Warkworth to Wellsford

Construction Traffic Assessment

July 2019

QUALITY ASSURANCE

Prepared by

Jacobs GHD Joint Venture in association with Flow Transportation Specialists Ltd. Prepared subject to the terms of the Professional Services Contract between the Client and Jacobs GHD Joint Venture for the Route Protection and Consenting of the Warkworth to Wellsford Project.

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GLOSSARY OF ABBREVIATIONS

The table below sets out the technical abbreviations.

Abbreviation	Term
AADT	Average Annual Daily Traffic
AEE	Assessment of Effects on the Environment
CoPTTM	Code of Practice for Temporary Traffic Management
CTMP	Construction Traffic Management Plan
HCV	Heavy Commercial Vehicles
MfTCD	Manual for Traffic Control Devices
MOTSAM	Manual of Traffic Signs and Markings
OPW	Outline Plan of Works
P2T model	Pūhoi to Te Hana SATURN traffic model
PCU	Passenger car units
P-W	Ara Tūhono Pūhoi to Wellsford project
P-Wk	Pūhoi to Warkworth section of the P-W project
RCA	Road Controlling Authority
RMF	Rayonier Matariki Forest
SAP	Site access point
SATURN	Simulation and Assignment of Traffic to Urban Road Networks. A suite of flexible network analysis programmes developed at the Institute for Transport Studies, University of Leeds in the United Kingdom.
SH1	State highway 1
SIDRA	Signalised and Unsignalised Intersection Design and Research Aid (traffic modelling software for isolated intersections, or for small groups of intersections)
SSTMP	Site Specific Traffic Management Plan
TTM	Temporary Traffic Management
vpd	Vehicles per day
vph	Vehicles per hour
V/C	Volume/capacity

GLOSSARY OF DEFINED TERMS

The table below sets out the defined terms.

Term	Meaning
Application	The Notice of Requirement and applications for resource consent being lodged by the NZ Transport Agency for the Warkworth to Wellsford Project.
Contra-flow	Defined in CoPTTM as “Traffic flow in a direction opposite to the normal flow. For example, directing traffic into a lane that normally operates in the opposing direction.”
Heavy vehicle	A motor vehicle having a gross laden weight exceeding 3500 kg
Indicative Alignment	An indicative road design alignment assessed by the technical experts that may be refined on detailed design within the designation boundary. The Indicative Alignment is a preliminary alignment of a state highway that could be constructed within the proposed designation boundary. The Indicative Alignment has been prepared for assessment purposes, and to indicate what the final design of the Project may look like. The final alignment for the Project will be refined and confirmed at the detailed design stage.
Project	The Ara Tūhono Pūhoi to Wellsford Project: Warkworth to Wellsford section, which extends from Warkworth in the south, to the north of Te Hana.
Project area	The area within the proposed designation boundary, and immediate surrounds to the extent Project works extend beyond this boundary.
Proposed designation boundary	The boundary of the land to which the notice of requirement applies.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Overview of the Project

The NZ Transport Agency (Transport Agency) is lodging a Notice of Requirement (NoR) and applications for resource consent (collectively referred to as “the Application”) for the Warkworth to Wellsford Project (the Project).

This report is part of a suite of technical assessments prepared to inform the Assessment of Effects on the Environment (AEE) and to support the Application. This assessment report addresses the actual and potential construction traffic effects arising from the Project. The assessment considers the effects of an Indicative Alignment and other potential effects that could occur if that alignment shifts within the proposed designation boundary when the design is finalised in the future.

1.2 Project description

The Project involves the construction, operation and maintenance of a new four lane state highway. The route is approximately 26 km long. The Project commences at the interface with the Pūhoi to Warkworth project (P-Wk) near Woodcocks Road. It passes to the west of the existing State Highway 1 (SH1) alignment near The Dome, before crossing SH1 just south of the Hōteo River. North of the Hōteo River the Project passes to the east of Wellsford and Te Hana, bypassing these centres. The Project ties into the existing SH1 to the north of Te Hana near Maeneene Road.

The key components of the Project, based on the Indicative Alignment, are as follows:

a) A new four lane dual carriageway state highway, offline from the existing State Highway 1, with the potential for crawler lanes on the steeper grades.

b) Three interchanges as follows:

    i. Warkworth Interchange, to tie-in with the Pūhoi to Warkworth section of the State Highway and provide a connection to the northern outskirts of Warkworth.

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

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

c) Twin bore tunnels under Kraack Road, each serving one direction, which are approximately 850 metres long and approximately 180 metres below ground level at the deepest point.

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

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

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

g) Changes to local roads:

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

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

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

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

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

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

a) Hōteo South: From the southern extent of the Project at Warkworth to the Hōteo River.

b) Hōteo North: Hōteo River to the northern tie in with existing SH1 near Maeneene Road.

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

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

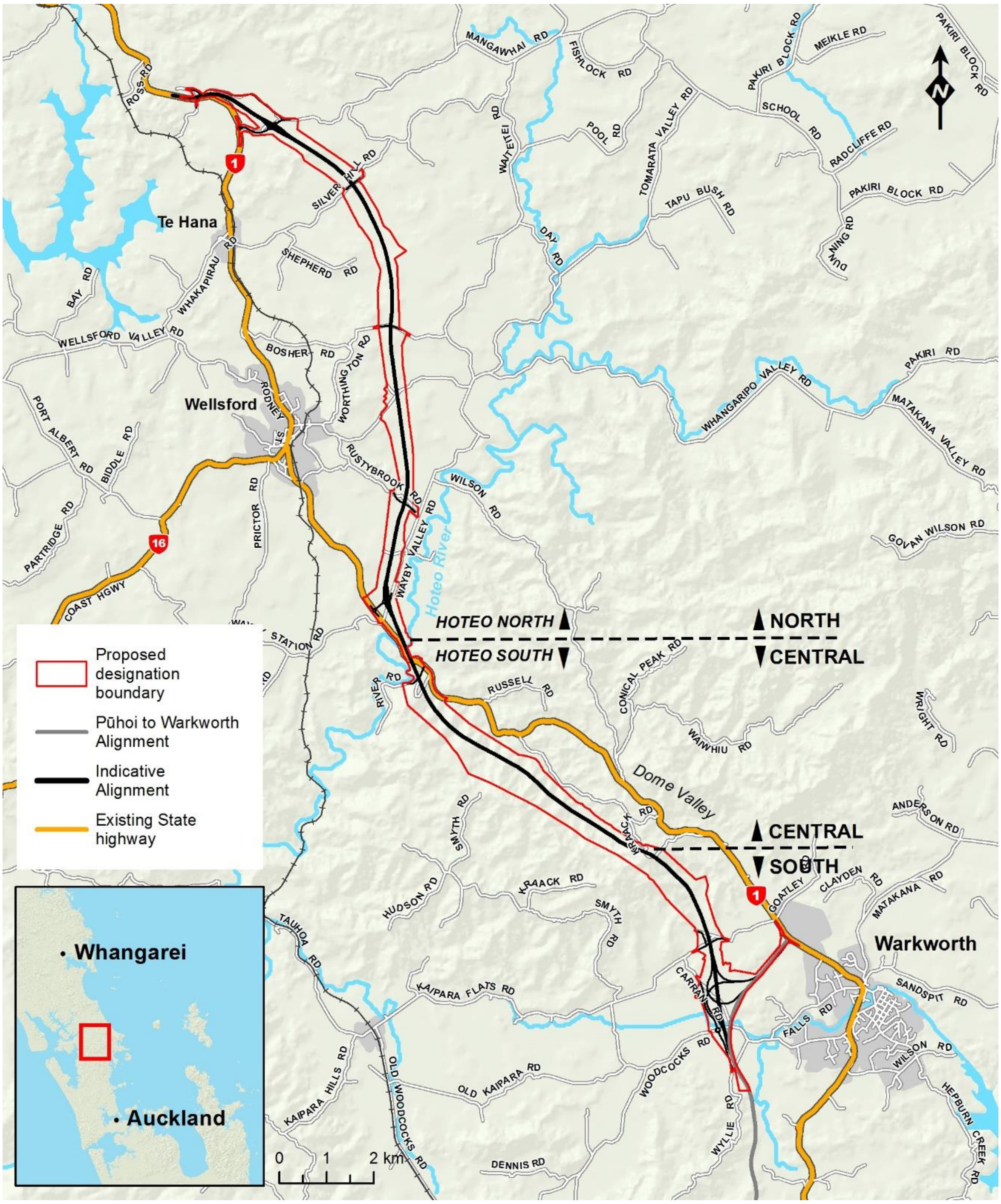

Figure 1 – Project Area

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

A full description of the Project including its design, construction and operation is provided in Section 4: Description of the Project and Section 5: Construction and Operation of the AEE contained in Volume 1 and shown on the Drawings in Volume 3.

1.3 Purpose and scope of this report

The purpose of this report is to inform the Assessment of Effects on the Environment (AEE) and to support the Application.

This report presents the results of an assessment of the potential transport effects of construction and temporary traffic management associated with the Project.

The Indicative Alignment shown on the Project drawings has been developed through a series of multi-disciplinary specialist studies and refinement. A scheme assessment phase was completed in 2016, and further design development has occurred throughout the AEE assessment process for the Project in response to a range of construction and environmental considerations.

The final alignment for the Project will be refined and confirmed at the detailed design stage. This assessment has addressed the actual and potential effects arising from traffic generated to construct the Indicative Alignment. We consider that our assessment is representative of construction of any similar project within the designation boundary and alignment design that would achieve the Transport Agency's Project objectives. The assessment is based on the best information available at the time of its undertaking and is as thorough as is practicable given how far in the future construction will occur. Therefore, it is recommended that an updated assessment of construction traffic management requirements should be undertaken closer to the time of construction, as changes to the surrounding transport network could occur between the time of this report and the assumed construction start date of 2030. This updated assessment could be carried out as part of the Construction Traffic Management Plan (CTMP) process, which is used to manage effects in accordance with this assessment.

The report is set out as follows:

- Section 2 gives an introduction to the framework for temporary traffic management that will be applied.
- Section 3 presents the methodology used to carry out the assessment, including information about the transport modelling upon which the assessment is based.
- Section 4 considers temporary traffic management effects.
- Section 5 considers the construction traffic effects.
- Section 6 considers effects on public transport.
- Section 7 considers effects on pedestrians and cyclists.
- Section 8 provides recommendations.
- Section 9 provides conclusions.

2 TEMPORARY TRAFFIC MANAGEMENT PRINCIPLES

Temporary traffic management principles summary

The requirements for Temporary Traffic Management (TTM) are regulated through the Land Transport Act 1998 and the Land Transport Rules made pursuant to that Act.

The primary standard that will be adhered to in planning, coordinating and implementing TTM for this Project is the Code of Practice for Temporary Traffic Management (CoPTTM).

We recommend the development of a Construction Traffic Management Plan (CTMP), and Site Specific Traffic Management Plans (SSTMP) for each location where the Project construction impacts existing traffic. These plans should be in accordance with CoPTTM to minimise disruption caused by construction traffic to the extent practicable.

2.1 Framework for temporary traffic management

Temporary Traffic Management (TTM) is regulated through the Land Transport Act 1998 and the Land Transport Rules made pursuant to that Act. The Rules that relate to TTM include:

- Land Transport (Road User) Rules 2004;
- Land Transport Rule: Traffic Control Devices 2004; and
- Land Transport Rule: Setting of Speed Limits 2017.

TTM is defined in the Code of Practice for Temporary Traffic Management (CoPTTM) as “The process of managing road users through or past a closure in a safe manner with minimal delay and inconvenience.” In this context, “closure” refers to any part of the road from which traffic is excluded for road works, including a lane or the shoulder. TTM includes measures such as temporary diversions, contra-flow lanes[1], traffic signals, and full road closures.

The Transport Agency Manual for Traffic Control Devices (MfTCD) provides guidance on industry good practice for TTM, including practice mandated by the Rules in relation to the use of traffic control devices. The part of the MfTCD which applies to planning, coordinating and implementing TTM is CoPTTM. CoPTTM will be the primary standard for TTM for this Project.

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[1] See glossary for explanation.

2.2 The Transport Agency's traffic management process

As part of its standard process for the construction of large roading projects, the Transport Agency requires Construction Traffic Management Plans (CTMP) to set out how the Project as a whole will be delivered, and which processes and standards need to be followed.

A CTMP typically incorporates objectives such as those below for the delivery of TTM during the construction of a project:

- TTM is to fully comply with CoPTTM wherever practicable. Non-compliance must be authorised by an Engineering Exception Decision[2] signed off by the Transport Agency's implementation team delivering the Project and the relevant RCA(s) and incorporated into the SSTMP;
- Focus on current best industry standards with regard to TTM and safety;
- Minimise disruption on State highways and local roads wherever practicable;
- Maintain existing flows and travel times on State highways and local roads adjacent to the work site where practicable;
- Minimise the impact of works on pedestrians and cyclists wherever practicable;
- Minimise the effects of construction traffic on local roads used for access wherever practicable;
- Minimise the impact of construction parking wherever practicable;
- Develop SSTMPs that consider key stakeholders (mainly local residents and the local RCAs, but also the wider travelling public);
- Ensure that a SSTMP is approved at least five days before it is implemented. The approval process should be carried out in conjunction with the applicable RCA and the Transport Agency;
- Provide effective communication to affected parties and the travelling public; and
- Implement TTM that provides stakeholders with functional and clear travel directions through roadwork sites.

In addition to the CTMP, which would cover the entire Project, Site Specific Traffic Management Plans (SSTMP) are produced for specific activities or locations, taking into account conditions at the specific location of the site. They cover all aspects of TTM, including setup, removal, timing, and maintenance. The plan details how road users will be directed around the site safely and with a minimum of disruption to users and workers.[3]

In order to be approved by the Road Controlling Authority (RCA), CTMPs and SSTMPs must plan in accordance with CoPTTM (including any RCA-specific procedures) to demonstrate that construction traffic effects on the transport network will be minimised to the extent

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[2] Submitted by the principal and approved by the RCA following consideration of all factors, including the safety of all concerned, to vary a code of practice(s), standard(s) and/or guideline(s), to suit a particular situation. The decision must be included with the TMP.

[3] NZ Transport Agency. February 2017. Traffic Control Devices Manual Part 8: Code of practice for temporary traffic management (CoPTTM). Section A7.3.1.

practicable and that TTM will be carried out safely. CTMPs and SSTMPs must be designed by a qualified traffic management provider.

Typically, the objectives set out above can be achieved through implementing the CTMP and associated SSTMPs. This approach ensures the overall effects of construction traffic are minimised as much as possible to an acceptable level. We consider these objectives are appropriate for this Project and recommend they be applied when developing a CTMP for the Project.

3 METHODOLOGY FOR ASSESSMENT

Assessment methodology summary

We have assessed the preliminary construction methodology for the Project in two parts:

- The effects of temporary traffic management measures and mitigation; and
- The effect of construction traffic moving through the transport network.

We assessed the effect of general traffic management activities by considering the likely construction traffic resulting from construction activities and associated TTM requirements on the existing network. We undertook a qualitative assessment to determine the likely level of impact from the activities based on our experience and understanding of capacity reductions and delays caused by such traffic management.

We have assessed the effects of construction traffic on the existing road network by:

- identifying the approximate number of additional vehicles that will travel on the existing road network during construction;
- analysing the forecast traffic volumes for 2036 (from the Pūhoi to Te Hana SATURN[4] traffic model (P2T model)) to assess whether there will be sufficient capacity to accommodate the expected heavy construction traffic; and
- identifying the intersections where there may not be sufficient capacity; for these intersections modelling has been carried out to estimate the impacts and inform the recommended mitigation discussed later in this report.

We have referred to the crash analysis performed for the Operational Transport Assessment to identity areas of safety concern along the indicative haul routes

The indicative construction methodology and programme are described in Section 5 of the AEE. The construction duration is expected to be approximately seven years. While this assessment relies on this indicative methodology, the final methodology may differ. Therefore, our assessment considers appropriate management for any construction methodology within the proposed designation boundary.

We have assessed the indicative construction methodology for the Project in two parts:

- The effects of temporary traffic management measures and mitigation; and
- The effect of construction traffic moving through the transport network.

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[4] SATURN (Simulation and Assignment of Traffic to Urban Road Networks) is a suite of flexible network analysis programmes developed at the Institute for Transport Studies, University of Leeds in the United Kingdom.

3.1 Transport modelling

Much of the assessment of operational transport effects is based on the outputs of the Pūhoi to Te Hana (P2T) model, which was developed by Jacobs for the road network from Pūhoi to Te Hana, including the townships of Warkworth and Wellsford. More detail about the model can be found in the Operational Transport Assessment. Three modelled time periods are used for this assessment:

- Weekday morning peak hour (8:00 am to 9:00 am);
- Weekday interpeak (12:00 pm to 1:00 pm); and
- Weekday evening peak hour (4:30 pm to 5:30 pm).

This assessment used the year 2036 forecast model to output future demands on SH1 and local roads impacted by the construction traffic. Construction is programmed to begin in 2030 and will take place over approximately 7 years. Forecast models are available for 2026 and 2036. We consider taking a conservative approach that 2036 will enable a reasonable worst-case scenario to be assessed, since traffic on the network is assumed to increase each year.

There are a number of infrastructure projects at various stages of planning that may be constructed in the vicinity of Warkworth and open by 2036. However, for this assessment, only committed projects were included in the model. The committed projects included are the Pūhoi to Warkworth Project (P-Wk) and the Matakana link road.[5] This assumption differs from the Operational Transport Assessment report because the construction traffic assessment has an earlier time frame, and we were less comfortable assuming that planned projects would be constructed by the start of Project construction. However, including committed projects only is also a conservative assumption, since there would be less road capacity to accommodate construction traffic in addition to general traffic. In particular, the Western Collector[6] (if completed) could reduce adverse effects of construction traffic, as it would create an alternative connection between the southern quarry and the southern part of the Project, including the likely location of the main Project office.

If the planned (but not committed) projects are in place, less traffic is expected to travel along Matakana Road, Hudson Road, Kaipara Flats Road, and northbound on the existing SH1 south of the Western Collector. While these roads are forecast to be congested in the 2036 model, the planned projects are predicted to lead to significant decreases in delays on these roads, due to the provision of additional infrastructure. The assumption to exclude the planned projects from the P2T model used for this assessment is an important conservative assumption, as Hudson Road, Kaipara Flats Road and SH1 are all part of the indicative haul routes for construction traffic related to the southern section of the Project. A sensitivity test has been undertaken to assess how the effects of construction traffic would differ if all planned projects are constructed in Warkworth. This test is presented in Section 5.5. If these projects are constructed, construction plans would need to be carefully scheduled and coordinated to minimise their impacts on each other.

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[5] See the Operational Transport Assessment for more detail on committed and planned projects.

[6] The Western Collector is a proposed local access road, which will provide a transport connection for proposed developments to the west of the existing SH1. The Western Collector will run roughly parallel to SH1 through the western side of Warkworth, between McKinney Road in the south and Hudson Road in the north. Stage 1 of the Western Collector, connecting Mansel Drive to Falls Road, was completed in March 2016.

We note that development of the Indicative Alignment has been informed by consultation with Rayonier Matariki Forest (RMF), so that their operational requirements during future forest harvesting have been taken into account. Data for the next rotation of forest harvesting was obtained from RMF so that we could consider the projected forest truck movements that may coincide with the Project construction.

3.2 Temporary traffic management effects and mitigation

We assessed the effect of general traffic management activities by considering the likely construction activities and associated TTM activities on the existing network. We then undertook a qualitative assessment to determine the likely level of impact from the activities based on our experience and understanding of capacity reductions and delays caused by temporary traffic management activities. We also identify the types of TTM measures that may be used to ensure that the effects of the Project construction activities on traffic are minimised as far as practicable. This test is in accordance with CoPTTM, which states that one of a contractor's responsibilities is "ensuring, so far as reasonably practicable, the safe and efficient movement of all road users through and around the working space."[7]

The TTM effects and mitigation assessment is presented in Section 4 of this Report.

3.3 Effects of construction traffic movements and mitigation

As part of the preliminary construction methodology, the Project team estimated traffic volumes travelling between each construction site and off-site locations. These estimated volumes were developed by the Project team based on the number of staff required at each site and the volume of construction equipment and materials likely to be required to construct the Project.

Section 5 of the AEE identifies the potential haulage routes that could be used to take fill and pavement aggregate from quarries to work locations along the Project. Maps of these routes are included in Appendix A. To assess the impact of construction traffic on the network, the following methodology was used:

- Based on the estimates of haulage requirements and routes, we identified the approximate number of additional vehicles that will travel on the existing road network during construction.

- We compared the forecast traffic volumes for 2036[8] to the capacities of the potentially impacted road segments and turning movements to assess whether the residual capacity would be enough to accommodate the increased traffic.

- In places where the residual capacity is predicted to be low compared to the additional demand, mitigation measures are recommended.

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[7] NZ Transport Agency. February 2017. Traffic Control Devices Manual Part 8: Code of practice for temporary traffic management (CoPTTM). Section A5.7.1, p. 22.

[8] The reason for using 2036 forecast traffic volume, when construction is expected to start in 2030, is explained in section 3.1)

- The southern section of the route, which includes Warkworth and uses the existing SH1 as a potential haulage route, is the area where construction traffic has the most potential to have adverse impacts on the existing road network. For this section, SIDRA intersection[9] analysis has been carried out to model the impacts of construction traffic at the intersections of the existing SH1/Hudson Road and the existing SH1/future Matakana link road and inform the recommended mitigation measures. In our assessment, these are the only intersections that may potentially be negatively impacted by construction traffic for the Project.

- We performed a sensitivity test to assess whether the effects of construction traffic would remain the same if the transport network is further developed to include all of the road projects planned for Warkworth (these projects are described in detail in the Operational Transport Assessment.)

The crash analysis performed for the Operational Transport Assessment was examined to find areas of safety concern along the indicative haul routes (see Appendix A), including consideration of programmed safety improvements. Results of this assessment are reported in Section 5 of this report.

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[9] SIDRA Intersection is an advanced micro-analytical traffic evaluation tool that simulates traffic conditions at intersections.

4 EFFECTS AND MITIGATION ASSESSMENT FOR TEMPORARY TRAFFIC MANAGEMENT

Effects and mitigation assessment summary

Temporary traffic management (TTM) is likely to be required at locations where construction activities may impede the flow of existing traffic. Existing traffic may be affected where there are interchanges and tie-ins, realignments, locations where the Project will pass over or under existing roads, and site access points (SAPs) where construction traffic enters and exits the construction sites.

The Project connects to the existing network at the following locations:

- Warkworth Interchange/Southern tie-in;
- Wellsford Interchange; and
- Te Hana Interchange and Northern tie-in.

At these locations, construction works will need to be carefully managed through the use of such measures as temporary roads, contra-flow, barriers, and temporary signals. SSTMPs will be required for these locations to ensure that TTM is carried out in accordance with CoPTTM and that traffic impacts are minimised as far as practicable.

The construction of the Indicative Alignment results in the modification of thirteen local roads and one crossing of the existing SH1. Of the local roads that intersect with the Project, four are proposed to be realigned to avoid crossing the State Highway (Carran Road, Phillips Road, Wyllie Road, and Vipond Road), while nine are proposed to pass over or under the Project. Some of the latter require realignment as well. To ensure continued local access along these roads is maintained during the construction of the Project, we recommend that realignment of local roads be undertaken prior to the severance of the original connections.

For each of these locations, we recommend that a SSTMP be prepared and include a plan for TTM in accordance with the standards in CoPTTM. This approach will ensure that the impacts on traffic are assessed and mitigated to minimise the traffic impacts as much as practicable.

