Air Quality Assessment

December 2017

Mt Messenger Alliance

Technical Report 11

NZ TRANSPORT AGENCY WAKA KOTAHI

Mt Messenger Bypass

New Zealand Government

Quality Assurance Statement			
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Contents

Glossary

Acronym /Term	Definition
AADT	Annual average daily traffic
CO	Carbon monoxide
FIDOL	Frequency, intensity, duration, offensiveness/character and location. Factors used to qualitatively assess whether dust is likely to have an objectionable or offensive effect.
HCV	Heavy commercial vehicles
MFE	Ministry for Environment
NO_2	Nitrogen dioxide
$PM_{2.5}$	Fine particulate matter with an equivalent aerodynamic diameter of less than 2.5 micrometres.
PM_{10}	Fine particulate matter with an equivalent aerodynamic diameter of less than 10 micrometres.
SO_2	Sulphur dioxide
TSP	Total suspended particulate matter

Executive Summary

This report includes an assessment of the potential air quality effects arising from the construction and operational phases of the proposed improvements to the Mt Messenger section of SH3 ('the Project').

The assessment draws the following conclusions:

- Existing air quality in the vicinity of the Project is very good;
- There are only three residential houses within 200 m of the Project and these are located at the northern and southern extremities of the Project. Houses are located between 30 m and 120 m from the closest construction activities. With standard dust controls in place, the risk of adverse effects of dust from construction activities at these houses is low;
- Proposed dust control measures for the construction phase of the Project are set out in the Dust Management Plan attached in Volume 5 of the AEE. The implementation of the Dust Management Plan will effectively mitigate the potential dust effects on the nearby houses;
- Effects of dust on plants are associated with high dust loadings sufficient to result in visible coating of the leaves within 10 m of proposed works, particularly in strong winds and dry conditions. The potential effects on ecological values are addressed in the assessments of ecological effects included in Volume 3 of the AEE;
- The NZ Transport Agency's air quality screening model predicts low concentrations of air contaminants as a result of the operational stage of the Project. Predicted maximum concentrations with the Project are well below the relevant human health and ecosystem-based air quality criteria and NZ Transport Agency significance criteria;

The NZ Transport Agency's air quality screening model predicts that there will be no significant change in concentrations of air quality contaminants between the "With Project" and "Without Project" scenarios for the assessment year. Additionally there is not predicted to be any significant change in concentrations between the baseline year and assessment year. The risk of adverse effects "With Project' are negligible. No mitigation of operation effects on air quality is necessary.

1 Introduction

1.1 Scope of report

This report forms part of a suite of technical reports prepared for the NZ Transport Agency's Mt Messenger Bypass project (the Project). Its purpose is to inform the Assessment of Effects on the Environment Report (AEE) and to support the resource consent applications and Notice of Requirement to alter the existing State Highway designation, which are required to enable the Project to proceed.

This report assesses the air quality effects of construction and operation the Project as shown on the Project Drawings in Volume 2: Drawing Set.

The purpose of this report is to:

- Assess potential effects of discharges to air from construction (principally dust emissions) on sensitive receptors, including residential houses and sensitive vegetation;
- Assess the potential effects of discharges to air from motor vehicles using the proposed alignment, once the road is operational; and
- Recommend mitigation of air quality effects from proposed works.

1.2 Project overview

The Project involves the construction and ongoing operation of a new section of State Highway 3 (SH3), generally between Uruti and Ahititi to the north of New Plymouth. This new section of SH3 will bypass the existing steep, narrow and winding section of highway at Mt Messenger. The Project comprises a new section of two lane highway, approximately 6 km in length, located to the east of the existing SH3 alignment.

The primary objectives of the Project are to enhance the safety, resilience and journey time reliability of travel on SH 3 and contribute to enhanced local and regional economic growth and productivity for people and freight.

A full description of the Project including its design, construction and operation is provided in the Assessment of Effects on the Environment Report, contained in Volume 1: AEE, and is shown on the Drawings in Volume 2: Drawing Set.

2 Statutory framework

The management of discharges of contaminants to air associated with the construction and operation of the Project will be subject to the provisions of the Resource Management Act 1991 (RMA).

The Regional Air Quality Plan for Taranaki (2011) (RAQP), prepared under the RMA, sets out the objectives and policies of the Taranaki Regional Council in relation to discharges to air. There are four objectives for air quality in the Taranaki region, being:

1. *To maintain the existing high standard of ambient air quality in the Taranaki region and to improve air quality in those instances or areas where air quality is adversely affected, whilst allowing for communities to provide for their economic and social wellbeing.*
2. *To safeguard the life-supporting capacity of air throughout the Taranaki region.*
3. *To provide for activities discharging to air.*
4. *To avoid, remedy or mitigate the adverse effects of activities discharging contaminants to air in the Taranaki region, including adverse effects on the amenity and aesthetic qualities of air.*

The policies to implement these objectives are grouped into eleven categories. The policies relevant to the Project are set out under the following category headings:

Category 1 Contaminants and effects;

Category 2 The management of air quality; and

Category 6 Discharge of contaminants to air from site development, earthworks or the application of soil conditioners.

An evaluation of the Project against the relevant policies in the RAQP is set out in Appendix D. This evaluation concludes that the Project complies with all relevant policies.

3 Environmental setting

3.1 Meteorology

In relation to road construction projects, wind conditions and rainfall are key factors affecting the generation of dust and potential effects. Dust emissions are increased during dry, windy conditions and conversely supressed under wet conditions. Dust pick-up by wind is usually only significant at wind speeds above 5 m/s and increases with increasing wind speed.

Meteorological conditions are also relevant to the dispersion of air emissions, during both the construction and operational phases. Calm wind conditions are associated with poor dispersion of discharges to air and therefore represent the worst case conditions for air quality impacts.

The following sub-sections describe the wind and rainfall patterns in the vicinity of the Project.

3.2 Wind conditions

There are no meteorological stations in the immediate vicinity of the Project. The closest meteorological stations measuring wind conditions are located at Awakino and New Plymouth Airport, around 30km north and 35km southwest of the Project, respectively. Wind roses prepared from data for the years 2011 to 2013 are presented in Figures 1 and 2. Wind roses depict the frequency of winds from different directions and in different wind speed bands (indicated by colour).

The predominant wind directions recorded at Awakino are from the east and west with very little winds from the north and south. Awakino is located at the mouth of the Awakino River and the wind pattern will reflect the orientation of the river valley. Awakino experiences a high proportion of strong winds, with approximately 48% of winds above 5m/s and 12% of winds above 10 m/s. The very high winds recorded from the west (onshore) reflect the exposed coastal nature of this site. The station records a very low proportion of calm periods (0.03%, or 2 to 3 hours per year), which are classed as winds less than 0.5m/s.

The New Plymouth Airport station records predominant wind directions from the southeast/south southeast and west/west southwest. The Airport is in a flat, exposed coastal location on the northern side of the Taranaki Bight, and wind conditions are strongly influenced by broad-scale weather conditions and terrain (orientation of the coastline and Mt Taranaki). The airport also experiences a high proportion of strong winds, with approximately 47% of winds above 5m/s and 9% of winds above 10m/s.

The proposed Project route is through complex terrain and largely follows a steep-sided valley. While winds may align broadly with those measured at the two meteorological stations, it is likely that wind conditions will vary along the route and will largely be determined by local terrain. At any particular location, winds will tend to be aligned with the orientation of the valley.

