



Te Tai Tokerau Northland Expressway

Unlocking economic growth and regional prosperity

NZIER report to the Northland Corporate Group

April 2024



New Zealand's state highways are the backbone of the economy, but Te Tai Tokerau Northland's dilapidated road infrastructure would have you thinking otherwise.

The pathway to prosperity in Aotearoa is interconnectivity. Critical road linkages connecting Auckland, Waikato and the Bay of Plenty facilitate an easy flow commerce between the regions, yet the same can't be said for those North of Auckland.

Decades of underinvestment along SH1 – the central artery connecting Te Tai Tokerau Northland to Auckland and beyond – has seen our road infrastructure languish, isolating our region from the rest of the country, choking regional economic growth, and squandering the potential to support Auckland's strong growth path from the North.

The following report contains economic modelling that proves this point; investment in a robust and resilient transport corridor between Auckland and Northland would empower our region to thrive, amplify Auckland's growth, and provide the critical next step to achieving Aotearoa's economic ambitions.

Our government has set an ambitious target to double exports in the next ten years. This report reveals that investing in a high-quality, four-lane expressway along the entirety of SH1 between Auckland and Northland now could boost national GDP by \$1.2 billion per year by 2050. That's \$23.8 billion over a twenty-year period.

It would also stimulate population growth and migration to Te Tai Tokerau Northland – modelling shows a 50% increase in our current growth rates will increase regional GDP by \$2.1b per annum by 2048. These numbers prove the case – quality infrastructure fuels economic performance.

On behalf of Northland and Aotearoa, we're rapped that our government has already committed to building a four-lane highway from Whangārei to Port Marsden, and Warkworth to Wellsford, as well as a four-lane highway alternative for the Brynderwyns. We consider it a demonstration of long-term infrastructure investment, but our report makes a compelling case for something even more ambitious.

We're calling for the Government to fast-track its commitments and extend their scope to include a wholesale upgrade of SH1. This means extending the expressway from Warkworth through the Brynderwyns to Whangārei. It's the only solution that will truly connect our region, and fully unlock our economic contribution.

Delve into the report, amplify our message and let's put our collective weight behind removing this economic barricade to Northland's future prosperity and growth, for the benefit of all New Zealanders.

Sincerely,

Andrew McCleod

Co-chair, Northland Corporate Group
Chief Executive, Northpower

Rosie Mercer

Co-chair, Northland Corporate Group
Chief Executive, Marsden Maritime Holdings Ltd

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice.

We undertake and make freely available economic research aimed at promoting a better understanding of Aotearoa New Zealand's important economic challenges.

Our long-established Quarterly Survey of Business Opinion and Quarterly Predictions are available to members of NZIER.

We pride ourselves on our reputation for independence and delivering quality analysis in the right form and at the right time. We ensure quality through teamwork on individual projects, critical review at internal seminars, and peer review.

NZIER was established in 1958.

About NCG

The Northland Corporate Group (NCG) comprises Northland business heavyweights Channel Infrastructure NZ, Culham Engineering, Marsden Maritime Holdings Limited, McKay Limited and Northpower. Together, they have a combined annual turnover exceeding \$1 billion, employ more than 3,500 people and deliver essential services to 65% of the region's population.

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Key points

The Northland Corporate Group (NCG) commissioned NZIER to estimate the benefits of efficient and resilient state highway infrastructure linking Te Tai Tokerau Northland to the rest of Aotearoa New Zealand. The state highway network forms the backbone of our economy, enabling goods, services, and ideas to flow between regions. Governments play a critical role in providing transport infrastructure to promote economic development, consistent with the purpose of the Land Transport Management Act 2003: “to contribute to an effective, efficient, and safe land transport system in the public interest.”

This report assesses the benefits of extending the four-lane expressway on State Highway 1 (SH1) from Auckland (Warkworth) to Whangārei and from Whangārei to Kaikohe (the ‘proposed investment’). The report explores the benefits of improved infrastructure in Te Tai Tokerau Northland using a wider perspective than the traditional approach taken in government transport investment appraisal. It aims to motivate the government to prioritise the investment and proceed with the required detailed analysis of the design and costs.

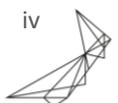
The expressway will unlock growth in Te Tai Tokerau Northland. It will form part of a network of high-quality four-lane highways connecting the major cities in the upper North Island and make the region more resilient to extreme weather events. It will enable Northport to expand and support Auckland’s future growth needs.

Using a standard transport appraisal, we find that the road will have quantified monetary benefits of between \$299 million and \$562 million a year by 2050. Using a business survey to estimate the potential that could be released by addressing infrastructure constraints in the region, we find that the overall benefits could be significantly larger. If the overall productivity of all Te Tai Tokerau Northland businesses increases by 2.5%, national GDP will increase by \$1.2 billion per year by 2050, or \$23.8 billion in total from 2040 to 2060.

Our approach

We used a combination of different approaches to understand the impacts of the investment. First, we used standard transport appraisal methodologies to estimate the direct benefits of improved efficiency, resilience and safety. We also considered environmental and social impacts, such as changes in vehicle emissions and access to social opportunities. Second, we surveyed businesses in Te Tai Tokerau Northland to find out how high-quality road infrastructure will affect business costs, revenue, employment and investment. Third, we used our regional computable general equilibrium (CGE) model to understand the flow-on effects for the Northland and Auckland economies. We estimated the benefits that would have been realised if the road had existed in 2019 and the benefits that will be realised by 2050 if traffic volumes and GDP grow at projected rates.

Because the proposed investment is still at an early stage of development, we needed to make some assumptions. There is currently no preferred route or road design, and we did not have access to a transport model to estimate how the road could affect traffic volumes and travel times. Instead, we made assumptions about the improvements that the road will bring. The assumptions were based on information from government business cases and comparisons with recent expressway projects. We assumed that average travel speeds



would increase from 67 km/h to 80–90 km/h, road closures would fall by 50–100%, and serious accidents would decline by 33–67%. In our high outcomes scenario, we also assumed traffic volumes could increase by an additional 50%, over and above projected growth rates, because of the new road.

Results from the standard transport appraisal

The direct benefits of the road have significant economic and social value. We found that faster travel speeds will reduce travel times for vehicles, occupants, and freight, resulting in travel time and vehicle operating cost savings of between \$238 million and \$467 million a year by 2050. In 2023, parts of the current route were closed due to severe weather events for 58 days. Weather-related closures are likely to become more common over time. With the proposed investment, closures will occur less often, and vehicles will not need to make so many costly diversions, resulting in further annual travel time and vehicle operating cost savings of between \$5 million and \$14 million. In addition, the reduction in serious accidents will reduce the social cost of crashes by between \$53 million and \$109 million.

The road could increase emissions, but the effect is relatively small. While faster travel times may reduce greenhouse gas emissions for heavy vehicles, it could lead to more road travel, raising emissions overall. However, the effect is small relative to the other impacts, partly due to the anticipated increase in fuel-efficient and electric vehicles.

Better transport links will lead to better social outcomes. Te Tai Tokerau Northland has been consistently underperforming the rest of the country, with higher deprivation levels, lower incomes, lower educational attainment and worse health outcomes. Investing in SH1 will improve access to key destinations, such as workplaces, schools and hospitals, stimulating the region’s social and economic development.

Table 1 Annual benefits by 2050 according to the standard transport appraisal

Benefit type	Auckland to Whangārei	Whangārei to Kaikohe	Auckland to Kaikohe
Efficiency	\$157m to \$306m	\$82m to \$161m	\$238m to \$467m
Resilience	\$4m to \$11m	\$1m to \$3m	\$5m to \$14m
Safety	\$35m to \$72m	\$18m to \$38m	\$53m to \$109m
Emissions ¹	\$2m to -\$21m	\$1m to -\$7m	\$3m to -\$28m
Social	Not quantified	Not quantified	Not quantified
Total quantified	\$198m to \$368m	\$102m to \$195m	\$299m to \$562m

Source: NZIER

Results from the business survey

The business survey shows how improving Te Tai Tokerau Northland’s road links will boost business confidence, unlocking investment and growth. Around 800 businesses responded to the business survey, representing 11% of the region’s employers, including 22% of medium businesses and 9% of large businesses. Nearly 80% of respondents said poor transport infrastructure is one of their top challenges. Over half said extending the four-lane expressway on SH1 will increase annual revenues and reduce costs by at least 5%.

¹ In the high outcomes scenario, greater vehicle volumes and faster travel speeds lead to an increase in the social cost of emissions, which is a negative benefit.



Around a half said they would increase employment, and a third said they would bring forward more than \$100k of investment. By grouping respondents into employment count bands and applying national data on business costs, revenues, employment and investment for each band, we calculated the total impacts implied by the survey results.

The survey implies much larger benefits than the standard transport appraisal. This indicates that the impact of low-quality roading in Te Tai Tokerau Northland goes beyond the direct impact on drivers on the road. Long travel times and delays cause businesses to accumulate larger inventories and reconfigure their operations. Poor connectivity also makes it harder to form networks with customers and suppliers. Uncertainty about closures and poor access holds back investment, constraining economic growth. The survey results indicate what could happen to the region as a whole if these constraints were removed.

Table 2 Impact according to the business survey

Impact type	Auckland to Whangārei	Whangārei to Kaikohe	Auckland to Kaikohe
Cost savings (annual)	\$1.0b to \$2.2b	\$0.6b to \$1.5b	\$1.6b to \$3.7b
Business revenue (annual)	\$0.7b to \$2.2b	\$0.5b to \$1.9b	\$1.2b to \$4.1b
New jobs (one-off)	820 to 3,430	700 to 2,530	1,520 to 5,960
Investment brought forward (one-off)	\$8.8b to \$22.9b	\$4.9b to \$15.4b	\$13.7b to \$38.3b

Source: NZIER

The survey results provide a different view of the impact of the road from the standard transport appraisal, and the two sets of results cannot be added together. The survey results only cover Northland businesses and do not cover impacts on Auckland businesses, non-work travel impacts, safety impacts and other social impacts.

Results from the CGE modelling

The full investment could increase GDP by between \$521 million and \$1.2 billion per year by 2050. Based on an interpretation of the survey results, we used the CGE model to understand what would happen to economic activity in the long run if the overall productivity of all Te Tai Tokerau Northland businesses increased by 2.5% and found an increase in national GDP of \$1.2 billion per year by 2050, or \$23.8 billion in total from 2040 to 2060. We also found that real wages will increase by 4.2% and real consumption will increase by 8.4%, showing that economic growth will lead to higher living standards for people in the region.

The CGE modelling results are based on the survey results and do not cover non-work travel impacts, safety impacts and other social impacts. It is not possible to break the results down by route section.

Indicative comparative cost estimate

Comparisons with recent four-lane expressway projects in Aotearoa New Zealand indicate a total project cost of between \$5.5 billion and \$11.1 billion. Similar projects have cost between \$30 million and \$60 million per kilometre, showing a total cost of between \$3.0 billion and \$ 5.9 billion for Warkworth to Whangārei and between \$2.6 billion and \$5.1 billion for Whangārei to Kaikohe. The full investment will cost between \$5.5 billion and

\$11.1 billion but could unlock \$23.8 billion of GDP growth over a 20-year period, indicating the road will provide value for money.

Next steps

The government has already committed to high-quality four-lane highways in Northland. Before the election, the National Party set out a long-term vision to connect Whangārei to Auckland, Hamilton, and Tauranga with modern, high-quality four-lane highways and committed to building expressways from Warkworth to Wellsford and from Ruakākā to Whangārei in its first term (National Party 2023). The coalition government committed to a four-lane highway alternative for the Brynderwyns ('Speech From the Throne' 2023).

To realise the full benefits, these initiatives should be combined into a single Northland Expressway. The road could have monetary benefits of between \$299 million and \$562 million a year by 2050 and, if productivity improves by 2.5%, increase annual GDP by \$ 1.2 billion. The investment between Auckland and Whangārei is urgently needed to help Te Tai Tokerau Northland realise its potential and maximise its contribution to the national economy. The Whangārei to Kaikohe section should follow as the region grows. The government should prioritise this road and begin work on the required detailed options appraisal, design, and costing activities, including a full cost-benefit analysis that considers all potential benefits, such as effects on business and consumer confidence.

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1 Introduction

Transport infrastructure underpins our economy by connecting people, businesses and regions. Governments play a critical role in providing transport infrastructure to promote economic development.

The draft Government Policy Statement on Land Transport, released in March 2024, reintroduces the Roads of National Significance programme (Ministry of Transport 2024). The programme aims to upgrade sections of some of New Zealand’s most essential state highway corridors from two to four lanes. Along State Highway 1 (SH1) from Auckland to Whangārei, this includes a four-lane alternative to the Brynderwyns and upgrades to the Warkworth to Wellsford and Port Marsden to Whangārei sections, confirming commitments made in 2023 as part of the Government’s Coalition Agreements (‘Speech From the Throne’ 2023; National Party and New Zealand First Party 2023; National Party 2023).

The Northland Corporate Group (NCG) commissioned NZIER to estimate the economic impacts of efficient and resilient state highway infrastructure between Te Tai Tokerau Northland and Tāmaki Makaurau Auckland.

1.1 Purpose

The purpose of this report is to assess the impacts of investing in a high-quality four-lane expressway on two sections of SH1 proposed by NCG: Warkworth to Whangārei and Whangārei to Kaikohe. It aims to show how substantive investment in resilient and efficient roading infrastructure will:

- support local and central government economic, social and environmental objectives
- help greater Auckland mitigate infrastructure and housing challenges
- identify the latent capital investment ready to deploy in the region.

Our assessment covers several types of benefits:

- **Efficiency** – travel time savings and reduced vehicle operating costs due to faster travel times (the largest benefit)
- **Resilience** – travel time savings and reduced vehicle operating costs due to reduced closures and diversions
- **Safety** – reduced social cost of crashes due to a safer road
- **Environmental** – changes in greenhouse gas emissions due to faster vehicle speeds and increased traffic
- **Social** – improved access to jobs, education, and healthcare opportunities.

The report aimed to explore the benefits of increased infrastructure in Te Tai Tokerau Northland, using a wider perspective than the traditional approach taken in government transport investment appraisal, to motivate the required detailed analysis of the design and costs.

1.2 Scope

The scope of our assessment is to identify, quantify and (where possible) monetise the overall benefits. It is intended to convince the government to combine its roading commitments into a single Te Tai Tokerau Northland Expressway and make the investment a national priority.

The following activities are out of scope:

- transport modelling and demand estimation
- options analysis and route design
- cost estimation and financial analysis
- commercial and management arrangements
- analysis of equity or distributional effects.

This report was funded by NCG and produced by NZIER.

1.3 Approach

We use three approaches to understand the size of the impacts:

- **Standard transport appraisal** – we use standard methodologies to estimate the direct benefits of improved efficiency, resilience and safety.
- **Computable general equilibrium (CGE) modelling** – our regional CGE model allows us to assess the flow-on impact on the wider economy in Te Tai Tokerau Northland, Tāmaki Makaurau Auckland, and the rest of Aotearoa New Zealand.
- **Business survey** – we use a business survey to highlight the impact of SH1 for Te Tai Tokerau Northland businesses, helping to capture the effect on business confidence.

We also indicate the potential costs of the proposed investments based on comparisons with recent expressway projects.

1.4 Structure

Section 0 summarises the case for the Te Tai Tokerau Northland Expressway and describes the proposed investment. Section 3 outlines our approach. Section 4 sets out the results from the standard transport appraisal, section 5 highlights results from the business survey, and section 6 provides the CGE results. Section 7 provides an indicative cost estimate, and section 8 concludes with a summary and next steps.



2 The case for the Te Tai Tokerau Northland Expressway

This section explains how better transport links will support economic and social development in Te Tai Tokerau Northland and outlines the proposed investment.