SAPs should be chosen in locations that allow for easy access without impeding on normal traffic flows. Any proposed SAP locations should require SSTMPs that consider the available capacity, the need for temporary capacity to be added, the ease of adding and maintaining the access and any temporary infrastructure, potential restrictions on construction vehicle turning movements, such as left in left out, sight distance, and proximity to quarries.

If the standard procedures as set out in CoPTTM are followed for selecting and implementing SAPs, we expect that they can be implemented with no more than a minor impact on existing traffic.

Overall, with the mitigation measures recommended in this section in place, we consider that the effects of TTM can be appropriately managed.

This section assesses the impacts of managing general traffic on the network while the Project is constructed. The impact of traffic generated by the construction of the Project is assessed in section 5. Temporary traffic management (TTM) is likely to be required at locations where construction activities will impede the flow of existing traffic. Existing traffic will be affected where there are interchanges and tie-ins, realignments, locations where the Project will pass over or under existing roads, and site access points where construction traffic enters and exits the construction sites. The construction methodology presented in Section 5 of the AEE suggests potential TTM strategies for each location where TTM would be required. However, the methodology is indicative, and the actual TTM used will be determined in SSTMPs closer to the time of construction. SSTMPs should be prepared and approved by the RCA(s) before works begin. The key locations where TTM measures are likely to be required for the Project, and where TTM measures have the potential to affect operating conditions on the existing road network, are shown in Figure 2 and Figure 3 below. TTM measures would also be needed at site access points (SAPs), but we assume that SAP locations will be chosen so that they do not impede on the existing road.

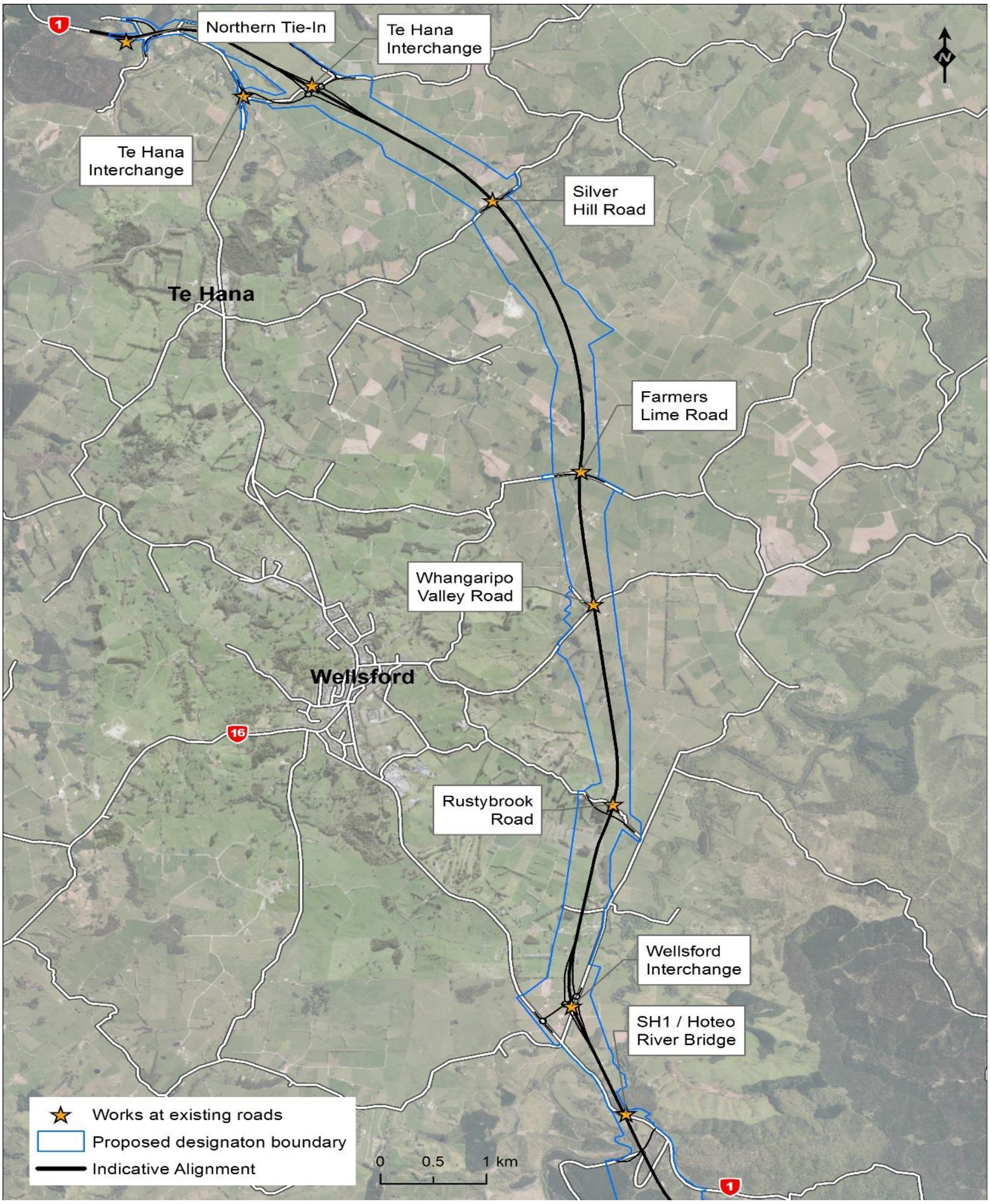

Figure 2 – Locations where TTM could impact traffic, north

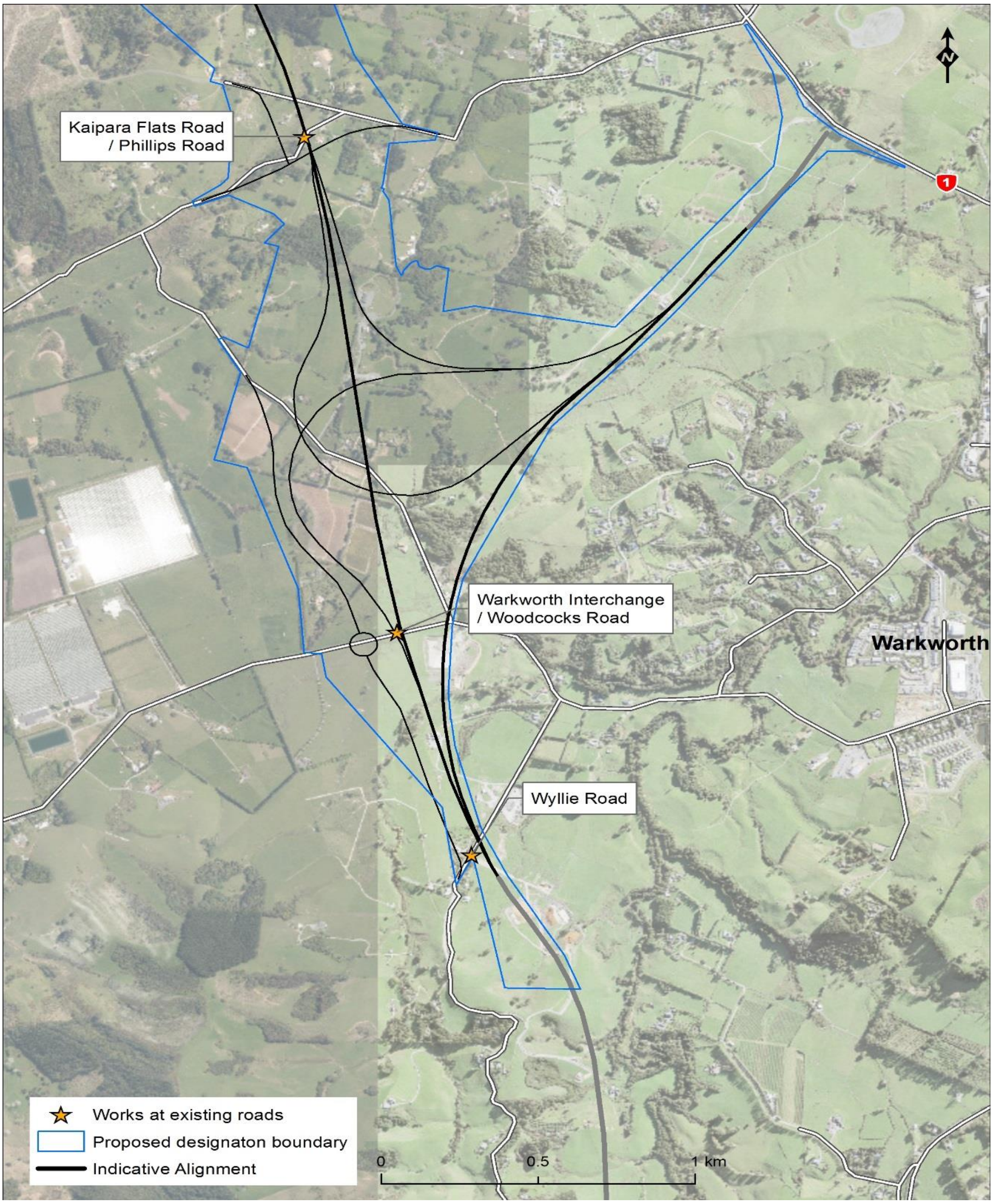

Figure 3 – Locations where TTM could impact traffic, south

The following sections describe the works in the vicinity of the existing roads and identify the types of TTM measures that may be used to ensure that the effects of the Project construction activities on traffic are minimised as far as practicable.

The final TTM plans will be developed as part of the CTMP process closer to the time of construction.

4.1 Project connections

4.1.1 Warkworth Interchange/Southern tie-in

The construction activity in this area consists of connecting the Project into the Pūhoi to Warkworth project (future SH1). The tie-in works are expected to be constructed under a shoulder closure. The integration with the existing alignment of the Pūhoi to Warkworth project will need to be carefully managed through the use of temporary road construction, and may need to temporarily reduce the road capacity through contra-flow measures. We anticipate the effects will be mitigated appropriately through the use of a SSTMP.

4.1.2 Wellsford Interchange

The proposed Wellsford Interchange is to be located at Wayby Valley Road. In the indicative design, Wayby Valley Road will be realigned to meet the existing SH1 at a roundabout north of the original intersection. In the indicative construction methodology contained in Section 5 of the AEE, it is proposed that the eastern ramps be constructed to provide access to the Project alignment for hauling purposes. Until the bridge is constructed, hauling using the Project alignment would cross Wayby Valley Road at grade. TTM, such as barriers and traffic signals, would be needed to control traffic at the crossing while the eastern ramps are being constructed. Earthworks for the new Wayby Valley Road, bridge, and approach could all be constructed off-line. Once the realignment of Wayby Valley Road is complete, local road traffic will be able to be moved onto the new Wayby Valley Road, and construction traffic will be able to go over the bridge. A SSTMP will be required to ensure that traffic impacts are minimised as far as practicable.

4.1.3 Te Hana Interchange and Northern tie-in

At Mangawhai Road, the proposed Te Hana Interchange is expected to consist of a bridge and two roundabouts. The intersection of the existing SH1/Mangawhai Road is also planned to be converted to a roundabout. As described in Section 5 of the AEE, the realignment, new roundabouts, and bridge can potentially be constructed off-line with minimal conflict with the traffic on local roads. While this construction is taking place, construction traffic would need to cross Mangawhai Road under temporary traffic controls. Tie-ins with the existing SH1 may be carried out under live traffic conditions, with stop/go TTM, with one-lane traffic at times. The works may require temporary widening, and are likely to require contra-flow lanes[10] due to traffic volumes. Closures should be carried out at times of lowest traffic, at night if practicable. Details of the type and timing of TTM will need to be addressed in the SSTMP.

4.2 Local roads

The construction of the Indicative Alignment results in the modification of thirteen local roads and one crossing of the existing SH1. Of the local roads that intersect with the Project, four are proposed to be realigned to avoid crossing the State Highway (Carran Road, Phillips Road, Wyllie Road, and Vipond Road), while nine are proposed to pass over or under the Project. Some of the latter require realignment as well. These modifications are described in more detail below.

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[10] See glossary for explanation.

To ensure continued local access along these roads is maintained during the construction of the Project, we recommend that realignment of local roads be undertaken prior to the severance of the original connections.

Woodcocks Road / Carran Road

Indicative construction activities in this area relate to the construction of the bridge embankments and bridge structure crossing Woodcocks Road. The indicative construction methodology proposes that this construction work would largely occur off-line. However, some works may require operations in or over existing traffic lanes, such as the installation of bridge beams. To facilitate these works, night closures of Woodcocks Road may be required for short durations.

The indicative construction methodology identifies two plausible alternatives for managing traffic during works on Woodcocks Road and Carran Road.

One option is as follows:

- Construct a temporary haul road at the base of the proposed eastern fills to provide passage for construction traffic crossing Woodcocks Road at grade, with TTM controls such as barriers and traffic signals.
- Construct new bridge and local roadworks under live traffic with one lane closure under traffic signals or stop/go.
- Once the bridge is complete, construction traffic can use it to pass over Woodcocks Road. Short term closures of Woodcocks Road should be scheduled to occur at night or during other periods of low demand, with cessation of works if delays are excessive.

An alternative option is to close Woodcocks Road within the extents of construction to allow uninhibited haulage across Woodcocks Road (no temporary signals or stop/go operation required). Traffic would require bypassing around the closed portion of Woodcocks Rd using the existing local road network, likely via the realigned Carran Road and Kaipara Flats Road.

Carran Road is proposed to be realigned to connect to Woodcocks Road west of the Indicative Alignment at a roundabout. The new Carran Road alignment can be constructed off-line, so TTM may not be necessary until traffic is diverted onto the new alignment.

Both Woodcocks Road and Carran Road are currently signed as access routes to SH16 for use when SH1 is either closed or congested during holiday periods. The SSTMP for this section should specifically include plans to accommodate these situations.

Given that traffic on that part of Woodcocks Road is forecast to roughly double by 2036, the potential temporary closure of Woodcocks Road would need to be carefully managed to mitigate traffic impacts on detour routes, including Carran Road.

Wyllie Road

Wyllie Road is proposed to be realigned to accommodate the new northbound off ramp, to avoid the need for crossing the Project. The new alignment can be constructed off line, with traffic diverted to the new alignment once it is complete.

Kaipara Flats Road

Indicative construction activities in this area relate to the construction of the bridge embankments and bridge structure to enable Kaipara Flats Road to cross over the Project. Although the bridge can potentially be built off-line, an at-grade construction crossing may be required across Kaipara Flats Road. To facilitate the crossing, temporary traffic signals may need to be implemented. In the Indicative Alignment, Kaipara Flats Road is proposed to be realigned, which can potentially be done off-line. Traffic on Kaipara Flats Road is forecast to increase significantly by 2036. A detour is available if necessary via Carran and Woodcocks Roads and the existing SH1, but any detouring would need to be carefully managed to mitigate traffic impacts on those roads and co-ordinated with any works on these other roads so that there isn't an accumulation of effects.

Phillips Road

Phillips Road is proposed to be realigned to connect to Kaipara Flats Road west of the Project, to avoid crossing the Project. The realignment is proposed to be constructed with a temporary tie-in to the existing Kaipara Flats Road. Traffic may be diverted temporarily along the existing Kaipara Flats Road.

Forestry Roads

River Road, Dibble Road, and other forestry roads within the Dome Valley may be impacted by the construction works. Some of these private roads have been identified as potential haulage routes for construction materials. These roads are privately owned by a forestry company. As noted in Section 3.1, the operational needs of RMF have been taken into account in the development of the Indicative Alignment. Similarly, road closures or diversions should be carried out in conjunction with the operational requirements of forestry managers, and with appropriate safety measures in alignment with CoPTTM. We have assessed site access for the forest harvest operations (refer Section 5.4 and Appendix C).

SH1 / Hōteo River Viaduct

Indicative construction activities in this area relate to the construction of twin viaducts and embankments to enable the Project to cross over the Hōteo River and existing SH1 on a viaduct.

The indicative construction methodology recommends constructing one carriageway first to provide a construction overpass over the existing SH1, the river, and the surrounding bush. Alternatively, a temporary bridge could be constructed. We expect that either option for these works will not impede traffic on the existing SH1, with the exception of brief closures of SH1 while the viaduct structure is put in place. These closures could be done at night, allowing openings for interim clearance of traffic (if feasible and done safely), and will be carried out in accordance with CoPTTM to ensure that it is done safely and with the least impact on traffic practicable.

Whangaripo Valley Road

As Whangaripo Valley Road is not being realigned, the bridge could potentially be constructed on-line with live traffic – under TTM such as narrow lanes, one lane closures, and stop/go. The indicative construction methodology suggests a temporary diversion be put in place under TTM, if it is not possible to temporarily close the local road. Any TTM put in place will be carried out in accordance with CoPTTM to ensure that it is done safely and with minimal impact on traffic practicable.

Other Local Roads

Construction works are proposed to occur on a number of other local roads. We recommend that the SSTMPs for these locations put plans in place to maintain access to properties on these roads through measures such as temporary diversions within the proposed designation boundary. These roads are:

- Rustybrook Road;
- Worthington / Farmers Lime Road;
- Silverhill Road;
- Vipond Road;
- Maeneene Road; and
- Waimanu Road.

Table 1 shows the 2036 forecast AADT on key roads affected by the Project that have the potential for TTM impacts as discussed above, including potential for closures. Roads that do not appear in this table are minor roads that mainly serve a small number of properties, and are less likely to have closures, as diversions can be put in place. These other roads are each forecast to have AADT of less than 1,000 vpd in 2036. AADT is used to determine the level of TTM required for the road by CoPTTM standards.

Table 1 – 2036 AADT on key roads that may be impacted by TTM

Location	2036 AADT
Wayby Valley Road	700
Woodcocks Road	5,000
Kaipara Flats Road	3,600
SH1 south of Wayby Valley Road	23,400
Whangaripo Valley Road	1,600
SH1 north of Maeneene Road	17,000

4.3 Site access points

Site access points (SAPs) are locations where construction traffic leaves the existing road network and enters the site, and vice versa. The indicative haul routes shown in Appendix A imply SAPs wherever the haul route departs from the existing network, but these locations are not necessarily where SAPs will be located. SAP locations should be chosen in locations that allow for easy access without impeding on normal traffic flows.

Any proposed SAP locations should require SSTMPs that consider the following:

- The available capacity for construction vehicles to queue if they need to wait to enter the site (for example, to wait for a gate to be opened);
- The need for temporary capacity to be added at the approach to the SAP (for example, a gravel turning lane) and whether space is available at the roadside to construct this temporary capacity;
- The ease of maintaining the access and any temporary infrastructure;
- Potential restrictions on construction vehicle turning movements, such as left in left out;
- Sight distance; and
- Proximity to quarries, in view of minimising the amount of distance construction vehicles need to travel on existing roads.

Site access points in Matariki Rayonier Forest will require coordination with forest owners, as forest harvesting may also require use of those access points.

Proposed SAPs can be excluded from the final CTMP if they do not meet acceptable criteria for safety and minimising traffic impacts. If the standard procedures as set out in CoPTTM are followed for selecting and implementing SAPs, we expect that they can be implemented with no more than a minor impact on existing traffic.

4.4 Over dimension haulage

Over dimension haulage will be necessary for the construction of the Project. We recommend over dimension haulage be carefully assessed in conjunction with the RCA to make sure the resulting impacts are minimised as far as practicable. As an example, we recommend rolling closures be undertaken at night.

4.5 Summary

We recommend that for any Project construction works that will impact traffic on existing roads, a SSTMP be prepared that will include a plan for TTM in accordance with the standards in CoPTTM. This approach will ensure that the impacts on traffic are managed appropriately and mitigated as far as practicable. The management requirements will vary depending upon the location, the traffic conditions at the time of construction, and the methodology and staging proposed by the contractor. It is essential that an in-depth analysis be undertaken closer to the time of construction as part of the recommended updated construction traffic assessment.

With the above recommended mitigation measures in place we consider that the TTM effects can be appropriately managed.

5 EFFECTS AND MITIGATION ASSESSMENT FOR CONSTRUCTION TRAFFIC MOVEMENTS

Effects and mitigation assessment summary

This section identifies the proposed construction haul routes and construction traffic volumes that would be likely to use these routes. Our assessment is based on the preliminary construction methodology outlined in the AEE and the assessment of 2036 traffic volumes. The assessment relies on recommended haul routes and estimated construction vehicle volumes from the preliminary construction methodology, but these are only indicative. An updated assessment of construction traffic management requirements should be undertaken closer to the time of construction, once a final construction methodology has been determined.

We expect that the majority of light vehicles required for the Project will come from Auckland or Warkworth. As the model indicates that the existing SH1 through Warkworth and south of the P-Wk / SH1 roundabout (currently under construction) will be congested during peak hours, there is a potential for additional delays and queuing on the existing SH1 if light construction vehicles use this route. It is recommended that light vehicles use alternate routes to reach the site compounds, during peak hours, if possible. We recommend that the contractor put travel plans in place to minimise potential impacts of staff travelling to and from the site.

Heavy vehicles will use haul routes to transport fill and pavement aggregate between local quarries and construction sites. These routes use both haul roads within the construction footprint and existing roads. Most locations where indicative haul routes use existing roads are expected to have sufficient capacity to allow hauling without impacting the operation of traffic. The exception is on SH1 between Hudson Road and the roundabout where P-Wk connects with the existing SH1. The model indicates that this location will be the most congested area that will be impacted by construction traffic. The congestion (during a “normal” week) is expected to be worst during the weekday evening peak.

To reduce the impacts of haulage in this section, the following measures are recommended:

- Trucks hauling from south easterly locations (such as the Matakana Quarry) to the southern section of the Project should turn right out of the future Matakana link road onto the existing SH1 at the SH1/Matakana link road intersection, where there will be traffic signals. The route should be a loop with a left turn from Kaipara Flats Road. The return would use Woodcocks Road, Mansell Road, Falls Road and Hudson Road, with a right turn back onto Matakana link road from the existing SH1 at the traffic signals. This route will avoid opposed right turns at priority intersections. It will also avoid Mahurangi College.

- Haulage trips should not be made during the evening peak hours of 4 pm to 6 pm to avoid the most congested time for SH1 through Warkworth.

We recommend that a thorough assessment of construction traffic effects, including consideration of seasonal variation in traffic flows and conditions, should be carried out when the contractor is finalising the construction methodology. By carrying out this assessment and incorporating the results into a CTMP, we expect that the effects of the construction traffic on the future road network can be mitigated to an acceptable level. The proposed mitigation measures should be checked by monitoring travel times on the existing SH1 and making sure they do not exceed a level of delay agreed with the RCAs. Effects can also be mitigated by maintaining communications with residents via measures such as mail drops, email messages, variable message signs, social media, and radio announcements to make road users aware of planned works. Road users who are aware of upcoming works can mitigate impacts by changing their route choice or time of travel if possible.

The indicative construction methodology in Section 5 of the AEE divides the Project area into three sections as shown in Figure 4:

- southern section: southern tie-in with SH1 to northern tunnel portal
- central section: northern tunnel portal to Bridge 11 (Hōteo Viaduct) spanning the Hōteo River
- northern section: Bridge 11 (Hōteo Viaduct) spanning the Hōteo River to northern tie-in to SH1.