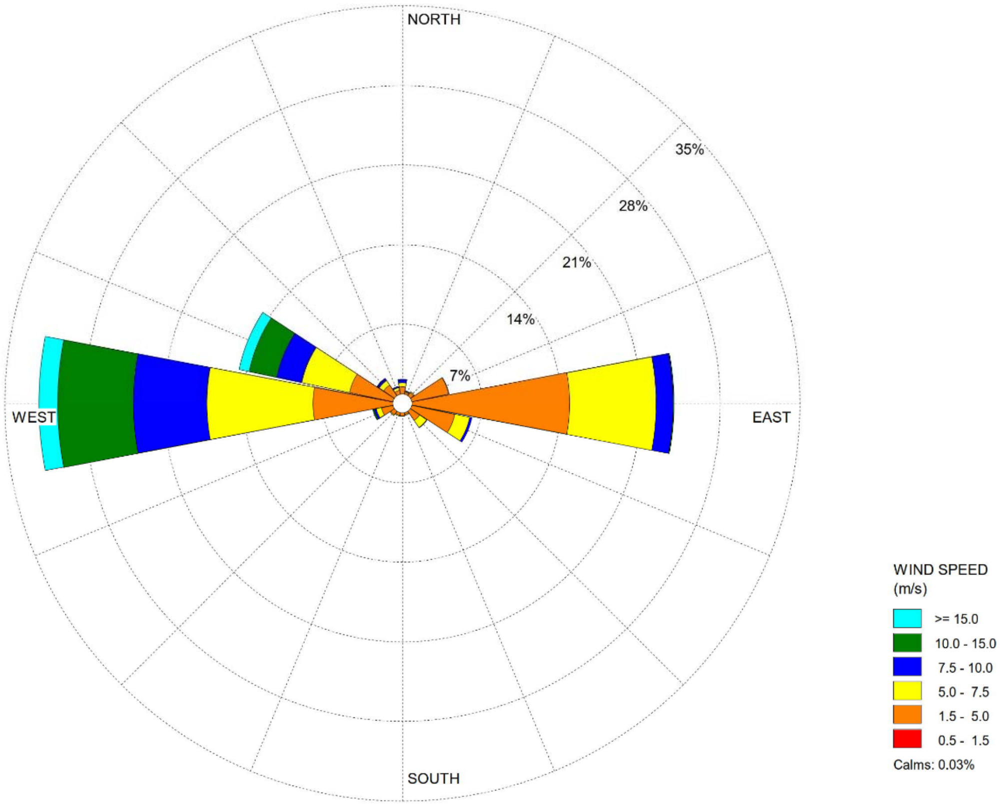

Figure 3.1 – Awakino wind rose for the years 2011-2013

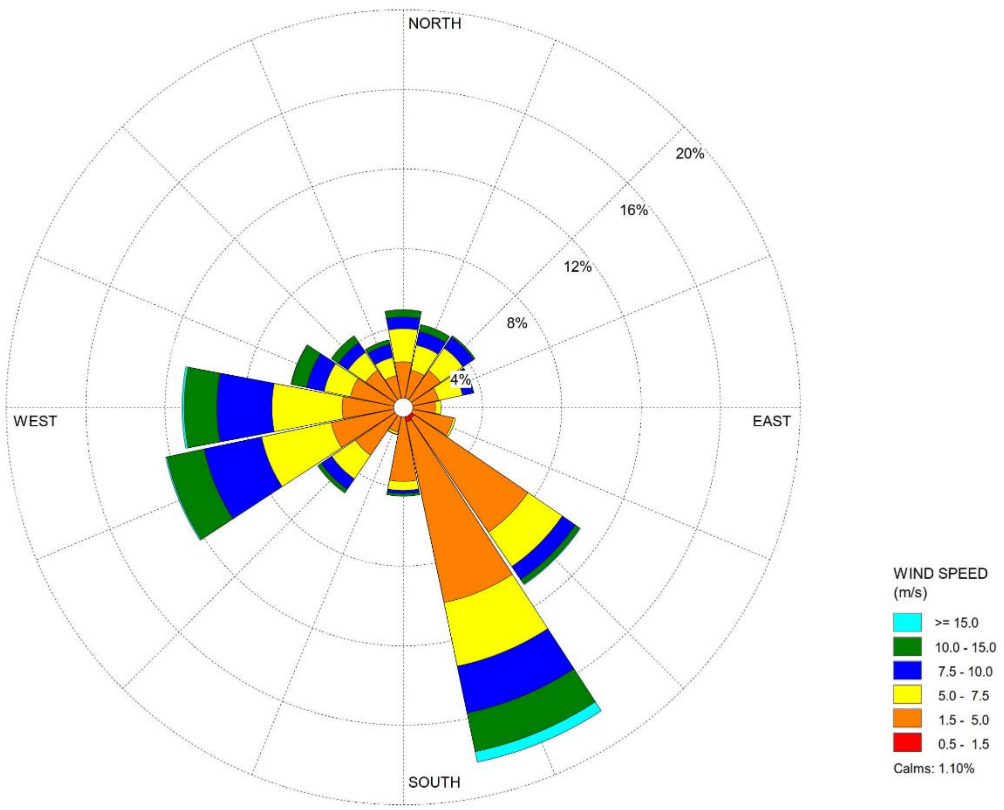

Figure 3.2 – New Plymouth wind rose for the years 2011-2013

3.3 Rainfall

The closest meteorological station in the vicinity of the Project that measures rainfall is at Urenui, approximately 20 km southwest. The rainfall measured at the Urenui station will be broadly applicable to the expected rainfall in the Project area. Daily rainfall has been measured from 2003 to 2017. Monthly average precipitation for the years January 2003 to December 2016 are shown in Figure 3.3 below. The area generally experiences high rainfall but November and January through to March typically experience less rainfall compared to other months.

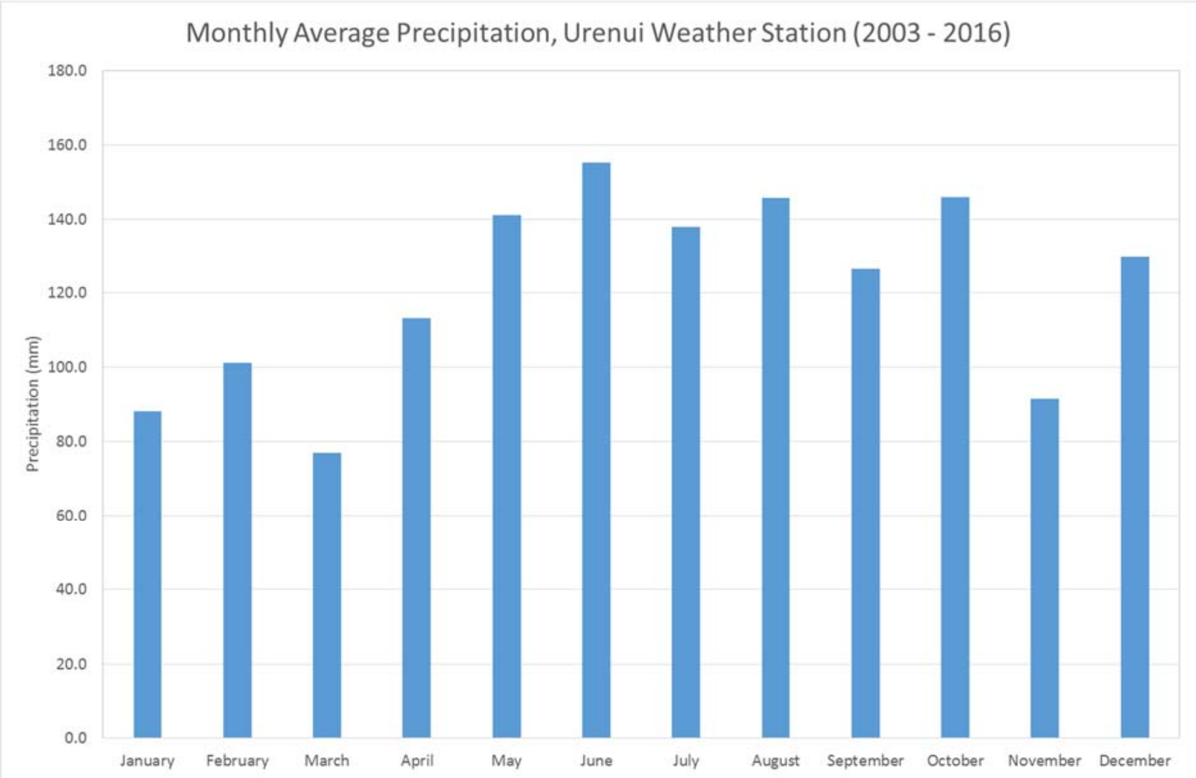

Figure 3.3 – Monthly average precipitation at the Urenui Weather Station (January 2003 to December 2016)

3.4 Existing air quality

The Project is located in a relatively undeveloped rural area characterised by low intensity farming (particularly at the northern and southern ends of the alignment) and bush. Anthropogenic air emissions in the area are very limited and will have only localised effects (e.g. motor vehicles using the existing SH3; domestic heating emissions, if any, from the residential houses along the route and intermittent discharges from farming activities). Non-anthropogenic sources of particulate that will contribute to background levels include marine aerosols. Existing air quality is expected to be very good.

