunga-Penrose area to the north of the Project. There is no provision for walking and cycling paths on the existing motorways (SH1 and SH20). There is an existing pedestrian path under the SH20 Manukau Harbour Bridge which will be retained.

New paths will connect to existing cycle and walking networks, improving connectivity to the wider Auckland region facilities. Key linkages provided by the Project are illustrated on *Plan Set 3: Road Alignment* in Volume 2, and include:

- Improved linkages in and around the Neilson Street Interchange linking with the New Old Māngere Bridge, the new pathways in Taumanu Reserve (Onehunga Foreshore), clearer access into Gloucester Park North Reserve and improved facilities on Onehunga Harbour Road and Onehunga Mall³¹;
- A new Māngere Inlet foreshore with recreational and commuter paths along the alignment;
- North-south shared path linkages to/from Alfred Street, Captain Springs Road, Waikaraka Park and Hugo Johnston Drive, improving access to businesses and the residential communities to the north;
- Linking the existing Waikaraka shared path through to Sylvia Park Town Centre thereby improving the functionality of the existing path which currently ends in an industrial environment in Hugo Johnston Drive;
- A shared pedestrian and cycle path over the Great South Road intersection will provide improved east west connections;
- Wider pedestrian and cycle paths on the replacement bridges across SH1 at Panama Road and at Princes Street, improving sight lines and crossing points, and connectivity to residential communities; and

³¹ This connection will maintain and enhance connections from the southern side of the Māngere Inlet, including to and from the Māngere Bridge township, across the Old Māngere Bridge (and its future replacement structure), and into the Onehunga Town Centre.

- A new pedestrian/cycle crossing at Ōtāhuhu Creek parallel to SH1, connecting Mataroa Road (north) with Deas Place (south), improving local connectivity between the residential communities east of SH1 (Panama Road and Princes Street East).

The Project has been designed to avoid the need for on-road cycling where practicable, with separated cycling facilities provided beside the Project Main Alignment between SH20 and SH1, and access to the separated recreational cycle and walkway on the Māngere Inlet coastal edge. Cycle paths will be designed to the following approximate design specifications (to be confirmed in detailed design):

- Off-road exclusive cycle paths will be generally be 3m wide;
- Shared paths will have a minimum width of 3m; and
- Separated foot/cycle paths will have widths as specified in *Auckland Transport Code of Practice (ATCOP)*³².

The detail of the type of walking and cycling infrastructure, will be developed in the detailed design process, including both the form and connections. Pedestrian footpaths will generally be provided on either side of the Project, on all local roads and at signalised intersections (except motorways). Pedestrian facilities will generally be designed in accordance with the Transport Agency's *Pedestrian Planning and Design Guide*³³, the design principles from the Transport Agency's *Urban Design Guideline – Bridging the Gap*³⁴ and the *Auckland Transport Code of Practice*.

6.3.6 Bus

The Project has been designed to enhance bus connectivity and travel time reliability for buses travelling from Māngere Town Centre to Onehunga Town Centre via SH20 by removing through traffic from the local network (Onehunga Mall) onto the EWL. The bus network will also benefit from a reduction of traffic on Church Street and Neilson Street, resulting from volumes of through traffic moving to the EWL, and the increased resilience in the network arising from more route options. The reduction of freight traffic accessing Onehunga Town Centre (including buses) and the traffic accessing the industrial areas to its east will occur as a result of industrial and freight traffic being encouraged to use the EWL. Key measures for buses include:

- Northbound buses: A realigned SH20 Neilson Street off-ramp and new link to Galway Street via the new EWL exit. Buses will no longer use Onehunga Harbour Road to access the town centre;
- Northbound buses: A new link road connecting Galway Street to Onehunga Mall via a roundabout and signalised intersection which will be used by buses to access the town centre; and
- Southbound buses: Existing southbound on-ramps will be realigned. The existing T2 lane (a lane for vehicles carrying two or more passengers) at Gloucester Park Road and the SH20 on-ramp will be converted to a bus-only lane and will connect directly into the existing bus lanes on SH20.

Galway Street will be primarily used by those travelling west, with Onehunga Mall used by those with northern destinations, this is self-defining. Onehunga Mall is designed to remain as a 2-lane facility, with Galway Street as 4-lanes. This will discourage 'rat-running' on Onehunga Mall. The role of Onehunga Mall as a route for pedestrians and cyclists will be via the facilities provided.

During engagement, Auckland Transport advised their preference that buses utilise the existing local network rather than the new State highway. Therefore no bus priority lanes are proposed on EWL.

³² Auckland Transport, *Auckland Transport Code of Practice*, March 2014.

³³ Transport Agency, *Pedestrian Planning and Design Guide*, October 2009.

³⁴ Transport Agency, *Bridging the gap: NZTA urban design guidelines*, October 2013.

6.3.7 Rail

A key feature of the Project is the strategic location in the vicinity of the rail network including Southdown rail line accessing the KiwiRail land and inland ports. The NIMT rail line is used for freight around the upper North Island, including from the Port of Tauranga. The Project has been designed to accommodate existing rail operations and to not preclude the future aspirations of KiwiRail for development of rail facilities, particularly in the vicinity of the inland ports and Great South Road intersection. Integration of the EWL with other transport projects (including Auckland Transport multi-modal and mass transit proposals) are discussed in *Section 6.7* of this AEE.

The Project:

- Where crossing the KiwiRail rail corridor, provides for structures with appropriate clearances over the rail network to accommodate ongoing use, electrification and operational constraints;
- Avoids requirement for land within the designated rail corridor, where there are future aspirations for development of rail infrastructure; and
- Seeks to integrate future rail development with the construction and operation of the Project.

6.4 Design approach

6.4.1 Design Standards and guidelines

The design, including geometric layout, safety features, stormwater, structures, noise barriers and lighting, has been developed using guidelines that include:

- The Transport Agency design standards and guidelines; (transport, urban design, pedestrian and cycling etc.);
- The Association of Australian and New Zealand road transport and traffic authorities (AUSTROADS) standards;
- Auckland Council and Auckland Transport standards and guidelines;
- New Zealand Standards; and
- Utilities standards.

Safety in Design will be an integral part of the detailed design process. This is a process to ensure that the right choices about the design are made as early as possible to enhance the safety of the Project, for those who will construct, operate or maintain it. For example, these choices may relate to methods of construction, on-going maintenance provisions, or materials used.

6.4.2 Urban and Landscape Design Framework

The Urban and Landscape Design Framework (ULDF) provides guidance on landscape and urban design principles for the area. The Transport Agency has worked with Mana Whenua, Auckland Council and a range of other stakeholders to develop an ULDF. The ULDF for the Project is contained in *Volume 4: ULDF*.

The overall purpose of the ULDF is to:

- Demonstrate how the design of the Project supports the Agency's strategic commitment to high quality urban design outcomes;
- Bring together the delivery of built and natural environment aspirations and outcomes; and
- Demonstrate alignment between the Transport Agency and other agencies in their planning, transport and urban design initiatives for the area. In this regard, the ULDF reflects a wider strategic direction

and has a longer term urban and landscape design vision than just what the Project will deliver on its own.

CPTED and accessibility principles are fundamental to the development of the ULDF (see for example Sections 4.1 and 4.1.1-4.1.2 of the *ULDF in Volume 4*) and will be incorporated into the detailed design.

6.4.3 Travel Times and Travel Time Reliability

A core Project objective is to improve travel times and travel time reliability between the businesses in the Onehunga-Penrose industrial area. The Project has been designed to improve travel time and reliability accessing the Onehunga-Penrose area, as well as to have positive travel time/reliability effects on the wider local road and motorway network.

The Project has been designed to achieve significant improvements in the consistency and reliability of travel times for trips accessing the strategic network (e.g. SH1 and SH20) from the Onehunga-Penrose area. With the Project in place, the access times become much more consistent and reliable across the day, which will in turn allow improved and more flexible journey and logistics planning for businesses in the area, and result in increased freight efficiency.

The general pattern of changes in daily flow suggests that traffic moves from the adjacent corridor to the Project, with large reductions in flow and therefore reduced congestion seen on Neilson Street and Church Street. There is a decrease in flows on other routes, particularly in residential areas.

More than half of the truck movements are expected to be removed from the Neilson Street/Onehunga Mall and Great South Road/Sylvia Park Road intersections. This reduction allows improved pedestrian and cycling facilities and amenity, and reduced traffic severance between Onehunga and the Māngere Inlet, new Taumanu Reserve foreshore and access to the New Old Māngere Bridge³⁵.

The reductions of flows and congestion, particularly on Neilson Street and Great South Road, will improve accessibility for local businesses onto those arterial roads.

The Project is expected to improve journey times over a much wider area than just Onehunga-Penrose, including:

- Between SH20 and Highbrook;
- Between Onehunga and the Airport;
- Between Royal Oak and the Airport;
- Between SH1 and the Airport;
- Between the inland port and Highbrook; and
- Between Pakuranga and Onehunga.

The Project has been designed to be complementary to the traffic flows on SH1 and SH20 such that the extra EWL ramp flows can be accommodated without a detrimental impact on travel along SH1 and SH20.

³⁵ The New Old Māngere Bridge is a proposed replacement bridge for the existing Old Māngere Bridge. Details of the New Old Māngere Bridge are included in Section 6.7.6.4.

6.4.4 Interchanges and local road connections

The Project has been designed to provide connectivity to the local network at regular intervals along the alignment. It is designed to function as an arterial route (not a motorway) which allows for local connectivity on and off the Main Alignment.

There are two main State highway interchanges – at Neilson Street, Onehunga and at Princes Street, Ōtāhuhu. The Project also crosses over the existing Mt Wellington Highway, merging into new SH1 lanes south of the Mt Wellington Interchange.

Direct access to and from the Main Alignment will be provided via controlled intersections accessing onto and off roads designed to local road standard, extending Galway Street and Captain Springs Road southwards, a new cul-de-sac accessing the inland ports land, at Hugh Johnston Drive and at Great South Road.

The intersections will generally be signalised, depending on the design requirements and space constraints. The EWL/Great South Road/Sylvia Park Road intersection will be maintained with traffic able to pass under the new viaduct. Access for all properties with existing access onto Great South Road will be maintained. However, some entrance/exits will be changed to accommodate improved safe ingress and egress onto the Great South Road intersection. The Sylvia Park Road and Pacific Rise intersection will be maintained with traffic able to pass under the new elevated south facing ramps onto SH1. Access will be maintained for all properties on the northern side of Sylvia Park Road, however some rationalisation of existing accessways and accommodation works will be required as not all movements will be provided for. The changes will limit the number of right turns in and out of properties along Sylvia Park Road.

6.4.5 Design speed/posted speed

The design speed across the Project varies depending on the function of the roads. Whilst State highways are often associated with motorway or open road speed, there are other State highways with lower design speeds (generally the design speed is 10km/h higher than the posted speed). The general philosophy of design speeds are as follows:

- SH1 and SH20 are designed at higher speed to match the speed limits within the existing State highway network with a normal posted speed of 100km/h;
- The Neilson Street Interchange is designed with a lower speed to accommodate curved ramp connections and connectivity from local roads;
- East of the ports link road through to where the ramps tie into SH1, the Main Alignment has a design speed of 80km/h. A shared path is located on the southern side of the Main Alignment between the ports link road and Great South Road;
- The Main Alignment along the Māngere Inlet foreshore will be an arterial catering for heavy vehicles turning in and out of signalised intersections (with a design speed of 70km/h). There will be a shoulders and pedestrian and cycle paths on each side of the carriageway. It will be designed to have an urban arterial appearance;
- The ramp connections to and from SH1 will be designed for a speed in between local road and motorway, accommodating the change in environment between motorway and urban arterial; and
- Local roads, Galway Street, Captain Springs Road, the port link road, Great South Road and Hugo Johnston Drive have a design speed of 50/60km/h depending on new and existing constraints.

6.4.6 Traffic Services

Traffic services includes features such as:

- permanent road signs and gantries, including variable message signs;

- lighting; and
- required safety features including barriers.

The traffic services that are to be in place when the Project initially opens to traffic will be considered and finalised during the detailed design phase and will be designed in accordance with the relevant standards at the time the Project is constructed. Throughout the life of the Project, it is anticipated that traffic services will be renewed and upgraded as required, to ensure the continued safe and efficient operation of the State highway. This would be done as part of the normal operation and maintenance.

The services will include:

Signage	Design of all road signs and markings will be in accordance with the appropriate versions at the time of the <i>Manual of Traffic Signs and Markings</i> (MOTSAM), and the <i>Land Transport Rule: Traffic Control Devices</i> . Signage, including overhead gantries, will be required to be installed at locations along the route to meet these standards.
Lighting	<p>Provision has been made for lighting along the full alignment. In some areas, lighting may be minimised to reduce the impact on ecologically sensitive areas.</p> <p>All operational lighting for the Project will be designed to comply with <i>AS/NZS 1158:2005 Lighting for Roads and Public Spaces</i> (Standards New Zealand and Standards Australia, 2005). Specific requirements:</p> <ul style="list-style-type: none"> • all SH1 and SH20 ramp lighting will have lighting levels appropriate for roads with no property accesses and carrying large volumes of traffic. • sections of the road which do not receive direct natural light due an obstruction will be lit 24 hours per day (e.g. under bridges). • sections of the road which do not receive direct illumination from the pole mounted road lighting, will be lit via alternative methods (e.g. mounted on a structure), as is provided for in the trench section of the new State highway at Onehunga wharf. • shared paths, where separated from roads by a significant distance, will be lit using ground mounted lights unless there is adequate light spill from the adjacent roadway lighting.
Safety features	Safety features will be appropriate to the motorway or arterial road environment in which they are located and will include medians, shoulders and barriers.

6.4.7 Network Utilities

The location of the Project at the narrowest point of the North Island means there are numerous infrastructure networks converging in the area, making for a complex built environment. The Project will require the relocation and works in the vicinity of major utilities – including regionally and nationally significant infrastructure. Major infrastructure that will require relocation and/or protection as part of the Project is discussed in detail in *Section 12.5: Network Utilities* of this AEE. In summary major infrastructure includes:

- Transpower: relocation of towers and lines in some locations (both 110 and 220kV lines);
- First Gas: relocation of a high pressure gas main; and
- Watercare: crossing over the Hunua No. 4 Watermain and other major water and wastewater infrastructure.

With the exception of the Transpower relocations (which are covered by specific legislative provisions), works required for network utility relocations are within the scope of the proposed works for which consents are being sought.

6.4.8 Structures approach

Structures comprise part of the two major interchanges, as well as bridging over areas that include elements of the existing built environment such as the rail corridor, and the natural environment, ecological and geological features.

The bridge structures required as part of the Project are summarised in Table 6-1 below and the location of the major structures are indicated in Figure 6-1. Further detail on the location and form of the bridges is contained within the drawings in *Volume 2: Drawing Set*.

Figure 6-1: Structures along the alignment

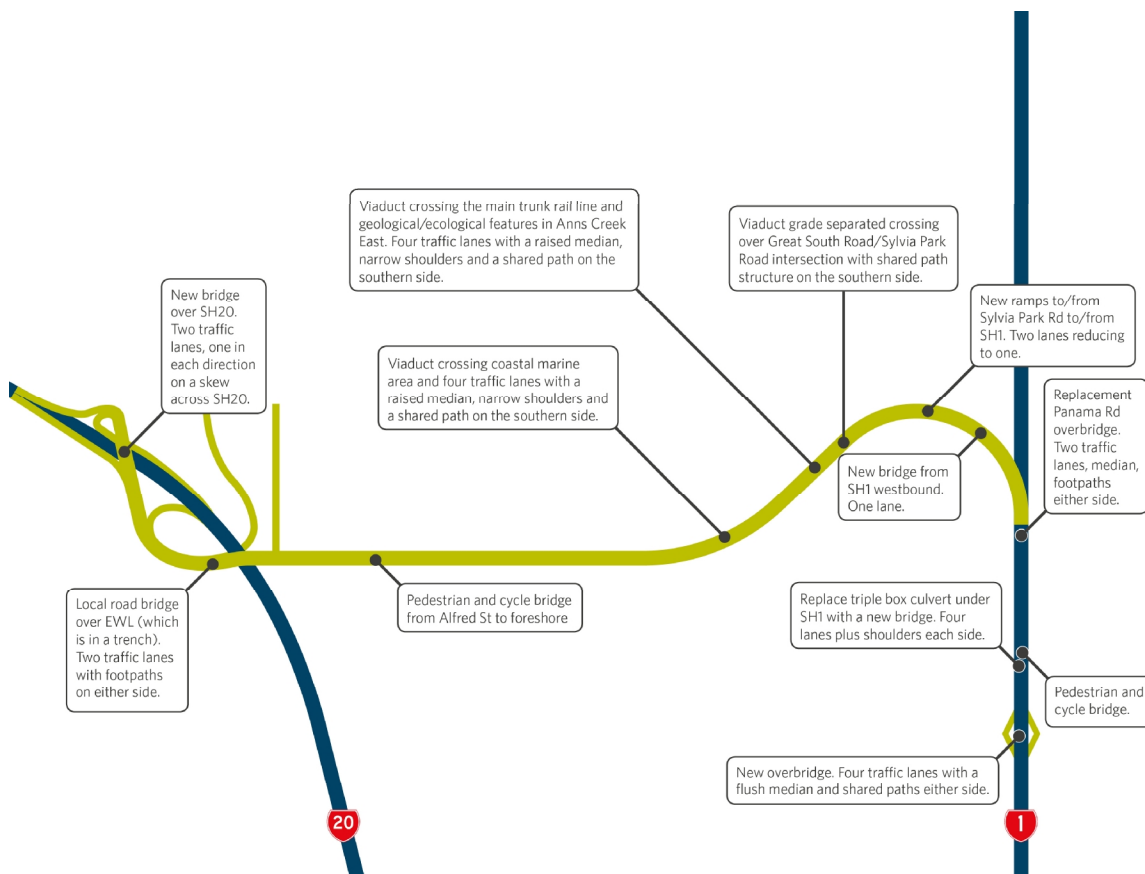


Table 6-1: Bridge structures

Chainage	Location and Purpose	Description
200	<p>As part of the new Neilson Street Interchange design, a new bridge over the existing SH20 alignment is required. Its purpose is:</p> <ul style="list-style-type: none"> to provide access onto EWL for traffic coming off SH20 at the Neilson Street southbound off-ramp; and for traffic coming from EWL and Onehunga getting onto SH20 heading southbound. 	<p>Two traffic lanes – one each way, on a skew across SH20. No pedestrian or cycle access will be provided.</p>

