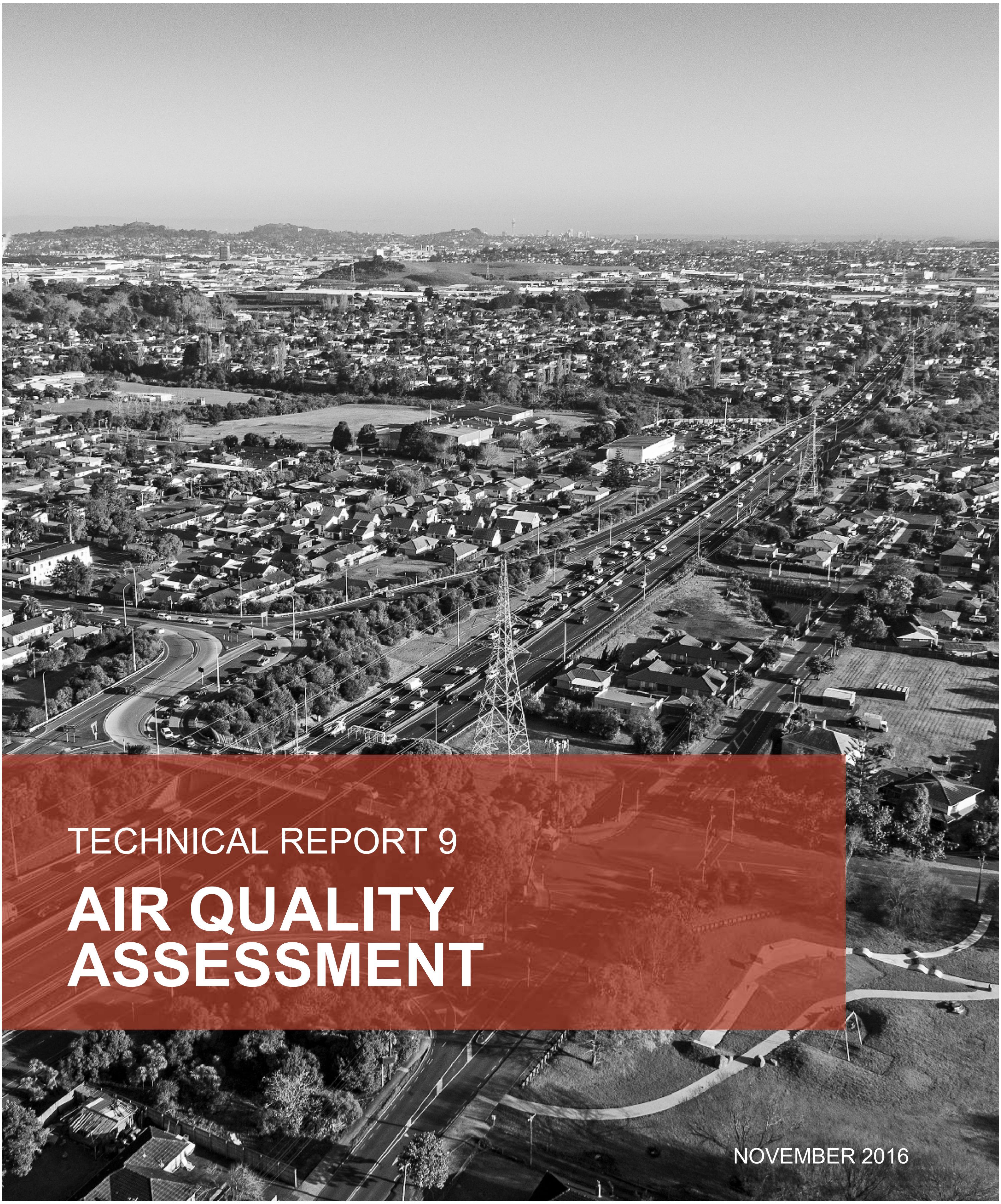

TECHNICAL REPORT 9

AIR QUALITY ASSESSMENT

NOVEMBER 2016

NZ TRANSPORT AGENCY
WAKA KOTAHI

East West Link

Quality Assurance Statement	
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Approved for release	 Patrick Kelly (EWL Alliance Manager)

Revision schedule					
Rev. Nº	**Date**	**Description**	**Prepared by**	**Reviewed by**	**Approved by**
0	November 2016	Final for Lodgement	Camilla Needham	Mathew Noonan	Patrick Kelly

EXECUTIVE SUMMARY

1. This technical air quality assessment forms part of the Assessment of Effects on the Environment (AEE) prepared for the Transport Agency's East West Link Project (the Project). Its purpose is to inform the AEE and to support the new Notice of Requirement (NoR) and alterations to the existing designation required for the Project.

2. This report considers the effects of:
    - Discharges to air from vehicles using the EWL (operational effects);
    - Discharges to air due to construction of the Project (construction effects)

3. Under both the Auckland Council ALW Plan and the Proposed Auckland Unitary Plan Decisions version 19 August 2016 (PAUP), discharges to air from mobile sources are a permitted activity and therefore no consent is required in relation to air discharges of motor vehicles using the EWL. Potential air quality effects have been assessed to assist the requiring authority in considering whether this designation meets the purposes of the RMA (e.g. safeguarding the life-supporting capacity of air).

4. The discharge of contaminants into air from earthworks and the construction, maintenance and repair of roads (road works) is also a permitted activity under both the ALW plan and the PAUP, providing the activity meets the relevant permitted activity standards. A resource consent is required for the operation of a concrete batching plant during construction of the Project.

Assessment methodology

5. In undertaking this assessment, the procedures outlined in the NZ Transport Agency AQ Guide and the MfE Dust Good Practice Guide have been followed. A conservative screening methodology (utilising the Transport Agency Screening Tool v2.0) was used to assess the level of air quality risk of vehicle emissions associated with the operation of the Project.

6. The air quality scenarios which have been considered are:
    - Existing (2013),
    - With Project 2026 and 2036, and
    - Without Project 2026 and 2036.

7. The Transport Agency Screening Tool was used to estimate the localised effects of the Project, where the increase in traffic and vehicle emissions is predicted to be most significant.

Existing environment

8. The Project extent includes Auckland's main manufacturing area and a regional hub for transport and distribution activities. As such, it includes many arterial roads with high volumes of trucks and heavy vehicles. Heavy vehicles are proportionally much higher emitters of some pollutants than light vehicles.

9. Motor vehicles discharge a wide range of contaminants; however, nitrogen dioxide (NO_2) and fine particles (PM_{10}) are the main indicator pollutants of concern due to potential adverse health effects.

Motor vehicles are a significant source of PM_{10} and are the main source of NO_2 in the Auckland airshed. Diesel vehicle emissions account for 72% of motor vehicle PM_{10} emissions[1].

10. Existing air quality data from the Auckland Council Penrose monitoring site and a NIWA research study carried out in Ōtāhuhu East, indicates background levels in the Project area currently comply with the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (AQNES). As with other urban areas of Auckland, air quality is influenced by both wintertime domestic solid fuel heating emissions and vehicle emissions.

11. Sectors 1 to 4 of the proposed EWL Main Alignment are areas with relatively low sensitivity to potential adverse effects of air emissions on human health and amenity values, due to the mixture of light and heavy industrial land use. The heavy industry zone within the PAUP is classified as a "medium air quality –dust and odour (industry) area."

12. The part of the Project area that is most sensitive to the potential air quality impacts of vehicle emissions is the residential land use in Sector 5 located adjacent to SH1 (between Panama Road and Princes Street). This area already experiences high traffic volumes, and a number of existing houses are located within 20m of the edge of the motorway. There is also a small number of dwellings located in Sector 1 close to the Neilson Street Interchange.

Operational effects

13. The Project brings about a redistribution of heavy vehicle traffic through the Project area. The positive effects of the Project include reduced levels of traffic congestion and reduction in the use of residential streets (in Onehunga and Ōtāhuhu) by heavy vehicles accessing Auckland's main industrial hub. As some of these roads currently experience high volumes of heavy vehicles, these reductions are particularly beneficial for local air quality.

14. The Project results in a reduction of general traffic and heavy vehicles from key arterials and local roads including Church Street, Onehunga Mall, Mt Smart Road, Mt Wellington Highway, Favona Road and Mahunga Drive. Increases in traffic are predicted on the strategic routes such as SH20, SH1, EWL and Sylvia Park Road.

15. Similarly, emissions of nitrogen oxides (NOx) and PM_{10} are forecast to increase on the strategic routes (SH1, SH20 and EWL) while significant reductions in vehicle emissions are predicted throughout Onehunga, and to a lesser extent Ōtāhuhu and Māngere Bridge. A number of schools and early childhood centres are located close to these existing busy roads, and will benefit from reductions in vehicle emissions in these locations.

16. The overall kilometres travelled (VKT) increases by 1.1% in the year of opening 2026 and by 1.5 % in 2036 when compared to the Without Project modelled scenario. This increase in VKT is due to some induced traffic using the routes because the level of service is predicted to improve.

17. In 2026, the overall quantity of NOx and PM_{10} vehicle emissions within the Project extent are predicted to increase slightly once EWL is operational compared to without EWL, by 0.5%, and 0.4% for NOx and PM_{10} respectively.

[1] Sridhar, S., Metcalfe, J and Wickham, L (2014). Auckland motor vehicle emissions inventory. Prepared by Emission Impossible Ltd for Auckland Council. Auckland Council technical report, TR2014/029

18. The maximum increase in vehicle emissions from the EWL Main Alignment is predicted to be 5.4% of the AQNES PM_{10} threshold and 17.5% of the NO_2 guideline in 2026. Ten years after opening of the Project, the concentrations in all locations are predicted to increase slightly above 2026 figures.

19. Residents living close to SH1 between Panama Road and Princes Street will experience a small increase in ambient concentrations of vehicle contaminants. SH1 roadside PM_{10} concentrations are modelled to increase by 0.9 - 1.5μg/m^3 and NO_2 concentrations by 2.6 - 4.0μg/m^3 as a result of the Project.