The Project is not located in a gazetted airshed and has not been identified by the regional council as an area where air quality is likely to exceed the ambient air quality standards[1]

The air quality contaminants of interest in relation to this assessment are particulate matter (PM_{10}) and nitrogen dioxide (NO_2). The nearest air quality monitoring sites are in urban areas of New Plymouth, and are unlikely to be representative of air quality in the vicinity of the Project. The NZ Transport Agency has developed conservative default background air quality values that can be used where local monitoring data are not available[2]. The default background concentrations of these air contaminants recommended by the NZ Transport Agency for the Project are:

- PM_{10}: 18.8 µg/m^3 (24-hour average); and
- NO_2: 23 µg/m^3 (1-hour average), 37 µg/m^3 (24-hour) and 4 µg/m^3 (annual average).

3.5 Sensitive Receptors

3.5.1 Human health and amenity effects

For the purpose of an air quality assessment, sensitive receptors are locations where people or surroundings may be particularly sensitive to the effects of air pollution. Examples include residential houses, hospitals, schools, early childhood education centres, childcare facilities, rest homes, marae, other cultural facilities, and sensitive ecosystems[3]. In terms of human health and amenity impacts, the only sensitive receptors identified in the vicinity of the Project are residential houses.

Discharges of dust from earthworks and construction activities typically deposit onto the ground within approximately 100m of the activity. In open conditions, there is unlikely to be any appreciable effect of dust from construction activities at distances over 200m. Dense vegetation acts as a filter to dust emissions, with dust being captured on the leaves. Consequently where earthworks are carried out in areas of bush, dust is unlikely to penetrate more than a distance of the order of 10 to 20m.

The effects of discharges from vehicles using roads (vehicle exhaust emissions and brake and tyre wear) also reduce significantly with increasing distance from the road. Studies have shown that beyond 50m from the road, any impacts of the road are not discernible from background concentrations[4].

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[1] A gazetted airshed is a part of the region of a regional council that is specified by the Minister by notice in the Gazette to be a separate airshed. An area would typically be gazetted as an airshed because the regional council has identified that air quality is likely to exceed one or more of the New Zealand Ambient Air Quality Standards.

[2] https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/tools/air-quality-map/

[3] NZ Transport Agency, Guide to Assessing Air Quality Impacts from State Highway Projects, Version 2.0, December 2014, Draft

[4] Laxen, D. and Marner, B. NO_2 Concentrations and Distance from Roads. Air Quality Consultants Ltd. 2008

For the reasons sets out above, we consider that there are only three sensitive residential receptors in the vicinity of the Project. These are the three houses located within 200m of the Project:

- 3072 Mokau Road (SH3) at the northern end of the alignment, 90m from the proposed construction yard, 97m from the nearest point of earthworks and 112 m from the proposed road edge (118m to the existing SH3 alignment);
- 2528 Mokau Road at the southern end of the alignment, 120m from the nearest point of earthworks and 117m from the proposed road edge (no change in distance to the existing alignment); and
- 2397 Mokau Road at the southern end of the alignment, 30m from the proposed southern stockpile area. The dwelling is greater than 200m from the proposed road edge.

For completeness, we also note that there is a house at 2750 Mokau Road, which is 300m from the nearest point of earthworks and 350m from the proposed road edge (510m to the existing SH3 alignment). This house is located on the opposite side of a ridgeline to the proposed works and therefore dust is unlikely to be transported to this site.

3.5.2 Ecological receptors

Dust emissions during road construction have the potential to adversely affect ecosystems in close proximity to works.

The sensitivity of different plant species to dust deposition will vary. Commercial crop species are sensitive to dust because it can cause marking and consequent downgrading of produce, and reduced effectiveness of pesticide sprays. The area adjacent to the Project is not used for horticulture and the area is not considered sensitive to these effects.

We have not identified any published information on the particular sensitivity of native New Zealand plant species to the effects of high dust loadings. A plant's sensitivity will depend on a variety of factors. For example, large flat leaves are more prone to accumulation of dust compared to narrow leaves with a smaller surface area. The location within the canopy will influence both the rate of dust deposition and the rate at which dust is washed off by rainfall. In the absence of specific information, we have assumed that all the bush areas along the proposed alignment are sensitive to dust deposition[5].

Plant species can also be adversely affected by gaseous contaminants, such as nitrogen dioxide, from motor vehicle exhausts during the operational phase of the Project.

[5] Mt Messenger Bypass Investigation – Botanical Investigation and Assessment of Effects, Nicolas Singers Ecological Solutions Ltd, 13 April 2017. Report Ref. 34:2016/17.

4 Discharges to air

4.1 Construction phase

4.1.1 Overview

Discharges to air from road construction activities primarily relate to dust generated by earthworks.

Other minor air discharges from construction activities may include odour, if contaminated soils are disturbed, or from exhaust emissions from construction vehicles and plant. The Contaminated Land Assessment (Technical Report 12, Volume 3 of the AEE) concludes that a small number of isolated contaminated sites (e.g. farm dumps) have been identified along the alignment that have the potential to cause odour. None of these sites are in close proximity to the nearest residential houses, with the nearest earthworks being at least 90 m away, and therefore the potential for odour effects has not been considered further in this report. The separation distance to residential houses is such that they would not be impacted by exhaust emissions from construction vehicles and plant.

4.1.2 Factors affecting dust generation

There are a number of factors which influence the potential for dust to be generated. These include:

- Surface wind speed – dust emissions from exposed surfaces generally increase with wind speed. Dust transported by wind becomes significant at wind speeds greater than 5m/s, above 10m/s dust picked up by wind increases rapidly;
- Moisture content of the material – moisture binds particles together and prevents dust from being generated through surface wind or disturbances such as vehicle movement;
- The area of the exposed surface – the higher the area of exposed surface, the larger the potential for dust generation will be. Vegetation of exposed surfaces significantly decreases the potential for generation of dust by binding particles together and reducing surface energy;
- Percentage of fine particles in the material – fine particles are more easily picked up by wind or other disturbances; and
- Disturbance of materials – movements of vehicles, excavators and other machinery used to transport, work, or distribute materials can increase dust generation. Vehicles may break down materials during travel over surfaces, reducing the resultant dust particle size. During transport dust particles may be lifted from exposed surfaces and sucked into the turbulent wake behind the vehicles. Dust can also be generated through the turbulence caused during excavation or movement of materials.

4.1.3 Potential dust sources

There is potential for dust to be generated from the following construction activities during the proposed works:

- Construction yard, site and haul road establishment;
- Topsoil removal and distribution;
- Excavations;
- Cut and fill operations;
- Soil stabilisation and base course construction;
- Loading and unloading of bulk materials;
- Stockpiling of materials, including unloading and placement;
- Vehicle movements on unsealed roads; and
- Wind erosion from exposed areas and stockpiles.