2.1 The economic potential of Te Tai Tokerau Northland

The Te Tai Tokerau Northland Growth Study (MartinJenkins 2015) highlighted the economic potential of the region:

- Natural assets create growth opportunities for resource-based industries, including forestry, pasture farming, and horticulture
- As the birthplace of Aotearoa New Zealand, the region's rich historic and cultural heritage are valued by locals and visitors
- Forthcoming Treaty settlements provide Māori, iwi and hapū with opportunities to act as partners and co-investors to generate sustainable prosperity in the region.

Despite these advantages, Te Tai Tokerau Northland underperforms compared to other regions. GDP per capita in 2022 was 34% lower than the national average (Stats NZ 2023b), and unemployment was 0.7 percentage points higher (Stats NZ 2023d). Poor transport connectivity with the rest of the country is a key factor holding back growth and investment. Te Tai Tokerau Northland does not benefit from its proximity to Auckland due to poor efficiency, resilience and safety on key routes. Travel times are long, diversions are lengthy and often do not have sufficient capacity to take heavy vehicles, and there are high numbers of accidents and deaths.

2.2 The benefits of growth to the region

Te Tai Tokerau Northland is expected to be one of the top three fastest-growing regions over the next 30 years, with the population rising from 185,800 in 2018 to 241,300 in 2048 under the medium projection – an increase of 55,300 (Stats NZ 2022).

In 2022, GDP per capita in Aotearoa New Zealand was \$76,266 compared to \$50,340 in Te Tai Tokerau Northland (Stats NZ 2023b) (\$ June 2023). If better transport links caused the rate of population growth to increase by 50%, and if every new person moving to Northland makes the same contribution to economic activity as the average New Zealander in 2022, Te Tai Tokerau Northland's annual regional GDP would grow by \$2,108.8 million by 2048.

Higher economic output means more job opportunities for local people, resulting in higher wages and better living standards. Improving transport links between Te Tai Tokerau Northland and the rest of the country will attract more people and investment to the region, accelerating its economic and social development.

2.3 Opportunities from better connectivity

Improving connectivity between Te Tai Tokerau Northland and the rest of Aotearoa New Zealand will create opportunities for growth and investment in the region that benefit the country as a whole.

2.3.1 Connecting the major cities in the upper North Island

Together, the regions of Northland, Auckland, Waikato and the Bay of Plenty account for more than half of Aotearoa New Zealand's population and economic activity, with over 2.6 million people (Stats NZ 2022) and a combined GDP of over \$216 billion (Stats NZ 2023b) (\$ June 2023). This area is vital to the country's social and economic prosperity. 65% of goods by value move through Auckland Airport and the upper North Island ports of Northport, Auckland and Tauranga, and 71% of international visitors arrive in the area (UNISA 2020).

The government has a long-term vision of connecting the major cities in the upper North Island – Whangārei, Auckland, Hamilton, and Tauranga – with high-quality four-lane highways (National Party 2023). A four-lane expressway between Te Tai Tokerau Northland and the 'Golden Triangle' of Auckland, Waikato and the Bay of Plenty will help the government realise its ambition, catalysing growth across the upper North Island.

2.3.2 Reducing the risk of future extreme weather events

In early 2023, the Brynderywn Hills section of SH1 was closed due to severe weather events for around 58 days, reducing GDP by an estimated \$54 million over a one-year period (Market Economics 2023). Increasing climate change related weather events in the future could stop the flow of goods and people between Te Tai Tokerau Northland and the rest of the country for extended periods. Resilience threats create uncertainty and weaken business confidence, holding back investment and preventing economic growth.

More resilient transport links are needed to mitigate the risk of Te Tai Tokerau Northland becoming disconnected from the rest of the country during future extreme weather events.

2.3.3 Enabling the expansion of Northport

As the northernmost deep-water port in Aotearoa New Zealand, Northport is the closest port to most of New Zealand's international markets. The port currently primarily serves Te Tai Tokerau Northland's forestry sector, but there are plans to expand the port's container capacity to support the growth of Auckland. These plans depend on upgrades to SH1 between Auckland and Whangārei.

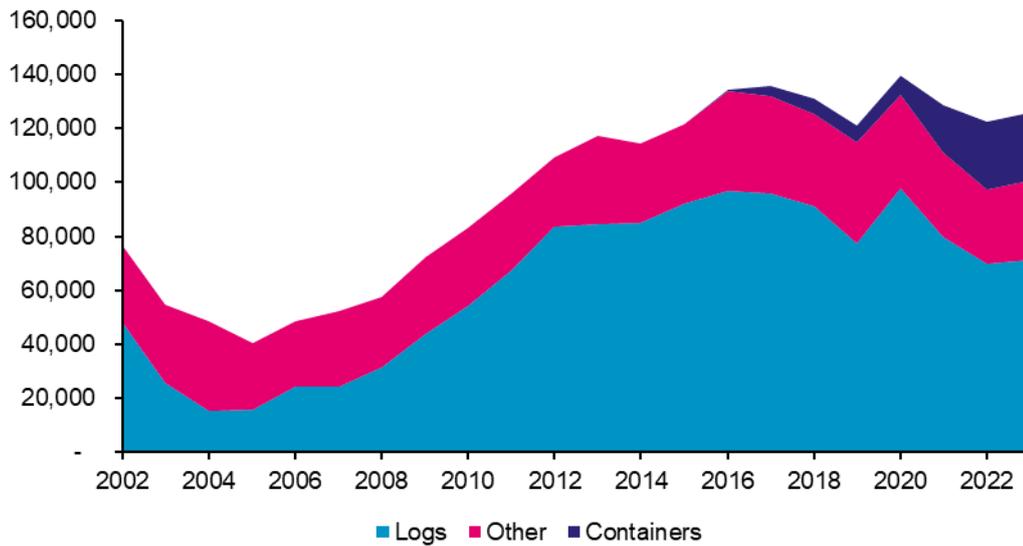
Figure 1 presents truck movements for Northport. Most of the freight currently passing through the port is logs (77% of bulk cargo by weight), which typically travel to the port by truck along SH1 from forestry in the north (Northport, private communication, 2024).

Northport expects log exports in Te Tai Tokerau Northland to temporarily fall for a period of 12–14 years from 2024 due to reduced wood volumes resulting from earlier planting decisions (Northport, private communication, 2024). In response, Northport has been investing in container handling. This began with regional container shipping in 2015 and has since expanded into international shipping, resulting in a rapid increase in container freight passing through the port. Annual container volumes rose to 16,925 TEU in the financial year ending March 2023, and containers account for 20% of truck movements associated with the port.

Prior to the extreme weather events in 2023, Northport had plans to establish two scheduled international shipping services. However, the road closures led to a loss of interest from shipping companies. Northport expects that international container business will resume if the road is upgraded and made more resilient.

Figure 1 Northport truck movements

Truck movements per year



Source: Northport

Northport plans to expand its container capacity to meet the growing demand for regional freight from North Auckland. It is planning to develop an Eastern Container Terminal with a capacity of 350–400,000 TEU per year and has gained consent for an interim expansion with a capacity of 165–200,000 TEU per year² (Northport, private communication, 2024). If realised, these plans will increase jobs at the port from 250 FTEs to 350–500 FTEs³ and increase port revenue from \$74.4 million to \$85.1 million.⁴

Studies show that the wider economic impact will be much larger. According to a 2021 study, Northport currently supports \$438 million of GDP per year and 6,300 jobs in Te Tai Tokerau Northland, and expanding the port will add \$107 million and 1,400 jobs to the local economy by 2050 (Market Economics 2021). A 2022 study found that the expansion would create \$160 million GDP per annum and approximately 1,500 new jobs by 2060, assuming efficient transport links to Northland (Polis Consulting Group 2022).

Full utilisation of the interim terminal and the expansion of the new terminal depend on better transport connections, including both the planned rail spur and upgrades to SH1. Attracting new shipping requires efficient and resilient infrastructure, and more capacity is required to avoid congestion associated with increased freight volumes.

With existing transport connections, the interim expansion will initially result in truck freight volumes of 33,000 TEU/year heading north via road bridging to be loaded on to rail in Whangārei and 70,500 TEU/year heading south towards Auckland, requiring around 61 and 84 truck movements per day respectively (Northport, private communication, 2024). When the full expansion is complete, the rail spur will carry around 60% of the freight (210,000 TEU per year) to a distribution hub in Northwest Auckland. The remaining 40%

² TEU refers to the twenty-foot equivalent unit, the volume of a 20-foot long shipping container.

³ These forecasts do not account for changes in FTE resulting from automation.

⁴ Assuming revenue of \$212.65 per TEU (based on today's rates). These figures do not include ancillary work, such as distribution, repairs, and storage.

(140,000 TEU per year) will travel south by road on SH1, resulting in 160–200 truck movements per day.⁵

Better road connections to Auckland will enable Northport's expansion, enabling more imports and exports to flow through the port. This will reduce the pressure on the port of Auckland, helping address capacity constraints. It will create new jobs for local people, helping to offset the impact of the closure of the Marsden Point oil refinery. The planned expansion will likely lead to population growth in Whangārei and Ruakākā, increasing traffic volumes on SH1 between Whangārei and Auckland.

2.3.4 Mitigating Auckland's housing and infrastructure challenges

Better transport links between Te Tai Tokerau Northland and Tāmaki Makaurau Auckland will support Auckland in mitigating its infrastructure and housing challenges. By improving access to land for urban expansion, the investment will provide more housing options outside of the city at more affordable prices. It will allow Auckland people and businesses to move north, alleviating the pressure on the city.

2.3.5 Supporting Northland to become a premium tourist destination

Te Tai Tokerau Northland offers outstanding natural attractions and a unique cultural and historical experience. A key part of the region's tourist offering is the Twin Coast Discovery Highway, which travels mostly on SH1 and brings visitors from Auckland to Whangārei along the region's east and west coasts.

Tourists are currently deterred from visiting Te Tai Tokerau Northland due to the region's reputation for long travel times and disruption. Investment in SH1 will make it faster, safer and easier for tourists to seek out destinations in Northland, attracting more people to the region.

By reducing travel times and improving confidence for visitors, better transport links with Auckland could enable Te Tai Tokerau Northland to become a premium tourist destination, combining natural and heritage attractions. It could also encourage Aucklanders to buy or develop holiday homes in the region. This will grow the visitor industry, helping businesses thrive and creating new and better jobs for Northland residents.

2.3.6 Allowing Northland to become a greater centre of food production

Te Tai Tokerau Northland's subtropical climate and diverse and fertile soils provide fantastic conditions for horticulture and fruit growing. Established crops include kiwifruit, avocados, citrus and berries. The region is also capable of producing tropical crops, such as pineapple, bananas and peanuts.

There is an opportunity for Te Tai Tokerau Northland's horticulture sector to play a greater role in food security for Aotearoa New Zealand, particularly Auckland. Better transport links would allow the region to become a centre of food production for the rest of the country by enabling produce to flow quickly through the region.

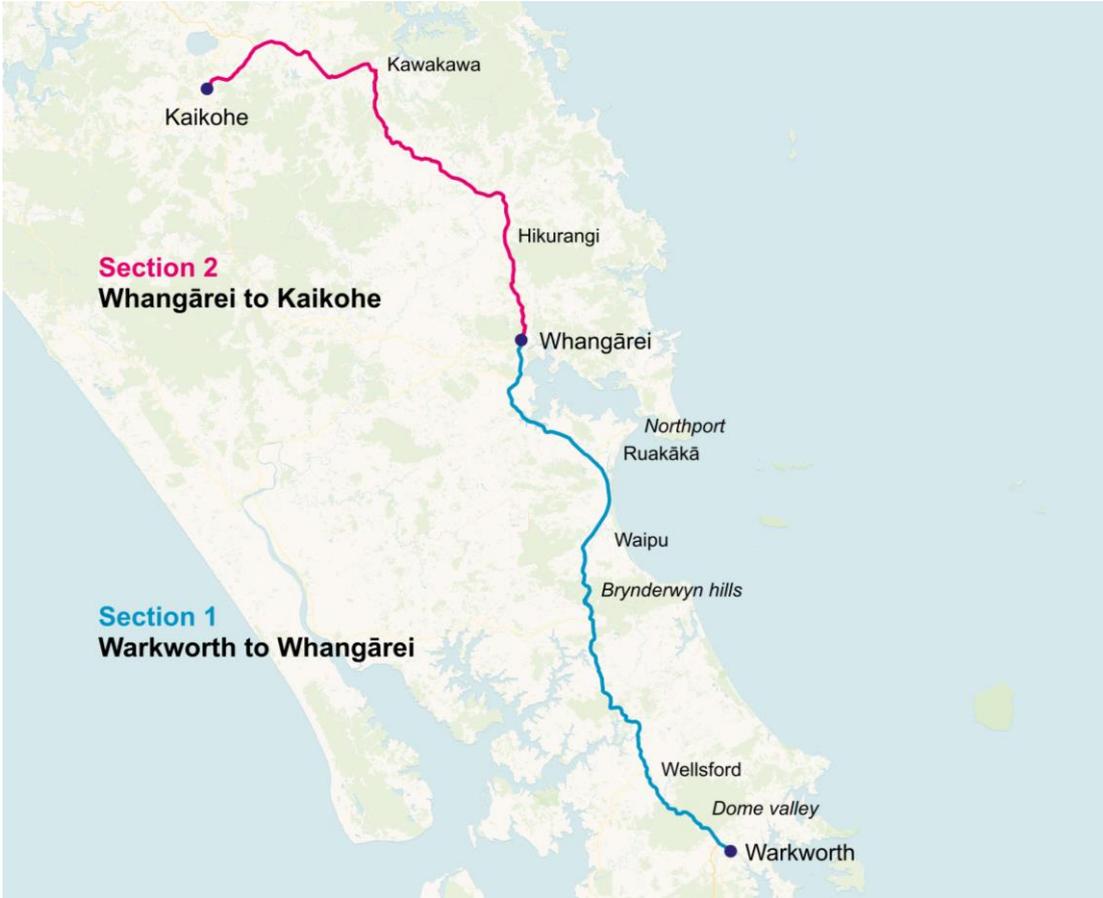
⁵ These forecasts do not allow for coastal shipping, which could enable the port to handle additional volume without using road or rail.

2.4 The proposed investment

This report assesses the benefits of improving transport links between Te Tai Tokerau Northland and Tāmaki Makaurau Auckland by upgrading SH1 to a high-quality four-lane expressway. This will improve efficiency, resilience and safety for tourists, commuters, and freight operators and increase regional investment and business confidence. The investment proposed by NCG consists of two sections:

- Section 1: Warkworth to Whangārei along SH1
- Section 2: Whangārei to Kaikohe along SH1 and SH12.

Figure 2 Map of the proposed investment



Source: NZIER

2.4.1 Warkworth to Whangārei

The road on SH1 between Warkworth and Whangārei is about 98.7 km long. It starts at the northern end of the Pūhoi to Warkworth motorway and passes Wellsford, Brynderwyn, Waipu and Ruakākā before ending at the SH14 (Maunu Road) intersection in Whangārei. It intersects with SH16 at Wellsford and SH12 at Brynderwyn and overlaps with SH15 between Ruakākā and Otaika. Much of the route forms part of the Twin Coast Discovery Highway, an 800 km tourist route in Te Tai Tokerau Northland.

