Attachment A

NZ TRANSPORT AGENCY
WAKA KOTAHI

Northern Busway Extension: Constellation to Orewa Investigation and Reporting (I&R)

Volume 1: Scheme Assessment Report

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Executive Summary

The New Zealand Transport Agency (the NZTA) has engaged Beca Infrastructure Limited (Beca) to investigate an extension of the existing Northern Busway from Constellation Station to a future Hibiscus Coast Busway Station at the Silverdale Interchange (the NBE). The investigation by Beca involved: review and development of previously investigated and new route options for the NBE, to identify a preferred route; identification of land required to accommodate the preferred route; and consideration of station location and operational issues.

The investigation responds to the strategic objective of the NZTA to deliver an integrated, safe, responsive, affordable and sustainable public transport solution for North Auckland. The extension has been considered as a dedicated facility, separate to SH1 with associated stations being the responsibility of Auckland Transport and Auckland Council. These parties as well as local Iwi have been engaged throughout the project.

Increased population and employment growth is forecast for North Auckland and this will place increasing pressure on the transport network and available land. Current predictions to 2041 show increased SH1 traffic, resulting in congestion and varied travel times for people and goods moving through North Auckland. The need for additional dwellings and places of employment associated with the predicted population growth will require land which may also be necessary for an extension to the Northern Busway.

An extension to the Northern Busway would provide a public transport solution to accommodate some of the transport needs of a growing population within North Auckland. The Busway extension is not predicted to result in a significant decrease in traffic on SH1 because the number of people expected to use the bus rather than travelling by car is small in comparison to the overall number of vehicles using SH1. However, the NBE would improve travel times for people travelling by bus in the future.

To ensure an extension to the Northern Busway can be built in the future there is a need to allocate land for this purpose. This can best be achieved by introducing a new designation for Busway purposes and purchasing required land. It is recommended that the land purchase initially focus on properties where there is likely to be an increase in land value (as a result of population growth placing pressure on available land) and/or where negotiations with land owners may require significant time.

Through investigation and evaluation an eastern aligned option has been identified, and is recommended for the future extension of the Northern Busway. Being aligned to the east of SH1 the option:

- avoids a site of ecological significance at the Lucas Creek West Bush (located just north of the Oteha Valley Road Interchange to the west of SH1) providing for the protection of the environment;
- provides the greatest flexibility for future State Highway improvement projects;
- provides a bus only road link across SH1 to serve the Albany Station, enabling this station to support the future growth of the Albany Centre; and
- is cheaper to construct as it avoids the need to construct one or more major structures across SH1.

Based on economic investigations, the full NBE would likely be economically justified as early as 2019. Should the NBE be constructed in stages, a first stage from Constellation Station to Albany Station could be economically justified as early as 2015. The construction of the Busway during the indicated years would support the growth of the Albany Metropolitan Centre, Silverdale and Orewa in accordance with the emerging strategic direction for growth in Auckland.

The analysis undertaken as part of this project demonstrates that there is little benefit in providing bus shoulder lanes to Silverdale or incrementally. However, the case for bus shoulder lanes should be considered further when the project proceeds to preliminary design, and better information is available as to the associated costs and the effects on the network following completion of other projects (i.e. SH1 to State Highway 18 connection, Constellation to Greville improvements, SH1 to State Highway 17 connection and Penlink).

Prior to confirming the preferred option for a future extension of the Northern Busway and setting aside land for this purpose, it is recommended that NZTA undertake further consultation with Auckland Council, Auckland Transport and Hokai Nuku, in addition to initiating consultation with other Stakeholders, such as Watercare, and the community. `

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Glossary of Abbreviations

Abbreviation	Definition
AEE	Assessment of Environmental Effects
AHB	Auckland Harbour Bridge
ARGS	Auckland Regional Growth Strategy 2010
ARLTS	Auckland Regional Land Transport Strategy, 2010
ARPS	Auckland Regional Policy Statement, 1999
ARPTP	Auckland Regional Public Transport Plan, 2010
ARTA	Auckland Regional Transport Authority
ATP	Auckland Transport Plan, 2009
BCR	Benefit Cost Ratio
CBD	Central Business District
Ch	Chainage
dBA	Decibels
HOV	High Occupancy Vehicle
HVC	Heavy Commercial Vehicle
LOS	Level of Service
LTMA	Land Transport Management Act 2003

Abbreviation	Definition
LTMAA	Land Transport Management Amendment Act 2008
m	Million
MCE	Multi Criteria Evaluation
MSE	Mechanically Stabilized Earth
MUL	Metropolitan Urban Limits
NBE	Northern Busway Extension
NOR(s)	Notice of Requirement(s)
NSCDP	North Shore City District Plan, 2002
NZTA	NZ Transport Agency
QTN	Quality Transit Network
RDP	Auckland Council District Plan (Rodney Section), 2011
RMA	Resource Management Act 1991
RTN	Rapid Transit Network
SAR	Scheme Assessment Report
SES	Site of Ecological Significance
SH	State Highway
V/C	Volume over capacity ratio

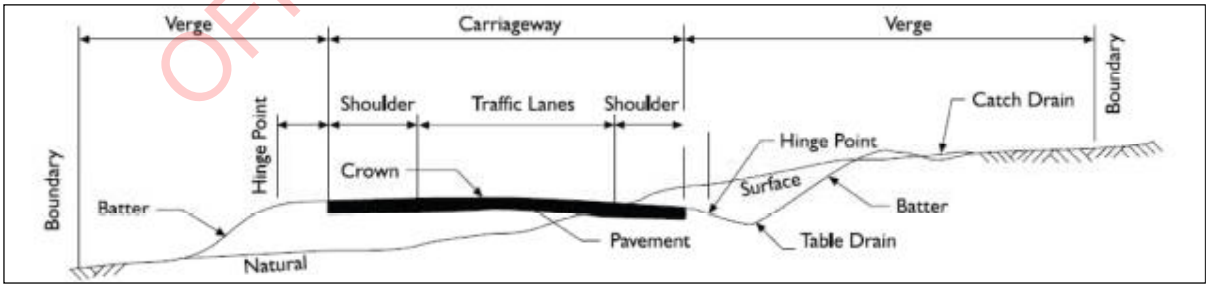
Glossary of Terms

Term	Definition
Alignment	The route or position of an existing or proposed motorway.
Ambient Noise Level	The total sound existing at a specified point and time associated with a given environment. The ambient sound is usually a composite of sounds from several sources, near and far.
Amenity	Defined in Section 2 of the RMA as those natural or physical qualities and characteristics that contributes to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.
Archaeological Site	Defined in Part 2 of the Historic Places Act as any place in New Zealand that – (a) Either– • Was associated with human activity that occurred before 1990; or • Is the site of the wreck of any vessel where that wreck occurred before 1990; and (b) Is or may be able through investigation by archaeological methods to provide evidence relating to the history of New Zealand.
Auckland Plan	The Auckland Plan is the working title for the Spatial Plan which the Auckland Council is required to prepare under the Local Government (Auckland Council Act) 2009. It sets out ideas, questions, and initial proposals on how the Auckland Plan can provide a blueprint for building the region into the "world's most liveable city" over the next 30 years.
Auckland Regional Land Transport Strategy, 2010	The Auckland Regional Land Transport Strategy sets the direction for Auckland Transport between 2010 and 2040. It is a statutory document prepared under the Land Transport Management Act 2003 with the purpose of identifying what is required to achieve an affordable, integrated, safe, responsive and sustainable land transport system that can cope with population growth and a changing economic environment within the Auckland Region.
Auckland Regional Public Transport Plan, 2010	The Auckland Regional Public Transport Plan is a statutory document which is prepared pursuant to the provisions of the Public Transport Management Act 2008. It specifies the public transport services proposed for the region, and the policies which apply to those services.

Term	Definition
Auckland Transport Plan, 2009	The Auckland Transport Plan unites the strategies, plans, projects and packages developed by the former Auckland Regional Transport Authority (now Auckland Transport), local authorities, the NZTA and KiwiRail, to provide a comprehensive transport plan for the Auckland Region to 2019 and beyond.
Northern and Western Sectors Agreement, 2001	The Northern and Western Sectors Agreement outlines how allocated growth capacities for the northern and western sectors of the Auckland region can be accommodated in appropriate locations, form and sequencing to 2021.
Batter Slope or Fill Batter	A backward slope in the face of a wall or of a bank; a receding slope.
Construction Footprint	The projected area on the ground or basement, upon which construction is to be placed.
Contaminated Land	Defined in Section 2 of the Resource Management Act 1991 as: • Land that has a hazardous substance in or on it that – (a) has significant adverse effects on the environment; or (b) is reasonably likely to have significant adverse effects on the environment.
dBA	A measurement of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
Designation	Defined in Section 2 and Section 166 of the RMA.
Heritage Site	A sit that contributes to an understanding and appreciation of New Zealand's history and cultures. A heritage site can be derived from archaeological, architectural, cultural, historic, scientific and technological fields.
Kiss and Ride Station	Stations that provide platforms, access for pedestrians and cyclists and an area where cars can discharge and pick up passengers in proximity to station platforms.
Metropolitan Urban Limits	The boundary of urban growth within the Auckland Region as applied under the Auckland Regional Policy Statement.
Motorway	Motorway means a motorway declared as such by the Governor-General in Council under section 138 of the PWA or under section 71 of the Government Roading Powers Act 1989.
Offline	In the context of a motorway means separate from the established motorway infrastructure.

Term	Definition
Park and Ride Station	Stations that include a large car parking area where people can park their vehicles before taking public transport.
Restoration	In an ecological sense restoration is the practise of renewing or restoring a damaged or destroyed ecosystems and/or habitat.
Revegetation	The process of replanting and rebuilding the soil of disturbed land through planting or trees, shrubs and grasses.
Sensitive Receivers	Any person(s) affected by, or sensitive to, impacts associated with activities within their environment. A sensitive receiving environment is of a similar nature but refers to natural systems or processes.
Sub-Regional Centre	Multi-purpose centres identified within the Auckland Regional Growth Strategy. These centres play a supporting role to the CBD and are a focal point for public transport services.
Western Ring Route	A Road of National Significance connecting the Maioro Street Interchange (SH20) to the Great North Road Interchange (SH16-20), and from St Lukes Interchange (SH16) to Westgate and Albany via SH18.
Vehicles per day	The number of vehicles observed passing a point on a road in both directions for 24 hours.
Volume to Capacity Ratio	A measure of the total vehicles using the road network compared with the potential capacity. A ratio approaching or at 1.0 represents a road that is nearing or at capacity.
Wahi tapu	Defined in Section 2 of the HPA as a place sacred to Maori in the traditional, spiritual, religious, ritual or mythological sense.
Wetland	Defined in Section 2 of the RMA as permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions.

Common terms used to define features within a state highway corridor are detailed in the diagram below:



1. Introduction

Beca Infrastructure Limited (Beca) along with sub-consultants, Aurecon, McCormick Rankin Cagney (MRC), the New Zealand Institute of Economic Research (NZIER), David Young Consulting Ltd and John Bolland Consulting Ltd, Boffa Miskell and Marshall Day Acoustics (hereafter collectively referred to as the consultant team), have been engaged by the NZ Transport Agency (the NZTA) to undertake investigation and reporting of a preferred route for an extension to the Northern Busway (the NBE or the Project).

The first stage of the Northern Busway on the North Shore was completed in 2008. It currently extends from the Auckland Harbour Bridge to Constellation Drive. It includes a dedicated offline Busway between Esmonde Road and Constellation Drive within the State Highway 1 (SH1) corridor. The Busway is currently served by Park and Ride stations at Constellation Drive and Kiss and Ride stations at Akoranga, Smales Farm and Sunnynook. A Park and Ride station is also located at Albany where the majority of services using the Busway currently start and end.

The NBE relates to the second stage of the Busway, which provides for an extension from Constellation Station through to the Silverdale Interchange, generally following the alignment of SH1 and connecting with the existing Park and Ride station at Albany (refer to Figure 1.1). The NBE seeks to identify and protect (via a designation) sufficient land for the future construction and operation of the Busway.

Figure 1.1 - Proposed Route

1.1 Project Objectives

The strategic objective of the NBE project is:

"To protect a route for passenger transport between Constellation Drive and Silverdale in order to deliver an integrated, safe, responsive, affordable and sustainable public transport solution having regard to increasing demand for travel within the Auckland Region for the period 2050."

In addition, the project objectives, which were set in through consultation with Auckland Transport and Auckland Council) are to:

- *"Improve the capacity, safety and efficiency of the Auckland transport network;*
- *Provide for the continuity of public transport services as future growth requires;*
- *Integrate effectively between all transport modes and with land use at Albany, Silverdale and Orewa;*
- *Integrate with planned and programmed future network improvements;*
- *Ensure that future State Highway 1 improvements are not compromised;*
- *Be fully integrated with the Northern Motorway;*
- *Help inform future complementary facilities;*
- *Provide a long term solution for a high quality rapid transit route; and*
- *Be optimised during investigation through option analysis and selection, and examination of scope, affordability and value for money issues."*

Throughout this NBE project full consideration has been given to these objectives.

1.2 Project Scope

The NBE project has considered the need to protect land for a future extension of the Northern Busway. Route options away from the existing SH1 motorway alignment have not been considered because such options would not meet the project objective for the NBE to be fully integrated (i.e. located adjacent to) SH1. This interpretation of full integration was supported by the NZTA.

The route identified for a future extension of the Northern Busway provides for Busway connections to the existing Park and Ride station at Albany and the proposed Hibiscus Coast Busway station at Silverdale. The Project scope has also included consideration of possible future stations at Rosedale Road, Greville Road and Redvale (refer Chapter 6 for details). The connection of the Busway to a station(s) in Orewa has not been investigated as part of this project because these stations are beyond the termination point of the NBE. Station design, operation and the protection of land for future stations is the responsibility of Auckland Council and Auckland Transport.

The proposed NBE design has been developed to accommodate light rail should this be required in the future. The footprint has also been developed to accommodate the necessary horizontal geometry for heavy rail (i.e. an alignment accommodating heavy rail could be provided within this footprint at some point in future should this be required).

There are major state highway and Auckland Council corridor projects that could influence the land requirement for an extension to the Northern Busway. These have been considered as part of the NBE project as follows:

- **Three Laning of SH1 –** the proposed NBE design and designation footprint has been developed in a manner that would enable three lanes in each direction to be provided continuously on SH1 as far north as Silverdale without disruption to the Busway in the future.
- **SH1 to SH18 Motorway to Motorway Connection** – the proposed NBE design and designation footprint has been developed to accommodate a future State Highway 18 (SH18) to SH1 motorway to motorway connection upon completion of the Auckland Western Ring Route (based on current design information).
- **SH1 Greville Road Interchange –** the proposed NBE design and designation footprint has been developed so as not to preclude improvements proposed at the Greville Road Interchange in the future (based on current design information).
- **Penlink (or Weiti Crossing scheme) –** the proposed NBE design and designation footprint has been developed so as not to preclude a proposed connection between the Whangaparaoa Peninsula and SH1 (south of Silverdale) in the future (based on current design information).
- **Weigh Station –** the proposed NBE design and designation footprint has been developed to accommodate a future weigh station (compliance checking site) located to the east of SH1 and north of Bawden Road, which would enable overweight vehicles to be diverted onto the Western Ring Route away from SH1 and the Auckland Harbour Bridge (AHB) should this be required in the future.
- **Hibiscus Coast Busway Station** – the proposed NBE design has been developed to accommodate and connect with the Hibiscus Coast Busway Station.

1.3 Project Investigation Process

The NBE project has involved two stages of investigation:

- **Scoping and Option Identification**: consideration of background information leading to the identification of a long list of options; the development of a multi-criteria evaluation (MCE) framework; and evaluation to identify a short list of options; and
- **Scheme Development and Assessment**: development of concept design for the short list options; and evaluation to identify a recommended option.

The methodology adopted for options evaluation throughout the NBE project stages is depicted in Figure 1.2.

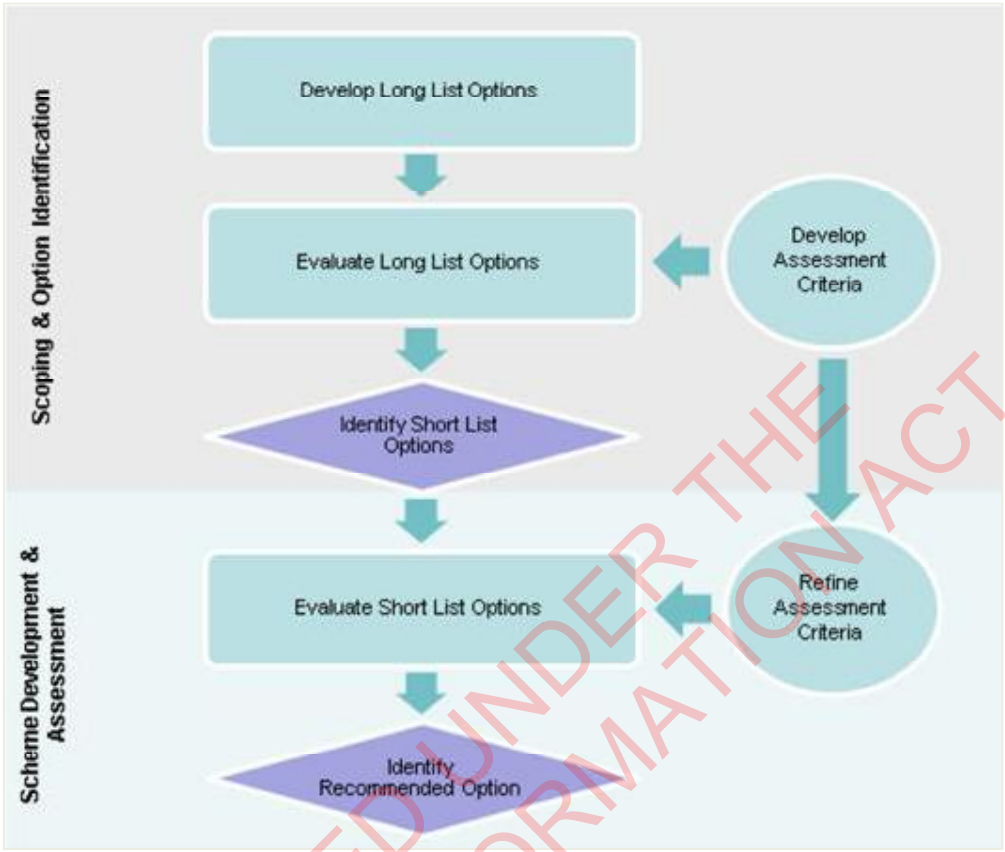


Figure 1.2: NBE Options Evaluation Methodology

1.3.1 Scoping and Option Identification

Stage one of the NBE project was completed in April 2011, with the findings reported within the *Northern Busway Extension Scoping Report,* attached as Appendix A within Volume 3 (Part A) of the SAR. During this stage of the project the following five long list options were developed by the project team and evaluated against a MCE framework:

- **Option 1:** Offline facility primarily on the western side of the existing motorway corridor (crossing north of the Rosedale Oxidation Ponds);
- **Option 2:** Offline facility wholly on the eastern side of the existing motorway corridor;
- **Option 3:** Offline facility crossing from east to west beneath SH1 in a covered trench or tunnel and returning to the east by way of a bridge to the north of Lonely Track Road;
- **Option 4:** Online facility comprising bus shoulder lanes in both directions, accessed via the existing motorway on and off ramps; and
- **Option 5:** Central median Busway, accessed at Silverdale interchange and Constellation Drive.

The MCE provided for coarse screening to identify options to be further developed and evaluated during Stage 2 of the NBE project. It included criteria to test the extent to which the long list options met the project objectives, and social, environmental and economic criteria.

The initial evaluation of the long list resulted in the identification of options 1, 2 and 3 as a short list of options for further development and evaluation. These options were identified for the short list as they performed better than options 4 and 5 against the project objectives, and performed well against the social, environmental and economic criteria. Whilst a shoulder bus lane option was dismissed during this stage of the project as a long term solution, it was acknowledged that bus shoulders could form an interim/staging opportunity for part of the SH1 corridor.

1.3.2 Scheme Development and Assessment

This Scheme Assessment Report (SAR) presents the findings of the second stage of the NBE project, building on the findings, conclusions and recommendations of the scoping and option identification stage. In particular the purpose of this report is to:

- present the logic and findings of the short list option evaluation and design processes; and
- recommend an option that meets the project objectives; and
- provide a "Preliminary" Assessment of Environmental Effects (AEE) as the basis for a Notice of Requirement (NoR) to designate sufficient land to construct and operate the Busway in the future.

In respect of the NBE, the SAR defines the constraints and opportunities within SH1 environs and current transportation conditions and trends. It provides a concise description of the strategic and transport issues the NBE project seeks to address and summarises the evaluation of the short list options. The report provides a reasoned recommendation, description and evaluation of a recommended option (and associated footprint) that meets the project objectives, allows for future innovation and stations as currently known, and can be protected via a designation.

2. Existing Environment

This section provides a brief description of the existing environment within the NBE corridor, and in particular highlights any key environmental constraints. The route is described in two sections as follows:

- **Northern Section:** Oteha Valley Road Interchange to Silverdale Interchange; and
- **Southern Section**: Constellation Station to Oteha Valley Road Interchange.

A full description of the existing environment is provided in the Preliminary Assessment of Environmental Effects (AEE) attached as Appendix B within Volume 3 (Part A) of the SAR.

2.1 Silverdale Interchange to Oteha Valley Road Interchange

The northern segment of the NBE corridor extends from the Silverdale Interchange in the north to Oteha Valley Road, in the south (near Albany). The environment is characterised by SH1 and rural residential land to the east and west. It includes the site of the proposed Hibiscus Coast Busway Station (and associated Park and Ride facility) which is planned to be established to the south and east of the Silverdale Interchange in the near future. Refer Figure 2.1 and Figure 2.2.

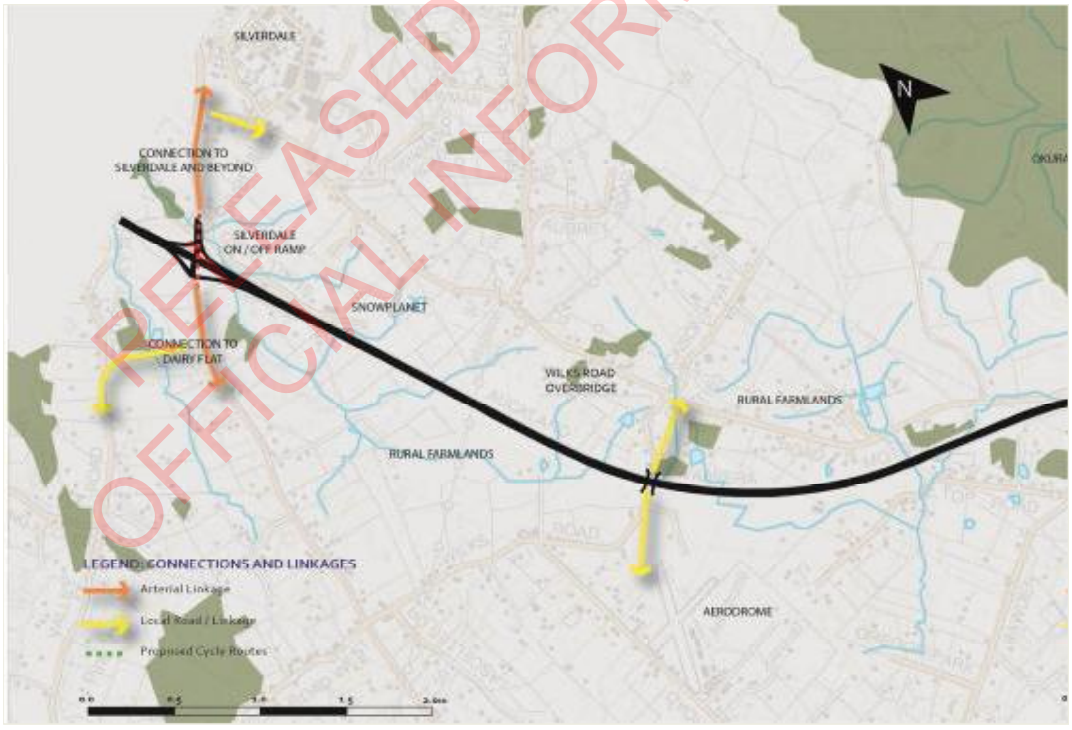


Figure 2.1: SH1 between the Silverdale Interchange and Bawden Road

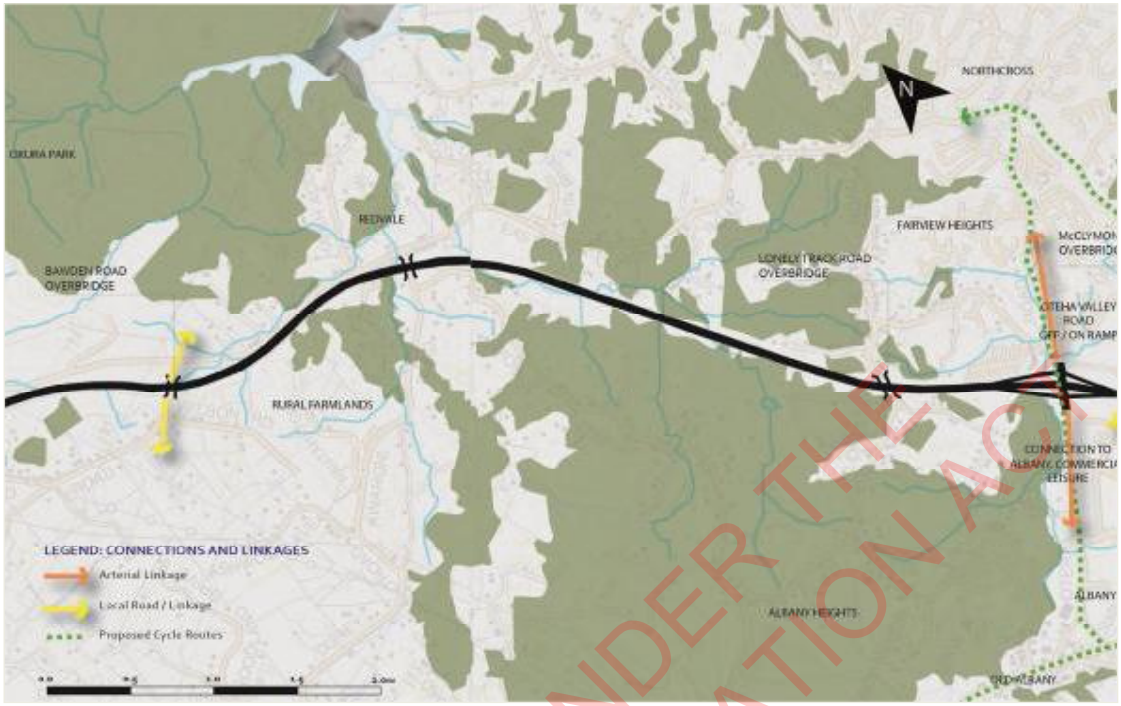


Figure 2.2: SH1 between Bawden Road and Oteha Valley Road

2.1.1 Form of Existing Motorway

SH1 generally provides for two traffic lanes in each direction through this section of the route. The Silverdale Interchange provides a connection with State Highway 17 to Dairy Flat in the west and to Silverdale, the Hibiscus Coast, Orewa and Whangaparaoa to the east (Hibiscus Coast Highway). Western on and off ramps provide access to and from a BP Service Station positioned to the west of SH1 near Wilks Road. There is a southbound climbing lane on the approach to the Lonely Track Road under passage.

