Warkworth to Wellsford

Assessment of Effects on the Environment

March 2020

Warkworth to Wellsford Project

Document title:	Assessment of Effects on the Environment: Warkworth to Wellsford Project
Version:	Final
Date:	March 2020
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File name:	WW2W – Final AEE 06032020

Table of Contents

List of Figures

List of Tables

Glossary of Abbreviations

The table below sets out the technical abbreviations

Abbreviation/acronym	Term
AAAQTs	Auckland Ambient Air Quality Targets
AADT	Average Annual Daily Traffic
ADP	Accidental discovery protocol
AEE	Assessment of Effects on the Environment
AEP	Annual Exceedance Probability
ANZECC/ARMCANZ	Australia and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand
ARI	Average Return Interval
ART	Auckland Regional Transport
ARLTP	Auckland Regional Land Transport Plan 2015–2025
AS/NZS 1158:2005	Standards New Zealand and Standards Australia, 2005
ASCV	Area of Significant Conservation Value
ASD	Approach Site Distance
ATP	Audio Tactile Profile (rumble strip)
AUP(OP)	Auckland Unitary Plan (Operative in Part)
BMM	Building modification mitigation
BPO	Best Practicable Option
BNZ/GLEAMS	Basin New Zealand and Groundwater Loading Effects of Agricultural Management Systems
CAQMP	Construction Air Quality Management Plan
CAS	Crash Analysis System
CEMP	Construction Environmental Management Plan
CESCP/s	Construction Erosion and Sediment Control Plan/s
CHI	Cultural Heritage Inventory
CLM	Contaminant Load Model
CLMP	Contaminated Land Management Plan
CLoS	Customer Levels of Service
CMA	Coastal Marine Area
CNVMP	Construction Noise and Vibration Management Plan
CoPTTM	Code of Practice for Temporary Traffic Management
Council	Auckland Council
CTMP	Construction Traffic Management Plan
CTP	Chemical Treatment Management Plan
CVA	Cultural Values Assessment

Abbreviation/acronym	Term
dB	Decibel
CWD	Clean Water Diversions
dB	Decibel
DBC	Detailed Business Case
DEB	Decanting Earth Bund
DOC	Department of Conservation
DSI	Detailed Site Investigation
DWD	Dirty Water Diversions
ECR	Environmental Compensation Ratio
EIANZ	Environment Institute of Australia and New Zealand
EM	Ecological Mitigation Series
EMMP	Ecological and Mitigation Management Plan
EPT	Ephemeroptera, Plecoptera and Trichoptera
ES	Ecological Sites
ESC	Erosion and Sediment Control
ESR	Environmental and Social responsibility
ESCP	Erosion and Sediment Control Plan
FFR	Freshwater Fisheries Regulations 1983
FIDOL	Frequency, Intensity, Duration, Offensiveness and Location factors
GD01	Stormwater Management Devices in the Auckland Region – Guideline Document 2017/001
GD05	Auckland Council Guidance for Erosion and Sediment Control
GDP	Gross Domestic Profit
GIS	Geographical Information System
GPS 2009	Government Policy Statement on Land Transport Funding 2009/2010 – 2018/19
GPS 2018	Government Policy Statement on Land Transport 2018/19–2027/28
ha	Hectares
HAIL	Hazardous Activities and Industries List
HAMP	Heritage and Archaeological Management Plan
HCV	Heavy Commercial Vehicles
HGMPA	Hauraki Gulf Marine Park Act 2000
HNZPT	Heritage New Zealand Pouhere Taonga
HNZPTA	Heritage New Zealand Pouhere Taonga Act 2014
HPMV	High Productivity Motor Vehicle
HSR	Highly Sensitive Receiver, as defined in the Transport Agency Guide to assessing air quality impacts from state highway projects (2015)

Abbreviation/acronym	Term
IAIA	International Association for Impact Assessment
IKHMG	Integrated Kaipara harbour Management Group
IMF	Integrated Management Framework
KDBP	Kauri Dieback Biosecurity Plan
KHIPA	Kaipara Harbour Integrated Strategic Plan of Action 2011
km	Kilometres
km2	Square kilometres
km/h	Kilometres per hour
kV	Kilovolt
LCA	Landscape character areas
LG(AC)A	The Local Government (Auckland Council) Act 2009
LINZ	Land Information New Zealand
LOS	Level of service
LTMA	Land Transport Management Act 2003
L/s	Litres per second
m	Metres
m2	Square metres
m3	Cubic metres
mgbl	Metres below ground level
MCA	Multi Criteria Analysis
MCI	Macroinvertebrate Community Index
MfE	Ministry for the Environment
MfE Dust Guide	Ministry for the Environment Good Practice Guide for Assessing and Managing Dust 2016
MSE	Mechanically Stabilised Earth
NAL	North Auckland Line
NEAP	Tai Tokerau Northland Economic Action Plan 2016
NES	National Environmental Standard
NESAQ	Resource Management (National Environmental Standard for Air Quality) Regulations 2004
NESETA	Resource Management (National Environmental Standard for Electricity Transmission Activities) Regulations 2009
NESSHDW	National Environmental Standards for Sources of Human Drinking Water 2007
NESPF	Resource Management (National Environmental Standard for Plantation Forestry) Regulations 2018

Abbreviation/acronym	Term
NES Soil	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
NFDS	National Freight Demands Study
NIWA	National Institute of Water and Atmoshperic Research
NLTP	National Land Transport Programme
NoR	Notice of Requirement
NO_2	Nitrogen dioxide
NPS	National Policy Statement
NPSET	National Policy Statement on Electricity Transmission 2008
NPSFM	National Policy Statement for Freshwater Management 2014
NPSUDC	National Policy Statement on Urban Development Capacity 2016
NRLTP	Northland Regional Land Transport Plan 2015–2021
NSMA	Natural Stream Management Area
NZAA	New Zealand Archaeological Association
NZCPS	New Zealand Coastal Policy Statement 2010
NZDWS 2008	New Zealand Drinking Water Standard
NZTS	New Zealand Transport Strategy
NZS 6803	New Zealand Standard NZS 6803:1999 "Acoustics – Construction Noise"
NZS 6806	New Zealand Standard NZS 6806:2010 "Acoustics – Road traffic noise – New and altered roads"
OGPA	Open Graded Porous Asphalt
ONC	Outstanding Natural Character
ONF	Outstanding Natural Feature
ONL	Outstanding Natural Landscape
ONRC	One Network Road Classification system
P-W	Ara Tūhono Pūhoi to Wellsford project
P2Wk	Pūhoi to Warkworth project
PBC	Programme Business Case
PPFs	Protected Premises and Facilities
PPP	Public Private Partnership
ppv	Peak Particle Velocity
PSI	Preliminary Site Investigation
PWA	Public Works Act 1981
RCA	Road Controlling Authority
REC	River Environment Classification

Abbreviation/acronym	Term
RFHA	River Flood Hazard Assessment
RLTS	Regional Land Transport Strategy 2010
RMA	Resource Management Act 1991
RMF	Rayonier Matariki Forests
RoNS	Roads of National Significance
RPS	Regional Policy Statement
RSA	Road Safety Audit
SAP	Site Access Points
SAR	Scheme Assessment Report
SEA	Significant Ecological Area
SEA-M1	Significant Ecological Area – Marine 1
SEA-M2	Significant Ecological Area – Marine 2
SEV	Stream Ecological Valuation
SH(x)	State highway (number)
SIA	Social Impact Assessment
SIDRA	Signalised and un-signalised Intersection Design and Research Aid
SOI 2017	Statement of Intent 2017-2021
SRA	Safe Road Alliance
SRP	Sediment Retention Pond
SSF	Super silt fences
SSTMP	Site Specific Traffic Management Plans
TPH	Total petroleum hydrocarbons
TP90	Auckland Regional Council Technical Publication No. 90
Transport Agency	NZ Transport Agency
TSS	Total Suspended Solids
TTM	Temporary Traffic Management
ULDF	Urban and Landscape Design Framework
ULDMPs	Urban and Landscape Design Management Plans
vpd	Vehicles Per Day
vph	Vehicles Per Hour
WWII	World War Two
2D	Two dimensional

Glossary of Defined Terms

The table below sets out the defined terms (and some acronyms above apply)

Term	Definition
Ambient air	The air outside that reflects the cumulative effect of all activities both human induced and natural. It does not refer to indoor air, air in the workplace, or to contaminated air as it is discharged from a source.
Ambient noise/vibration	The total noise or vibration existing at a specified point and time associated with a given environment, excluding the sound or vibration requiring control. It is a composite of all noise or vibration sources, near and far.
Amenity values	Defined in section 2(1) of the RMA 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."
Annual exceedance probability	Defined in section J1 of the AUP(OP), as "the probability of exceeding a given threshold within a period of one year. It can be applied to any type of risk".
Archaeological site	Defined in section 6 of the Heritage New Zealand Pouhere Taonga Act 2014 as "Means, subject to section 42(3), (a) any place in New Zealand, including any building or structure (or part of a building or structure), that (i) was associated with human activity that occurred before 1900 or is the site of the wreck of any vessel where the wreck occurred before 1900; and (ii) provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand; and (b) includes a site for which a declaration is made under section 43(1)."
Average annual daily traffic	The equivalent to the total volume of traffic passing a roadside observation point over the period of a calendar year, divided by the number of days in that year for which traffic volumes were recorded. Measured in vehicles per day.
Average Recurrence Interval	The average time period between rainfall or flow events that exceed a given magnitude.
Best practicable option	Defined in section 2(1) of the RMA, as "in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to – (a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and (b) the financial implications, and the effects on the environment, of that option when compared with other options; and (c) the current state of technical knowledge and the likelihood that the option can be successfully applied."
Construction works	Activities undertaken to construct the Project.

Term	Definition
Contaminant	Defined in section 2(1) of the RMA, as "any substance (including gases, odorous compounds, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat – (a) when discharged into water, changes or is likely to change the physical, chemical, or biological condition of water; or (b) when discharged onto or into land or into air, changes or is likely to change the physical, chemical or biological condition of the land or air onto or into which it is discharged."
Contaminated land	Defined in section 2(1) of the RMA, as "land that has a hazardous substance in or on it that – (a) has significant adverse effects on the environment; or (b) is reasonably likely to have significant adverse effects on the environment."
Damming	Defined in section J1 of the AUP(OP), as "the activity of impounding surface water (and any substances dissolved in, suspended in or otherwise combined with the water) with any structure. This excludes water held in tanks, rain gardens, culverts and culvert headwalls and reclamation or drainage which results in the creation of dry land".
dB $L_{Aeq(24h)}$	Sound pressure level average, A-weighted, sound pressure level over the measurement period of 24 hours.
Designation	Defined in section 166 of the RMA, as "a provision made in a district plan to give effect to a requirement made by a requiring authority under section 168 or section 168A or clause 4 of Schedule 1 of the RMA."
Proposed designation boundary	The boundary of the land to which the notice of requirement applies.
Discharge	Defined in section 2(1) of the RMA, as including emitting, depositing, and allowing to escape.
Diversion of stormwater	Defined in section J1 of the AUP(OP), as "altering the natural course of stormwater flow, primarily through recontouring land or the establishment of impervious surfaces and associated drainage."
Earthworks	Defined in section J1 of the AUP(OP), as "disturbance of soil, earth or substrate land surfaces. Includes: blading, boring (greater than 250mm diameter); contouring; cutting; drilling (greater than 250mm diameter); excavation; filling; ripping; moving; placing; removing; replacing; trenching; and thrusting (greater than 250mm diameter). Excludes: ancillary forest earthworks; and ancillary farming earthworks."
Ephemeral stream	Defined in section J1 of the AUP(OP), as "stream reaches with a bed above the water table at all times, with water only flowing during and shortly after rain events. This category is defined as those stream reaches that do not meet the definition of permanent river or stream or intermittent stream".
Erosion control	Methods to prevent or minimise the erosion of soil, in order to minimise the adverse effects that land disturbing activities may have on a receiving environment.
Fish passage	The movement of fish between the sea and any river, including up-stream or downstream in that river.

Term	Definition
Flocculation	The process whereby fine particles suspended in the water column clump together and settle. In some instances, this can occur naturally, such as when fresh clay-laden flows mix with saline water, as occurs in estuaries. Flocculation can be used to promote rapid settling in sediment retention ponds by the addition of flocculating chemicals (flocculants).
Fuels and gas pipelines	Refining NZ and First Gas fuels and gas pipelines.
Groundwater	Natural water contained within soil and rock formations below the surface of the ground.
Heavy vehicle	A motor vehicle having a gross laden weight exceeding 3500 kg.
Historic heritage site	A site that is not identified as an archaeological site, but which has heritage significance.
Hui	Meeting or workshop with Mana Whenua.
Indicative Alignment	An indicative road design alignment assessed by the technical experts that may be refined on detailed design within the designation boundary. The Indicative Alignment is a preliminary alignment of a state highway that could be constructed within the proposed designation boundary. The Indicative Alignment has been prepared for assessment purposes, and to indicate what the final design of the Project may look like. The final alignment for the Project will be refined and confirmed at the detailed design stage.
Intermittent stream	Defined in section J1 the AUP(OP), as "stream reaches that cease to flow for periods of the year because the bed is periodically above the water table. This category is defined by those stream reaches that do not meet the definition of permanent river or stream and meet at least three of the following criteria: (a) it has natural pools; (b) it has a well-defined channel, such that the bed and banks can be distinguished; (c) it contains surface water more than 48 hours after a rain event which results in stream flow; (d) rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel; (e) organic debris resulting from flood can be seen on the floodplain; or (f) there is evidence of substrate sorting process, including scour and deposition."
Kaitiakitanga	Guardianship.
$L_{Aeq\ (t)}$	The average, A-weighted, sound pressure level over the measurement period, t.
$L_{A90\ (t)}$	The A-weighted sound pressure level equalled or exceeded for 90% of the measurement period, t. This is commonly referred to as the background noise level.
L_{AFmax}	The maximum fast time weighted, A-frequency weighted sound pressure level which occurs during the measurement period.
Mainline carriageway	The mainline carriageway is the through-route portion of the Project, excluding the on and off ramps at interchanges, and works to local roads and the existing SH1.

Term	Definition
Mauri	The essential quality and vitality of a being or entity.
Network Utility Operator	As defined in section 166 of the RMA, "means a person who— (a) undertakes or proposes to undertake the distribution or transmission by pipeline of natural or manufactured gas, petroleum, biofuel, or geothermal energy; or (b) operates or proposes to operate a network for the purpose of— (i) telecommunication as defined in section 5 of the Telecommunications Act 2001; or (ii) radiocommunication as defined in section 2(1) of the Radiocommunications Act 1989; or (c) is an electricity operator or electricity distributor as defined in section 2 of the Electricity Act 1992 for the purpose of line function services as defined in that section; or (d) undertakes or proposes to undertake the distribution of water for supply (including irrigation); or (e) undertakes or proposes to undertake a drainage or sewerage system; or (f) constructs, operates, or proposes to construct or operate, a road or railway line; or (g) is an airport authority as defined by the Airport Authorities Act 1966 for the purposes of operating an airport as defined by that Act; or (h) is a provider of any approach control service within the meaning of the Civil Aviation Act 1990; or (i) undertakes or proposes to undertake a project or work prescribed as a network utility operation for the purposes of this definition by regulations made under this Act, — and the words network utility operation have a corresponding meaning."
Overland flow path	Defined in section J1 of the AUP(OP), as "a low point in terrain, excluding a permanent watercourse or intermittent river or stream, where surface runoff will flow, with an upstream contributing catchment exceeding 4,000 m2."
Permanent river or stream	Defined in section J1 of the AUP(OP), as "the continually flowing reaches of any river or stream."
Pier	Vertical support structure for a bridge.
PM10	Particulate matter with a diameter less than 10 micrometres.
PM2.5	Particulate matter with a diameter less than 2.5 micrometres.
Project	The Ara Tūhono Pūhoi to Wellsford project: Warkworth to Wellsford section.
Project area	The area within the proposed designation boundary, and immediate surrounds to the extent Project works extend beyond this boundary.
Project works	All proposed activities associated with the Project.
Sediment control	Defined in section J1 of the AUP(OP), as "measures to prevent or minimise the discharge of sediment that has been eroded."
Sediment yield	That sediment which leaves the sediment retention devices and enters the receiving environment.

Term	Definition
Stabilised area	An area inherently resistant to erosion such as rock, or rendered resistant by the application of aggregate, geotextile, vegetation or mulch. Where vegetation is to be used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once an 80% vegetation cover has been established.
State highway	Means a road, whether or not constructed or vested in the Crown, that is declared to be a State highway under section 11 of the National Roads Act 1953, section 60 of the Government Roading Powers Act 1989 (formerly known as the Transit New Zealand Act 1989), or under section 103 of the LTMA.
Taonga	A treasured/highly prized object or natural resource.
The Dome	The highest elevation within the Dome Forest Conservation Area.
The Application	Notice of Requirement and applications for resource consent

1. Introduction

1.1. Introduction to this Report

The NZ Transport Agency (Transport Agency) has lodged a Notice of Requirement (NoR) and applications for resource consent (collectively referred to as "the Application") for the Warkworth to Wellsford Project (the Project).

This Project is the second stage of the Ara Tūhono Pūhoi to Wellsford (P–W) project covering the State Highway 1 (SH1) corridor from the Northern Gateway Toll Road at the Johnstone's Hill tunnels, to Wellsford and Te Hana. The first stage, the Pūhoi to Warkworth project (P2Wk), was progressed as a separate project. It proceeded through scheme assessment, selection of a preferred alignment, and designation through a Board of Inquiry and is under construction. P2Wk provides a new and alternative alignment to the existing SH1 route between Pūhoi and SH1 just south of the Kaipara Flats Road intersection, which lies to the north of Warkworth.

This report has been prepared to support the Application for the Project, covering a new alignment for SH1 north from Wyllie Road, bypassing Wellsford and Te Hana, to tie in with a connection back to the existing SH1 north of Te Hana.

In summary, the primary reasons for the Project are to:

- Improve safety performance to reduce incidents on SH1;
- Improve route security and resilience of the state highway network north of Auckland;
- Reduce travel times and improve travel time reliability along the state highway network north of Auckland;
- Improve freight travel times, safety and reliability; and
- Improve the amenity of Wellsford and Te Hana through the removal of heavy truck movements through the townships.

1.2. The Requiring Authority/Applicant

The Transport Agency is a Crown entity established on 1 August 2008 under the Land Transport Management Act 2003 (LTMA). As a Crown entity it must give effect to government policy as directed by the Minister of Transport.

The Transport Agency's statutory objective, as set out in section 94 of the LTMA is:

> "*to undertake its functions in a way that contributes to an effective, efficient, and safe land transport system in the public interest*".

This objective also forms one of the Transport Agency's functions as defined in section 95(1)(a) of the LTMA.

The Transport Agency's other key function of relevance to the Project is:

> "*to manage the State highway system, including planning, funding, design, supervision, construction, and maintenance and operations, in accordance with this Act* [the LTMA] *and the Government Roading Powers Act 1989*" *(section 95(1)(c)).*

In meeting its objective and undertaking its functions the Transport Agency must adhere to, among others, the operating principles set out in section 96 of the LTMA. These operating principles include an obligation to exhibit a sense of social and environmental responsibility (section 96(1)(a)).

The Transport Agency's organisational direction is comprehensively set out in its Statement of Intent 2017–21 (SOI 2017). The SOI 2017 states that its direction will enable the Transport Agency to:

> *"...more effectively deliver on the transport sector goal for a transport system that maximises economic and social benefits for New Zealand and minimises harm".*[1]

The SOI 2017 further states that the direction:

> "...*will also contribute to the government's wider priorities, providing modern infrastructure and services that support a more productive economy with more jobs, higher incomes and higher living standards.*"[2].

The Transport Agency is a network utility operator under the Resource Management Act 1991 (RMA) and is approved as a requiring authority under section 167 of that Act.[3] The Transport Agency's approval as a requiring authority includes:[4]

> *"the construction and operation (including the maintenance, improvement, enhancement, expansion, realignment and alteration) of any State highway or motorway pursuant to the Government Roading Powers Act".*

The Transport Agency, in its capacity as a requiring authority, is giving notice of a requirement for, and is also lodging resource consent applications for, the future construction, operation and maintenance of the Project.

1.3. The Warkworth to Wellsford Project

The Project involves the construction, operation and maintenance of a new four lane state highway, approximately 26 km in length. The Project commences at the interface with P2Wk near Wyllie Road and passes to the west of the existing SH1 alignment near The Dome, before crossing SH1 just south of the Hōteo River. North of the Hōteo River, the Project passes to the east of Wellsford and Te Hana, bypassing these centres. The Project ties into the existing SH1 to the north of Te Hana, near Maeneene Road.

[1] Statement of Intent 2017-21, Page 3.
[2] Statement of Intent 2017-21, Page 3.
[3] See Resource Management (Approval of Transit New Zealand Limited as Requiring Authority) Order 1992; Resource Management (Approval of Transit New Zealand as Requiring Authority) Notice 1994; and Resource Management (Approval of NZ Transport Agency as a Requiring Authority) Notice 2015.
[4] Resource Management (Approval of Transit New Zealand as Requiring Authority) Notice 1994.

The key components of the Project, based on the current Indicative Alignment, are shown on Figure 1-1 and summarised below (noting the Application seeks comprehensive approvals for all components of the Project):

a) A new four lane dual carriageway state highway, offline from the existing SH1, with the potential for slow vehicle lanes on the steeper grades.

b) Three interchanges as follows:

   i. Warkworth Interchange to tie-in with P2Wk and provide a connection to the northern outskirts of Warkworth.

   ii. Wellsford Interchange located at Wayby Valley Road to provide access to Wellsford and eastern communities including Tomarata and Mangawhai.

   iii. Te Hana Interchange located at Mangawhai Road to provide access to Te Hana, Wellsford and communities including Port Albert, Tomarata and Mangawhai.

c) Twin bore tunnels under Kraack Road, each serving one direction, that are approximately 850 metres long and approximately 160 metres below ground level at the deepest point.

d) A series of steep cut and fills through the forestry area to the west of the existing SH1 (west of The Dome) and other areas of cut and fill along the remainder of the Project.

e) A viaduct (or twin structures) approximately 485 metres long, to span over the existing SH1 and the Hōteo River.

f) A tie in to existing SH1 north of Maeneene Road, including a bridge over Maeneene Stream.

g) Changes to local roads:

   i. Maintaining local road connections through grade separation (where one road is over or under the other). The Indicative Alignment passes over Woodcocks Road, Wayby Valley Road, Whangaripo Valley Road, Mangawhai Road and Maeneene Road. The Indicative Alignment passes under Kaipara Flats Road, Rustybrook Road, Farmers Lime Road and Silver Hill Road.

   ii. Realignment of sections of Wyllie Road, Carran Road, Kaipara Flats Road, Phillips Road, Wayby Valley Road, Mangawhai Road, Vipond Road, Maeneene Road and Waimanu Road.

   iii. Closing sections of Phillips Road, Robertson Road, Vipond Road and unformed roads affected by the Project.

h) Associated works including bridges, culverts, stormwater management systems, soil disposal sites, signage, lighting at interchanges, landscaping, realignment of access points to local roads, and maintenance facilities.

i) Construction activities, including construction compounds, borrow sites, lay down areas and establishment of construction access and haul roads.

Further details of the Project are contained in *Section 4: Description of the Project* and *Section 5: Construction of the Project* of this Assessment of Effects on the Environment (AEE).

The Indicative Alignment is a preliminary alignment of a state highway that could be constructed within the proposed designation boundary. The Indicative Alignment has been prepared for assessment purposes, and to indicate what the final design of the Project may look like. The final alignment for the Project (including the design and location of associated works including bridges, culverts, stormwater management systems, soil disposal sites, signage, lighting at interchanges, landscaping, realignment of access points to local roads, and maintenance facilities), will be refined and confirmed at the detailed design stage.

The timing for construction of the Project is not certain. To enable an assessment of the potential effects of the Project on the environment, the assumed construction start date is 2030. However, the actual timing for construction could be sooner or later than this date.

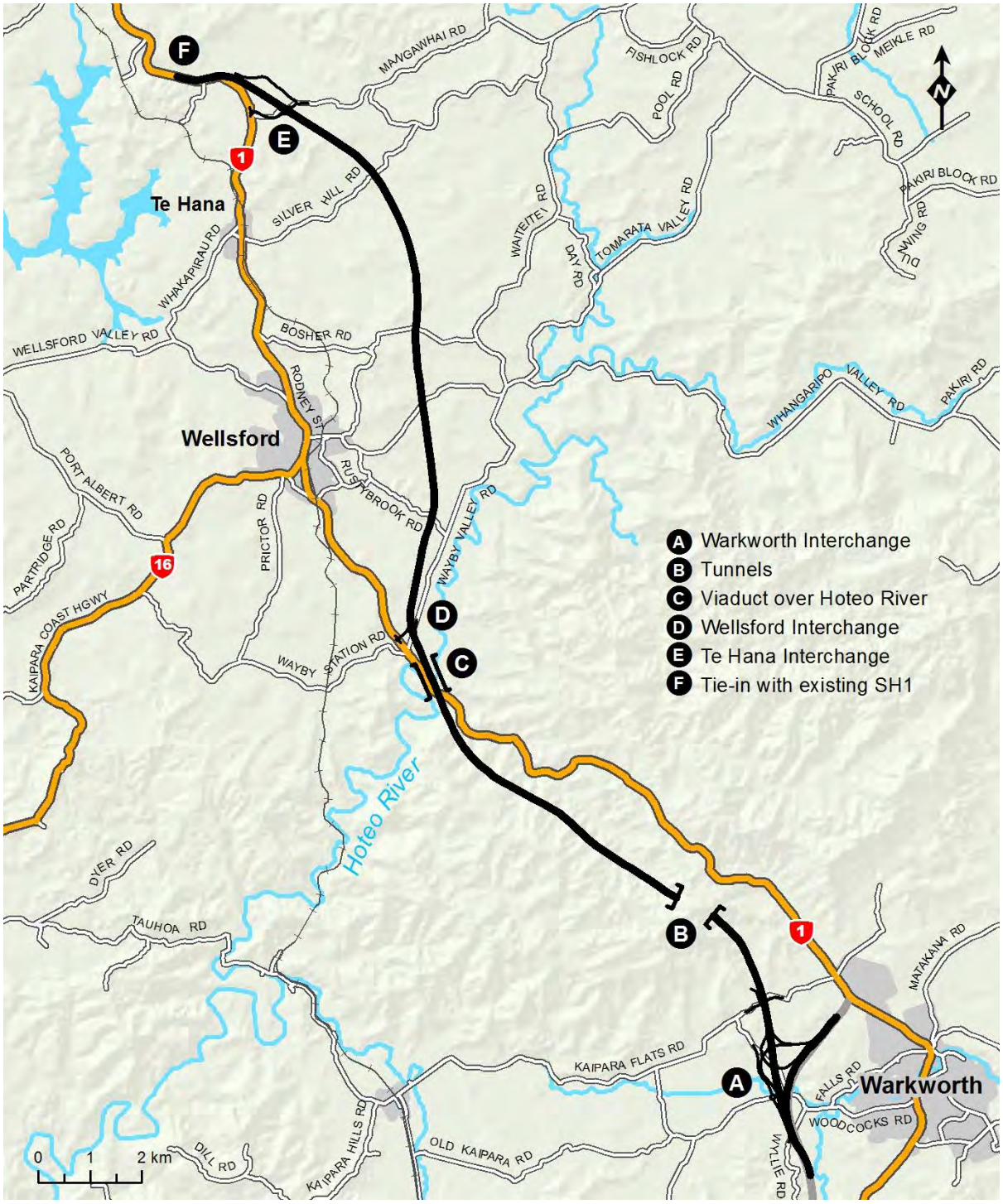

Figure 1-1: Key Project components

1.4. NoR to be confirmed and resource consents sought ("the Application")

To enable the construction, operation and maintenance of the Project, a new designation is proposed, and resource consents are sought.

1.4.1. NoR

The extent of the proposed designation is from Wyllie Road, north of Warkworth, bypassing Wellsford and Te Hana to tie in with a connection north of Te Hana. The proposed designation covers a total area of approximately 1,294 hectares (ha).

The extent of the proposed designation is sufficient to construct, operate, and maintain the Project, and includes land for access to construction sites, construction compounds, soil disposal, and mitigation of effects.

Once the Project is operational the Transport Agency will review the extent of the designation boundary and may remove any parts that are not required for the safe and efficient long-term operation, maintenance and improvements to the state highway. The Transport Agency will inform Auckland Council of its intention to remove parts of the designation (if required) following the process set out in section 182 of the RMA.

The proposed designation boundary is shown on the designation plans attached to the Notice of Requirement (NoR) and in the drawings in *Volume 3: Drawing Set*.

The Transport Agency will submit outline plans to Auckland Council under section 176A of the RMA or details required by designation conditions once the Project's detailed design has been progressed to an appropriate level of detail and prior to the commencement of the construction work. It is anticipated that some aspects of detailed design will be staged to accommodate an efficient construction programme.