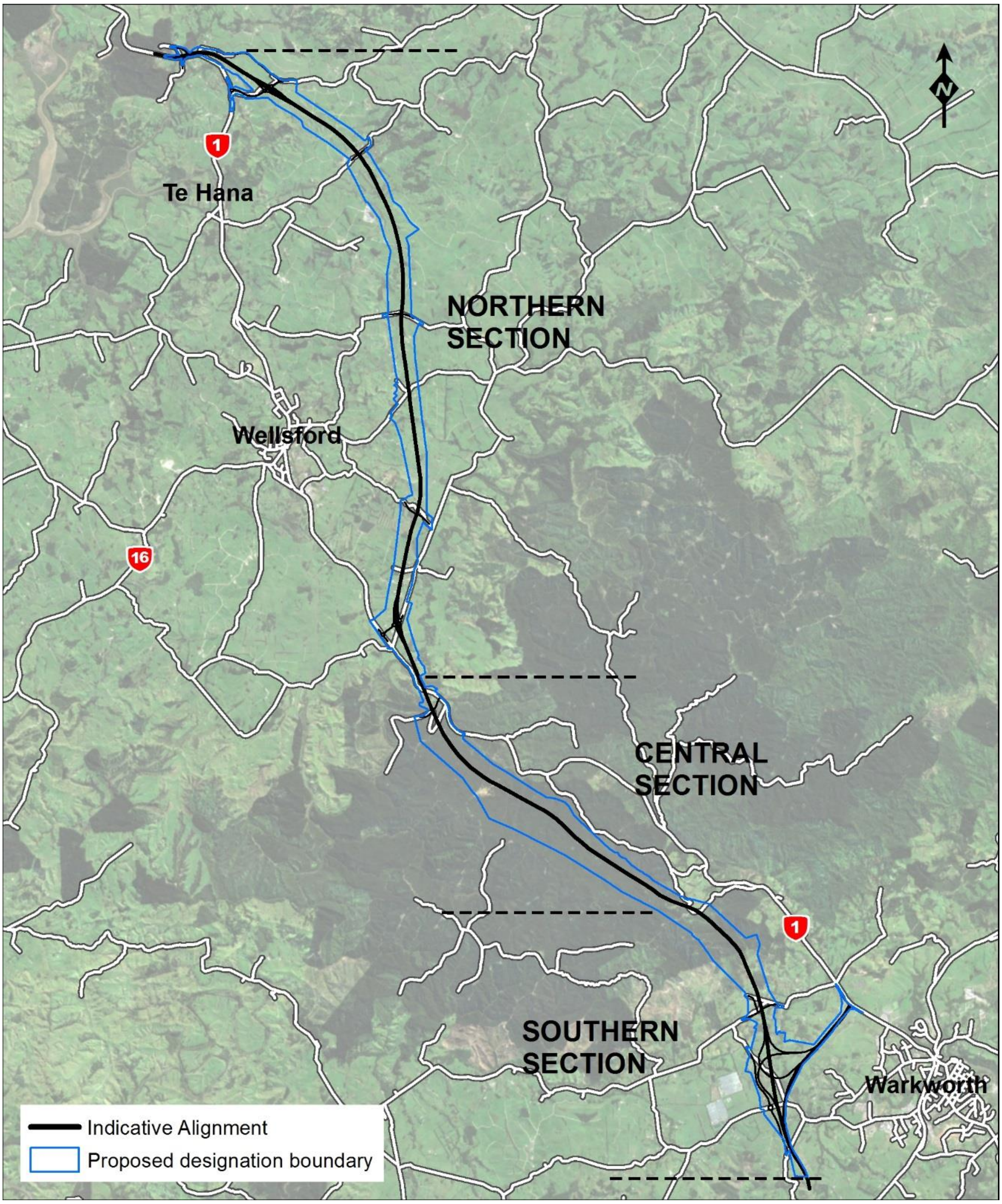

Figure 4 - Northern, Central, and Southern Sections for Construction Assessment

5.1 Light vehicle movements

Light vehicle traffic generated by the Project's construction has been estimated based on the anticipated workforce at each section and the expected number of visitors to the site, as set out in Table 2 below.[11]

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[11] See Section 5 of the AEE for indicative staff numbers.

Table 2 – Estimated daily light vehicle movements on the road network (two-way) for construction of the Indicative Alignment (rounded to the nearest 10 vehicles)

Main Site Office	Southern Section	Central Section	Northern Section	Visitors / day
70-90	430-490	430-490	580-660	40-60

The volumes in Table 2 are not likely to be spread over the ten-hour workday – they will be mainly travelling at the beginning and end of the working day, primarily accommodating staff commuting to the Project worksite. The indicative construction methodology recommends general hours of operation from sunup to sundown, with the exception of night works when required. In summer, these working hours would have staff travelling before and after commuter peaks. At other times of the year, the construction working hours may be shorter and staff travel could coincide with commuter peaks. However, as we expect that most staff and visitors will be travelling from the south (from Auckland and Warkworth), these movements would be in the counter-peak direction in the morning and evening peaks, and therefore would not contribute to increased congestion in the peak traffic direction.

Light vehicles are assumed to travel to and from the office compound locations in each section, as it is likely that staff and visitors would park at these locations. Based on the proposed constructability methodology, the main office for the entire Project will likely be incorporated into the southern section compound, since the southern compound is closest to Auckland and Warkworth.

Figure 5 shows the potential areas in which construction compounds may be located.

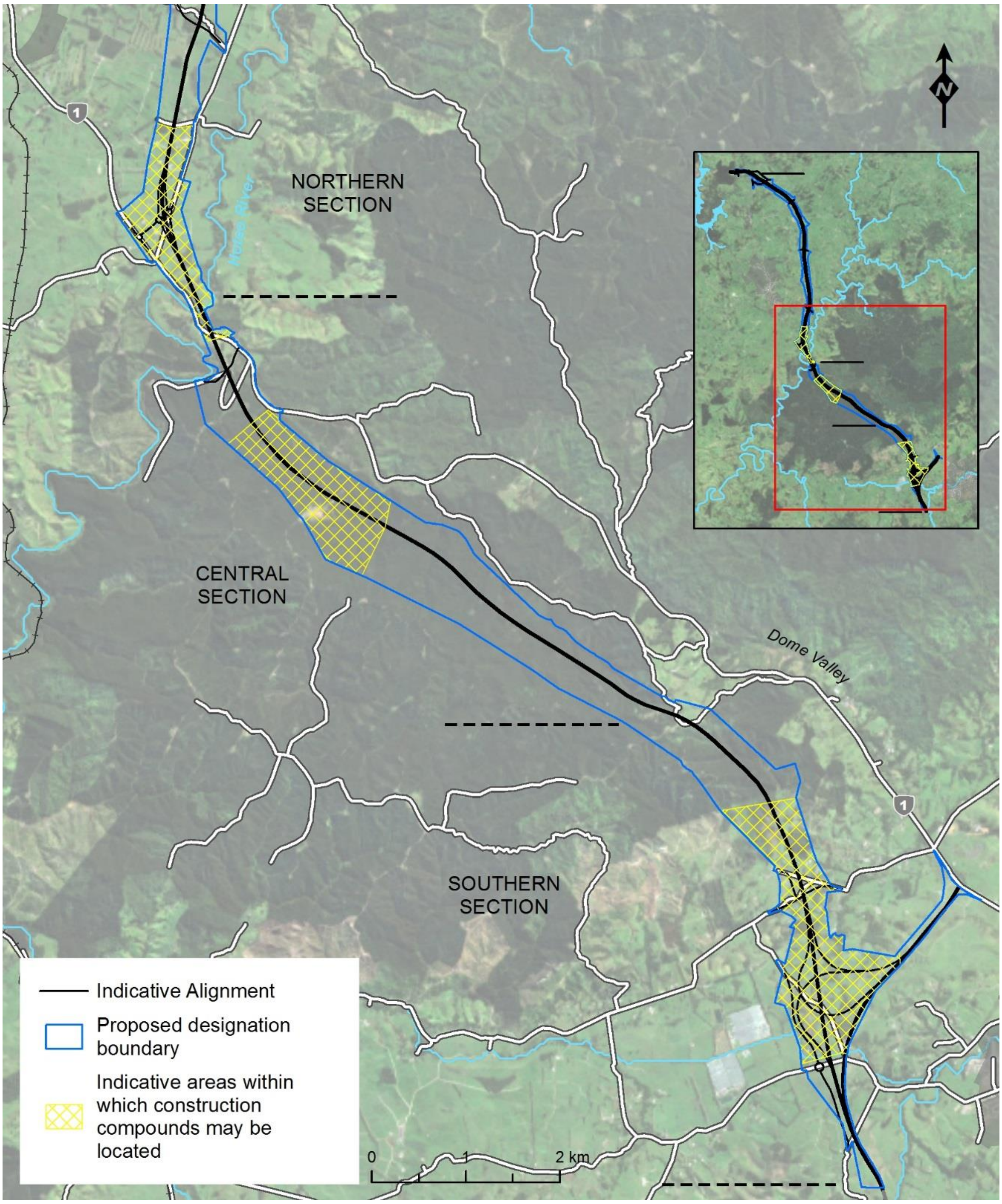

Figure 5 – Indicative areas within which construction compounds may be located

5.2 Effects and mitigation for light vehicles

We expect that the majority of light vehicles will come from Auckland or Warkworth. As the existing SH1 through Warkworth and south of Kaipara Flats Road is forecast to be congested during peak hours, it is recommended that light vehicles use alternate routes to reach the site compounds, where possible. Traffic from Auckland should use P-Wk rather than the existing SH1. P-Wk is predicted to have sufficient spare capacity at the time of the Project's construction (volume/capacity ratio about 25% in the 2036 model), such that the estimated light vehicle traffic will have little or no impact. Traffic from Warkworth should use local roads such as Woodcocks Road, to avoid travelling on the most congested section of the existing SH1. We also recommend that drivers should avoid travelling during peak hours in the vicinity of Warkworth if possible, especially during the evening peak (between 4 and 6 pm). To facilitate this, site hours of operation could be set to end outside of the evening peak, or the end of shifts could be staggered so that staff do not all leave at the same time.

If construction light vehicle traffic will be using Woodcocks Road and Hill Street, appropriate treatments will need to be put in place to mitigate any adverse effects during the morning and evening school peaks, outside Mahurangi College and Warkworth Primary School, respectively. For example, barrier arms could be placed at pedestrian crossing locations to aid safe crossings.

Given the volumes of light vehicles anticipated, it is recommended that the contractor put a staff travel plan in place to ensure that the most congested areas be avoided as much as possible, and to alert workers to consider alternative routes, and to travel outside of peaks. This can be carried out in accordance with the Transport Agency's workplace travel plan guidelines.[12] To reduce the impact on the road network of these vehicles, staff should be encouraged to carpool to sites. In addition, a contractor could consider reducing traffic impacts by providing a bus or shuttle service from Auckland, Warkworth, or wherever the bulk of employees are located. This would also reduce the need for car parking space within the Project designation.

5.3 Heavy vehicle movements

Heavy commercial vehicle (HCV) numbers have been estimated based on the volume of fill and pavement aggregate needed to be transported to each section of the Project route.

The central and northern sections have been assessed as being self-contained, meaning they will have sufficient structural cut to meet their needs for fill. The central section is likely to have excess structural cut. The southern section is likely to have a shortfall of fill, which will need to be met with material from the central section and/or quarried material. The preliminary construction methodology identifies one quarry near the southern section of the Project. There are three other quarries identified in proximity to the Project: one to the east of the northern section and two to the north of the northern section. The indicative construction methodology assumes that these quarries will be used, but that represents only one option for sourcing material, and the contractor may choose to use other sources and newer sources may be available in the future.

The indicative construction methodology indicates that there are two periods of time in which hauling is likely to occur:

- Year 3 - Year 5 of construction: Fill to be transported to the southern section from the central section and from a southern quarry.

- Year 6 - Year 7 of construction: Pavement aggregate to be transported to the southern section from a southern quarry, to the northern section from one of the three northern quarries, and to the central section from any of the four quarries.

The indicative haul routes are shown in Appendix A. These routes use both haul roads within the construction footprint and existing roads open to traffic. Once the Project alignment is partially constructed, it may be possible to use it for hauling in order to reduce impacts on existing roads.

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[12] NZ Transport Agency. Workplace travel plan guidelines. August 2011. http://www.nzta.govt.nz/assets/resources/travel-planning-toolkit/docs/workplace-travel-plan-guidelines.pdf

Table 3 shows the approximate number of heavy vehicles construction of the Indicative Alignment will generate in each section, along with where these vehicles are expected to come from. These are one-way approximations per hour, and assume that trips will be evenly distributed throughout the day. These numbers assume that pavement aggregates will be hauled over approximately 100 working days and fill will be hauled over 2 years (approximately 300 working days). These figures are conservative, as they represent a low estimate for the number of days on which hauling could occur. If hauling occurs over more days, there would be fewer HCV movements per day. Section 5 of the AEE provides details on the calculation of these estimates. Aggregates for the central section can come from either a quarry in the south (shown as "A" in Table 3) or from any of the quarries to the north ("B"). The assessment uses the higher number of vehicle movements between the two options ("A" or "B"), to ensure that the assessment covers either option.

Table 3 – Approximate heavy vehicle numbers and movements (one-way vph) for construction of the Indicative Alignment (numbers used in assessment in bold)

Section	Year 3-5	Year 6-7 (A)	Year 6-7 (B)
Southern Section			
From southern quarry	**6**	13	**26**
From Central Section	**8**	0	**13**
Central Section			
From southern quarry/Southern Section	**8**	0	**13**
From northern quarry/ Northern Section	**0**	**13**	0
Northern Section			
From Central Section	**0**	**13**	0
From northern quarry	**0**	**44**	31

There will be some day-to-day variation in the number of HCV movements into and out of the Project's site accesses throughout the duration of construction. During some periods, a site access may not be in use where construction has not started (or has been completed) or where there is limited construction activity taking place. During critical periods, there may be increased activity. For example, there may be a larger number of trucks into and out of a bridge staging site as beams are being transported to site for launching or while plant is being delivered to site. However, temporary increases in construction traffic are generally provided for when planning for the site. A typical CTMP would include requirements to observe traffic conditions at the site, and SSTMPs would indicate how to avoid adverse effects (e.g. through the timing of trucks entering and leaving the site) and give specific instructions on how to react to incidents, e.g. in the case of an unexpected event.

The final construction methodology will be determined by the contractor appointed to undertake the works. While it is likely that the construction methodology will differ from that set out in the preliminary programme, we consider that our assessment of the construction traffic effects provides a conservative approach and is appropriate in order to determine the level of effects from the Project and recommend mitigation.

In reality, the traffic volumes are likely to be lower than those assessed, in particular in the peak period. The reasons for this are as follows:

- The volumes estimated for light and heavy vehicle construction traffic are high estimates due to the conservative assumptions made in the construction methodology;
- As noted in section 3.1, we used 2036 forecast traffic to assess impacts on the network, although construction is programmed to begin in 2030;
- Many of the light vehicle movements are likely to take place at the start and end of shifts (nominally 7am and 7pm). These will generally not coincide with the peak traffic volumes on the adjacent roads and would reduce the peak traffic construction volumes assessed; and
- The Transport Agency and its contractors are likely to programme their activities to maximise the efficiency of their operations by avoiding congested periods, and minimising the effects of their activities on the existing road network.

5.4 Effects and mitigation for heavy vehicles

To assess the effects of heavy vehicle construction traffic, we extracted traffic volume and capacity information from the 2036 P2T model. By subtracting the volume of traffic in the model from the capacity of the road, the spare capacity or “residual capacity” gives an indication of how many more vehicles can be added to the road before traffic flow breaks down, resulting in delays and queuing. This analysis has been carried out for both ‘midblock’ capacities (i.e. between intersections) and intersection turning movement capacities for the proposed haul routes.

Two locations have been identified where the additional (construction related) vehicles are predicted by the model to cause the road to be over capacity: the existing SH1/Hudson Road intersection and the existing SH1/future Matakana link road intersection. To examine the construction traffic effects at these locations in more detail, SIDRA intersection analysis has been carried out for each location, as described in the following section.

We do not consider parking of heavy construction vehicles to be an issue or in need of mitigation because it is considered that all parking will take place within the construction sites themselves, not on local roads or SH1.

We recommend that the contractor put a haulage operations plan in place, to coordinate the routes and state any restrictions on deliveries to ensure that haulage operates smoothly.

5.4.1 Southern section

The existing SH1 between Hudson Road and the P-Wk roundabout (under construction) is forecast by the model to be the most heavily congested part of the Project area. The congestion is predicted by the model to be worst (during a “normal” week) during the weekday evening peak. The 2036 model forecasts significant delays in the evening peak, even without construction traffic from this Project, partly due to the series of three sets of traffic signals in close proximity. Figure 6 shows the forecast volume/capacity (V/C) ratios on network links in this area. V/C ratios shown for links in the network are average, so some movements that are over capacity may not appear due to being averaged out. V/C ratios over 85% indicate that breakdowns in traffic flow are more likely to occur resulting in delays and queuing.

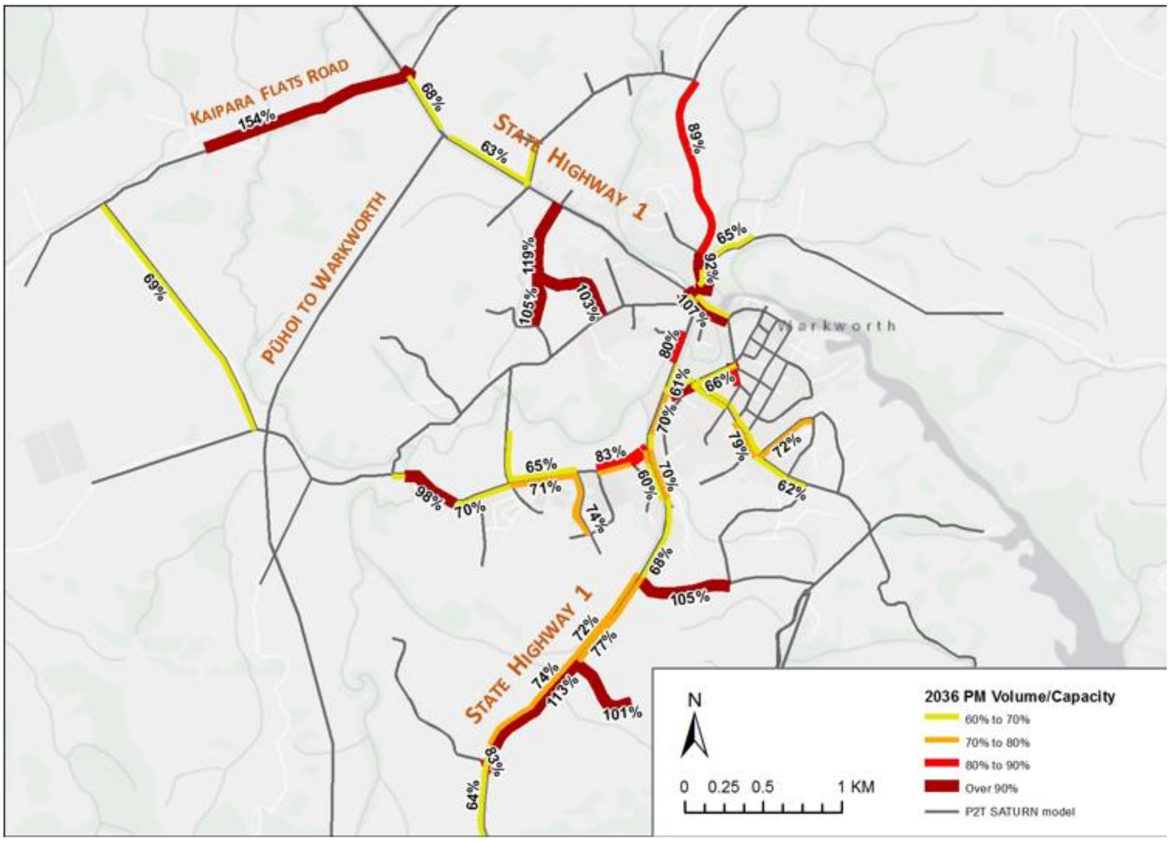


Figure 6 – Volume/capacity ratio (%) on links in 2036 evening peak, Warkworth, excluding construction traffic

The construction methodology outlined in Section 5 of the AEE identifies the existing SH1 between Hudson Road and the P-Wk roundabout as part of the haulage route from a southern quarry. Any construction traffic added to the network during peak hours will worsen the forecast congestion and these vehicles may have difficulty in making turns at priority intersections. Trucks waiting to turn are likely to delay other traffic.

The model indicates that the existing SH1/Hudson Road intersection and the existing SH1/future Matakana link road intersection are forecast to be operating close to capacity, and the expected heavy construction traffic could contribute to increased delays at these locations during peak periods. These intersections are addressed in more detail in the SIDRA analysis later in this section.

The remainder of the southern section, beginning at Kaipara Flats Road and northward, is not forecast to have issues with congestion in 2036, so analysis has been carried out using the capacity of the road and forecast traffic volumes to determine whether the additional traffic is expected to be within the capacity of the road.

Table 4 shows the volumes, capacities, and volume/capacity (V/C) ratio for the existing roads that are potential haul routes for the Project. Volumes and capacities are from the 2036 model and are presented in passenger car units (PCUs; one HCV is two PCUs). The model forecasts spare capacity on the roads in this section. The table shows that all of these roads are expected to operate at 65% of capacity or less, even in the evening peak. We note that the performance of the road can be expected to begin to deteriorate before capacity is reached. However, the expected HCV volumes generated by the Project construction are predicted to be small in comparison to the remaining capacity. Therefore, the construction traffic is not expected to negatively impact road performance between intersections.

Table 4 – Estimated 2036 two-way volumes and capacities (PCUs per hour), and V/C for potential haul roads, southern section for construction of the Indicative Alignment

	AM			IP			PM		
Location	**Volume**	**Capacity**	**V/C**	**Volume**	**Capacity**	**V/C**	**Volume**	**Capacity**	**V/C**
Hudson Road	400	2,900	14%	400	2,900	14%	1,000	2,500	40%
Woodcocks Road at Carran Road	300	2,800	11%	300	2,800	11%	900	2,700	33%
Carran Road	200	2,200	9%	200	2,200	9%	800	1,900	42%
SH1 South of Matakana link road	1,900	4,600	41%	2,100	4,600	46%	1,900	4,700	40%
Matakana link road	700	4,800	15%	800	4,800	17%	2,100	4,800	44%
SH1 South of P-Wk	1,900	6,200	31%	1,900	6,000	32%	2,500	6,100	41%
P-Wk Interchange	1,300	8,000	16%	1,500	8,000	19%	2,100	8,000	26%
SH1 South of Kaipara Flats Road	1,600	3,400	47%	1,800	3,400	53%	2,200	3,400	65%
Kaipara Flats Road	200	2,200	9%	200	2,200	9%	600	2,100	29%
SH1 North of Kaipara Flats Road	1,300	3,400	38%	1,500	3,400	44%	1,600	3,400	47%

SIDRA analysis

SIDRA analysis has been carried out for the intersections most likely to be adversely impacted by construction traffic, being Hudson Road / existing SH1 and future Matakana link road / existing SH1. Both intersections will be signalised at the time of construction, and for this analysis signal timings were optimised within SIDRA to minimise all delays. It should be noted that in reality, signal phasings and timings can be adjusted to optimise certain movements, in conjunction with RCAs and stakeholders. The full results of the SIDRA analysis and a more detailed list of our assumptions are in Appendix B.

Hudson Road SIDRA

The recommended route described above would have HCVs hauling to the southern section of the Project using Hudson Road to return to a south easterly quarry. These HCVs would turn left onto the existing SH1 northbound. We expect that the typical number of construction related trucks using this road would be approximately 26 vehicles per hour per direction, based on the truck movements in Table 3 and Appendix A, though this number may vary depending on weather and other factors. SIDRA analysis has been carried out for this intersection assuming that 26 additional HCVs per hour would turn left out of Hudson Road. As a sensitivity test, further SIDRA analysis has been carried out adding twice that number of HCVs to that movement (52 HCVs per hour).

