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North Harbour 2 Watermain and Northern Interceptor in Shared Corridor

VOLUME ONE
ASSESSMENT OF EFFECTS ON THE ENVIRONMENT

Watercare
An Auckland Council Organisation

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Volume Two – Technical Reports

Volume Three – Consent Drawing Set

ABBREVIATIONS

Abbreviation	Description
AEE	Assessment of Effects on the Environment
CAR	Corridor Access Request
CMA	Coastal Marine Area
CNVMP	Construction Noise and Vibration Management Plan
DN	Diameter Nominal
ESCM	Erosion and Sediment Control Measure
ESCP	Erosion and Sediment Control Plan
GBWD&C	Greenhithe Bridge Watermain Duplication and Causeway
HNZPTA	Heritage New Zealand Pouhere Taonga Act 2014
LCP	Landscape Concept Plan
MHWS	Mean High Water Springs
MSL	Mean Sea Level
NH1	North Harbour 1 Watermain
NH2	North Harbour 2 Watermain
NI	Northern Interceptor
NOR1	Notice of Requirement 1 NH2 Waitakere
NOR2	Notice of Requirement 2 NH2 North Shore
NOR3	Notice of Requirement 3 NH2/NI Waitakere shared corridor
ND	Overall Diameter
PAUP	Proposed Auckland Unitary Plan
Projects	The North Harbour 2 Watermain Project and Northern Interceptor in Shared Corridor Project
RMA	Resource Management Act 1991
SH16	State Highway 16
SH18	State Highway 18
SMP	Site Management Plan
TMP	Traffic Management Plan
NCoPATC	National Code of Practice for Utility Operators' Access to Transport Corridors
Watercare	Watercare Services Limited

EXECUTIVE SUMMARY

Watercare Services Limited (Watercare) provide bulk water supply and wastewater services for the Auckland Region. Future development and population growth predictions for Auckland identify the need to provide additional water and wastewater infrastructure to accommodate this growth. Watercare have initiated two infrastructure projects to assist with accommodating this growth:

- The North Harbour 2 Watermain (NH2) project will convey potable water from storage reservoirs in Titirangi, via west Auckland and North Shore, to storage reservoirs in Albany (a length of approximately 33kms) to increase capacity and resilience of Watercare's water supply network to the North Shore of Auckland.
- The Northern Interceptor (NI) will comprise a new number of wastewater pipelines installed in phases that will connect the flows originating from Northwest Auckland to the Hobsonville Pump Station. These flows will then be conveyed north, to the Rosedale Wastewater Treatment Plant (WWTP). Phase 1 of the NI connecting the existing Hobsonville Pump Station to the Rosedale WWTP has been consented.

This Assessment of Effects on the Environmental report (AEE) provides support for Watercare to designate three separate land areas along the NH2 and NI alignments to appropriately and sufficiently enable both their construction and on-going operation and maintenance. Watercare seeks to designate the full length of NH2, but only a portion of NI at this time. In this report, the "NI project" is the portion within the shared corridor and the "Project" refers to both the NH2 project and the NI project.

The three designation corridors proposed are:

1. NOR1 - for the NH2 from Titirangi to the eastern end of Fred Taylor Drive;
2. NOR2 - for the NH2 from the eastern side of Greenhithe Bridge to the Albany Reservoir; and
3. NOR3 - that will be a "shared corridor" for the NH2 and a section of NI from the eastern end of Fred Taylor Drive to the western end of the Greenhithe Bridge Causeway.

In addition to the above land designations, this AEE provides support to the various resource consents that will be required for the NH2 part of the Project. Assessments of environmental effects have been undertaken to identify potential adverse effects on the environment and recommendations for appropriate avoidance, remediation and mitigation measures. These measures can be appropriately implemented through use of construction management practices and mitigation measures for noise, vibration, traffic, dust, visual and landscape effects and include adopting erosion and sediment control measures for earthworks activities; monitoring the effects of excavation on ground water and associated settlement; remedial planting alongside pipe bridges and other above ground ancillary componentry. Post construction, effects of the Project will result in an overall positive nett benefit on the environment insofar as they will provide significant infrastructure services considered necessary to support the growth aspirations of the Auckland region.

A statutory assessment forms part of the AEE and confirms that the Projects are consistent with the relevant objectives and policies of the Auckland regional and district plans, and the Proposed Unitary Plan. The statutory assessment confirms that the Projects pass the relevant statutory tests of sections 171, 104D and 104 of the Resource Management Act.

Consultation has been undertaken with affected parties, key stakeholders and interested iwi groups. This consultation is ongoing and will ensure that the Projects will be well communicated to all those with an interest through to their commissioning.

Overall the Projects have significant positive effects, potential adverse effects during construction that can be adequately mitigated and has been assessed against the relevant statutory criteria and found to support the purpose of the Resource Management Act.

1 INTRODUCTION & PROJECT OVERVIEW

1.1 Watercare Services Limited

Watercare Services Limited (Watercare) is the bulk water and wastewater service provider for the Auckland Region. Watercare is wholly owned by Auckland Council (Council) and became a Council Controlled Organisation (CCO) on 1 July 2012. The company's obligation to deliver water and wastewater services for Auckland is established under section 57(1) of the Local Government (Auckland Council) Act 2009.

Watercare's vision and key goals are set out in its Statement of Intent for the period 2014-2017. The vision is "outstanding and affordable water services for all the people of Auckland". "Outstanding" means Watercare will provide safe drinking water, promote efficient water use, and protect waterways and the environment through the effective transport and treatment of wastewater. "Affordable" water services means that Watercare will run an efficient business and keep the overall costs of services to customers (collectively) at minimum levels.

Watercare's service objectives require development of durable assets to meet required service delivery standards and foreseeable future needs. This includes providing sufficient capacity to convey wastewater and potable water.

Future development and population growth predictions for Auckland identify the need to provide additional water and wastewater infrastructure to accommodate growth. Two of the infrastructure projects being planned to assist with accommodating this growth are the North Harbour 2 Watermain (NH2) and the Northern Interceptor (NI) (collectively referred to in this report as the "Projects").

1.2 Watercare Responsibilities & Corporate Objectives

Watercare's obligations to deliver water and wastewater services for Auckland are established under s57 (1) of the Local Government (Auckland Council) Act 2009.

1.2.1 Project Objectives

The specific objectives for the NH2 project are:

- *To increase security of supply within the water reticulation network in the Auckland region;*
- *To increase distribution capacity to accommodate projected growth in the Auckland region and associated increase in water demand;*
- *To increase resilience of the water reticulation network of the Auckland region.*

The specific objectives for the NI project are:

- *To provide additional capacity in the wastewater network for growth and development in the west and north-west of Auckland;*
- *To provide for an effective / efficient pipeline route for wastewater to be conveyed from west and north-west Auckland to the Rosedale Waste Water Treatment Plant.*

1.2.2 NOR specific objectives

The objective for Notice of Requirement 1 NH2 Waitakere (NOR1) is to protect the route through an area of the former Waitakere City Council for the construction, operation and maintenance of NH2.

The objective for Notice of Requirement 2 NH2 North Shore (NOR2) is to protect the route through the area of the former North Shore City Council for the construction, operation and maintenance of NH2

The objective for Notice of Requirement 3 NH2/NI shared corridor Waitakere (NOR3) is to protect the corridor shared by NH2 and NI through an area of the former Waitakere City Council for the construction, operation and maintenance of NH2 and NI.

1.3 Existing Infrastructure

Watercare's existing North Harbour 1 Watermain (NH1) supplies water to the northern parts of Auckland's North Shore, Whangaparaoa and Orewa. The only other supply to the North Shore is via watermains crossing the Auckland Harbour Bridge. These latter watermains supply Devonport, Takapuna, Northcote, Birkenhead and East Coast Bays.

Watercare's current wastewater system takes all wastewater generated from the north west of Auckland to the Mangere Wastewater Treatment Plant (WWTP).

1.3.1 The Greenhithe Bridge Watermain Duplication (GBWD) And Causeway Project

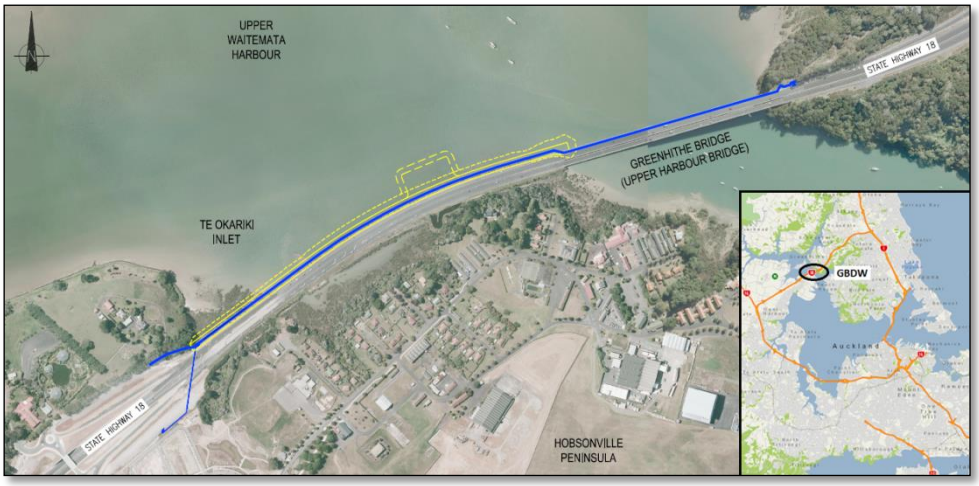


Figure 1: Greenhithe Bridge and Causeway

The NH1 is one of two main pipelines supplying water to the North Shore. It crosses the Upper Waitemata Harbour between Hobsonville Point and Greenhithe through the original (southern) Greenhithe Bridge. Significant risks have been identified relating to the section of NH1 within the Greenhithe Bridge in relation to on-going wear, age, movement of the NH1 from bridge movement, the potential for damage from seismic activity, and limited access for maintenance. These combine to present a major supply risk for Watercare to securely provide water to the north and north-west of Auckland. In particular, to currently undertake more significant remedial and maintenance to the NH1, the water supply must be cut off for unacceptable periods of time causing water supply issues for north and north-west Auckland.

The GBWD project (spatial extent shown in Figure 1 above) involves constructing the section of the NH2 within the northern side of the Greenhithe Bridge, and soon to be widened western approach causeway. This NH2 will duplicate the existing NH1. With this duplication in place, the NH1 can be shut down for essential maintenance work to be undertaken while the NH2 maintains water supply to the North Shore. The GBWD consent includes scope for sections of NI to be constructed within the new causeway. The first phase of NI was consented at the same time as the GBWD&C and starts at Hobsonville Pump Station and passes under the Upper Waitemata Harbour from the widened causeway towards Rahui Road in Greenhithe. NI terminates at the Rosedale Wastewater Treatment Plant.

1.4 North Harbour 2 Watermain Project Overview

The NH2 Project is a new pipeline to convey potable water from Titirangi, via west Auckland, Westgate, Hobsonville and the North Shore, to storage reservoirs in Albany (a length of approximately 33kms). Construction of NH2 will increase capacity and resilience to Watercare's water supply network within the North Shore of Auckland.

The Project will involve obtaining resource consents for the construction and on-going operation and maintenance of the NH2, along with creation of suitable designated areas along the NH2 route via submission of Notice of Requirements to Council.

NH2 within the NOR3 shared corridor will link with the NH2 within NOR2 through the GBWD project outlined in section 1.3.1 of this report.

1.5 Northern Interceptor Project Overview

The NI project will comprise a new wastewater pipeline that will connect the flows originating from northwest Auckland (including Red Hills, Massey North, Kumeu, Riverhead, Huapai and Whenuapai), convey these to the Hobsonville Pump Station from where they will then be conveyed to the Rosedale Wastewater Treatment Plant (WWTP). The NI project will be delivered over a number of years as different independent phases, and as demand for wastewater services increases with urban development.

The section of NI to be provided for within NOR3 land (approximately 6 kilometres in length) will be one of these phases. NIwill be located along a similar alignment as NH2 as it travels from the intersection of Fred Taylor Drive and the North Western Motorway (State Highway 16 'SH16'), along the southern side of the Upper Harbour Highway (State Highway 18 "SH18"), to the Hobsonville Pump Station where it will link with the portion of the pipeline already consented by the GBWD project (as outlined in section 1.3.1 above). .. References to NI within this AEE are only in respect to the section of the NI (and its associated ancillary components) to be constructed within the NOR3 corridor outlined in more detail in section 1.6 below. NOR3 is referred to within this AEE as a "shared corridor" as it will provide for both the NH2 and NI projects. The remainder of the NI to be constructed that will be outside of NOR3 are to be consented separately.

1.6 Purpose of this Report

Watercare proposes to designate land for the length of NH2 and section of NI within NOR3 in accordance with Section 168 of the Resource Management Act 1991 (RMA). The planning approval and consenting strategy for NH2 comprised designating the NH2 corridor and NI within the shared corridor (including associated ancillary components), along with obtaining a suite of resource consents for NH2 only. Given NH2 is 33 kilometres in length and on both sides of the upper Waitemata Harbour, and that NI is sharing part of the corridor, Watercare have sought three NORs that reflect these (albeit) minor distinctions. The purpose of this report is to provide the statutory support for these designations and the resource consents to be sought for NH2. The three designation corridors will include:

1. NOR1 (area generally within yellow in Figure 2): A corridor for NH2 travelling from Titirangi to the eastern end of Fred Taylor Drive;
2. NOR2 (area generally within green in Figure 2): A corridor for NH2 travelling from the eastern side of the Greenhithe Bridge to the Albany Reservoir; and
3. NOR3 (area generally within orange in Figure 2): This is the shared corridor for both NH2 and a section of NI from the eastern end of Fred Taylor Drive to the western end of the Greenhithe Bridge Causeway.

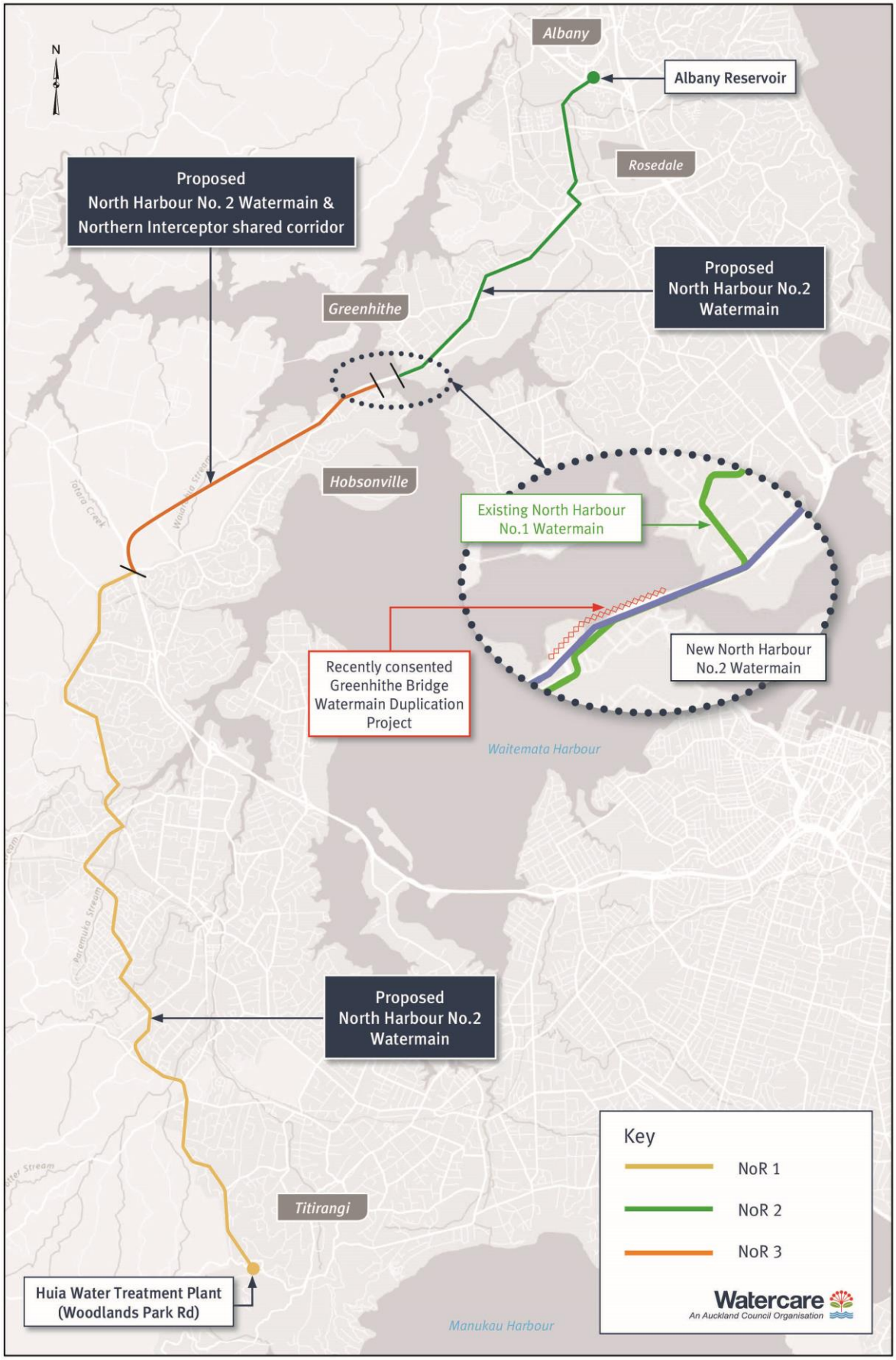


Figure 2: NOR 1 (yellow) and NOR 3 (orange)

The land to be designated is shown in detail on land requirement plans in Volume 1 of the AEE.

The three designations include sufficient land to enable the construction and the on-going operation and maintenance of NH2 and NI. The designated land includes sufficient space for temporary construction activities and/or storage of materials and plant. After construction, some of these construction areas will be surplus to requirements and the designation will be either be uplifted or reduced pursuant to section 182 of the RMA as appropriate.

1.7 Structure of this Report

This report comprises three volumes which should be read in conjunction with the resource consent applications and drawing set. The three volumes of the AEE are as follows:

Volume 1 Notices of Requirement for Designation being:

- NOR1: Titirangi – Fred Taylor Drive (NH2 only);
- NOR2: Greenhithe to Albany Reservoirs (NH2 only);
- NOR3: Fred Taylor Drive to Greenhithe Bridge (NH2 and NI, shared corridor)

Resource consent applications (NH2 only)

Assessment of Effects on the Environment Report

Volume 2 Technical Reports

Technical Report A	Earthworks, Erosion and Sediment Generation
Technical Report B	Soil, Sediment and Groundwater Contamination
Technical Report C	Groundwater Assessment
Technical Report D	Ecological Assessment
Technical Report E	Traffic Assessment
Technical Report F	Construction Noise and Vibration Assessment
Technical Report G	Landscape and Visual Assessment
Technical Report H	Arboriculture Assessment
Technical Report I	Archaeology Assessment

Volume 3 Drawing Set

2 PROPOSED WORKS

2.1 Description of NH2 Proposed Works

Watercare are seeking to designate a corridor along the route of the NH2 and obtain a suite of resource consents for its construction and on-going operation and maintenance in preparation for its planned construction within the next two years. Key elements of the NH2 project include:

1. Pipeline installation, operation and maintenance of a new watermain of 1200mm nominal diameter (ND) (from Woodlands Park Road Reservoir to the Greenhithe Bridge), and 900mm ND (from Greenhithe Bridge to the Albany Reservoirs);
2. Pipeline length of approximately 33 kilometres mostly within public road reserve; and
3. Other features including valve chambers, scour valves, air valves, line valves, bulk supply points, pipe bridges, cathodic protection and associated works.

The Woodlands Park Road Reservoir is the intended (designated) location for the new Huia Water Treatment Plant (WTP). Construction of the Huia WTP will also require regional consents, which will be sought at the time of construction. All regional consents required for the site (including vegetation removal within an SEA) will be sought at the same time. As the construction of NH2 in this location will not occur in advance of the Huia WTP works, any regional consent's required for the Huia WTP will include sufficient clearance of vegetation that can subsequently be used for the tunnel launching pit for NH2. As a result, no consent is sought for vegetation clearance for the tunnel launching pit within the current designated site.

In light of recent community opposition to the felling of mature kauri trees in Waitakere, Watercare is currently doing a further assessment of potential alternative sites for the Huia WTP. Should an alternative WTP site be selected, the connection point at this end of the alignment for NH2 may need to be amended. If an alternative WTP site is selected then an NoR will need to be lodged to designate both the alternative WTP site and the NH2 route connecting to that new site. In that scenario, the alternative route is likely to rejoin NOR1 at the intersection of Parrs Cross Road and Holdens Road. The current route the subject of NOR1 is from the existing designation for the Huia WTP. Until such time as an alternative site is selected and designated, the intended route of the NH2 watermain is as shown in the Drawing Set (volume 3) appended to this AEE.

NH2 will be constructed by open trench and trenchless technologies (trenchless being micro tunnelling and / or bored tunnel, (referred to as "trenchless technology") within a typical construction corridor between 12 – 22 metres in width. The launching pit within the Woodlands Park Road Reservoir site will be located within a cleared area that has previously served as the site for geotechnical investigations. This will reduce the amount of vegetation removal necessary to facilitate the tunnel launching.

Additional areas will be required for erosion and sediment control devices, traffic management, construction yards and storage areas at intervals along the route for construction purposes. The Greenhithe Bridge and Watermain Duplication (GBWD) and Causeway project and advanced works in Fred Taylor Drive will be integrated into the NH2 project.

Chambers for scour valves, air valves and line valves will be installed along the alignment to allow access for commissioning, maintenance, and operational reasons. These chambers are described below.

Scour valves enable the watermain to be drained for commissioning, maintenance, and for operational reasons. A number of scour valves and discharge pipes of 200mm to 300 mm ND will connect to the watermain. The discharge pipes will pass through a dry chamber (which enables access to the valves) and will discharge into a common stilling chamber. The stilling chamber will provide for energy

dissipation and de-chlorination before water is discharged through an outlet to a local watercourse (as done elsewhere in Watercare's network).

Line valves enable sections of pipeline to be isolated, by closing adjacent line valves, for operational reasons, inspection and maintenance. Line valves are located in underground chambers and accessed through manhole covers at ground level. A line valve chamber varies in size according to the valve size and specific detailed requirements. They can be in the order of 4m x 5m in area and 3.5m deep.

Air valves are to be located at a number of high points along the pipeline. Air valves are designed so that maintenance can be carried out without shutting down the pipeline. Each air valve has a diameter of approximately 150mm with minimum ground cover of 1.5m and is contained in a chamber of approximately 2 m by 3 m in area.

2.2 Description of NI Proposed Works

The section of NI to be designated for within the NOR3 shared corridor will incorporate the following:

- A new wastewater pipeline of 2100mm ND approximately 5km in length;
- 16 pits / shafts for trenchless technology construction purposes. 5 of these will be permanent manholes (MT Pits 2, 7, 11, 13 & 17) while the others (MT Pits 3, 4, 5, 6, 8, 9, 10, 12, 14, 15 and 16) will be temporary only until construction / testing is completed;
- MT Pit 7 will be a drop structure with permanent access, to allow for a future wastewater pipeline connection across SH18;
- A new wastewater pipeline approximately 50m long, and manholes connecting the 2100mm ND pipeline to the existing pump station;
- A new 1750 l/s pump station with future capacity of 3,500l/s;
- Wastewater storage (within pipeline);
- Two 1500mm ND rising mains (length to the causeway), approximately 800m long;
- A 2100mm ND pipe installed by trenchless technology at SH18; and
- Installation of vents to let air in and out where necessary. Locations to be confirmed through pneumatic design.
- Air valve and scour valve chambers.

2.3 Pipeline Routes

The **blue** line in Figure 3 indicates the proposed route for the NH2 starting from adjacent to the Woodlands Park Road Reservoir, then passing through West Auckland and North Shore before ending at the Albany Reservoirs (approximately 33km in length including a section within the Greenhithe Bridge Duplication and Causeway project).

The **orange** line in Figure 3 indicates the approximate extent of the NI project to be included in the shared corridor (approximately 6km in length). This section will begin to the north of the western end of Hobsonville Road, travel along the southern side of SH18 to the Hobsonville Pump Station at 68 Buckley Avenue, to the edge of a new causeway westward of the Greenhithe Bridge (refer drawings in Volume 3) at Hobsonville.

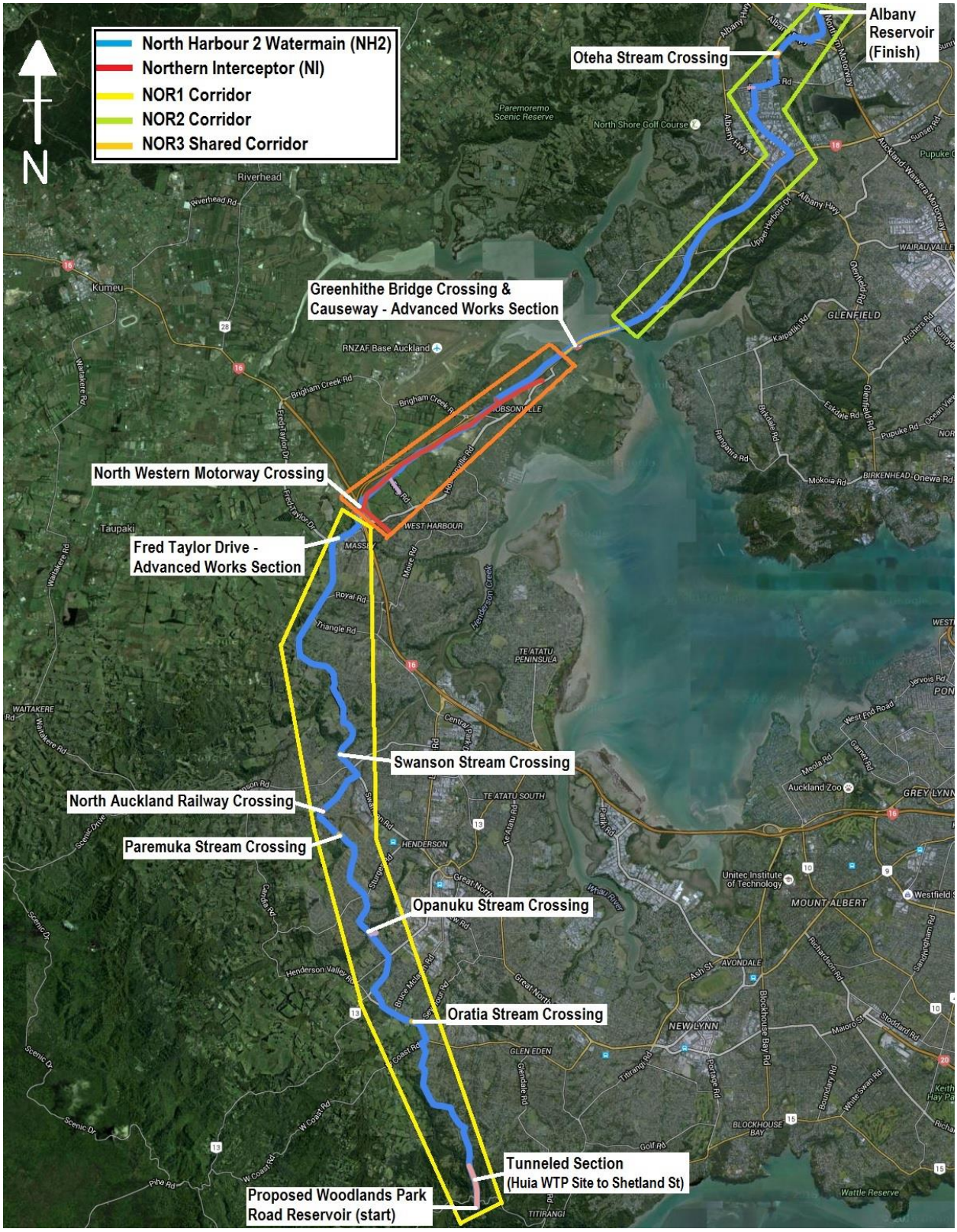


Figure 3: Blue line is the proposed NH2 route and Orange line is NI section within shared corridor

2.4 Construction Options

The various components of the two projects can be constructed by a number of methodologies. Where this is the case, this AEE describes potential options. The selected methodology will be finalised once a contractor has been appointed. Assessments provided in this report are sufficiently broad to enable

consideration of effects associated with different construction methodologies. The NI wastewater infrastructure construction programme has a longer project timeline so design concepts presented herein are conceptual.

All dimensions, areas and volumes provided in this AEE are approximate and it is possible that some details may change as the design and construction methods are finalised. Any refinements that may occur during this process are not expected to result in substantive changes to the assessment of effects on the environment as set out in this AEE and the supporting technical reports.

2.5 Key Roads and Property Within Designation

Drawings showing the proposed alignments of NH2 and section of NI to be located within the shared corridor are included in the drawing set in Volume 3 of the AEE. Project and route features for key roads and property are described below. The majority of the NH2 will be constructed using open trench methods. The majority of NI will be constructed using trenchless methods.

2.5.1 Titirangi to Fred Taylor Drive

Key roads the NH2 will be located within or alongside:

Shetland Street, Phillip Avenue, Glengarry Road, Parrs Cross Road, Forest Hill Road, Border Road, Palmino Drive, Summerland Drive, Munroe Road, Metcalfe Road, Swanson Road, Don Buck Road, Fred Taylor Drive.

Key route features:

- The NH2 will start from within the Woodlands Park Reservoir property. Trenchless technology will then send the NH2 approximately 800m through a ridge where it will travel northward under Scenic Drive, Konini Road,adjacent private properties, and a unnamed paper road reserve adjacent to Tawini Road, The trenchless technology will cease at the southern end of Shetland Street where open trenching will then be used. Some areas of vegetation will be removed above the start of the trenchless technology section within the Woodlands Park Road reservoir site to facilitate this type of activity ;
- Primarily along local roads to Metcalfe Road. Option to cross under railway line at Metcalfe Road via trenched or trenchless technology;
- Minor intrusion into private property and/or esplanade reserve at Parrs Cross Road to enable the pipe bridge at Oratia Stream.
- Pipe bridges over Oratia Stream; Opanuku Stream; Paremuka Stream, and Swanson Stream;
- Cathodic protection to be placed within the Plumer Domain, east of Opanuku Stream;
- The section along Fred Taylor Drive from Don Buck Road to just short of SH16 has already been constructed in collaboration with Auckland Transport's roading upgrade project (and referred to as advanced works within this document).

2.5.2 North-Western Motorway to Hobsonville Pump Station (NOR3 shared corridor)

Key roads that NH2 and NI will be located within or alongside:

North-Western Motorway (SH16), Upper Harbour Motorway (SH18), Trig Road, Ryans Road, Brigham Creek Road, Olive Sinton Road and Squadron Drive.

Key route features:

- Connection to advanced works (described section 2.5.1) at eastern end of Fred Taylor Drive;

- Trenchless technology to tunnel NH2 under SH16 northward of the intersection of SH16 and Fred Taylor Drive. Both the NH2 and NI to be tunnelled under SH18 prior to and after the Hobsonville Pump Station respectively;
- The NOR3 designation corridor will include privately owned land to the south of SH18 including recently issued titles for residential housing within the Hobsonville area.
- The NH2 will be constructed via open trench within land designated for SH18.
- The NI will be constructed partly underneath private property via trenchless technology. A number of above ground construction areas (including shafts and access roads) are to be provided, however after construction only five permanent access shafts (numbers 2, 7 11, 13 and 17) will remain for pipeline access purposes for operation and maintenance.
- Cathodic protection will be provided on Trig Road. This is a permitted activity whereby NOR3 does not seek to include this land area within the designation. However the earthworks consent will be relied on for installation of the infrastructure.

2.5.3 Eastern End of Greenhithe Bridge to Albany reservoir

Key roads the NH2 will be located within:

SH18, William Pickering Drive, Douglas Alexander Parade, Rosedale Road, Bush Road, Albany Expressway, Corinthian Drive.

Key route features:

- The majority of the NH2 to be constructed progressively within roads or road berms via open trench including vegetation removal.
- Option for pipe bridge, trenchless technology or combination at Oteha Stream, Bushlands Park Reserve.
- Trenchless technology to pass beneath the intersection of Tauhinu Road and State Highway 18 and Greenhithe Road near SH18, Albany Highway and Albany Expressway as well as a number of other shorter lengths along SH18.
- Cathodic protection to be placed within the Rosedale Park.

2.6 Construction Methodologies for NH2 and NI

2.6.1 Open Trenching

The majority of the NH2 will be constructed by conventional open trenching methods and predominantly located within road reserve.

Figure 4: trench being dug in road

Figure 5: pipe section being lowered into trench

Figure 6: example of construction area with traffic management

Typically the construction corridor will be approximately 12 to 22 metres wide within the designation corridor. This width is necessary to provide room for the trench, the construction machinery, temporary storage of materials to be used, and safety set-backs for traffic, public and construction crew. Entire work areas are expected to be approximately 200m long to include approach areas for distance and setbacks required for traffic management at either end of the work area. The length of open trench at any one time will generally be 20-40 metres with gradients of the trenching to generally follow land topography. The pipe trench itself will be between 2-3m wide and 3-4m deep. The pipeline will normally be buried underground with a minimum cover (top of pipe to ground level) of 1.5m to provide protection and to avoid creating a barrier for the installation of future utility services. Figure 4 shows an example of an open trench being dug into a local road. Figure 5 shows large pipeline section being lowered into trench. Figure 6 shows an example of an open trench construction area.

The typical plant and equipment required for trenching includes a 20-30 tonne excavator, 6 wheeler tip trucks, support vehicles, construction equipment and site facilities.

Construction may be undertaken at a number of concurrent work areas along the pipeline route. Concurrent construction areas are not uncommon on linear projects such as this (for example Hunua 4 has multiple work areas open at any one time). The traffic management plan process will ensure that traffic effects from different work sites do not result in cumulative traffic effects on any community. The Corridor Access Request process will provide further checks during construction to ensure that impacts on traffic disruption are minimised.

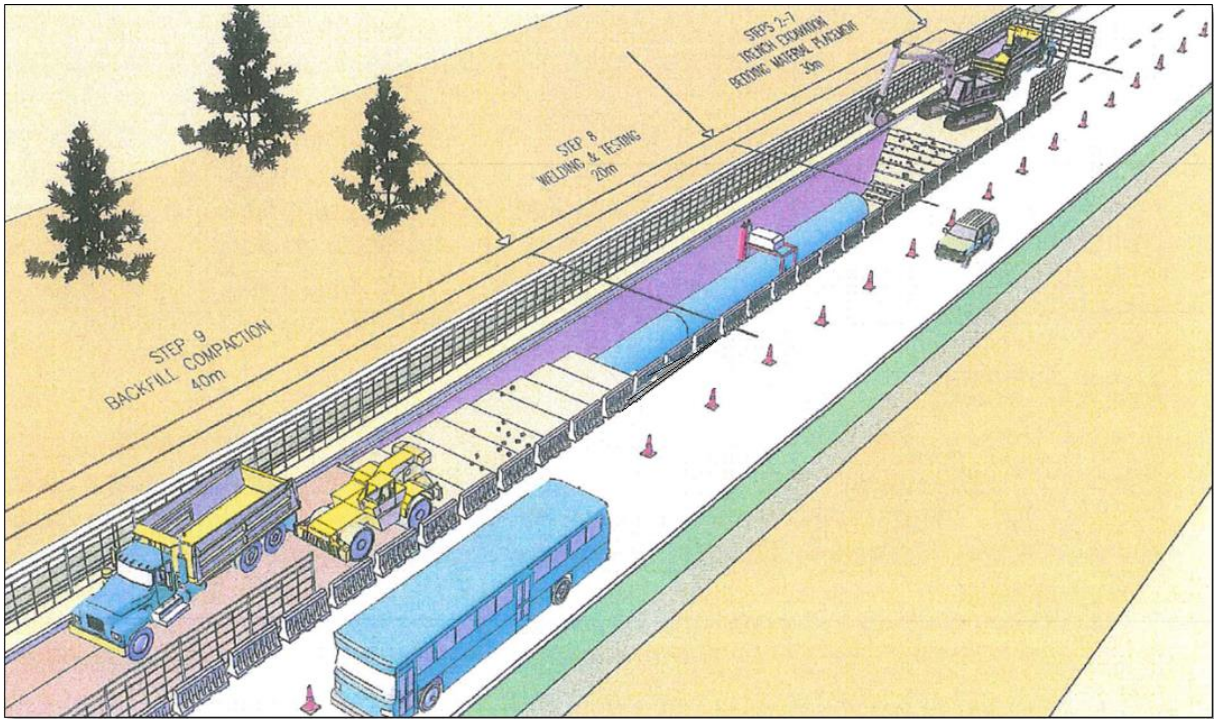


Figure 7: Typical open trenching construction footprint

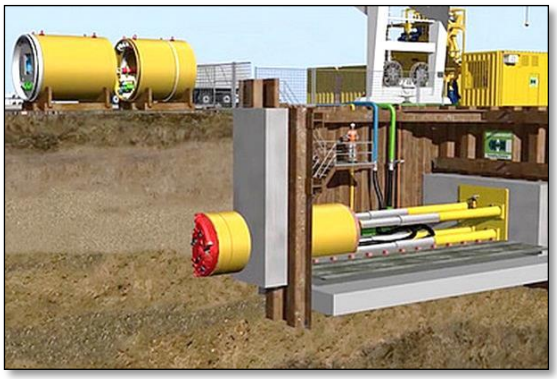
The following outlines the typical sequence for open trenching construction for NH2 illustrated in Figure 7:

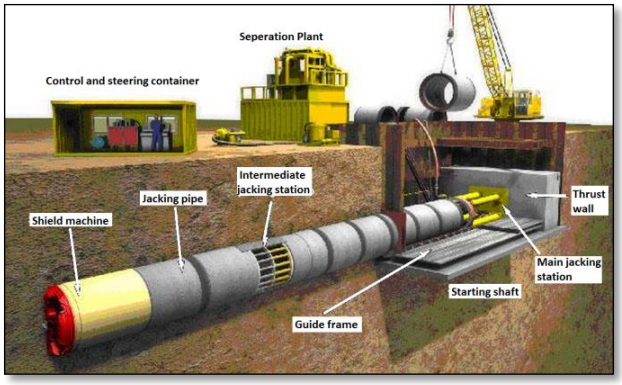
- Site safety and traffic control set up as required;
- Cut into ground surface, with road surface and sub-base removed for disposal;
- Where required, place trench support with the type and extent determined by geotechnical conditions anticipated to vary along the project route;
- Excavation of trench to approximately 150-300mm below the pipe invert level with the majority of excavated material loaded onto a truck for immediate removal from site;
- Dewatering as required, depending on groundwater table level;
- Placement of granular pipe bedding material;
- Pipes lowered into the trench using a large excavator or crane;
- Where required installation of shoring boxes for safe welding and wrapping of pipe joints;
- Internal and external welding of pipe joints carried out and tested; internal concrete lining repair and application of external wrapping;
- Backfilling of trench and compaction up to ground level. Compaction usually required in 200-300mm;
- Reinstatement of the road surface with pavement material to match the adjacent pavement in compliance with the Code of Practice for Temporary Traffic Management (COPTTM);
- Removal of site safety and traffic controls.

2.6.2 Trenchless Technology

Trenchless technology will be used in some locations for the NH2 and all of NI within the shared corridor. This is a practical method to use when it is desired to locate a pipeline at depth e.g. under Scenic Drive

Ridge (Woodlands Park tunnel), to minimise disruption that may otherwise result using standard trenching methods e.g. SH18 motorway crossing or where necessary to allow for the wastewater to flow by gravity.





Figures 8 and 9: show jacking station (left) and subsequent additional jacking pipe installation (right)

A shaft is constructed at the beginning of the tunnel section (jacking station), and at the end of the tunnel section (receiving pit). These shafts will be secured with sheet piles to the required depth (refer Figure 8). A boring machine is lowered into the jacking station shaft by crane and attached to a jacking frame. The boring machine is then pushed into the ground at the trajectory the pipeline is to travel. The boring machine has a rotating cutting head that excavates / grinds larger particles into smaller particles that can then be transported to the ground surface via the closed loop slurry system where a cleaning system removes the spoil from the slurry water.

The boring action at the excavation face can be either mechanical or via fluid pressure to balance groundwater and earth pressures. Control cables and slurry lines are attached to the boring machine to transport bored materials from the excavation face to the segregation plant (refer Figure 9).

After the boring machine is inserted, the jacks are retracted and the slurry lines / control cables are disconnected to allow for subsequent pipe sections to be lowered down the shaft and inserted between the jacking frame and previously jacked pipe section. The slurry lines and control cables are reattached and the subsequent section is inserted behind the already installed pipe. This process is repeated until the boring machine reaches the receiving pit. The pipe is pushed through to the receiving pit and the boring machine and trailing equipment are retrieved.

2.6.3 Horizontal Directional Drilling

Watercare prefer the trenchless technology method described in section 2.6.2. However HDD may be considered by Watercare if that method is not viable. In this case the HDD will be used to install a sleeving pipe with which the NH2 watermain will pass through.

Horizontal Directional Drilling (“HDD”) is a steerable trenchless method of installing underground pipes in a shallow arc along a prescribed bore path using a surface launched drilling rig.

The HDD process involves drilling an electronically steered pilot bore from one end of a crossing to the other (refer Figure 10). A back ream, in effect a second larger drill bit, is connected to the pilot drill stem at the far end of a crossing and drawn back through the hole left by the pilot bore. Construction sites are thus required at both ends of the HDD alignment. This process continues until the hole is of a larger diameter than the pipe to be installed.

Prior to pipe installation pipe lengths will be welded into long strings at one end of the construction site. The pipe will then be pulled through the HDD bore hole by the drill rig. Specialised drilling fluids are injected into the hole to assist in maintaining the drill hole open, lubricating the drill and recovering drilled

materials. The drilling fluids are re-cycled through the segregation plant and waste material removed from site by trucks.

The construction area at HDD sites will likely be used to store the drill rods used in the drilling process, recycle and pump drilling fluids, power packs to drive the HDD machine, contractor facilities, material stockpiling and other equipment.

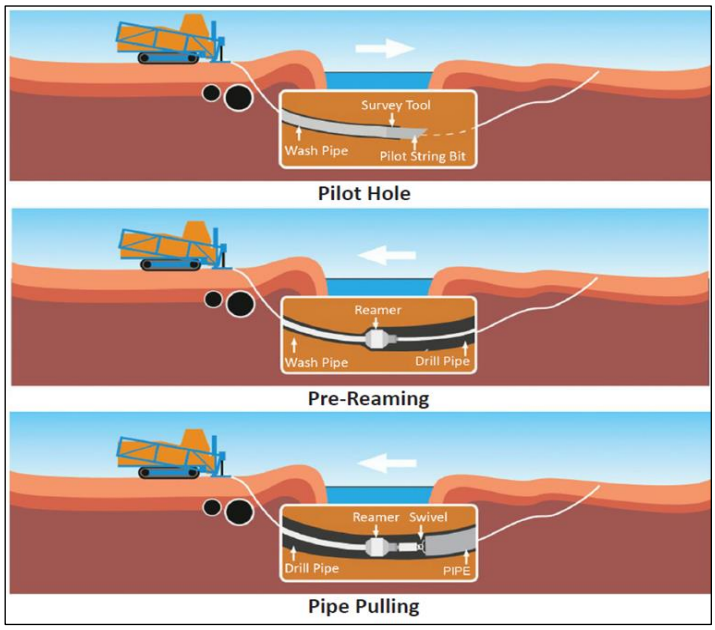


Figure 1: Horizontal Directional Drilling

HDD generally comprises the following construction activities:

- Site establishment at each end of the drill hole, including vegetation clearance, establishment of working areas, offices and storage containers and the construction of hard standing and parking areas;
- Set up for directional drilling activities;
- HDD pipe installation as described previously;
- Installation of line and scour valve chambers at each end as required; and
- Site reinstatement.

HDD installation activities can take anywhere between 10 and 20 weeks to complete for each drill shot, depending on the site. A large amount of this time is in the mobilisation and demobilisation of the directional drilling machine, the actual drilling process can take between 2 - 4 weeks depending on the pipe diameter and geology. To reduce project risks of the ground relaxing around the prepared holes, HDD drilling is typically continuous.

2.7 Location specific construction details

2.7.1 Woodlands Park Tunnelling

From Watercare's reservoir site at Titirangi through to the southern end of Shetland Street, the watermain will be installed within an approximate 900m long, 2.1 metre diameter micro tunnel. The tunnel launch pit will be located within the Woodlands Park Reservoir site (refer Figure 11) with the receiving pit in Shetland Road. The launching pit is approximately 16m x 6m and the receiving pit is approximately 10m x 6 m. Only two shafts are proposed, one at each end of the tunnel.