There are a number of other lower order roads that provide east-west connections through the Dairy Flat area, including under passages at Wilks Road, Bawden Road and Lonely Track Road and an overbridge at Awanohi Road. None of these roads connect with SH1. East Coast Road follows closely alongside SH1 for part of its length. The Oteha Valley Road Interchange provides connections to the west (to Albany Town Centre) and east (to Torbay and Browns Bay).

2.1.2 Land Use

The land use predominantly comprises rural lifestyle blocks interspersed with farming activities (and zoned Countryside Living Rural). Notable exceptions to this are:

- entertainment uses east of SH1 at the Silverdale Interchange (i.e. a covered go-kart track, a luge, and an artificial ski field (Snow Planet));
- a BP Service Station located to the south of Wilks Road (west of SH1);

- the Fairview Retirement Village east of SH1 and north of the Oteha Valley Road Interchange (on residentially zoned land); and
- the recreational area of Lucas Creek to the west of SH1 just north of Oteha Valley Road.

2.1.3 Current Designations

All land within and surrounding the NBE corridor falls with Auckland Council jurisdiction, having previously been within North Shore City Council (land to the south of Lonely Track Road) and Rodney District Council (land to the north of Lonely Track Road) jurisdiction prior to the amalgamation of the Auckland Councils.

The following key designations apply along this section of the route:

- the NZTA 'motorway and limited access highway and associated interchange structures' designation (reference 401);
- the NZTA 'State Highway 1' designation (reference 404); and
- the NZTA 'Auckland-Waiwera Motorway' designation (reference 111);

Designation 401 applies to SH1 and SH1A between Puhoi and Lonely Track Road. Designation 404 applies to Hibiscus Coast Highway, extending from Puhoi through Orewa and Silverdale to tie in with designation 401 and the Silverdale Interchange. Designation 111 ties in with designation 401 at Lonely Track Road and extends southwards to the Greville Road Interchange.

There are a number of designated local roads administered by Auckland Transport (an Auckland Council controlled organisation) through or adjoining this section of the route. These include Small Road, Wilks Road, East Coast Road, Bawden Road, Awanohi Road and Lonely Track Road.

In addition the following designations are located in proximity to the SH1 corridor along this section of the route:

- the NZTA 'State Highway 17' designation (reference 406) to the west of SH1 at the Silverdale Interchange[1];
- Auckland Transport ('Weiti Crossing' designation (reference 167) located to the east of SH1 just north of Redvale; and
- Watercare Services Limited 'Water Supply Purposes' designation (reference 952) at Redvale in the vicinity of East Coast Road and Bawden Road.

[1] It is noted that this designation is expected to be revoked by NZTA as of January 2012, enabling SH17 to be returned to the control of Auckland Transport.

2.1.4 Freshwater Catchments

The existing SH1 corridor between Silverdale and Oteha Valley Road passes through the upper reaches of four catchments. From north to south these are:

- John's Creek/ Weiti River catchment.
- Dairy Stream/ Rangitopuni Stream catchment
- Okura River catchment,
- Lucas Creek catchment,

The passage of SH1 route through these catchments is shown in Figure 2.3 below.

The Silverdale South Catchment is an area of approximately 500 hectares to the south west of the Silverdale Township. Stormwater flows in the catchment travel via a number of ephemeral creeks either side of SH1, ultimately discharging to John's Creek or an unnamed stream, then to the Weiti River, which discharges to Karepiro Bay the Hauraki Gulf. Existing and potential flooding issues have been raised in the Small Road area, to the east of SH1, and within the John's Creek catchment. John's Creek lies in a relatively flat valley, and the area is prone to flooding and ponding of stormwater.

The Rangitopuni/ Dairy Stream catchment covers an area of 92 square kilometres and drains to the Upper Waitemata Harbour. SH1 crosses the eastern upper reaches of the Dairy Stream which is a major tributary of the Rangitopuni Stream. There are identified flooding issues within the catchment, with SH1 being located within the Dairy Stream flood Plain.

The Okura River is tidally influenced and flows east out through Okura Estuary to Karepiro Bay in the Hauraki Gulf. The Okura River and Estuary are recognised as a Site of Ecological Significance in the NSCDP. Wrights stream, which runs along the western side of SH1 from Lonely Track Road, discharges into a tributary of the Okura Estuary. SH1 is not within the section of the Okura Catchment that is affected by flooding.

The Lucas Creek (stream) is 16.3 kilometres long with a contributing catchment of approximately 600 hectares. The stream flows approximately northeast-southwest and discharges into the low energy Lucas Creek (estuary), along with streams from eight other stormwater catchments, which in turn discharge into the Upper Waitemata Harbour. Flooding issues have been identified through hydraulic modelling, overland flow path assessment as well as from historic information available through previous catchment management plans and community feedback.

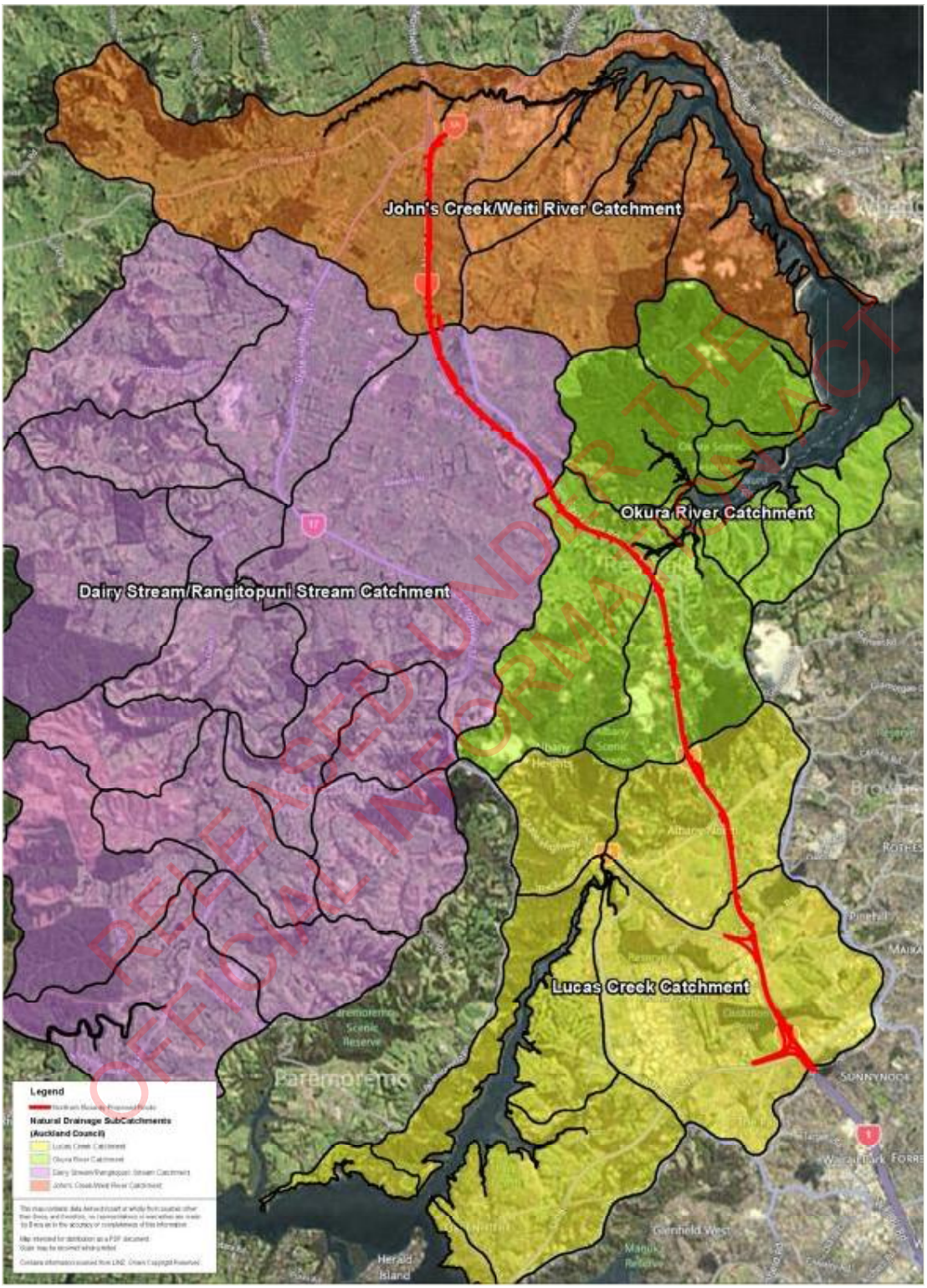


Figure 2.3: Passage of SH1 through catchments

2.1.5 Landscape

The landform through the majority of this section of the route is expansive, comprising a wide valley system (refer Figure 2.4). To the east low hill country continues northwards, and to the west a broad lowland area is dissected by a network of small tributaries of the Weiti Stream. To the south of Lonely Track Road is the Lucas Creek escarpment, which has high landscape and visual amenity qualities, forming a natural buffer and backdrop to the urban edge. Lucas Creek at the base of the escarpment is a significant landscape feature within this part of the NBE corridor. It provides a natural backdrop to the urbanising Albany Basin (to the south) and essentially defines the urban edge of the Albany area.

Figure 2.4: Environment to the north viewed from Lonely Track Road

2.1.6 Ecology

There are six areas of ecologically significant remnants of indigenous vegetation along this section of the SH1 corridor providing a local food resource for native birds and a refuge for forest invertebrate species (refer to the AEE attached as Appendix B within Volume 3 (Part A) of the SAR for full details):

- Okura River Bush – located on both sides of SH1 at Redvale;
- Wrights Stream Bush – located on both sides of SH1, south of Awanohi;
- Lonely Track Road East Bush – located on the eastern side of SH1 just north of Lonely Track Road;
- Lonely Track Road West Bush –located on the western side of SH1 just north of Lonely Track Road;

- Lucas Creek North Bush – located on the eastern side of SH1 just south of Lonely Track Road; and
- Lucas Creek Bush (east and west) – located on both sides of SH1 just north of Oteha Valley Road.

The Lucas Creek West Bush is identified as a Site of Ecological Significance (SES) by the former Auckland Regional Council (ARC) and North Shore City Council (NSCC). The SES is a major ecological constraint for the NBE (refer Figure 2.5).

In addition there are multiple areas of exotic tree land and exotic bush along this section of the NBE corridor as well as a number of planted highway verges and freshwater wetlands. The majority of the wetlands are artificial, providing stormwater treatment for SH1.

Refer to the Assessment of Effects attached as Appendix B within Volume 3 (Part A) of the SAR for full details.

Figure 2.5: General Location of Significant Ecological Site[2]

2.1.7 Ground Conditions & Geologic Constraints

The geology of this area comprises the Northern Allochthon between Silverdale and approximately Awanohi Road, and Waitemata Group from approximately Awanohi Road to Oteha Valley Road. Low lying areas are infilled with alluvial soils (refer to the maps within the Interpretive Geotechnical Report attached as Appendix C within Volume 3 (Part B) of the SAR for further details of the geology along the NBE alignment).

[2] sourced from the Auckland Council GIS Viewer: http://maps.aucklandcouncil.govt.nz

Northern Allochthon materials are noted for instability on comparatively shallow slopes due to intense shearing and saturated weak clays within the rock mass. Many of the natural and cut slopes along the NBE route exhibit some form of instability, typically either rotational slumps or the on-going surface creep of the top few metres.

Slope instability is the major geologic constraint along the northern part of the NBE alignment. This constraint varies in its form, extent and frequency of occurrence within the different geological conditions (refer to the instability hazard plans which relate geology, topography and mapped instability features within the Geotechnical Interpretive Report).

Waitemata Group materials will generally stand at steeper slopes and many existing slopes along the NBE route are underlain by residually weathered soils. Rock joints, defects and clay seams are known to exist and pose a risk to large cuts. Many gullies are infilled with weak slope debris and require careful engineering where embankments encroach over these areas.

The main geologic constraint along this section of the route is the potential instability of the alluvial soils when loaded by embankment or retained fills, and settlement under imposed loads.

2.2 Oteha Valley Road Interchange to Upper Harbour Highway Interchange

The southern part of the NBE corridor extends from the Oteha Valley Road Interchange at Albany, south to Upper Harbour Highway Interchange and Constellation Station. The environment is characterised by the existing motorway, built up residential and commercial areas, and the oxidation ponds at the Rosedale wastewater treatment plant (refer to Figure 2.6).

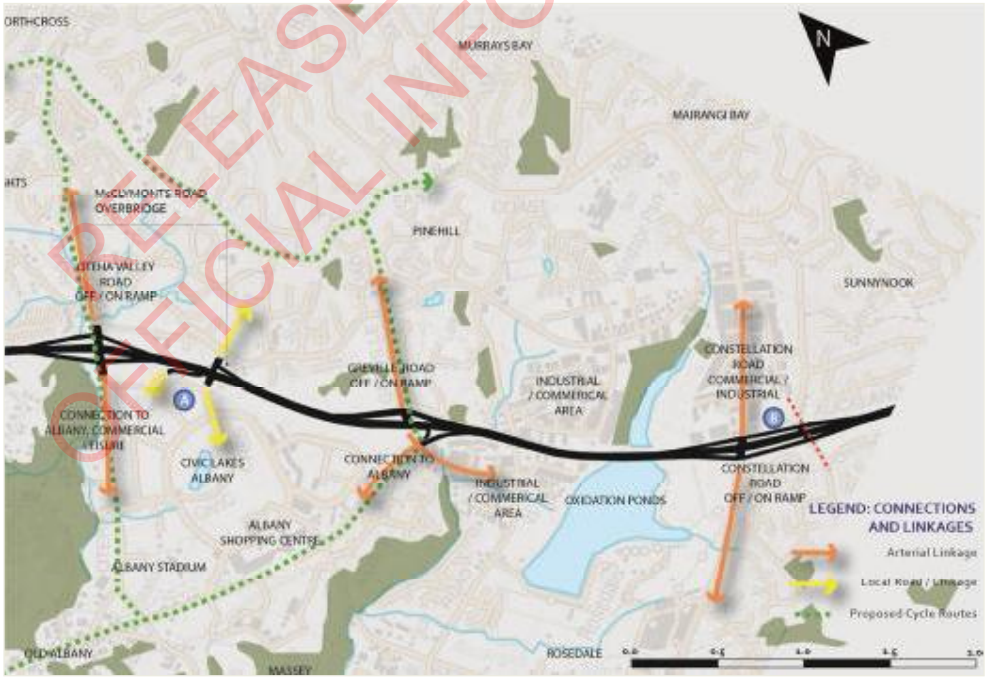


Figure 2.6: SH1 between Oteha Valley Road and Upper Harbour Highway

2.2.1 Form of Existing Motorway

The existing motorway through this section provides for three lanes (with 2.5 metre shoulders) in each direction between Oteha Valley Road and Greville Road Interchange and two lanes (with 2.5 metre shoulders) in each direction between the Greville Road Interchange and Upper Harbour Highway Interchange. A northbound climbing lane is located between the Greville Road Interchange and McClymonts Road overbridge.

The Greville Road Interchange (located south of Albany Station) provides connections to the northwest via the Albany Expressway (SH17), and to the Pinehill Residential area to the east (via Greville Road). Other roads connecting areas to the east and west of SH1 (but not connected to SH1) include the McClymonts Road underpass (south of Albany Station) and the Rosedale Road overbridge (south of Greville Road). The Upper Harbour Highway Interchange provides connections to Greenhithe, Hobsonville and West Auckland to the west (via SH18 Upper Harbour Highway) and to residential areas around Mairangi Bay to the east (via Constellation Drive, a regional arterial road). Upper Harbour Highway is the northernmost segment of the Western Ring Route.

2.2.2 Bus Stations

This part of the route includes the Albany Bus station (on the western side of SH1, just south of Oteha Valley Road) and Constellation Station (to the east of SH1, at Constellation Drive). The location of Albany station on the west presents added complexity, as all other Busway stations are located on the eastern side of motorway, and the provision of a direct Busway connection to Albany Station would require a new crossing of SH1.

The current southbound connection at Albany Bus Station is somewhat convoluted, as buses must exit SH1 at the Oteha Valley Road southbound off ramp, access Albany Station via the local road network, before crossing back to the eastern side of SH1 via McClymonts Road, where they utilise the Medallion Drive roundabout to turn around and join SH1 via the (bus only) McClymonts Road on ramp. Northbound buses exit SH1 to the north of McClymonts Road (via a bus only exit ramp) and following pickup/drop off at the Albany Station are able to re-join SH1 via the Oteha Valley Road northbound on ramp.

2.2.3 Land Use

Land use within the southern segment comprises predominantly low to medium density residential activities (on land zoned residential 4 and residential 5 within the North Shore City District Plan (NSCDP)) and low intensity business activities comprising a mix of older established uses and more recent development (on land zoned Business 9 and 10 within the NSCDP). Notable exceptions to this are:

- the Albany Sub-Regional centre (located west of SH1 and just south of Oteha Valley Road), which is partially developed and contains a number of large format retail activities, the Westfield Shopping Mall, North Harbour Stadium and the Albany Busway Station and associated Park and Ride facilities. A substantial area earmarked for the centre remains largely undeveloped (but is zoned for a mix of uses, including high intensity office and residential use);
- the former Rosedale Landfill site to the south of Greville Road Interchange (east of SH1) that is zoned Recreation 4 within the NSCDP and is known to be subject to contamination;

- the Rosedale wastewater treatment plant and oxidisation ponds located to the east and west of SH1 and south of Rosedale Road (and zoned Special Purpose 3 within the NSCDP); and
- a block of land zoned Recreation 4 (organised sports) adjoining the oxidation ponds to the east of SH1.

2.2.4 Current Designations

All land within and surrounding the NBE corridor falls with Auckland Council jurisdiction, having previously been within North Shore City Council prior to the amalgamation of the Auckland Councils. The key designations that apply through the southern section include the NZTA 'Auckland-Waiwera Motorway' designations (reference 111 and 110). Designation 111 applies to SH1 from Lonely Track Road to the Greville Road Interchange. Designation 110 which applies to SH1 ties in with designation 111 at the Greville Road Interchange, extending southwards to the Auckland Harbour Bridge.

There are a number of designated local roads administered by Auckland Transport through or adjoining this section of the route. These include Oteha Valley Road, McClymonts Road, Greville Road, Rosedale Road and Constellation Drive.

In addition, the following designations are located in proximity to the SH1 corridor through the southern section of the environment:

- 'Albany Bus Station' designation (reference 163) located to the west of motorway between Oteha Valley Road and McClymonts Road;
- Watercare services limited 'water supply purposes' designation (reference 105) located to the west of SH1 and adjacent to Spencer Road and Corinthian Drive;
- the NZTA 'State Highway 17' designation (reference 112) at the Greville Road Interchange;
- Auckland Regional Council 'Refuge Disposal' designation (reference 116) to the east of the SH1 between Greville Road and Rosedale Road;
- Watercare Services Limited 'wastewater treatment plant odour buffer' designation (reference 163) located along SH1 where it crosses the Rosedale oxidation ponds;
- Watercare Services Limited 'wastewater treatment plant' designation (reference 164) to the east and west of where SH1 passes the Rosedale oxidation ponds;
- North Shore City Council 'Constellation Bus Station' designation (reference 161) to the south of Constellation Drive and east of SH1;
- Transit New Zealand 'Constellation Drive Station' designation (170) to the south of Constellation Drive and east of SH1; and
- the NZTA 'North Shore Busway' designation (reference 169) extends as far as Constellation Drive on the eastern side of SH1.

2.2.5 Freshwater Catchments

The existing SH1 corridor between Oteha Valley Road and Constellation Station passes through the upper reaches of the Lucas Creek catchment, as depicted in Figure 2.3 above.

The Lucas Creek (stream) is 16.3 kilometres long with a contributing catchment of approximately 600 hectares. The stream flows approximately northeast-southwest and discharges into the low energy Lucas Creek (estuary), along with streams from eight other stormwater catchments, which in turn discharge into the Upper Waitemata Harbour. Flooding issues have been identified through hydraulic modelling, overland flow path assessment as well as from historic information available through previous catchment management plans and community feedback.

2.2.6 Landscape

The landscape of the southern segment comprises flat broad valleys inter-fingered with narrow lower ridges. The landscape is defined by Albany Basin and the Spencer Road ridgeline to north and the Sunset Road ridgeline and Rosedale Oxidation ponds to the south. The landscape character of this section of the NBE corridor is highly modified given the presence of the existing motorway and commercial, industrial and residential development. Refer Figure 2.7.

Figure 2.7: View from motorway looking north over the Rosedale Ponds

2.2.7 Ground Conditions & Geologic Constraints

The geology of this area comprises Waitemata Group with alluvial soils infilling low laying areas (refer to the maps within the Interpretive Geotechnical Report attached as Appendix C within Volume 3 (Part B) of the SAR for further details of the geology along the NBE alignment).

Slope instability is the major geologic constraint in the southern part of the environment (refer to the instability hazard plans which relate geology, topography and mapped instability features within the Geotechnical Interpretive Report).

Waitemata Group materials generally stand at slopes commonly adopted for engineering works (around 3hor:1ver within residual soils) and many areas are underlain by deep residually weathered soils. Rock joints, defects and clay seams are known to exist and pose a risk to large cuts. Many gullies are infilled with weak slope debris, requiring careful engineering where embankments encroach over these areas.

The main geologic constraints along the NBE are the potential instability of the alluvial soil when loaded by embankment or retained fills, and settlement under imposed loads.

3. Current Transport Conditions

An analysis of the current transport conditions along the SH1 corridor between the Central Business District (CBD) and Silverdale Interchange (including Interchanges along SH1 and main adjacent road links) has been undertaken to provide an understanding of transportation trends and current transport conditions of relevance to the NBE project. This has involved examination of transport data (including traffic flow, travel time and crash data), review of previous transport studies, and analysis of a range of outputs from the base year transport model used to forecast future transport demand as part of this NBE project. Further details of the traffic model are contained in the Transport Modelling Report in Appendix D within Volume 3 (Part B) of the SAR.

3.1 Overview

In general, traffic currently flows satisfactorily on SH1 north of the Greville Road Interchange. South of Greville Road to the AHB, there is often extensive congestion and delays at morning (AM) and evening (PM) peak times (Mondays to Fridays). This is despite the relatively recent introduction of ramp signalling at motorway interchanges to help smooth the flow of traffic on SH1.

During the AM peak period, the volume of traffic southbound along SH1 consistently exceeds capacity, often resulting in traffic queues on SH1 in excess of ten kilometres. From approximately 6:30am, vehicles queue north of Esmonde Road, with the tail of the queue usually extending to Upper Harbour Highway, and often as far north as Greville Road. Queuing on SH1 clearly affects the capacity of all southbound motorway on ramps, and queues frequently form on the local road network surrounding SH1 interchanges. Vehicles can queue for substantial periods of time on motorway on ramps and local roads, before they reach SH1 itself. Bus services operating between Albany and Auckland's CBD are affected by queuing at the Upper Harbour Highway Interchange and on SH1 north of this interchange.

During the PM peak period, northbound traffic queues are particularly evident between Northcote Road and Tristram Avenue interchanges, and at the Greville Road interchange. Southbound queuing between Esmonde Road and the AHB is often evident during the PM peak period. Bus services operating between Auckland's CBD and Albany are at times affected by queuing at the Greville Road interchange. Queuing on the northbound motorway on ramps is not as evident during the PM peak period as the majority of traffic joins SH1 south of the AHB. Southbound bus services are affected by queuing between Esmonde Road and the AHB. The Oteha Valley Road to Silverdale section of motorway rarely gets congested in the PM peak period; although the SH1 northbound off ramp at Silverdale experiences considerable traffic congestion which affects the operation of bus services between Auckland's CBD and the Hibiscus Coast area. Despite metered signals at the exit, traffic queuing on the off ramp often extends onto SH1 impeding SH1 northbound flows.

Over the past few years investment in the Northern Busway, and efforts to improve bus and transit lanes in other parts of the North Shore, have resulted in a significant increase in the proportion of trips made by bus. Not only has the number of bus users across the Harbour Bridge improved significantly during this time, but there has been a decline in the number of cars crossing the bridge: freeing up space so everyone's trip is faster and more reliable.

Recent figures indicate that almost 12,000 out of the 29,000 people crossing the bridge in the morning peak period are now travelling by bus (i.e. almost 41 percent of all people use the bus). This figure represents a significant increase in bus mode split compared to 2004 (which had roughly 5,000 out of 27,000 (18.5 percent)) of people crossing the bridge at peak times by bus.

3.2 Traffic Flows

Data collected by the NZTA[3] shows that during the period 2006 to 2010 daily traffic flows along the SH1 corridor between the CBD and Silverdale Interchange have generally increased. The greatest increase in traffic flows has taken place between the Oteha Valley Road and Silverdale Interchange. There has been a slight reduction in traffic flows over the Auckland Harbour Bridge (refer to the transport data in Appendix E of Volume 3 (Part B) of the SAR for further details).

Current AM and PM peak hour and daily traffic flows on SH1 between the Silverdale Interchange and Upper Harbour Highway Interchange are summarised in Table 3.1 below. Daily flows between Upper Harbour Highway and Greville Road are generally over double the flows between Oteha Valley Road and Silverdale. It should be noted that due to 'peak spreading' (i.e. when journeys are delayed or started earlier to avoid the main peak hour) the peak period often extends from approximately 6:30am until as late as 10:00am and from approximately 3:30pm until 7:00pm.

Table 3.1: Current Traffic Flows on SH1 between Silverdale and Upper Harbour Highway

Section of SH1	Northbound			Southbound		
	AM Peak Hour	PM Peak Hour	Daily	AM Peak Hour	PM Peak Hour	Daily
Silverdale Interchange to Oteha Valley Road	1,000	2,500	21,000	2,200	1,200	21,000
Oteha Valley Road to Greville Road Interchange	1,400	2,000	28,000	2,700	2,000	27,000
Greville Road Interchange to Upper Harbour Highway Interchange	2,800	4,200	45,000	3,000	3,000	43,000

3.3 Traffic Speeds and Delays

Based on surveys undertaken annually by Beca for the NZTA, peak period, peak direction traffic speeds are generally lower than peak period, counter-peak direction traffic speeds between the Silverdale and Tristram Avenue Interchanges (refer to the average travel times and speed summary in Table 3.2).

[3] Published in the NZTA State Highway Traffic Data Booklet (2006-2010)

Table 3.2: Average Travel times and speeds on SH1 (Silverdale to Tristram Avenue)

Metric	Northbound			Southbound		
	AM Peak Hour	Inter-peak Period	PM Peak Hour	AM Peak Hour	Inter-peak Period	PM Peak Hour
Travel Time (sec)	632	604	933	2882	920	926
Average Speed (km)	88	92	59	19	60[4]	60

Based on (2011) surveyed traffic speeds along SH1 between Oteha Valley Road and Fanshawe Street (for car traffic in the AM peak, PM peak and inter-peak periods (by direction)) there are currently few delays experienced along the SH1 corridor north of Greville Road. Significant delays are experienced on SH1 south of the Upper Harbour Highway Interchange to the CBD in both the AM and PM peaks (refer to Appendix E within Volume 3 (Part B) of the SAR for graphs of travel speeds between Silverdale and Fanshawe Street).