Chainage	Location and Purpose	Description
720	Local road bridge, pedestrian and cycle access over the EWL from Onehunga Harbour Road providing access to the Onehunga Wharf (25m width). This bridge spans over the new EWL alignment which is constructed below current ground level in a trench in order to improve accessibility and connectivity to the port. The structure provides for the future bridging of up to 50m over the State highway in this section (if appropriate to enable integration with the future development of the Onehunga wharf).	Two traffic lanes with footpaths either side.
850	As part of the construction of a new configuration of Onehunga Harbour Road and extension of Galway Street, a new replacement pedestrian bridge, crossing over Onehunga Harbour Road and the Project is required, providing access to the foreshore walkway and Māngere Bridge.	Replacement structures for pedestrians and cyclists.
850-3350	A bridged boardwalk is proposed along the Māngere Inlet foreshore as part of the new recreational shared path. This will tie into paths constructed as part of the new foreshore landscaped edge.	Pedestrian / shared paths.
3620 - 4420	New viaduct crossing the CMA and the Southdown rail spur, between the Māngere Inlet foreshore and landing on new embankment at the end of Hugo Johnston Drive. Viaduct has been designed to cross over marine ecological areas and geological features. "Pier exclusion" areas are specified based on these sensitive environmental features.	Four traffic lanes with a raised median, narrow shoulders, and a shared path (pedestrian and cycle) on the southern side.
4470-4980	New viaduct crossing the main trunk rail line, geological and ecological areas in Anns Creek, to tie in with the new intersection at Great South Road.	Four traffic lanes with a raised median, narrow shoulders, and a shared path (pedestrian and cycle) on the southern side.
4980-5700	Viaduct continuing from Anns Creek, tying in with the new grade separated Great South Road intersection to maintain existing connections and provide for east west movements.	Grade separated two traffic lanes – one each way over Great South Road and connections from EWL to Great South and Sylvia Park Roads. Separate pedestrian and facilities provided as a shared path over Great South Road.
5730-6500	New bridge from Sylvia Park Road linking onto SH1 southbound, merging into an additional (new) lane on the eastern side of SH1.	Two lanes reducing to one at SH1.
5730-6280	New bridge from Mt Wellington Highway SH1 northbound providing an off-ramp to Sylvia Park Road and EWL.	One lane.
7150	Replacing the existing Panama Road overbridge over SH1 with a new, longer bridge to accommodate additional lanes on SH1 (one lane either side of SH1). The new bridge will also accommodate wider footpaths and provide for safer cycle access.	Two traffic lanes, flush median, shared paths either side.
8000	The existing triple box culvert carrying SH1 over Ōtāhuhu Creek will be replaced with a new bridge. The new bridge will accommodate additional lanes (on either side of the existing SH1).	New SH1 bridge – eight lanes plus shoulders in each direction.

Chainage	Location and Purpose	Description
8000	To carry out the culvert replacement on SH1 a new additional bridge structure will be constructed to divert traffic onto. This will be constructed on the eastern side of the existing SH1 alignment. This bridge will remain in place permanently and will enable local pedestrian and cycle connectivity across Ōtāhuhu Creek.	Local access bridge.
8600	In order to widen SH1 on either side, the Princes Street Interchange overbridge will be replaced with a longer structure, and a complete reconfiguration of the Princes Street Interchange is proposed. This includes a new on-ramp for southbound traffic (from Frank Grey Place) which will pass underneath the new overbridge. The new bridge will accommodate additional lanes, better providing for local through traffic separated from motorway traffic, and more clearly defined walking and cycling routes.	Four traffic lanes with a flush median, shared paths on either side of the new overbridge.

6.5 Other works

6.5.1 Open Space / Recreation

The Project involves the creation of new public open space on the coastal edge. This will comprise open areas and walkways, pebble banks and headlands. This is shown in the *Volume 2: Drawing Set*.

In addition to the pedestrian and cycle connections, the following recreation linkages are incorporated within or enabled by the Project:

- Provision of a 4.0m recreation path on the southern side of the new State highway, between Old Māngere Bridge (or its planned replacement) and its connection to the existing Manukau Foreshore Walkway (also known as the Waikaraka Walkway) at the inland Port, with separation between the walkway and the new arterial road; and
- Opportunity for provision of connection between the Project shared path and recreation walkway and the future 'greenways' link to the eastern edge of the Māngere Inlet (parallel to rail).

6.5.2 Coastal works

The Project requires works on the coastal edge and within the CMA in the Māngere Inlet and in Ōtāhuhu Creek. Table 6-2 describes the approximate areas of coastal works in the Māngere Inlet and Table 6-3 describes the approximate areas of coastal works in Ōtāhuhu Creek.

Table 6-2: Approximate Areas of Reclamation, Permanent and Temporary Occupation (Sector 2)

	Reclamation (rounded)	Permanent Occupation (rounded)	Temporary Occupation (for construction)
Road Embankment	5.6 ha	0.9 ha	11.1 ha
Landscape features and wetlands	12.7 ha	4.4 ha	
Boardwalk	-	0.7 ha	
Anns Creek bridges	-	0.8 ha	1.1 ha
Anns Creek bridge piles	-	0.01 ha	0.02 ha
Total	18.4 ha	6.68 ha	12.85 ha

The proposed construction methodology also includes the potential excavation of marine sediments to use in construction of the proposed road embankment and foreshore bund. This is described in *Section 7.0: Construction of the Project* of this AEE.

Table 6-3: Approximate Areas of Reclamation, Permanent and Temporary Occupation (Sector 5)

	Reclamation	Permanent Occupation	Temporary Occupation (for construction)
Ōtāhuhu Bridge	0.5 ha	0.12 ha	0.16 ha

6.5.3 Acoustic barriers

The Project passes through a variety of different noise environments some which have low ambient noise levels and others which have reasonably high ambient noise levels. Different levels of noise mitigation are required throughout the Project area.

The guiding approach for the acoustic design is to address the adverse effects of road-traffic noise on people through adopting the best practicable noise mitigation options to keep noise at a reasonable level at sensitive receivers. The design solutions to address the increased noise levels can be, but are not limited to:

- New noise barrier construction at the boundary of the State highway corridor or adjacent to traffic lanes;
- Design and incorporation of low noise roadway surfacing;
- Increased heights of roadside barriers; and
- Modifying of existing buildings at sensitive locations to mitigate noise issues.

All noise attenuation design will be carried out in accordance with NZS 6806:2010 – *Acoustics – Road Traffic Noise – New and Altered Roads*.

Where required, acoustic barrier height varies depending on the modelled requirements and topography. Barriers will be constructed from a material that performs to meet the appropriate acoustic performance requirements. Options that can meet the required standard include a range of concrete or timber products, which will also need to meet the Transport Agency's durability considerations from a maintenance and whole of life cost perspective. The recommended options for traffic noise mitigation are set out in further detail in *Section 12.11: Noise and Vibration* of this AEE.

6.5.4 Stormwater

In developing the stormwater treatment concept for the Project, the opportunity to incorporate treatment of a wider urban catchment (other than just the road surfaces) was identified. The integrated design development incorporates treatment for over 600ha additional to the requirements for the road in Sector 2 of the Project.

The approach for stormwater design has been to use guiding principles, identified below, and to develop the solution for the whole alignment from those principles. The approach has been to seek opportunities for “natural” treatment of stormwater as a preference where there is space available, and to use proprietary devices as an alternative where less space is available.

For the treatment of stormwater from the road alignment (both the new road and sections of existing SH20 and SH1), the design concept is to use “best practicable option” that aligns with Auckland Council guidance documents (including the AUP (OP) and Auckland Council Technical Publications) with respect to discharges in relation to flow rates, volumes and quality.

The stormwater concept – for both quality and quantity – has been developed to a preliminary level, and will be further developed at subsequent design stages in consultation with Auckland Council. These designs will be *aligned* with the outcomes described in this AEE.

6.5.4.1 Stormwater – quantity

The performance of stormwater systems is a key design objective for safe operation and use of the road network both on local roads and the State highway network. Specifications include managing stormwater flows on main carriageways to disperse quickly away from traffic lanes. This includes designed overland flow paths that cater for a 1% annual exceedance probability³⁶ rainfall event, or where no overland flow path is available, the capacity of the primary system is designed to cater for the 1% annual exceedance probability rainfall event.

6.5.4.2 Stormwater – quality

The approach for stormwater quality has been to take a “best practicable³⁷ option” approach having regard to:

- Mana Whenua’s views of appropriate outcomes, including a preference for natural methods that involve water passing through or over land;
- Guidance set out in Auckland Council TP10 (Stormwater Management Devices) and testing against other guides;
- Wetlands preferred and constructed devices (such as cartridges or storm filters) secondary;
- Ease of maintenance and whole of life considerations including safety for access;

³⁶ Annual Exceedance Probability (AEP) event indicates the significance of the potential storm event and percentage chance of it occurring in any given year. It is used as a design criteria to inform sizing (such as pipework, ponds and treatment devices) for stormwater infrastructure.

³⁷ From RMA Section 2 “**Best practicable option**, in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to – (a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; (b) the financial implications, and the effects on the environment, of that option when compared to other option; and (c) the current state of technical knowledge and the likelihood that the option can be successfully applied.”

- Use of innovation to reduce treatment area footprint having regard to the constrained urban environment and limited corridor space;
- Opportunity to incorporate stormwater treatment within a constructed coastal edge reclamation; and
- Where practicable, the use of temporary (construction) ponds to be converted into permanent wetlands.

Practical design considerations and outcomes need to take into account:

- The existing stormwater collection and disposal network that includes older pipework discharging to natural watercourses and the CMA at a low level, meaning discharge is often below the level of the tide;
- Climate change and sea level change effects;
- Ability to accommodate a 10% annual exceedance probability rainfall event (that is, a one in 10 year event), with pipework designed to achieve self-cleaning velocities, minimising build-up of debris in pipes;
- Potential for water to back up in the pipes during rainfall events, due to the low level of discharge and the flat gradient of pipe work;
- Permanent erosion protection measures to protect against localised scour at outfall locations, including new structures within the CMA and existing outfall structures; and
- Placing stormwater manholes outside live traffic lanes and sealed areas to accommodate a safe environment for maintenance activities.

The following provides a summary of the approach:

Overall concept	The stormwater treatment wetland areas consist of two key components; freshwater wetland areas and biofiltration areas (raingardens). The use of biofiltration areas in addition to wetlands, enables the treatment of stormwater in a greater number of rainfall events in a smaller surface area.
Wetlands	Wetlands will be shallow (water depths 100-300mm), extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant processes to remove pollutants from stormwater. Stormwater will be discharged from the collection network into a forebay where coarse sediment will settle out. Flows will then enter the main shallow heavily vegetated area to remove fine particulates and soluble pollutants. Wetlands will treat base flows and small storm events and discharge treated flows through outfalls in, for the most part, the CMA.
Bio-filtration/ rain gardens	A concept for using biofiltration systems (an alternative filtration system using natural plants) has been developed for EWL because they are less space-hungry than wetlands, and emulate natural treatment systems. Space is an important consideration in a constrained urban environment. These systems are vegetated soil biofiltration systems that provide efficient sediment and nutrient removal from stormwater. The biofiltration system remains dry under normal conditions and minor storm events and will treat stormwater flows during moderate rainfall events.
Proprietary devices	In some instances, proprietary devices will be used. This will be where there is limited space so an underground solution (that limits land requirements) is preferred.
Outfalls	Treated water will be discharged from either the wetland and biofiltration systems, or the proprietary devices (whichever is used), to constructed outfall structures in the CMA – some with tidal control included, natural watercourses or the piped network. These are designed to function effectively with predicted sea level changes as discussed in <i>Volume 3: Technical Report 12 - Stormwater Assessment</i> .

6.5.4.3 Stormwater treatment wetland

Stormwater from the local road network, and the wider Onehunga-Penrose urban catchment is currently untreated and discharges directly to Miami Stream, and via the stormwater network to the CMA through

eleven discharge locations along the foreshore. Working in collaboration with Auckland Council, the Transport Agency has undertaken to achieve stormwater quality treatment for both the new road carriageway and part of the wider urban catchment within a new constructed coastal edge.

This involves the construction of new wetlands and biofiltration areas to capture and treat stormwater from both the road alignment and inland Onehunga-Penrose catchment. The wetlands will contain a range of vegetation types suitable for these environments and intended to visually appear similar to estuarine marshland, blending in with the landscape treatment. The current concept includes new outfalls with flap gates (to prevent tidal inundation) occupying the CMA which will require access for periodic maintenance.

As the majority of the Onehunga-Penrose urban catchment is outside of the future State highway corridor, it is intended that Auckland Council will become the future asset owner of a large component of the stormwater system. The final details of the catchment areas to be treated and the treatment standards to be achieved, will be developed in the detailed design phase in close consultation with Auckland Council as future asset owner. The final arrangements will also be subject in some areas to the ability to secure private land outside of the proposed designation area (e.g. at Miami Stream).

6.5.4.4 Drainage and stormwater treatment

The Project will involve new stormwater quality treatment with extended detention and flood attenuation for all the new surfaces and modified existing surfaces. The stormwater treatment includes:

- A new wetland on the north-western side of the interchange adjacent to the end of Hill Street within the proposed new loop on-ramp to SH20 from the Main Alignment and an enlarged wetland on the south-western side of the interchange adjacent to the off-ramp from SH20 onto the Main Alignment;
- Upgrading the existing wetland within Gloucester Reserve South;
- A number of existing outfalls will be retained, along with the existing stormwater management area in the Anns Creek area bounded by the western extent of the rail corridor, and which overlaps with existing ecological areas. The viaducts over the Great South Road intersection will discharge treated stormwater to Anns Creek;
- One new stormwater treatment wetland is located at the end of Hugo Johnston Drive capturing and treating stormwater from the new viaduct west of Great South Road and discharging to existing pipework on the edge of Southdown Reserve;
- Surface water treatment from all road surfaces in proprietary devices where wetlands are not an option, including on the new viaduct structures;
- Installation of new treatment for all existing and modified SH1 surfaces – a significant improvement to the current situation where sections of SH1 are currently untreated. This involves a complex network of underground infrastructure and the use of proprietary devices to provide treatment; and
- Proprietary devices will be installed on SH1 which will treat all stormwater from the Transport Agency's existing and new road surfaces. An existing stormwater wetland at Princes Street Interchange will be expanded.

All outfalls and discharge points for stormwater are shown in indicative locations in *Plan Set 9: Stormwater* in *Volume 2*.

6.5.5 Climate change

For coastal infrastructure, sea level rise is required to be considered over a 100 year period. The Ministry for the Environment publication "*Preparing for coastal change: A guide for local government in New Zealand*" (dated 2009) and the AUP (OP) recommend a sea level rise of 1.0m for infrastructure projects be provided for over a 100 year period. The Transport Agency's *Coastal Effects Assessment Guide* has also been considered for the Project. The Māngere Inlet alignment has been designed to accommodate 1.0m sea level rise and includes a "wave run-up allowance" suitable for the low energy environment (of

0.50m). This means the combined effect is to establish the outer edge of the road alignment at a minimum of 4.5m RL.

6.5.6 Contaminated land and geotechnical consideration

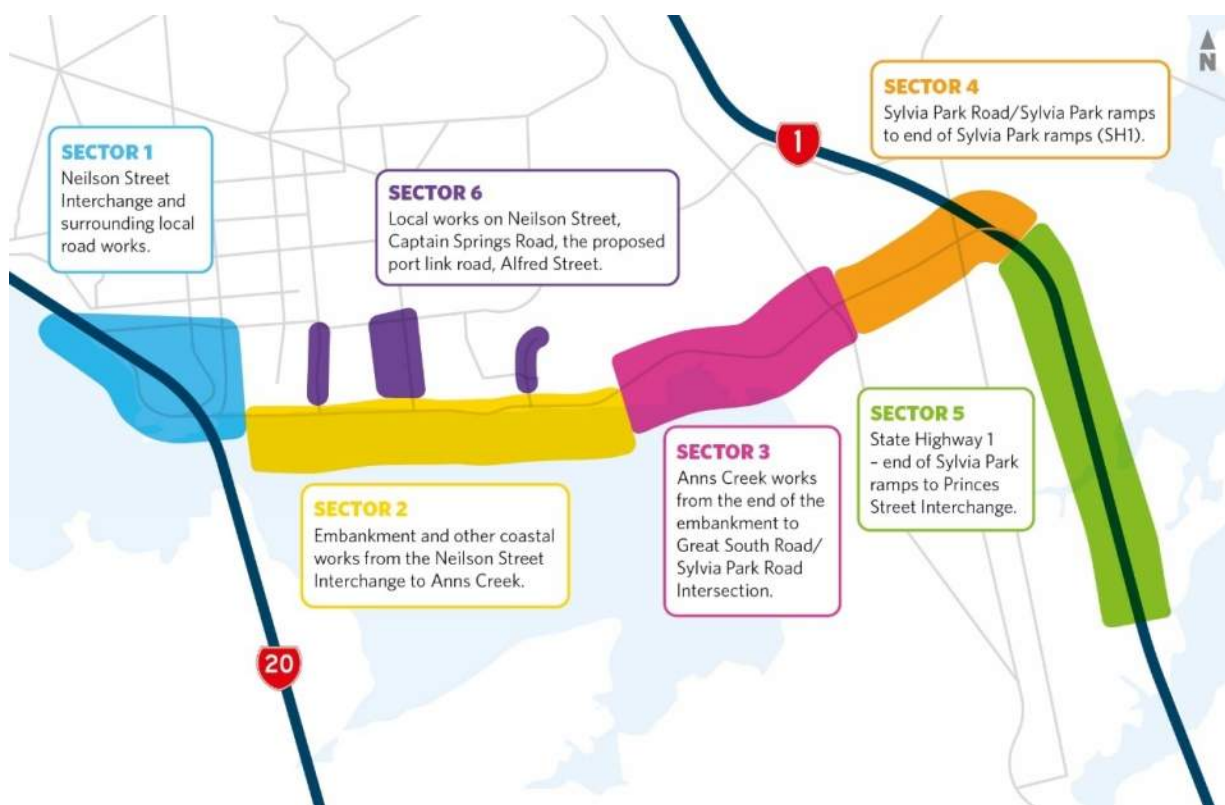
The Main Alignment along the Māngere foreshore and some of the local roads will be constructed over historic landfills. In these areas specific design is proposed in order to limit post construction settlement of the road alignment. This will involve specific design on a case-by-case basis to achieve a firm foundation to build from, and to minimise post-construction settlement. In some locations there are specific design requirements to accommodate the presence of contaminated materials and these are discussed in the sector descriptions below.