The methodology of construction is described in 2.6.2.

Once the pipeline is placed within the tunnel it is likely that the annulus between the watermain and the tunnel will be grouted with concrete.

Figure 11: Aerial image indicating tunnelled section – NH2 in blue

2.7.2 SH16 / SH18 Interchange Crossing

At the crossing of State Highway 16 / 18 interchange the watermain will be installed within a 1500mm - 2100mm ND micro tunnel (refer Figure 12). It is envisaged that the tunnel would be installed using a trenchless technology. The tunnel will be approximately 140m long and have minimum cover to the top of pipe of 4m. After installation of the watermain inside the tunnel, the annulus will likely be grout filled with concrete.

A 16m x 6m (approximately) launching / jacking pit up to 9m deep is proposed to be installed on the eastern side of the motorway with construction access from an access road off Hobsonville Road. A scour valve will be located in this vicinity. The receiving pit on the western side will be approximately 8m in diameter and approximately 14m deep.

Figure 12: Aerial image of State Highways 16 / 18 interchange - NH2 (in blue) and NI (in brown)

2.7.3 SH18 Crossing

From the SH16/18 crossing to the section of SH18 (refer Figure 13) near Sinton Road, the watermain will be installed within road berms using open trenching. For the crossing under SH18, the watermain will be installed by trenchless technology within a 1500mm to 2100mm ND pipe. The tunnel will be approximately 40m long and have minimum cover to the top of pipe of 4m. A 16m x 6m (approximately) launching / jacking pit up to 9m deep is proposed to be installed on the northern side of the motorway with construction access from an access road off Clarks Lane. The receiving pit will be 8m in diameter and approximately 10m deep. The pipe will rise at a slight grade to the receiving pit on the opposite side.

Figure 13: Aerial image of NH2 crossing under SH18

2.7.4 Northern side of SH18, to west of Squadron Drive

The section of NH2 watermain west of the Squadron Drive overbridge is located on the seaward side of an existing Transport Agency stormwater pond. The land at this location has been visually identified as having potentially poor soil conditions. Potential solutions to support the watermain would be to import fill material and create a causeway (Option 1) and/or driven piles on the CMA side to support the watermain and provide strength in the situation of lateral movement (Option 2). The selected option is subject to further geotechnical investigations and recommendations before detailed design is undertaken. There will be no works within the CMA (refer Figure 14). The works will then connect with NH2 or NI as consented previous (and described in 1.3.1 above).

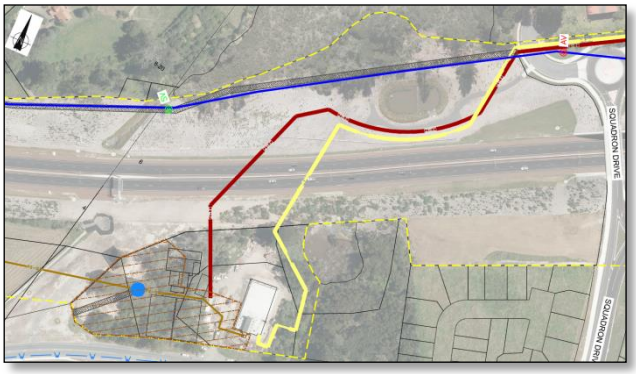


Figure 14: Aerial image of NH2 north of SH18

2.7.5 Greenhithe Bridge to Albany Highway

Trenchless technology (described in 2.6.2) is considered the most practical method of construction of the pipeline at a number of locations along the section of watermain running parallel with SH18 east of the Greenhithe Bridge to William Pickering Drive due to the topography, depth and available work space which restricts normal trenching methodology.

2.8 Other Key Infrastructure

2.8.1 Valve Chambers

Valves will be installed within reinforced underground concrete chambers. The chambers are generally rectangular in shape with excavations retained with sheet piling or other suitable support systems.

Chambers need to be watertight to eliminate ingress of groundwater. Primary access to all chambers will be from the road, located clear of intersections, driveways, road junctions and other high traffic areas. Where gravity drainage from the valve chambers is not available, sump pumps will be installed (refer Figures 15 and 16). Locations of valve chambers are shown on the Drawings in Volume 3. NI within the shared corridor will include a single air valve on the northern side of SH18 in the vicinity of Squadron Drive.

Figures 15 and 16 above show examples of valve chambers using sheet pile (left image) and tilt slab concrete (right image)

2.8.2 Watermain Corrosion Protection

The NH2 will be constructed in concrete lined steel pipe. Protective coatings are applied to external pipe surfaces at the time of manufacture and pipe joints welded at construction forming a continuous pipeline. Pipe joints are protected with specialist applied coatings to prevent corrosion. To further protect the pipe against corrosion, cathodic protection systems will be installed (anode beds and associated transformer rectifier units) at the following three locations along the pipeline route:

- Within the Plumer Domain adjacent to the Opanuku Stream;
- Within a road reserve next to Ryans Road off Trig Road; and
- Within Douglas Alexandra Reserve.
- Only junction boxes are above ground, with the anode bed being below ground (refer Figure 17 and Drawing 20011979.133A)).

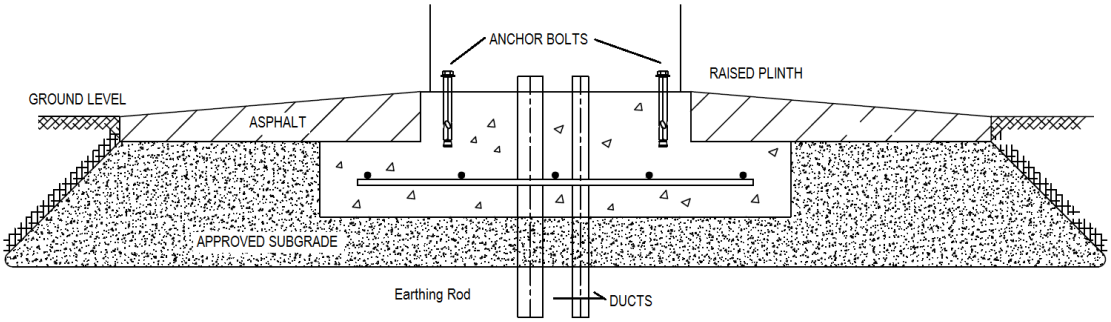
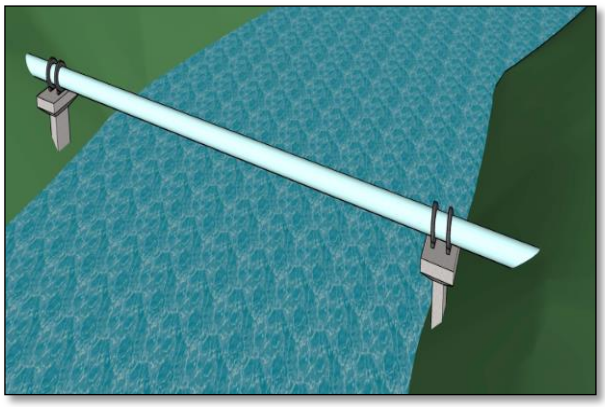


Figure 17: Example of Water Reticulation Standard Cathodic Protection Power Supply (2001979.133A)

2.9 Stream Crossings

Pipe bridges will be built to carry the NH2 across the Oratia, Opanuku, Paremuka and Swanson Streams and a fifth may be built across the Oteha Stream. The bridge supports construction will generally comprise of monopole column supports being installed to suitable ground depths on either side of the streams. The pipeline will exit the adjacent ground; extend out onto the pipe bridge supports, then re-enter the ground on the opposite side of the stream. The pipe bridges will be secured by permanent security fencing / railing at pipe bridge approaches.

The pipe bridge designs have taken into account estimated flood levels for their respective locations. The design of the proposed pipe bridges has aimed to minimise the footprint of the structure within the stream valley. The supports are located as close as possible to the top of valley sides to reduce the extent of access works for construction and avoid any work within the watercourse. This approach also reduces the scour risk to the stream crossing (refer Figures 18 and 19).



Figures 18 and 19 above illustrate indicative pipe bridge and supports across a stream

2.9.1 Oratia Stream, Parrs Cross Road

A pipe bridge is proposed to cross the Oratia stream parallel to, and immediately upstream, of the Parrs Cross Road Bridge. This pipe bridge will comprise a continuous 1200mm ND pipeline supported on two 0.9m diameter columns socketed 3 metres into competent bedrock, founding at approximately 12m below existing ground level (refer Figure 20 for location context).

Figure 20: Existing Oratia Stream with pipe and road crossing

2.9.2 Opanuku Stream Crossing, Border Road / Palomino Drive

A pipe bridge is proposed to cross the Opanuku Stream parallel to and immediately downstream of the Border Road / Palomino Drive road bridge. The proposed crossing will comprise a continuous 1200mm ND pipe supported on four 0.9m diameter columns. The bridge design includes the pipe, columns and supports that will be socketed 3 metres into competent bedrock founding at approximately 16m below existing ground level (refer Figure 21 for proposed alignment).

Figure 21: View of Opanuku Stream from road crossing

2.9.3 Paremuka Stream Crossing, Summerland Drive

A pipe bridge is proposed to cross the Paremuka Stream parallel to and immediately downstream of the Summerland Drive Bridge (refer Figure 22 for proposed alignment). The completed pipe bridge will be contained entirely within the road reserve. In order to construct the bridge, the works will extend into the park. The proposed crossing will comprise a continuous 1200mm ND pipe supported on three 0.9m diameter columns.

Figure 22: Paremuka Stream crossing

2.9.4 Swanson Stream Crossing, Don Buck Road

The NH2 is proposed to cross Swanson Stream 20 metres upstream of the Don Buck Road Bridge, and within the Don Buck Corner Reserve (refer Figure 23). The pipe bridge will be located away from the road bridge and other services it carries across the watercourse and will not affect their operation. The proposed crossing will comprise a continuous 1200mm ND pipe supported on two 0.9m diameter columns. Inclines at each end will achieve a profile that maximises the span while passing beneath the existing wastewater pipeline that runs along each bank of, and approximately parallel to, the watercourse.

Figure 23: Swanson Stream passing under Don Buck Road

2.9.5 Oteha Stream Crossing

The crossing of the Bushlands Park Reserve needs to be designed around steep topography, mature native bush adjoining both sides of the Bush Road bridge, and the Oteha Stream (refer Figure 24). The NH1 spans the stream parallel to the eastern side of the road bridge. Separation between the NH2 and NH1 watermains is preferred for security reasons. There are three options available to cross the stream with the final option to be selected by the contractor. Consent is sought for all options.

Figure 24: Bush Road Proposed Route Alignment traversing between the Albany Scenic Reserve and Bushlands Park Reserve

<u>Option 1 – Trenchless Technology</u>

The trenchless technology option is approximately 400m long and follows a curved alignment. The proposed alignment would pass at depth under several properties (refer Volume 3 Drawings). Based on the vertical profile of the ground, the cover would range from greater than 4m beneath the Oteha Stream to over 25m at the deepest point (exact depths will depend on the geology at the site).

At this stage the pipe material for the trenchless sections is anticipated to be 900mm ND (to be confirmed through detailed design).

The construction methodology is as described under section 2.6.2

Option 2 – Pipe Bridge

If option 1 is not considered feasible then option 2 is to use a three-span pipe bridge that would avoid placing supporting columns within the existing stormwater channel that runs alongside the northern edge of Bush Road. This would require some tree clearance for piling activity given the difficult terrain and significant temporary works are required. This option would only be progressed if a trenchless option is not deemed feasible at detailed design.

Option 3 – Combination of trench and trenchless technology

Using a combination of Option 1 and 2 above, the crossing may be able to be undertaken using sections of trench and trenchless technologies.

2.10 Road & Rail Crossings

2.10.1 North Auckland Railway Line Crossing, Metcalfe Road

To cross the North Auckland Railway at Metcalfe Road (refer Figure 25), two crossing options have been identified to provide flexibility to work within KiwiRail requirements at the time of construction. Both options require construction within the road carriageway.

Figure 25: Location of rail crossing of Metcalfe Road

Option 1: Open Trenching

Construction will require line closure to be implemented by KiwiRail for a duration of approximately 2 to 3 days. Alignment of the watermain would be most likely within the northbound lane of Metcalfe Road. After installation of the watermain, the trench would be backfilled with reinforced concrete to subgrade level. Reinstatement of the ballast, sleepers and tracks would be carried out by a contractor approved by KiwiRail.

Option 2: Pipe jacking/tunnelling

An outer reinforced concrete encasing pipe with a 1500mm ND will be installed by pipe jacking followed by insertion of the watermain. A shored jacking pit will be required at the northern side of the railway crossing and aligned to the side of the carriageway as far as practicable in order to minimise traffic impacts. The jacking pipe would then be advanced by hand excavation behind an open face shield, although use of a boring machine is also possible. A receiving pit would be excavated at the southern end

of the jacked drive to facilitate installation of the watermain and connection to the open trenched section. Installation of the watermain will be on an appropriate pipe spacer/skid system with likely grouting of the annulus after installation. The construction methodology is similar to that described in section 2.6.2.

Watercare has a well-established relationship with KiwiRail and proven construction methodologies for working within rail corridors from previous projects such as Hunua 4 watermain. It is expected that the crossing timeline will be less than three weeks and consideration will be given to carrying out the work during periods of low rail use (such as in conjunction with other shutdowns on the line or during the Christmas period). A detailed traffic management plan will be prepared in consultation with KiwiRail prior to construction and submitted to Auckland Transport in accordance with Corridor Access Request procedures.

2.10.2 Tauhinu Road Crossing

This area has a cycleway lane, the NH1, a high pressure gas main and multiple power cables. On the northern side of the cycleway there is a steep gully that falls at approximately a 1:1 slope making open trench construction impractical. East of Tauhinu Road the corridor for the proposed watermain is further obstructed by an approach ramp to a motorway overpass (refer Figure 26).

Trenchless technology techniques are likely to be used. There is a steep cutting on the corner of Tauhinu Road and SH18 that would need to be battered to allow a serviceable working platform to be constructed. The receiving area will be within the road reserve, near the cross connection to the NH1 and is likely to require the clearing of several trees. A receiving area can be set up and will be within the road reserve, with access for this area from the shared private driveway at the end of The Close or SH18 motorway shoulder to minimise effects on motorway users.

Figure 26: Location of Tauhinu Road crossing

2.10.3 Greenhithe Road Crossing

This section comprises the crossing of a road embankment and high voltage underground cables supplying a substation (refer Figure 27). A possible construction method is to use trenchless technology to tunnel approximately 150m with a jacking shaft area adjacent to an existing stormwater pond. Access for trenchless operations would be off Greenhithe Road. There is a steep cutting on the corner of Greenhithe Road that will need to be battered to allow a serviceable working platform to be constructed.

All reinstatement of works in the state highway corridor will be undertaken in accordance with the Transport Agency's requirements.

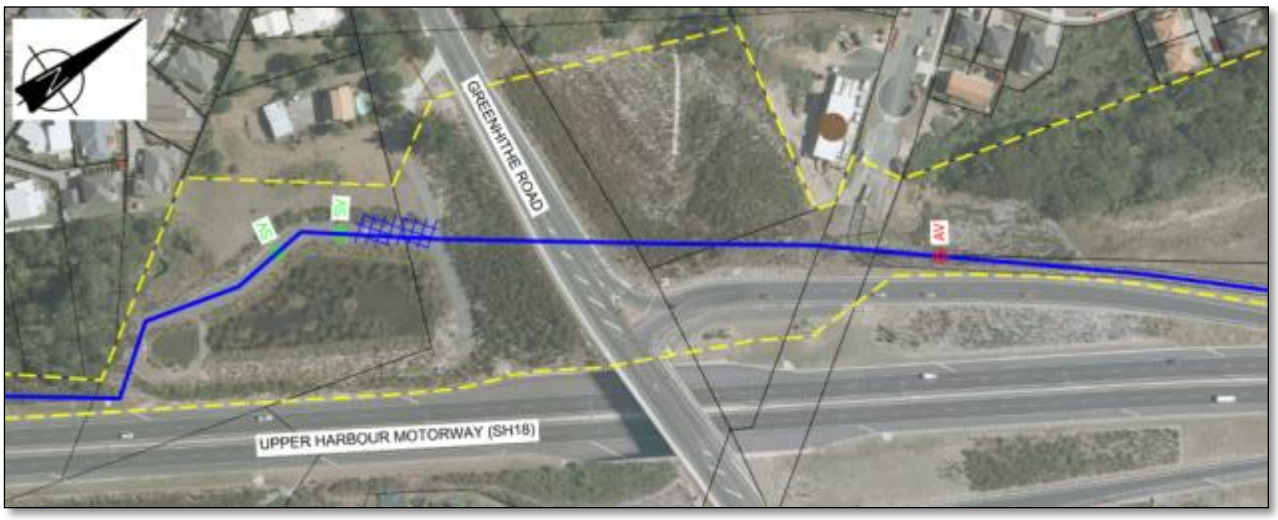


Figure 27: Greenhithe Road crossing over SH18

2.10.4 Albany Expressway Crossing

The Albany Expressway Crossing is likely to be installed using trenchless technology. The crossing of Albany Expressway is approximately 120m long. The set up area would be the same area as that used for the Oteha Stream with a short open trenched section in between. There is also an opportunity to investigate combining the trenchless section of the Albany Expressway and the Oteha Stream into one longer trenchless section.

2.10.5 End of Line Connection to Albany Reservoirs

The proposed connection to the Albany Reservoir will be via the existing 700mm nominal diameter inlet watermain.

2.11 Construction Methodology – NI Proposed Works

The section of NI proposed to be constructed within the shared corridor between Westgate and Hobsonville will comprise a 2100mm ND wastewater pipeline laid at depth. This will be located well below ground level east of SH16, and adjacent to SH18 (to the Hobsonville Pump Station). The construction methodology and activities for this section of the NI are outlined below.

2.11.1 Pipeline Installation

The NI pipeline will be installed via trenchless technology techniques as described in section 2.6.2. The boring machine will be set up within a shaft at the appropriate depth, and will travel through to a series of approximately 16 shafts that will be between 250m – 700m apart, depending on geological constraints. The maximum distance between shafts is dictated by the present operational limits of the tunnelling equipment. The NI will be installed at depths between 10-35m below the ground surface, getting shallower as the pipeline approaches the Hobsonville Pump Station.

2.11.2 Pit / Shaft Access

16 shafts are proposed along the NI route within the shared corridor that will be used to launch and retrieve the tunnel boring equipment. The number of shafts may change if technology advances sufficiently to allow for longer drives prior to construction. Longer drives could also influence the final alignment of NI.

There will be three permanent manholes and one drop structure to allow for a future connection across State Highway 18.

Selected shafts will be retained permanently to house operational and maintenance components of the NI e.g. installation of air vents. The remaining shafts will be back filled on completion of construction activities as part of the site reinstatement. The permanent and construction shaft access points are shown on Drawings in Volume 3 of the AEE.

The following outlines the typical sequence for shaft construction and reinstatement:

1. Site establishment and formation of temporary site access. The site compound area will typically be in the order of 500m^2;
2. Protection or diversion of any existing services to enable shaft excavation;
3. Excavation of shaft and removal of spoil. Shafts will be approximately 8 x 5m and excavated to 1m – 2m below the invert level of the tunnel;
4. Installation of sheet piling or H-piles with timber lagging dependent on ground conditions and water table level;
5. Dewatering as required, depending on groundwater table level;
6. Formation of concrete base and thrust block for tunnelling operation;
7. Establishment of the tunnel boring machine and ancillary plant including diesel generators, separation plant, polymer storage tanks and circulation pumps;
8. On completion of tunnelling and pipe installation the shafts will be backfilled and sheet piling and shoring will be removed;
9. Any diverted services will be reinstated;
10. The compound will be disestablished and surfaces reinstated;
11. Reinstatement of the road surface with pavement material to match the adjacent pavement;
12. Removal of site safety and traffic controls.

Three of the shafts will have permanent manhole structures constructed during the process of backfilling the shafts. Manhole structures will be precast concrete and may have a manhole access lid at surface level for occasional tunnel access for inspection and maintenance purposes. No permanent surface access will be required at these locations.

The drop shaft will be approximately 6m diameter constructed from precast and insitu concrete elements and have manhole and access covers at surface level for occasional inspection and maintenance purposes.

Construction traffic for shaft and access chamber construction will remove excavated spoil, delivery of sheet piling, precast chamber sections, concrete for drop shaft walls and baffles and imported fill for backfilling of shafts.

Shafts will typically take 6 – 8 weeks to construct prior to the tunnelling operation and on completion of tunnelling permanent chambers will take approximately 2 months to construct. Site compounds for shafts will be in place for 5 – 9 months.

2.11.3 New Hobsonville Pump Station

A new pump station (“PS”), dosing facility and storage tank is proposed at the site of the existing Hobsonville pump station (Buckley Avenue). The new pump station is within the shared corridor is not anticipated to be required until about 2030. The new pump station will eventually be required when future

stages of NI are constructed to enable Rosedale WWTP to receive wastewater flows from the Concourse (where Watercare have a large wastewater storage and pumping facility that services Te Atatu and other areas of west Auckland) in Henderson. The above-ground PS structure at Hobsonville will be approximately 2-6m high, 16m long and 25m wide and will be located to the west of the existing pump station. Mechanical and electrical equipment will be installed at the PS site, these include: pumps, valves, pipes, transformer, gantry crane and extraction fan. Construction activities will consist of:

- Site clearance, topsoil removal and excavation to proposed ground level;
- Excavation for below ground structures;
- Sheet piling and retaining wall construction;
- Dewatering of excavations;
- Construction of concrete pump station wet well and dry well chambers;
- Construction of and precast concrete storage tanks and chambers;
- Construction of above ground pump station and switch room buildings;
- Construction of diversion pipework and valves;
- Installation of electrical and mechanical equipment;
- Trenching and laying of pipework;
- Backfilling of excavations;
- Formation of paved surfaces;
- Landscaping and surface reinstatement.

The indicative location is shown in Figure 28. These works are indicative only.

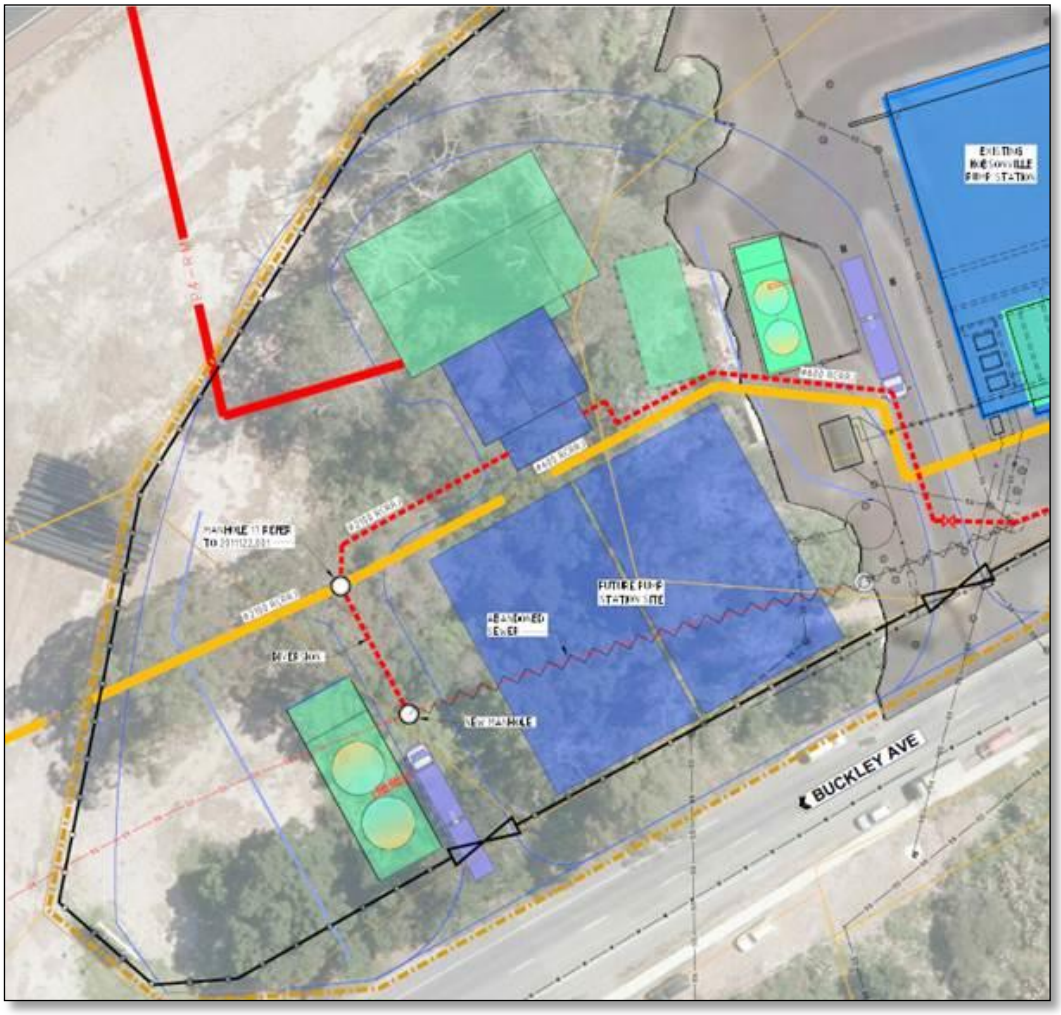


Figure 28 Indicative layout of new pump station for NI within shared corridor

The detailed layout and cross section of the new pump station is shown on Drawing 2011134.009 in Volume 3.

2.12 General Construction Management

The following applies to both NH2 and NI.

2.12.1 Construction Management Plans

Construction management plans will be prepared and implemented to address the following matters:

- Details of the site or project manager and the construction liaison person, including their contact details (phone, postal address, email address);
- An outline construction programme;
- The proposed hours of work;
- Measures to be adopted to maintain the land affected by the works in a tidy condition in terms of disposal / storage of rubbish, storage and unloading of construction materials and similar construction activities;
- Location of site infrastructure including site offices, site amenities, contractors yards site access, equipment unloading and storage areas, contractor car parking, and security;

- Outline of procedures for controlling sediment run-off, dust and the removal of soil, debris, demolition and construction materials (if any) from public roads or places adjacent to the work site (detail to be provided in Erosion and Sediment Control Plan);
- Procedures for ensuring that residents, road users and businesses in the immediate vicinity of construction areas are given prior notice of the commencement of construction activities and are informed about the expected duration and effects of the works;
- Means of providing for the health and safety of the general public;
- Procedures for the management of works which directly affect or are located in close proximity to existing network utility services;
- Procedures for responding to complaints about construction activities;
- Measures to manage the potential impacts of construction on trees and vegetation;
- Measures to address Crime Prevention Through Environmental Design ("CPTED") issues within and around the construction site;
- Protocols for the management of accidental discoveries of archaeological material;
- Procedures for the refuelling of plant and equipment;
- Measures to address the storage of fuels, lubricants, or hazardous or dangerous materials, along with contingency procedures to address emergency spill response and clean up;
- Procedures for the maintenance of machinery to avoid discharges of fuels of lubricants to watercourses or the Coastal Marine Area ("CMA"); and
- Methods and systems to inform and train all persons working on site of potential environmental issues and how to avoid remedy or mitigate any potential adverse effects.

2.12.2 Site Establishment

Site establishment works will generally comprise a combination of the following:

- Establishment of erosion and sediment control measures;
- Appropriate vegetation removal to make room for construction activity;
- Identification of existing services and undertaking relocations if necessary;
- Site levelling and drainage works;
- Formation of vehicular access and manoeuvring areas around the construction site;
- Establishment of site buildings, services (water, electricity etc);
- Construction of site perimeter fencing, noise mitigation barriers, temporary/alternative access setup.

2.12.3 Access ways

Access ways are proposed for operation and maintenance purposes. The same access routes will be used for the construction phase. Temporary access for construction of NI will be mostly via local roads to each shaft site except for the Pit 2 at Westgate (where NH2 and NI are sharing the permanent access way). Approximate access way areas (temporary and permanent) and locations are provided in Table 1.

The permanent access ways are shown on the drawings provided in Volume 3 of the AEE.

NORS	Location	Approximate Area (m²)	Purposes
NOR 1	No new impervious areas and access ways are required as part of the NH2 proposed works from Titirangi to Westgate		
NOR 2	Albany Highway	3000	NH2 Access road for construction and maintenance purposes
	Greenhithe Road	4000	NH2 Access road for construction and maintenance purposes
	Tauhinu Road	4000	NH2 Access road for construction and maintenance purposes
NOR 3	Hobsonville Road to SH18 (NI Shaft 2)	2000	NH2 and NI access road for construction and maintenance purposes
NOR 3	SH18 – NI Shaft 3	740	NH2 and NI access road for construction and maintenance purposes
NOR 3	SH18 – NI Shaft 3 to Trig Road	N/A	NI temporary access road for construction
NOR 3	SH18 – NI Shaft 4	N/A	NI temporary access road for construction
NOR 3	SH18 – NI Shaft 5	N/A	NI temporary access road for construction
NOR 3	SH18 / 51 Trig Road – NI Shaft 6	N/A	NI temporary access road for construction
NOR 3	SH18 / 51 Trig Road – NI Shaft 7	N/A	NI Access road for construction and maintenance purposes
NOR 3	SH18 / 51 Trig Road – NI Shaft 8	N/A	NI temporary access road for construction
NOR 3	SH18 / 51 Trig Road – NI Shaft 9	N/A	NI temporary access road for construction
NOR 3	SH18 / 175 Brigham Creek Road (between NI Shafts 9 to 13)	5000	NH2 and NI access road for construction and maintenance purposes
NOR 3	SH18 / Brigham Creek Road (between NI Shafts 13 to 15)	2500	NH2 and NI access road for construction and maintenance purposes
NOR 3	Sinton Road (NI Shaft 15) to Squadron Drive	5000	NH2 and NI access road for construction and maintenance purposes
Total access ways for NH2 shared corridor (excluding temporary access ways for construction)		26240	

Table 1: NH2 and NI Proposed Access ways

Use of the SH18 corridor has been agreed in principle with the Transport Agency on the understanding that, where practicable, accessways developed for the NH2 would become available for use as a cycleway by Auckland Transport, albeit with appropriate modification to serve cyclists.

An accessway will be provided along the majority of the NH2 within the shared corridor to facilitate access to the watermain and permanent access points to NI. East of the Greenhithe Bridge, it is impractical to provide a continuous access and several entry points together with end turning heads will be required. Entry to the accessway will be via gated locations off local streets. Access for routine maintenance is expected to occur three to four times a year using a light truck or utility vehicle. In the rare event that repair of the watermain or structures are required (e.g. once every 5-10 years), six wheel truck access may be necessary.

In a number of sections the accessway will traverse embankments where there will be a requirement to retain one or both sides of the accessway. It is proposed that mass block retaining systems would be typically used due to construction speed, cost, and design life. On the basis of the above the accessway

width has been preliminarily selected as 3.5m. Turning and parking areas will also be required as appropriate once the detailed design has been completed

2.12.4 Laydown Areas

The number and location of laydown areas will be determined by the contractor and will depend on available land at the time of construction. These areas would be sited in practical and convenient places along the proposed pipeline route and are expected to be used to provide secure storage for materials (likely to include pipes, machinery, fuelling facilities, and site offices and parking). It is anticipated that laydown areas will be surrounded by temporary fencing for safety and security purposes, and will be occupied for several months.

Contractors may set up a main site yard including offices, equipment storage and material stockpiling, for a longer duration at other convenient locations. If these are not within the designated areas the contractor will need to make their own arrangements in terms of how this area is used e.g. lease or requirement to seek any necessary resource consents.

2.12.5 Earthworks and Spoil Disposal Sites

Earthworks, as part of trenching or trenchless methods, will most commonly result in temporary, short term stockpiling of spoil material for removal off site or for reinstatement. All stockpiled material will be contained and stabilised to prevent sediment run off. Excavated material which is unable to be reused as part of the project works will be disposed of to an authorised site. The spoil disposal sites will be determined by the contractor and do not form part of the consent applications. Possible sites for spoil disposal may include other construction sites where cleanfill material is required, existing cleanfill sites, or to landfill for any contaminated material. All sites will be managed according to best practise methods to minimise the loss of soil from the site as recommended in Technical Report A Earthworks, Erosion and Sediment Generation.

2.12.6 Corridor Sharing with Other Network Utilities

The proposed pipeline route generally avoids existing or planned major infrastructure services. Where it is impractical to carry out construction activities without impact on existing services, temporary diversions should be able to be created around the work area. Working within existing utility corridors frequently occurs and Watercare has well established practices in place to ensure minimal disruption to customers.

2.12.7 Construction Programme &Duration

NH2 is expected to be constructed in stages to meet the water supply demands for different areas of the system. The timeframes listed in Table 2 are approximate and dependant on factors such as the rate of development in the wider Auckland area and assumption of the approval of detailed design.

Construction programming for NI at this time are indicative only and will be confirmed closer to 2021 with actual construction planned to begin in 2022.

NH2 Stage	Timeframe
Greenhithe Bridge Watermain Duplication (consented)	2016/2017
Eastern end of Greenhithe Bridge to Albany Reservoir (NOR2)	2018-2022
Titirangi to western end of Greenhithe Bridge (NoR 1 and NoR 3)	2022-2025
NI Shared Corridor	**Timeframe**
NI construction Hobsonville Road to Hobsonville Pump Station (NOR3)	2022-2027
Hobsonville Pump Station upgrade (consented)	2022-2027

New Hobsonville Pump Station (NOR3)	2032-2035

Table 2: NH2 and NI in shared corridor Proposed Programme

3 DESCRIPTION OF EXISTING ENVIRONMENT

The NH2 route will traverse through approximately 33km of west and northern Auckland, with a section of the NI to join this journey for 5km alongside SH18 in the proposed NOR3 corridor. Outlined below is a description of the existing environment along the proposed route, starting in Titirangi and ending in Albany. This description is based on information from the technical reports contained in Volume 2 that can be referred to for more detailed information.

3.1 Land uses

The NH2 and NI are proposed to be constructed predominantly below ground within roading corridors under either Auckland Transport or New Zealand Transport Agency control. Descriptions of the land-uses alongside the NH2 and NI routes include:

Residential Activity:

A significant portion of the NH2 travels through the established suburban and urban suburbs of Titirangi, Glen Eden, Henderson, Western Heights, Ranui, Massey, West Harbour, Greenhithe, Schnapper Rock, Rosedale and& Albany. The predominant land uses observed through these areas are single detached dwellings on individual properties that have access to the adjacent local roads via single or shared driveways. The NI corridor will travel below the existing SH18 corridor, current and planned residential activity at Hobsonville along SH18. . Designation of the NOR3 corridor will provide suitable identification of the planned infrastructure, type and route for potential future land users to allow for appropriate consideration and development; e.g. contact can be made with Watercare regarding any development proposal, and whether it would affect the designation. Consent for proposed activities can be sought from requiring authorities where land has a designation on it.

Business & Commercial Activity:

The NH2 route predominately travels along local roads where it passes a variety of commercial businesses and industry nodes. These range in scale from smaller local centres (service stations, grocery stores, butcher, building supplies outlet, medical centre, take away food outlets, Leisure Centre), to larger bulk format shopping centres (Westgate to the south of Fred Taylor Drive; Industrial Business type areas located in Rosedale and Albany). The NI will not travel near present businesses or commercial activity through the NOR3 corridor

Education & Other Community Facilities:

The NH2 route passes by various primary, secondary and early childhood educational facilities (Summerland Primary, Don Buck Primary School, Massey High School, Massey Primary School, St Pauls Primary School). The route travels past a range of community related places of assembly (Salvation Army, Sturges West Community House, Massey Hall, churches, sports clubs & recreational playing fields). The NI will travel below the Hobsonville Bowling Club as it is located within the NOR3 corridor.

Parks & Reserves:

The NH2 route passes by and through numerous parks and reserves including beneath the Waitakere Ranges Regional Park, then past Parrs Park, Oratia Esplanade, Border Road Esplanade, Gus Nola Park, Paremuka Lakeside, Massey Domain, Triangle Park, Hobsonville War Memorial Park, Douglas Alexander Reserve and the Albany Scenic Reserve. The NI will travel below the Hobsonville War Memorial Park that is located within the NOR3 corridor.

Infrastructure:

Except as noted above, NH2 and NI within the shared corridor will be located predominantly within the NZ Transport Agency corridor for SH18.

3.1.1 Woodlands Park, Titirangi

This section will include the start of the pipeline with trenchless technology tunnelling from Woodlands Park Road reservoir site underneath Scenic Drive and the well vegetated Waitakere Ranges Regional Park through to the southern end of Shetland Street.	
Land Use	Woodlands Park Road reservoir operates from the parcel of land where the pipeline is proposed to begin.
Community and Recreational Facilities	There are no community or recreational facilities located in this section of works.
Watercourses	The Whakarino Stream travels in a deviated direction away from the NOR1 corridor, Northward through the Waitakere Ranges Regional Park.
Vegetation and Ecology	Sloped ground with high presence of vegetation / trees however trenchless technology will locate pipeline well below ground level.
Historic Heritage and Archaeological Values	No archaeological or historic heritage sites are identified within this section of the Project.

3.1.2 From Shetland St to the Oratia Stream

Trenching works within formed public local roads (Shetland St, Glengarry Rd, West Coast Road, Parrs Cross Rd) up until the Oratia Stream.	
Land Use	Mixture of larger sized residential properties with detached housing.
Community and Recreational Facilities	Parrs Park is located northeast of Parrs Cross Road.
Watercourses	Oratia Stream.
Vegetation and Ecology	Trees and other vegetation in the road berms alongside route.
Historic Heritage and Archaeological Values	1. CHI: 2167, Category: Historic Botanical Site Site Type: Tree 2. CHI: 3721, Category: Historic Structure Site Type: BUILDING-DWELLING 3. CHI: 5963, Category: Archaeological Site NZAA Site Number: R11_503 Site Type: MIDDEN (SHELL) | REPORTED 4. CHI: 3729, Category: Historic Structure Site Type: BUILDING-DWELLING 5. CHI: 2186, Category: Historic Botanical Site Name: Tara Orchard | Poplar 

3.1.3 Oratia Stream to the Opanuku Stream

Pipebridge across Oratia Stream then trenching works continuing along formed public roads (Parrs Cross Rd, Forest Hill Rd, Palomino Dr) until the Opanuku Stream.	
Land Use	Range of larger sized residential properties with detached housing.

Community and Recreational Facilities	The Twin Streams Cycleway is located alongside stream. There are no community or recreational facilities located in this section of works.
Watercourses	Opanuku Stream.
Vegetation and Ecology	Grass, trees and other vegetation in the road berms alongside route.
Historic Heritage and Archaeological Values	6. CHI: 11271 Category:Archaeological Site NZAA Site Number: R11 1458 Site Type: COTTAGE SITE 7. CHI: 19865 Category:Historic Structure Name: Tara Orchard Packing Shed & Homestead (former) Site Type: Orchard 8. CHI: 2334 Category: Historic Botanical Site Name: English Oak Site Type: Tree  

3.1.4 Opanuku Stream to the Paremuka Stream

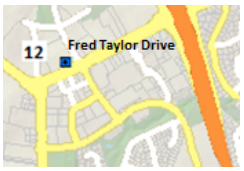
Pipebridge across Opanuku Stream then trenching works continuing along formed public roads (Palomino Dr, Summerland Dr, Munroe Rd) until the Paremuka Stream.	
Land Use	Range of residential properties with detached housing.
Community and Recreational Facilities	Summerland Primary School to the east of Summerland Drive. There are no community or recreational facilities located in this section of works.
Watercourses	Paremuku Stream.
Vegetation and Ecology	Grass, trees and other vegetation in the road berms alongside route.
Historic Heritage and Archaeological Values	No archaeological or historic heritage sites are identified within this section of the Project.

3.1.5 Paremuka Stream to Swanson Stream

Pipebridge across Paremuka Stream then trenching works continuing along formed public roads (Munroe Rd, Metcalfe Rd, Swanson Rd, Don Buck Rd) Swanson Stream.	
Land Use	Range of residential properties with detached housing. Rail crossing at road grade across Metcalfe Road.
Community and Recreational Facilities	There are no community or recreational facilities located in this section of works.
Watercourses	Swanson Stream.
Vegetation and Ecology	Grass, trees and other vegetation in the road berms alongside route.
Historic Heritage and Archaeological Values	No archaeological or historic heritage sites are identified within this section of the Project.

3.1.6 Swanson Stream to SH16

Pipebridge across the Swanson Stream, then trenching works continuing along formed public roads (Don Buck Rd, Fred Taylor Dr) to the west of State Highway 16.

Land Use	Range of residential properties with detached housing. A ribbon of commercial shops is located Northward of Triangle Park. The Westgate shopping centre is located south of Fred Taylor Drive. Numerous other retail / commercial premises are situation along this section of the NH2
Community and Recreational Facilities	There is a range of community and recreational facilities located along this section of the NH2 route. To the west of the NH2 route is the Don Buck Primary School, Massey High School, Massey Primary School and Kindergarten, the Massey Domain and Hall, St Paul's Primary School, Massey Presbyterian Church, The Salvation Army. To the east of the NH2 route is Triangle Park, the Massey leisure centre, library, building supply store.
Watercourses	No open watercourses.
Vegetation and Ecology	Grass, trees and other vegetation in the road berms alongside route.
Historic Heritage and Archaeological Values	9: CHI: 15094 Category:Historic Structure Name: Don Bucks Camp Site Type: GUM DIGGERS CAMP | MONUMENT | PLAQUE 10: 3333 Category: Historic Structure Site Type: BUILDING-DWELLING 11: CHI: 3804 Category: Historic Structure Name: Massey Post Office (former) 12: 3327 Category: Historic Structure Name: Midgely House Site Type: BUILDING-DWELLING  

3.1.7 SH16 Tunnelling

This section of the NH2 to pass underneath State Highway 16 is to be installed via microtunnel.	
Land Use	This area and land adjacent to it is being used for roading purposes.
Community and Recreational Facilities	There are no community or recreational facilities located in this section of works.
Watercourses	No open watercourses.
Vegetation and Ecology	Trees and other vegetation installed for reinstatement, however these will be above ground and the NH2 will be installed below ground.
Historic Heritage and Archaeological Values	No archaeological or historic heritage sites are identified within this section of the Project.

3.1.8 From SH16, alongside SH18, through to Greenhithe Bridge.

NI tunnelling and NH2 trenching works alongside State Highway 18 predominantly within Transport Agency corridor.	
Land Use	The nearby areas comprise undulating road verge generally in grass. NI will pass beneath land zoned for residential purposes that has varying degress of urban development occuring.
Community and Recreational Facilities	Hobsonville War Memorial Park on Hobsonville Road. There are no other community or recreational facilities located in this section of works.
Watercourses	Both pipelines travel under Waiarohia Stream.
Vegetation and Ecology	Trees and other vegetation in the road berms alongside route.

Historic Heritage and Archaeological Values	No archaeological or historic heritage sites are identified within this section of the Project.

3.1.9 Greenhithe Bridge to William Pickering Drive

Trenching works continuing alongside the northern side of the State Highway 18 corridor. Trenchless technology to be used under Tauhinu Road and Greenhithe Road.	
Land Use	Land uses outside of State Highway corridor along this section of the NOR2 route is predominately residential.
Community and Recreational Facilities	There are no community or recreational facilities located in this section of works.
Watercourses	No open watercourses.
Vegetation and Ecology	Both sides of the State Highway 18 roading corridor are lined with well-established trees and other vegetation.
Historic Heritage and Archaeological Values	No archaeological or historic heritage remains are identified within this section of the Project.

3.1.10 William Pickering Drive to the Oteha Stream

Trenching works continuing from SH18 Northward into Industrial Business land uses (William Pickering Dr, Douglas Alexander Parade, Rosedale Road, Bush Road) to the Oteha Stream.	
Land Use	Land use surrounding the alignment along this section is predominately industrial business / warehousing where roads have wide berms.
Community and Recreational Facilities	Summerfield Early Learning Centre and the Pinehurst School.
Watercourses	The Oteha Stream travels through the well-established vegetation in the Albany Scenic Reserve and Bushlands Park Reserve adjacent to Bush Road.
Vegetation and Ecology	Grass, trees and other vegetation in the road berms alongside route.
Historic Heritage and Archaeological Values	No archaeological or historic heritage sites are identified within this section of the Project.

3.1.11 From Oteha Stream to Albany

Tunnel to go beneath the Oteha Stream before climbing up to the Albany Expressway.	
Land Use	Both sides of Bush Road have well established vegetation in the Albany Scenic Reserve and Bushlands Park Reserve. To the east of the Albany Expressway is residential housing. Once the NH2 travels under the Albany Expressway, the nearby land uses are commercial business activity with wide berms.
Community and Recreational Facilities	Summerfield Early Learning Centre and the Pinehurst School.
Watercourses	Oteha Stream.
Vegetation and Ecology	The escarpment adjacent to Bush road includes some well-established vegetation.
Historic Heritage and Archaeological Values	No archaeological or historic heritage sites are identified within this section of the Project.