3.4 Traffic Levels of Service

Outputs from the transport model used for this study indicate that SH1 (between intersections on the NBE corridor) currently operate with free flow or reasonably free-flowing traffic at 'Level of Service' (LOS) A or B north of Oteha Valley Road at all times during the day. Between the Interchanges of Oteha Valley Road and Upper Harbour Highway, SH1 operates at a lower LOS throughout the day, due to the volume of traffic which using the network, as set out below:

- the Oteha Valley Road Interchange itself operates with either an unstable flow, or has a flow breakdown (LOS E or F) in both the AM and PM peak periods;
- the northbound section from Greville Road to the Oteha Valley Road Interchange off ramp either operates with a stable flow or approaches an unstable flow (LOS C or D) in both the AM and PM peak periods; and
- the section between Greville Road and Upper Harbour Highway currently operates with either an unstable flow, or has a flow breakdown (LOS E or F) (southbound in the AM peak and northbound in the PM peak).

3.5 Traffic Volume to Capacity Ratios

Outputs from the transport model indicate that SH1 (within the NBE corridor) generally operates with available capacity (i.e. volume to capacity (V/C) ratio of less than 0.8) along SH1 in both directions in both the AM and PM peaks. One exception to this is the stretch of SH1 between Greville Road Interchange and Upper Harbour

[4] Off-peak delays occurred due to works associated with the construction of the NZTA Victoria Park Tunnel project

Highway Interchange, which is approaching or has reached capacity (i.e. V/C ratio of between 0.8 and 1.0) southbound in the AM peak and northbound in the PM peak. During the inter peak all sections of SH1 operate with capacity (i.e. V/C ratio below 0.8).

3.6 Bus Patronage

The current Northern Busway (and associated services) is widely acknowledged to have generated a significant modal shift to public transport. The Northern Express bus passenger numbers for the twelve months to September 2011 totalled more than two million. Northern Express bus service carried 2,153,830 passenger trips for the 12-months period, 272,958 more passengers or 14.5 percent more trips than the same period for 2010 (refer Figure 3.3). This compares to an annual growth in bus passenger trips of around of 6,059,096 (or 9.8 percent more passenger trips) in the Auckland Region (including the Northern Express passenger trips) in the same period.

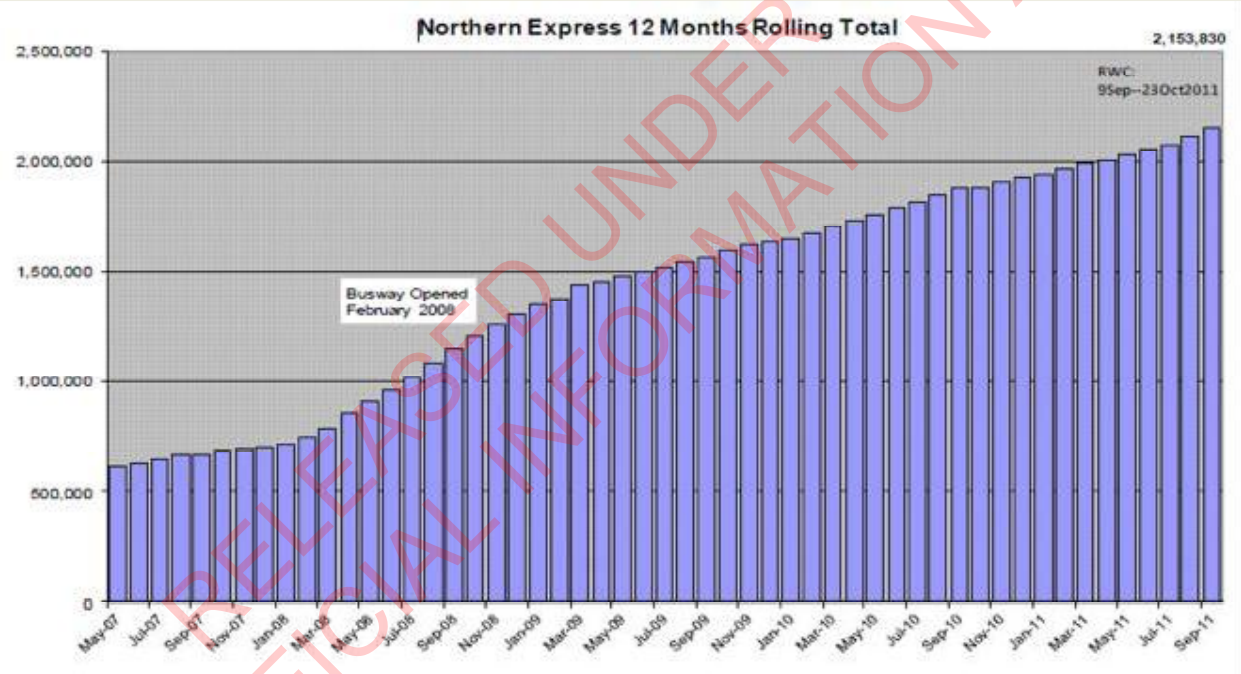


Figure 3.3: Northern Express Patronage (May 2007-Septmeber 2011)[5]

3.7 Bus Operations

The Northern Busway currently operates with Stations (north to south) at Albany, Constellation, Sunnynook, Smales Farm and Akoranga.

[5] Graph sourced from: *Statistics Report, Auckland Transport, September 2011*

A broad hierarchy of services operate in North Auckland consisting of 'express' services which use the Busway for all of their journey, other express services which use the Busway for or part of their journey, and 'local' bus services which connect or 'feed' into the express services at Busway stations. Interchange between Busway and other bus services takes place mainly at Albany, Constellation and Smales Farm stations.

The majority of bus services utilising the Busway are north to south services operating between the CBD (Britomart) and Albany Bus Station, though some other north-south services use part or all of the Busway, and a limited number of other (east-west) services use part of the Busway.

The most frequent bus service using this route is the Northern Express, which operates between Auckland's CBD and Albany. There are approximately 230 Northern Express services per day arriving at or departing from Albany Bus Station.

Other north-south services operating on the Northern Busway south of Constellation station are as follows:

- Services between the Hibiscus Coast and Auckland (hourly off-peak and via Flat Bush, more frequent at peak times and some via the motorway) – approximately 50 buses per day (i.e. services 893/895/896/898/899).

- Weekday peak period only services between Long Bay and Auckland / Newmarket – approximately 20 buses per day (i.e. service 86X/881).

- Bus Service 962 which operates between Albany Bus Station and Newmarket via Auckland CBD – approximately 10 buses per day.

A number of other services also utilise the Busway between Constellation and Smales Farm station (e.g. east-west services between New Lynn and Takapuna via Greenhithe), or between Smales Farm station and Akoranga station (e.g. north-south services between Castor Bay and Auckland CBD).

At peak times (Monday to Friday) a number of additional services use the Busway. The majority of these additional services are north-south services to/from Auckland CBD (e.g. services between Greenhithe / Browns Bay and Auckland CBD (Mayoral Drive / Wellesley Street / Albert Street)).

The operation of the Northern Busway is currently affected by the limited capacity that exists at the Busway stations and traffic congestion that occurs at the southern end of the Busway in the vicinity of Onewa Road. Metrics on the operational performance (level of service / volume to capacity ratio) obtained from the traffic model do not fully reflect the current situation well, particularly in the vicinity of Busway Stations, and are therefore not included in this report.

Bus services operating on SH1 also experience some delays at peak times between the Oteha Valley Road and Upper Harbour Highway Interchanges due to traffic congestion. This is despite the existence of shoulder bus lanes along much of this length.

Further details of current bus services operating in the Albany area are contained in the Albany Station Bus Service Review attached as Appendix F within Volume 3 (Part B) of the SAR.

3.7 Busway Maintenance

The operation of the busway is currently managed by Auckland Transport, with Maintenance carried out by NZTA through the Auckland Motorway Alliance (AMA). Maintenance activities include sweeping, graffiti removal and painting, and these are all carried out after 11pm when buses are not running.

3.8 Crash History

Cash data extracted from the Crash Analysis System (CAS) demonstrates that a total of 1,346 accidents were recorded along SH1 between the AHB and the Silverdale Interchange for the period January 2006 to December 2010 (the most recent five year period available). In addition, there were a further 371 crashes recorded at the seven interchanges along this section of the SH1 corridor. Of the 1,346 crashes recorded a total of 272 were injury crashes, one of which was fatal, twelve resulting in serious injuries and 259 with minor injuries (refer to Appendix E) within Volume 3 (Part B) of the SAR.

The Northern Busway between Upper Harbour Highway Interchange and Esmonde Road Interchange opened in late 2008. In the five years prior to the opening (November 2004 to October 2008, inclusive) there were eight crashes involving a bus on SH1 between these two interchanges. One minor injury crash resulted, with the remaining crashes being non-injury (refer Table 3.4).

Table 3.4: Crashes Involving Buses on SH1 between Upper Harbour Highway and Esmonde Road Interchanges

Date	Number of crashes	Bus at Fault	Injury
2003 (November and December)	0	0	0
2004	2	1	0
2005	1	1	0
2006	1	1	1
2007	2	2	0
2008 (January to October)	1	0	0
Total over five year period	**8**	**5**	**1**

Since the offline Busway opened between Upper Harbour Highway Interchange and Esmonde Road Interchange there have been no reported crashes on the Northern Busway. However, there have been four non-injury crashes on this section of SH1 since the opening in November 2008 (reported and recorded in CAS from November 2008 to July 2011), with the bus being at fault in three of these. The four crashes all occurred during 2010 in the southbound direction of SH1 at approximately the following locations:

- 200m south of Upper Harbour Highway On-ramp Southbound;
- 250m south of the Constellation Drive Overbridge;

- At the intersection of SH1 with the Tristram Southbound Off-ramp; and
- 20m south of the Northcote Road On-ramp Southbound.

In the five year period between January 2006 and December 2010, inclusive there have been no crashes in either direction on SH1 between Silverdale Interchange and Oteha Valley Road Interchange. In the same five year period, between Oteha Valley Road Interchange and Upper Harbour Highway Interchange there have been two crashes involving buses, with the bus being at fault in one of these crashes. The details of these crashes are as follows:

- 2008, 500m south of the Greville Road Overbridge; and
- 2010, on SH1 at the intersection with Greville Road On-ramp Northbound.

The available crash history indicates that the provision of the Northern Busway to Upper Harbour Highway has not resulted in a significant reduction in the number of bus crashes on SH1. In addition, there have only been 2 bus crashes between Silverdale and Upper Harbour Highway in the last 5 year period. Therefore, any accident savings associated with the provision of the busway are likely to be negligible.

4. Future Strategic Issues and Transport Conditions

This chapter provides an outline of the future strategic issues and transportation conditions to which the NBE relates.

4.1 Overview

Increased population and employment growth is forecast for North Auckland to 2050[6] and will place increasing pressure on the transport network. This growth is planned to be accommodated within the Metropolitan Urban Limits (MUL) in the areas of Albany, East Coast Bays, Orewa and Silverdale. It is widely recognised in strategic planning documents that future growth needs to be supported by public transport infrastructure and associated enhancements to public transport services in order for increased travel demand generated by this additional growth to be met. In relation to North Auckland (i.e. the former North Shore and Rodney Districts) the NBE is identified as a key project to support increased travel demand generated by future growth.

Transport forecasts for SH1 show a trend toward increasing congestion along SH1 with implications for travel time and trip reliability for private vehicles, public transport and freight (refer section 4.3). Northern Busway Patronage figures (refer figure 3.3 in Section 3.6) indicate a trend toward increasing demand for public transport. It is recognised that the NBE would potentially reduce vehicle trips on SH1 (compared to a scenario without the NBE) and support the predicted increased demand for public transport in North Auckland. In doing so the NBE would improve travel time and trip reliability for all vehicles.

In addition, population and employment growth in North Auckland is increasingly placing pressure on available development land. There are currently pressures to rationalise the existing state highway designations and release surplus land. Much of the currently designated land within the SH1 corridor, and potentially additional land, is required to accommodate a future extension of the Northern Busway. It is therefore recognised that in order to provide for the future construction and operation of the NBE there is a need to fully investigate and understand the land requirements.

4.2 Strategic Planning

The current strategic direction for both urban growth and transport in the North Auckland Region is set out in statutory planning documents such as the *Auckland Regional Growth Strategy 1999* (ARGS) and the *Auckland Regional Policy Statement* (as amended by Plan Change 6[7]) (ARPS) and the strategies and plans prepared by the

[6] "*Projections suggest that by 2050, the region could be home to between 1.6 and 2.2 million people, depending on the growth rate over this period. This is an average increase of around 20,000 people per annum and could lead to a doubling of the population in 50-60 years*" (Auckland Regional Growth Strategy, 1999)

[7] Plan Change 6 places further emphasis on the integration of land use and transport planning and is currently in the process of being made operative.

former Auckland Regional Council (ARC), Auckland Regional Transport Authority (ARTA), North Shore City Council (NSCC) and Rodney District Council (RDC). In addition, Auckland Council has released a Draft Auckland Plan and is working on other associated strategies and plans which set out the strategic direction for urban growth and transportation in the Auckland Region.[8]

4.2.1 Urban Growth

The ARGS (produced as a requirement of the Local Government Act 1974 and detailed in the "Growing Smarter" document) recognises the need to strengthen the region's transport system (with these systems playing an important role in shaping land use). It sets out a 50 year concept for sustainable growth in the population of the Auckland Region from 1.2 million in 1999 to 2.0 million people by 2050. This concept for growth includes the development of intensive sub-regional centres in Albany and Orewa.

The ARPS (which gives effect to the ARGS in accordance with the Local Government (Auckland) Amendment Act 2004)) sets out the strategic direction for the Auckland Region. It seeks to contain growth within defined urban limits and achieve a compact form comprising a network of urban centres and corridors. The ARPS puts in place policy for promoting the sustainable management of the Auckland Region's resources, and in this regard sets out where growth can occur and confines growth within the identified MUL.

The allocation of future growth in North Auckland (North Shore and Rodney) is set out in the *Northern and Western Sectors Agreement* 2001 (the Agreement). The Agreement identifies capacity for 231,000 more people in these areas by 2050. This equates to population growth of 120,000 for North Shore City and population growth of 111,000 for the Rodney District.

To accommodate a projected additional 13,000 to 19,500 dwellings in the North Shore in the next 20 years, the *North Shore City District Plan* focuses on new growth in both built-up and peripheral areas. This includes 3,000 - 4,000 new dwellings in Albany and 2,500 - 4,500 in Okura/ Long Bay. Significant population and employment growth is anticipated for Albany as a result of its development as a sub-regional centre.

A significant increase in population is also forecast in the former Rodney District with much of the capacity spread across the primary growth and employment areas of Orewa, Orewa West and Silverdale. In order to manage growth in Rodney District, the *Auckland Council District Plan (Rodney Section), 2011* (RDP) identifies 1,379 hectares of land zoned "Future Urban" in which new development will ultimately occur. These zones were derived from the Council's structure plans.[9]

The *Draft Auckland Plan* generally supports the continuation of the current strategic direction to urban growth as set out in the aforementioned planning documents. It sets out a vision for a quality, compact city where growth of people and jobs is directed into centres and along main arterial routes. Growth is identified as being confined within a Rural Urban Boundary (similar to the MUL). Albany is identified as 'Metropolitan' centre for growth and has being prioritised for development through the period 2012 to 2032. Silverdale and Orewa are identified as 'town' centres, with development prioritised for the period 2012 to 2022. It is envisaged that

[8] Consultation has been undertaken on the Draft Auckland Plan. The Auckland Plan is expected to be released in early 2012.

[9] The population growth capacities identified in the Regional Growth Strategy and the Northern and Western Sectors Agreement also came from the structure plans being based on the land identified as suitable for future growth. There is therefore a match between land identified for growth and growth projections.

Metropolitan centres would reach a gross average density of 40-100 dwellings per hectare and town centres 20-60+ dwellings per hectare. Albany and Silverdale are also identified as key employment areas with Albany forming part of the Upper harbour and Albany innovation hub.

4.2.2 Transportation

An efficient transport system is identified within the ARGS as "*vital to the prosperity of the Auckland Region and to the well-being of Aucklanders.*" Access and transport efficiency improvements; increased efficiency in the use of natural and physical resources; and improved opportunities for business and employment are included in the desired regional outcomes identified within the ARGS.

The ARPS seeks to "develop and manage the region's transport system in a manner that supports urban development and land use intensification" and to "achieve a high level of mobility and accessibility within the region that provides for the integrated, responsive, sustainable, safe, affordable and efficient movement of goods and people."

The Auckland Regional Land Transport Strategy 2010 (ARLTS), Auckland Transport Plan, 2009 (ATP) and Public Transport Network Plan, 2010 (PTNP) all identify a rapid transit network (RTN) between Albany and Orewa as a key component of a future passenger transport network within the Auckland Region. The ARLTS sets out a target for extension of the RTN from Constellation Station to Redvale in the period 2021-2030 and from Redvale to Orewa in the period 2031-2040. The Draft Auckland Plan signals an extension to the Northern Busway between Constellation Station and Silverdale in the period 2021-2030.

4.3 Future Transport Conditions

Traffic modelling forecasts traffic volumes to increase significantly between 2011 and 2041. The predicted increases are due to planned growth in the Silverdale and Orewa areas, Albany and Long Bay. This growth is to be supported by planned widening of SH1 between Upper Harbour Highway and Greville Road, completion of the Western Ring Route (including the SH1 to SH18 motorway to motorway interchange) and completion of the Puhoi to Wellsford Road of National Significance. Additionally, traffic congestion at the SH1 / Upper Harbour Highway intersection in the PM peak (including along Constellation Drive) is predicted to worsen due to the increased capacity of the recently completed Hobsonville deviation which will bring additional vehicle trips through this Interchange, rather than along other previously utilised route alternatives. Increased congestion at the intersection is anticipated to cause greater delays to bus movements between Constellation and Albany.

The increase in traffic will further exacerbate the levels of congestion and delay experienced by all traffic as outlined in Chapter 3. The expected future transportation conditions are summarised below and described in full in the Transport Modelling Report attached as Appendix D to Volume 3 (Part B) of the SAR. The Transport Modelling Report also contains details of the assumptions made in the forecasts. These include completion of the following key transport projects:

- SH1 Wainui interchange (by 2016);
- SH1 Victoria Park Tunnel (currently under construction);

- Penlink (by 2026);
- SH1 Widening to three lanes in each direction between Upper Harbour Highway Interchange and Greville Road Interchange (by 2026);
- SH18 – SH1 Motorway to Motorway Link (by 2026);
- SH1 Puhoi to Wellsford (by 2041);
- SH1 Waitemata Harbour Crossing (by 2041);
- Integrated public transport ticketing and fares (by 2016);
- Hibiscus Coast Busway Station site (by 2016); and
- Extension to Albany Park and Ride station facilities (by 2016).

The future bus network has been assumed to be as defined in the current Auckland Region Public Transport Network Plan (PTNP) for the Auckland region. An additional service was assumed to operate between Orewa and Albany via SH1. The service would operate every 15 minutes in the AM and PM peak and every 30 minutes in the inter-peak, accessing a future Hibiscus Coast Busway Station (at the Silverdale Interchange), Albany Station, Massey University Campus, and Albany Village.

4.3.1 Traffic Flows

Peak traffic volumes are forecast to increase significantly within the northern part of SH1 between 2011 and 2041. Predicted increases in traffic on SH1 between Redvale and Oteha Valley Road (Albany) between 2011 and 2041 in the AM and PM peak (two hour) periods are as follows:

- Northbound AM – 2,200 to 5,800 vehicles (160%);
- Northbound PM – 7,700 to 10,300 vehicles (30%);
- Southbound AM – 4,500 to 5,700 vehicles (30%); and
- Southbound PM – 2,300 to 6,300 vehicles (170%).

There are also large increases in traffic volumes predicted between the Greville Road Interchange and the Upper Harbour Highway Interchange with predicted increases between 2011 and 2041 in the AM and PM peak (two hour) periods as follows:

- Northbound AM – 6,000 to 10,000 vehicles (70%);
- Northbound PM – 4,800 to 7,800 vehicles (60%);
- Southbound AM – 7,200 to 10,200 vehicles (40%); and
- Southbound PM – 6,300 to 10,200 vehicles (60%).

Smaller increases in traffic volumes are predicted on SH1 south of the Upper Harbour Highway Interchange as the road network is currently close to capacity and no additional capacity has been assumed to be provided (apart from the Additional Waitemata Harbour Crossing in 2041).

4.3.2 Car Journey Times

Increased traffic flows are predicted to result in increases in car journey time over the next 30 years along some parts of SH1 within the Project corridor. Between the Silverdale and future Penlink Interchange, car journey times are predicted to increase by around one minute. Between Redvale and Oteha Valley Road car journey times are predicted to increase by around 9 minutes. The Greville Road to Upper Harbour Highway section of SH1 is predicted to experience increased car travel times of around one minute through to 2016. If this section of SH1 is widened to three lanes (assumed by 2016) this will be followed by a reduction in car journey times (to below 2011 journey times) through to 2041. Table 4.1 summarises the car journey times suggested by modelling along the corridor through to 2041 for the AM peak and PM peak.

Table 4.1: Forecast average car journey times along SH1 (2011-2041)

Journey	Average journey time (minutes)			
	2011	2016	2026	2041
AM Peak, Southbound				
Orewa – Silverdale	2.7	2.7	2.7	2.7
Silverdale – Redvale	2.4	2.4	3.2	3.4
Redvale – Oteha Valley Road	3.9	3.9	6.4	12.6
Oteha Valley Road – Greville Road	1.0	1.1	1.6	3.1
Greville Road – Upper Harbour Highway[10]	2.0	3.0	1.4	1.4
Upper Harbour Highway – Fanshawe Street	14.8	19.1	21.3	20.8
PM peak, Northbound				
Fanshawe Street – Upper Harbour Highway	9.7	13.6	16.2	17.2
Upper Harbour Highway – Greville Road	3.0	5.4	3.9	3.5
Greville Road – Oteha Valley Road	0.9	1.0	2.4	3.9
Oteha Valley Road – Redvale	3.9	3.9	7.2	17.5
Redvale – Silverdale	2.5	2.5	3.4	3.4
Silverdale – Orewa	2.7	2.7	2.7	2.8

[10] Assumes three laning of SH1 by 2016.

4.3.3 Traffic Delays

Some delays are expected along SH1 between the Upper Harbour Highway Interchange and Orewa through to 2041 in both the AM and PM peak periods. While there are some delays forecast for the inter-peak period, these are much lower than those predicted for the peak periods (refer to the Traffic Modelling Report attached as Appendix D within Volume 3 (Part B) of the SAR for further details).

4.3.4 Traffic Level of Service

The LOS for traffic is predicted to significantly worsen on SH1 within the Project Corridor to 2041, mainly at peak times, although there is some LOS deterioration also predicted to occur in the inter-peak period. Based on projected traffic volume increases, a number of sections of SH1 are predicted to operate with either an unstable flow or with flow breakdown (LOS E or F) in 2041. This includes the northbound section of SH1 between the Redvale and Silverdale Interchanges in the PM peak period.

4.3.5 Traffic Volume to Capacity (V/C) Ratios

The V/C ratios on SH1 are predicted to worsen between 2011 and 2041. A number of sections of SH1 within the Project Corridor are predicted to approach capacity (i.e. a V/C ratio of 0.8 or higher) by 2041. In particular, the points of congestion are forecast to be between:

- Upper Harbour Highway and Greville Road – northbound in the AM peak (over 1.0);
- Greville Road and Upper Harbour Highway – in both directions and in both peaks (0.8-1.0); and
- Oteha Valley Road and Silverdale – in the AM (southbound) and PM (northbound) peaks (0.8-1.0).

4.3.6 Bus Patronage

Bus patronage is forecast to increase along all sections of SH1 south of Silverdale including the existing Busway between 2011 and 2041 (in all time periods). Between Silverdale and Albany patronage is predicted to increase by up to 180 percent in the southbound AM peak period and by up to 200 percent in the northbound PM peak (two hour period) between 2016 and 2041. Between Albany and Constellation stations, patronage is forecast to increase by up to 150 percent in the southbound AM peak period and by up to 340 percent in the northbound PM peak period to 2041. This is due to increasing traffic congestion and as a consequence of assumed improvements in bus service provision. Further details of the predicted changes in bus patronage, and the reasons for this, are given in the graphs in the Traffic Modelling Report attached as Appendix D to Volume 3 (Part B) of the SAR.

4.3.7 Bus Operations

In the future the Hibiscus Coast Busway Station will be established at Silverdale with a QTN or RTN connection between the station and Orewa. Stations may also be established at Greville Road or Rosedale Road, and Redvale to service the Busway (although there is not yet commitment to providing any of these stations).[11]

Some Northern Busway services are planned to be extended to the Hibiscus Coast Busway Station once the proposed Bus Station and associated Park and Ride site is opened. A QTN is proposed on Oteha Valley Road (linking Albany Centre with the East Coast Bays area), between Albany and Birkenhead (via Albany Highway/Glenfield Road), and between Albany and Takapuna (via Albany Highway/Wairau Road/Taharoto Road) in the future (refer Figure 4.1). In addition a RTN is proposed on Upper Harbour Highway to connect with the existing Constellation Drive Station.

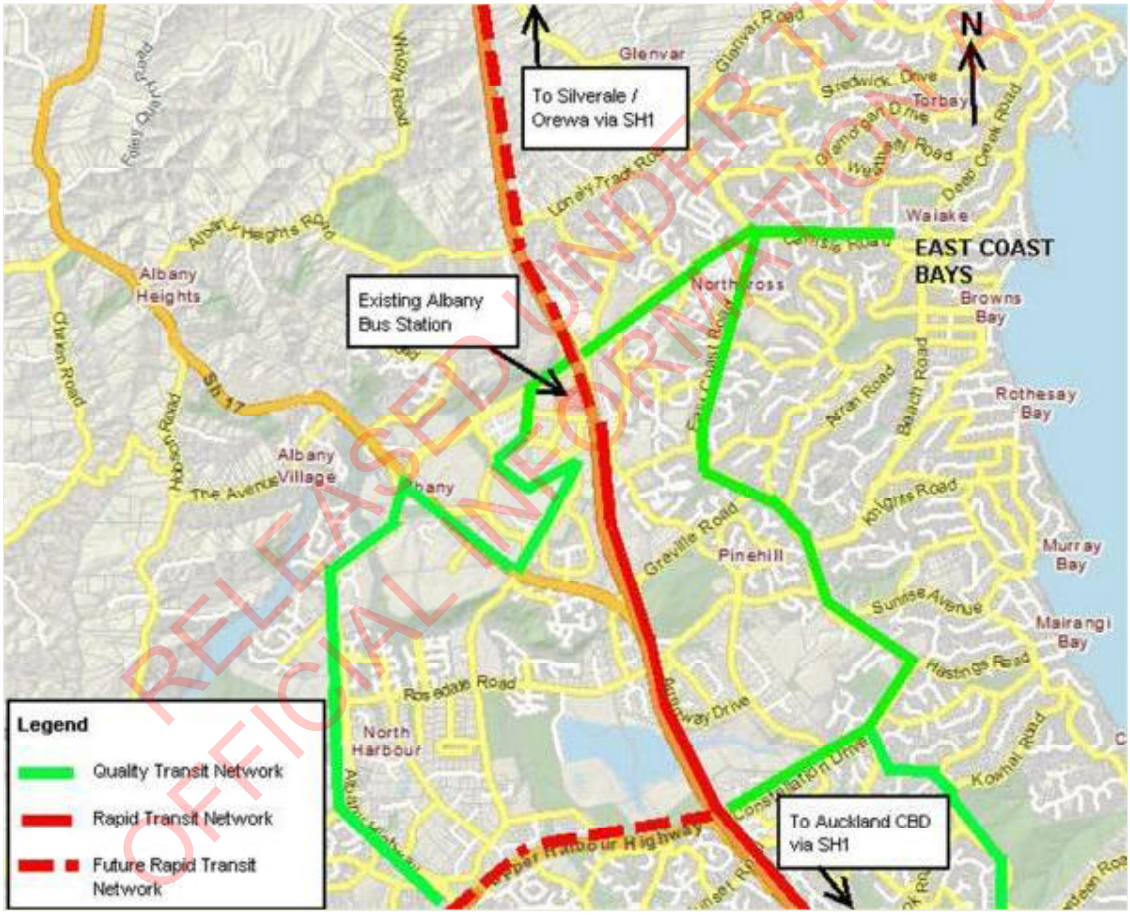


Figure 4.1 Proposed Rapid, Quality and Local Transit Network in the Albany Area [12]

[11] The *Northern Busway Stations Study*, prepared by Beca (for Auckland Transport) contemporaneously with this Project considered the feasibility of additional stations at Redvale, Greville Road and Rosedale from a patronage perspective. The relevant findings of this Stations Study to developing the scheme design of the recommended option are summarised in Section 7.2 of this report.