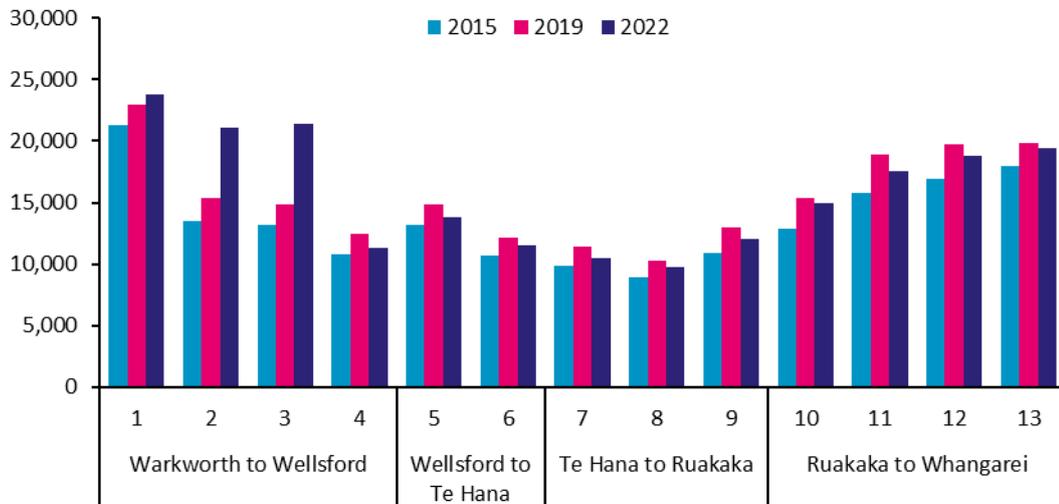
In recent years, the average daily flow on SH1 between Warkworth and Whangārei was between 10,000 and 25,000 vehicles (see Figure 3). Traffic volumes increased between

2015 and 2019 but decreased slightly between Wellsford and Whangārei during the pandemic. The proportion of heavy vehicles ranges from 6% to 11%. The road has a One Network Road Classification (ONRC) of 'National', meaning it makes the largest contribution to the country's society and economy (NZ Transport Agency, n.d.).

Warkworth to Whangārei is a major transport corridor and is important for freight and commercial vehicle movements. It connects the region to Auckland and the rest of the North Island. It also links Northport to the nearby urban areas of Auckland and Whangārei.

Figure 3 Traffic volumes on SH1 between Warkworth and Whangārei

Annual average daily traffic (AADT) in 2019, vehicles per day



Source: NZ Transport Agency (2021)

NZTA's (2017) Whangārei to Auckland programme business case highlights a number of concerns with the efficiency, resilience and safety of the current corridor:

- The corridor regularly suffers from unplanned incidents resulting from crashes, flooding and slips. The detour routes are often long and unable to carry large trucks.
- The average speed and cost of travel on this section of SH1 are slower and lower than other sections of the highway with the same classification, and heavy vehicles are delayed in hilly areas, including the Dome Valley and the Brynderwyns.
- The corridor has poor safety performance, with many crashes involving injury and death. The personal risk rating is below the standard expected for a national route.

2.4.2 Whangārei to Kaikohe

Extending the four-lane expressway further north to Kaikohe will connect the centre of Te Tai Tokerau Northland to the rest of the North Island.

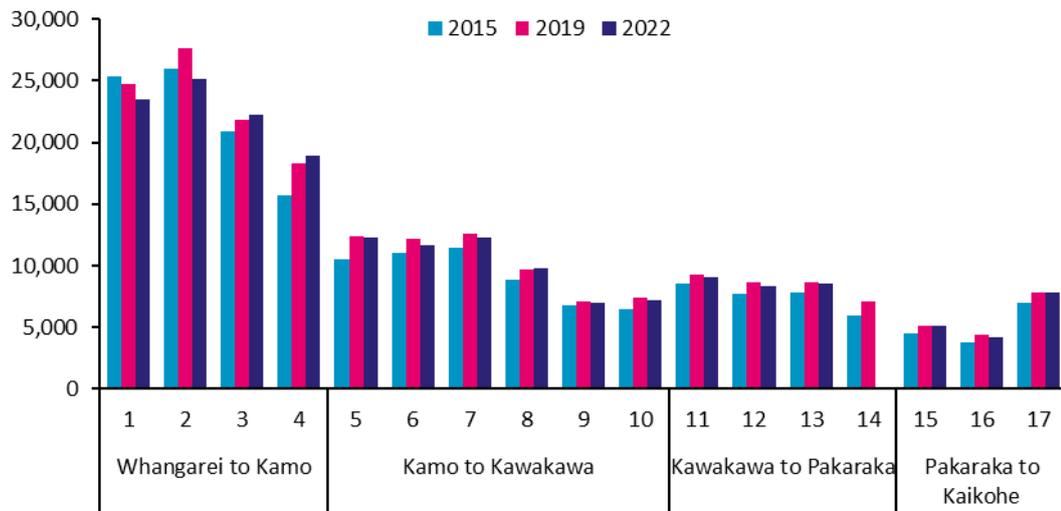
This section of the route is approximately 85.6 km long. It starts at the SH14 intersection in Whangārei and continues north through Hikurangi, intersecting with SH11 in Kawakawa and SH10 in Pakaraka. At Ōhaeawai, the route leaves SH1 and follows SH12 to Kaikohe. The section from Hikurangi to Kawakawa is part of the Twin Coast Discovery Highway.



Average daily traffic volumes vary from over 25,000 in Whangārei to under 5,000 near Kaikohe (see Figure 4). Traffic volumes generally increased from 2015 to 2019. The proportion of heavy vehicles is between 4% and 11%, depending on the part of the route. The section from Whangārei to Kawakawa has a One Network Road Classification (ONRC) of 'National', and the section from Kawakawa to Kaikohe has an ONRC of 'Primary Collector' (NZ Transport Agency, n.d.).

Figure 4 Traffic volumes on SH1 between Whangārei and Kaikohe

Annual average daily traffic (AADT), vehicles per day



Source: NZ Transport Agency (2021)

The Whangārei to Kaikohe section has road quality and safety concerns similar to the Warkworth to Whangārei section.

2.5 Opportunities for improved infrastructure delivery

The government has made a number of commitments about the delivery of future infrastructure and transport projects ('Speech From the Throne' 2023). It committed to:

- setting up a National Infrastructure Agency to coordinate government investment, attract investors, and improve funding, procurement and delivery
- making it easier to consent new infrastructure, including establishing a fast-track process for significant regional and national projects
- establishing an agreed and visible pipeline of priority projects across the country
- considering public-private partnerships, tolls and other funding mechanisms
- establishing a regional Infrastructure Fund with \$1.2 billion in capital funding.

These changes present opportunities for improved and accelerated transport investment in Te Tai Tokerau Northland.



3 Our approach to assessing the economic impacts

This section describes our overarching approach to assessing the proposed investment’s economic, environmental, and social impacts.

3.1 Key assumptions

As the route and road design has not yet been developed, we need to make some assumptions about the improvements it will deliver.

Table 3 outlines our assumptions about the immediate outcomes of the investment in terms of travel speeds, closures, and crashes. While these assumptions are informed by information in NZTA business cases and comparisons with recent motorway and expressway projects, they remain our professional judgement and cover only a subset of potential outcomes.

Table 3 Assumed immediate outcomes of the investment

Outcome	Supporting evidence
Average travel speeds increase from 67 km/h to 80–90 km/h	<p>The Whangārei to Auckland programme business case (NZ Transport Agency 2017) sets an investment objective of increasing average speeds for Whangārei to Pūhoi to 90 km/h, and the two four-lane programme options considered are expected to achieve average speeds of around 85 km/h.</p> <p>Travel speeds on recent expressway investments such as the Waikato Expressway, the Pūhoi to Warkworth motorway, Transmission Gully, and the Kāpiti Expressway are typically around 95 km/h, so an estimate of 80–90 km/h is conservative.</p>
Hours of full road closures per year fall by 50–100%	<p>A dual carriageway should prevent road closures. If a crash or slip causes a closure on one carriageway, traffic can be diverted to the other carriageway.</p> <p>The Whangārei to Auckland programme business case (NZ Transport Agency 2017) sets an investment objective of reducing the number of full closures per year to zero. Similarly, the 2019 Warkworth to Wellsford Detailed Business Case states that the investment is expected to reduce the hours of full closures to zero over 30 years.</p>
Deaths and serious injuries fall by 33–67%	<p>The Whangārei to Auckland programme business case (NZ Transport Agency 2017) sets an investment objective of reducing deaths and serious injuries (DSIs) per 5 years by 86 from a baseline of 144 (a 60% reduction). The two four-lane options considered are expected to achieve a reduction of 91 (63%) and 99 (69%).</p> <p>The Warkworth to Wellsford detailed business case (NZ Transport Agency 2019) states the project is expected to reduce DSIs per 5 years by 29 from a baseline of 88 (a 33% reduction).</p>

Source: NZIER

3.2 Standard transport appraisal

We use standard approaches for estimating direct benefits as outlined in NZTA’s Monetised Benefits and Costs Manual (MBCM) (NZ Transport Agency 2023c).

We quantify and monetise four types of direct benefits:

- **Efficiency:** Lower travel time and vehicle operating costs (i.e. fuel and maintenance) due to faster travel speeds.
- **Resilience:** Lower travel time and vehicle operating costs due to reduced closures.



- **Safety:** Lower social cost of crashes due to fewer deaths and serious injuries.
- **Emissions:** Changes in the value of greenhouse gas emissions.

We also discuss the social benefits arising from improved access to opportunities.

We do not estimate agglomeration benefits as these benefits are only likely to occur within major cities (NZ Transport Agency 2023c).

For more detail on our methodology for estimating each type of direct benefit, see Appendix A.

We use 2019 as the base year to mitigate the impact of distortions caused by the COVID-19 pandemic. We present the benefits that would be realised if the road existed in 2019 and the benefits that will be realised by 2050 if traffic grows at projected rates.

3.2.1 Outcomes scenarios

There is significant uncertainty about projected future traffic volumes and the outcomes that the project could achieve. To reflect this, we modelled two scenarios, summarised in Table 4.

Table 4 Scenario overview

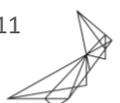
Scenario	Low outcomes scenario	High outcomes scenario
Traffic growth	Traffic grows at projected rates There is no change in traffic volumes due to the investment	Traffic grows at projected rates Traffic volumes increase by an additional 50% due to the investment
Investment outcomes	80 km/h average travel speed 50% reduction in closures 33% reduction in DSI	90 km/h average travel speed 100% reduction in closures 67% reduction in DSI

Source: NZIER

In both scenarios, we assumed that traffic for each subsection would grow at the same rate as 2015–2019. The assumed traffic growth rate is more than twice as high as Stats NZ’s projected population growth rate for Northland (2022), as it reflects changing travel patterns as well as population growth.

The recently completed Pūhoi to Warkworth expressway has led to rapid population growth in towns near the investment, such as Matakana and Omaha. This reflects induced demand. Induced demand refers to increased traffic volumes that may occur because of road improvements. Road improvements provide a better transport experience by increasing speeds, improving reliability, making driving safer and providing access to new areas. As a result, people choose to live further from where they work or make new trips, and the number of people who drive on the road with investment is higher than without investment.

We have modelled the potential for induced demand by including an additional 50% increase in traffic volumes in the high outcomes scenario. Induced demand is typically measured by the elasticity of vehicle kilometres travelled (VKT) with respect to lane kilometres. Drawing on evidence from a range of US-based studies, Volker and Handy (2022) propose a region-level elasticity of 0.75 for expressway projects in California.



Although discussions of induced demand typically centre on congested urban roads, there is evidence that induced demand also applies to rural and uncongested roads, but elasticities are likely to be smaller (Deakin 2020; Chang, Indra, and Maiti 2020). For the high outcomes scenario, we assume an elasticity of 0.5, which means doubling the number of lanes will increase traffic by 50%.

When calculating impacts for induced traffic, we apply the 'rule of half' (NZ Transport Agency 2023c). When users change their travel behaviour, they experience higher benefits from their new behaviour but also forgo the benefits from their previous behaviour. Some new users receive the full, incremental benefits of the investment, but others gain almost zero benefits. The rule of half assumes that people who change their travel behaviour on average receive half of the incremental benefits.

3.2.2 Limitations

Because the investment is still at an early stage, limited information is available. This means our assessment is subject to two limitations:

- As the route and road design have not yet been determined, we made assumptions about the improvements it will deliver based on information in NZTA business cases and comparisons with other projects.
- We did not have access to a transport model, so we do not have accurate information about traffic projections or travel time savings. We developed traffic projections based on historical data and trends and estimated travel time savings by comparing current Google Maps travel speeds with speeds on existing four-lane expressways in Aotearoa New Zealand.

3.3 Computable general equilibrium modelling

Our approach goes beyond the impacts traditionally captured in cost-benefit analysis. We use NZIER's CGE model of Aotearoa New Zealand regional economies to assess the flow-on impacts from productivity gains generated by the investment's impact on efficiency and resilience during its operational phase.

The model captures the interactions between households, industries, and government in the Aotearoa New Zealand economy. It incorporates the complex and multidirectional relationships between the various parts of each regional economy and how they interact with the rest of the country and the world (see Figure 5).

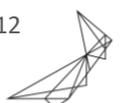
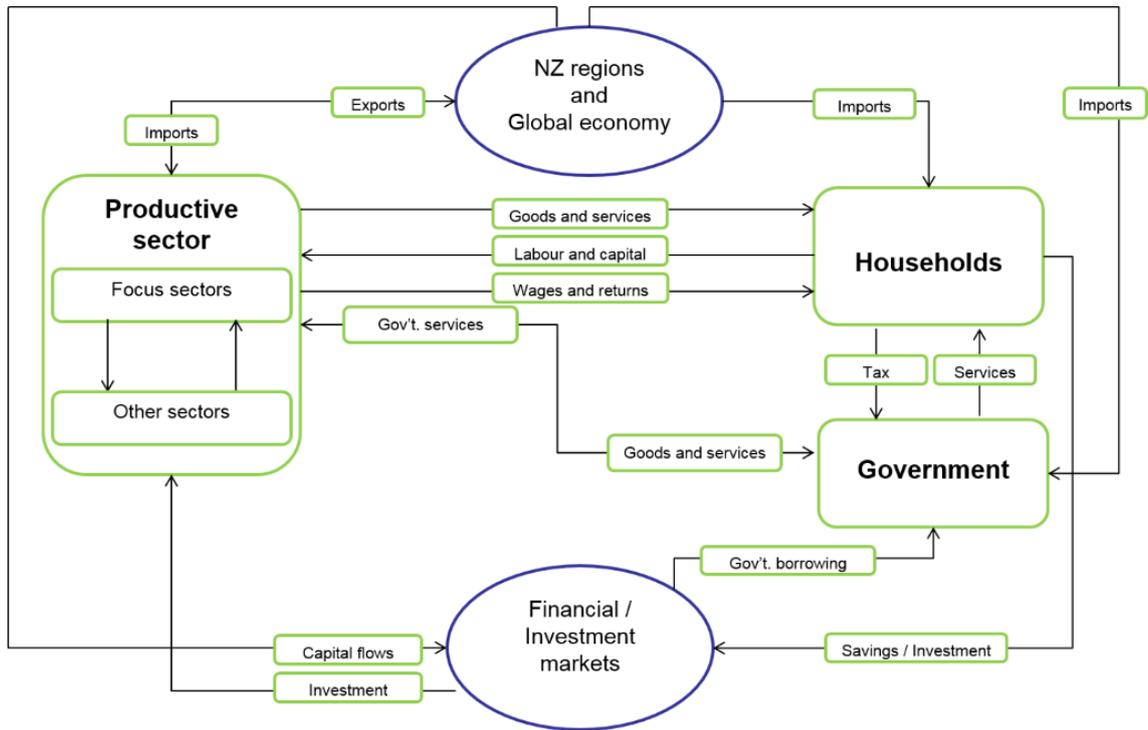


Figure 5 NZIER’s regional TERM CGE framework



Source: NZIER

We estimate flow-on effects by applying a ‘shock’ (i.e. externally chosen change to key model parameters) as an input into our CGE model and comparing the results of the economy with and without the investment. The shock we apply to our CGE model is an annual change in productivity relative to the baseline (i.e. productivity shock) based on the survey results.