1.4.2. Resource consents

Various resource consents are required for the construction, operation and maintenance of the Project as detailed in *Section 6: Statutory context* of this AEE. In summary, the following resource consents are required pursuant to the Auckland Unitary Plan (Operative in Part) (AUP(OP)):

- Land use consents in accordance with sections 9(2) and 13 of the RMA;
- Water permits in accordance with section 14 of the RMA; and
- Discharge permits in accordance with section 15 of the RMA.

1.4.3. Later approvals

The AEE is based on an Indicative Alignment and indicative construction methodology. Once a contractor is appointed and detailed design undertaken, additional approvals for the Project may be required and will be obtained prior to construction. These approvals may include:

- Resource consents determined relevant at the time of construction, such as consents for soil disturbance under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES Soil); forestry removal under the National Environmental Standard for Plantation Forestry (NESPF); water takes (e.g. for dust management); consents or consent

variations required to modify covenants relating to the removal of vegetation; and wastewater discharges from site office facilities;
- Archaeological Authority from Heritage New Zealand Pouhere Taonga (HNZPT) to modify and/or destroy or modify any known archaeological sites;
- Wildlife Act Authority to relocate any protected species prior to the commencement of construction; and
- Authority under the Freshwater Fisheries Regulations relating to fish passage.

1.5. Structure of the Application and supporting documents

This AEE and the associated technical reports, design drawings and supporting information, contains the information required by the RMA and the AUP(OP). The structure of the Application is set out in Table 1-1.

Table 1-1: Structure of the Application

Volume	Name	Contents
	Notice of Requirement	Form for Notice of Requirement (Form 18). Gazette notices. Designation plans showing the land to which the Notice of Requirement relates. Schedule of land directly affected by the Notice of Requirement. Proposed designation conditions.
	Resource Consent Application Forms	Forms for resource consents (Form 9). Schedule of land directly affected by the resource consents. Proposed resource consent conditions.
1	Assessment of Effects on the Environment	AEE (this report).
2	Supporting Technical and Assessment Reports	Technical reports assessing the effects of the construction and operation of the Project.
3	Drawing Set	Indicative design drawings for all aspects of the Project including the road alignment, structures, lighting and water systems. Drawings supporting the technical assessments, and the Urban and Landscape Design Framework (ULDF).

1.6. Structure of this AEE

In accordance with the requirements of the RMA (particularly Schedule 4), this AEE provides the following information and is structured as follows:

Table 1-2: Structure of this AEE

Section	Name	Contents
1	Introduction	An introduction to the Application, Applicant and Project, including summary of approvals required and structure of the AEE and Application.
2	Background and strategic context for the Project	Sets out the background and strategic context and need for the Project and the Project objectives.
3	Description of the existing environment	Description of the existing environment.
4	Description of the Project	Description of the Project.
5	Construction of the Project	An outline of an indicative method to construct the Project.
6	Statutory context	Identification of the legal framework that applies to the Application, and identification of the approvals required.
7	Consideration of alternatives	The methodology by which alternative sites, routes and methods of undertaking the work have been considered.
8	Consultation and engagement	An outline of engagement that has occurred during preparation of the Application, feedback received and responses to issues raised.
9	Assessment of effects on the environment	Outline of the methodology and assessment of the actual and potential effects on the environment, including consideration of measures proposed to avoid, remedy or mitigate effects.
10	Management of effects on the environment	Proposed measures to manage the identified effects, including a management plan framework.
11	Statutory assessment	An assessment of the Project against the matters set out in applicable provisions of the RMA. An assessment of the Project against the relevant provisions of relevant national, regional and local statutory and non-statutory documents.
12	Conclusion	Conclusion.

2. Background and strategic context for the Project

2.1. Overview

As the main inter-regional route connecting the Auckland and Northland regions, SH1 provides a vital lifeline connecting the Far North to Whangārei, Auckland and beyond. The Agency seeks to provide a safe, accessible, secure and efficient state highway network with environmental benefits to provide local, regional and national transport connections consistent with the outcomes sought in national, regional and local transport planning policy.

The Transport Agency has carried out a series of studies on the state highway network investigating the transport needs and opportunities for improving connections between the Auckland and Northland regions safety and reliably by road. These studies have considered the role of the state highway network in relation to the wider transport system between Auckland and Northland.

The Transport Agency's strategic studies and investigations of the state highway network have identified a number of key concerns in relation to the state highway network connecting Auckland and Northland, including:

- Safety of the network;
- Accessibility;
- Limited network resilience;
- The efficient movement of freight; and
- The capacity of the existing network to accommodate anticipated population growth.

The Project is supported by a range of broad strategic plans, which include projects and initiatives aimed at stimulating and transforming the Northland economy including the Tai Tokerau Growth Study[5] and Tai Tokerau Northland Economic Action Plan 2016 (NEAP). One of the key enablers identified in the NEAP for improving the economic performance of Northland is transport accessibility. Completion of the Project is seen as one of the key projects to address transport accessibility by Auckland Council, other government agencies and key stakeholders.

The Auckland Plan 2050 acknowledges the need to improve accessibility between Auckland and Whangārei and identifies the Project in the Strategic Road Network.

The Whangārei to Auckland – Connecting Northland Programme Business Case 2017[6] involved the development of options to best address the problems identified for the corridor and a suite of programmes to deliver the agreed outcomes sought by stakeholders. This project formed part of that suite of programmes.

More specifically, the problems on the existing SH1 Warkworth to Wellsford route identified in the Detailed Business Case for Ara Tūhono Pūhoi to Wellsford: Stage II Warkworth to Wellsford[7] are, in summary:

[5] Tai Tokerau Northland Growth Study Opportunities Report February 2015
[6] NZ Transport Agency, 2017a.
[7] NZ Transport Agency, 2019.

1. By national standards the corridor is substandard for a national strategic route, resulting in a higher number of crashes involving injury and death, flooding and slips; and
2. Poor resilience and costly journeys between Northland and key markets, which is constraining economic growth and investor confidence.

The above mentioned strategic investigations and assessments have formed the basis for the Project, which in turn assist the Transport Agency to meet its objectives under the LTMA. The outcomes of this Project, being a safer, more resilient route that provides improved accessibility to Northland (a key Regional Development area) are consistent with the Government Policy Statement on Land Transport 2018/19–2027/28 (GPS 2018). In delivering the Project in accordance with the Project objectives as outlined in the NoR, the agreed wider corridor objectives are expected to be delivered.

The Project objectives and outcomes are detailed in section 2.2 and section 2.5 of this AEE.

2.2. Project objectives

The Transport Agency's wider objectives for the Pūhoi to Wellsford project are:

- To enhance inter-regional and national economic growth and productivity;
- To improve movement of freight and people between Auckland and Northland;
- To improve the connectivity between the medium to long-term growth areas in the northern Rodney area (Warkworth and Wellsford); and
- To improve the reliability of the transport network through a more robust and safer route between Auckland and Northland.

To give effect to the above objectives, the Transport Agency's objectives for this Project (under RMA section 171(1)(c)) are to:

- Increase corridor access, improve route quality and safety, and improve freight movement between Warkworth and the Northland Region;
- Provide resilience in the wider State highway network;
- Improve travel time reliability between Warkworth, Wellsford and the Northland Region;
- Provide connections to and from Warkworth, Wellsford and Te Hana;
- Provide a connection at Warkworth that optimises the use of infrastructure from, and maintains the level of service provided by, the Pūhoi to Warkworth project; and
- Alleviate congestion at Wellsford by providing an alternative route for north – south through traffic.

2.3. Strategic context

The Project has been developed in accordance with key legislation and government transport policy that provides the Transport Agency with strategic direction and guidance. The key legislation and policies that have guided the development of the Project and the evaluation of the expected outcomes from it include:

- The Local Government (Auckland Council) Act 2009 (LG(AC)A), which has informed regional spatial planning (the Auckland Plan) which in turn provides input to a number of other implementation plans;
- The LTMA, which informs both the development of strategy (e.g. the Government Policy Statement on Land Transport and New Zealand Transport Strategy) as well as plans (e.g. the New Zealand and Regional Land Transport Plans and the Integrated Transport Plan); and
- The RMA, which is implemented through policy statements, national environmental standards (NES), and plans.

2.3.1. National context

The New Zealand Transport Strategy (NZTS) (Ministry of Transport, 2008) seeks to ensure that "people and freight in New Zealand have access to an affordable, integrated, safe, responsible and sustainable transport system." The Project will support the key objectives of the NZTS.

The Government released the National Land Transport Programme (NLTP) 2018-2021 in August 2018. The programme gave effect to GPS 2018, which recognised a transport system that prioritises safety and access followed by environmental benefits and value for money. GPS 2018 sets out the government's priorities for expenditure from the National Land Transport Fund over a ten-year period.

The key strategic priorities of the GPS 2018 are safety and access. In order to progress these outcomes, investments are also required to demonstrate benefits for the environment and offer value for money.

The Project responds to the direction set out in GPS 2018 for the following reasons:

- The design of the Project will meet high safety standards[8];
- The total number of crashes (including deaths and serious injuries) is predicted to reduce significantly;
- The Project will support safe cycling and walking by the provision of linkages where feasible as part of the Project scope (such as across interchanges, onto SH1 at the northern tie in, on local roads where the Project passes over on a bridge structure);
- The Project will support increased access for economic and social opportunities through improved access for freight and tourist movements between Auckland and Northland, improved access for residents of Wellsford and Te Hana who are currently subject to disruption due to congestion, and improved connectivity within Wellsford and Te Hana by removing significant levels of traffic off their main thoroughfares and allowing them to reconnect and improve the main streets of both centres;
- The Project provides resilience to the critical SH1 network, which is currently subject to delays and unreliable travel times due to road closures resulting from accidents, breakdowns and/or severe weather event related incidents, or due to congestion – especially during weekend and summer periods;

[8] As evidenced in the *Operational Transport Assessment* in Volume 2

- There will be improvements to the amenity of the townships of Wellsford and Te Hana with the removal of the heavy truck movements that currently influence walkability, noise and air quality within those town centres; and
- Once operational the Project will make a contribution to improvements in the environment, through treatment of road stormwater to leading to reduced contaminant loads for two river catchments, retiring of some land that contributes to the sediment load of the Kaipara Harbour, through landscaping and planting for mitigation and through design which will assist with more fuel efficient travel (through better gradients and less need to brake, accelerate and/or decelerate).

2.3.2. Regional context

The SH1 corridor is identified[9] as a National (High Volume) route between Pūhoi and Wellsford (the highest classification) and a National route from Wellsford to Whangārei, due to its role in providing access between Auckland and Whangārei (including Auckland International Airport and port facilities (Northport and Ports of Auckland)). It currently has a dual role providing for local as well as inter-regional traffic for light and heavy vehicles (freight) between major centres of population and economic activity. Currently, this corridor suffers significantly when there are unplanned incidents that affect its resilience and availability. These issues are discussed in section 2.4 below.

The overarching strategic approach adopted by the Transport Agency for Northland is 'Connecting Northland'; an integrated transport approach which recognises the importance of improving transport access. The Auckland to Whangārei Programme Business Case[10] (2017) responds to the vision of Connecting Northland with a number of major infrastructure schemes to deliver a safe corridor which provides reliable journey times to support the economic growth of the region and access to key markets. The current corridor strategy is a combination of significant capital investment targeted at the southern portion of the corridor through the P-W project, complemented by targeted investment to address localised safety and resilience issues along the corridor further north.

Northland's regional economy has been underperforming relative to other New Zealand regions[11]. Transport connections and resilience are critical for the Northland region given its geographical position and isolation from key markets. Efficient access to the markets and economic opportunities of metropolitan Auckland, and also connectivity to the Auckland airport and seaports at Northport, Auckland and Tauranga, are key to supporting future growth. One of the key enablers for improving the economic performance of Northland is transport accessibility. The Tai Tokerau Growth Study and all-of-government NEAP identify Connecting Northland, including the route protection and completion of the Ara Tūhono Pūhoi to Wellsford project as

[9] One Network Road Classification, NZ Transport Agency
[10] The Transport Agency, Whangārei to Auckland - Connecting Northland Programme Business Case, August 2017.
[11] Northland Economic Action Plan, 2016.

well as improvements between Wellsford and Whangārei, as enablers to support key economic growth opportunities.

The Project is identified in the Regional Land Transport Strategy 2010 (RLTS), developed by Auckland Transport. A key emphasis in the RLTS is reducing congestion for freight vehicles. The Project will improve journey times and journey time reliability for freight.

The Auckland Regional Land Transport Plan 2015-2025 (ARLTP) outlines how transport priorities will be delivered over a ten-year period and implements the NLTP. The ARLTP identifies the Project as a necessary improvement project with inter-regional significance.

2.3.3. Other strategic considerations

In 2006, the Transport Agency commissioned a strategic assessment of SH1 and SH16 between Auckland and Wellsford: the SH1/SH16 Auckland to Wellsford Strategic Study[12]. The purpose of the study was to identify the future function and form of SH1 and SH16. The recommended strategy, which emerged from a LTMA based evaluation framework, was retention of the functions defined in what was then the National State Highway Strategy, namely, retaining the national function on SH1, with SH16 fulfilling a regional function (refer Figure 2-1). The study concluded that the SH1 corridor was the preferred route for future development to meet the long-term inter-regional transport needs of Auckland and Northland.

[12] Sinclair Knight Merz, 2008.

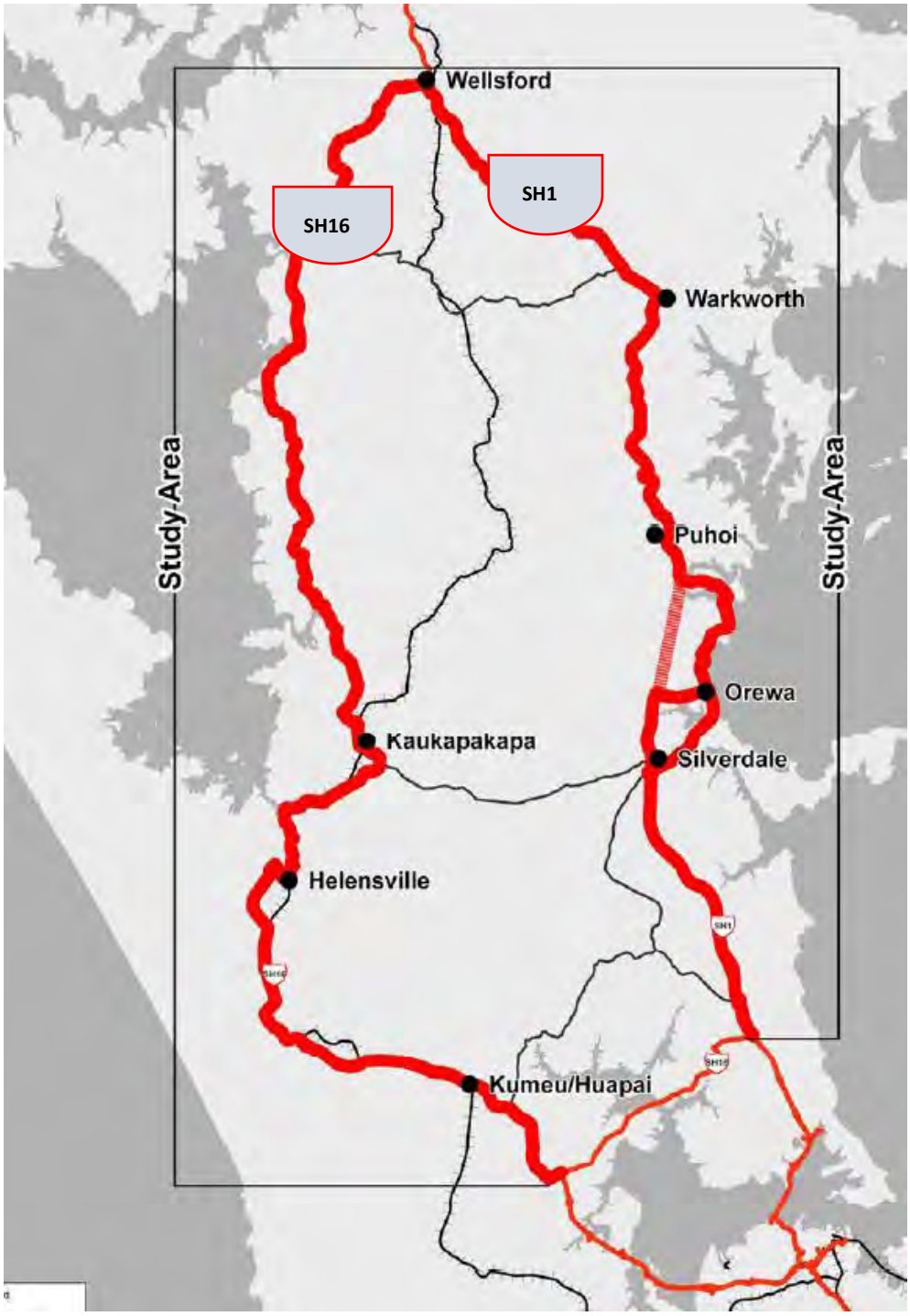

Figure 2-1: SH1/SH16 corridor

(Source: SH1/SH16 Auckland to Wellsford Strategic Study, 2008)

The Auckland to Whangārei Strategic Assessment: Strategic Context Report (2010)[13] concluded that by 2021, SH1 between Pūhoi and Wellsford would experience significant congestion during the peak traffic periods as a result of the current network capacity. The Strategic Context Report identified and confirmed the importance of the state highway network to the economic growth and sustainability of the Northland Region.

[13] Sinclair Knight Merz, 2010.

The key recommendation of the Strategic Context Report was that road-based transport was the only mode where a significant increase in capacity was possible to accommodate increased demand along the transport corridor between Auckland and Whangārei. In addition, the assessment provided clear guidance on the route configuration (a four-lane offline alignment being preferable to an online upgrade) that was most appropriate to meet the strategic objectives set down by the LTMA and the Government Policy Statement on Land Transport Funding 2009/2010 – 2018/19 (GPS 2009), and the objectives for Pūhoi to Wellsford adopted by the Transport Agency.

The Transport Agency developed a Network Plan for SH1 between Auckland and Whangārei[14] for the long-term future (2050) to consider the wider transport network implications of the Auckland to Whangārei Strategic Assessment (2010). The key purpose of the Network Plan is to support on-going integrated planning, optimisation of benefits and decision making for the local network and activities and infrastructure associated with the Pūhoi to Wellsford project, and wider Auckland and Northland Regional transport networks.

In 2010, the Transport Agency commenced a scheme assessment for the proposed state highway from Pūhoi to Wellsford. It was at this time that the Transport Agency determined that the Pūhoi to Wellsford project should be split in two discrete sections, given the scale of the works. The two sections were:

- Stage 1: Pūhoi to Warkworth, including a Warkworth bypass.
- Stage 2: Warkworth to Wellsford, including a Wellsford bypass.

The Pūhoi to Warkworth section was progressed as a separate project through scheme assessment, selection of a preferred alignment, and obtained resource consents and a designation through a Board of Inquiry. The P2Wk is currently under construction, and is being delivered as a Public Private Partnership (PPP).

The progression of the design, and the options considered for Stage 2: the Warkworth to Wellsford Project, are discussed in *Section 7: Consideration of Alternatives*.

2.4. The need for the Project

The Project has its genesis in the strategic planning documents referred to in section 2.3, above. In addition to these documents, the following more localised transport issues inform the need for the Project. These issues are documented in the Programme Business Case (PBC)[15] for the Auckland to Whangārei corridor and the Detailed Business Case (DBC)[16] for Warkworth to Wellsford and are summarised below.

2.4.1. Corridor resilience

SH1 between Auckland and Whangārei is of nationally strategic significance, as it is the primary inter-regional transport route between the Auckland and Northland regions. The section of SH1 from Warkworth to Te Hana is part of this main transport connection. This corridor suffers regularly from unplanned incidents (crashes,

[14] Auckland to Whangārei Strategic Assessment: Network Plan, Sinclair Knight Metz, July 2010.
[15] Whangārei to Auckland – Connecting Northland Programme Business Case, NZ Transport Agency, 2017.
[16] Detailed Business Case for Ara Tuhono – Puhoi to Wellsford: Stage II – Warkworth to Wellsford, NZ Transport Agency, 2019.

flooding or slips blocking the road), affecting its resilience and availability, and leading to increased travel times.

The DBC identifies:

> *"The existing section of SH1 between Warkworth and Te Hana traverses difficult terrain. The existing alignment is defined by a number of geometric constraints, resulting in areas of tight horizontal and steep vertical alignment.*
>
> *This situation is resulting in a disproportionately high number of deaths and serious injuries along the route. The route is also subject to resilience challenges, with over 30 hours delay from full closures on this section of SH1 (generally due to motor accidents and some environmental factors such as flooding and slips) over the period 2013-mid 2018. This is high compared to other High Volume Strategic National Routes"*[17].

The DBC reports that, in the 2013–2018 period, there were 9 full closures in this section of SH1, equivalent to full closure of the route every 7.3 months. A full closure is where SH1 is closed to both northbound and southbound traffic. There was a total of 29 hours of full closure during this period, giving an average delay of over 3 hours per closure. This data excludes partial closures, which would further compound resilience issues. Of these unplanned incidents, 89% resulted from crashes with the remainder a combination of other predominantly environmental factors (for example, flooding or slips). The location of these closures is shown in Figure 2-2, indicating that resilience challenges in the Dome Valley are a priority. Figure 2-2 shows a high number of incidents around the Wayby Valley Road intersection and the Hōteo River crossing.

The detour routes for many of these closures are challenging for users, as shown in Figure 2-2. The section between Warkworth and Wayby Valley Road is subject to a large detour with a significant travel time. Many of the detour routes are also not able to carry full High Productivity Motor Vehicles (HPMVs). SH16 provides the only available alternative route between Wellsford and Auckland in the event that SH1 through the Dome Valley is closed for these vehicles. The length of the detour routes and their inability to carry HPMVs significantly restrict the ability to divert freight traffic away from incidents.

[17] Ibid, 8.

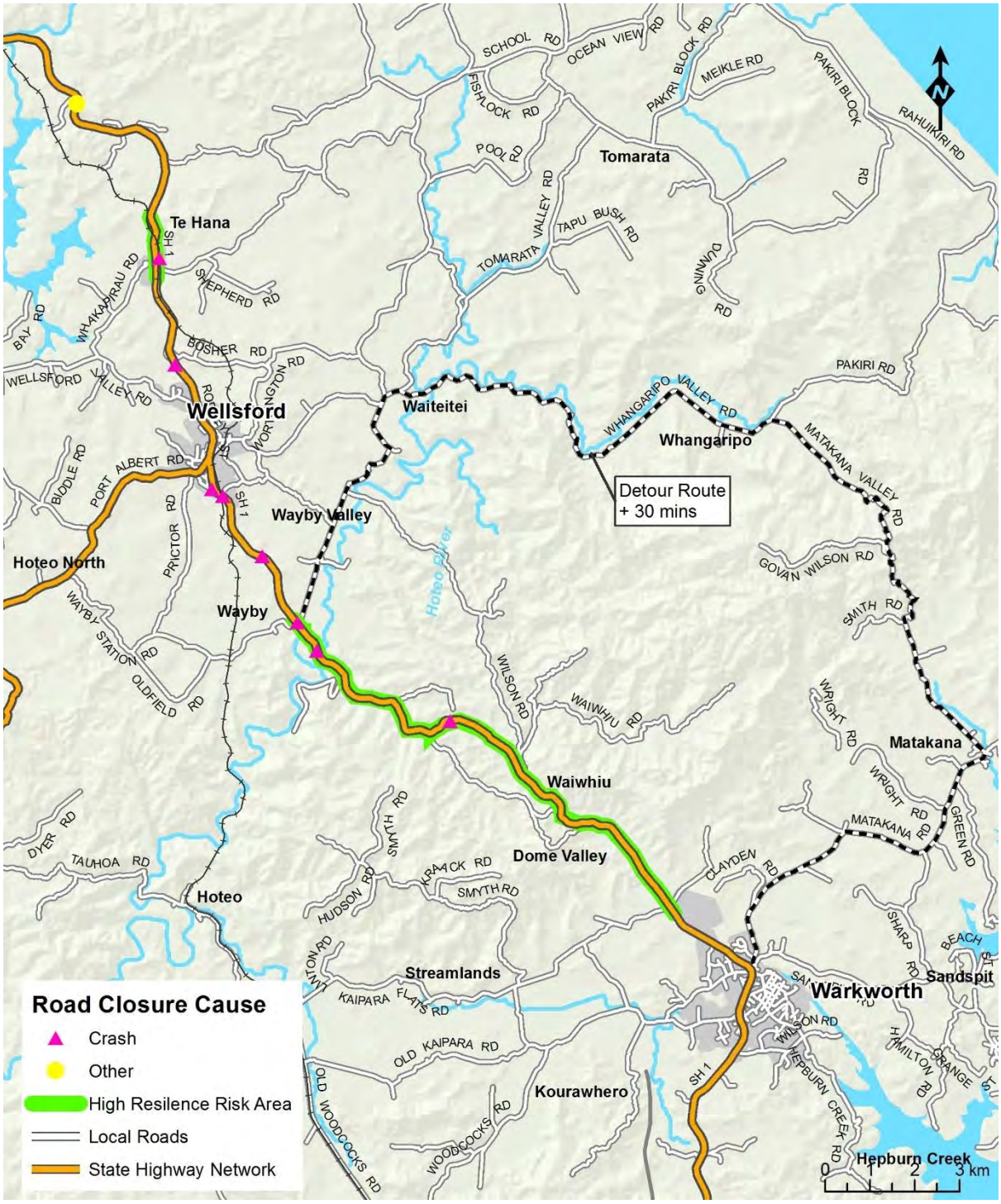

Figure 2-2: Warkworth to Te Hana unplanned incidents and detour restrictions (2013-2018)

(Source: Modified from the DBC)

2.4.2. Traffic volumes and travel time reliability

The Transport Agency's Traffic Management System (TMS) database records an Average Annual Daily Traffic (AADT) on SH1 of approximately 20,000 vehicles per day (vpd) through Warkworth, 12,000 vpd through the Dome Valley between Goatley Road and Wayby Valley Road, and 12,000 vpd between Wellsford and Te Hana. Traffic volumes vary throughout the year, with a noticeable decrease over the winter months.

Traffic volumes between Warkworth and Wellsford are the highest in December (13,000 vpd) and lowest in June (9,000 vpd)[18].

There are pronounced peaks in vehicle numbers coinciding with evening peaks, weekends and public holidays. This is particularly noted in summer, when the beaches and holiday areas east of Wellsford and further north draw people from Auckland. The typical holiday end[19] AADT on SH1 is on average 47% greater than the weekday AADT in the southbound direction (the direction in which most traffic is travelling at holiday end). AADT going both directions is 19% greater during the holiday end period than a typical midweek day[20].

The existing SH1 between Warkworth to Te Hana is currently subject to congestion[21]. The most regular congestion currently along SH1 occurs through Warkworth, at the southern end of the Project, and southbound queues extend back along SH1 towards Wellsford from Warkworth for several kilometres. This congestion results in increased travel times, not only through Warkworth but also through Wellsford and at various locations along the route, such as at the end of passing lanes. Congestion is quite pronounced at peak periods, such as weekends over the summer, and particularly around weekends which coincide with public holidays. Travel times for northbound traffic are significantly higher at the start of a holiday weekend, and for southbound traffic at the end of a holiday weekend. In addition, severe congestion can occur as a result of unexpected incidents (such as crashes, slips, etc.)

Analysis[22] shows southbound journeys from south of Te Hana to south of Wellsford have the most travel time variability in morning and evening peaks. In the morning peak 92% of these trips have a journey time between 2 and 5 minutes. During the holiday end period the same section, southbound through Wellsford, has the most variability with only 31% southbound trips achieving a journey time between 3 and 5 minutes. This analysis shows that travel time variability on SH1 between Warkworth and Te Hana is a significant issue during holidays, particularly through Wellsford, with typical journeys varying by up to 7 minutes in this section.

Daily traffic volumes on SH1 are predicted to grow at a rate of approximately 3.4% per annum between 2016 and 2046 between Warkworth and Te Hana, increasing by 71% between 2016 and 2036, without the Project in place. This growth rate means that daily traffic volumes on SH1 are expected to be in the order of 29,000 vpd in 2046 between Warkworth and Wellsford (with slightly lower traffic volume between Wellsford and Te Hana)[23], which would further reduce travel time reliability[24].

2.4.3. Safety of the network

A significant increase in traffic over the past few decades has highlighted the geometric issues associated with the current SH1 alignment, which has an unsatisfactory safety record.

[18] Based on average daily traffic volumes on SH1 between Warkworth and Wellsford for each month of 2016 (Traffic and Transportation Assessment, Jacobs, 2018).
[19] 10:00 am to 6:00 pm on a holiday end day.
[20] Operational Transport Assessment, Section 3.4.
[21] Operational Transport Assessment, Section 3.5
[22] Operational Transport Assessment, Section 3.6.
[23] Operational Transport Assessment, Section 4.2.
[24] Operational Transport Assessment, Section 4.4.