Other potential changes to the Bus Network servicing the Albany Station are proposed in the near future. The general aim is to simplify the bus network in the North Shore area and operate more frequent services on a smaller number of routes. A network of QTN services (focussed on Oteha Valley Road towards the East Coast Bays and on Albany Highway) is expected to be formed and serve as feeder routes to the Northern Express Rapid Transit Services (RTN) operating on the Northern Busway. Refer to the Albany Bus Station Service Review attached as Appendix F within Volume 3 (Part B) of the SAR.

Increased traffic congestion (as described above) is predicted to adversely affect bus travel times in the future. In the period 2016 and 2041 there is predicted to be an increase in bus travel time between Silverdale Interchange and Upper Harbour Highway Interchange of approximately eleven minutes in the AM peak period southbound, and 17.5 minutes in the PM peak period northbound. The section of SH1 where the greatest increase in travel times is forecast to occur is between the Oteha Valley Road and future Penlink Interchange. Refer to Table 4.2 for further details of the predicted changes in the average bus travel times.

Table 4.2 Forecast bus travel times along corridor (2016-2041)

	AM Peak			Inter-Peak			PM Peak		
	2016	2026	2041	2016	2026	2041	2016	2026	2041
Southbound									
Silverdale to Redvale	2.4	3.2	3.4	2.3	3.2	3.3	2.3	3.2	3.2
Redvale to Oteha Valley Road	6.5	11.0	17.6	6.9	8.9	13.6	7.2	7.5	7.5
Oteha Valley Road to Greville Road	2.2	3.1	5.4	3.1	7.8	10.5	4.1	10.9	13.3
Greville Road to Upper Harbour Highway	3.4	1.9	1.9	2.5	1.9	1.9	2.2	1.9	1.9
Upper Harbour Highway to Fanshawe Street	10.6	10.6	19.3	10.6	10.6	17.8	10.6	10.6	17.9
Northbound									
Fanshawe Street to Upper Harbour Highway	9.5	9.5	18.7	9.5	9.5	18.7	9.7	9.6	20.1
Upper Harbour Highway to Greville Road	5.2	5.3	8.1	5.7	6.6	7.9	8.7	8.4	8.8
Greville Road to Oteha Valley Road	1.5	1.7	2.6	1.5	2.0	2.3	1.6	3.0	4.5
Oteha Valley Road to Redvale	4.7	4.9	4.9	4.7	4.9	6.0	4.7	8.0	18.3
Redvale to Silverdale	2.4	3.4	3.4	2.4	3.4	3.4	2.5	3.4	3.4

4.4 Land Use Pressures

The NZTA designations (described in Section 2.1.3 and Section 2.2.4) for motorway and state highway purposes (relating to the NBE corridor) include 163 properties, a number of which are privately owned. The NZTA designations are wider than the area currently occupied by the SH1 carriageway, offering the opportunity for an extension to the Northern Busway to be accommodated (or partly accommodated) within existing designation footprint. That said the following factors limit the ability for the Northern Busway to be fully accommodated within the NZTA designations:

[12] Source:http://maps.aucklandcouncil.govt.nz/AucklandCouncilViewer

- a need to provide sufficient space to accommodate potential and proposed future state highway and Auckland Council corridor projects as discussed in Chapter 1;

- difficult geotechnical conditions along the NBE route which require some batter slopes to be of a reduced gradient to that which would be achievable under good geotechnical conditions (refer to Section 8.2); and

- a need for new and existing stormwater treatment devices (refer to Section 8.4) and other mitigation measures to be accommodated within the NBE footprint.

Some of the land beyond the NZTA designation that may be necessary to accommodate an extension to the Busway is undeveloped. Demand by developers for land has significantly reduced in recent years and this is not likely to change in the short term. However, it is expected that in the longer term demand by developers for this land will increase, particularly if projected growth forecasts are realised.

From a strategic perspective it is recognised that given the potential future land use pressure there is a need to fully understand what land is required for the NBE. Where this land is not currently designated this needs to be protected by way of designation. Conversely, where there is privately owned land that is currently designated and is no longer necessary for motorway purposes or to accommodate an extension to the Northern Busway, the designation on this land could be uplifted in accordance with the Section 182 process under the Resource Management Act 1991(RMA). Additionally, there is potential for the NZTA to rationalise its land holdings in this corridor and sell any land that is unnecessary for motorway, state highway or Northern Busway purposes.

5. Options Evaluation

Stage one of the NBE project was completed in April 2011, with the findings presented within the *Northern Busway Extension Scoping*, prepared by Beca. As outlined in the Scoping Report attached as Appendix A, within Volume 3 (Part A) of the SAR, Stage 1 of the NBE project resulted in the identification of three short list options (i.e. option 1 – west alignment, option 2 – east alignment, and option 3 – east/west alignment).

The Scheme Development and Assessment (Stage 2) of the NBE project (to which this report relates) has involved design and investigation of these short list options to enable the identification of a recommended option. The investigations and design development undertaken during Stage 2 of the NBE project are summarised below, followed by a detailed description of the logic and decision making process used to evaluate the short list options and arrive at a recommended option.

5.1 Design Development

Design development included requirements for stormwater infrastructure and more detailed analysis of connections required in the vicinity of the existing Albany Station (in response to stakeholder concerns). Only limited design development was undertaken during Stage 2 of the NBE project because the level of the design undertaken during Stage 1 of the NBE project was largely sufficient to inform the identification of a recommended option and an adequate footprint to accommodate this option. For details of the resulting option designs, refer to the Short List Option drawings within Volume 2 of the SAR.

5.2 Investigations

The following investigation and reporting was carried out to inform the options evaluation undertaken during this stage of the NBE project:

- environmental specialists undertook investigations into the ecological, landscape and visual and noise and vibration effects of each short list (refer to the AEE attached as Appendix B within Volume 3 (Part A) of the SAR);
- Social and Environmental Screening worksheets were completed (refer to Appendix G within Volume 3 (Part B) of the SAR);
- a property cost estimate was prepared for each short list option;
- a cost estimate (to option estimate (OE) level) was prepared for each short list option;
- scheme benefits were predicted and economic evaluation was undertaken (refer to the Economic Appraisal of Short List Options attached as Appendix H within Volume 3 (Part B) of the SAR);
- a designation footprint sufficient to accommodate construction requirements of each short list option was identified; and

- Auckland Transport commissioned a Station Study, contemporaneously with this Project to determine if there was likely to be sufficient catchment to support any additional stations on the NBE at Rosedale Road, Greville Road and Rosedale (refer Chapter 6 for summary of study).

5.3 Shortlist Evaluation Criteria

The long list evaluation criteria outlined in the Scoping Report were reviewed and amended to reflect the additional information available at the shortlisting stage (i.e. the additional design information, costing and environmental assessments). This resulted in four evaluation criteria being identified – Integration, Social, Environmental, and Economic (outlined in Table 5.1 below).

The criteria did not include the entire list of project objectives as all the shortlisted options had met the objectives during the long list evaluation. However, it was acknowledged that there was the ability to distinguish further in terms of "integration" criteria. In particular this category recognised the ability to:

- stage works;
- connect with existing and proposed transport services; and
- achieve land use and transport integration.

A further integration criteria relating to a potential station at Greville Road was also added to reflect the draft Auckland Transport Station Study finding that the future catchment could potentially support an additional Busway station at Greville Road.

The social and environmental criteria differentiated between effects as a result of short term construction, those that were long term or operational. In addition a criteria dealing with safety was also added as a social criteria.

An additional property cost criteria was added to the economic criteria.

Table 5.1: Short List Evaluation Criteria

Evaluation Criteria	Performance Indicator
Integration	Integrates well with existing transportation infrastructure at Albany
	Ease with which option can be staged
	Integrates well with preferred site for additional station at Greville Road
	Integrates well existing and proposed transport services
	Provides for a future proofed corridor
	Provides for integration of land use and transport

Social	Degree of operational noise and vibration effects
	Degree of effects on cultural and historic heritage
	Degree of effects on visual amenity
	Degree of construction impact on the network
	Degree of construction impact on amenity
	Degree of effects on property and land use from land take
	Degree of effects on road safety
Environmental	Degree of effects on terrestrial ecology during both construction and operation
	Degree of effects on freshwater ecology during construction
	Degree of long term effects on freshwater ecology
Economic	Scheme Benefits
	Construction Cost
	Property Cost
	Operational Cost

5.4 Evaluation of Short List Options

In order to evaluate the short list options the NBE route was split into two sections as follows:

- **Northern Section:** Oteha Valley Road Interchange to Silverdale Interchange; and
- **Southern Section**: Constellation Station to Oteha Valley Road Interchange.

This split was made to capture key elements of differentiation. For example, the ecological effects of an option were confined to the northern section of the route. This provided the opportunity for a recommended option to comprise a northern segment of one option combined with a southern segment of another option. This also recognised the ability to stage works north and south of Albany.

Each of the short list options were evaluated in a workshop by the Project Working Group and a team of technical experts. The evaluation involved the scoring of options against the criteria above using the evaluation rating system set out in Table 5.2 below. The evaluation was then challenged in a further workshop involving

the project Challenge Team. The scoring adopted at each of these workshops is attached as Appendix H within Volume 3 (Part B) of the SAR and summarised below.

Table 5.2: Evaluation Scoring System

Evaluation	Rating
Strongly supports criteria / significant positive effect	√√
Supports criteria / potential positive effect	√
Neutral to this criteria / minor effect	0
Does not support this criteria / adverse effect requiring mitigation	X
Strongly does not support this criteria / significant adverse effect with limited opportunity to mitigate	XX

5.4.1 Integration Criteria

Table 5.3 sets out the scoring of options against the integration criteria for the northern section. Overall, all options perform similarly in terms of these criteria, with there being only a subtle difference in relation to future proofing of the corridor. In this regard option 1 being aligned to the west of SH1 can be more easily accommodated around the planned Penlink connection than the other options which join from the east. Options 2 and 3 to the east have been designed to pass beneath the Penlink ramps. Direct Busway connections to Penlink itself can be accommodated, although these will be more complex with an eastern Busway alignment.

Table 5.3: Integration Criteria Scoring (northern segment)

Performance Indicator	Option 1	Option 2	Option 3
Ease with which option can be staged	√	√	√
Integrates well with existing and proposed transport services	√	√	√
Provides for a future proofed corridor	√	0	0
Provides for integration of land use and transport	√	√	√

Table 5.4 sets out the scoring of options against the integration criteria for the southern section. The evaluation largely resulted in only subtle differences between the options, with the points of difference as follows:

- The main difference between options relates to the degree to which the options integrate with Albany Station. Options on the west at Albany (options 1 and 3) would connect directly to the existing Albany station, whereas option 2 (to the east) would either: (1) connect to the Albany Station via a bus only bridge (potentially with a pedestrian connection from the Park and Ride across to platforms on the eastern side of SH1); or (2) connect into Oteha Valley Road, and/or McClymonts Road to serve the existing Albany Station.

- On the basis that Albany Station would likely form a first stage of the NBE the western aligned options (1 and 3) were slightly favoured in terms of staging as they easily enabled termination of a first stage at Albany Station.

- The Northern Busway Stations Study, prepared by Beca contemporaneously with this project identified Greville Road as a potential additional station location to service the NBE (refer study summary in Chapter 6). A site for this station would be most easily accommodated east of SH1, thus options 2 and 3 were viewed slightly more favourably in terms of the ease with which they could be integrated with a proposed station at Greville Road.

- Option 2 being entirely eastern aligned provides for a less constrained western side of SH1, enabling greater flexibility for future changes within the SH1 corridor. Eastern options at Greville Road (2 and 3) better future proof for a proposed SH17 to SH1 interchange upgrade because they are aligned to the east at Greville Road. That said it was recognised that all options have been designed to accommodate planned future changes to SH1 and have been future proofed so as not to preclude rail (as discussed in Chapter 1).

Table 5.4: Integration Criteria Scoring (southern segment)

Performance Indicator	Option 1	Option 2	Option 3
Integrates well with existing transportation infrastructure at Albany	√	X	√
Ease with which option can be staged	√√	√	√√
Integrates well with preferred site for additional station at Greville Road	0	√	√
Integrates well will existing and proposed transport services	√	√	√
Provides for a future proofed corridor	0	√	√
Provides for integration of land use and transport	√	√	√

5.4.2 Social Criteria

Table 5.5 sets out the scoring of options against the social criteria for the northern section. The key conclusions drawn from this evaluation are as follows:

- The operational noise and vibration effects of all options have been assessed as barely distinguishable based on the limited volume of buses on the Busway (relative to the traffic flow on the adjacent motorway) and the high level of ambient noise.

- All options will result in a similar degree of adverse visual effects that will require mitigation. For Option 1 these are primarily associated with a long elevated bridge leading to a large cut in the escarpment as the western option rises up towards Lonely Track Road. The adverse visual effects of Option 2 are more localised due to the potential for the Busway to be located closer to the adjacent retirement village than the existing off ramp. Option 3 involves extensive bridging and earthworks associated with the approach to the elevated crossing of SH1 and extensive embankment as the Busway rejoins the eastern side of SH1 which will have adverse visual effects that can be mitigated.

- The effect of construction on amenity is likely to be greater for option 2, as the option is aligned in closer proximity to residential areas than options 1 and 3 (i.e. Fairview Heights Retirement Village).

- The social effects of land take are generally similar for all options, although options 2 and 3 affect more residential property in the vicinity of Fairview Heights. The majority of the route is rurally zoned and therefore the impact on the fringes of these large landholdings has less of an effect (in terms of lost development potential) than an equivalent area of residential land use.

Table 5.5: Social Criteria Scoring (northern segment)

Performance Indicator	Option 1	Option 2	Option 3
Degree of operational noise and vibration effects	0	0	0
Degree of effects on cultural and historic heritage	0	0	0
Degree of effects on visual amenity	X	X	X
Degree of construction impact on the network	X	0	X
Degree of construction impact on amenity	0	X	0
Degree of effects on property and land use from land take	0/ X	X	X
Degree of effects on road safety	√√	√√	√√

Table 5.6 sets out the scoring of options against the social criteria for the southern section. Overall option 1 scores most favourably against these criteria. The key conclusions drawn from this evaluation are as follows:

- The operational noise and vibration effects of all options have been assessed as barely distinguishable based on the limited volume of buses on the Busway (relative to the traffic flow on the adjacent motorway) and the high level of ambient noise.

- Option 1 being aligned to the west of SH1 (separate from residential properties) reduces the potential for long term adverse effects on visual amenity. Option 2 and 3 being aligned to the east of SH1 in close proximity to residential properties (at McClymonts Road) cannot avoid localised visual effects, but all effects can be mitigated.

- The social effects of land take are similar for all options. Option 1 affects several large commercial properties near Albany. Option 2 affects a portion of a large, undeveloped residential site on Spencer Road (to the east of the Greville Road off ramp). Option 3 is more contained within the current designation footprint through this section of the route, compared to others.

- Construction of the cut and cover tunnel for option 3, would have significant adverse effect on the operation of SH1. Options 1, involving an expansive bridge crossing of SH1 would also impact on SH1 operation. Option 2, in only requiring a short bridge across SH1 would cause least disruption.

- The effect of construction on amenity is likely to be greater for option 2, as the option is aligned in closer proximity to residential areas than options 1 and 3 (e.g. Spencer Road).

- Whilst it is recognised that the degree to which an option provides for safety could be differentiated by the number of bridge crossing piers, all options have been scored the same in terms of safety, as it has been assumed that any potential safety issues would be fully mitigated through design.

Table 5.6: Social Criteria Scoring (southern segment)

Performance Indicator	Option 1	Option 2	Option 3
Degree of operational noise and vibration effects	0	0	0
Degree of effects on cultural and historic heritage	0	0	0
Degree of effects on visual amenity	0	X	0/ X
Degree of construction impact on the network	X	0	XX
Degree of construction impact on amenity	0	X	0
Degree of effects on property and land use from land take	X	X	0/ X
Degree of effects on road safety	√√	√√	√√

5.4.3 Environmental Criteria

Table 5.7 set out the scoring of options against the environmental criteria for the northern section. Overall option 2 scores most favourably against these criteria. In this regard the following is of note:

- While a viaduct is proposed over the Lucas Creek Bush West, options 1 and 3 would result in the loss of approximately 7% of this Site of Ecological Significance (ARC and NSCC, 2005).[13] This would be difficult to mitigate by way of post-construction restorative re-vegetation.

- Option 1 also has a significant adverse effect on 4.23ha of bush west of Lonely Track Road which acts as a buffer to adjacent areas of vegetation which were recommended for protection as sites of special wildlife interest due to their value as habitat for forest gecko and other native fauna[14].

- Option 2 was assessed as having less than minor ecological effects with the lowest extent of native bush clearance. The option 2 alignment would entirely avoid the Site of Ecological Significance located at Lucas Creek and other areas of native forest that are of moderate-high ecological value.

- Option 1 will be constructed parallel to Wrights Stream as it travels northwards from Lonely Track Road to an arm of the Okura Estuary which flows to the Long Bay and Okura Marine Reserve. As such, the risk of adverse effects from accidental discharges during construction is highest with Option 1.

Table 5.7: Environmental Criteria Scoring (northern segment)

Performance Indicator	Option 1	Option 2	Option 3
Degree of effects on terrestrial ecology	XX	0	XX
Degree of effects on freshwater ecology during construction	0/ X	0	0
Degree of long term effects on freshwater ecology	X	0	0

Table 5.8 set out the scoring of options against the environmental criteria for the southern section. None of the options are expected to result in any more than minor effects on terrestrial or freshwater ecology, because there are no significant ecological areas through the southern segment.

[13] The Site of Ecological Significance at Lucas Creek Bush West is considered to meet the test for protection as a "matter of national significance" in accordance with Section 6(c) of the RMA, given it high ecological values and it's classification both locally and regionally as a significant ecological area (refer to Section 9.4).

[14] ARC & NSCC (2005) *North Shore City Ecological Survey – A survey of sites of ecological significance in Tamaki and Rodney Ecological Districts*.

Table 5.8: Environmental Criteria Scoring (southern segment)

Performance Indicator	Option 1	Option 2	Option 3
Degree of effects on terrestrial ecology	0	0	0
Degree of effects on freshwater ecology during construction	0	0	0
Degree of long term effects on freshwater ecology	0	0	0

5.4.4 Economic Criteria

Table 5.9 set out the cost of the options in terms of the economic criteria for the northern segment. All options have relatively similar construction, property and operational costs through the northern segment of the Busway project corridor.

Table 5.9: Economic Criteria (northern segment)[15]

Performance Indicator	Option 1	Option 2	Option 3
Scheme Benefits	✓✓	✓✓	✓✓
Construction Cost (estimated)	$300m	$300m	$300m
Property Cost (estimated)	$13m	$9m	$10m
Operational Cost (estimated)	$10m	$10m	$10m

Table 5.10 sets out the cost of options in terms of the economic criteria for the southern segment. Overall option 2 has the least cost, having a lower construction, property and operational cost to option 3 and lower property cost compared to option 1. In this regard the following key points are of note:

- All options deliver broadly the same scheme benefits in terms of savings in travel time, vehicle operating costs and benefits for public transport users.
- The cost to construct option 3 over this section of the route is approximately 50 percent (or $100m) more than options 1 and 2 because it includes a tunnel crossing of SH1 (a bridged alternative is not possible at this location due to gradient constraints).

[15] The construction costs have been rounded to the nearest $100 million and the property and operational costs to the nearest $1 million. The operational cost provided is the net present value. It comprises 75 percent of the total operational cost on the basis that this section of the NBE is approximately three quarters of the total length.

- The property costs of option 1 and option 3 are approximately twice as much as option 2 as there is a need to acquire parts of high value commercial properties to the west of SH1 between Upper Harbour Highway and Albany Station.

- The operation cost of option 3 is approximately twice as much as options 1 and 2 because it includes a short length of tunnel, requiring plant maintenance and operational costs associated with lighting and ventilation equipment.

Table 5.10: Economic Criteria (southern segment)[16]

Performance Indicator	Option 1	Option 2	Option 3
Scheme Benefits	✓✓	✓✓	✓✓
Construction Cost (estimated)	$200m	$200m	$300m
Property Cost (estimated)	$10m	$5m	$12m
Operational Cost (estimated)	$3m	$3m	$6m

5.4.5 Summary

The above assessment demonstrates some subtle differences between the options.

5.4.5.1 Northern Segment

Through the northern segment:

- options 1 and 3 would have significant adverse effects on areas of high ecological value with limited ability to mitigate these effects and a higher degree of consenting risk;

- option 2 avoids all areas of high ecological value and adverse effects on areas of moderate or low ecological value can be mitigated or avoided through design; and

- all options will have adverse visual and landscape effects (in different locations) which will require mitigation primarily between Oteha Valley and Lonely Track Roads.

[16] The construction costs have been rounded to the nearest $100 million and the property and operational costs to the nearest $1 million. The operational cost provided is the net present value. It comprises 25 percent of the total operational cost on the basis that this section of the NBE is approximately one quarters of the total length.

5.4.5.2 Southern Segment

Through the southern segment:

- option 2 being entirely eastern aligned provides for a less constrained western side of SH1, enabling the greatest degree of flexibility for future changes within corridor;
- options 1 and 3 provide a more favourable integration with existing infrastructure at Albany Station. These options provide a direct tie in to the existing facilities because of their western alignment at Albany. However, the long term connection to the north will have greater impacts (as noted above);
- option 1 a relatively higher property cost on account of a need to acquire parts of a number of high value properties to the west of SH1 (though property costs are small in overall terms compared to construction costs);
- option 2 would have localised visual impact on residential properties to the east of SH1 which would require mitigation (albeit at a cost);
- option 3 would cost approximately 35 percent more than the other options between Constellation and Oteha Valley Road to deliver broadly the same scheme economic benefits as options 1 and 2 on account of the tunnel crossing of SH1; and
- option 3 would result in significant disruption to the operation of SH1 during construction because it includes a tunnel to cross SH1.

While option 2 would protect land required for an entirely eastern Busway alignment it is noted that Option 3 could be accommodated without requiring additional land (beyond the existing SH1and Albany Bus Station designations) between Upper Harbour Highway and Albany Station. As such, a western connection to Albany Station could be accommodated without the need to designate additional land.

5.5 Sensitivity Analysis

Sensitivity analysis has been carried out on the results of the options evaluation. This has involved three different scenarios[17]:

- **Scenario 1:** Integration criteria have twice the weight than the social criteria and the environmental criteria;

[17] It is noted that the economic criteria do not factor in this analysis as these criteria were not assessed comparatively but rather assigned dollar values to provide an indication of the variance in cost across the options assessed.

- **Scenario 2**: Social criteria have twice the weight than the integration criteria and the environmental criteria; and

- **Scenario 3**: Environmental criteria have twice the weight as the integration criteria and the social criteria.

5.5.1 Northern Segment

In analysing the northern segment (refer Figure 5.1) option 2 scores as the better option under all scenarios (including the un-weighted scenario). Increasing the weight of the integration criteria (scenario 1) and increasing the weight of the social criteria (scenario 2) makes little difference because the scoring of options against these criteria is relatively the same. The greatest difference between the options is apparent under scenario 3 where more weight is placed on the environmental criteria. This is on account of option 2 being score better than options 1 and 3 because it avoids the site of ecological significance.

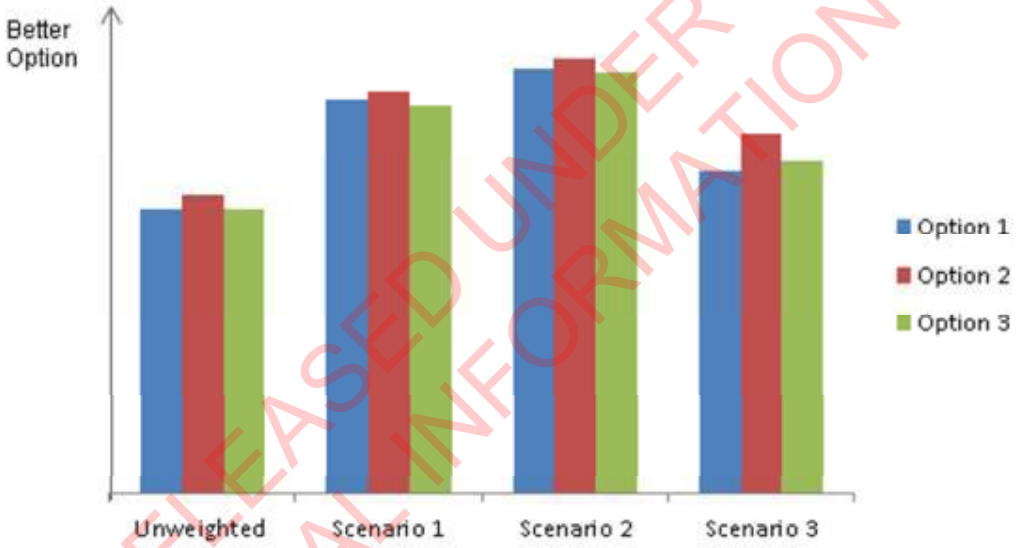


Figure 5.1: Comparison of Sensitivity Testing – northern segment

5.5.2 Southern Segment

In analysing the southern segment (refer Figure 5.2) option 2 is the least favourable option in all scenario (including the un-weighted scenario). Where the integration criteria are given more weight (scenario 1) option 1 and option 3 are the better options compared to option 2 because they provide a more direct connection to Albany Station. When the social criteria are weighted greater (scenario 2) option 1 is slightly better than options 2 and 3 on account of avoiding localised visual amenity impacts on residential properties. There is no change in the better option under scenario 3 when compared to the un-weighted option on account of there being no difference in the options from an ecological perspective through the southern segment.

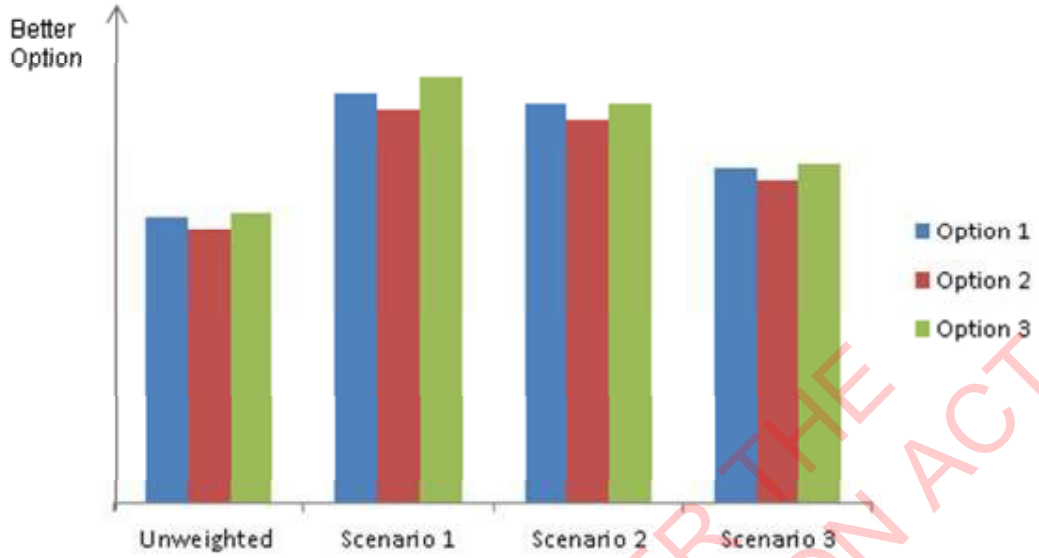


Figure 5.2: Comparison of Sensitivity Testing – southern segment

5.5.3 Overall Route

A comparison of the sensitivity analysis across the full extent of the NBE route is depicted by Figure 5.3. There is very little difference between the options in all scenarios. As can be expected for the reasons stated above:

- options 1 and 3 score marginally better when more weight is given to the intergration criteria (scenario 1);
- the differences between options is barely discernable when more weight is given to the social criteria (scenario 2); and
- option 2 is slightly more favourable when more weight is given to the environmental criteria (scenario 3).