Key construction considerations for works in contaminated land are discussed in *Section 7.0: Construction of the Project* of this AEE. Key design considerations include the use of piled and reinforced road alignment, even where constructed at current ground level to minimise settlement and potential impact on drainage piped networks.

6.6 Physical description – Project sectors

To assist with an understanding of the proposed works and the potential effects of these works, the alignment has been divided into six sectors as shown on Figure 6-2.

Figure 6-2: Project sectors



Note: In this section, Sector 6 is described in conjunction with Sector 2 – as it relates to the local roads that provide connectivity to EWL in this location.

Further detail is contained in *Plan Set 1: General Drawings* in *Volume 2: Drawing Set*. The Project will be in general accordance with these plans. Table 6-2 lists the sectors described in the remainder of this

section along with their drawing page references from *Plan Set 1: General Drawings* in *Volume 2: Drawing Set*.

Table 6-4: General Arrangement design drawings for each Sector

Sector	Drawing in Plan Set 1
Sector 1 – Neilson Street Interchange	G-101
Sector 2 – Māngere Inlet	G-102 to 103
Sector 3 – Anns Creek	G-103 to 104
Sector 4 – Sylvia Park Road and Mt Wellington ramps	G-104 to 105 Rev 1
Sector 5 – SH1 widening and Princes Street	G-106
Sector 6 – Local connections	G102 to 103

6.6.1 Sector 1 – Neilson Street Interchange

6.6.1.1 General Description

The Neilson Street Interchange has been designed with a main alignment route around the southern part of the interchange connecting to SH20 to and from EWL and the new Galway Street extension to connect local traffic into the local community and to and from SH20. The interchange provides for the following:

- Additional capacity at the SH20 interchange.
- Separation of local (Onehunga) and industrial/business traffic through this interchange; this includes reducing traffic (especially trucks) in the area between Onehunga Town Centre and the foreshore/New Old Māngere Bridge and Galway Street because the traffic accessing EWL and SH20 will predominantly use the new Galway Street extension instead of the existing Onehunga Harbour Road.
- Reduction of the significant current traffic congestion for buses accessing Onehunga Town Centre via SH20 – the frequent bus service from Māngere to Onehunga will be able to use the Galway Street/Onehunga Harbour Road connection.
- A significant reduction in traffic on Onehunga Harbour Road/Onehunga Mall enabling enhanced pedestrian and cycle facilities to be provided between the Onehunga Wharf and Town Centre.
- Free-flowing connections between EWL and SH20 with a T2 lane giving priority to buses, heavy vehicles and high occupancy vehicles.

Figure 6-3: Sector 1 diagram



6.6.1.2 Local roads

The Project will involve modification to local roads:

- Closing Gloucester Park Road north access onto Neilson Street to allow for the new SH20 access configuration;
- Improving local connectivity from Gloucester Park Road south to Neilson Street with a reconfigured connection;
- The existing Onehunga Harbour Road will be reconfigured with the wharf access local road crossing over the EWL Main Alignment to connect to Orpheus Drive;
- Parking outside The Landing and apartments on Onehunga Harbour Road will be reconfigured and alternative parking provided in areas on Onehunga Harbour Road for the equivalent number of car parks. Other areas currently used for parking for recreation activities (e.g. the informal parking under Manukau Harbour Crossing on Onehunga Harbour Road) will be removed and alternative locations for on-street parking for the recreation will be provided (e.g. at Hugo Johnston Drive);
- Onehunga Harbour Road/Orpheus Drive will include a new shared path to link to the existing pedestrian/cycle way on Orpheus Drive (to Taumanu Reserve); and
- Galway Street will be extended south with a four-lane configuration providing at grade signalised intersection onto the Main Alignment for local connectivity and with cross-connection to Onehunga Harbour Road and Onehunga Mall.

6.6.1.3 Onehunga Wharf connectivity

A new land-bridge will provide access along Onehunga Harbour Road and between Onehunga Harbour Road and the Onehunga Wharf. This has been developed in consultation with Panuku Development Auckland (an Auckland Council Controlled Organisation (CCO) hereafter referred to as Panuku) to integrate with the “Transform Onehunga” strategy for the future of the Port and wider surrounding area.

While the Project provides for construction of a 20m wide bridge (with local road and shared paths), there is provision for the bridge structure of the trench to be up to 50m (approximate) wide/long. The current design provides for local connection along Onehunga Harbour Road to/from Orpheus Drive, while the extended bridging provides an opportunity for future land use integration between 2-6 Onehunga Harbour Road and the Onehunga Wharf development site.

6.6.1.4 Pedestrian, cycleway and shared path

The Project includes new and modified pedestrian and cycle connections at Neilson Street as follows:

- Shared path from the New Old Māngere Bridge connecting with the existing walking and cycling facilities at the Taumanu-Onehunga Foreshore via Onehunga Harbour Road, the Wharf and Orpheus Drive;
- Shared path between the Onehunga Wharf land-bridge and the intersection of Onehunga Mall and Neilson Street. The shared path will pass underneath SH20 and along the western side of Onehunga Harbour Road and Onehunga Mall;
- Footpath on the northern side of the new Galway Link and both sides of Galway Street (between Neilson Street and Galway Link);
- The existing Onehunga Harbour Road pedestrian overbridge will be replaced to go over the EWL and the existing underpass under the SH20 bridge to the cul-de-sac at Onehunga Mall will remain; and
- Commuter cycle path, footpath, and recreation connections on the southern side of the Main Alignment, providing contained public access to and along the CMA through this area.

6.6.1.5 Key bridges and structures

In Sector 1, the Project includes these major bridges and structures:

- A new bridge over the existing SH20 alignment to provide access onto EWL for traffic coming off SH20 at the Neilson Street southbound off-ramp, and for traffic coming from the Main Alignment and Onehunga getting onto SH20 heading southbound;
- The new bridge over SH20 involves construction of retaining wall abutments of some 8-10m in height facing onto Onehunga Harbour Road / Orpheus Drive;
- Local road crossing over the new Main Alignment (with the EWL constructed in a trench) to improve accessibility and connectivity to Onehunga Wharf (described further above); and
- A new replacement pedestrian bridge, crossing over Onehunga Harbour Road and the Main Alignment providing access to the foreshore walkway and the New and Old Māngere Bridges. The foreshore walkway is on structure in part.

6.6.1.6 Acoustic barrier

The Project involves the construction of new noise barriers on one side of SH20 adjacent to residential terrace housing located on Onehunga Harbour Road. The location of the acoustic barriers are shown on the drawings in *Plan Set 3: Road Alignment* in *Volume 2: Drawing Set*.

6.6.1.7 Closed landfills

There are areas of fill that the Project will affect in Sector 1 at Gloucester Park Reserve and Galway Street. The former municipal landfills such as Galway Street and the others described in Sector 2 below are recognised as distinct from the areas of “uncontrolled fill” such as the reclamation within Gloucester Reserve.

There are limited works required that will disturb soils in the filled parts of Gloucester Reserve. These include:

- Widening of SH20 southbound; and
- Realignment of the SH20 northbound off-ramp.

At the Galway Street landfill (partly located in Sector 1), the Main Alignment is located on existing reclamation, and the local road connection will encroach into the landfill footprint. The description for works on this landfill is described below under Sector 2.

6.6.2 Sector 2 – Māngere Inlet and Sector 6 - Local Road Connections

6.6.2.1 Sector 2 – General description

The Māngere Inlet foreshore alignment includes:

- Four lane arterial road constructed on ‘land’ (partly on existing landfill and partly on an earth and mudcrete embankment) with shoulders and a mixture of commuter cycling path on the south side and shared path along the length;
- The alignment straddles the CMA edge and land to varying degrees along the northern shore of the Māngere Inlet;
- Removal of the existing Auckland Council foreshore amenity strip and Manukau Foreshore Walkway in part;
- A new landscaped foreshore and recreational space comprising three reclaimed headlands, pebble banks, recreational paths and bridged coastal walkways, and incorporating stormwater and leachate treatment wetlands;

- A new cycleway path and overbridge on Alfred Street; and
- Local connections at Captain Springs Road and a new link to Southdown (inland ports and Miami Parade area).

Figure 6-4: Sector 2 diagram



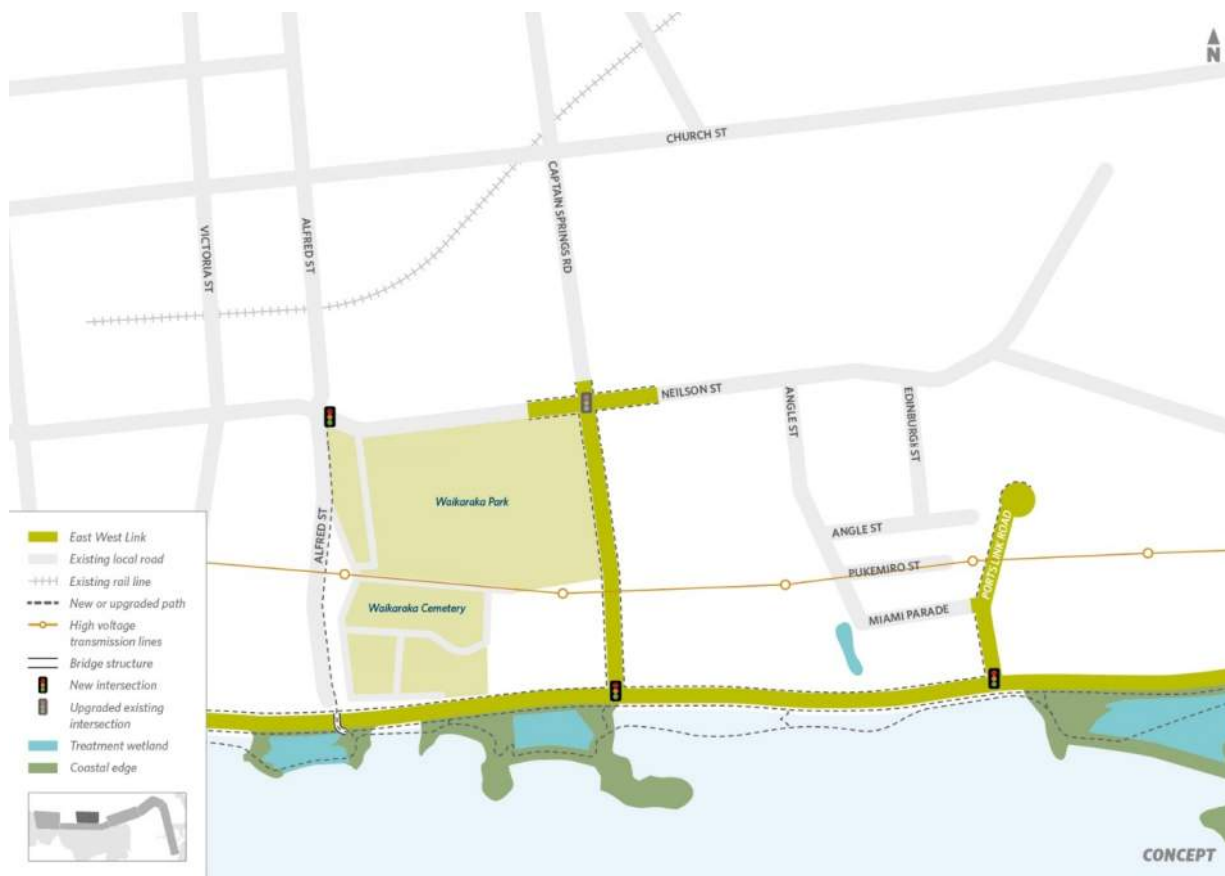
Note: In this section, Sector 6 is described in conjunction with Sector 2 – as it relates to the local roads that provide connectivity to the Main Alignment in this location.

6.6.2.2 Sector 6 – General description

The local road connections to the Project alignment on the Māngere Inlet foreshore include:

- An extension to the existing carriageway of Captain Springs Road. Captain Springs Road is currently a two lane local road ending in a cul-de-sac and will be widened to four lanes along its full length south of Neilson Street. This will necessitate the removal of some parking and the implementation of a clearway in morning and evening peak times only;
- Widening the existing intersection of Captain Springs Road and Neilson Street to provide for turning movements for large freight vehicles;
- New shared path on the western side of Captain Springs Road to the entrance of Waikaraka Park. This shared path will connect with the new shared path on the northern side of EWL. A footpath will be provided on the eastern side of Captain Springs Road;
- A new shared path along Alfred Street connecting via an overbridge from EWL to Neilson Street. A signalised crossing will be established on Neilson Street to provide for safe crossing; and
- A new cul-de-sac referred to as port link road connecting from EWL northwards improving access into the inland ports and connecting to Miami Parade.

Figure 6-5: Sector 6 diagram



6.6.2.3 Pedestrian, cycleway and shared path

The Sector 2 and Sector 6 works will provide the following pedestrian, cycleways and shared paths:

- 3m commuter cycle path and 1.8m pedestrian path on southern side of road;
- 3m shared path from Alfred Street to Captain Springs and a 1.8m path from Captain Springs Road to the port link road;
- Recreational shared path along the foreshore comprising a combination of paths and bridged walkways;
- Cycle and walking connectivity into Alfred Street, Captain Springs Road, Waikaraka Park and Cemetery; and
- Signalised pedestrian facilities at Captain Springs Road and the port link road.

6.6.2.4 Landscaping, stormwater treatment, wetlands and amenity areas

The northern shore of Māngere Inlet formerly comprised lava flows and tidal mudflats creating an indented, irregular shoreline. However, the inlets were filled and the northern shoreline is now an artificially straight line bordered by a rip-rap seawall. This infilling comprised a range of fill types, including general municipal waste, which is described further below. The Project alignment is to be constructed on embankment that straddles this shoreline, partly on land and partly in the CMA. It will be approximately 4.5m higher than the adjacent mudflats of the Inlet, designed to accommodate predicted sea level rise.

It is proposed to naturalise the shoreline on the seaward side of the alignment by creating three new headlands, pebble banks and paths to improve the natural character of, and public access to, the Māngere Inlet.

The landscape works will comprise three major landforms to echo the original shoreline, and to be in scale with Māngere Inlet as a whole. The landforms will comprise three main components:

1. Headlands faced in basalt rock designed to replicate “fingers” of lava. These will be built up to a height of approximately RL 6.0m at high points, and will contain a range of coastal vegetation;
2. Pebble and shell banks; and
3. Marshland contained behind the pebble banks and headlands which will be able to be used to capture and treat stormwater runoff from the road and inland catchments.

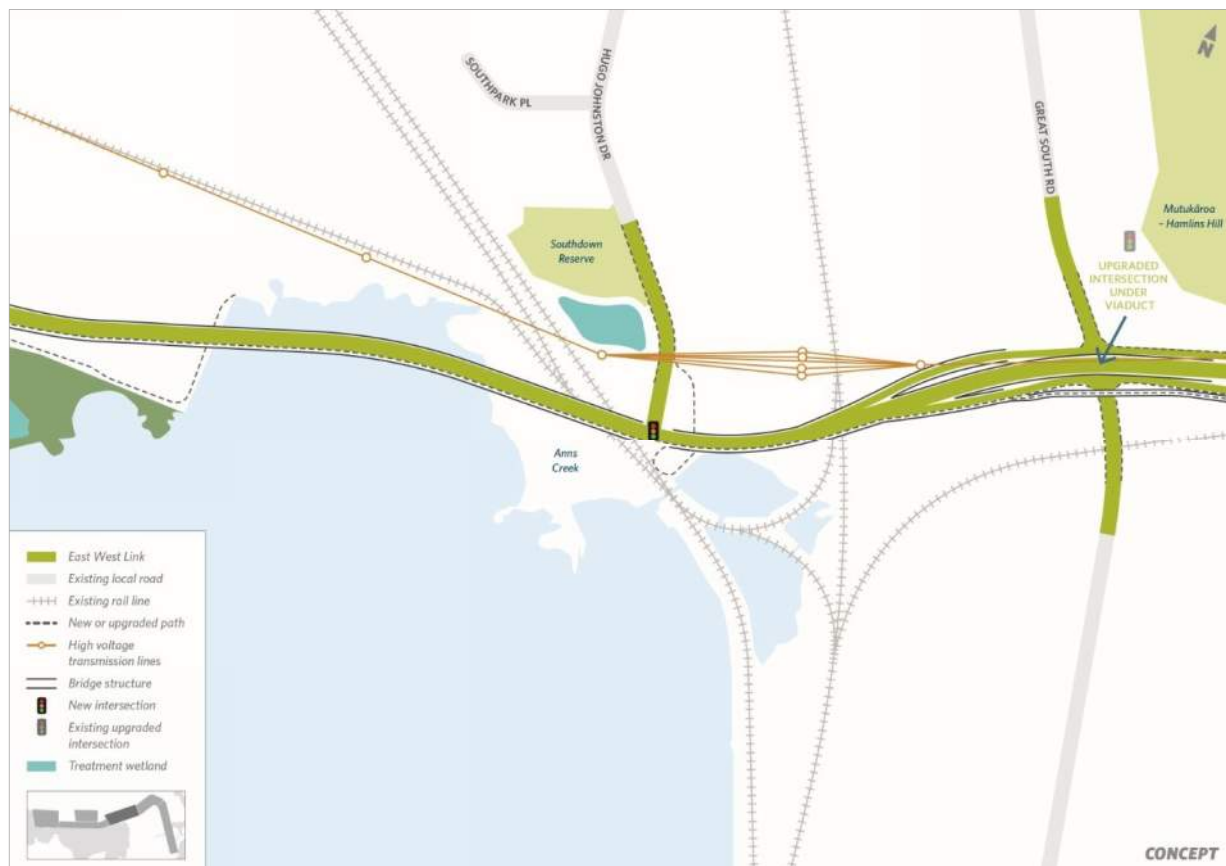
6.6.3 Sector 3 – Anns Creek and Great South Road Intersection

6.6.3.1 General description

In this location the Project comprises:

- Four lane arterial with shoulders and walk/cycle shared path on the south side only;
- Major crossings of the KiwiRail corridor and live commuter and freight rail lines;
- Major crossings of the CMA and Anns Creek on structures;
- Extension of Hugo Johnston Drive to provide a new connection with EWL at the southern end – westbound free flow traffic with signalised right turn (signalised “seagull” intersection);
- Hugo Johnston Drive will remain two lanes, however due to narrow widths at the northern end this will necessitate the removal of some parking at pinch points and the implementation of a clearway in morning and evening peak times only;
- New western approach (seven lanes eastbound, two lanes westbound) connecting EWL into the existing signalised Great South Road / Sylvia Park Road intersection;
- Upgrade of Sylvia Park Road from two lanes to four lanes necessitating the removal of parking on both sides of the road;
- Access to some properties on Sylvia Park Road may require access movements to be via a longer route;
- A grade separated intersection of EWL/Great South Road/Sylvia Park Road, including two lanes for east west traffic with east and west bound connections to Great South Road and Sylvia Park Road;
- Widening on Great South Road to accommodate an upgraded intersection with Sylvia Park Road and EWL;
- All movements on and off the Main Alignment will be provided for with the exception of west bound (right hand turns) from Hugo Johnston Drive onto the EWL;
- Access to Mutukāroa-Hamlins Hill is unchanged; and
- Access to the TR Group Ltd site on Great South Road will accommodate all movements (currently left in left out).