3.2 Soil Contamination

Soil contamination investigations have been carried out with more detailed information contained within Technical Report B Soil, Sediment and Groundwater Contamination in Volume 2. Investigations included reviewing historical aerial photographs; making a Site Contamination Enquiry with the Council; review of Council files; and a site drive-by route assessment. Investigations to date have shown that there is limited

potential for soil and groundwater contamination and that existing contamination is below the NES and ARP:ALW standards are met.

For the large part of the Project sites where no soil contamination testing was carried out, there is a low risk of encountering soil contamination, more specifically, that there is a low risk of encountering land containing elevated levels of contamination.

3.3 Geology

Understood geology of the Auckland area anticipates the likely geological deposits to be encountered along the proposed route (from oldest to youngest) include: East Coast Bays Formation (ECBF), Cornwallis Formation, Albany Conglomerate, Piha Formation, Nihotupu Formation, Puketoka Formation and Alluvium. The main geological units occurring within the Projects areas include:

- NOR1: The proposed alignment geology is dominated mainly by the ECBF and the Puketoka Formation with some alluvial sediments in the Northern part of this area. However, the south of this area (e.g. through the tunnelled section from Woodlands Park Rd to Shetland St) is dominated by the Cornwallis Formation, the Piha Formation and the Nihotupu Formation.
- NOR2: The proposed alignment goes through the ECBF and the Puketoka Formation within this area. There are some localised areas of Albany Conglomerate occurring about 1km west of the proposed alignment.
- NOR3: Within this area the proposed alignment geology is dominated by the ECBF and the Puketoka Formation. Some alluvial sediments may be associated to the Puketoka Formation and this is evident in some patches towards the north of this area.

3.4 Groundwater

Groundwater investigations have been undertaken with more detailed information contained within Technical Report C Groundwater Assessment. Key groundwater elements include:

- Regionally groundwater will generally flow from higher elevated land areas and where recharge occurs (Waitakere Ranges), to lower elevated areas. Streams and gulley areas provide discharge points for confined groundwater.
- The majority of the NH2 alignment will traverse through sediments of the Tauranga Group (Alluvium and Puketoka Formation) as well as the ECBF. The Tauranga Group contains materials that have, generally, a higher permeability than sediments of the ECBF.
- Groundwater levels for the whole project are 3.8 mBGL (meters below ground level) on average, with a median of 3.2 mBGL. The standard deviation for groundwater levels is 2.74mbgl which means that shallow groundwater levels would typically occur below 1mbgl.
- Groundwater in the area traversed by the NH2 alignment is not being extensively used with only four bores abstracting groundwater for domestic and stock purposes within 1.5km of the proposed NOR3 area.
- For NOR1, bores installed within this project area show that the groundwater level near the streams is generally between 2.3 to 5.7mBGL. Groundwater levels at the start of the tunnelled section near Woodlands Park ranges between 4 and 9.2mBGL. In general, other piezometers along this area of the alignment show groundwater levels in the 1.5 to 5mBGL range.
- For NOR2, certain bores show groundwater levels to be within ranges of 3.79mBGL and 4.13mBGL, and 1.71 to 2.15mBGL. Other non-specific piezometers in this area indicate, for the most part, groundwater levels in the 1.5 to 5mBGL range but there are some bores with shallow (0-

1mBGL). In any case, many of these water level measurements may not be completely accurate as they do not come from monitoring bores but are recorded at the time of drilling, and may indicate unsaturated soils (e.g. moisture) or "perched" water conditions.

- For NOR3, certain bores show that the groundwater level towards the northern part of NOR3 range between 2.7 to 3.48mBGL. Previous investigations carried out through other projects show that the majority of the groundwater levels in the 1.5 to 5mBGL range but some locations have experienced higher groundwater levels.
- Most of the alignment goes through established urban areas which do not use groundwater for domestic use.

3.5 Stormwater & Hydrology

3.5.1 Existing Stormwater Infrastructure

The existing stormwater network consists of multiple stormwater culverts and drains:

- NOR1 – Titirangi to Westgate: Multiple Council stormwater culverts and pipelines exist within this residential area.
- NOR2 – Eastern end of Greenhithe Bridge to Albany Reservoir: Similar to NOR1, multiple Council stormwater culverts and pipelines exist within NOR2 which is generally a light industrial area and a more developed Council stormwater network within the residential area (near Douglas Alex Parade and Rosedale Road). In addition, a stormwater pond embankment is located along SH18 in the vicinity of Greenhithe Road (refer Drawing No 2010673.528 in Volume 3 of the AEE).
- NOR3 – Stormwater networks within the SH18 corridor are limited to ponds (including one to the west of Squadron Drive) which serve SH18 with runoff collection and a couple of private stormwater ponds located in the vicinity of Brigham Creek Road.

3.5.2 Overland Flow Paths

Overland Flow Paths (OFLPs) existing in (or in the vicinity of) the Project are listed in Table 1 and shown on the Drawings attached in Volume 3 of the AEE. These are limited to NOR3 as OLFPs are not affected elsewhere along the alignment.

The OLFPs listed are based on Council GIS catchment and hydrology layers. These were formed by the construction of SH18 and consist of defined channels and culverts under roads and SH18. The location of the affected OLFPs and streams are listed in the table below. Many of these are likely to be dry during the low rainfall summer months.

Existing OLFPs within NH2 and NI shared corridor (NOR3		
OLFP Category	**Stream Name**	**Description of Location**
OLFP >3ha	Unnamed	East of Hobsonville Road Off Ramp
OLFP >3ha	Trig Stream	North of 27 Trig Road
OLFP >3ha	Rawiri Stream	North east of 27 Trig Road
OLFP >3ha	Unnamed	South west of Brigham Creek Road On Ramp adjacent to stormwater pond
OLFP 4000m² to 3 ha	Unnamed	South west of Brigham Creek Road On Ramp adjacent to stormwater pond
OLFP >3ha	Unnamed	Brigham Creek Road On Ramp
OLFP >3ha	Unnamed	Permanent stream adjacent to 6 Sinton Road
OLFP >3ha	Unnamed	Adjacent to Ockleston Landing

Existing OLFPs within NH2 and NI shared corridor (NOR3		
OLFP Category	**Stream Name**	**Description of Location**
OLFP 4000m² to 3 ha	Unnamed	Adjacent to 30 Ockleston Landing
CMA	Unnamed	Wallace Inlet

)

3.5.3 Flood Plains & Stormwater Management Area (Flow) (SMAFs)

100 year flood plains in (or in the vicinity of) the Project are identified on the Council GIS and are listed in the Table below. The majority of the route is within the Auckland Transport road corridor and SH16/18 corridors.

100 year Flood Plains		
NOR	**Location**	**Description**
Titirangi to Hobsonville (NOR1)	334 to 336 Glengarry Road	Residential land use, 2 houses
	Parrs Cross Road between Legacy Drive and Seymour Road (Oratia Stream)	Reserve land and Artisan Wines property
	53 Parrs Cross Road and 72 to 80 Parrs Cross Road	Residential land use, up to 6 houses either side of NH2 route
	1/14 to 28 Border Road (eastern side)	Residential land use, 4 houses south western side of Border Road
	Opanuku Stream	Road is elevated but flood plain extends either side of Palomino Drive/ Border Road along stream and overland flow paths through reserve
	20 to 30 Summerland Drive	Mainly within road corridor on eastern side of the road and front yards
	70 and 79 Summerland Drive to 87 and 100 Summerland Drive	Mainly within the road corridor, an overland flow path of Paremuka Stream
	21 and 16 Munroe Road to 1a Charlenne Close	Small reserve and 2 residential houses
	122 to 132 Metcalfe Road to 1 Duxfield Drive	Within road corridor
	Don Buck Road from Universal Drive to Woodside Road and around Swanson Stream	Residential land use, flood plain extends either side of road affecting multiple houses and properties.
	Fred Taylor Drive from Fernhill Drive to Main Street	Car parking area of Westgate Shopping Centre
Hobsonville to western start of GBWD and Causeway Project (NOR3 & NI shared corridor)	SH16/ SH18 Intersection	Small extents of flooding around overland flow paths
	Trig Road Off Ramp to 27 Trig Road	Small extents of flooding around overland flow paths
	Brigham Creek Road On and Off Ramps	Small extents of flooding around overland flow paths
	SH18 (Sinton Road)	Small extents of flooding around overland flow paths
	SH18 (Clarks Lane)	Small extents of flooding around overland flow paths
	West of Squadron Drive	Large flood extent from Buckley Ave across SH18 to the Squadron Drive stormwater pond
	Squadron Drive On Ramp	Small extents of flooding around overland flow paths
	Western Greenhithe Bridge approach from Squadron Drive	Southern side of SH18, does not extend into residential land uses
Eastern side of Greenhithe Bridge to Albany Reserve (NOR2)	William Pickering Drive from Ride Way to Douglas Alexander Parade intersection	Within road corridor (flood sensitive areas extend into industrial properties) either side of Douglas Alexander Parade and William Pickering Drive
	Douglas Alexander Parade from William Pickering Drive intersection to 19 Douglas Alexander Parade	Within road corridor (flood sensitive areas extend into industrial properties) either side of Douglas Alexander Parade

	Bush Road from Pinehurst School around Oteha Stream	Oteha Stream flood plain extending through park and bush reserve

100 Year Floodplains within NH2 and NI shared corridor

3.5.4 Flood Sensitive & Flood Prone Areas (FPA)

As with the 100 year flood plains, the Auckland GIS flood sensitive and prone areas were identified along the NH2 and NI shared corridor proposed routes (refer Table below).

Flood Sensitive and Flood Prone Areas		
Route Sections	**Location**	**Description**
Titirangi to Hobsonville (NOR1)	334 and 336 Glengarry Road	FPA within road corridor extending into adjacent properties
	Munroe Road/ Summerland Drive (Paremuka Strem)	FPA extends along Paremuka Stream and across Munroe Road/ Summerland Road
	122-132 Metcalfe Road to 1 Duxfield Drive	FPA within road corridor along Metcalfe Road
	Swanson Stream (Swanson Road)	FPA western side of Don Duck Road along Swanson Stream
Hobsonville to western start of GBWD and Causeway Project (NOR3 & NI shared corridor)	West of Squadron Drive	FPA from Buckley Ave across SH18 to the Squadron Drive stormwater pond
Eastern side of Greenhithe Bridge to Albany Reserve (NOR2)	SH18 South of Greenhithe Road Bridge	FPA and FSA extending across SH18
	SH18 Corridor (112 – 108 George Deane Place)	Small FPA in surface catchment for stormwater pond
	William Pickering Drive	Within road corridor extending into industrial properties
	Douglas Alexander Parade	Within road corridor
	Pinehurst School	Across Bush Road
	Oteha Stream	Extent along Oteha Stream and across Bush Road

Flood sensitive and pone areas within NH2 and NI shared corridor

3.5.5 Stormwater Management Areas (SMAF)

Stormwater Management Areas – Hydrology mitigation flow levels 1 or 2 (SMAFs)[1] have been identified along the entire NH2 and NI shared corridor proposed routes. Except for a localised area in NOR1 between Woodlands Park and Parrs Cross Road, the PAUP requires that runoff mitigation is required for both retention (volume reduction) and detention (peak flow reduction) where new impervious areas are created in SMAF locations over permitted activity thresholds (refer PAUP H4.14.4.2).

Generally, SMAF 1 have been identified at the following locations:

- NOR 1 – majority is within Parrs Cross Road, Palomino Drive, Summerland Road, West and south of Don Buck Road.
- NOR2: SH18 corridor, Oteha Stream Crossing.
- NOR3: SH18 corridor (Trig Road).

[1] Auckland Unitary Plan stormwater management provisions: Technical basis of contaminant and volume management requirements, Technical Report 2013/035 August 2013: SMAF 1 (level 1 hydrology mitigation) areas require for a 24hr rainfall event detention with a 95th percentile of the runoff and retention of 10mm rainfall event. SMAF 2 (level 2 hydrology mitigation) areas require for a 24hr rainfall event detention with a 90th percentile of the runoff and retention of 8mm rainfall event.

Generally, SMAF 2 have been identified at the following locations:

- NOR 1: Metcalfe Road, East of Don Buck Road.
- NOR2: crossing with William Pickering Drive, Bush Road.
- NOR3: South of Hobsonville Road near SH16, South of SH18 and Rawiri North catchment on the western part of Greenhithe Bridge.

The section within NOR3 which is not identified as SMAF (located in the vicinity of Brigham Creek Road) is part of the Waiarohia Catchment (Rawiri North sub-catchment) and stormwater is managed under the Integrated Catchment Management Plan (ICMP).

3.6 Water Quality

The NH2 and NI shared corridor proposed routes pass through several suburban stream valleys with variable vegetation cover. Details of those watercourses are provided below.

3.6.1 NOR1 – Titirangi to Westgate

Four main watercourse crossings were identified, being: Oratia Stream, Opanuku Stream, Paremuka Stream, and Swanson Stream. All of the main streams have road bridge crossings running parallel with the proposed NH2 route. All road bridges appear to be above the 100 year flood level except for the Swanson Road bridge (ref Council data and Drawings No 2010675.231 in volume 3 of the AEE). All the streams are of a significant size, being 4-8m in width and deeply incised with a water line typically 6-10m below the bridge deck. The riparian zones of all streams generally consist of planted native species with large exotic trees. The stream corridor, including banks are generally wide with adjoining residential properties setback between 10 and 20m from the stream centre line.

Three minor watercourse crossings were also identified at these approximate locations: 15 Palomino Drive, 72 Parrs Cross Road and 334 Glengary Road. All of the minor watercourses have been previously piped or culverted under the road.

A stream has been identified (Whakarino Stream) in the vicinity of the Woodlands Park tunnel (approximately 17m east of the proposed Woodlands Park tunnel). From the preliminary design drawings, the NH2 pipeline will be tunnelled beneath the properties (but not under Whakarino Stream) at depths in excess of 20m below ground level (refer section 6.2 of AEE).

Stream Ecological Valuation (SEV) assessments within the Auckland region recorded SEV scoring[2] for the following streams of interest within NOR1: Opanuku and Paremuka Stream were assessed and scored 0.8 and 0.71 respectively, i.e. representative of a good ecological quality.

Water quality within Oratia and Paremuka streams (NOR1) have been assessed as good ecological rating based on Council SEV assessment results[3].

3.6.2 NOR2 – Eastern end of Greenhithe Bridge to Albany Reservoir

One main watercourse crossing was identified within the NOR2: Oteha Stream. The proposed pipeline runs parallel with Bush Road which bridges over the Oteha Stream.

The alignment crosses Oteha Stream which is an important local feature and a site of ecological significance (Fernhill Escarpment Significant Ecological Area - SEA). The waterway is composed of natural banks and native riparian vegetation. The stream is crossed by Bush Road as well as a number of

[2] Auckland Council, Stream Ecological Valuation (SEV) User's guide, Guideline Document 2011/001, Table 21 in Part 7.
[3] Auckland Council. 2012. *Upper Harbour Freshwater Report Card 2012*. Auckland: Auckland Council

other pipes, attached on the downstream side. The waterway has natural banks and base with limited signs of modification visible.

Council undertakes regular monitoring at Oteha Stream, including ecological and water quality assessments. The overall health across sampled parameters[4] indicates the health of the stream is impaired, reflecting the largely urban catchment in which it is located. Urban development has led to a high level of impervious surface in the area, which prevents rainfall from soaking into the ground. This has follow-on effects for Oteha Stream, leading to high water temperatures, changes to the natural flow patterns and increased pollution from contaminated stormwater. Monitoring in 2013 at Oteha Stream produced a water quality indice of 58.1 and an associated class of 'fair'. Heavy metal concentrations reflected the influence urban land uses had on the stream: mean total lead concentrations were 0.44 µg/L; mean total zinc concentrations were 46.7 µg/L; and mean total copper concentrations were 2.4 µg/L. These heavy metal concentrations are relatively high when compared against results taken from streams with more natural surroundings.

In addition, Council carried out at SEV at Oteha Stream in 2010 and 2012 and results reported overall SEV scoring of 0.59 and 0.60 respectively, indicative of moderate ecological value. Water quality at Oteha Stream (NOR2) has been recorded as 'fair' from the Council SoE report[5] with high concentrations of heavy metals and an increasing trend of relative pollution from contaminated stormwater.

3.6.3 NOR3 – Westgate to Hobsonville Pump Station

Seven minor watercourse crossings were identified within NOR3 along SH18, including:

- two streams: Trig and Rawiri Stream;
- five unnamed watercourses.

The streams are diverted into culverts under the motorway.

Two streams have been identified in NOR3 including Trig Stream and Rawiri Stream, which are the two main tributaries of the Waiarohia stream. Parts of these streams were identified as being category 2 in a report by Kingett Mitchell (2001)[6]. The streams are also reported to be category 2 in a report by Beca Carter (1999)[7]. Category 2 streams do not contain permanent flowing water all year, and for parts of the year remain as dry or boggy channels. It is not known whether the stream contains permanent pools of water (NIWA, 2000)[8], but parts of the stream were found to have flows of water[9]. Category 2 streams do retain populations of macroinvertebrates and fish under certain conditions. The ecological values of the streams are similar to Waiarohia Stream, and results indicated a low diversity and low abundance of macro invertebrates, with no rare or endangered species occurring in the stream (Kingett Mitchell, 2001).

In addition SEV undertaken at Rawiri Stream in 2013 by Boffa Miskell[10] reported overall scoring of 0.58 (lower) and 0.62 (upper), indicative of moderate and good ecological quality. Rawiri Stream is part of the Rawiri North sub catchment within Waiarohia catchment, which includes a Stream Management Area

4.Upper Harbour Freshwater report card 2012, Neale, M.W., and Lockie, S.E. 2013.
5 Auckland Council. State of the Environment Monitoring: River Water Quality Annual Report 2013 – Technical Report 2014/032. Auckland: Auckland Council
6 Kingett Mitchell and Associates, 2001: Ecological Characteristics of the Northern Strategic Growth Area (Whenuapai and Hobsonville), Waitakere City: Issues and Options
7 Beca Carter, 1999. Upper Harbour Corridor. SH 16 & SH 18 (Hobsonville Road realignment study): Technical Report #2 Environmental Investigations. Beca Carter, Auckland
8 NIWA, 2000. Potential ecological effects of SH16 and SH18 realignment on lowland streams and the Upper Waitemata Harbour.
9 Waitakere City Council, Waiarohia Integrated Catchment Management Plan, URS, 2005
10 Auckland Council, Hosbonville Precincts A2 and C1, Stream Assessment Update, Boffa Miskell, 2013

which consists of 20m of riparian margin on each side of the stream (refer Draft Council Rawiri North Addendum to Waiarohia ICMP[11]).

Coastal Water quality is generally fair to good in this part of the Upper Waitemata Harbour but has been found to be slightly compromised in the immediate vicinity of a discharge from an existing stormwater drain (Greenhithe Bridge and Watermain Duplication and Causeway).

3.7 Sediment Quality

Council produced a marine report of the Upper Waitemata Harbour in 2013 to investigate contaminant levels in sediments. The report found that sediment contaminant concentrations were generally below, or just exceeded, amber Environmental Response Criteria (ERC) thresholds; however, these levels were higher than expected given the largely rural land use in the surrounding area. This discrepancy was attributed to ongoing development and urbanisation of the catchment, and the effects of commercial coastal activities in the wider Waitemata Harbour.

NIWA (2012) reported that decreasing trends in copper, lead and zinc have been observed at the majority of routinely monitored sites in upper Waitemata Harbour sites. However, PAH was found to be increasing in the vicinity of the Hobsonville monitoring site. As part of the T&T NH2 Fatal flaw assessment (2014) sediment quality was tested in the immediate vicinity of the existing crossing. Except for one site with high arsenic levels, all test metal concentrations were considerably lower than the respective ANZECC ISQG-low guidelines. Where arsenic exceeded the ISQG-low guideline, it was approximately one-third of the ISQG-high guideline; this concentration is not atypical of sediments in the Auckland region, and may be derived from a geological source rather than from human activity.

3.8 Coastal Water Quality

Marine water quality was monitored in 2011 at various sampling locations in the Upper Waitemata Harbour (refer State of the Environment, Auckland Council Technical Report 2013/031, July 2013). Low levels of contaminants (Total Suspended Solids, ammonia, nitrate, nitrite, nitrogen, phosphorous) were reported at Hobsonville Jetty. In addition, enterococci concentrations ranged from 5 to 30 CFU/100mL at the same site which is a very low concentration when compared to marine water quality and bathing beach standards (source: Ministry for the Environment, 2003). Overall, the coastal water quality at this sampling location was ranked as excellent for both 2010 and 2011 State of the Environment monitoring rounds. It has been subsequently ranked with a marine water quality index of “Fair” in Council Marine Water Quality Annual Report, 2013, TR2014/030.

Marine water quality was also sampled at four locations on 2 July 2014 and analysed as part of the ecological assessment for GBWD and C Project[12]. Overall the water quality results suggest that the receiving water quality has some localised nutrient and microbial issues, particularly at one sampling location near a stormwater outfall that flows into the harbour.

3.9 Ecology

Ecological investigations have been carried out with more detailed information contained within Technical Report D Ecological Assessment in Volume 2. Key findings included:

- NOR1: Six sites of interest were identified along the NOR1 route with the two highest areas of recorded ecological value being at the western end of the route at the Woodlands Park Road Reservoir Connection Point, and between Scenic Drive and Selwyn Avenue. They exhibit older

[11] Auckland Council Draft Rawiri North Addendum to Waiarohia Integrated Catchment Management Plan (ICMP), AECOM, July 2015.
12 Greenhithe Bridge Watermain Duplication and Causeway AEE volume 2, Technical Report D Ecological Assessment dated November 2014.

more established vegetation and important wildlife habitats associated with the Waitakere Ranges. The four other sites were associated with stream crossings where the vegetation was young, planted and generally of poor or marginal fauna habitat value.

- NOR2: Five sites of interest were identified along the NOR2 route, including four associated with Significant Ecological Areas along the northern side of SH18 and at the Oteha Stream Crossing / Fernhill Escarpment. Sites along SH18 comprise of mixed native and exotic scrub and support potential habitat for indigenous reptiles and birds, however vegetation at the Oteha Stream Crossing / Fernhill Escarpment consisted of older growth forest.
- NOR3: Native vegetation that could be affected involves young restoration planting that was implemented as part of the SH18 motorway development. These areas generally contain only a limited range of common pioneer species such as kanuka, cabbage trees and flax or, in the case of stormwater ponds, common native wetland species.

3.10 Air Quality

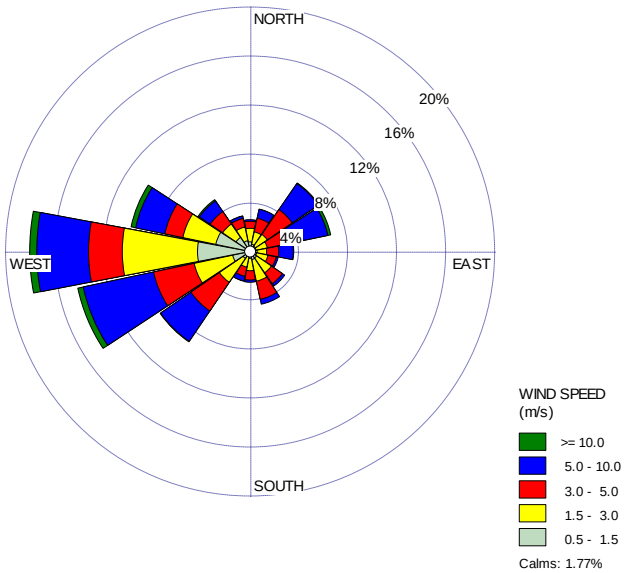
An air quality assessment has been undertaken for the Project. A summary of the existing environment and potentially sensitive receivers is provided below.

3.10.1 Meteorological Conditions

One of the factors that can have significant impacts on air quality, particularly for construction related activities is meteorology, as it is generally the combination of hot windy conditions that give rise to dust nuisance effects.

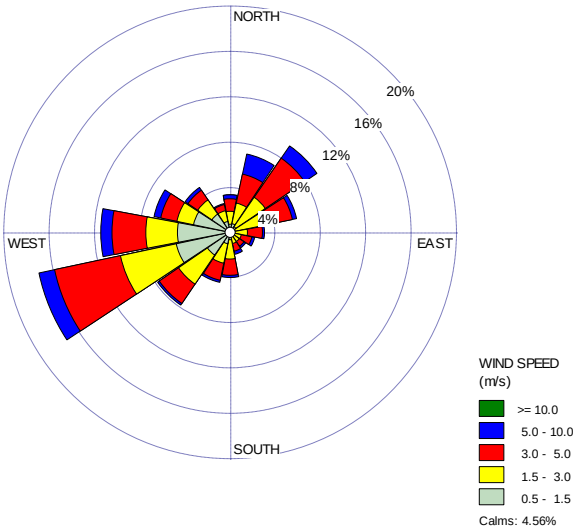
There are three publicly available stations that lie within the route. The Whenuapai data presented in Figure 2 is collected at the Whenuapai aerodrome which is located at the south eastern corner of NOR1, but is most representative of conditions in NOR3.

Figure 2 Whenuapai Meteorological Data 2008 to 2014



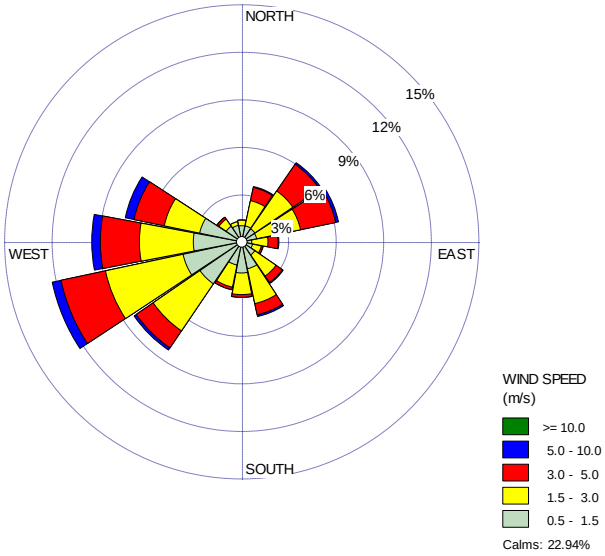
The Albany data presented in Figure 3 is collected from a site located at Rosedale and is generally considered representative of conditions within the NOR2.

Figure 3 Albany Meteorological data 2009 to 2014



The Lincoln Road meteorological site is located on Lincoln Road, and is considered to be generally representative of the conditions within NOR1.

Figure 4 Lincoln Road Meteorological Data 2008 to 2014



These three wind roses have similar characteristics, with predominant west south westerly winds. The data for Lincoln Road has lower overall wind speeds and a higher percentage of calms. This is partly a reflection of the lower height of the mast (6 m v 10 m for the others) but also the fact that it is a suburban location surrounded by houses and trees.

Overall the data indicates that there is a significant period of time (17% to 25%) when wind speeds will be greater than 5 m/s and therefore have the potential to generate nuisance dust from construction related activities.

3.10.2 Existing Ambient Particulate Data

Total Suspended Particulate (TSP) is generally defined as the portion of particulate in the air up to about 100 microns in size. There is no ambient TSP monitoring in the project area, and little ambient suburban TSP monitoring as a whole within Auckland. Council monitoring currently focuses on PM_{10} which is related to combustion activities, which have been linked to potential health effects.

The only urban monitoring currently being undertaken by Council is for Penrose, where in 2013 average concentrations were 18 $\mu g/m^3$ with maximum concentrations of 31 $\mu g/m^3$. These values were for a seven day period and therefore it is probable that average 24 hour concentrations (a more typical monitoring period) are closer to 27 $\mu g/m^3$ with maximums in the order of 46 $\mu g/m^3$. These values are significantly less than the 80 $\mu g/m^3$ to 100 $\mu g/m^3$ monitoring guidelines developed by the Ministry for the Environment to indicate whether nuisance effects are occurring in urban areas.

3.10.3NOR1 – Titirangi to Westgate

NOR1 runs primarily through built-up suburban areas and along suburban streets. Consequently the existing environment can be considered to be a low dust one, with a reasonably high sensitivity to high concentrations of nuisance dust for residential properties.

There are also some locations that are typically considered sensitive to effects from air quality which include hospitals, schools and childcare centres. In NOR 1, the following are located sufficiently close to the proposed designation to have been specifically identified as falling into this classification:

- Summerland Primary School;
- Bear Park Early Childcare Centre;
- Don Buck Primary School;
- Massey High School; and
- Massey Primary School.

3.10.4NOR2 – Greenhithe Bridge to Albany Reservoir

The existing environment in NOR2 is divided into the primarily residential area located from Greenhithe Bridge to Albany Highway and commercial / retail to the Albany Reservoir. As the first 5 kilometres (approximately) runs primarily within the State Highway 18 corridor, and is therefore reasonably well separated from the residential properties the sensitivity for this length of NOR2 is considered to be low.

The majority of the commercial areas will also have a low sensitivity although there are a number of cafes with outdoor eating areas along the route that are likely to be more sensitive to dust.
There are also the following specific locations which could be considered sensitive to air quality effects in this section:

- Summerfield Early Learning Section; and
- Pinehurst School.

3.10.5NOR3 – Westgate to Greenhithe Bridge

This section of works and the proposed designation primarily run within the State Highway 18 corridor and consequently this section is considered less sensitive to dust nuisance effects than NOR1. That having been said it is considered that where any works are undertaken very close to residential properties, then those residences are likely to be sensitive to air quality related effects. No specific dust sensitive locations have been identified in this NOR.

3.11 Traffic

Traffic investigations have been carried out with more detailed information contained within Technical Report E Traffic Assessment in Volume 2. Key findings included:

- NOR1: The majority of the NH2 will be constructed within public road corridors, with the remainder to be constructed via pipe bridges over streams and tunnelling. The table below includes average data collected from Auckland Transport's traffic flow counting programme:

Road	Average daily traffic (veh/day)	Heavy vehicle (%)	Average AM peak hour traffic (veh/hour)	Average PM peak hour traffic (veh/hour)
Glengarry Road	4,898	2.5%	531	611
Parrs Cross Road	26,836	3.1%	2,488	2,725
Palomino Drive/Border Road	12,311	4.3%	1,268	1,314
Summerland Drive	9,041	3.0%	884	1,005
Metcalfe Road	15,854	2.7%	1,445	1,444
Don Buck Road – south	17,414	3.1%	1,950	1,892
Don Buck Road - North	23,140	3.9%	2,261	2,591

- NOR2: The majority of the NH2 will be constructed within public road corridors, with some tunnelling to occur through more problematic construction areas where open trenching cannot or is not preferred to be used. The table below includes average data collected from Auckland Transport's traffic flow counting programme:

Road	Average daily traffic (veh/day)	Average AM peak hour traffic (veh/hour)	Average PM peak hour traffic (veh/hour)
William Pickering Drive	10,237	1,600	1,524
Douglas Alexander Parade	1,153	233	214
Rosedale Road	5,895	996	1,624
Bush Road	8,085	1,366	1,823
Corinthian Drive	1,532	182	300

- NOR3: The NH2 and NI will be primarily constructed along either side of SH18 in road berms or private property. The table below includes average data collected from Auckland Transport's traffic flow counting programme:

Road	Average daily traffic (veh/day)	Average AM peak hour traffic (veh/hour)	Average PM peak hour traffic (veh/hour)
SH18	35,192	4,116	3,920
Trig Road	5,557	650	619
Brigham Creek Road	4,484	427	574

An array of private car, bus, cycling and walking opportunities are provided alongside and nearby the proposed NOR and pipeline routes. A new bus network (the New Network) is to be implemented by Auckland Transport in late 2016, prior to construction of NH2 and NI. The routes of six buses in the New Network will travel on roads along the proposed alignment. The alignment will also run through the level crossing of the Western train line at Metcalfe Road. Ranui train station is located directly to the west of

this level crossing and trains on the Western line currently run at 15 minute frequencies in the peak periods and 30 minute frequencies off-peak.

The volume of construction vehicle movements is relatively small and will not have any adverse traffic impacts on the surrounding road network.

3.12 Noise & Vibration

A noise related assessment has been carried out along the three NOR areas with more detailed information contained within Technical Report F Construction Noise and Vibration Assessment in Volume 2.

The proposed route travels through and alongside numerous different environments that have a range of applicable planning zones. Each zone has prescribed noise standards in the respective operative District and Proposed Unitary Plans that along with the type of land uses occurring within these zones, sets a level of noise and vibration that can readily be anticipated to be received on any given day e.g. within Residential Zones the presence of humans undertaking residential activity such as music playing, lawn mowing, wood chopping, vacuuming, washing machine / drier use, regular vehicular trips from properties to attend work. Residential Zones are predominant along the NOR1 corridor.

Sections of the NOR3 corridor are being used or are zoned for residential activity. Within the larger Business and Industrial Zones (Westgate, Rosedale and Albany), the prescribed noise standards are elevated to accommodate the higher noise generating activities.

The majority of the residential areas alongside the route are subjected to considerable traffic related noise from road related activity especially during peak day time hours. This substantially reduces overnight and outside of busier commuting periods (7-9am, and 3-7pm). Where the designation route passes education facilities and places of assembly, these activities exhibit higher noise around start/finish times, and during the various class recesses throughout the day. Overnight reduced or very limited noise is generated from these activities as their use is generally during daytime hours.

Along with commuter traffic along roadways, other noise is commonly experienced from activities generating noise within road corridors. This includes road maintenance, mowing grass berms, rubbish / recycling collection, social interaction.

3.13 Landscape and Visual

Landscape related investigations have been carried out with more detailed information contained within Technical Report G Landscape and Visual Assessment in Volume 2. Key findings with regard to the existing landscape and visual environment included are below.

NOR1: Two distinct landscape areas are traversed. The first being the tunnelled section from Woodlands Park Road reservoir to Shetland Street where the pipe goes underneath the Waitakere Ranges Regional Park. The steep hillside is covered by regenerating native bush, large stands of native trees and houses are dotted within the bush. The natural character of the area is more dominant than its suburban character with large trees and shrubs screening views of houses and auxiliary buildings. Fences are few and many boundaries are either not defined, or defined by vegetation as opposed to hard materials. Roads in the area are narrow with no kerb and channel, being two way but with limited on-street parking potential without blocking the road. Large stands of manuka are common, being in excess of ten metres in height. This area has a high sensitivity to change due to the dominance of natural elements over built structures.

The second landscape area is from Shetland Street to Westgate where the environment is characterised by low density suburban development and pockets of commercial businesses. Surrounding houses are typically one or two stories and generally standalone, fully detached dwellings. The topography is

undulating and the network of roads and streets tend to follow the form of the topography as opposed to being a grid pattern. The main road which the alignment follows is typically 20m wide and is largely free of any street trees for the entire 16km length. The alignment crosses 4 streams:

- Oratia Stream on Parrs Cross Road has a mix of native riparian planting, mostly on the northern side of the 65m wide corridor, and larger exotic tree species including poplars. The southern side of the stream is undeveloped farm land while the northern side is heavily planted and contains the Oratia walk /cycleway which a 2.5m concrete path connecting downstream to Sunnyvale train station. The bridge has open railings and the water surface is clearly visible.
- Opanuku Stream on Palomino Drive is a heavily planted stream corridor, approximately 50m wide (in the vicinity of the proposed crossing point) with both native and exotic plantings. A walkway/cycleway is located on the eastern bank of the stream, linking upstream to Henderson Valley Road and downstream into a network of reserves and paths. The bridge has open style railings and the water surface is clearly visible, being approximately 8m below the bridge deck.
- Paremuka Stream on Munroe Road is heavily vegetated stream corridor approximately 70m wide with a mix of native and exotic vegetation. The banks are relatively steep with the water located 8-10m below the bridge deck. The bridge has a decorative railing detail which provides character but limits views of the stream due to the solid nature of the railing. There is a large grass area on the eastern side of the stream but no formed pathway.
- Swanson Stream on Don Buck Road is heavily vegetated on the downstream side with well-established stands of native riparian vegetation and large exotic trees. Large manuka trees frame the stream corridor on the stream side. The stream is approximately 6m below the bridge deck and with open style railings the water is clearly visible. The upstream side of the stream is more open with vegetation less well established and a pathway.

NOR2: Once the pipeline leaves the SH18 alignment it moves through a light industrial / business park environment with large, predominantly two storey modern buildings on either side of the road corridor. The area has a suburban commercial character with considerable space between buildings, internal landscaping and on site-carparking in front of buildings. The roads are typically 20m wide with few street trees or vegetation of note.

The Oteha Stream area is an escarpment with native vegetation. The stream is located at the southern base of the escarpment, being 6-8m below the bridge deck. There are a number of pipes crossing the stream adjacent to the downstream side of the bridge but are of a scale that they do not detract from the naturalness of the corridor. Vegetation is well established with some good examples of tall native trees and epiphytes as well as exotic pine species.

The last section of the NH2 is in Albany that is characterised by wide roads, large expanses of carparking and big box retail buildings and business park-like buildings up to four storeys in height. The alignment roughly follows an existing pathway through a wide grass area. There is little vegetation and the environment is considered to be modified and commercial in character.

NOR3: The pipelines will largely be contained within the SH18 corridor. Residential development is occurring on the southern side of the motorway corridor, with the redevelopment of Hobsonville Air Base into a new urban centre with retail, schools and housing. At the northern end is an existing marae. There are four watercourses within NOR3 being Trig and Rawiri Streams, and two unnamed watercourses. The streams have a modified character and are diverted into culverts under the motorway. Within the SH18 corridor there are some native riparian plantings.

Vegetation along SH18 is considered to have a low sensitivity to change. Existing vegetation on the MT17 where the Pump Station is proposed consists of a mixture of more established invasive species but also

includes native tree ferns. There are no heritage trees listed within the receiving environment and there were few trees of any notable size.

3.14 Arboriculture

An arborist has undertaken an assessment of trees along the route with more detailed information contained within Technical Report H Arboriculture Assessment in Volume 2. The new pump station at Hobsonville is located in an area of large gum trees, understorey native vegetation and weed species. NH2 will pass through the following types and forms of vegetation areas:

- well-treed/forested suburbs in the Waitakere Ranges foothills of Titirangi;
- less-densely vegetated suburbs of West Auckland and Albany;
- several suburban stream valleys with variable vegetation cover;
- transit corridors with mass revegetation planting areas;
- sparsely vegetated commercial and light-industrial precincts in Albany.

Trees located within the designation alignments or overhanging from adjoining neighbouring properties on either side of the designation boundary can be categorised into the following four classifications:

Private trees: A variety of privately-owned trees overhang the road and road reserve from residential and commercial properties. Common species include pohutukawa (Metrosideros excelsa), English oak (Quercus robur) and American sweet gum (Liquidambar styraciflua). Most private trees identified were exotic species of commonly occurring species.

Roadside reserve trees: Tree species growing in the various roadside reserves, such as adjacent to the several stream crossings along the route include native species such as kohuhu (Pittosporum tenuifolium), karo (Pittosporum crassifolium), kanuka (Kunzea ericoides), tī kōuka (Cordyline australis), pohutukawa and karamu (Coprosma robusta). Exotic species include Chinese privet (Ligustrum lucidum), lilly pilly (Syzygium smithii), and black wattle (Acacia mearnsii). Included in this classification are large areas of native vegetation planted as part of SH18 Motorway embankment enhancements, which includes mass plantings of native species such as kanuka, tī kōuka and harakeke (Phormium spp.)

Street trees: The majority of solitary specimen street trees identified were of commonly used species, which include pohutukawa, titoki (Alectryon excelsus), American sweet gum, southern magnolia (Magnolia grandiflora) and bead tree (Melia azederach). Most trees identified were early mature or small trees.

Park trees: A few small reserves were encountered along the route that is associated with the watermain installation and some of them will serve as site compounds whilst works are being carried out. Trees within Council parks include pohutukawa, rimu, oak, pine and swamp cypress.

3.15 Archaeology

Archaeological related investigations have been undertaken along the alignment with more detailed information contained within Technical Report I Archaeology Assessment in Volume 2.

Multiple archaeological and historic heritage sites have previously been recorded within 100m of the full extent of the proposed NH2 alignment, in particular the Don Buck's camp (CHI 15094). Its precise location and the extent of any subsurface features or deposits have not been confirmed. The potential archaeological significance of the site is considered to be limited, but the site has moderate local historic heritage significance based on its association with Don Buck.

The NH2 and NI shared corridor has been heavily modified and there are no sites identified within the shared corridor.

3.16 Planning Zones

The proposed NH2 route has a lineal distance of approximately 33kms. The proposed NI section located in the NOR3 corridor will be approximately 5kms. These two pipelines will be located predominantly below ground level however a variety of associated ancillary and operational componentry will be located at ground level. The majority of the NH2 and NI project will be installed within local road corridors, however as described earlier in this report, some sections will be constructed via trenchless technologies under residential land use activities, or will cross streams as a pipebridge.

Under the Auckland Council District Plan (North Shore City section) local roads are shown to have the zone Transport Environment and are subject to a designation held by Auckland Transport.

Under the Auckland Council District Plan (Waitakere section) local roads are zoned Road and are designated. Some parts of SH16 and SH18 are not yet shown in this plan but are designated.

Under the Proposed Auckland Unitary Plan local roads are not assigned any zoning and are not designated. Activities within local roads are administered by Auckland Transport through Corridor Access Requests ("CAR") and the Utilities Access Act 2010.

State Highways 16 and 18 have the planning zone "strategic transport corridor" and are managed by the Transport Agency as the road controlling authority for State Highways. Consultation with the Transport Agency is undertaken when works are proposed within or will potentially have an effect on a State Highway.

The following table describes the relevant Auckland Council District Plan (Waitakere Section) and Proposed Auckland Unitary Plan zones and overlays applicable to the NH2 and NI pipelines:

Activity / Location	ACDP: Waitakere Section Zones	Proposed Auckland Unitary Plan Zones
Tunnelling under Scenic Drive, Konini Road, private property and the Waitakere Ranges Regional Park.	Human Environment (HE): Bush Living, Transport Environment, Open Space Natural Area (NA): Managed, Sensitive Ridge – Moderate (65m)	Large Lot Public Open Space – Conservation.
Open trenching works from North end of Shetland St then along Glengarry Rd	NA: Sensitive Ridge – Broad (100m)	No zoning - public road
Pipebridge across Oratia Stream to west of the road	HE: Foothills, Oratia Overlays. NA: General, Ecological Linkage Opportunity	No zoning - public road, Countryside Living Public Open Space – Conservation across stream (Water)
Pipebridge across eastern side of Opanuku Stream and cathodic protection provided further east into Plumer Domain	HE: Open Space. NA: General / Protected / Managed, Ecological Linkage Opportunity.	Public Open Space – Conservation across stream (Water)
Pipebridge across Paremuka Stream to the east of the road	HE: Open Space. NA: Managed, Riparian Margin (10m)	Public Open Space – Conservation
Pipebridge over Swanson Stream to the west of road.	HE: Open Space NA: General, Ecological Linkage Opportunity	Public Open Space - Conservation
Open Trenching along Fred Taylor Drive (works already undertaken).	HE: Special Area NA: General	Public Open Space – Informal Recreation
Tunnelling under SH16	HE: Countryside NA: General	Strategic Transport Corridor Large Lot

Activity / Location	ACDP: Waitakere Section Zones	Proposed Auckland Unitary Plan Zones
NH2 (open trenching) and NI (tunnelling) along southern side of SH18 to approx. chainage of 18900 (NH2)	HE: Countryside NA: General and crossing over non-riparian margin.	Strategic Transport Corridor
NH2 (open trenching) and NI (tunnelling) along southern then Northern sides of SH18 to MHWS approx. chainage of 22200 (NH2)	HE: Special Area to south side of SH18 and Countryside to the North. NA: General, then crossings of non-riparian margin.	Strategic Transport Corridor for NH2 entirely, but NI passes under: Mixed Use, Public Open Space – Sport and Active Recreation, Mixed Housing Suburban, Public Open Space – Conservation Strategic Transport Network.