20. The estimated cumulative concentrations (including the existing background) are not expected to exceed the AQNES criteria of 50μg/m^3 for 24-hour average PM_{10} concentrations at any location in 2026 due to the Project.

21. The cumulative concentration of NO_2 is predicted to slightly exceed the annual WHO guideline in 2026 in one of the Sector 5 With Project scenarios. The screening model is conservative, however these results are an indication that guideline levels may be approached in some localised spots adjacent to SH1 both with and without the EWL.

22. Construction of the EWL will entail significant earthworks, which can be a source of dust. Disturbance of closed landfills, known asbestos contaminated areas and historically contaminated sites have the potential to discharge odour, landfill gas, and hazardous air pollutants. A range of control measures have been identified that demonstrate how the construction contractor can achieve the permitted activity standards.

23. A Construction Air Quality Management Plan will be prepared prior to construction, once the conditions of any designation and consents are known. Once finalised, this plan will detail methods to be used to mitigate discharges of odour, dust and hazardous pollutants to air from the construction of the Project. Provided that appropriate control measures are implemented, any adverse effects on air quality arising from the construction of the Project will be minor and the permitted activity standards can be achieved.

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Glossary of Technical Terms/Abbreviations

Abbreviation	Term
AADT	Annual average daily traffic flow in vehicles per day
AAQG	Ambient Air Quality Guidelines
AAAQS	Auckland Ambient Air Quality Standards
AEE	Assessment of Effects on the Environment
ALW Plan	Auckland Council Regional Plan: Air, Land and Water
AQNES	Resource Management (National Environmental Standards for Air Quality) Regulations 2004, including the 2011 amendments
BoI	Board of Inquiry
CO	Carbon monoxide
CEMP	Construction Environmental Management Plan
CLMP	Contaminated Land Management Plan
CAQMP	Construction Air Quality Management Plan
EPA	Environmental protection authority
EWL	East West Link
HAIL	Ministry for the Environment's hazardous activities and industries list
HCV	Heavy Commercial Vehicle
HSR	Highly Sensitive Receivers
IBC	Indicative Business Case
LCV	Light Commercial Vehicle
LTMA	Land Transport Management Act
MCA	Multi Criteria Analysis process
mg/m^3	Concentration in milligrams per cubic metre
NES	National Environmental Standard
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides (NO + NO_2)
NoR	Notice of Requirement
The NZ Transport Agency	New Zealand Transport Agency
PAUP	Proposed Auckland Unitary Plan
PM10	Airborne particulate matter with a diameter less than 10 micrometres
PM2.5	Airborne particulate matter with a diameter less than 2.5 micrometres
RMA	Resource Management Act 1991
SH(x)	State highway (number)
SATURN	Simulation and Assignment of Traffic to Urban Road Networks. A traffic modelling tool.
The Plan	The Auckland Plan
TSP	Total Suspended Particulate
VEPM	Vehicle Emission Prediction Model
WES- TWA	Workplace Exposure Standards – Time Weighted Average
$\mu g/m^3$	Concentration in micrograms per cubic metre

Glossary of Defined Terms used in this report

Term	Meaning
Auckland Council	Means the unitary authority that replaced eight councils in the Auckland Region as of 1 November 2010.
Airshed	An area designated by regional councils for the purposes of managing air quality and gazetted by the Minister for the Environment.
Background air quality	Background air quality is the level of contaminant across a geographical area from all sources. This includes contributions from natural sources (e.g. volcanoes, sea salt, wind-blown dust) and from man-made sources such as industry, domestic heating and 'remote' roads.
Existing	The existing traffic and air quality scenario against which all Project options are compared. It is defined as 2013 in the *Volume 3: Technical Report 1-Traffic and Transportation Assessment.*
Dust Good Practice Guide	Good practice guide for assessing and managing dust, Ministry for the Environment, draft 2015
Earthworks	Means the disturbance of land surfaces by blading, contouring, ripping, moving, removing, placing or replacing soil, earth, or by excavation, or by cutting or filling operations.
Alignment	Means the route and designation footprint selected through the project area.
EWL Main Alignment	EWL arterial between Gloucester Park Interchange and SH1
Transport Good Practice Guide	Good practice guide for assessing discharges to air from land transport, Ministry for the Environment, 2008
Highly Sensitive Receiver	A location 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.
Transport Agency AQ Guidance	Guide to assessing air quality impacts from State highway projects (draft) NZ Transport Agency, 2015.
Project	Means the East West Link Project as described in Part C, *Volume 1 of the AEE*.
Project extent	Means the extent of the project SATURN transportation model, which is from Mt Albert Road in the north to Manukau City Centre in the south. The extent of the SATURN model boundary is shown in Figure 6.1.
With Project	Modelling scenario including the East West Link Project.
Without Project	Modelling scenario where the traffic volumes would grow due to population growth, but the future road network would not include the East West Link Project.

1 Introduction

1.1 Purpose and scope of this report

This report forms part of a suite of technical reports prepared for the NZ Transport Agency's East West Link project (the Project). Its purpose is to inform the Assessment of Effects on the Environment Report (AEE) and to support the resource consent applications, new Notices of Requirement and an alteration to existing designation required for the Project.

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

The purpose of this report is to:

(a) Identify and describe the existing air quality environment;

(b) Describe the potential adverse air quality effects of discharges to air from motor vehicles using the Project;

(c) Describe the potential effects of discharges to air due to construction of the Project;

(d) Recommend measures as appropriate to avoid, remedy or mitigate potential adverse air quality effects (including any conditions/management plan required); and

(e) Present an overall conclusion of the level of potential adverse air quality effects of the Project after recommended measures are implemented.

1.2 Project description

The Project involves the construction, operation and maintenance of a new four lane arterial road from State highway 20 (SH20) at the Neilson Street Interchange in Onehunga, connecting to State highway 1 (SH1) at Mt Wellington as well as an upgrade to SH1 between the Mt Wellington Interchange and the Princes Street Interchange at Ōtāhuhu. New local road connections are provided at Galway Street, Captain Springs Road, the port link road and Hugo Johnston Drive. Cycle and pedestrian facilities are provided along the alignment.

The primary objective of the Project is to address the current traffic congestion problems in and across the Onehunga, Penrose and Mt Wellington commercial areas which will improve freight efficiency and travel reliability for all road users. Improvements to public transport, cycling and walking facilities are also proposed.

For description purposes in this report, the Project has been divided into six sectors. These are:

Sector 1. Neilson Street Interchange and Galway Street connections

Sector 2. Foreshore works along the Māngere Inlet foreshore including dredging

Sector 3. Anns Creek from the end of the reclamation to Great South Road

Sector 4. Great South Road to SH1 at Mt Wellington

Sector 5. SH1 at Mt Wellington to the Princes Street Interchange

Sector 6. Onehunga local road works

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

2 Experience

2.1 Expertise

Camilla Needham is a Senior Environmental Engineer employed by Beca Ltd (Beca). She has an honours degree in Chemical and Process Engineering from the University of Canterbury, New Zealand and is a Chartered Chemical Engineer. She has 18 years of experience in air quality assessment and process engineering.

Camilla is a member of the Clean Air Society of Australia and New Zealand (CASANZ) and a member of the Transport Significant Interest Group of CASANZ. She has co-authored and contributed to a number of transport air quality related good practice guidance documents[2].

Camilla has provided air quality expert evidence before Boards of Inquiry and Council Hearings. These have included a number of NZ Transport Agency Roads of National Significance Projects including MacKays to Peka Peka Expressway and Christchurch Southern Motorway Stage 2. More recently, Camilla has provided air quality expert evidence on the effects of vehicle emissions, reverse sensitivity and separation distances at the Auckland Council hearings on the air quality related provisions of the Proposed Auckland Unitary Plan (PAUP). Camilla also presented expert evidence on construction dust effects and the management construction air quality impacts to the Auckland Council hearing for the City Rail Link Project.

Mathew Noonan is a Senior Air Quality Specialist at Beca with extensive experience in air dispersion modelling and air quality impact assessment. Mathew holds a Masters of Environmental Science (1st class honours), a Bachelor of Mechanical Engineering, (1st Class honours) and a Bachelor of Science in Pure Mathematics. He has carried out air quality assessments and detailed dispersion modelling for a number of major roading projects including Transmission Gully, Christchurch Southern Motorway Stage 2 and MacKays to Peka Peka.

Mathew is an expert in multipathway health risk exposure assessments for air quality contaminants, and has carried out work for the Ministry of Public Health, Ministry for the Environment and the Environmental Risk Management Authority. These projects related to soil remediation for organochlorines, dioxins and metals.

[2] Guide to assessing air quality impacts from State highway projects (draft), NZ Transport Agency 2014; and Construction Air Quality Management Plan Template, NZ Transport Agency, June 2015.

3 Assessment Methodology

This assessment considers both the operational and construction effects of the Project on air quality.

The methodology for the assessment of air quality effects is based on the following guidance documents:

- Guide to assessing air quality impacts from State highway projects v2.0 Draft, NZ Transport Agency, Dec 2015. ("Transport Agency AQ Guide"); and
- Good practice guide for assessing discharges to air from land transport, Ministry for the Environment (MfE), 2008. ("Transport Good Practice Guide").

The Project has been assessed against the relevant air quality standards and guidelines. Exposure levels are predicted through screening modelling and compared with the relevant air quality criteria which are designed to protect the health of the most vulnerable individuals in the community.

3.1 Preparation for this report

This assessment relies on data presented in the following factual reports:

- *Technical Report 1: Traffic and Transportation Assessment*; and
- *Technical Report 17: Contaminated Land Assessment*.

The author is familiar with the area that the Project covers as well as the State highway and local roading network in the vicinity of the Project. Camilla has been involved in the Project since 2014 as an air quality advisor. At the detailed business case stage, she was also the technical reviewer of the air quality report which was prepared to inform the final option selection.[3]

3.2 Assessment of Operational effects

3.2.1 Effects of motor vehicle emissions

Air pollution from motor vehicles travelling on surface roads is caused primarily by combustion of fuels (e.g. petrol and diesel) but can also come from brake wear, tyre wear and road dust. Motor vehicle emissions are of concern because many of the pollutants that are released are known to cause adverse health effects. These include:

- Gases – e.g. Carbon monoxide (CO), nitrogen dioxide (NO_2) and volatile organic compounds (VOCs) such as benzene; and
- Particulate matter in different size fractions – e.g. Particles smaller than 10µm (PM_{10}) and particles smaller than 2.5µm ($PM_{2.5}$).