The section of SH1 from Warkworth to Wellsford is classified as a High Volume National route in the One Network Road Classification (ONRC) system. North of Wellsford to Whangārei it is classified as a National Route. From a safety perspective the High Volume National route requires the following standard (customer levels of service (CLoS)):

> ***High Volume National**: Mostly forgiving roads and roadsides, equivalent to KiwiRAP 4-Star standard. User hazards absent or mitigated, including head on risk. Active road users generally do not have access - if present, they are provided with separate space or are physically separated. The road form provides road user guidance.*

Currently, SH1 between Pūhoi and Whangārei is predominately a 2-Star standard as assessed by KiwiRAP[25], which falls short of the required 4-Star standard for a High Volume National route. The Dome Valley is noted as a particular blackspot for incidents.

The crash history reflects this lower standard road, with the Transport Agency's Crash Analysis System (CAS) database along SH1 between Warkworth and Te Hana identifying a total of 312 crashes between 2013 and 2018. Of these crashes, 46 involved minor injuries, 17 involved serious injuries, and 4 were fatal. The most common type of crash along this section of state highway is cornering crashes, with head on and rear end crashes being the second and third most common respectively. The majority of the fatal and serious injuries resulted from head on crashes, with cornering crashes resulting in the highest proportion of minor injury and non-injury crashes. The lack of a central median barrier on the route is considered to contribute to the high number of head-on crashes, many of which result in serious injuries or fatalities. Figure 2-3, below, shows the location of fatal and serious injury crashes on the corridor between 2013 and 2018. The collective risk rating is also shown through this corridor, which is measured in terms of the number of crashes per kilometre of state highway.

[25] KiwiRAP is the New Zealand Road Assessment Programme. It is part of the International Road Assessment Programme, otherwise known as iRAP (refer www.kiwirap.org.nz).

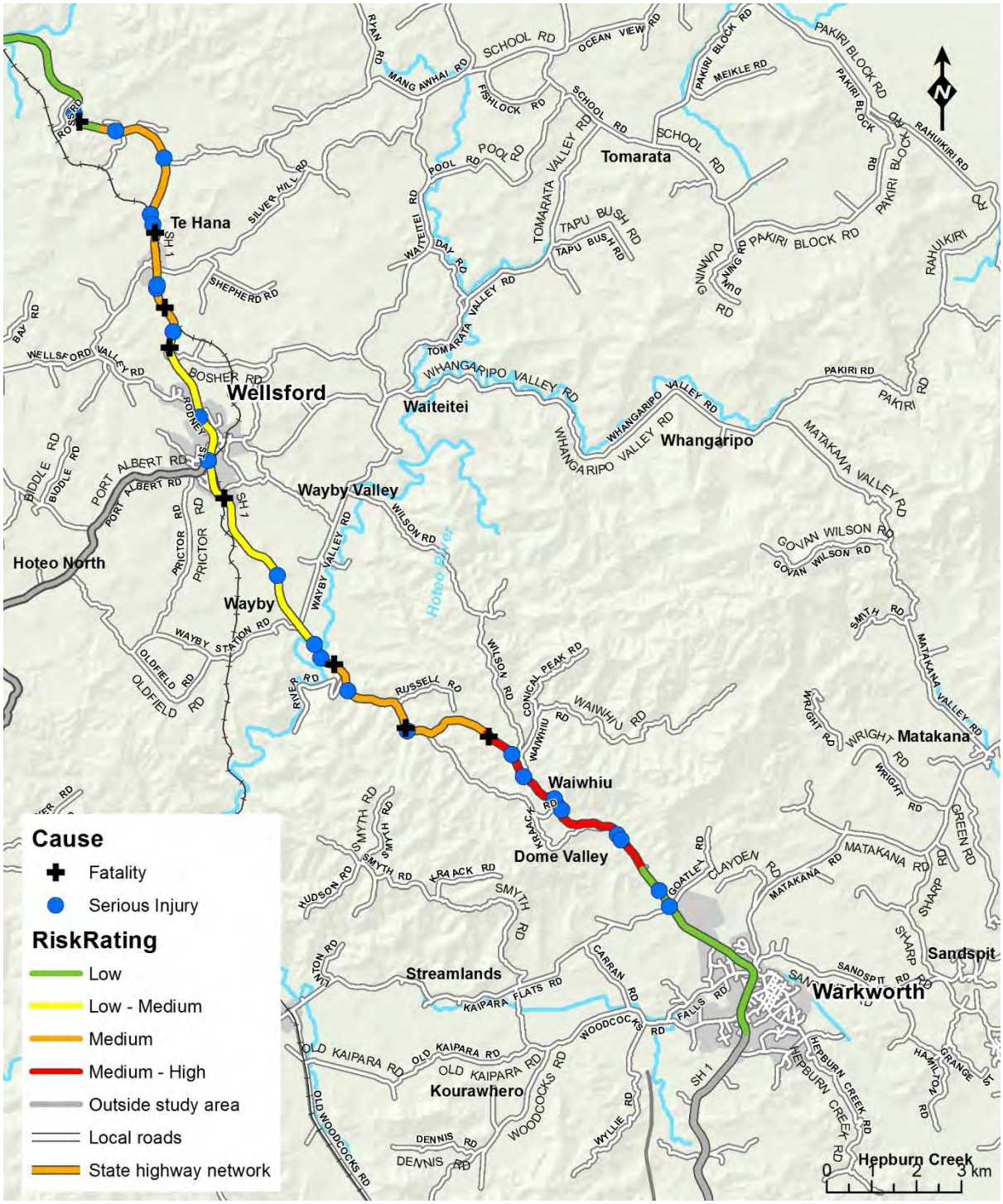

Figure 2-3: Fatal and serious crashes 2013-2018

(Source: Detailed Business Case, 2019)

SH1 intersects with local roads between Warkworth and Te Hana, and relatively few of these intersections include adequate acceleration and deceleration lanes on SH1. The lack of appropriate acceleration and deceleration lanes increases the potential for conflicts between state highway traffic and local traffic. This issue, coupled with the steep grades, tight corners and restricted sightlines along SH1, contributes to a number of crashes, particularly through the Dome Valley.

The speed limit along SH1 is generally 100 km/h, although this varies at some locations. In December 2007 the speed limit through the Dome Valley between Phillips Road and Wayby Valley Road was reduced to 80 km/h as an initiative by the Transport Agency to help address the poor safety record through this section. In 2012, further signage and minor safety improvements were carried out. As a result of the interventions, the road safety record over this corridor improved. However, three fatal crashes occurred in 2016-2017, two of which were as a result of head on crashes in the Dome Valley.

The government announced a Safe Network Programme in 2018 indicating the high priority of safety improvements. The Transport Agency, through the Safe Roads Alliance (SRA), is delivering safety improvements on SH1 from Warkworth to Wellsford, through the Dome Valley, as part of the governments Safe Network Programme launched in 2018. Construction commenced in early-2019 and includes widening the centre line and road side shoulders, installing flexible road safety barriers and installing right turn bays at key intersections. Northbound and southbound passing lanes will be replaced with widened shoulders to make the approach to the summit of the Dome safer.

These improvements will improve the safety of this corridor by reducing head-on and loss of control crashes. However, due to road geometry, the safety improvements will not achieve the KiwiRAP 4-Star standard sought for a High Volume National road. Nor will these works solve the issues identified above around route resilience or travel time reliability as no capacity enhancements are proposed.

2.4.4. Movement of freight

As the main inter-regional route between Northland and Auckland, SH1 has an important function in providing freight access between Auckland and Northland and carries a significant volume of freight traffic. An average of just under 10% of vehicles travelling on SH1 between Pūhoi and Whangārei are medium/heavy commercial vehicles, with the figure being higher, at 12%, between Warkworth and Te Hana.

The Northland region is a major producer of primary products, including milk and dairy products, meat, logs and timber products, aggregates and other building materials. In addition, a number of consumer goods and inputs to manufacturing in Northland and north Auckland are sourced from the Auckland region.

Northland-based industries are heavily reliant on a safe and efficient transport network to provide reliable access for people and freight to markets in the Auckland region, Auckland International Airport and beyond. As such, the provision of reliable freight links is an integral part of servicing the economies of the Northland and Auckland regions.

The 2014 National Freight Demands Study (NFDS) identified that freight tonnage by mode shares in 2012 between Auckland and Northland were: 76% by road, 3% by rail, and 21% by coastal shipping. The NFDS forecasts that by 2042, freight volumes between Northland and Auckland could increase by 68%, from 2.8 to 4.71 million tonnes. It also predicts that freight movements originating or terminating in Northland could increase by 38%, from 30.2 to 41.6 million tonnes.

The NFDS concludes that truck movements are likely to grow significantly in the future, particularly given the current (low) level of investment in non-road-based modes. Even if investment levels were to change, the study identified limited potential

for a modal shift away from road-based freight. The NFDS does not forecast freight modal share by region, but its forecast for New Zealand overall remains stable at about 91% of freight tonnage moved by road in 2012 and is predicted to remain the same in 2042. The Government Policy Statement 2018 indicates the Government's commitment to investigate moving more freight by rail or coastal shipping. At 3%, the freight mode share of rail by volume is currently very low, so a doubling or trebling of the volumes of freight moved by rail would not have a significant effect on the overall traffic volumes, and therefore would not impact the need for improvements to SH1.

The Upper North Island Strategic Alliance (a group of industry, local authority and government organisations) undertook work in 2013 to support informed decision making on key land use, infrastructure and investment, to improve the economic performance of the Upper North Island and New Zealand. Their work, the Upper North Island Freight Story[26], sought to understand the supply and demand of industrial land, promote a strategic and integrated approach towards land use and transport planning and identify constraints on the Upper North Island's strategic rail and road networks. The problems identified for the SH1 corridor are consistent with a number of the critical freight issues that the Upper North Island Freight Story seeks to address.

2.4.5. Importance of the corridor to the Northland economy

Northland has approximately 175,000 residents spread across urban and rural areas.[27] It is connected to the rest of New Zealand through Auckland, and a key challenge of the road network in the Northland region is to provide a reliable, secure route to connect geographically, socially and economically disparate communities. Northland in the past has had an unemployment rate 3% above the national rate and nominal GDP per capita 32% below the national average.

The Northland Regional Land Transport Plan 2015-2021 (NRLTP) (Northland Regional Council, 2018) indicates the physical and socio-economic challenges that Northland has and one of its key outcomes is to ensure that the region is well-connected to Auckland and the rest of New Zealand[28]. One of the two key strategic road priorities identified in the NRLTP is the:

> *"Increase economic productivity and improve connectivity by progressively upgrading SH1 from Pūhoi to Whangārei."*[29].

SH1 plays a critical transport accessibility role, connecting Northland with New Zealand. The Auckland to Whangārei Programme Business Case[30] identifies that:

> *"Improving the northern state highway network will help Northland contribute to the so-called 'golden triangle' of Auckland, Hamilton and Tauranga. Together these three centres generate 36% of New Zealand's Gross Domestic Product (GDP) with a prediction for this to rise to 47% by 2026. Investment in transport between Auckland and Whangārei will contribute significantly to this".*

While rail and coastal shipping infrastructure connect the Auckland and Northland regions, SH1 to the north of Auckland remains the key transport link with Northland

[26] NZ Transport Agency, 2013
[27] Statistics New Zealand, Subnational population estimates: As at 30 June 2017 (provisional).
[28] NRLTP, 2018 (being the three year review version)
[29] NRLTP, 2015, page 6
[30] NZ Transport Agency, 2017a.

and the northern part of the Auckland region. It is therefore important that SH1 can accommodate the increasing demand for travel between these regions. As outlined above, at present the corridor between Auckland and Whangārei is often closed, its alignment is comparatively unsafe by national standards and the cost of travel and travel time reliability issues are an impediment to economic growth in Northland.

Providing for the reliable movement of goods and people to and from the North is important. Given the Northland economy's proximity to the country's largest and strongest performing centre – Auckland – there is real opportunity to improve the current issues in the Auckland and Whangārei corridor. The NEAP has identified that the lack of robust transport accessibility between Northland and the rest of the country is a contributing factor to the area's poor economic situation and has identified four 'game changers' to underpin business growth. One of these game changers is transport – promoting better connectivity with Auckland. Roading, in particular, is recognised in the NEAP as:

> *"critical for Northland to develop and affects virtually every part of the economy".*[31]

The Northland and north Auckland regions contain a large number of tourist destinations and the tourism industry is a major employer in both these regions. Providing reliable, uncongested routes for tourist travel to the region makes an important contribution towards increasing economic development.

2.4.6. Projected population and employment growth

The Auckland Plan 2050 sets the long-term strategic direction for Auckland over the next 30 years. The overarching objective of the Plan is to "create the world's most liveable city". Statistics New Zealand has projected the Auckland region will account for more than half New Zealand's population growth between 2013 and 2043, with an increase of 833,000 – from just under 1.5 million to over 2.3 million (using the medium projection figures).

Warkworth had a population of around 4,000 residents (at the time of the 2013 census) and around 2,300 jobs. As the largest settlement in rural north Auckland, it is a sub-regional centre servicing a wide rural catchment and many smaller towns and villages. The Auckland Plan identifies Warkworth as a Satellite Town with anticipated population growth of up to 20,000 over the next 30 years (refer Figure 2-4). The AUP(OP) has rezoned approximately 1,000 hectares in the north, west and south of the existing north Auckland urban area to allow for future urban development to meet the expected growth. The Warkworth Structure Plan enables 7,500 dwellings. To enable increased local employment opportunities to support this anticipated growth, new employment areas are identified, comprising land for new industry (e.g. warehousing, manufacturing, wholesalers, repair services) and land for small centres (e.g) convenicnce retail, local offices, restaurants/cafes).

Wellsford is identified in the Auckland Plan as a Rural and Coastal Town (refer Figure 2-4). While Rural and Coastal Towns are "less independent from the main metropolitan area[32]" than the Satellite Towns and will be less of a focus for developing substantial intensification or development, it is still anticipated to grow substantially in the future. Te Hana is identified as a Rural and Coastal Village (un-serviced). Un-

[31] Northland Economic Action Plan, page 7
[32] Auckland Council, Auckland Plan, page 235

serviced villages (particularly if small and more dispersed) are envisaged to have little or no growth. They are predicted to change and develop in ways that preserve their character, but are a lower priority for planning, services and infrastructure[33].

Rural and coastal towns like Wellsford are envisaged to grow to between 2,000 and 10,000 people and will become stronger and more attractive centres[34]. Wellsford is identified for future urban growth of approximately an additional 830 houses from 2023 – 2027[35] subject to confirmation around ground stability, a new water source and an upgrade to the wastewater treatment plant[36]. The AUP(OP) has rezoned around 1,000 hectares in the north, west and south of the existing Wellsford urban area to allow for future urban development to meet the expected growth.

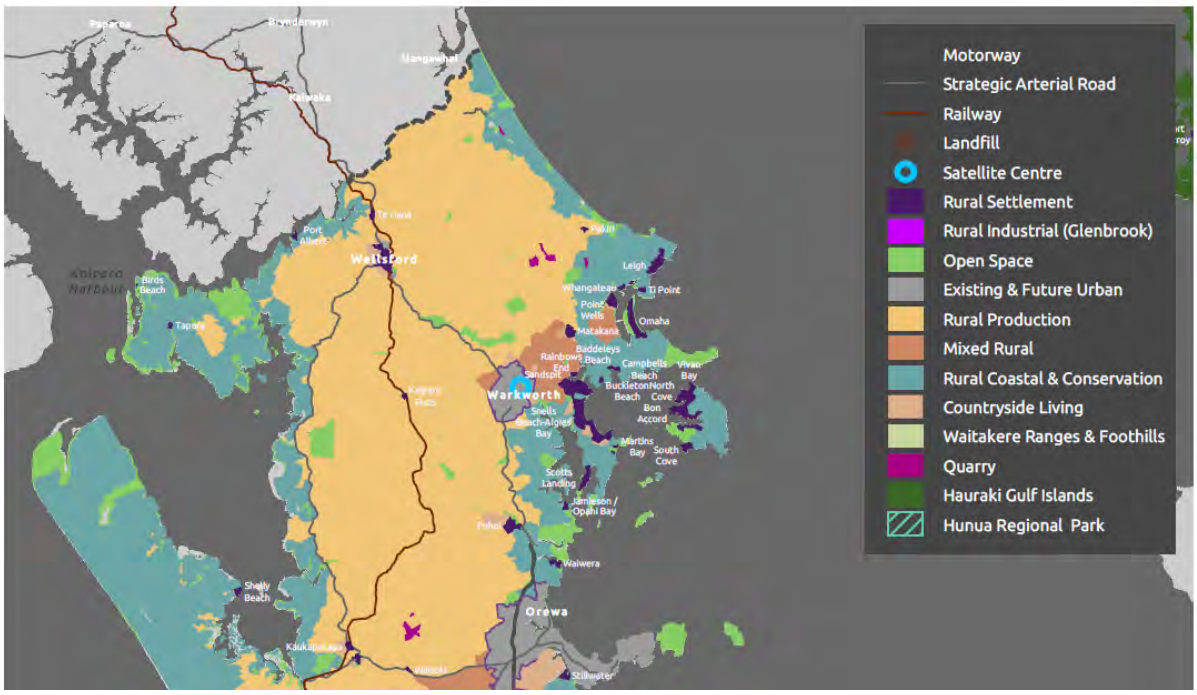

Figure 2-4: Auckland's Development Strategy: Rural

(Source: Auckland Plan, 2050)

To enable this growth in Warkworth and Wellsford, the Project is identified in the Auckland Plan as an enabling infrastructure project.

Future population growth will likely result in economic and social benefits at the local, regional and national levels. However, this level of predicted growth and additional demand needs to be appropriately managed and provided for to avoid significant adverse impacts on the safety and efficiency of the existing state highway network, which has limited capacity.

[33] Auckland Council, Auckland Plan, page 236.
[34] Auckland Council, Auckland Plan Table 9.1 Rural Settlements Classification, 2012.
[35] Auckland Council, Auckland Future Urban Land Supply Strategy, 2017.
[36] Auckland Council granted resource consent to Watercare on 27 November 2017 to expand the plant and discharge treated wastewater to a tributary of the Hōteo River.

2.5. The benefits to be delivered

In delivering the Project in accordance with the Project objectives outlined in section 2.2, the following benefits will be delivered:

- Improved safety performance compared to the existing SH1 with the Indicative Alignment designed to motorway standards and therefore, with the intended diversion of traffic to the new road, reduced incidents on the existing SH1;
- The Project will support safe cycling and walking by the provision of linkages where feasible as part of the Project scope (such as across interchanges, onto SH1 at the northern tie in, on local roads where the Project passes over on a bridge structure;
- Improved freight performance in terms of reduced travel times, improved route quality and safety, resilience and travel time reliability;
- Improved route security and resilience of the state highway network north of Auckland through reducing the reliance on one main route (the current SH1);
- Reduced travel times and improved travel time reliability along the state highway network north of Auckland increasing accessibility across many parts of the Regions' road network;
- Improvements to the amenity of Wellsford and Te Hana through the removal of heavy truck movements through the townships, including improved air quality and reduction in noise levels and improving walkability; and
- Treatment of stormwater, reduced contaminant loads for two river catchments, reduction of sediment load over time to the Kaipara Harbour, retiring of some land that contributes to the sediment load of the Kaipara Harbour, through landscaping and planting for mitigation and through design which will assist with more fuel efficient travel (through better gradients and less need to brake, accelerate and/or decelerate).

3. Description of the existing environment

3.1. Introduction

This section provides a description of the existing environment within which the Project will be constructed and operated. The wider Project area extends between Warkworth in the south, the wider Wellsford area, and the northern outskirts of Te Hana in the north. The specialist technical assessment reports in Volume 2 that accompany this AEE provide detailed descriptions of specific environmental features relevant to each discipline. The following section of this AEE is derived from these technical reports and provides a broad description of the Project area and surrounding environment, focussing on its historical and regional context, and the built and natural environment.

3.2. Historical context

The historical context for the Project area is described in detail in the *Historic Heritage Assessment* in Volume 2 of the AEE. Key aspects are summarised below.

3.2.1. Māori occupation

The area between Warkworth and Te Hana transects two significant areas of traditional Māori occupation: Mahurangi and Kaipara. A number of iwi and hapu groups are affiliated with the land within the Project area, dating from the arrival of the Mahuhu-ki-te-rangi waka between the Kaipara Harbour and the Hokianga.

Māori in the Mahurangi and Kaipara areas moved seasonally between villages, rather than occupying permanent settlement areas all year. The coastal boundaries to the east and west provided abundant marine resources, and the inland forest areas were utilised for hunting and gathering. The rivers present in the area supplied fresh water and coastal and alluvial soils were ideal for horticulture. Tracks and portage routes between the east (Mahurangi) and west (Kaipara) coast provided a good means of communication between the groups, most of which maintained close peaceful relationships.

3.2.2. European settlement

European missionaries and sawyers (timber millers) arrived in the Mahurangi and Kaipara areas around the early 1830s. With these arrivals came pressure on Ngāti Whatua to relinquish land for European settlement.

The Crown acquired its first large tract of land in the area on 13 April 1841. The Mahurangi Purchase, as it was known, included the Mahurangi and Omaha Block, approximately 100,000 acres stretching from Takapuna in the south to Te Arai Point in the north.

Prior to European settlement, the area was almost entirely covered with broadleaf and podocarp forest. Following European settlement, almost all the kauri and large areas of podocarp forest were felled for timber and to create pasture. Further clearing occurred in the pursuit of kauri gum.

3.2.3. Warkworth

A survey of the Mahurangi Harbour in 1840 revealed the area as an ideal site for the development of a town. Some European settlement had already commenced due to the attraction of the timber trade, and the deployment of camps of seamen cutting and dressing spars for the Royal Navy.

In 1853, one of the first licensees, John Anderson Brown purchased 153 acres of land between the Mahurangi River and the proposed Great North Road. He renamed the area Warkworth and began advertising quarter acre lots for sale in 1854. Settlement progressed slowly, with the Mahurangi Library and Post Office opening in 1859, and the first Mahurangi School established in 1863. The development of a flour mill and the manufacture of lime expanded the local industry. Lime production had begun in Warkworth as early as 1849, and eventually paved the way for the development of the Wilsons Cement Works in 1884.

During World War II, several United States military camps were established throughout the wider Warkworth area. These camps were set up to train forces for conflict, and to provide rest and relaxation for some of the troops fighting the war in the Pacific. The camps operated from October 1942 until mid-1944.

3.2.4. Wellsford

Wellsford was founded by non-conformist settlers known as the 'Albertlanders', who had arrived in New Zealand under a special settlement scheme. The first Albertland settlers arrived in September 1862. Wellsford was established in two stages: 'Old Wellsford' stretched between the mouth of the Whakapirau Stream and the eastern boundary of the Oruawharo Block. 'New Wellsford', further inland, was developed later after the sale of the Old Pakiri Block to the Crown in 1885.

Wellsford grew primarily as a timber town, and a timber mill was opened on the south bank of the Oruawharo River in 1864. Kauri gum was an important resource for early settlers in the local area, and temporary gumdiggers' camps spread across the district in the 1870s. Both industries had begun to decline by the turn of the 20th century, and farming became a primary source of income for settlers. The establishment of the Wayby Cooperative Dairy Company in 1902-1903 served the burgeoning dairy industry, and the establishment of the railway line into 'New Wellsford' in 1909 furthered the move inland away from the initial settlement areas, to the present day location of Wellsford.

3.3. Regional context

The population of the Rodney Local Board Area, which covers the northern most part of Auckland City and includes the Warkworth and Wellsford urban areas and their surrounding hinterland was approximately 54,882[37] in 2013.

Statistics New Zealand estimates total employment in the Rodney Local Board Area in February 2017 at 15,500, which represents 0.7% of the total persons employed in New Zealand. This figure compares with Rodney's 1.3% share of New Zealand's total population, highlighting that the area is currently more of a "dormitory suburb" for employment centres elsewhere within Auckland.

[37] 2013 Census

The Project area comprises predominantly rural, commercial plantation forestry (through the Dome Valley), and rural residential land uses. The main settlement areas in the vicinity of the Project are Warkworth, Wellsford and Te Hana. These areas are where the majority of local community facilities / amenities such as schools, shopping centres, churches and social services are located. This is described in further detail below.

3.3.1. Warkworth

Warkworth is the largest urban area in the vicinity of the Project. Warkworth's population in 2017 was approximately 4,760. Warkworth accounts for 2,750 jobs (17.7% of the Rodney Local Board Area's jobs). The most significant employment sectors in Warkworth are retail trade, manufacturing, education and training, healthcare and social assistance, construction and accommodation and food services.

Land in and around Warkworth is zoned for a variety of typical urban uses including residential, business, rural and open space. Large areas to the north-east, west, and south-west of the township are zoned Future Urban, which reflects the expectations and aspirations of significant growth in Warkworth. Auckland Council has prepared a Warkworth Structure Plan which will inform the future land use zones of the land currently zoned Future Urban. The Indicative Alignment, on the north west outskirts of Warkworth, passes through Mixed Rural and Rural Production zones.

The existing SH1 route passes through the town to the west of the commercial centre. Upon its opening (scheduled for 2021), the P2Wk will form part of the SH1 network. This motorway will bypass Warkworth to the west and join SH1 south of Kaipara Flats Road.

Some significant trip-generating activities include Mahurangi College, situated at the intersection of Woodcocks Road and SH1, and Warkworth Primary School on Hill Street. The Warkworth town centre provides a range of retail, commercial, healthcare, community, and other professional services, which, in combination, draw traffic from a wide catchment area.

A commercial centre (Kowhai Falls) is being developed off Woodcocks Road, to the west of the College and the existing industrial estate. This centre adopts a 'big box' retail warehouse format capable of drawing trade and traffic from a wider catchment area.

The spatial distribution of these activities, in combination with the road network pattern, leads to congestion and conflicts with SH1 at peak periods, such as the evening peaks, school closing times, weekends, and holidays.

3.3.2. Wellsford

Wellsford is the second largest urban area in the vicinity of the Project. It is the northern-most urban settlement in the Auckland region. Wellsford's population in 2017 was 2,030. Wellsford accounts for 970 jobs (6.2% of the Rodney Local Board Area's jobs). The most significant sectors are transport, postal and warehousing, education and training, healthcare and social assistance, retail trade and accommodation and food services.

The existing SH1 route passes through the commercial centre of the town, generally on a north-south alignment. SH16 connects with SH1 in the middle of the town. The North Auckland Line railway passes immediately east of the township with the railway

station located to the east of the town, south of Matheson Road. The line is used for freight services with no commuter passenger service provided.

The development of Wellsford has been notably influenced by transport networks, in particular the junction of SH1 and SH16 and the North Auckland Line. As such, development of the town centre is, in general, constrained to a linear form. The North Auckland Line creates a physical barrier on the eastern edge of the town centre.

Given its strategic location, Wellsford has developed and functions as a district retail and highway service centre. A number of the commercial activities in the town centre are focussed on meeting the needs of regional through traffic, particularly travellers. Wellsford is the main service centre for the surrounding rural areas of northern Rodney and small coastal towns and settlements, including Matakana, Pakiri, Mangawhai and Te Arai to the east, and Port Albert, Wharehine, and Tapora to the west.

Land in and around Wellsford is zoned for a variety of typical urban uses including residential, open space, and rural. Several areas are zoned Future Urban, primarily to the south of the town (around the intersection of Centennial Park Road and SH1), and at the northern end of the settlement (south of Bosher Road).

Wellsford contains a number of service and wholesale trade and industrial activities, many of which are related to agriculture and manufacturing.

The town centre provides a range of retail, commercial, healthcare, community, and other professional services, which, in combination, draw traffic from a wide catchment area. Educational facilities in the town include Wellsford Primary School on School Road, Rodney College on Rodney Street, and Living Way Christian School on Station Road.

3.3.3. Te Hana

Te Hana is approximately 5 km north of Wellsford and services a population of approximately 200 people. The population is predicted to remain relatively constant in the future. Te Hana contains few services or shops. Businesses and industries include a plant nursery, orchard, house removal and relocation services, a café, and a service station. The Arts Factory is a workshop, studio and exhibition venue housing exhibitions from local and international artists.

In mid-2011, a replica 17th Century Māori village/cultural tourism centre was opened in Te Hana. Te Hana o Te Ao Marama is a community driven initiative that offers guided tours and cultural experiences, events, and noho (overnight stays). According to a case study undertaken as part of Auckland's Economic Development Strategy[38], Te Hana o Te Ao Marama draws in several thousand visitors monthly. Profits are reinvested into the community through the Te Hana Charitable Trust to support local economic development.

3.3.4. Smaller settlements

Several concentrations of smaller settlements are located in the vicinity of the Project, as follows:

- A rural-residential subdivision at Viv Davie-Martin Drive is present on the upper slopes in the vicinity of Falls Road to the west of Warkworth.

[38] Auckland Council, 2012.