We use 2019 as the base year for our CGE modelling and assume that the structure of the economy has not fundamentally changed since 2019. We present the change in annual GDP that would have occurred if the road existed in 2019 and the change that will occur by 2050 if GDP continues to grow at historic rates.

3.4 Business survey

Traditional transport appraisal methodologies do not capture the broader effects that road infrastructure can have on business and consumer confidence. For example, closures can disrupt business operations and deter tourists from visiting the region.

We surveyed Te Tai Tokerau Northland businesses to understand how the investment will likely impact businesses’ costs and revenue and influence their employment and investment decisions. The survey was advertised through business networks and social media. Seven hundred ninety-eight businesses participated, representing 11% of the region’s employers, including 22% of medium businesses and 9% of large businesses.

More details on the approach to the survey can be found in section 0.



3.5 Indicative costs

We developed an indication of the costs of the project based on the cost per kilometre of other recent four-lane expressway investments in Aotearoa New Zealand.

4 Results from the standard transport appraisal

We used standard transport appraisal methodologies outlined in NZTA's Monetised Benefits and Costs Manual (MBCM) (NZ Transport Agency 2023c) to estimate the direct impacts of the investment.

4.1 Traffic projections

The size of the impacts depends on the volume of traffic likely to use SH1 in the future. This section outlines the traffic projections that underpin our analysis.

Table 5 presents estimates of traffic volumes in 2019 and projections for 2050 for each road section and vehicle type. The projections assume that traffic volumes continue to grow at historic rates. The low outcomes scenario assumes that the investment will not affect traffic volumes, and the high outcomes scenario assumes that traffic volumes will increase by 50% because of the investment.

Table 5 Traffic projections

Vehicle kilometres travelled by vehicle type (million km)

Vehicle type	Low outcomes scenario		High outcomes scenario	
	2019	2050	2019	2050
Warkworth to Whangārei				
Passenger cars	389	912	584	1,368
Light commercial vehicles	50	117	75	175
Heavy vehicles	52	122	78	183
All vehicles	491	1,151	737	1,726
Whangārei to Kaikohe				
Passenger cars	252	271	378	407
Light commercial vehicles	32	35	48	52
Heavy vehicles	27	29	40	43
All vehicles	311	335	466	502
Total	802	1,485	1,203	2,228

Source: NZIER

4.2 Efficiency impacts

Efficiency impacts refer to the travel time and vehicle operating costs saved for undisrupted journeys due to a faster, better-quality road.



Table 6 presents the travel time savings in minutes for each section of the road. Using data from Google Maps, we assume that average travel speeds for light vehicles increase from 67 km/h to 80 km/h in the low outcomes scenario and 90 km/h in the high outcomes scenario. Using national speed survey data for 2006–2015 (Ministry of Transport 2016), we estimate that heavy vehicles travel at speeds 7.74% lower than light vehicles. This results in total travel time savings of 25.2–40.9 minutes for light vehicles and 27.3–44.3 minutes for heavy vehicles.

Table 6 Travel time savings due to faster speeds by vehicle type

Travel time savings per trip (minutes)

Vehicle type	Low outcomes scenario	High outcomes scenario
Warkworth to Whangārei		
Light vehicles	15.0	23.2
Heavy vehicles	16.2	25.1
Whangārei to Kaikohe		
Light vehicles	10.2	17.7
Heavy vehicles	11.1	19.2
Total		
Light vehicles	25.2	40.9
Heavy vehicles	27.3	44.3

Source: NZIER

It is difficult to determine how travel times will be affected by growing traffic volumes. For simplicity, we assume that travel time savings per vehicle will be the same in 2050 as in 2019. This is a conservative assumption. The amount of capacity created by the investment will be greater than the amount of traffic it induces, so congestion will be less severe with investment than without investment, increasing travel time savings.

Table 7 summarises the value of travel time savings from improved efficiency. This is calculated by multiplying the travel time savings per trip by the projected traffic volumes and the monetary value of travel time for each vehicle type and travel purpose.

Table 7 Value of efficiency travel time savings by travel purpose

Annual impact (\$m June 2023)

Travel purpose	Low outcomes scenario		High outcomes scenario	
	2019	2050	2019	2050
Warkworth to Whangārei				
Work travel	36.5	83.8	71.0	164.0
Non-work travel	28.0	64.0	54.1	124.8
All travel	64.5	147.8	125.0	288.8
Whangārei to Kaikohe				
Work travel	25.7	42.0	49.5	83.1



Travel purpose	Low outcomes scenario		High outcomes scenario	
	2019	2050	2019	2050
Non-work travel	21.5	35.1	41.0	68.5
All travel	47.2	77.2	90.5	151.6
Total	111.7	225.0	215.5	440.4

Source: NZIER

Table 8 summarises the vehicle operating cost savings from improved efficiency. Although faster speeds generally increase base running costs, a straighter road, smoother road, reduced gradients, lower congestion and bottlenecks, and lower speed changes will reduce vehicle operating costs overall. In line with Wallis and Lupton (2013), we assume that faster travel times generally result in vehicle operating cost savings equal to 6% of travel time savings.

Table 8 Efficiency vehicle operating cost savings by travel purpose

Annual impact (\$m June 2023)

Travel purpose	Low outcomes scenario		High outcomes scenario	
	2019	2050	2019	2050
Warkworth to Whangārei				
Work travel	2.2	5.0	4.3	9.8
Non-work travel	1.7	3.8	3.2	7.5
All travel	3.9	8.9	7.5	17.3
Whangārei to Kaikohe				
Work travel	1.5	2.5	3.0	5.0
Non-work travel	1.3	2.1	2.5	4.1
All travel	2.8	4.6	5.4	9.1
Total	6.7	13.5	12.9	26.4

Source: NZIER

4.3 Resilience impacts

Direct resilience impacts refer to the travel time and vehicle operating costs saved due to reductions in diversions and delays due to closures.

In 2023, the Warkworth to Whangārei section was impacted by extreme weather events, and the Brynderwyn to Waipu section was closed or reduced to a single lane for 73 days (NZ Transport Agency, private communication, 14 November 2023). Light vehicles were generally directed via Mangawhai, and heavy vehicles were directed via SH12 and SH14. The Dome Valley was also closed for around 10 days, and vehicles were directed via SH16.

Climate change means extreme weather events are likely to occur more often in the future, leading to more closures. Table 9 lists resilience risks on SH1 between Warkworth and Kaikohe as at 2020.



Table 9 Resilience risks on State Highway 1

Location	Type	Risk rating	Frequency	Duration
Turntable Hill	Flood	Moderate	5–50 years	48+ hours
South of Kawakawa	Slip	Major	5–50 years	48+ hours
Hikurangi Swamp	Flood	Moderate	0–5 years	12–48 hours
Ruakākā to Whangārei	Slip	Extreme	0–5 years	12–48 hours
Brynderwyn to Ruakākā	Slip	Extreme	0–5 years	48+ hours
Te Hana Rail Bridge	Flood	Moderate	0–5 years	0–12 hours
Wayby Road	Slip	Extreme	0–5 years	48+ hours
Dome valley	Slip	Moderate	0–5 years	0–12 hours

Source: NZ Transport Agency (2020)

Using the midpoints of the ranges, we estimated the probability of extreme weather events and their expected duration for each route subsection. We assumed that vehicles affected by closures must use an alternative route that increases their travel time by one hour, except for 20% of heavy vehicles that cannot use alternative routes and must wait for the route to reopen. This allowed us to determine the travel time savings if the investment reduced closures by 50% in the low outcomes scenario and 100% in the high outcomes scenario. Table 10 summarises the results.

Table 10 Value of resilience travel time savings by travel purpose

Annual benefit (\$m June 2023)

Travel purpose	Low outcomes scenario		High outcomes scenario	
	2019	2050	2019	2050
Warkworth to Whangārei				
Work travel	1.2	2.7	2.9	6.7
Non-work travel	0.6	1.4	1.5	3.4
All travel	1.7	4.0	4.3	10.1
Whangārei to Kaikohe				
Work travel	0.3	0.6	0.9	1.5
Non-work travel	0.2	0.3	0.5	0.9
All travel	0.5	1.0	1.3	2.4
Total	2.3	5.0	5.7	12.5

Source: NZIER

Table 11 summarises the vehicle operating cost savings from improved resilience. These results assume that alternative routes involve travelling an extra 20 km on average at a speed of 65 km/h for light vehicles and 60 km/h for heavy vehicles.



Table 11 Resilience vehicle operating cost savings by travel purpose

Annual impact (\$m June 2023)

Travel purpose	Low outcomes scenario		High outcomes scenario	
	2019	2050	2019	2050
Warkworth to Whangārei				
Work travel	0.1	0.2	0.2	0.5
Non-work travel	0.1	0.2	0.2	0.5
All travel	0.2	0.4	0.4	1.0
Whangārei to Kaikohe				
Work travel	0.0	0.0	0.1	0.1
Non-work travel	0.0	0.1	0.1	0.1
All travel	0.1	0.1	0.1	0.2
Total	0.2	0.5	0.6	1.2

Source: NZIER

4.4 Safety impacts

Table 12 summarises the number of crashes by severity between 2015 and 2019 extracted from NZTA’s Crash Analysis System (CAS) data (NZ Transport Agency 2023a).

Table 12 Road crashes by severity between 2015 and 2019

Total number of road crashes between 2015 and 2019, by severity

Section	Fatal	Serious	Minor	Non-injury
Warkworth to Whangārei	32	79	216	660
Whangārei to Kaikohe	21	40	155	461
Total	53	119	371	1,121

Source: NZIER

Table 13 presents the road safety benefits from the proposed investment, calculated using NZTA’s crash cost savings worksheet (NZ Transport Agency 2022). The worksheet makes adjustments for trends in crash numbers and underreporting and calculates the total cost of rashes per year with and without investment using the cost per crash and the reduction in crashes.

Without investment, the cost per crash was \$14,438,000 for fatal accidents and \$784,580 for serious accidents. With investment, the cost per crash is higher due to faster travel speeds. Under the low outcomes scenario, the cost per crash is \$14,620,000 for fatal accidents and \$807,200 for serious accidents. Under the high outcomes scenario, the cost is \$14,760,000 for fatal accidents and \$824,600 for serious accidents.

Based on information from NZTA business cases, we assume that fatal and serious crashes reduce by 33% in the low outcomes scenario and 67% in the high outcomes scenario. We do not include crash cost savings for induced traffic.



Table 13 Crash cost savings

Annual impact (\$m June 2023)

Section	Low outcomes scenario	High outcomes scenario
Warkworth to Whangārei	34.5	71.6
Whangārei to Kaikohe	18.2	37.7
Total	52.6	109.3

Source: NZIER

4.5 Emissions impacts

Table 14 presents the monetary value of changes in greenhouse gas emissions from changes in vehicle speeds and traffic volumes.

We calculated changes in greenhouse gas emissions using emissions intensity figures from NZTA’s vehicle emissions prediction model (VEPM) (NZ Transport Agency 2023b). These figures show how emissions intensity is expected to change over time due to increases in vehicle efficiency and electric vehicles. We then applied a shadow price of carbon of \$164 per tonne for 2019 and \$294 for 2050 (\$ June 2023).

Under the low outcomes scenario, there is little change in the emissions of light vehicles, but heavy vehicles can travel closer to their optimal speed for reducing greenhouse gas emissions. Under the high investment outcomes scenario, light vehicles rise above their optimal speed, causing emissions to increase. In addition, the new traffic generated by the investment results in more emissions. The effect of greenhouse gas emissions rises over time as traffic grows, but this is offset by an increase in vehicle efficiency.

Table 14 Value of greenhouse gas emissions from vehicles

Annual impact (\$m June 2023)

Vehicle type	Low outcomes scenario		High outcomes scenario	
	2019	2050	2019	2050
Warkworth to Whangārei				
Passenger cars	0.0	0.1	3.5	3.9
Light commercial vehicles	0.0	0.0	0.4	0.5
Heavy vehicles	-0.3	-0.9	0.9	2.9
All vehicles	-0.2	-0.7	4.8	7.2
Whangārei to Kaikohe				
Passenger cars	0.0	0.1	2.3	1.9
Light commercial vehicles	0.0	0.0	0.3	0.2
Heavy vehicles	-0.1	-0.3	0.5	1.1
All vehicles	-0.1	-0.3	3.0	3.3
Total	-0.7	-1.9	15.7	21.0

Source: NZIER



The construction of the expressway will also produce greenhouse gas emissions. This has not been quantified as it depends on the design of the road.

As well as affecting greenhouse gas emissions, the investment will impact Te Tai Tokerau Northland's local natural environment. It will increase the size of the road and result in faster and potentially larger volumes of traffic, raising noise and air pollution. However, the construction will provide opportunities to enhance the areas around it, for example, by planting native trees and improving ecosystems and habitats.

4.6 Social impacts

Inadequate transport links prevent people from accessing employment, education and healthcare. Te Tai Tokerau Northland has higher deprivation levels, lower educational attainment, and worse health outcomes than the rest of the country. Investing in SH1 will make it easier for people to reach key destinations, such as workplaces, schools, and hospitals, and contribute to the region's social and economic development. It will improve access to culture and heritage sites and attract more tourists to the region.

4.6.1 Access to employment

Te Tai Tokerau Northland has lower incomes, a lower labour force participation rate and a higher unemployment rate compared to Aotearoa New Zealand as a whole. A higher proportion of the region's working-age population earns income from benefits, and a lower proportion earns income from wages or salaries. Māori have lower incomes, a lower labour force participation rate, a higher unemployment rate and a higher proportion of beneficiaries than non-Māori.

More people in Te Tai Tokerau Northland travel to work via car, truck or van than in the country as a whole (77% compared to 73%) (Stats NZ 2020). Investing in improved roading in the region will make it easier for people to reach employment centres. Job seekers will have access to a wider range of employers, increasing their chances of finding new roles. The economic growth created by the investment will lead to more job opportunities, raising employment and incomes.

4.6.2 Access to education

Educational attainment in Te Tai Tokerau Northland is below national levels. According to the 2018 Census, more people have no qualifications (23.1% compared to 18.2% overall and 28.2% compared to 25.3% for Māori), and fewer people have higher qualifications (15.8% compared to 24.8% overall and 9.6% compared to 12.5% for Māori) (Stats NZ 2020).

Te Tai Tokerau Northland has the worst school attendance in Aotearoa New Zealand, with just 28% of students attending school regularly in Term 2 of 2022 (Education Counts 2023b). The percentage of school leavers with NCEA Level 3 or above in 2022 was 41.7% compared to 51.8% nationally (Education Counts 2023a). Many schools in the region are geographically isolated, which makes it difficult to attract and support high-quality teachers, manage school maintenance and deliver learning support and outreach (Ministry of Education 2022).

Students depend on Te Tai Tokerau Northland's road network for access to education. 52.0% of students aged 15–29 travel to education by car, truck or van, and 26.9% travel by bus (Stats NZ 2020).



Investing in SH1 will contribute to improved education outcomes. It will make it easier for students to get to school or university, improving attendance and educational attainment. It will enable school students to travel to larger schools with more diverse curricula and make it easier for tertiary students to access wider education opportunities in Whangārei and Auckland. Higher education levels will improve employment outcomes and increase employers' access to skilled workers.

4.6.3 Access to healthcare

Te Tai Tokerau Northland has a high health burden. More people smoke, drink and use illicit drugs, and fewer people are physically active than the rest of the country.⁶ 72.5% of people are overweight or obese, compared to 56.3% for the country as a whole (Ministry of Health 2021). The region suffers from high rates of cardiovascular disease, cancer and chronic conditions. 15.5% rate their health as fair or poor, compared to 13.1% for Aotearoa New Zealand (Ministry of Health 2021).