The risk of exposure of sensitive receptors to dust emissions depends on the following factors:

- Proximity of sensitive receptors to construction activities that could give rise to dust emissions; and
- Frequency and duration of meteorological conditions that are likely to transport dust towards the sensitive receptors (e.g. dry conditions and strong winds (greater than 5 m/s) in the direction of receptors).

The most significant source of dust generation is likely to be unstabilised, dry exposed surfaces, such as stockpiles and exposed areas during earthworks and vehicle movements on unsealed haul roads.

4.2 Operational phase

Once the new alignment has been opened, there will be emissions to air comprising exhaust emissions and brake and tyre wear from vehicles. There are a variety of air contaminants from motor vehicle emissions, including carbon monoxide (CO), sulphur dioxide (SO_2), fine particulates (PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2).

Sulphur dioxide (SO_2) and carbon dioxide (CO) concentrations arising from road traffic have been consistently shown to comply with national air quality standards and guidelines, except in close proximity to roads with high annual average daily traffic (AADT) and significant congestion. This section of SH3 is not expected to have high AADT or significant congestion (as noted in Section 5.2.2). Therefore the focus of the assessment of discharges to air during the operational phase is PM_{10} and NO_2 because if the assessment of these contaminants is within relevant assessment criteria, then there is reasonable confidence that levels of other traffic related pollutants will also be acceptable.

5 Assessment methodology

5.1 Construction dust effects

There are two approaches that can be taken to assessing the environmental effects of dust emissions[6]

- A quantitative assessment comprising estimates of dust emission rates, dispersion modelling predictions of the resulting dust concentrations and comparison with numeric assessment criteria; and
- A qualitative assessment taking into account the likely frequency, intensity, duration, offensiveness/character and location of the dust effects and making a conclusion as to whether the dust emissions are likely to have an objectionable or offensive effect (a 'FIDOL assessment').

In this case, we consider that a FIDOL assessment is appropriate for the following reasons:

- It is difficult to accurately quantify the rate of dust emissions, so dispersion modelling predictions will be inaccurate;
- There are a small number of discrete sensitive receptors to be considered; and
- The risk of adverse effects at these receptors is low because of the relatively large separation distance and/or dust generation from the activity can be adequately controlled through implementing standard dust controls.

The FIDOL assessment considers the three sensitive receptors identified in Section 3.5.1 (2397, 2528 and 3072 Mokau Road).

5.2 Operational phase

5.2.1 Air quality screening model

The methodology for assessing operational air quality effects is based on the NZ Transport Agency Guide[3]. The NZ Transport Agency Guide provides guidance on how to assess the air quality impacts associated with state highway improvement projects and sets out minimum requirements for good practice, but does not preclude higher standards being adopted for projects. The Guide is more current than the MfE Good Practice Guide for Assessing Discharges to Air from Land Transport[7] and incorporates assessment techniques which have been developed and validated after the release of the MfE Good Practice Guide.

The NZ Transport Agency Guide recommends use of the Transport Agency's air quality screening model which considers the effect of PM_{10} and NO_2. Almost all of the PM_{10}

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[6] Ministry for the Environment, Good Practice Guide for Assessing and Managing Dust, November 2016
[7] Ministry for the Environment, Good practice guide for assessing discharges to air from land transport, June 2008, Publication reference number: ME 881.

emissions associated with motor vehicle emissions is present as $PM_{2.5}$. Therefore, the air quality screening model results for PM_{10} can be used to infer $PM_{2.5}$ air quality effects.

The assessment focuses on the effects of vehicle emissions on the nearest sensitive receptors. The assessment includes evaluating the existing effects of traffic emissions ('baseline') and also the potential effects of traffic emissions through 'with Project' and 'without Project' scenarios.

The NZ Transport Agency Guide recommends the evaluation of likely effects resulting from the operation of surface roads be initially based on the web-based air quality screening model. This model is designed to provide a worst case assessment of air quality impacts from a single road for the two key transport-related air pollutants – particulate matter (PM_{10}) and nitrogen dioxide (NO_2). If the results of the air quality screening model indicate that the air quality risk is likely to be low, then further modelling work should not be required and the model output should provide sufficient detail to inform the air quality assessment.

The NZ Transport Agency's air quality screening model for surface road effects has therefore been used to provide a conservative assessment of air quality impacts from the proposed SH3 improvements for air quality contaminants PM_{10} and NO_2. The air quality screening model incorporates the annual average daily traffic (AADT), proportion of heavy vehicles, average vehicle speed, and the distance to the nearest identified sensitive receptor for each road link.

5.2.2 Traffic Data

Traffic estimates for SH3 over years 2017, 2027, 2037 and 2047 are set out in the Traffic and Transport Assessment (Technical Report 2, Volume 3 of the AEE). Projected traffic volumes are based on the measured 2016 AADT and heavy commercial vehicles (HCV) counts and AADT growth between 2007 and 2016.

The NZ Transport Agency's air quality screening model allows for assessment years between 2010 through to 2030, enabling past, current and future predictions. The assessment year for the modelling has therefore been taken as 2027.

The traffic assessment includes the predicted AADT and proportion of HCVs. The traffic assessment assumes a speed of 90km/hr during free flow traffic conditions, which has been adopted for this assessment.

Predicted AADT and percentage HCV[8] that have been used in the air quality screening assessment are provided in Table 5.1.

[8] HCV has been rounded to the nearest whole number in the air quality screening model.

Table 5.1 – Predicted daily AADT for SH3 Uruti to Tongaporutu

Assessment year	AADT	No. HCV	HCV (%)
2017	2364	459	19%
2027	2996	550	18%

5.2.3 Air quality assessment criteria

As outlined in Section 4.2, the contaminants of interest for this assessment are PM_{10} and NO_2. The relevant health-based ambient air quality criteria for these contaminants are set out in the following (and are summarised in Table 5.2):

- The Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (NESAQ), which include ambient air quality standards (AAQS) for PM_{10} (24 hour average) and NO_2 (1-hour average);
- The New Zealand Ambient Air Quality Guidelines[9] (AAQG), which are consistent with the NESAQ but include some additional criteria including PM_{10} (annual average) and NO_2 (24-hour average); and
- The World health Organization (WHO) global air quality guidelines, which include an annual average criterion for NO_2. This annual criterion is generally used in New Zealand, in the absence of an equivalent NZ guideline or standard, for assessing effects of long term exposure to NO_2 from motor vehicle emissions.

Table 5.2 – Ambient air quality standards and guidelines

Pollutant Human health-based	Threshold concentration	Time average	Reference
Fine particulate (PM_{10})	50 $\mu g/m^3$ 20 $\mu g/m^3$	24-hours Annual	AAQS AAQG
Nitrogen dioxide (NO_2)	200 $\mu g/m^3$ 100 $\mu g/m^3$ 40 $\mu g/m^3$	1-hour 24-hours Annual	AAQS AAQG WHO

[9] Ministry for the Environment, Ambient air quality guidelines: 2002 update, May 2002.

The NZ Transport Agency[3] has developed 'significance criteria' for use with the screening air quality modelling (as set out in Table 5.3). The significance criteria are expressed as follows:

- The project contribution – the pollutant concentration predicted to be contributed by the operation of the road/link under consideration as a percentage of the air quality guideline; and
- The cumulative contribution – the pollutant concentration predicted to be contributed by the operation of the road/link under consideration plus the estimated background air quality at that location, as a percentage of the air quality guideline.