Despite the wide variety of pollutants in vehicle emissions, in the Auckland region the most significant potential health effects result from exposure to fine particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2). Concentrations of CO in the Auckland area usually comply with air quality standards and guidelines as improved technology has reduced levels considerably in the past decade, particularly at peak traffic sites. In addition, due to the progressive reductions in the sulphur content of petrol and diesel since 2002,[4] vehicle exhaust emissions are no longer a significant source of SO_2 in New Zealand.

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[3] East West Connections Project : Air quality impact assessment to inform option selection, Beca Ltd, Oct 2014

[4] The NZ Engine Fuel Specification Regulation reduced the limits of sulphur content of petrol to 50ppm (1 January 2008) and diesel to 10ppm (1 January 2009).

For the purposes of this assessment, the effects of NO_2 and PM_{10} are the key indicator pollutants considered.

3.2.2 Background to this assessment

The Transport Agency AQ Guide recommends the following stage-wise assessment methodology:

1. Environmental and social responsibility screen (ESR Screen);

2. Preliminary technical assessment; and

3. Comprehensive technical assessment.

At the Indicative Business Case stage of the Project, the ESR screen was carried out. The ESR screen consists of a simple checklist of questions which have been designed to identify effects, sources of risk and project opportunities. This screening stage indicated that there may be a potential air quality risk due to the Project, thus triggering the more rigorous second stage of assessment, i.e. a preliminary technical assessment.

At the Detailed Business Case stage of this Project, a preliminary technical assessment[5] was carried out to inform the multi-criteria analysis. Six connection options were compared using the Transport Agency Air Quality Screening Model v2.0. This screening assessment indicated that none of the alignment options being investigated by the Project team were likely to result in relevant air quality criteria being exceeded and therefore the air quality risk was low.

3.2.3 Modelling methodology

This assessment is therefore based on the preliminary technical assessment methodology, which has been updated for the final Project alignment. Detailed dispersion modelling is only required if the preliminary technical assessment at the earlier assessment stage indicates the air quality risk is high.

This methodology utilises the Transport Agency Air Quality Screening Model. This modelling toolkit estimates ground level concentrations arising from vehicle emissions, both at the kerbside and at the nearest sensitive location for each road link. The screening model is designed to estimate air quality near roadways, and provides a worst case assessment of potential air quality impacts.

3.2.4 Scenarios to be assessed

A key purpose of the preliminary air quality technical assessment is to establish whether the predicted relative air quality impact from the Project or cumulative air quality impact (when combined with background air quality) is likely to result in relevant air quality criteria being exceeded.

The air quality scenarios which have been considered are:

Existing 2013	Aligns with the regional traffic models (ART3) used to provide a scenario against which to compare future effects
With Project 2026	Traffic flows and fleet composition predicted for year of opening of the Project.

[5] East-West Connections Project: Air Quality Impact Assessment to Inform Option Selection, Beca Ltd, 2014.

Without Project 2026	"Base case" opening year for comparison with the 2026 With Project scenario; assumes that all other projects in the region, unrelated to the Project, have been completed, but that the Project itself has not been constructed.
With Project 2036	Traffic flows and fleet composition predicted 10 years after opening of the Project
Without Project 2036	"Base case" for comparison with the 2036 With Project scenario assuming the Project has not been completed.

3.2.5 Assessment of regional operational effects

In order to assess the regional and wider air quality effects, which include Project benefits through reducing congestion in some locations, the 'with Project' and 'without Project' scenarios on SH1 and within the Project extent have been compared on a total mass emission basis. This is achieved through using emission factors for indicator contaminants from the Vehicle Emissions Prediction Model (VEPM, Version 5.1) and integrating these factors with the SATURN model outputs[6], to develop estimates of the mass emission of contaminants by road link and location.

3.3 Construction effects

Air pollution from road construction activities relates mainly to dust caused by earthworks. Other construction-related emissions include the exhaust emissions from construction vehicles and odour (where landfills or highly contaminated areas are disturbed). The Project alignment passes through the edge of three closed landfills: Galway Street and Pikes Points East and West landfills, and associated construction works will disturb a known asbestos contaminated area. The potential for adverse air quality effects to occur due to contaminated land and landfill disturbance includes:

- Construction-related safety risks in relation to accumulation of landfill gas through explosivity and asphyxiation risks;
- Discharge of respirable fibres during asbestos disturbance;
- Discharge of odour; and
- Discharge of contaminated dust.

The Transport Agency AQ Guide presents a checklist to evaluate the construction air quality risk. Construction impacts are typically defined as either low or high risk. The potential air quality risk associated with road construction impacts is mostly determined by the number of highly sensitive receivers (HSRs) within 200m of the Project. Based on this checklist, the construction air quality risk is rated as being high because there are more than 50 HSRs within 200m of the Project, and the scale of earthworks is greater than 10,000 m².

In accordance with the Transport Agency AQ Guide, as the dust risk is assessed as being high, a construction air quality management plan (CAQMP) should be prepared. This document (or section of Construction Environmental Management Plan (CEMP)) will describe a range of appropriate dust management and emission controls, which could be applied by the construction contractor at the time of construction to minimise the effects of dust.

[6] SATURN modelling is detailed in Volume 3: Technical Report 1 - Traffic and Transportation Assessment

The assessment of construction air quality effects is based on reviewing the proposed construction methodology to identify dust generating activities and assessing the proximity of these activities to HSRs. HSRs to dust emissions for this assessment have a wider definition, including commercial activities which may be particularly sensitive to dust (e.g. vehicle showrooms). Having identified these locations, mitigation measures are recommended for managing and minimising the impacts of dust emissions.

3.4 Summary of the assessment methodology

A preliminary technical assessment as defined in the NZ Transport Agency AQ Guide is the appropriate method for assessing the air quality effects of the Project. The Project operational air quality risk was assessed at the detailed business case stage using the Transport Agency's Air Quality Screening Model. This conservative screening model classified the operational air quality effects of the Project as low risk.

In this assessment, the screening model has been re-run to assess the EWL alignment and associated connections to the existing transport network.

The assessment of the operational effects of the Project has focused on the "worst case" exposure scenario, where the predicted increase in traffic volumes is predicted to make the greatest contribution to ambient pollutant levels in nearby residential areas.

The Project has a potential risk of adverse dust and odour effects being generated during construction. This assessment recommends a range of appropriate dust management and emission controls to be implemented by the Contractor through the CEMP and conditions.

4 Statutory Framework

The legal and planning framework for the air quality assessment is outlined in Appendix C. This section of the report outlines the statutory and non-statutory criteria specific to the assessment of effects of discharges to air. It therefore covers air quality standards, guidelines and other criteria used to assess the Project's effects on air quality.

Under both the Auckland Council ALW Plan and the Proposed Auckland Unitary Plan (PAUP), discharges to air from mobile sources are a permitted activity[7] and therefore no consent is required in relation to air discharges of motor vehicles using the EWL.

The discharge of contaminants into air from earthworks and the construction, maintenance and repair of roads (road works) is also a permitted activity,[7] providing the activity meets the relevant permitted activity rules. Therefore, no discharge consent is required in relation to construction air quality effects of EWL, where these standards can be met.

A resource consent is required for the operation of a concrete batching plant during construction of the Project.

4.1 Regulatory framework for vehicle emissions

Over the last 10 years, central government has been progressively introducing measures to reduce vehicle emissions in New Zealand. The main method is the Land Transport Rule: Vehicle Exhaust Emissions 2007 (the Vehicle Exhaust Emissions Rule), which is the primary control on vehicle emissions that replaced the earlier 2003 and 2006 Rules. The Land Transport Rule sets emissions standards for imported vehicles entering the New Zealand fleet and for those operating on New Zealand roads. This rule was amended in 2012 to update the emissions standards for new vehicles.

The regulatory direction of the PAUP has been that mitigation of vehicle emissions through vehicle emission controls should be the responsibility of central government at a national level. Urban intensification, such as is occurring in Auckland, ultimately increases the population density of people living and working close to busy highways and arterials. In response to this challenge, one of the key air quality objectives in the Transport Agency State Highway Environmental Plan[8] is to:

A1: Understand the contribution of vehicle traffic to air quality

To support this objective, the Transport Agency undertakes monthly monitoring using NO_2 passive samplers, at over 120 sites across the State highway network. Measurements are made at a variety of potential sensitive locations near State highways, including residences and schools.

4.2 Ambient air quality assessment criteria

The Transport Agency Good Practice Guide sets out the following hierarchy of air quality assessment criteria:

1. National Environmental Standards for Air Quality (AQNES);

[7] Refer Appendix C

[8] Environmental Plan: Improving environmental sustainability and public health in New Zealand, NZ Transport Agency, (2008)

2. Regional Air Quality Targets (RAQT) and proposed Auckland Ambient Air Quality Standards (AAAQS); and

3. New Zealand Ambient Air Quality Guidelines (AAQG).

Many of the criteria are repeated across the various sets of standards and guidelines. The subset of criteria relevant to road transport related air pollutants is summarised in the following sections. Where a regional air quality plan has an objective that is more stringent than an AQNES, the more stringent level applies.

4.2.1 National Environmental Standards for air quality (AQNES)

The RMA gives requiring authorities the ability to designate areas of land for specific uses (e.g. as roads). Where the Transport Agency seeks a new or altered designation, it must take into account any air quality effects and the requirements of the AQNES.