Māori in Te Tai Tokerau Northland, who comprise over a third of the region's population and more than half of its young people, have life expectancies that are about nine years shorter than non-Māori in the region and one and a half years shorter than Māori in other regions (Stats NZ 2021).

These problems are exacerbated by difficulty accessing health care services. The proportion of adults with an unmet need for a GP due to lack of transport is 3.9% overall – 34.5% higher than the national average of 2.9% (Ministry of Health 2021). The proportion of people with an unmet need for after-hours due to lack of transport is 1.8% overall, compared to 1.1% in Aotearoa New Zealand. For Māori, these proportions increase to 8.0% and 3.3%, respectively. Almost all patients who need hospital services must travel to Whangārei or Auckland, and many specialised services are only available in Auckland.

The proposed investment will make it easier to access health services, helping to reduce the level of unmet health needs. Better access to healthcare will improve health outcomes and support a higher quality of life for people in the region.

4.6.4 Access to culture and heritage

Te Tai Tokerau Northland is regarded as the birthplace of Aotearoa New Zealand. It is said to be the first area discovered and inhabited by Māori and contains many early European settlements. The Treaty of Waitangi, our nation's founding document, was first signed in the Bay of Islands. As a result of this rich history, Te Tai Tokerau Northland is home to many places of heritage and cultural importance to Aotearoa New Zealand. Improving road transport in the region will make accessing these places faster and more reliable, allowing more people to benefit from their spiritual, cultural and historic value. Faster travel times and a lower risk of disruption will attract more domestic and international tourists to the region, creating new jobs for locals.

⁶ 22.6% of people in Northland are current smokers, compared to 14.5% for New Zealand. 22.4% are hazardous drinkers, compared to 20.6% for New Zealand. 16.4% use cannabis, compared to 14.3% for New Zealand. 38.0% are physically active, compared to 52.2% for New Zealand (Ministry of Health 2021).

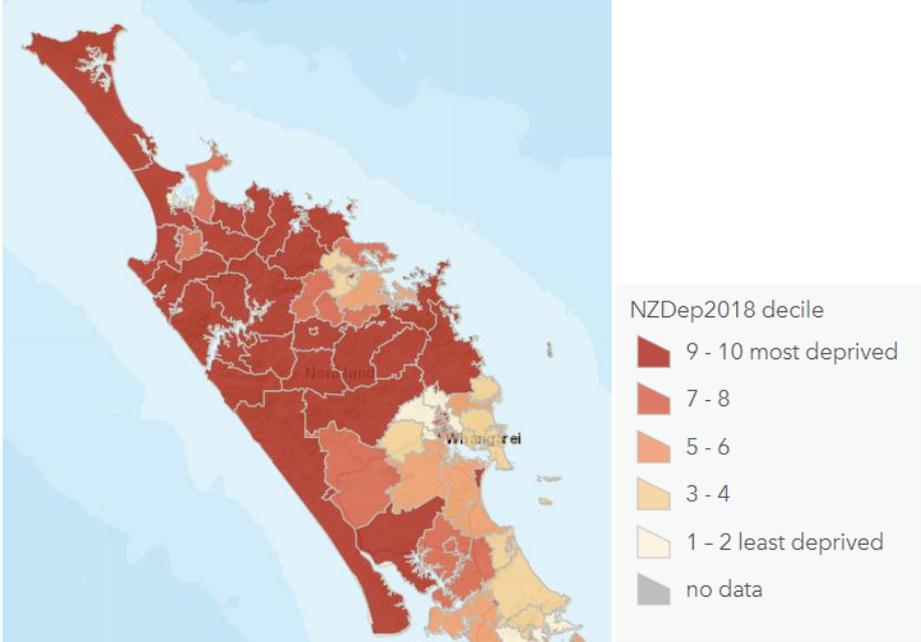


4.6.5 Poverty reduction

Some parts of Te Tai Tokerau Northland, particularly the Far North, have among the highest levels of socio-economic deprivation in NZ (see Figure 6). High levels of deprivation are associated with poor health, education and employment outcomes.

Te Tai Tokerau Northland has a very high proportion of people in deprived communities. According to NZDep2018,⁷ 26% of the region’s residents live in the most deprived decile areas (Atkinson, Crampton, and Salmond 2021). Māori are disproportionately affected by socio-economic deprivation.

Figure 6 NZDep2018 by statistical area 2 in Te Tai Tokerau Northland



Source: EHINZ (Environmental Health Intelligence NZ) map for NZDep2018

At \$378 per week in 2023, the median income in Te Tai Tokerau Northland is the lowest in Aotearoa New Zealand and 59% below the national median of \$921 (Stats NZ 2023a). GDP per capita in 2022 was \$46,611, 34% below the national level of \$70,617 (Stats NZ 2023b).

A four-lane expressway on SH1 will promote economic growth and enable businesses to grow, increasing investment, incomes and employment. It will improve access to jobs, education, and healthcare. This will improve wages and reduce socio-economic deprivation.

⁷ NZDep2018 stands for New Zealand Deprivation Index 2018. It provides a deprivation score for small geographic areas by combining nine variables from the 2018 census: internet access, household benefit income, household income, unemployment, qualifications, home ownership, single-parent households, overcrowding and the presence of damp or mould.

5 Results from the business survey

The economic impact of road infrastructure on businesses extends beyond travel time savings from efficiency and resilience. Slow or disrupted travel can have knock-on effects on business operations and impact business and consumer confidence, increasing costs, reducing sales and delaying investment.

NCG undertook a survey of businesses in Te Tai Tokerau Northland to understand how they were impacted by closures in 2023 and how they might be affected if the route is upgraded to a high-quality four-lane expressway.

The responses from the survey indicate that the full benefits from improved road infrastructure could be many times larger than the direct benefits of travel time and vehicle operating cost savings.

5.1 Overview of the survey

5.1.1 Respondents

The survey was an opt-in internet survey that was publicised through business networks and social media. Seven hundred ninety-eight businesses responded to the survey, representing 11% of Te Tai Tokerau Northland's employers, including 22% of medium businesses and 9% of large businesses. 81% of respondents completed the entire form.

The survey respondents have a different mix of industries, a lower proportion of small businesses, and a higher proportion of medium and large businesses compared to the Te Tai Tokerau Northland business population.

Assuming that the sample of survey respondents was selected randomly from the population of Northland employers, the margin of error is +/- 3.3 percentage points at a 95% confidence level.

Appendix B provides an overview of the survey respondents and outlines limitations arising from the sampling approach.

5.1.2 Questions

Respondents were asked questions about the nature of their business, their challenges, and their use of SH1. They were then asked to quantify how their costs, revenue, employment and investment were affected by closures in 2023 and how they would change if the road were upgraded to a high-quality four-lane expressway. Only respondents who said they use each section were asked questions about the impact of closures and upgrades for that section.

Appendix C provides a full list of survey questions.



5.1.3 Analysis

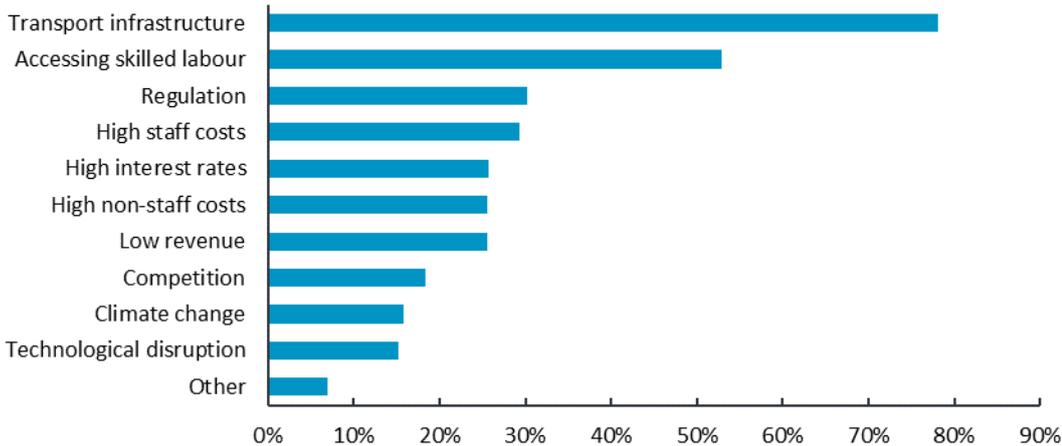
As part of our analysis, we estimated the total impact across all respondents. To do this, we grouped responses by employee count bands and used national data⁸ from Stats NZ (2023c) to estimate the average costs and revenue for businesses in each band. In each band, we multiplied the average costs or revenue by the average percentage change from the survey results. Finally, we added the results across income bands to get the total impact.

We also estimated the total impact across all Te Tai Tokerau Northland businesses if we assume the sample is representative. This involved scaling up the average cost and revenue increase for businesses in each employment band by the proportion of businesses in that band participating in the survey.

5.2 Importance of SH1 for businesses

Inadequate transport infrastructure is the most common problem facing Te Tai Tokerau Northland businesses, with 78% of respondents placing it among their top challenges (see Figure 7).

Figure 7 Top challenges

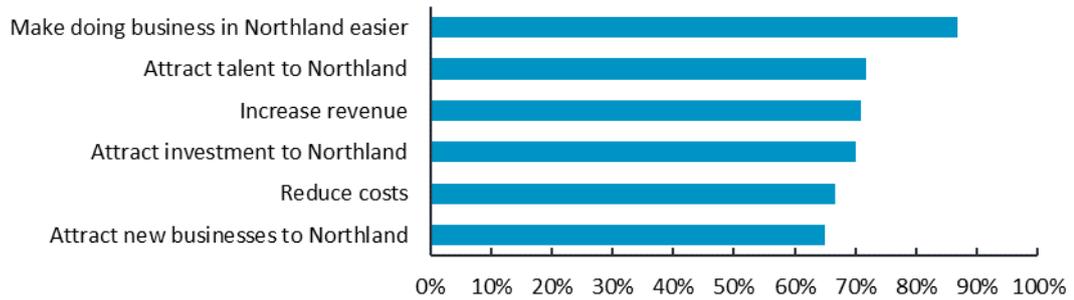


Source: NZIER

The most common way a high-quality four-lane expressway on SH1 would benefit businesses is by making it easier to do business in Te Tai Tokerau Northland (see Figure 8). Respondents also said upgrading SH1 would help attract investment and talent to the region.

⁸ While it would be more appropriate to use Northland data, only national data was available. It is likely that businesses in Northland have lower costs and revenues per employee than in the rest of the country, so using Northland data would decrease the size of the estimates.

Figure 8 Impact of a high-quality four-lane expressway on State Highway 1



Source: NZIER

93% of respondents use SH1 between Auckland and Whangārei to do business, and 62% use SH1 between Whangārei and Kaikohe.

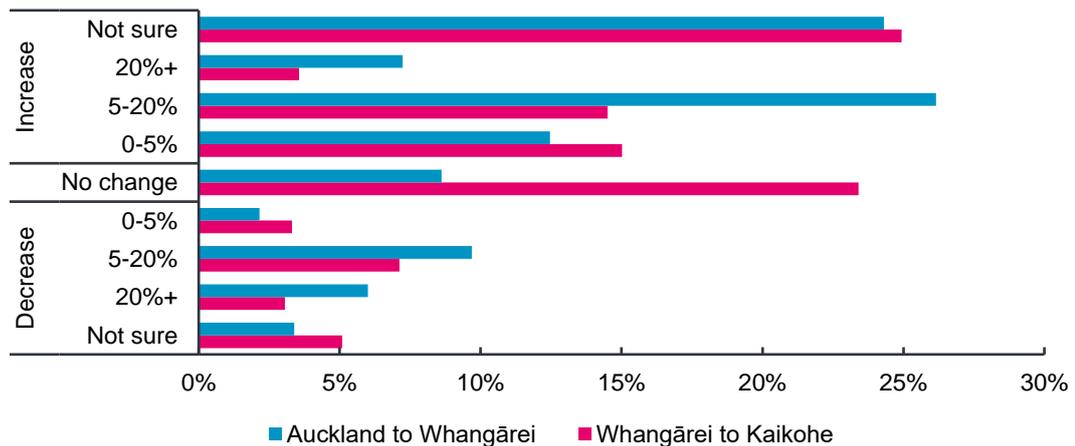
5.3 Impact of closures and diversions

Respondents were asked to quantify the impact of closures and diversions in 2023 on costs, revenue, employment, and investment compared to 2022.

5.3.1 Cost impacts

70% of respondents said that closures between Auckland and Whangārei had increased their costs (see Figure 9). The median or central estimate of the size of the change was an increase of 0–5%.

Figure 9 Impact of closures on costs



Source: NZIER

In total, the 798 respondents said that their collective costs increased by between \$60 million and \$230 million for Auckland to Whangārei and between \$30 million and \$80 million for Whangārei to Kaikohe. Assuming the responses are representative of the broader Te Tai Tokerau Northland business population, this implies costs increased by between \$270 million and \$1,210 million due to closures between Auckland and Whangārei



and between \$300 million and \$770 million due to closures between Whangārei and Kaikohe.

5.3.2 Revenue impacts

70% of respondents said that closures between Auckland and Whangārei had decreased their revenue. The median estimate was an increase of 0–5% (see Figure 10).

Figure 10 Impact of closures on revenue



Source: NZIER

Overall, respondents’ revenue decreased by between \$90 million and \$200 million due to closures between Auckland and Whangārei and between \$20 million and \$70 million due to closures between Whangārei and Kaikohe.

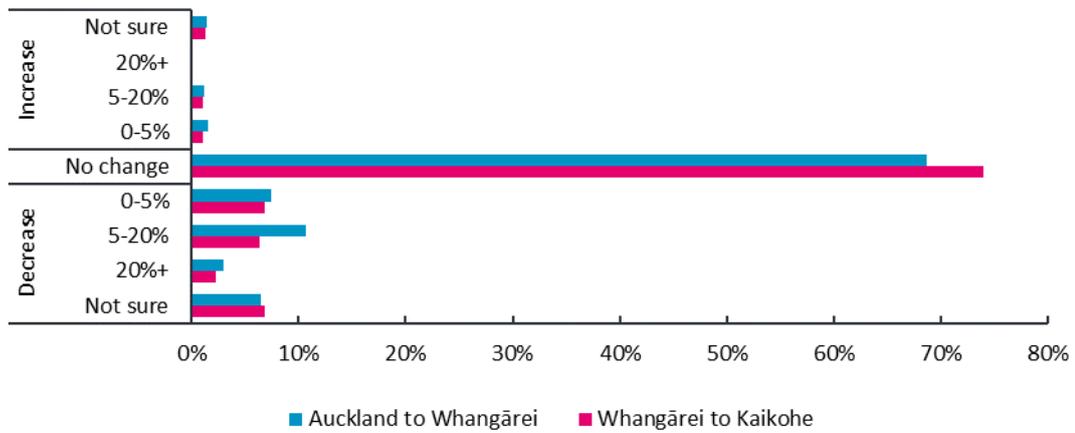
This indicates that the total decrease in revenue across all Te Tai Tokerau Northland businesses was between \$1,070 million and \$1,970 million for Auckland to Whangārei and between \$590 million and \$1,490 million for Whangārei and Kaikohe.

5.3.3 Employment impacts

Almost a third of respondents said that closures between Auckland and Whangārei reduced their employment due to closures and diversions between Auckland and Whangārei in 2023, presumably due to the pressure on costs and revenue (see Figure 11). The median respondent said that there was no change in employment.