The following table describes the relevant Auckland Council District Plan (North Shore City Section) and Proposed Auckland Unitary Plan zones and overlays applicable to the NH2 and NI pipelines:

Activity / Location	ACDP: North Shore Section Zones	Proposed Auckland Unitary Plan Zones
NH2 from east end of Greenhithe Bridge through to Greenhithe Road	Zone (Z): Road Special Provisions (SP): Coastal Conservation Area at western edge of SH18.	Strategic Transport Corridor
NH2 trenchless technology under Greenhithe Road.	Z: Road SP: nil	Strategic Transport Corridor
NH2 from Greenhithe Road through to William Pickering Drive (trenchless technology used under Tauhinu Rd / SH18 intersection).	Z: Road then Business 9 on Northern corner onto Albany Highway. SP: nil	Strategic Transport Corridor Heavy Industry.
NH2 extending up William Pickering Drive, Douglas Alexander Parade, Rosedale Road, Bush Road to the Oteha Stream.	Z: Road SP: Building Line Restriction on Bush Road.	No zoning - public road. Cathodic protection - Public Open Space – Informal Recreation
NH2 to be constructed either via trenchless technology under Oteha Stream, or pipebridge across Oteha Stream.	Z: Recreation 1 SP: Site of Special Wildlife Interest 4, Building Line Restriction.	Public Open Space – Conservation.
NH2 open trenching along road to end of NOR2.	Z: Road SP: nil.	No zoning - public road.

4 NOTICES OF REQUIREMENT & RESOURCE CONSENTS SOUGHT

4.1 Introduction

Watercare is a network utility operator approved under s167 of the Resource Management Act 1991 (RMA). Watercare proposes to designate land for the NH2 and the part of NI within the shared corridor in accordance with s168 of the RMA and also seeks a number of resource consents for the NH2 project. This section sets out the scope of the NORs and the reasons for resource consent. It also provides an assessment of permitted activities.

4.2 Proposed Activities

As outlined in Section 2 above, the NH2 and NI projects will involve (but is not limited to) the following activities:

- Earthworks (temporary, being excavation / deposition / surface clearance / below ground);
- Groundwater take and diversion (temporary);
- Works in watercourses (temporary / permanent being structure, excavation / deposition);
- Diversion and discharges to land or water (temporary and permanent being sediment laden water and stormwater respectively);
- Discharge of contaminants from works in contaminated sites;
- Vegetation disturbance and clearance; and
- Installation, operation and maintenance of pipelines, below and above (pipebridges) ground, including their ancillary associated componentry.

4.3 Notices of Requirement and Purpose of the Designation

Land within the following three corridors are to be designated for the NH2 and NI projects in accordance with Section 168 of the Resource Management Act 1991 (RMA):

- NOR1 - A corridor for the NH2 travelling from Titirangi through to Westgate;
- NOR2 - A corridor for NH2 travelling from the eastern side of Greenhithe Bridge to the Albany Reservoir; and
- NOR3 - A shared corridor for NH2 and NI along SH18 from Westgate to the western start of GBWD and Causeway project.

The purpose of NOR1 and NOR2 is for Water Supply Purposes. The purpose of NOR3 is for Water Supply and Wastewater Infrastructure purposes. Watercare do not propose to seek a waiver of an outline plan of works.

4.4 Applications for Resource Consent

A single package of resource consents are sought for NH2. Resource consents for the NI project will be sought at a later date.

NH2 requires resource consent under the operative regional plans and the PAUP for:

- Earthworks and Sediment Control – (earthworks section 9 RMA)
- Discharge of contaminants – (sediment laden water and stormwater runoff from new impervious surfaces, potential discharges from contaminated land section 15 RMA);
- Groundwater diversion – (construction related diversions section 14);

- Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 – discretionary activity.

4.4.1 Permitted Activities

The NORs obviate any reliance on permitted activities relating to District Plan related land use. The PAUP is still at hearing stage, but rules in the PAUP that relate to water, air, or soil and the protection of significant indigenous flora and fauna have legal effect from notification.

The following table outlines aspects of the Project that are considered to be permitted activities (relating to Regional Plans including regional rules with immediate legal effect in the PAUP):

Geographical Location	Type of Work	Activity being undertaken	Relevant Rule / Provision	Comments	Activity Status
Tunnelling activity and associated structures	Permanent and temporary	New structures and the associated bed disturbance or depositing any substance, diversion of water and incidental temporary damming of water for structure solely under the bed including drilling and tunnelling within rivers or streams including intermittent stream reaches and wetlands outside Natural Stream Management Areas, Natural Lake Management Areas, Urban Lake Management Areas, Significant Ecological Areas (SEAs) and Wetland Management Areas	PAUP H.4.13.1	Tunnelling activity and associated structures for pipeline sections to be installed from Woodlands Park Road reservoir through to Shetland street; tunnelling under SH16 at Westgate, along sections of SH18, under the Oteha Stream.	**Permitted**
Various locations along pipeline route	Temporary	Discharges of potable water for the purpose of draining pipelines or water reservoirs for inspection, repair or maintenance.	PAUP H.4.13.1	Pipeline construction testing and on-going operational maintenance	**Permitted**
Pipe bridges	Permanent structures	Pipe bridges outside of SEA (Oratia Stream and Paremuka Stream)	PAUP H.4.13.1.2	Pipe bridges	**Permitted**
Various locations along pipeline route	Permanent structures	Minor utility structures within roads, unformed roads, Strategic Transportation Corridor Zone including cathodic protection structures which sit outside designation (eg Trig Road).	PAUP H.1.1	Definition of "**Minor utility structure**" - Any aboveground box-like structure or enclosure associated with a network utility or that receives or transmits to or from any part of a network utility. Includes: water infrastructure and cabinetry for stormwater / wastewater networks.	**Permitted**
Various locations along pipeline route	Temporary	Potential dust generating activities associated with construction	PAUP H4.3.1	Dust management will be standard part of construction management practise to meet permitted activity controls.	**Permitted**
Various locations along pipeline route	Temporary	Potential dust generating activities associated with construction	ACRP:ALW 4.5.1	Dust management will be standard part of construction management practise to meet permitted activity controls.	**Permitted**
Various locations along pipeline route	Temporary	Potential discharge of contaminants to land and water	ACRP:ALW 5.5.41	Disturbance of land potentially contaminated from previous land use	**Permitted**

4.4.2 Auckland Council Regional Plan (Air, Land & Water)

The following table details resource consents sought under (but not limited to) the rules as identified:

Rule / Activity	Provision	Activity Status
5.5.5 Diversion and Discharge of stormwater	Diversion and discharge of stormwater	**Non complying**
5.5.44A	Discharge of contaminants to land or water from land containing elevated levels of contaminants that does not comply with the standards and terms Rule 5.5.43 or 5.5.44	**Restricted Discretionary**
6.5.77 Diversion of groundwater	The diversion of groundwater not covered by Rule 6.5.76	**Restricted Discretionary**
6.5.43 Groundwater take	The taking of groundwater for the purposes of groundwater diversion under Rule 6.5.77 of this plan	**Restricted Discretionary**
7.5.5 Use, erection or placement of new structures	The use, erection or placement of any new structure or part of any new structure listed in this rule in, on, under or over permanent river of stream and any associated bed disturbance or deposition, any associated diversion of water and any incidental temporary damming of water **iv.** Pipe bridge subject to specific structure conditions (a), (c), (e), (f) and (g) **xv.** Any structure located solely under the bed, that is not covered by clauses I to xiv, subject to specific structure conditions (m) and (n).	**Permitted** (subject to conditions)
7.5.15 Tunnelling and placement of new structures	Any disturbance, removal, damage or destruction of any exotic or indigenous plant, or part of any plant, or the habitats of any such plants, or of animals, or any excavation (other than dredging), drilling, tunnelling, or other disturbance in, on or under the bed of a lake or Permanent river or stream, and any associated discharge of sediment.	**Permitted** (subject to conditions)
7.5.19 Tunnelling	Other than provided for by Rule 7.5.18, any disturbance, removal, damage or destruction of an exotic or indigenous plant or part of any plant, or the habitats of any such plants, or of animals, or any excavation, drilling, tunnelling, or other disturbance in, on or under the bed of a lake or Permanent river or stream and any associated discharge of sediment, which does not meet the conditions of Permitted Activity Rules 7.5.15 or 7.5.16	**Restricted Discretionary**

Overall the activity falls to being considered as a non-complying activity under the ACRP:ALW.

4.4.3 Auckland City Regional Plan (Sediment Control)

The following table details resource consents sought under (but not limited to) the rules as identified:

Rule / Activity	Provision	Activity Status
5.4.3.1 Earthworks on all soils	Within SCPA (Sediment Control Protection Areas are defined as 50 metres landward of the edge of a watercourse, or wetland of 1000m² or more) • Area greater than or equal to 0.25 hectares Outside SCPA • Area greater than or equal to 5.0 hectares on land with a slope less than 15°. • Area greater than or equal to 0.25 hectares where the land has a slope greater than or equal to 15°.	**Restricted Discretionary**
5.5.2 Discharge of Contaminants into the Environment	Any discharge of sediment laden runoff not allowed by a rule in this Plan	**Discretionary**

Overall the activity falls to being considered as a discretionary activity under the ACRP:SC.

4.4.4 Proposed Auckland Unitary Plan – Activities Requiring Resource Consent

The following table details resource consents sought under (but not limited to) the rules as identified:

RMA Section Consent Type	Geographical Location	Type of Work	Activity being undertaken	Relevant Rule / Provision Comments	Activity Status
S 13 Works in the bed of a stream	Oratia Stream, Opanuku Stream, Paremuka Stream, Swanson Stream, Oteha Stream	Permanent structures	Pipe bridges to be constructed over various streams, with permanent structures including pipe bridge supports, ancillary operational components and security fencing.	H4.2.1.1 Permanent aboveground pipelines and fittings for the conveyance of water.	**Restricted Discretionary**
S9 Land use	Project wide	Construction works	General earthworks greater than 2500m2 and 2500m3	H.4.2.1.1 Earthworks required for open trenching and trenchless technology activity.	**Discretionary**
S9 Land use	Project wide	Temporary & permanent	Earthworks greater than 2500m2 or 2500m3 within the 100 year flood plain overlay	H.4.2.1.2 Earthworks required for open trenching and trenchless technology activity.	**Restricted Discretionary**
S9 Land use	Project wide	Temporary & permanent	Earthworks greater than 2500m2 or 2500m3 within Significant Ecological Area overlay, including pipe bridges	H.4.2.1.2 Earthworks required for open trenching and trenchless technology activity.	**Discretionary**
S9 Land use	Opanuku Stream, Swanson Stream, Oteha Stream.	Temporary & permanent	Vegetation alteration or removal within an SEA	H.4.3.1.2 Works within an SEA for construction and installation of pipeline and pipe bridge supports.	**Discretionary**
S 14 Water permit	Project wide	Temporary & permanent	The diversion of groundwater caused by any excavation, trench, tunnel up to 1m diameter, or thrust bore that does not meet the permitted activity controls or is not otherwise provided for	H.4.17.1 Taking, using, damming and diversion of water and drilling	**Restricted Discretionary**
S 15 Discharge permit	Project wide	Permanent	Diversion and discharge of stormwater from impervious areas not otherwise authorised by stormwater discharge and diversion rules	H4.14.1 Discharge of stormwater Formation of access roads to maintenance and operational components.	**Discretionary**
S 15 Discharge permit	Project wide	Temporary	Discharges of contaminants from land not meeting the controlled activity controls	H4.5.1 Discharge of contaminants encountered during construction	**Restricted Discretionary**
S 14 Water permit	Project wide	Temporary	Diversion of groundwater caused by any excavation, trench, tunnel up to 1m diameter, or thrust bore that does not meet the permitted activity controls or is not otherwise provided for	H.4.17.1 Discretionary when permitted activity control not met.	**Restricted Discretionary**
S 15 Discharge permit	Project wide	Temporary	Discharge of wastewater or washwater from: b. installation, repair, maintenance and removal of network utility infrastructure that does not meet the permitted activity conditions	H.4.18.1 Discretionary when permitted activity control not met	**Controlled**
S14 Water permit	Project wide	permanent	The development of new impervious areas that do not meet the permitted or controlled activity controls	H4.14.2.1 Discretionary when permitted or controlled activity controls not met	**Discretionary**

Overall the activity falls to being considered as a discretionary activity under the PAUP.

4.4.5 Processing of NORs and other Applications

The NORs and resource consent applications are to be lodged simultaneously for joint notification and processing by Council.

A 20 year lapse date for consents and designations, and a 35 year expiry date for operational consents is requested. It is expected that construction works authorised by the proposed designation for NH2 will commence within five years. However, flexibility is required for programming and implementation to ensure that works are appropriately timed to co-ordinate with other works (such as Huia WTP) within the network and to meet demand increase related to population growth.

A lapse period of 20 years is sought for NI to ensure that the staged approach necessary to respond to and appropriately accommodate the functionality of the network can be maintained and to align with the wider NI project.

In addition, the periods requested will safeguard the alignment whilst providing sufficient time to give effect to the designation including progressing property negotiations, further necessary site investigations and detailed design, and allowing for an appropriate period to address required additional resource consenting, tendering and construction processes.

4.5 Other Consents & Approvals

4.5.1 Specific Access Permission

There are a number of locations along the proposed route where the NH2 and NI may require specific access permissions such as easements, deeds of grant, or rights of occupation for both construction and long term operation. These will be addressed with the Watercare Property Team as required and include section 177 approvals where existing designations have priority, wildlife approvals if fauna is relocated and authorities under HNZPTA.

5 ASSESSMENT OF ALTERNATIVES

5.1 Introduction

When considering a Notice of Requirement by a Requiring Authority, the Council is required under section 171(1)(b) of the RMA to have particular regard to whether adequate consideration has been given to alternative sites, routes, or methods of undertaking the work if either:

(i) The requiring authority does not have an interest in the land sufficient for undertaking the work; or

(ii) It is likely the work will have a significant adverse effect on the environment.

Having regard to these matters, Watercare does not have an interest in the land through NOR1, NOR2 or NOR3 sufficient for undertaking the work.

This AEE and the specialist technical assessment reports demonstrate that the proposed work will not result in significant adverse effects on the environment. Conditions are proposed to appropriately manage other actual and potential adverse effects on the environment. Having undertaken a process of firstly identifying the need for the NH2 project, confirming project objectives and operational requirements and then assessing alternative sites, the proposed route for NH2 and the part of NI within the shared corridor was selected as the preferred location for construction of the required watermain and wastewater interceptor.

5.2 Consideration of NH2 Project Alternatives

5.2.1 Introduction

Auckland's water supply comes from a variety of sources that is then reticulated throughout the Auckland region through Watercare's networks. Forecast population increases along with predicted business growth in the Auckland region mean that there will need to be increases in water supply capacity to accommodate anticipated demand. This growth is predicted not only through intensification within existing urban areas, but also for new growth areas that will be located on the current periphery of developed / serviced areas.

Alternative methods for increasing water supplies were considered early in the process which included improving efficiency of supply from existing sources, and promotion of water reduction methods within households and business. While there will be some continued success from implementing these, this would not have freed up sufficient capacity within the water supply network and it was determined that a new secondary pipeline needs to be constructed to supplement the water supply (NH1) already being provided from west Auckland to the North Shore. Provision of a second pipeline will also increase security and resilience to the Watercare water supply network.

5.2.2 Alternative sites and routes Section 171(1)(b) - Route Option Selection

URS (on behalf of Watercare) undertook an analysis of the alternative routes/sites for NH2 from the Huia Water Treatment Plant to the Albany reservoirs in May 2011[13]. The following analysis is drawn from that report. The Route Selection Report outlines detail of the route selection process.

The ACRE (Area, Corridor, Route, Easement) model strategy was used to develop route options, and identify their constraints and opportunities.

The **A**rea phase considers the region through which the NH2 is required and generally includes an area between the east and west coasts from Huia in the South to Albany in the North.

[13] Route Selection Report North Harbour No.2 Watermain Route Alignment Options Assessment May 2011

The **C**orridor phase gave consideration to possible geographic corridors the NH2 could traverse that included:

1. Eastward towards the Harbour Bridge then following SH1 north to Albany;
2. Centrally northward through Waitakere, Te Atatu, Hobsonville and across the harbour at Greenhithe and on to Albany;
3. West of Waitakere around west Auckland, then north of the harbour and estuaries, then eastward to Albany.

The preferred corridor was selected on evaluation of criteria relating to

- Separation for NH1 to provide supply security and resilience.
- Land use (road corridors had preference over privately owned land);
- Length of route;
- Geology and topography;
- "Hydraulic no-go" areas; and
- Length of route within the harbour crossing using existing bridges (Harbour Bridge and Greenhithe Bridge).

The preferred NH2 corridor was confirmed based on the criteria above as being a central option (2 above) through Waitakere, Te Atatu, Hobsonville, across the harbour at Greenhithe and on to Albany. Figure 5.1 below shows the various routes considered for construction of the NH2.

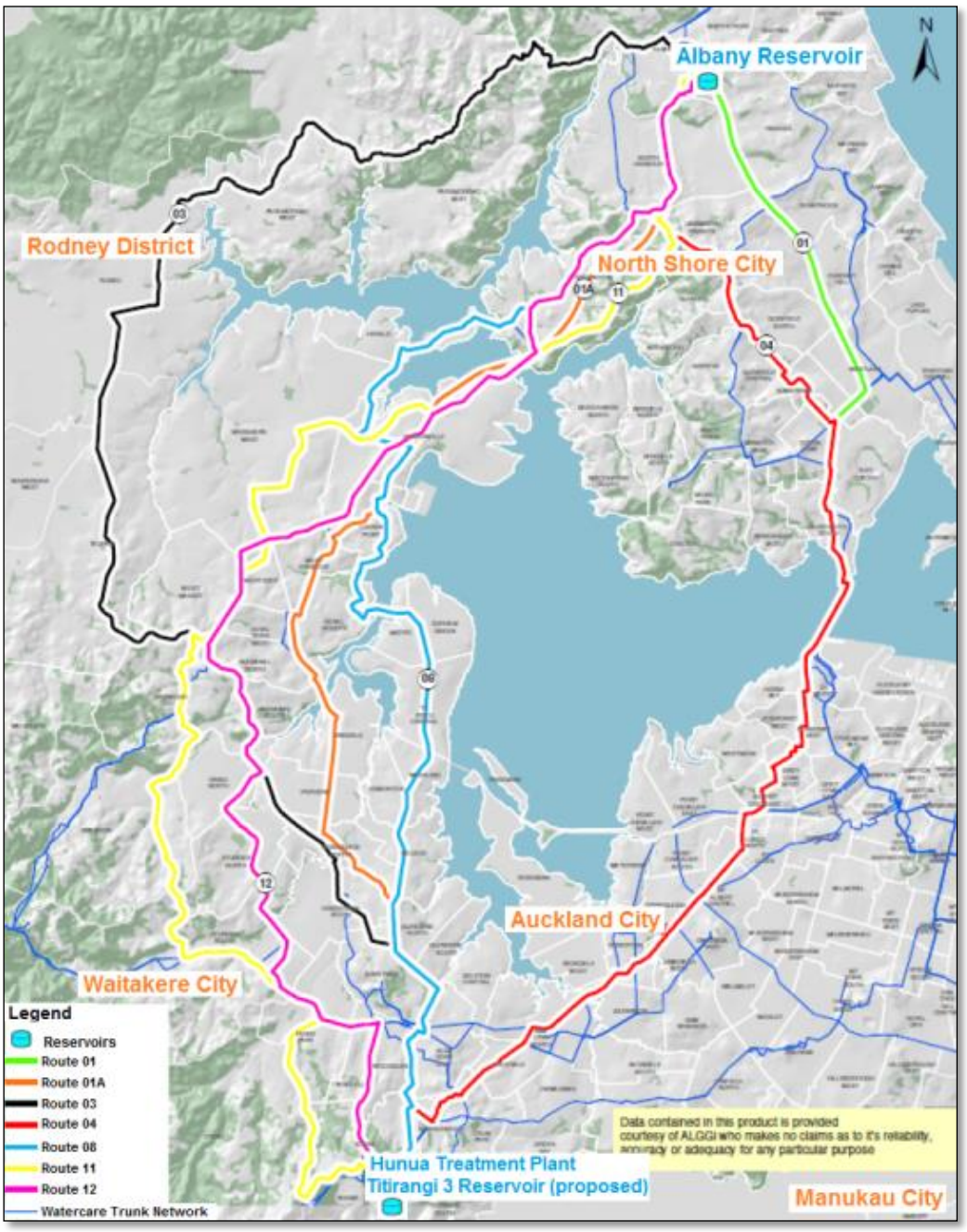


Figure 5.1 Route Options Considered

5.2.3 Route Development Process

On confirmation of the corridor, the **R**oute phase considered the alignment of the pipeline through the community.

Possible route options were broken into segments and combined to form 3-4 alignment options within three zones, Titirangi, Waitakere and North Shore summarised below:

Zone 1 – Titirangi

The characteristics of this zone are the topography, geology and the tight, small roads available for access and construction. There is a general requirement that the new pipeline would not follow the existing NH1 route in this area, primarily for security of supply reasons.

Zone 2 – Waitakere

There are many route alignment options available through the general Waitakere City area using relatively major roads as the key focus. The main drivers that restrict the alignment selection process in this zone are the vicinity to town centres, population density, length and distance to the existing NH1. Connectivity to water supply pressure zones through trunk or local network pipes is also a primary consideration with redundancy of supply required between the future NH2 and the existing system.

Zone 3 – North Shore

The primary consideration in this zone is the harbour crossing required to get across to the North Shore. The Greenhithe Bridge Watermain Duplication and Causeway project considered the alternatives with respect to alternative crossings.

The final alignment was determined by refining the route options based on:

1. Constructability issues and operational requirements;
2. Intersections with other network utility services;
3. Number of 'sensitive uses' within a specified distance of the route (e.g. number of schools within 100m of each route);
4. Population levels along the route options;
5. Number of scheduled heritage features within a specified distance of the route (e.g. number of scheduled buildings within 200m of each route);
6. Proximity of the routes to areas of potential significance to tangata whenua;
7. Number of stream/watercourse crossings;
8. Area of sensitive land within a specified distance of the route (e.g. area of Maori freehold land within 200m of each route); and
9. Potential collaboration/conflict with other projects.

Watercare then undertook a constraints analysis process to assist in defining the optimal route alignment across the three zones. The analysis considered:

- Environmental issues;
- Community issues;
- Ease of consenting;
- Constructability;
- Impact to services;
- Long-term operability;
- Design;
- Costs – capital and operational (construction related).

The current alignment is the realisation of the analysis and assessment of a broad range of options within each of the zones.

5.2.4 Easement

The “easement” in this instance is achieved through designation of the corridor as shown in NORs 1, 2 and 3. Watercare could choose to undertake the works through land use consents in conjunction with the suite of regional consents necessary. However the designation of the land will enable more flexibility in construction of the works, important route protection in the interim, and serves to identify the works to the public through its inclusion in the Unitary Plan (and any relevant district plans if operative when the designation is confirmed). Importantly land use consents would not preclude other land use consents being implemented in the interim which may render the proposed design obsolete.

5.2.5 Alternative methods - Consideration of Construction Methods for Works on Land

The NH2 needs to convey water between two points that are approximately 33km apart (23km in a straight line). The proposed design solution is preferred as it meets all of the route selection objectives (as outlined in 5.2.3 above); offers sufficient hydraulic performance; has an acceptable associated capital and predicted operating cost; and provides an efficient and effective way of meeting Watercare’s statutory objectives. Due to this significant length, there are limited alternatives available for the construction of the NH2 that would meet the project objectives (outlined in 5.2.1 above). There are alternative route options for the NH2 to travel however the construction methodologies and activities would essentially still be the same as that being proposed.

Part of the route selection process gave consideration of how the NH2 pipeline could be constructed along certain route sections given the varying composition of land attributes (topography changes, private land ownership, locations of existing or planned services, geological constraints). While alternative construction methods will be considered as part of the detailed design process, and subsequent construction methodology, two methods are proposed being open trenching and trenchless technology (including include tunnelling, horizontal boring, directional drilling, pipe jacking or micro-tunnelling). These activities take place beneath ground and at the surface at either end of the trenchless section.

5.2.6 Advantages and disadvantages for works on land

The alternative construction methods for works are summarised in the following table:

Method	Advantages	Disadvantages
Open Trench	- Usually a lower cost except where significant disruption is likely. - Pipe in shallow location easier to access for future maintenance or repair. - Reliable construction method - Adaptable to variable ground conditions.	- Traffic disruption along roads and temporary restriction on private property. - Adverse environmental and amenity effects e.g. dust, noise, vegetation disturbance. - Long length of above ground land requirements.
Trenchless Technologies	- Little impact on above ground features - Limited traffic disruption due to working areas for jacking and receiving shafts. - Less above ground or visible noticeable environmental impact. - Potentially less disruption to existing services. - Can tunnel in straight line underneath aboveground obstacles e.g. live roads, existing urban buildings.	- Usually higher cost associated with preparatory investigations and design. - Pipe is often at a deeper location thereby becomes more difficult for future access for repairs or maintenance. - Less able to adapt to variable ground conditions if encountered.

5.2.7 Alternative Construction Methods for Stream Crossings

The NH2 route proposes five stream crossings over the Oratia Stream, Opanuku Stream, Swanson Stream, Paremuka Stream and the Oteha Stream. Pipe bridges are proposed over these streams to carry the NH2 pipeline.

Pipe bridges are the preferred method for crossing steams as micro tunnels create low points in the pipeline where sediment deposits can build up. When the flow regime changes this sediment can be mobilised resulting in turbidity issues. Additionally it is difficult to drain these low points when emptying the pipeline.

Overall, it is considered that the alternative routes (including sites) and methods including construction methods have been robustly analysed.

5.3 Consideration of NI Project Alternatives

A detailed analysis of alternatives, from options through to route selection, has been prepared by Watercare to support the Northern Interceptor. The analysis below draws on that report[14], and is a summary of that report only.

5.3.1 Alternative sites and routes Section 171(1)(b) - Route Option Selection

The planned growth for the northwest of Auckland requires a planned approach to provision of wastewater to meet these demands. Figure 5.1 below shows the various areas within northern Waitakere and south Rodney. Watercare's wastewater infrastructure has limited capacity to accommodate the projected future growth in these areas.

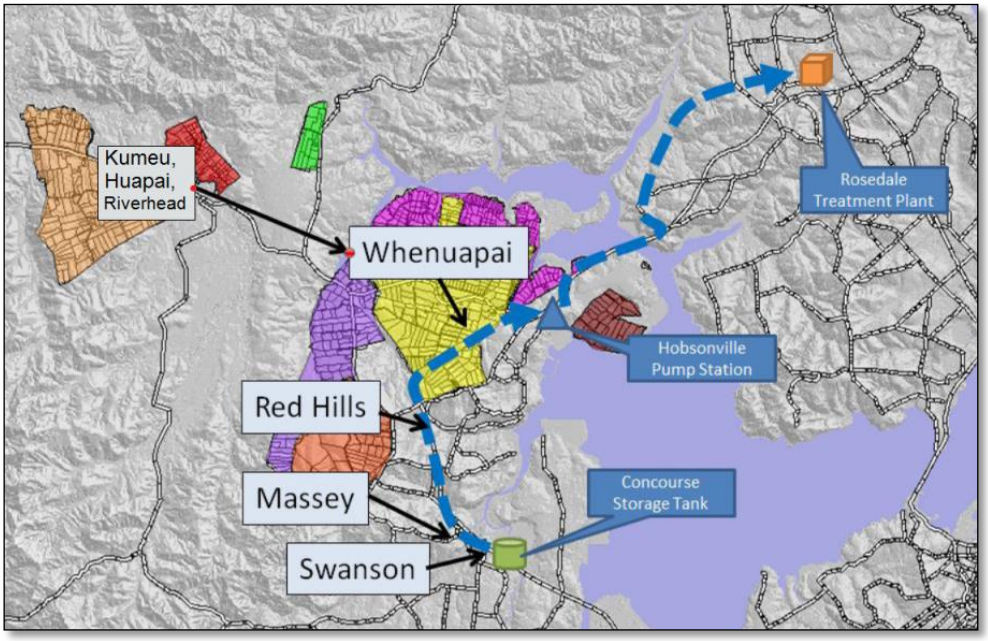


Figure 5.2 shows spatial locations of areas to be serviced

Watercare has identified various alternatives to provide the required conveyance and treatment capacity to maintain service levels and to provide for the planned population growth. Watercare identified and developed a number of potential strategic wastewater servicing options for the region which are summarised in the "*Northern Interceptor - Assessment of Project Alternatives"* report. These alternatives included:

1. Option 1 – Do nothing: This option assumes Watercare would provide no additional wastewater conveyance or treatment capacity to service growth in the northern Waitakere and south Rodney areas;

[14] Northern Interceptor – Assessment of Alternatives (draft for client comment), MWH, February 2016

2. Option 2 – Mangere wastewater treatment plant (WWTP): This option provided for an upgrade of existing infrastructure to convey wastewater flow from northern Waitakere (inclusive of the North West Transformation Area (NWTA), Whenuapai, Massey and Swanson) and south Rodney (inclusive of Kumeu, Huapai and Riverhead) to the Mangere WWTP;

3. Option 3 – Rosedale and Mangere WWTP: This option required construction of a new Northern Interceptor to convey wastewater from NWTA and South Rodney to the Rosedale WWTP, and upgrade existing infrastructure to convey all remaining Northern Waitakere wastewater (Whenuapai, Massey and Swanson) to the Mangere WWTP;

4. Option 4 – Rosedale WWTP: This option required construction of a new Northern Interceptor to convey wastewater from Northern Waitakere (inclusive of NWTA, Whenuapai, Massey and Swanson) and South Rodney (inclusive of Kumeu, Huapai and Riverhead) to the Rosedale WWTP; and

5. Option 5 – New North Western Regional WWTP: This option proposed the construction of a new North Western Regional WWTP and conveyance system to service wastewater needs for Northern Waitakere (inclusive of NWTA, Whenuapai, Massey and Swanson) and South Rodney (inclusive of Kumeu, Huapai and Riverhead).

6. Option 6 – No service growth: This option assumed Watercare will not provide additional wastewater conveyance or treatment capacity to service growth in the North Waitakere and south Rodney areas, and that as a result, Council would place a moratorium on growth in the NWTA.

Watercare undertook assessments that considered:

- The development of each alternative to a sufficient level of detail to understand the key scope and requirements of the alternative;
- The development of a set of criteria and associated attributes for the assessment of each of the alternatives; and
- The assessment of each alternative against these criteria and comparison of the outcomes; and Identification of a preferred alternative.

Based on those assessments, Option 4 (Rosedale WWTP) was identified as the overall preferred solution because:

- On a technical basis it provides the most flexibility of all options in terms of the ability to stage construction;
- The option provides the additional benefit of more efficiently utilising the existing capacity of the Rosedale WWTP and the consequential reduction in flows and loads to the Mangere WWTP;
- Operationally it is similar to the other conveyance options (Options 2 and 3), but has lower operational complexities to Option 5;
- It had the lowest overall risk in terms treatment requirements given available capacity at the Rosedale WWTP and ability to utilise the Rosedale sea outfall;
- Results in lower environmental, social and cultural effects than other options.
- Has the lowest overall whole of life cost.

5.3.2 Route Selection

On confirmation of Option 4 as the preferred option, two stages were identified as key aspects being:

- A pipeline from the Concourse storage tank to Hobsonville Pump Station; and

- A pipeline from Hobsonville Pump Station to the Rosedale WWTP.

There are three 'fixed points", those being the Concourse storage tank, the Hobsonville pump station and the Rosedale WWTP. These critical and established infrastructure elements determined the range of route options that could be considered.

Thirteen possible route alignments were formulated to convey wastewater between the Concourse storage tank and Hobsonville Pump Station. Three options were short listed. Each of the three was further refined and the route within the motorway corridor was identified as the preferred option.

A phased approach was developed to ensure that pipework was not initially oversized which would increase the risk of significant operational problems including blockages, septicity, odour and corrosion due to the low flows in the early years of operation.

The following staged project was developed:

"Phase One: *The first phase of the Northern Interceptor is a new pipeline planned for completion by 2020 to serve the immediate population growth. This phase will transfer existing flows from the Hobsonville PS to Rosedale WWTP, via a crossing of the Upper Waitemata Harbour and through Greenhithe. Construction is expected to begin 2017-2018.*

Future Phases: *Future phases of the Northern Interceptor may include a new pipeline from the Westgate commercial area to the Hobsonville PS, and Concourse to Westgate, additional pipelines from the Hobsonville PS to Rosedale WWTP (including an additional harbour crossing), new pump stations in Hobsonville, Concourse (Henderson) and Greenhithe/Schnapper Rock, and associated works. The timing of these future phases will depend on the rate of growth in north-western Auckland".*[15]

NI phase 1 (from Hobsonville pump station to Rosedale WWTP) was granted resource consent in January 2016.

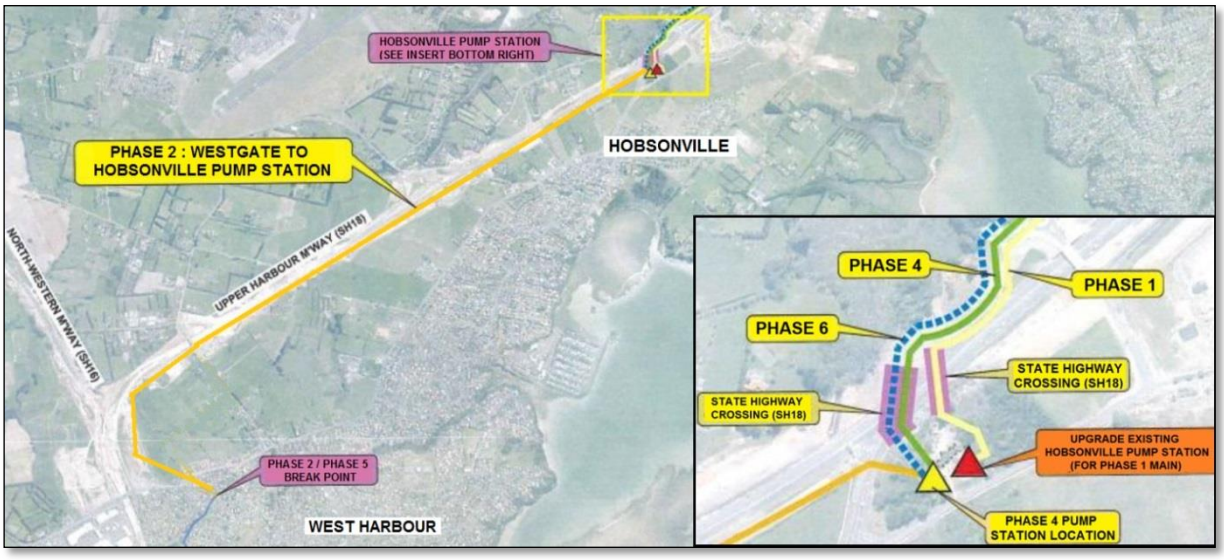


Figure 5.3 shows the section of NI to be within shared NOR3 corridor

5.3.3 Options for Construction

[15] AEE Northern Inteceptor Wastewater Project Watercare and MWH, July 2015

The NI in its entirety will be a long pipeline. The section of the NI to be located within the NOR3 shared corridor will travel approximately 5km. Because this section of the NI will be a gravity pipeline, there are prevalent gradient limitations for running the pipeline from the proposed start (higher end) at the east end of Hobsonville Road, to the proposed end (lower end) at the Hobsonville Pump Station.

The proposed design is preferred as it meets design objectives; offers sufficient hydraulic performance; has an acceptable associated capital and predicted operating cost; and provides an efficient and effective way of meeting Watercare's statutory objectives. There are limited alternatives available for the construction of this section of the NI where it can meet the project objectives. There are alternative route and construction options however the construction methodologies and activities would essentially still be the same as that being proposed.

Trenchless technology is the preferred option as it has less effects on the environment (noise, traffic, construction health and safety) compared to a trenched option.

5.4 Conclusion

Watercare has evaluated a wide range of alternatives for addressing the wastewater network needs for the north west of Auckland. That evaluation process confirmed the delivery of wastewater to Rosedale WWTP for treatment and discharge is the preferred option. NI was confirmed as the preferred integrated network upgrading solution. A subsequent detailed consideration of alignment options and design and construction configurations confirmed the alignment. The NI project works described in this AEE represents the outcome of that process (where relevant to the NI within the shared corridor) and is considered to be the option that best provides for future wastewater network needs. The work lays the foundations for the wastewater network in this part of Auckland for the next 50 years and represents a cost effective solution to provide for future growth, asset risk management and an appropriate level of overflow mitigation.

6 ASSESSMENT OF EFFECTS

This section provides an assessment of the actual and potential effects on the environment of the proposed North Harbour 2 Watermain (NH2) Project and the part of the Northern Interceptor (NI) Project within the shared corridor, with specific reference to the alignment between Titirangi and Westgate (NOR1), the alignment from the eastern side of Greenhithe Bridge to the Albany Reservoir (NOR2), and the shared corridor between Westgate and the Western end of Greenhithe Bridge (NOR3). The existing environment is described in Section 3 of this AEE. The assessment also draws upon the technical reports contained in Volume 2 of the AEE, being:

- Technical Report A Earthworks, Erosion and Sediment Generation Assessment
- Technical Report B Soil and Groundwater Contamination Assessment
- Technical Report C Groundwater Assessment
- Technical Report D Ecological Assessment
- Technical Report E Traffic Assessment
- Technical Report F Construction Noise and Vibration Assessment
- Technical Report G Landscape and Visual Assessment
- Technical Report H Arboriculture Assessment
- Technical Report I Archaeological Assessment

All technical reports and section 6 of this AEE relate to NH2 and the part of NI within the shared corridor except for Technical Reports A - Earthworks, Erosion and Sediment Generation Assessment and Technical Report C - Groundwater Assessment and respective sections 6.2 and 6.4 of this AEE. These latter reports only refer to NH2 and have been produced solely to support resource consents for the NH2 project.

6.1 Positive Effects

The NH2 project will have significant positive effects on the social, cultural and economic well-being of Auckland including:

- Addressing the operational and supply risks of the existing North Harbour No.1 Watermain from Titirangi to Albany by providing a secure and resilient water supply to the North Shore;
- Providing additional water supply infrastructure to accommodate future growth in north and north western Auckland;
- Integrating critical water and wastewater projects to enable efficient infrastructure development.

The NI project within the shared corridor will have significant positive effects on the social, cultural and economic well-being of Auckland including:

- Addressing wastewater servicing issues in north-western Auckland by diverting flows from the new Hobsonville Pump Station to the Rosedale WWTP by increasing the capacity of the existing network through additional attenuation within pipeline, and enabling connection to future network upgrades anticipated from Whenuapai Structure Plan and North-West Strategy
- Providing for wastewater infrastructure to service growth in north-western parts of Auckland.
- Integrating critical water and waste water projects to enable efficient infrastructure development.

6.2 Effects on Private Property

The majority of NH2 and NI pipelines will be constructed within road corridors however some pipeline sectionsare proposed to travel beneath private property. Private property may have restrictions over the piece of land where a designation is placed, in particular land use e.g. the property owner will need to request permission from the requiring authority to undertake works that may prevent or hinder the public work, project, or work to which the designation relates. The NOR are lodged on the basis that “no person may, without the prior written consent of Watercare, do anything in relation to the land that is subject to the designation that would prevent or hinder the work authorised by the designation."

Notably, NOR1 designation will be placed over portions of the properties at 105, 107, 109, 111 and 114 Scenic Drive; 283, 285 and 289 Konini Road; and 43 Tawini Road. The NH2 pipeline will be tunnelled beneath these properties at depths in excess of 20m below ground level. Continued residential activity on these properties, and to a large extent possible future land use may not be compromised by the NH2 or the designation corridor on the property e.g. vehicular use on site, building modification. Watercare will however still need to provide approval for activity to occur within the designation footprint. Private property south of and adjacent to SH18 west of Brigham Creek under which NI will be tunnelled is subject to the same restriction. A complete list of properties and their legal descriptions is included within the Schedules of Land included in the Designation tables (Appendix A).

Any impediment to reasonable use is managed through the Public Works Act, independently of the RMA process to designate land.

6.3 Earthworks, Erosion and Sediment Generation

Earthworks activities have the potential to lead to soil erosion and sediment generation. The erosion and sediment generation effects associated with the NH2 Project have been assessed and are summarised in this section. An outline Erosion and Sediment Control Plan (ESCP) has been prepared based on preliminary design drawings (refer Volume 3 of the AEE) and in response to the proposed construction methodology (described in Section 2.5-2.9 of this AEE). It is provided in Volume 2, Technical Report A – Earthworks, Erosion and Sediment Generation Assessment. It follows industry best practice and in particular was developed having reference to:

- Auckland Council Erosion and Sediment Control Guidelines for Land Disturbing Activities Technical Publication 90 (TP90);
- Auckland Council, Best Management Practice: Catchpit protection;
- Auckland Council, Best Management Practice: Dewatering;
- Auckland Regional Plan: Sediment Control.

Potential Earthworks, Erosion and Sediment Generation Effects

The construction activities will consist of predominantly open-cut trenching with sections of tunnelling using trenchless techniques and pipe bridges over permanent streams. These activities have the potential to have an adverse impact on the environment through the release of sediment laden runoff into the water ways. Sediment if not appropriately managed will adversely affect water quality by increasing turbidity and total suspended solids, this in turn will adversely affect the ecology and biota of the receiving water bodies. This is further exacerbated by increased surface runoff rates typically associated with current urban-industrial land uses and the proximity of the physical works to streams and the Upper Waitemata Harbour.

NOR1 – Titirangi to Westgate

This section of the route consists predominantly of residential suburbs with some commercial land use in the Westgate area. The topography varies from a high elevation in the Waitakere Ranges to gently

sloping hills and valleys from Glen Eden to Swanson and the route includes a number of stream crossings. This section is the largest in area with an estimated earthworks volume of 177,000 m^3 (minimum) and, due to the presence of streams (Oratia, Opanuku, Paremuka and Swanson) within the impacted area, is classed as a Sediment Control Protection Area (SCPA)[16].

All proposed construction methodologies for this area have the potential to produce sediment laden runoff due to increased soil exposure, runoff from impervious surfaces, and vegetation removal. These effects can negatively impact on receiving waterways. A 800m (approximately) section in the Woodlands Park location will be tunnelled using a boring machine; a technique which uses a closed loop slurry system to 'clean' spoil from the slurry water and pump it to a waiting truck/ tank for removal from site. However, there is the potential for contaminated spoil to be unintentionally released at the surface in what is known as a flushing fluid discharge. In addition to sediment runoff, drilling fluid discharge is also a potential risk at the proposed tunnel site between Manuka Road and Shetland Road.

Preliminary design includes the installation of pipe bridges crossing the permanent streams. The construction of these elements poses a risk of sediment release during physical works due to their close proximity to waterways.

NOR2 – Eastern end of Greenhithe Bridge to Albany

This section of the proposed works is characterised by gentle contours to the south and steeper slopes to the north; earthworks will cover an area of at least 85,000 m^2. The SH18 road corridor is bordered in numerous places by steep embankments that lead up from the SH18 road carriageway, to the top of plateaued areas of urban / residential sections. Land use transitions from residential to commercial to light industrial. The high incidence of existing impervious surfaces and proximity to marine and freshwater receiving environments at lower elevations classifies this section as SCPA.

Three construction options are proposed for the Oteha Stream Crossing: Option 1 will involve trenchless technology (micro tunnelling) along Bush Road to Albany Expressway, Option 2 entails pipe bridge construction and open-cut trench to Albany Expressway and Option 3 is a combination of Options 2 and 3. If the trenchless technology proposed in Option 1 is selected, the Oteha Stream will be at risk from the consequences of potential drilling fluid discharge.

All proposed construction methodologies for this area have the potential to produce sediment laden runoff due to increased soil exposure, presence of impervious surfaces, and vegetation removal of which can negatively impact on receiving waterways. Oteha Stream may be affected by the construction works due to the close proximity of the waterway (regardless of the construction methodology), therefore there is a potential for adverse environmental effects to occur prior to mitigation.

NOR3 – Westgate to Western end of Greenhithe Bridge

Earthworks in this section of the NH2 alignment will span a minimum area of 61,000 m^2 located on flat, low-lying land within SH18, with relatively new residential developments occurring on either side. The northern limits of NOR3 are in the vicinity of the Upper Waitemata Harbour; approximately 400 m to the north and 1,500 m directly west. A number of Overland Flow Paths (OLFPs) and stream channels traverse SH18 within the NH2 and NI shared corridor. Although many of the OLFPs are likely to be dry during the summer months they are likely to convey water during rain fall events and if so would be classified as intermittent streams. Works in or around OLFP/streams can have direct impacts on watercourse habitat (e.g. by habitat disturbance or destruction) and ecology (such as through sediment and temperature related effects).

[16] Auckland Council, 2011. Auckland Council Regional Plan – Sediment Control. "Sediment Control Protection Areas (SCPA)" and are defined as follows: (i)100 m either side of a foredune or 100 m landward of the coastal marine area (whatever is the more landward of mean high water springs); or (ii) 50 m landward of the edge of a watercourse, or wetland of 1,000 m^2 or more.

OLFP and stream diversions are required to establish dry, off-line work areas to allow the open-cut trenching to be undertaken while minimising the risk of erosion and sediment generation (refer to section 6.7 for details on water quality effects).