- Small scale farming and rural residential blocks are located on Phillips Road and Kaipara Flats Road.
- Kaipara Flats is located approximately 12 km west of Warkworth. The township has a community hall, a sports club and a primary school with a roll of approximately 85.
- A scattering of rural dwellings accessed from Kraack Road.
- Rural residential properties located to the west and south-west of Wellsford, around Rustybrook Road, Whangaripo Valley Road, and Worthington Road, and also located further south-west around Wayby Valley Road.
- Twelve lots have been subdivided at Charis Lane, north of Te Hana, and are being developed as rural residential properties.

3.3.5. Other commercial activities

Businesses that operate outside the main settlement areas in the wider Project area include:

- Southern Paprika: 504 Woodcocks Road, Warkworth – a large scale horticultural producer and capsicum exporter. It operates 15 hectares (ha) of greenhouses to produce over 4000 tonnes of capsicums per year. Southern Paprika employs more than 100 staff.
- Sheep World: SH1, Warkworth – comprises a farm and nature park with sheep shearing and sheepdog shows, New Zealand's Sheep and Wool Centre, a shop selling natural NZ products, and a cafe.
- Top of the Dome café: Dome Lookout SH1, Warkworth – situated at the start of the Dome Forest walkway.
- A raw milk stall at a farm gate outside of Wellsford.

3.4. Transport environment

The transport network within the wider Project area is characterised by a range of existing infrastructure and facilities including state highways, local roads, freight rail lines, pedestrian paths, cycle ways and bus services.

3.4.1. State highways

State Highway 1

SH1 serves the dual purposes of providing the inter-regional transport function between the Auckland and Northland regions for the movement of people and goods, as well as providing access to local areas. As a consequence of this dual function, there is a mix of regional and local traffic on SH1. SH1 passes through Warkworth, Wellsford and Te Hana, although once construction of the P2Wk motorway is complete SH1 will bypass Warkworth to the west and join the existing SH1 north of Hudson Road.

The Warkworth to Te Hana section of SH1 has a single carriageway, with generally one lane each way. There are six passing or climbing lanes between Warkworth and Te Hana, with three northbound and three southbound. SH1 intersects with numerous local roads between Warkworth and Te Hana, which provide access to sparsely populated rural areas, settled rural communities and small towns. Other local roads provide connections or access to places of interest to tourists. The road follows the

undulating landform, with restricted sightlines and steep grades in some locations, which present limited opportunities for overtaking safely, and inadequacies are identified with respect to length and spacing requirement of passing lanes and acceleration and deceleration lanes.

State Highway 16

SH16 runs from Ports of Auckland to Wellsford via West Auckland and the southern fringes of the Kaipara Harbour. In the Wellsford area SH16 predominantly serves as an access route for rural communities and development near the highway. It also acts as an alternative route to SH1 in the event of an incident on SH1, and for peak holiday periods. SH16 is part of the Twin Coast Discovery Highway tourist route, accessing Kumeu, Helensville, Parakai and Kaukapakapa, the West Auckland beaches, Woodhill Forest, and coastal areas on the southern side of the Kaipara Harbour. SH16 is generally a single carriageway (i.e. one lane in each direction) between the end of the North western Motorway at Brigham Creek Road and its terminus at Wellsford.

The Twin Coast Discovery Route is an 800 km circular tourist route of Northland, which includes SH1 and SH16 through Wellsford. The Twin Coast Discovery Route is extensively marketed by tour operators, rental car and campervan suppliers and accommodation providers.

Safe Network Programme

The Government is investing $1.3-1.5 billion over the next three years to prevent up to 160 deaths and serious injuries every year across New Zealand's highest risk state highways and local roads. The Safe Network Programme uses the Safe Systems approach, focusing on safe roads and roadsides, safe and appropriate speeds and safe level crossings (where relevant). Dome Valley, as part of the Auckland region, has been identified as a priority for the first phase of the three-year programme.

The SH1 Dome Valley Safety Improvements project, being delivered by the Safe Roads Alliance, aims to make this section of road more forgiving of human error, and reduce the risk of serious or fatal injuries when cars leave the road or cross the centreline. The project commenced construction in early-2019 and safety improvements include:

- New right turn bays at L Phillips Road/Sheepworld and, the Top of the Dome to make it safer for vehicles to turn;
- Side barriers to stop vehicles that have lost control from running off the road;
- Widened centreline areas and/or flexible median safety barriers in certain sections to keep vehicles apart and prevent head-on crashes; and
- The northbound and southbound Top of the Dome passing lanes will be replaced with a wide shoulder so slower vehicles will have room to pull over.

The Safe Roads Alliance is also reviewing the current speed limit along the following sections of Dome Valley:

- The 100km area from L Phillips Road (Sheepworld) to Kaipara Flats Road.
- The 70km area outside Wharehine Contractors and Castle Court motel.

3.4.2. Local road network

Between Warkworth and the northern outskirts of Te Hana, the existing SH1 intersects with a number of local roads providing access to small towns or settlements. These settlements include Pakiri and Mangawhai. Some of these local roads serve sparsely populated rural areas, whereas others serve more closely settled rural communities and settlements.

The Indicative Alignment intersects with Wyllie Road, Woodcocks Road, Carran Road, Phillips Road and Kaipara Flats Road in the vicinity of Warkworth. These are local roads serving rural residential properties.

Within the Dome Valley the Indicative Alignment crosses existing forestry access roads, some of which are unformed public roads and others are private roads used for forestry activities.

Wayby Valley Road and Wayby Station Road intersect with SH1 north of the Dome Valley. The Indicative Alignment will cross Wayby Valley, Rustybrook and Whangaripo Valley Roads, which are local roads serving rural properties and residences. Whangaripo Valley Road provides a link to Pakiri and Matakana.

Farmers Lime Road/Worthington Road is an unsealed local road servicing rural properties and residences. Silver Hill Road is an unsealed road providing a link between Te Hana and Waiteitei Road, and services the Silver Hill quarry. The Indicative Alignment crosses both of these local roads.

Mangawhai Road intersects with SH1 north of Te Hana. The Indicative Alignment will cross Mangawhai Road. It carries the Twin Coast Discovery Highway east to Mangawhai and beyond. It also serves communities at Te Arai and provides a link to Tomarata and Pakiri.

Vipond Road is a no exit road that intersects with SH1 north of Mangawhai Road. It is sealed for about 50 m and then changes to an unsealed road that provides access to farm and residential properties. Maeneene Road and Waimanu Road at the north end of the Indicative Alignment are also unsealed, no exit roads intersecting SH1 north of Te Hana. They provide access to private farms and residences.

3.4.3. Planned road network upgrades

There are a number of significant road upgrades either committed or planned that will or are likely to be in place prior to the Project being completed. The future transport network in Warkworth will be taken into account when the detailed design of this Project is undertaken at a later date. These upgrades will likely form part of the existing transport network at the time of construction of the Project and are summarised below and shown in Figure 3-1.

Pūhoi to Warkworth project (currently under construction)

The P2Wk will be a four lane motorway connecting SH1 north of the Johnstone's Hill tunnels with the existing SH1 north of Warkworth. At the southern end, south facing ramps are to be provided at Pūhoi Road. At the northern end, the motorway will connect into SH1 north of Warkworth at a roundabout. P2Wk is scheduled to be open to traffic in 2021.

Matakana link road (committed)

The Matakana link road project (Tūhonohono ki Tai) will provide a connection from the existing SH1 north of Hudson Road to Matakana Road in the area around Clayton Road. This project is scheduled to be open to coincide with opening of P2Wk in 2021.

Warkworth Western Link Road (previously known as the Western Collector) (Stage 1 open, remaining stages in planning)

The Warkworth Western Link road project is a three-stage plan to improve road connections to the west of the state highway developed to support the future urbanisation of the Warkworth area. The completed Stage 1 of the Western Link, connecting Mansel Drive to Falls Road, is the first of many transport infrastructure improvements planned for Warkworth over the next 30 years. The timing and exact route of the remaining two stages have yet to be determined but they will likely connect to SH1 in the vicinity of McKinney Road in the south and the new Matakana link road intersection which will be built in the north.

Supporting Growth (uncommitted)

The Supporting Growth Alliance (between Auckland Transport, Auckland Council and the Transport Agency) is a strategic transport planning programme set up to investigate and deliver the transport networks Auckland needs over the next 30 years to accommodate future urban growth. The Supporting Growth Alliance has identified a range of transport projects to support the anticipated growth of Warkworth over the next 20 years. These are:

- Future Matakana Road extension to Sandspit Road;
- Western Link road (previously known as Western Collector and referred to as the Western Collector on Figure 1-1);
- A new Eastern Connector route;
- Frequent bus services to Auckland, potential park and ride facilities and local services;
- Walking and cycling network; and
- Options for a new motorway interchange in the southern part of Warkworth.

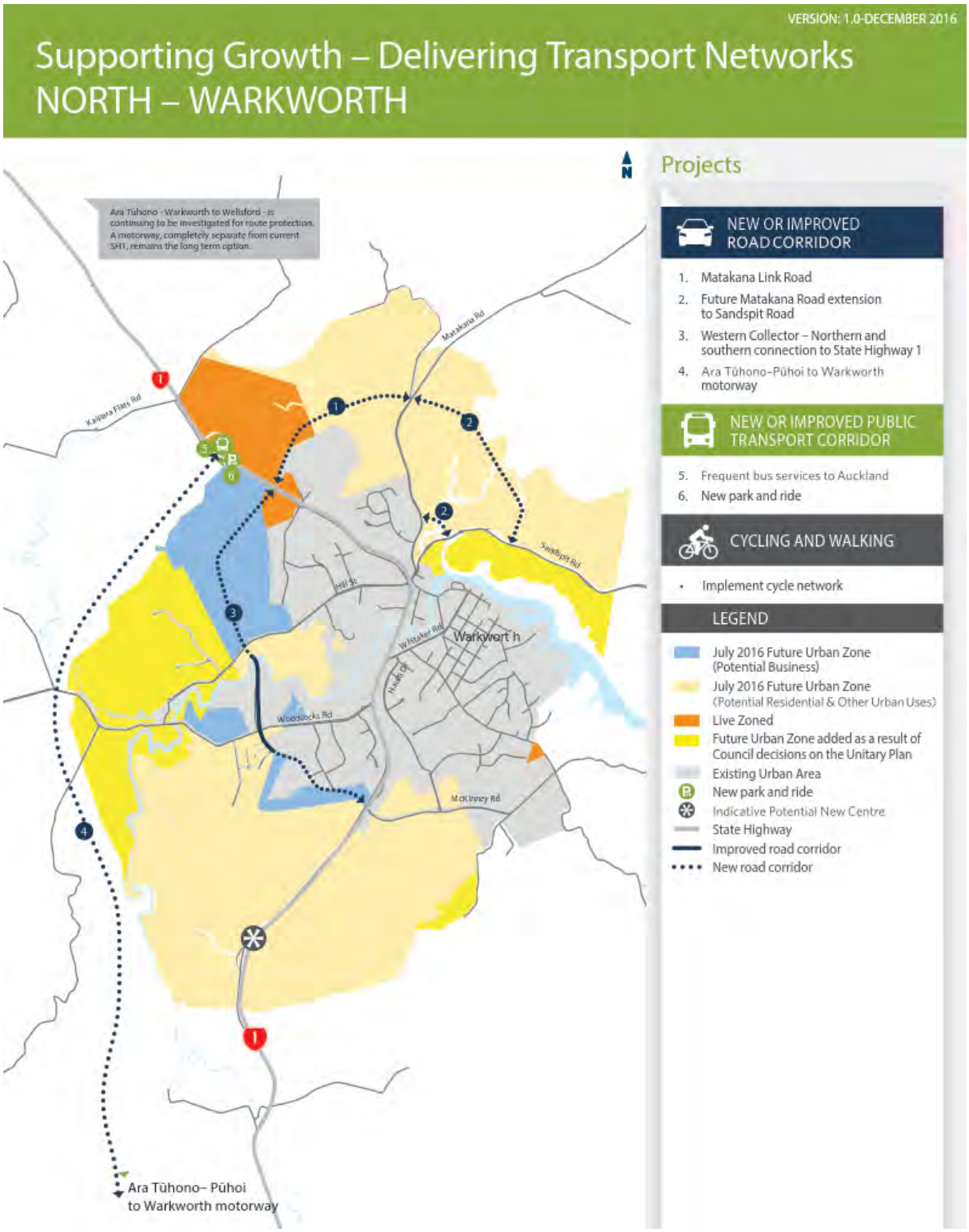

Figure 3-1: Planned network upgrades

(Source: Supporting Growth Programme)

3.4.4. Pedestrian and cycle networks

There are no pedestrian or cycle facilities along the majority of SH1 between Warkworth and Te Hana. There is a greater level of pedestrian activity within Wellsford, both along and across SH1. The section of SH1 through the Wellsford township generally has footpaths on both sides, but formal crossing opportunities are limited.

Te Araroa Trail is located within the Project area north of Warkworth within Matariki Forest above the proposed tunnels. Te Araroa Trail is a continuous 3,000 km walking track from Cape Reinga to Bluff. The Trail will not be affected by the Project.

3.4.5. Bus network

There are currently about eight regular buses that run along the SH1 corridor between Warkworth and Te Hana, daily, operated by various bus companies. In Wellsford, stops for these buses are located on SH1, on both sides of the road.

3.4.6. Rail network

The North Auckland Line (NAL) is located in the wider Project area to the west of the Indicative Alignment. The railway line provides freight services but no commercial passenger services.

3.5. Built environment

3.5.1. Land use

The Project area is located within a largely rural environment zoned Rural Production Zone for the most part, with some Mixed Zone Rural around the Warkworth Interchange and remaining zoned road reserve. The land use activities taking place within the Project area in this rural environment include pastoral farming and commercial plantation forestry activities. Rural residential properties are also scattered throughout the Project area, between the more concentrated areas of settlement at Warkworth, Wellsford and Te Hana.

Extensive tracts of pasture are present near Warkworth, largely used for mixed grazing, and to the north around Wellsford, which is predominately dairying / grazing land.

Commercial plantation forestry is a significant land use in the Project area. Matariki Forest is located between the proposed southern tunnel portals and the Hōteo River. Approximately 34% of the Project area (488 ha) is commercial plantation forestry. Through engagement with Rayonier Matariki Forests (RMF), based on the age of the trees, the forestry within the Project area is likely to reach maturity around the same time as the Project pre-construction phase and will be progressively harvested from around 2025-2027.

Resource consents to facilitate rural activities have been granted in the Project area. There are currently three water permits for properties located within the Project area, stretching between Warkworth and Te Hana. These water permits authorise:

- an off-stream dam used for stock watering[39],

[39] 50 Borrows Road

- the damming of the Maeneene Stream and Te Hana Creek to provide stock watering and dairy shed washing[40]; and
- the damming of an unnamed tributary of the Mahurangi River for "wildlife purposes"[41].

Within the wider Project area, where pastoral farming activities are dominant, water permits have been granted for stock watering and dairy shed washing. In addition, surface water and groundwater takes for reasonable domestic or stock watering purposes that are within permitted activity thresholds in the AUP(OP) do not require consent and are likely to occur throughout the Project area[42] and the surrounding rural environment.

Four discharge permits exist in the Project area to provide for the discharge of dairy wash water from dairying facilities[43].

A water permit for the extraction of groundwater is located near Te Hana for the take of up to 200 m^3 of water per day and up to 73,000 m^3 per year for community water supply and dairy farm use (North Albertland Community Water Supply Association).

Other consents granted in the wider Project area include water permits for horticultural activities (glasshouse crops and outdoor flower production).

Reserves of note located adjacent to the Project area include the Dome Forest Conservation Area and Sunnybrook Scenic Reserve (each zoned Open Space Conservation), both located within the Dome Valley on the eastern side of SH1. The project does not directly affect any reserves.

3.5.2. Infrastructure and network utilities

A number of regionally and/or nationally significant utilities are located within and surrounding the Project area, including transmission and distribution networks for gas, fuel, electricity, water supply, wastewater, telecommunications and rail.

These utilities include:

- The NZ Refining Company pipeline carrying fuels from the oil refinery at Marsden Point to the Wiri Oil Terminal in South Auckland, and the gas transmission pipeline owned and operated by First Gas. These pipelines are located within the same corridor. The Indicative Alignment crosses the gas and oil pipelines south of the Hōteo River bridge, Farmers Lime Road, and near Mangawhai Road at the location of the Te Hana Interchange.
- The Wellsford Delivery Point for natural gas distribution (and other associated infrastructure) owned by Vector in Farmers Lime Road (on land owned by First Gas).
- The Kraack Hill radio/telecommunications tower managed by Spark, under which the Indicative Alignment is proposed to pass in a tunnel.

[40] 18 Hindle Road
[41] 141 Kaipara Flats Road
[42] Land use consents to establish a groundwater bore for stock watering and domestic purposes was granted at 119 Carran Road and for domestic purposes at 17 Maeneene Road, domestic supply and stock watering at 351A Wayby Valley Road.
[43] 542 SH1 Topuni, 170 Whangaripo Valley Road, 18 Hindle Road, 263 Silver Hill Road

- The Wellsford water treatment plant operated by Watercare, is located at Wayby Valley Road. Wellsford's municipal water supply is sourced from the Hōteo River and is piped to the town reservoir (located near the intersection of Matheson Road and Worthington Road) via the water treatment plant.
- Wellsford's wastewater is piped from connected properties to Watercare's wastewater treatment plant, located on SH1 south east of the town. Wastewater is treated, and then discharged into a small, unnamed tributary of the Hōteo River.
- A 110 kV national grid electricity transmission line owned and operated by Transpower, crosses to the north of Wellsford passing east of Te Hana. The Indicative Alignment crosses this corridor (passing under the lines) near the location of the proposed Te Hana Interchange.

In addition to the above, there are numerous local service utilities such as telecommunications lines and power lines throughout the Project area.

Watercare's existing water abstraction and discharge consents in the surrounding environment are listed below:

- Two consented water takes for the municipal water supply at Warkworth. One of these takes is from the Mahurangi River at Warkworth and the other from a groundwater borehole to the west of Warkworth. It is noted that Watercare has transferred the potable water supply for Warkworth from surface water to groundwater abstraction.
- Four discharge consents to the Mahurangi River, including borehole and water treatment overflow discharges, and the discharge of treated wastewater from the Warkworth wastewater treatment plant.
- One consented water take from the Hōteo River to the west of Wellsford for the municipal water supply of Wellsford and Te Hana.
- Two discharge consents to the Hōteo River catchment. One is associated with the abstraction, while the other is the discharge consent for treated wastewater from the Wellsford and Te Hana wastewater treatment plant.

3.5.3. Built heritage and archaeology

Most of the Project area consists of sparsely populated rural land, which has little known history of concentrated settlement or human activity, other than the early settlements of Warkworth and Wellsford. As a result, relatively few historic buildings are present outside of these urban areas.

The *Historic Heritage Assessment* describes the recorded and unrecorded heritage and archaeological sites within the Project area. There are no sites listed on the Heritage New Zealand List/Rārangi Kōrero present within the Project area. Twelve archaeological sites are located within the Project area.

The archaeological and historic heritage sites are all located at the southern extent of the Project around Warkworth and relate to 19th century European settlement around Phillips and Carran Roads, and include one building (Woodthorpe House), with the possibility of archaeology where the buildings no longer exist on unsurveyed properties (the old Dome Valley school and school teacher's residence sites). Four US military camp sites related to World War II are also located within the Project area around Wyllie, Carran and Phillips roads. These World War II sites are of historic

interest but are not recorded archaeological sites because of their post-1900 status. These sites are shown in section 9.8.

There is potential for unrecorded Māori sites within the Project area particularly at the Hōteo River and watercourses in the Te Hana area, which are reported in traditional histories.

There are three heritage sites located in the surrounding environment (although unaffected by the Project), which are detailed in the *Historic Heritage Assessment*.

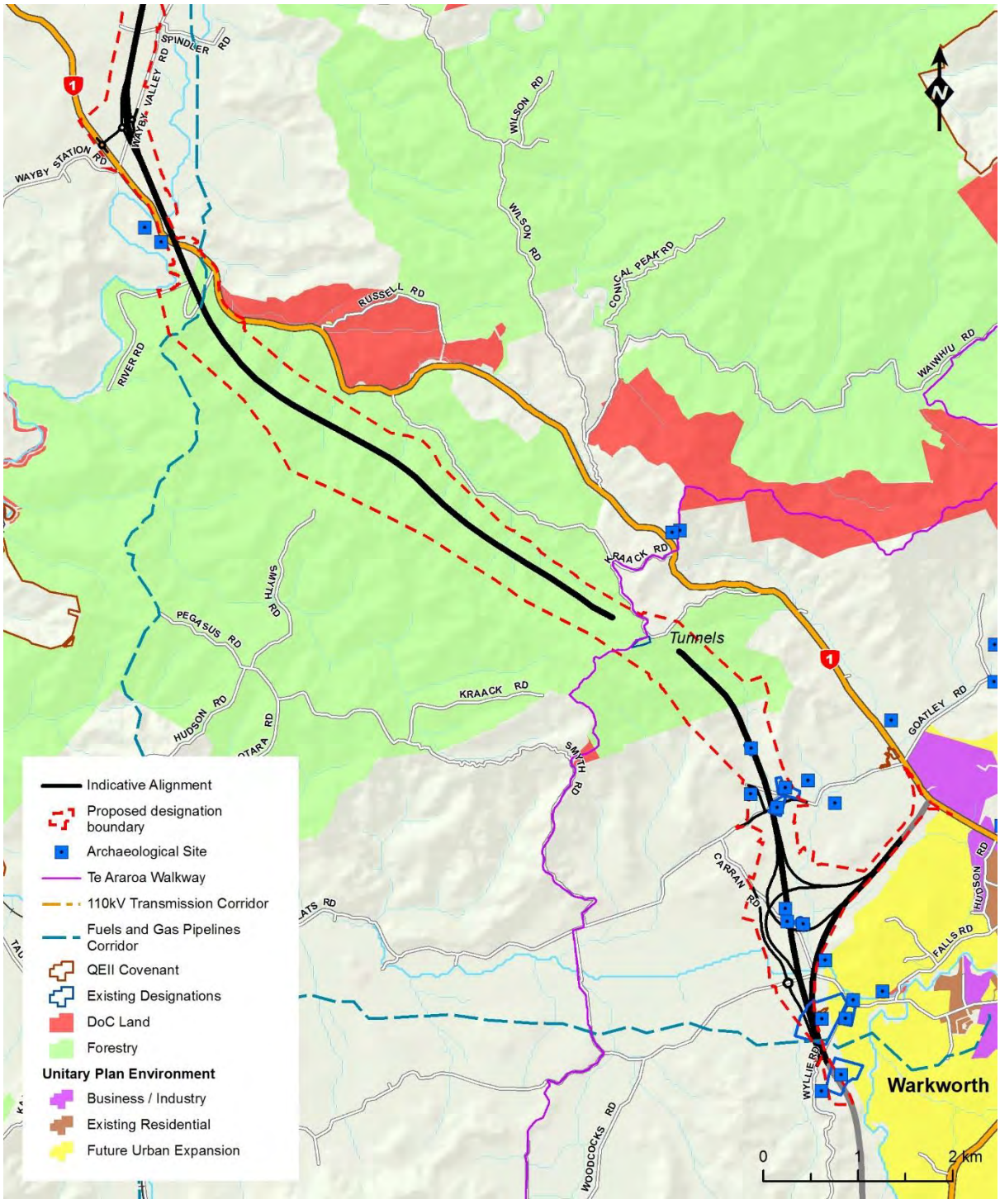

Figure 3-2: Built environment features south of the Hōteo River

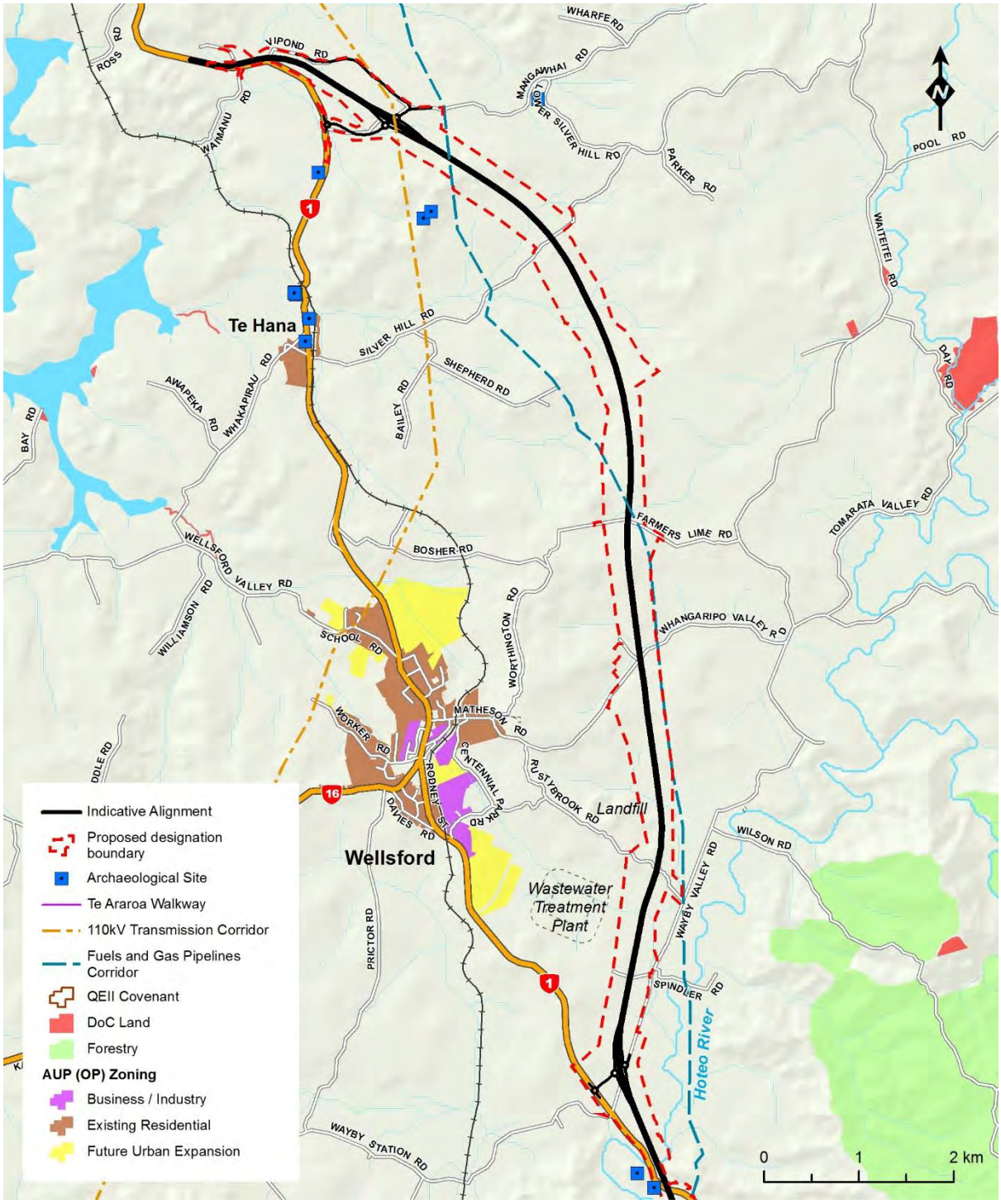

Figure 3.3: Built environment features north of the Hoteo River

3.6. Natural environment

3.6.1. Topography and landscape

The key landscape characteristics of the Project area are:

- A mixture of pastoral farming, native bush, and exotic forestry;

- Large land holdings; and
- Varied landforms.

The extensive network of rivers and streams throughout and surrounding the Project area reflects the relative complexity of the landform along much of the Indicative Alignment.

The topography of the area immediately surrounding the Project is shown in Figure 3-4 and can be broadly described as follows:

- Immediately to the west of Warkworth is generally flat with Warkworth situated on low hills and ridges and framed to the west by a low ridge and to the east by the Mahurangi River and Mahurangi Harbour.
- The topography north of Warkworth, particularly north of Kaipara Flats Road, rises steeply towards the prominent landform of The Dome (338 m elevation). The Dome Forest is located to the east of SH1, outside the Project area.
- The central and southern parts of the Project area comprise steeper rolling hill country with distinctive complex incised landforms of interconnected ridge and valley systems.
- The topography immediately south and east of Wellsford is characterised by rolling hills primarily in pasture, with gentle inclines along the current SH1 rising up to Wellsford. Similar topography continues northward to Te Hana.