Figure 6-6: Sector 3 diagram



6.6.3.2 Pedestrian, cycleway and shared path

The Project includes:

- Shared path on one side of the Main Alignment linking in to Sylvia Park Road;
- Existing foreshore cycle and walkway remains unchanged, with a short length of shared path on the eastern side of Hugo Johnston Drive. This shared path will connect with the new shared path on the southern side of the EWL;
- A grade separated shared path is provided for the east west movements on the southern side of the Great South Road intersection;
- Shared path on the western side of Great South Road over the extent of works; and
- Commencement of shared path on southern side of Sylvia Park Road.

6.6.3.3 Key structures

- The viaducts over Anns Creek East tie into Great South Road intersection with two west facing connections, providing access onto and off the EWL west of Great South Road;
- Grade separated pedestrian and cycle shared path;
- Embankment at end of Hugo Johnston Drive providing for access onto the Main Alignment;
- The viaduct over Anns Creek East which balances severance of the remnant Anns Creek environment, and encroachment into mapped geological and ecological features;

- A specific pier exclusion area and an area where construction works are excluded. These areas are dictated by:
 - Location of pahoehoe (folded) lava flows and areas of particular ecological significance;
 - Mapped and ground-truthed significant ecological areas – both land and marine;
 - Outstanding natural features – pahoehoe lava flows remnant in and around the Anns Creek area; and
 - Specific rare plant habitat coincident with the lava flows, saline and freshwater sequences and presence of a variety of plant species.

6.6.4 Sector 4 – Sylvia Park Road and Mt Wellington ramps

6.6.4.1 General description

The proposed works at Sylvia Park Road and Mt Wellington Ramps include:

- Upgrading Sylvia Park Road carriageway to two lanes each way;
- One east bound lane accessing the SH1 ramp structure and the other eastbound ramp continuing at grade to Mt Wellington Highway;
- One westbound lane joining Sylvia Park Road from the SH1 northbound off ramp and the other west bound lane allowing traffic from Mt Wellington Highway and Pacific Rise to continue at grade to Great South Road;
- Raised median along Sylvia Park Road means some limitations to private property accesses – a “U” turn facility will be provided at the Pacific Rise / Sylvia Park Road intersection;
- A widened intersection for entering and existing Pacific Rise from Sylvia Park Road westbound;
- New south-facing ramps onto and off SH1 south of the existing Mt Wellington Interchange, providing access for traffic travelling north on SH1 to get onto the Main Alignment, and for traffic travelling east to south on the Main Alignment to get onto SH1 to travel south; and
- Pedestrian and cycle access from EWL into Sylvia Park Town Centre.

Figure 6-7: Sector 4 diagram



6.6.4.2 Pedestrian, cycleway and shared path

Pedestrian and cycle paths continue along the Main Alignment to the Sylvia Park Town Centre.

6.6.4.3 Key structures

The Project requires major ramp structures from the Main Alignment linking to SH1:

- New off-ramp for traffic travelling north on SH1 onto the EWL; and
- New on-ramp for traffic travelling from the EWL onto SH1 to go south.

6.6.4.4 Utilities

The Project will require the relocation of Transpower assets (towers and lines) for the construction and operation of the new ramps in this location. The design of these are under discussion with Transpower (see further discussion in *Section 12.5: Network utilities* in this AEE).

6.6.5 Sector 5 – SH1 widening and Princes Street Interchange

6.6.5.1 General description

Sector 5 of the Project is from the end of the ramps linking from the EWL onto and off SH1 to south of the Princes Street Interchange and involves:

- Adding one lane each side of SH1 from the new on/off ramps in the north to just south of Princes Street Interchange in the south – resulting in a total of four lanes in each direction with shoulders;

- Complete replacement of the Panama Road overbridge to accommodate additional SH1 lanes including a wider bridge to accommodate a shared path on both sides;
- Complete replacement of the existing triple box culverts over Ōtāhuhu Creek with a new wider bridge structure to accommodate additional lanes, plus separate bridge structure with a new pedestrian and cycle connection;
- Complete replacement and reconfiguration of the Princes Street Interchange, including a new wider overbridge accommodating four lanes of traffic and shared paths; and
- Noise barriers for adjacent residential properties along both sides of SH1.

6.6.5.2 Transport function

- Additional capacity is included on SH1 between the Mt Wellington Ramps and Princes Street to both accommodate the extra flows and provide consistent four lanes for the section between the Mt Wellington and Highbrook Interchanges;
- Widening Panama Road bridge and improving the vertical geometry provides an opportunity to improve turning movements out of Hillside Road which are currently restricted to turning left out only (onto Panama Road). The new configuration will allow for a new movement for vehicles to turn right into Panama Road, improving vehicle connectivity between communities on the west and east of SH1;
- Upgrade of the Princes Street Interchange includes:
 - Extra capacity and lane arrangement to reduce the effects of existing motorway ramp queuing on the local road network;
 - A reconfigured interchange providing controlled crossing points across SH1 Princes Street off-ramps;
 - Provision of a large refuge for waiting pedestrians across the SH1 Princes Street on-ramps;
 - A more direct and shorter pedestrian route between the two communities on the east and west of SH1; and
 - A shared path on both sides of Princes Street Bridge, certain lengths of Princes Street, Princes Street East and Frank Grey Place.

6.6.5.3 Pedestrian, cycleway and shared path

The Project involves the following:

- Widening the Panama Road overbridge improving pedestrian and cycling access across;
- Construction of an additional bridge over Ōtāhuhu Creek to allow for diversion of motorway traffic whilst constructing the new bridge. Constructing this bridge on the eastern side of SH1 offers the opportunity to retain the structure and use it for permanent pedestrian and cycle access north-south across the Ōtāhuhu Creek linking in to local road carriageways of Deas Place and Mataroa Road;
- Significant improvements for movements through the Princes Street Interchange, including a shared path on both sides of Princes Street Bridge, certain lengths of Princes Street, Princes Street East and Frank Grey Place; and
- A footpath will be along both sides of Frank Grey Place tying into the existing footpath.

Figure 6-8: Sector 5 diagram



6.6.5.4 Key structures

Widening of SH1 by adding more capacity in two additional lanes requires the replacement of the existing overbridges. The key structures (for which a design is provided in *Plan Set 8: Structural* in Volume 2) in Sector 5 include:

- Complete replacement of the existing Panama Road overbridge over SH1 with a new wider structure;
- Replacement of an existing triple box culvert underneath SH1 at Ōtāhuhu Creek. The existing box culvert will be removed and replaced with a new bridge, which will require slight raising of the height of the motorway carriageway either side of the alignment and construction of a traffic diversion during construction, also on a new bridge;
- Retaining the additional bridge used for temporary traffic diversion at Ōtāhuhu Creek and using it for permanent pedestrian and cycle access north-south across the Ōtāhuhu Creek linking in to local road carriageways of Deas Place and Mataroa Road;
- Replacement of the Princes Street Interchange will involve reconfiguration of the interchange:
 - Bringing the southbound on-ramp to the northern side of the interchange requiring local road widening and reconfiguration works on Frank Grey Place;
 - Moving the southbound off-ramp further to the north along Frank Grey Place;
 - Widening the Princes Street overbridge to accommodate four lanes (from the current two), with two each way, with one lane straight through for local traffic travelling east improving accessibility for local traffic. Widened pedestrian and cycleways on both sides of the bridge improves community connectivity for east-west movements across this bridge, linking these communities with schools, shops, sports fields and other amenities; and
 - The new layout is expected to notably improve safety, particularly for pedestrians and cyclists that includes children walking to school who will have a more legible environment that does not require as many unsignalised road crossings and has more clearly marked footpaths.

6.6.5.5 Acoustic barriers

The Project involves the construction of new noise barriers on both sides of SH1 adjacent to residential properties and as determined in *Technical Report 7 - Traffic Noise Assessment* in Volume 3 using New Zealand Standard 6806:2010 *Acoustics – Road traffic noise – New and altered roads*. Noise barrier height varies depending on the modelled requirements and topography. The recommended barrier heights are shown on the plans contained in the Traffic Noise Assessment and range from 1.1-3.0m. Barriers will be constructed from a material that performs to meet the appropriate acoustic performance requirements. Options that can meet the required standard include a range of concrete or timber products, which will also need to meet durability considerations. The visual appearance of the barriers will also require treatment to meet principles set out in the ULDF and Transport Agency guidelines and provide general visual consistency with other parts of the Transport Agency's network.

6.6.6 Sector 6 – Local roads

Refer Section 6.6.2 above – described with Sector 2.

6.7 Integration with other transport projects

As discussed in *Section 2.0: Background* of this AEE, the Onehunga-Penrose area plays an important role in the growth and spatial planning of Auckland. As a consequence, and given the unique geographic characteristics of the area (being the narrowest part of the city isthmus between the Manukau and Waitematā Harbours), there are a number of other transport projects progressing that either complement or are supported by the Project. These projects are not part of this Project and are not assessed in this AEE. However, they are described below, and illustrated on Figure 6-10, to show how land use and transport integration is being progressed in the area and the contribution that the Project makes to this.

6.7.1 Local improvements – Neilson Street

Auckland Transport and the Transport Agency have jointly progressed local improvement works within the vicinity of the Project. Local road upgrades to meet increasing demands, maintain safety and improve access along Neilson Street are underway including the removal of the road bridge over the existing (disused) rail corridor to reduce the gradient of Neilson Street, and four-laning within the existing carriageway from the rail over bridge through to the Captain Springs Road intersection.

6.7.2 Auckland Manukau Eastern Transport Initiative, Sylvia Park Bus Interchange

AMETI is a multi-modal transport project in the Sylvia Park, Panmure, Pakuranga and Botany area being delivered by Auckland Transport to address existing public transport and vehicle transport capacity constraints on the network. Parts of AMETI have already been completed, such as the new Panmure bus-train interchange.

AMETI provides additional capacity for passenger transport, walking, cycling and private vehicles in order to support expected population growth within the eastern suburbs. AMETI interfaces with the Project at Sylvia Park where a new bus station is proposed adjacent to the Sylvia Park rail station.

A shared path will tie in with the AMETI bus lane works under SH1 and continue to the key destination of Sylvia Park Town Centre. A shared path is proposed on the southern side of the AMETI bus connection before swapping to the northern side to link into the proposed roundabout. It is likely a crossing facility will be provided to allow pedestrians and cyclists to cross the bus connection safely. It is noted that bus volumes along this connection road will not be that frequent and pedestrians and cyclists will be able to cross the road independently. Coordination with Auckland Transport should continue on design and programme details.

The full benefits of the enhanced connectivity to Sylvia Park Mall Shopping Centre are dependent on the AMETI link. A condition is recommended which will ensure the shared path through this area is delivered in conjunction with Auckland Transport and AMETI and the designation extends through to the Sylvia Park Mall Shopping Centre boundary.

6.7.3 Bus Frequent Network 32

Frequent Network 32 is an Auckland Transport project which seeks to improve bus public transport connection between Māngere Town Centre, Ōtāhuhu and Sylvia Park. It includes walking, cycling and public transport improvements and an upgrade to the Māngere Bus Interchange. It is an important part of the wider programme of transport projects in the area, improving the capacity of the network for pedestrian and public transport modes. In particular, it supports the planned population growth in the area and supports economic activity (focusing on providing access to people between living and working areas of the southern part of the city). The Project integrates with this work, in particular in the design of the cycle and pedestrian connection to Sylvia Park Town Centre and for the local road and bus connections at Mt Wellington.

6.7.4 Future rail development at and around Southdown

As shown on Figure 6-9 designations for rail purposes are held for the rail sidings at Southdown and for the NIMT, and Auckland Eastern Line. In addition, the Onehunga Branch Line connects further to the north of Southdown. Much of the Southdown designation is occupied by the MetroPort operation, part of the Port of Tauranga's Auckland inland port. Ports of Auckland owns land immediately to the south, which may also have the potential to be served by rail in future.

Figure 6-9: Existing KiwiRail designations (shown in blue)



As explained in *Part A: Introduction and Background* of this AEE, the Southdown area is of strategic importance for the rail network, being at a convergence between both freight and commuter rail networks. KiwiRail Holdings Limited as the requiring authority (KiwiRail), continues to hold existing designations in this area. KiwiRail has indicated as part of Project discussions that it intends to carry out a range of future upgrades to the rail network in this area, generally within the scope of these existing designations. These upgrades include:

- Increasing capacity to run both commuter and freight services on the rail network. These services are not always complementary, because commuter services run quicker but stop frequently, whilst freight generally runs continuously and stops infrequently. Establishment of a third rail line in future as well as improving the linkage between the NIMT and eastern lines through grade separation is part of current rail planning; and
- Adding additional capacity to the Southdown rail sidings is also planned in future as part of accommodating the longer trains that are required as a result of the increasing number of larger tankers coming into the Port of Tauranga.

Land use and transport integration, including the integration of transport modes, are key to the EWL Project. As such, the Project has been designed in consultation with KiwiRail to make sure rail overbridges are able to accommodate the planned future rail development in the Southdown area. The location of the designations has also been a key influence in the options assessment process, given the constraints imposed by the presence of the existing designations and future planned development, which have limited inland alignments available. This is discussed further in the in *Part D: Consideration of Alternatives* in this AEE and in *Report 1: Assessment of Alternatives Report* in *Volume 3*.

6.7.5 Mass transit to Auckland Airport

Auckland Transport has been developing a business case considering options for mass transit to Māngere and the airport employment area. Various options and alignments for this connection have been developed by Auckland Transport.

The design of the EWL has provided for Auckland Transport's current preferred alignment and design for future mass transit to the airport. These future plans are indicatively shown on the design drawings for the Project contained in *Volume 2: Drawing Set*. The proposed EWL design for public transport (bus) connection between Galway Street and Onehunga Harbour Road supports a future integrated bus-rail connection at the Onehunga Station (both for the existing Onehunga Branch Line and potentially for any future connection to the airport).

6.7.6 Other State highway projects

6.7.6.1 The Western Ring Route

The Western Ring Route, including the Waterview Connection tunnel project and the SH16 causeway widening, is due to be completed in early 2017. The Waterview Connection project delivers a new connection through Mt Roskill and Mt Albert connecting SH16 to SH20. It provides an alternative south-western route between the south and north of the isthmus (e.g. a route connecting from Manukau in the south to Albany in the north). This route provides improved resilience for transport in the city (e.g. an alternative to SH1 and the Auckland Harbour Bridge) and will both enable greater transport capacity and provide more reliable travel times. With the completion of the Waterview Connection, the Western Ring Route (the route linking Albany and Manukau – SH18, SH16, and SH20) will have increased capacity and as a result there will be increasing traffic volumes on SH20 in the Project area (e.g. between the SH20 Manukau Harbour Crossing and Queenstown Road).

6.7.6.2 EWL SH20 Capacity Improvements: Neilson Street to Queenstown Road

As an early work for the Project, auxiliary lanes are being constructed along SH20 between Queenstown Road and Neilson Street in Onehunga. These works are due for completion in early 2017. The purpose of this work is to:

- Improve traffic flows on SH20 and provide improved capacity to support the completion of the Western Ring Route; and
- To improve network efficiency once the Neilson Street Interchange is delivered as part of the Project.

This work supports the planned opening of the Waterview Connection in early 2017 and is within existing designation. Therefore it has been delivered in advance of the main EWL Project works.

6.7.6.3 SH1 - Southern Corridor

Growth within southern Auckland and surrounding the Auckland International Airport has created a need to increase capacity and upgrade interchanges along SH1. The current Southern Corridor Improvements Project includes work on SH1 from the SH20/SH1 connection at Manukau to Papakura in the south. The Southern Corridor Project includes additional lanes in both directions, an upgraded Takanini Interchange and a 4.5km shared use pedestrian/cycle path from Takanini to Papakura. Construction works for this project commenced in 2016 and are due to be completed by the end of 2018.