The proposed construction methodologies are likely to increase sediment runoff into receiving freshwater and marine environments, largely as a result of increased soil exposure and presence of significant impervious area coverage.

Prior to mitigation, there is a potential for adverse effects on OLFPs due to diversion of them and on waterbodies due to the potential release of sediment.

6.3.1 Proposed Mitigation Methods

Erosion and Sediment Control Measures (ESCM) are proposed for reducing impacts on the environment as a result of earthworks and construction activities, refer Table 6-1. All mitigation measures prescribed are further detailed in Volume 2 Technical Report A – Erosion and Sediment Generation of the AEE and are to be designed and implemented in accordance with TP90 guidelines.

It is recommended that construction is staged in order to limit the time and area of unstabilised soil exposure in erosion prone locations.

Table 6-1: NH2 ESCM

NORs	Risks associated to Proposed Works	Potential Effects without mitigation	Proposed Mitigation	Potential Effects with mitigation
NOR 1	Sediment runoff increase – Open cut trenching	Minor	Clean water diversion, Catchpit /Stormwater inlet protection, Dirty water diversion bunds Dewatering and Runoff Treatment, Stockpiling If discharge is directly to the stormwater system (e.g. catchpit) additional treatment may be required (e.g. chemically treated filter sock).	Less than minor
	Spill Risks to watercourse / stormwater network during construction (open trench and trenchless technologies)	More than Minor	Spoil disposal options	Less than minor
	Spill Risks to watercourse / stormwater network during construction (trenchless technologies only)	More than Minor	Drilling fluid discharge Site specific Response Plan Training staff on drilling fluid discharge prevention, containment and clean up.	Less than minor
	Effects on Stream Crossings (Oratia, Opanuku, Paremuka and Swanson): contamination, sediment increase	Minor	Silt fence / super silt fence Floating silt curtain (if silt fence not feasible): potential measure for larger streams (e.g. Opanuku and Paremuka Streams). Construction of the pipe bridges restricted to the summer period (December to March), i.e. within the earthworks season. Stabilisation of work areas for cranes and piling equipment. Clean and Dirty Water Diversion Monopole Spoil - Spoil disposal options for the proposed excavation works (Oratia Stream Crossing).	Less than minor
NOR	Sediment runoff increase	Minor	Clean water diversion, Catchpit /Stormwater inlet	Less than

NORs	Risks associated to Proposed Works	Potential Effects without mitigation	Proposed Mitigation	Potential Effects with mitigation
2			protection, Dirty water diversion bunds Dewatering and Runoff Treatment, Stockpiling If discharge is directly to the stormwater system (e.g. catchpit) additional treatment may be required (e.g. chemically treated filter sock).	minor
	Untreated sediment discharge to existing Stormwater Pond	Minor	Decanting Earth Bund, Sedimentation Tank, Silt fences or super silt fences. Spoil disposal	Less than minor
	Spill and contamination risk to water quality/stormwater during construction (open trench and trenchless technologies)	More than Minor	Specific ESCM for work under existing watercourse within 10m of watercourse Spoil disposal	Less than minor
	Spill Risks to watercourse / stormwater network during construction (trenchless technologies only)	More than Minor	Drilling fluid discharge site specific Response Plan, training staff on drilling fluid discharge prevention, containment and clean up.	Less than minor
NOR 2	Effect on Stream Crossing at Oteha: contamination, sediment increase	Minor	Silt fence, Floating silt curtain: potential measure for larger streams (Oteha stream). Option 1 –Trenchless: refer above drilling fluid discharge mitigation. Options 2 and 3 - Construction of the pipe bridges restricted to the summer period (December to March), i.e. within the earthworks season. Spoil disposal options for the proposed excavation works (Oteha Stream Crossing)	Less than minor
	Construction of Access ways: Water quality	Minor	Geosynthetic Erosion Control system (“GECS”). Diversion channel/bund	Less than minor
	OLFP diversion or blockage	Minor	ESCM and manual fish relocation (if required).	Less than minor
	Construction of Access ways: exposed substrate, sediment generation in runoff	Less than Minor	Specific ESCM, such as silt fence / super silt fence.	Less than minor
NOR 3	Spill and contamination risk to water quality/stormwater during construction	More than Minor	Specific ESCM for work under existing watercourse (within 10m of watercourse) Spoil disposal options for some of the proposed excavation works (open trenches).	Less than minor
	Construction of Access ways: Water quality	Minor	Geosynthetic Erosion Control system (“GECS”). Decanting Earth Bund. Diversion channel/bund.	Less than minor
	OLFP diversion or blockage	Minor	ESCM and fish relocation (if required).	Less than minor
	Construction of Access ways: exposed substrate, sediment generation in	Less than Minor	Specific ESCM, such as silt fence / super silt fence.	Less than minor

NORs	Risks associated to Proposed Works	Potential Effects without mitigation	Proposed Mitigation	Potential Effects with mitigation
	runoff			

6.3.2 Earthworks, Erosion and Sediment Conclusions

All construction activities associated with installation of the NH2 pipeline have the potential to cause erosion and result in sediment release to the receiving environment. A suite of Erosion and Sediment Control Measures (ESCMs) have been identified to avoid or mitigate potential effects on the receiving environments. Representative sections of the NH2 route have been identified to describe in more detail the layout of required ESCMs (refer Erosion and Sediment Control Arrangement Drawings in Volume 3 of the AEE). Once detailed designs are complete and the appointed Contractor has confirmed the construction methodologies, the ESCP will be developed to detail implementation of the ESCMs for NH2. With correct design, construction and monitoring of ESCMs it is anticipated that the effects on the environment will be less than minor. Earthworks associated with NI in the shared corridor will be assessed closer to the time of construction and as part of a separate consent application process.

6.4 Contamination of Soil and Groundwater Assessment

Contamination of soil, sediments and groundwater associated with the NH2 Project and the NI shared corridor between Fred Taylor Drive and Greenhithe Bridge has been assessed and is summarised in this section, based on any existing contamination, geology and groundwater environment (refer sections 3.1.2, 3.1.3 and 3.1.4 of this AEE). More detail is provided in Technical Report B - Soil and Groundwater Contamination Assessment.

Bore-hole information from selected sites, a site drive-by assessment (October 2015) and desktop investigations were used to summarise the geology and hydrogeology, and identify potential ground contamination sites, both current and historic, within the proposed alignment. A Site Contamination Enquiry (SCE) with Council and review of their property files were also undertaken. Soil and groundwater sampling was undertaken within the five stream crossings along the alignment to test for a range of organic and inorganic parameters; results were then assessed against relevant regulatory and off-site disposal requirements.

6.4.1 Potential Soils and Groundwater Contamination Effects

NOR1 – Titirangi to Westgate

The land use of the Titirangi to Westgate section of NH2 is largely residential and includes a small section of vineyard. It is proposed that the pipeline will be laid predominantly within the road corridor, except at stream crossings.

Several sites, including four service stations, were noted along the route as having the potential to cause soil contamination during construction. Historical aerial photographs show that the route of the proposed alignment along parts of Glengarry Road, Border Road, Palomino Drive and Summerland Drive may have had past horticultural activities operating on them, presenting the potential for associated land contamination.

SCE revealed seven sites/items were investigated for the release of pollutants into groundwater and soil contamination.

A Gull petrol station off Forrest Road presents a low to medium risk in regards to ground contamination during proposed excavation works, and a conservative assumption is to assume that soil and shallow

groundwater within 20m site is contaminated. Therefore there is a potential for more than minor effects on the soil and ground contamination at this location prior mitigation.

The risk of encountering ground contamination during excavation at the other sites is considered to be low.

NOR2 – Eastern end of Greenhithe Bridge to Albany

This area of the alignment is largely within the SH18 road reserve, and some industrial and residential properties.

Several small electrical transformers and a timber storage site have the potential to cause ground contamination. Historical aerials indicate that the potential for significant ground contamination as a result of previous land uses or activities is doubtful.

The only item registered in the SCE for this area was a diesel spill on Upper Harbour Drive in 1998. Although the Council site file could not be located, it is considered that there is a low risk of encountering ground contamination during the proposed excavation works within the SH18 corridor due to its likely removal from site during the construction of SH18.

Soil contamination test results indicate there are elevated levels of organic compounds in the form Polycyclic Aromatic Hydrocarbons (PaHs) at some borehole locations. These effects are considered to be minor prior to mitigation.

NOR3 – Westgate to Western end of Greenhithe Bridge

This section of the alignment lies largely in the SH18 motorway reserve. Historical aerials indicate that the potential for significant ground contamination as a result of previous land uses or activities is assessed as being low.

The following sites were identified as having a risk of soil contamination:

- Closed Landfill at Kedgley Drive, The closed landfill is located 350 m north-west of the alignment and should not be affected by ground and surface water discharges from the site.
- One small transformer located between the Fred Taylor Drive on-ramp to SH18 and Gunton Drive was noted as a potential ground contamination site.
- Retirement Village site , 1 Squadron Drive
- Former Airstrip near Squadron Drive on ramp
- The existing Hobsonville Pump Station located at 2 Buckley Avenue contains a former sludge disposal bed (from the NZDF) that has been remediated,
- Former Horticultural Sites.

A site on Brigham Creek Road was identified in Council files, which suggested soil contamination levels at this site are above background levels in some areas, and that some Asbestos Containing Materials (ACM) was present within this discrete area within NOR3. The effects on the soil and groundwater contamination are anticipated as being minor at Brigham Creek Road site prior to mitigation.

All sites with the exception of the former sludge bed are considered low risk for both NH2 and NI. The former sludge bed has been reported as medium to high risk for NI (T&T, 2015), as the proposed NI alignment is indicated to pass approximately 10m east (down-gradient) of the former sludge bed. Validation testing of soil down gradient of the sludge bed is indicated to contain levels of metals (arsenic and zinc) above published background concentrations, but below levels that have the potential to pose a risk to human health. Available groundwater monitoring data indicate that water quality has been impacted down gradient of the sludge bed

Provided appropriate mitigation measures are taken (refer to Section 6.3.2) it is considered that there is a low risk of encountering ground contamination that will adversely impact proposed excavation works.

Soil contamination tests indicate samples are below Council background values and are not contaminated. These effects are considered to be minor prior to mitigation.

NH2 and NI shared corridor potential soil and groundwater effects prior mitigation

Test results from soil contamination samples indicate contamination levels are below the NES (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) soil contamination standards for commercial/industrial land use and below the ACRP:ALW (Auckland Council Regional Plan: Air, Land & Water) Schedule 10 criteria. Similarly, most groundwater samples were less than the laboratory limit of detection (LOD) and all test results are less than the permitted activity criteria for fresh and marine water.

Desktop reviews and site drive-by assessments within the entire NH2 and NI shared corridor route indicate the potential for soil and groundwater contamination is categorised as typically low and occasionally low-medium. However the former sludge drying bed location is considered medium to high risk. There is a potential for adverse effects on the soil and groundwater at discrete locations within the NH2 and NI shared corridor route which are recommended to be addressed by implementing the mitigation measures proposed in section 6.4.2.

6.4.2 Proposed Mitigation Methods

Assessment for potential contamination at or adjacent to the proposed alignment was based on the drive-by assessment, site history review, Council SCE and existing soil contamination information. Linkages between source, target and receptor are important in assessing the ground contamination risk during the construction of the proposed pipeline, both in terms of human health and environmental risks.

Aside from the Gull service station in the Titirangi to Westgate area (NOR1), analysis indicates the potential for contamination, both in terms of human health and environmental risks, is low risk and that any residual soil and/or groundwater contamination related to the relevant sites can be appropriately managed via a Contaminated Land Management Plan (CLMP).

CLMP at a minimum should include guidance for site staff on how to recognise ground contamination during excavation works; and procedures on how to deal with unforeseen ground contamination and contamination resulting from construction activities such as inadvertent spillages. Unforeseen ground contamination can be appropriately managed via a CLMP, and should include site management procedures that avoid stockpiling or double handling of spoil in risk areas, that all spoil within 20m of the contamination location be disposed off-site to a licensed solid waste landfill and that all groundwater or surface water that has come into contact with site soils should be disposed of as contaminated groundwater.

At higher risk sites, such as the Gull petrol station on Forest Hill Road (NOR1), it is recommended that soil and groundwater contamination investigations be carried out by excavating boreholes and installing groundwater monitoring wells at the proposed NH2 pipe location or between the pipe and risk sites to test both the soil and groundwater for hydrocarbons and other related contaminants. If soil and groundwater are not contaminated then soils/spoil can be disposed off-site.

Where Asbestos Containing Materials (ACMs) are thought to be present (in particular within the SH18 corridor), it is recommended that an Asbestos Management Plan be developed, including the removal of the ACM and any possible soil contaminated with asbestos fibres should be removed by a competent person with a certificate of competence.

For excavation located west of the Hobsonville Pump Station and the former NZDF sludge bed, a conservative assumption would be to assume that the soils up to a depth of 1 m would contain low level contamination and require off-site disposal to a licensed managed fill site.

6.4.3 Soil and Groundwater Contamination Conclusions

The overall effects of construction and operation of NH2 and NI within the shared corridor on the potential receptors of land and groundwater contamination, particularly construction workers, general public and future site users, are assessed to be less than minor, provided that appropriate mitigation measures are implemented.

6.5 Groundwater and Ground Settlement

The groundwater assessment analysed groundwater levels and used modelling to evaluate potential groundwater and hydrogeological effects as a result of proposed NH2 works and to identify activities that could result in potential adverse effects. (Refer sections 3.1.3 and 3.1.4 of this AEE for description of the existing geology, groundwater and settlement environment).

The potential for ground settlement was assessed through a review of pipeline route, geology and existing geotechnical investigations, and evaluation of groundwater drawdown to evaluate ground settlement. Further detail can be found in Technical Report C – Groundwater Assessment.

Deeper aquifers within the vicinity of NH2 are important in Kumeu (about 6.5 km west of the project). Refer to section 3.1.3 for further details on the geology and groundwater conditions at the site. The shallow ground waters related to the deeper aquifers are generally hard calcium carbonate waters with near-neutral pH, high total iron and silica concentrations.

Groundwater levels for the whole project are 3.8 mBGL (meters below ground level) on average, with a median of 3.2 mBGL. The standard deviation for groundwater levels is 2.74mbgl which means that shallow groundwater levels would typically occur below 1mbgl. Although some groundwater usage has been identified, most of the alignment goes through urban areas which do not use groundwater or crosses unpopulated estuarine areas. Groundwater contamination is not considered in this assessment as this is previously covered in Section 6.3 of this AEE.

In all areas drawdown in the open trench sections may be in the order of 2.3m at the excavation, and about 1m at a distance of 30m. However, groundwater levels recover to pre-construction conditions within a matter of days depending on the geology and the risk of ground settlements occurring in response to groundwater drawdown is low. Analysis indicates groundwater levels are generally deeper than the pipe invert throughout the whole alignment.

In general, groundwater levels are 1.5–5 mBGL at stream crossings while the pipe invert will be at 2.7mBGL (considering 1.5m clearance and 1.2m diameter pipe). Groundwater levels can be deeper (5-16mbgl) at some locations however the pipe is unlikely to cause an elevation or damming of groundwater at these sites. No areas of unusually low permeability have been identified throughout the project area.

6.5.1 Potential Groundwater and Settlement Effects

NOR 1 – Titirangi to Westgate

There were no groundwater uses identified in this area, however, the ridge at the start of the alignment would likely act as a recharge area for ephemeral streams in the vicinity.

The tunnel section between Manuka Rd and Shetland St will go through sandstones of the Cornwallis and Nihotupu formations. Drawdown effects in the tunnel between Manuka Road and Shetland Street will be localised and temporary. Therefore, any potential settlement due to tunnelling will be negligible.

Groundwater will discharge into the tunnel between Manuka Road and Shetland Street during construction. The maximum discharge rate of about 23.4 m^3/day per metre will occur at tunnel completion; this will reduce to nil once the tunnel annulus is grouted. At shallow crossings using trenchless technologies along the rest of the alignment, seepage will not be significant because the unconsolidated sediments will be close to the annulus as the tunnel is being drilled and these tunnel sections are typically shallow. Groundwater inflow into the open trench sections and pit excavations in soft soils are expected to be of a similar magnitude. Groundwater flow into the permanent access shaft between Woodlands Park Road and Scenic Drive is expected to be closely dependant on rainfall and seasonality, but is not expected to influence groundwater flow paths during rainfall.

The alignment will cross over the Oratia, Opanuku, Paremuka, and Swanson streams in this area so there will be no effects on stream flow due to pipe emplacement. As the pipe will be generally above the groundwater level in stream areas, no groundwater diversions are envisaged and water levels will very rarely exceed the pipe crown level. Temporary jacking and receiving pits are not expected to affect groundwater flow paths in the long term. Other structures (e.g. valve and scour chambers) will be permanent but generally above the groundwater level.

Trenched sections will be largely confined to the road reserve and features either side of the trench are likely to settle. Significant settlement effects (higher than 10mm) will extend into residential properties at some locations. At very limited locations, these will extend into buildings or house footprints within these properties; in all cases settlement is considered “slight” (lower than 20mm).

Potential settlement effects due to tunnelling have been assessed at the Woodlands Park and Metcalfe Road locations to be minor (comprised between 5mm and 10mm) with very localised settlements at the shafts, but likely restricted to the construction site. There are no existing structures within Woodlands Park zone of influence, but part of Shetland Street is within the construction site.

In the absence of any mitigation there is the potential for less than minor effects on groundwater and more than minor effects on ground settlement.

NOR 2 – Eastern end of Greenhithe Bridge to Albany

Although groundwater levels range between 1.5 and 5mbgl in this area, shallower groundwater levels have been recorded at some locations. The NH2 watermain pipe will sit at about 2.7mBGL so it is unlikely it will cause an elevation or damming of groundwater and, in localised areas where the pipe will intersect groundwater, the water level above the pipe will not be significantly high. No areas of unusually low permeability have been identified throughout the extent of this project.

Groundwater inflows into open trenches and temporary pits are expected to be lower than in the Westgate to Hobsonville section. The tunnel section at Bush Rd, under Bushlands Reserve is smaller and shallower than the Titirangi to Westgate tunnel, maximum seepage rates into this tunnel’s annulus will be 23.4m^3/day. Construction of temporary and permanent structures will not affect groundwater flow paths in the long term.

Settlement effects from trenching may overlap the motorway sealed shoulders, noise walls, gantry structures, off-ramps, embankments, property fence lines, Chester Avenue and a pedestrian footpath. Settlement effects (13.5m extent) will overlap commercial property frontage at William Pickering Drive to Oteha Stream, but all buildings are set back and clear of the settlement zone. Additionally, there is potential for the pipeline bedding materials to act as a drainage layer and possibly induce settlement in areas within NOR2 with shallow groundwater tables. Any settlement effects in the remainder of the route will be limited to roadways.

Tunnelling of SH18 (near Wicklam Lane) has potential settlement of up to 50mm if an open face Tunnel Boring Machine (TBM) operation is used. There are no buildings within this zone of influence; however, a tennis court located near Wicklam Lane, about 4m from the alignment is at risk of settlement from the

construction alignment. Highly localised settlement (lower than 25mm) at the shafts is estimated. There are no buildings within the zone of influence. Tunnelling at the Albany Highway and Oteha Stream crossings (Options 1 and 3 including trenchless technology) have a potential settlement of 20mm, with no buildings in the zone of influence. Localised settlements within the construction site are estimated to be 25mm and 100mm, respectively; no buildings are within the zone of influence of either location.

The effects on groundwater and settlement prior to mitigation are considered to be less than minor.

NOR 3 – Westgate to Western End of Greenhithe Bridge

Drawdown at the deepest receiving pit is predicted to be about 1.7m at the excavation, and less than 0.5m at a distance of about 30m from the excavation face. At 110m from the excavation, the drawdown will be zero. After the pit is backfilled, it will take about 90 days for the water level to recover. The level of groundwater effects in NOR3 will be dependent on the use of sheet pile walls. The effects are considered to be minor prior to mitigation.

An expected seepage inflow of less than 2 m^3/day per metre of excavated trench is anticipated in locations where sediments of the Tauranga Group lay on top of the ECBF. In localised areas where the permeability of these materials could be unusually high (e.g. clean sand) this value could increase to up to 9 m^3/day per metre,.however, the likelihood of occurrence is very low. At locations where the trench is excavated directly into the ECBF, an expected seepage inflow of less than 0.2 m^3/day per metre of excavated trench is expected. At locations where the ECBF is more permeable this value could increase to up to 0.8 m^3/day. In both cases, discharge will stop as soon as the trench is backfilled.

Seepage inflow will occur at the pit excavations used for pipe jacking during micro tunnelling. The deepest pit, located at the SH18 crossing has the potential for seepage inflow and will be about 12 m^3/day. Discharge into the pit will stop once the tunnel is completed and the pit is backfilled.

As in the previous areas, the final trench and temporary jacking and receiving pits are not expected to affect groundwater flow paths in the long term. Other structures (e.g. valve and scour chambers) will be permanent but generally above the groundwater level.

Trenched areas are within open grassed areas and typically will not affect the motorway. Trig Road, Brigham Creek Road, Sinton Road and Squadron Drive will be crossed by the trench and are likely to settle locally, affecting surface drainage grades and driveability. The potential settlement due to tunnelling has been assessed as 5mm to 10mm, indicative of a less than minor level of groundwater effects. There are no buildings within this zone of influence. Settlements of between 25mm and 100mm have been estimated at the shafts of the three tunnel locations; however this would be very localised and likely restricted to the construction site. There are no buildings within the zone of influence, therefore the settlement effects are assessed as less than minor.

The overall effects on groundwater and settlement prior to mitigation are considered to be less than minor.

6.5.2 Proposed Mitigation Methods

It is recommended that a Construction Management Plan (CMP) be developed to include management of the effects of settlement and drawdown. A number of approaches are recommended to mitigate groundwater drawdown and any associated potential for transport of contaminants depending on the type of construction methodology being used. In general, open trench excavations will induce low drawdown values at distances greater than 30m from the excavations. Should drawdown close to open trenches be a concern the use of Sheet Pile Walls (SPW) during trench construction is recommended to effectively reduce drawdown to negligible levels. SPWs will also effectively control groundwater inflow to negligible levels (lower than 0.02 m^3/d per metre of excavated trench). In locations flagged as contaminated (refer

section 6.3 of this AEE), clay cut-offs will be constructed to prevent contaminants from entering the trench and to inhibit groundwater flow along the trench, to maintain the existing groundwater regime.

Excavation of temporary jacking pits is likely to induce drawdown through unconsolidated soil materials as groundwater may seep through the excavation walls. This can be controlled by driving SPWs past the excavation invert level so that there is an impermeable barrier between shallow groundwater and the excavation.

Settlement mitigation for tunnelling requires careful selection of techniques. For trenching, mitigation largely involves groundwater inflow control and trench side wall support such as through use of propped sheet piles and trenching shields. Specific mitigation measures are recommended to address ground settlement, including:

- adjustment of pipeline alignment to clear sensitive structures and features;
- provision of trench wall support to limit consequential ground surface settlement magnitude and differential gradient;
- installation of sheet piles to reduce groundwater inflow and drawdown;
- construction of the pipeline in shorter lengths of open trench; and
- provision of other protection measures where effects on critical structures cannot be avoided. Numerous options are available and would be reviewed as part of detailed design.

Measures such as impermeable cut off zones to prevent the granular bedding acting as a drainage layer and affecting the local groundwater levels will be designed if appropriate. All trenched areas require settlement monitoring and reinstatement requirements endorsed by Auckland Transport or the Transport Agency.

Mitigation may need to be implemented to control settlement effects to motorway traffic lanes where open trenching has occurred. Trenched sections in the Titirangi to Westgate component of the alignment may require mitigation to control settlement effects on residential addresses, subject to further investigation and detailed design. Temporary works design of the tunnel shafts will specifically address the risk of damage and settlement to the motorway, local roads and other key features. Instrumentation and monitoring will be carried out during construction and comprise surveying of ground marks and an inclinometer at each shaft. Monitoring of the motorway, local roads and the railway will be carried out during construction to NZTA, Auckland Transport and Kiwirail requirements respectively.

6.5.3 Groundwater and Ground Settlement Conclusions

Overall the effects of the Project on the groundwater drawdown along the proposed NH2 route is expected to be low, therefore the effects associated with the construction of the NH2 alignment is expected to be less than minor.

There will be no effect on groundwater bores in the area due to the minimal drawdown anticipated during the construction work, as well as the fact that all of the bores abstract water from the deep aquifer. Groundwater seepage rate into excavation areas and tunnelled sections will be reasonably low and can be managed with SPWs or adequate collection systems. No effects are expected in terms of temporary groundwater extraction. Monitoring of flow (e.g. through tunnel annulus, pit excavations, and trench excavations) and groundwater level in project piezometers needs to be completed before the actual construction of the works and during construction, to minimise the risk of environmental effects taking place. This includes monitoring of project piezometers and regular water level monitoring.

Overall, settlement will potentially develop but minor effects are manageable through design and mitigation and considered to be less than minor post mitigation. Some settlement effects, such as road

surface settlement immediately adjacent the trench, are largely unavoidable and some reinstatement works will be required, such as levelling the road surface immediately adjacent trench works.

The effects on the groundwater and settlement are assessed as being less than minor providing that mitigation measures stated in section 6.5.2 are implemented.

6.6 Ecology

Ecological assessment was undertaken to provide a description of the terrestrial and freshwater values of areas surrounding project sites in order to identify potential adverse effects resulting from the project and recommend actions to avoid and minimise potential negative outcomes. Further detail can be found in Technical Report D – Ecological Assessment.

Specialists used a combination of desktop and field assessments to evaluate vegetation against criteria in the Waitakere City District Plan and the Proposed Auckland Unitary Plan (PAUP). Particular focus was given to protected vegetation within Significant Ecological Areas (SEAs) and heritage trees that are likely to be impacted by the project. The same methods were employed by faunal experts, focusing on species protected by the Wildlife Act 1953 (all native lizards, birds and bats), with particular note given to species with a conservation rating of nationally "At Risk" or higher. Freshwater Ecologists undertook desktop studies to determine the locations and general characteristics of the watercourses and field surveys on 5 November 2015 to determine the extent and nature of water ways and the quality of the instream habitat.

6.6.1 Potential Ecological Effects

NOR1 – Titirangi to Westgate

Vegetation along this section of the proposed route varies from good quality secondary kauri podocarp-broadleaved forest located within the Waitakere Ranges to mixed exotic and native species within urban areas and riparian margins. The pipeline crosses four streams close to or within SEAs made up of riparian zones composed of a variety of vegetation types. Weed species were common at the proposed pipeline crossing at Paremuka Stream. The only scheduled heritage trees within the designation are two pohutukawa (*Metrosideros excelsa*) trees at 251 Don Buck Road.

Proposed installation of the tunnel launch and receiving pits within Woodlands Park Road Reserve are likely to impact an area of good quality native forest and it is expected some mature native trees will need to be removed during construction. Vegetation removal associated with the installation of NH2 tunnel launch pit within the Woodlands Park reservoir site will be consented as part of the Huia Water Treatment Plant (WTP) upgrade. The potential ecological effects for NH2 are therefore assessed from the receiving pit at Shetland Street.

The tunnelling pit at the end of Shetland Street has the potential to impact the terrestrial ecology environment due to the current high ecological value. This site has potential for significant adverse effects due to the presence of mature native vegetation and important wildlife habitats associated with the Waitakere Ranges (SEA), in particular potential to spread kauri dieback disease.

The loss of exotic and native species will occur at and near stream crossings; and potential adverse effects may occur on an unknown number of trees within berms or residential gardens if works are carried out within their drip line or root systems are damaged. There is also the potential for the loss of some trees if works cannot be sited to avoid them, including potential adverse effects on the scheduled pohutukawa trees at 251 Don Buck Road.

Field assessments indicated that the SEAs within the vicinity of the Waitakere Ranges have very high ecological values, including the potential presence of several of "At Risk" and "Threatened" species, including long-tailed bats (*Chalinolobus tuberculatus*), Hochstetter's frogs (*Leiopelma hochstetteri*) and kokako (*Callaeus wilsoni*). Removal of vegetation could result in significant adverse effects on native

fauna and their habitats. The more urbanised areas and stream crossings have generally low potential habitat values for native fauna, but may provide habitat for native lizard species, such as skinks (*Oligosoma spp*.). Removal of vegetation and potential fauna habitats in these areas would result in no more than minor adverse effects but would require preconstruction survey and management.

Construction around waterways could result in sediment runoff into the associated streams, which could cause potential adverse effects on the streams. No direct adverse effects on the minor watercourses are expected from an ecology point of view, as sections of these watercourses have already been piped or culverted. Further details on the water quality effects are provided in section 6.7 of this AEE.

Overall, these effects are considered to be no more than minor prior to mitigation.

NOR2 – Eastern end of Greenhithe Bridge to Albany

The key vegetation likely to be affected in this NOR is within the Fernhill Escarpment Reserve to the north west of Bush Road; consisting of mainly good quality kauri podocarp broadleaved forest with a diverse understorey. Oteha Stream is the only watercourse identified as being directly affected by the proposed works within NOR2. Vegetation along the remainder of this section of the proposed route consists of vegetation types of relatively low ecological value. Vegetation within the NOR includes combined exotic/native vegetation types and restoration plantings on the eastern side of the Greenhithe Bridge; young native restoration planting along SH18; common native wetland species in the vicinity of stormwater ponds; combined native and exotics (SEA_T_8319); native scrub reserves skirting the proposed alignment (SEA_T_8020, SEA_T_8021 and SEA_T_8355C).

Proposed works will result in the loss of a small amount of mainly young vegetation from SEA_T_8319 and areas around SH18. A variety of effects on the Fernhill Escarpment SEA are possible depending on the option chosen for pipe installation through the forest (refer to Section 2.6, but will result in a degree of vegetation loss regardless). Three options are proposed for the crossing of Oteha Stream, these are pipe installation via trenchless technology (Option 1), a pipe bridge (Option 2) or a combination of the two (Option 3).

From a terrestrial ecology perspective Option 2 has the potential to generate the least impact . Option 1 may cause root damage of well-established individuals within the SEA which could compromise tree health. Option 2 would mainly affect younger native vegetation within the SEA, with the exception of two larger totara trees close to the road (refer arboriculture assessment in section 6.7). As most of the larger trees are further than 10m from the road, the effects on the better quality trees within the SEA could be minimised through the selection of Option 2.

Only three sites provided suitable fauna habitat. Removal of vegetation and fauna habitats at the Knoll, Greenhithe and Fernhill Escarpment could result in significant adverse effects on native fauna and their habitats. This effect could be significant due to the potential presence of several At Risk species, particularly lizard species such as Ornate skink (*Oligosoma ornatum*) and Forest gecko, (*Mokopirirakau granulatus*).

From a freshwater ecology perspective, construction of a pipe bridge across Oteha Stream (Option 2) could result in sediment runoff into the stream, which would result in potential adverse effects on the streams (refer sections 6.3 Erosion and Sediment generation and 6.8 water quality effects). No direct effects on freshwater ecology are expected for use of a trenchless technology (Option 1). Sediment runoff into the watercourses may occur from works in close proximity but can be managed through the use of erosion and sediment controls.

These ecological effects are considered to be minor without mitigation except for the construction of the Oteha Stream Crossing at Fernhill Escarpment which will be significant without mitigation.

NOR3 – Westgate to Western end of Greenhithe Bridge

In general the only vegetation that will be affected in this section of the proposed NH2 and NI shared corridor pipelines routes are areas of young native restoration planting that have been implemented as part of the motorway development, and generally contain a limited range of common pioneer species, such as kanuka, or in the case of stormwater ponds common native wetland species. Vegetation along streams within the alignment is rank pasture grasses, young restoration planting or mixed native/exotic vegetation with a weedy character. The designation does not cross any SEA areas or include any Heritage Trees.

The potential effects on vegetation are minimal and will only result in the loss of young native restoration plantings associated with SH18 and low quality riparian vegetation (Trig Stream and Rawiri Stream). Small areas of estuarine habitat exist along the coastal marine boundary and have potential foraging and nesting habitat for banded rail (*Gallirallus philippensis*), a nationally "At Risk" species. Removal of vegetation in these areas could result in mortality or loss of foraging or nesting habitat; although this would be minor at a population level, it could lead to an overall decline. The proposed NH2 watermain and NI within the shared corridor will not be constructed under any existing watercourses within this area. As a result no direct adverse effects are expected on any existing watercourses. Sediment runoff into the watercourses may occur from works in close proximity (refer section 6.3).

The new Pump Station will require clearance and result in a loss of low quality vegetation dominated by exotic weedy tree species and pest plants. The loss of this small area of low quality vegetation will result in negligible effects on the environmental values of the area. In addition, the NI pipeline will run from the Hobsonville Pump Station across SH18 where it then approximately follows the route of the NH2 pipeline. This will also have negligible effects on vegetation.

To the east of the Pump Station, at 4 & 7 Buckley Avenue, is the Duke Esplanade Reserve which surrounds a stormwater pond and, while generally similar to the vegetation that will be lost at the pump station site, it contains a greater component of native plants and is of better quality. The NI pipeline runs within the edge of this vegetation. However it will be located well below ground level and installed via trenchless technology, so with the exception for where pit access shafts and work areas will be located, existing vegetation and trees along the NI route are not anticipated to be disturbed.

It is expected though, that localised vegetation clearance is required where pit access shafts and work areas are located for the NI pipeline within the new Pump Station area.

Overall, these effects are considered to be minor prior to mitigation. However, effects could be more than minor on banded rail populations.

6.6.2 Proposed Mitigation Methods

To mitigate potential adverse effects it is recommended that areas of native vegetation, particularly within SEAs, and the removal of large native trees be avoided where practicable. If unavoidable, removal should be done by a qualified arborist. Trees over 15cm dbh (diameter at breast height) should be replaced at an appropriate site using a suitable ecological compensation ratio. The alignment should be carefully sited to avoid the oak trees at the Don Buck Corner Reserve, the two scheduled pohutukawa trees at 251 Don Buck Road (NOR1) and other large street trees where possible. If they are not able to be avoided then replacement trees need to be planted at the reserve once construction is complete.

The felling or pruning of any large trees should be overseen by a qualified arborist and soil disturbance within the drip line of trees should be avoided. Good hygiene protocols should be observed when carrying out any soil disturbing activities within 30m of any kauri tree to avoid spread of kauri dieback. Permanent and temporarily cleared areas should be planted with appropriate native species post construction according to Ecological Replacement Planting and Landscape Plans.

Any works within 10m of a watercourse should incorporate standard sediment controls (TP90 – Erosion and Sediment Control: Guidelines for Land Disturbing Activities in the Auckland Region) to prevent

sediment runoff into any watercourses (refer section 6.2.3 on recommended ESCM). All bare ground exposed by site works should be stabilised and replanted with appropriate vegetation as soon as practicable. Although physical works within watercourses will be minimised, any unanticipated works within any watercourses will require a full ecological assessment of effects and if required a fish recovery and relocation management plan would be put in place.

Preclearance surveys for bats and nesting birds should be undertaken prior to any vegetation clearance in sensitive areas. A Lizard and Frog Management Plan should be prepared to minimise any adverse effects on lizard or frog populations that could be affected by any necessary vegetation clearance form sensitive areas in NOR1 and NOR2. Preclearance surveys for banded rail should be undertaken where any vegetation is required to be removed at the coastal marine boundary in the Westgate to Hobsonville section of works (NOR3). All vegetation that requires removal should be replaced and enhanced through planting rush grass (*Apodasmia similis*) along the southern edge of the Wallace Inlet as such vegetation is an important nesting habitat for banded rail in estuarine areas.

Careful consideration should be given to the three different options for taking the pipeline along Bush Road adjacent to or within the Fernhill Escarpment SEA (Eastern end of Greenhithe Bridge to Albany section, NOR2). Further investigation is needed to determine the least ecologically damaging option, but at this stage Option 2 (pipe bridge) appears to result in the least damage and disturbance. Once the preferred option has been determined, a more detailed assessment of effects on the forest can be carried out and suitable mitigation determined.

6.6.3 Ecological Assessment Conclusion

Overall the effects of the project (including all options) along the proposed NH2 and NI shared corridor routes on the terrestrial ecology (vegetation and native fauna) are expected to be minor and the effects on the freshwater ecology are expected to be less than minor with adequate mitigation (refer to Section 6.5.2).

6.7 Arboriculture

Arboriculture assessments were undertaken along the proposed alignment in order to provide a description of the environmental baseline for the particular receiving environments potentially affected by the Project and to evaluate the actual or potential effects on the identified tree assets; this includes activities that could result in potentially adverse effects on trees. Further detail can be found in Volume 2, Technical Report H - Arboriculture Assessment.

6.7.1 Potential Arboriculture Effects

NOR1 – Titirangi to Westgate

This section of NH2 contains a variety of trees including groupings and singular native and exotic trees. The effects from construction and operation of the proposed alignment on the majority of trees within the vicinity will be less than minor. This is largely because most of the proposed alignment occurs within the road reserve. A number of exotic and native trees on both private and Council-owned land directly adjacent to the construction site have been observed overhanging the road reserve. Although it is unlikely that significant root activity will be encountered during excavations, in these instances the likelihood of encountering roots will increase. Works required in berm, reserve and stream bank areas are also more likely to cause root system disturbance.

There are a small number of tree groupings which are directly in the path of proposed works. These are a mixture of native and exotic species of relatively low significance occurring on private property and within riparian margins. Where trenchless installation is proposed for the section of pipe from the Huia WTP (Woodlands Park reservoir) site to Shetland Street, the establishment of a site compound and permanent

access shaft will require removal of a few trees within the Waitakere Ranges Regional Park. . Trees here are deemed to be unaffected by the proposed works, which involve trenchless pipe installation below the designation footprint, however, a small triangle of land is affected at the junction of Shetland Road and Woodlands Park, which requires removal of a a small area of trees to facilitate the change of the construction method from trenchless to trench.

The proposed alignment at Parrs Cross Road and pipe bridge construction over Opanuku, Paremuka and Swanson streams will also require the removal of both native and exotic trees within the riparian margins. Large, well-established trees that may require removal include a black poplar and a group of pin oaks at Oratia Stream, and some oaks at Swanson Stream.

Proposed construction methodologies will also require:

- The removal of a singular well-formed pin oak from the intersection at Swanson and Don Buck roads. This tree is considered a significant feature of the location.
- Establishment of a site compound and permanent access shaft will require removal of trees at the end of Shetland Street.

These effects are generally considered to be minor prior to mitigation, except at certain locations (e.g. Shetland Street) where those are considered significant prior to mitigation.

NOR2 – Eastern end of Greenhithe Bridge to Albany

As with the Titirangi to Westgate section, this component of NH2 contains a variety of trees including groupings and singular native and exotic trees. The effects from construction and operation of the proposed alignment on the majority of trees within the vicinity will be less than minor. A number of exotic and native trees on both private and council owned land directly adjacent to the construction site have been observed overhanging the road reserve.

The only trees that are directly affected by the alignment are a stand of native trees on Council-owned land on William Pickering Drive which will require removal.

Proposed options for the Tauhinu Road and Oteha Stream crossings (refer to Section 2.6) will affect the surrounding vegetation differently. In both instances Option 1 (trenchless technology) is the least invasive and preferred option. However, if option 2 (pipe bridge) is selected at Tauhinu Road, groupings of mixed native and exotic species will be adversely affected; requiring removal. The selection of Option 2 or 3 (combination of Options 1 and 2) construction methodologies for the Oteha Stream crossing would require the removal of group of native trees at the southern end of the Fernhill Escarpement, including totara (*Podocarpus totara*), tanekaha (*Phyllocladus trichomanoides*) and significant kahikatea (*Dacrycarpus dacrydioides*). These significant trees are to be avoided by the alternative option one for pipe installation.

These effects are generally considered to be less than minor prior to mitigation except at Oteha Stream and Fernhill Escarpment where the effects of stream crossing construction will be significant without mitigation.

NOR3 – Westgate to Western end of Greenhithe Bridge

The majority of the proposed works for this section of NH2 and NI in the shared corridor are located within the motorway reserve of SH18. Therefore the effects on vegetation within the vicinity will be less than minor. The vegetation proposed for removal includes recently planted trees and native plants growing within the motorway corridor and are considered to be of small dimension and relatively low significance.

Clearance of existing vegetation located around the existing pump station will be required to complete the works associated with the Hobsonville Pump Station. The largest trees affected in this site are gum trees, which are assessed to generally be in poor condition, likely as a result of a combination of insect

browsing and historic alteration to their growing environment. The trees are large and highly visible, however their condition reduces their value from a visual perspective and the trees have no particular arboricultural qualities.

These effects are considered to be less than minor prior to mitigation.

6.7.2 Proposed Mitigation Methods

A range of activities carried out as part of the proposed works have the potential to cause damage to the above and below-ground parts of the trees adjacent to the alignment, this will result in adverse tree health and aesthetic effects.

Tree protection methodologies are recommended to address and mitigate these issues. Implementations of these methodologies would require a suitably qualified arborist to direct, monitor and supervise works within the dripline of the protected trees. These activities typically occur at the start of physical works to enable tree protection and thereafter arboricultural advice will be required periodically throughout construction in response to issues arising or specific incidents. Regular communication will be maintained with Council officers. It is recommended protective fencing is erected and positioned between the line of works and all permeable areas within the dripline of protected trees prior to any works where appropriate. Where roots may be affected by proposed works all exposed tree roots are to be retained and protected where possible from damage and from drying-out by a covering of hessian (or accepted equivalent) that is to be kept damp until the excavated area can be backfilled. Roots requiring removal, should be cleanly cut back to the edge of excavations by the appointed arborist. Activities within the dripline area of protected trees should avoid soil excavation, modification, compaction and contamination.

Where trees adjacent to proposed works are observed overhanging the road reserve, pruning is to be carried out by the appointed arborist to reduce conflicts between the trees' canopies and the proposed works. The required pruning is generally minor in nature and therefore not likely to result in any noticeable reduction in the aesthetic values provided by the trees.

Removal of trees should be mitigated by replacement planting of suitable species in locations where they were removed from or in new areas where there is agreement from Council or respective landowners. Replanting with a large grade specimen tree would be required where large trees have been removed to mitigate their loss. The removal and control of exotic weed species that degrade vegetation, particularly in riparian areas, is also recommended.

The vegetation clearance at Hobsonville Pump Station (NOR3) will concern the understory native vegetation which is not of any particular quality; however it should be retained wherever possible as a natural ground cover. Removal of exotic weeds and revegetation with native species will enhance the qualities of the site.

6.7.3 Arboriculture Conclusions

The proposed trenching and ground surface works have the potential to cause disturbance to tree root systems and damage to the above ground components; however, tree protection methodologies have been developed to address these issues and mitigate any adverse effects caused by the proposed works (refer to Section 6.7.2). Mitigation measures will not result in any adverse health or aesthetic effects.

If the proposed works are carried out in accordance with the tree protection methodologies, the overall effect on the trees to be retained arising from the proposed works will be less than minor. It has been assessed that the proposed tree removal will not result in any adverse environmental effects. The effects of the proposed tree removals will be mitigated through replacement planting.

Overall, with the implementation of suitable mitigation measures, the effects of the NH2 and NI shared corridor (NOR1, NOR2 and NOR3) on trees within and adjacent to the route will be less than minor

except at two locations where the scale of tree removal will not be mitigated by replanting and where effects are anticipated:

- Shetland Street (NOR1): The well-treed environment at the end of Shetland Road will be permanently modified by the infrastructure installation. Planting of replacement trees will not be possible in and around the immediate location of the proposed access chamber and new pipeline. It has been assessed that the proposed tree removal will not result in any adverse environmental effects that can be considered more than minor as the effects of the proposed tree removals can be mitigated through replacement planting
- Oteha Stream crossing (NOR2): It has been assessed that the proposed tree removal required for pipeline installation will not result in any adverse environmental effects that can be considered more than minor as the effects of the proposed tree removals can be mitigated through replacement planting. Options that avoid excavations within the forest area will avoid the effects on the significant forest area, however if Options 2 or 3 are chosen the effects will be more than minor due to the removal of large mature native trees.

It is recommended that, where practicable, construction options that avoid excavation within the vegetated areas are implemented.

6.8 Water Quality

An assessment of potential effects on water quality has been undertaken, based on the existing water quality and hydrological environment. This section covers the assessment of effects on the hydrological environment and water quality separated into the three NOR's (NOR1, NOR2, NOR3) and includes an assessment of stormwater runoff, new impervious areas, building in floodplain and diversion / filling of overland flow paths.

6.8.1 Potential effects on Stormwater Infrastructures / Discharges

The existing stormwater network and culverts are not proposed to be modified as part of the proposed works. Potential effects from the construction works on stormwater discharges and infrastructure are described below.