The SIDRA analysis used 2036 forecast flows. The model assumed that the signals would be optimised to minimise all delays and have some coordination along the existing SH1. The model indicates that the intersection is expected to operate close to capacity in the evening peak, which is expected to be the most congested period. The addition of the construction HCVs to the Hudson Road left turn approach is predicted to have only a minimal impact on delays, even when the expected number of HCVs is doubled in the evening peak. The left turn movement from Hudson Road onto SH1 is not predicted to experience any significant increase in delay.

Matakana link road SIDRA

The intersection of the future Matakana link road and the existing SH1 is the main connection between the south easterly quarry and the southern section. We expect that the typical number of construction trucks using this road will be between about 25 and 40 HCVs per hour per direction, based on the truck movements in Table 3 and Appendix A, depending on whether pavement aggregates for the central section come from southern quarry or northern quarry. SIDRA analysis has been carried out using both the high end and low end of this range. For the high range, HCVs are also added to the left turn from the north approach to SH1 into Matakana link road, where vehicles coming from the central section would return to the quarry. The SIDRA analysis assumes that the Western Collector will not have been constructed at the time of the Project construction, as the Western Collector is not a committed project. It also assumes two lanes in each direction on Matakana link road. The modelled layout and the results of the SIDRA tests are in Appendix B.

The most affected movement is predicted to be the right turn from Matakana link road onto the existing SH1. Assuming that construction trucks follow the route recommended within this report to access the southern section and that pavement aggregates come from the south easterly quarry, all of the HCVs (up to 40 HCVs per hour) that come from a south easterly quarry would make that turn.

During the morning peak and interpeak, the intersection is predicted to be operating well within capacity and increases in delays of less than six seconds are predicted for all movements, even with the high end number of HCVs.

In the evening peak, this intersection is predicted to be close to reaching capacity, even without the construction traffic associated with the Project and is predicted to be performing at an unsatisfactory level of service resulting in delays and queuing. The left turn from the north on SH1 into Matakana link road is predicted to be the most delayed movement, with about 80 seconds of delay. With the additional HCVs, this movement is predicted to be adversely affected, gaining up to about 30 seconds of additional delay with the higher number of HCVs. The signal timing optimisation minimises the forecast impact on the Matakana link road approach, when the HCVs travelling from the quarry are added. However, at the high end of the estimate, the Matakana link road approach is predicted to be negatively impacted as well, with about a 10-second increase in delay predicted for right-turning traffic. The right turn from SH1 northbound into Matakana link road, where HCVs travelling from the southern section of the Project to the quarry are added to traffic, is not predicted to be impacted.

Summary and Recommendations

The southern section is the section with the heaviest traffic, and is therefore the most likely to experience traffic impacts from construction vehicles. The section of SH1 between Hudson Road and the P-Wk roundabout is forecast to be congested at peak times, especially the weekday evening peak (4 pm to 6 pm) and on holidays. The model forecasts that the Matakana link road / SH1 intersection will be over capacity at these times.

To reduce the impacts of haulage in the southern section, the following measures are recommended as mitigation options, based on the current understanding of future traffic conditions:

- Trucks hauling from a south easterly quarry (such as Matakana Quarry) to the southern section of the Project should turn right out of Matakana link road onto SH1, where there will be traffic signals. The route should be a loop using left turns onto the P-Wk project or Kaipara Flats Road, and back to the quarry using Woodcocks Road, Falls Road, and Hudson Road, with a right turn back onto Matakana link road at the traffic signals. This route will avoid opposed right turns at priority intersections. It will also avoid Mahurangi College on Woodcocks Road.

- Haulage trips should not be made during the weekday evening peak hours of 4 pm to 6 pm, to avoid the most congested time for this section of SH1. As noted previously, ongoing monitoring should be put in place to ensure that the network continues to function during hauling.

5.4.2 Central section

The central section passes through the Dome Valley. The proposed haulage routes are identified in Section 5 of the AEE. As shown on the Drawing set in Volume 3 of the AEE, in this section vehicles will access the Central compound using forestry roads to the west of SH1. There are two places where traffic will be able to turn onto the forestry roads from SH1, being Dibble and Coach Access Roads.

The existing SH1 through this section of the Project area has no forecast issues with congestion in 2036 and few intersections.

Two sections of the existing SH1 within the central section were identified in the Operational Transport Assessment as locations with a high collective safety risk. SH1 between Kraack Road and L Phillips Road had five serious injury crashes during the five-year assessment period from 2012 to 2016. SH1 near Saunders Road had one fatal crash and one serious injury crash in that time. It will be important for a safety assessment, including sight lines, to be carried out when the SSTMP is prepared for this location if construction trucks are expected to travel along this section of SH1. If feasible, construction traffic could use the Project alignment for hauling to avoid these risks; however, that is dependent upon access point locations.

The Safe Roads Alliance plans to install a wire rope barrier along the centre of SH1 through the Dome Valley, and these works are expected to be in place prior to the construction of the Project. The barrier will not impede access for construction vehicles as the current barrier design shows gaps in the barrier at the entrances to the proposed internal haul routes. However, it will slow speeds and prevent other vehicles from overtaking the HCVs. This will improve safety on SH1, but may adversely affect travel time, as cars will have to wait for passing lanes to overtake slow-moving HCVs. The largest volume of hauling to the central section is expected to take place during the last two years of construction, when pavement aggregates are to be hauled. By that time, the Project alignment will likely be able to accommodate these trucks. Therefore, the volume of construction HCVs travelling on SH1 through the central section is likely to be low, and the impact of the slower speeds of these HCVs on other traffic is expected to be reduced.

Table 5 shows the volumes, capacities, and volume/capacity (V/C) ratio for the existing roads that are potential haul routes for the Project. Volumes and capacities are from the 2036 model and are presented in PCUs. The table shows that all of these roads are expected to operate at less than 45% of capacity, even in the evening peak. The expected HCV volumes generated by the Project construction are predicted to be small in comparison to the remaining capacity. Therefore, the construction traffic is not expected to negatively impact road performance between intersections.

Table 5 – 2036 two-way volumes and capacities (PCUs per hour), and V/C for potential haul roads, central section

	AM			IP			PM		
Location	Volume	Capacity	V/C	Volume	Capacity	V/C	Volume	Capacity	V/C
SH1 South of Wayby Valley Road	1,300	3,600	36%	1,600	3,600	44%	1,500	3,600	42%

The central section is not expected to experience negative traffic impacts from construction traffic. There are areas of high crash risk along the proposed haul route along SH1 in this section, though these risks can be expected to be mitigated by the programmed safety improvements in the Dome Valley. It is important that a safety assessment be carried out as part of any SSTMPs prepared in this section. In addition, the locations of SAPs in this section should be carefully considered, as this section of road may present challenges for sight distance and space for temporary added capacity (such as turning lanes into the site) required to allow for easy site accessibility. If possible, SAP locations should minimise the amount of distance construction HCVs need to travel on the existing SH1, especially through the Dome Valley.

Rayonier Matariki Forest (RMF) will be felled prior to the construction of the Indicative Alignment, currently assumed to be 2030. As Project construction is assumed to begin in 2030, there is the potential for interaction between Project construction traffic and logging trucks from the forest harvest operation. We assessed the projected forest truck movements based on information provided by RMF. We do not expect logging vehicles to cause capacity issues for Project construction traffic, provided that (as recommended) the Project does not haul during the evening peak through Warkworth, where logging trucks may contribute to congestion if they pass through there. See Appendix C for more detail on RMF logging traffic.

5.4.3 Northern section

Haulage routes in the northern section will be along rural roads, mainly Wayby Valley Road. Wayby Valley Road will likely provide access to a Northern compound near the intersection with SH1 and the Wayby Valley interchange.

The section of the existing SH1 between River Road and Wayby Valley Road, including the Wayby Valley Road / SH1 intersection, was identified in the Operational Transport

Assessment as a location with a high collective safety risk. The intersection had one serious injury crash and four minor injury crashes between 2012 and 2016. South of the Wayby Valley Road / SH1 intersection there has been one fatal crash and two serious injury crashes in that time period. The intersection was upgraded in 2013 with turning lanes and a median added on SH1, and the serious injury crash occurred before that upgrade. However, two minor injury crashes occurred after the upgrade, so it will be important for a safety assessment, including sight lines, to be carried out when the SSTMP is prepared for this location. The Project alignment may provide an alternate route when it is considered suitable for hauling.

Table 6 shows the volumes, capacities, and volume/capacity (V/C) ratio for the existing roads that are potential haul routes for the Project. Volumes and capacities are from the 2036 model and are presented in PCUs. The table shows that all of these roads are expected to operate at 35% of capacity or less, even in the evening peak. The expected HCV volumes generated by the Project construction are predicted to be small in comparison to the remaining capacity. Therefore, the construction traffic is not expected to negatively impact road performance between intersections.

Table 6 - 2036 two-way volumes and capacities (PCUs per hour), and V/C for potential haul roads, northern section

	AM			IP			PM		
Location	**Volume**	**Capacity**	**V/C**	**Volume**	**Capacity**	**V/C**	**Volume**	**Capacity**	**V/C**
Wayby Valley Road	100	3,600	3%	0	3,600	0%	100	3,600	3%
Whangaripo Valley Rd (Matheson Road extension)	100	3,500	3%	100	3,500	3%	100	3,500	3%
Waiteitei Road	100	3,500	3%	100	3,500	3%	100	3,600	3%
SH1 North of Maeneene Road	1,000	3,400	29%	1,200	3,400	35%	1,200	3,400	35%

The northern section is not expected to experience negative traffic impacts from construction traffic. The Wayby Valley Road / SH1 intersection, has been identified as high-risk, though safety improvements have been made to that intersection since the last serious injury crash was recorded there. It is important that a safety assessment be carried out as part of the SSTMP prepared for that location, especially since the Northern site compound is likely to be located near this intersection.

5.5 Sensitivity test: full Warkworth network

A number of transport network changes and improvements are planned to take place in Warkworth over time. These projects have not been committed for funding, but they have been recommended by the Transport Networks for Growth project as necessary for enabling Warkworth's planned development. These projects are described in detail in the Operational Transport Assessment. We have carried out a sensitivity test to assess how the effects of construction traffic would differ if all planned projects are constructed in Warkworth. Figure 7 shows the model network in Warkworth as it was used for this sensitivity test. In addition to Matakana link road and P-Wk, which were included in the main assessment, the other projects in red have also been included.

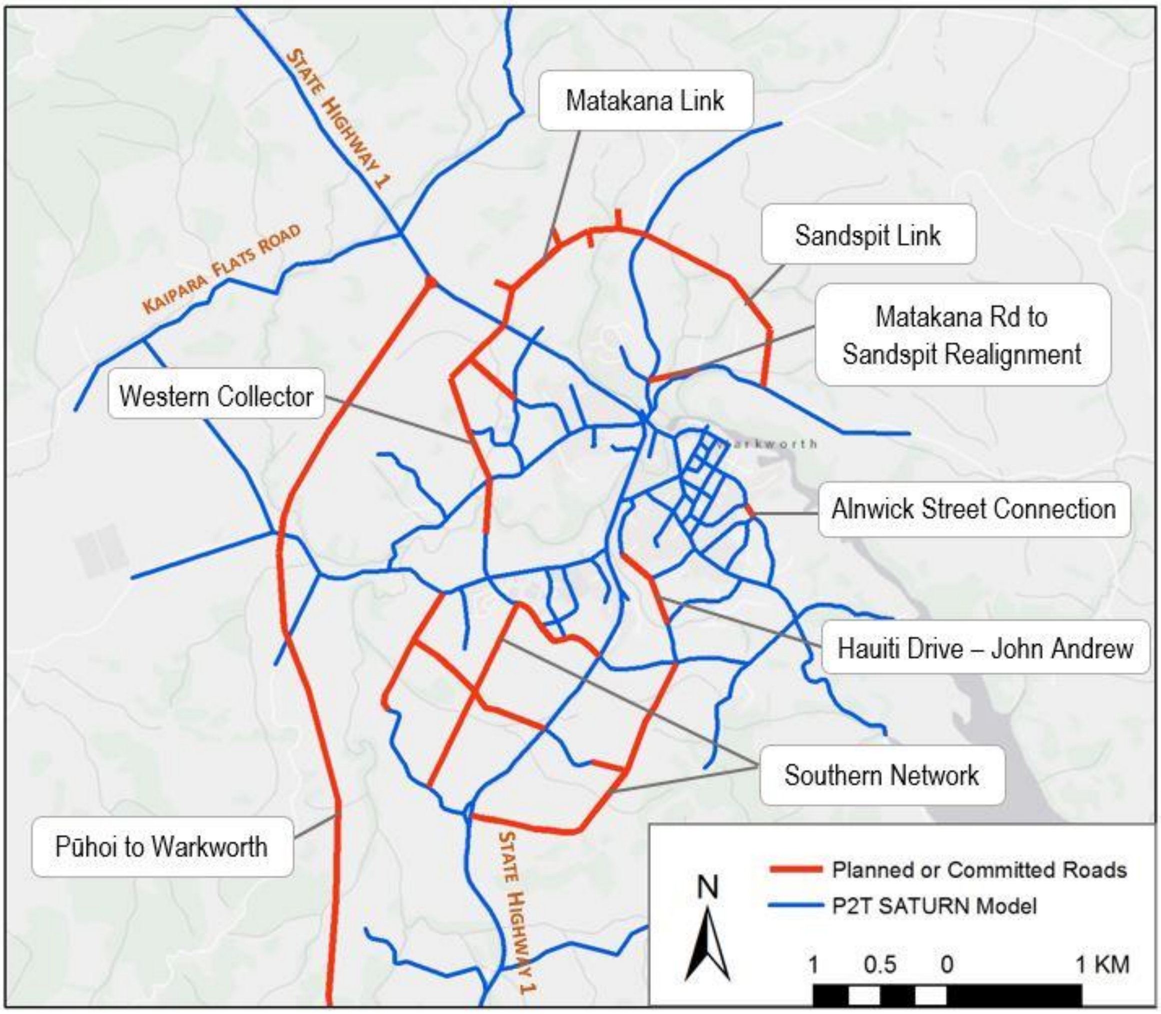


Figure 7 – Planned and committed road projects in Warkworth

As these planned projects are located in Warkworth, there is no significant change in road capacity north of Warkworth. Therefore, this sensitivity test focuses on the southern section.

SH1 between Hudson Road and the P-Wk roundabout is still forecast by the model to be the most heavily congested area that will be impacted by construction traffic, but congestion is forecast to be reduced with the inclusion of the planned projects in the network model. Traffic is forecast to be more evenly spread throughout the network and less concentrated at choke points like the Hudson Road / SH1 intersection. Because congestion is generally reduced in this scenario, there are not expected to be any locations where the impact of construction traffic would be greater than in the base scenario.

As in the base scenario, congestion in the sensitivity test is predicted to be worst (during a "normal" week) during the weekday evening peak. Figure 8 shows the forecast volume/capacity (V/C) ratios on network links in this area. V/C ratios for the links shown are average, so some movements that are over capacity may not appear due to being averaged out. V/C ratios over 85% indicate that breakdowns in traffic flow are likely to occur. Note that compared to the base (Figure 6), the network has fewer locations that are approaching or over capacity. The capacity and connectivity added by the planned projects relieve pressure on the existing SH1 south of Warkworth centre, Hudson Road, and Matakana Road. However, the SH1 approach to the future Matakana link road intersection has an increased V/C due to the addition of the Western Collector to that intersection.

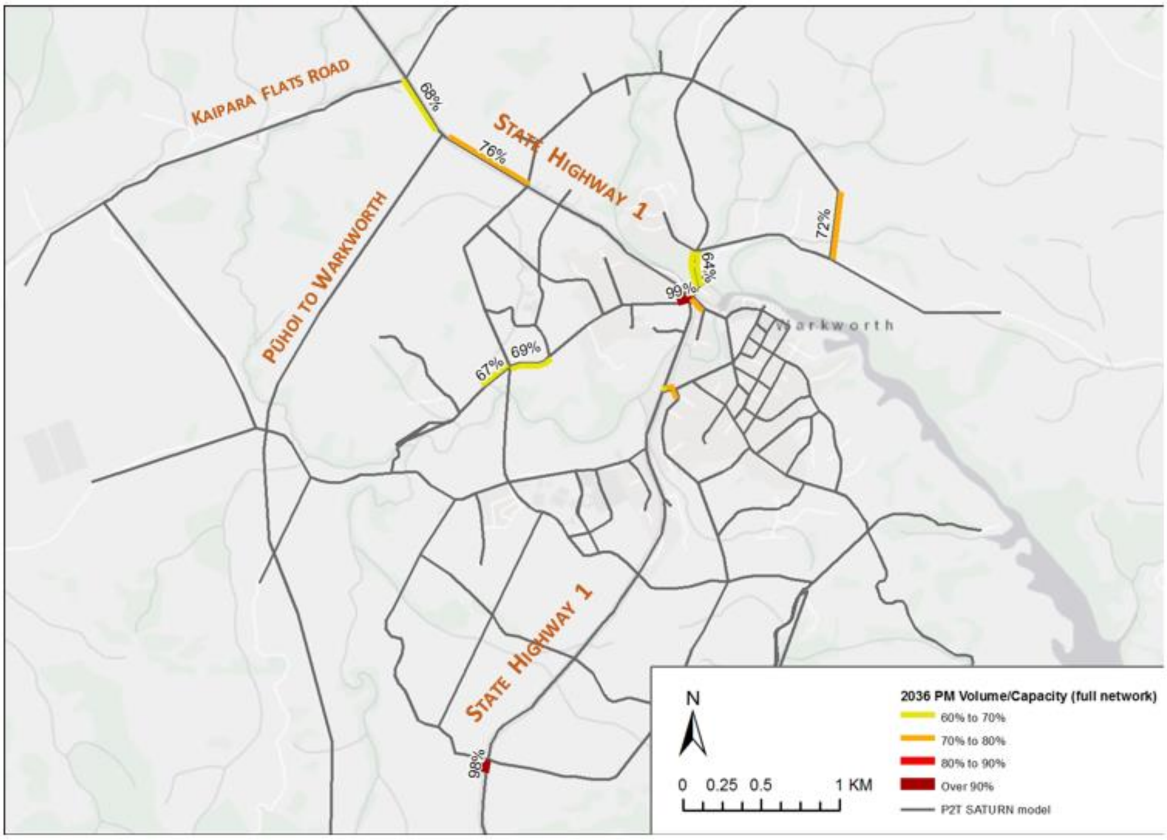


Figure 8 – Volume/capacity ratio (%) in 2036 evening peak, full planned Warkworth network, excluding construction traffic

Table 7 shows the volumes, capacities, and volume/capacity (V/C) ratio for the existing roads that are potential haul routes for the Project, using the sensitivity test P2T model. Volumes and capacities are from the 2036 model and are presented in passenger car units (PCUs; one HCV is two PCUs). The table shows that all of these roads are expected to operate at less than 65% of capacity, even in the evening peak. In most cases, the V/C is lower than in the base case. It is higher on the P-Wk interchange and SH1 south of P-Wk; however, these segments are still well below capacity. Therefore, the construction traffic is not expected to negatively impact road performance between intersections in the full network scenario.

Table 7 – Estimated 2036 two-way volumes and capacities (PCUs per hour), and V/C for potential haul roads, southern section for construction of the Indicative Alignment

	AM			IP			PM		
Location	**Volume**	**Capacity**	**V/C**	**Volume**	**Capacity**	**V/C**	**Volume**	**Capacity**	**V/C**
Hudson Road	100	3,600	3%	100	3,600	3%	400	3,600	11%
Woodcocks Road at Carran Road	300	2,800	11%	300	2,800	11%	300	2,800	11%
Carran Road	200	2,100	10%	200	2,200	9%	200	2,100	10%
SH1 South of Matakana link road	700	3,700	19%	900	3,700	24%	1,400	3,900	36%
Matakana link road	1,200	4,800	25%	1,300	4,700	28%	1,800	4,800	38%
SH1 South of P-Wk	2,000	5,700	35%	2,100	5,500	38%	2,800	5,500	51%
P-Wk Interchange	1,300	8,000	16%	1,600	8,000	20%	2,400	8,000	30%
SH1 South of Kaipara Flats Road	1,700	3,400	50%	1,800	3,400	53%	2,100	3,400	62%
Kaipara Flats Road	300	2,200	14%	200	2,100	10%	300	2,100	14%
SH1 North of Kaipara Flats Road	1,300	3,400	38%	1,500	3,400	44%	1,700	3,400	50%

The model indicates that the intersections of Hudson Road / SH1 and Matakana link road / SH1 still have the potential to be adversely impacted by construction traffic. The SIDRA analyses of these two intersections have been run using the forecast traffic volumes from the sensitivity test scenario. These tests use the same SIDRA layouts and assumptions as the base analysis; only the traffic volumes are different, due to the changes in the model network.

Hudson Road SIDRA

As in the base analysis, two tests were carried out:

- adding HCVs to the left turn movement from Hudson Road onto northbound SH1: the estimated hauling traffic of 26 HCVs per hour (based on the truck movements in Table 3 and Appendix A); and
- adding twice that number (52 HCVs per hour) for the left turn movement at Hudson Road/SH1.

While the base model showed the intersection operating close to capacity in the evening peak, which is expected to be the most congested period, the intersection in the sensitivity test model does not indicate delays greater than 35 seconds. The addition of the construction HCVs to the Hudson Road left turn approach is predicted to have only a minimal impact on delays, even when the expected number of HCVs is doubled in the evening peak. The left turn movement from Hudson Road onto SH1 is not predicted to experience any significant increase in delay.

Matakana link road SIDRA

In the sensitivity test scenario, this intersection has a fourth leg, where the Western Connector joins SH1. See Appendix B for a layout diagram. The modelled signal phases are therefore different from the base case, but have been similarly optimised based on the best current knowledge, and assumed to be coordinated with the Hudson Road / SH1 intersection to the south.

As in the base analysis, it was assumed that the typical number of construction trucks using this road will be between about 25 and 40 HCVs per hour per direction, based on the truck movements in Table 3 and Appendix A. SIDRA analysis was carried out using both the high end and low end of this range. For the high range, HCVs are also added to the left turn from the north approach to SH1 into Matakana link road, where vehicles coming from the central section would return to the southern quarry.

The most affected movement is predicted to be the right turn from Matakana link road onto SH1. Assuming that construction trucks follow the route recommended within this report to access the southern section and that pavement aggregates come from a south eastern location (such as Matakana Quarry), all of the HCVs (up to 40 HCVs per hour) that come from the quarry would make that turn.

This intersection is predicted to operate at a better level of service in the sensitivity test scenario than in the base scenario, in all periods. During the morning peak and interpeak, the intersection is still predicted to be operating within capacity. Construction traffic is predicted to increase delays by up to about 10 seconds on some movements, but the intersection is still predicted to operate satisfactorily, with an average delay of about 40 seconds, though for some movements the delays are up to about 80 seconds.

In the evening peak, this intersection is predicted to be at capacity, even without the construction traffic associated with the Project, and is predicted to be performing at an unsatisfactory level of service. The Matakana link road approach is predicted to be over capacity and experiencing significant delays. The addition of construction traffic to this intersection is predicted to worsen this congestion.

A test was carried out to see the impact if construction traffic specifically from Matakana Quarry to the southern section used the Western Collector to access the site. This was done by moving these HCVs at the Matakana link road approach from the right turn movement to the through movement. This change had no significant impact on the SIDRA results.