The AQNES came into effect in 2005 and among other things, sets concentration limits for five common 'criteria' air pollutants including PM_{10}, CO, and NO_2. The AQNES provide for the protection of human health and are mandatory standards which have an enforceable legal status. The AQNES criteria limits for the relevant contaminants are summarised in Table 4-1:

Table 4-1: National Environmental Standards for Ambient Air Quality

Pollutant	Averaging period	Limit
Carbon monoxide	Rolling 8-hour	10 mg/m^3
PM_{10}	24-hour	50 µg/m^3
Nitrogen dioxide	1 hour	200 µg/m^3

Guidance is provided by the MfE with respect to the application of the AQNES in relation to land designations, as follows:

> "*For new designations after 1 September 2005, territorial authorities and/or requiring authorities should consider the ambient air quality standards when weighing up whether new designations, or alterations to existing designations, meet the purposes of the RMA (e.g. safeguarding the life-supporting capacity of air). Territorial authorities will need to take into account the potential impacts of a new designation on air quality in the airshed, and the subsequent impact upon their ability to issue future resource consents within that airshed.*"

4.2.2 Regional Air Quality Targets (RAQT) and proposed Auckland Ambient Air Quality Standards (AAAQS)

The ARP:ALW provides Regional Air Quality Targets (RAQTs), which cover ambient pollutants or averaging periods not included in the AQNES. In particular, the targets provide a 24 hour average criteria for PM2.5 and an annual average criteria for PM_{10}.

Auckland Council has proposed Auckland ambient air quality standards (AAAQS) in the PAUP. The AAAQS have been appealed and therefore it is necessary to consider both plan provisions. Table 4-2 summarises the relevant criteria from both Auckland plans:

Table 4-2: Regional Air Quality Targets (RAQT) and proposed Auckland air quality standards

Pollutant	Averaging period	Limit	Source
PM_{10}	24 hour	50µg/m^3	AAAQS/RAQT
	Annual	20µg/m^3	AAAQS/RAQT
$PM_{2.5}$	24 hour	25µg/m^3	AAAQS/RAQT
	Annual	10µg/m^3	AAAQS

Pollutant	Averaging period	Limit	Source
Nitrogen dioxide	24 hour	100µg/m³	AAAQS/RAQT
	1 hour	200µg/m³	AAAQS
	Annual	40µg/m³	AAAQS
Carbon monoxide	1 hour	30mg/m³	AAAQS/RAQT
	8 hour	10mg/m³	AAAQS

4.2.3 NZ Ambient Air Quality Guidelines (AAQG)

The AAQG criteria limits preceded the AQNES and are comparable to them. The relevant pollutant criteria which are not prescribed in the AQNES are presented in Table 4-3.

Table 4-3: NZ Ambient Air Quality Guidelines

Pollutant	Averaging period	Limit
Nitrogen dioxide	Annual (ecosystems)	30µg/m³
Nitrogen dioxide	24 hours	100µg/m³
PM_{10}	Annual	20µg/m³
Carbon monoxide	1 hour	30mg/m³

The AAQG for annual average NO_2 is 30µg/m³, which is set for ecosystem protection. The WHO criteria for NO_2 is an annual average of 40 µg/m³. This criteria is generally used in New Zealand for assessing human health effects for longer term exposures in the absence of an equivalent New Zealand guideline or standard.

4.3 Dust assessment criteria

Dust contains PM_{10} and therefore any dust generating activity must comply with the AQNES, where people may reasonably be exposed to dust emissions.

The MfE Draft Good Practice Guide for Assessing and Managing Dust (Dust Good Practice Guide) and Transport Agency Air Quality Guide both recommend trigger levels for on-site dust control, where there is potential for significant adverse effects beyond the site boundary. These are intended to be practical guidance for the proactive management of dust on-site.

The 24-hour average criteria is commonly used to assess the overall performance of the construction dust management controls. The short term one-hour average trigger levels are designed to assist in identifying potential dust events as they occur. The “trigger value 2” is also a good indication that the 24-hour value will be exceeded. The trigger value criteria are relevant to the Construction Air Quality Management Plan (CAQMP). The protection level is subjective, however Sector 5 would be classified as sensitive due to the number of dwellings and the remaining sectors of the Project would be either moderately sensitive or insensitive. The trigger value criteria are set out in Table 4-4.

Table 4-4: Recommended trigger levels for construction dust management: total suspended particulate (TSP)

Protection	24 hour criteria	Trigger value 1 (investigate)	Trigger value 2 (stop work)
Sensitive area	80µg/m³	100µg/m³	160µg/m³
Moderately sensitive	100µg/m³	140µg/m³	200µg/m³
Insensitive area	120µg/m³	180µg/m³	240µg/m³

4.3.1 Assessment criteria for dust from contaminated soils

Trigger levels for contaminated soil dust management may need to be determined once the detailed contaminated land investigation has been completed during construction. Given the nature and extent of the contaminated soils (i.e. landfills and historic reclamations), a wide range of contaminants is likely. The public may be exposed to contaminated dust through a number of pathways, including the inhalation of fine particulates and through ingestion of deposited dust. The NZ soil guidelines[9] (as outlined in the Contaminated Land Assessment) are based on exposure from inhalation and ingestion and can be conservatively applied to contaminant levels in dust.

4.4 Auckland Council ALW Plan and PAUP (Decisions version 19th August 2016)

Auckland Council is responsible for ensuring that AQNES standards are met in the region. As the regulatory authority, the Council must consider the AQNES when deciding whether a new or altered designation (such as for the Project) meets the purpose of the RMA.

Under both the ALW Plan and the PAUP:

- The discharge of contaminants into air from earthworks and the construction, maintenance and repair of roads (road works) is a permitted activity, providing the activity meets the relevant permitted activity rules.
- Concrete batching, which is required in the main contractors yard within Waikaraka Park is a discretionary activity where the “manufacture of concrete is at a rate of more than 110 tonnes/day where discharges to air are through a bag filter system”

Relevant rules and policies from the ALW Plan and PAUP are detailed in Appendix C.

Waikaraka Park is zoned Public Open Space – Sport and Active Recreation. Under PAUP Chapter E14, the public open space zone is classified as a high air quality area.

4.5 Summary of air quality criteria for assessment

The potential operational air quality effects of the Project have been compared with the relevant health-based air quality standards and guidelines. The standards and guidelines to be used for this assessment are:

- NO_2 guideline of 40μg/m^3 annual average (AAQS)
- PM10 standard of 50μg/m^3 24-hour average (AQNES)

These criteria have been used to evaluate the operational phase effects in the screening modelling and are a representative subset of the full list of criteria detailed above. The assumption is that if levels meet these ambient air quality criteria, then the other averaging periods are also likely to meet the acceptable criteria.

For discharges to air from construction activities, the criterion for assessment from the PAUP is:

“The discharge must not cause noxious, dangerous, offensive or objectionable odour, dust, particulate beyond the boundary.”

The following values are commonly used to assess compliance with the above criterion:

[9] Contaminated Land Management Guidelines No. 2. *Hierarchy and Application in New Zealand of Environmental Guideline Values.* 2001 (revised 2011). Prepared by the Ministry for the Environment.

Table 4-5: Recommended criteria levels for construction dust,

Protection level	TSP concentration (24 hour average)
Sensitive area	80μg/m^3
Moderately sensitive	100μg/m^3
Insensitive area	120μg/m^3

5 Existing Environment

5.1 Auckland Urban Airshed

The entire Project area is located within the Auckland Urban Airshed, as gazetted in accordance with the AQNES regulations. This airshed encompasses the whole extent of the Auckland urban area. The term 'airshed' means an area delineated by the respective Councils for the purposes of managing air quality. Councils managing airsheds that breach the PM_{10} standard must plan to improve air quality. This airshed is classified as "polluted"[10] under AQNES Regulation 17 because ambient concentrations of PM_{10} within this airshed have exceeded the threshold concentration of 50 µg/m^3.

5.1.1 Air quality amenity (dust and odour) areas

Under the PAUP provisions, air quality amenity (dust and odour) areas[11] are defined with respect to different land use and zoning. The policy intent of the classification of these areas is to "*provide for higher levels of dust and odour provided that any adverse effects on human health are avoided, remedied or mitigated*".

The Business - Heavy Industry zone (Sectors 1- 4 of the Project) is classified as a "*medium air quality – dust and odour area (Industry)*". A "high air quality area" applies to the residential zones in Sector 5 of the Project. Sector 6, being the local works, is mostly in the Business- Heavy industry zone.

5.2 Land use and sensitivity of the receiving environment

It is important to consider the sensitivity of the surrounding land uses in relation to the potential for adverse effects of air emissions on human health and amenity values.

The proposed alignment travels predominantly through a mixture of light and heavy industrial land use with residential areas in Sector 5. In terms of operational air quality effects, the worst case location in the Project area is likely to be the residential properties located adjacent to SH1 (between Panama Road and Princes St), due to the combination of high traffic volumes and proximity to HSRs.

5.2.1 Highly Sensitive Receivers (HSRs)

For the purposes of assessing air quality effects for transport projects, highly sensitive receivers are defined as "*a location 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. The PAUP has a similar definition for activities sensitive to air discharges.

Of particular note when assessing transport related air quality effects is the proximity of roads to schools and early childhood education centres. Young children are particularly vulnerable to air pollution because their lungs are still developing, they have higher respiration rates and they breathe more air per kilogram of body weight than adults do.

Concentrations of air pollutants from vehicles on roads tend to decrease fairly rapidly with increasing distance from the road. For the purposes of this air quality assessment, residential and other HSRs have

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[10] Polluted airsheds are those airsheds where the average number of exceedance of the PM_{10} standard over the preceding five years was more than one per year

[11] Note the word "amenity" has been replaced with "dust and odour" in the Auckland Unitary Plan Decisions Version 19 August 2016

been identified if they are located within 200m of the EWL Main Alignment or SH1 (where widening is planned from Panama Road to Princes Street). The majority of HSRs are dwellings. There is one resthome (Awanui Rest Home). There are approximately 150 residential properties within 200m of SH1 between Panama Road and Princes Street Interchange.

The location of HSRs, and schools and education centres which will benefit from network improvements are shown in Figures A1 – A3. (Appendix A). These figures indicate the areas within the Project extent which are zoned for residential land use in the PAUP, which is where the majority of HSRs (dwellings) are located.