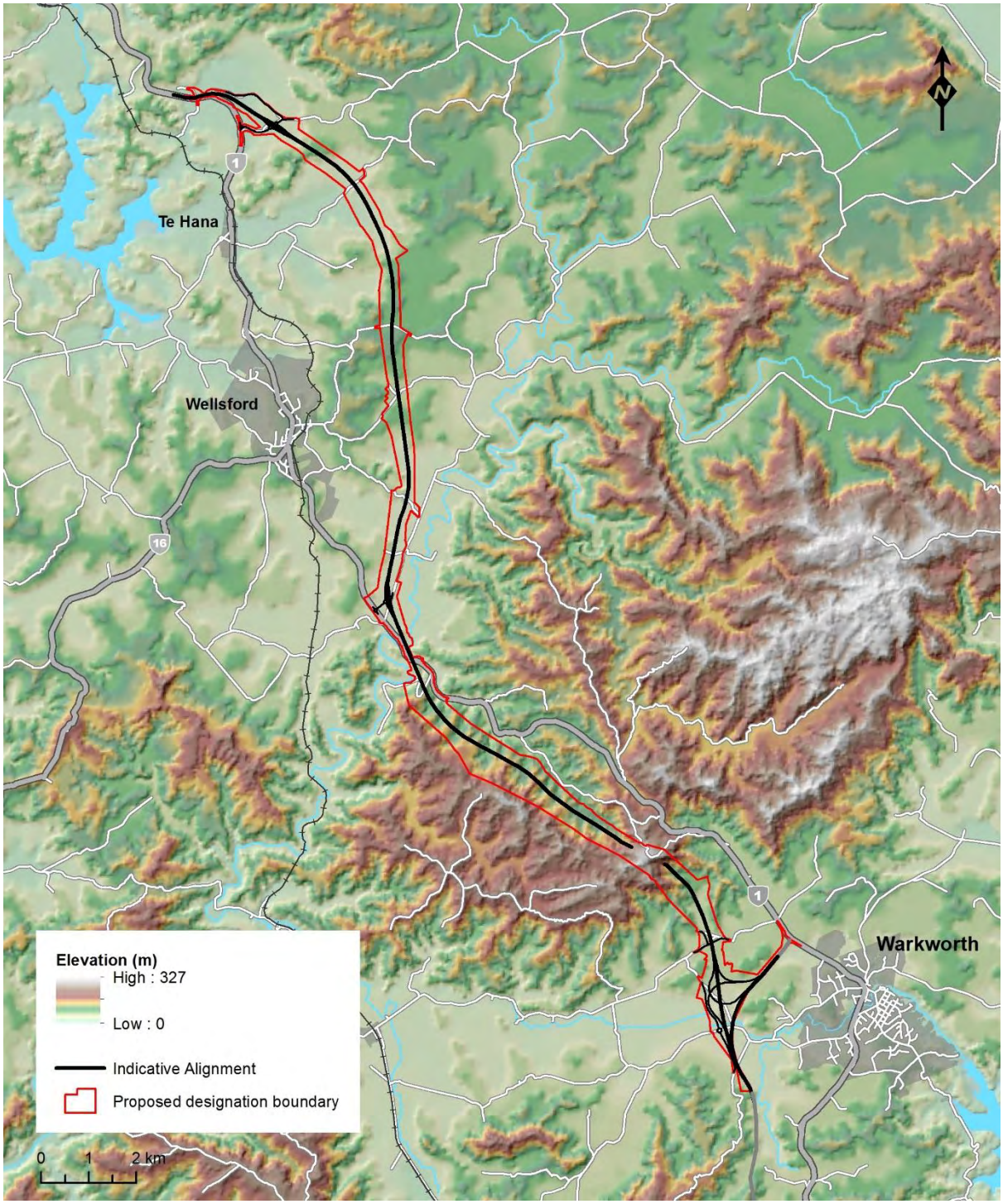

Figure 3-4: Topography of the Project area and surrounding environment

There are no Outstanding Natural Landscapes (ONL) scheduled in the AUP(OP) located within the Project area. The closest scheduled ONL is the Dome Forest (ID 32) which is immediately east of the Project. This ONL is shown in Figure 3-5 and Figure 3-6. There is one Outstanding Natural Feature (ONF) identified in the AUP(OP) (ID 49, Hōteo River incised meander) located within the Project area, located to the south of the existing SH1 bridge across the Hōteo River. This ONF is shown on Figure 3-6. There are no ONL, Significant Ecological Area (SEA) features within the proposed designation boundary north of Rustybrook Road as shown in Figure 3-7.

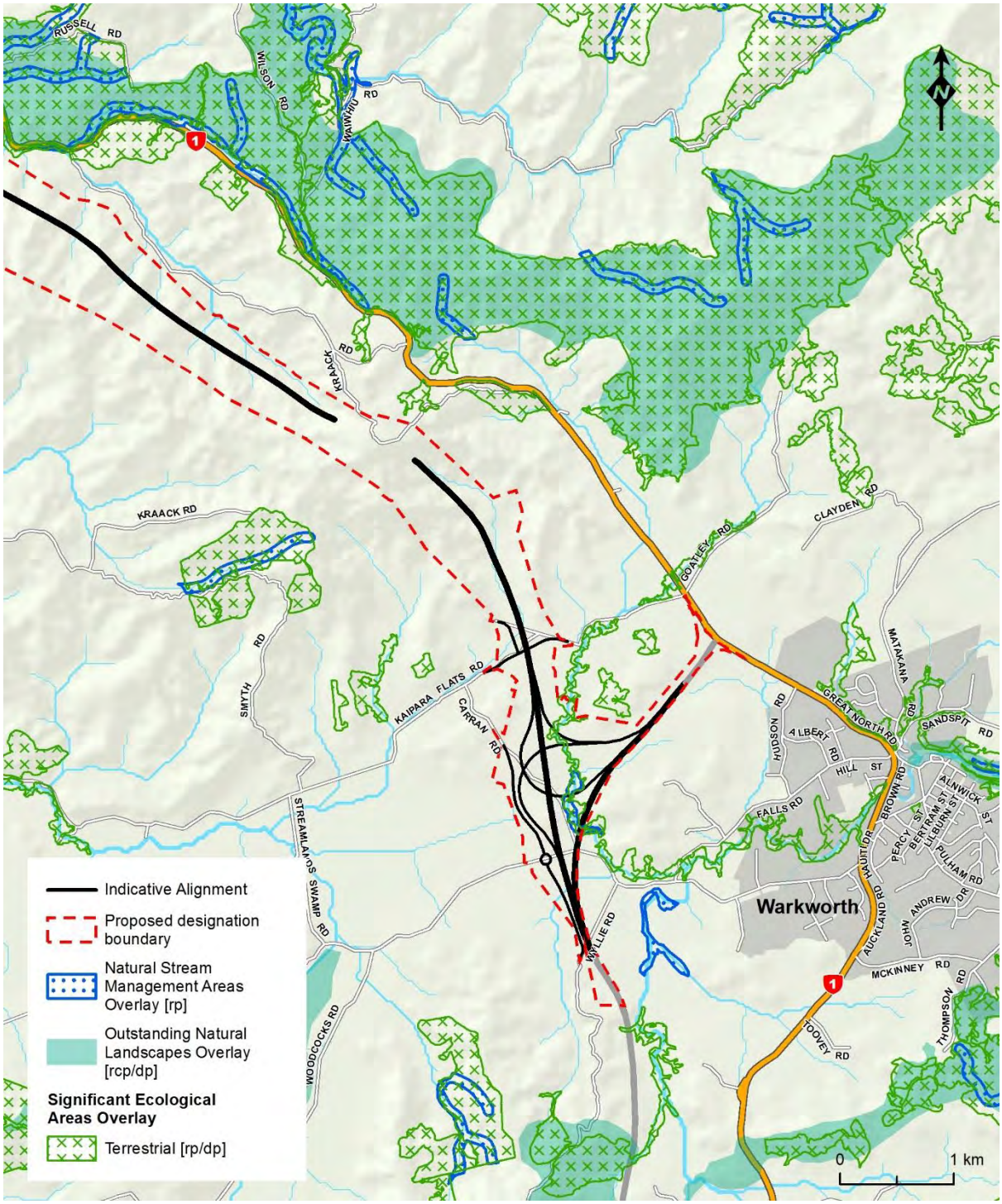

Figure 3-5: Location of ONL, ONF and SEA features in relation to the proposed designation boundary and Indicative Alignment near Warkworth

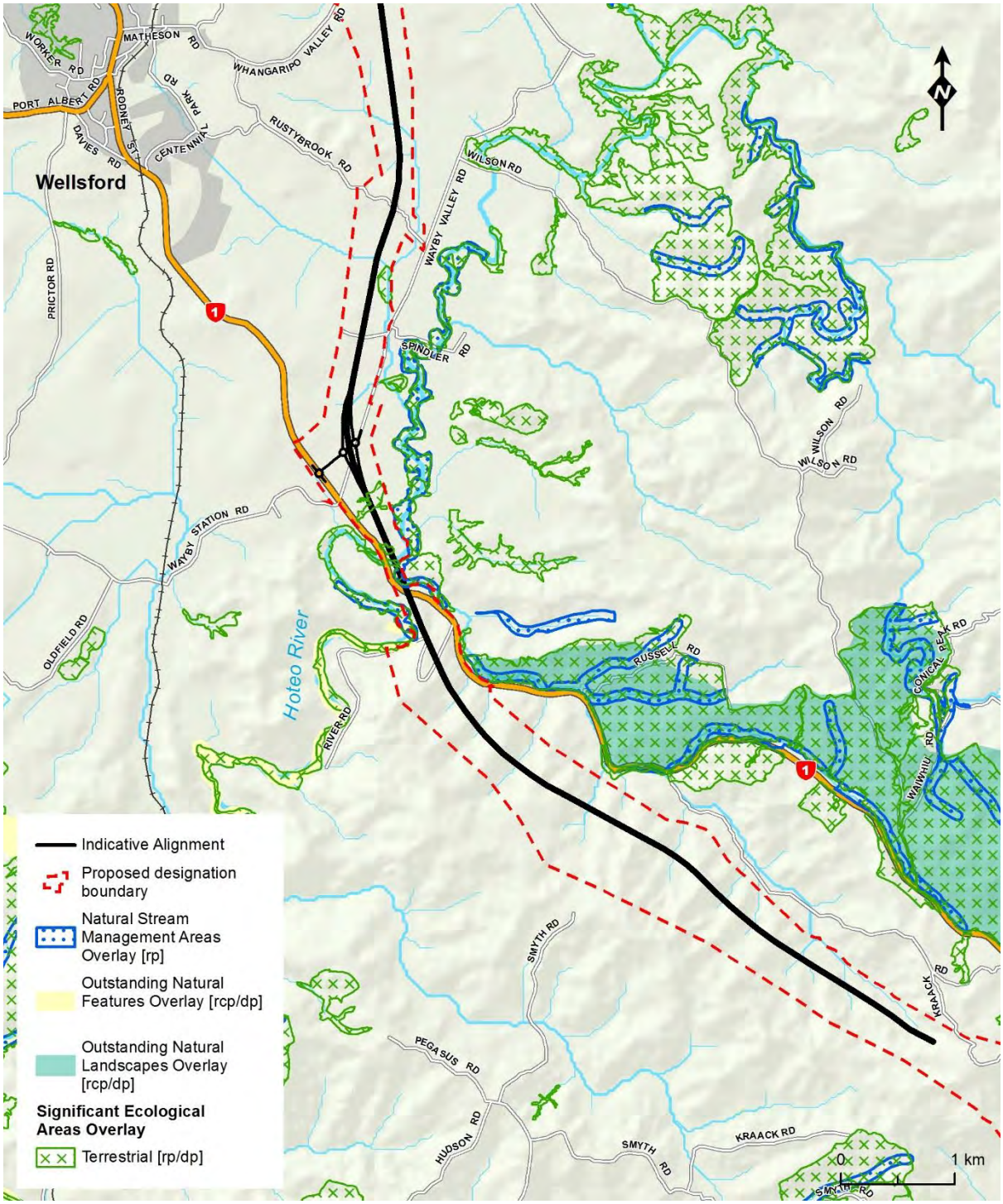

Figure 3-6: Location of ONL, ONF and SEA features in relation to the proposed designation boundary and Indicative Alignment around the Hōteo

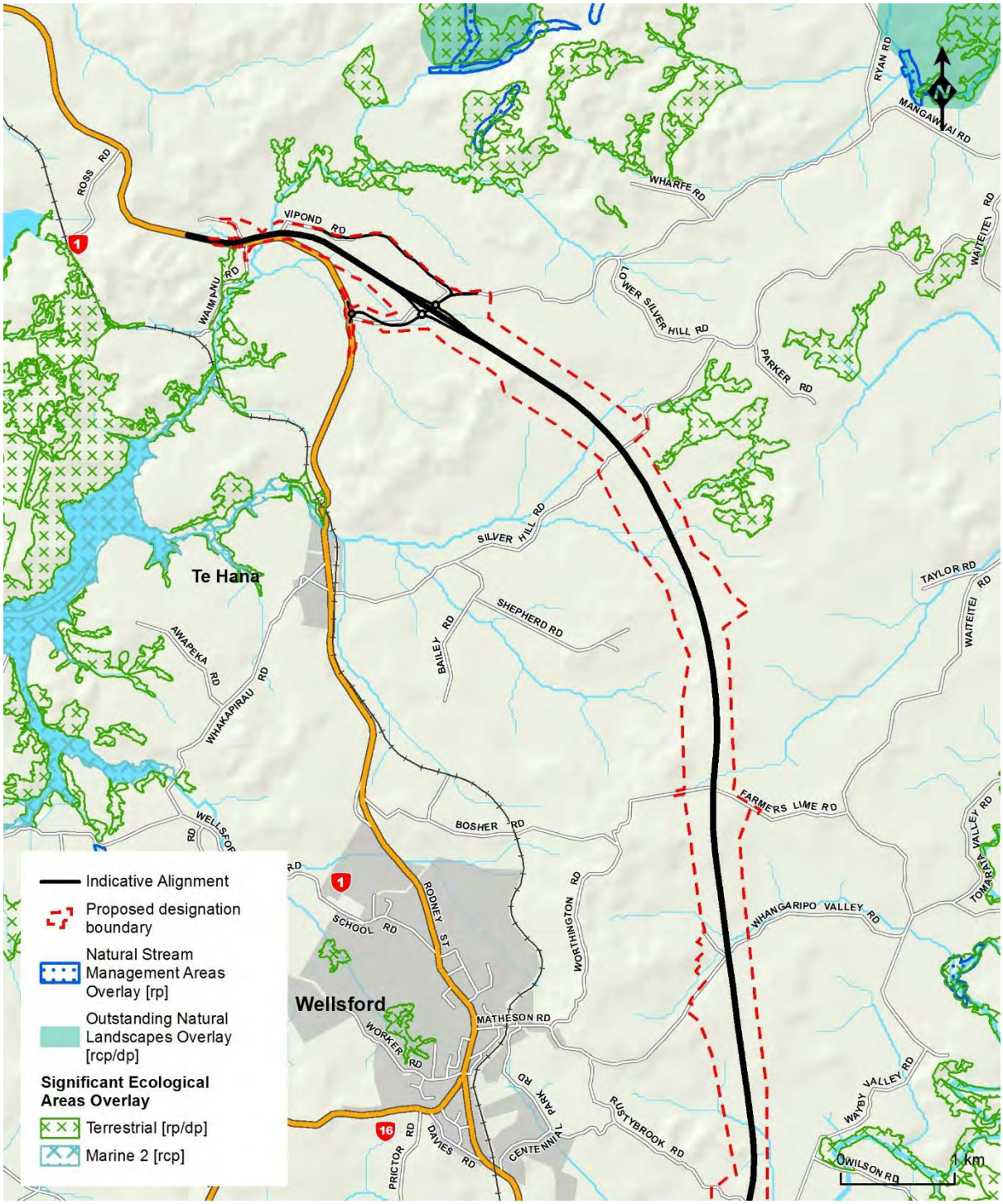

Figure 3-7: Location of ONL, ONF and SEA features in relation to the proposed designation boundary and Indicative Alignment around Te Hana.

3.6.2. Geology

The geology of the area surrounding the Project is shown in Figure 3.8. The Project is predominantly underlain by 'Northland Allochthon' rocks to the north of the Hōteo River and sedimentary rocks of the Waitemata Group south of the Hōteo River.

Over a few million years from about 25 million years ago, a tectonic plate collision process forced huge slabs of older sediment/rock formations (0.5-2 km thick and up

to hundreds of square kilometres in area) to be uplifted and displaced onto large parts of Northland from the north east (Hayward, 2017) extending southwards as far as Silverdale, Auckland. These displaced rocks are geologically known as the 'Northland Allochthon'.

The Project spans the frontal (southern) edge of the continuous Northland Allochthon mass on land, just south of Wellsford (Hayward, 2017), and extends southwards across Waitemata Group rocks which were also deformed and disrupted by the Northland Allochthon emplacement at the time of their formation. Consequently, the southern end of the Project includes areas with an arrangement of faulted and folded Waitemata Group rocks with some smaller detached slices of significantly weaker and sheared Northland Allochthon rocks present around Warkworth.

The geology of the Project area typically comprises:

- Variable Northland Allochthon rocks of the Mangakahia Complex and the Motatau complex – composed of highly sheared siliceous and calcareous mudstones, siltstone, muddy limestone (Mahurangi Limestone) and a mixture of variable proportions of each. These rocks are typically encountered north of the Hōteo River.
- Areas where limestone outcrops along the Indicative Alignment have historically been quarried for small-scale and local commercial, roading or agricultural use.
- Sedimentary rocks of the Waitemata Group – in particular the Pakiri Formation – thick sandstones, gritstones and/or regular alternating layers of sandstone and siltstone. These are the predominant geological materials underlying the steep rugged topography of the Dome and hills surrounding Dome Valley, south of the Hōteo River.
- Relatively soft estuarine and alluvial soils (clays, silts and sands with some organic or peat layers) of the Tauranga Group are present in low lying regions and in-filled valley floors, including the Woodcocks Road, Carran Road, Kaipara Flats Road, Wayby Valley Road, Silver Hill Road and Vipond Road areas.

The main regional geological structures are inactive thrust faults (faults which do not have earthquakes) associated with emplacement of the Northland Allochthon. These faults define many of the sharp boundaries between the Pakiri Formation and Northland Allochthon thrust sheets. The layered Pakiri Formation rocks adjacent to these faults are often deformed with faults, tight folds, extensive jointing and sheared defects. Faults and folds formed during the deposition of the sedimentary layers have also added to the local deformation of the Pakiri Formation rocks in the area.

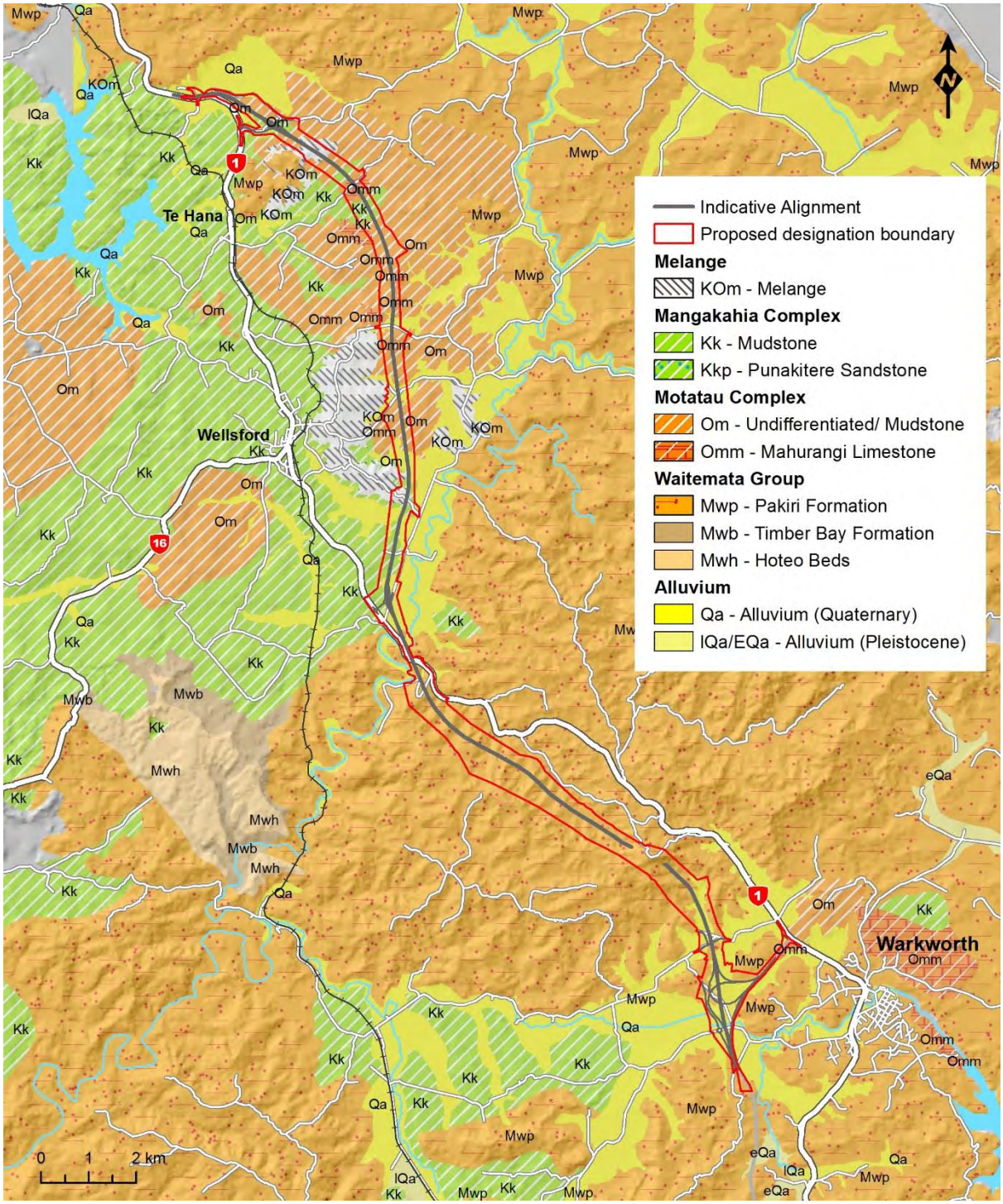

Figure 3.8: Geology within and surrounding the Project area

Landslide hazards exist throughout the region and are present within the Project area. Numerous examples of historical and current shallow slope failures (<5 m deep) exist along the present road network as a result of intense or prolonged rainfall events (e.g. SH1 through Dome Valley and local road cuts around Wellsford).

Larger landslides occur in both Pakiri Formation and Northland Allochthon Rocks and several very large features within the proposed designation are traversed by the Indicative Alignment. The landslides are predominantly considered dormant or

inactive and are unlikely to be naturally re-activated unless subjected to significant earthquakes.

The Auckland and Northland regions are some of the least seismically active regions of New Zealand. The closest known active faults are the Wairoa North Fault located in the Hunua Ranges south-east of Auckland and the Kerepehi Fault within the Firth of Thames (Edbrooke, 2001). Another considered potentially active is the Drury Fault on the edge of the Hunua Ranges (Williams et al., 2006).

No major faults are identified on published geological maps in the vicinity of the Indicative Alignment (Edbrooke, 2001). However, fault shear zones have been intercepted in deep investigation boreholes in the Kraack Hill area and several main linear features have been recognised and may reflect weaker crushed or sheared rock marking significant, inactive fault zones associated with the Northland Allochthon.

3.6.3. Hydrogeology

The hydrogeological regimes found within the Project area are strongly influenced by the underlying geological units.

Permeability of the Northern Allochthon is typically very low, and groundwater is typically observed as a line of seepage or minor springs at geological boundaries between units within the formation.

Groundwater in the Pakiri Formation is strongly influenced by incised valleys, with groundwater typically being elevated along ridgelines and depressed along valley sides and floors. Perched and leaky water tables may be present at higher elevations than the local water table in discrete localities, reflecting the interbedded nature of the sandstone/siltstone formation and typically low permeability of the siltstones.

The Tauranga Group Alluvium within river valleys and estuarine embayments comprises shallow aquifers that have limited potential to supply good quality or high yields of groundwater.

3.6.4. Hydrology and drainage catchments

The Project traverses three major drainage catchments: the Mahurangi River catchment; the Hōteo River catchment; and the Oruawharo River catchment. The Project commences in the Mahurangi River catchment, which flows generally towards the south-east and discharges through the south-facing Mahurangi Harbour. North of the Mahurangi River catchment is the Hōteo River catchment (which includes the Kourawhero subcatchment). The northern extent crosses into two subcatchments of the Oruawharo River catchment (the Maeneene and Te Hana streams) at the northern extent of the Project. The Hōteo and Oruawharo Rivers both flow into the Kaipara Harbour.

There are numerous smaller streams and creeks in the wider Project area, some of which are steeply incised into the landscape.

The catchment and sub-catchment areas and divides are described in detail in the *Water Assessment Report* in Volume 2 and key aspects are summarised below. The catchments are shown on Figure 3-9.

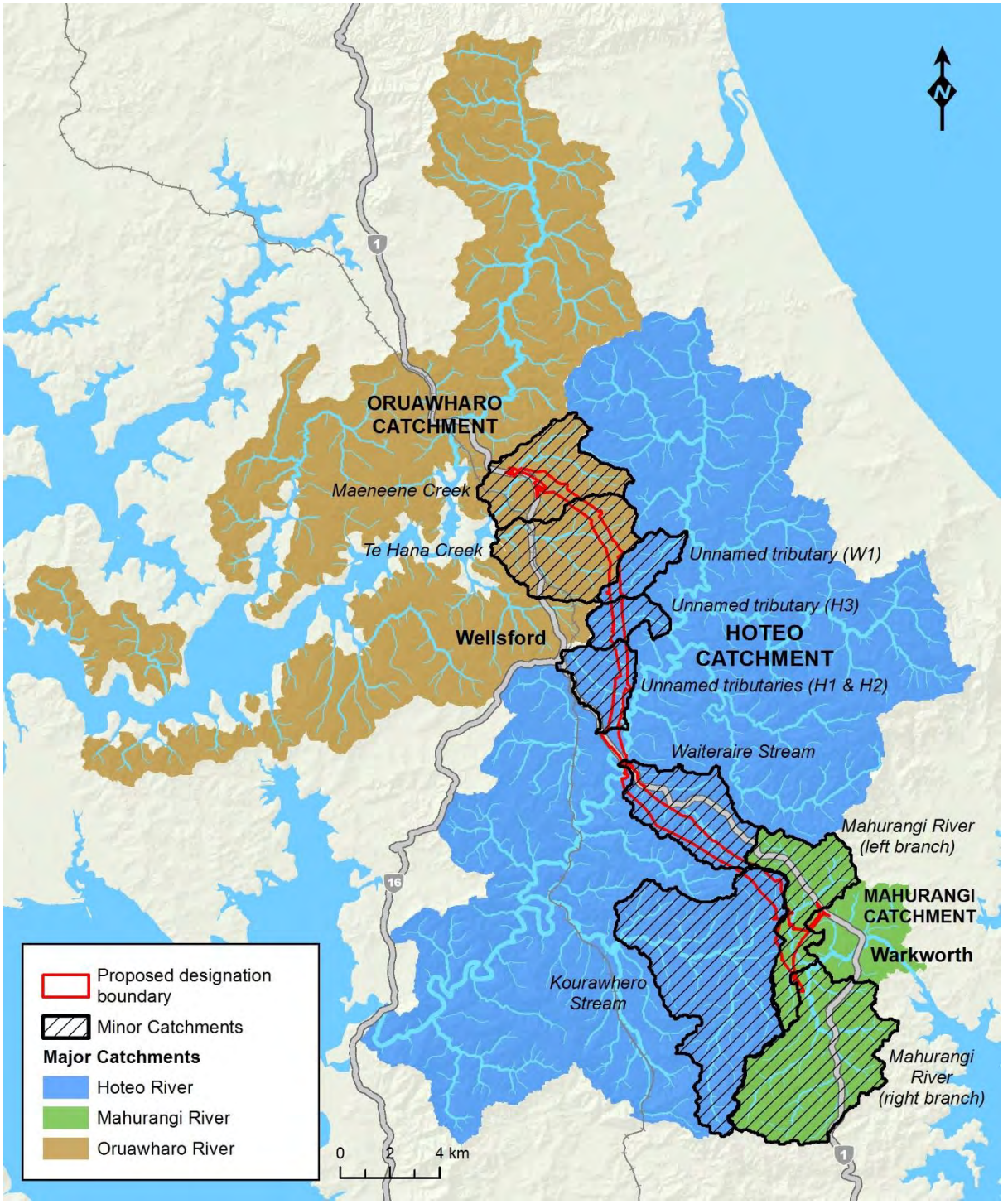

Figure 3-9: Catchment boundaries within the wider Project area

Mahurangi River catchment

The Mahurangi River catchment is approximately 11,700 ha in area. It has a wide catchment formed by its Right Branch flowing from the northern slopes of Moir Hill in the south, and the Left Branch flowing from the southern slopes of The Dome. The Left and Right branches of the Mahurangi River converge west of Warkworth, before flowing through the town into the estuary and then Mahurangi Harbour. Numerous freshwater streams discharge into the Mahurangi Harbour directly or via the Mahurangi River.

The Project area covers approximately 224 ha of the Mahurangi River catchment which is 1.9% of the total catchment area. The catchment divide between the Hōteo and Mahurangi catchments occurs near Carran Road and Kaipara Flats Road, approximately 8 km to the west of Warkworth.

The Mahurangi catchment has a rural character. The primary land use is rural production, particularly pastoral farming (64% of the catchment area), followed by native forest (20%) and production forestry (8%). Within the Project area the primary catchment land use is rural production and rural residential land uses.