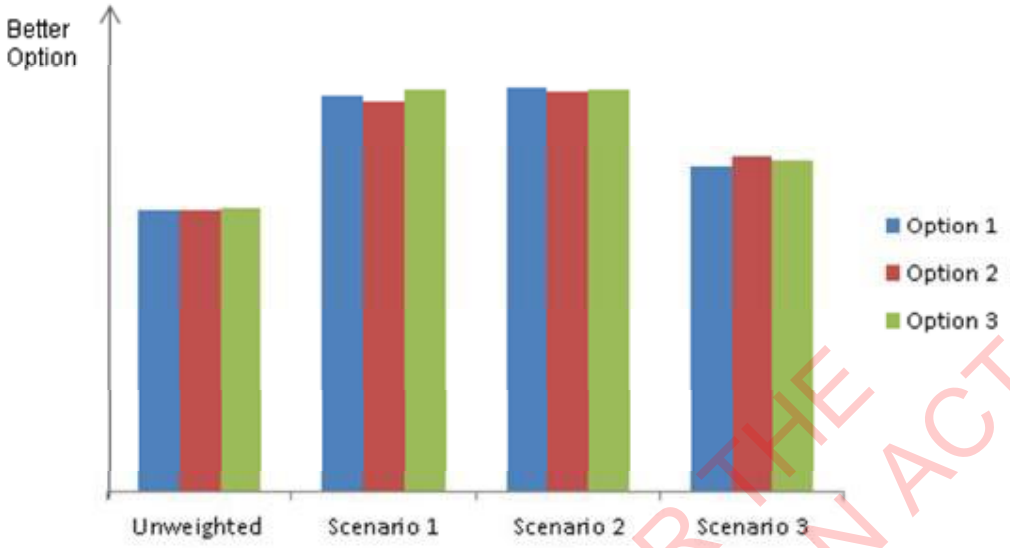


Figure 5.3: Comparison of Sensitivity Testing – full route length

5.6 Discussion

The evaluation (including the sensitivity analysis) does not point to one option being significantly differentiated from another. Through the northern segment option 2 is arguably the better option because it avoids a significant ecological area at the Lucas Creek West Bush. Option 2 is the least favoured through the southern segment from an integration perspective given that it does not directly connect to the existing Albany Station.

Throughout the options evaluation phase of the project Auckland Council and Auckland raised specific concerns in relation to the integration of the NBE with Albany Station. Refer to Section 7.1 and the Consultation Summary Report attached as Appendix J within Volume 3 (Part B) of the SAR). It was recognised that whilst these concerns were valid (with further investigation necessary to better understand how an eastern aligned option would integrate with Albany Station), they did not influence the extent of new designation required for the NBE, because a western aligned option connecting to Albany Station could be accommodated within current SH1 and Albany Station designations (meaning that designation of additional land would not be required).

In terms of the factors differentiating the options, the Site of Ecological significance at Lucas Creek West Bush meets the tests for protection as a "matter of national significance" in accordance with Section 6(c) of the RMA. It is appropriate to select an option that avoids significant adverse effects on this ecological area because any option that cannot avoid or mitigate such effects would be contrary to the purpose and principles of the Act and therefore difficult to consent.

It is recognised that the integration criteria are also a key differentiator between options (and in particular the integration with Albany Station). However, it is not considered to be appropriate to apply a stronger weighting to these criteria, because there are engineering and design solutions, as well as improvements that can be

made to bus routes servicing the Albany Station that would improve the ability for an eastern aligned NBE to integrate with the Albany Station.[18]

To avoid both the ecological and integration issues there is potential for a hybrid option to be developed that adopts the southern component of option 3 between Constellation Station and Albany Station, and the northern portion of option 2 between Albany Station and the Silverdale Interchange. A hybrid option would (similar to option 2) require a connection across SH1 at the Albany Station, meaning that the option would involve two crossings of SH1. Like option 3, the hybrid option would not provide for the same degree of flexibility for future changes in the SH1 corridor given that the option would switch from one side of SH1 to another. It would also be one of the higher cost options given that it involves two crossing of SH1 and is aligned west of SH1 through the Albany basin where land costs are understood to be high. The option would easily provide for a staged approached with the first stage terminating at the Albany Station and being accommodated within existing SH1 and Busway designations.

5.7 Recommended Option

The both the hybrid option and option 2 would similarly meet the project objectives (as set out in Chapter 1) and provide a long term solution to address the transportation problem and strategic issues set out in Chapter 4, whilst avoiding or mitigating adverse effects on the environment. That said, option 2 (the eastern aligned option) is recommended for an extension to the Northern Busway. The following points are of particular note in relation to this option:

- it avoids the Site of Ecological Significance at Lucas Creek West Bush, and adverse effects on other ecologically significant areas can be avoided or mitigated;
- while it will generate localised visual effects on some residential properties these can be adequately mitigated;
- it provides for a less constrained western side of SH1, enabling greater flexibility for future changes within SH1 corridor;
- it is comparatively one of the least expensive options, costing 20 percent less than option 3 (and the relatively the same as option 1) whilst offering broadly the same scheme economic benefits as the other options; and
- changes that can be made to the bus network serving the Albany Station, in combination with a good bus connection to Albany Station, will provide for integration with the current bus network and existing Albany Station (refer to the Albany Bus Station Bus Service Review attached as Appendix F within Volume 3 (Part B) of the SAR).

[18] Since completing options evaluation the Albany Station Bus Service Review (attached as Appendix F within Volume 3 (Part B) of the SAR (and summarised in Chapter 7)) has been undertaken by Beca. This study demonstrates that there are various options available to improve integration of an eastern aligned option with Albany Station.

6. Station Investigations

Two stations investigations have been undertaken by Beca, either as part of the NBE project or contemporaneously with the NBE Project (under the commission of Auckland Transport) as follows:

- The *Northern Busway Stations Study* (the Stations Study); and
- The *Albany Bus Station Bus Service Review.*

These investigations have informed the selection of a preferred option and are summarised below.

6.1 Northern Busway Stations Study

The *Northern Busway Stations Study* (the Stations Study) was undertaken by Beca for Auckland Transport, contemporaneously with the options evaluation phase of the NBE Project. The Stations Study considered the potential patronage that could be generated by each of these stations, to enable feasible station(s) to be included in the consideration of a preferred option during the short list option evaluation.

The Stations Study concluded that:

- The provision of a new Busway station at Redvale may encourage development in a form and location that is contrary to the strategic direction for growth within the Auckland Region, given its location outside of the MUL.
- An additional station between Albany and Constellation could be viable, with a station at Greville Road (either east or west of SH1) appearing more feasible than the Rosedale location because it serves both residential and employment land uses (rather than just employment).
- The viability of a new station at Greville Road is being dependent on the planned developments and future land use intensification taking place adjacent to the proposed Greville Road station location and improved access to/from the station to/ from the residential and employment walk-up catchment.
- The case for a Busway station at Greville Road could be strengthened by the provision of Park and Ride facilities, although any facility would serve a smaller catchment than the existing Park and Ride facilities at Constellation and Albany and would be contrary to Auckland Transport's general aim of encouraging more people to access Busway stations by feeder bus services.
- There does not appear to be case to provide a Busway station at both Greville Road and Rosedale Road.

The existing catchment figures upon which these conclusions are based are set out in Table 6.1 below.

Table 6.1: Potential Bus Station Catchment (Number of Residents)

Station	Walk – Up (0–1.2km)	Kiss and Ride/Cycle (1.2–3km)	Park & Ride (within 10 minute drive)
Greville Road	1100	10,100	15,400 (Exclusive users of this station)
Rosedale Road	630	11,200	13,400 (Exclusive users of this station)
Overlap Between Greville Road and Rosedale Road	180	6,400	30,900*
Overlap Between Greville Road and Existing Busway Stations	<10	7,500	Constellation – 10,200, Albany – 24,500*
Overlap Between Rosedale Road and Existing Busway Stations	0	7,300	Constellation – 16,800, Albany – 17,900*

* Numbers are not based on exclusive users and are comparisons of the total population living within a 10 minute journey of the two stations.

Based on the conclusions of the Stations Study, a station at Greville Road was considered as part of the options evaluation (refer Chapter 5) and is included in the Scheme Design (refer Chapter 8). Stations at Redvale and Rosedale have not been considered as part of this NBE study.[19]

6.2 Albany Bus Station Bus Service Review

The *Albany Bus Station Bus Service Review* attached as Appendix F within Volume 3 (Part B) of the SAR I was undertaken following the options evaluation process. It identifed the following options for the future Albany Station configuration:

- the provision of a pedestrian link between a new East side Bus Station and the existing (west side) Bus Station;
- the provision of a bus only road link between the east side Busway and existing West Side Bus Station (with no Bus Station on East Side);

[19] It is noted however that for the economic evaluation of the NBE Project new stations have been assumed to be provided at Rosedale Road, Greville Road and Redvale. This assumption was made early on in the Project prior to the completion of the Station Study. It is acknowledged that had the timing for completion of the Station Study been different the approach to the economic modelling would have been different.

- the provision of a bus only road link between the east side Busway and existing West Side Bus Station (with a new Bus Station on East side and no Bus Station on West Side); and

- the provision of a bus only road link between east side Busway and MyClymonts Road (with all buses using a new east side Bus Station).

These options require further consideration (as part of a later study) to enable the preferred option to be identified. However, the option of providing an Eastern Busway serving the existing Bus Station at Albany without a bus only link to the existing Bus Station (or equivalent road link) was rejected as it is inconsistent with the standard for a RTN. This is because it would require all buses that needed to serve Albany Bus Station to access or egress it via the Oteha Valley Road Interchange, which would incur a significant time penalty for buses (even if priority could be provided for buses at the Oteha Valley Road intersection).

7. Consultation

To provide for a robust solution to the future strategic issues and transportation conditions outlined in Chapter 4, and facilitate a full understanding of constraints and opportunities within the environment to which the NBE relates (as outlined in Chapter 2) the project team has engaged with key stakeholders (Auckland Council and Auckland Transport) throughout the NBE project. This consultation has occurred primarily via a Project Advisory Board (strategic matters) and a Project Working Group (integrated decision making on option development and evaluation).

In addition the NZTA commenced consultation with local Iwi (Hokai Nuku). Community consultation and consultation with affected land owners and other key stakeholders (e.g. Watercare) will be undertaken during the next project phase.

Full details of all consultation undertaken and feedback received during the course of this NBE project are provided within the Consultation Report attached as Appendix J within Volume 3 (Part B) of the SAR.

7.1 Auckland Council and Auckland Transport

The majority of the consultation with Auckland Council and Auckland Transport officers (i.e. Simon O'Connor, Darren Davis, Chris Smith, Anthony Blom, Anthony Cross and Daniel Newcombe) (the Stakeholders) was undertaken via a series of interactive workshops:

- **Issues and constraints workshop** – collective identification and review of issues, constraints and opportunities of specific relevance for the development of route options;
- **Validation of options evaluation framework** – involving discussion and agreement around the criteria that would be used to evaluate long list options;
- **Long list options evaluation** – involving evaluation of the long list of NBE options; and
- **Short list options evaluation** – involving evaluation of the short list of NBE options to assist in the identification of a recommended option.

In addition, meetings were held to discuss and get feedback on the recommended eastern aligned option and in particular understand any issues in relation to the integration of the recommended option with the Albany Station.

Throughout the options evaluation process the Stakeholders recognised a need to provide for the integration of the NBE with land use in accordance with current planning policies. At the time it was acknowledged that Auckland Council was currently reviewing future land use and areas of priority for urban growth through the spatial planning process. The Stakeholders agreed that land use intensification in Albany and Orewa would likely remain as part of the growth scenario under the developing Auckland Plan and therefore the NBE should support this growth. It was agreed that the potential for changes in land use policy would be dealt with through continued consultation with Auckland Council officers working on the Auckland Plan.

The Stakeholders saw the need to connect and integrate the extension to the Northern Busway with existing and future stations and bus services. They were of the view that it was particularly important for the NBE to be well integrated with the existing bus network which serves the existing Albany Station and its existing catchment area (given that the station would serve future high intensity growth within the Albany Metropolitan Centre). Despite there being an ability for eastern or western aligned options to connect to the Albany Station, the Stakeholders indicated a preference for a western alignment throughout the options evaluation process as this would more directly connect with Albany Station (without the need to cross SH1 to re-enter the Busway).

Following the selection of the eastern aligned option (for the reasons outlined in Chapter 5) and the completion of the Albany Bus Station Service Review (summarised in Chapter 6 and attached as Appendix F within Volume 3 (Part B) of the SAR) the Stakeholders developed a strong preference for a western option on the basis that the western alignment through the Albany Basin would not only better serve the Albany Station but also a proposed station at Greville Road (which would most likely be established on the western side of SH1) and would better support the future growth of the Albany Metropolitan Centre (which remains a Growth Centre within the Draft Auckland Plan). The specific issues that the Stakeholders have in relation to the eastern option are yet to be resolved and a meeting is proposed to discuss these issues prior to confirming the preferred option.

7.2 Local Iwi

Scott Wickman and Amanda Cosgrove from NZTA met with Hokai Nuku to inform local iwi and discuss engaging their services in a future cultural impact assessment. The meeting was attended by Mook Hohneck, Tame Te Rangi, Tracy Davis and Gena Moses-Te Kani for Hokai Nuku.

Through the Hokai Nuku iwi consultation forum, iwi representatives indicated their interest in on-going involvement in the project, particularly through the design and construction phases. NZTA agreed to further consultation in 2012, following a complete investigation and review by the NZTA Board in late 2011.

Hokai Nuku prepared a Cultural Impact Assessment which has been used to inform the Assessment of Environmental Effects attached as Appendix B within Volume 3 (Part A) of the SAR. No Waahi Tapu sites were identified as part of this assessment.

8. Recommended Option Description

The recommended option for an extension to the Northern Busway from Constellation Drive to Silverdale is option 2 which follows an alignment to the east of SH1. The recommended option has been developed in accordance with the Design Philosophy Statement attached as Appendix K within Volume 3 (Part B) of the SAR. This section provides a detailed description of the recommended option that has been used to determine the footprint necessary for protection, with a focus on design, constructability, and property requirements. The Scheme Drawings for the recommended option are attached within Volume 2 of the SAR.

8.1 Alignment Overview

At the northern extent of the Project corridor, the Busway alignment has been developed to integrate with the proposed Hibiscus Coast Busway Station. The current concept for the station would incorporate a realignment of Small Road so that the intersection of Small Road with State Highway 17 is further to the east. The Busway would then tie in directly with the bus station, with Small Road realigned to the south (east) as part of the Hibiscus Coast Busway Station Project.

The Busway would extend south from the Hibiscus Coast Busway Station on a slight embankment to run alongside the SH1 motorway corridor. While the vertical alignment of the Busway is generally consistent with SH1, there are areas where it will be above or below the existing motorway shoulder. This is the result of vertical geometry requirements to achieve a grade that would not preclude light rail should it be required in the future.

The Busway will pass beneath four existing bridge structures, each of which will require some form of reconstruction (refer Section 8.3). In addition, the construction of the Busway will require numerous cut slopes and fill embankments, with retaining walls provided where required. These are outlined in Section 8.2 below.

To the north of Bawden Road, the Busway alignment moves further east away from SH1 to accommodate the proposed future interchange for the Weiti Crossing (Penlink) connection to Whangaparaoa Peninsula. It is anticipated that the connection will be constructed prior to this stage of the Busway. Although the final layout is not confirmed at this stage, the Busway alignment has been developed to pass beneath the future ramp connections to the SH1 motorway. The design of the Busway does not provide for a connection to the Weiti Crossing. However, this could be achieved via a bridge structure within the designation footprint.

A weigh station for heavy vehicles can be accommodated on the eastern side of SH1 to the north of Bawden Road (ch 14300) and west of East Coast Road. This would enable overweight vehicles to be diverted away from the Harbour Bridge and onto the Western Ring Route. The Busway alignment has been developed to pass to the east of the weigh station.

Further south of Bawden Road, the alignment comes in close proximity to East Coast Road. It is anticipated that this can be accommodated without a realignment of East Coast Road. The recommended option incorporates a post and panel wall to avoid conflict with the road.

Just north of Awanohi Road the alignment passes over the Okura River, passing the Okura River Bush and continuing south to the Lonely Track Road East Bush. At the Lonely Track Road East Bush there are batter slopes associated with the Busway design which will necessitate the removal of some native vegetation from within the ecologically significant bush area, unless the extent of the batter slope is reduced through detailed design.

The Busway passes under Lonely Track Road and follows closely to the eastern side of SH1 on a large embankment. There is an existing stream in this location which will require realignment around the toe of the embankment, unless the extent of the embankment is reduced through the detailed design phase of the NBE project. Beyond this section the surrounding environment becomes more developed with residential housing giving way to more commercial development.

The alignment passes between the Oteha Valley Road southbound off ramp and Fairview Retirement Village on the eastern side of SH1. The design of the Busway has been developed to reduce (as far as practicably possible) adverse effects on visual amenity at the Retirement Village. In particular, the Busway will be cut down into an existing earth bund through this section, enabling existing vegetative screening to be retained on the eastern site of the bund (adjoining the residences). In addition, a wall will be established on top of the bund to further provide for visual screening. Refer to the cross sections within Volume 2 of the SAR.

South of the Retirement Village the Busway will cross over Lucas Creek and Oteha Valley Road on bridge structure, avoiding the site of ecological significance on the western side of SH1 at Lucas Creek West Bush. Bridge piers can be positioned so as to avoid the creek channel and span across the east and westbound carriageways of Oteha Valley Road.

Just south Oteha Valley Road on the eastern side of SH1 there is an opportunity to provide a bus station, which either fully replaces or is in addition to the existing Busway station at Albany (refer to the Albany Bus Station Bus Service Review attached as Appendix F within Volume 3 (Part B) of the SAR). A bus only road link from the Busway across the motorway to the Albany Station is located between Oteha Valley Road (refer Figure 8.1 below) and McClymonts Road.

Figure 8.1: Concept Drawing Showing Connection between the NBE and Albany Station

The alignment continues south to Greville Road beneath McClymonts Road on a series of cut and fill embankments and retaining walls. Retaining walls have been provided where the Busway passes in close proximity to residential properties and adjacent to the former Rosedale Landfill.

At the Greville Road interchange, the future upgrade of the interchange has been taken into account and there is the potential for the provision of a new station in this location. The Busway alignment has been positioned to the east to allow for the upgrade. A bridge structure will be provided over Greville Road, running adjacent to the southbound ramps.

A connection between the Busway and Greville Road has not been provided in this location, as few bus services currently join or leave SH1 at Greville Road, and it was assumed that this would not change in the future, with bus services more likely to use Oteha Valley Road and Constellation Drive once the NBE opens.

Between the Greville Road Interchange and Rosedale Road overbridge, a significant length of retaining wall either side of the Busway will minimise impacts on commercial development. A short bridge structure is provided over Rosedale Road, with the alignment generally following SH1 and avoiding the Turners Car Auction building at 9 Arrenway Drive, Rosedale. Refer to the cross sections within Volume 2 of the SAR.

The Busway crosses the oxidation ponds on embankment, before bridging Constellation Drive to tie in with the existing bus station on the southern side of the Upper Harbour Highway Intersection with Constellation Drive.

The alignment of the Busway does not preclude the future widening of SH1 between Constellation and Greville Road nor the future motorway to motorway connection between SH1 and SH18 at Upper Harbour Highway.

8.2 Geotechnical

The geotechnical design includes earthworks design recommendations to suit the underlying ground conditions, concept geotechnical design for bridges and retaining structures, and provides recommended allowances for ground improvements.

The mitigation of geologic constraints included a revision of the NBE alignment to reduce encroachment within higher risk areas, the evaluation and application of measures to address effects, and an assessment of project risks related to ground conditions to be included into the overall project cost estimate. A summary of the geotechnical design and mitigation of geologic constraints is provided below and discussed in more detail within the Interpretive Geotechnical Report attached as Appendix C to Volume 3 (Part B) of the SAR.

Within areas underlain by Northern Allochthon materials (Silverdale Interchange to approximately Awanohi Road), the NBE vertical alignment has been lifted to reduce encroachment into marginally stable cut slopes along the existing state highway corridor. New cuts are either retained with embedded retaining walls or are cut back at a slope that will increase the margin against instability relative to existing slopes. Larger retained fills comprise MSE walls where they are positioned over gently sloped ground (and are constructible), and embedded pile walls where global stability concerns may preclude a shallow founded retaining option. New bridges and modified bridge structures are supported on pile foundations, and abutments are retained with embedded pile retaining walls.

No wide scale treatment is proposed to improve the stability of a number of extensive existing cut slopes within Northern Allochthon materials, many of which have areas exhibiting some form of instability. We understand that these cuts were originally designed using an observational approach that, while endeavouring to provide a long-term stable slope, may not provide normal design margins against instability commonly adopted for the NZTA's projects. On-going maintenance is required to manage areas of instability on these cut slopes. In constructing the NBE it is proposed to only stabilise these slopes where they are located adjacent to the alignment of the Busway. This approach assumes that this original design basis remains acceptable to NZTA, including provision for on-going maintenance as currently undertaken for SH1. An effective treatment to improve the stability of these slopes, if required by NZTA, is to re-grade to a flatter slope. This would require an increase to the designation in these areas.

Within areas underlain by Waitemata Group materials earthworks are similar in form to those adopted elsewhere within the SH1 corridor, as encountered from approximately Awanohi Road to Upper Harbour Highway. Retained cuts generally comprise soil nail walls or bored pile retaining walls. Pile retaining walls have been adopted for higher retained cuts and where adjoining private properties could be adversely affected by ground movements associated due to the wall construction. Anchored walls can be designed to reduce such movements. Retained fills over gently sloped ground predominantly comprise MSE walls. Embedded pile

walls have been adopted where global stability concerns or constructability would preclude a shallow founded retaining option.

An allowance for undercutting or ground improvements has been made for embankments and retained fills over alluvial soils to address potential concerns over ground settlements, in particular where in close proximity to buildings or existing bridges.

Most of the embedded pile walls will require ground anchors for both strength and to reduce ground movements above and behind the retained face. Easements must be sought in a number of locations to allow ground anchors or soil nails to be installed beyond the proposed designation. These areas are most prevalent south of Oteha Valley Road. Where easements cannot be obtained via property negotiation then subterranean designations would have to be sought.

Drainage measures will be widely required to locally lower ground water levels below cut and fill slopes, and for natural slopes in close proximity to the NBE.

Proposed construction works will potentially induce various ground movements including settlement beneath fills due to loading, lateral movement and settlement behind retained cuts, settlement due to changes in groundwater levels behind cut slopes and retained cuts, and construction vibrations. The construction measures proposed allow for the mitigation of these effects on adjoining properties though will require careful consideration in future design stages.

8.3 Structural

The project would involve the construction of several new bridges to accommodate the Busway over local roads, water courses and interchanges. The Busway would also require alteration to four existing local road bridges that currently cross over SH1[20] (refer to the Structural Drawings within Volume 2 of the SAR).

The Busway configuration provides for two 3.5m lanes with 1.6m shoulders and allows for 0.9m for a TL5 barrier between the Busway and motorway. This configuration will be utilised for new bridges carrying the Busway and at existing underpasses.

8.3.1 Wilks Road

The existing Wilks Road overbridge comprises a four span structure, with the back spans open with 1-2.5 slopes. The abutments are supported on two 1.0 metre diameter columns with a high level retaining wall outside the footprint of the structure (Figure 8.2).

[20] It is noted that an opportunity exists to strengthen existing bridges as part of any works necessary to implement the NBE. That said detailed consideration and costing of bridge upgrades falls outside of the Project scope and has not been included as part of this NBE study.

The Busway can be accommodated beneath the existing eastern backspan, although localised shoulder narrowing would be required. The existing slope would need to be excavated and a new abutment, including an anchored contiguous bored pile wall, constructed behind the existing wall. The existing retaining wall at the front of the abutment will require extension downwards to the new carriageway level.

Figure 8.2: Wilks Road Overbridge

8.3.2 Bawden Road

The existing Bawden Road overbridge is a four span structure, skewed approximately 20 degrees to the new Busway alignment.

The eastern backspan is not sufficient to accommodate the proposed NBE carriageway and will require demolition and replacement. The replacement span could be designed to allow construction of full hard shoulders on the Busway.

8.3.3 Okura River Bridge

At Okura River, SH1 is carried over the river by a pair of three span precast concrete Super-T bridges. The new Busway would need to be supported on a separate structure to the east. This structure would be of a similar form to the existing bridges and no modification to the existing bridge sub-structure would be required. Construction can be undertaken without interference with the adjacent motorway.

8.3.4 Awanohi Road

SH1 is carried over Awanohi Road by a pair of single span bridges as an overpass. A new bridge would need to be provided to the east to carry the Busway and would also be a single span bridge to give a more open aspect to the structure. Construction can be undertaken without interference with the adjacent SH1. Partial demolition of the existing 45 degree MSE wingwalls to the east of SH1 will be required to accommodate the new structure.

8.3.5 Lonely Track Road

Lonely Track Road overbridge is a four span bridge with single column intermediate piers (Figure 8.3).

The eastern span is long enough to accommodate the new Busway carriageway without the need for shoulder narrowing. The abutment will require modification by excavation and progressive top down installation of a retaining wall in front of the existing piles.

Alteration to the abutment can be achieved without interference to the side road above.

Figure 8.3: Lonely Track Road Overbridge

8.3.6 McClymonts Road

SH1 currently passes beneath McClymonts Road. The McClymonts Road overbridge is a two span bridge, and a new span on the eastern side will be required to accommodate the Busway carriageway beneath.

The existing abutment and wingwalls will require demolition and replacement to provide an additional span of approximately 13 metres with a width of 11.5 metres to match the existing carriageway and footpaths.

8.3.7 New Viaducts

New viaducts are required to carry the Busway over the local roads at Oteha Valley Road, Greville Road, Rosedale Road and Constellation Drive as summarised in Table 8.1 below (refer to Figure 8.4 for typical detail). The bridges are expected to comprise pre-caste beam elements. Typical elements that are suitable would be Super-T type, of sizes ranging from 1025mm to 1525mm depth.

Table 8.1: Viaduct Configurations

Location	Number of Spans	Sketch Reference
Oteha Valley Road	10	SD-106
Greville Road	9	SD-108
Rosedale Road	1	SD-109
Rosedale (Ch 23620 to 23760)	4	SD-110
Constellation Drive	3	SD-111

The vertical alignment of the new Busway will be designed to provide 4.9m minimum clearance beneath the new viaducts in accordance with the Appendix A of the NZTA Bridge Manual or the equivalent headroom of the adjacent SH1 structure.[21]

Spans will be in the range of 24 – 35 metres with piers located in the median or central islands of carriageways. The transition to MSE wall embankments at the start and end of each structure will be dictated by the allowable height of each wall in these areas.