NOR1 – Titirangi to Westgate

The NH2 watermain will be built beneath the existing stormwater network and therefore no direct effect is anticipated. However, there is a potential for contaminant discharge to streams, sediment release and spills that will need to be addressed through appropriate mitigation measures which will be provided in the ESCP. These effects are considered to be more than minor prior to mitigation.

NOR2 – Eastern end of Greenhithe Bridge to Albany Reservoir

Several embankment works are proposed for NH2 as per Drawing 2010673.528 (refer Volume 3 of the AEE):

- A stormwater pond embankment located along SH18 in the vicinity of Greenhithe Road is proposed to be retained (approx. length of 180 m).
- A cut and fill of the existing embankment is proposed directly next to the stormwater pond (approx. length of 420m).

There is a potential for adverse effects on the stormwater pond water quality as well as on the existing stormwater pipes/ existing watercourses (refer Drawings in Volume 3) during construction of the NH2 watermain. Potential effects on the existing stormwater pond along SH18 will include the discharge of untreated sediment laden runoff if appropriate ESCM are not in place.

NOR3 – Westgate to Hobsonville Pump Station

The stormwater network within the SH18 corridor is not yet completed (except for a few stormwater ponds located in the vicinity of the proposed works) and no stormwater works are anticipated as part of NH2 and NI shared corridor projects. There is the potential for contaminant (spoil) discharge through sediment release and spills that may impact directly or indirectly on streams. These will need to be addressed through the enforcement of appropriate mitigation measures. These effects are considered to be more than minor prior to mitigation.

6.8.2 Stream Crossings and Construction under existing watercourses

NH2 proposed works consist of five stream crossings including four located in the area from Titirangi to Westgate and one stream crossing in the area going from the eastern end of Greenhithe Bridge to Albany reservoir. The stream crossings are proposed to be pipe bridges within NOR1 and either a pipe bridge or tunnelling options for Oteha Stream in NOR2 as described in the NH2 construction methodology in Section 2 of this AEE. No pipe bridges are anticipated within NOR3 (NH2 and NI shared corridor).

NOR1 – Titirangi to Westgate

The NH2 proposed works within this area will follow the road from Titirangi to Westgate and four stream crossings (Oratia, Opanuku, Paremuka and Swanson streams) are proposed using pipe bridges. Pipe bridges will consist of monopole column supports located on banks and within the floodplain based on the 100yr flood event. There is the potential for adverse effect on the streams prior to mitigation.

Potential effects on the quality of stormwater runoff generated by tunnelling construction will include: fluid drilling discharge risk . The drilling mud would temporarily increase the turbidity of the water and cause siltation of the stream bed thus affecting water quality and aquatic life (refer to Technical Report A in volume 2 of the AEE for further details). This will generate a potential adverse effect on the receiving environment at Woodlands Park tunnelling (Manuka Road to Shetland Street) and Metcalfe Road rail crossing (Option 2) locations if mitigation is not in place.

NOR2 – Eastern end of Greenhithe Bridge to Albany Reservoir

The NH2 proposed works within this area will mostly follow the roads and SH18 corridor from the eastern end of Greenhithe Bridge to Albany Reservoir and will include one stream crossing at Oteha Stream, potentially through trenchless technology (Option 1), pipe bridge (Option 2) or a combination of both options (Option 3).

- Option 1 – trenchless (tunnelling) and Option 3 (combination of Options 1 and 2). The receiving environment would be significantly affected if the drilling fluid was released into the watercourse. The drilling fluid would temporarily increase the turbidity of the water and cause siltation of the stream bed thus affecting water quality and aquatic life. Appropriate ESCM will have to address those risks in order to mitigate the more than minor effects on the water quality and receiving environment.
- Option 2 – Pipe Bridge, and Option 3. A pipe bridge of monopole column supports located on banks of Oteha Stream and within the floodplain based on 100yr flood event from Council data is proposed. Works in the streams will be minimised, therefore the effects on water quality are assessed as being minor without implementation of mitigation actions.

Potential effects on stormwater discharges generated by tunnelling construction will include: drilling fluid discharge risk (refer to section 6.2 of this AEE) which could potentially generate an adverse effect on the receiving environment at Tauhinu Road Crossing (Option 1), Greenhithe Road crossing, Oteha Stream Crossing and Bush road (Option 2 and 3) and Albany Expressway crossing locations if mitigation is not in place.

NOR3 – Westgate to Western end of Greenhithe Bridge

The proposed works within this area will mostly follow the SH18 corridor from Westgate to Hobsonville Pump Station and the western end of Greenhithe Bridge. No pipe bridges are proposed as part of the construction methodology for this area. However, various locations have been identified where the pipes are anticipated to be built under existing watercourses (e.g. Trig Stream and Rawiri Stream in the vicinity of Trig Road) and Overland Flow Paths (OLFPs), refer section 6.7.1.5 of this AEE.

Potential effects on stormwater discharges generated by tunnelling construction will include: drilling fluid discharge risk (refer to section 6.2 of this AEE) which could potentially generate an adverse effect on the receiving environment at SH16/ SH18 Interchange crossing and SH18 crossing (Sinton Road) locations if mitigation is not in place.

6.8.3 New Impervious Areas

The effects resulting from the creation of new impervious areas have been assessed for the NH2 and NI shared corridor project and are detailed in the following sections. It is proposed that all access ways be gravelled. Approximate access way areas and locations are provided in Table 6-2 and shown on the drawings (refer Volume 3 of the AEE). Further details about access ways are provided in section 2 of this AEE.

Table 6-2: NH2 and NI Shared corridor Proposed Access ways

NORs	Location	Approximate Area (m^2)*	Purposes
NOR1	No new impervious areas and access ways are required as part of the NH2 proposed works from Titirangi to Westgate		
NOR2	Albany Highway, Greenhithe Road and Tauhinu Road	11,000	NH2 Access roads for construction and maintenance purposes
NOR3	SH18 corridor	15,000	NH2 and NI access roads for construction and maintenance purposes
Total		26,000	

** These are indicative areas only and will be confirmed at detailed design.*

No new impervious areas are proposed within the NH2 section from Titirangi to Westgate (NOR1) therefore there is no effect on the stormwater runoff anticipated.

Three new access ways are proposed along the SH18 from the eastern end of Greenhithe Bridge to Albany reservoir. Several new access ways are proposed along the SH18 shared corridor from Westgate to Hobsonville Pump Station (western end of Greenhithe Bridge). These will be gravel roads and provide access for Watercare's future inspection, maintenance and operational activities. Access is required for routine maintenance and is expected to occur on a three monthly basis using a light truck or utility vehicle. In the rare event that repair of the watermain or structures are required (e.g. once every 5-10 years), six wheel truck access may be necessary. These effects are therefore considered minor prior to mitigation given the level of traffic expected.

6.8.4 Stormwater Runoff

There will be eight permanent access roads constructed in the NZTA SH18 corridor. Five (refer assumption (ix) below Table 6-3) will be in NOR3 and provide shared access for the NH2 and NI projects and three will be in NOR2 for access to the NH2 pipeline. The purpose of these permanent roads is to gain access for the maintenance of any valves and chambers where access is not currently provided. The access roads will be used by Watercare for maintenance purposes and provision will be made for a cycleway.

The access roads will be the width of a single lane, and generally in the form of a loop from entry to exit points. Where this does not occur a 'hammerhead' turnaround area will be provided where the road terminates. The roads will be constructed with a cross fall of approximately 2%.

Stormwater runoff calculations have been undertaken for these access roads using the Council TP108[17] method for both pre and post construction. The volume of runoff generated from the access ways have been estimated using 24 hour rainfall depths from TP108: volumes and increase in peak flows have been provided for both NOR2 and NOR3 detailing the maximum values and combined values for the access ways, refer Table 6-3. Assumptions for the calculations are also listed below Table 6-3.

Table 6-3: NH2 and NI Shared corridor Stormwater Runoff Calculations based on Council TP108[17]

Locations	NOR3 – SH18 corridor				NOR2 – SH18 corridor			
Flood Events	Increase in peak flows		Volume		Increase in peak flows		Volume	
	Max (L/s)	Combined Accessways (L/s)	Max (m^3)	Combined Accessways (m^3)	Max (L/s)	Combined Accessways (L/s)	Max (m^3)	Combined Accessways (m^3)
2yr	24.5	66.0	370.4	973	19.1	50.0	271.4	715.5
10yr	29.1	82.7	621.7	1,635.8	22.0	58.7	460.2	1,214.6
100yr	35.0	92.5	1,142.7	3,013.0	25.2	67.59	855.09	2,260.8

Stormwater Runoff Calculations Assumptions:
(i) Initial abstraction = 5mm
(ii) Minimum time of concentration = 10min
(iii) Good grass CN = 74
(iv) Gravel CN = 89
(v) Channelisation factor = 0.8
(vi) Grade 2%
(vii) Catchment length 6m
(viii) Approx. Rainfall Depths for a 24hr storm: 2yr = 88mm; 10yr = 135mm; 100yr = 230mm.
(ix) Access ways SH18 – NI Shaft 9 and 175 Brigham Creek Road (between NI Shafts 9 to 13) have been grouped together for the purpose of the calculations as these are linked through Shaft 9.

The stormwater calculations provided in Table 6-3 show the largest increase in stormwater runoff during a 100 year Annual Return Interval storm event will be approximately 35L/s. This calculation uses the cross fall of 2% as the average slope and assumes the cross fall will allow the great majority of the runoff to only run the width of the road making the catchment length only approx. 5-6 m in length. Sensitivity analysis has shown that the increase in stormwater runoff is likely to be less than the 35 L/s when calculated from the minimum values set out in Council TP108[17]. No formal stormwater drainage is proposed to manage this runoff volume. It is anticipated that the stormwater volume will runoff as sheet flow across the width of each access way and run into the existing grassed areas.

Given the very infrequent use of the access ways by motorised vehicles, the resulting contaminant load generated will be minimal. It is proposed that stormwater runoff from the access ways be managed using ESCM during construction (refer section 6.2 of this AEE and Technical Report A in Volume 2 of the AEE).

In the longer term, these areas are considered not to require stormwater treatment as they will be stabilised through the use of gravel and post construction use will be very infrequent.

6.8.5 Overland Flow Paths Diversion

The natural streams and gullies in the catchments currently serve as overland flow paths. Overland flow paths are often modified by the re-contouring of land during development and it is important that

[17] Auckland Council, Guidelines for stormwater runoff modelling in the Auckland Region Technical Publication 108 (TP108)

allowances are made for overland flow under such circumstances. OLFP and stream diversions are required to establish dry, off-line work areas to allow the open trenching to be undertaken while minimising the risk of erosion and sediment generation. Works in or around OLFPs or streams have the potential to have a direct impact on watercourse habitat and on watercourse ecology.

The SH18 OLFPs are part of the local stream network which can be adversely affected by spills from construction activities. In addition, there is a potential for effect on the OLFP diversion and blockage prior to mitigation.

6.8.6 Flood Plains

The identified locations where the route is potentially affected by Flood Sensitive Areas and Flood Prone Areas are listed in section 3.5.

The 100 year flood plains identified in section 3.5 potentially affect the route alignment in the locations listed. The proposed NH2 watermain and NI shared corridor will not impact or alter these flood plains; however a 100 year flood event will impact construction activities within the listed locations and must be identified for contingency planning purposes during construction.

There are no habitable floors in the vicinity of the access ways in the SH18 corridor (NOR2 and NOR3) and hence there is no potential for habitable floor flooding.

6.8.7 Proposed Mitigation

Several construction activities have the potential to affect water quality. In particular, sediment generation during construction may generate potential contamination that will have to be appropriately addressed through the Erosion and Sediment Control Plan (ESCP) and Construction Management Plan (CMP) in order to reduce the potential for contamination of receiving waters. Management of erosion and sediment from earthworks and construction activities for NH2 are proposed to be addressed by a series of Erosion and Sediment Control Measures (ESCMs), refer to Volume 2, Technical Report A. All ESCMs are to be designed and constructed in accordance with Auckland Council TP90 requirements. It is anticipated that an Erosion and Sediment Control Plan (ESCP) be prepared for NI shared corridor when Resource Consent will be prepared. Specific mitigation measures proposed to be implemented for each general area are listed in Table 6-4.

Table 6-4: NH2 and NI shared corridor Proposed Water Quality and Stormwater Mitigation Actions

NORs	Risks associated to Proposed Works	Potential Effects prior mitigation	Proposed Mitigation (refer notes below Table)	Potential Effects post mitigation
NOR 1	Stormwater discharge to existing network – Open trenching	Minor	ESCM	Less than minor
	Spill Risks to watercourse / stormwater network during construction (open trench and trenchless technologies)	More than minor	Spoil disposal options	Less than minor
	Spill Risks to watercourse / stormwater network during construction (trenchless technologies only)	More than minor	Drilling fluid discharge Site specific Response Plan and Staff Training	Less than minor
	Effects on Stream Crossings (Oratia, Opanuku, Paremuka and Swanson): contamination, sediment increase	Minor	ESCM Spoil disposal options	Less than minor
NOR	Stormwater discharge to existing network	Minor	ESCM	Less than minor

NORs	Risks associated to Proposed Works	Potential Effects prior mitigation	Proposed Mitigation (refer notes below Table)	Potential Effects post mitigation
2	Untreated sediment discharge to existing Stormwater Pond	Minor	ESCM Spoil disposal options	Less than minor
	Spill and contamination risk to water quality/stormwater during construction (open trench and trenchless technologies)	More than Minor	ESCM for work under existing watercourse as per Council TP90 Spoil disposal options	Less than minor
	Spill Risks to watercourse / stormwater network during construction (trenchless technologies only)	More than minor	ESCM	Less than minor
	Effect on Stream Crossing at Oteha: contamination, sediment increase	Minor	Option 1 – trenchless (and Option 3): ESCM and drilling fluid discharge. Response plan. Option 2 (and Option 3) - Construction of the pipe bridges: ESCM Spoil disposal options	Less than minor
	Construction of Access ways: Water quality	Minor	No stormwater treatment proposed due to the low level of traffic anticipated after construction. ESCM	Less than minor
	OLFP diversion or blockage	Minor	ESCM and manual fish relocation (if required)	Less than minor
NOR 2	Construction of Access ways: water quantity (Flood flow, Building in floodplain, Sufficient provisions to accommodate additional stormwater volume)	Less than Minor	ESCM No specific mitigation required post construction.	Less than minor
NOR 3	Spill and contamination risk to water quality/stormwater during construction	More than Minor	ESCM for work under existing watercourse as per Council TP90. Spoil disposal options	Less than minor
	Construction of Access ways: Water quality	Minor	No stormwater treatment proposed due to the level of traffic. ESCM	Less than minor
	OLFP diversion or blockage	Minor	ESCM and manual fish relocation (if required)	Less than minor
	Construction of Access ways: water quantity (Flood flow, Building in floodplain, Sufficient provisions to accommodate additional stormwater volume)	Less than Minor	No specific mitigation required due to the level of traffic.	Less than minor

Notes:
(i) Details about ESCM and drilling fluid discharge Site specific Response Plan are provided in section 6.2 of this AEE and Technical Report A in volume 2 of the AEE.
(ii) Spoil disposal options for the proposed excavation works are either at a licensed managed fill site or a licensed cleanfill site, refer section 6.3 of this AEE.

It is anticipated that with the appropriate mitigation measures implemented for NH2 and NI shared corridor, the level of effects on the stormwater environment and water quality be less than minor.

6.8.8 Assessment of Water Quality Effects Post Mitigation

Construction activities are generally not anticipated to significantly increase the level of contaminants in the receiving water providing mitigation and management protocols are put in place to minimise the discharge of sediment and other contaminants such as fuels, bulk chemicals and those derived from the trenchless construction activities (drilling fluid). In the long term the provision of new access ways along the length of the SH18 corridor will introduce new “impervious areas” of approximately 26,000 m². The runoff from these access ways is considered to be minimal and, therefore, not required to be treated. In the longer term, stormwater runoff from the proposed access ways in SH18 corridor has the potential to convey sediment and other contaminants to the watercourses and harbour; however, given the frequency of use by motorised vehicles and the provision of ESCMs, the potential for adverse effects is considered to be less than minor.

Given the likely low flow rates, OLFP diversion around the works area can be achieved using ESCM (i.e. an upstream dam and pumping around the work area to discharge back into the channel downstream of the work area), as described in section 6.2 of this AEE and Technical Report A in Volume 2 of the AEE.

Fish passage will need to be considered with the dam and pump diversion method suggested in the ESCM (refer section 6.2.2 of this AEE). If required, manual fish capture and relocation downstream of the work area and the use of screens over pump and pipe inlets is sufficient given the short timescale the diversion will be in place and the type of OLFPs and streams to be crossed.

There is a potential for adverse effects on the streams (stream crossings and works under watercourses), however, with the appropriate ESCMs and ecology measures in place, and given the fact that works in the streams will be minimized, the effects on water quality are assessed as being less than minor. The water quality at the site is therefore expected to have similar annual water quality index following the construction works.

6.8.9 Water Quality / Stormwater Assessment Conclusions

It is recommended that the following be implemented for the proposed works:

- Implementation of appropriate ESCMs including: Installation of perimeter controls below the site to detain sediment and prevent contamination of the existing stormwater system and receiving environment.
- Preparation of ESCP and CMP for NH2 and NI shared corridor.
- Ecological assessment if works in streams (intermittent or permanent) are anticipated at detailed design.

The Project will not affect the stormwater quality either during construction or in the longer term with the provision of appropriate ecological mitigation and, erosion and sediment control measures (ESCMs). On the basis of the above assessment, the overall effects are considered to be less than minor.

6.9 Traffic

A transport assessment was undertaken to evaluate the traffic effects associated with project construction on the existing transport environment (refer section 3.1.8 of this AEE for description of the existing traffic environment). It is assumed that upon completion of the project the transport environment will be restored to its pre-construction condition i.e. there will be no lasting effect on the transport environment post construction and the effect of maintenance operations will be less than minor. Further detail can be found in Technical Reports E -Traffic Assessment Report.

The effects to the transport network are envisaged to arise from the construction activities taking place in the road corridor. In general, this will lead to a temporary reduction in road capacity which may cause delays or disruption to road users. Because delays and disruptions will be most significant immediately before and after general work hours, assessments were only undertaken during weekday AM and PM

peak periods. Although it is anticipated that the physical works will be undertaken only during weekdays, the traffic assessment recommended locations where off-peak work may be required and traffic effects may need to be mitigated. Assessments were undertaken using SIDRA modelling of traffic data obtained from Auckland Transport's Traffic Flow Counting Programme.

6.9.1 Potential Traffic Effects

General Traffic Effects relating to entire route

The Projects will generate the following effects on the traffic environment:

- Minor impacts are expected for pedestrian traffic as the construction area may be required to occupy footpaths.
- Effects to cyclists are expected to be less than minor. Cycle lanes exist on part of Don Buck Road (NOR1) and Rosedale Road (NOR2) and these would be maintained during construction through the use of traffic management planning.
- The expected volume of construction vehicle movements is relatively small and will not have any adverse impacts on the surrounding road network.
- Where on-street parking currently exists, parking restrictions will need to be implemented in order to provide sufficient space in the corridor for the work areas. The amount of parking to be restricted will depend on the length of trench being dug at each particular location i.e. approximately 20-30m. These impacts are therefore expected to be minor.
- Potential effects to properties may arise as access to properties will need to be maintained at all times along the route.

Specific traffic effects have been assessed for each of the NORs in sections 6.8.1.2 to 6.8.1.4.

NOR1 – Titirangi to Westgate

During construction, two traffic lanes will be maintained through the majority of the proposed alignment. Where only one lane is able to remain open, modelling was undertaken to assess the performance of an alternating two-way traffic control system which suggests more than minor impacts may occur such as increased delays and significant queuing at the locations listed below:

- Along Parrs Cross Road between Bruce McLaren Road and Pine Avenue due to the alternating two-way traffic control system.
- Don Buck Road – Between Swanson Road and Red Hills Road

Modelling was undertaken to assess the performance of manually controlled intersections, indicating more than minor impacts such as increased delays and that significant queuing may occur at:

- Parrs Cross Road due to the length of the section and rate of trenching. Construction along the 270m section is expected to take approximately four to five weeks, assuming 60m of trenching per week. Traffic effects are therefore anticipated at West Coast Road / Parrs Cross Road roundabout and Seymour Road roundabout.
- Don Buck Road between Universal Drive and Red Hills Road due to the alternating two-way traffic control system.
- Swanson Road at the Metcalfe Road and Universal Drive roundabouts.
- Ranui level crossing. Two options are being considered at this locality (refer to Section 2.6 of this AEE). Option 1 involves using open trenching similar to that undertaken for most of the project.

Option 2 would have the least impact, but both options would likely require closure of one lane on Metcalfe Road during the works; with overall impacts considered to be less than minor.

NOR2 – Eastern end of Greenhithe Bridge to Albany

A summary of the average traffic on roads along this section of the proposed route is shown in section 3.1.6 of this AEE. New Network[18] in the North Shore is still in the planning and consultation phase and is not yet finalised. However, it is expected to be in place by 2017, before construction begins on NH2.

Construction will need to be staged through roundabouts and other major intersections to enable all movements to be maintained and manual traffic control will be required. Modelling was undertaken to assess the performance of manually controlled intersections, indicating more than minor impacts such as increased delays and significant queuing may occur at:

- William Pickering Drive/Douglas Alexander Parade roundabout: traffic controls would result in effects that are considered to be minor.
- Rosedale Road/Bush Road intersection: traffic controls would result in effects that are no more than minor.

The proposed construction alongside the SH18 corridor will have minimal impacts on traffic and the trenchless construction proposed from Greenhithe to Willian Pickering Drive. Tauhinu Road, Greenhithe Road and Albany Highway will minimise traffic impacts at these locations. Launching and receiving construction areas will be located inside the SH18 corridor but will not directly impact the live traffic lanes. However access to these construction areas will, in some circumstances, be from the SH18 shoulder lanes

Locations at Rosedale Road and Corinthian Drive will require lane or road closure and subsequent traffic controls. Therefore these effects are anticipated to be minor before traffic mitigation measures are in place.

However, the short construction timeframes mean that, overall, these impacts will be considered as no more than minor.

NOR3 – Westgate to Western end of Greenhithe Bridge

This section of construction is generally located outside of the road corridor and hence will have minimal impacts to the road network.

Construction in NOR3 will have less than minor to minor impacts. Lane closures and manual traffic control will be required along Trig Road; however, the impacts will be less than minor. Construction on Brigham Road/SH18 off ramp roundabout will require manual traffic controls to safely accommodate traffic movements and will experience minor to significant delays during peak traffic flow.

Overall, these effects are considered to be minor due to the very short construction duration (i.e. no more than five days for the construction works at each intersection).

However, it is noted that ongoing residential development in the area may result in increased traffic flows in excess of 2% per year. It is therefore recommended further assessment is done closer to the construction date. In the event of larger than expected traffic growth, mitigation measures such as construction during off-peak periods will be sufficient to provide acceptable outcomes.

For NI, there are 16 proposed microtunnel pits along the NOR3 alignment between Fred Taylor Drive and Squadron Drive. For NI in the shared corridor, the pipeline is offline and any traffic effects resulting from microtunnel pit construction will be less than minor for the majority of pits. These pits will be accessed

[18] New region-wide public transport network which involves significant changes to the existing bus routes and timetables. The New Network for West Auckland is to be implemented in late 2016 i.e. before construction begins on NH2.

from low volume roads, or cul-de-sacs where the traffic impacts will be negligible. Access to microtunelling pits 10, 11 and 12 have however the potential to cause more than minor impacts at the Brigham Road / SH18 roundabout. The traffic impacts during construction can be adequately managed and effects will be no more than minor.

The access to the Hobsonville Pump Station is from Buckley Avenue, there is an existing vehicle crossing in this location. Traffic impacts during construction in this location are expected to be less than minor.

6.9.2 Proposed Traffic Mitigation Methods

Standard Traffic Management Mitigation

Several standard traffic management mitigation actions are applicable to several areas of the Projects. Adequate signage at safe crossings prior to construction areas will mitigate the effects on pedestrian traffic.

Although the majority of the alignment will be installed whilst maintaining two traffic lanes, where only one lane is able to remain open manual controls are to be implemented and mitigation measures, such as strong communication prior to construction, advising of possible detours and construction during off peak hours, are recommended to help mitigate the impacts and reduce the effects to no more than minor.

Where detours cannot be provided and significant reductions in traffic are unlikely a targeted campaign to inform drivers of expected impacts may provide some suppression during peak travel periods and demand may spread either side of the peak hours, reducing the impacts of the works. It is therefore recommended that all efforts are made to reduce both the width and length of the work area at these locations. If possible, construction could be limited to off-peak times and/or school holidays.

Where the alignment passes through intersections, it is assumed that access will be maintained for all traffic movements. For T-intersections, all effort should be made to setup the construction work area on the far side of the intersection, allowing the full length of the alignment to be constructed without the need for intersection staging. This configuration will lead to only minor impacts as a result of a reduction in lane widths and speed limits. Four-legged intersections and all roundabouts will require staging of construction and manual traffic control in order to maintain all movements during construction.

Parking for construction workers will need to be carefully planned so as to avoid adverse impacts on the road network. Site parking is subject to further investigation and will need to be arranged on a site by site basis.

Specific traffic mitigation measures are proposed for each NOR area:

NOR1 – Titirangi to Westgate

- Along Parrs Cross Road between Bruce McLaren Road and Pine Avenue due to the alternating two-way traffic control system. Strong communication prior to construction, advising of possible detours and construction during off peak hours should be implemented to help mitigate these impacts.
- At West Coast Road / Parrs Cross Road roundabout: manual traffic control will be required to ensure all construction activities movements can be safely accommodated.
- At Parrs Cross Road and Seymour Road roundabout, causing delays at this intersection.
- On Swanson Road at the Metcalfe Road and Universal Drive roundabouts. It is recommended that construction take place outside of the AM and PM peak periods.
- On Don Buck Road between Universal Drive and Red Hills Road due to the alternating two-way traffic control system. Signposting the detour via Triangle Road is recommended and achieving a 10% reduction in Don Buck Road demand will help to mitigate these impacts.

NOR2 – Eastern End of Greenhithe Bridge to Albany

- William Pickering Drive/Douglas Alexander Parade roundabout. Recommended mitigation measures to reduce the scale of impacts to no more than minor include banning right turns from William Pickering Drive during construction.
- Rosedale Road/Bush Road intersection. It is recommended that the right turn from Rosedale Road into Bush Road southbound be banned during construction in order to reduce the scale of impacts to no more than minor.

NOR3 – Westgate to western end of Greenhithe Bridge

All impacts are generally expected to be no more than minor and standard traffic mitigation (detailed in section 6.8.2.1 of this AEE) will be required as part of the traffic management for NH2 and NI shared corridor construction works. Recommended mitigation measures at Brigham Creek Road / SH18 roundabout (due to access requirements to microtunnel pits 10, 11 and 12) include the provision of advance warning signage.

6.9.3 Traffic Assessment Conclusions

Modelling indicates that more than minor impacts will occur at a number of locations along the Titirangi to Westgate (NOR1) and Eastern end of Greenhithe Bridge to Albany (NOR2) sections prior mitigation. Mitigation measures such as strong communication with the public prior to construction, detours and manual traffics controls should be implemented to minimise impacts to no more than minor. Traffic impacts due to the proposed NH2 and NI shared corridor works in the Westgate to Hobsonville Pump Station / Western end of Greenhithe Bridge (NOR3) area are expected to be no less than minor after mitigation is implemented (refer section 6.8.2.1 of this AEE). A project specific Traffic Management Plan (TMP) will be required to be prepared by the appointed contractor prior to the commencement of construction works.

The traffic effects from the construction and operation of NH2 and the NI are assessed as being less than minor in most instances, and no more than minor overall. This is assuming that recommended mitigation measures are implemented (refer to Section 6.8.2 of this AEE).

6.10 Noise and Vibration

An assessment of the noise and vibration effects associated with the construction of the Projects was undertaken to assess whether adverse effects can be sufficiently mitigated such that residual effects are effectively managed. Further detail can be found in Volume 2, Technical Report F – Construction Noise and Vibration Assessment.

Specific equipment and durations have not yet been finalised and will not be known until a contractor has been engaged. At the construction stage, detailed predictions will be made for the purpose of confirming the extent of the necessary mitigation. For the purposes of this assessment, indicative noise levels for key activities and locations have been predicted separately for the three different NORs of the Projects. Assessments have been based on the use of indicative construction equipment and comparisons to the relevant day or night-time noise limits from NZS 6803 have been made. The extent of any adverse effects has been determined in order to develop an appropriate management framework which will be documented in a Construction Noise and Vibration Management Plan.

6.10.1 Potential Noise and Vibration Effects

Noise and vibration are an expected consequence of construction activity and people generally have a tolerance for this, particularly if the construction is for public works. Daytime noise effects are generally limited to annoyance (amenity effects), but only if people are home. Works at night can cause sleep

disturbance and associated short-term health effects, as well as annoyance. People will tolerate higher noise levels for short durations, and hence NZS 6803 includes a variety of guideline limits for activities of different durations. These are listed below, along with the key activities that they relate to:

- Construction of chambers and trenchless construction have been assessed based on the 'long-term' daytime guideline noise criteria of 70 dB $L_{Aeq(15min)}$.
- Trenching activities have been assessed using the 'typical duration' daytime guideline noise criteria of 75 dB $L_{Aeq(15min)}$.

While extensive night works are not anticipated, they will be required for continuous operations such as trenchless tunnelling. NZS 6803 provides a guideline noise criteria of 45 dB $L_{Aeq(15min)}$, however it is recognised that it is seldom practical to achieve this level if night works are necessary.

In addition to numeric noise limits, the character of the noise is also important. The NZS 6803 criteria assumes some special audible characteristics, however certain activities, such as piling, can be more noticeable and hence considered to be more annoying/disturbing.

Compliance with NZS 6803 criteria does not mean there will be no adverse effects. Works will still be audible and may still cause annoyance, in particular shift workers or other people trying to sleep during the day or if people are working at home. NZS 6803 recommends good construction management and communication practices, which the numeric criteria assume are adopted.

Effects from vibration are predominantly annoyance. Some sensitive receivers may perceive vibration from tunnelling activity as "reradiated" noise usually in the form of a "rattle or hum".

During the day, people will tolerate high levels for limited durations (depending on the task), however at night when people are relaxing or sleeping, even low levels will cause disturbance. At higher vibration levels, building damage is possible. This can range from cosmetic damage such as cracking of plaster to structural damage. Structural damage is not anticipated on this project.

NOR1 – Titirangi to Westgate

The potential effects of the construction noise and vibration within NOR1 are provided in Table 6-5. The effects vary given the proximity of the nearest residential properties. The noise effects exceed the day time compliance levels for a number of construction activities. Trenchless construction from Woodlands Park Road reservoir to Shetland Street is expected to exceed the night time criteria. Perceptible vibration is likely for the majority of the Titirangi to Westgate section, but levels will be below building damage criteria. Adverse noise and vibration effects will occur at the properties nearest to the construction activity within NOR1, and will require mitigation to reduce these effects.

Table 6-5 Potential affected properties by noise and vibration effects in NOR1

Location	Properties affected by noise and vibration levels due to construction activity	Potential Risk
Trenching activities throughout the entire NOR1:	Site establishment (no property affected within first and second row of houses away from the road corridor, i.e. 10m and 30m away from the road)	Compliance with noise levels
	Properties within the first row of houses away from the road corridor, i.e. 10m away from the road will be affected by: - Trenching, pipe installation and back-filling - Paving	Noise exceeding compliance levels by up to 9 dB
	No property affected within second row of houses away from the road corridor, i.e. 30m away from the road by: - Trenching, pipe installation and back-filling Paving	Compliance with noise levels

Location	Properties affected by noise and vibration levels due to construction activity	Potential Risk
	Excavation: properties within 15m of the road - Vibratory compaction: 2 properties within 20m of the road	Perceptible vibration which may cause annoyance, but below building damage threshold
Trenchless activities: Woodlands Park Road to Shetland Street Trenchless activities	Daytime: - Site establishment and vegetation clearance (15 properties) - Sheet piling (24 properties) - Excavation (receiving pit only) (2 properties) Night time: - Tunnel boring and pipe jacking: 24 properties - Grouting: 24 properties	Noise exceeding compliance levels by up to 18 dB Noise exceeding compliance levels by up to 20 dB
	Sheet piling: 4 properties - Tunnel boring: 28 properties	Perceptible vibration which may cause annoyance, but below building damage threshold
North Auckland railway crossing Metcalfe Road	Site establishment (3 properties) Sheet piling (~100 properties) Excavation (3 properties) Tunnel boring and pipe jacking (3 properties) Grouting (7 properties)	Noise exceeding compliance levels by up to 22 dB
	Excavation: 1 property - Sheet piling: 21 properties	Perceptible vibration which may cause annoyance, but below building damage threshold
Oratia, Opanuku and Swanson Stream Crossings – pipe bridge construction	Site establishment (11 properties) Piling (18 properties) Column construction (2 properties)	Noise exceeding compliance levels by up to 8 dB
	- Piling: 4 properties	Perceptible vibration which may cause annoyance, but below building damage threshold
Paremuka Stream Crossing – pipe bridge construction	Site establishment (19 properties) Piling (33 properties) Column construction (4 properties) Pipe installation (2 properties)	Noise exceeding compliance levels by up to 13 dB
	- Piling (11 properties)	Perceptible vibration which may cause annoyance, but below building damage threshold
Chamber construction and valve installation: Chamber construction and valve installation:	Site establishment and vegetation clearance (2 properties, or within 20 m of the work area) Sheet piling (17 properties, or within 115m of the work area) Excavation (2 properties, or within 20m of the work area) Chamber construction and valve installation (4 properties, or within 50m of the work area)	Noise exceeding compliance levels by up to 18 dB
	Sheet piling	Perceptible vibration which may cause annoyance, but below building damage threshold

Location	Properties affected by noise and vibration levels due to construction activity	Potential Risk
Cathodic protection adjacent to Opanuku Stream	Site establishment: nine properties within 40 m of the work area. Excavation: nine properties Concreting: nine properties Installation of cathodic protection devices: nine properties	Noise exceeding compliance levels by up to 15 dB
	- Vibration effects	Vibration may be perceptible, but unlikely to cause annoyance

NOR2 – Eastern End of Greenhithe Bridge to Albany

The potential effects of noise and vibration within NOR2 have been assessed based on the construction methodology and are provided in Table 6-6. The noise effects exceed the day time compliance levels for a number of construction activities. Night time levels are anticipated to be exceeded for various trenchless activities.

The vibration may be perceptible for the entire eastern end of Greenhithe Bridge to Albany section, and may cause some annoyance but will be below building damage criteria. Trenchless construction within Albany industrial area is considered high risk, as indicative calculations show potential vibration levels exceed the acceptable vibration levels for commercial/industrial dwellings. The overall noise and vibration effects on the nearest properties within NOR2 are assessed as being moderate to significant without mitigation.

Table 6-6 Potential affected properties by noise and vibration effects in NOR2

Location	Properties affected by noise and vibration levels due to construction activity	Potential Risk
Trenching activities throughout the entire NOR2:	Site establishment (no property affected within first and second row of houses away from the road corridor, i.e. 10m and 30m away from the road)	Compliance with noise levels
	Properties within the first row of houses away from the road corridor, i.e. 10m away from the road will be affected by: - Trenching, pipe installation and back-filling - Paving	Noise exceeding compliance levels by up to 13 dB
	No property affected within second row of houses away from the road corridor, i.e. 30m away from the road by: - Trenching, pipe installation and back-filling Paving	Compliance with noise levels
	Excavation: properties within 15m of the road - Vibratory compaction: properties within 20 metres of the road	Perceptible vibration which may cause annoyance, but below building damage threshold
Trenchless activities: Tauhinu Road (option), Greenhithe Road (option), Greenhithe embankment, Oteha Stream crossing (Options 1 and 3), Albany expressway crossing	Daytime: - Site establishment and vegetation clearance (15 properties) - Sheet piling (24 properties) - Excavation (receiving pit only) (2 properties) Night time: - Tunnel boring and pipe jacking: 24 properties - Grouting: 24 properties	Noise exceeding compliance levels by up to 9-13 dB

Location	Properties affected by noise and vibration levels due to construction activity	Potential Risk
	Sheet piling: 4 properties - Tunnel boring: 28 properties	Perceptible vibration which may cause annoyance, but below building damage threshold
Trenchless activities: Albany industrial area	Daytime - Site establishment and vegetation clearance (15 properties) - Sheet piling (24 properties) - Excavation (reception shaft only) (2 properties) Night time - Tunnel boring and pipe jacking: 24 properties - Grouting: 24 properties	Noise exceeding compliance levels by up to 12 dB
	Sheet piling: 4 properties - Tunnel boring: 28 properties	Perceptible vibration which may cause annoyance, but below building damage threshold
	Sheet piling and Tunnel boring: Commercial properties adjacent to the tunnelled section within 15m	Annoyance from vibration likely and potential cosmetic building damage
Oteha Stream Crossing (Options 2 and 3) – pipe bridge construction	Site establishment (11 properties) Piling (18 properties) Column construction (2 properties)	Noise within compliance levels
	- Piling: 4 properties	Vibration may be perceptible, but unlikely to cause annoyance
Albany Cathodic protection adjacent to Rosedale Road Albany Cathodic protection adjacent to Rosedale Road (continued)	Site establishment: commercial property, nearest residential property is 28m away	Noise within compliance levels
	Excavation: commercial property, nearest residential property is 28 metres away Concreting: commercial property, nearest residential property is 28 metres away Installation of cathodic protection devices: commercial property, nearest residential property is 28 metres away	Noise exceeding compliance levels by up to 8 dB
	- Vibration effects	Vibration may be perceptible, but unlikely to cause annoyance
Chamber construction and valve installation:	Site establishment and vegetation clearance (2 properties, or within 20 metres of the work area) Sheet piling (17 properties, or within 115m of the work area) Excavation (2 properties, or within 20m of the work area) Chamber construction and valve installation (4 properties, or within 50m of the work area)	Noise exceeding compliance levels by up to 15 dB
	- Sheet piling	Perceptible vibration which may cause annoyance, but below building damage threshold

NOR3 – Westgate to Western end of Greenhithe Bridge

The potential effects on the noise and vibration environment within NOR3 have been assessed based on the construction methodology and are provided in Table 6-7. The effects vary given the proximity of the nearest residential properties. The noise effects exceed the day time compliance levels for a number of

construction activities. Night time levels are anticipated to be exceeded for trenchless activities within SH18 for NH2 and NI within the shared corridor.

The vibration effects are generally assessed as low to medium risk (i.e. exceeding acceptable vibration levels) within the entire Westgate to Western end of the Greenhithe Bridge section.

The overall noise and vibration effects on the nearest properties within NOR3 are assessed as being minor to moderate without mitigation.

Table 6-7 Potential affected properties by noise and vibration effects in NOR3

Location	Properties affected by noise and vibration levels due to construction activity	Potential Risk
Trenching activities (multiple locations within NH2 and NI shared corridor):	Site establishment (no property affected within first and second row of houses away from the road corridor, i.e. 10m and 30m away from the road)	Noise at levels below guideline criteria
	Properties within the first row of houses away from the road corridor, i.e. 10m away from the road will be affected by: - Trenching, pipe installation and back-filling - Paving	Noise at levels up to 13 dB above guideline criteria
	No property affected within second row of houses away from the road corridor, i.e. 30m away from the road by: - Trenching, pipe installation and back-filling: - Paving	Noise at levels below guideline criteria
	Excavation: properties within 15m of the road - Vibratory compaction: properties within 20m of the road	Perceptible vibration, but below building damage threshold
Trenchless activities: SH16 crossing	Nearest building being located 300m away	Noise at levels below guideline criteria
Trenchless activities: SH18 motorway crossing Trenchless activities: SH18 motorway crossing (continued)	Nearest residence being located at 38m from the proposed works - Site establishment and vegetation clearance - Excavation - Tunnel boring and pipe jacking (daytime only) - Grouting (daytime only)	Noise at levels below guideline criteria
	Nearest residence being located at 38m from the proposed works - Sheet piling (1 property) - Tunnel boring and pipe jacking (night time only) - Grouting (night time only)	Noise at levels up to 24 dB above guideline criteria
	Nearest residence being located at 38m from the proposed works - Sheet piling: (1 property) - Tunnel boring: (1 property) – during the first 10m.	Perceptible vibration which may cause annoyance, but below building damage threshold. This is considered low risk.
Trenchless activities: SH18 (NI within the shared corridor)	Nearest residence being located at 100m from the proposed works: - Site establishment and vegetation clearance - Excavation - Tunnel boring and pipe jacking (daytime only) - Grouting (daytime only)	Compliance with noise levels
	Nearest residence being located at 100m from the proposed works: - Sheet piling (1 property)	Noise exceeding compliance levels by up to 1 dB

Location	Properties affected by noise and vibration levels due to construction activity	Potential Risk
	- Tunnel boring and pipe jacking (night time only) - Grouting (night time only)	
	Tunnel boring and pipe jacking: (4 properties) - Grouting : (4 properties)	Perceptible vibration which may cause annoyance, but below building damage threshold
Hobsonville Option 1 Causeway construction west of the Squadron Drive overbridge	Site Establishment and Vegetation clearance: one property (nearest) at 70m from the proposed works	Noise exceeding compliance levels by up to 1 dB
	Causeway construction - Pipe installation and back-filling	Compliance with noise levels
	- Vibration	Vibration may be perceptible, but unlikely to cause annoyance
Hobsonville Option 2 (pipe bridge construction)	Site establishment: one property (nearest) at 70m from the proposed works Piling: one property (nearest) at 70m from the proposed works	Noise exceeding compliance levels by up to 3 dB
	Bridge column construction - Pipe installation	Compliance with noise levels
	- Vibration	Vibration may be perceptible, but unlikely to cause annoyance
New Hobsonville Pump Station	- Properties within 50m	Noise exceeding day time compliance levels by up to 10 dB during piling. Vibration may be perceptible, but below building damage threshold

6.10.2 Proposed Mitigation Methods

Mitigation measures should be planned and implemented in a structured hierarchy depending on the extent of predicted effects. In general this should be based on managing activities, selecting equipment and programming works to avoid night works and other sensitive times, and minimise noise and vibration where practicable; using screening/enclosure/barriers; and providing periods of respite.

An effective and integrated management processes will be detailed in a Construction Noise and Vibration Management Plan (CNVMP), which will be prepared prior to construction and implemented by the appointed contractors. For construction noise and vibration it is critical that effective management processes are followed and that these are specified in designation conditions. In particular, dealing with property owners directly will enable Watercare to agree site specific mitigation with them.

While there may be some disturbance and annoyance at times, with appropriate management of noise and vibration through a CNVMP, it is considered that both daytime and night-time effects can be managed to an acceptable level with residual effects being no more than minor.

6.10.3 Noise and Vibration Conclusions

Several distinct construction activities have been identified for the project, with each construction activity generally occurring at least once in each section of NH2. While the total number of affected receivers will

be lowest in the eastern end of Greenhithe Bridge to Albany section, the nature of the effects (i.e. annoyance or sleep disturbance) will be consistent across all sections for receivers at similar distances from a given construction activity. Construction activities are typical for this type of project, and it is common for these to occur in residential areas.

In general it is noted that whilst perceivable construction noise and vibration effects occur along much of the route, in most circumstances this is commensurate with the typical levels expected for the proposed construction activities and is transient in nature.

In cases where sheet and impact piling is to be conducted close to residences, exceedance of the daytime criteria is expected, and mitigation and management will need to be implemented through a CNVMP (in particular specific communication with residents).

Night-time works will exceed the relevant criteria and will require implementation of enhanced noise and vibration management procedures. Any night works without appropriate communication, or night works for extended periods, are likely to cause disturbance and complaints would be expected.

Appropriate mitigation and management measures will be confirmed when the specific construction methodology and equipment are known, and will be documented in a CNVMP.

It is considered that annoyance from construction activities will be limited and with appropriate management and mitigation, the overall effects of noise and vibration resulting from the construction and operation of NH2 and the NI are considered to be acceptable and no more than minor.

6.11 Air Quality and Dust

An air quality environment description is provided in section 3.1.7 of this AEE. There are three potential air quality related emissions associated with this project which are: construction dust, odour and vehicle emissions. An air quality assessment was undertaken to determine the impacts of these emissions which have the potential to occur as a result of activities undertaken within all three NOR's of NH2 and NI within the shared corridor. The air quality assessment involved the preparation of wind roses from meteorological data at publicly available stations.

6.11.1 Potential Air Quality and Dust Effects

NOR1 – Titirangi to Westgate

This section of NH2 runs primarily through built-up suburban areas and along suburban streets. Consequently the existing environment can be considered to be a low dust one, with a reasonably high sensitivity to high concentrations of nuisance dust for residential properties. A number of locations in the NOR1 general area are sufficiently close to the proposed alignment and considered sensitive to effects from air quality, these include; hospitals, schools and childcare centres. Construction in NOR1, in worst case scenarios, would generate dust inputs to the atmosphere and could therefore ingress into the residences. However, it is noted that due to the small excavation footprint, the level of dust effects that might be experienced from construction are probably less than those that might occur from a normal road reinstatement process.