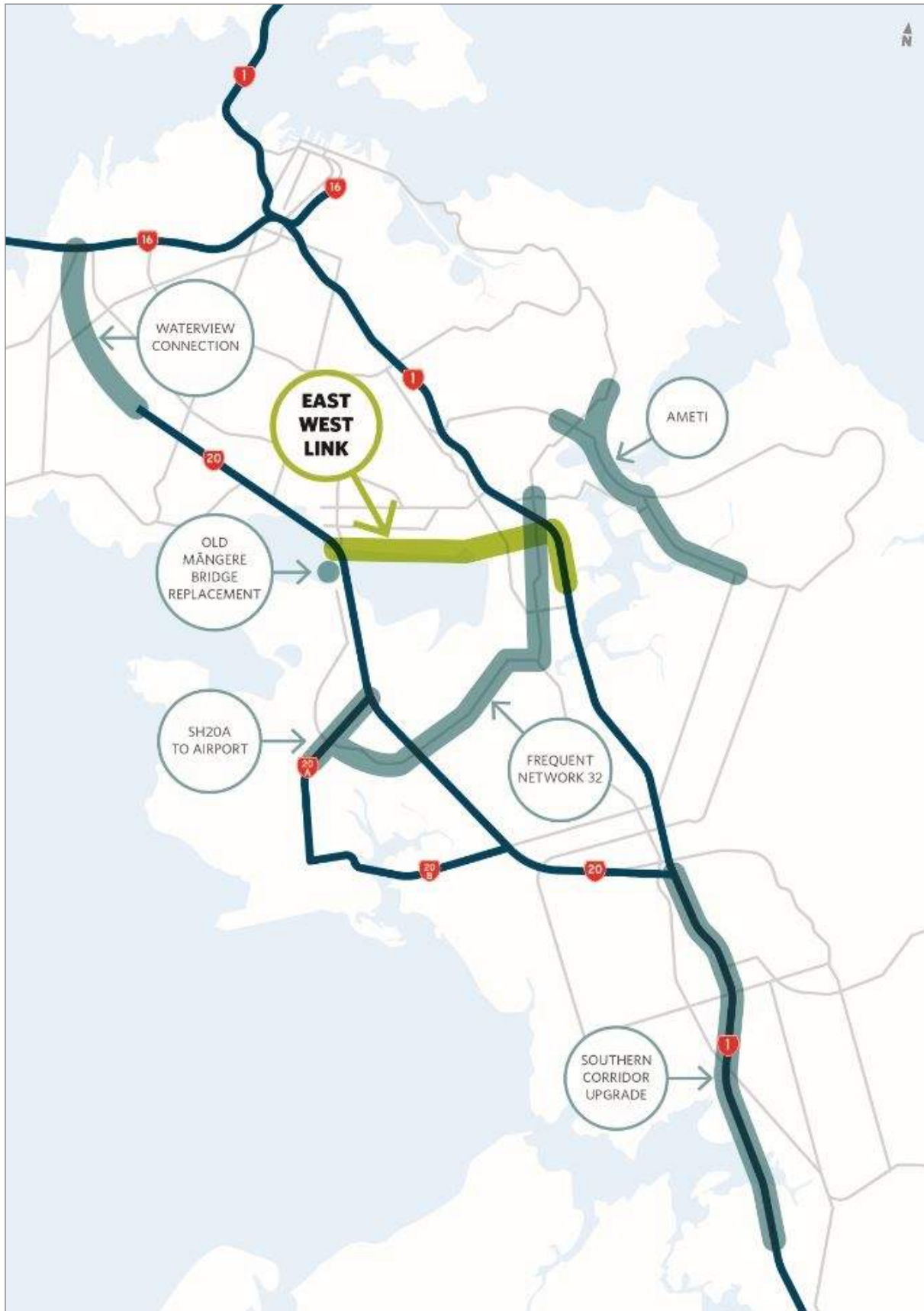
The network capacity improvements (e.g. removal of bottlenecks on SH1), safety improvements (e.g. Takanini Interchange) and provision for pedestrians and cyclists will increase capacity for road users and for pedestrians and cyclists. This project complements the work on the EWL Project, providing for both existing demand and supporting the planned growth in the southern Auckland area.

6.7.6.4 The Old Māngere Bridge replacement

The Transport Agency is planning to replace the Old Māngere Bridge, now used for pedestrian and cycle access. The replacement Old Māngere Bridge will provide continued walking and cycling access between Māngere Bridge Township and Onehunga. It is required to be replaced as the existing structure is aging and in poor condition. The Transport Agency has been granted resource consents for the complete replacement of the bridge with a new structure for recreational use. It is an important component of walking and cycling access between Māngere Bridge township and Onehunga Town Centre.

The Project design is integrated with the proposed New Old Māngere Bridge. The Project will enhance connectivity in and around the Neilson Street Interchange and onto the new network of paths on the northern foreshore of the Māngere Inlet. During construction of the Project, pedestrian and cycle access between Māngere Bridge and Onehunga will be maintained at all times.

Figure 6-10: Interaction of EWL with other transport projects



6.8 Future Ownership, Operations and Maintenance

This section describes the intended ownership of new land to be created by reclamation in CMA, and the intended ownership, operations, and maintenance responsibilities for other assets, including:

- Local roads, pedestrian and cycle facilities;
- Park land and reserves;
- Stormwater assets;
- Dams; and
- Structures in the CMA.

The proposed works will be constructed by the Transport Agency, and the majority of the completed infrastructure and associated assets will be owned, operated and maintained by the Transport Agency. Aspects of the completed works which may be owned, operated or maintained by other parties are summarised below.

The final details of future land and asset ownership, operations and maintenance will be developed in consultation with the relevant parties, and agreements established between the Transport Agency and those other parties.

6.8.1 Reclaimed land

6.8.1.1 Future ownership of new land to be created by reclamation

The ownership of land created by reclamation in the CMA is set out in the Marine and Coastal Area (Takutai Moana) Act 2011 (MACA Act). Ownership of the proposed reclamation will initially vest in the Crown once Auckland Council has approved a plan of survey under section 245 of the RMA³⁸. Other provisions of the MACA Act provide for the granting of interests in the reclaimed land, including provision for network utility operators to obtain an interest in reclaimed land.

Future ownership and legal interests in the new land will be determined through the process set out in the MACA Act. This process will include discussions between the Transport Agency and the Crown, Mana Whenua, Auckland Council, Auckland Transport and network utility operators to determine future interests in, and management of, the new land.

6.8.1.2 Future activities, operations and maintenance of assets on proposed new land

The proposed activities to be undertaken on the new land to be created by reclamation in the CMA are described in the early parts of this section. The new “land” includes the proposed stormwater treatment wetlands within the new coastal foreshore area.

The final layout of the proposed reclamation and activities on the new land will be developed in the detailed design phase, and in consultation with Auckland Council, Auckland Transport, Mana Whenua and other key stakeholders.

At this stage, the management responsibilities envisaged are:

- The Transport Agency to own, operate and maintain assets directly associated with the safe and efficient operation of the new State highway;

³⁸ Section 30 MACA Act.

- Auckland Council to own, operate and maintain assets not primarily associated with the ongoing operation of the State highway – e.g. the stormwater treatment wetlands along the Māngere Inlet foreshore, and other recreation and amenity areas; and
- Auckland Council or Auckland Transport to own, operate and maintain recreational pedestrian and cycle facilities not abutting the State highway.

6.8.2 Connections to local roads, pedestrian and cycle facilities

New road connections are proposed between existing local roads and the new State highway at the southern end of Onehunga Mall, Captain Springs Road, and Hugo Johnston Drive.

The land required for these connections is currently owned by Auckland Council, the Crown, or private landowners. The future ownership of the land will depend on the location, the physical nature of the proposed road (e.g. on land or on bridge structure), and on statutory requirements of the Public Works Act 1981 and Local Government Act 2002.

The Transport Agency will be responsible for the ongoing management, operation and maintenance of the State highway. At this stage, it is envisaged that Auckland Transport will be responsible for the ongoing management, operations and maintenance of the local road connections, and the proposed pedestrian and cycle paths or shared pedestrian and cycle paths associated with and abutting the local road network.

6.8.3 Stormwater asset ownership, operations and maintenance

The proposed stormwater infrastructure to be constructed as part of the Project is described in *Section 6.5.4: Stormwater* of this AEE. In summary, the proposed stormwater infrastructure includes:

- New or upgraded stormwater infrastructure directly associated with the existing and proposed works to SH1 and SH20;
- New stormwater infrastructure directly associated with the EWL main alignment and its connections to SH1 and SH20;
- New stormwater infrastructure associated with the proposed new local road connections and pedestrian and cycle paths; and
- New stormwater infrastructure associated with run-off from existing and future impervious surfaces in the wider Onehunga-Penrose catchment.

At this stage, the management responsibilities envisaged are:

- Transport Agency to own, operate and maintain stormwater assets directly associated with the safe and efficient operation of SH20, SH1 and the EWL main alignment;
- Auckland Council to own, operate and maintain:
 - Stormwater assets not directly associated with the State highways – e.g. stormwater collection and conveyance infrastructure associated with local road connections and the shared pedestrian and cycleway;
 - Stormwater detention and treatment areas and associated structures provided for in the new coastal foreshore area;
 - Stormwater detention and treatment wetland area at Miami Stream; and
 - Stormwater outfalls in the CMA;

The stormwater collection and conveyance infrastructure includes but is not limited to swales, pipes, chambers, risers and outfalls to the CMA.

6.8.4 Structures within the CMA

Permanent structures to be located within the CMA are described earlier in this section and are shown on the drawings in *Plan Set 5: Coastal Occupation* in *Volume 2: Drawing Set*. Permanent structures will include the seawalls of the new road embankment and coastal foreshore, bridge structures, boardwalks and stormwater outfalls.

At this stage, the management responsibilities envisaged are:

- Transport Agency to own, operate and maintain permanent structures in the CMA which are directly associated with the safe and efficient operation and maintenance of the new State highway; and
- Auckland Council to own, operate and maintain assets not directly associated with the State highway.

6.8.5 Potential future transfer of consents in whole or in part

The permanent structures and long term activities described above will be authorised if the consents sought for the Project are granted. As part of the agreements to be developed with other parties regarding asset ownership, operations and maintenance, all or part of some consents may be transferred at a future date from the Transport Agency to another party. In particular, consents authorising land use activities on the new land area, long term stormwater discharges, dams, and structures in the CMA may be transferred in part to Auckland Council for activities intended to be under its control.

Any future consent transfer would be undertaken in accordance with sections 134 – 137 of the RMA. If, and until any transfer occurs, the Transport Agency will be responsible for operations and maintenance of the assets, and for compliance with all consent conditions.

7.0 Construction of the Project

Overview

Indicative information about key construction activities is provided in this section as a basis for the assessment of effects in *Part G: Assessment of Effects on the Environment* of this AEE. It provides a description of the likely scale, duration and type of construction activities that are anticipated, to enable potential effects to be identified and any necessary mitigation measures developed.

The design and construction methods proposed for the Project have incorporated measures to avoid and mitigate effects. These therefore form an inherent part of the Project.

7.1 Introduction

This section provides an outline of the proposed construction of the Project to provide a basis for the assessment of the effects in *Part G: Assessment of Effects on the Environment* of this AEE. It provides a broad overview of the construction methodology across the Project in Section 7.5, and then provides further details of main construction elements that will be undertaken within each of the Sectors. An indicative construction programme for the Project is set out in Section 7.4.

Throughout this section there are cross references to drawings where further information describing construction of the Project is available. In particular the drawings contained in *Volume 2, Plan Set 11: Construction Activities* show the construction footprint, proposed construction yards and other key construction features of the Project.

The information provided in this section is indicative only and is intended to provide sufficient detail of the proposed construction activities to assess their potential effects on the environment and to identify any necessary measures to avoid, remedy or mitigate those effects, where appropriate.

Construction of the Project will be influenced by a number of factors, including:

- The detailed design of the Project which will occur once the designations have been confirmed and resource consents have been granted;
- The construction duration and target completion date;
- The procurement method adopted; and
- Technological advances in construction methods.

Where appropriate, the Transport Agency seeks a degree of flexibility in construction methods to accommodate these factors. Once the contract(s) for the Project have been awarded and a contractor (or contractors) are in place, the construction methodology will be further refined and developed. This will be undertaken within the management plan framework (as set out in Section 7.13) and conditions of the designations and consents which will be in place to manage the effects of the construction activities. Should a contractor wish to undertake construction activities in a manner which is not within the scope of the designations or consents held, appropriate assessment and additional authorisations would need to be obtained at that time.

Management plans form an integral part of the construction methodology for the Project setting out how specific matters will be managed. A suite of management plans is proposed for the Project. These are discussed in *Section 13.1.5: Management plans* of this AEE.

The management plans, Outline Plan(s) required for the designations, and other pre-construction documentation will be submitted to Auckland Council prior to the commencement of construction. The

anticipated process for this is discussed further in *Part H: Management of effects on the environment* of this AEE.

7.2 Development of construction methodology

The construction methodology and activities outlined in this section were developed through an iterative process that involved several rounds of multidisciplinary reviews and workshops. The intention was to balance the cost, programme implications and likely adverse effects of various construction options to achieve a methodology that, as far as practical, avoids or where avoidance is not possible, minimises adverse effects. This included consideration of the following:

- The location and extent of construction compounds, laydown areas and construction access tracks. The intent was to minimise disturbance and vegetation clearance in sensitive environmental areas and as far as practicable avoid locating construction activities in or in close proximity to sensitive land uses;
- Various methodologies for coastal works including reclamation, temporary occupation, mudcrete and dredging;
- Construction programme and timing of particular activities to take advantage of seasonal weather conditions or ecological breeding patterns; and
- Transport Agency construction guidelines and standards relevant to the avoidance and minimisation of adverse effects on the environment.

While aiming to avoid adverse effects and taking into consideration social, environmental and cultural constraints, the construction methodology also aims to maximise flexibility in the methodology for any future construction contractor(s). The construction methodology will be further refined and developed during the detailed design phase of the Project and once a contractor is appointed. This will be undertaken with consideration of the designation and resource consents conditions, and balancing cost and programme, environmental and social outcomes.

7.3 Detailed design and construction procurement

The Transport Agency's *Highway and Network Operations Environmental and Social Responsibility Manual* sets a framework for integrating environmental and social commitments into all phases of Transport Agency infrastructure projects. This includes development of detailed design and procurement of construction contractors.

Procurement of the construction contractor will integrate environmental and social commitments into the procurement process. Any Request for Proposal documentation for the Project will capture designation and consent requirements to ensure detailed design meets conditions and commitments are carried from the approvals process, through detailed design and into construction management documentation.

During detailed design, refinement of the construction methodology will further consider the actual and potential impacts to determine if they are consistent with the assessment of effects documented in *Part G: Assessment of Effects on the Environment* of this AEE. The process of finalising the construction methodology will be undertaken in consultation with key parties (e.g. network utility operators for the relocation of their assets). This process is discussed further in *Section 14.2: Introduction to the statutory framework* of this AEE.

The specialist technical investigations that informed this AEE will be utilised to understand the environmental and social constraints and ensure that the final design and construction methodology meets the Transport Agency's legal requirements, environmental commitments and conditions of designations and resource consents.

7.4 Anticipated construction programme

Construction of the Project is expected to be completed by 2025. This date is dependent on funding processes and property acquisition. Many elements of the Project may be undertaken concurrently during the construction period.

The main construction elements for the Project are expected to be:

- Neilson Street Interchange including the Galway Street link (Sector 1);
- Foreshore (road embankment, headlands and stormwater treatment areas)(Sector 2) including Captain Springs Road and the port link road (Sector 6);
- Anns Creek viaducts, Great South Road intersection and Hugo Johnston Drive extension (Sector 3);
- Sylvia Park Road and SH1 ramps (Sector 4);
- SH1 Auxiliary Lanes and Ōtāhuhu Creek Bridge (Sector 5); and
- Panama Road Bridge and Princes Street Interchange (Sector 5).

Figure 7-1 shows the approximate timing of the proposed works and how the different elements may progress within the construction timeframe. It is reiterated that while there are some dependencies between construction elements, the specific staging and phasing of the work will be dependent on the methods of procurement, land acquisition, the availability of contractors and availability of other resources (such as materials and construction equipment). As outlined further in Section 7.5, this timeframe assumes occasional night time works depending on activities required.

Figure 7-1: Indicative construction timing (subject to change with contractor methodology)



7.5 General construction aspects

This section contains a description of the following general construction aspects across the whole Project:

- Enabling works;
- Night time works;
- Protection and/or relocation of existing network utilities;
- Temporary traffic management;
- Construction yards and site compounds;
- Earthworks and vegetation clearance;
- Managing contaminated material; and
- Works in watercourses.

7.5.1 Enabling works

Prior to the main phase of construction commencing, there are a number of activities that may be required along the alignment. These include:

- Site investigations including geotechnical, contaminated land and groundwater investigations, and investigations to confirm the location of existing services;
- Building and structure demolition and removal;
- Site establishment activities including site access points, construction yards, fencing etc.; and
- Protection and/or relocation of existing network utilities (as discussed in Section 7.5.3).

7.5.2 Night time works

In order to minimise disruption to traffic, tie in with tidal cycles and network outages, some works will be undertaken on SH20, SH1 and in other locations at night. This may include (amongst others) the following major construction activities:

- Neilson Street overbridge construction (Sector 1);
- Neilson Street Interchange on/off-ramps (localised sections only, where offline works need to tie in with the existing SH20) (Sector 1);
- Placement of bridge beams at the Great South Road intersection;
- Erection of structures at Sylvia Park Road over the live motorway (Sector 4);
- Some aspects of the widening works on SH1 between the Sylvia Park Road ramps and Princes Street Interchange adjacent to the live motorway (Sectors 4 and 5);
- Sylvia Park Road ramps tie in with the existing SH1 (Sector 5);
- Demolition and removal of the Panama Road overbridge (Sector 5);
- Installation of bridge beams over the SH1 at Panama Road, (Sector 5);
- Demolition and removal of the Princes Street overbridge (Sector 5);
- Installation of bridge beams over the SH1 at Princes Street (Sector 5);
- Princes Street Interchange on/off-ramps to tie in with the existing SH1) (Sector 5); and
- General traffic management set up and changes and removal throughout the life of the contract (all sectors).

7.5.3 Protection and/or relocation of existing network utilities

The Project traverses a highly modified urban environment and as a result there are numerous network utilities crossing the alignment. These services range from major arterial networks (such as gas and electricity transmission and water supply mains) to local reticulation services.

The key services within the Project area include:

- High voltage transmission lines (Section 7.5.3.1);
- High pressure gas transmission pipelines (Section 7.5.3.2);
- Bulk water supply and wastewater infrastructure (Section 7.5.3.3);
- Fibre optic communication cables and telephone lines (Section 7.5.3.4); and
- Electricity and gas distribution (Section 7.5.3.5).

Discussions have been undertaken with network utility operators and agreements are being developed with each operator regarding their assets. Services will be relocated to the relevant provider's standards and where possible located within dedicated service corridors. Services will be constructed and tested in the realigned position to enable a short switch-over timeframe with minimal disruption to users. *Section 12.5: Network Utilities* of this AEE sets out the assessment of effects of the Project on these network utilities.