Table 5.3 – Air quality significance criteria

Pollutant	Limit	Averaging time	Significance criteria	
			Project contribution	Cumulative contribution
Nitrogen dioxide (NO_2)	40 $\mu g/m^3$	Annual	10%	90%
Fine particulate (PM_{10})	50 $\mu g/m^3$	24-hour	10%	90%

The risk of an adverse air quality effect is determined by comparing the screening model output with the significance criteria in Table 5.3. If the results are less than the significance criteria then the air quality risk is considered to be low, meaning that air quality effects are likely to be less than the human health-based ambient air quality standards and guidelines in Table 2 (including the other averaging periods not specifically assessed in the model). In this case, the screening model output is generally sufficient to demonstrate the levels of effects and no further assessment is required.

6 Assessment of effects

6.1 Construction dust effects

6.1.1 Potential effects of dust emissions

The size of dust particles (often referred to as their 'aerodynamic diameter') determines how long a particle will remain suspended in the air and also the potential health effects of exposure. Larger particles will drop out of the air in a shorter time than smaller particles, while smaller particles will remain airborne for longer.

Particulate matter can be characterised in a number of ways, as described below:

- Deposited dust – generally greater than 20 micron (µm) and refers to the size fraction that falls out of the air and deposits on exposed surfaces
- Total suspended particulates (TSP) – refers to the particulate size fraction suspended in air at the time of sampling and generally consists of particles smaller than 30 µm.
- PM_{10} (particles with an aerodynamic diameter less than 10 µm) will penetrate the nose or mouth under normal breathing conditions, and is the most commonly used indicator of the potential for health effects.
- $PM_{2.5}$ (particles less than 2.5 µm in size) are the very fine subset of PM_{10}. There is increasing evidence that $PM_{2.5}$ is of greater concern than PM_{10} with regard to adverse health effects.

There are two main effects from particulate matter; nuisance/amenity effects and health effects. Nuisance/amenity effects are generally associated with deposited dust and the coarser fraction of TSP while health effects are generally associated with PM_{10} and $PM_{2.5}$, as these are able to penetrate the nose and mouth if breathed in, and can enter the lungs.

The dust emitted from construction activities (mechanically generated dust) will generally be in the deposited dust range (greater than 30 µm in diameter). As the proportion of fine particles in the emissions is likely to be low, the potential adverse effects are mainly associated with nuisance effects.

The effects of deposited dust are generally localised, as most deposited particulate will deposit out of the air within about 100 m of the source (except under very high wind speed conditions). Potential complaints about deposited dust include the visible soiling of surfaces such as house, furniture, cars and the visible deposition of dust on flowers and vegetable gardens. The nearest sensitive rural houses are also likely to collect rainwater from their roofs as a drinking water source.

Aside from potential amenity impacts, deposited dust (where there is high dust loading) also has the potential to impact on vegetation and ecosystems through:

- Interference with photosynthesis, potentially retarding plant growth and maturity time and the early senescence of leaves;

- Increased incidence of disease from dust accumulation in the crevices of plant surfaces, aiding moisture retention, which can provide a medium for growth of bacteria and fungi; and
- Deposited dust may also indirectly affect vegetation through impacts to beneficial insect species where dust can affect the insects ability to feed, or potentially can affect sensory organs of beneficial insects.

6.1.2 Evaluation of amenity effects of construction dust

Section 4.1 describes the nature of dust emissions from the proposed construction activities. The effects of these emissions have been evaluated using a FIDOL assessment as described in Section 5.1. The FIDOL assessment is used to evaluate the potential for dust emissions to cause offensive or objectionable dust effects on sensitive receptors, such as residential houses.

In summary, the FIDOL assessment (Table 6.1) shows that there is the potential for significant amounts of dust to be generated from the proposed construction activities during dry, windy weather conditions unless appropriate dust controls are implemented. Most of the area surrounding the Project is not sensitive to amenity effects of dust and there are only three residential houses located within 200m of the Project. The frequency and duration of construction activities in the vicinity of these houses is not currently well characterised. However, with a separation distance of at least 30m from activities and the use of standard dust control measures (see Section 7.1 and 7.2), the residual effects of dust are unlikely to be offensive or objectionable. For the same reasons, deposition of dust from construction activities is not at a scale that would be of concern for roof drinking water supply.

Table 6.1 – FIDOL Assessment

FIDOL Factors	Consideration
Frequency/ Duration – How often and how long an individual is exposed to the dust.	The Project is expected to take three years to construct, with general working hours between Monday to Sunday 6:30 am to 9:00 pm. Discharges of dust from earthworks and construction activities typically deposit onto the ground within approximately 100 m of the activity (assuming open ground). The nearest residential property is approximately 30 m from the nearest point of earthworks (stockpiling near 2397 Mokau Road) and this activity will therefore require targeted dust mitigation and management measures as there is a higher risk of dust effects. The other houses are located around 97 m and 120 m from the nearest point of earthworks. With dust controls in place there is not expected to be any appreciable exposure to dust at these residential houses.
Intensity – The concentration of the dust.	In strong winds and dry conditions there is high potential for dust generation without controls. Standard dust controls for earthworks

FIDOL Factors	Consideration
	activities, such as application of water, are effective at reducing dust emissions.
Offensiveness/character – The type of dust.	Offensiveness relates to the particular characteristics of the dust, such as colour, which may increase its potential for adverse effect. An example is black coal dust. Dust generated during the proposed works will be soils that do not have any particularly offensive characteristics. There is the potential for certain dusts, such as crushed aggregates or sand, to include crystalline silica, which can cause health effects from inhalation. With the available separation distance between activities and residential houses and with the implementation of targeted dust controls, the risk of offsite exposure to crystalline silica in dust is considered low.
Location – The type of land use and nature of human activities in the vicinity of the dust source.	Sparsely populated rural area with only 3 residential houses within 200 m of works. The proposed alignment passes through sensitive ecosystems. The residential houses will have a high sensitivity to dust, however with dust controls in place there is not expected to be any appreciable exposure.

6.1.3 Evaluation of ecological effects of construction dust

There are a limited number of studies correlating dust loadings with adverse effects, and none specifically relate to New Zealand native plants. However the effects of dust on plants identified in Section 6.1.1 are associated with high dust loadings sufficient to result in visible coating of the leaves. Depending on the density of the dust, dust loadings of this magnitude are unlikely to occur beyond around 10 m from the construction footprint. Bush areas within 10 m of dust generating construction activities could therefore experience high levels of dust at times, particularly in strong winds and dry conditions. Works will be of a relatively short duration in relation to particular sections of bush, as road construction progresses. We also understand that 'edge effects' on the bush margins are addressed in the Assessment of Ecological Effects – Vegetation (Technical Report 7a, Volume 3 of the AEE). Based on comments received from the NZ Transport Agency's terrestrial vegetation expert on the Mt Messenger Bypass project, Mr Nick Singers, we understand that any ecological effects of dust are not expected to be significant.

6.2 Operational phase air quality effects

The NZ Transport Agency's air quality screening model results for the baseline year (2017) and assessment year (2027) 'without Project' and 'with Project' (for the nearest sensitive residential receptor) are shown in Table 6.2. The screening model output files are provided in Appendix B.

The results show that the Project is not predicted to have significant contributions to NO_2 and PM_{10} concentrations when compared with significance criteria (Section 5.2.3) with maximum road contributions of 0.1% for NO_2 and 0.0% for PM_{10}. There is no increase in predicted contribution 'With Project' in comparison to the 'Without Project' scenario for the assessment year, or in comparison with the baseline year.

The results show that the concentrations of NO_2 and PM_{10} during the operational phase are well within the significance criteria and therefore the risk of adverse air quality effects is low. The finding that there will be no appreciable effects on PM_{10} air quality also demonstrates that there will also be no appreciable effect on $PM_{2.5}$ air quality (as the majority of PM_{10} emissions from motor vehicle will be present as $PM_{2.5}$).