Figure 11 Impact of closures on employment



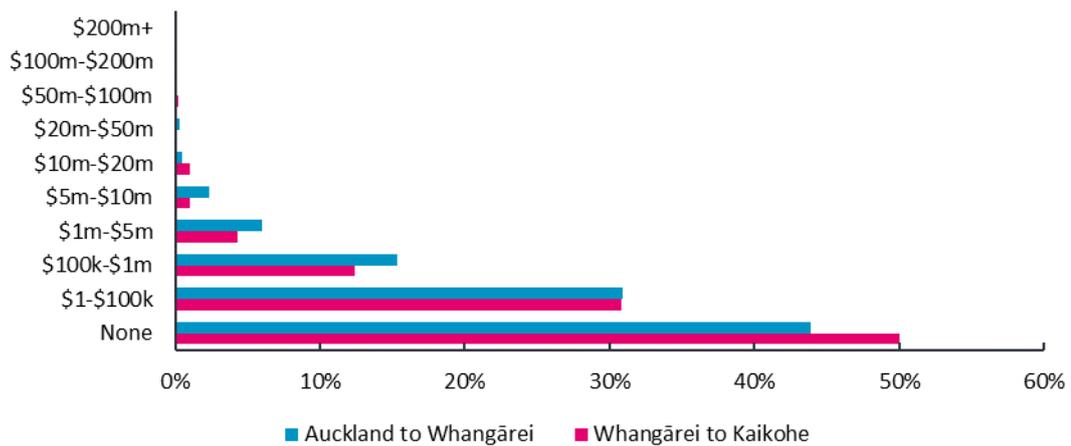
Source: NZIER

Respondents said their employment decreased by 120–350 due to closures between Auckland and Whangārei, implying an overall decrease of 720–2,020 jobs across the wider business population. Employment decreased by 30–100 due to closures between Whangārei and Kaikohe, implying an overall decrease of 410–1,080 jobs.

5.3.4 Investment impacts

Over half of the respondents said that closures between Auckland and Whangārei caused them to delay investment, and a quarter said the closures caused them to delay investment of more than \$100k (see Figure 12).

Figure 12 Impact of closures on investment



Source: NZIER

In total, closures between Auckland and Whangārei caused respondents to delay between \$340 million and \$920 million of investment, indicating that between \$3,020 million and \$13,180 million was delayed overall. Closures between Whangārei and Kaikohe caused



respondents to delay between \$130 million and \$370 million of investment, indicating that between \$2,190 million and \$7,120 million was delayed overall.

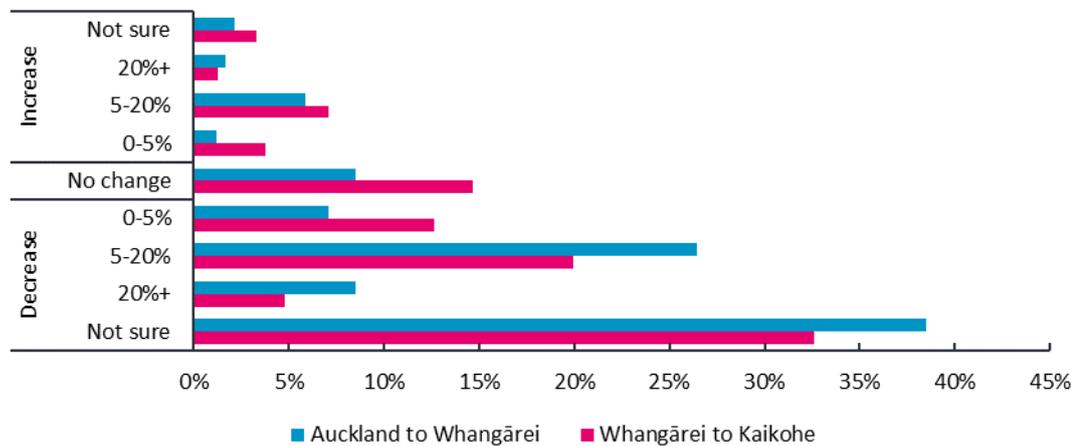
5.4 Impact of upgrading to a four-lane expressway

Respondents were asked to quantify how their costs, revenue, employment, and investment would change if each section of the route on SH1 was upgraded to a high-quality four-lane expressway.

5.4.1 Cost impacts

81% of respondents said their costs would reduce if the route from Auckland to Whangārei was upgraded, compared to 70% for Whangārei to Kaikohe (see Figure 13). The median estimate was a decrease of 5–20%.

Figure 13 Impact of a four-lane upgrade on costs



Source: NZIER

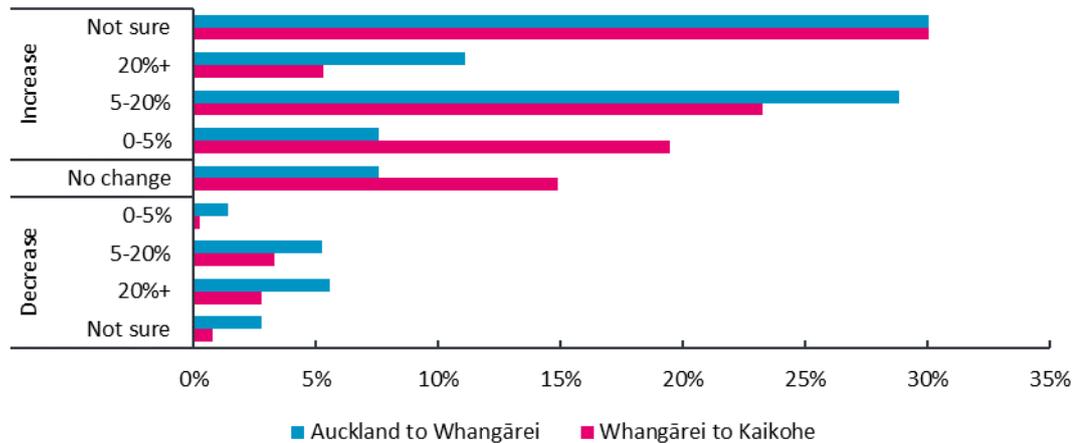
Overall, the 798 respondents indicated that upgrading the route between Auckland and Whangārei could reduce their collective costs by around \$90 million to \$230 million a year, and upgrading the route between Whangārei to Kaikohe could reduce their costs by around \$30 million to \$80 million. Assuming the responses are representative of Te Tai Tokerau Northland businesses as a whole, this implies costs for all businesses would be reduced by between \$1,040 million and \$2,210 million for the Auckland and Whangārei section and between \$560 million and \$1,460 million for the Whangārei to Kaikohe section.

5.4.2 Revenue impacts

The proportion of respondents who expected the upgrade to increase revenue was 78% for both sections of the road, and a typical business expected revenue to increase by 5–20% (see Figure 14).



Figure 14 Impact of a four-lane upgrade on revenue



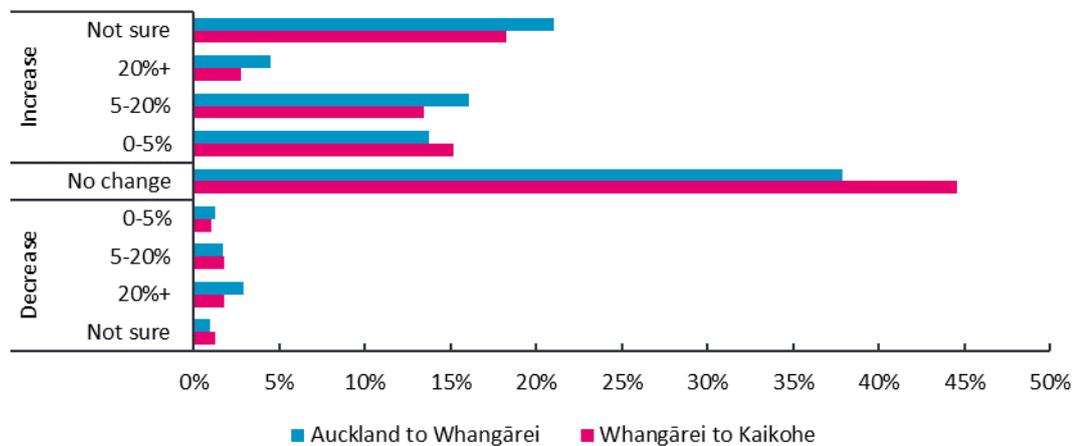
Source: NZIER

In total, respondents indicated that upgrading the route between Auckland and Whangārei would increase revenue by around \$100 million to \$280 million and upgrading the route between Whangārei and Kaikohe would increase revenue by between \$24 million and \$110 million. This implies an overall revenue increase of between \$690 million and \$2,200 million across Te Tai Tokerau Northland businesses for Auckland to Whangārei and between \$460 million and \$1,900 million for Whangārei to Kaikohe.

5.4.3 Employment impacts

Around half of the respondents said upgrading SH1 would increase employment, presumably because reduced costs and increased sales would allow businesses to expand (see Figure 15).

Figure 15 Impact of a four-lane upgrade on employment



Source: NZIER

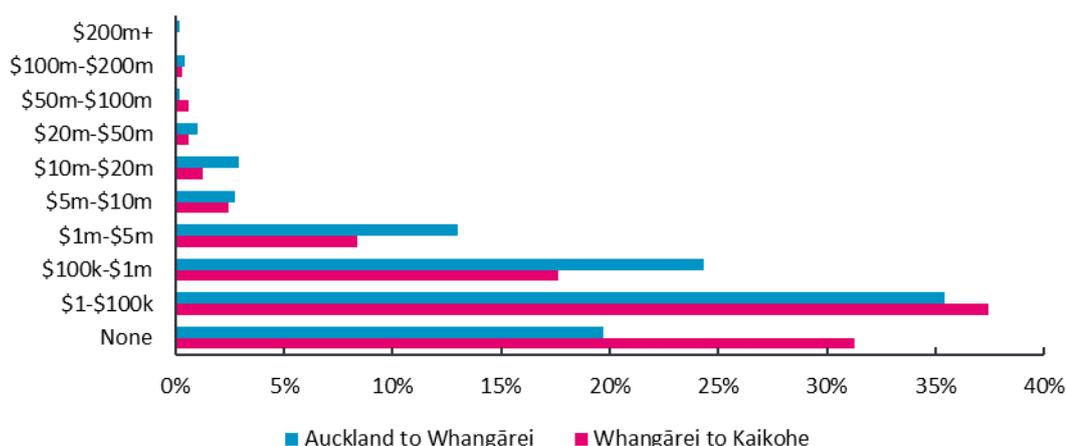


Respondents said upgrading Auckland to Whangārei would increase their employment by 100–520 employees in total, indicating a total increase of 820–3,430 for Te Tai Tokerau Northland as a whole. Upgrading Whangārei to Kaikohe would increase respondents’ employment by 70–240, implying an overall increase of 700–2,530 across all businesses.

5.4.4 Investment impacts

The majority of respondents said that they would bring forward investment if SH1 were upgraded to a four-lane expressway (80% for Auckland to Whangārei and 69% for Whangārei to Kaikohe), and around a third said they would bring forward more than \$100k of investment (see Figure 16).

Figure 16 Impact of a four-lane upgrade on investment



Source: NZIER

Across the responses, upgrading SH1 between Auckland and Whangārei would bring forward between \$830 million and \$1,800 million of investment, indicating that Te Tai Tokerau Northland businesses could bring forward around \$8,840 million to \$22,940 million in total. Respondents said that upgrading SH1 between Whangārei and Kaikohe would increase their investment by between \$350 million and \$860 million, indicating a range of between \$4,870 million and \$15,350 million for the region as a whole.

5.5 Comments

Respondents highlighted the following themes in their comments:

- Long travel times, closures and delays raise costs associated with staff time, vehicle maintenance and fuel.** Many respondents said they travel regularly between Te Tai Tokerau Northland and other regions, including Auckland, Waikato, and the Bay of Plenty. Issues with the road in Te Tai Tokerau Northland raise costs for businesses.
- Poor quality road infrastructure negatively affects the quality of products and services.** Some goods, such as healthcare supplies and food, lose value quickly when delayed. Goods can be damaged during transport or arrive later than planned, resulting in poor customer satisfaction. Uncertainty about travel times makes it harder for service providers to make appointments or meet deadlines.



- **Road closures have damaged Te Tai Tokerau Northland's reputation.** Respondents in the tourism industry have highlighted how extreme weather events in 2023 have damaged the public perception of the region. Tourists have lost trust in the region and now prefer more accessible locations, resulting in a major fall in revenue for the tourism sector.
- **Poor transport links make it harder to build networks.** Respondents described how poor transport impacts the ability of staff to attend in-person meetings, conferences and training events and develop and maintain relationships with colleagues, customers and suppliers.
- **Businesses have shrunk, closed, or moved.** Some respondents said the closures had reduced profits or caused them to lay off staff. Others said they were considering closing their business, moving to Auckland, or going online.
- **Businesses are concerned about the safety of their staff.** Poor road quality and a lack of passing lanes increase the risk of crashes. Long travel times can also cause fatigue. Respondents are worried that more accidents will occur in the future.



6 Results from the CGE modelling

The survey results provide a different picture of the impact on businesses compared to the standard transport appraisal results. We interpret the survey results as indicating a productivity improvement and use the CGE model to understand how this would affect GDP.

6.1 Shock design

The survey results indicate that the full impact on businesses from upgrading the road could be significantly greater than the travel time and vehicle operating cost savings.

Throughout the survey, more than half of businesses said upgrading SH1 to a high-quality four-lane expressway would decrease costs or increase revenues by 5% or more. This could be due to an increase in the quantity of outputs firms can produce using a given quantity of inputs, implying an increase in productivity, but it could also be due to expected changes in prices. We interpret the survey results as indicating that the full investment would lead to an average increase in productivity of at least 2.5% and use our CGE model to understand the flow-on effects on the economy. We apply a productivity shock of 2.5% across labour, capital and intermediate inputs for all sectors in Te Tai Tokerau Northland.

6.2 Results

6.2.1 Change in GDP

Table 15 summarises the wider economic impacts implied by the survey results. Because the survey only included businesses in Te Tai Tokerau Northland, we only shocked productivity in the Northland region. As a result, economic growth is concentrated in Northland, increasing the region's GDP by \$2,311.4 million per year by 2050. About half of the GDP increase in Northland is due to the creation of new activity, and the rest is due to redistribution from other regions. The overall increase in national GDP is \$1,160.5 million per year by 2050 or \$23,772.1 million in total from 2040 to 2060.

Table 15 Change in GDP

Annual impact (\$m June 2023)

Region	2019	2050
Northland	1,038.4	2,311.4
New Zealand	521.3	1,160.5

Source: NZIER

6.2.2 Change in other variables

Figure 17 highlights changes in other key economic variables for Northland. It shows that:

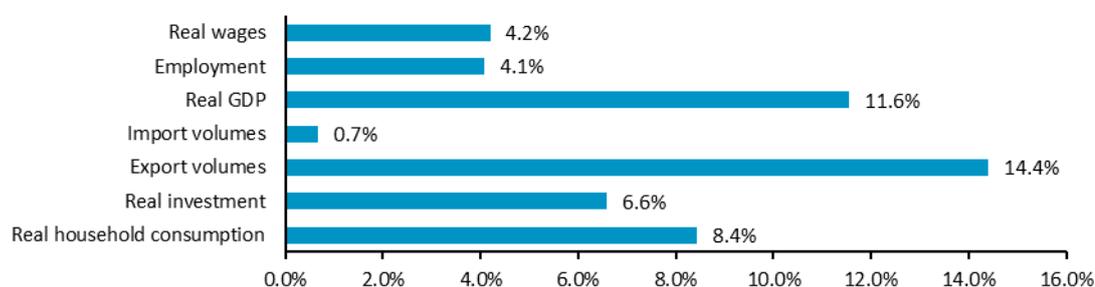
- real wages will increase by 4.2%
- aggregate employment will increase by 4.1%



- real GDP will grow by 11.6%
- export volumes will rise by 14.4%
- import volumes will rise by 0.7%
- real investment will rise by 6.6%
- real household consumption will rise by 8.4%.