Construction methodologies for each service will be developed in consultation with each operator. Options being considered include directional drilling for small services within existing corridors and trenching.

The Project also crosses a number of operational rail lines. Preliminary discussions have been held with KiwiRail regarding the construction activities that have the potential to affect rail operations. Some construction activities will be timed to occur during periods of scheduled line closure. All construction activities on or over the rail corridors will be co-ordinated with KiwiRail.

7.5.3.1 High voltage transmission lines (including towers)

There are three transmission lines in close proximity to the Project.

The *New Zealand Code of Practice for Electrical Safe Distances* (NZECP:34) specifies minimum approach distances to all overhead power lines for construction activities and the permanent road alignment. The design has sought to avoid transmission lines wherever possible. However, there are locations where the lines are affected by both construction activities and the permanent works and as a result, works are required to either relocate existing towers or increase the clearance under lines by raising the height of the transmission towers. Details of the anticipated works to specific towers are provided in *Section 12.5: Network Utilities* of this AEE.

The Transport Agency is in discussion with Transpower regarding the specific design and proposed construction timing for relocation/modification of transmission assets.

7.5.3.2 High pressure gas pipelines

The Westfield-Hillsborough high pressure gas pipeline is located within the Project area, between the Neilson Street Interchange in the west, along the edge of the Māngere Inlet and Anns Creek and the northern side of Sylvia Park Road. The proposed road embankment (Sectors 1 and 2) and viaducts (Sector 3) conflict with the pipeline in some locations and as a result, a new pipeline will need to be constructed at various locations. Along the foreshore, the pipeline will be constructed to lie immediately to the north of the embankment within a services trench and through other areas it will be constructed clear of the alignment. Where the new pipeline relocation is located clear of the road alignment, this can be undertaken prior to main construction works on the Project.

Along the foreshore section, the new pipeline can be constructed concurrently with the construction of the road embankment. It is estimated that the pipeline construction will be undertaken in three to four stages to enable construction of the new pipeline within the embankment whilst maintaining operation of the existing pipeline during this time. This will be managed to meet the requirements for permanent and temporary construction loading required by First Gas under an operational asset. The proposed alignment for the replacement gas pipeline is shown on the design drawings in *Plan Set 12: Utilities Relocation*.

The Transport Agency is in discussion with First Gas regarding the specific design and construction methodology for the gas pipeline relocation.

7.5.3.3 Water Infrastructure

The Hunua 4 bulk watermain crosses the Project in Sector 1. Due to the depth of the pipeline, no impact is anticipated on this asset. Therefore, no specific works are required to protect or divert the watermain during construction of the Project.

Other local water and wastewater reticulation is located within and adjacent to the road alignment. The water infrastructure will require relocation and/or some form of protection during construction. However, it is expected that the water and wastewater infrastructure will be kept operational during construction or an alternative implemented with the agreement of the provider. The Transport Agency is in discussions with Watercare regarding the relocation of water and wastewater assets.

7.5.3.4 Fibre optic communication cables

The Project conflicts with a number of below ground telecommunication cables and these will require relocation during construction. Ducting will be installed to relocate these services with the existing cables kept operational until the new ducts are available (or alternative measures implemented as agreed by the utility operators). The relocations will be undertaken as part of the enabling work for the Project.

The Transport Agency is in discussion with Chorus, Vodafone, Vector Communications and FX Networks regarding the specific design and relocation of assets.

7.5.3.5 Electricity and gas distribution

Most of the local reticulation network in the Project area is underground with the exception of overhead infrastructure near Onehunga Harbour Road. Relocation of existing lines may be required to avoid or manage conflict. Where required, the lines will be undergrounded into a common services trench out of the direct earthworks/carriageway construction zones.

There are a number of low to medium pressure gas mains within the Project area. Any affected services will be relocated or protected during construction. Such works can be managed for continuity of supply during construction.

The Transport Agency is in discussion with First Gas regarding the specific design and relocation of assets.

7.5.3.6 Stormwater drainage

There are many areas throughout the Project area where the existing stormwater network will need to be modified and upgraded to accommodate the Project. There are also a number of existing Auckland Council stormwater outfalls along the edge of the Māngere Inlet which will be retained, diverted or upgraded as part of the Project.

The Transport Agency is in discussion with Auckland Council regarding the design of proposed new stormwater assets, including assets to service parts of the Onehunga-Penrose Catchment and the impact of the Project works on the existing stormwater drainage assets. Auckland Council will be involved in the detailed design of these assets.

7.5.4 Temporary traffic management

Construction of the Project will require temporary traffic management. This may include:

- Footpath closures / detours;
- Pedestrian crossing closures;
- Cycle lane closures / path closures/ detours;
- Property access closures;
- Shoulder and lane closures;
- Road closures / detours;
- Site access arrangements; and
- Temporary speed limits.

The proposed temporary traffic management measures are discussed in *Section 12.13: Construction traffic* and detailed in *Technical Report 10: Construction Traffic Impact Assessment* in *Volume 3*.

7.5.5 Construction yards and site compounds

Fourteen areas within the Project footprint have been identified as construction yards/laydown areas for construction of the Project. These areas are shown on *Plan Set 11: Construction Activities*. The construction yards/laydown areas have been selected because of their proximity to key construction elements (as set out in Sections 7.6 to 7.12 below).

A description of the construction yards/laydown areas is set out in Table 7-1 below.

Seven main construction yards are proposed with seven supporting laydown areas. The final construction yard locations and activities may change depending on the final construction methodology and will be confirmed once a contractor(s) has been confirmed.

The construction yards/laydown areas may contain the following (or similar) activities commonly associated with construction:

- Temporary site buildings;
- Material laydown areas including stockpiling of material;
- Workers' office and workshop;
- Plant and equipment maintenance facilities;
- Fuel storage and refuelling facilities;
- Wheel washing and cleaning facilities;
- Lighting;
- Vehicle parking; and
- Plant and equipment storage areas.

The seven main yards will include the activities set out above as well as yard specific activities (e.g. the mudcrete operation and concrete batching at Yard 4 – Waikaraka Park). In addition to these specific yards and laydown areas, typical construction activities (such as stockpile, laydown and assembly areas, plant and equipment storage) will occur throughout the construction footprint.

As night time works are required on occasions across all the Sectors, the yards/laydown areas will operate both during the day and at some times during the night depending on activities required (e.g. night time motorway lane closures for bridge beam lifts).

Site establishment activities for the construction yards/laydown areas will include site clearance, ground preparation, and establishing erosion and sediment control measures prior to any construction activities occurring. Upon completion of the works, the construction yards will be disestablished.

The main construction yards will be provided with water, telecommunications and power connections, and where required wastewater connections. In most cases, these services are able to be connected directly to the existing adjacent networks. Where there is no existing network adjacent to the yard, a temporary connection will be made. These temporary connections will be removed on completion of construction.

The final location of construction yards and the activities undertaken within each yard will be confirmed as part of the preparation of the Construction Environmental Management Plan (CEMP). Further discussion of the CEMP is contained in *Section 13.1.5: Management plans and other information*.

Table 7-1: Construction yards/laydown areas

Yard	Location	Yard specific activities	Approx. commencement date	Approx. duration of use	Plan Set 11 ref
Yard 1	Neilson Street	Laydown area for the construction of Neilson St Interchange.	Mid 2021	18 months	CA-101
Yard 2	Onehunga Wharf	The main yard for construction activities associated with the Neilson Street Interchange. Access will be from Onehunga Harbour Road. Supported with an additional construction laydown area at Neilson Street.	Mid 2021	18 months	CA-102
Yard 3	Waikaraka Reserve (South)	The main yard for construction activities associated with the new road embankment. Will contain the activities associated with the mudcrete operation including a pugmill, cement storage and mudcrete transport (including conveyors or similar).	Late 2018	42 months	CA-104
Yard 4	141 Hugo Johnston Drive	The main yard for construction of the Anns Creek viaducts. Access from Hugo Johnston Drive.	Late 2020	42 months	CA-107
Yard 5	Great South Road	Supporting laydown area for the construction of the Anns Creek viaducts and Great South Road intersection.	Late 2020	30 months	CA-108 Rev 1
Yard 6	Sylvia Park Road	The main yard for the construction activities to the east of Hugo Johnston Drive. Access provided from Sylvia Park Road.	Mid 2021	30 months	CA-109 Rev 1
Yard 7	430 Mt Wellington Highway	The main yard for the construction activities for the on/off-ramp construction and motorway widening. Access provided from Mt Wellington Highway.	Mid 2021	42 months	CA-109
Yard 8	103 Carbine Road	Laydown area and access for the construction of the SH1 ramps. Provides access to the eastern side of the works.	Mid 2021	42 months	CA-110
Yard 9	Hillside Road	Laydown area for the construction of the Panama Road bridges.	Mid 2021	18 months	CA-111
Yard 10	61 Mataroa Road	Laydown area for the construction of the Ōtāhuhu Creek bridges.	Mid 2021	24 months	CA-112
Yard 11	12 and 14 Deas Place	Laydown area for the construction of the Ōtāhuhu Creek bridges.	Mid 2021	24 months	CA-113
Yard 12	89 Luke Street	The main yard for the construction activities for the on/off-ramp construction and motorway widening.	Mid 2020	24 months	CA-113
Yard 13	Todd Place	A supporting laydown area for construction of the Princes Street Interchange.	Mid 2020	24 months	CA-113

Yard	Location	Yard specific activities	Approx. commencement date	Approx. duration of use	Plan Set 11 ref
Yard 14	Frank Grey Place	The main yard for the construction of the Princes Street Interchange. This yard will be used in conjunction with Yard 15 depending on the staging of the works.	Mid 2020	24 months	CA-114

7.5.6 Earthworks and vegetation clearance

Construction of the Project will involve vegetation (both terrestrial and marine) removal and earthworks within the construction footprint. The Project construction footprint consists of approximately:

- 15.5ha of land based works; and
- 25ha of coastal works

For the purposes of this assessment, it has been assumed that any existing vegetation located within the Project footprint will be removed where required to facilitate construction. The exceptions are where there are amenity trees that can be retained (see Section 12.9), and the pier and construction exclusion areas within the Anns Creek Estuary and Anns Creek East (see Section 12.20).

Table 7-2 sets out the approximate total cut and fill quantities anticipated for the Project.

Table 7-2: Total cut and fill quantities for the Project

Cut and fill	Quantity (approx.)
Imported fill	850,000 m ³
Reused marine sediments from within embankment footprint	450,000 m ³
Dredged marine sediment for use as mudcrete	300,000 m ³
Cut to waste	200,000 m ³

The use of marine sediment to produce mudcrete is detailed in Section 7.7.1.

Fill material required for the Project will be sourced from quarries with suitable material. Concrete and steel required for structural components will be manufactured off-site. All other common components will be manufactured off-site and transported in as required, and may include amongst other things: precast components (such as culverts, bridge beams etc), surfacing materials (including bitumen) and street furniture.

Erosion and sediment control measures will be implemented for the Project. The Erosion and Sediment Control measures are discussed in further detail in *Section 12.15: Erosion and Sediment Control* of this AEE and in summary will include:

- Appropriate staging of the works, to ensure earthworks are carried out in a staged manner to limit the area of exposed earth open to the elements at any one point in time;
- Perimeter controls (predominantly earth bunds and drains) to divert clean runoff away from the land disturbance area and divert sediment laden runoff to the sediment retention devices;
- Erosion protection; and
- Sediment control devices including sediment retention ponds, decanting earth bunds (where there is insufficient space to use ponds), sediment fences and silt socks.

The drawings contained in *Plan Set 10: Erosion and Sediment Control* show how erosion and sediment control could be delivered for the Project.

7.5.7 Managing contaminated material

There are numerous locations along the alignment where there is the potential of encountering contaminated soil and groundwater during construction. The activities undertaken in areas with contaminated soil and groundwater and the handling of contaminated material requires management during construction in order to minimise potential risks to human health and the environment.

The location and nature of contaminated material and the measures to be adopted during construction are set out in *Section 12.18: Contaminated land* of this AEE. These are likely to include specific measures to cover:

- Containment, handling and disposal of contaminated soil during construction;
- Discharges of dust generated by land disturbance activities;
- Discharge of potentially contaminated sediment from land disturbance activities;
- Exposure of construction worker and the public to landfill gas;
- Potential human health risks for the construction work force; and
- Discharge of leachate from the Pikes Point Landfill leachate interception system and potentially contaminated groundwater elsewhere along the alignment.

Where excavations are to be undertaken in contaminated material, containment measures will be put in place which will include diversion of surface water and groundwater from excavation and pumping of contaminated water to the trade waste system. Contaminated material will be removed from site to approved disposal sites.

7.5.8 Works in watercourses (including associated diversions)

The Project will involve the placement of culverts and permanent diversions of streams as follows:

- A tidal section of Hill Stream will be realigned for construction of the Neilson Street Interchange and new stormwater treatment wetland;
- Miami Stream will be realigned at the lower end to allow the construction of a wetland and biofiltration area before it enters the Māngere Inlet;
- A section of Southdown Stream will be culverted to provide an extension of the existing culvert under Hugo Johnston Drive;
- A section of the existing Anns Creek culvert will be extended to allow for filling of the land directly west of Great South Road; and
- Clemow Stream will require realigning and culverting to allow the new off-ramp to Sylvia Park Road to be constructed. This will involve sections of the stream being culverted to divert it around new bridge piers.

For the permanent diversions, new channels will replicate the form and morphology of existing natural channels where ever practicable. The following factors will be considered when forming new channels:

- The composition of the stream bed (material type and particle size);
- The hydraulic characteristics of the channel (including its gradient and flow capacity);
- Whether fish passage needs to be provided; and
- The existing riparian vegetation and any proposed new riparian planting to be provided.

The installation of culverts and associated erosion control and protection structures will require the temporary diversion of streams in most instances. Diversion channels will be stabilised using geotextile liner prior to water being diverted. Water will be discharged back into the natural channel downstream of the works.

Culverts and erosion control and protection structures will then be installed in the dry stream bed as quickly as possible. Temporary erosion and sediment control methods (as detailed in *Section 12.15: Erosion and sediment control* of this AEE) will be used around the works to limit sediment runoff into the stream. Once all the in-channel works have been completed water will be diverted back to the final channel.

The area used for temporary diversions will be stabilised following works.

7.6 Neilson Street Interchange (Sector 1)

Construction of the Neilson Street Interchange involves the connection between the Project and SH20, and the Onehunga area via Neilson Street and Galway Street. Retaining walls are required on either side of the new SH20 overbridge, along Orpheus Drive near the CMA, and on the Neilson Street off and on-ramps to SH20. The alignment is located close to existing transmission towers which may need to be raised to achieve the required clearance for construction.

The key construction features for the Interchange are:

- New interchange bridge over SH20 and associated on/off-ramps;
- The widening of SH20;
- A new trenched section of EWL (including stormwater detention tank and pumping infrastructure) with a local road over the trench;
- New pedestrian bridge over the EWL to align with New Old Māngere Bridge;
- Link Road between Galway Street extension and Onehunga Mall/Onehunga Harbour Road; and
- A new at grade intersection at Galway Street.

These key features are shown on the design drawings in *Plan Set 11: Construction Activities*.

The general sequencing of the work may be as follows:

- Local road diversions (e.g. temporary Galway Street link and signalling the intersection with Neilson Street);
- Relocate the gas main and other utilities;
- Construction of temporary pavement for traffic diversions for construction of the new ramps on the northern side of the interchange;
- Constructing the Neilson Street southbound off-ramp;
- Construction of northbound on-ramp;
- Construction of the SH20 overbridge and embankments;
- Construction of the new pedestrian bridge over EWL;
- Construction of temporary pavement for traffic diversions for construction of the trench;
- Construct the Project connection;
- Construction of local road bridge to Onehunga Wharf; and
- Construction of Galway Street connections.

Orpheus Drive will be temporarily closed at the southern end to allow construction of the northbound on-ramp. Access to the port and properties on the northern side of Onehunga Harbour Drive, e.g. The Landing will be maintained during construction.

Earthworks will be required adjacent to the shoulder of the widened SH20 and associated ramp connections for the Neilson Street Interchange. The earthworks will involve fill for the SH20 overbridge and cuts required for new SH20 ramps. Earthworks are largely expected to balance within the sector with additional engineered fill required for construction of the bridge embankment approaches.

Existing vegetation within the footprint of the works will be cleared to enable construction of the Interchange. Some of the pōhutukawa trees located immediately south of SH20 between the northbound off-ramp and Orpheus Drive will need to be removed as part of the works.

7.6.1 Bridges and other structures

The SH20 overbridge will be constructed from precast concrete Super Tee girders with spans of up to approximately 28m, and supported on in situ concrete piers with circular columns. The piers and one abutment will be carried by reinforced concrete bored piles, approximately 900 mm in diameter.

Bridge construction will involve:

- Temporary traffic management including changes to existing median and adjacent lanes, temporary realignment of motorway lanes, with safe entry and exit points onto the motorway for construction traffic;
- Bored piles at each pier position with access to each pier position by the piling rig, and then cranes to lower the reinforcing cage;
- Concrete pile caps, followed by columns and the pier capping beam constructed at each of the piers and the abutment; and
- Bridge beams crane erected one span at a time. This requires access to each span by the vehicles carrying the girders and the erection cranes and late night closure of the motorway in one direction at a time will be required.

Construction of the bridge spans adjacent to the Transpower tower requires working under and adjacent to the overhead lines. This will require restrictions on crane movements and will require raising the line height. One of the piers is directly under the lines and the use of a low height piling rig may need to be investigated to reduce the extent of overhead line raising required.

The construction of the trench at Onehunga Harbour Road will commence with the construction of a temporary road to divert the existing Onehunga Harbour Road north of the proposed trench walls. This will be followed by construction of the northern and southern trench walls. These walls consist of 750mm diameter concrete piles known as a secant pile wall. From this point, the trench will be excavated to the underside of the base slab. When the underside of the base slab is reached, the base slab, sump slab and walls can be constructed and temporary props reused in other locations.

As space is constrained around the Neilson Street Interchange retaining walls are proposed. These generally fall into two categories:

- Mechanically stabilised earth walls (MSE) for approach embankments to the Neilson Street Interchange and other fill locations, e.g. at the Galway Street connections. There are 21 retaining walls that are over 3 m in height; and
- L shaped walls, these tend to be smaller walls and can be used in cut situations as well.