Table 6.2 – Air quality screening model results for nearest residential receptor

		2017 (baseline year 'Without Project')	2027 ('Without Project')	2027 ('With Project')	Significance Criteria
PM_{10}	Road contribution (μg/m^3)	0.0	0.0	0.0	
	Road contribution to guideline (%)	0%	0%	0%	10%
	Background air quality (μg/m^3)	18.8	18.8	18.8	
	Cumulative contributions (μg/m^3)	18.8	18.8	18.8	
	Cumulative contribution to guideline (%)	38%	38%	38%	90%
NO_2	Road contribution (μg/m^3)	0.1	0.1	0.1	
	Road contribution to guideline (%)	0%	0%	0%	10%
	Background air quality (μg/m^3)	4.0	4.0	4.0	
	Cumulative contributions (μg/m^3)	4.1	4.1	4.1	
	Cumulative contribution to guideline (%)	10%	10%	10%	90%

The ecosystem-based assessment criterion for NO_2 is 30 μg/m^3 (annual average). The results of the NZ Transport Agency's air quality screening model (Appendix B) show that the Project is not predicted to have significant contributions to NO_2 concentrations at 10m from the road edge, where adjacent ecosystems would be exposed. The maximum road contribution is 0.5 μg/m^3 NO_2 (annual average) and cumulative contribution (with background) is 4.5 μg/m^3 NO_2 (annual average). The results show that predicted levels of NO_2 during the operational phase are well within the criterion and therefore any effects on ecosystems will be negligible.

7 Mitigation measures

7.1 Construction dust management

Good practice dust control methods can be used to mitigate or minimise the amount of dust generated during construction. In general, methods to mitigate dust effects include:

- Means to modify or control properties of the materials, to reduce the likelihood of the materials being transported by wind or turbulence. This may include wet suppression of materials, sealing or stabilising surfaces, or controlling traffic speeds; and
- Methods to shield or reduce wind velocity at surfaces. This may include covering/stabilising stockpiles, minimising stockpile heights or creating windbreaks where possible.

General control measures that can be used to mitigate and proactively manage dust generation are outlined in Table 7.1. These will be considered in the development of the Dust Management Plan for the Project, with measures implemented during construction dependent on the type of construction activities being undertaken, weather conditions and the proximity of works to sensitive receptors.

Table 7.1 – General dust mitigation and management measures

Dust source	Control measure
Stockpiles	• Limiting the height of stockpiles near sensitive receptors to reduce entrainment by wind. • Surfaces of stockpiles to be kept damp (e.g. through wet suppression systems), covered or stabilised to reduce dust generation in areas adjacent sensitive receptors. • Stockpiles oriented to maximise wind sheltering where possible.
Unsealed surfaces	• Where practical, compacting unconsolidated surfaces to minimise dust. • Stabilisation of surfaces when works are completed by grassing, metalling or sealing surfaces to reduce dust emissions. • Unsealed surfaces managed to reduce dust emissions in areas adjacent sensitive receptors (e.g. kept damp).
Vehicles	• Setting lower vehicle speed limits on unsealed surfaces adjacent sensitive receptors. • Reducing tracking of dust by regular cleaning of vehicles including wheels. • Covering truck loads if the materials carried are fine, dry or otherwise likely to generate dust and travelling off site.
Earthmoving and construction	• Minimise drop heights of materials to reduce dust generation.

Dust source	Control measure
	• Monitoring and managing of earthworks activities to limit dust generation during dry or windy weather conditions.
General	• Monitoring of site conditions (weather/soil conditions) to anticipate and prevent dust effects. • Limiting operations which have the potential to cause high dust during high wind events. • Use of water cart and sprays to keep surfaces damp as required adjacent sensitive receptors. A critical part of this control measure is identification of a sufficient water supply at the site for this purpose with adequate volume. • Cleaning paved surfaces if affected by tracking of transported dust.

7.2 Dust management plan

Good practice measures for dust control via a Dust Management Plan (DMP) is recommended to proactively manage dust emissions and avoid adverse effects during the construction phase of the Project.

The DMP will need to incorporate the following aspects:

- Identification of potential sources of dust taking into account the construction programme/methodology;
- Identification of sensitive receptors in proximity to identified potential sources of dust for targeted dust management;
- Dust management and mitigation measures to address dust effects;
- Monitoring of potential dust generation, including assessment of weather conditions/soil conditions and visual dust assessments;
- Training of staff in relation to dust management; and
- A dust complaint system so that action can be taken to avoid, remedy or mitigate dust events and adapt the dust management systems if adverse effects occur.

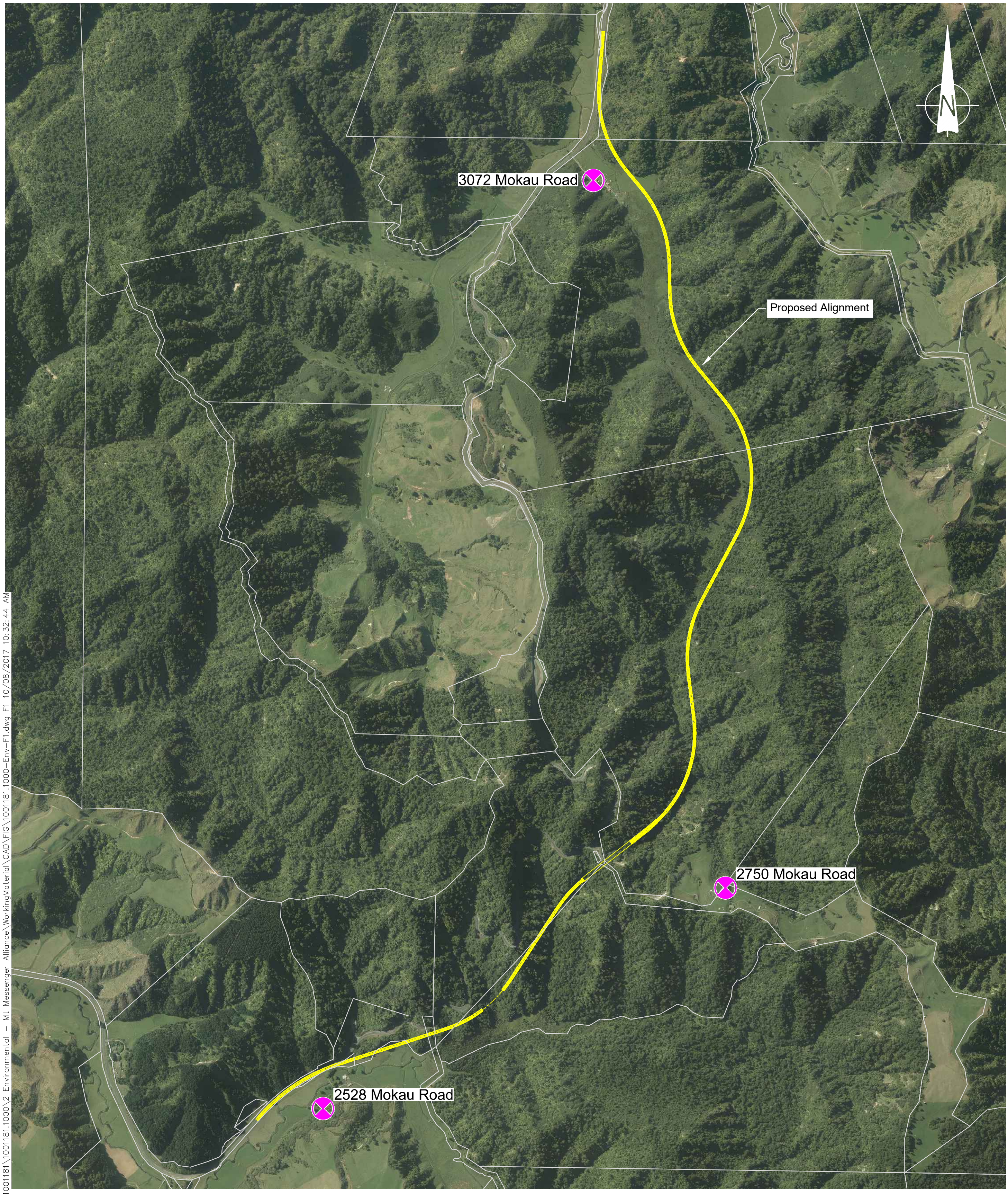
A draft DMP for the proposed works that covers the above aspects is included in Volume 5 of the AEE.