The side protection barriers on the ramp structures will comprise a concrete barrier (TL5) which provides both containment and a noise screen.

Figure 8.4: Typical Viaduct Formation

8.4 Stormwater

The treatment of quality and the control of quantity of stormwater runoff from the proposed extension of the Northern Busway will principally be undertaken by the use of wet ponds. These ponds will be located within either the existing designation or the new designation as part of the NBE project (refer to the Scheme Drawings

[21] Whilst the design shows a 4.9 metres clearance beneath new viaducts there is sufficient flexibility within the currently identified designation footprint to accommodate a 6.0 metre clearance should this be adopted as the preferred clearance at the detailed design stage.

in Volume 2 of the SAR). In total there are 24 ponds associated with the NBE, including 21 new ponds (one if which is to be relocated) and three extension to existing ponds. A number of culvert extensions are also proposed as part of the stormwater design.

The stormwater design (and ponds) accommodates both existing and future pavement areas. Ponds have been designed to attenuate stormwater runoff to pre-development flows allowing for future widening of the motorway and the additional busway footprint. Treatment has been calculated for the whole catchment, including the existing motorway.

The ponds will provide quality treatment and runoff storage from the new Busway through their normal storage of stormwater. Where ponds are not suitable because of the topography, or the existing motorway alignment constrains their use, roadside swales will be used as an alternative.

The use of ponds will provide three main functions as follows:

- reduction of the risk of flooding downstream of the new Busway associated with increased runoff from the catchment;
- provision of water quality treatment to any additional runoff and where possible treatment to runoff from the existing motorway where this is not already provided; and
- minimisation of any potential for downstream channel erosion resulting from additional runoff from the catchment.

Stormwater will be collected at the edge of the Busway and conveyed to the pond collection point in either swales or table drains where possible. If the available corridor is constrained then stormwater will be collected via cess pits and conveyed to the pond via a piped system.

The preliminary location and size of the proposed stormwater ponds have been designed in accordance with the Auckland Regional Council's Technical Publication 10, to treat one third of the two year frequency storm. In addition the ponds have been conservatively designed to ensure that both the peak two year and ten year discharge rates remain at their pre-development rates.

It is noted that where the NBE route passes through an existing flood plain (as is the case for the Dairy Stream), there will be a loss of flood storage within the catchment and consequential elevation of existing flood levels. Potential flooding issues associated with a loss of flood storage will be investigated at the detailed design phase.

8.5 Constructability

As part of the NBE project, the Fletcher Construction Company has undertaken a constructability review. Based on this review, this section of the report outlines the main requirements for constructing the NBE, and outlines some of the likely temporary traffic management required. The construction areas are indicated on the Scheme Drawings within Volume 2 of the SAR.

8.5.1 Land Requirement

In developing the Preliminary Land Requirement Plans and Schedule attached within Volume 2 of the SAR consideration has been given to the following aspects in regards to the construction requirements:

- contractor project office and amenity establishment;
- temporary erosion and sediment control (TP90);
- insitu material handling and disposal;
- material storage and aggregate stockpiling;
- crane and heavy plant access;
- potential lay down, precast and or concrete batching area; and
- access to work areas from SH1 and local Roads.

8.5.2 Construction Methodology

The area of land designated for the NBE needs to be sufficient to allow for the necessary construction activities. A high level assessment of likely construction activities has been undertaken to inform the project footprint (accordingly some of this land may only be required temporarily), with key construction elements identified below:

- **Extension of the Wilks Road and Bawden Road bridges:** this will require closure of the existing bridges during retrofitting, with detours required to divert traffic. In addition there may be a requirement for shoulder closure/ lane narrowing on SH1 (particularly at Bawden Road). This work would need to be staged so that construction of the bridges does not occur concurrently, enabling access over either the Wilks or Bawden Road Bridges to be maintained during the construction period.

- **Fill batter near East Coast Road (Ch 13500 to 13700):** The fill batter for the Busway carriageway extends out to the boundary of East Coast Road. This will require some temporary traffic management on East Coast Road to construct this section of work due to its proximity to the Road boundary. Construction should be able to occur from within the design footprint and therefore temporary traffic management is likely to require a shoulder closure only.

- **Retaining wall on the shoulder of East Coast Road (Ch 15100 to 15350)**: A relatively low retaining structure is required to be constructed to support the Busway carriageway and will likely be constructed as a keystone or MSE wall. In order to construct this section of works, temporary traffic management of East Coast Road will be required. This may require temporary widening of the opposite side of the road and shifting the traffic lanes over to create a work zone from which to access and build the structure (refer to Figure 8.5 below).

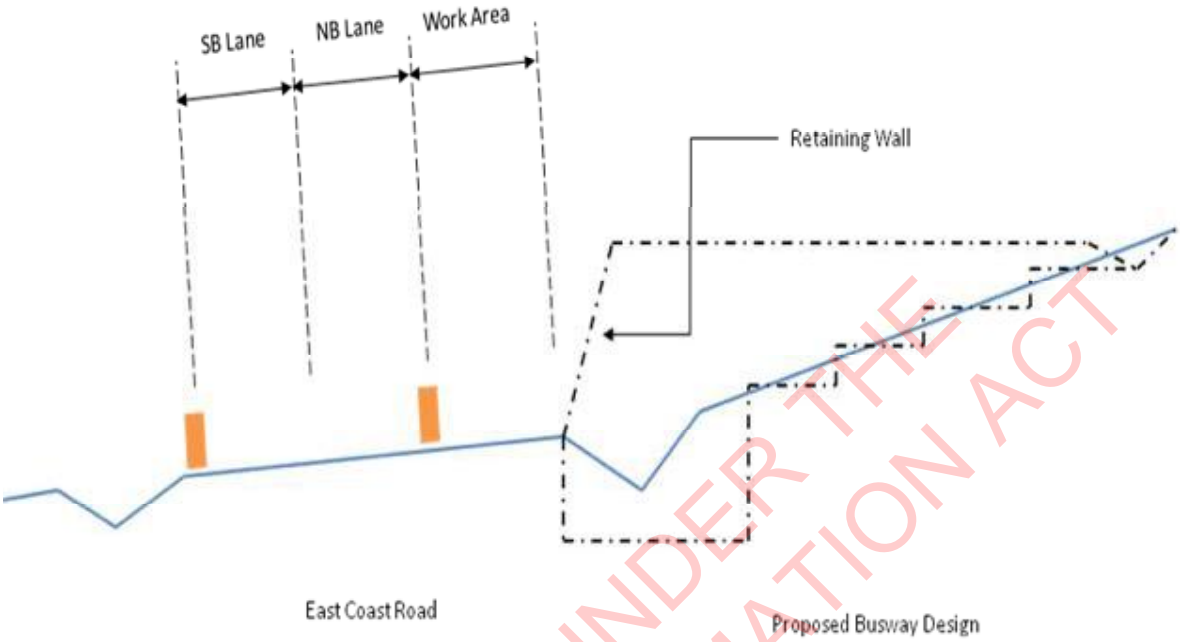


Figure 8.5: Cross section at East Coast Road (Ch15200)

- **Retaining Structure between Awanohi Road and Lonely Track Road (Ch 16500 to 19100):** Site access is limited along this section of SH1. A retained structure for the proposed Busway carriageway in the form of a keystone or MSE wall is positioned on the shoulder of SH1. In order to construct this section of works temporary traffic management on SH1 will be required. Site access points would be required, spaced at reasonable distances, together with a shoulder closure. This may incorporate temporary paving of the median strip and moving traffic lanes over or alternately reducing the width or number of southbound lanes to create site access and or work areas.

- **Retained Embankment North of Oteha Valley Road Interchange (Ch 19500 to 19850):** The outside retained face of this embankment is located in close proximity to a residential boundary and the inside face is located on the shoulder of the existing Oteha Valley Road off ramp. Temporary traffic management will be required in the form of a shoulder closure or possible temporary realignment of the off ramp in order to construct and access this section of works.

- **Retained Trench and Cut Batter South of McClymonts Road (Ch 20950 to 21500)**: A combination of a fully retained trench and cut batter with a retained face against SH1 feature through this section. Temporary traffic management will be required due to the proximity of the retained cut face to SH1. It will be necessary to close the shoulder for this section of work and possibly protect the edge of the trench with a fixed concrete barrier.

- **Bridge Structures over local roads**: These are required at Awanohi Road, Oteha Valley Road, Greville Road, Rosedale Road and Constellation Drive. Construction of the viaduct structures over the local

roads can be undertaken without interference with the existing motorway and can be achieved with standard multi-staged temporary traffic management on the side roads below. In most cases temporary night time closures will be required for lifting bridge beams into place.

- **Construction of New Span for McClymonts Road Underpass:** This may be achievable by alternate lane working. Alternatively a full road closure will be required with traffic diverted to Greville Road to the south. The new span is not expected to interfere with the existing 'bus only' southbound on ramp which can remain open during construction.

8.5.3 Temporary Site Establishment and Material Handling Areas

This project extends over a long length, and therefore intermediate locations are required for site offices and materials handling areas. This reduces the length and duration with which personnel must travel to site and that materials are being transported. These intermediate sites need to be relatively level, with good access either from the local road network or directly from SH1. Temporary site establishment areas have been considered at the following locations:

- Small Road (Ch 9000);
- East Coast Road (Ch 12300);
- Bawden Road (Ch 14000);
- Oteha Valley Road (Ch 20300); and
- Constellation Drive (Ch 23500).

Material handling and landscape fill areas have been considered north and south of the future Penlink Interchange (between Ch 13100 and 13450, and Ch 14400 and 14650).

8.6 Safety

In March 2010, the Government released *'Safer Journeys: New Zealand's Road Safety Strategy 2010 – 2020'.* The strategy has a vision for "a safe road system increasingly free of death and serious injury". While this strategy is focussed on the period from 2010 to 2020, and the construction of the Busway is likely to be beyond this horizon, the principles of a safe road system are still relevant to the development of the scheme. The purpose of the NBE project is to extend the RTN through provision of a facility separate to general traffic. Therefore, the Busway will separate travel modes and provide a purpose built facility that can be designed to provide for the safety of bus users. As indicated earlier in this report, the existing Northern Busway has an excellent safety record to date.

8.6.1 Safety in Design

A safety in design workshop was held on 13 September 2011. This involved the identification of key design risks (from a safety perspective) associated with the recommended option. The 'High' risk safety in design matters identified included:

- Instability of heavy plant in areas of know unstable soils
- Working on steep slopes adjacent to water
- Narrow working areas leading to heavy machinery and workers operating in close quarters;
- Deep excavations on unstable ground for culverts
- Removal of existing soil nail walls resulting in slope instability
- Demolition of post tensioned concrete structures leading to explosive failure.

All safety in design risks, and associated measures to mitigate these risks are described in the Safety in Design Risk Register attached as Appendix L, within Volume 3 (Part B) of the SAR.

8.6.2 Road Safety

The NBE design has been developed with the safety of all users in mind. The vertical and horizontal geometry has been developed to a 90km/hr design speed with a view to providing a posted speed limit of 80km/hr. The proposed cross section provides for adequate shoulders to enable buses to be clear of the roadside barriers. As this facility will provide for buses only, the drivers will be familiar with the corridor, and will they will not interact with other modes of transport. The main safety issues relate to the proposed station platforms where there will be considerable interaction between passengers and buses. This level of detail will need to be considered when the station designs are developed by Auckland Transport and Auckland Council.

The NBE Project has focused on identifying the land requirements to accommodate a future extension to the Northern Busway rather than detailed design. As such, a Road Safety Audit of the recommended option has not been undertaken.

8.7 Urban Design

As a signatory to the NZ Urban Design Protocol, the NZTA developed an Urban Design Policy with two key objectives: (1) to ensure state highways contribute to vibrant, attractive and safe urban and rural areas; and (2) to achieve integration between state highways, local roads, public transport, cycling and walking networks and the land uses they serve.

Urban design principles have been developed for this NBE project to respond to the desire to link and enhance connections between movement networks, centres and communities. These are captured within a preliminary

Urban Design Framework a copy of which is attached as Appendix M within Volume 3 (Part B) of the SAR. The integrated landscape and urban design concept for the route is to:

"Integrate and connect seamlessly with the surrounding environment, including the existing Northern Busway corridor, local communities and the natural environment, by celebrating existing character and qualities that will encourage use of the public transport facilities and enhance community wellbeing."

Key design principles have been identified around highway identity; respect for context; landscape character; approach to earthworks; shotcrete minimisation; bridge design; retaining walls and noise barriers; pedestrian and cycle network connections; station design; planting; and lighting, signage and fencing. It is recommended that this framework be adopted to inform the detailed design of future stages of the NBE project.

8.8 Property Requirements

The land required to be support the recommended option is based on the design and construction footprint required to construct, operate and maintain an extension to the Northern Busway. Refer to the Land Requirement Plans and Schedule attached within Volume 2 of the SAR. Utilisation of land within the NZTA SH1 designations[22] has been a key principle to minimise requirement for additional land to that which is currently designated.

The majority of land to be designated for the NBE is required permanently for the operation of the NBE and associated stormwater infrastructure. Exceptions to this are as follows (as shown on the Scheme Drawings attached within Volume 2 of the SAR):

- Land adjacent to Small Road in Silverdale required as a site establishment area;
- Land off East Coast Road in Redvale, required as a temporary establishment area;
- Land off East Coast Road at the proposed Weiti Crossing required as a material handling area;
- Land off Bawden Road in Dairy Flat required as a temporary establishment area;
- Land at 38 Masons Road in Oteha required as a temporary establishment area;
- Land off Holder Drive adjacent to the Rosedale Wastewater Treatment Plant required as a site establishment area; and

[22] For the purposes of this assessment and the preparation of land requirement plans it has been assumed that the NZTA designations for State Highway purposes between Constellation Station and the Silverdale Interchange accord with the designations detailed on the NSCDP and RDP planning maps within the online versions of the District Plan (and the associated Geographic Information provided by Auckland Council). Any land requirement identified as necessary to support a future extension to the Northern Busway as part of this study is in addition to land capture by these designations.

- DOC owned land around the Okura River crossing required during works to enable construction access.

As detailed with the cost estimate attached as Appendix N within Volume 3 (Part B) of the SAR around 85 parcels of land, owned by approximately 39 parties is required to be purchased. The total land requirement equates to approximately 220,262sqm, 70,286sqm of which is located between Constellation Station and Albany Station, and 149,976 of which is between Albany Station and the future Hibiscus Coast Busway Station.

A *Draft Property Acquisition Strategy* (the Strategy) has been completed by the Property Group Limited for the NBE Project. The Strategy recommends strategic advance purchase of properties where this may be desirable for economic reasons or where a protracted high cost negotiation is expected. There are no unmanageable risks are identified within the Strategy.

This chapter describes the impact of the recommended option on existing designations, outlines the private and crown property requirement and identifies properties where easements may be necessary, Land within the existing SH1 and motorway designations that is not required to support the recommended option for an extension to the Northern Busway is also discussed within this chapter.

8.8.1 Land Currently Designated

Much of the footprint of the recommended option can be contained within the NZTA designations set aside for motorway and State Highway purposes, including:

- the NZTA: 'motorway and limited access highway and associated interchange structures' designation (reference 401) within the RDP;
- the NZTA: 'State Highway 1' designation (404) within the RDP; and
- the NZTA: 'Auckland-Waiwera Motorway' designations (reference 110 and 111) within the NSCDP.

The NBE also impacts on land subject to the following designations:

- Auckland Transport local road designations including Small Road, Wilks Road, East Coast Road, Bawden Road, Awanohi Road, Lonely Track Road, Oteha Valley Road, McClymonts Road, Greville Road, Rosedale Road and Constellation Drive.
- Watercare: 'Wastewater Treatment Plant Odour Buffer' designation (reference 163) located along SH1 around the Rosedale oxidation ponds; and
- Watercare: 'Wastewater Treatment Plant' designation (reference 164) to the east and west of where SH1 passes the Rosedale oxidation ponds.

The Auckland Transport 'Weiti Crossing' designation (reference 167) located to the east of SH1 just north of Redvale (refer to Figure 8.8 below) is not impacted on by the NBE. This designation starts to the east of East Coast Road whilst the proposed NBE designation starts on the western side of East Coast Road (refer to the Land Requirement Plan attached within Volume 2 of the SAR). The proposed designation for the NBE does however impact on Auckland Transport designated land forming part of the East Coast Road, road reserve (showed white and positioned between the Weiti Crossing designation (167) and the SH1 designation (401) (both depicted with brown lines) in Figure 8.6 below).

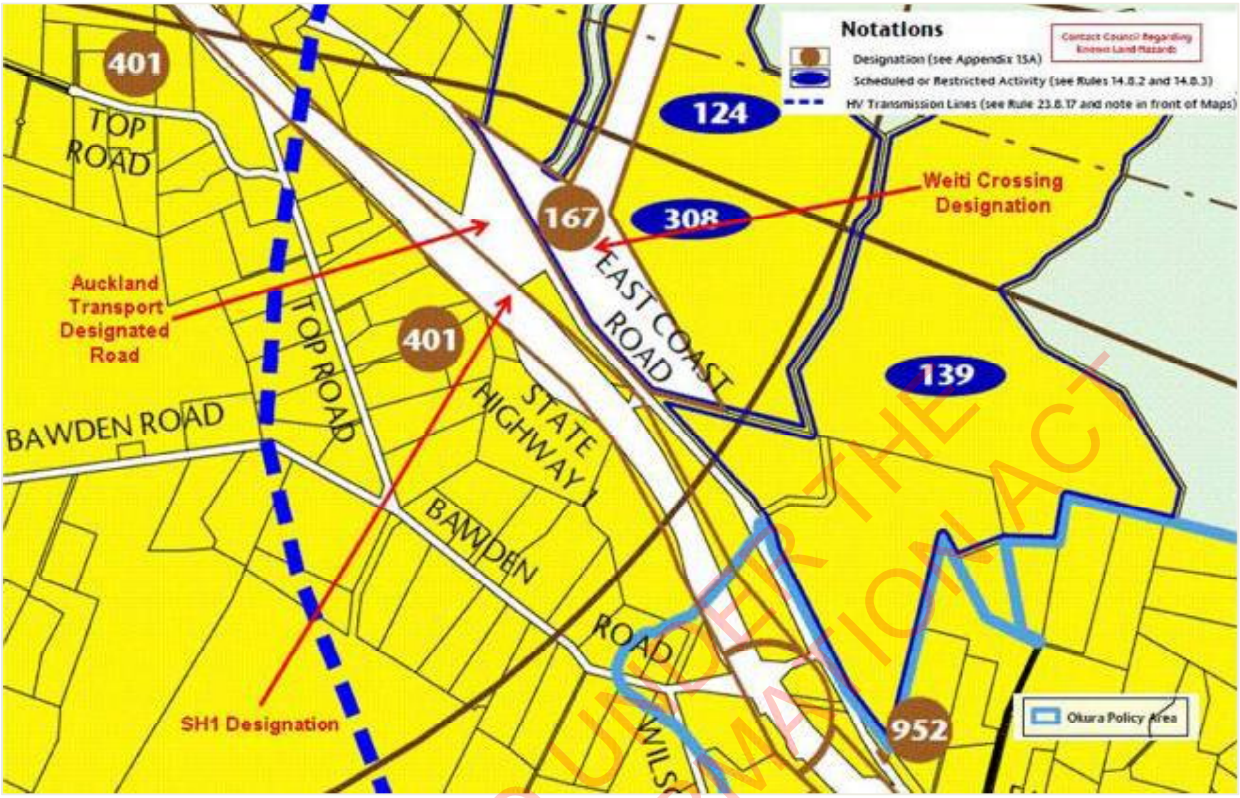


Figure 8.6: Image showing relationship between Weiti Crossing, East Coast Road and SH1 designations[23]

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[redacted]	[redacted]	[redacted]	[redacted]
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9. Recommended Option Assessment

This section of the report outlines how the recommended option will affect future traffic conditions and bus operations, the degree of adverse effects on the environment (including consideration of mitigation), costs and economic benefits and consistency with relevant statutory documents.

9.1 Effect on Traffic Conditions

The implementation of the recommended option (and indeed any extension to the Busway) would alter the predicted future transport conditions described in Chapter 4. This section provides a summary of the predicted effect of the NBE on future transport conditions along SH1 between the CBD and Orewa. These predictions are based on outputs from transport modelling undertaken for the NBE project.[27] Full details are provided in the Transport Modelling Report attached as Appendix D within Volume 3 (Part B) of the SAR.

In the forecasts, new Busway stations were assumed to be provided at Silverdale (the Hibiscus Coast Busway Station), Redvale, Greville Road, and Rosedale Road. The Hibiscus Coast Busway Station was assumed to be of the same standard in the model as the existing Albany station. The Busway stations at Redvale, Greville Road and Rosedale Road were assumed to be local stations only (i.e. with no Park and Ride facilities). The same service frequencies and patterns have been assumed as in forecasts described in Chapter 4.

9.1.1 Traffic Conditions on Motorway

General traffic volumes on SH1 are not predicted to change significantly (i.e. generally less than 3 percent) as a result of the NBE in all three forecast years (2016, 2026 and 2041). This is largely because the absolute number of trips which are predicted to switch from car to bus is small relative to overall traffic volumes. This also occurs because as car users switch to bus services, other car trips are attracted to SH1 (either as a result of reassignment or redistribution of trips).

While traffic volumes are not predicted to change significantly as a result of the NBE, traffic speeds are predicted to change (though largely by less than 10%). The largest increases in speed are predicted on SH1 south of the Greville Road Interchange as opposed to north of this location. The increase in traffic speeds is as a result of there being slightly less traffic on SH1 through this section.

[27] A number of assumptions were made in the NBE transport modelling. These are described in detail in the Transport Modelling Report attached as Appendix D. Of particular note is that only one NBE option was modelled (which consists of a two-way, off-line Busway between Constellation Drive and Silverdale Interchange) because all options provide broadly the same operational functionality for traffic and buses.

9.1.2 Public Transport Patronage

Modelling undertaken predicts large increases in Busway patronage when comparing the NBE to the future scenario without the NBE (as outlined in Chapter 4). Increases of up to approximately 20 percent are predicted in 2041 in the southbound direction (during the AM peak period) and up to approximately 40 percent in the northbound direction (during the PM peak period) between Silverdale and Albany. The predicted bus patronage between 2016 and 2041 is set out in Table 9.1 below.

Table 9.1: Forecast Northern Busway patronage levels with the NBE (2016 – 2041)

Section of SH1	AM Peak			Inter-Peak			PM Peak		
	2016	2026	2041	2016	2026	2041	2016	2026	2041
Southbound									
Silverdale – Redvale	1,500	2,000	3,200	100	200	700	100	200	500
Redvale – Albany	1,600	2,900	4,600	100	700	1,200	100	400	700
Albany – Greville Road	2,800	3,700	6,000	400	1,100	1,900	600	1,600	2,700
Greville Road – Constellation	2,900	3,800	6,100	500	1,200	1,900	700	1,700	2,800
Constellation –Sunnynook	4,300	5,200	7,800	600	1,200	2,000	700	1,500	2,700
Northbound									
Sunnynook – Constellation	700	1,600	2,800	500	1,400	2,200	3,300	4,200	6,700
Constellation Drive – Greville Road	700	1,800	3,000	500	1,400	2,200	2,200	3,100	5,400
Greville Road – Albany	600	1,700	2,800	400	1,400	2,200	2,100	3,100	5,300
Albany – Redvale	100	300	500	100	400	600	1,200	2,200	3,700
Redvale – Silverdale	100	100	300	100	200	400	1,100	1,400	2,400

A number of sensitivity tests of the likely effect on bus patronage (and general traffic flows) have been undertaken. These include testing the effects of constructing:

- the NBE only as far as Albany;
- an offline NBE to Albany and then a shoulder bus lane north to Silverdale; and
- the NBE north of Albany prior to the construction of the Penlink project.

Sensitivity testing indicates that:

- constructing the NBE as far as Albany Busway only still results in increased public transport patronage between Albany and Silverdale (i.e. people travelling between Silverdale and Auckland CBD would benefit from an extension of the Busway to Albany only);

- patronage on services using a shoulder bus lane NBE north of Albany is generally predicted to be significantly lower than demand for an offline NBE; and

- patronage on the NBE is predicted to be lower if the Penlink project is not completed.

9.1.3 Busway Operations

Extending the Busway from Constellation to Albany on the eastern side of SH1 will require changes to be made to bus services throughout the Albany area. This is the case whether bus services continued to serve the existing Bus Station or whether a new Bus Station was constructed on the east side of SH1 (as per the options set out in Section 6.2). The degree of changes required to the bus network, and the impact of the changes on the market for bus travel, will depend on the nature of option implemented and the extent to which enhancements are made to pedestrian and road infrastructure. Refer to the Albany Bus Station Bus Service Review attached as Appendix F within Volume 3 (Part B) of the SAR.

In both modelled years (2026 and 2041), there are significant reductions in total journey time predicted for buses in both directions (at all times of the day). By 2041 the Busway extension is expected to result in travel times that are up to 17 minutes faster compared to the scenario without the NBE described in Chapter 4. The transfer of cars from SH1 to the Busway is forecast, in some instances (notably between Redvale and Silverdale), to result in a slight increase in the speed of the remaining traffic.

Table 9.2 provides a comparison of the predicted bus travel times with and without the NBE in the 2016, 2026 and 2041 forecast years. It should be noted that in all three forecast years, the NBE project is assumed to be constructed between Constellation and Hibiscus Coast Busway Station.

Table 9.2: Forecast change in bus journey times (minutes)

	AM Peak			Inter-Peak			PM Peak		
	2016	2026	2041	2016	2026	2041	2016	2026	2041
Southbound									
Silverdale – Redvale	2.6	1.8	1.7	2.7	1.8	1.8	2.7	1.9	1.8
Redvale – Oteha Valley Road	1.5	-1.7	-8.6	-0.7	-2.6	-7.3	-0.9	-1.2	-1.2
Oteha Valley Road – Greville Road	-1.2	-1.9	-3.9	-1.1	-2.3	-4.0	-1.4	-2.0	-4.2
Greville Road – Constellation Drive	0.0	0.0	0.0	-2.5	-1.9	-1.9	-2.2	-1.9	-1.9
Constellation Drive – Fanshawe Street	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total change in journey time	**3.0**	**-1.8**	**-11.0**	**-1.6**	**-5.0**	**-11.5**	**-1.9**	**-3.3**	**-5.5**
Northbound									
Fanshawe Street – Constellation Drive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
Constellation Drive – Greville Road	-1.5	-1.6	-4.6	-2.1	-2.9	-4.2	-1.6	-1.6	-1.4
Greville Road – Oteha Valley Road	-1.2	-1.4	-2.3	-1.2	-1.7	-2.0	-1.3	-2.7	-4.2

Oteha Valley Road – Redvale	1.1	0.9	0.8	1.1	0.8	-0.3	1.0	-2.3	-12.5
Redvale – Silverdale	2.6	1.7	1.6	2.6	1.7	1.6	2.5	1.6	1.6
Total change in journey time	**1.0**	**-0.5**	**-4.4**	**0.3**	**-2.1**	**-5.0**	**0.7**	**-4.9**	**-16.7**

9.1.4 Busway Maintenance & Emergency Access

It is anticipated that the northern extension to the Busway will be managed in the same manner as the existing southern section. That is, Auckland Transport will manage Busway operations with maintenance carried out by NZTA through the Auckland Motorway Alliance (AMA). Maintenance activities would include sweeping, graffiti removal and painting, and these are all carried out after 11pm when buses are not running.