Summary of sensitivity test

The sensitivity test using the full planned Warkworth network indicates that the recommendations in this assessment would still apply if the planned projects in Warkworth are constructed. In particular, hauling should cease on SH1 through Warkworth during the weekday evening peak and holiday peaks. This is especially important for heavy vehicles hauling specifically from Matakana Quarry (or any quarry in that area) using Matakana link road, to avoid causing adverse impacts on the Matakana link road / existing SH1 intersection.

6 POTENTIAL IMPACT ON PASSENGER TRANSPORT

Potential impact on passenger transport summary

Construction operations will not affect the bus stops used by the services using SH1 in the Project area. The bus services will be subject to the same road performance conditions as general traffic.

Provided that access and suitable set down areas are maintained for public and school bus routes, the effects of construction are expected to be minimal.

As outlined in the Operational Transport Assessment, only a small number of regular passenger transport services use the existing SH1 in the Project area. These services would be subject to the same road performance conditions as general traffic, as described previously in this report.

The regular passenger transport services (Intercity and Mana Bus services) allow pre-booked passengers to board and alight on SH1 at Warkworth, Wellsford and Te Hana. The bus stop in Warkworth is in central Warkworth, not on SH1. The stops in Wellsford and Te Hana are on SH1, but the construction operations will be well east of these locations and will have no impact.

There are a high number of school bus runs in the Project area due to its rural location and number of students living far from schools. The schools in Warkworth are well served by school buses using Woodcocks Road and Hill Street. Bus boarding and alighting takes place on Mahurangi College grounds and not on Woodcocks Road so construction traffic is not likely to impact on this boarding/alighting. The CTMP needs to consider Ministry of Education rules for school buses. For example, children must be dropped off on the side of the road their home is on, so turnaround locations must be maintained or provided. Provided that access is maintained for these routes and suitable set-down areas are maintained, it is expected that the effects on passenger transport during construction will be minimised and will be acceptable.

7 POTENTIAL IMPACT ON PEDESTRIANS AND CYCLISTS

Potential impact on pedestrians and cyclists summary

There is currently limited opportunity for walking or commuter cycling in the Project area, although recreational cyclists do use SH1. There will be additional traffic on SH1 during construction, which could increase the exposure of pedestrians and cyclists to HCVs in particular. As the proportion of construction traffic will be low compared to general traffic, the overall increase in risk for pedestrians and cyclists will be very low, particularly near schools

As noted in the Operational Transport Assessment, the numbers of pedestrians and cyclists within the area of the Project are generally very low, with the exceptions being mainly within the townships of Wellsford and Warkworth.

Auckland Transport has been consulted regarding the Project, and AT has advised that they are working with Rodney Local Board to support development of their two greenway initiatives and to develop cycle facilities through the structure planning process for the Warkworth area. They support Auckland Council's aspirations for recreational improvements in the area and initiatives to enable safer cycling and pedestrian access along the existing SH1 corridor once the Project is operational.

Given the large distances between centres (i.e. Warkworth and Wellsford), there is limited opportunity for walking or commuter cycling between centres. There are no roads that form part of the Auckland Regional Cycle Network that are within the vicinity of the Project area. However, recreational cyclists do use the existing SH1.

There will be some additional traffic on SH1 during construction, which could increase the exposure of pedestrians and cyclists to additional conflicts. Given the relatively low proportion of construction traffic to general traffic, it is not considered that the overall increase in risk will be high. However, since many of the construction vehicles will be HCVs, and these vehicles pose a higher risk to pedestrians and cyclists due to blind spots, it will be important that construction vehicle drivers have appropriate training in sharing the road with vulnerable users.

As currently proposed, the indicative haul route does not pass Mahurangi College on Woodcocks Road. However, if the route changes to include this road, pedestrians' safety risk may increase with the increased traffic volumes and increased number of HCVs. This is particularly important around Mahurangi College, as the school zebra crossing is located near a sharp bend in the road with on-street parking, restricting the sight distance. Appropriate mitigations for this situation should be addressed in the SSTMP if hauling will take place near schools, including a ban on hauling during school drop off and pickup hours.

The contractor should provide detailed safety briefings for all truck drivers during Project inductions and as part of regular "Tool Kit" sessions to highlight the potential hazards through this area.

The contractor, in developing the Project CTMP and SSTMPs, will need to give due consideration to the safe passage of pedestrians and cyclists through the areas controlled by TTM and routes used by construction traffic. However, the effects of the construction activities on pedestrians and cyclists can be managed so that they are minimal.

8 RECOMMENDATIONS

Recommendations summary

This assessment has resulted in a number of recommendations, which have been made throughout the report. These recommendations have been collected in this section for ease of access.

We recommend that the following should be included in consent conditions:

- A CTMP should be developed for the Project.
- A hauling operations plan and a staff travel plan should be developed for the Project.
- For any works that will impact traffic on existing roads, a SSTMP should be prepared that includes a plan for TTM in accordance with the standards in CoPTTM. This will ensure that the TTM measures are put in place safely and that the impacts on traffic are minimised as much as practicable.
- An updated assessment of construction traffic management requirements should be undertaken closer to the time of construction, as changes to the transport network could occur between the time of this assessment report and 2030.

The remaining recommendations in this section should be considered when developing the CTMP, SSTMPs, haulage plan, and staff travel plan for the Project works.

This section summarises the recommendations made throughout the report. We recommend that the following should be included in consent conditions:

- A CTMP should be developed for the Project.
- A hauling operations plan and a staff travel plan should be developed for the Project.
- For any works that will impact traffic on existing roads, a SSTMP should be prepared that includes a plan for TTM in accordance with the standards in CoPTTM. This will ensure that the TTM measures are put in place safely and that the impacts on traffic are minimised as much as practicable.
- An updated assessment of construction traffic management requirements should be undertaken closer to the time of construction, as changes to the transport network could occur between the time of this assessment report and 2030.

We recommend that the following points be considered when developing the CTMP, SSTMPs, haulage plan, and staff travel plan for the Project works:

- As part of developing the CTMP and associated SSTMPs for the Project, we recommend that the Transport Agency also considers the suitability of detour routes (as is usual Transport Agency practice) where short-term road closures are considered necessary to facilitate construction works. We recommend that the future assessment should also take into account seasonal variations in traffic flows and conditions, and the construction of the Project should avoid exacerbating traffic issues during periods of increased traffic (such as holidays) when developing the overall schedule of works for the Project.

- Both Woodcocks Road and Carran Road are signed as access routes to SH16 for use when SH1 is either closed or congested during holiday periods. The SSTMP for this location should specifically include plans to accommodate these situations if closures of either of these roads is needed.

- Closures should be carried out at times of lowest traffic, and at night if practicable.

- For roads requiring realignment, to ensure continued local access is maintained during the construction of the Project, the realignment of local roads should be undertaken prior to the severance of the original connections.

- Proposed SAP locations should require SSTMPs that consider available capacity for queuing vehicles, the need and ease of maintenance of adding temporary capacity, potential restrictions on vehicle turning movements, sight distance, proximity to quarries, and site-specific conditions.

- The section of SH1 through Warkworth and south of Kaipara Flats Road will be congested during peak hours. It is recommended that construction traffic avoid this part of SH1 as much as practicable, and when it cannot be avoided, travel should be outside of peak hours. Light vehicles coming from Auckland should use the P-Wk project rather than the existing SH1. Light vehicles from Warkworth should use local roads and avoid travelling through Warkworth during the evening peak (between 4pm and 6 pm).

- If construction light vehicles are expected to use Woodcocks Road and Hill Street, appropriate treatments, such as barrier arms, may need to be put in place during the morning and evening school peaks at Mahurangi College and Warkworth Primary School. The need for these treatments would be evaluated as part of the SSTMP prior to the work commencing.

- To reduce the impact on the road network of staff vehicles, a travel management plan could be included in the CTMP. For example, staff should be encouraged to carpool to sites, and a contractor could consider reducing traffic impacts by providing a bus or shuttle service from Auckland, Warkworth, or wherever the bulk of employees are located.

- Trucks hauling from south easterly locations (such as the Matakana Quarry) to the southern section of the Project should turn right out of the future Matakana link road onto the existing SH1 at the SH1/Matakana link road intersection, where there will be traffic signals. The route should be a loop using left turns from Kaipara Flats Road. The return would use Woodcocks Road, Mansell Road, Falls Road and Hudson Road, with a right turn back onto Matakana link road from the existing SH1 at the traffic signals. This route will avoid opposed right turns at priority intersections. It will also avoid Mahurangi College.

- Haulage trips from a south easterly location (such as Matakana Quarry) should not be made during the evening peak hours of 4 pm to 6 pm to avoid the most congested time for this section of SH1.

- SSTMPs must take into account passenger transport, pedestrian, and cyclist access as well as vehicle access.

- Site access points in Matariki Rayonier Forest will require coordination with forest owners, as forest harvesting may also require use of those access points.

- Truck drivers must have the appropriate training in sharing the road with vulnerable users.

9 CONCLUSIONS

Conclusions summary

This report has identified a number of potential impacts along SH1 and on the local road network as a result of Project construction traffic that will require detailed mitigation strategies at the construction planning stage. The effects and mitigation strategies identified in this assessment can be used to inform the traffic management methodologies employed for facilitating the successful construction of the Project.

Overall, our assessment indicates that with the recommended measures in place, the effects of construction traffic on the existing network are expected to be minimised as far as practicable to an acceptable level. Careful planning and communications with stakeholders (including but not limited to RCAs, emergency services, and the public) are key to successfully delivering the Project with minimal impacts on road users.

This assessment has considered the traffic impacts that are anticipated to arise from the construction of the Project, on the basis of an indicative construction methodology.

This report has identified a number of potential impacts along SH1 and on the local road network as a result of Project construction traffic that will require detailed mitigation strategies at the construction planning stage. The effects and mitigation strategies identified in this assessment can be used to inform the traffic management methodologies employed for facilitating the successful construction of the Project. The recommendations would apply to any final design within the proposed designation boundary.

Overall, our assessment indicates that with these measures in place, the effects of construction traffic on the existing network are expected to be minimised as much as practicable to an acceptable level.

The results of the sensitivity test using the full planned Warkworth network indicate that the majority of the network would have less traffic if all Warkworth projects are constructed, and therefore effects of construction would be reduced. However, the Matakana link road / SH1 intersection would be closer to capacity in this case, and construction traffic would be more detrimental at this location during peak times and will require specific construction traffic management measures to be in place.

APPENDIX A: HAUL ROUTES

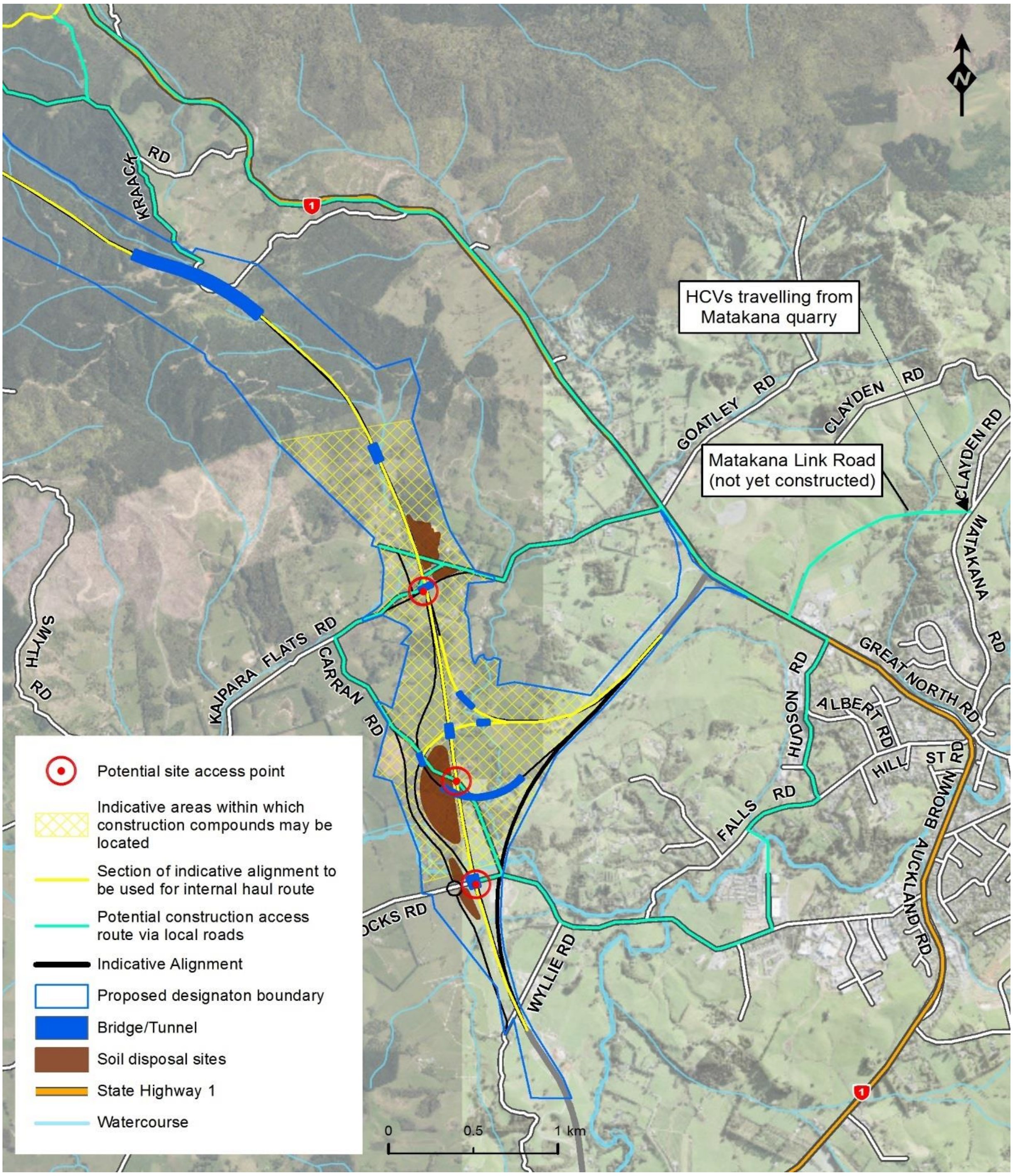


Figure 9 – Indicative haul route for southern section

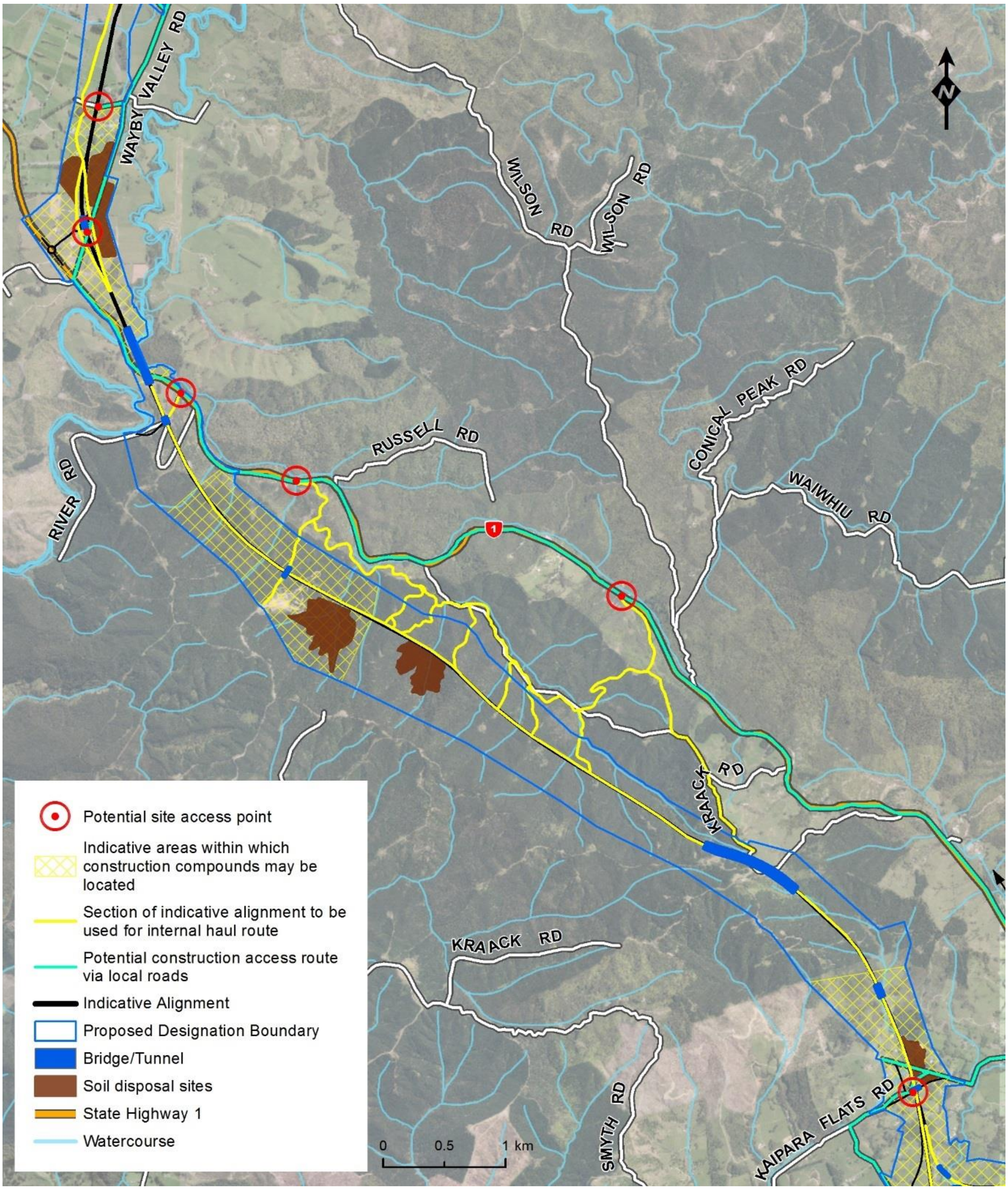


Figure 10 – Indicative haul route for central section

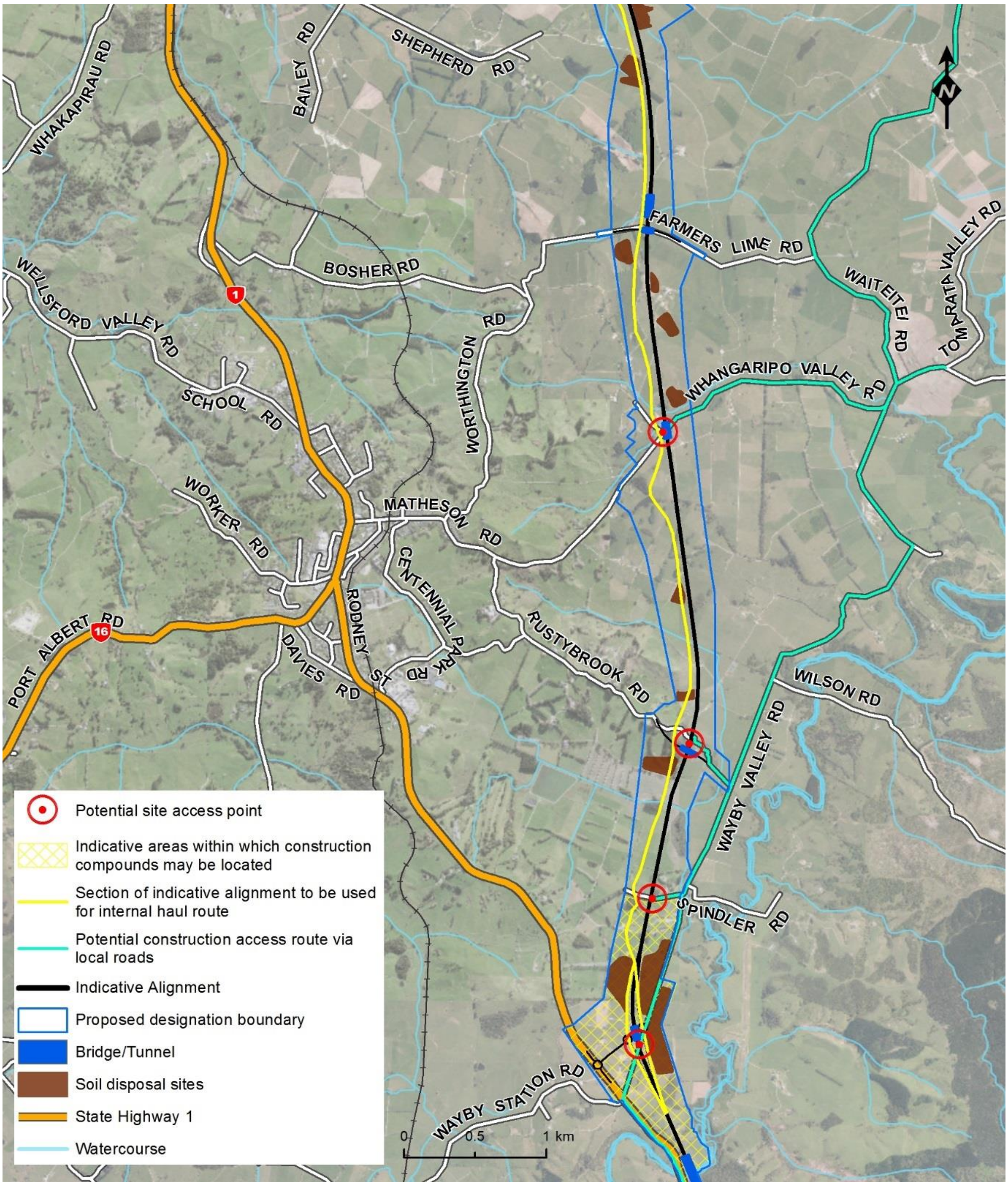


Figure 11 – Indicative haul route for southern end of northern section

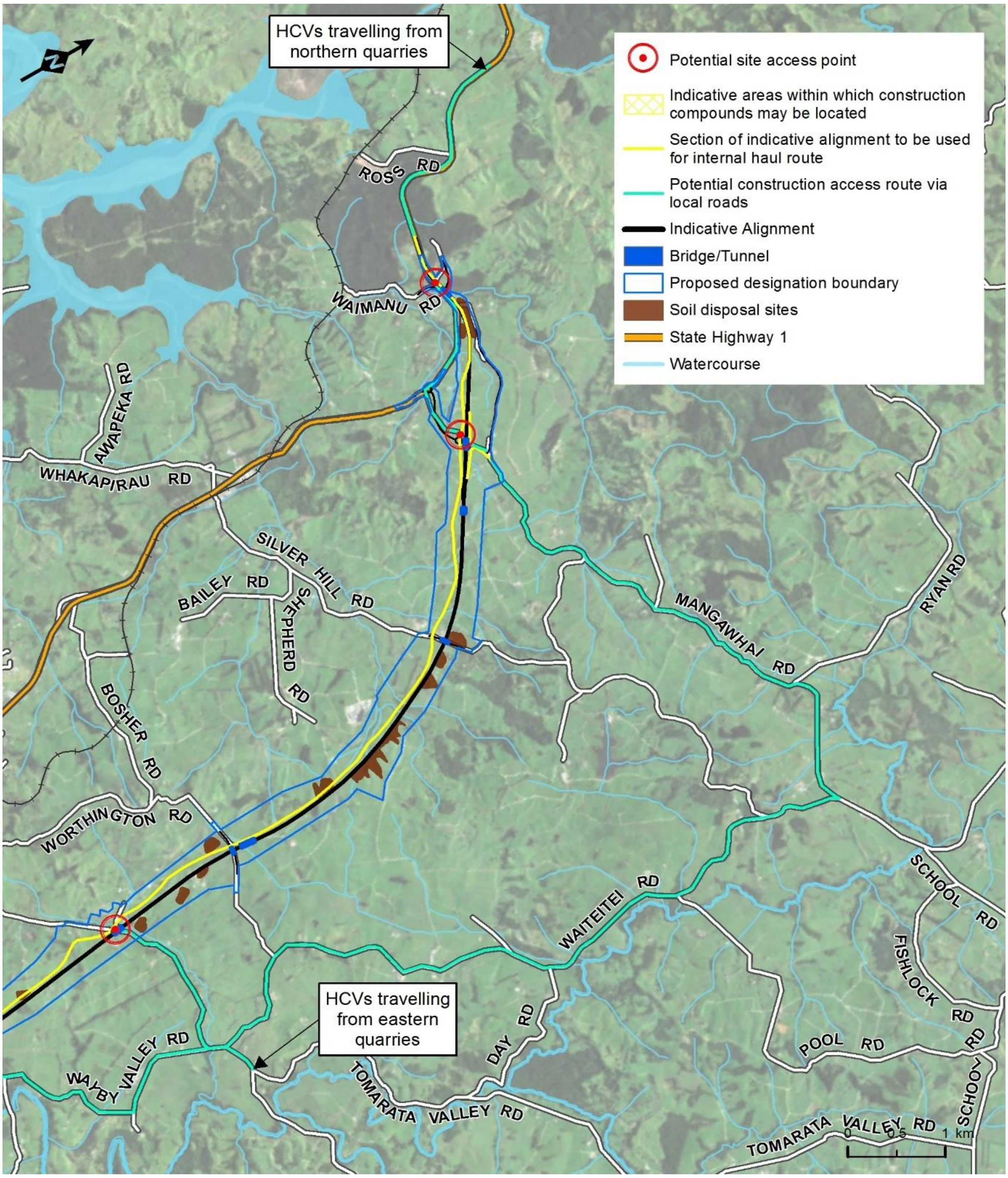


Figure 12 – Indicative haul route for northern end of northern section

APPENDIX B: SIDRA INPUTS AND OUTPUTS

The SIDRA models were created based on the following assumptions:

- Traffic volumes were extracted from the P2T model for the year 2036 for the "Do Minimum" scenario. This scenario includes only committed projects. Planned projects, such as the Western Collector, are not included.