The Mahurangi River is identified as a High Use Stream in the AUP(OP), and much of the catchment from the Dome Forest Conservation Area in the north to Moir Hill Road in the south is categorised as a High Use Stream Management Area. The catchment is under pressure from demands for water take and use by a number of users as set out in sections 3.5.1 and 3.5.2.

Some of the Mahurangi River is identified as a Natural Stream Management Area (NSMA) in the AUP(OP) (refer Figure 3-5). These are areas with high natural character and high ecological values. The NSMA and SEA areas identified in the AUP(OP) are shown in section 3.6.1.

Sediment accumulation within the Mahurangi Harbour has been linked to deforestation, development, and intensive land use[44]. This sedimentation has impacted on the quality of the river and harbour for navigation, recreation, commercial use (fishing and aquaculture) and as a habitat for fish and shellfish. Concerns regarding sedimentation pressures on the catchment have led to the adoption of the Mahurangi Action Plan[45] by Auckland Council in 2011 to address sediment inputs through land management techniques such as riparian planting and fencing, and education programmes.

Hōteo River catchment

The Hōteo River has the largest catchment in the Auckland Region, with an area of 40,502 ha. The Hōteo River drains into the Kaipara Harbour, where monitoring over the past 20 years shows continued pressure from contaminants, particularly sediment and phosphorus. Recent research has highlighted the importance of the Kaipara Harbour ecosystem, particularly the seagrass beds, which provide significant habitat for juvenile snapper. Extensive seagrass beds are located adjacent to the mouth of the Hōteo River.[46]

906 ha of the Project area sits within the Hōteo River catchment, which is 2.24% of the total catchment. North of Kaipara Flats Road, the Indicative Alignment passes through the Kourawhero Stream sub-catchment (a tributary of the Hōteo River). The Indicative Alignment runs along the southern valley of the Waiteraire Stream and crosses multiple tributaries in its sub-catchment. The Indicative Alignment crosses the Hōteo River immediately upstream of the existing SH1 road crossing and crosses multiple tributaries of the Hōteo River.

The main land uses in the Hōteo River catchment include pastoral farming (57%), commercial plantation forestry (23%), and indigenous forest (15%). Within the Project

[44] Mahurangi Action Plan, A strategic plan for the catchment 2010-2030 (2011).
[45] ibid.
[46] Auckland Council – Technical Report 2014/201 - Hōteo River catchment: environment and socio-economic review – August 2014.

area the primary land use is commercial plantation forestry (Matariki Forest) and pastoral farming. The extent of the Matariki Forest is shown in Figure 3-10.

The existing land use (2017) for 35.2 km^2 of the Hōteo River catchment is exotic plantation forests. These forests are likely to reach maturity around the same time as the Project construction phase and are scheduled to be harvested prior to construction in 2025-2027. Harvesting within Matariki Forest within the Hōteo catchment is predicted to increase the sediment load within the Hōteo River by an average of between 3.2-7.5%.[47]

[47] Catchment Sediment Modelling technical report, section 5.

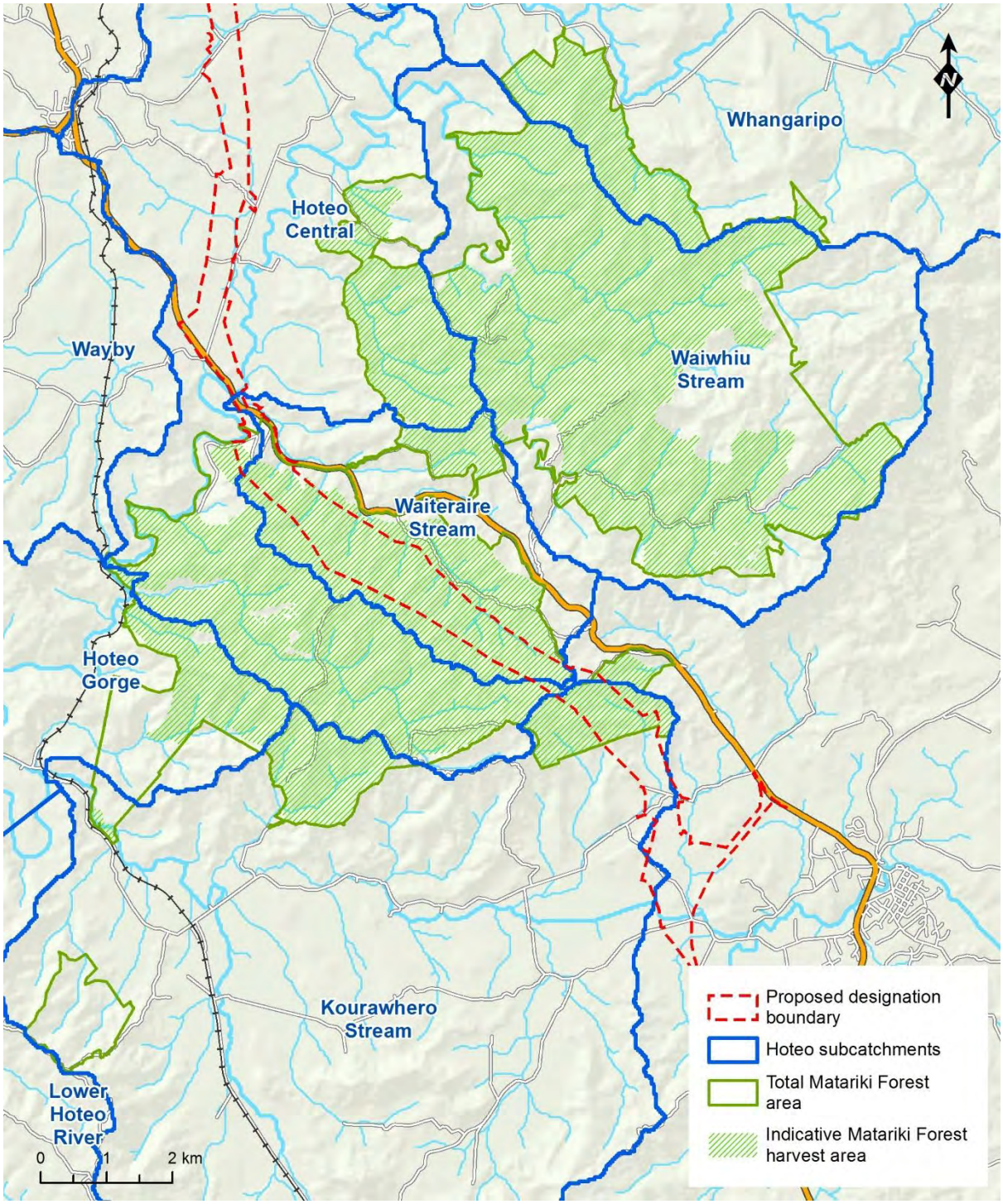

Figure 3-10: Extent of Matariki Forest

A number of the upper tributaries within the Hōteo River catchment, and parts of the Hōteo River mainstem, are identified as Natural Stream Management Areas (NSMAs) under the AUP(OP), and are shown in Figure 3-5, Figure 3-6 and Figure 3-7. Although identified on the AUP(OP) planning maps as a NSMA, the NSMA within the proposed designation west of the Indicative Alignment along the Hōteo River, does not meet the definition of a NSMA[48].

[48] Refer AUP(OP) Chapter J Definitions

Oruawharo River catchment

The catchment of the Oruawharo River is approximately 26,600 ha. The Indicative Alignment crosses two tributaries of the estuarine Oruawharo River; Te Hana Creek and Maeneene Creek. These tributaries collectively drain to the Oruawharo catchment, which ultimately drains to the Kaipara Harbour.

287 ha of the Project area sits within the Oruawharo River catchment, which is 1.07% of the total catchment area. Pastoral farming is the predominant land use in this catchment. Gradients in the catchment are moderate and soils are variable.

Te Hana Creek is a small creek with a total catchment of approximately 170 ha. The Indicative Alignment crosses multiple tributaries of Te Hana Creek. These tributaries are in the upper reaches within undulating pasture. Te Hana Creek becomes estuarine to the west of the existing SH1 and flows into Maeneene Creek, prior to discharging to the Oruawharo River, and ultimately the Kaipara Harbour.

Maeneene Creek has a total catchment of approximately 150 ha. Maeneene Creek becomes estuarine to the south of the existing SH1 and flows into Oruawharo River. The Indicative Alignment crosses multiple tributaries of the Maeneene Creek and crosses the main channel of the creek in an estuarine reach. The proposed Te Hana interchange at the northern end of the Project is located within this catchment.

3.6.5. Coastal marine areas

The coastal environment is described in detail in the *Marine Ecology Assessment* in Volume 2. The Project does not pass through any coastal marine areas (CMA). At its closest point the Project is located approximately 1 km upstream of the CMA at the northern tie-in with the existing SH1. The CMA in the surrounding area includes the Mahurangi Harbour and the coastal reaches of the inner Kaipara Harbour inlets at Te Hana Creek and Maeneene Stream. These harbours are the ultimate receiving environment for discharges from the Project and are shown Figure 3-9.

Mahurangi Harbour

The Mahurangi Harbour is part of the Hauraki Gulf. It is characterised by large areas of intertidal mud flats and sand flats inside the harbour, and a variety of more exposed shores (ranging from broad rock platforms to small sandy beaches) outside the mouth of the harbour. The harbour provides habitat for a varied range of animal and plant communities. Several established marine farms are located within the Mahurangi Harbour.

The AUP(OP) overlays classify a large area within the Mahurangi Harbour as Significant Ecological Area – Marine 2 (SEA-M2), and some smaller areas as Significant Ecological Area – Marine 1 (SEA-M1).

The western half of the Harbour and its surrounds are identified as an ONL (ID 43) under the AUP(OP), with several pockets of High Natural Character within and adjacent to the Harbour. The Mahurangi Harbour is also identified by the Department of Conservation (DOC) as an Area of Significant Conservation Value.

The Mahurangi Harbour has been identified as vulnerable to soil erosion and harbour infilling, primarily due to weather conditions that affect the area, the steep slopes

present within parts of the catchment, and erosion-susceptibility of soils.[49] Sediment enters the Harbour from the Mahurangi River and sub-catchments along the Harbour. Most sediment originates from pasture and native forest areas between the Mahurangi River and the Harbour entrance[50].

Inner Kaipara estuarine areas

The Kaipara Harbour is the largest harbour in the Auckland Region, with a total area of 947 km^2. It contains a variety of high value species, habitats, and values. The AUP(OP) recognises a number of SEA-M1 and SEA -M2 areas within the harbour, including significant wading bird areas. In particular, the southern parts of the Kaipara Harbour contain much diversity of habitat, and are home to mangroves and salt marshes, seagrass beds, intertidal and subtidal habitat, deep channels, and rocky reefs.[51] The seagrass and horse mussel beds present in the harbour provide important nursery habitat for snapper[52].

The closest areas of CMA to the Project area include the intertidal area around Te Hana Creek, and Maeneene Stream. Te Hana Creek and Maeneene Stream are located to the immediate north-west of Te Hana.

There are pockets of High Natural Character (as identified in the AUP(OP)) within the Kaipara Harbour, on the northern side of the Te Hana Creek (AREA 7 – Browns Hill, high rating), between Maeneene Creek and the Topuni River (AREA 6 – Topuni River, high rating) and within the Hargreaves Basin in the Oruawharo River (AREA 5 – Hargreaves Basin, high rating). There are also areas of Outstanding Natural Landscape. These overlays are shown on Figure 3-7.

The Northland Regional Policy Statement identifies the Oruawharo River arm within the Kaipara Harbour as High Natural Character and there are two areas of Outstanding Natural Character also located in the Oruawharo River. The Kaipara District Plan identifies the interface between the Oruawharo River and land as an area of significance to Māori (SM03) which recognises the Statutory Acknowledgement of the Kaipara Harbour coastal area.

The Kaipara Harbour also has issues relating to the amount of sediment entering the marine environment. The environmental values of the Harbour have been and are continuing to degrade. The key threats to the Harbour include land use activities that generate sediment and other contaminants. The Hōteo River is found to be a key contributor of sediment to the southern Kaipara Harbour and river sedimentation poses a threat to the snapper breeding ground located near the Hōteo River mouth.[53]

3.6.6. Wetlands

The wetlands within the Project area are detailed in the *Ecology Assessment*, and a summary is presented here. Wetland habitats throughout the Project area vary in their ecological value; from low value to very high value. Low value wetland habitats occur

[49] Carbines and Vaughan, 2013.
[50] Ibid.
[51] Ibid.
[52] Ibid.
[53] Warkworth to Wellsford Existing Water Quality Report, 2018.

throughout the Project area, where many of the wetland areas are degraded from stock access and modifications in the surrounding drainage systems.

The higher value wetland ecological values occur in the upper Kourawhero Stream valley northwest of Warkworth, which contains a high quality wetland mosaic with significant flora and fauna values and includes suitable habitat for birds and at least one regionally significant plant species (swamp maire). A wetland in the Kourawhero Stream headwaters is contiguous with a raupo reedland wetland downstream in the Phillips Road area.

Although many of the wetlands north of the Hōteo River are degraded due to stock access and modifications in the surrounding drainage systems there are also a number of high and very high value remnant wetland patches where stock have been excluded. These wetland sites are located on the alluvial terrace derived from the Hōteo River and likely formed part of an extensive kahikatea swampland prior to land conversion.

The AUP(OP) does not identify any Wetland Management Areas within the Project area.

3.6.7. Ecology

Vegetation and land cover

The majority of the land within the Project area is in productive land use, particularly for commercial plantation forestry and pastoral farming. Within the Project area there is approximately 848 ha of grass/pasture (59% of the total area), 488 ha of plantation forestry (34% of the total area), and 74 ha of native vegetation (5% of the total area).[54] The land cover of the Project area is represented in Figure 3-11.

Extensive tracts of pasture are present near Warkworth, largely used for mixed grazing, and to the north around Wellsford. The pasture near Wellsford is predominately dairying land. Matariki Forest is largely comprised of mixed aged stands of pine. Smaller areas of hardwoods, such as eucalyptus, are scattered along the corridor. While the commercial plantation forestry is currently vegetated, the nature of this environment is subject to a revolving cycle of change from a temporarily highly modified environment (during and immediately after harvesting) to a more natural environment while the replanted trees are growing. As discussed in section 3.5.1, these forests are likely to reach maturity around the same time as the Project pre-construction phase and progressively harvested from around 2025-2027.

The Mahurangi River (Left Branch) and the Kourawhero Stream are located within predominantly pastureland, interspersed with lowland kahikatea forest remnants and regenerating scrub. Riparian taraire forest and podocarp broadleaf forest border the Mahurangi River.

Plantation pine forest on steep, dissected hill country dominates the hills either side of the Dome Valley, interspersed with narrow riparian margins of native vegetation that line incised stream gullies. Also present are areas of mature Eucalyptus, small podocarp broadleaf forest remnants, and mixed native and exotic regenerating scrub along roadsides and in recently harvested sites.

[54] As adapted from Landcare Research's Land Cover Database - Plantation forestry definition

Forest and treeland clusters across north of the Hōteo River are largely surrounded by pasture and are currently in varying degrees of isolation and degradation due to the surrounding agricultural land use. The Hōteo River and its tributaries connect a number of remnant patches of lowland forest, including the totara-dominated forest lining the Hōteo River as well as patches of kahikatea swamp forest and taraire forest on areas of higher ground and escarpment near the river. The northern extent of the Project area towards Te Hana grades into rolling farmland interspersed with small patches of indigenous treeland, often associated with small tributaries.

Around Wellsford, the vegetation is characterised by areas of open pasture fragmented by some limited clusters of exotic and indigenous vegetation, including shelterbelt plantings.

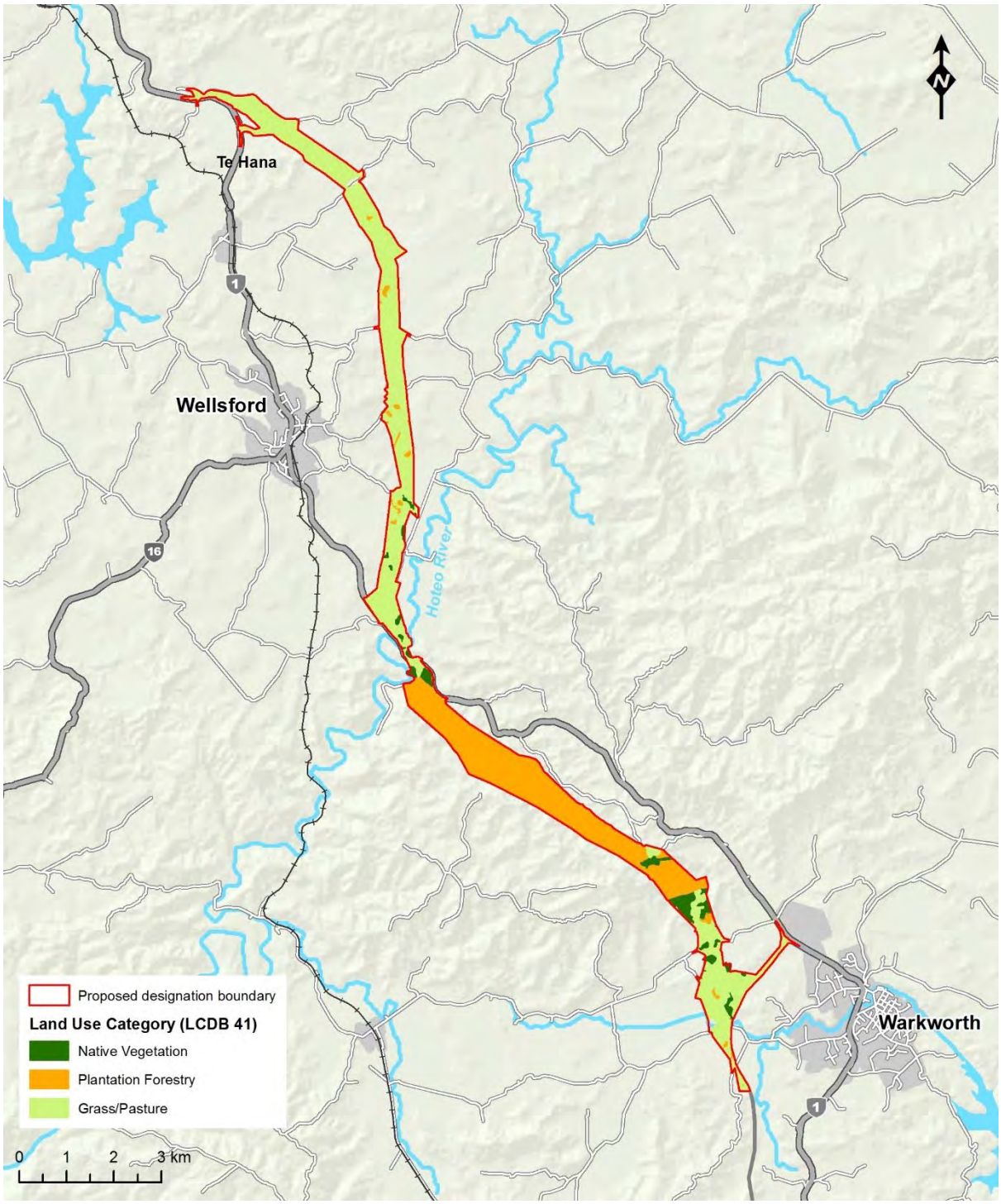

Figure 3-11: Vegetation and land cover within and surrounding the Project area

The AUP(OP) identifies several Significant Ecological Areas (SEA) in the Project area, including the riparian vegetation around the Mahurangi River and Hōteo River; some stands of indigenous vegetation around Wayby Valley Road and estuarine areas around Te Hana (refer Figure 3-5, Figure 3-6 and Figure 3-7).

Terrestrial fauna

The terrestrial fauna present in the Project area is detailed in the *Ecology Assessment* and consists of a combination of indigenous and exotic species, largely typical of the

wider region. Several threatened species inhabit the Project area, including native land snails, native birds, native long-tailed bat and Hochstetter's frogs, details of which are summarised below. Introduced pest mammals including pigs, goats, possums, rabbits, hedgehogs and rats are also present in the Project area.

Native land snails

Two species of native land snails; the Kauri snail and the Rhytid snail, have been recorded in patches of native forest within the Project area and its surrounds. These species are classified as 'At Risk – Declining' in the New Zealand Threat Classification System. During the surveys undertaken as part of the *Ecology Assessment* live kauri snails were found in Matariki Forest.

Birds

A large proportion of the birds present in the Project area are native and introduced species common within the wider region and throughout New Zealand. Of the native species present within the wider Project area, five are classified as At Risk, namely: North Island kaka, New Zealand pipit, North Island fernbird, North Island robin and red-crowned parakeet. During the surveys as part of the *Ecology Assessment* a single banded rail was detected in the area north of Warkworth and Cooks petrel were recorded over-flying in the Dome Valley and north of the Hōteo. Kaka and red-crowned parakeet are likely to be intermittent visitors to both the plantation forest habitats and remnant native habitat in the wider area. These species are probably more frequent in the larger tracts of native forest vegetation nearby, such as the Dome Forest Conservation Area.

Kereru and other native forest birds likely use areas of remnant native vegetation present throughout the wider area. A number of wetland birds are known to exist in the wider area including marsh crake and spotless crake.

Bats

Native long-tailed bats have been detected using acoustic recorders as part of the *Ecology Assessment*, within Matariki Forest. Long-tailed bats are highly mobile. Shelterbelts and small forest remnants with cavity bearing trees that could be used by bats exist throughout the Project area. Long-tailed bats are classified as nationally vulnerable in the North Island and have a high risk of extinction in the wild.

Lizards

At least six species of native lizards are known to occur within the wider Rodney area, and potential habitat for these species may exist within the Project area. Areas of native forest, native riparian and wetland vegetation, and some pine forest areas present potential habitat for native lizards. In particular, areas north of Kaipara Flats Road through the western slopes of the Dome Valley, Matariki Forest and around the heavily vegetated hill area north-east of Te Hana, may provide habitat for lizards.

Native frogs

The Hochstetter's frog is a small endemic frog that occurs in small isolated populations throughout the northern half of the North Island and Great Barrier Island. No specific frog surveys have been undertaken for the *Ecology Assessment* however Hochstetter's frog surveys undertaken previously have identified the commercial plantation forest as the only part of the Project area with suitable habitat and where Hochstetter's frogs have been recorded previously. Frog habitat was assessed in the *Ecology Assessment* and suitable habitat was identified at several sites surveyed.

Aquatic fauna

There is great variation in the ecological value of freshwater habitats within the Project area, from low value to very high value. Low value aquatic habitats are present north of Warkworth up to the Dome Valley and north of the Hōteo River, where many of the streams are located within grazed pasture. These watercourses are often degraded with low aquatic faunal diversity, no riparian vegetation and extensive stock damage. However, in these pastoral areas the *Ecology Assessment* has identified that small pockets of existing riparian vegetation and areas with riparian fencing present were associated with an increase in aquatic habitat value.

The commercial plantation forest has freshwater habitats of high ecological value, with high diversity of fish and macroinvertebrate species.

Mahurangi and Kourawhero freshwater habitats

Two watercourses (Mahurangi River (Left Branch) and Kourawhero Stream) were assessed in the *Ecology Assessment* as having moderate to high freshwater values, with the surveys indicating excellent fish populations, good stream ecological valuation (SEV) scores and Macroinvertebrate Community Index (MCI) scores that were indicative of good water quality. Electric fishing carried out as part of the surveys has identified good diversity including short and long fin eel, banded kokopu and common bully. Koura (freshwater crayfish) was also identified at one site.

Matariki Forest freshwater habitats

Freshwater environments within Matariki Forest are characterised by steep hill country aquatic habitats located within plantation pine forest. The surrounding catchments are predominantly plantation pine, with the occasional forestry road. Riparian margins across the three sites surveyed for the *Ecology Assessment* were similar, with plantation pine canopy and a number of native species that had become established closer to the stream channel. Freshwater values identified in the *Ecology Assessment* were high across all sites surveyed, indicating very good fish populations, a high abundance of Ephemeroptera, Plecoptera and Trichoptera (EPT) species (mayflies, stoneflies and caddisflies), excellent SEV scores and MCI scores were indicative of excellent water quality. Fish surveys at three sites for the *Ecology Assessment* identified Longfin Eel, Banded Kokopu, Common Bully, Redfin Bully. Freshwater crayfish, koura, were also abundant across each of the sites.

Hōteo River and tributaries freshwater habitats

Freshwater environments north of the Hōteo River are characterised by degraded lowland aquatic habitats that are surrounded by grazed pasture. Watercourses are typically small to medium sized tributaries that are highly modified, with many historically channelised. Fine silts and sand dominant stream channels, with abundant bank erosion present and extensive damage by cattle at many sites. Riparian margins are rare with some pockets of existing native vegetation present, with overall shade and organic input to watercourses low.

Freshwater values north of the Hōteo River are generally low, with some discrete moderate value features including the Hōteo River and Waiteraire Stream. Surveys undertaken for the *Ecology Assessment* generally indicated poor fish populations, low abundance of EPT species, low SEV scores, and MCI scores indicative of poor water quality. Fish species were recorded at the ten sites surveyed by the Project ecologists; including shortfin and longfin eel, the whitebait species inanga and banded kokopu

and redfin bully. Freshwater crayfish, koura was recorded at one of the sites surveyed by the Project ecologists.

Marine ecology

Mahurangi Harbour

The harbour contains areas classified as SEA M1 and M2 in the AUP(OP), in addition to the entire harbour being recognised as an ASCV by DOC. Dense mangrove stands fringe the tidal flats of the upper estuary and side embayments. Estuarine vegetation including seagrass meadows provides significant habitat for native fish, birds and invertebrates.

Benthic invertebrate community species diversity and richness is high in middle and lower reaches of the harbour. Benthic invertebrate diversity is low in the upper harbour (upstream of Hamiltons Landing). A large range of fish and birds use the harbour, including several Threatened or At Risk bird taxa.

Various embayments within the harbour have been modified through the establishment of intertidal oyster farms and terrigenous sediment input.

Kaipara Harbour

The Kaipara Harbour is identified as a SEA in the AUP(OP). The upper intertidal zone contains vegetation sequences consisting of mangrove forest and shrubland, various indigenous saltmarsh and exotic grassland and rushland species. Vast areas of shallow intertidal mud and sandflats exist, which, along with mangrove and saltmarsh, provide important habitat for a number of avifauna species. Some of these avifauna species are Threatened or At Risk.

Kaipara Harbour has vast seagrass meadows that support a wide variety of fish, invertebrates and birds. These meadows provide important ecosystem functions such as stabilising sediment, nutrient cycling, and primary productivity as well as habitat.

The Kaipara Harbour has significant channel environments with healthy shellfish communities, which provide significant nursery areas for range of fish species including snapper, rig, and Great White Shark (protected under the Wildlife Act and an International Union for the Conservation of Nature red listed species). The harbour is also recognised as an important area for the protected Maui Dolphin.

Benthic invertebrate community species diversity and richness is low in the middle and lower reaches of the harbour, and moderate in the upper harbour (Oruawharo River and Hōteo River), mainly due to the abundance of a number of mud tolerant species.

The harbour has been modified through the establishment of intertidal oyster farms, dredging, mangrove removal and the invasion of weed species within various embayments.

4. Project description

4.1. Introduction

The Project is for the design, construction, operation and maintenance of a new four-lane state highway, approximately 26 km in length. The Project will provide an alternative alignment to the existing SH1. The route heads north from the interface with P2Wk near Wyllie Road initially travelling to the west of the existing SH1 before crossing SH1 just south of the Hōteo River and then travelling to the east of Wellsford and Te Hana, bypassing these centres. The Project ties into the existing SH1 to the north of Te Hana, near Maeneene Road.

The design of the Project has been an iterative process, developed through collaborative design, input from environmental disciplines and considering feedback from stakeholders. This has enabled the large scale of the Project and the complex natural and moderate built environment values associated with the Project area to be addressed.

This section gives a description of the Project and should be read in conjunction with the *Volume 3: Drawing Set*. The Project description as set out in this section has informed the *Volume 2: Technical Assessment Reports*.

The information provided in this section and in the drawings describe the Indicative Alignment.

Any numbers, areas or dimensions outlined in this section are approximate and may change as a result of detailed design. The final alignment for the Project (including the design and location of ancillary components, such as stormwater treatment devices and soil disposal sites), will be refined and confirmed at the detailed design stage.

4.2. Indicative Alignment description by area

For description and assessment purposes, the Project has been divided into the following areas (as shown in Figure 4-1):

a) Hōteo South: From the southern extent of the Project at Warkworth to the Hōteo River.
b) Hōteo North: Hōteo River to the northern tie in with existing SH1 near Maeneene Road.

For construction purposes, the Hōteo South section is divided into two subsections being:

- South – from the southern tie in with P2Wk to the northern tunnel portals; and
- Central – from the northern tunnel portals to the Hōteo River.