There are no schools or preschools currently within 200m of the proposed alignment or SH1. Although there are no schools directly affected by the Project, there are some educational facilities within the Project extent which will experience positive air quality effects through network changes to existing busy arterials. Schools which are adjacent to roads that will benefit from less traffic and congestion in future are:

- Onehunga Primary School – 122 Arthur Street
- St Joseph's School –125 Church St
- Ōtāhuhu Intermediate School – 22 Luke St
- Ōtāhuhu Primary School – 41 Station Road
- Te Papapa School – 219 Mt Smart Road

There are also a number of early childhood centres located close to busy arterials within the Project extent, which may benefit from a reduction in heavy vehicle numbers. Those identified are:

- Young and Amazing – Mays Road
- Piccolo Park – Mt Wellington Highway
- Waipuna Preschool Centre – Carbine Road

5.2.2 Zoning

The land use and relative sensitivity to air quality effects is described in Table 5-1 by sector.

Table 5-1: Sensitivity of land use by sector

Sector	PAUP zoning	Sensitivity to air quality
1 -Neilson Street Interchange	The land use around the Neilson Street Interchange is a mixture of Mixed Use and Light Industry. There are some houses in the Business-Light Industry zone. All dwellings are located on Onehunga Harbour Road and Onehunga Mall.	There are houses and rows of townhouses at 35- 39 Onehunga Mall and an apartment complex at 2 Onehunga Harbour Road. It is assumed that the owner of the Airport Harbour view motel lives onsite also. These locations are highly sensitive.
2 –Foreshore Works	Waikaraka Park is Public Open Space zone – sport and active recreation. Heavy industry zone	The Onehunga Sports football club is based at Waikaraka Park. These sports fields are considered moderately sensitive to reduced air quality amenity- i.e. dust and odour. People are only present for a short time and therefore it is not considered highly sensitive. The remainder of the area is low sensitivity.
3 –Anns Creek	Characterised by the Business-Heavy industry zone	Low sensitivity
4 -Great South Road to SH 1	This area is zoned Business-Light Industry. General business zone applies around Pacific Rise.	Low sensitivity
5 -State highway	Tip Top corner is zoned Business-Light Industry. Land use transitions to residential at Panama Road, with zones of Mixed Housing and Suburban.	Residential land use is highly sensitive. Approximately 150 residential properties are located within 200m. Awanui Rest Home 446 Panama Road is 50m from SH1.
6 –Local Works	Captain Springs Road (southern end where widening is planned), Hugo Johnston Drive, and works to reconfigure Great South Road (T2 lane) are all within the Business -Heavy industry zone.	Low sensitivity

5.3 Meteorology

Wind speed, direction and rainfall are key determinants for the potential for impacts to occur from emissions during road construction and operation.

Auckland meteorology is dominated by southwesterly and northeasterly winds for a significant proportion of the year. Land and sea breezes also influence regional flow patterns. In terms of air quality, light winds and calm, stable atmospheric conditions are the most critical for dispersion of pollutants. These conditions are typical on calm winter evenings and early mornings. Dust nuisance effects are generally associated with higher wind speeds (refer Section 5.3.1)

The three closest meteorological monitoring sites are located in Onehunga, Penrose and Māngere. Figure 5-1 shows the location of these sites. Brief descriptions for each of the sites are as follows:

1. Māngere – located within the Māngere wastewater treatment plant.

2. Penrose – located at the Gavin Street substation on open, level ground.

3. Onehunga – located in Waikaraka Park at the southern end of Captain Springs Road.

Meteorological data (wind speed and direction) from these sites were obtained from the CliFlo database. Table 5-2 shows a frequency distribution of maximum wind speeds (on an hourly basis) while Figure 5-2 shows wind roses illustrating hourly average wind speeds and directions recorded at these sites for the years 2006 to 2011.

The Onehunga site is closest to the Project area, however this site was discontinued in 2011, and therefore the data set is 2007–2011. This smaller data set is still useful for characterising local differences in meteorological conditions across the Project area.

Figure 5-1: Locations of closest meteorological monitoring stations

The Onehunga site is closest to the proposed EWL alignment and has more frequent higher wind speeds than Penrose, while Māngere is windier than both sites. Stronger winds at all sites (> 5m/s) are most likely to be southwesterlies. Based on the data from these monitoring stations, the prevailing wind direction in the Project area is from the south-west. A higher proportion of calm conditions (i.e. wind speed < 1.5m/s) were observed at the Penrose monitoring site than Onehunga or Māngere.

The conditions most likely to produce the worst case effect in terms of dispersion of contaminants discharged from the road are light winds. Light winds limit the dispersion of traffic discharges, resulting in higher concentrations of contaminants near the road. By contrast, strong winds result in greater dispersion of traffic emissions and lower concentrations.

Table 5-2: Frequency of wind speeds at three met monitoring stations

Wind speed (m/s)	Onehunga	Penrose	Māngere
<0.5	4.7%	5.2%	1.7%
0.5- 1.5	18.2%	25.2%	14.4%
1.5 to 3.0	33.7%	38.2%	21.7%
3.0 to 5.0	32.6%	26.3%	23.1%
5.0 to 8.0	10.3%	5.0%	25.0%
>8.0	0.5%	0.1%	14.0%

5.3.1 Auckland's meteorology in relation to construction dust management

Dust discharges due to construction earthworks are exacerbated under dry, windy conditions. Auckland's sub-tropical climate with plentiful rain all year round is beneficial for managing potential dust impacts. Rainfall data for Auckland is summarised below. One or two dry spells per year are common in Auckland between December and March; the average duration of a dry spell is 20 days.[8] These dry spell periods will increase the risk of dust nuisance, and need to be anticipated and planned for in the Construction Air Quality Management Plan. Appropriate dust control measures are described in Section 8.1.

A feature of the local meteorology is sea breezes, which are initiated in the Manukau Harbour on fine days and occur most frequently between 8am and 10am during November to March. Sea breezes are local onshore daytime winds generated on fine days by the sun warming the land surface more than the sea surface. The breezes typically have speeds of less than 5m/s, and tend to weaken late afternoon and stop by the evening. Auckland is also vulnerable to strong gusty westerlies which may be accompanied by thunderstorms, most often occurring in winter and spring.

For construction effects, winds above 5m/s will start to give rise to airborne dust from exposed surfaces, particularly after extended periods without rainfall. High wind speeds above 10m/s have the most potential for excessive dust if winds are blowing towards the direction of sensitive receptors. Based on the Onehunga windrose data, wind of this strength is rare in the Project area. Dust monitoring locations should be selected to be downwind of the prevailing southwesterly wind direction.

5.3.2 Rainfall

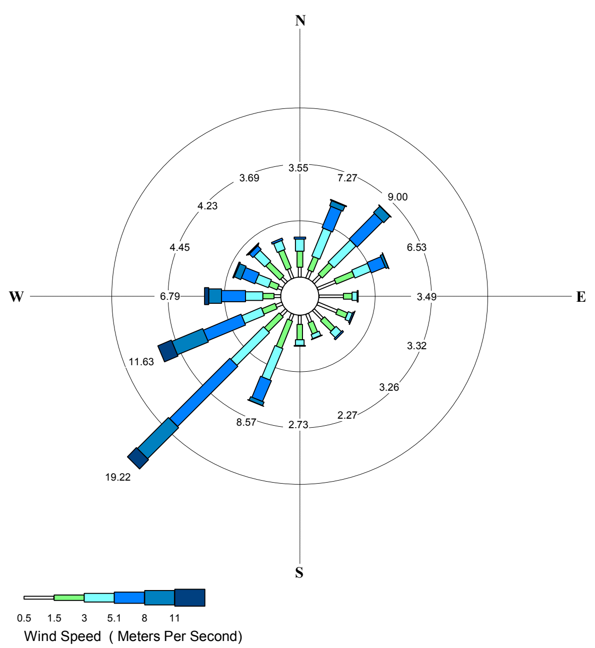
The average number of days per year on which more than 1mm of rain was recorded at the weather station in Owairaka (approximately 7 km from the alignment) is shown in Table 5-3. This data is a reasonable indication of the probable rainfall frequency during the Project construction period.

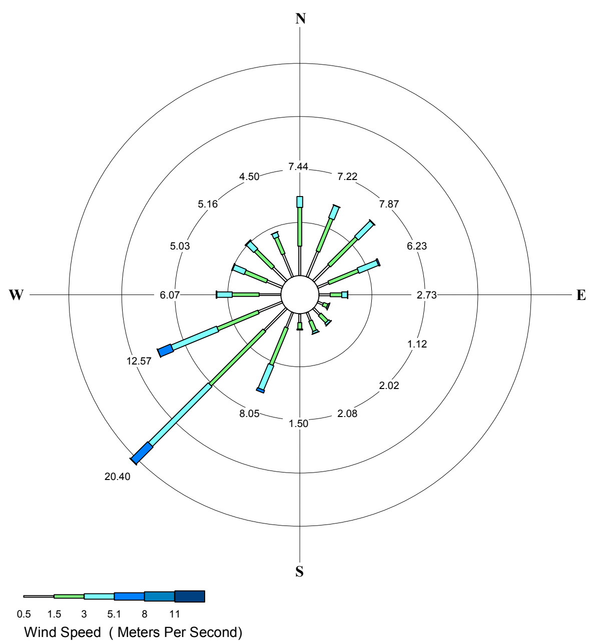
Table 5-3: Average monthly number of wet days in central Auckland region (Owairaka)[12]

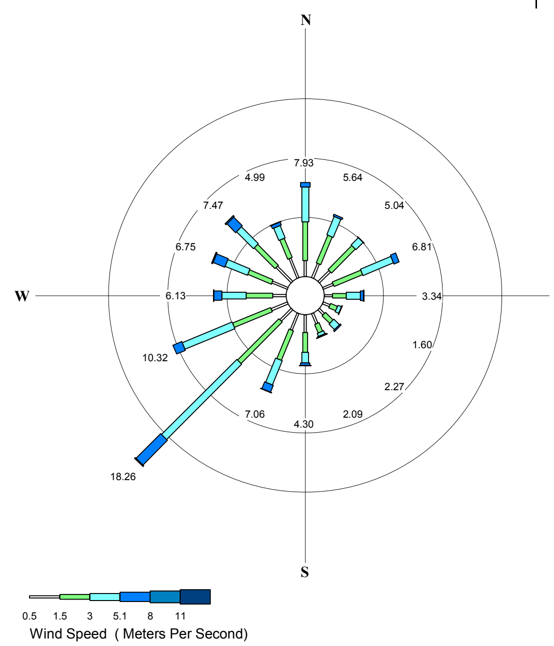
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
No. of days	8	7	8	11	12	15	16	15	13	12	10	9	136

[12] The Climate and Weather of Auckland, NIWA Science and Technology Series, 2nd edition.