7.7 Foreshore (Sector 2) including local roads connections (Sector 6)

Construction of the new road embankment, headland, stormwater treatment areas and the local road connections will involve:

- An embankment along the foreshore on both existing land and new coastal reclamation;
- Landscape features within new coastal reclamation;
- Stormwater treatment systems within the new landscape features;
- Local road and other road connections at Galway Street, Captain Springs Road and the port link road; and

- A pedestrian cycle connection at Alfred Street.

The key construction features are shown on the design drawings in *Plan Set 11: Construction Activities*.

The general sequencing of the work may be as follows:

- Access from Galway Street and Captain Springs Road and establishing the main construction yard at Waikaraka Park;
- Enabling works including vegetation clearance (predominantly mangroves) and construction of the cut off trench and new gas pipeline on the northern side of proposed road;
- Dredge a channel between the construction yard and the dredging location in the Inlet to provide all tide access to the mudcrete production area;
- Construct the outer edge of the embankment/landscape features from Neilson Street to Captain Springs Road. This area will provide an enclosed construction environment for the embankment and the bund. This bund will be constructed from mudcrete within the Project footprint;
- A barge will be setup on the other side of the embankment in a sub tidal environment. This barge will collect (dredge) mud from the Inlet to use as mudcrete on site. The mudcrete will be made onsite and placed along the embankment and containment bund;
- Where works are over existing landfill, excavation of contaminated material will be required and the material disposed of at approved sites. Raft type construction (where the road sits on top of the landfill) is proposed in these areas with the “raft” supported on steel ‘I’ beams piles to minimise settlement; and
- The road formation can then be constructed using mudcrete on the coastal side of the embankment and imported fill.

The section below discusses the anticipated construction methodology for the reclamation works in more detail.

7.7.1 Reclamation works

The foreshore embankment will require reclamation along a 2900 metre length of the Māngere Inlet between the Neilson Street Interchange and the eastern end of the reclaimed embankment. The proposed reclamation will require a large quantity of bulk fill material (approximately 800,000m³).

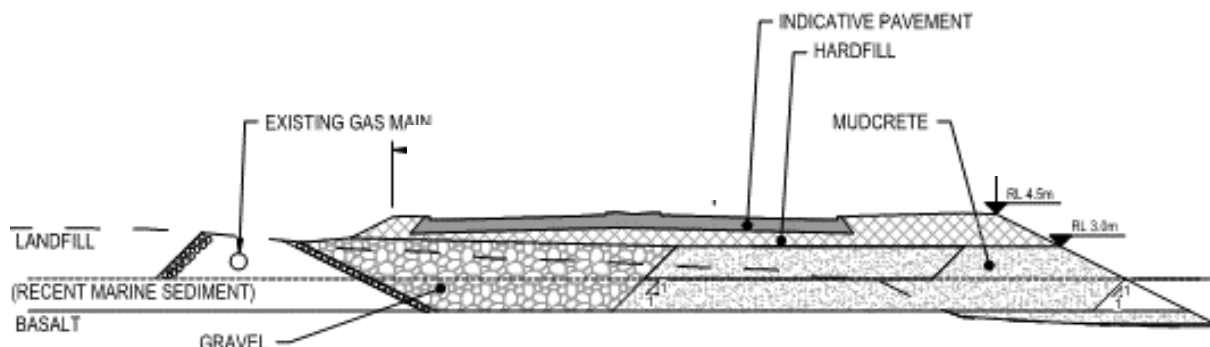
The reclamation works will be constructed using;

- Stabilised marine sediments – mudcrete;
- Bulk fill – material used to raise the embankment to the proposed design level;
- Rock armour – used to combat wave attack/erosion; and
- Pavement material – for the pavement layers.

Rock rip-rap from the current shoreline will be recovered and reused where possible on the outer face and will be supplemented by imported rip-rap material. The fill requirements take into account additional considerations such as natural coastal erosion, stability of underlying sediments and settlement.

While the embankment design differs along the length of the foreshore, Figure 7-2 shows a typical indicative cross-section for the section between Galway Street and Waikaraka Cemetery where the embankment is located partially on land and partially within the CMA. This shows the likely mix of materials required for the road embankment. More detailed cross-sections of the embankment and landscape features can be found on design drawings 321-324 in *Plan Set 7: Typical Cross-Sections*.

Figure 7-2: Indicative embankment configuration for Galway Street to Waikaraka Cemetery



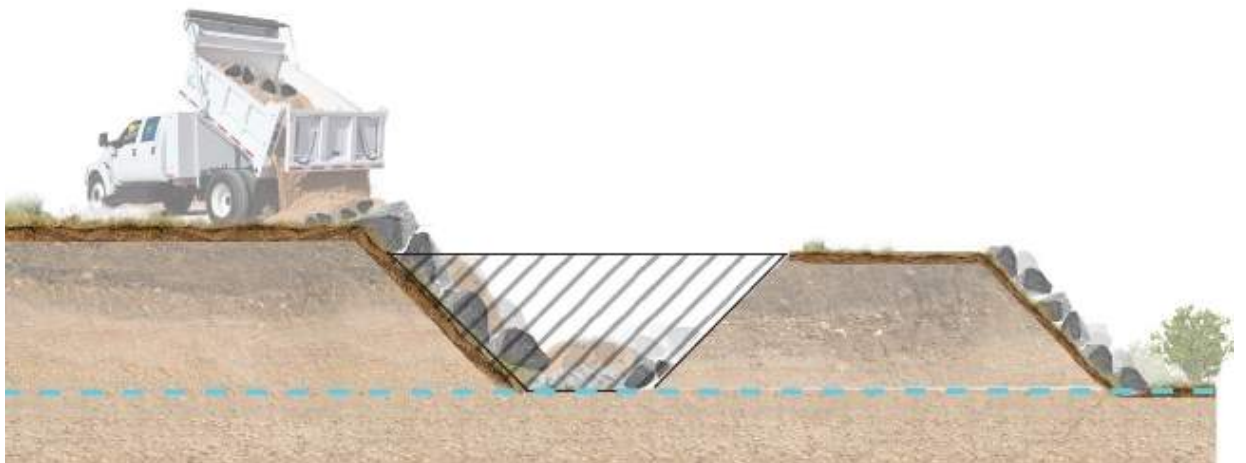
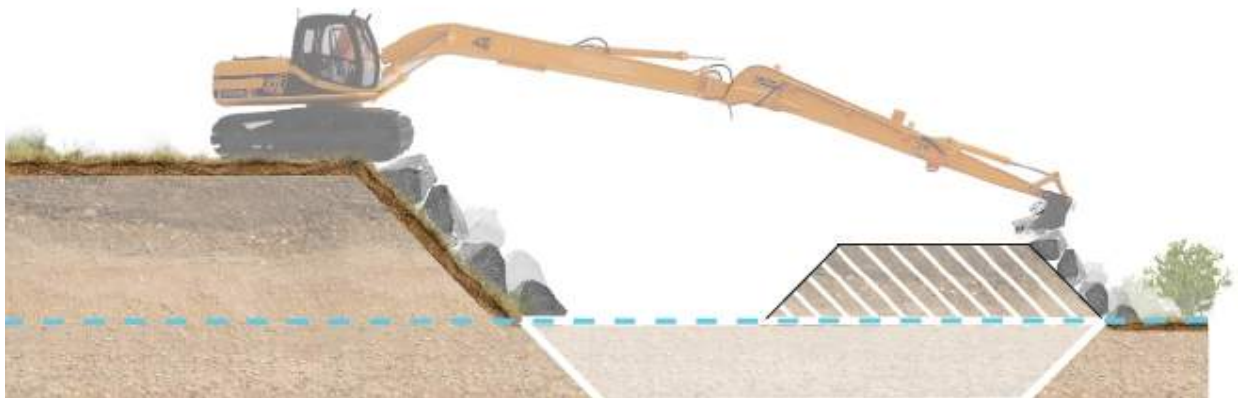
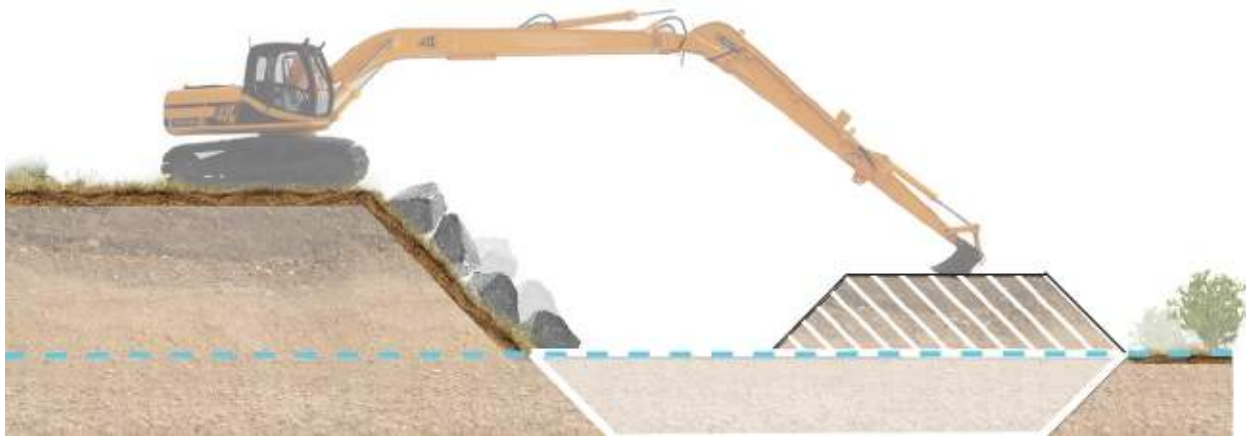
*Not to scale; dimensions approximate

The outer portion of the embankment will be formed with mudcrete and the remainder of the embankment will be formed with engineered fill. Figure 7-3 shows the general construction sequence for the reclamation which is:

1. Clear existing mangroves using excavator. Undertake in-situ mudcrete foundation for the embankment.
2. Construction a mudcrete bund using dredged material from within the reclamation footprint and from the dredging area in the Māngere Inlet (see Figure 7-4).
3. Using existing and imported riprap, construct coastal protection.
4. Import fill to complete embankment construction. Complete riprap coastal protection.

Figure 7-3: General construction sequence for the reclamation





It is currently envisaged that the mudcrete will be produced by dredging marine sediments from the Māngere Inlet and mixing these with cement and then placed back in the excavated area as ground improvement. Alternatively, the excavated marine sediments may be replaced with imported granular (gravel/rock) fill, or strengthened by in situ mixing with cement.

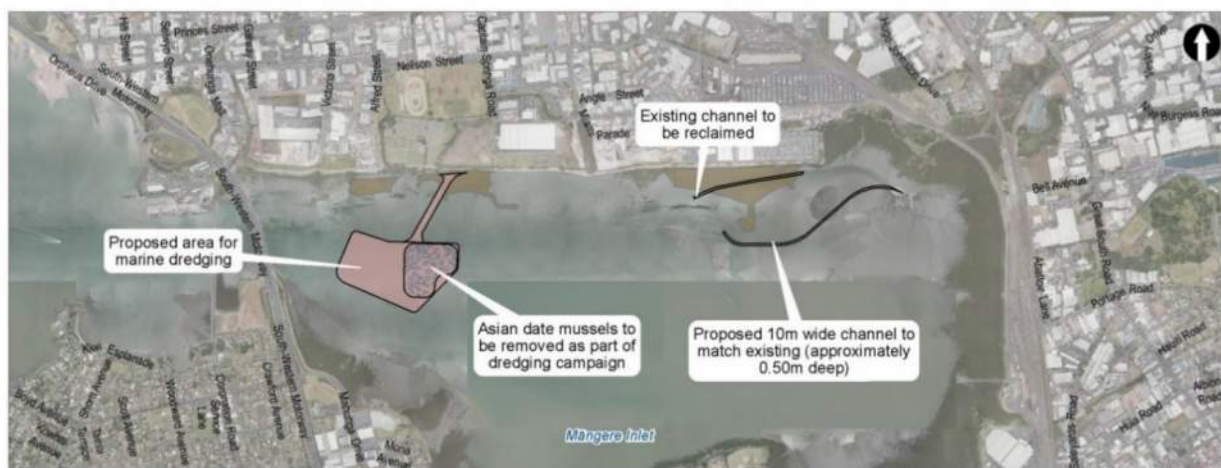
The dredged marine sediments will be sourced from the following areas:

- 100,000m³ of in situ material under the embankment to form a stable foundation;
- 100,000m³ sourced from within the wetland footprints and used to form the seal or liner for the wetlands and to create the main embankment for the road;
- 250,000m³ sourced from within the headland footprints; and
- 300,000m³ sourced outside of the Project footprint to form the outer landscape features to contain the wetlands.

The marine sediments required from outside the Project footprint will be dredged from a 15 ha subtidal area as shown on Figure 7-4. A temporary dredged channel will be formed to transport the dredged material to the Project area.

An alternative approach may be to import material to the site. At this stage, the Transport Agency is seeking consent for marine dredging, but also wishes to retain flexibility for the import of material depending on the final design and contractor's proposed methodology.

Figure 7-4: Dredging site and low tide channel



The dredging, if undertaken, will be undertaken by a long reach excavator located on a barge. The barge will be relocated based on where sediments are being won. Dredged sediment will be placed in a receiving barge or a conveyor and transported to the processing plant within the construction yard.

Figure 7-5 shows a barge set up similar to that which may be used for the dredging.

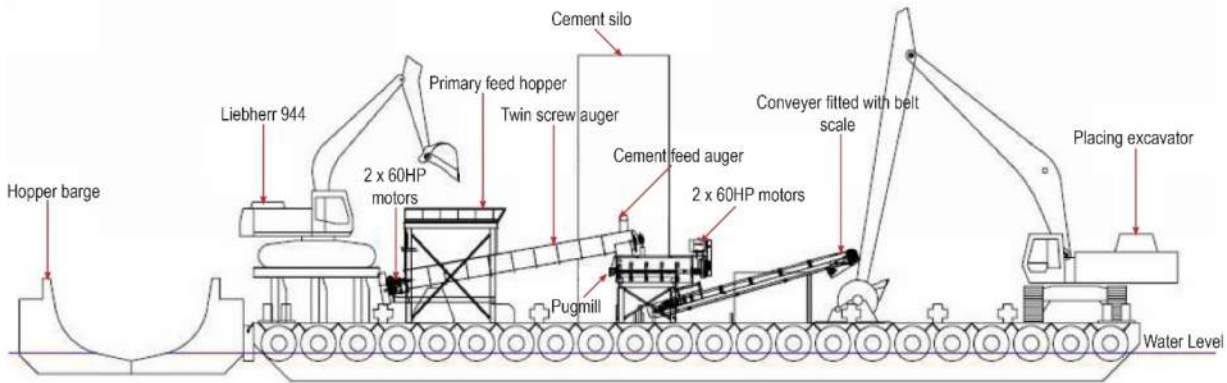
Figure 7-5: Typical dredging barge

It is anticipated that dredging will occur for approximately 12 months for the material won from the dredged area. The timing will be tide dependent so is likely to be undertaken at night time when required. Other dredging within the Project footprint could occur for a further 12 months.

Mudcrete will be produced at a rate of approximately 1,000m³ per day. This will use about 80 tonnes of cement per day. The cement will be stored in small-medium sized silos within the Waikaraka Park construction yard. The silos will incorporate a bag filter system to remove particulates from the air.

Figure 7-6 shows a typical set up for a marine based mudcrete plant. This type of set up could be used for the in situ mixing of mudcrete along the foreshore. For other areas, a land based operation will be used and will consist of similar plant and layout.

Figure 7-6: Typical marine based mudcrete plant



Once the dredged marine sediments are mixed with cement to produce mudcrete, the material will be transported to the required location using a conveyor system along the foreshore. This will be a mobile system and will be relocated depending on the area being formed. Another transport system would be to place the material in trays and move it to the disposal site with mobile plant. The figures below show examples from other projects of reclamation using mudcrete.

Figure 7-7: Reclamation using mudcrete for Upper Harbour Crossing (SH18, Greenhithe)



Figure 7-8: Reclamation using mudcrete at Fergusson Container Terminal



Following completion of the embankment and the outer bund, the stormwater treatment areas and pipework can be installed. These wetland areas will require the construction of a sealed layer beneath them to minimise ground water/seawater intrusion. Tidal gates will be installed in the outlets to allow discharge at low tide.

7.7.1.1 Occupation of the CMA during construction along the foreshore

Construction of the road embankment, landscape features, wetlands, boardwalks and other coastal elements will require temporary and permanent occupation of the CMA. *Section 6.0: Description of the Project* sets out the temporary (construction) and permanent occupation of the CMA for these works. These areas are shown on the design drawings in *Plan Set 5: Coastal Occupation* in *Volume 2: Drawing Set*.

In summary, the construction will require temporary occupation of the CMA consisting of the physical footprint of the new road embankment, landscape features and stormwater wetland as well as an additional area for construction activities/disturbance beyond the permanent footprint.

Feature	Permanent occupation and reclamation	Additional temporary occupation	Total construction area
Road embankment	6.5 ha	11.65 ha	35 ha
Landscape features and stormwater wetland	17 ha		
Dredging site	-	15 ha	15 ha

7.7.2 Construction of local road connections

Construction of the local road connections/intersections include the following:

- Galway Street/Neilson Street Intersection;
- Captain Springs/ Neilson Street Intersection; and
- Port link road.

The intersection of Galway Street with Neilson Street will provide a key link for Onehunga to the Project and SH20 networks. Due to the current nature of Neilson Street being an arterial connection, construction works will be undertaken during off-peak hours to minimise impacts on the existing road network.

The connection from EWL via Captain Springs Road to Neilson Street is a key link into the local area and will require improvements to the existing roads. The key construction features are:

- Widening of the existing intersection;
- Relocation of existing services; and
- Accommodation works.

The port link road will require construction works on historic landfills. The key construction features are:

- Removal of contaminated material and constructing over the landfills;
- Connection to existing Miami Parade intersection;
- Relocation of existing services; and
- Accommodation works including security fencing.

As construction of the local road connections will be across areas of closed landfills some excavation of contaminated material will be required. Construction will be similar to the main EWL using raft type construction.

Earthworks will be required for the embankment interface works and local road construction. There will be limited excavation within landfill materials with these left in situ wherever possible and suitably capped. Where cut is required into the landfill material this will be removed and disposed of to an approved disposal site.