7.3 Operational phase

Specific mitigation measures for the operational phase of the Project are not warranted as potential adverse effects “With Project” are negligible.

Appendices

Appendix A: Figures



SCALE 1: 20,000
0 200 400 600 800 1000 (m)

Aerial photo and property boundaries sourced from Linz Data Service, licensed by LINZ for re-use under the Creative Commons Attribution 3.0 New Zealand licence (CC BY 3.0 NZ)

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PROJECT No. 1001181.1000		

NEW ZEALAND TRANSPORT AGENCY
ENVIRONMENTAL – MT. MESSENGER ALLIANCE
PROPOSED ALIGNMENT MOKAU ROAD
Receptor Location Plan

FIG. No. Figure 1

REV. 0

Appendix B: NZ Transport Agency screening model output

Air quality calculator

Project name: Te Ara o Te Ata

Project notes: 2017 Assessment Year - Existing Alignment

This calculation was made at 15:46 04/08/2017. The calculation can be reopened at this web page.

AADT:	2364vpd	PM_{10} 24hr average:	18.8µg/m³
Heavy vehicles:	19%	NO_2 annual average:	4.0µg/m³
Vehicle speed:	90km/h	Area unit name or ID:	Okoki-Okau/Rural
Distance to receptor:	118m		
Assessment year:	2017		

PM_{10}	**24hr average**	**NO_2**	**Annual average**
Assessment guideline (NES):	50.0µg/m³	Assessment guideline (WHO):	40.0µg/m³
Road contribution:	0.0µg/m³	Road contribution:	0.1µg/m³
Road contribution to guideline:	0%	Road contribution to guideline:	0%
Background air quality:	18.8µg/m³	Background air quality:	4.0µg/m³
Cumulative contributions:	18.8µg/m³	Cumulative contributions:	4.1µg/m³
Cumulative contribution to guideline:	38%	Cumulative contribution to guideline:	10%

Air quality calculator

Project name: Te Ara o Te Ata

Project notes: 2027 Assessment Year - With Project

This calculation was made at 04:13 11/08/2017. The calculation can be reopened at this web page.

AADT:	2996vpd	PM_{10} 24hr average:	18.8µg/m³
Heavy vehicles:	18%	NO_2 annual average:	4µg/m³
Vehicle speed:	90km/h	Area unit name or ID:	Okoki-Okau/Rural
Distance to receptor:	10m		
Assessment year:	2027		

PM_{10}	**24hr average**	**NO_2**	**Annual average**
Assessment guideline (NES):	50.0µg/m³	Assessment guideline (WHO):	40.0µg/m³
Road contribution:	0.2µg/m³	Road contribution:	0.5µg/m³
Road contribution to guideline:	0%	Road contribution to guideline:	1%
Background air quality:	18.8µg/m³	Background air quality:	4.0µg/m³
Cumulative contributions:	19.0µg/m³	Cumulative contributions:	4.5µg/m³
Cumulative contribution to guideline:	38%	Cumulative contribution to guideline:	11%

Air quality calculator

Project name: Te Ara o Te Ata

Project notes: 2027 Assessment Year - Existing Alignment

This calculation was made at 15:47 04/08/2017. The calculation can be reopened at this web page.

AADT:	2996vpd	PM_{10} 24hr average:	18.8µg/m³
Heavy vehicles:	18%	NO_2 annual average:	4.0µg/m³
Vehicle speed:	90km/h	Area unit name or ID:	Okoki-Okau/Rural
Distance to receptor:	118m		
Assessment year:	2027		

PM_{10}	**24hr average**	**NO_2**	**Annual average**
Assessment guideline (NES):	50.0µg/m³	Assessment guideline (WHO):	40.0µg/m³
Road contribution:	0.0µg/m³	Road contribution:	0.1µg/m³
Road contribution to guideline:	0%	Road contribution to guideline:	0%
Background air quality:	18.8µg/m³	Background air quality:	4.0µg/m³
Cumulative contributions:	18.8µg/m³	Cumulative contributions:	4.1µg/m³
Cumulative contribution to guideline:	38%	Cumulative contribution to guideline:	10%

Air quality calculator

Project name: Te Ara o Te Ata

Project notes: 2027 Assessment Year - Proposed Alignment

This calculation was made at 15:48 04/08/2017. The calculation can be reopened at this web page.

AADT:	2996vpd	PM_{10} 24hr average:	18.8µg/m³
Heavy vehicles:	18%	NO_2 annual average:	4.0µg/m³
Vehicle speed:	90km/h	Area unit name or ID:	Okoki-Okau/Rural
Distance to receptor:	112m		
Assessment year:	2027		

PM_{10}	**24hr average**	**NO_2**	**Annual average**
Assessment guideline (NES):	50.0µg/m³	Assessment guideline (WHO):	40.0µg/m³
Road contribution:	0.0µg/m³	Road contribution:	0.1µg/m³
Road contribution to guideline:	0%	Road contribution to guideline:	0%
Background air quality:	18.8µg/m³	Background air quality:	4.0µg/m³
Cumulative contributions:	18.8µg/m³	Cumulative contributions:	4.1µg/m³
Cumulative contribution to guideline:	38%	Cumulative contribution to guideline:	10%

Appendix C: Assessment against the policies in the Regional Air Quality Plan for Taranaki

Table C1: Assessment against policies in the Regional Air Quality Plan for Taranaki (2011)

Policy reference	Policy	Assessment	Overall evaluation
Policy 1.1 Hazardous, noxious, dangerous or toxic contaminants	Discharges to air of contaminants should avoid, remedy or mitigate adverse effects of potentially hazardous, noxious, dangerous or toxic contaminants by ensuring that any such discharge does not occur at a volume, concentration or rate or in such a manner that causes or is likely to cause a hazardous, noxious, dangerous or toxic effect on human or animal health, significant ecosystems or structures.	The potential effects of discharges to air from construction activities are limited to nuisance effects of dust and effects on vegetation adjacent to the construction area. Discharges of dust will not give rise to any hazardous, noxious, dangerous or toxic effect on human or animal health. High dust loadings, of a magnitude likely to cause adverse effects on vegetation, are unlikely to occur beyond around 10 m from the construction footprint. Mitigation measures to address 'edge effects' on the bush margins are proposed in the Assessment of Ecological Effects – Vegetation (Technical Report 7a, Volume 3 of the AEE). The operational phase of the Project will give rise to emissions of contaminants from motor vehicle exhaust and brake and tyre wear. As discussed in Section 6.2, the effects of operational discharges to air on human or animal health, or ecosystems, are predicted to be negligible.	Complies
Policy 1.2 Odour	Ensure that, (to the fullest extent practicable), any discharges to air of odorous contaminants do not cause odours beyond the boundary of the property of the discharger that are offensive or objectionable.	As discussed in Section 4.1.1, there is the possibility that construction activities may encounter old "farm dumps" containing potentially odorous material. These sites may cause very localised odours, however they are located some distance from sensitive receptors. On this basis, there is unlikely to be any offensive or objectionable effects of odour associated with the Project.	Complies
Policy 1.3 Smoke, dust and other	Ensure that any discharge to air of dust, smoke and other particulate matter beyond the boundary of	Construction activities will give rise to discharges to air of dust. Discharges of dust will not give rise to any hazardous or noxious effects.	Complies