Figure 5-2: Wind speeds (m/s) and directions (hourly averages)







Māngere 2010-2015	Penrose 2010-2015	Onehunga June 2007 to June 2011
The length of the coloured bar is proportional to the frequency of wind from that direction. The colours partition the wind into speed ranges.		

5.4 Topography

Topography can influence dispersion of air pollutants. The best example of this is in valleys under atmospheric inversion conditions when the warm air close to the ground is trapped. The topography in the Project area is mainly flat and low lying coastal reclaimed land. The most significant topographical features nearby are the remnants of the volcanic Tuff Ring, Te Hōpua in Sector 1 and Mutukāroa-Hamlins Hill. These terrain features will not have a significant effect on pollutant levels in the vicinity of the Project and were not incorporated in the screening model.

5.5 Existing traffic volumes

An important feature of the existing environment is the existing traffic environment within the Project extent. The Project area is Auckland's main manufacturing location, containing almost 20% of Auckland's manufacturing employment. It is a regional hub for transport and distribution activity, containing the MetroPort inland port, Southdown KiwiRail and Toll Freight terminals and a large number of other major distribution and logistics firms. The nature of local industry results in large volumes of heavy vehicles on local corridors, as a means of connecting to the State highways (SH1 and SH20).

Current congestion on the existing access points to and from SH1 and SH20 restricts the ability for vehicles to enter the corridor. Congestion is a significant factor influencing vehicle emissions, as traffic congestion leads to higher emissions of harmful products of combustion from vehicles.

5.6 Existing air quality

In order to assess the impacts of the Project on future air quality, an estimate was made of the state of current air quality in the Project area. Within the Project area, air quality is likely to be influenced by domestic solid fuel heating emissions and vehicle emissions. These are the two predominant emission sources within the wider Auckland urban airshed. There are also natural sources of fine particles, including sea salt, pollen, and soil. Industrial discharges in the area will also have localised effects on air quality.

This section provides a review of the best available air quality monitoring data for estimating background pollution levels in the Project area. This is based on air quality data reported by Auckland Council, the Transport Agency and the results of comprehensive roadside monitoring study undertaken in part of the Project area by NIWA in 2010.

5.6.1 Auckland Council data

Ambient air monitoring sites operated by local authorities are typically located in urban or residential areas where people may be exposed to air pollution and/or where air quality is likely to be worst. Auckland Council measures ambient air quality at 13 monitoring sites in the Auckland Region. The nearest of these sites to the Project area is Penrose. The results of PM_{10} monitoring carried out at this station since 2011 is summarised in Table 5-4.

Table 5-4: Air quality monitoring data recorded at Penrose, 2011- 2016

Contaminant		24 hour average PM_{10} concentrations (µg/m³)					
Year		2011	2012	2013	2014	2015	5 year average
PM10	Max	30.6	42.5	43.0	32.8	38.4	37.6
	Mean	14.7	14.6	15.7	15.5	13.9	14.9

This data indicates that PM_{10} concentrations measured at Penrose over the last five years have complied with the AQNES for PM_{10} of 50µg/m³. The Penrose monitoring data is expected to be representative of Sectors 1 to 4 of the Project area, due to the similar land use. Sector 5 of the Project area is better characterised by another monitoring campaign, which is described in Section 5.6.3.

In Auckland, peak concentration is most likely to occur in the winter months (May to August) when domestic wood smoke emissions coincide with calm winds. Consistent with other analysis of air quality in Auckland[13], the trends in PM_{10} concentrations are weakly downward. However, as the trends are weak and subject to inter-annual variability due to climate conditions, it has been assumed that background air quality remains unchanged between the Project assessment years of 2013, 2026 and 2036.

5.6.2 Passive NO_2 Monitoring

Nitrogen dioxide concentrations are regarded as a reasonable marker of exposure to traffic related emissions. The Transport Agency operates a network of passive diffusion samplers to monitor NO_2 in the vicinity of State highways across the country. Diffusion samplers are typically exposed to ambient air for periods of up to a month at a time, so cannot be used to measure short term concentrations of air pollutants. Instead, the results of this monitoring are typically expressed as annual average concentrations, which can be used to compare overall air quality at a number of locations.

Several of these passive NO_2 monitoring sites are located close to SH1 and SH20 in the Project area. The results of passive NO_2 monitoring[14] at each site are summarised in Table 5-5. The AAAQS for NO_2 annual concentrations against which these measurements can be compared is 40µg/m³.

Table 5-5: Annual average nitrogen dioxide concentrations measured at State highway locations within and close to the Project area

Site ref.	Location	Annual average NO_2 µg/m³				
		2011	2012	2013	2014	Average
AUC013 AUC014 AUC015	SH1/ Gavin St	31.7 30.8 30.3	29.6 28.7 28	32.6 30.5 32.1	30.8 30 29.1	31.2 30 29.9
AUC017	SH1/ Todd Pl	23.4 (2009)	-	-	-	23.4
AUC026	SH20/ Hastie Ave	25	25	23.7	19.9	23.4
Source: Ambient air quality (nitrogen dioxide) monitoring network 2007 to 2014 Annual report, NZ Transport Agency, Feb 2016.						

The data recorded at all these sites is less than the AAAQS of 40 µg/m³. Over time, NO_2 concentrations have been relatively constant at the SH1 Gavin Street location and have decreased at the SH20 monitoring location. This is consistent with the overall observations from the national monitoring programme which has observed on average, a slight reduction of 3% in NO_2 concentrations since 2010. Concentrations measured close to SH1 are higher than SH20, which correlates with the higher traffic volumes on SH1.

5.6.3 Roadside Ambient Air Quality Study - Ōtāhuhu

A detailed ambient air quality monitoring study of roadside pollutant levels was carried out by NIWA within the Project area in 2010.[15] The purpose of the investigation was to measure the impact of the motorway on local air quality.

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[13] Waterview Connection - Air Quality Assessment of Effects, Beca/NIWA, July 2010.

[14] Transport-related air quality monitoring system (TRAMS)

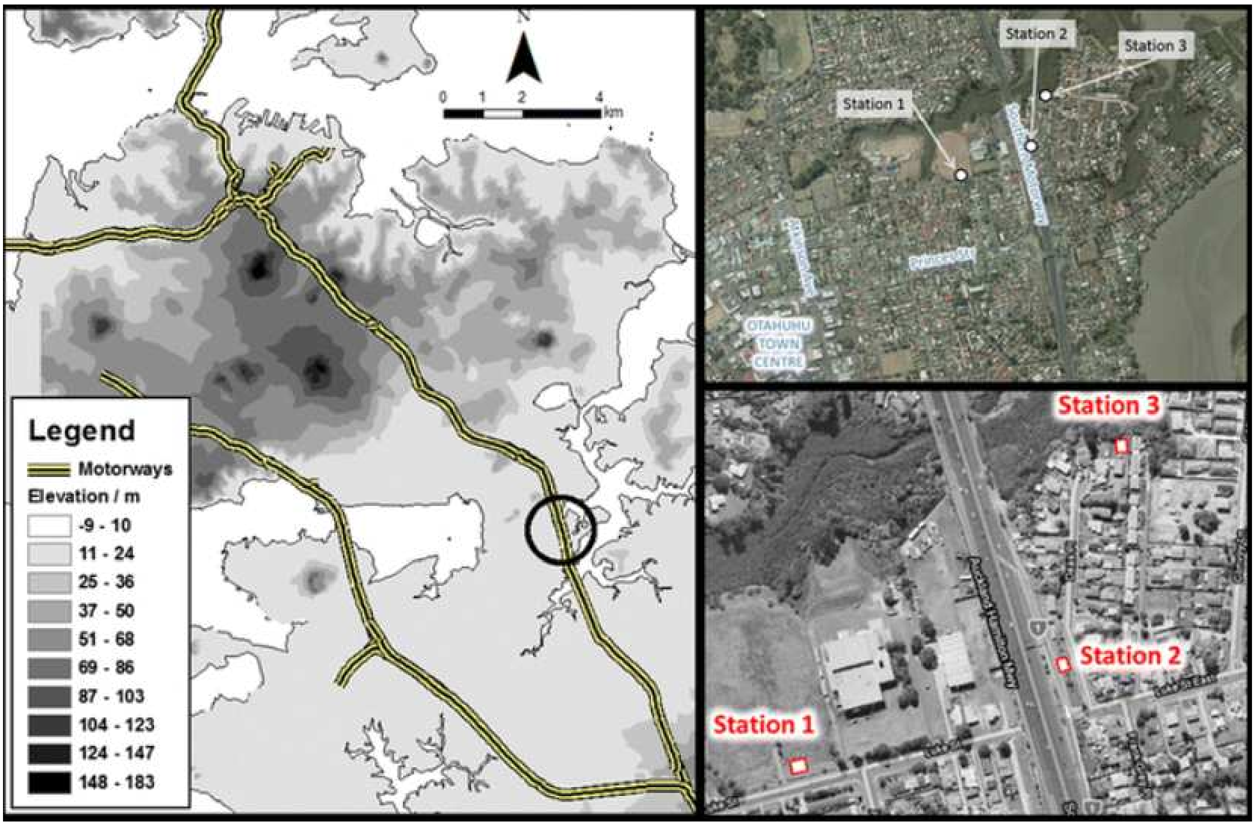
[15] Roadside increments in PM_{10}, NOx and NO_2 concentrations observed over 2 months at a major highway in New Zealand, I. Longley, E. Somervell, and S. Gray. NIWA Ltd, Journal of Air Quality and Atmospheric Health, 2015.