7.8 Anns Creek viaducts and Great South Road Intersection (Sector 3)

Construction of the Anns Creek viaducts will involve:

- An at grade signalised intersection at Hugo Johnston Drive;
- West of Hugo Johnston Drive, the viaduct structure will span across the Southdown rail siding and across the CMA; and
- East of Hugo Johnston Drive, the viaduct will span across the NAL continuing over Great South Road providing a grade separated intersection with EWL/Great South Road/Sylvia Park Road.

Retaining walls are proposed at the abutment at the western end of the viaduct over the CMA, adjacent to the connection to Hugo Johnston Drive and at the eastern abutment near Great South Road. The walls range in height from 3m to 6m.

The key construction features for this area are shown on the design drawings in *Plan Set 10: Construction Activities*.

The general sequencing of the work may be as follows:

- Construction yard setup at the southern end of Hugo Johnston Drive;
- Relocate the gas main and other utilities;
- Demolition of part of the Southdown Co-generation Plant;
- Construction of temporary staging over the CMA and Anns Creek;
- Piling and installation of the bridge piers during a Block of Lines³⁹. This will take priority due to limited time frames to work within the rail corridor. This can be done alongside the piling and installation of piers to the west of Hugo Johnston Drive;
- Constructing the embankment at Hugo Johnston Drive may be undertaken at the same time as the piling and pier installation to the east of Hugo Johnston Drive, depending on how access is used from Great South Road;
- A section of the viaduct east of Hugo Johnston Drive is likely to be of steel construction to allow greater spans to avoid sensitive ecological areas adjacent to Great South Road;
- Installing the deck of the bridges east of Hugo Johnston Drive with any construction over the rail corridor undertaken during a Block of Line;
- Installing the deck on the bridges to the west of Hugo Johnston Drive along with the construction of the EWL/Great South Road/Sylvia Park Road intersection;
- Construction of the viaduct over Great South Road will be undertaken in stages maintaining two lanes of traffic in both directions on Great South Road. Bridge beams will be lifted in at night requiring partial road closures, detours will be put in place; and
- Relocation of a Transpower high voltage transmission tower to facilitate construction of the extended viaducts at the Great South Road intersection.

Access within this area is limited and therefore enabling works will be required to establish access to the southern side of the Southdown Co-generation Plant and construct the embankment at the base of Hugo Johnston Drive. The embankment ties together the two bridge structures that cross over the rail lines.

Earthworks in this area are associated with construction of the bridge embankments at Hugo Johnston Drive and the intersection at Great South Road/Sylvia Park Road. A number of haul roads will need to be temporarily constructed to access and construct the viaducts over the rail corridor as well as relocate the gas pipeline.

Existing vegetation within the footprint of the works will need to be cleared. This includes approximately 150m² of terrestrial vegetation in Anns Creek East and approximately 100m² in Anns Creek West.

The section below discusses the anticipated construction methodology for the Anns Creek viaducts in more detail.

³⁹ A period when the rail operator has a planned shutdown of the rail line.

7.8.1 Coastal works for viaducts

The construction of the Anns Creek viaducts to the west of the Southdown rail siding will require works in the CMA. Moving east of the NIMT, the alignment crosses Anns Creek, an area of ecological and geological value. A construction methodology similar to the CMA components has been adopted due to the similar ecological and natural character features found in both areas. The general construction sequence for the viaducts will involve construction of the piles, then piers and then the superstructure. Construction of the viaducts could take approximately two years each.

The viaducts will consist of single structures of approximately 800m, generally 515m in length supported on single column piers. Spans for the new ramps will be generally 35m (and longer for a section within Anns Creek East) steel beams and will be supported by piers of approximately 2,100mm. The piers are likely to be constructed of reinforced concrete and supported on piled foundations.

Construction within Anns Creek Estuary and Anns Creek East will require temporary staging platforms to provide access for the piers and other structures. To avoid areas of ecological and geological value the staging for Anns Creek Estuary will be located on the southern side (seaward) of the alignment and through Anns Creek East it will be generally located on the northern side (landward) of the alignment. The design drawings in *Plan Set 11: Construction Activities* shows the indicative location of the temporary staging.

Within Anns Creek Estuary and Anns Creek East, pier and construction exclusion areas have been identified. These are areas of significant ecological and geological value. These areas have been mapped and are shown on the design drawings in *Plan Set 11: Construction Activities*. The piers and construction access will be located to avoid these areas.

The construction staging has been assumed to be in the form of a bridge structure constructed of steel piles driven into the seabed/land with a steel decking and concrete or timber deck slab. The temporary platforms could be in place for up to 18 months, depending on the final construction sequence. Access tracks to the platforms will be required and will be a suitable size and width to provide for piling rigs, cranes, excavators and trucks. Figure 7-9 shows an example of temporary staging similar to that anticipated for the Project.

Figure 7-9: Temporary staging used for Great North Road Interchange (SH16)



Figure 7-10: Construction of the substructure at Great North Road Interchange (SH16)



The bridge piers are expected to be cast in-situ reinforced concrete. Construction would typically comprise fixing the steel reinforcement for the piers, placing the formwork and pouring the concrete using either a concrete skip or by pumping through a pipeline. The pier could be constructed in several vertical lifts and the formwork moved up the pier shaft.

Once the foundations and piers are in place, the superstructures will be constructed. Precast concrete girders or steel girders will be used for the superstructure. A crane will be used to lift the girders into place on the pier crossheads. Once in place, reinforcement will be fixed and the slab cast with concrete placed either by concrete skip or pumped via pipeline.

An alternative method of construction to erect the girders might be to use a launching gantry, located above the span being erected, which will lift the girders into place. The effects of these are considered comparable but cranes have been assumed as “worse case” for construction.

Following completion of the construction works the temporary platforms will be dismantled with the temporary piles removed.

7.8.1.1 Temporary occupation of the CMA for construction

Construction of the Anns Creek Estuary viaducts and other coastal elements will require temporary and permanent occupation of the CMA. *Section 6.0: Description of the Project* sets out the temporary (construction) and permanent occupation of the CMA for these works. These areas are shown on the design drawings in *Plan Set 5: Coastal Occupation* in Volume 2.

In summary, the construction in Anns Creek will require the following occupation of the CMA:

Project element	Permanent occupation	Additional temporary coastal occupation	Total construction area
Anns Creek Viaduct	0.8 ha	0.2 ha	1.0 ha
Bridge piles	0.01 ha	0.02 ha	0.03 ha

7.9 Sylvia Park Road and SH1 ramps (Sector 4)

Construction of the Sylvia Park Road and SH1 ramps involves:

- Widening of Sylvia Park Road to four lanes and space to construct new structures linking to SH1;
- Relocation of Transpower towers near SH1;
- Construction of southbound on and northbound off-ramps across Mt Wellington Highway, Clemow Drive and the NIMT;
- Stormwater diversion and treatment adjacent to SH1; and
- Construction of a shared path linking from Great South Road to Mt Wellington Highway and then into Sylvia Park Town Centre.

The key construction features are shown on the design drawings in *Plan Set 10: Construction Activities*.

The general sequencing of the work may be as follows:

- Relocation and increasing the height of electricity transmission towers;
- Construction of box culverts and associated stormwater works on the western side of SH1;
- Piling and pier placement of on/off-ramps with all works over SH1 and Mt Wellington Highway;
- Widening on the south side of Sylvia Park to cater for the westbound lane and northbound off-ramp from SH1;
- Construction of the northbound off-ramp;
- Widening of the southbound lane on SH1; and
- Construction of the southbound on-ramp.

Earthworks activities will involve clearing and filling of the sites located to the south of Sylvia Park Road. It is expected that a considerable amount of the excavated material in this area will be unsuitable and/or contaminated and will not be able to be reused. Unsuitable material will be removed and disposed of at an approved site with imported engineered fill placed under the widened carriageway, Sylvia Park Ramps embankment and wetland perimeter.

The existing stormwater drainage system on the eastern side of SH1 will require significant upgrading. This work is likely to include construction of a double, large diameter, culvert or box culvert at Great South Road to replace the small pipes. Pumping due to existing low point location is proposed along with stormwater detention and treatment.

The section below discusses the anticipated construction methodology for the SH1 ramps in more detail.

7.9.1 SH1 Mt Wellington Ramps

The SH1 Mt Wellington ramp structures will be constructed using both from precast concrete Super T girders with spans generally up to 35m and steel box beams up to 60m both supported on in situ concrete pier caps and single circular column piers approximately 1.8m in diameter. Each column is typically carried by a reinforced concrete bored pile, approximately 2.1m in diameter, except for a number of the piers along Sylvia Park Road where pad foundations resting on the basalt flows beneath are proposed.

The ramps consist of two long bridges connecting EWL to the SH1 motorway, one off-ramp and one on-ramp. Two transmission towers are required to be moved and raised by Transpower. An additional tower will be required between these two towers. The existing lattice towers will be replaced with monopoles.

Bridge construction commences with the installation of the bored piles at each pier position and under the abutments. This requires access to each pier position by the piling rig, and then the cranes to lower the reinforcing cage. Most of the piles will penetrate through or into basalt. Drilling and grouting of the underlying basalt will be required.

Concrete bridge beams may be erected by a launching gantry working along the structure from one end to the other, and the contractor may also need to use crane erection along the Sylvia Park Road section due to the length of the viaducts and the number of bridge spans.

The figures below show examples of pier construction which are similar to that anticipated for the Project.

Figure 7-11: Ramp columns



Figure 7-12: Construction of superstructure using a gantry



The steel box beam sections of the on-ramp will be erected by crane. The beams will be erected progressively in stages and temporary support towers will be required at the splices. Late night motorway closures will be required for erection of beams over live traffic.

For the girders to be erected over occupied areas and roads or rail lines, the closure of the area below the works will be required during critical activities.

Construction areas for the on-ramp piers near Tip Top corner are very restricted. Occupation of the motorway shoulder will be required for this work.

Construction of the spans adjacent to Transpower towers and where the lines cross the ramps, requires working under and adjacent to the overhead power lines. This will require restrictions on crane movements and may require raising the towers. The use of a low height piling rig together with a launching gantry may reduce the extent that the lines need to be raised.

7.9.2 Retaining walls (Sector 4)

As space is constrained along Sylvia Park Road and on SH1, a significant number of high (6m) retaining walls are proposed in this area. Rock bolts or soil nails are proposed to retain a section of the existing slope between Tip Top and Panama Road on the eastern side of SH1. The retained height will be up to 4m.

7.10 SH1 Auxiliary Lanes and Ōtāhuhu Creek Bridge (Sector 5)

Construction of the SH1 Auxiliary Lanes and Ōtāhuhu Creek Bridge will involve:

- Constructing an additional lane on SH1 northbound and southbound from the Sylvia Park ramps through to Princes Street; and
- Construction of a new Ōtāhuhu Creek Bridge with removal of the existing culverts.

The key construction features are shown on the design drawings in *Plan Set 10: Construction Activities*.

The general sequencing of the work may be as follows:

- Site establishment, vegetation removal, utilities relocations, temporary traffic management and establishing erosion and sediment control measures;
- Widening of SH1 northbound lane;
- Construction of new bridge east of SH1 over Ōtāhuhu Creek;
- Construction of Ōtāhuhu Creek northbound lane bridge extension including declamation;
- Widening of SH1 southbound lane;
- Construction of Ōtāhuhu Creek southbound lane bridge extension;
- Median barrier construction, pavements and ancillary works; and
- Retaining wall and noise wall construction.

Earthworks will be associated with the carriageway widening along SH1 with associated bridge and stormwater works. Existing vegetation within the footprint of the works will need to be cleared including existing landscape planting within the motorway corridor and mangroves adjacent to the Ōtāhuhu Creek Bridge.

The section below discusses the anticipated construction methodology for the Ōtāhuhu Creek Bridge in more detail.

7.10.1 Ōtāhuhu Creek Bridge

The Ōtāhuhu Creek Bridge comprises precast concrete girders with spans up to 15m supported on bored piles and a small pier cap. The piles are located on the existing motorway batter slopes.

Ōtāhuhu bridge construction will commence with the staged erection of the new local road bridge, removal of the existing SH1 culverts and construction of the new SH1 bridge involving multiple traffic switches to facilitate the necessary lane configuration required for temporary traffic management.

Construction will commence with the installation of the bored piles on one side of the motorway. Following completion of the piles and construction of the small pile cap, the girders will be crane erected. Following this the settlement slab and remaining works will be completed. The work will be carried out in two stages to provide sufficient working area and access.

Construction of the first bridge will require temporarily shifting the motorway lanes and median across to provide adequate working area and safe access to the site. On completion of the first bridge the process will need to be reversed and the second bridge constructed.

Foundations for these bridge piers and abutments are expected to be piled. Bridge piers are generally concrete columns and are approximately 900mm diameter. Approximately 14 piers will be located within the CMA.

Abutments are concrete seats upon which the bridge beams can be supported at each end of the bridge. It is proposed that the bridge deck will consist of precast concrete beams.

Temporary staging may be required to install the piers but the existing structure may minimise this subject to traffic management requirements.

As part of the Ōtāhuhu Bridge works, an area of approximately 4,500m² on the southern side of the creek may be declaimed, with the location and extent depending on the final design details and construction methodology for the work.

The removal of the existing culverts will also be staged. Construction methodology is likely to include the diversion of water away from one culvert. This culvert will then be removed in stages by removing the slab and then walls. Potential concrete dust generated during works can be managed in a number of ways. For example, isolating the works area from operational culverts, installation of erosion and sediment control and watering or vacuuming during and after works.

Construction of the Ōtāhuhu Creek Bridges and other coastal elements will require temporary and permanent occupation of the CMA. Section 6.5.2 of this AEE sets out the temporary (construction) and permanent occupation of the CMA for these works. These areas are shown on the design drawings in *Plan Set 5: Coastal Occupation in Volume 2*.

In summary, the construction will require the following occupation of the CMA:

Project element	Permanent footprint	Additional temporary coastal occupation	Total construction area
Ōtāhuhu Creek bridge	0.12 ha	0.16ha	0.28 ha

7.11 Panama Road Bridge (Sector 5)

Construction of the Panama Road Bridge involves:

- Constructing a new raised overbridge to the south of the existing structure; and
- Raising Panama Road including the tie in to Hillside Road and McLennan Road.

The key construction features are shown on the design drawings in *Plan Set 10: Construction Activities*.

The general sequencing of the work may be as follows:

- Site establishment, vegetation removal, utilities relocations including works to transmission lines, temporary traffic management and establishing erosion and sediment control measures;

- Piling and pier installation for the new overbridge;
- Partial construction of new bridge;
- Road works along Hillside Road and Panama Road west;
- Road works along McLennan Road and Panama Road east;
- Deconstruction of existing bridge;
- Complete construction of the new bridge;
- Tie in of the overbridge on Panama Road; and
- Works to reinstate/modify residential site accesses.

The bridge will be constructed from precast concrete girders with spans up to 30m, and supported on an in situ concrete piers with circular columns. The pier and abutments are carried by reinforced concrete bored piles, approximately 900mm in diameter.

Construction of the bridge will commence with the installation of the bored piles for the central pier in SH1. This requires access to the central pier position and abutments by a piling rig and cranes. Provision of appropriate working areas at each abutment and pier will be required to facilitate the construction. This will involve reducing lane widths on SH1 with temporary realignment and barriers and a reduced speed limit on the motorway.

On completion of the piles, concrete pile caps, followed by columns and the pier capping beam will be constructed at the pier and the abutments. Bridge beams will be crane erected one span at a time. This requires access to each span by the vehicles carrying the girders and the erection cranes. For the girders to be erected over live traffic lanes, late night closure of the motorway in one direction will be required for a short period.

A staged construction is proposed keeping one lane of traffic controlled by signals operating at all time.

Following construction of the new overbridge, the existing bridge will be demolished. The existing bridge will be cut into sections and removed during late night closures of the motorway.

7.12 Princes Street Interchange (Sector 5)

Construction of the Princes Street Interchange involves:

- A new bridge over SH1 and removal of the existing bridge;
- A signalised intersection at Princes Street and the northbound off and northbound on-ramps on the western side of the motorway;
- A signalised intersection at Frank Grey Place and Princes Street on the eastern side of the State highway; and
- A signalised intersection at Frank Grey Place and the southbound off and the southbound on-ramps east of the motorway.

The key construction features are shown on the design drawings in *Plan Set 10: Construction Activities*.

The general sequencing of the work may be as follows:

- Site establishment, vegetation removal, utilities relocations including works to transmission lines, temporary traffic management and establishing erosion and sediment control measures;
- Piling and pier construction for the new overbridge will be undertaken in the motorway;
- Construction of the Frank Grey Place/Princes Street intersection;

- Construction on the north side of the bridge to be undertaken while the existing bridge remains live to reduce traffic impacts;
- Demolition of the existing bridge and construction of the south side of the new bridge;
- Construction of the southbound on/ off-ramps and Frank Grey Place; and
- Construction of the northbound on/ off-ramps and Princes Street West.

Earthworks required for the construction of the interchange will be limited to the widening of the SH1 carriageway along with reconstruction of the bridge abutments at Princes Street. Excavation north of the Princes Street Bridge will also be undertaken to reshape and extend the existing wetlands at the southbound off-ramp.

The overbridge will be constructed from precast concrete Super T girders with spans up to approximately 27 m, and supported on an in situ concrete pier with circular columns. The pier and abutments are carried by reinforced concrete bored piles, approximately 900 mm in diameter.

Construction of the overbridge will follow the same methodology as for the Panama Bridge as set out in Section 7.11.

As space is constrained along SH1 retaining walls are proposed in order to reduce encroachment where possible outside the existing motorway designation. Generally these are low walls (1m to 3m) however around the Princes Street Interchange a number of larger walls are also proposed. Where cut into existing embankment is required adjacent to the northbound carriageway, if basalt is encountered rock bolting may be considered.

7.13 Construction management plans

Construction of the Project will be managed through the implementation of a suite of project plans including health and safety management plans, quality management plan and construction management plans. The construction management plans form an integral part of how construction activities are managed to address the social, environmental and cultural effects identified in *Part G: Assessment of effects of the environment* in this AEE. *Part H: Management of effects on the environment* in this AEE, sets out what these plans will contain and the process for their approval and implementation.