During an incident, the Busway could be used for emergency access, although this would then be under the direction and control of the NZ Police.

9.2 Economic Evaluation

This section provides a summary of the estimated costs and transport economic benefits of the recommended option. The summary draws on information contained in the Economic Appraisal of Short List Options attached as Appendix H and the Cost Estimate attached as Appendix O within Volume 3 (Part B) (Part B) of the SAR. It is noted that some of the costs outlined in Appendix H vary from the stated costs in this chapter as they relate to the option estimate (rather than the scheme estimate). The option estimate does not incorporate the costs associated with further design development undertaken during the scheme assessment stage (i.e. since the completion of the option estimate).

9.2.1 Estimated Costs

The capital construction, property and operating costs of the recommended option have been estimated and are set out in Table 9.3 below. A construction period of five years to complete the entire project was assumed with the capital cost spread evenly over that period. Construction was assumed to begin in the 2024/25 year, and an opening year (the first year of benefits) of 2030 was assumed. No change in bus operating costs has been assumed between the 'with' and 'without' NBE options.

Table 9.3: Estimated Cost of Recommended Option

Item	Cost (Quarter 1 2011 prices)
Capital cost expected	$553.0m
Property costs	$18.0m
Operating cost per annum	$2.2m
Maintenance cost (8 yearly)	$10.10m

9.2.2 Benefits

Table 9.4 shows the estimated benefits of the Project in the modelled years, being 2026 and 2041.

Table 9.4: Total Benefits by year

Undiscounted benefits by year	2026	2041
Total travel time, congested travel time, vehicle operating cost and public transport user benefits	$34.5m	$58.7m
CO2	$0.04m	$0.13m
Reliability	$1.4m	$3.3m
Accidents	$2.4m	$1.4m
Agglomeration Benefits	$36.3	$38.7
Total benefits	**$74.6**	**$102.3**

The NZTA Economic Evaluation Manual provides for the inclusion of agglomeration benefits[28] as part of establishing the benefit to cost ratio for a Project. Therefore the benefits below include agglomeration benefits in addition to benefits associated with: Total travel time, congested travel time, vehicle operating cost and public transport user benefits; CO2; Reliability; and Accidents.

Travel time, vehicle operating cost and public transport user benefits make up about 46 percent of the total benefits in 2026 and 57 percent of the total benefits in 2041. In 2026 agglomeration benefits consist of approximately 49 percent of all benefits and in 2041 agglomeration benefits account for approximately 38 percent of the benefits. The remaining benefits arise from accident savings and reliability benefits. The annual increase in benefits between 2026 and 2041 is around 4 percent.

9.2.3 Benefit to Cost Ratio

A benefit to cost ratio (BCR) for the full scheme has been developed based on the benefits and costs outlined above. In addition, a BCR has been developed for potential interim stages of the project.

[28] Agglomeration benefits of transport projects derive from the indirect impacts transport can have on transport using markets that are not perfectly competitive. Agglomeration economies describe the productive advantages that arise from the close spatial concentration of economic activity. Urban economic theory maintains that the existence of such benefits can explain the formation and growth of cities and dense industrial areas. Typically, a distinction is made between intra-industry localization economies and extra-industry urbanisation economies.

9.2.3.1 Construction of Full Off-line Busway to Silverdale

Assuming an opening year of 2030[29] and the present values of costs and benefits, the benefit to cost ratio (BCR) of the project is as shown in Table 9.5.

Table 9.5: NBE Benefits and Costs (discounted)

Present Values Summary	($m)
Benefits	$274.2
Costs	$175.9
BCR	**1.6**

This evaluation indicates that the NBE Project is economically justified (i.e. BCR >1.0) based on a construction start of 2026. In order to determine when the full Busway becomes financially viable, we have interpolated the results of the Benefit to Cost analysis from the output of the 2026 model, and found that the BCR would increase above 1 by approximately the year 2019. If the scheme benefits were reduced or the project costs increased then the BCR would fall (see Appendix I within Volume 3 (Part B) of the SAR for further details).

9.2.4 Interim Project Staging

9.2.4.1 Offline Busway to Albany Station

An economic evaluation has been undertaken for an interim stage to construct the Busway to Albany Station only (staging options are discussed in more detail in Chapter 11), with the results outlined in Table 9.6 below. As mentioned above, this assessment was undertaken using the 2026 model.

Table 9.6: Staging to Albany – Benefits and Costs (discounted)

Present Values Summary	($m)
Benefits	$215
Costs	$78.0
BCR	**2.8**

The economic evaluation undertaken indicates that the first stage of the NBE project would have a BCR of 2.8 in 2026, and by interpolation, it could be economically justified by as early as 2015 (i.e. the year in which the BCR increases above 1.0).

9.2.4.2 Bus Shoulder Lanes to Silverdale

The evaluation of bus shoulder lanes includes the provision of an offline busway to Albany Station. The costs and benefits of this section of offline busway have therefore been included in the assessment of bus shoulder lanes. Bus shoulder lanes are not feasible south of Albany Station (as discussed further in Chapter 11), and as

[29] Given the years for which forecasts were prepared of the effect of the NBE project, an opening year of 2030 has been adopted as an appropriate year for the evaluation.

the southern section accrues the majority of the benefit sooner, it is considered that the bus shoulder lanes would not be constructed without providing the offline busway to Albany.

The results of the economic evaluation are outlined in Table 9.7 below (based on the 2026 model as above). Based on this assessment, there is little benefit in providing bus shoulder lanes to Silverdale (or incrementally to the Penlink connection).

Table 9.7: Bus Shoulder lane – Benefits and Costs (discounted)

Present Values Summary	($m)
Benefits	$215
Costs	$137.3
BCR	**1.5**

The significant cost for the widening is due to the need to provide additional pavement on both sides of the motorway, and also to accommodate super shoulders. This has been based on typical rates, and more detailed intrusive investigations would better define the construction requirements.

The evaluation of benefits is potentially understated as it assumes that buses travel slower in the shoulder lanes compared to free-flowing traffic conditions on SH1 (80kph in the shoulder lanes). The case for bus shoulder lanes should be considered further when the project proceeds to preliminary design, and better information is available as to the congestion on the network north of Oteha Valley Road following completion of other projects (i.e. SH1/18 connection, Constellation to Greville Improvements, SH1/17 connection, Penlink). At that stage, a more detailed cost estimate can also be determined to gain a better understanding of the economic return.

9.2.5 Sensitivity Analysis

A sensitivity analysis, to test the effect of including agglomeration benefits in the BCR for the NBE Project has been undertaken. The salient results of this analysis are that the exclusion of agglomeration benefits is predicted to:

- reduce the scheme benefits by around 70 percent from $274 million to $160 million;
- reduce the BCR of the preferred option from 1.6 to 0.9; and
- move out the year at which the BCR exceeds one from approximately 2019 to 2030.

9.2.6 Conclusions

The following conclusions are made in relation to the above analysis:

- Travel time, vehicle operating cost and public transport user benefits make up about 46 percent of the total benefits in 2026 and 57 percent of the total benefits in 2041. Agglomeration benefits consist of

approximately 49 percent of all benefits on 2026 and approximately 38 percent of the benefits in 2041.

- The main benefits of the NBE Project are realised between Constellation Station and Albany Station. Approximately $215m of the benefits are between Constellation Station and Albany Station compared to $274.2m the benefits relating to the full NBE scheme.

- The construction of the full offline busway would have a BCR of 1.6 in 2026, and is expected to be economically feasible (i.e. BCR > 1.0) by 2019.

- The southern stage of the Busway to Albany Station would have a BCR of 2.8 in 2026, and could be economically justified by as early as 2015.

- Based on this assessment, there is little benefit in providing bus shoulder lanes to Silverdale (or incrementally to the Penlink connection). However, the case for bus shoulder lanes should be considered further when the project proceeds to preliminary design, and better information is available as to the associated costs and the effects on the network following completion of other projects (i.e. SH1/18 connection, Constellation to Greville Improvements, SH1/17 connection, Penlink).

9.3 Assessment of Environmental Effects

This section provides a summary of the main adverse environmental effects associated with the recommended option. A more detailed assessment of effects (including an outline of the Positive effects of the NBE) is provided within the AEE (which includes the specialist Subconsultant reports that inform it) attached as Appendix B within Volume 3 (Part A) of the SAR.

9.3.1 Silverdale Interchange to Oteha Valley Road

The environment between the Silverdale interchange and Oteha Valley Road is predominantly rural-residential in character with the exception of entertainment and commercial uses around the Silverdale Interchange and the more intensive residential use to the south between Lonely Track Road and Oteha Valley Road. SH1 is a dominant feature within the rural-residential environment.

Table 9.6 provides a summary of the main adverse effects of the recommended option on this environment.

Table 9.6: Adverse Effects - Northern Segment of Environment

Adverse Effect	Mitigation
Land Use	
The rural and residential land acquisition required to accommodate the NBE has the potential to impact on the use and/ or development potential of land.	The NBE has been designed to minimise land impacts through containment largely within the existing designation and the use of retaining structures where necessary to avoid significant impacts.
Noise and Vibration	

Noise and vibration generated by the construction of the Busway has the potential to result in adverse effects on residential amenity, particularly in the vicinity of Fairview Retirement Village, where the Busway is aligned in close proximity to residential dwellings.	The use of acoustic barriers, quiet machinery, and drilling rather than driving of bridge piles during construction (where possible) and the implementation of a Construction Noise and Vibration Management Plan will mitigate adverse effects associated with construction noise and vibration (where there are any potentially sensitive receivers).
With the use of low-noise road surface material operational noise associated with the Busway has been assessed as likely to be imperceptible because of the existing level of ambient background noise associated with the motorway.	The use of low-noise road surface material such as Open Graded Porous Asphalt will mitigate any adverse noise effects (where there are any potentially sensitive receivers).
Amenity	
The alignment of the Busway in close proximity to the Fairview Retirement village will potentially have localised adverse effects on the visual amenity of the residential environment.	Fencing and landscape screening as well as cutting of the Busway down into an existing earth bund at the interface with the Fairview Retirement village will mitigate the adverse visual effects associated with the Busway infrastructure.
Extensive earthwork and in particular cutting and associated vegetation clearance required to accommodate the Busway alignment has the potential to result in long term adverse effects on the visual amenity values associated with the landscape of the area.	Replanting of cleared vegetation and grassing cut and fill slopes will mitigate adverse effects on visual amenity values to a degree that is no more than minor.
During construction, dust and construction vehicle emissions have the potential to degrade air quality, with resulting effects on amenity, particularly in residential areas.	These effects will be mitigated to a degree that is no more than minor through the implementation of construction management measures, including the dampening of construction areas to control dust.
Geotechnical	
There is potential for failure and instability in the Northern Allochthon, the predominant geology in this area as a result of the construction of the NBE.	These effects can be mitigated through design measures including: lifting of the vertical alignment to reduce encroachment into marginally stable cut slopes along the existing state highway corridor; and retaining of new cuts.
Ecological Values	
Vegetation removal (at Lucas Creek East Bush, Lonely Track Road East Bush and Okura Creek Bush), culvert extensions and earthworks associated with the construction of the Busway have the potential to result in adverse effects on the ecological value of freshwater and terrestrial ecology in the area.	Design changes (e.g. retaining instead of a batter slope) to avoid vegetation removal at Lonely Track Road Bush East, and the realignment of the stream at Lucas Creek North Bush, as well as the implementation of an Ecological Restoration and Enhancement Programme, a Vegetation Clearance Plan, erosion and sediment control measures, and vegetation replacement will help to mitigate adverse ecological effects.

There is potential for significant long term adverse effects on the ecological values of the Lucas Creek East Bush and Okura Creek Bush as a result of rain and sun shadow effect of bridge structures.	Monitoring freshwater resources to identify degradation in quality will assist in a limited way to mitigate the effects of rain and sun shadow on the ecological value of the Lucas Creek East Bush and Okura Creek Bush.
The additional roadway for a new Busway will increase the impervious surface within the catchments to which the NBE relates, with potential resulting adverse effects on freshwater resources as a result of: increased flooding; the mobilization of contaminants in runoff; and channel erosion, resulting from additional runoff in the catchment.	The construction of stormwater infrastructure (as outlined in Section 8.4) and implementation of erosion and sediment control measures, will mitigate these actual and potential adverse effects to a degree that is no more than minor.
Traffic Disruption	
There NBE has the potential to disrupt traffic, particularly on local roads within the vicinity of the NBE and to a lesser extent on SH1 itself.	Traffic Management measures will be implemented as part of the construction management plan to ensure these effects are mitigated to a degree that is no more than minor.

Overall, with mitigation the adverse effects of the northern segment of the NBE will be able to be managed in a way that achieves the purpose and principles of the RMA, which are set out in Section 9.4.2.

9.3.2 Oteha Valley Road to Upper Harbour Highway

The urban environment between Oteha Valley Road and Upper Harbour Highway is characterised by commercial, industrial and residential development and the Rosedale oxidation ponds. There are also large areas of undeveloped land in the vicinity of Albany Station.

Table 9.7 provides a summary of the main adverse effects of the recommended option on this environment.

Table 9.7: Adverse Effects – Southern Segment of Environment

Adverse Effect	Mitigation
Land Use	
The residential and business land acquisition required to accommodate the NBE has the potential to impact on the use and/ or development potential of land.	The NBE has been designed to minimise land impacts through containment largely within the existing designation and the use of retaining structures where necessary to avoid significant impacts.
The alignment of the NBE through the Rosedale Wastewater Treatment Plant Ponds has the potential to result in adverse effects on the operation of the treatment plant.	Adverse effects on the operation of the wastewater treatment plant can be mitigated through the replacement of lost pond area/ volume adjacent to the existing pond.
Noise and Vibration	

Noise and vibration generated by the construction of the Busway has the potential to result in adverse effects on residential amenity, particularly in the vicinity of apartment complexes adjoining the current motorway between Oteha Valley Road and Greville Road.	The use of: acoustic barriers, quiet machinery, and drilling rather than driving of bridge piles during construction (where possible) and the implementation of a Construction Noise and Vibration Management Plan will mitigate adverse effects associated with construction noise and vibration.
With the use of low-noise road surface material operational noise associated with the Busway has been assessed as likely to be imperceptible because of the existing level of ambient background noise associated with SH1.	The use of low-noise road surface material such as Open Graded Porous Asphalt will mitigate any adverse noise effects associated with the operation of the Busway.
Visual Amenity	
The alignment of the Busway in close proximity to the residential properties to the north of Greville Road will have adverse effects on the visual amenity of the residential environment.	Fencing and landscape screening at the interface with the residential environment will mitigate the adverse visual effects associated with the Busway infrastructure.
During construction, dust and construction vehicle emissions have the potential to degrade air quality, with resulting effects on amenity, particularly in residential areas.	These effects will be mitigated to a degree that is no more than minor through the implementation of construction management measures, including the dampening of construction areas to control dust.
Ecological Values	
The additional roadway for a new Busway will increase the impervious surface within the catchments to which the NBE relates, with potential resulting adverse effects on freshwater resources as a result of: increased flooding; the mobilization of contaminants in runoff; and channel erosion, resulting from additional runoff in the catchment.	The construction of stormwater infrastructure (as outlined in Section 8.4) and implementation of erosion and sediment control measures will mitigate these actual and potential adverse effects to a degree that is no more than minor.
Contamination	
There is potential for contamination associated with the former Rosedale Landfill site which the NBE traverses. Where contaminated materials are not managed appropriately during construction this can result in adverse effects on the environment.	Any adverse effects associated with land disturbing activities can be managed through site investigation to determine contamination levels, and the appropriate treatment or disposal of contaminated soil where contamination exists.
Traffic Disruption	
There NBE has the potential to disrupt traffic, particularly on local roads within the vicinity of the NBE and to a lesser extent on SH1 itself.	Traffic Management measures will be implemented as part of the construction management plan, to mitigated any potential effects.

Overall, with mitigation the adverse effects of the southern segment of the NBE will be able to be managed in a way that achieves the purpose and principles of the RMA, which are set out in Section 9.4.2.

9.4 Statutory Assessment

This section of the report sets out the key statutory considerations in relation to the recommended options.

9.4.1 Land Transport Management Act 2003

This section of the report considers the NBE in terms of the relevant provisions of the Land Transport Management Act 2003 (as amended by the Land Transport Management Amendment Act 2008) (LTMA). The LTMA is the main statute for New Zealand's land transport planning and funding system.

9.4.1.1 LTMA Purpose and the Objective of the NZTA

The purpose of this legislation as set out in section 3 is 'to contribute to the aim of achieving an affordable, integrated, safe, responsive and sustainable land transport system'. Under section 94 of the LTMA 'the objective of the Agency is to undertake its functions in a way that contributes to an affordable, integrated, safe, responsive, and sustainable land transport system'.

The LTMA provides clear guidance on national priorities through the New Zealand Transport Strategy (NZTS) and the Government Policy Statement on Land Transport Funding (GPS).

The recommended option is consistent with the LTMA purpose and enables the NZTA to achieve its objective under the LTMA because:

- of the options considered for an extension to the Northern Busway is the least expensive option, providing affordable solution for an extension to the Busway;
- it provides for the integration with current Busway stations and the planned future upgrades to the state highway network, contributing to the achievement of an integrated land transport system whilst minimising the social and economic costs of property acquisition by predominantly utilising the existing designated motorway corridor;
- the area of land acquisition associated with the option is sufficient to accommodate a Busway design that meets safety standards, contributing to the achievement of a safe land transport system;
- the recommended option maximises flexibility for planned long term improvements to the state highway corridor (including new interchanges and other modes such as light rail), contributing to the achievement of a responsive land transport system; and
- in providing for an alternative, more sustainable mode of transport to the private motor vehicle it will contribute to the achievement of a sustainable land transport system.

9.4.1.2 Responsibilities of the NZTA

Section 96(1) of the LTMA requires the NZTA, in meeting its objective, to exhibit a sense of 'social and environmental responsibility'. Exhibiting a sense of social and environmental responsibility is further detailed in the Act to include:

- avoiding, to the extent reasonable in the circumstances, adverse effects on the environment;
- taking into account the views of affected communities; and
- giving early and full consideration to land transport options and alternatives in a manner that contributes to paragraphs (a) and (b).

The recommended option will enable the NZTA to exhibit a sense of social and environmental responsibility should it be carried forward as a preferred option, because:

- as outlined in Section 9.2 the option provides for mitigation and avoidance of adverse effects on the environment to an acceptable degree;
- consultation with affected communities will be undertaken on the recommended option prior to confirming a preferred option to take forward for designation; and
- as set out in this report full consideration has been given to alternative options for an extension to the Northern Busway, with the recommended option reflecting an option which best avoids adverse effects on the environment.

9.4.1.3 Social and Environmental Responsibility

The LTMA identifies five key outcomes for activities (in sections 19 and 20), which provide direction in achieving social and environmental responsibility in the provision of land transport. These outcomes are:

- assisting economic development;
- assisting safety and personal security;
- improving access and mobility;
- protecting and promoting public health; and
- ensuring environmental sustainability.

The recommended option will provide for the achievement of these outcomes by:

- enabling the efficient movement of people and goods through the provision of a dedicated offline facility connecting future employment and residential hubs, with corresponding environmental and economic benefits through reduced congestion on SH1;
- increasing accessibility and mobility through the provision of additional public transport infrastructure; and
- providing for a more energy efficient and sustainable travel mode to the private motor vehicle whilst integrating with the existing public transport network.

9.4.2 Resource Management Act

This section of the report considers the recommended option in terms of the RMA. In particular consideration is given to the purpose and principles of Part 2, sections 5 through 8.

9.4.2.1 Section 5

The purpose of the RMA is to promote the sustainable management of natural and physical resources. Sustainable management is defined in Section 5(2) of the RMA as:

"…managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while—

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment."

The recommended option is consistent with the purpose of the RMA because it provides for improvement to Auckland's public transport network with benefits for economic and social wellbeing of people and communities, whilst identifying how adverse effects on the environment can be avoided, remedied or mitigated. Specific mitigation measures are outlined in Section 9.2.1.

9.4.2.2 Section 6

Under Section 6 of the RMA the following matters of national importance are of particular relevance to the NBE:

"(a) the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development…

(c) the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna…

(e) the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga…"

The recommended option has the potential to impact on the natural character of the coastal environment, wetlands, and lakes and rivers and their margins, as a result of the removal of vegetation and discharge of silt, sediment and other contaminants during both construction and operation of the busway. As outlined in Section 9.3 (and the AEE attached as Appendix B within Volume 3 (Part A) of the SAR) these effects can be mitigated through design changes that avoid vegetation removal and the realignment streams, as well as the implementation of an Ecological Restoration and Enhancement Programme, a Vegetation Clearance Plan, erosion and sediment control measures, a stormwater management system, and the planting of replacement vegetation. The recommended option in providing for the preservation of the natural character of the coastal environment, wetlands, and lakes and rivers and their margins is consistent with Section 6(a) of the RMA.

There are a number of areas of ecological significance within the NBE corridor to which the recommended option relates. The Site of Ecological Significance at Lucas Creek West Bush, is considered to be an area of significant indigenous vegetation and a significant habitat of indigenous fauna that merits protection in terms of Section 6(c), given it high ecological value and it's classification both locally and regionally as a significant ecological area.

Other areas of ecological significance (i.e. Okura River Bush, Wrights Stream Bush, Lonely Track Road East Bush, Lonely Track Road West Bush, Lucas Creek North Bush and the Lucas Creek East Bush) also within the NBE corridor, are not considered as areas for protection in terms of Section 6(c) of the RMA, because they are only of low to moderate ecological value. Refer to the Assessment of Ecological Effects within the AEE attached as Appendix B within Volume 3 (Part A) of the SAR.

The recommended option is consistent with section 6(c) of the RMA as it avoids the Site of Ecological Significance at Lucas Creek West Bush and any adverse effects on other ecological areas can be avoided and mitigated as outlined in Section 9.3 and the AEE.

The NBE corridor is located within an area of cultural significance to Maori. In particular it is of note that:

- Otehā Valley takes its name from the prominent tupuna (forbearer) Te Hākaiarara, the grandson of Manuhiri (Ngāti Manuhiri);
- Te Hākaiarara and his people lived in the Albany and North Shore area with particular connections to Weiti River and Ōkura River;
- Te Hākaiarara and his people maintained kāinga (living quarters) and nohonga (seasonal campsites) for mahinga kai (harvesting a variety of food sources) within the area; and
- the area was also a significant travel route between East and West Coast as there are many noted portages on both Coasts.

NZTA have adopted a proactive approach and are consulting, and will continue to consult with, Hokai Nuku in relation to the NBE, to facilitate the matters set out in Section 6(e) of the RMA.

9.4.2.3 Section 7

Section 7 of the RMA lists the matters to which particular regard must be had in making resource management decisions. Those of particular relevance to the Northern Busway Extension project are as follows:

- the efficient use and development of natural and physical resources;
- the efficiency of the end use of energy;
- the maintenance and enhancement of amenity values;
- intrinsic values of ecosystems; and
- maintenance and enhancement of the quality of the environment.

The NBE in providing for an alternative and more sustainable mode of transport to the private motor vehicle and reducing motorway congestion will contribute to the achievement of a more efficient use of natural resource and more specifically efficiency in the end use of energy (fuel). It occupies much of an existing motorway corridor and therefore minimise the impact on amenity values on the wider area. As outlined in the AEE attached as Appendix B the adverse effects the environment from the recommended option can be avoided and mitigated.

9.4.2.4 Section 8

Section 8 of the RMA requires the principles of the Treaty of Waitangi to be taken into account in resource management decisions. Consultation with Iwi will be on-going as the project progresses.

9.4.3 Conclusion

The recommended option will contribute to the achievement of the purpose of the LTMA and will enable the NZTA to achieve its objective and social responsibilities as set out in the LTMA with respect to the NBE project. In addition the recommended option is consistent with the purpose and principles of the RMA.

10. Consenting Strategy

This section provides a detailed outline of the alternative mechanisms available to consent the recommended option for and extension to the Northern Busway.

10.1 Alternative Consenting Mechanisms

The alternative mechanisms under the RMA for authorising the construction, operation and maintenance of an extended Busway are as follows:

- Applying for resource consent for the works from Auckland Council;
- Altering the existing motorway designation in the relevant District Plans in terms of its function and area;
- Altering the area subject to the existing Busway designation (North Shore District Plan) and altering the motorway designation (or serving a new designation) under the Rodney District Plan; or
- Serving new Notices of Requirement in the relevant District Plans over the land required for the Busway (which will overlap some of the surplus motorway designation).

10.1.1 Resource consent

The NZTA has the option of applying for resource consent for land use activities from Auckland Council closer to the time of construction. As the project is likely to be built in stages the resource consents would also be staged as the timing of the stages are confirmed. Seeking staged resource consents are not considered to be the best approach as:

- It would not protect land along the route from inappropriate use that would hinder future development of the corridor;
- The location and extent of the corridor and nature of the intended use would not be identified in the District Plan;
- All areas of non-compliance with the District Plan would need to be consented, providing less flexibility than a designation (which provides for undertaking works in accordance with the designation); and
- The NZTA is not decision making authority and does not control the wording of conditions.

A series of resource consents will however be required under the regional plans for the construction of the project under sections 9 and 13 through 15 of the .

10.1.2 Notice of Requirement

A Notice of Requirement to designate the land required for the Project would secure the corridor in the long term and accurately reflect the intended use of the land within the jurisdiction of Auckland Council (and reflected in the North Shore and Rodney District Plans).

Conditions attached to a designation can provide for a framework of management plans to address environmental effects which also have the flexibility to allow for design innovation.

Complementary designations for station facilities would be established by Auckland Transport. To provide for an integrated approach the NZTA and AT NOR processes would ideally be running in parallel.

The land required to be designated as set out in this SAR is a conservative footprint and includes sufficient land to construct and operate the NBE to Silverdale. Land that is temporarily occupied (e.g. during construction) would not necessarily have to be purchased by the NZTA. The NZTA could negotiate leasing and access agreements with the owners. However, the designation is necessary to enable the appropriate property mechanisms to be agreed and if necessary the land may need to be acquired.

The designation of land for construction only (such as setdown area, spoil disposal areas) that would become surplus once the stages of the Busway become operational can be uplifted in accordance with section 182 of the RMA. As the full extent of this land would not be known until the construction it is appropriate that the designation allow sufficiently for all activities (consultation, operation or maintenance)

10.1.3 Recommendation

Based on the level of integration and certainty required for the project seeking resource consents for each stage of the project is not considered to be suitable as this would not secure the corridor in the long term.

A designation is the more appropriate tool for this Project for the following reasons:

- It will protect a corridor suitable for the long term development of a Busway through to Silverdale from inappropriate land use;
- It will identify in the District Plan the location, nature and extent of NZTA's future use of that land;
- It will enable NZTA to have the flexibility to construct, operate and maintain the Busway and undertake the proposed works or Project in accordance with the designation, notwithstanding anything contrary within the relevant District Plans; and
- It will enable the Project or work to be undertaken in a comprehensive and integrated manner.

10.2 Alternative Approaches to Designation

Three options are available to secure the corridor for the Busway using the designation tool:

- Altering the existing "motorway" designations (Rodney and North Shore) to provide the additional land necessary for the Busway
- Altering the existing "Busway" designation (North Shore only) and either altering the "motorway" designation or having a new project-specific designation through Rodney.
- A new project specific designation covering the additional land and surplus parts of the existing NZTA motorway designation (the approach that was taken for the current Busway).