The location of the three monitoring sites within the Ōtāhuhu East study area is shown in

Figure 5-3. Passive monitoring of NO_2 was also conducted at 32 sites across the study area.[16] Continuous measurement of PM_{10} and NO_2 was carried out for a period of eight weeks next to a stretch of SH1 (Station 2) and at two "setback" sites (Station 1 and 3), in the surrounding residential neighbourhood.

During the monitoring programme three ambient air monitoring stations were located in the Ōtāhuhu East study area. PM_{10} and NO_2 concentrations were continuously monitored at each station for a period of eight weeks on either side of a stretch of SH1 and two "setback" sites in the surrounding residential neighbourhood. The location of these monitoring stations is shown below.

Figure 5-3: Location of the Study area



The 2010 traffic flows have been compared to 2013 (Existing scenario) to assess the change in traffic flows on SH1 since the study was carried out. The annual average daily traffic volume (AADT) on the motorway through Ōtāhuhu is compared in Table 5-6 below.

Table 5-6: AADT (vehicles per day) SH1 at Princes Street Interchange[17]

	2010	2011	2012	2013	2014	2015

[16] Detailed observations and validated modelling of the impact of traffic on the air quality of roadside communities, 2013, NZ Transport Agency Research Report 516.

[17] State Highway AADT Data Booklet 2011-2015, NZ Transport Agency 2016

North of the interchange	116,000	113,204	114,787	117,218	119,572	121,452
South of the interchange	122,000	119,447	120,531	124,208	126,454	129,411

Based on these traffic flows, AADT increased 3-4% between 2010 and 2013 and 5-6% from 2013 to 2015. On this basis, the concentrations measured below are considered to be sufficiently representative of the current existing environment. Table 5-7 and Table 5-8 show a statistical summary of the PM_{10} concentrations and NO_2 measured at each monitoring site.

Table 5-7: 24 hour average PM_{10} concentrations measured in the Ōtāhuhu East study area during NIWA campaign (µg/m³)[7]

Monitoring site location	24 hour average PM_{10} (µg/m³)			(µg/m³)
	Mean	Max	99.9th percentile	AQNES
Station 1- Luke Street - 250m west of SH1	16.8	43.5	43.1	50
Station 2 – Deas Place Reserve, adjacent to southbound Princes Street off-ramp	18.5	43.4	43.1	50
Station 3 –Private property on Deas Place, 150m east of SH1	20.5	45.5	45.2	50

Table 5-8: 1 hour average NO_2 concentrations measured in the Ōtāhuhu East study area during NIWA campaign (µg/m³)[7]

Monitoring site location	1 hour average NO_2 concentration		(µg/m³)
	Mean µg/m³	Max µg/m³	AQNES
Station 1- Luke Street - 250m west of SH1	18.9	46.4	200
Station 2 – Deas Place Reserve, adjacent to southbound Princes Street off-ramp	26.1	80.8	200
Station 3 – Private property on Deas Place, 150m east of SH1	16.6	54.9	200

The passive NO_2 monitoring (Table 5-4) shows air quality in the State highway corridors has been reasonably constant over the last few years. The 2010 monitoring campaign is considered to be sufficiently representative of the existing air quality in Sector 5 of the Project area.

Despite the proximity of the monitoring sites to the heavily trafficked SH1 motorway corridor, all measurements were compliant with the AQNES at all times.

On average, the study estimated that the contribution of emissions from the motorway to 1 hour average NO_2 levels ranged from 7.2 – 9.4µg/m³ and 0 - 1.1µg/m³ for the 24 hour average PM_{10}. However, for the majority of the time, Station 3 had higher concentrations than the Station 2 roadside site, which contradicted expectations that the Station 2 roadside concentrations would be highest. This means that the road was not the main source of PM_{10} at this kerbside SH1 location. Peak PM_{10} concentrations occurred around midnight, when traffic on the motorway was very light. The study concluded that during times of peak concentrations, the contribution of the motorway to PM_{10} concentrations was small compared to a much larger, different source. The study concluded that the source was most likely to be domestic wood-burning for home heating.

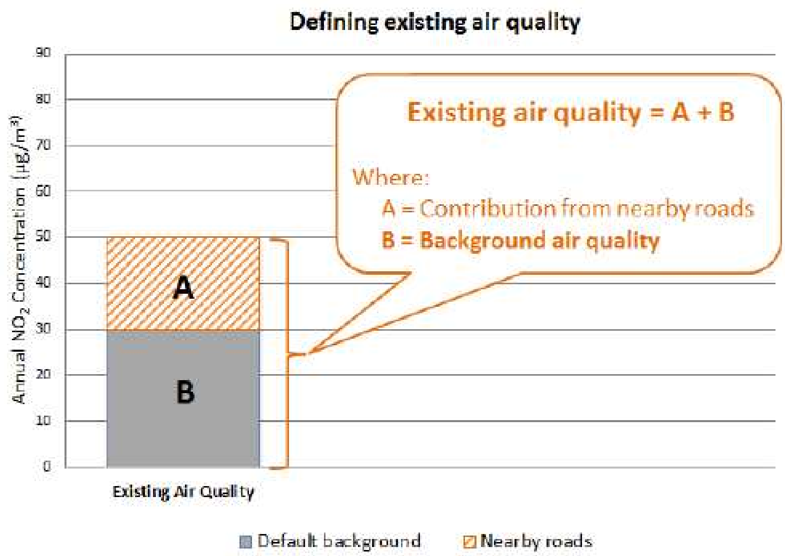
NO_2 concentrations at the roadside Station 2 were higher than both stations 1 and 3. The passive monitoring data indicated strong localised gradients of NO_2 within approximately 200m of the motorway.

Overall this study indicated that the motorway did have a measurable impact on air quality when NO_2 is used as the indicator, but not when PM_{10} is measured as there were too many other sources of PM_{10} nearby. The impact of emissions from vehicles travelling on SH1 did not cause the AQNES to be exceeded.

5.6.4 Background Concentrations

Background air quality is the level of contaminants across the airshed including contributions from natural sources (e.g. volcanoes, sea salt and wind-blown dust, etc.) and from man-made sources such as industry, domestic heating and other roads. The difference between existing air quality and background air quality is shown in Figure 5-4.

Figure 5-4: How existing and background air quality are defined.



The Transport Agency has prepared draft Background Air Quality Guidance which recommends default values for background air quality, based on data collected at ambient air monitoring sites throughout New Zealand.[18] The Ōtāhuhu East study measured roadside air quality, so it cannot be used to define "background air quality" for the purposes of the screening modelling assessment, since it would mean the SH1 contribution would be counted twice in the modelling.

The background concentrations recommended in the guidance for the census area unit which corresponds with Sector 5 of the Project are presented in Table 5-9.

Table 5-9: Background air quality concentrations for screening assessments (Transport Agency Guidance)

Contaminant	Averaging Period	Estimated Background Concentration (µg/m³)
NOx	Annual	19
PM_{10}	24-hour	30 - 39.99

[18] Background Air Quality Guide (Draft), NZ Transport Agency, June 2014.

The value of 35µg/m^3 has been selected for the background PM_{10} concentration in the screening modelling. This is the mean of the conservative range of 30 to 39.9µg/m^3 recommended above in the absence of site specific data. The selected value is also in the order of the 5 year average of maximum concentrations measured at Penrose of 37.6µg/m^3, which indicates it is conservative. The NO_2 concentration of 19µg/m^3 has been selected in the absence of more site specific annual data. The NO_2 monitoring data described in this report is all roadside and is therefore not representative of background concentrations.

5.7 Summary

Sectors 1 to 4 of the proposed route of the EWL Main Alignment have relatively low sensitivity to potential adverse effects of air emissions on human health and amenity values, due to the mixture of light and heavy industrial land use. The heavy industry zone within the PAUP is an "air quality reduced amenity area."

The Ōtāhuhu residential areas in Sector 5 between Panama Road and Princes Street are the most sensitive part of the Project area to the potential effects of vehicle emissions, due to the number of houses and proximity of some houses to the motorway. A small number of dwellings also exist in Sector 1 at Onehunga Mall.

Existing air quality data from the Auckland Council Penrose monitoring site and a NIWA research study carried out in Ōtāhuhu East indicates background levels in the Project area currently comply with the AQNES. As with other urban areas of Auckland, air quality is influenced by both wintertime domestic solid fuel heating emissions and vehicle emissions.

The background concentrations for use in screening modelling assessment are:

- 24 hour average PM10 = 35.0µg/m^3
- Annual average NO2 concentration = 19µg/m^3

6 Predicted Project Operational Air Quality Effects

6.1 Factors which affect vehicle emissions

The effects of vehicle exhaust emissions are primarily proportional to the volume of traffic. This is described in Section 6.2. However, there are many other complex factors that influence the type and magnitude of the emissions. The principal factors affecting emissions from vehicles are:

a. Vehicle type (light or heavy). The proportion of heavy vehicles is significant as they are usually diesel and thus high emitters of particulate. Buses and trucks also tend to be some of the oldest vehicles in the fleet.

b. Fuel type used by a vehicle (diesel or petrol). Diesel vehicles are more polluting than petrol (higher particulate emissions) and diesel exhaust has been classified by the World Health Organisation as carcinogenic to humans.[19]

c. Type and condition of a vehicle's emission control equipment e.g. catalytic converters and electronic engine management systems. Catalytic converters are very effective at reducing CO, VOCs and NOx although these do not reduce PM_{10} discharges. Most modern cars (<2003) have emission controls, however tampering with controls is also a known problem.[20]

d. Age, state and maintenance of the vehicle. Older cars tend to be less efficient, and have higher emissions. The average age of cars in the NZ fleet is old compared to other western countries. In 2014, the average age was 14 years, which is forecast to reduce slowly as the large peak of 1995-1997 Japanese imports eventually gets scrapped.

e. Vehicle speed and level of service. Vehicles generally emit lower amounts of pollutants when they are travelling steadily at their optimal design speed which is around 30-70 km/hour for most vehicles. Emissions are typically a factor of five to ten times higher in congested traffic when compared to a free flowing highway without interruptions.

f. Journey length and gradient. Short trips with cold engines have higher emissions, because cold engines operate inefficiently. Road gradients increase or decrease fuel consumption depending on whether the vehicle travels uphill or downhill. Gradient effects are most significant for heavy vehicles.