The Indicative Alignment through these areas is shown on drawings R-100 to R-124 in *Volume 3: Drawing Set.*

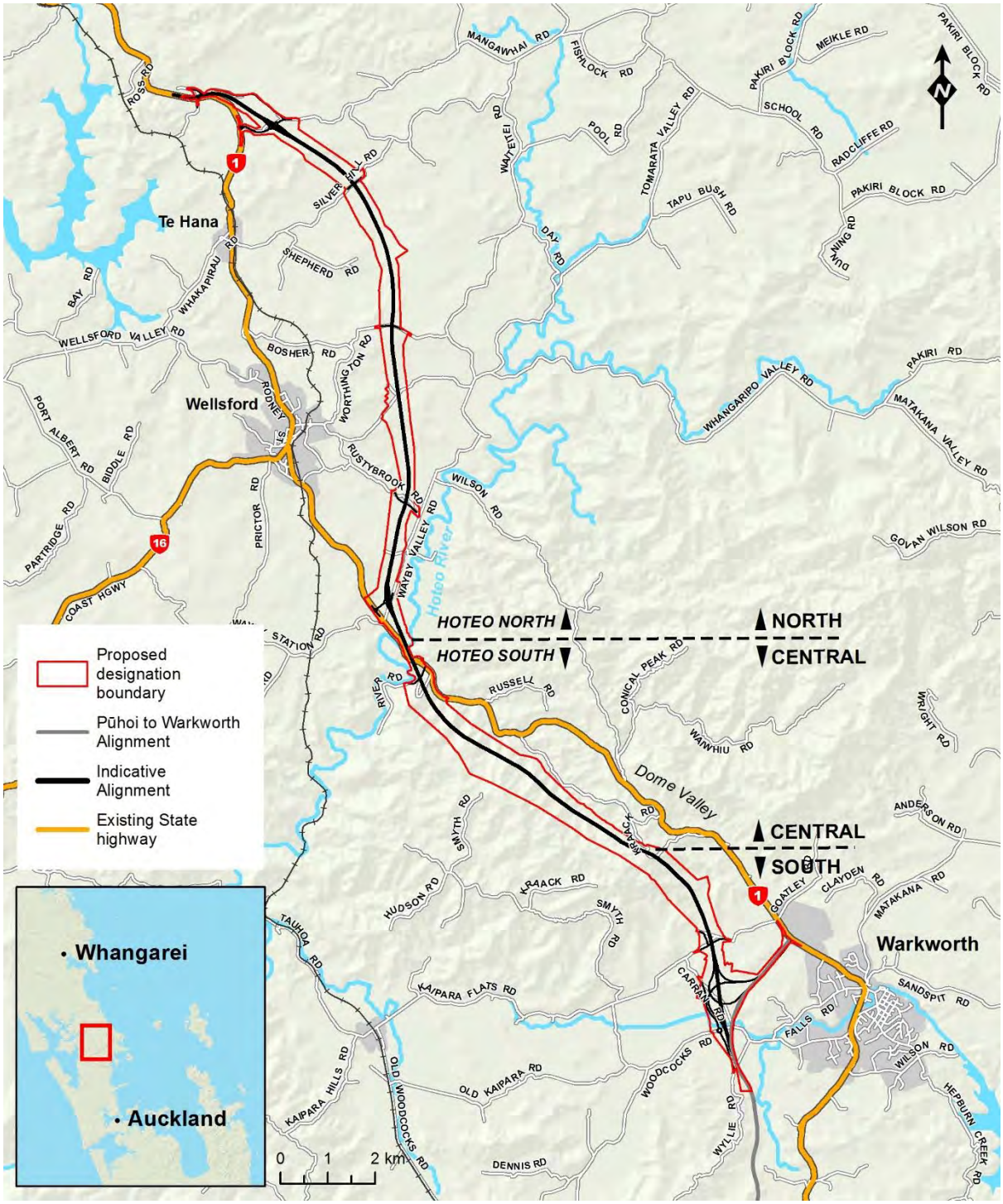

Figure 4-1: Indicative Alignment

4.2.1. Hōteo South

The Indicative Alignment connects to the alignment of P2Wk and continues in a northerly direction. The proposed Warkworth Interchange is located to the north of Wyllie Road. The Indicative Alignment passes over Woodcocks Road and requires a diversion of Carran Road to the west of the alignment at the proposed Warkworth Interchange.

Continuing north, the Indicative Alignment crosses the flat valley of the Mahurangi River and passes under Kaipara Flats Road near Phillips Road. Both Kaipara Flats Road and Phillips Road require realignment. Heading north, the Indicative Alignment begins to climb as it runs along a short valley towards the southern extent of the Matariki Forest, to the west of SH1. Due to the steepness of the terrain through this area, the Indicative Alignment will pass through 850 m long tunnels below Kraack Road. Two separate tunnels will carry north and south bound traffic.

The Indicative Alignment continues from the northern portals of the tunnels through the Matariki Forest plantation to the west of the existing SH1, running parallel to and below the main ridge and across a series of steep valleys as it passes through the Dome Valley. The Indicative Alignment in this location requires substantial cut slopes and fill embankments. The Indicative Alignment passes under and over private forestry roads to maintain forestry access.

The Indicative Alignment crosses the New Zealand Refining Company Ltd (Refining NZ) and First Gas pipelines (fuels and gas pipelines) just south of the Hōteo River, which will necessitate relocation works to these pipelines prior to construction of the Project in this location.

4.2.2. Hōteo North

At the north end of the Dome Valley the Indicative Alignment crosses SH1, the Hōteo River, and the Waiteraire Stream (which runs through the Dome Valley and discharges into the Hōteo River) on a viaduct. The proposed Wellsford Interchange is located north of Hōteo River, centred on Wayby Valley Road. The mainline carriageway spans over Wayby Valley Road, with Wayby Valley Road itself requiring a realignment to accommodate the interchange. The proposed interchange provides access to Wellsford and includes a new (roundabout) intersection with the existing SH1. The position of the interchange has been set to minimise intrusion into the floodplain of the Hōteo River.

The Indicative Alignment continues northward, parallel to Wayby Valley Road, crossing Robertson Road (which in that location would be closed by the Indicative Alignment), crossing beneath Rustybrook Road, before turning north and crossing over Whangaripo Valley Road (east of its intersection with Borrows Road). Continuing north, the Indicative Alignment passes beneath Farmers Lime Road, before crossing over the fuels and gas pipelines. The Indicative Alignment descends from Farmers Lime Road along the valley and crosses under Silver Hill Road at the site of a disused quarry. It then rises, turning northwest as it crosses the eastern extent of the ridgeline of the hills that extend westwards to Te Hana. The Indicative Alignment continues northwest and crosses over the fuels and gas pipelines again, and also a realigned Mangawhai Road with which the alignment connects at the proposed Te Hana Interchange. The Indicative Alignment passes under a Transpower high voltage electricity transmission line in the vicinity of this interchange and to the west of the existing Vipond Road reserve. The construction of an additional transmission line support structure is required to ensure the necessary vertical clearances are achieved between the carriageway and the lines. Vipond Road will be formed from Mangawhai Road, and its existing intersection with SH1 will be closed.

The Indicative Alignment continues northwest to bridge over the Maeneene Stream and a realigned Maeneene Road/Waimanu Road intersection before tying into the existing alignment of SH1 north of Waimanu Road.

4.3. Design principles and parameters applying to key Project components

4.3.1. Mainline carriageway characteristics

The mainline carriageway[55] of the Indicative Alignment has been designed in accordance with the following design parameters:

- Full length of the mainline carriageway designed to motorway standards with access to and from the state highway obtained via grade-separated interchanges;
- The design speed adopted for the mainline carriageway is 110 km/h;
- Two 3.5 m wide traffic lanes in each direction, including 3.0 m wide outside shoulders and edge barrier protection;
- Median divided carriageways incorporating a 6.0 m minimum median width, including 1.0 m wide shoulders and median barrier;
- Maximum uphill grade of 6% along the mainline carriageway; however, within the tunnel the maximum uphill grade is 5%;
- Minimum of 10.0 m wide x 6.0 m high clearance envelope for over dimension vehicles, including within the tunnel.

An approximately 2.7 km long slow vehicle lane is proposed in the northbound direction commencing on the approach to the southern tunnel portal, continuing through the northbound tunnel, before terminating approximately 600 m after the northern portal.

The Indicative Alignment northbound carriageway reduces from two lanes to one lane at the proposed Te Hana Interchange to enable a safe transition into the tie-in with the existing SH1. The southbound carriageway develops into two lanes approximately 1 km north of the proposed Te Hana interchange.

Cross sections representing these layouts are shown in Drawing R-181 of the Road Alignment (R-Series) in *Volume 3: Drawing Set*.

4.3.2. SH1, local and private access roads

The existing SH1 will be maintained for local access and will provide an alternate route once the Project is operational. It is anticipated that existing SH1 between SH16 and the Te Hana interchange will be re-named SH16, i.e. it will remain a state highway, this is yet to be confirmed. Connections to the existing SH1 are provided via all interchanges.

The Project requires works on a number of local roads along its length in order to maintain local access. With the exception of Robertson Road, all formed local roads that intersect with the Indicative Alignment are grade separated, enabling local connections, and therefore access to properties along these roads to be maintained.

[55] The mainline carriageway is the through-route portion of the Project, excluding the interchanges and local road connections.

The Indicative Alignment will result in the closure of eastern end of Robertson Road to its intersection with Wayby Valley Road.

The Indicative Alignment passes over the following existing roads:

- Woodcocks Road;
- Existing SH1 at Hōteo River;
- Wayby Valley Road;
- Whangaripo Valley Road;
- Mangawhai Road; and
- Maeneene Road.

The Indicative Alignment passes under Kaipara Flats Road, Rustybrook Road, Farmers Lime Road and Silver Hill Road.

Local road realignments to avoid intersecting with the Indicative Alignment are proposed to sections of Wyllie Road, Carran Road, Phillips Road, Vipond Road and Waimanu Road. Realignments are proposed to sections of Kaipara Flats Road, Wayby Valley Road, Rustybrook Road, Mangawhai Road and Maeneene Road to enable access around the Indicative Alignment.

Sections of Robertson Road, Vipond Road and paper roads within the Project area will be stopped. Where necessary, access to private properties will be maintained through road realignments.

The Indicative Alignment passes under and over forestry roads to provide for forestry access. Rationalisation of the forestry tracks may be undertaken, with further discussions to be held with the forestry owners/operators to confirm the final requirements. Consideration will be given to the provision of stock underpasses beneath the Indicative Alignment at appropriate locations where these are required to maintain viable farming operations. Access to private properties will be maintained through local roads where necessary. The design approach for private property access is as follows:

- Access is required from local roads to all properties; and
- Where access to existing dwellings or land use activities (e.g. operating farm) is severed and the activity remains viable within the residual land holding then new accesses will provide sufficient clearances for vehicles appropriate for the land use.

4.3.3. Interchanges and local road connections

The Project has been designed to provide connectivity to the local transport network along the Indicative Alignment. There are three state highway interchanges proposed – near Warkworth, Wellsford and Te Hana. Direct 'all direction' access to and from the main alignment will be provided at these interchanges.

Proposed Warkworth Interchange

The proposed Warkworth Interchange interfaces with P2Wk and provides a safe and efficient connection to the existing SH1 on the northern outskirts of Warkworth.

The proposed Warkworth Interchange in the Indicative Alignment includes free-flow ramps[56] connecting the Project with the existing SH1 at the northern terminus roundabout, north of Woodcocks Road, which will be built as part of P2Wk.

The Warkworth Interchange is shown in Figure 4-2 below.

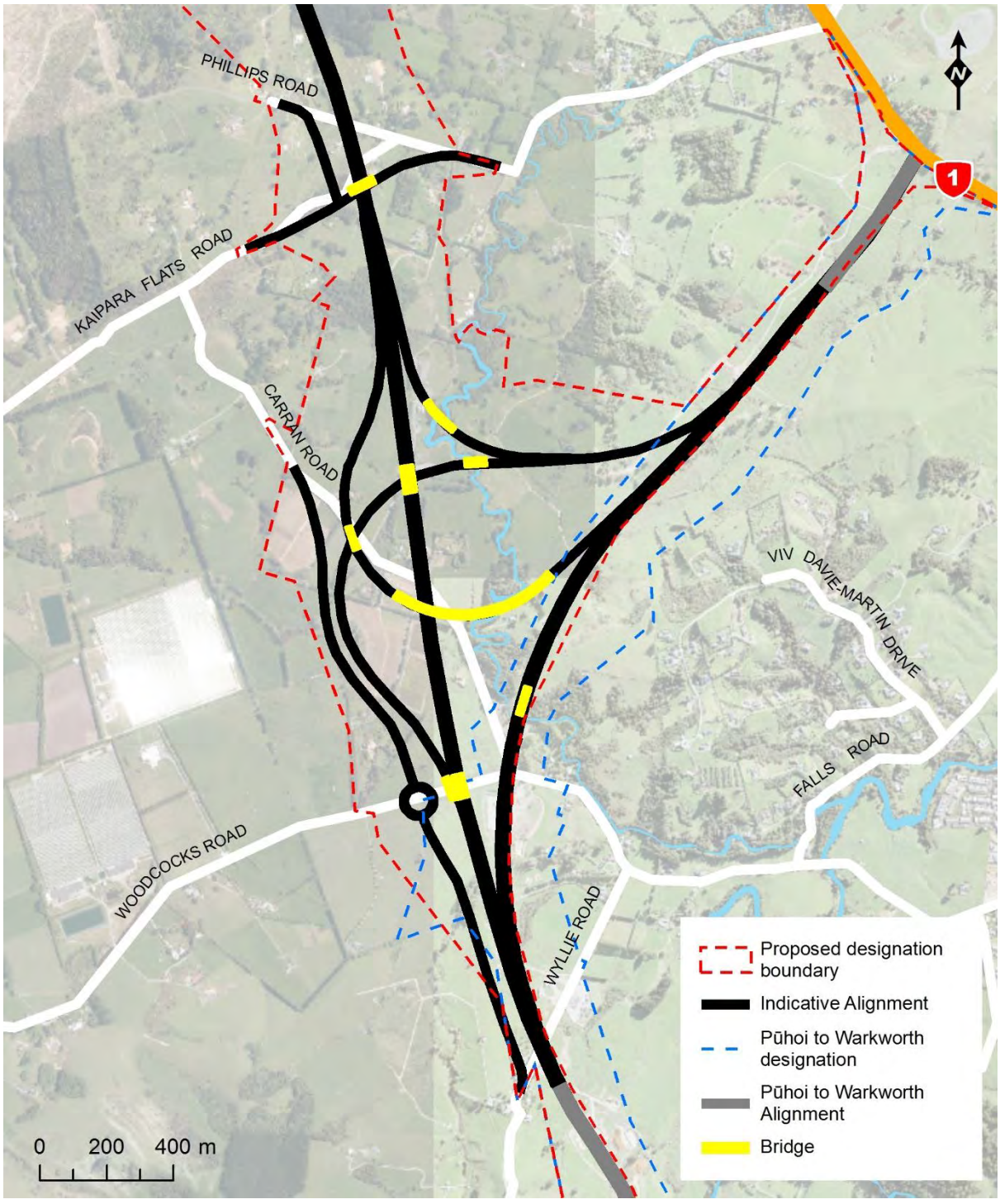

Figure 4-2: Proposed Warkworth Interchange

[56] Free flow ramps are motorway on and off ramps that allow unimpeded traffic movement on and off the highway, as distinct from intersections that are controlled by traffic lights or 'give-way' or 'stop' sign controls.

Proposed Wellsford Interchange

The proposed Wellsford Interchange in the Indicative Alignment is a diamond service interchange, where the on and off ramps diverge slightly from the mainline carriageway connecting to Wayby Valley Road. The on and off ramp connections to Wayby Valley Road are configured with a pair of roundabouts. The Indicative Alignment will necessitate the relocation of the existing intersection of Wayby Valley Road with SH1 for safety reasons. The Indicative Alignment includes a roundabout at the Wayby Valley/SH1 intersection.

The proposed Wellsford Interchange will provide the primary connection to Wellsford from the south and will provide access to and from SH1 and Wellsford, with approximately 12 km between adjacent interchanges i.e. the Wellsford and Te Hana interchange are 12km apart. The proposed Wellsford Interchange shown in Figure 4-3.

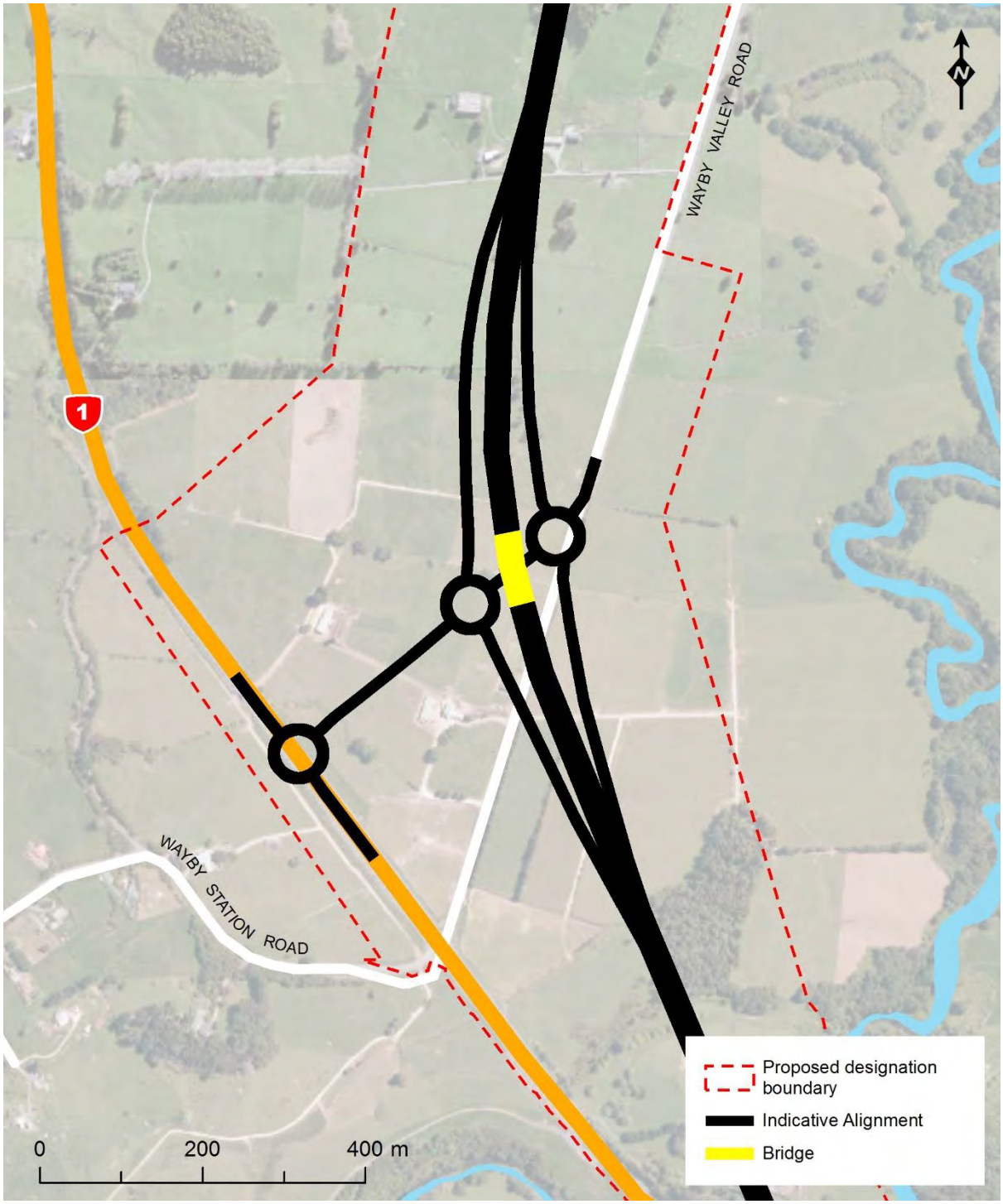

Figure 4-3: Indicative Wellsford Interchange

Proposed Te Hana Interchange

The proposed Te Hana Interchange in the Indicative Alignment is a diamond service interchange and the on and off ramp connections to Mangawhai Road are configured with a pair of roundabouts. Approximately 3 km of Mangawhai Road will be realigned and the existing intersection of Mangawhai Road with the existing SH1 replaced with a roundabout.

The proposed Te Hana Interchange will provide access to Mangawhai Road and the Twin Coast Discovery Highway. It will also provide access to Wellsford from the north

and will service settlements such as Te Hana to the southwest and Mangawhai to the east and surrounding communities.

The proposed Te Hana Interchange is shown in Figure 4-4 below.

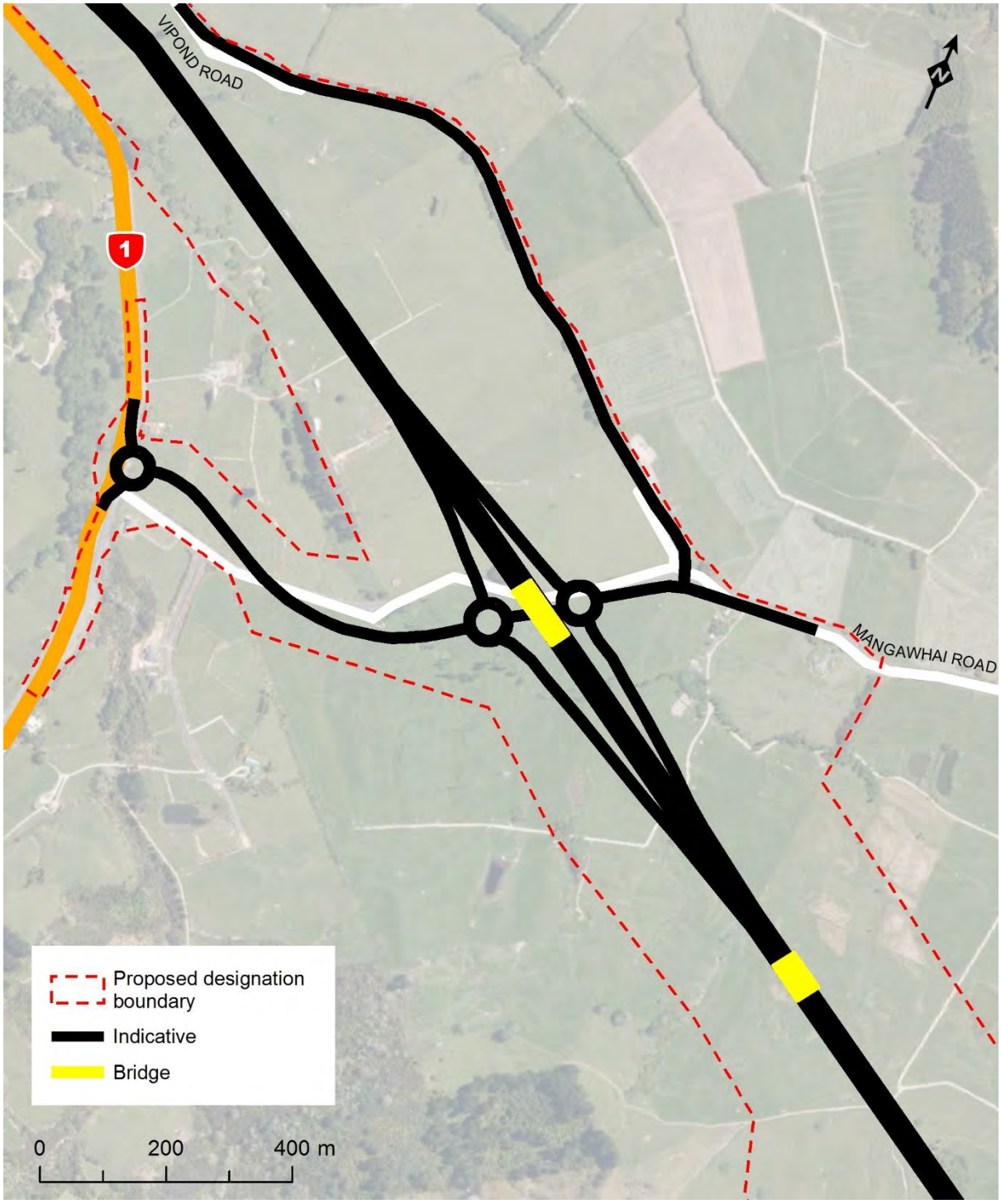

Figure 4-4: Indicative Te Hana Interchange

4.3.4. Structures

New structures proposed for the Indicative Alignment include bridges over the existing SH1, local roads, waterways and network utility assets; local road bridges over the mainline carriageway, and the tunnels. The location of these structures are shown in Figure 4-5 and Figure 4-6 and are described in further detail below.

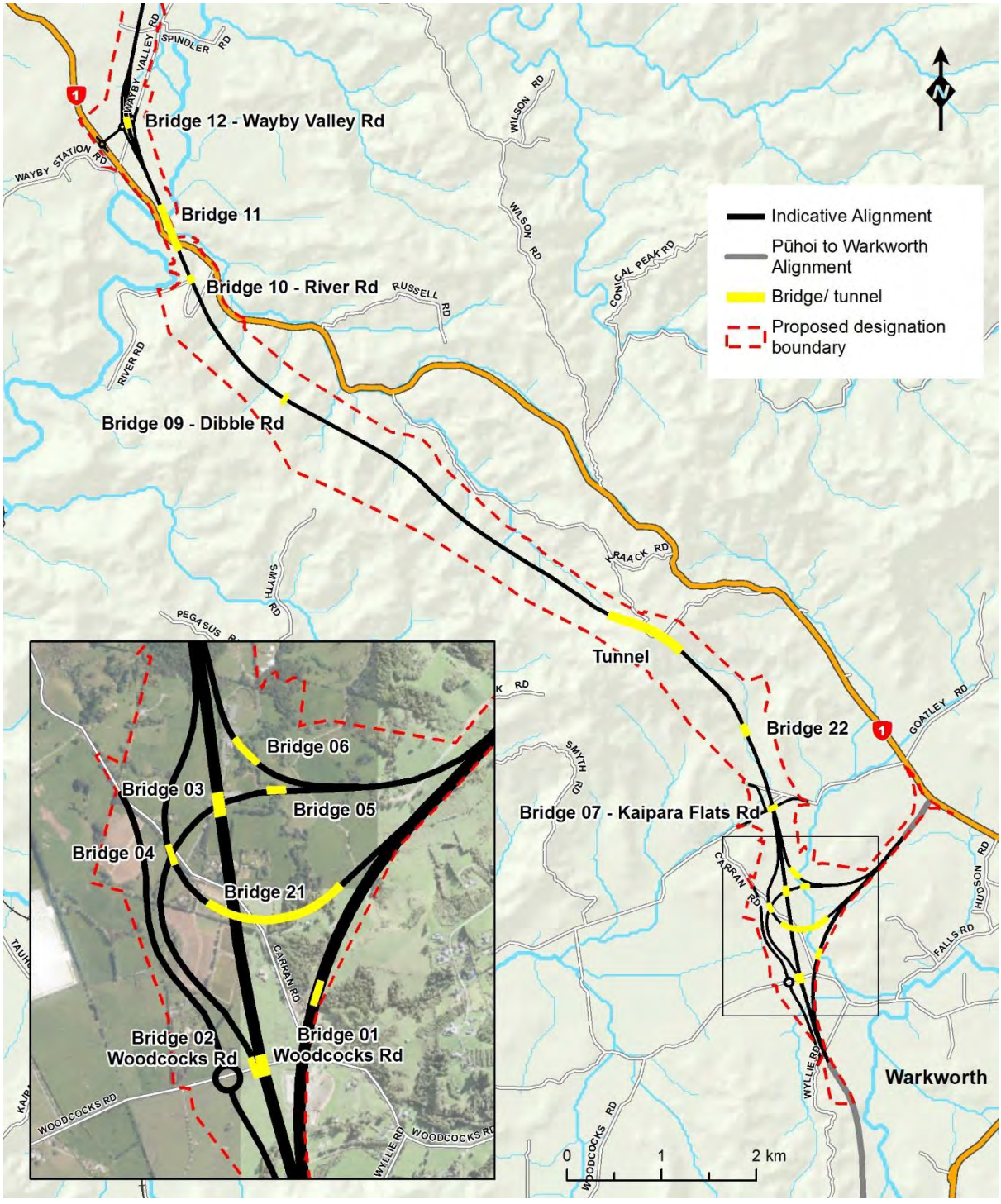

Figure 4-5: Indicative structures in Hōteo South

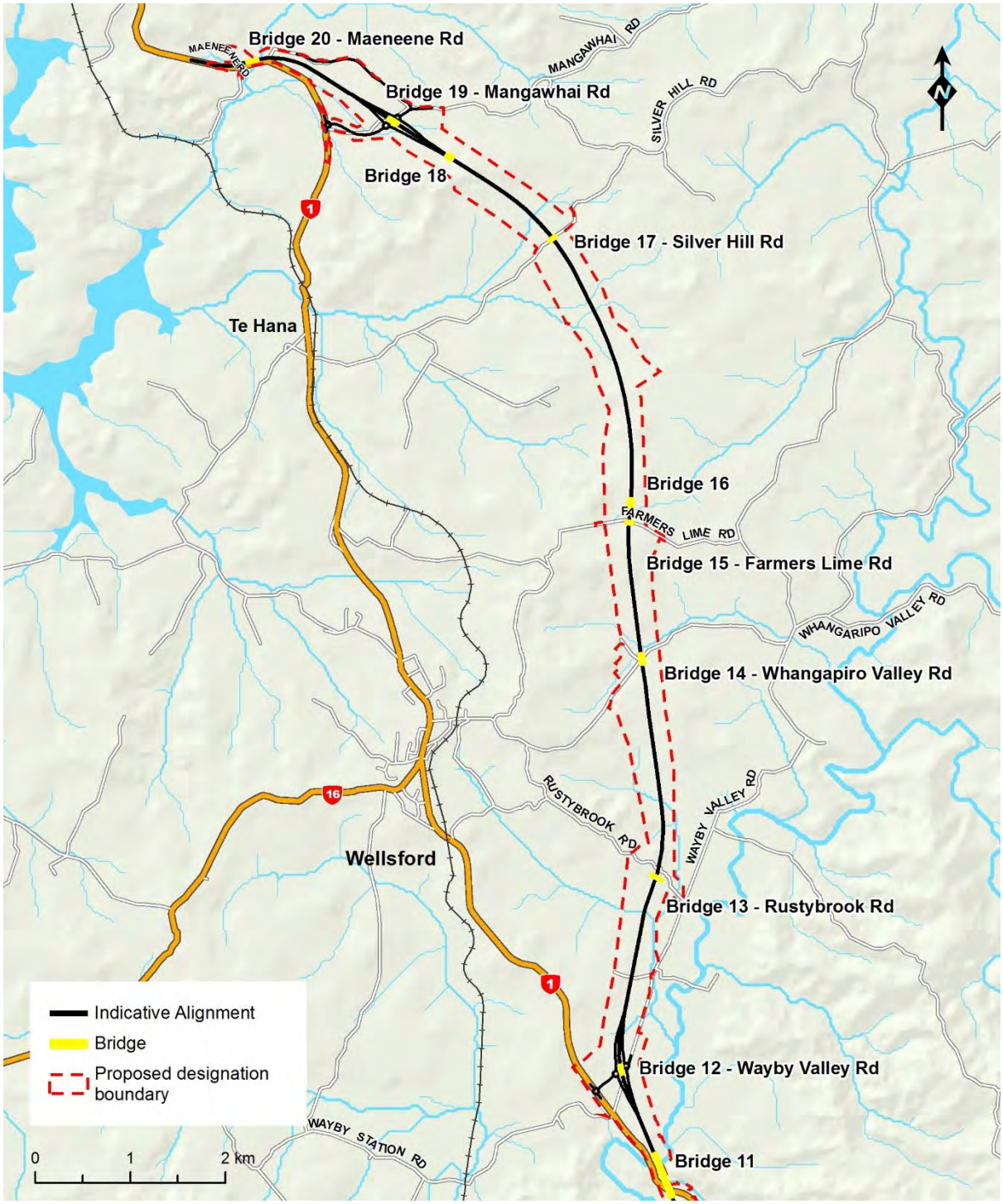

Figure 4-6: Indicative structures in Hōteo North

Bridges

The Indicative Alignment has 21 bridge structures. Three different bridge categories have been proposed for the bridges along the route. These are:

- Viaducts: Viaduct structures are proposed where the mainline carriageway crosses natural valley features at height or crosses waterways and floodplains. Carriageways on viaducts may be separate (i.e. separate structures for northbound and southbound lanes).