- Signal phases were kept consistent with the P2T model. SIDRA optimum cycle time was used with an upper limit of 150 seconds and 5 second increments. A favourable level of coordination was assumed with other signals along SH1.

- When setting turn pocket lengths, it was assumed that traffic would use the flush median for queuing.

- No pedestrian data is available for this location, so the default value of 50 pedestrians per hour was accepted.

- In general, SIDRA default values were retained

Hudson Road / SH1

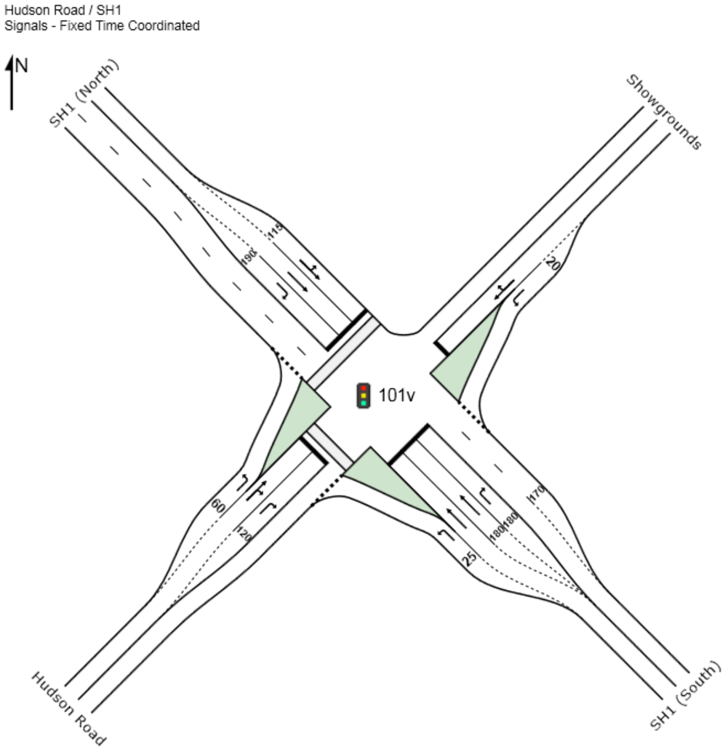
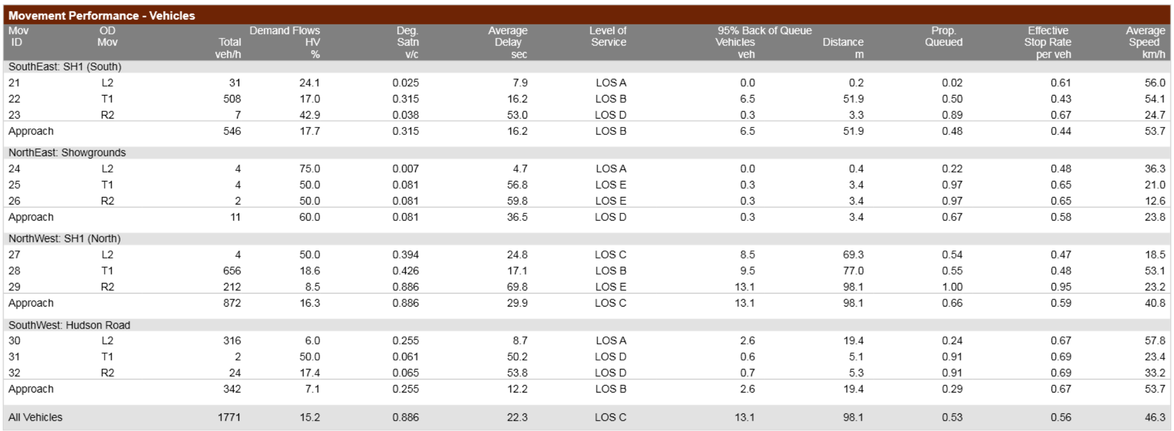


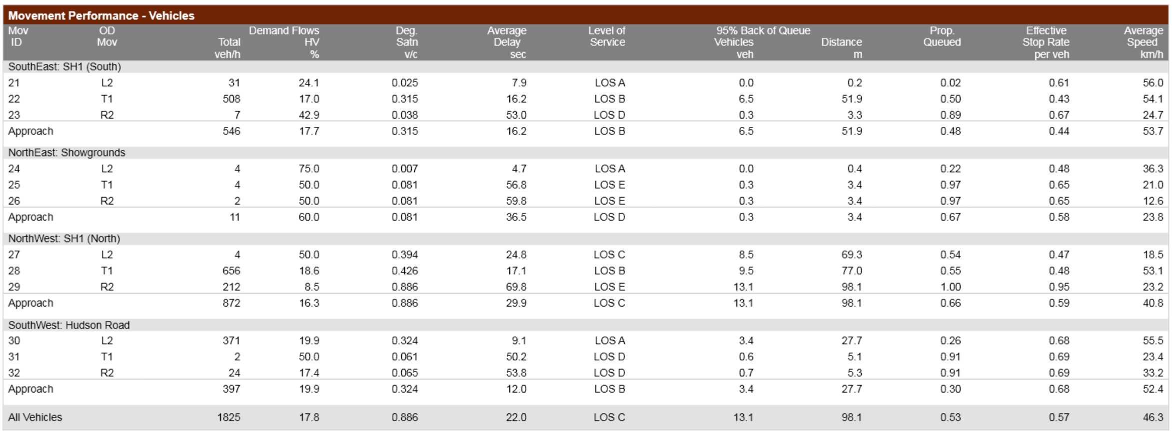
Figure 13 – SIDRA layout for Hudson Road / SH1 intersection



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
SouthEast: SH1 (South)											
21	L2	31	24.1	0.025	7.9	LOS A	0.0	0.2	0.02	0.61	56.0
22	T1	508	17.0	0.315	16.2	LOS B	6.5	51.9	0.50	0.43	54.1
23	R2	7	42.9	0.038	53.0	LOS D	0.3	3.3	0.89	0.67	24.7
Approach		546	17.7	0.315	16.2	LOS B	6.5	51.9	0.48	0.44	53.7
NorthEast: Showgrounds											
24	L2	4	75.0	0.007	4.7	LOS A	0.0	0.4	0.22	0.48	36.3
25	T1	4	50.0	0.081	56.8	LOS E	0.3	3.4	0.97	0.65	21.0
26	R2	2	50.0	0.081	59.8	LOS E	0.3	3.4	0.97	0.65	12.6
Approach		11	60.0	0.081	36.5	LOS D	0.3	3.4	0.67	0.58	23.8
NorthWest: SH1 (North)											
27	L2	4	50.0	0.394	24.8	LOS C	8.5	69.3	0.54	0.47	18.5
28	T1	656	18.6	0.426	17.1	LOS B	9.5	77.0	0.55	0.48	53.1
29	R2	212	8.5	0.886	69.8	LOS E	13.1	98.1	1.00	0.95	23.2
Approach		872	16.3	0.886	29.9	LOS C	13.1	98.1	0.66	0.59	40.8
SouthWest: Hudson Road											
30	L2	316	6.0	0.255	8.7	LOS A	2.6	19.4	0.24	0.67	57.8
31	T1	2	50.0	0.061	50.2	LOS D	0.6	5.1	0.91	0.69	23.4
32	R2	24	17.4	0.065	53.8	LOS D	0.7	5.3	0.91	0.69	33.2
Approach		342	7.1	0.255	12.2	LOS B	2.6	19.4	0.29	0.67	53.7
All Vehicles		1771	15.2	0.886	22.3	LOS C	13.1	98.1	0.53	0.56	46.3

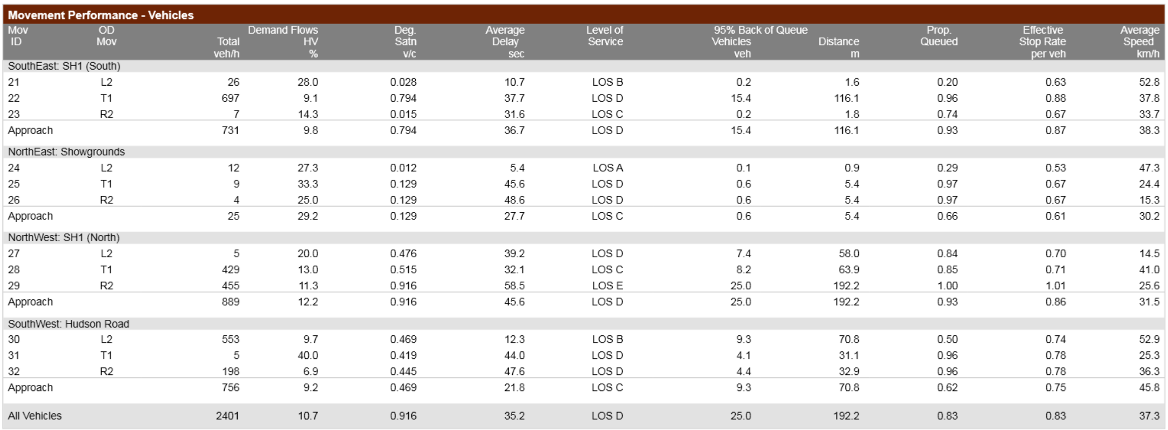
Figure 14 – Hudson Road intersection AM, no construction traffic



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
SouthEast: SH1 (South)											
21	L2	31	24.1	0.025	7.9	LOS A	0.0	0.2	0.02	0.61	56.0
22	T1	508	17.0	0.315	16.2	LOS B	6.5	51.9	0.50	0.43	54.1
23	R2	7	42.9	0.038	53.0	LOS D	0.3	3.3	0.89	0.67	24.7
Approach		546	17.7	0.315	16.2	LOS B	6.5	51.9	0.48	0.44	53.7
NorthEast: Showgrounds											
24	L2	4	75.0	0.007	4.7	LOS A	0.0	0.4	0.22	0.48	36.3
25	T1	4	50.0	0.081	56.8	LOS E	0.3	3.4	0.97	0.65	21.0
26	R2	2	50.0	0.081	59.8	LOS E	0.3	3.4	0.97	0.65	12.6
Approach		11	60.0	0.081	36.5	LOS D	0.3	3.4	0.67	0.58	23.8
NorthWest: SH1 (North)											
27	L2	4	50.0	0.394	24.8	LOS C	8.5	69.3	0.54	0.47	18.5
28	T1	656	18.6	0.426	17.1	LOS B	9.5	77.0	0.55	0.48	53.1
29	R2	212	8.5	0.886	69.8	LOS E	13.1	98.1	1.00	0.95	23.2
Approach		872	16.3	0.886	29.9	LOS C	13.1	98.1	0.66	0.59	40.8
SouthWest: Hudson Road											
30	L2	371	19.9	0.324	9.1	LOS A	3.4	27.7	0.26	0.68	55.5
31	T1	2	50.0	0.061	50.2	LOS D	0.6	5.1	0.91	0.69	23.4
32	R2	24	17.4	0.065	53.8	LOS D	0.7	5.3	0.91	0.69	33.2
Approach		397	19.9	0.324	12.0	LOS B	3.4	27.7	0.30	0.68	52.4
All Vehicles		1825	17.8	0.886	22.0	LOS C	13.1	98.1	0.53	0.57	46.3

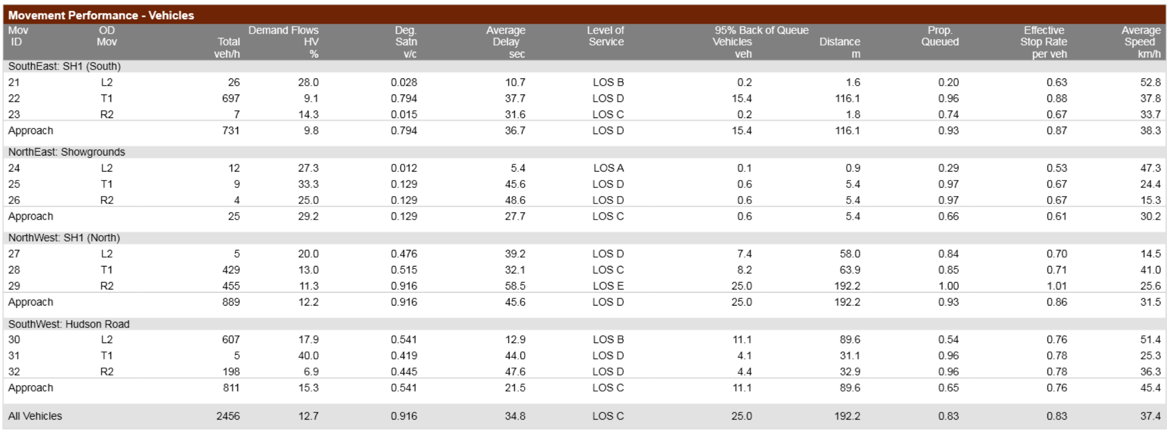
Figure 15 – Hudson Road intersection AM, with construction traffic



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
SouthEast: SH1 (South)											
21	L2	26	28.0	0.028	10.7	LOS B	0.2	1.6	0.20	0.63	52.8
22	T1	697	9.1	0.794	37.7	LOS D	15.4	116.1	0.96	0.88	37.8
23	R2	7	14.3	0.015	31.6	LOS C	0.2	1.8	0.74	0.67	33.7
Approach		731	9.8	0.794	36.7	LOS D	15.4	116.1	0.93	0.87	38.3
NorthEast: Showgrounds											
24	L2	12	27.3	0.012	5.4	LOS A	0.1	0.9	0.29	0.53	47.3
25	T1	9	33.3	0.129	45.6	LOS D	0.6	5.4	0.97	0.67	24.4
26	R2	4	25.0	0.129	48.6	LOS D	0.6	5.4	0.97	0.67	15.3
Approach		25	29.2	0.129	27.7	LOS C	0.6	5.4	0.66	0.61	30.2
NorthWest: SH1 (North)											
27	L2	5	20.0	0.476	39.2	LOS D	7.4	58.0	0.84	0.70	14.5
28	T1	429	13.0	0.515	32.1	LOS C	8.2	63.9	0.85	0.71	41.0
29	R2	455	11.3	0.916	58.5	LOS E	25.0	192.2	1.00	1.01	25.6
Approach		889	12.2	0.916	45.6	LOS D	25.0	192.2	0.93	0.86	31.5
SouthWest: Hudson Road											
30	L2	553	9.7	0.469	12.3	LOS B	9.3	70.8	0.50	0.74	52.9
31	T1	5	40.0	0.419	44.0	LOS D	4.1	31.1	0.96	0.78	25.3
32	R2	198	6.9	0.445	47.6	LOS D	4.4	32.9	0.96	0.78	36.3
Approach		756	9.2	0.469	21.8	LOS C	9.3	70.8	0.62	0.75	45.8
All Vehicles		2401	10.7	0.916	35.2	LOS D	25.0	192.2	0.83	0.83	37.3

Figure 16 – Hudson Road intersection PM, no construction traffic



Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: SH1 (South)											
21	L2	26	28.0	0.028	10.7	LOS B	0.2	1.6	0.20	0.63	52.8
22	T1	697	9.1	0.794	37.7	LOS D	15.4	116.1	0.96	0.88	37.8
23	R2	7	14.3	0.015	31.6	LOS C	0.2	1.8	0.74	0.67	33.7
Approach		731	9.8	0.794	36.7	LOS D	15.4	116.1	0.93	0.87	38.3
NorthEast: Showgrounds											
24	L2	12	27.3	0.012	5.4	LOS A	0.1	0.9	0.29	0.53	47.3
25	T1	9	33.3	0.129	45.6	LOS D	0.6	5.4	0.97	0.67	24.4
26	R2	4	25.0	0.129	48.6	LOS D	0.6	5.4	0.97	0.67	15.3
Approach		25	29.2	0.129	27.7	LOS C	0.6	5.4	0.66	0.61	30.2
NorthWest: SH1 (North)											
27	L2	5	20.0	0.476	39.2	LOS D	7.4	58.0	0.84	0.70	14.5
28	T1	429	13.0	0.515	32.1	LOS C	8.2	63.9	0.85	0.71	41.0
29	R2	455	11.3	0.916	58.5	LOS E	25.0	192.2	1.00	1.01	25.6
Approach		889	12.2	0.916	45.6	LOS D	25.0	192.2	0.93	0.86	31.5
SouthWest: Hudson Road											
30	L2	607	17.9	0.541	12.9	LOS B	11.1	89.6	0.54	0.76	51.4
31	T1	5	40.0	0.419	44.0	LOS D	4.1	31.1	0.96	0.78	25.3
32	R2	198	6.9	0.445	47.6	LOS D	4.4	32.9	0.96	0.78	36.3
Approach		811	15.3	0.541	21.5	LOS C	11.1	89.6	0.65	0.76	45.4
All Vehicles		2456	12.7	0.916	34.8	LOS C	25.0	192.2	0.83	0.83	37.4

Figure 17 – Hudson Road intersection PM, with construction traffic

Matakana link road / SH1

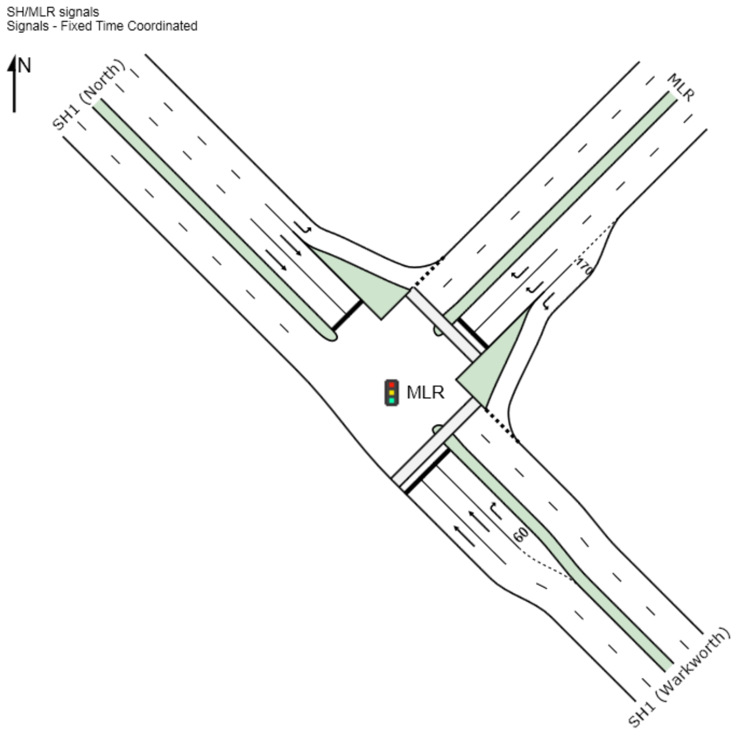
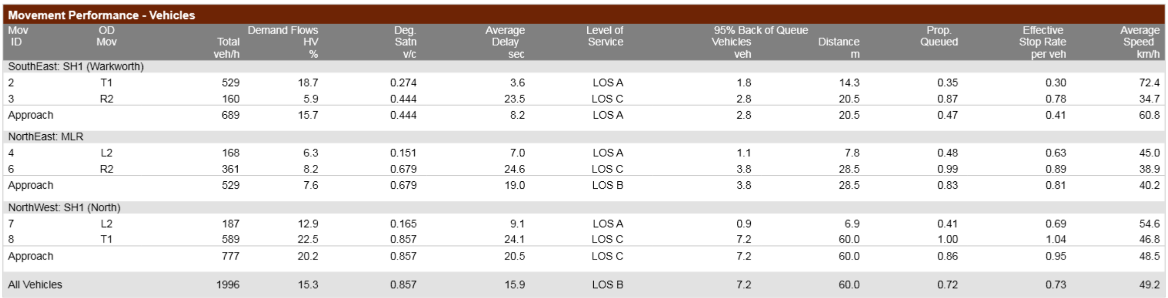


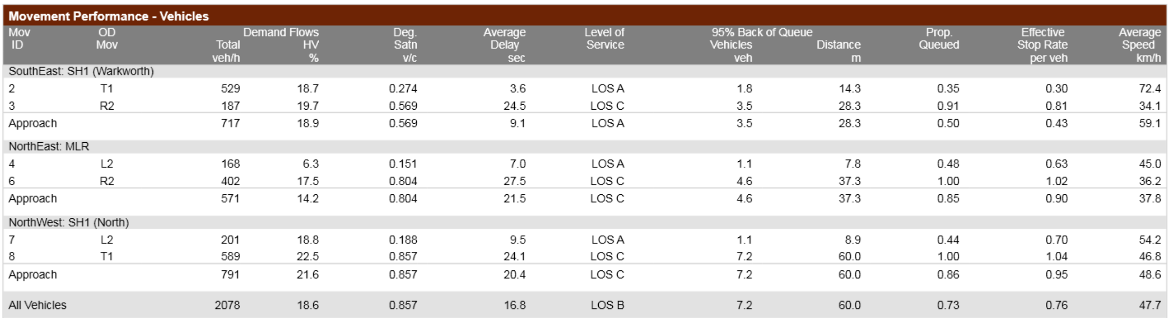
Figure 18 – SIDRA layout for Matakana link road / SH1 intersection