Higher productivity increases investment, employment and wages. This shows that the economic growth triggered by the investment will lead to higher living standards for people in the region.

Figure 17 Change in key economic variables for Northland



Source: NZIER

6.2.3 Breakdown by sector

Table 16 provides a breakdown of CGE results for Northland by sector. The forestry, food production, manufacturing, horticulture, and livestock sectors experience the largest GDP growth. The increase in imports is largest in the trade, tourism, services and non-road transport sectors, and the growth in exports is largest in the non-civil construction, forestry tourism and services sectors.

The CGE model does not explicitly account for the capacity of Northport and the effect that the planned port expansion would have on imports and exports. The port expansion could lead to a higher percentage growth in imports in some sectors.

Table 16 Change in Northland GDP, imports and exports by sector

Percentage change

Sector	Northland GDP	Northland imports	Northland exports
Horticulture	9.9%	0.0%	5.3%
Livestock	9.7%	0.0%	0.0%
Forestry	19.7%	-0.8%	15.3%
Road transport	8.5%	0.0%	0.0%
Other transport	5.6%	2.3%	3.4%
Civil construction	4.7%	0.0%	0.0%
Food production	17.8%	0.3%	0.0%



Sector	Northland GDP	Northland imports	Northland exports
Other manufacturing	12.8%	0.4%	5.3%
Services	6.0%	2.3%	10.2%
Trade	6.1%	5.1%	8.1%
Tourism	6.2%	2.6%	10.4%
Rest of the economy	7.2%	4.2%	9.5%

Source: NZIER



7 Indicative comparative costs

To develop an indicative cost estimate, we assessed the cost per kilometre of recent four-lane expressway projects in Aotearoa New Zealand.

Table 17 provides an overview of costs for recent comparator projects. Costs for each section are assumed to be expressed in money values for the middle of the construction period and are converted to June 2023 money values. Costs per kilometre typically range from around \$30 million to about \$60 million, with an average of approximately \$40 million.

Table 17 Costs of comparator projects

Project	Period	Cost (nominal)	Cost (\$m 2023)	Distance (km)	Cost per km (\$m 2023)
Pūhoi to Warkworth	2016–2023	877	1,035	19	56
Transmission Gully	2014–2022	1,250	1,513	27	56
Waikato Expressway					
Hamilton section	2016–2022	837	996	22	46
Longswamp section	2016–2019	92	112	6	19
Huntly section	2015–2020	383	467	12	31
Rangiriri section	2013–2017	123	155	5	32
Kāpiti Expressway					
Peka Peka to Ōtaki	2017–2022	445	525	13	40
Mackays to Peka Peka	2013–2017	630	794	18	44
Total		3,938	4,801	123	39

Source: NZIER analysis based on information on the NZ Transport Agency website

Based on this information, we estimate that a four-lane expressway could cost between \$3,000 million and \$5,900 million for Warkworth to Whangārei and an additional \$2,600 million to \$5,100 million for Whangārei to Kaikohe. Due to the difficult terrain between Te Hana and Ruakākā, we consider it more likely that the cost for the Warkworth to Whangārei section will be toward the upper end of the range. The Whangārei to Kaikohe section is less hilly, so we consider the midpoint of the range more likely.



8 Conclusion

8.1 Summary

This report assesses the economic impact of upgrading SH1 to a high-quality four-lane expressway connecting Auckland, Whangārei and Kaikohe.

8.1.1 Standard transport appraisal

First, we assess the direct benefits using standard transport appraisal methodologies. Because we did not have a proposed route or transport model to work with, our assessment was underpinned by assumptions about the improvements that the road would bring. These assumptions were informed by comparisons with other four-lane expressway projects and information in NZTA business cases.

Assuming that the road will enable average travel speeds to increase to 80–90 km/h, we estimate that improved efficiency will produce travel time savings of between \$215.5 million and \$440.4 million a year by 2050 and vehicle operating cost savings of between \$12.9 million and \$26.4 million. Assuming that the road will reduce the hours of full closures by 50–100% a year, we estimate that improved resilience will produce annual travel time savings of between \$5.7 million and \$12.5 million and vehicle operating cost savings of between \$0.6 million and \$1.2 million. If deaths and serious injuries fall by 33–67%, the social cost of crashes will fall by between \$53.3 million and \$111.3 million a year.

The project will have significant social benefits. Te Tai Tokerau Northland is underdeveloped compared to the rest of the country, with worse employment, education and healthcare outcomes. This is partly due to long distances and poor connectivity, making it more difficult for people to access services and opportunities. Improving the region's road infrastructure will stimulate its social and economic development, providing a better quality of life for people in the region.

8.1.2 Business survey

Improving speeds and avoiding disruption could have other benefits to businesses that are not captured by the traditional benefits included in standard transport appraisal. To understand the full impact a high-quality four-lane expressway could have, NCG surveyed Te Tai Tokerau Northland businesses. The respondents, who represent 11% of Northland's employers, said preventing closures and upgrading the road would majorly impact their businesses. More than half said that the proposed upgrades would increase their revenues and decrease their costs by at least 5%.

When businesses face slow or uncertain travel times, they need to accumulate larger inventories and build more redundancy into their business operations. Businesses also struggle to form productive relationships with their customers and suppliers, weakening supply chains. The risk of closures also undermines business and consumer confidence, causing businesses to delay investment. Releasing these constraints by investing in high-quality road infrastructure in Te Tai Tokerau Northland will bring about more investment and employment, allowing businesses to expand and the economy to grow.



Using our CGE model, we interpret the survey results as implying a 2.5% improvement in the productivity of all industries and find that this could lead to an increase in annual GDP of 1,160.5 million by 2050, or \$23,772.1 million in total from 2040 to 2060.

8.2 Next steps

Prior to the election, the National Party set out a long-term vision to connect Whangārei to Auckland, Hamilton, and Tauranga with modern, high-quality four-lane highways and committed to building expressways from Warkworth to Wellsford and from Ruakākā to Whangārei in its first term (National Party 2023). Subsequently, the coalition government committed to a four-lane highway alternative for the Brynderwyns ('Speech From the Throne' 2023).

This report highlights the benefits of combining these initiatives into a single expressway from Auckland to Whangārei and, ultimately, Kaikohe. The road could have monetary benefits of between \$299 million and \$562 million a year by 2050, unlock social prosperity, and, if productivity improves by 2.5%, increase annual GDP by \$1,161 million. The investment between Auckland and Whangārei is urgently needed to help Te Tai Tokerau Northland realise its potential and maximise its contribution to the national economy. The Whangārei to Kaikohe section should follow as the region grows.

The government should prioritise this road and immediately begin work on the required detailed options appraisal, design, and costing activities. This should include a full cost-benefit analysis based on detailed transport modelling that considers all potential benefits, including effects on business and consumer confidence, building on existing analysis. The government should investigate the use of private financing to accelerate delivery in line with its commitments.



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Appendix A Direct benefits methodology

This appendix outlines how we estimated direct benefits using NZTA's MBCM (NZ Transport Agency 2023c).

A.1 Traffic volumes

We estimated future traffic volumes and composition using the following steps:

1. **Identify route subsections.** As traffic volumes vary significantly across the route, we divided each section into four subsections⁹ and developed projections for each subsection.
2. **Estimate historical traffic volumes.** We selected a representative traffic count site for each subsection and used annual average daily traffic counts to obtain each subsection's total annual traffic volumes.
3. **Project future traffic volumes.** We projected annual traffic volumes forward from 2019 to 2060, assuming that traffic will grow at the same arithmetic annual growth rate as 2015–2019. For the high outcomes scenario, we assumed that traffic volumes would increase by an additional 50% because of the investment.
4. **Decompose vehicles into passenger cars, light commercial vehicles (LCVs) and heavy vehicles (HVs).** We estimated the proportion of light and heavy vehicles on each subsection of the route using the average figure for 2015–2019 and used figures from the MBCM to divide light vehicles into cars and LCVs.

As there is little variation in travel times for different days of the week or different times of day, we did not consider it necessary to break down traffic volumes by weekday and weekend or peak and interpeak.

A.2 Efficiency impacts

We estimated efficiency benefits using the following steps:

1. **Estimate baseline travel times.** We used data from Google Maps to estimate the current travel time, distance, and light vehicle speeds for each subsection. Using national speed survey data for 2006–2015 (Ministry of Transport 2016), we estimated that heavy vehicles travel at speeds 7.74% lower than light vehicles.
2. **Estimate travel times with investment.** We estimated what the travel times would be for light and heavy vehicles for each route subsection if average travel speeds increased to 80 km/h for the low outcomes scenario or 90 km/h for the high outcomes scenario.
3. **Calculate travel time savings (TTS) per trip.** We calculated TTS per trip and assumed they would remain constant over time. This assumption is conservative, as rising traffic volumes could lead to congestion over time. The amount of capacity the investment creates will be greater than the amount of traffic it induces. With investment, congestion will be less severe than without investment, increasing travel time savings.

⁹ The section 1 subsections are Warkworth to Wellsford, Wellsford to Te Hana, Te Hana to Ruakākā, and Ruakākā to Whangārei. The section 2 subsections are Whangārei to Kamo, Kamo to Kawakawa, Kawakawa to Pakaraka, and Pakaraka to Kaihōhe.



- 4 **Calculate total TTS.** We calculated the TTS savings by multiplying traffic volumes by travel time savings per trip for each subsection and vehicle type. Using figures from the MBCM, we decomposed TTS by travel purpose (work, commuting and other).
- 5 **Calculate monetary value of travel time savings (VTTS).** We used figures from the MBCM to calculate the value of travel time (VTT) for vehicles and occupants by vehicle type and travel purpose. We then multiplied the total TTS for each vehicle type and travel purpose by the VTT to get VTTS.
- 6 **Estimate vehicle operating cost savings (VOCS).** Although faster speeds generally increase base running costs, a straighter road, smoother road, reduced gradients, lower congestion and bottlenecks, and lower changes of speed will reduce vehicle operating costs overall. Based on earlier research, Wallis and Lupton (2013) estimate that faster travel times generally result in VOCS equal to approximately 6% of VTTS. In contrast, Wallis, Rupp and Alban (2015) reviewed 40 New Zealand state highway projects and found that the total estimated VOCS is more than 11% of VTTS. In the Pūhoi to Warkworth detailed business case (NZ Transport Agency 2015), VOCS are 7% of VTTS, whereas in the Warkworth to Wellsford detailed business case, the figure is 3% (NZ Transport Agency 2019). Based on this evidence, we assume VOCS are equal to 6% of VTTS.

A.3 Resilience impacts

We used the following methodology to estimate resilience benefits:

- 1 **Estimate the frequency and duration of closures.** Using data provided by NZTA on full closures between 2015 and 2022, we estimated the average number of closures per year due to crashes and their average duration. This is lower than the number of accidents as accidents do not always cause full closures. The resilience programme business case (NZ Transport Agency 2020) lists flood and slip risks on the route, including ranges for their frequency and duration (see Table 9). Using the midpoints of the ranges, we estimated the probability of extreme weather events and their expected duration for each route subsection.
- 2 **Estimate travel time lost per closure.** We assumed that vehicles affected by closures must use an alternative route that increases their travel time by one hour. We also assumed that 20% of heavy vehicles cannot use alternative routes and must wait for the route to reopen.
- 3 **Calculate the total travel time lost due to closures.** We multiplied the volume of traffic in each subsection by the proportion of traffic affected by closures and the extra travel time lost per closure.
- 4 **Calculate the value of travel time saved (VTTS) from the reduction in closures.** We assumed that the investment would reduce closures by 50% for the low outcomes scenario and 100% for the high outcomes scenario. We estimated the monetary value of the resulting travel time savings (TTS) by applying VTT figures from the MBCM.
- 5 **Estimate extra vehicle operating costs (VOC) per closure.** We assumed that alternative routes involve travelling an extra 20 km on average at a typical speed of 65 km/h for light vehicles and 60 km/h for heavy vehicles. Using figures from the MBCM, this implies an increase in vehicle operating costs (VOC) per closure of \$4.6 for cars,



\$5.9 for light commercial vehicles and \$22.1 for heavy commercial vehicles (\$ July 2015).

- 6 **Calculate the vehicle operating costs savings (VOCS) from the reduction in closures.** We multiplied the volume of traffic by subsection and vehicle type by the proportion of traffic affected by closures, the increase in vehicle operating costs per closure, and the percentage reduction in closures.

A.4 Safety impacts

We used the following methodology to estimate safety benefits:

- 1 **Estimate the frequency and severity of crashes.** We extracted the number of crashes in Northland by severity for 2015–2019 using NZTA’s Crash Analysis System (CAS) data (2023a) and filtered out crashes that did not occur on the relevant sections of SH1.
- 2 **Convert to monetary values.** We used NZTA’s crash cost savings worksheet (2022) to calculate the crash cost savings associated with a reduction in fatal and serious crashes of 33% for the low outcomes scenario and 67% for the high outcomes scenario. While our data includes a higher proportion of fatal crashes than the weights used in NZTA’s worksheet, this could be a result of random chance.

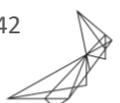
A.5 Emissions impacts

We used the following methodology to estimate the value of changes in greenhouse gas emissions for vehicles on the route:

- 1 **Estimate changes in greenhouse gas emissions.** We used figures from NZTA’s vehicle emissions prediction model (VEPM) (NZ Transport Agency 2023b) on the greenhouse gas emissions intensity of light and heavy vehicles and the projected vehicle kilometres travelled to calculate the total volume of greenhouse gas emissions created by travel on the road before and after investment.
- 2 **Convert to monetary values.** We multiplied the change in emissions by the shadow price of carbon to determine the total value of greenhouse gas emissions. We used a shadow price of carbon of \$164 per tonne for 2019 and \$294 for 2050 (\$ June 2023).

A.6 Rule of half

The high outcomes scenario assumes that traffic on the route will increase by 50% due to the investment. We use the ‘rule of half’ to estimate the benefits to people and businesses who increase their travel on the route due to the investment (NZ Transport Agency 2023c). When users change their travel behaviour, they experience higher benefits from their new behaviour but also forgo the benefits from their previous behaviour. Some new users receive the full, incremental benefits of the investment, but others gain almost zero benefits. The rule of half assumes that people who change their travel behaviour on average receive half of the incremental benefits.



Appendix B Survey respondents and limitations

This appendix presents additional results from the business survey that were not included in the body of the report. It also outlines some limitations of the survey.

B.1 Survey respondents

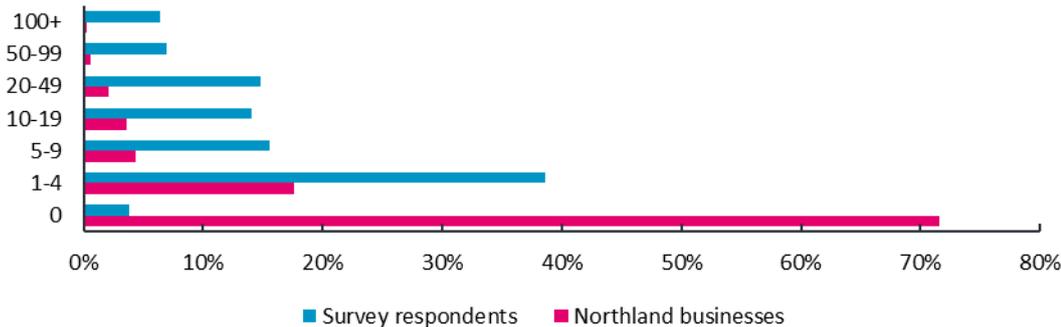
Respondents were asked about their size, industry, presence in Te Tai Tokerau Northland, and how their revenue has changed over time.