- Underpass: Bridges over the mainline carriageway. The majority of these bridges will carry local roads across the mainline carriageway, generally where it the mainline carriageway sits within a cut. Indicative bridge structures spanning over the mainline carriageway provide a vertical clearance of at least 6 m above the mainline carriageway surface and are generally less than 10 m in height.
- Overpass: Mainline carriageway bridges. These bridges are used to take the mainline carriageway (including on/off ramps) over localised features (e.g. local roads, pipelines or water courses) and are generally sitting on a fill embankment. The length of these bridge structures has been determined by the width of the local road. Bridge structures are generally less than 10 m in height.

A summary of the proposed bridge structures in the Indicative Alignment is included in Table 4-1.[57]

Table 4-1: Summary of indicative bridge structures

Bridge No.	Description	Approximate length (m)	Approximate spans (m)
1	Overpass – mainline carriageway over Woodcocks Road	70	1 x 30 2 x 20
2	Warkworth Interchange: Overpass – northbound off ramp over Woodcocks Road	70	1 x 30 2 x 20
3	Warkworth Interchange: Overpass – mainline carriageway over northbound off-ramp	70	1 x 30 2 x 20
4	Warkworth Interchange: northbound on-ramp over northbound off-ramp	70	1 x 30 2 x 20
5	Warkworth Interchange: northbound off-ramp over Mahurangi River	65	1 x 24 1 x 21 1 x 20
6	Warkworth Interchange: southbound off-ramp over Mahurangi River	120	5 x 24
7	Underpass – mainline carriageway under Kaipara Flats Road	72	1 x 32 2 x 20
8	Not allocated	–	–
9	Underpass – mainline carriageway under Dibble Road (forestry)	90	6 x 15
10	Overpass – mainline carriageway over River Road (forestry)	25	1 x 25
11	Hōteo viaduct – mainline carriageway over existing SH1, Hōteo River, and Waiteraire Stream	485	6 x 65 2 x 50
12	Wellsford Interchange: Overpass – mainline carriageway over Wayby Valley Road	70	1 x 30 2 x 20
13	Underpass – mainline carriageway under Rustybrook Road	74	1 x 32 2 x 21

[57] Bridge Number 8 was removed during design refinement prior to lodgement.

Bridge No.	Description	Approximate length (m)	Approximate spans (m)
14	Overpass – mainline carriageway over Whangaripo Valley Road	70	1 x 30 2 x 20
15	Underpass – mainline carriageway under Farmers Lime Road	64	1 x 32 2 x 16
16	Overpass – mainline carriageway over fuels and gas pipelines	105	3 x 35
17	Underpass – mainline carriageway under Silver Hill Road	72	1 x 32 2 x 20
18	Overpass – mainline carriageway over fuels and gas pipelines	25	1 x 25
19	Te Hana Interchange: Overpass – mainline carriageway over Mangawhai Road	70	1 x 30 2 x 20
20	Overpass – mainline carriageway over Maeneene Road	104	1 x 30 2 x 26 1 x 22
21	Warkworth Interchange: Underpass – mainline carriageway under northbound on-ramp	555	7 x 65 2 x 50
22	Overpass – mainline carriageway over wetland feature	96	3 x 32

Tunnels

Twin bore tunnels (each serving one direction) are proposed to enable the Project to pass beneath the ridgeline topped by Kraack Hill. A significant east-west ridge line to the north west of Warkworth is the key reason for the proposed tunnels, so that suitable gradients can be achieved (maximum grades of around 6% and 5% within the tunnel).

The indicative tunnels are approximately 850 m long and are approximately 160 m below existing ground surface at their deepest point. The design is similar to the existing Johnstone's Hill Tunnels (approximately 400m in length) located immediately south of Pūhoi.

The incline to the northbound tunnel will need a third lane northbound to safely accommodate slower vehicles.

The indicative tunnel design includes, but is not limited to, the following items:

- Tunnel drainage to cater for groundwater, wash-down and deluge systems, including capture and treatment;
- Lighting;
- Ventilation including requirements for emergency management;
- Provision for services (utilities);
- Emergency management systems (deluge and fire) including monitoring and incident management/response;
- Access requirements; and
- Power requirements.

The tunnels will be serviced by deluge tanks, a distribution point for power supply and other ancillary assets (E.g. power lines), that will sit within the proposed designation in proximity to the tunnel portals. The deluge tanks will sit on the hill above the tunnel.

Cross passageways will be included to provide access between each of the tunnels. These will allow access from one tunnel to another in the event of an incident in one tunnel requiring that tunnel be evacuated.

4.3.5. Traffic services

Traffic services along the Indicative Alignment will likely include (but are not limited to) ancillary features such as:

- Permanent road signs;
- Road lighting;
- Road markings;
- Roadside and median barriers;
- Ramp signalling;
- Gantries;
- Traffic count stations;
- Closed-circuit television;
- Speed enforcement;
- Emergency phones;
- Emergency laybys;
- Emergency vehicle access; and
- Maintenance access.

The traffic services in place when the Project opens to traffic will be finalised during the detailed design phase and will be designed in accordance with the relevant standards which apply at that time. Throughout the life of the Project, it is anticipated that traffic services will be renewed and upgraded as required, to ensure the continued safe and efficient operation of the state highway. Renewal and upgrade activities would be undertaken as part of the normal operation and maintenance of the road.

Interchanges will be lit in accordance with NZTA M30 and AS/NZS 1158:2005 (Standards New Zealand and Standards Australia, 2005), or the equivalent standard applicable at the time the Project is designed.

4.3.6. Walking and cycling facilities

Walking and cycling facilities are not included along the mainline carriageway, as the Indicative Alignment has been designed to motorway standards and specific aspects of the Project specifically preclude access (i.e. the tunnels and distance between local access connections). Pedestrians, cyclists and other road users will be able to use the existing SH1 and the local road network. Cycle paths are proposed where appropriate to provide cyclists with continuous and safe access to and across the Project and to the existing SH1.

Design of local road and interchange crossings will allow for pedestrians, cyclists and other road users within the width of the local road corridor across the Indicative

Alignment. The Project design will futureproof these structures for walking and cycling if such programmes are undertaken in the future and would integrate with potential cycle ways proposed by others (e.g. Auckland Council) to connect Wellsford with Pakiri (along Whangaripo Valley Road), and to connect Te Hana with Mangawhai along Mangawhai Road.

As with other aspects of the Indicative Alignment, walking and cycling facilities will be considered in detail at the later detailed design stage, taking into account the transport environment at that time.

Given the Indicative Alignment passes through tunnels below Kraack Road, the Te Araroa Trail will not be affected by the Project.

4.3.7. Geotechnical design considerations

The geotechnical design philosophy is based on identifying, avoiding where possible, or otherwise minimising key known geotechnical risks and environmental impacts to provide a safe, secure and constructible Indicative Alignment.

The proposed designation has been identified to, where practicable:

- Avoid or minimise exposure to major landslides and natural hazards;
- Avoid the need for large retaining walls and structures;
- Minimise earthworks and structures on steep or unstable slopes;
- Maintain flexibility and scope for future design innovations and improvements; and
- Use reinforced soil (mechanically stabilised earth (MSE) embankments) to steepen embankment slopes, where appropriate, for example to minimise further encroachment into SEAs.

Cut slopes

The Indicative Alignment will pass through steep terrain with numerous ridges and valleys. As such, the Indicative Alignment will include numerous cut slopes, ranging in height up to approximately 56 m. Cut slope gradients adopted in the Indicative Alignment vary depending on the geology and erosion characteristics. Detailed cut slope designs will be carried out during the detail design phase of the Project in accordance with standard geotechnical design guidelines and accepted New Zealand design criteria and standards.

A range of common stabilisation and construction management measures are available to manage potential slope instability (including rock fall hazards). Likely stabilisation measures include:

- Flattened cut batters and/or the rounding of the soil profile;
- Drainage, including horizontal bored drains, cut off drains and surface counterfort drains;
- Rock anchors or rock bolting;
- Undercutting to remove existing landslide masses and shear surfaces;
- Vegetation cover;
- Retaining structures, including anchored bored pile retaining walls;
- Scaling of the cut face to remove rocks;
- Compacted shear keys or buttress fill; and
- Rock fall barriers.

Figure 4-7: Indicative cut face batter (possible for cuts within the plantation forestry area)

Fill embankments

Given the terrain through which the Project passes, the Indicative Alignment in some locations will be located on engineered embankments up to approximately 40 m above existing ground level. Embankment design will respond to each geological formation that could reasonably be expected to be the material on which the embankment is founded (Pakiri Formation, Tauranga Group alluvium, and Northland Allochthon mudstones and limestone) to determine stable slope gradients and acceptable levels of settlement according to the general geotechnical conditions anticipated. Embankment construction will require the placement of large volumes of earthworks fill material and localised or site-specific ground treatment. Additional stabilisation measures may be incorporated during detailed design where appropriate to the circumstances.

MSE walls are proposed at some bridge abutments and approaches, and at certain other locations to prevent encroachment into or realignment of local streams located adjacent to the Indicative Alignment.

4.3.8. Network utilities

The Project will require the relocation of, and works in the vicinity of, several major utilities, including regionally and nationally significant infrastructure. Major infrastructure assets affected by the Project, and the proposed methods to address this, include:

- First Gas: in various locations, relocation of the gas transmission pipeline and/or bridging over it;
- Refining NZ: in various locations, relocation of the fuel pipeline and/or bridging over it;
- Vector: Wellsford Delivery Point; and

- Transpower: installation of an additional support structure along the existing transmission line alignment (110 kV line).

In addition, proposed stormwater discharge points are located upstream of Watercare's surface water supply take point for Warkworth. It is noted that Watercare has transferred from surface water to groundwater abstraction for Warkworth.

4.3.9. Operational drainage and stormwater management

The indicative stormwater design for the Project is outlined in the *Water Assessment Report* in Volume 2, and indicative elements of these systems are shown on the *Operational Water Series* drawings in *Volume 3: Drawing Set*.

The indicative stormwater design for the Project provides a best practicable option to safely convey and discharge stormwater runoff from the new road and to avoid, remedy or mitigate adverse environmental effects of the construction and operation of drainage and stormwater systems, determined through a robust evaluation of the Project against the Auckland Council and Transport Agency requirements relating to the design and construction of stormwater conveyance and treatment systems.

The indicative stormwater design integrates all aspects of the drainage and stormwater system, including the stormwater collection and conveyance network, treatment devices, culverts and watercourse diversions and has had due consideration of the floodplain.

The following design principles for the stormwater systems servicing the Indicative Alignment and altered local road corridors within the Project have been adopted:

- Water from outside the proposed designation is diverted around or through the Project, so that it does not mix with stormwater run-off from the new road.
- Cross drainage structures are designed to allow the continued flow of existing watercourses and overland flow paths with minimal effect on the surrounding environment.
- Overland flow paths are provided and maintained for flows in excess of the primary drainage network capacity, to allow for flows up to and including the 100 year average return interval (ARI) storm.
- Outfalls will incorporate erosion control measures that support fish passage.
- The design provides fish passage in culverts for all permanent streams with upstream habitats, and for intermittent streams where there is potential for fish habitat upstream.
- The mainline carriageway level will be set at a freeboard clearance above design flood levels (100 year ARI storm).
- Works will not significantly increase flood levels outside the designation.
- All stormwater runoff from the mainline carriageway and rock cuts will be captured and treated prior to discharge into the receiving environment.
- Stormwater discharges from the mainline carriageway and rock cuts will be directed to stormwater treatment devices, which will be designed to target the removal of suspended solids and contaminants of concern including zinc, copper and other persistent and bio-accumulative contaminants in accordance with Transport Agency and Auckland Council standards and guidelines.
- The design will include a range of water sensitive design solutions including treatment swales and treatment wetlands to deliver stormwater hydrology (flows and volumes) and stormwater quality (treatment) mitigation.

Overland flow paths and cross drainage

Overland flow paths will be designed to cater for a 100 year ARI event. Where no secondary flow route is available then the capacity of the primary system will be designed to cater for the 100 year ARI rainfall event.

Many small tributaries, some larger rivers, and overland flow paths are crossed by the Indicative Alignment. Cross drainage structures have been designed to allow the continued flow of existing watercourses and overland flow paths and will generally be in the form of viaducts or bridges or pipe or box culverts.

Viaducts and bridges will be designed to pass flow rates attributable to a 1 in 100 year ARI storm. These structures will have a freeboard of 600 mm in non-forested areas and a freeboard of 1200 mm in forested areas, where the risk of debris blockage is higher.

Culverts that cross the mainline carriageway will allow the passing of a 1 in 100 year ARI storm with a freeboard of 500 mm below the carriageway edge in accordance with the Transport Agency's Bridge Manual. All new culvert structures and pipe crossings under local roads will be designed in accordance with Auckland Council's Stormwater Code of Practice.

The Indicative Alignment requires 85 culverts – 69 are new and 16 are existing culverts beneath the existing SH1 and local roads which may require upgrading/extension due to construction of the Project. No culverts longer than 30 metres and will be located within SEAs.

Culverts will be designed to include consideration of debris management, fish passage, and erosion control and energy dissipation, as discussed below.

Culverts in forested catchments may include debris control structures such as a debris rack or screen.

Provision of fish passage in culverts placed within watercourses will be in accordance with Auckland Council's Technical Publication 131 and Transport Agency fish passage guidance. Fish passage will be provided at culverts for all permanent streams with upstream habitats and for all intermittent streams where there is potential for upstream fish habitat. Two methods of providing fish passage are proposed, being baffle type fish passage (refer to Figure 4-8) and natural bed type fish passage.

Figure 4-8: Baffle type fish passage installed at Waiwera

Erosion control measures are proposed upstream and downstream of culverts to provide for the on-going functioning and performance of culverts, by reducing the likelihood of erosion of the stream bed.

Energy dissipation structures will be required at all culvert outlets prior to discharge into the natural stream. Examples of energy dissipation structures typically used on similar roading projects and which could be used for this Project are included in the *Operational Water Design Report*.

Permanent stream diversions

Permanent stream diversions and flow channels are proposed where it is necessary to realign a natural stream channel for the Project, including around soil disposal site areas. The diversions will be designed to allow for the 1 in 100 year ARI storm event.

The design objective for stream diversions is to recreate streams and habitats to replicate as much as possible the natural state and habitats of the streams that existed prior to the Project.

A number of stream diversions are proposed within three stream typologies as follows:

- Stream Diversion Type 1: 'Lowland stream' that recreates habitats associated with a natural lowland stream. The total proposed stream diversion length is approximately 12,700m;

- Stream Diversion Type 2: 'Steep stream' that recreates habitats associated with a natural steep stream. The total proposed stream diversion length is approximately 5,560m; and
- Stream Diversion Type 3: 'Flow channel' for flow conveyance only. The total proposed stream diversion length is approximately 1,150m. These are either rock lined flow channels for high flow/steep gradients or grass lined flow channel for low flow or flat gradients.

The design of stream diversions will also meet the ecological objectives of the integrated mitigation approach outlined in section 10 of this AEE.

Stream Diversion Types 1 and 2 are shown in Figure 4-9 and Figure 4-10 below.

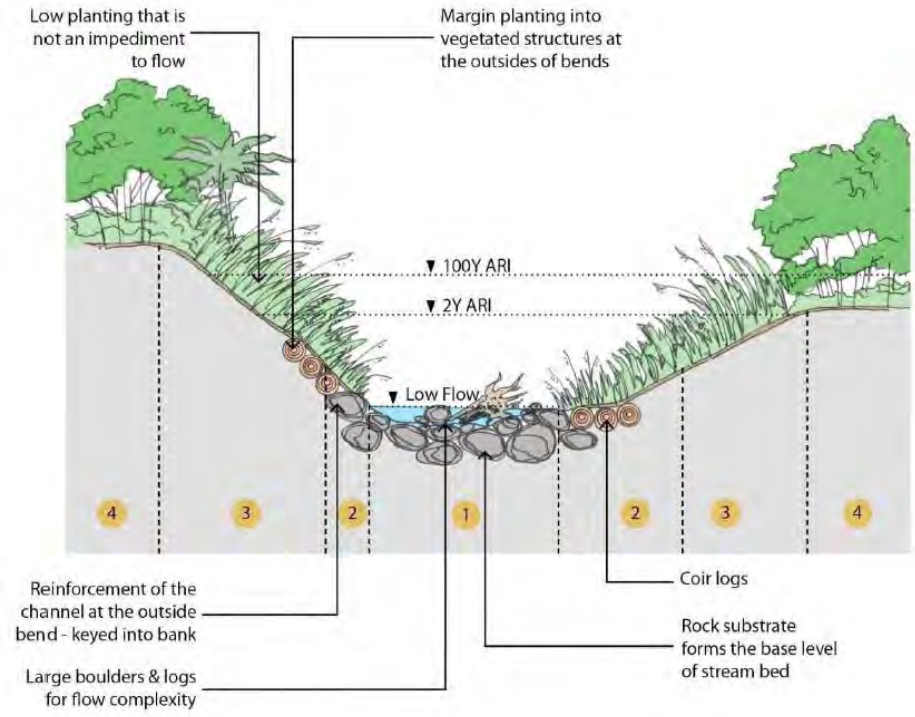

Figure 4-9: Indicative Stream Diversion Type 1 – Lowland stream cross section

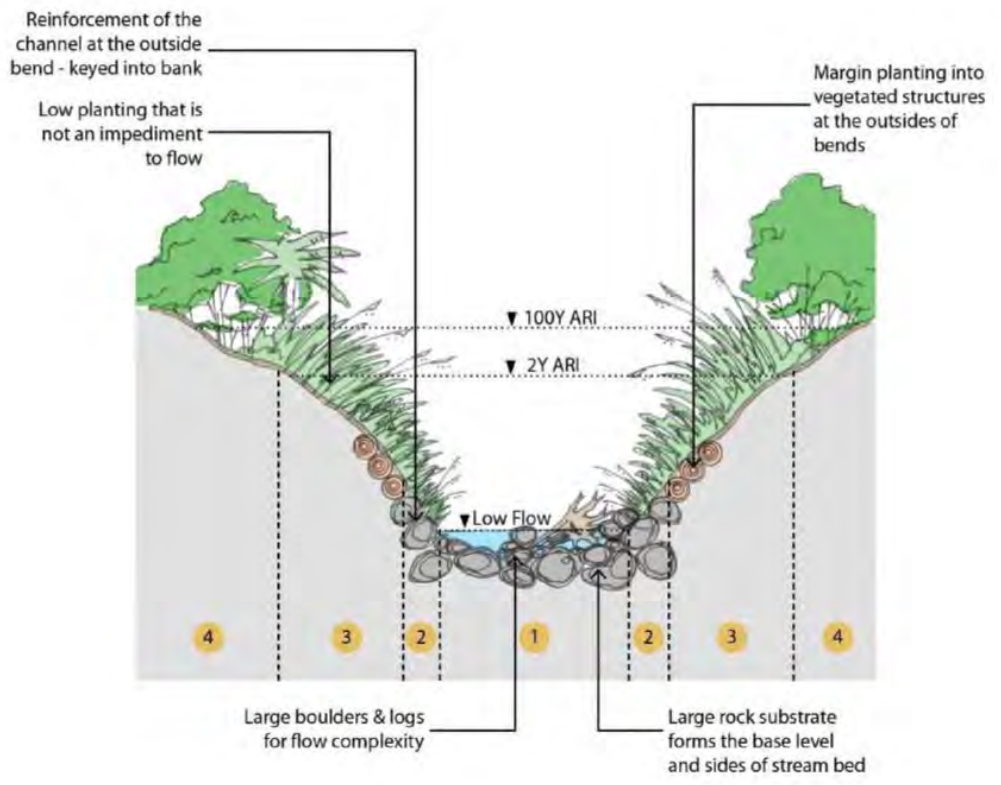

Figure 4-10: Indicative Stream Diversion Type 2 – Steep stream cross section

Stormwater collection and conveyance systems

Stormwater runoff collection systems for the Indicative Alignment will be designed as follows:

- Longitudinal drainage is designed to cater for the 1 in 10 year ARI event flow from all road pavements. Where no overland flow path is available to cater for the 1 in 100 year rainfall event the primary system will be designed to cater for the 1 in 100 year ARI event.
- Swales or open drains will be used adjacent to the road along the base of cut batters to convey flows in excess of the pavement collection system and will be designed to cater for the 1 in 100 year ARI event flow.
- Cut off drains are included at the top of all cut slopes and bottom of fill slopes to prevent stormwater flows from the natural catchment uphill of the mainline carriageway from flowing down the cut face or flowing along the toe of fill batters. These cut off drains will be sized as a minimum to convey the 1 in 100 year ARI storm event from the upstream catchment.
- Bridges and viaducts will be designed to ensure that stormwater runoff does not encroach onto a live traffic lane during a 1 in 10 year ARI event flow.

The stormwater conveyance system will convey stormwater from the carriageway and from the toe of cut (and fill) slopes to stormwater treatment devices. The stormwater conveyance system may include the following:

- Kerb and channel with catchpits to collect stormwater runoff for piping to stormwater treatment devices;
- Drainage channels including vegetated roadside drains/swales; and

- Inlet and outlet structures (i.e. inlets and outlets from wetlands, from carriageway and/or streams).

The road collection and conveyance systems will collect stormwater from new or modified impervious surfaces and rock cuts and will be designed to cater for a 1 in 10 year ARI rainfall event and will convey stormwater runoff to the stormwater treatment devices (wetlands and swales) located at appropriate locations along the Project.

Conveyance of water runoff from ancillary local roads will be via vegetated or rock lined swales that will discharge to existing streams.

Stormwater treatment and discharge

All stormwater runoff from the mainline carriageway and rock cuts will be conveyed to stormwater treatment devices and treated prior to discharge into the receiving environment.

The primary water quality objective of permanent stormwater treatment systems and devices is to remove suspended solids. Stormwater treatment systems and devices will be designed with a Best Practicable Option approach and in accordance with Auckland Councils *Stormwater Management Devices in the Auckland Region Guideline Document (GD01)* with an additional volume allowance made in each of the treatments systems for the hydrology mitigation and treatment requirements of the AUP(OP) in Chapter E10 (Stormwater Management Area – Flow 1 and Flow 2).

Stormwater runoff from the Project's impervious areas will be treated by stormwater treatment devices designed in accordance with GD01 and to meet the following criteria:

- Remove 75% total suspended solids (TSS) on a long-term annual average basis;
- Target the removal of contaminants such as copper, zinc, particulate nutrients, oil, grease and bacteria;
- Removal of litter and floatables including oil and volatile hydrocarbons;
- Where alternative or proprietary devices are proposed, the design will demonstrate how the device achieves an equivalent level of contaminant or sediment removal performance to that of GD01;
- Provide an emergency overflow or bypass system that will cater for the 1 in 100 year ARI event flow; and
- Where the discharge point is natural watercourse, erosion protection measures shall be provided at the outfall location.

The Indicative Design includes 34 stormwater treatment wetlands (refer Figure 4-11). The indicative locations and typical details of wetlands are indicated in the *Volume 3: Drawing Set*, *Operational Water Management Plan (SW-Series)*.

Figure 4-11: Indicative stormwater treatment wetland

4.3.10. Urban and Landscape Design

The planning version Urban and Landscape Design Framework (ULDF) provides a framework for the integration of the Project into the local context and sets out the urban and landscape design principles that will guide the design development of the Project such that it can be integrated into the landscape and minimise and mitigate adverse effects. The ULDF provides a consistency of urban and landscape approach for the whole Pūhoi to Wellsford project. The planning version of the ULDF for the Project is contained in *Volume 3: Drawing Set*.

The ULDF will be developed in further detail in accordance with the Transport Agency's guidance documents – "Bridging the Gap" and the "Landscape Guidelines", which require Transport Agency projects to be delivered utilising best practice to achieve positive urban design and landscape outcomes.

The overall purpose of the ULDF will be to:

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

5. Construction

5.1. Introduction

This section provides an outline of a possible construction methodology for the Project to inform the assessment of environmental effects in section 9 of this AEE. It provides a broad overview of an indicative construction methodology for the Project and gives further detail of the main construction elements that are likely to be undertaken. The approach outlined is based on the experience the Transport Agency has in developing and constructing road projects of a similar scale throughout New Zealand. An indicative construction programme for the Project is set out in section 5.3. Throughout this section there are cross-references to *Volume 3: Drawing Set* where further information describing construction of the Project is available.

The information provided in this section is indicative only and is intended to provide sufficient detail of the proposed construction activities to confirm the Project can be constructed, to enable an assessment of the potential construction related effects on the environment and to identify any necessary measures to avoid, remedy or mitigate those effects.

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

- The detailed design of the Project, which will occur at a future date once the designation has been confirmed and resource consents have been granted;
- The construction timing, staging, and duration;
- The procurement method adopted for construction of the Project; and
- Technological advances in construction techniques and methodologies.

The Transport Agency seeks flexibility in final design and construction methods to accommodate these factors, while ensuring that adverse effects on the environment are appropriately remedied or mitigated. Once the contract(s) for the Project have been awarded and a contractor (or contractors) are in place, the construction methodology will be further refined and developed. This refinement will be undertaken in compliance with conditions of the designation and resource consents which will be in place to manage the effects of the construction activities.

5.2. Development of construction methodology

The construction methodology and activities outlined in this section were developed through an iterative process that involved several rounds of multidisciplinary reviews and interaction with technical specialists. The intention was to consider the programme implications and potential adverse effects of various construction options to achieve a methodology that, as far as practicable, avoids, or otherwise minimises, potential adverse effects, while being operationally efficient. This included consideration of the following:

- The potential location and extent of construction compounds, bridge construction yards and construction haul and access roads. The intent is to minimise disturbance and vegetation clearance in sensitive environmental areas, and as far as practicable avoid locating temporary construction activities near sensitive land uses;