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: SH1 (Warkworth)											
2	T1	529	18.7	0.274	3.6	LOS A	1.8	14.3	0.35	0.30	72.4
3	R2	160	5.9	0.444	23.5	LOS C	2.8	20.5	0.87	0.78	34.7
Approach		689	15.7	0.444	8.2	LOS A	2.8	20.5	0.47	0.41	60.8
NorthEast: MLR											
4	L2	168	6.3	0.151	7.0	LOS A	1.1	7.8	0.48	0.63	45.0
6	R2	361	8.2	0.679	24.6	LOS C	3.8	28.5	0.99	0.89	38.9
Approach		529	7.6	0.679	19.0	LOS B	3.8	28.5	0.83	0.81	40.2
NorthWest: SH1 (North)											
7	L2	187	12.9	0.165	9.1	LOS A	0.9	6.9	0.41	0.69	54.6
8	T1	589	22.5	0.857	24.1	LOS C	7.2	60.0	1.00	1.04	46.8
Approach		777	20.2	0.857	20.5	LOS C	7.2	60.0	0.86	0.95	48.5
All Vehicles		1996	15.3	0.857	15.9	LOS B	7.2	60.0	0.72	0.73	49.2

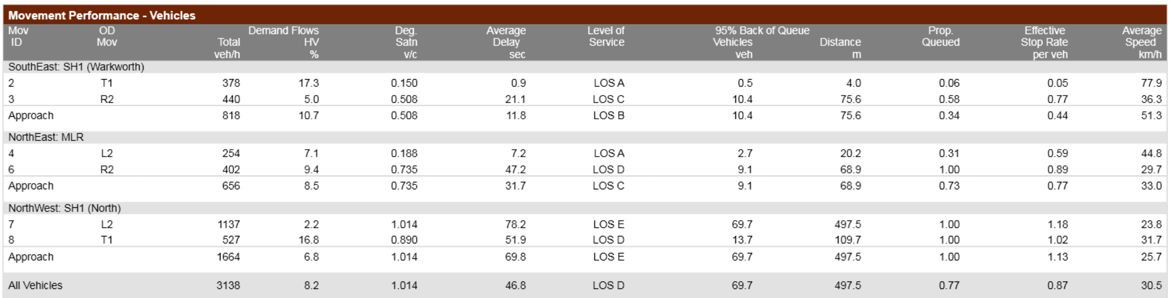
Figure 19 – Matakana link road intersection AM, no construction traffic



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: SH1 (Warkworth)											
2	T1	529	18.7	0.274	3.6	LOS A	1.8	14.3	0.35	0.30	72.4
3	R2	187	19.7	0.569	24.5	LOS C	3.5	28.3	0.91	0.81	34.1
Approach		717	18.9	0.569	9.1	LOS A	3.5	28.3	0.50	0.43	59.1
NorthEast: MLR											
4	L2	168	6.3	0.151	7.0	LOS A	1.1	7.8	0.48	0.63	45.0
6	R2	402	17.5	0.804	27.5	LOS C	4.6	37.3	1.00	1.02	36.2
Approach		571	14.2	0.804	21.5	LOS C	4.6	37.3	0.85	0.90	37.8
NorthWest: SH1 (North)											
7	L2	201	18.8	0.188	9.5	LOS A	1.1	8.9	0.44	0.70	54.2
8	T1	589	22.5	0.857	24.1	LOS C	7.2	60.0	1.00	1.04	46.8
Approach		791	21.6	0.857	20.4	LOS C	7.2	60.0	0.86	0.95	48.6
All Vehicles		2078	18.6	0.857	16.8	LOS B	7.2	60.0	0.73	0.76	47.7

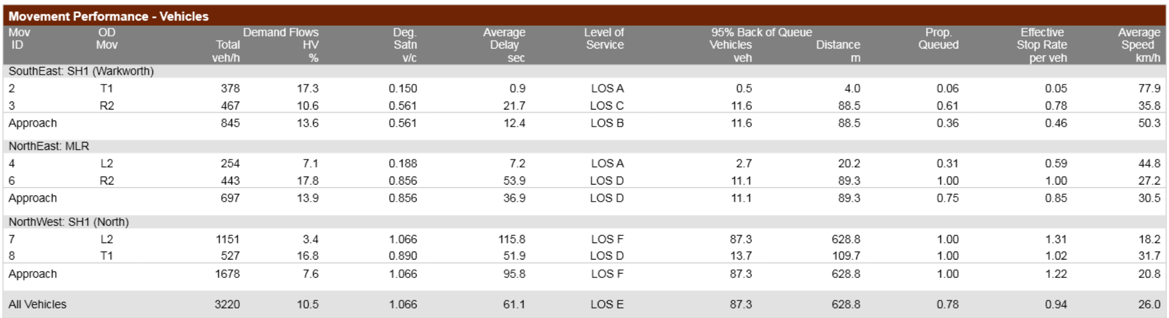
Figure 20 – Matakana link road intersection AM, with construction traffic



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: SH1 (Warkworth)											
2	T1	378	17.3	0.150	0.9	LOS A	0.5	4.0	0.06	0.05	77.9
3	R2	440	5.0	0.508	21.1	LOS C	10.4	75.6	0.58	0.77	36.3
Approach		818	10.7	0.508	11.8	LOS B	10.4	75.6	0.34	0.44	51.3
NorthEast: MLR											
4	L2	254	7.1	0.188	7.2	LOS A	2.7	20.2	0.31	0.59	44.8
6	R2	402	9.4	0.735	47.2	LOS D	9.1	68.9	1.00	0.89	29.7
Approach		656	8.5	0.735	31.7	LOS C	9.1	68.9	0.73	0.77	33.0
NorthWest: SH1 (North)											
7	L2	1137	2.2	1.014	78.2	LOS E	69.7	497.5	1.00	1.18	23.8
8	T1	527	16.8	0.890	51.9	LOS D	13.7	109.7	1.00	1.02	31.7
Approach		1664	6.8	1.014	69.8	LOS E	69.7	497.5	1.00	1.13	25.7
All Vehicles		3138	8.2	1.014	46.8	LOS D	69.7	497.5	0.77	0.87	30.5

Figure 21 – Matakana link road intersection PM, no construction traffic



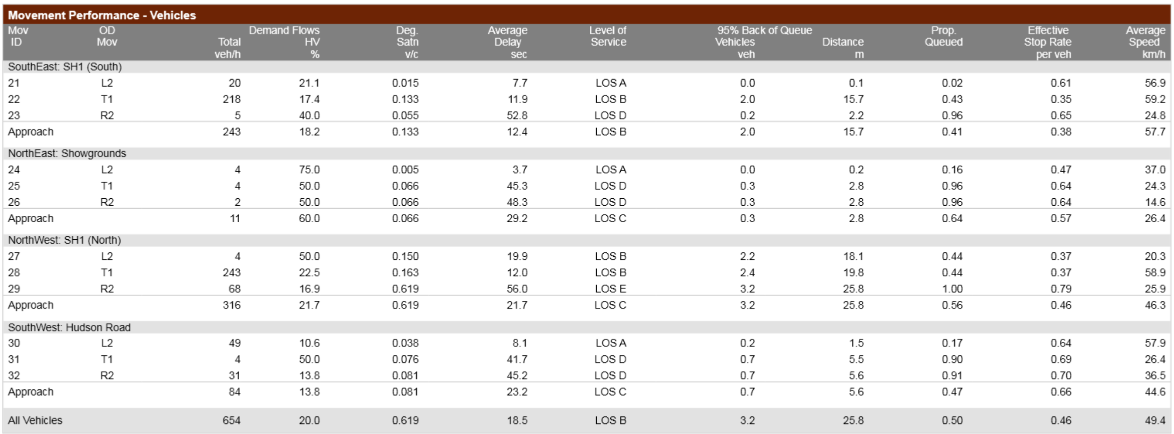
Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: SH1 (Warkworth)											
2	T1	378	17.3	0.150	0.9	LOS A	0.5	4.0	0.06	0.05	77.9
3	R2	467	10.6	0.561	21.7	LOS C	11.6	88.5	0.61	0.78	35.8
Approach		845	13.6	0.561	12.4	LOS B	11.6	88.5	0.36	0.46	50.3
NorthEast: MLR											
4	L2	254	7.1	0.188	7.2	LOS A	2.7	20.2	0.31	0.59	44.8
6	R2	443	17.8	0.856	53.9	LOS D	11.1	89.3	1.00	1.00	27.2
Approach		697	13.9	0.856	36.9	LOS D	11.1	89.3	0.75	0.85	30.5
NorthWest: SH1 (North)											
7	L2	1151	3.4	1.066	115.8	LOS F	87.3	628.8	1.00	1.31	18.2
8	T1	527	16.8	0.890	51.9	LOS D	13.7	109.7	1.00	1.02	31.7
Approach		1678	7.6	1.066	95.8	LOS F	87.3	628.8	1.00	1.22	20.8
All Vehicles		3220	10.5	1.066	61.1	LOS E	87.3	628.8	0.78	0.94	26.0

Figure 22 – Matakana link road intersection PM, with construction traffic

Sensitivity Test – Full Warkworth Network

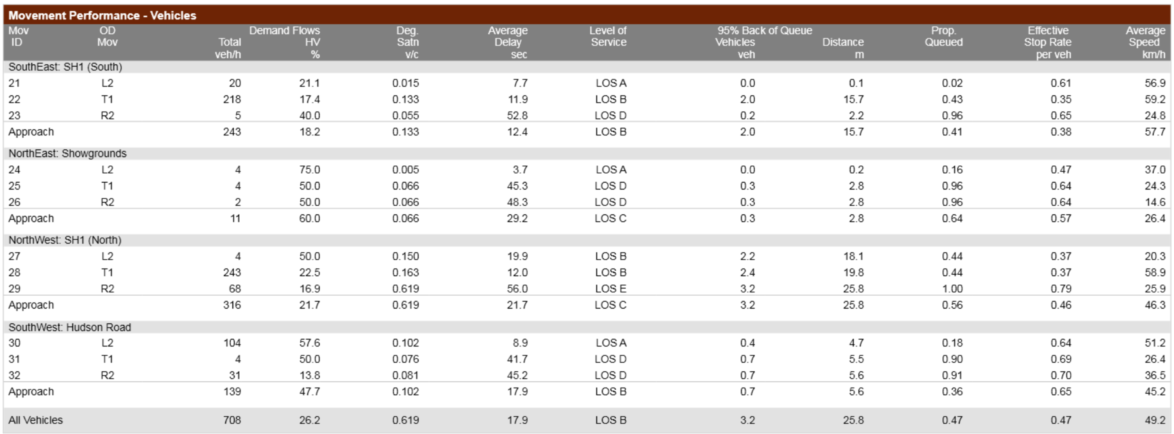
Hudson Road / SH1



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m		per veh	km/h
SouthEast: SH1 (South)											
21	L2	20	21.1	0.015	7.7	LOS A	0.0	0.1	0.02	0.61	56.9
22	T1	218	17.4	0.133	11.9	LOS B	2.0	15.7	0.43	0.35	59.2
23	R2	5	40.0	0.055	52.8	LOS D	0.2	2.2	0.96	0.65	24.8
Approach		243	18.2	0.133	12.4	LOS B	2.0	15.7	0.41	0.38	57.7
NorthEast: Showgrounds											
24	L2	4	75.0	0.005	3.7	LOS A	0.0	0.2	0.16	0.47	37.0
25	T1	4	50.0	0.066	45.3	LOS D	0.3	2.8	0.96	0.64	24.3
26	R2	2	50.0	0.066	48.3	LOS D	0.3	2.8	0.96	0.64	14.6
Approach		11	60.0	0.066	29.2	LOS C	0.3	2.8	0.64	0.57	26.4
NorthWest: SH1 (North)											
27	L2	4	50.0	0.150	19.9	LOS B	2.2	18.1	0.44	0.37	20.3
28	T1	243	22.5	0.163	12.0	LOS B	2.4	19.8	0.44	0.37	58.9
29	R2	68	16.9	0.619	56.0	LOS E	3.2	25.8	1.00	0.79	25.9
Approach		316	21.7	0.619	21.7	LOS C	3.2	25.8	0.56	0.46	46.3
SouthWest: Hudson Road											
30	L2	49	10.6	0.038	8.1	LOS A	0.2	1.5	0.17	0.64	57.9
31	T1	4	50.0	0.076	41.7	LOS D	0.7	5.5	0.90	0.69	26.4
32	R2	31	13.8	0.081	45.2	LOS D	0.7	5.6	0.91	0.70	36.5
Approach		84	13.8	0.081	23.2	LOS C	0.7	5.6	0.47	0.66	44.6
All Vehicles		654	20.0	0.619	18.5	LOS B	3.2	25.8	0.50	0.46	49.4

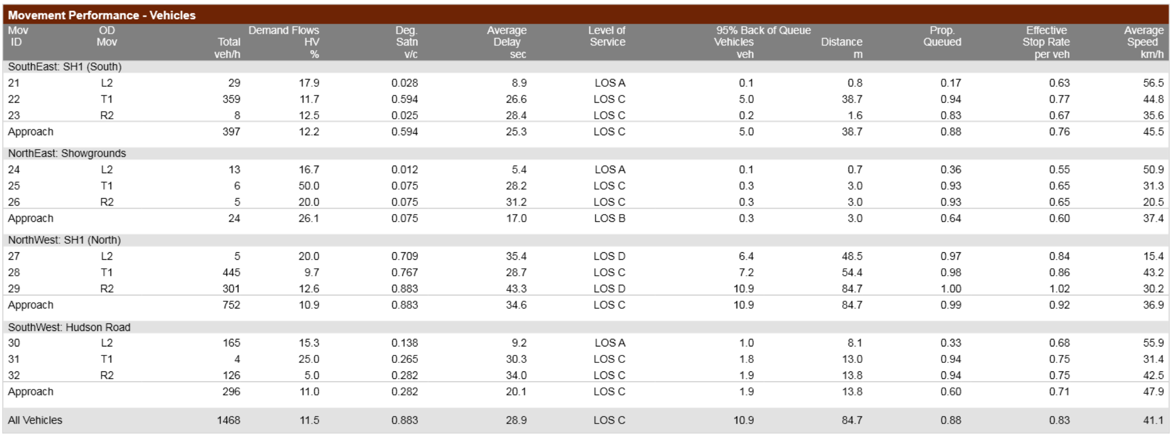
Figure 23 – Hudson Road intersection AM, no construction traffic, full network scenario



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m		per veh	km/h
SouthEast: SH1 (South)											
21	L2	20	21.1	0.015	7.7	LOS A	0.0	0.1	0.02	0.61	56.9
22	T1	218	17.4	0.133	11.9	LOS B	2.0	15.7	0.43	0.35	59.2
23	R2	5	40.0	0.055	52.8	LOS D	0.2	2.2	0.96	0.65	24.8
Approach		243	18.2	0.133	12.4	LOS B	2.0	15.7	0.41	0.38	57.7
NorthEast: Showgrounds											
24	L2	4	75.0	0.005	3.7	LOS A	0.0	0.2	0.16	0.47	37.0
25	T1	4	50.0	0.066	45.3	LOS D	0.3	2.8	0.96	0.64	24.3
26	R2	2	50.0	0.066	48.3	LOS D	0.3	2.8	0.96	0.64	14.6
Approach		11	60.0	0.066	29.2	LOS C	0.3	2.8	0.64	0.57	26.4
NorthWest: SH1 (North)											
27	L2	4	50.0	0.150	19.9	LOS B	2.2	18.1	0.44	0.37	20.3
28	T1	243	22.5	0.163	12.0	LOS B	2.4	19.8	0.44	0.37	58.9
29	R2	68	16.9	0.619	56.0	LOS E	3.2	25.8	1.00	0.79	25.9
Approach		316	21.7	0.619	21.7	LOS C	3.2	25.8	0.56	0.46	46.3
SouthWest: Hudson Road											
30	L2	104	57.6	0.102	8.9	LOS A	0.4	4.7	0.18	0.64	51.2
31	T1	4	50.0	0.076	41.7	LOS D	0.7	5.5	0.90	0.69	26.4
32	R2	31	13.8	0.081	45.2	LOS D	0.7	5.6	0.91	0.70	36.5
Approach		139	47.7	0.102	17.9	LOS B	0.7	5.6	0.36	0.65	45.2
All Vehicles		708	26.2	0.619	17.9	LOS B	3.2	25.8	0.47	0.47	49.2

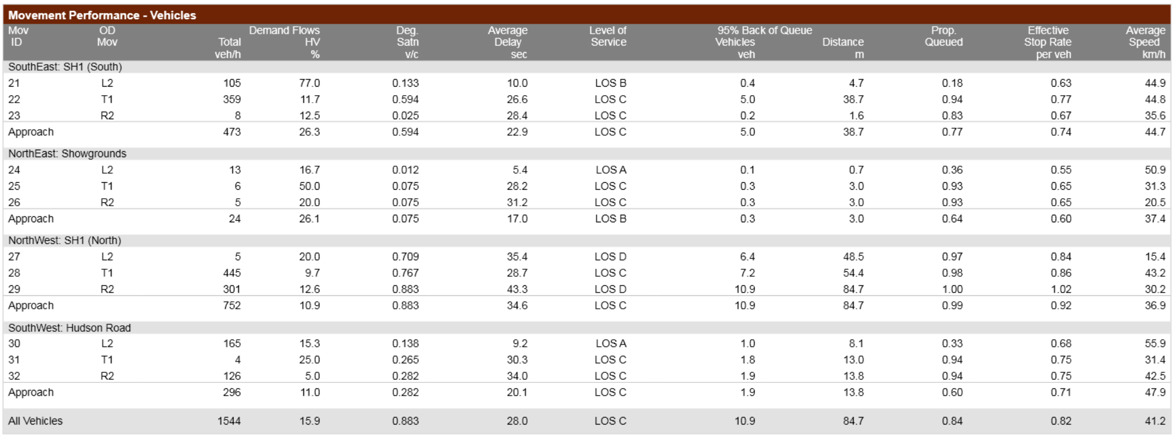
Figure 24 – Hudson Road intersection AM, with construction traffic, full network scenario



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total veh/h	HV %	v/c	sec		Vehicles veh	Distance m		per veh	km/h
SouthEast: SH1 (South)											
21	L2	29	17.9	0.028	8.9	LOS A	0.1	0.8	0.17	0.63	56.5
22	T1	359	11.7	0.594	26.6	LOS C	5.0	38.7	0.94	0.77	44.8
23	R2	8	12.5	0.025	28.4	LOS C	0.2	1.6	0.83	0.67	35.6
Approach		397	12.2	0.594	25.3	LOS C	5.0	38.7	0.88	0.76	45.5
NorthEast: Showgrounds											
24	L2	13	16.7	0.012	5.4	LOS A	0.1	0.7	0.36	0.55	50.9
25	T1	6	50.0	0.075	28.2	LOS C	0.3	3.0	0.93	0.65	31.3
26	R2	5	20.0	0.075	31.2	LOS C	0.3	3.0	0.93	0.65	20.5
Approach		24	26.1	0.075	17.0	LOS B	0.3	3.0	0.64	0.60	37.4
NorthWest: SH1 (North)											
27	L2	5	20.0	0.709	35.4	LOS D	6.4	48.5	0.97	0.84	15.4
28	T1	445	9.7	0.767	28.7	LOS C	7.2	54.4	0.98	0.86	43.2
29	R2	301	12.6	0.883	43.3	LOS D	10.9	84.7	1.00	1.02	30.2
Approach		752	10.9	0.883	34.6	LOS C	10.9	84.7	0.99	0.92	36.9
SouthWest: Hudson Road											
30	L2	165	15.3	0.138	9.2	LOS A	1.0	8.1	0.33	0.68	55.9
31	T1	4	25.0	0.265	30.3	LOS C	1.8	13.0	0.94	0.75	31.4
32	R2	126	5.0	0.282	34.0	LOS C	1.9	13.8	0.94	0.75	42.5
Approach		296	11.0	0.282	20.1	LOS C	1.9	13.8	0.60	0.71	47.9
All Vehicles		1468	11.5	0.883	28.9	LOS C	10.9	84.7	0.88	0.83	41.1

Figure 25 – Hudson Road intersection PM, no construction traffic, full network scenario



Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: SH1 (South)											
21	L2	105	77.0	0.133	10.0	LOS B	0.4	4.7	0.18	0.63	44.9
22	T1	359	11.7	0.594	26.6	LOS C	5.0	38.7	0.94	0.77	44.8
23	R2	8	12.5	0.025	28.4	LOS C	0.2	1.6	0.83	0.67	35.6
Approach		473	26.3	0.594	22.9	LOS C	5.0	38.7	0.77	0.74	44.7
NorthEast: Showgrounds											
24	L2	13	16.7	0.012	5.4	LOS A	0.1	0.7	0.36	0.55	50.9
25	T1	6	50.0	0.075	28.2	LOS C	0.3	3.0	0.93	0.65	31.3
26	R2	5	20.0	0.075	31.2	LOS C	0.3	3.0	0.93	0.65	20.5
Approach		24	26.1	0.075	17.0	LOS B	0.3	3.0	0.64	0.60	37.4
NorthWest: SH1 (North)											
27	L2	5	20.0	0.709	35.4	LOS D	6.4	48.5	0.97	0.84	15.4
28	T1	445	9.7	0.767	28.7	LOS C	7.2	54.4	0.98	0.86	43.2
29	R2	301	12.6	0.883	43.3	LOS D	10.9	84.7	1.00	1.02	30.2
Approach		752	10.9	0.883	34.6	LOS C	10.9	84.7	0.99	0.92	36.9
SouthWest: Hudson Road											
30	L2	165	15.3	0.138	9.2	LOS A	1.0	8.1	0.33	0.68	55.9
31	T1	4	25.0	0.265	30.3	LOS C	1.8	13.0	0.94	0.75	31.4
32	R2	126	5.0	0.282	34.0	LOS C	1.9	13.8	0.94	0.75	42.5
Approach		296	11.0	0.282	20.1	LOS C	1.9	13.8	0.60	0.71	47.9
All Vehicles		1544	15.9	0.883	28.0	LOS C	10.9	84.7	0.84	0.82	41.2

Figure 26 –Hudson Road intersection PM, with construction traffic, full network scenario