It is considered extremely unlikely that there will be any construction related odour effects within NOR1 other than those associated with tar sealing. Given the temporary nature of this activity, and the fact this is essentially no different to what could occur as of right for road reinstatement, it is not considered that the tar sealing odour will result in any nuisance effects.

There is a potential for minor effects on dust and odour prior to mitigation.

NOR2 – Eastern End of Greenhithe Bridge to Albany

The existing environment in this area is divided into the primarily residential area located from Greenhithe Bridge to Albany Highway and commercial / retail from there to the Albany Reservoir. The first section runs primarily within the SH18 corridor and is reasonably well separated from the residential properties. The sensitivity is considered to be low. Most of the commercial residential areas will have a low sensitivity, although a number of cafes with outdoor eating areas along the route are likely to be more sensitive to dust. There are also two schools in the area which are considered sensitive to air quality effects.

The sensitivity of the majority of the properties in this section of the alignment is less than for the Titirangi to Westgate section (NOR1). However, the alignment boundary is still within 10 to 20 m of residential and commercial properties; well within the distance that dust nuisance effects are likely to have a higher threshold. In dry windy conditions these effects may include: dust build-up on windows and external surfaces; and build-up of dust on vehicles parked outside. A couple of cafés with outdoor seating areas on Douglas Alexander Parade could be affected by dust. With the exception of tar sealing activities, construction related odour effects are considered extremely unlikely. Given the temporary nature of tar sealing, and the fact this is essentially no different to what could occur as of right for road reinstatement, it is not considered that the tar sealing odour will result in any nuisance effects.

There is a potential for minor effects on dust and odour prior to mitigation.

NOR3 – Westgate to Western end of Greenhithe Bridge

This section of works and the proposed alignment are primarily within the SH18 corridor, consequently this section is considered less sensitive to dust nuisance effects than the Titirangi to Westgate section (NOR1). Where any works are undertaken very close to residential properties, residences are likely to be sensitive to air quality related effects.

No specific dust sensitive locations have been identified in the vicinity, as a result it is considered that there is generally a low potential for dust nuisance effects to occur in this area. However, the alignment is within 50 m of a couple of potential receptors, particularly Summerset Park where some dust nuisance effects are likely to be experienced, at a higher threshold. Effects may include dust build-up on windows, external surfaces, and vehicles parked outside. The level of potential effects is no greater than, and probably less than, those that might occur from a normal road reinstatement process which occurs periodically in all urban areas. It is extremely unlikely that there will be any construction related odour effects in this section apart from odour associated with tar sealing. Given the temporary nature of this activity, and the fact this is essentially no different to what could occur as of right for road reinstatement, it is not considered that the tar sealing odour will result in any nuisance effects. No mitigation measures can be implemented to reduce this odour.

There is a potential for minor effects on dust and odour prior to mitigation.

6.11.2 Proposed Mitigation Methods

One of the most important aspects of mitigation for dust is undertaking monitoring, to determine what mitigation may be required, and to assess the effectiveness of the mitigation being implemented. This will require daily inspections on site, adjacent land and for weather to ascertain the potential risk for dust emissions. Recommended mitigation measures include, but are not limited to, ensuring vehicle speeds are reduced around sensitive areas and ensuring that care is taken when loading vehicles to minimise material being tracked out from the work site; having a comprehensive complaints procedure and a community liaison person to address concerns; and the use of watercarts to control dust and cleaning up any dirt on surfaces to avoid dust being generated.

There were no specific locations identified that may produce construction odour. In the event they do arise it is recommended the following measures are implemented:

- Trucks transporting material off site are covered to reduce potential odour and delivery is made to an appropriate disposal facility as soon as practicable;
- Open excavations are minimised at all times and odorous sources are covered or temporarily backfilled when not excavating; and
- That an odour masking agent or deodoriser such as “Power Green” is available for use on the surface of odorous material, this can be applied by a worker using a back-pack pressurised sprayer.

6.11.3 Air Quality and Dust Conclusions

Based on the limited nature of the excavations it is considered extremely unlikely that there will be any dust nuisance effects associated with the construction of NH2 and the NI shared corridor with appropriate implementation of the mitigation measures outlined in Section 6.10.2 of this AEE. Where locations are sensitive to air quality related effects it may be necessary that work undertaken immediately adjacent to the area occurs outside of their normal operating hours or at a time of year when it is less likely that their daily operation will be affected.

It is considered extremely unlikely that there will be any construction related odour effects along the alignment apart from odour associated with tar sealing (applicable to the three NORs). However, given the nature of this activity, it is not considered that the tar sealing odour will result in any nuisance effects.

6.12 Amenity Values

An assessment of the potential effects of construction and operation of the Projects on amenity values was undertaken. As with aesthetic values, with which amenity values share considerable overlap, this evaluation was professionally-based using current and accepted good practice rather than community-based. Amenity values are defined in the Act as “those natural or physical qualities and characteristics of an area that contribute to people’s appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.” Further detail can be found in Volume 2, Technical Report G – Landscape and Visual Impact Assessment.

Upon completion of the project the amenity values will be restored to the pre-construction condition or enhanced compared to the existing, therefore the effects are considered less than minor on the amenity environment.

The amenity values will therefore be slightly enhanced compared to the existing situation i.e. opportunities for passive recreation and continued access for cyclists and pedestrians within the new proposed access ways in the SH18 corridor.

6.13 Landscape

A landscape assessment was undertaken to assess the effects of NH2 and NI shared corridor on landscape values. Section 3.1.10 of this AEE provides a description of the landscape environment. This assessment considered the likely effects of the proposal in a holistic sense and addresses whole-of-landscape issues, particularly those identified by Sections 6 and 7 of the Resource Management Act 1991 (RMA). The landscape assessment consists of two components: a descriptive component that describes landscape character, natural character (s6a) and landscape amenity (s7c), and an evaluative component that addresses landscape values in terms of the requirements of s6b. It draws upon landscape assessment theory, professional best practice, the requirements of the RMA (particularly with regard to matters of national importance identified in Part 2 Section 6), and procedures and principles established through case law in the Environment Court.

Further detail can be found in Volume 2, Technical Report G- Landscape and Visual Impact Assessment.

6.13.1 Potential Landscape Effects

NOR1 – Titirangi to Westgate

The effects on landscape context are considered to be minor at most resulting from localised vegetation clearance. A significant portion of the pipe where the landscape is most sensitive will be tunnelled. The majority of the works are being undertaken in an urban environment within the road corridor and it is considered to be no different from other infrastructure services being laid within the road. Minor changes will occur on Shetland Street and at the stream crossings but it is considered that these changes will be less than minor.

The potential loss of the 10m Pin Oak at the intersection of Swanson, Don Buck and Universal roads will be noticeable in the short term. The tree is protected and where possible, options should be investigated and considered to retain this tree (refer arboriculture assessment in section 6.6 of this AEE). The effects have been assessed as minor on the landscape environment prior to mitigation.

NOR2 – Eastern End of Greenhithe Bridge to Albany

Overall the proposed alignment between the eastern end of Greenhithe Bridge and Albany have the potential to generate adverse effects on the landscape context, with most elements experiencing negligible impacts with the exception of Oteha Stream and the Fernhill escarpment (Significant Ecological Area), refer ecological assessment in section 6.5 of this AEE. The stream and escarpment are a highly sensitive landscape element with high natural character values.

The majority of the alignment passes through light industrial environment or highway corridors. During construction the work areas will affect the character of the receiving environment but are temporary in nature so are considered to be less than minor. If Options 2 (pipe bridge) or 3 (combination of pipe bridge and trenchless technology) are implemented for the stream crossing at Oteha Stream / Fernhill escarpment, it will require the removal of a group of trees at the southern end of the bush for the pipe stream crossing and would result in a significant effect prior to mitigation. In addition, construction works that will increase additional artificial structures could have a more than minor effect on the character and amenity of the stream.

NOR3 – Westgate to Western end of Greenhithe Bridge

The majority of the NH2 and NI shared corridor works are located within designation NZTA4 for SH18 with the underlying zones being countryside on the northern side of the motorway and Special Area – Hobsonville on the southern side. The alignment is not located within an Outstanding Natural Landscape Area and there are no landscape values outlined in the District Plan for this section.

Overall, the sensitivity to change of the landscape environment is :

- low for the vegetation and topography along SH18; and.
- low to medium for the the built form of the alignment.

Construction of the Hobsonville Pump Station will result in the loss of some trees but the level of disturbance is small in the context of that associated with the adjacent SH18. Overall the proposed works will have less than minor effects on the landscape context as the corridor is dominated by the roading infrastructure associated with SH18.

The potential effects of the NI micro tunnelling shafts in the shared corridor are nil at all locations except at the new Pump Station or Micro tunnelling shaft 17 at Buckley Avenue where the potential effects are considered less than minor prior mitigation.

6.13.2 Proposed Mitigation Methods

A series of mitigation measures have been recommended to ensure any adverse effects are addressed, and mitigated or avoided where possible. The mitigation methods are proposed in general terms and more specific recommendations are provided for NOR1 and NOR2:

General recommendations should follow these guiding principles:

- Any above ground pipes and other structures should be finished in subdued natural colours that will blend in with the receiving environment.
- Walls and paving materials shall be at a natural reflectivity of no greater than 37%; where required restrictions should be placed around all exterior lighting; works areas are to be reinstated to their original condition prior to construction; plantings should be implemented by at least the first available planting season (1st April to 30th August); as part of construction, detailed landscape plans are to be prepared for sensitive areas and submitted to Council; and ongoing maintenance of landscaped areas.

Mitigation specific to the Titirangi to Westgate section (NOR1) include:

- Requirement that pipes at stream crossings should be located as close as practicable to existing bridge structure and at a height below the main bridge deck to maintain open views of the water. In some instances there maybe engineering, ecological or other requirements which require the pipe location to vary but this should be the starting point in alignment selection.
- It is recommended the pipe crossing over Oratia Stream should maintain its alignment on the southern side of the bridge, away from the footpath, Oratia walk and cycleway to avoid a well-established stand of cabbage trees located on the northern side. A Planting Plan should be prepared to mitigate for the loss of vegetation on the central median on Shetland Street and for the loss of the tree in the intersection at Don Buck/Universal/ Swanson.

Mitigation specific to the eastern end of Greenhithe Bridge to Albany section (NOR2) include:

- It is recommended that the removal or pruning of vegetation at Oteha Stream and Fernhill Escarpment is avoided. There are significant native trees which would be affected by the pipe bridge and open trench option (Options 2 and 3). If Option 1 is selected, residual effects will be less than minor. If Option 2 or 3 is selected and significant trees are required to be felled then the residual effects are considered to remain more than minor after general mitigation measures are applied (refer above). It is recommended that existing native trees be retained as far as practicable. From a landscape perspective, it is considered that the proposed tunnelling (Option 1) will result in minimal effects and the least amount of vegetation disturbance.

Mitigation specific to the Westgate to Western end of Greenhithe Bridge section (NOR3) includes:

- Replacement planting at disturbed areas and around the edges of the Hobsonville Pump Station site. As the landscape environment is a highly modified transport corridor, the residual effects are considered to be less than minor.
- Specific measures applicable to the new Pump Station i.e. specific landscape bund design and planting with native species, shared maintenance entrance for Vector / Watercare, security fencing and gate mitigation measures, any buildings to be designed to be sympathetic to the nearby residential dwellings (color, built forms, etc.).

6.13.3 Landscape Conclusions

Overall, the effects on landscape values as a result of construction of the proposed NH2 and NI projects are considered to be predominantly less than minor at most, with a small number of locations where effects will be more than minor. In all cases the residual effects reduced to less than minor following mitigation and construction (refer to Section 6.13.2). This is largely due to the pipeline following the road

corridor without the need for widespread vegetation clearance or above ground structures. The main areas of concern are the four streams within the Titirangi to Westgate section (NOR1) and Oteha stream in the section from eastern end of Greenhithe Bridge to Albany (NOR2) where the pipeline crosses streams with high amenity values and where the pipe may be located above ground. The remainder of the alignment is below ground and will only result in minimal vegetation clearance. A series of mitigation measures were developed to ensure any adverse effects were addressed, mitigated or avoided where possible. The residual effects are considered less than minor following implementation of the proposed mitigation measures.

In the case of Oteha Stream (NOR2), if construction Options 2 or 3 are selected, the likely effects are considered to be significant prior to mitigation and effects are reduced to minor if vegetation removal is minimised . Option 1 in this instance is the preferred option from a landscape point of view as it avoids felling significant native vegetation. If construction Options 2 or 3 are chosen, specific mitigation measures described in section 6.13.2 will reduce the landscape effects to minor.

The existing landscape environment surrounding the Westgate to the western end of Greenhithe Bridge section is considered the most modified and is therefore the least sensitive to change. Both NH2 and NI in the shared corridor will have less than minor effects on the landscape environment. The proposed construction methodology will minimise effects during construction and avoid the need to remove existing motorway planting.

6.14 Visual

A visual assessment was undertaken to assess the effects of the Project on visual sensitivity receptors. Section 3.1.10 of this AEE provides a description of the landscape and visual environment. The assessment considered the likely effects of the proposal in a holistic sense and was primarily concerned with the effects of the proposal on the visual experience of the landscape by the principle groups of landscape users: residents, workers, travellers and recreationists. The assessment looked at the sensitivity of receptors to changes in their visual amenity through the analysis of selected representative viewpoints and wider visibility analysis. It identifies the potential sources for visual effect resulting from the project and describes the existing character of the area in terms of openness, prominence, compatibility of the project with the existing visual context, viewing distances and the potential for obstruction of views. Further detail can be found in Volume 2, Technical Report G – Landscape and Visual Assessment.

6.14.1 Potential Visual Effects

NOR1 – Titirangi to Westgate

Although visual sensitivities in the Titirangi to Westgate area are high, it is consider that the effects on visual amenity will be minor to less than minor given the nature of the proposed works. The greatest changes to the existing environment will occur during construction; however, these are temporary with the majority of final works below ground. The loss of vegetation is not considered to cause a significant change to the visual character of the area.

The proposed works within NOR1 on the visual amenity are considered as minor prior mitigation.

NOR2 – Eastern End of Greenhithe Bridge to Albany

Visual sensitivities within the NOR2 area (from Eastern End of Greenhithe Bridge to Albany) are generally low to medium, with high sensitivity at Oteha Stream and Fernhill escarpment. Overall, the effects on visual amenity will be nil to less than minor before mitigation given the nature of the proposed works; except in the case of Oteha Stream. The greatest changes to the existing environment will occur during construction; however, these are temporary with the majority of final works below ground. The loss of vegetation at Oteha Stream will depend on which construction option is implemented: option 1

(trenchless) will result in a minor visual effect and option 2 (open trench pipe bridge) and 3 (combination of options 1 and 2) in significant visual effects, due to the felling of significant trees, prior to mitigation.

NOR3 – Westgate to Western end of Greenhithe Bridge

The impacts on visual amenity as a result of construction and operation of NH2 and NI within the shared corridor (from Westgate to Western end of Greenhithe Bridge) will be nil prior to mitigation except for the new Pump Station / Micro tunnelling shaft 17 at Buckley Avenue where the effects are anticipated more than minor prior mitigation. Temporary views will be available but given the scale of the motorway and its associated infrastructure, the visual sensitivity is low.

6.14.2 Proposed Mitigation Methods

A series of mitigation measures have been recommended to ensure any adverse effects on the visual environment are addressed, and mitigated or avoided where possible. The mitigation methods are the same as those specified for effects on landscape values (refer to Section 6.12.2 of this AEE) for each NOR area.

6.14.3 Visual Assessment Conclusions

Overall, the effects on amenity values as a result of construction of the Projects are considered to be predominantly less than minor at most, with a small number of specific locations where effects are considered more than minor. In all cases the residual effects reduced to less than minor following mitigation and construction (refer to Section 6.12.2 of this AEE). This is largely due to the pipeline following the road corridor without the need for widespread vegetation clearance or above ground structures. The main areas of concern are the four streams within the NOR1 (Titirangi to Westgate) section and Oteha stream in the NOR2 section (from eastern end of Greenhithe Bridge to Albany) where the pipeline crosses streams with high amenity values and where the pipe maybe located above ground. The remainder of the alignment is below ground and will only result in minimal vegetation clearance. A series of mitigation measures were developed to ensure any adverse effects were addressed. The residual effects are considered less than minor following implementation of the proposed mitigation measures.

In the case of Oteha Stream, if construction Options 2 or 3 are selected, the likely effects are considered to be significant prior mitigation and effects are reduced to minor if vegetation removal is minimised. Option 1 in this instance is therefore the preferred option from a landscape point of view as it avoids felling significant native vegetation. If construction Options 2 or 3 are chosen, specific mitigation measures described in section 6.13.2 will reduce the landscape effects to a minor level.

The existing landscape environment surrounding the Westgate to the western end of Greenhithe Bridge section (NOR3) is considered the most modified and is therefore the least sensitive to change. Specific mitigation measures applicable to the new Pump Station at Buckley Avenue will reduce the level of effects to less than minor. Both NH2 and NI in the shared corridor will have less than minor effects on the visual environment. The proposed construction methodology will minimise effects during construction and avoid the need to remove existing motorway planting.

6.15 Archaeological

An archaeological assessment was undertaken along the proposed alignment, and included a desktop review of relevant historic heritage databases including the New Zealand Archaeological Association ArchSite database, the Auckland Council Cultural Heritage Inventory (CHI), District Plan and Proposed Auckland Unitary Plan schedules and the New Zealand Heritage List for archaeological and/or historic heritage sites recorded within c.100m of the proposed NH2 alignment. Previous archaeological reports relevant to the project area were consulted, as were early survey plans held at Land Information New

Zealand (LINZ) and historic aerial photographs. Visual inspections of the proposed alignment were undertaken on 23 November 2015. This section does not include an assessment of effects on Maori cultural values. Further detail can be found in Volume 2, Technical Report I – Archaeology Assessment.

6.15.1 Potential Archaeological Effects

The archaeology environment is described in the section 3.1.12 of this AEE. This section summarises the archaeological assessment carried out and more detail is provided in Volume 2 Technical Report I – Archaeology Assessment. This assessment of effects does not include an assessment of effects on Maori cultural values.

NOR1 – Titirangi to Westgate

No archaeological or other historic heritage remains were identified along this section of the proposed works with the exception of one site (see below). Although vegetation cover did restrict visibility along stream banks, visibility was generally adequate for the purposes of this assessment. A number of historical heritage sites are located within proximity of the proposed alignment; however, proposed works are located within road reserves and will have no known effects on buildings.

The only area of concern is a gumdigger camp (CH 15094) located within Don Buck Reserve at the Swanson Stream crossing. Research has confirmed that the camp site was most likely located at the junction of Don Buck Road with Glen Road, within the location of the proposed pipe alignment. The extent of any subsurface features or deposits has not been confirmed. An assessment of the area within the immediate vicinity of the proposed works did not identify any archaeological or historic heritage remains. A plaque marking the general area is located adjacent to the playground outside of the proposed area of works.

The archaeological significance of the site is considered to be limited, therefore any adverse effects are likely to be minor. Operation and maintenance are unlikely to have any additional adverse effects.

NOR2 – Eastern End of Greenhithe Bridge to Albany

The majority of the proposed alignment is within areas that have been extensively developed in the recent past for both roads and commercial, industrial and residential development. No archaeological or other historic heritage sites have previously been recorded within 100m of this portion of the proposed alignment. A visual survey of the Oteha Stream crossing, the only area not extensively developed, failed to identify any archaeological or other historic heritage remains.

The proposed NH2 works along this section will have no known effects on any archaeological or other historic heritage sites.

NOR3 – Westgate to Western end of Greenhithe Bridge

This section of the proposed NH2 and NI shared corridor works is located entirely within the road reserve in an area that has been extensively modified in the recent past for the construction of the SH18. Multiple historic heritage and archaeological sites have previously been recorded within 100m of the proposed alignment. However, these have either been destroyed/removed as part of previous motorway development or will not be impacted by the proposed works.

The proposed works along the Westgate to Hobsonville section and NI shared corridor alignment will have no known effects on any archaeological or other historic heritage sites.

6.15.2 Proposed Mitigation Methods

Assessment indicates there should be no major constraints on development on archaeological grounds, as no confirmed sites will be affected. The possible presence of archaeological remains can be managed

through the provisions of the Heritage New Zealand Pouhere Taonga Act 2014, Designation conditions and accidental discovery protocols attached as a condition of designation.

There is limited potential for pre-1900 archaeological remains to be exposed by the proposed works. It is recommended applications are made for an Authority to modify an archaeological site as a precaution prior to any subsurface excavations, to minimise delays should any archaeological remains be exposed during construction.

Research indicates that Don Buck's camp (NOR1) is of early 20th century date, therefore there are no requirements to obtain an authority to modify the site. Earthworks operating within 50m of the site should be monitored by an archaeologist for historic heritage remains. In the event remains are found, at this or any site, they should be investigated and recorded in accordance with the conditions of an Authority from the Heritage NZ. Construction methodology and programme should allow sufficient time for the investigation and recording of any remains that may be exposed.

Since archaeological survey cannot always detect sites of traditional significance to Maori, it is recommended that tangata whenua be consulted regarding the possible existence of such sites on the property. If koiwi tangata (human remains) are uncovered, work should cease immediately in the vicinity of the remains and the tangata whenua, Heritage NZ, NZ Police and Council should be contacted.

6.15.3 Archaeological Conclusions

The proposed works within the Titirangi to Westgate section (NOR1) of the proposed NH2 alignment have the potential to affect remains that form part of the former Don Buck's gumdiggers' camp (CHI 15094) located at the junction of Don Buck Road and Swanson Stream. The effects on the archaeology environment have been assessed as minor, and can be appropriately mitigated through archaeological information recovery.

The proposed works along the remainder of the alignment (NOR2 and NOR3) will have no known effects on any archaeological or other historic heritage sites. It is possible that unrecorded subsurface remains may be exposed during development. However, this is considered unlikely due to the heavily modified nature of the proposed alignment. Procedures should be put in place to ensure Council, project archaeologist and/or Heritage NZ are contacted in the event remains are found at any location in the proposed alignment.

The potential effects of the construction and operation of NH2 and the NI within the shared corridor on archaeological values are considered to be minor, given that there are few archaeological or other historic heritage sites remaining in the path of the proposed alignment. Any residual impacts, such as at CH 15094 (refer to Section 6.15.1.1), can be appropriately mitigated through archaeological information recovery.

6.16 Cultural

Engagement with mana whenua groups has been undertaken as part of NH2 and NI in the shared corridor Projects, and will continue through the construction phase of the Projects and as part of Watercare's ongoing relationship with mana whena.

Mana whenua engagement, and the resulting CIA discussions have provided information on the existing cultural heritage values of the GBWD and Causeway Project, how the Project may affect these values and potential mitigation measures for addressing adverse effects. No specific CIAs were prepared for NH2 remainder of the route and NI in the shared corridor areas, although one CIA was received covering both Projects. The existing environment is described in Section 3 of this AEE. The consultation section 7 of this AEE describes in details the involvement to date.

Mana whenua indicated that they have an interest in the Projects and have recognised the need for the proposed NH2 and NI in the shared corridor developments to support the communities that will be serviced by the infrastructure. NH2 and NI in the shared corridor Projects works did not generate any potential adverse effects on the cultural values identified by mana whenua entities during the consultation process.

Overall, there is a potential for opportunities with mana whenua involvement as part of the NH2 and NI in shared corridor Projects:

- Watercare's ongoing relationships with mana whenua groups will ensure mana whenua involvement through the construction and operational phases of the Projects.
- An accidental discovery protocol will be developed for the project. The protocol will include the requirement to notify interested mana whenua groups should any archaeology of relevance to mana whenua be uncovered.
- Ecological, arboriculture and water quality effects will be managed as addressed in Sections 6.6, 6.7 and 6.8 of this AEE. This will include planting of native species, stream crossings and active management of erosion and sedimentation during construction.

7 CONSULTATION

In the early consultation phase, consultation activities for the North Harbour 2 Watermain and Northern Interceptor project were combined, as these share similar geographic areas. The GBWD&C (and NI Phase 1) projects were subsequently developed as a standalone physical works package, and the later mana whenua consultation records reflect that. Consultation is ongoing for both NH2 and NI Projects. This consultation section highlights the aspects/outcomes of consultation as it relates to the NH2 Project to date.

7.1 Auckland Council

7.1.1 Local Boards

The project is within the Upper Harbour, Henderson-Massey and Waitakere Ranges Local Board areas. Watercare has maintained engagement with the Local Boards regarding these proposed works since 2013, and have recently provided them with a status update of the project. Consultation with these Local Boards will continue until the project is completed. Regular updates have also been provided to other Local Boards as part of discussions on the Mangere WWTP.

7.1.2 Waitakere Ranges Local Board

Watercare presented to the Waitakere Ranges Local Board in April 2016. This presentation provided the Local Board with a broad overview of the works to be associated with the NH2 Project, and discussed the proposed works to be within the Oratia Esplanade Reserve.

7.1.3 Henderson-Massey Local Board

Watercare presented to the Henderson-Massey Local Board in March 2016. This presentation provided the Local Board with an overview of the NH2 and NI projects, and discussed the proposed works within the Henderson-Massey Local Board Area, particularly those with parks and reserves. The Local Board raised concern over the safety of the pipe bridges, noting that local residents sometimes attempt to cross. The Local Board also requested a site visit, which has been arranged for May.

7.1.4 Upper Harbour Local Board

Watercare presented to the Upper Harbour Local Board in April 2016. This presentation provided the Local Board with an overview of the NH2 and NI projects, and discussed the proposed works within the Upper Harbour Local Board Area. As the NH2 Project is primarily located within or immediately adjacent to SH18, much of the discussion at the meeting focused on the works associated with the Northern Interceptor project. No specific concerns on the NH2 project were raised.

7.1.5 Parks, Sports and Recreation

The proposed designation boundaries will include areas within a number of parks and reserves. Discussions with representatives of Council Parks, Sports and Recreation (“PSR”) regarding the alignment and facilities to be located within parks have been on-going since 2013. These parks include:

NOR	Project	Local Board	Park
1	NH2	Regional Park	Waitakere Ranges Regional Park
1	NH2	Waitakere-Ranges	Oratia Esplanade Reserve
1	NH2	Henderson-Massey	Border Road Reserve and Shona Esplanade
1	NH2	Henderson-Massey	Public Open Space, 58-62 Munroe Road, Henderson
1	NH2	Henderson-Massey	Don Buck Corner Reserve/Public Open Space, Conservation, 20-28 Don Buck Road, Henderson
2	NH2	Upper Harbour	Public Open Space, Conservation , 6 William Pickering
2	NH2	Upper Harbour	Douglas Alexandra Reserve / Public Open Space, Informal Rec., 12 Douglas Alexander Parade
2	NH2	Upper Harbour	Bushlands Park Reserve/Public Open Space, Conservation, 66 Bush Road
3	Combined	Upper Harbour	Hobsonville War Memorial Park

The key areas of concern raised by PSR include:

- whether PSR would be able to develop the parks over designated areas;
- what the extent of the designation boundaries will be once works have been completed;
- what the construction areas and duration of works would be; and
- whether there is a need for pipe bridges to be installed within parks/reserve (or whether these can be moved).

7.1.6 Regulatory

Watercare has maintained engagement with Council's Major Infrastructure Projects Resource Consents team, as well as the North West Planning and Policy Team. These discussions covered matters such as the need and scope for the project, the statutory requirements and process, and the potential effects of the works. This engagement has included site visits.

7.2 Mana Whenua

To date Watercare has led the consultation process with mana whenua. Watercare's summary of the consultation undertaken, and the key matters raised, is set out below.

7.2.1 Mana Whenua Participants

The 19 mana whenua entities in the Council area with a potential interest in the projects are:

Ngāi Tai Ki Tāmaki

Ngāti Manuhiri

Ngāti Maru

Ngāti Paoa

Ngāti Rehua Ngātiwai Ki Aotea

Ngāti Tamaoho

Ngāti Tamaterā

Ngāti Te Ata

Ngāti Wai

Ngāti Whanaunga

Ngāti Whatua o Kaipara

Ngāti Whatua o Orakei

Te Ahiwaru

Te Akitai

Te Kawerau a Maki

Te Patukirikiri

Te Rūnanga o Ngāti Whatua

Te Uri o Hau

Waikato Tainui

The mana whenua underlined in the above list have indicated a particular interest in the projects and have participated in the consultation process to date.

7.2.2 Consultation Process

The consultation process has involved:

- Initial briefing to Watercare's Mana Whenua Kaitiaki Forum ("MWKF") in July 2013;
- Initial briefing at meetings in late 2013 with mana whenua who indicated an interest in the project;
- Further consultation with interested mana whenua, including meetings and site visits as appropriate;
- Update on the projects to all mana whenua entities in November 2014 to confirm those parties already involved in the process, and to invite others to participate if they wished to do so, with the focus being primarily on the GBWD&C and NI Phase 1 projects;
- Further engagement with the interested mana whenua entities;
- Supply and review of Cultural Impact Assessments ("CIA");
- Update on the projects to all mana whenua entities in August, November and December 2015. This provided opportunity for those not already involved to join and participate in the NH2 NoR and Northern Interceptor NoR process; and
- Further consultation with interested mana whenua in early 2016, including meetings and site visits as appropriate;

7.2.3 Kaitiaki Managers' Projects List

An established process is in place for mana whenua engagement on projects initiated by Watercare. This process includes early notification of works to be undertaken by Watercare which do or are likely to require a resource consent.

A "Kaitiaki Managers Projects List" is provided on an approximately monthly basis to nominated representatives of all 19 mana whenua in the Council area. A brief summary of each project is included in the list, along with an identification of the applicable PAUP CIA rules. Mana whenua are invited to indicate which projects they have an interest in. Further information on the identified project or projects is then provided to those parties, followed by further engagement depending on the responses received.

The North Harbour 2 Watermain Project has been on the Kaitiaki Managers Project List provided to mana whenua since July 2013. Eight mana whenua entities indicated that they have an interest in the project, these being:

- Ngāti Manuhiri;
- Ngāti Whātua o Ōrākei;
- Te Kawerau a Maki;
- Ngāti Maru;
- Te Akitai;
- Te Rūnanga o Ngāti Whātua;
- Ngaati Whanaunga; and
- Ngāti Paoa.

Those mana whenua that are underlined, also indicated an interest in the Greenhithe Bridge Watermain Duplication and Causeway project that forms part of the North Harbour 2 Watermain project. Due to the close interrelationship of these projects, conversations about the projects would naturally overlap that is reflected in the record of consultation (Table 7.1 below).

7.2.4 Cultural Impact Assessments

A Cultural Impact Assessment ("CIA") has been prepared by Ngāti Maru ("North Harbour 2 Watermain, July 2014"). Key points raised in this report are summarised within the following discussion.

7.2.5 Mana Whenua Involvement

Consultation with mana whenua on the NH2 and NI projects has been on-going since 2013. The 19 mana whenua entities in the Council area, and their engagement in the Project to date, is summarised in Table 7.1 below.

Table 7.1 Mana whenua engagement to date

Mana Whenua	Involvement to Date
Ngāi Tai Ki Tāmaki	Ngāi Tai Ki Tāmaki was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in July 2013. Ngāi Tai did not register their interest in the projects at that stage. An update on the project was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. At this stage, Ngāi Tai responded confirming they have an interest in the projects, and requested their further involvement. Following this, a meeting was held in November 2014 to update Ngāi Tai on the process to date, and to provide further information on the project. Upon reviewing the information, Ngāi Tai confirmed their interest in the preparation of a CIA for the Greenhithe Bridge and Watermain Duplication & Causeway project, and overall North Harbour 2 Watermain project. In January 2015, the following CIAs were received: • Cultural Impact Assessment Report: North Harbour No. 2; and • Cultural Impact Assessment Report: Greenhithe Bridge Duplications. • A further update on the status of the projects was provided to all mana whenua in August 2015, which included an invitation to discuss the projects further, to which Ngai Tai Ki Tamaki replied indicating their interest to meet. A hui was held in September 2015, and the following points were discussed:Alternatives considered for the GBWD&C and NI Phase 1 projects, and the preference for works to be undertaken outside the CMA; • Proposed conditions; and • Involvement of iwi entities going forward and opportunities for cultural elements to be incorporated in to the final design. In November and December 2015 a further update on the North Harbour 2 Watermain and Northern Interceptor NoRs was provided to all mana whenua, both included an invitation to meet to discuss these projects further. Ngāi Tai indicated their continued interest in the project, and Watercare are presently in the process of scheduling a hui.
Ngāti Manuhiri	Ngāti Manuhiri was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in July 2013. Ngāti Manuhiri registered their interest in the projects at that time. An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest. The works and proposed alignments were discussed at a meeting in February 2014 and the draft archaeological assessment for the NH2 Watermain project provided in March 2014. Ngāti Manuhiri confirmed their primary interest is in the works north of the Greenhithe Bridge, particularly works in coastal areas, stream crossings and mitigation planting. Cultural monitoring was requested for works near any known recorded archaeological sites. An update on the projects was provided in November 2014, including a request to meet to discuss

Mana Whenua	Involvement to Date
	the projects. Ngāti Manuhiri responded confirming they wish to prepare a CIA. An update meeting was held with Ngāti Manuhiri and Te Kawerau a Maki in November 2014. Concerns regarding proposed Northern Interceptor works within the North Shore Memorial Park were raised. Ngāti Manuhiri confirmed that although their primary interest lies north of the Greenhithe Bridge, they support Te Kawerau a Maki's views on proposed works in the Upper Harbour, and also the identified opportunities to recognise cultural values. A further site visit was held with Ngāti Manuhiri in May 2015. A further update on the status of the projects was provided to all mana whenua in August 2015, and included a request to meet to discuss the projects, of which Ngāti Manuhiri confirmed their interest. In the interim, Watercare received a CIA from Ngāti Manuhiri in October 2015 relating to the combined Greenhithe Bridge Watermain Duplication and Causeway and Northern Interceptor (Phase 1) Projects. A hui was held with Ngāti Manuhiri in November 2015 to discuss the works associated with components of the Northern Interceptor project. Following this meeting, Watercare provided Ngāti Manuhiri with a response to the recommendation set out in the CIA, as well as an overview of alternatives considered through the NSMP. In November and December 2015, an update on the status of the North Harbour 2 Watermain and Northern Interceptor NoRs was provided to all mana whenua, both included an invitation to disucss these projects further. Ngāti Manuhiri replied and indicated their continued interest in the project, and a meeting was held to discuss the project in February 2016. At this meeting, Ngāti Manuhiri expressed interest in the works around the Oteha Stream, which is within their rohe. Further information and technical reports have been provided to Ngāti Manuhiri.
Ngāti Maru	Ngāti Maru was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. Ngāti Maru registered their interest at that time. An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest. Watercare met with Ngāti Maru in December 2013 and provided an overview of the works. Items discussed included construction methodology, services relocation, potential for discovery of koiwi and lava caves during construction, and potential cultural monitoring requirements in some areas. Further updates on the projects were provided to Ngāti Maru at regular meetings during 2014. Ngāti Maru confirmed their primary area of interest is in the proposed works north of the Greenhithe Bridge. Watercare received a CIA from Ngāti Maru in July 2014 relating to the NH2 project. Ngāti Maru's main concerns were discussed in the CIA, including the potential impact on land of significance to Ngāti Maru due to its past history and usage, and the potential for disturbance of remaining historical evidence. The project corridor intercepts two historic coastal settlement areas accessed by the Marutahu people in the west for fishing, hunting and trapping. Cultural monitoring has been requested. In mid-December 2014, Ngāti Maru advised that they would defer to Ngāti Manuhiri for the proposed works in Greenhithe, but advised that they wished to prepare a CIA for the Northern Interceptor, which was received in January 2015. A further update on the status of the projects and an invitation to participae in further consultation was provided to all mana whenua in August, November and December 2015 for the North Harbour 2 Watermain NoRs. To date, Ngāti Maru have not indicated any further interest in the project.
Ngāti Whatua o Orakei	Ngāti Whatua o Orakei were initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013, and registered their interest at that time. An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest. Watercare met with Ngāti Whatua o Orakei in February 2014. Points discussed included the opportunity for Ngāti Whatua o Orakei to be involved in possible cultural arts initiatives, the use of native vegetation for reinstatement planting, extent of mangrove removal associated with the proposed causeway widening, and the effects of stormwater and wastewater discharges. An e-mail confirming Ngāti Whatua o Orakei's interest were received following the meeting. This included avoiding cultural heritage and archaeological sites, and opportunities for works around

Mana Whenua	Involvement to Date
	waterways to enhance ecological function and native habitat / biodiversity. Watercare met again with Ngāti Whatua o Orakei in May 2014 to provide an update on the projects, relating primarily to the Greenhithe Bridge Watermain Duplication & Causeway and Northern Interceptor projects. Topics discussed included the potential integration of project works with future cycleway development, the methodology for stream crossings, riparian planting and proposed causeway widening. An update on the projects was provided to Ngāti Whatua o Orakei in November 2014, including a request to meet to discuss the project. No response was received. Ngāti Whatua o Orakei attended a site visit in May 2015 and raised concerns regarding works within the CMA and alternatives considered. A further update on the status of the projects and an invitation to participate in further consultation was provided to all mana whenua in August, November and December 2015 for the North Harbour 2 Watermain NoRs. Ngāti Whatua o Orakei indicated their continued interest in the projects, and a hui was held at Ngāti Whatua's offices to discuss these projects in January 2016. Points discussed included the opportunity for Ngāti Whatua to be involved in the provision of native vegetation for reinstatement planting, and with respect to the GBWD&C and NI Phase 1 projects, to be involved in any discussions around the naming of the shared path along the reclamation.
Te Akitai	Te Akitai was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013, and registered their interest at that time. An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest. At a meeting in December 2013, Te Akitai indicated their particular areas of interest on the NH2 watermain related to any potential discharges, stream crossings, areas of work not within road reserve, and landscape modifications. General project updates were provided to Te Akitai at regular meetings during 2014, and a written update provided in November 2014. The need for the proposed causeway widening at Hobsonville, and the options considered were a key point of discussion at a meeting with Te Akitai in November 2014. A further update on the status of the projects, and an invitation to participate in further consultation was provided to all mana whenua in August and December 2015 for the North Harbour 2 Watermain NoRs. To date, no response has been received from Te Akitai to confirm their continued interest.
Te Kawerau a Maki	Te Kawerau a Maki was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013, and registered their interest at that time. An introductory letter was sent in November 2013 including an overview of the projects and requesting confirmation of their interest. Watercare met with Te Kawerau a Maki later that month to provide an overview of the NH2 and Northern Interceptor projects. Potential areas of interest to Te Kawerau a Maki were discussed. This included Lucas Creek as a significant cultural area, preference for works to take place where land has already been modified rather than coastal areas, and opportunities for ecological enhancement. Te Kawerau a Maki's initial CIA for the Northern Interceptor project was received in February 2014. The main points noted, and which confirmed the points discussed at the previous meeting, were: • Their preference for works to take place within the road corridor or other modified sites and to avoid the shorelines and waterways. • Any works within the coastal environment should be deep or well under harbour channels. Ecological enhancement will be necessary where works pass through the coastal environment. • A taniwha is present in the South East portion of the project corridor; therefore works around Hellyers Creek should be avoided. • Lucas Creek and Bomb Point should be avoided due to high environmental and cultural values, and the future development of a Marae. Watercare and Te Kawerau a Maki met again in March 2014. Feedback from Te Kawerau a Maki included support for integration of the NH2 project works with future cycleway development, their preference for the proposed pipelines to be located within roads and motorway corridors, and opportunities for stream crossings to include enhancement works.

Mana Whenua	Involvement to Date
	An update meeting was held with Ngāti Manuhiri and Te Kawerau a Maki in November 2014. The significance of the Upper Harbour and Lucas Creek to Te Kawerau a Maki was restated. Opportunities for ecological restoration at stream crossings and at the proposed causeway widening were discussed. It was also suggested that a cultural art work could be installed on the widened causeway, acknowledging the history and significance of the area. A further update on the status of the projects, and an invitation to participate in further consultation, was provided to all mana whenua in August and December 2015 for the North Harbour 2 Watermain NoRs. To date, no response has been received from Te Kawerau a Maki to confirm their continued interest.
Te Rūnanga o Ngāti Whatua	Te Rūnanga o Ngāti Whatua was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects. An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Te Rūnanga o Ngāti Whatua responded requesting that Watercare provide them with the responses received from mana whenua engaged in the projects to date and would provide their confirmed position following this. A further update on the status of the projects was provided to all mana whenua in August and December 2015, both included an invitation to participate in further consultation on the North Harbour 2 Watermain NoRs. Te Rūnanga o Ngāti Whatua replied and indicated their continued interest in the project, and a meeting was held to discuss the project in February 2016. Overall, Ngati Whatua noted that they support the project, and would like to continue discussions. Watercare confirmed that consultation with Te Runanga o Ngati Whatua will continue during project development.
Ngāti Tamaoho	Ngāti Tamaoho was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects. An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Ngāti Tamaoho responded confirming that they would defer to mana whenua already engaged in the projects.
Ngāti Whatua o Kaipara	Ngāti Whatua o Kaipara was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects. An update email was sent regarding the NH2 project in May 2014, advising which iwi were involved at that time, and offering further information or a meeting to discuss the project. No response was received. An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. No response was received from Ngāti Whatua o Kaipara. A further update on the status of the projects, and an invitation to participate in further consultation, was provided to all mana whenua in August 2015. Ngāti Whatua o Kaipara replied at this time, indicating their interest, and requested a site visit. A hui and site visit was held in September 2015. Points discussed included their support of the projects, the opportunity for Ngāti Whatua o Kaipara to be involved in possible cultural arts initiatives, the use of native vegetation for reinstatement planting, and pest control. In December 2015, a further update for the North Harbour 2 Watermain NoRs, was provided to mana whenua, and included an invitation to further participate. In November and December 2015, an update on the status of the North Harbour 2 Watermain and Northern Interceptor NoRs was provided to all mana whenua, and included an invitation to discuss these projects further. A full update meeting was held with Ngāti Whatua o Kaipara in March 2016. Ngati Whatua o Kaipara wish to be engaged with the project going forward.
Ngāti Whanaunga	Ngāti Whanaunga was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects. An update email was sent regarding the NH2 project in May 2014, advising which iwi were involved at that time, and offering further information or a meeting to discuss the project. No response was received. An update on the projects was provided to all mana whenua in November 2014, including an

Mana Whenua	Involvement to Date
	invitation to participate in further consultation. No response was received from Ngāti Whanaunga. Ngāti Whanaunga registered their interest in the projects for the first time via the Kaitiaki Managers Projects List in February 2015. Updated information on the projects was provided to Ngāti Whanaunga including another invitation to participate in further consultation, no further response was received. A further update on the status of the projects was provided to all mana whenua in August and December 2015, both included an invitation to participate in further consultation on the North Harbour 2 Watermain NoRs. To date, no further response has been received from Ngāti Whanaunga.
Te Uri o Hau	Te Uri o Hau was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects. An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Te Uri o Hau responded confirming that the projects are outside their statutory area of interest.
Waikato Tainui	Waikato Tainui was initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects. An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. Waikato Tainui responded requesting that Watercare undertake a full assessment against the Waikato Tainui Environmental Plan to ensure consistency with it.
Ngāti Paoa Ngāti Rehua Ngātiwai Ki Aotea Ngāti Tamaterā Ngāti Te Ata Te Ahiwaru Te Patukirikiri	Ngāti Paoa, Ngāti Rehua Ngātiwai Ki Aotea, Ngāti Tamaterā, Ngāti Te Ata, Te Ahiwaru and Te Patukirikiri were initially advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects. An update on the projects was provided to all mana whenua in November 2014, including an invitation to participate in further consultation. No responses were received from Ngāti Paoa, Ngāti Rehua Ngātiwai Ki Aotea, Ngāti Tamaterā, Ngāti Te Ata, Te Ahiwaru or Te Patukirikiri.
Ngāti Wai	Ngāti Wai was advised of the projects via the MWKF and distribution of the Kaitiaki Managers Projects List in 2013. They did not register an interest in the projects.

7.3 Transport Authorities

The project interfaces with the State Highway and local road network at a number of locations, as summarised earlier in this report. Meetings with representatives of the Transport Agency, Auckland Motorway Alliance, and Auckland Transport have taken place to discuss the proposed works.