Policy reference	Policy	Assessment	Overall evaluation
particulate matter	the property, and on the electricity transmission network, does not occur at a volume, concentration, or rate or in a manner that causes or is likely to cause a hazardous, noxious, dangerous, offensive or objectionable effect, including the significant restriction of visibility or the soiling of property, to the extent that the restriction of visibility or the soiling of property causes or is likely to cause the above effects.	As outlined in Section 6.1.2, with a separation distance from receptors of at least 30 m and the use of standard dust control measures (see Section 7), the discharges of dust are not expected to give rise to any offensive or objectionable effects of dust, including restriction of visibility or soiling. The nature and scale of dust emissions from construction activities would not cause any effects on the electricity transmission network.	
Policy 2.3 Management areas	Air quality management in Taranaki will be carried out in a way that recognises that some areas of the region have within them, uses or values or activities that are more sensitive to the discharge of contaminants to air than other areas. In particular, recognition will be given to any adverse effects from the discharge of contaminants to air on: a People and property in urban areas, residences and places of public assembly and on the safe and efficient operation of roads, airports and flight paths and other infrastructure; b Sensitive crops or farming systems, domestic and community water	Sensitive receptors in the vicinity of the Project are described in Section 3.5. The assessment has paid particular attention to the effects of discharges on residential houses, including potential for effects on roof supply drinking water, and sensitive ecosystems.	Complies

Policy reference	Policy	Assessment	Overall evaluation
	supplies and other water bodies including wetlands; f The heritage values of the region including places or areas of special historical, cultural, archaeological, architectural, scientific, ecological, intrinsic or amenity value; g Places, areas or features of significance to tangata whenua for spiritual, cultural or historical reasons.		
Policy 2.4 Cross-media effects	The potential for the discharge of contaminants to air to adversely affect other alternative receiving environments (i.e. land and water) should be taken into account.	The relatively small scale of discharges to air from the Project means that there will be no adverse effects to alternative receiving environments, such as from deposition of dust onto surface water or land.	Complies
Policy 2.5 Reverse sensitivity	Land use and subdivision should be managed to avoid, remedy or mitigate adverse effects on people and the environment from reverse sensitivity effects arising from the inappropriate location of sensitive activities in proximity to legitimate activities discharging contaminants to air. Problems arising from reverse sensitivity effects shall be avoided, remedied or mitigated primarily through district plans and territorial	Not relevant	Not relevant

Policy reference	Policy	Assessment	Overall evaluation
	authority consent decisions which: a) prevent the future establishment of potentially incompatible land use activities near each other; or b) allow the establishment of potentially incompatible land use activities near each other provided no existing lawful activity, operating in a lawful manner is restricted or compromised		
Policy 2.6 Cumulative effects	Discharges of contaminants to air should not occur at a rate or in a manner that contribute to a cumulative effect which over time, or in combination with other effects, is likely to have an adverse effect on human health and safety, ecosystems, property or other aspects of the environment.	Existing air quality in the Project area is very good. The assessment of the operational effects of the Project explicitly considers the cumulative effects of the discharges along with background concentrations of contaminants. The effects are predicted to be negligible	Complies
Policy 2.7 Best practicable option	The Taranaki Regional Council may, when provided for in the Rules of the Plan, require the adoption of the best practicable option to prevent or minimise adverse effects on the environment from the discharge of contaminants to air arising from the process under consideration. When considering what is the	Section 7 outlines good practice dust control methods for the construction phase of the Project, including the preparation of a dust management plan. These control methods are consistent with the best practicable option for managing construction dust, taking into account the sensitivity of the receiving environment. Specific mitigation measures for the operational phase of the Project are not warranted as the potential	Complies

Policy reference	Policy	Assessment	Overall evaluation
	‘best practicable option’ to reduce the effects of the discharge, the Taranaki Regional Council will give consideration to the following factors when applying the definition in the Act, of best practicable option: a The implementation of Policies 1.1, 1.2 and 1.3, when having regard to the nature of the discharge; b Any sensitive receiving environments (areas) as described in Policy 2.3; c The capital, operating and maintenance costs of relative technical options to reduce the effects of the discharge, the effectiveness and reliability of each option, and the relative benefits to the receiving environment offered by each option; d The weighing of costs in proportion to any benefits to the receiving environment to be gained by adopting the method or methods; and e Maintaining and enhancing existing air quality in the	adverse effects “With Project” are negligible.	

Policy reference	Policy	Assessment	Overall evaluation
	neighbourhood as far as practicable.		
Policy 6.1 Avoidance, remediation or mitigation – General policy	The discharge of contaminants to air from site development, earthworks or the application of soil conditioners, including the rate and concentration of the discharge will be managed to avoid remedy or mitigate any significant off site adverse effects on the environment arising from the discharge.	The assessment of effects of both the construction and operational discharges to air from the Project demonstrates that there will be no significant adverse effects on the environment arising from the discharges.	Complies
Policy 6.2 Actual or potential effects that require particular consideration	In considering the effects of any discharge of contaminants to air from site development, earthworks or the application of soil conditioners, particular regard will be had to the following effects: a Any actual or potential effects on the health and functioning of ecosystems, plants and animals including indigenous ecosystems and plants and animals of commercial significance; b Any actual or potential effects on amenity values, including any effects of odour or particulate matter arising from the discharge, and any nuisance effects;	An assessment of construction dust effects is provided in Section 6.1. The identified matters are addressed as follows: a Actual or potential effects of discharges from site development and earthworks on the health and functioning of ecosystems, etc. are addressed in Section 6.1.3. b Actual or potential effects on amenity values arising from the discharge of particulate matter of discharges from site development and earthworks are addressed in Section 6.1.2. c The assessment specifically addresses effects of dust emissions from site development and earthworks on residential houses and domestic water supply (Section 6.1.2) and sensitive ecosystems (Section 6.1.3). d There will be no actual or potential effects of discharges from site development and earthworks on other receiving environments.	Complies

Policy reference	Policy	Assessment	Overall evaluation
	c Any actual or potential adverse effects on areas, places, sites or features identified in Policy 2.3; d Any actual or potential adverse effects on other receiving environments; e Any actual or potential adverse effects on human health, safety and well-being; f any cumulative adverse effects identified in Policy 2.6; g Any adverse effects of low probability but high potential impact; and h Any positive effects of the discharge, including social and economic benefits of activities using air resources.	e The potential effects of discharges to air of dust from site development and earthworks are restricted to nuisance effects. Given the scale of the proposed activities and the separation distance to residential houses, there are no potential adverse effects on human health, safety and well-being. f Existing air quality in the Project area is very good. There is not expected to be any cumulative adverse effects of dust discharges from site development and earthworks. g Positive effects are addressed in the overarching Assessment of Environmental Effects of the Project.	
Policy 6.3 Assessment of effects	In considering the effects of any discharge of contaminants to air from site development, earthworks or the application of soil conditioners, matters that will be taken into account include: a The nature, volume, composition and concentration of the contaminant and the frequency, rate and	The nature of dust discharges from site development and earthworks activities, and the factors affecting generation are described in Section 4.1. Section 3 describes the wind and rainfall conditions in the Project Area. Section 6.1.2 sets out a detailed assessment of the frequency, duration and intensity of environmental effects of dust emissions, taking into account the prevalent weather conditions, terrain	Complies

Policy reference	Policy	Assessment	Overall evaluation
	manner of the discharge; b Surrounding environmental conditions that may affect the frequency, duration, intensity and degree of environmental effects including topography, wind speed and direction, and other climatic or weather conditions; and c The best practicable option to prevent or minimise any adverse effects on the environment in accordance with Policy 2.7.	and the proximity of sensitive receptors. Section 7 outlines good practice dust control methods for the construction phase of the Project, including the preparation of a dust management plan. These control methods are consistent with the best practicable option for managing construction dust, taking into account the sensitivity of the receiving environment.	