Matakana link road / SH1

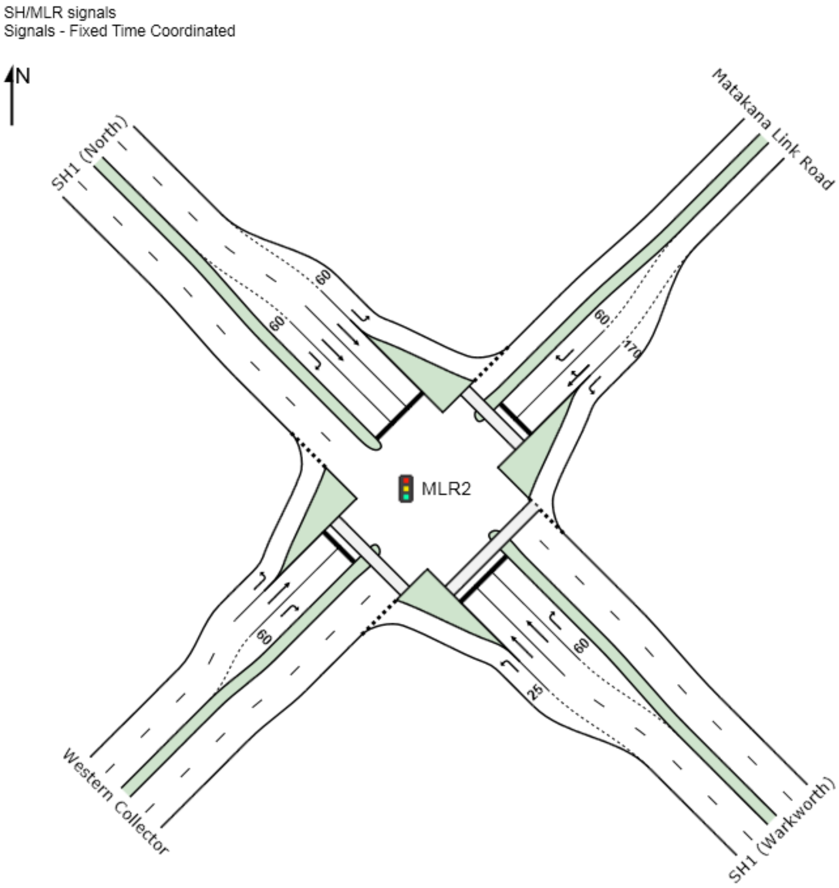
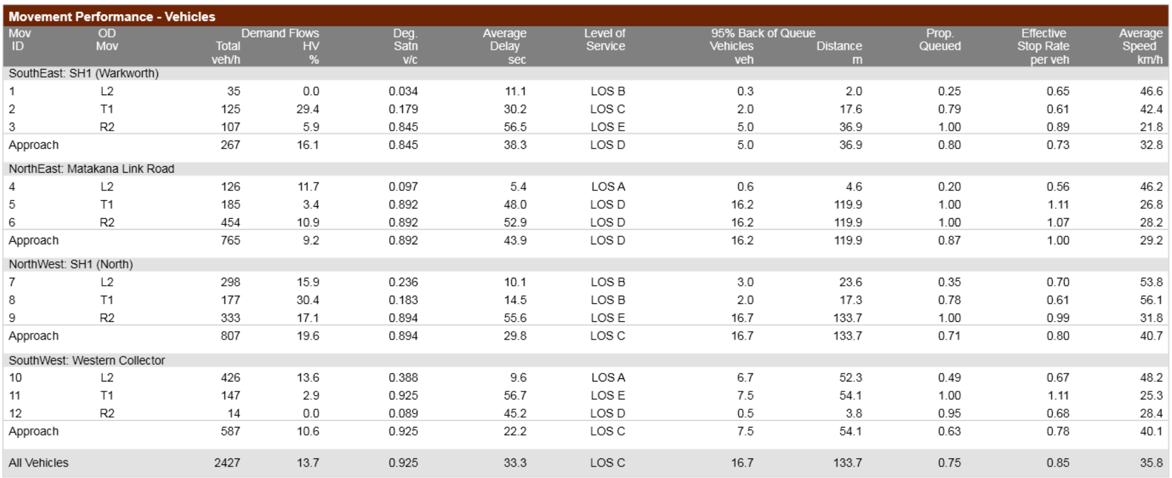


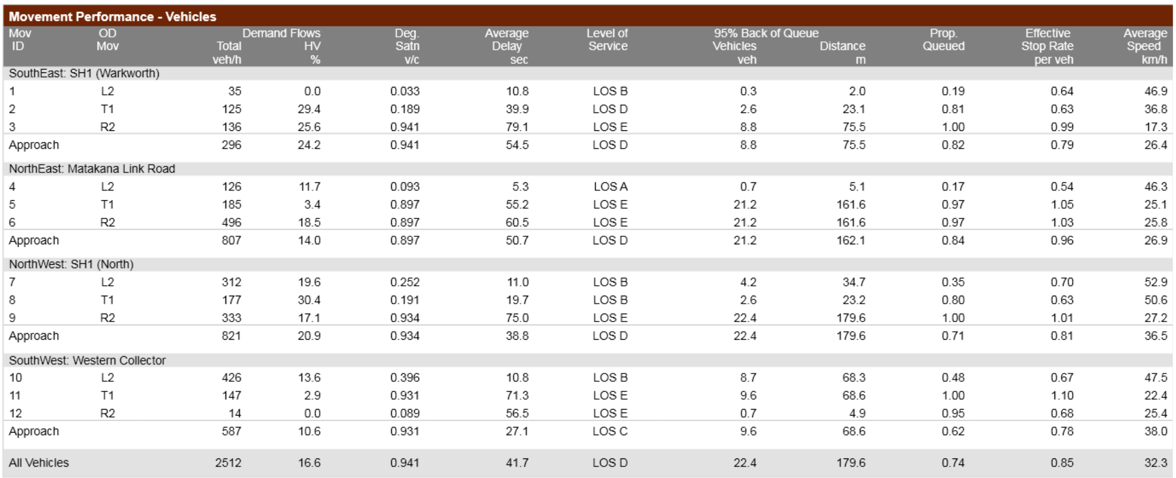
Figure 27 – SIDRA layout for Matakana link road / SH1 intersection, full network scenario



Movement Performance - Vehicles

Mov	OD	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Average
ID	Mov	Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: SH1 (Warkworth)											
1	L2	35	0.0	0.034	11.1	LOS B	0.3	2.0	0.25	0.65	46.6
2	T1	125	29.4	0.179	30.2	LOS C	2.0	17.6	0.79	0.61	42.4
3	R2	107	5.9	0.845	56.5	LOS E	5.0	36.9	1.00	0.89	21.8
Approach		267	16.1	0.845	38.3	LOS D	5.0	36.9	0.80	0.73	32.8
NorthEast: Matakana Link Road											
4	L2	126	11.7	0.097	5.4	LOS A	0.6	4.6	0.20	0.56	46.2
5	T1	185	3.4	0.892	48.0	LOS D	16.2	119.9	1.00	1.11	26.8
6	R2	454	10.9	0.892	52.9	LOS D	16.2	119.9	1.00	1.07	28.2
Approach		765	9.2	0.892	43.9	LOS D	16.2	119.9	0.87	1.00	29.2
NorthWest: SH1 (North)											
7	L2	298	15.9	0.236	10.1	LOS B	3.0	23.6	0.35	0.70	53.8
8	T1	177	30.4	0.183	14.5	LOS B	2.0	17.3	0.78	0.61	56.1
9	R2	333	17.1	0.894	55.6	LOS E	16.7	133.7	1.00	0.99	31.8
Approach		807	19.6	0.894	29.8	LOS C	16.7	133.7	0.71	0.80	40.7
SouthWest: Western Collector											
10	L2	426	13.6	0.388	9.6	LOS A	6.7	52.3	0.49	0.67	48.2
11	T1	147	2.9	0.925	56.7	LOS E	7.5	54.1	1.00	1.11	25.3
12	R2	14	0.0	0.089	45.2	LOS D	0.5	3.8	0.95	0.68	28.4
Approach		587	10.6	0.925	22.2	LOS C	7.5	54.1	0.63	0.78	40.1
All Vehicles		2427	13.7	0.925	33.3	LOS C	16.7	133.7	0.75	0.85	35.8

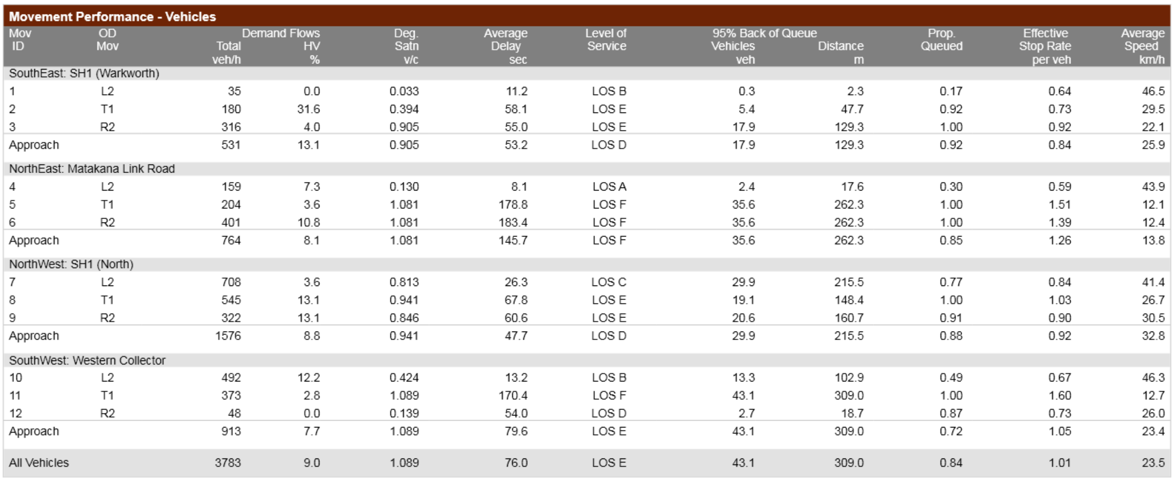
Figure 28 – Matakana link road intersection AM, no construction traffic, full network scenario



Movement Performance - Vehicles

Mov	OD	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Average
ID	Mov	Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: SH1 (Warkworth)											
1	L2	35	0.0	0.033	10.8	LOS B	0.3	2.0	0.19	0.64	46.9
2	T1	125	29.4	0.189	39.9	LOS D	2.6	23.1	0.81	0.63	36.8
3	R2	136	25.6	0.941	79.1	LOS E	8.8	75.5	1.00	0.99	17.3
Approach		296	24.2	0.941	54.5	LOS D	8.8	75.5	0.82	0.79	26.4
NorthEast: Matakana Link Road											
4	L2	126	11.7	0.093	5.3	LOS A	0.7	5.1	0.17	0.54	46.3
5	T1	185	3.4	0.897	55.2	LOS E	21.2	161.6	0.97	1.05	25.1
6	R2	496	18.5	0.897	60.5	LOS E	21.2	161.6	0.97	1.03	25.8
Approach		807	14.0	0.897	50.7	LOS D	21.2	162.1	0.84	0.96	26.9
NorthWest: SH1 (North)											
7	L2	312	19.6	0.252	11.0	LOS B	4.2	34.7	0.35	0.70	52.9
8	T1	177	30.4	0.191	19.7	LOS B	2.6	23.2	0.80	0.63	50.6
9	R2	333	17.1	0.934	75.0	LOS E	22.4	179.6	1.00	1.01	27.2
Approach		821	20.9	0.934	38.8	LOS D	22.4	179.6	0.71	0.81	36.5
SouthWest: Western Collector											
10	L2	426	13.6	0.396	10.8	LOS B	8.7	68.3	0.48	0.67	47.5
11	T1	147	2.9	0.931	71.3	LOS E	9.6	68.6	1.00	1.10	22.4
12	R2	14	0.0	0.089	56.5	LOS E	0.7	4.9	0.95	0.68	25.4
Approach		587	10.6	0.931	27.1	LOS C	9.6	68.6	0.62	0.78	38.0
All Vehicles		2512	16.6	0.941	41.7	LOS D	22.4	179.6	0.74	0.85	32.3

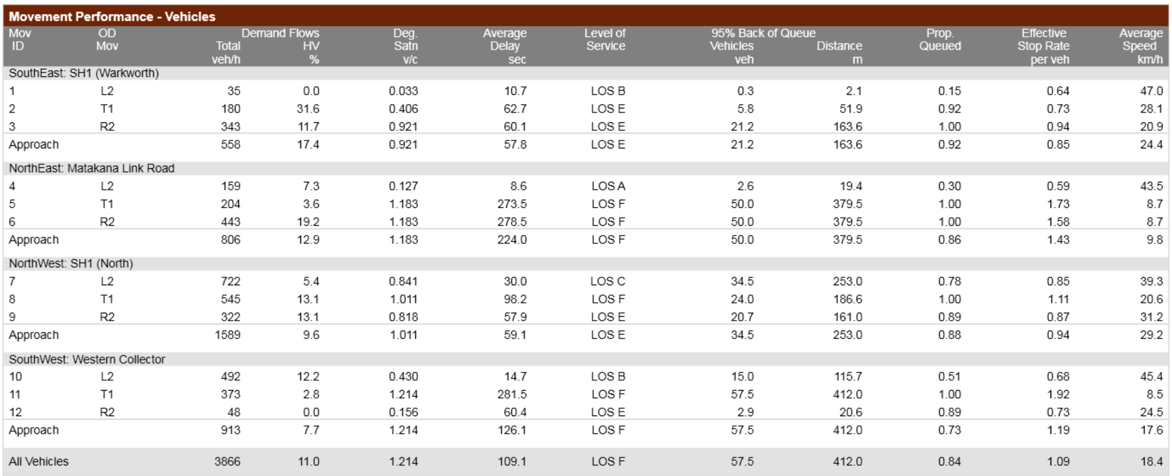
Figure 29 – Matakana link road intersection AM, with construction traffic, full network scenario



Movement Performance - Vehicles

Mov	OD	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Average
ID	Mov	Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: SH1 (Warkworth)											
1	L2	35	0.0	0.033	11.2	LOS B	0.3	2.3	0.17	0.64	46.5
2	T1	180	31.6	0.394	58.1	LOS E	5.4	47.7	0.92	0.73	29.5
3	R2	316	4.0	0.905	55.0	LOS E	17.9	129.3	1.00	0.92	22.1
Approach		531	13.1	0.905	53.2	LOS D	17.9	129.3	0.92	0.84	25.9
NorthEast: Matakana Link Road											
4	L2	159	7.3	0.130	8.1	LOS A	2.4	17.6	0.30	0.59	43.9
5	T1	204	3.6	1.081	178.8	LOS F	35.6	262.3	1.00	1.51	12.1
6	R2	401	10.8	1.081	183.4	LOS F	35.6	262.3	1.00	1.39	12.4
Approach		764	8.1	1.081	145.7	LOS F	35.6	262.3	0.85	1.26	13.8
NorthWest: SH1 (North)											
7	L2	708	3.6	0.813	26.3	LOS C	29.9	215.5	0.77	0.84	41.4
8	T1	545	13.1	0.941	67.8	LOS E	19.1	148.4	1.00	1.03	26.7
9	R2	322	13.1	0.846	60.6	LOS E	20.6	160.7	0.91	0.90	30.5
Approach		1576	8.8	0.941	47.7	LOS D	29.9	215.5	0.88	0.92	32.8
SouthWest: Western Collector											
10	L2	492	12.2	0.424	13.2	LOS B	13.3	102.9	0.49	0.67	46.3
11	T1	373	2.8	1.089	170.4	LOS F	43.1	309.0	1.00	1.60	12.7
12	R2	48	0.0	0.139	54.0	LOS D	2.7	18.7	0.87	0.73	26.0
Approach		913	7.7	1.089	79.6	LOS E	43.1	309.0	0.72	1.05	23.4
All Vehicles		3783	9.0	1.089	76.0	LOS E	43.1	309.0	0.84	1.01	23.5

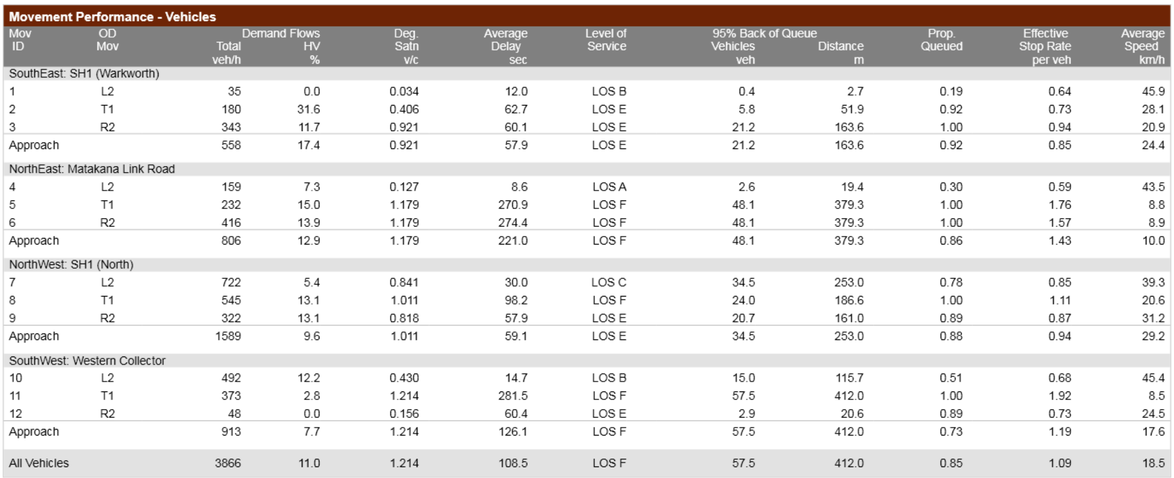
Figure 30 – Matakana link road intersection PM, no construction traffic, full network scenario



Movement Performance - Vehicles

Mov	OD	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Average
ID	Mov	Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: SH1 (Warkworth)											
1	L2	35	0.0	0.033	10.7	LOS B	0.3	2.1	0.15	0.64	47.0
2	T1	180	31.6	0.406	62.7	LOS E	5.8	51.9	0.92	0.73	28.1
3	R2	343	11.7	0.921	60.1	LOS E	21.2	163.6	1.00	0.94	20.9
Approach		558	17.4	0.921	57.8	LOS E	21.2	163.6	0.92	0.85	24.4
NorthEast: Matakana Link Road											
4	L2	159	7.3	0.127	8.6	LOS A	2.6	19.4	0.30	0.59	43.5
5	T1	204	3.6	1.183	273.5	LOS F	50.0	379.5	1.00	1.73	8.7
6	R2	443	19.2	1.183	278.5	LOS F	50.0	379.5	1.00	1.58	8.7
Approach		806	12.9	1.183	224.0	LOS F	50.0	379.5	0.86	1.43	9.8
NorthWest: SH1 (North)											
7	L2	722	5.4	0.841	30.0	LOS C	34.5	253.0	0.78	0.85	39.3
8	T1	545	13.1	1.011	98.2	LOS F	24.0	186.6	1.00	1.11	20.6
9	R2	322	13.1	0.818	57.9	LOS E	20.7	161.0	0.89	0.87	31.2
Approach		1589	9.6	1.011	59.1	LOS E	34.5	253.0	0.88	0.94	29.2
SouthWest: Western Collector											
10	L2	492	12.2	0.430	14.7	LOS B	15.0	115.7	0.51	0.68	45.4
11	T1	373	2.8	1.214	281.5	LOS F	57.5	412.0	1.00	1.92	8.5
12	R2	48	0.0	0.156	60.4	LOS E	2.9	20.6	0.89	0.73	24.5
Approach		913	7.7	1.214	126.1	LOS F	57.5	412.0	0.73	1.19	17.6
All Vehicles		3866	11.0	1.214	109.1	LOS F	57.5	412.0	0.84	1.09	18.4

Figure 31 – Matakana link road intersection PM, with construction traffic, full network scenario



Movement Performance - Vehicles

Mov	OD	Demand Flows		Deg.	Average	Level of	95% Back of Queue		Prop.	Effective	Average
ID	Mov	Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: SH1 (Warkworth)											
1	L2	35	0.0	0.034	12.0	LOS B	0.4	2.7	0.19	0.64	45.9
2	T1	180	31.6	0.406	62.7	LOS E	5.8	51.9	0.92	0.73	28.1
3	R2	343	11.7	0.921	60.1	LOS E	21.2	163.6	1.00	0.94	20.9
Approach		558	17.4	0.921	57.9	LOS E	21.2	163.6	0.92	0.85	24.4
NorthEast: Matakana Link Road											
4	L2	159	7.3	0.127	8.6	LOS A	2.6	19.4	0.30	0.59	43.5
5	T1	232	15.0	1.179	270.9	LOS F	48.1	379.3	1.00	1.76	8.8
6	R2	416	13.9	1.179	274.4	LOS F	48.1	379.3	1.00	1.57	8.9
Approach		806	12.9	1.179	221.0	LOS F	48.1	379.3	0.86	1.43	10.0
NorthWest: SH1 (North)											
7	L2	722	5.4	0.841	30.0	LOS C	34.5	253.0	0.78	0.85	39.3
8	T1	545	13.1	1.011	98.2	LOS F	24.0	186.6	1.00	1.11	20.6
9	R2	322	13.1	0.818	57.9	LOS E	20.7	161.0	0.89	0.87	31.2
Approach		1589	9.6	1.011	59.1	LOS E	34.5	253.0	0.88	0.94	29.2
SouthWest: Western Collector											
10	L2	492	12.2	0.430	14.7	LOS B	15.0	115.7	0.51	0.68	45.4
11	T1	373	2.8	1.214	281.5	LOS F	57.5	412.0	1.00	1.92	8.5
12	R2	48	0.0	0.156	60.4	LOS E	2.9	20.6	0.89	0.73	24.5
Approach		913	7.7	1.214	126.1	LOS F	57.5	412.0	0.73	1.19	17.6
All Vehicles		3866	11.0	1.214	108.5	LOS F	57.5	412.0	0.85	1.09	18.5

Figure 32 – Matakana link road intersection PM, with construction traffic, full network scenario, using Western Collector for hauling

APPENDIX C: COORDINATION WITH RAYONIER MATARIKI FOREST

Rayonier Matariki Forest (RMF) will be felled prior to the construction of the Indicative Alignment, currently assumed to be 2030, As Project construction is expected to begin in 2030, there is the potential for interaction between Project construction traffic and logging trucks from the forest harvest operation.

The forest harvest schedule for their forest west of existing SH1 was provided from RMF. We used the schedule to estimate post-2030 annual forest truck movements onto existing SH1 via Coach Access Road, Dibble Road, River Road and Saunders Road. No post-2030 harvesting was scheduled for movements to Kaipara Flats Road. RMF also provided an estimate for the number of trucks required per hectare of harvest (18 logging trucks/ha) over a 3 to 6 month period, so we derived the daily logging truck movements assuming the worst case 3 month period (60 working days) and allowing for entry and egress. RMF has stated that the logging trucks may exit to the north or south onto SH1, so the truck movements we have calculated reflect this uncertainty.

RMF data for upgrades to their forestry roads was also provided, assuming the need for 6 trucks of imported gravel per hectare. Taking account of the extensive harvesting prior to 2030, we have assumed that these upgrades and the associated gravel truck movements will occur prior to commencement of the Project construction.

We also note that light vehicle traffic will also be associated with the forest harvest operations, although these movements are not expected to be significant for the Project construction.

The results of our assessment for the estimated number of logging trucks per day (vpd) are summarised in Table 8 below.

Table 8 – Potential Forest Logging Truck Movements (vpd), both directions

Location	2030	2031	2032	2033	2034
Coach Access Road/ SH1	13	16	0	0	0
Dibble Road/SH1	114	21	152	0	12
River Road/SH1	2	0	0	0	0
Saunders Road/SH1	2	0	0	0	7

Table 9 shows the estimated hourly logging truck movements, assuming that hauling is evenly spread over a 9-hour work day.

Table 9 – Potential Forest Logging Truck Movements (vph), both directions

Location	2030	2031	2032	2033	2034
Coach Access Road/ SH1	1	2	0	0	0
Dibble Road/SH1	13	2	17	0	1
River Road/SH1	0	0	0	0	0

Location	2030	2031	2032	2033	2034
Saunders Road/SH1	0	0	0	0	1

In terms of capacity on existing roads, logging vehicles that travel north once they exit onto the existing SH1 are not expected to impact the Project construction traffic. Logging vehicles only have the potential to cause capacity issues for Project construction traffic if they travel south and pass through Warkworth; however, those issues are only expected to arise during the evening peak. We have recommended that hauling for the Project cease during evening peak hours. If that recommendation is followed, we do not expect that logging traffic will impact our assessment of construction traffic.

Two of the exit gates for logging trucks, Dibble Road and Coach Access Road, have been proposed as site access points for the Project. Site access points that will be used for both the Project and logging will require coordination to ensure smooth operation that does not impede on SH1.