7.3.1 NZ Transport Agency and Auckland Motorway Alliance

Watercare, the Transport Agency and Auckland Motorway Alliance staff have been meeting since 2014 to discuss the organisations' various projects in the northern and north-western parts of Auckland, including the NH2. This liaison will continue into the future and will include detailed consideration of the progress and schedule of the NH2 works under and along the motorway corridor. Detailed design reports will be submitted to the Transport Agency and Auckland Motorway Alliance as part of the Corridor Access Request ("CAR"), and Watercare have an Agreement in Principle for works within the motorway corridor.

7.3.2 Auckland Transport

Initial discussions with Auckland Transport have canvassed the general scope of the project, as much of the works will be within the road corridor. Trenching activities within road carriageways are common throughout Auckland and there are well established procedures in place to manage the associated traffic impacts.

Auckland Transport will be closely involved in detailed design of the project and during preparation and implementation of the required Traffic Management Plans. CARs will be submitted to Auckland Transport for approval for all works within roads. As roads in the North Shore section of the District Plan are also designated, works undertaken in North Shore roads will also require written approval under section 176 of the RMA. Auckland Transport in its provision of the Works Access Permit effectively provides its approval under section 176.

7.4 Network Utilities

The project interfaces with other utility services along the full length of the proposed route, including KiwiRail. Other network utility companies will be contacted during the design process in order to confirm the locations of existing services or any future development plans in the vicinity of the proposed construction sites.

7.5 Other Agencies

7.5.1 Heritage New Zealand

Although no known archaeological sites will be affected by the proposed works, Watercare intends to apply for an archaeological authority under Section 44(a) of the HNZPTA to cover all works undertaken for the project as a precaution.

7.6 Directly Affected Private Landowners

The directly affected landowners are listed in Appendix A. These include private landowners, Crown agencies, Auckland Council and Auckland Transport. Watercare note that land ownership is presently in flux in the shared corridor, due to on-going development occurring in this area, and efforts have been made to ensure that the list of directly affected landowners is accurate.

All owners of land in which the proposed works are to be located have been contacted by Watercare. The consultation undertaken with the directly affected landowners is summarised below.

7.6.1 Residential Landowners and Developers

A number of private residential properties and land earmarked for development will be directly affected by the proposed designation. The owners of these properties have been contacted by Watercare. An overview of the proposed works as it relates to their property has been provided along with an invitation to meet with Watercare to discuss the projects. Initial discussions have commenced, and matters raised by directly affected landowners and developers will be addressed as part of the on-going negotiations between each of the landowners and Watercare.

7.6.2 Commercial Activities

Watercare has begun consultation with representatives from each of the commercial activities listed in Appendix B. The effects on these private properties include both temporary and permanent effects. Depending on the extent of work at each site, Watercare will seek agreements for access and occupation at each of these properties.

At the time of writing this report, the necessary property access and occupation arrangements are not finalised, but initial discussions have commenced. Matters raised by directly affected commercial landowners will be addressed as part of the on-going negotiations between each of the landowners and Watercare.

7.6.3 Landowners in Proximity

In order to raise awareness of the proposed works for those landowners in proximity to the designation boundary, and those in the surrounding community, Watercare has distributed project flyers to owners/occupiers within the vicinity of the proposed designation. Included in this invite was an invitation to Open Evenings, which were held in early April 2016.

Landowners and occupiers along the proposed route will also be contacted as part of the pre-construction and construction phases of the project. This is to provide information on the proposed works, and receive information on any special access or other requirements, and to ensure potentially affected parties have a key point of contact during construction activities. This communication is an integral part of Watercare's construction works throughout Auckland and is a well-established process.

7.7 Key Consultation Outcomes

7.7.1 Summary of Key Issues

Generally, the parties consulted to date have been supportive of the overall project, acknowledging the need for new infrastructure to support Auckland's future growth and development.

The main outcome of the consultation process to date has been the changes in alignment and refinements made along the proposed route and at some key sites.

Identifying opportunities to achieve mutually beneficial outcomes with affected landowners and occupiers, has also formed a key part of the consultation and will continue as the design is further developed.

7.7.2 On-going Consultation

The on-going consultation process prior to construction will incorporate:

- Targeted and wider community consultation during the statutory process;
- Consultation with directly affected parties on matters of detail to be incorporated in final design; and
- Consultation with directly affected parties prior to construction to develop the details of the construction methodology and construction management plans.

A detailed project communications plan will also be developed prior to construction. The communications plan will cover matters such as:

- The methods of consultation and liaison with key stakeholders, owners and occupiers of neighbouring properties, and the wider community regarding the likely timing, duration and effects of construction works;
- Name and contact details for the nominated community liaison person and alternative contact details in the event of that person not being available (to ensure a contact person is available during the construction phase); and
- Procedures to record and respond to complaints.

The project communications plan will be implemented during construction, and updated and revised as appropriate.

8 STATUTORY FRAMEWORK

8.1 Introduction

The scope of the resource consents and NORs is set out in Section 4 of this AEE. This section assesses the NH2 and NI projects against the relevant provisions of section 168 and 171 of the RMA. Additionally this section assesses the NH2 Project against the requirements of the consenting authority under section 104 of the RMA with respect to the resource consents sought for NH2.

8.2 Part 2 Resource Management Act 1991

8.2.1 Purpose and Principles (Section 5)

Section 5(1) of the RMA says that its purpose is to promote the sustainable management of natural and physical resources. Section 5(2) then states what sustainable management means in the RMA. The NH2 and NI projects support the purpose of the RMA for the following reasons:

- The projects will provide critical water supply and wastewater services at a regional level to support both existing communities and anticipated population growth;
- The projects will use the opportunity to provide both water supply and wastewater services within public road reserves and the same construction corridor where their alignments overlap, to minimise the effects of their construction;
- As demonstrated in Section 6 of this AEE, the project can be undertaken in a manner that avoids, remedies, mitigates, or minimises the adverse effects on the environment;
- A construction methodology and concept design has been developed for a designation footprint and construction envelope to reasonably manage actual and potential adverse effects of the project through avoidance, remediation and mitigation measures. With incorporation of these design measures, the projects can be undertaken while safeguarding of the life-supporting capacity of air, water, soil and ecosystems; and
- The project provides Watercare the opportunity to use and develop natural and physical resources in a sustainable and cost effective manner to meet its statutory objectives.

8.2.2 Matters of National Importance (Section 6)

Section 6 of the RMA sets out 'Matters of National Importance that are to be recognised and provided for in managing the use, development and protection of natural and physical resources. The following matters are considered relevant to both resource consents and designation of the three corridors:

(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:

The works will involve 5 pipe bridges across areas with similar natural character values. There is a need for the NH2 to cross the streams, and the use of a pipe bridge is considered to be a reasonable solution to achieve this. The effects that the pipe bridges will have has been assessed by a suitably qualified landscape architect from a landscape and visual perspective, and from an ecological perspective. Neither of these assessments identified significant adverse effects on the natural character values of the affected watercourses. Some changes to the natural character values would result primarily from

vegetation disturbance and / or removal, and the permanent pipe bridge structures. With appropriate mitigation measures implemented as recommended in the draft conditions of designation and resource consent, effects were assessed as minor. Overall the activity is not considered to be inappropriate.

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

The effect of the project on significant indigenous vegetation has been assessed as being minor, and with appropriate mitigation implemented, will be less than minor. There are pockets of vegetation identified in the PAUP as SEA-T that are predominantly along the SH18 corridor within NOR3 and NOR1 at the southern end (Shetland Road). The one area which is highlighted for particular attention at detailed design is within the Fernhill escarpment adjacent to Bush Road (refer section 6.5 above and Technical Report D Ecological Assessment).

(d) the maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers:

The project will not adversely affect or interfere with public access to the streams being crossed by the NH2 pipeline.

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

(f) the protection of historic heritage from inappropriate subdivision, use, and development:

(g) the protection of protected customary rights

The Project will not compromise the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga, or on any areas that have protected customary rights. Iwi with interest in the Project area have been invited to prepare cultural impact assessments by Watercare. Technical Report I (Preliminary Archaeological Assessment) has recommended that an authority be sought from HNZPTA for any accidental discoveries. The Report recommends further investigation into the potential location of the Don Buck camp, thought to coincide with the proposed NH2 alignment in the vicinity of the indicative camp site. Overall the project will be reasonably affording protection to historic heritage, and as noted above, the function, design and strategic importance of the project does not render it “inappropriate” in the context of section 6 matters.

8.2.3 Other Matters (Section 7)

Other matters to have particular regard to when managing the use, development and protection of natural and physical resources includes:

(a) kaitiakitanga:

(aa) the ethic of stewardship:

Watercare recognise the importance of Iwi exercising their functions as kaitiaki over their natural and physical resources. All iwi with interests in the Auckland region have been made aware of the project through Watercare’s Kaitiaki Forum. Considerable efforts have been made to ensure Iwi groups, in recognition of their mana whenua and in their roles as kaitiaki, were provided with an appropriate opportunity for involvement in the early stages of the project. Watercare will continue to encourage ongoing involvement of Iwi in the project in order to meet their responsibilities as kaitiaki of their natural and physical resources.

(b) the efficient use and development of natural and physical resources:

In the provisioning of two identified regionally critical infrastructure projects within the same corridor, protected by designation, Watercare is ensuring that the availability of underground space to efficiently provide for infrastructural demand arising from anticipated population growth in north-west Auckland, and the North Shore in the future.

(c) the maintenance and enhancement of amenity values:

(f) maintenance and enhancement of the quality of the environment:

Except for routine maintenance and unforeseen situations, the project is anticipated to have negligible adverse effects on amenity values post construction. Above ground infrastructure is limited to pipe bridges over five streams and a new pump station within the existing Hobsonville pump station compound. The project, post construction will not result in discernible adverse noise, odour or traffic effects. During construction, effects resulting from traffic generation or disruption, noise, dust and site compounds, will be managed by appropriate ongoing conditions to ensure that the amenity of any area affected by construction activities is maintained to the extent practicable. Overall the project will maintain amenity values and the quality of the environment.

8.2.4 Treaty of Waitangi (Section 8)

Section 8 of the RMA requires the principles of the Treaty of Waitangi to be taken into account in resource management decisions. It is considered that the Project will not affect any Treaty of Waitangi matters. Watercare have engaged with iwi to identify issues and effects of concern to them as outlined in Section 7 above. No issues of significance were raised. The Project does not affect items of indigenous heritage or recognised customary activities.

8.3 Section 171 Recommendation by Territorial Authority

Section 171 sets out matters to be taken into consideration by Council when considering the notices of requirement for designation. Section 171 matters are addressed throughout the documentation and as they relate to the Projects are as noted:

a) Relevant provisions of policy statements and plans are addressed below;
b) Adequate consideration of alternative sites, routes and methods is addressed in Section 5 above;
c) Whether the works and designations are reasonably necessary to achieve the objectives for which the designations are sought is addressed in the NORs 1 and 2 and specifically are considered necessary because:

a. The proposed work will increase the resilience of the north and north east water supply system by providing additional and duplicated water supply networks to the Albany Reservoirs.

b. The proposed works will increase security of supply to the north and north east Auckland.

c. The proposed work will enable Watercare to manage its water supply operations more efficiently under increasing demand.

d. The proposed work will enable Watercare to comply with the statutory purpose of the Resource Management Act 1991 to promote the sustainable management of natural and physical resources.

e. The designation will allow Watercare and / or its authorised agents to undertake works for construction of a water pipeline and its associated ancillary components in accordance with the designation.

f. The designation will enable works to be undertaken in a comprehensive and integrated manner.

g. The designation will add protection to the route from future incompatible development which may preclude or put at risk the construction and / or operation of the works.

With respect to which the designation and works are reasonably necessary to achieve the objectives for which NOR3 is sought is addressed in it, and is specifically considered necessary because:

a. Provision of these pipelines will allow water services to be provided in an economically viable, environmentally sound, socially responsible and responsive manner to meet customer demands.

b. The proposed designation and work will provide for increased security of water supply within the water reticulation network in the Auckland region.

c. The proposed NH2 watermain will provide increased distribution capacity in the network to meet both current demands and predicted demand in 2057.

d. The NI will provide for anticipated growth in north-west Auckland and increase capacity in the existing wastewater network.

e. The proposed work will enable Watercare to comply with the statutory purpose of the Resource Management Act 1991 to promote the sustainable management of natural and physical resources.

f. The designation will allow Watercare and / or its authorised agents to undertake works for construction of a water pipeline and its associated ancillary components in accordance with the designation.

g. The designation will enable works to be undertaken in a comprehensive and integrated manner.

h. The designation will add protection to the route from future incompatible development which may preclude or put at risk the construction and / or operation of the works.

d) Other matters that inform the territorial authority's consideration are contained within this AEE and notably within Section 6 and Section 8.

8.4 Section 104D Assessment

As indicated in Section 4 of this AEE, the stormwater discharge from creation of new impervious surfaces is a non-complying activity in the ARP:ALW. Sections 104B and 104D of the RMA allow resource consent for this type of activity to be granted provided the consent authority can be satisfied that either:

- The adverse effects of the activity on the environment will be minor; or
- The activity will not be contrary to the objectives and policies of relevant plans and proposed plans.

The following sections, in particular sections 8.4.7 and 8.4.11 below, outline how the project is generally consistent with, and certainly not repugnant to the relevant objectives and policies of the relevant plan and proposed plan.

It is considered that the consenting authority can be satisfied that the project can pass the second arm of the particular non-complying restrictions of s104D of the RMA.

As the project is considered to the second limb of the the gateway test of section 104D, it can be considered under s104 accordingly.

8.5 Section 104 and Section 171(1)(a) Assessment

8.5.1 New Zealand Coastal Policy Statement

While the Projects do not require obtaining any coastal permits (as there are no works within the coastal marine area) the works are partially within the broader coastal environment (notably the western end of NOR2). The effects of the Projects within the broader coastal environment (notably the western end of NOR2 at the Greenhithe Bridge) have been assessed against the provisions of the NZCPS and found to be consistent with those. Notably Policy 6 recognises the provision of infrastructure as being activities in the coastal environment that are important to the social, economic and cultural well-being of communities, including meeting the foreseeable needs of population growth. No further provisions are considered relevant to this project.

8.5.2 Hauraki Gulf Marine Park Act

The project has been assessed with regard to the provisions of the Hauraki Gulf Marine Park Act (HGMPA). For the coastal environment of the Hauraki Gulf, Sections 7 and 8 of the HGMPA must be treated as a New Zealand coastal policy statement issued under the RMA. The project will not affect the wider Gulf area or the life supporting capacity of the Gulf (including the islands). The project will not have adverse effect on the historic or physical characteristics of the Gulf, and no significant adverse effects on the natural resources of the Gulf.

8.5.3 National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011 (NES:S)

The project has been assessed against the provisions and requirements of the NES:S. Consents are required under the NES and form part of the suite of consents that have been sought in conjunction with the NORs. Technical Report B (Soil and Groundwater Contamination Assessment) identified a limited number of potentially contaminated sites along the project and assessed the effects that the project may have. Mitigation through active management of these sites is proposed and considered to be reasonably sufficient given the significant scale and spatial extent of the Project.

8.5.4 National Policy Statement for Freshwater Management 2014

The NPS:FM sets out the objectives and policies for freshwater management under the RMA. Decision-makers under the RMA must have regard to the objectives and policies when making resource consent decisions.

Objective A1 refers to the need to safeguard the life-supporting capacity of freshwater environments by sustainably managing the use and development of land and the discharge of contaminants, while Objective A2 requires that the overall quality of fresh water within a region is maintained or improved.

When considering an application for a discharge, the consent authority must under the NPS:FM have regard to the following matters:

a) *The extent to which the discharge would avoid contamination that will have an adverse effect on the life supporting capacity of fresh water including on any ecosystem associated with fresh water; and*

b) *The extent to which it is feasible and dependable that any more than minor adverse effect on fresh water, and on any ecosystem associated with fresh water, resulting from the discharge would be avoided.*

c) *The extent to which the discharge would avoid contamination that will have an adverse effect on the health of people and communities as affected by their secondary contact with fresh water;*

d) *The extent to which it is feasible and dependable that any more than minor adverse effect on the health of people and communities as affected by their secondary contact with fresh water resulting from the discharge would be avoided.*

As shown on the Project drawings in Volume 3, erosion and sediment control measures in accordance with TP90 will be implemented throughout the Project area during all land disturbance works. These measures are expected to safeguard the life-supporting of the waterbodies and ensure the overall freshwater quality is maintained.

Technical Report D (Ecological Assessment) concluded the effects of the short and long term works within the five streams will be minor.

The applications for consent to discharge contaminants from construction sites and for works to land containing of elevated levels of contaminants have been assessed and found to avoid adverse effects on the life supporting capacity of fresh water and on the health of people and communities, given the erosion and sediment control measures to be put in place and the limited extent of works that will result in discharges to freshwater environments.

Overall the Project is consistent with the NPS:FW.

8.5.5 Auckland Regional Policy Statement

The ARPS outlines the broad policy direction for the management, use and protection of the natural and physical resources in the Auckland region. Of most relevance to this Project are objectives and policies relating to Regional Overview and Strategic Direction (Chapter 2), matters of significance to iwi (Chapter 3), Chapter 6 (Heritage), Chapter 8 (Water Quality) and Chapter 17 (Contamination). Regard has been had to these relevant provisions and the Project is considered to be consistent with the strategic direction (Chapter 2) of the ARPS for the following reasons:

- The Project actively supports the regional growth policies of the Auckland region through the augmenting of water and wastewater infrastructure to serve projected growth in Auckland's north west and northern suburbs;
- NH2 efficiently utilises existing infrastructure (the water supply infrastructure associated with Huia Water Treatment Plant) to serve growing populations in the north which avoids needing to find sources from elsewhere;
- NI actively supports the provision of wastewater services through the provision of the NI pipeline. NI will provide essential wastewater services to growing communities in the west and north-western parts of Auckland. Connection of the NI to the Rosedale WWTP will utilise its available capacity, which in turn will release some capacity within Mangere WWTP to then serve projected growth in the south Auckland region;
- The Projects can be constructed and operated in a manner that will not result in significant adverse effects on the environment, and will be in a location that when completed, will provide an enhanced level of amenity.

As a result of on-going consultation, iwi with interests in the project area have been able to engage with the project managers from Watercare, prepare cultural impact assessments, and offer means to ensure that they can reinforce their role as kaitiaki over the project area during and after construction. This

demonstrates that there has been regard to, and that the project is consistent with, the objectives and policies of Chapter 3.

Objective 6.3.9 relating to Heritage is considered to be relevant to the Projects. This objective seeks to manage heritage resources in an integrated way to ensure their contribution to the variety of heritage values is protected and enhanced. The Projects will ensure that heritage values identified during construction is appropriately managed. Watercare will seek an authorisation under the HNZPTA prior to works commencing. An Accidental Discovery Protocol will be in place for such events. Additionally and in accordance with Technical Report I (Archaeological Assessment), the indicative site of Don Bucks Camp will be investigated prior to works commencing.

The relevant objectives and policies in Chapter 8: Water quality are those relating to management of water quality during construction, and non-point source discharges from new impervious surfaces post construction, being policies 8.4.1 and 8.4.7.

The management of discharges of sediment laden water and contaminants during construction will be managed through best practise erosion and sediment control practises and contamination management. Such practises are outlined in Technical Report B Soil, Sediment and Groundwater Contamination.

Increased impervious surface areas will be created through new permanent access points being created to the maintenance shafts for NI. Any run off from these surfaces is proposed to discharge to swale type treatment and generally absorbed to ground. Given the limited vehicular use of these accessed points, runoff is assessed as having an immeasurable effect on water quality.

Chapter 17 of the ARPS outlines objectives and policies relating to contaminated sites. Technical Report B Soil, Sediment and Groundwater Contamination has assessed known and potentially contaminated sites along the route. These sites can be managed to ensure that the works do not result in uncontrolled discharges during construction.

Overall the Projects are considered to be consistent with the relevant objectives and policies of the ARPS.

8.5.6 Auckland Proposed Regional Policy Statement

Chapter B of the Proposed Auckland Unitary Plan (PAUP) contains the provisions of the proposed Regional Policy Statement. B3.2 outlines the objectives and policies considered to be relevant to this Project. The Project supports objectives B3.2.2 and B3.2.3 which recognise the benefits of significant infrastructure to provide for the anticipated growth of Auckland. The Project will optimise existing infrastructure including that associated with the Huia Water Treatment Plant, and the Rosedale and Mangere WWTPs, through locating infrastructure within common corridors to limit potential adverse effects during construction. As demonstrated by the analysis in Section 6 of this AEE, the effects on the environment will be minor and can be adequately mitigated.

B5.1 seeks to ensure that mana whenua can exercise tino rangatiratanga through participation in resource management processes and decisions. Watercare has a well-established forum for engaging with iwi on all projects and has invited iwi with an interest in the project area to provide cultural impact assessments.

B7.4 addresses recognition and provision for the life-supporting capacity and ecological values of the Hauraki Gulf. To the extent practical the Project has identified a route that minimises effects on watercourses. The Project will adopt best practise management for works within the margins of water courses and sediment control.

Overall the Projects are considered to be consistent with the relevant objectives and policies of the PAUP.

8.5.7 Auckland Regional Plan: Air, Land and Water

The ARP:ALW outlines objectives, policies, rules and assessment criteria in relation to the management of the air, land and water resources of Auckland region. The relevant provisions have been assessed as follows:

- The Project will have limited adverse effects on the natural character of the stream margins. The Project is not considered to be "inappropriate" in the context of this Chapter given the recognised strategic importance of providing wastewater reticulation and water supply to service the predicted growth in the Auckland area. Construction management will provide adequate mitigation of adverse effects (Objective 2.1.3.2, 2.2.3.2, 2.2.3.3, 2.2.3.4, and 2.2.3.5 and Policies 2.1.4.1, 2.1.4.5, 2.2.4.1, 2.2.4.3, 2.2.4.4 and 2.2.4.6);
- The Project has limited effects on cultural heritage, by largely locating in a manner to avoid any site registered with NZAA or the Council's Cultural Heritage Inventory. The site that may be affected will be investigated to determine whether it coincides with the alignment of NH2 and appropriate mitigation will be put in place in accordance with NZHPTA requirements (objective 2.2.4.16 and 2.2.4.17)
- Matters of significance to tangata whenua have been addressed through consultation and engagement via Watercare's Kaitiaki forum and the invitation to provide cultural impact assessments. Minimising adverse effects on water quality is managed through appropriate erosion and sediment control. Works are designed to be largely kept out of watercourses except where there is no other option, in which case pipe bridges are adopted as the most appropriate means to cross them which will minimise disturbance of the stream bed to the extent practicable. The proposed route avoids any known sites of significance to iwi (objectives 2.3.3.1, 2.3.3.2 and 2.3.3.3 and associated policies).
- Construction related discharges will be managed in accordance with TP90 as demonstrated in Technical Report A Earthworks, Erosion and Sediment Generation (objective 5.3.1, 5.3.5 and 6.3.2 and policy 5.4.2 and 5.4.4A).
- Potentially contaminated sites have been identified in Technical Report B Soil, Sediment and Groundwater Contamination and will be appropriately managed to avoid risks to human health or the natural environment (objective 5.3.16 and policies 5.4.37 and 5.4.37A).
- Groundwater and settlement effects have been assessed and found to be minor in Technical Report C Groundwater Assessment. There is the potential for ground water drawdown, but with appropriate mitigation the effects will be minor (objective 6.3.8 and policy 6.4.49).

Overall the Project is considered to be consistent with the relevant provisions of the ARP:ALW.

8.5.8 Auckland Regional Plan: Sediment Control

The Project has been assessed against the relevant provisions of ARP:SC (notably section 5) as follows:

- As noted above and in Technical Report A Earthworks, Erosion and Sediment Generation the effects of the Project will maintain water quality in watercourses through implementing TP90 practises during construction activities (objective 5.1.1 and policy 5.2.1);
- Mana whenua have been invited to submit cultural impact assessments to Watercare through the Kaitiaki forum. This will allow iwi to determine whether the works are appropriate with respect to sustaining mauri of waterbodies affected by the works (limited to the five streams) and the quality of discharge from construction sites as discussed above (objective 5.1.2 and policy 5.2.2).

Overall the Project is considered to be consistent with the relevant provisions of the ARP:SC.

8.5.9 Auckland Council District Plan (Waitakere section)

Much of the Project is located within the road reserve within the Waitakere section (NOR1 and 3). The Project has been assessed against the relevant provisions below.

The Project is considered to be consistent with the provisions relating to water quality, natural character, features and ecosystems, land disturbance and tangata whenua. These provisions are consistent with the ARPS and the commentary provided against provisions above reflects the assessment made against the ACDP:WS (refer objectives 1, 2, 3, 5, 7 and 8 and associated policies).

Objective 10 relates to amenity values, health and safety. The Project is considered consistent with this objective and its associated policies as the potential effects of the Project are primarily associated with construction activities which will be short term. These effects have been assessed in Technical Report D Ecological Assessment, Technical Report E Traffic Assessment, Technical Report F Construction Noise and Vibration Assessment, Technical Report G Landscape and Visual Assessment, Technical Report H Arboriculture Assessment and Technical Report I Archaeology Assessment. The potential construction effects are anticipated to be minor and can be appropriately mitigated. The long term adverse effects of the Project can be mitigated through landscape plans to assist with blending the four pipe bridges into the environment.

It is noted that the Project "start point" is land designated by Watercare for "water supply purposes". As such the Project is considered to be consistent with this designation. Further consideration of the southern extent of the Project against the underlying District Plan zone is not considered necessary. Furthermore, as the first 800 metres is tunnelled and will not affect the surface until within the Shetland Street road reserve, the applicable zones are not assessed. Potential effects associated with settlement are assessed against regional plan provisions.

Overall the Project is considered to be consistent with the relevant provisions of the ACDP:WS.

8.5.10 Auckland Council District Plan (North Shore section)

This assessment is relevant to NOR 2 only. The majority of the Project will be undertaken within the road reserve or motorway corridors. There is a small section of the alignment within the Recreation 1 zoned land where the alignment runs parallel to Bush Road, within the Fernhill escarpment. The Project has been assessed against the relevant provisions below.

The Project will affect the vegetation within the Fernhill escarpment. The works have been designed to avoid ecosystems and habitats to the extent practicable. There are two options for work through the escarpment, one a pipe bridge and the other through trenchless technology, however there is no preference and both options have been assessed to retain flexibility. Generally the project will avoid significant habitats of native fauna and flora and if vegetation is required to be cleared within the Fernhill escarpment, the mitigation will ensure that the biodiversity is enhanced (objective 8.3.2 and policy 8.3.2.6).

As noted above the works will be undertaken in accordance with TP 90, ensuring that the effects of land disturbance are minimised (objective 9.3.1 and policies 9.3.1.2 and 9.3.1.6). The Project will ensure that the infrastructure servicing is planned in relation to ensuring that there is adequate potable water supply for growth areas in the north (objective 9.3.3 and policy 9.3.3.7).

Once completed, the Project will facilitate the continued effective operation of the water supply network within the north of the region. The Project provides regionally significant infrastructure, and the effects (primarily construction related) can be mitigated to ensure they do not adversely affect amenity or the health and safety of the community (objectives and policies of Chapter 14 Network Utilities and Designations).

Given the limited extent of the works within the Recreation 1 zoned land, its proximity to the road corridor and the ability to mitigate adverse effects, the Project will generally conserve and enhance the features that are of high natural value. While not all trees can be protected through the construction of a pipe bridge, only limited vegetation will be removed, and the construction methodology can be selective about the location of piers to support the structure. Should the trenchless technology be selected, works will be managed to ensure that the root systems of the vegetation are not affected significantly (through route selection and depth of the trenchless pipework) (objective 19.4.1 and policies 19.4.1.1 and 19.4.1.2).

Overall the Project is considered to be consistent with the relevant provisions of the ACDP:NS

8.5.11 Proposed Auckland Unitary Plan

The Proposed Auckland Unitary Plan (PAUP) was notified on 30 September 2013. Submissions have been received on the PAUP and the hearings process is underway. No decisions have yet been made in relation to the relevant objectives and policies of the PAUP and therefore these provisions carry limited legal weight. Overall, regard has been given to the PAUP provisions and it is considered that the Project will be consistent with the relevant objectives and policies of the PAUP for the reasons noted below:

- The Project recognises and supports the economic and social wellbeing of the communities that it will serve, in the north west and north through the provision of regionally significant infrastructure. The potentially adverse effects during construction can be adequately mitigated through the implementation of a construction management plan (objective C1.1.1, C1.1.2, C1.1.3, C1.1.4 and C4.1.3 and associated policies).
- Vegetation removal is necessary to facilitate the works, some of which will be within significant ecological areas (SEAs). Although ecologically valuable, the extent of removal is limited and the adverse effects can be mitigated through replanting of the general area as noted in Technical Report D Ecological Assessment and Technical Report G Landscape and Visual Assessment. This supports objective C4.1.3 and the related policies.
- Earthworks will be undertaken in accordance with best practise erosion and sediment control measures (refer Technical Report A Earthworks, Erosion and Sediment Generation). A detailed erosion and sediment control plan (ESCP) will be forwarded to Council prior to works commencing, implementing the most appropriate measures for the project. This Project is quite routine and the construction methodology proven. The measures identified and the ESCP will ensure that earthworks will be managed to ensure that little sediment is discharged into adjacent and nearby watercourses (objective C5.2.1 and .3). Post construction the site will be reinstated and stabilised.
- The stormwater treatment and quantity discharged from resulting hard surfaces is relatively minor given the extent of the works. The additional stormwater generated will not result in any significant changes upstream, or to volume, or quality of stormwater. Post construction the project will not generate runoff that will contain significant levels of contaminants (being from infrequently used vehicle accesses for maintenance). Overall the effects of the project on water quality have been assessed as being less than minor. This supports the general policy direction of the PAUP to ensure that water quality is protected from further degradation (objective C5.15.1.3 and associated policies).
- Technical Report C Groundwater Assessment addresses potential effects associated with diversion of groundwater during construction and potential settlement effects. The PAUP objectives relating to water quantity, allocation and use are not considered relevant to diversion of groundwater. However policy 18 addresses diversion of groundwater. Given that the effects of the project on groundwater are assessed as being minor, if not benign, from construction, on nearby groundwater takes and with respect to water quality, the project will be consistent with policy C5.15.2.18.

- With respect to provisions relating to natural character, features, water bodies and ecosystems, the infrastructure associated with the project will generally be sub-surface, and infrastructure located above ground will not be within areas of high natural character. Effects on streams will generally be avoided through the proposed construction methodology that includes: the installation of pipe bridges across five streams and the implementation of erosion and sediment control measures during all land disturbances activities to prevent sediment laden discharges. Effects upon terrestrial ecosystems from construction activities primarily related to vegetation clearance. A range of mitigation measures and options have been identified (refer to section 6 of this Report). Some removal of vegetation at riparian margins will be required to enable the proposed works (objective C.4.1.1 and policies C.4.1.1 and C.4.1.4 (being natural heritage), Objective C.5.3.1 Policies C.5.3.1, C.5.3.2, C.5.3.5 and C.5.3.6 (Vegetation Management) Objectives C.5.14.1, C.15.14.2, C.5.14.4 and C.5.14.5 Policies C.5.14.1, C.5.14.2, C.5.14.4, C.5.14.6, C.5.14.7 and C.5.14.12 (Lakes, rivers and streams)).
- The investigations undertaken as part of the Technical Report B Soil, Sediment and Groundwater Contamination indicate that contaminant concentrations within the project area are not at levels that would pose human health risks to construction workers and the general public. Construction can also be managed using standard earthworks procedures to ensure that effects on the environment from the presence of these contaminants will be less than minor (objective C.5.6.1 Policies C.5.6.2 and C.5.6.3).
- The proposed works are expected to cause some temporary adverse effects due to construction activities. The construction methodology and management procedures will help to avoid, minimise or mitigate these effects.
- Some construction methodologies (if utilised) will cause more than minor adverse effects for properties located adjacent to construction sites. These activities may also occur during the night, exceeding night-time noise criteria. Construction methodology and management procedures in the Project's CNVMP will help to avoid, minimise or mitigate these effects. (Objectives C.7.3.1, C.7.3.2, C.7.3.3, C.7.3.7 and C.7.3.9 Policies C.7.2.2, C.7.3.2, C7.3.7 and C.7.3.10)
- Consultation with iwi and Cultural Impact Assessments prepared for the Project highlight the special significance of water to tangata whenua. Minimising adverse effects on water quality is considered to be fundamental. The implementation of erosion and sediment control measures in a manner consistent with TP 90 will assist in maintaining water quality during construction. The mauri of native vegetation and natural processes may be impacted through the removal of vegetation required to facilitate the works. Construction activities will be temporary in nature during and immediately following the construction period and will be mitigated through replacement planting (Objective C.5.15.2.5 Policy C.5.2.4, C.5.14.4, C.5.14.5, C.5.15.1.5 and C.5.15.2.18).

Overall the Project is considered to be consistent with the relevant provisions of the PAUP.

8.6 Other Legislative Requirements

8.6.1 Heritage New Zealand Pouhere Taonga Act 2014

Under the Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA) no person may modify or destroy an archaeological site unless an authority is granted by Heritage New Zealand Pouhere Taonga (whether or not the site is a recorded archaeological site).

A preliminary archaeological assessment has been undertaken for the NH2 watermain route (Technical Report I by Clough & Associates, 2015). While this assessment indicates that the effects of the proposed works on heritage values are likely to be low, there remains a possibility that unidentified subsurface

archaeological remains may be exposed during construction. Watercare intends to apply for an archaeological authority to cover all construction works.

8.6.2 Waitakere Ranges Heritage Act 2008

The purpose of the Waitakere Ranges Heritage Act (WRHA) is set out in section 3 of the Act and must be taken into account when considering resource consents and/or making decisions or recommendations relating to designations. The purpose of the WRHA is to:

(1) (a) recognise the national, regional, and local significance of the Waitakere Ranges heritage area; and

(b) promote the protection and enhancement of its heritage features for present and future generations.

(2) To this end, the Act—

(a) establishes the Waitakere Ranges heritage area; and

(b) states its national significance; and

(c) defines its heritage features; and

(d) specifies the objectives of establishing and maintaining the heritage area; and

(e) provides additional matters for the Council and certain other persons to consider when making a decision, exercising a power, or carrying out a duty that relates to the heritage area.

The project falls within peripheral areas of the Waitakere Ranges at its southern (Titirangi) end. Consideration of the WRHA is relevant to NOR1 only. The works are limited to construction effects only, as the watermain will be tunnelled for the first 800 metres which falls within the area of the Waitakere Ranges Heritage Area, thus avoiding potentially significant effects within the Park area. The vegetation clearance at Shetland Road falls within the WRHPA area. The vegetation clearance has been identified by the arborist as being a permanent modification. Section 7 of the WRHA identifies the public water catchment and supply system as a heritage feature of the Area. As such, a permanent and very minor alteration to the vegetation on the periphery of the Heritage Area is considered to be appropriate and necessary to the functioning of the water supply system within the Waitakere Ranges.

8.6.3 Reserves Act 1977

In some locations the NH2 watermain route crosses reserve land. Should the proposed works materially alter the purpose of a reserve or require changes to a Reserve Management Plan (confirmation is required as to which, if any, of the reserves in question are subject to a management plan), then approval will be required under the Reserves Act.

Consultation will need to be undertaken with Council Parks, Sport and Recreation in relation to securing formal access for the watermain through Council owned and administered reserve land, such as through an easement or other mechanism.

8.6.4 The Auckland Plan

The Auckland Plan is a non-statutory document which guides Auckland's future over the next 30 years and addresses issues such as:

- Transport and housing shortages;
- Giving children and young people a better start;
- Creating more jobs; and
- Protecting the environment.

The Auckland Plan was adopted by the Council in March 2012. 108 Directives 12.1 and 12.2 relate to the efficient provision of infrastructure and integration of planning network utilities to provide for population growth. Given that the purpose of the project is to facilitate infrastructure to meet current and future demand, and that the project integrates the NH2 and NI to optimise construction efficiencies, it is considered that the project supports the relevant Auckland Plan directives.

8.6.5 Iwi Management Plans

Ngati Whatua o Orakei Maori Trust Board has produced an Iwi Management Plan for their rohe, including the upper Waitemata Harbour. The key issues, objectives and policies of that plan relevant to the Project are 7.1 Te Wai Ora a Tane and Mauri Moana (Waters and their Ecological Communities) and 7.2 Te Wao Nui a Tane (terrestrial biodiversity). The provision of the NI and NH2 projects reinforces the reliance throughout the region on infrastructure that minimises to the greatest extent possible, adverse effects on the environment that would result from poorly designed and inadequate wastewater infrastructure. This supports Ngati Whatua o Orakei objectives to maintain and restore the mauri of waimaori networks and moana, and avoiding the direct discharge of wastewater into the sea. As discussed in Section 7, Watercare will assist Ngati Whatua o Orakei to achieve the objectives and policies within the Iwi Management Plan where practical within the context of the NH2 and NI projects.

9 CONCLUSION

The Project will provide security of supply and resilience to the water supply network, and will provide protection of the route along SH18 for the NI. It represents an efficient coordination of infrastructure necessary to serve the growing populations of the north and east of Auckland.

The new watermain will form a part of Auckland's water supply network and is required to address water supply capacity deficiencies in this area.

The proposed wastewater pipe will assist to provide for future growth in the northwest of metropolitan Auckland and will contribute to the efficient operation of Auckland's wastewater network.

During construction, appropriate management plans and protocols will be developed and implemented to manage potential construction effects, and the completed works will be predominantly underground apart from manhole access lids located at ground level and the watermain that will only be in view from below the bridge structure. The new Pump Station at Hobsonville will be subject to an outline plan of works on completion of detailed design in conjunction with other works associated with NI. Construction effects can be adequately managed to ensure that, overall, the effects on the environment are minor. On completion of the construction the effects of the operation of the new watermain and wastewater infrastructure will be positive and enduring effects of the Project can be adequately mitigated.

The proposed work and designations are reasonably necessary for achieving the objectives of Watercare and this AEE demonstrates that the Project meets the tests of sections 171.

The resource consents for NH2 have been demonstrated above to meet the relevant gateway tests of s104D, and subject to Part 2 of the RMA, regard has been had to the relevant provisions identified in s104 of the RMA.

The proposed work is consistent with the purpose of the RMA in that it allows for the management of natural and physical resources in a way that enables people and communities to provide for their social, economic and cultural well-being and for their health and safety.

The proposed work is consistent overall with the objectives and policies of the relevant statutory documents as it is public infrastructure and can be constructed, operated and maintained in a manner which avoids, remedies or mitigates adverse effects.

Watercare requests that the Notices of Requirement for designation be confirmed and the resource consents associated with NH2 are granted so that the proposed work and the resulting network improvements can be implemented as planned.

APPENDIX A

DIRECTLY AFFECTED LANDOWNERS

NoR Ref	Map ID	Type2	Description	Legal Description / Appellation / Road Name	Certificate of Title	Physical Address
NoR 1	100	Private	Residential	Lot 58 DP 20226	NA466/217	114 Scenic Drive Waitakere-Titirangi
NoR 1	102	Private	Residential	Lot 88 DP 20226	NA95C/938	107 Scenic Drive Waitakere-Titirangi
NoR 1	103	Private	Residential	Lot 89 DP 20226	NA95C/937	105 Scenic Drive Waitakere-Titirangi
NoR 1	105	Private	Residential	Lot 87 DP 20226	NA681/262	109 Scenic Drive Waitakere-Titirangi
NoR 1	106	Private	Residential	106 Lot 86 DP 20226	NA681/262	111 Scenic Drive Waitakere-Titirangi
NoR 1	107	Private	Residential	Lot 85 DP 20226	NA677/82	113 Scenic Drive Waitakere-Titirangi
NoR 1	108	Private	Residential	Lot 1 DP 92531	NA49B/5	289 Konini Road Titirangi
NoR 1	109	Private	Residential	Lot 2 DP 195743	NA124C/39	285 Konini Road Titirangi
NoR 1	110	Private	Residential	Lot 1 DP 195743	NA124C/38	283 Konini Road Titirangi
NoR 1	113	Private	Residential	Lot 136 DP 27719	NA5C/755	43 Tawini Road Titirangi
NoR 1	127	Private	Residential	Lot 2 DP 402587	408390	105-107 Parrs Cross Road Mclaren Park-Sunnyvale
NoR 3	154	Private	Residential	Lot 52 DP 484815	687727	24 Lockheed Street West Harbour-Hobsonville
NoR 3	155	Private	Residential	Lot 36 DP 484815	687711	51 Lockheed Street West Harbour-Hobsonville
NoR 3	156	Private	Residential	Lot 37 DP 484815	687712	54 Lockheed Street West Harbour-Hobsonville
NoR 3	157	Private	Residential	Lot 51 DP 484815	687726	26 Lockheed Street West Harbour-Hobsonville
NoR 3	158	Private	Residential	Lot 38 DP 484815	687713	52 Lockheed Street West Harbour-Hobsonville
NoR 3	160	Private	Residential	Lot 50 DP 484815	687725	28 Lockheed Street West Harbour-Hobsonville
NoR 3	161	Private	Residential	Lot 39 DP 484815	687714	50 Lockheed Street West Harbour-Hobsonville
NoR 3	162	Private	Residential	Lot 49 DP 484815	687724	30 Lockheed Street West Harbour-Hobsonville
NoR 3	163	Private	Residential	Lot 40 DP 484815	687715	48 Lockheed Street West Harbour-Hobsonville
NoR 3	164	Private	Residential	Lot 48 DP 484815	687723	32 Lockheed Street West Harbour-Hobsonville
NoR 3	165	Private	Residential	Lot 41 DP 484815	687716	46 Lockheed Street West Harbour-Hobsonville
NoR 3	167	Private	Residential	Lot 47 DP 484815	687722	34 Lockheed Street West Harbour-Hobsonville
NoR 3	168	Private	Residential	Lot 42 DP 484815	687717	44 Lockheed Street West Harbour-Hobsonville
NoR 3	169	Private	Residential	Lot 46 DP 484815	687721	36 Lockheed Street West Harbour-Hobsonville
NoR 3	170	Private	Residential	Lot 43 DP 484815	687718	42 Lockheed Street West Harbour-Hobsonville
NoR 3	171	Private	Residential	Lot 44 DP 484815	687719	40 Lockheed Street West Harbour-Hobsonville

NoR 3	172	Private	Residential	Lot 59 DP 484815	687734	41 Lockheed Street West Harbour-Hobsonville
NoR 3	173	Private	Residential	Lot 45 DP 484815	687720	38 Lockheed Street West Harbour-Hobsonville
NoR 3	175	Private	Residential	Lot 58 DP 484815	687733	43 Lockheed Street West Harbour-Hobsonville
NoR 3	176	Private	Residential	Lot 57 DP 484815	687732	45 Lockheed Street West Harbour-Hobsonville
NoR 3	177	Private	Residential	Lot 56 DP 484815	687731	47 Lockheed Street West Harbour-Hobsonville
NoR 3	179	Private	Residential	Lot 55 DP 484815	687730	49 Lockheed Street West Harbour-Hobsonville
NoR 3	180	Crown (HNZ)	Residential	PT ALLOT 12 DP 8956 & PT WAITEMATA HARBOUR BED SO 60255	CT-647732	2 Buckley Avenue
NoR 3	181	Crown (HNZ)	Residential	PT ALLOT 12 DP 8956 & PT WAITEMATA HARBOUR BED SO 60255	CT-647732	2 Buckley Avenue
NoR 3	189	Private	Residential	Lot 1 DP 475066	654401	2 Squadron Drive Hobsonville

APPENDIX B

REPRESENTATIVES OF COMMERCIAL PROPERTIES

NoR Ref	Map ID	Type2	Description	Legal Description / Appellation / Road Name	Certificate of Title	Physical Address
NOR 1	129	Private	Business	Lot 2 DP 375113	302413	79-97 Parrs Cross Road Mclaren Park-Sunnyvale
NOR 2	112	Private	Business	Section 3 SO 395478	584482 (Land Taken as Severance pursuant to Section 119 Public Works Act 1981)	177 Albany Highway, Rosedale
NOR 2	113	Private	Business	Lot 5 DP 176021	NA113B/507, NA134D/325, NA113B/495, NA113B/494, NA113B/496, NA113B/493, NA113B/492, NA113B/497, NA128C/557, NA128C/556	1/2A William Pickering Drive, Rosedale
NOR 2	131	Private	Business	Sec 1 SO 64438	NA82C/749 (Subject to the provision of Marginal Strips)	66 Bush Road, Albany
NOR 2	134	Crown (Massey)	School/University	Lot 2 DP 137152	NA81B/334	RA 5 University Avenue, Albany
NOR 3	102	Private	Business	Sec 44 SO 430649	587009, 642492 (Fee Simple Title.)	1-5 Fred Taylor Drive, Massey
NOR 3	135	Private	Business	Lot 2 DP 57408	NA12C/162	122 Hobsonville Road West Harbour Hobsonville