B.1.1 Size

Seven hundred ninety-eight businesses responded to the survey, representing around 11% of Te Tai Tokerau Northland’s employers, including 22% of medium businesses and 9% of large businesses. Sole traders were not well represented by the survey respondents.

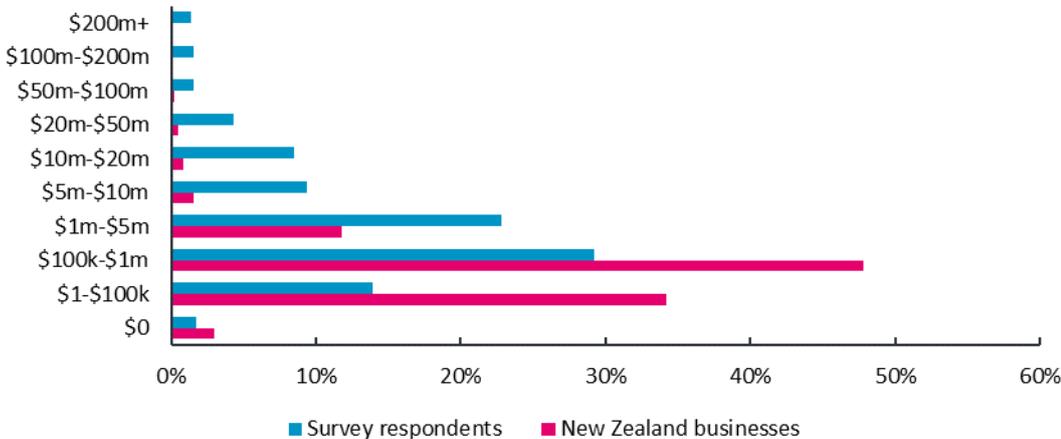
Figure 18 presents respondents by employee count, and Figure 19 shows respondents by income band.

Figure 18 Survey respondents by employee count



Source: NZIER

Figure 19 Survey respondents by income band

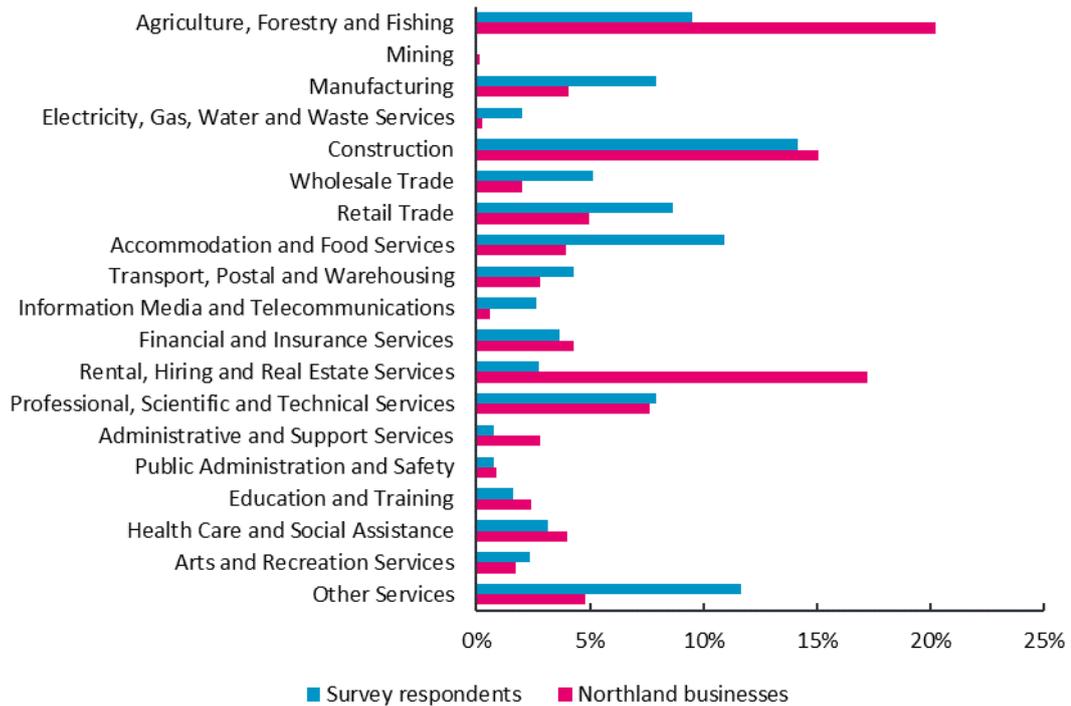


Source: NZIER

B.1.2 Industry

Figure 20 presents respondents by industry. The agriculture, forestry and fishing and rental, hiring and real estate services industries were underrepresented compared to the Te Tai Tokerau Northland business population. The accommodation and food services, information media and telecommunications, and utilities industries were overrepresented.

Figure 20 Survey respondents and Northland businesses by industry

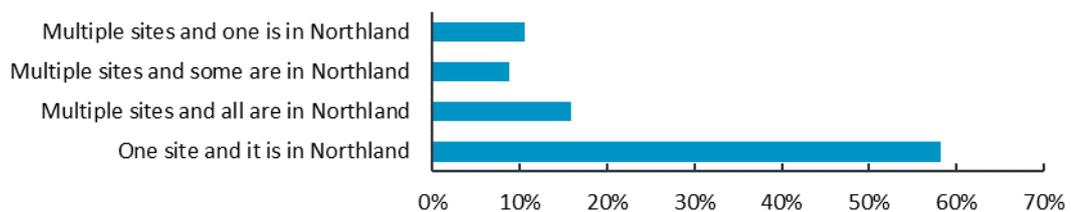


Source: NZIER

B.1.3 Presence in the region

Figure 21 presents respondents by the nature of their presence in Te Tai Tokerau Northland. Most survey respondents had a single Northland site, and around a quarter had multiple Northland sites.

Figure 21 Survey respondents by presence in Northland



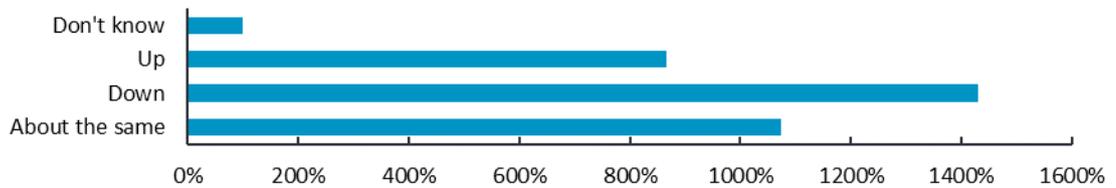
Source: NZIER



B.1.4 Change in revenue over time

Figure 22 shows how respondents' current revenue compared to their revenue a year ago. The most common response is that revenue decreased.

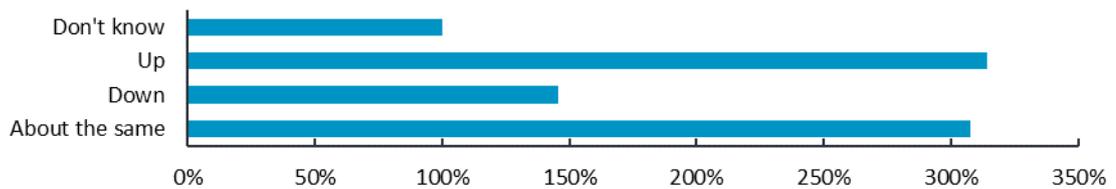
Figure 22 Current revenue compared to a year ago



Source: NZIER

Figure 23 shows respondents' expected revenue in one year compared to now. The most common response is that revenue will increase, indicating optimism about the future.

Figure 23 Expected revenue in a year compared to now



Source: NZIER

B.2 Survey limitations

The survey represents a very large proportion of Te Tai Tokerau Northland's employers and provides insights into the effects of transport infrastructure on business confidence. However, it also has some important limitations:

- The results may be affected by selection bias. Businesses that are more impacted by road infrastructure may be more likely to respond, and the sample may not be representative of the broader business population.
- The responses may not be accurate. It could be difficult for businesses to accurately estimate road transport's effect on their costs, revenue, employment and investment, and there is potential for optimism bias.
- We were not able to verify the identity of the respondents. Some respondents may not represent Northland businesses, and others may have filled out the survey multiple times.

These limitations are common to most business opinion surveys.



Appendix C Survey questions

This appendix lists the questions used in the survey.

Table 18 Survey questions

Question	Options
First, we would like to understand a bit more about your business. What industry is your business in?	<ul style="list-style-type: none"> • Agriculture, Forestry and Fishing • Mining • Manufacturing • Electricity, Gas, Water and Waste Services • Construction • Wholesale Trade • Retail Trade • Accommodation and Food Services • Transport, Postal and Warehousing • Information Media and Telecommunications • Financial and Insurance Services • Rental, Hiring and Real Estate Services • Professional, Scientific and Technical Services • Administrative and Support Services • Public Administration and Safety • Education and Training • Health Care and Social Assistance • Arts and Recreation Services • Other Services • Don't know
How many employees does your business have?	<ul style="list-style-type: none"> • 0 • 1-4 • 5-9 • 10-19 • 20-49 • 50-99 • 100 and over
What was the turnover of your business in the last financial year?	<ul style="list-style-type: none"> • Nil • \$1-\$100k • \$100k-\$1million • \$1m-\$5m • \$5m-\$10m • \$10m-\$20m • \$20m-\$50m • \$50m-\$100m • \$100m-\$200m • \$200m and over • Don't know
What presence does your business have in Te Tai Tokerau Northland?	<ul style="list-style-type: none"> • We have one office/site in the country, that's in Northland • We have multiple offices/sites that are all in Northland • We have multiple offices/sites in the country and multiple offices/sites Northland. • We have multiple offices/sites in the country and only one in Northland • Other (please specify)
What are the most significant challenges facing your business? Choose the three impacting you most	<ul style="list-style-type: none"> • Accessing skilled labour • High staff costs • High non-staff costs



Question	Options
	<ul style="list-style-type: none"> • Low revenue • High interest rates • Competition • Roading / Transport infrastructure • Technological disruption • Climate change • Regulation • Other
At the present time, is your business revenue (or gross turnover or sales) up or down on a year ago, or about the same?	<ul style="list-style-type: none"> • Don't know • Revenue Up • Revenue Down • Revenue about the same
And how do you expect your business revenue (or gross turnover or sales) in 12 months' time to compare with your business revenue at the present time?	<ul style="list-style-type: none"> • Don't know • Revenue will be Up • Revenue will be Down • Revenue will be about the same
Overall, how do you think upgrading to a high quality four-lane motorway and decreasing travel time would impact your business? Select all that apply	<ul style="list-style-type: none"> • Make doing business in Northland easier • Make other businesses more likely to invest in Northland • Motivate people to set up new businesses in Northland • Make it easier to attract talent to the region • Help businesses reduce costs • Help increase business revenue • Not applicable to my business
Auckland to Whangārei	
Does your business use SH1 between Auckland and Whangārei? (e.g. to get your products to customers, for deliveries from your suppliers or to do business in Auckland or further south)?	<ul style="list-style-type: none"> • Yes • No • Don't know
How much would your business costs change if SH1 between Auckland and Whangārei was upgraded to a high quality four-lane motorway and travel times decreased?	<ul style="list-style-type: none"> • Decrease in costs, but not sure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increase in costs, but not sure how much
How much would your business revenue change if this road was upgraded to a high quality four-lane motorway and travel times decreased?	<ul style="list-style-type: none"> • Decrease in revenue, but not sure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increase in revenue, but not sure how much
How would the number of staff your business employs change if this road was upgraded to a high quality four-lane motorway and travel times decreased?	<ul style="list-style-type: none"> • Decrease, but unsure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increase, but unsure how much



Question	Options
How much investment would you bring forward, if any, if this road was upgraded to a high quality four-lane motorway?	<ul style="list-style-type: none"> • None • \$1-\$100k • \$100k-\$1million • \$1m-\$5m • \$5m-\$10m • \$10m-\$20m • \$20m-\$50m • \$50m-\$100m • \$100m-\$200m • \$200m and over • Don't know
This road had several closures and diversions due to weather events in 2023. How have your business costs changed compared to 2022 due to closures or diversions on this road?	<ul style="list-style-type: none"> • Decrease in costs, but unsure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increase in costs, but unsure how much
How has your business's revenue changed compared to 2022 due to closures or diversions on this road?	<ul style="list-style-type: none"> • Decrease, but unsure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increased but unsure how much
How has the number of staff your business employs changed compared to 2022 due to closures or diversions on this road?	<ul style="list-style-type: none"> • Decreased, but unsure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increased, but unsure how much
How much investment have you delayed, if any, due to closures or diversions on this road?	<ul style="list-style-type: none"> • None • \$1-\$100k • \$100k-\$1million • \$1m-\$5m • \$5m-\$10m • \$10m-\$20m • \$20m-\$50m • \$50m-\$100m • \$100m-\$200m • \$200m and over • Don't know
Please provide any other comments about travel times or closures and diversions on this road have impacted your business (optional)	
Whangārei to Kaikohe	
Does your business use SH 1 from Whangārei to Kaikohe? (e.g.: to get your products to	<ul style="list-style-type: none"> • Yes • No



Question	Options
customers, supplier deliveries, or to do business)?	<ul style="list-style-type: none"> • Don't know
Does your business use SH1 from Whangārei to Kaikohe? (e.g.: to get your products to customers, supplier deliveries, or to do business)?	<ul style="list-style-type: none"> • Decrease in costs, but not sure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increase in costs, but not sure how much
How much would your business's costs change if SH 1 between Kaikohe & Whangārei was upgraded to a high quality four-lane motorway and travel times decreased?	<ul style="list-style-type: none"> • Decrease in revenue, but not sure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increase in revenue, but not sure how much
How much would your business's revenue change if this road was upgraded to a high quality four-lane motorway and travel times decreased?	<ul style="list-style-type: none"> • Decrease, but unsure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increase, but unsure how much
How would the number of staff your business employs change if this road was upgraded to a high quality four-lane motorway and travel times decreased?	<ul style="list-style-type: none"> • None • \$1-\$100k • \$100k-\$1million • \$1m-\$5m • \$5m-\$10m • \$10m-\$20m • \$20m-\$50m • \$50m-\$100m • \$100m-\$200m • \$200m and over • Don't know
How much investment would you bring forward, if any, if this road was upgraded to a high quality four-lane motorway?	<ul style="list-style-type: none"> • Decrease in costs, but unsure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increase in costs, but unsure how much
This road had several closures and diversions due to weather events in 2023. How have your business's costs changed compared to 2022 due to closures or diversions on this road?	<ul style="list-style-type: none"> • Decrease, but unsure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase



Question	Options
How has your business's revenue changed compared to 2022 due to closures or diversions on this road?	<ul style="list-style-type: none"> • Increased but unsure how much • Decreased, but unsure how much • More than 20% decrease • 5-20% decrease • Up to 5% decrease • No change • Up to 5% increase • 5-20% increase • More than 20% increase • Increased, but unsure how much
How has the number of staff your business employs changed compared to 2022 due to closures or diversions on this road?	<ul style="list-style-type: none"> • None • \$1-\$100k • \$100k-\$1million • \$1m-\$5m • \$5m-\$10m • \$10m-\$20m • \$20m-\$50m • \$50m-\$100m • \$100m-\$200m • \$200m and over • Don't know
How much investment have you delayed, if any, due to closures or diversions on this road?	<ul style="list-style-type: none"> • Yes • No • Don't know
Please provide any other comments about travel times or closures and diversions on this road have impacted your business (optional)	

Source: NZIER