10.2.1 Altering the existing designation(s)

Section 181 of the RMA provides for the alteration of an existing designation.

10.2.1.1 Existing Motorway Designations

As set out in section 2.1.1 of the Preliminary Assessment of Environmental Effects (Appendix A - Volume 3 (Part A)) the existing SH1 designation within North Shore (references 110 and 111) are both for the "Auckland-Waiwera Motorway". Within Rodney District the SH1 corridor designation 401 provides for "Motorway and limited access highway and associated structures". Current operations do not utilise all the land within the existing designation footprint.

The extent of the existing designations could be altered to provide for the additional area required to construct, operate and maintain the Busway. Given that there is currently designated land which could be utilised to construct a Busway the amount of additional land is minimised. The key advantage of altering the current designation is that only the effects of the additional area of land would need to be considered. However, in terms of ease of acquisition, or savings in the timeframes to progress the designation, the parcels within the existing designation are primarily already in Crown ownership.

In addition, the Land Transport Management Act (LTMA) regulations with respect to motorways do not allow pedestrian access. Therefore altering the existing motorway designation would not be appropriate where pedestrian access to bus stations may be proposed. For example, some platforms may be located "online" with overbridge connections to station facilities.

Altering the motorway designation would not be consistent with the approach taken for the existing Busway which differentiates between motorway and Busway purposes in the District Plan and its maps.

10.2.1.2 Existing Busway designation

Section 181 could also be used to alter the existing Northern Busway designation 169 within the North Shore District Plan. This designation currently extends from the Auckland Harbour Bridge to Constellation Drive.

While this would result in only one Busway designation (rather than two) in the North Shore section of the Auckland Council District Plan it is noted that all District Plans in the Auckland region are currently under review as part of the Unitary Plan process. The physical extent of the alteration is also significant (and likely to extend through to the boundary with Rodney District at Lonely Track Road). As such, many of the current conditions, which relate to specifics of the existing area, would not be appropriate and therefore additional conditions would need to be applied for the new area. As such, there would be limited benefits in terms of process and administration when compared to a new designation.

10.2.2 Project specific designation

Section 168 of the RMA provides for new designations by requiring authorities such as NZTA. A new designation would overlay the existing motorway designation in parts together with additional land required for the Busway, stormwater treatment and local road realignment and private property access.

A designation that relates only to the footprint of the Busway would provide a clear depiction of the actual land requirements for the Busway and conditions would relate solely to the construction, operation and maintenance of the Busway (as opposed to the operation of the motorway as well). Most of the land subject to the existing motorway designation will already be in Crown ownership. It would avoid the need for duel sets of conditions applying to the existing designations.

A designation of land for a Busway also avoids conflicts with the status of a motorway which does not allow for pedestrians or cyclists.

Once sections of the NBE are constructed the primary motorway designation would no longer be necessary (over the land occupied by the Busway) and could be drawn back to meet the Busway designation.

10.2.3 Recommendation

A project specific designation with project specific conditions is recommended to provide the clearest signal to the community of the location and purpose of the long term use of the additional land and a clean, tailor made approach for NZTA. This approach is consistent with that taken on the original Northern Busway which also overlaid the existing motorway designation.

Some land that is designated for construction (such as setdown area, spoil disposal areas) which is no longer required once the Busway becomes operational can be uplifted in accordance with section 182 of the RMA. However, this is not able to be identified until after the construction detail is known. For the purposes of assessing the effects an envelope based on an indicative methodology and concept design is appropriate along with a framework of proposed conditions.

A series of resource consents will however be required under the regional plans for the construction of the project under sections 9 and 13 through 15 of the RMA. These will specifically relate to matters such as:

- earthworks (erosion and sediment control),
- works in relation to watercourses,
- discharges relating to stormwater or contaminated materials.

The resource consents would be prepared prior to construction of each stage of the project and not necessarily at the same time as the Notice of Requirement.

10.3 Unitary Plan

Auckland Council is currently considering submissions on the draft Auckland [Spatial] Plan. This will inform the new Unitary Plan that will ultimately replace the District and Regional Plans of the 8 legacy Councils. The exact timing of the notification of the Proposed Unitary Plan is not yet known for certain but is likely to be late 2012/early 2013.

Schedule 1 of the RMA specifies how "roll-over designations" and notices for new designations are dealt with where they are intended to be notified through a Proposed District Plan (section 170 of the RMA).

A "rolled-over designation" is a designation that was in the operative District Plan and that the requiring authority requests to have included (rolled over) into the proposed District Plan. It is not considered likely that the designation process would be complete before the Proposed Plan is notified in late 2012. As such, the roll over process has not been considered further at this stage.

The District Plan Review process provides the opportunity to serve of the NOR to enable it to be notified at the same time as the Proposed Plan. Specifically, clause 5 of the Schedule 1 of the RMA allows Council to, with the consent of the requiring authority, include a new requirement within its proposed District Plan instead of using the process under s169 of the RMA. This can be done where the NOR is lodged within 40 working days of the planned notification of the Proposed Plan. This would require the preparation of the documentation through early 2012 to be ready to coincide with the notification period for the Proposed Plan.

The key benefits of this approach are:

- Efficiencies in the process as only one notification process to go through, which is a part of the plan development process; and
- Any requests for further information on new notices of requirement must be made prior to the notification of the Proposed District Plan.

The key risks to this approach would be:

- The potential for on-going delays in the plan preparation process given the scale of the task being undertaken
- Potential need to re-lodge the NOR if there are delays in notification (as it must be within 40 working days of notification)
- Delaying serving the NOR until late 2012/early has the potential for escalation in the cost of property purchase.

The Council can recommend that conditions be imposed by the NZTA on either a new requirement, in a similar manner to that under section 168.

10.4 Designation Purpose

The existing NSCDP designation provides for: "*The North Shore Busway: For the construction, operation and maintenance of a State highway with provision for bus and high occupancy vehicle rapid transit facilities*".

Assuming high occupancy vehicle (HOVs) are not being provided for, the designation purpose for the extension (this project) would appropriately be for *"The Northern Busway Extension: For the construction, operation and maintenance of a state highway with provision for bus rapid transit facilities"*.

10.5 Effect on Existing Designations

The Busway designation will overlap a number of existing designations. The NZTA are the requiring authority for most of these (designations are detailed in Section 2.5). However, the designation will also overlap primary designations for Watercare and Auckland Transport.

The Busway design that has informed the footprint has been developed so that they will not prevent or hinder the works to which the primary designations relate. Discussions with the primary requiring authorities, pursuant to section 176 of the RMA, will be undertaken at the next stage and approval will be sought. The NZTA will require the approval of these primary designation authorities for any works (including construction and future maintenance activities).

10.6 Lapse Period

Part 8 of the RMA sets out provisions applying to designations. Section 184(1) sets out provisions in relation to the lapsing of designations as follows:

"(1) A designation lapses on the expiry of 5 years after the date on which it is included in the district plan unless—

(a) it is given effect to before the end of that period; or

(b) the territorial authority determines, on an application made within 3 months before the expiry of that period, that substantial progress or effort has been made towards giving effect to the designation and is continuing to be made and fixes a longer period for the purposes of this subsection; or

(c) the designation specified a different period when incorporated in the plan."

It is not unusual for the lapsing period of a designation to be extended over the standard 5 years as provided for by Section 184(1)(c) of the RMA. Appropriate circumstances where a lapse period could be extended include where there is a strategic direction to provide for the project in local, regional and/or national planning documents and/or where there is a need for the additional time to confirm funding and/or where there is a need for the additional time to acquire additional land holdings to enable construction.

In the case of the recommended option, it would be appropriate to seek an extended lapse period as the NBE has been signalled in the various strategies and policies for the Auckland Region (including in the Draft Auckland Plan) for the period 2021 to 2030. Early designation will provide certainty to NZTA that they will be able to deliver the NBE as provided for within these strategies as it will enable the protection of land which may otherwise be developed in the future.

11. Staging Opportunities

As indicated in Section 9.3 construction of an off line Busway extension through to Silverdale would be economically justified by around 2019, though there are a wide range of factors (not just economics) that could influence the year at which the project is deemed to be justified. This chapter considers whether there are opportunities to provide for a staged approach that could allow some of the scheme benefits to be realised earlier and considers options to integrate the NBE with the road network north of Silverdale.

In considering staging options, the possibility of providing bus shoulder lanes (or super shoulder lanes) in advance of the off line Busway has been examined. The shoulder lanes are located adjacent to the main traffic lanes, and enable buses to by-pass queuing traffic on the main carriageway during periods when SH1 is congested. This can result in a reduced journey time and subsequent travel time savings (with economic benefits). During uncongested periods, buses can remain on SH1, although frequent weaving on and off the shoulder lane is not desirable from a safety point of view.

Bus shoulder lanes are not normally extended through motorway interchanges. This is due to the conflict with the ramp merge and diverge areas. Bus shoulders usually commence some 100-200 metres beyond a ramp merge (or join at the on ramp) and terminate some 100-200 metres in advance of an off ramp. Consequently, the benefits that bus shoulders can provide does not include providing priority through interchanges or in the immediate vicinity of the ramp merge and diverge areas. Typically buses are required to merge with slow moving congested general traffic lanes over lengths of in excess of 500 metres for simple interchanges and longer distances where the ramps have multiple entry or exit lanes.

11.1 Constellation Station to Albany Station/ Oteha Valley Road

Bus shoulder lanes as an interim measure between Constellation Station and Albany Station were previously considered by a separate study undertaken by Aurecon for the NZTA (i.e. *Bus Shoulder Design and Future Proofing Options*, June 2009). This study concluded that bus shoulder lanes were not recommended in the short term due to safety concerns as well as a lack of economic support as the costs far outweighed the benefits (which accrued only to public transport users). The study concluded that general widening of the northbound lanes between Constellation Station and the Greville Road Interchange provided far greater benefits at roughly the same cost and without the safety concerns inherent in bus shoulder running.

In addition it is of note that the ability to provide interim bus shoulders between Constellation Station and Albany Station is affected by PM peak congestion, that results in vehicles queuing back to SH1 at the Upper Harbour Highway Interchange and the Greville Road Interchange.

An offline Busway could be constructed as an initial stage between Constellation Station and either the Greville Road Interchange, the McClymonts Road on ramps/ Albany Bus Station off ramp, or the Oteha Valley Road Interchange. The practicality of each of these potential initial staging options is considered below.

11.1.1.1 Constellation Station to Greville Road Interchange

Extending the Busway off line to the Greville Road Interchange is a possible first stage of the project. A connection to/from the Albany Bus Station could be achieved via the north facing Greville Road Interchange ramps. These would provide access the existing motorway which leads to the bus only on ramp at McClymonts Road and the bus only exit ramps at Albany Bus Station.

The NBE project, as currently proposed, does not incorporate south (or north) facing ramps at the Greville Road Interchange. It is likely therefore that some abortive costs would be incurred in terminating an interim stage of the Busway at the Greville Road Interchange. Therefore this option is not recommended as a feasible staging option.

11.1.1.2 Constellation Station to McClymonts Road

It would be possible to terminate an offline Busway at McClymonts Road with both northbound and southbound buses accessing the existing Albany Station via the existing road network. This option would require a significant and challenging upgrade of the McClymonts Road intersection, unless a connection to McClymonts Road is included in the project.[30] The upgrade could be abortive work if/ when the Busway is extended further north. Furthermore, to continue the Busway north, the Busway would need to be temporarily closed north of Constellation Station to enable this section to be constructed. This option is not recommended as a feasible staging option, unless a connection to McClymonts Road is included in the project.

11.1.1.3 Constellation Station to Albany Station

It is possible to terminate an offline Busway at Albany Station with northbound and southbound buses accessing the existing Albany Station via to a new bus only road connection across SH1 located to the north of McClymonts Road. This option is the preferred staging option. It would not result in any abortive work/ redundant infrastructure when the Busway is extended further north.

11.1.1.4 Constellation Station to Oteha Valley Road

Termination of the first stage of the Busway at Oteha Valley Road could incorporate a ramp termination and commencement at the Oteha Valley Road Interchange, and either a new station on the eastern side of SH1 or no station facility to the east (with the west station remaining). In the latter scenario, buses could access the existing Albany Station via Oteha Valley Road. Buses travelling southbound from the Busway station could join the northbound carriageway of the SH1 and then leave SH1 at the northbound off ramp onto Oteha Valley Road before turning south and joining SH1 via the southbound on ramp.

If the latter scenario is adopted as Albany develops into the future, there is an opportunity to establish a station (potentially incorporating both 'Kiss and Ride' and 'Park and Ride' facilities) on the eastern side of SH1 to complement (or possibly entirely replace) the existing bus station on the western side of SH1. The provision

[30] A connection to McClymonts Road was considered in the *Albany Bus Station Service Review* (attached as Appendix F), but was not adopted as part of the recommended option in favour of the bus only road connection across SH1 as proposed.

of Park and Ride facilities on the east side of SH1 would also permit redevelopment of the existing Park and Ride at Albany bus station.

This option is not recommended as buses could experience an increase in travel times between Constellation Station and Albany Station compared to the current situation.

11.1.2 Conclusion

There is not a strong economic case to justify bus shoulders as an interim stage between Constellation Station and Albany Station. In addition, the provision of shoulders along this section of SH1 would be problematic given congestion issues in the PM peak.

There are a number of staging options for an offline extension to the Northern Busway between Constellation Station and Oteha Valley Road. It is considered that the most feasible staging option would terminate on the eastern side of SH1 with a bus-only bridge providing access to the Albany Station on the western side of SH1. This option is considered most feasible as it does not result in abortive work/ redundant infrastructure at the time that the second stage of the NBE is constructed, does not require temporary busway closure to facilitate construction of a second stage and does not increase travel times between Constellation Station and Albany Station compared to the current situation.

11.2 Albany Bus Station/ Oteha Valley Road Interchange to Redvale

This section considers staging opportunities between Albany Station/ Oteha Valley Road and the future Penlink (Weiti Crossing) Interchange in the vicinity of Redvale.

11.2.1 Bus Shoulder Lanes

While the timing for the construction of a direct connection from SH1 to the Whangaparaoa Peninsula (Penlink) is not certain, the opening of this project would give an opportunity to provide bus shoulders between Oteha Valley Road and the Redvale Interchange as an interim stage of the NBE project. This option could also be implemented prior to Penlink being constructed, although the economic evaluation summarised in Section 9.3 indicates that there is a less strong economic case for the NBE project prior to the completion of the Penlink project.

Providing a bus shoulder on SH1 north of Oteha Valley Road would require some widening and strengthening of the existing motorway shoulder (currently approximately 2.5m wide) to accommodate buses. A super shoulder would incorporate an extension of SH1 surface with a separation strip (approximately 1 metre wide) between the bus shoulder and the through traffic, and further shoulder provided beyond the bus shoulder (approximately 2.5m wide). Significant construction work is therefore required.

The transport modelling indicates that by 2026 with the Penlink connection in place, journey times between Redvale and Albany will increase by as much as 80 percent, and by 2041 this will increase to near 350 percent (Refer Table 4.1 within Chapter 4). This indicates that there would be some benefit in providing bus shoulders to Redvale by 2026 in conjunction with the opening of the Penlink connection. However, given the high cost of

widening the existing shoulder, the economic case is unlikely to be strong enough to justify a shoulder bus lane for some time. It is recommended however that the overall case for this interim scheme is considered in more detail as a funding case is developed for the NBE project.

It is considered even less likely that there would be an overall economic case to construct a shoulder bus lane between the Oteha Valley Road and Silverdale Interchanges.

11.2.2 Off Line Busway

As outlined in Section 9.3, by approximately 2019 it is estimated that there would be an economic case for extending the NBE further north to the Silverdale Interchange. The provision of an offline NBE on the east of SH1 could potentially terminate at Redvale (possibly serving a new Busway station at this location), where the Busway could then be connected to SH1 and (ideally also Penlink) to allow buses to continue further north.

It should be noted, that there would be some construction challenges associated in connecting an off line busway to Redvale with SH1 to the north, as a bridge structure over SH1 would be required to accommodate journeys continuing north. The connection provided would also be likely to incur abortive costs when the Busway is extended through to Silverdale, as would be any temporary connections to Penlink.

While there would be some benefit in constructing the off line busway to Redvale by 2026, this is expected to be small relative to the cost of construction. This option does not therefore appear to be a realistic option.

11.2.3 Conclusion

There is unlikely to be a strong economic case to construct an off line bus lane between Oteha Valley Road and a future Penlink Interchange as an interim stage. There may be a case for shoulders as an interim scheme between Oteha Valley Road and a future Penlink Interchange, although this would need to be considered in more detail as a funding case is developed for the NBE project. The provision of bus shoulders to Silverdale may be justified as an interim stage of construction if a low cost means can be found of widening the shoulder and connecting it back to SH1 at the Redvale Interchange.

11.3 Redvale to Silverdale

Between Redvale and Silverdale there may also be a case to provide a shoulder bus lane in advance of an off-line Busway, although this is also unlikely to be a strong economic case as an interim stage of the NBE project. This option would therefore need to be considered in more detail as a funding case is developed for the NBE project.

11.4 Options North of Silverdale

North of the Silverdale Interchange the NBE could be integrated with the proposed Quality Transit Network (QTN) on the Hibiscus Coast Highway (SH17) through to the Silverdale North development site and on to Orewa. This would probably only be practical once the Penlink project is complete.

In the longer term the NBE could potentially be extended along SH1 to the existing Grand Drive intersection.

11.5 Summary

In summary, there are a number of opportunities to stage the development of the full off line busway through to Silverdale. It is recommended that an initial stage involves the construction of an off line busway from Constellation Station to Albany Station. This first stage of the NBE could be economically viable by approximately 2015 (refer Section 9.2).

The second stage is recommended to involve either the construction of shoulder bus lanes as an interim stage between Oteha Valley Road and Redvale (if this proves to be justifiable as the funding case is developed for the NBE project) to integrate with the construction of Penlink, or alternately where shoulders cannot be justified the construction of the full off line Busway through to the Silverdale Interchange. As indicated in section 9.2, there is little economic benefit in providing bus shoulder lanes to Silverdale (or incrementally to the Penlink connection). However, the case for bus shoulder lanes should be considered further when the project proceeds to preliminary design, and better information is available as to the associated costs and the effects on the network following completion of other projects (i.e. SH1/18 connection, Constellation to Greville Improvements, SH1/17 connection, Penlink.

12. Risk

In accordance with the NZTA Risk Management Process Manual, a formal facilitated risk workshop was held with the project design team to identify and assess project risks during the scheme assessment stage of the NBE project. The objective of the workshop was to review and update the existing project risk register to identify key project risks relating to the recommended scheme design. A copy of the updated project risk register is included in Appendix O within Volume 3 (Part B) of the SAR.

The workshop format comprised a brainstorming session with the design team and the NZTA involving:

- review the risk register and deletion and/or amendment of previously identified risks;
- addition of new risks that emerged during the scheme design phase;
- scoring of the risks in terms of probability and consequence to identify key risks; and
- update and/or formulation of risk treatment plans for new risks identified.

The following key risks have been identified in relation to the project:

- land acquisition and design scope required to future proof the project for suburban rail renders the project un-fundable / unjustifiable (the NZTA staging requires a greater footprint);
- there is no funding to purchase land to support designation;
- designation is not adequate to allow for sufficient working space to construct the busway;
- designation is not adequate for permanent works (e.g. stormwater treatment);
- property purchase values are greater than allowed for in project funding;
- footprint increases from assumed amount;
- location and extent of contaminated material encountered during earthworks, particularly at Rosedale is greater than assumed due to limited investigation;
- a greater amount of surplus cut material is found to be unsuitable for engineering works than assumed in design and estimate due to limited geotechnical information;
- the type and extent of retaining walls increases;

- foundation conditions discovered during construction do not align with design assumptions regarding ground conditions, due to limited geotechnical information availability during the design phase; and

- redesign and/or additional costs associated with mitigation of impacts on the Rosedale Wastewater treatment plant resulting from no consultation with Watercare Services Limited .

In accordance with the NZTA's SM014 Cost Estimation manual the residual costs risks not allowed for in the Base Estimate included in the risk register were identified and assessed in terms of their overall effect on the project Scheme Estimate. A brainstorming session was undertaken where the designs provided risk modelling notes for each of the cost risks in terms of the potential additional cost to the project should the risk occur. These notes were used by Beca to assess appropriate allowance for Contingency and 95th Funding Risk to be added to the Base Estimate.

13. Conclusions & Recommendations

This section draws overall project conclusions and makes a number of recommendations for the Project going forward.

13.1 Project Need

Forecast population and employment growth in North Auckland (as outlined in the Auckland Growth Strategy, 1991) will place increasing pressure on the transport network. Strategic planning documents recognise that travel demand from this future growth must be supported by public transport infrastructure. An extension to the current Northern Busway has been identified as a key project to help meet this demand. Based on traffic modelling the need for the Busway extension is triggered by increased congestion on SH1. However, the Busway extension is not predicted to result in a significant decrease in traffic volumes on SH1 because the number of trips predicted to switch from car to bus is small relative to overall traffic volumes.

In addition, population and employment growth will increasingly placing pressure on available development land. There are currently pressures to rationalise the existing state highway designations and release surplus land. Much of the currently designated land within the SH1 corridor, and additional land, is required to accommodate a future extension of the Northern Busway. The NBE project has fully investigated the land requirement for a future extension to the Northern Busway and a strategy for the acquisition land required to support the NBE is recommended (refer Section 13.5).

13.2 Project Objectives

The strategic project objective of this NBE study was to identify a route and land to be protected for an extension to the Northern Busway between Constellation Station and Silverdale that will be integrated, safe, responsible, affordable and sustainable. The recommended option described and assessed herein meets this Project objective having been identified through a robust evaluation process that gave consideration to this objective. In addition, it meets the project objectives (as do the other options) by:

- assisting to meet future transportation demand generated by predicted population and employment growth in North Auckland;
- improving the future capacity on the SH1 motorway corridor through modal shift to public transport;
- providing for a high degree of safety for transport users;
- being designed to integrate with planned and programmed future transport network improvements, ensuring that such improvements are not precluded in the future by the NBE;
- providing for effective integration between all transport modes and with existing and planned future land use, at Albany and Silverdale; and

- ensuring that a long term RTN solution is provided through horizontal design that allows for future conversion to light or heavy rail.

13.3 Consultation

Consultation with Auckland Transport and Auckland Council (as key stakeholders) has been on-going throughout the investigation. Decision making at each stage of the process has been collaborative with officers involved in all key workshops. Auckland Council and Auckland Transport have residual concerns in relation to the integration of an eastern aligned option with the Albany Station. It is therefore recommended that further consultation be undertaken with these stakeholders, prior to NZTA confirming the preferred option.

In addition, it is recommended that Watercare be consulted in relation the impacts of the recommended option on the Rosedale Wastewater Treatment Plant, and that consultation with Hokai Nuku be advanced further, with wider community consultation being undertaken thereafter.

13.4 Recommended Option

Subject agreement being reached with Auckland Council and Auckland Transport on a preferred option, it is recommended that a route be protected for an eastern aligned extension of the Northern Busway between Constellation Station and the future Hibiscus Coast Busway Station. An eastern aligned NBE is recommended because:

- it avoids the Site of Ecological Significance at Lucas Creek West Bush, and adverse effects on other ecologically significant areas can be avoided or mitigated;
- while it will generate localised visual effects on some residential properties these can be adequately mitigated;
- it provides for a less constrained western side of SH1, enabling greater flexibility for future changes within SH1 corridor;
- it is comparatively one of the least expensive options, costing 20 percent less than option 3 (and the relatively the same as option 1) whilst offering broadly the same scheme economic benefits as the other options; and
- changes can be made to the connections and bus network serving the existing Albany Station to better provide for integration with the current bus network (refer to the *Albany Bus Station Bus Service Review* attached as Appendix F within Volume 3 (Part B) of the SAR).

13.5 Staging

It is recommended that the Busway is implemented in stages over a number of years. The most feasible initial stage would involve the construction of an off line Busway from Constellation Station to Albany Station. This stage could deliver approximately 70 percent of the benefits of the full NBE. The analysis indicates that construction of this stage would be economically justified (i.e. have a BCR of greater than one) by as early as 2015.

There is little benefit in providing bus shoulder lanes to Silverdale (or incrementally to the Penlink connection). However, the case for bus shoulder lanes should be considered further when the project proceeds to preliminary design, and better information is available as to the associated costs and the effects on the network following completion of other projects (i.e. SH1/18 connection, Constellation to Greville Improvements, SH1/17 connection, Penlink).

13.6 Property Acquisition

The recommended option affects around 85 parcels of land, owned by approximately 39 parties. The total land requirement equates to approximately 220,262sqm, 70,286sqm of which is located between Constellation Station and Albany Station, and 149,976 of which is between Albany Station and the future Hibiscus Coast Busway Station.

A *Draft Property Acquisition Strategy* (the Strategy) has been completed by the Property Group Limited for the NBE Project. The Strategy recommends strategic advance purchase of properties where this may be desirable for economic reasons or where a protracted high cost negotiation is expected. There are no unmanageable risks are identified within the Strategy.

In addition, it is recommended that consideration be given to whether designated land surplus to the Busway is required for future motorway purposes. Where this is land is not owned by the NZTA and is not required for motorway purposes the designation can be uplifted in accordance with the Section 182 process under the RMA.

13.7 Consenting Strategy

There are various mechanisms available to consent the recommended option for an extension to the Northern Busway as described in Chapter 10. In this instance it is recommended that the most appropriate mechanism is a NoR to designate the land required. A designation would enable land required for the NBE would be protected from future development and identify it in the District Plan. It is recommended that NZTA seek an extended lapse period on the designation of 15-20 years to further provide this certainty.

The designation would overlay the motorway designation in part, in the same manner as the existing Busway designation. It is recommended that the purpose of the designation be for: *"The Northern Busway Extension: For the construction, operation and maintenance of a state highway with provision for bus rapid transit facilities"* and that NZTA develop a set of conditions which provide for the use of management plans which can

be updated through the construction phase. This will provide flexibility in terms of construction methods and processes at different stages of the project.

In addition, the Busway designation would overlay Watercare and Auckland Transport designations. The Busway design that has informed the footprint has been developed so that they will not prevent or hinder the works to which the primary designations relate. Discussions with the primary requiring authorities, pursuant to section 176 of the RMA, will need to be undertaken at the next stage and approval will be sought. The NZTA will require the approval of these primary designation authorities for any works (including construction and future maintenance activities).

Resource consents will be required prior to construction of each stage of the project and not necessarily at the same time as the Notice of Requirement. The resource consents are likely to be required under the Regional Plans for the construction of the recommended option under sections 9 and 13 through 15 of the RMA. These will specifically relate to matters such as earthworks (erosion and sediment control), works in relation to watercourses, discharges relating to water or contaminated materials.

14. Next Steps

The following next steps are recommended to progress the NBE project to the designation stage:

- **Consultation:** continued consultation with Auckland Transport and Auckland Council to gain agreement on a preferred option; continued Iwi consultation; and consultation with Watercare and the community, including the holding of a public open day.

- **Confirmation of a preferred option:** following the completion of the consultation noted above.

- **Development of a funding strategy:** involving further analysis of the wider economic benefits and preparation of a funding application.

- **Development of documentation (including finalisation of the AEE) and drawings:** to an appropriate level of detail to support designation and the lodging of Notice(s) of Requirement, with consideration of the principles set out in Urban Design Framework attached as Appendix M within Volume 3 (Part B) of the SAR.

- **Application for Designation and Lodging of Notice of Requirements**: to secure land for the recommended option for an extension to the Northern Busway.

- **Preparation of resource consent applications:** involving further investigations where these are required to support the construction works for the NBE