Factors (a) to (d) are addressed in the vehicle emissions model (VEPM) described in Section 6.3. VEPM is an average speed model, so does not directly model emission rates near intersections which may vary as a consequence of acceleration, deceleration and idling.

Factor (e) is assessed in the traffic modelling analysis under travel times. Improved travel time and level of service means increased travel speed and reduced congestion.

The journey length (f) is included in the summary of changes in emission rates (Section 6.3). Gradient effects are not included in the screening model input options.

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[19] (IARC, 2012).

[20] The Ministry of Transport has been investigating the issue of tampering with vehicle emissions control equipment and options to address the issue since late 2014. The extent of tampering is still unknown (2016).

6.2 Effects of motor vehicle exhaust contaminants

6.2.1 Particulate matter

Sources of fine particulate matter (PM_{10} and $PM_{2.5}$) include exhaust emissions, re-suspension of road surface dust, tyre wear, and brake and road surface wear. Large particulate matter (e.g. dust) generally causes loss of amenity or nuisance caused by soiling of surfaces due to deposition.

Abrasion processes produce particulate matter from tyre wear and brake wear across a wide range of particle size, with approximately 40% of tyre wear being greater than PM_{10}. Brake wear particles are predominantly (>90%) PM_{10}.

The health effects of PM_{10} have been well-studied in New Zealand and overseas. PM_{10} is inhalable, penetrating into and depositing in the respiratory tract, and if in high concentration for sufficient time will increase lung irritation and decrease lung function. Epidemiological studies have shown increased levels of PM_{10} are associated with an increase in a range of health effects including respiratory disease, cardiopulmonary disease and the exacerbation of asthma.

Diesel exhausts contain higher particulate concentrations than petrol exhausts, and diesel particulate is especially concerning because it has been identified as a potential carcinogen, although at present all particulate matter is regulated in the same way regardless of its source.

Most countries (including New Zealand) have taken a pragmatic approach and have set guidelines (typically 50µg/m^3 for PM_{10}, 24-hour average) aimed at minimising the occurrence of health effects. Recent research is showing that it is probably the finer particles causing greater effects ($PM_{2.5}$), and particles from diesel combustion are possibly having greater effects than those from other sources. The AQNES is expected to be revised in 2017, and it is likely the standard for fine particles will be revised in line with this research.

At present the only way to use the screening model to assess $PM_{2.5}$ is to assume all PM_{10} emitted from vehicles is $PM_{2.5}$, which will overestimate values in an already conservative assessment tool. PM_{10} and NO_2 are considered to be suitable indicator parameters for this air quality assessment of effects.

6.2.2 Effects of Oxides of nitrogen (NOx)

Vehicle traffic is a major source of NOx emissions in urban areas. Nitrogen oxides (NOx) are emitted mainly in the form of nitric oxide (NO) but, once released into the atmosphere, variable proportions are oxidised to the more harmful nitrogen dioxide (NO_2).

NO_2 causes inflammation of the airways, particularly in young children, asthmatics and those with respiratory disease. It can cause both short-term and long-term effects. While there is some uncertainty over the thresholds at which these human health effects can occur, it is considered that the guidelines set out in Section 4.5 are conservative.

6.3 Predicted changes in traffic volumes

Traffic modelling has been used to compare the future changed transportation network scenario ("With Project") with the scenario where the traffic volumes would grow due to population growth, but the future road network would not include EWL ("Without Project"). Full details of this traffic modelling are available in *Volume 3: Technical Report 1-Traffic and Transportation Assessment* -.

The assessment of air quality effects is based on the outputs of the project SATURN transportation model. The extent of the SATURN model is from Mt Albert Road in the north to Manukau City Centre in the south. The extent of the SATURN model boundary is shown in Figure 6-1.

The Project is predicted to result in a reduction of general traffic and heavy vehicles from other key arterials and local roads in the Onehunga area, including Church Street (west) and Mt Smart Road.

These areas are predominantly residential in nature and as such, reduction in traffic volumes is likely to have a positive impact on safety and air amenity. Under the Without Project scenario, congestion is expected to increase at many points in the existing routes between the State highways.

Figure 6-1: SATURN traffic model extent

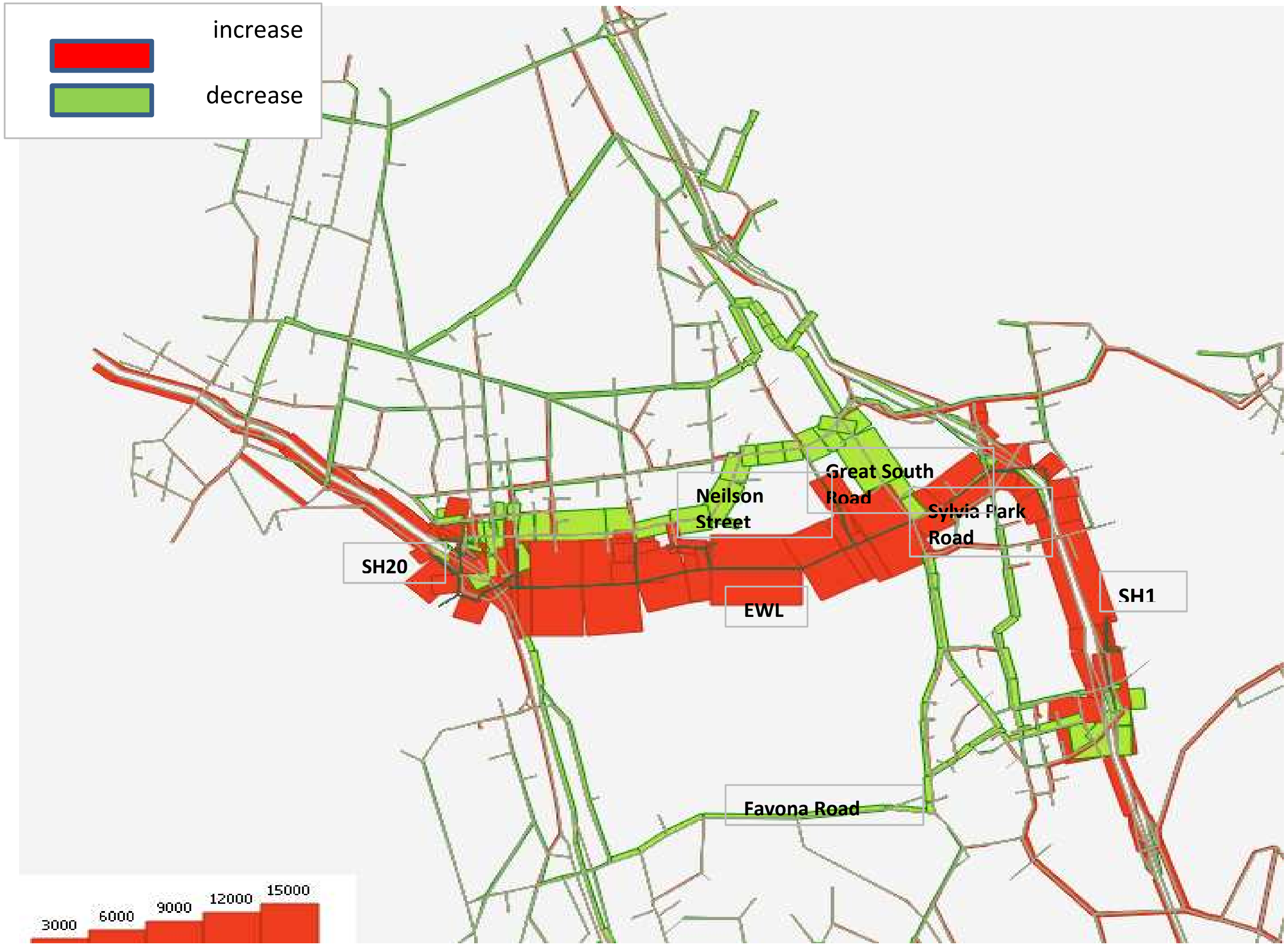
Table 6-1 compares the existing traffic volumes with future growth predictions.

Table 6-1: Existing traffic volumes at key locations within the Project area

Key Road	2013 Existing	2026 Without Project	2036 Without Project	Growth 2013 - 2036
Church Street east of Neilson Street	43,300	48,400	51,200	7,900 (18%)
Great South Road at Southdown Lane	31,900	32,900	33,000	1,100 (3%)
Neilson Street east of Victoria Street	27,700	31,400	35,200	7,500 (27%)
SH1 at Panama Road	123,600	137,900	145,900	22,300 (18%)
SH20 Māngere Bridge	108,800	170,700	188,000	79,200 (73%)

Figure 6-2 illustrates the predicted change in daily traffic flows on the network as a result of the Project, by comparing the 2026 With Project and 2026 Without Project scenarios. The key increases and reductions in traffic as they relate to air quality impacts are summarised in Sections 6.3.1 and 6.3.2.

Figure 6-2: Predicted change in daily traffic volumes (vehicles per day) due to EWL, comparing 2026 With Project and 2026 Without Project.



6.3.1 Reductions in traffic

Key network changes of relevance to the air quality assessment are those roads which are located in residential areas, where the traffic model predicts reductions in traffic. As many of these roads currently experience high volumes of heavy vehicles, these reductions are particularly beneficial for local air quality. These benefits are further quantified in Section 6.4 which summarises the changes in actual emission rates due to reduced traffic. These roads are:

- Church Street, Campbell Road, Mt Albert Road, Onehunga Mall and Beachcroft Avenue, Mt Smart Road, Mt Wellington Highway (south of Panama Road), Favona Road and Mahunga Drive

The following roads through commercial and industrial areas are also predicted to benefit from significant reductions in traffic:

- Neilson Street, Carbine Road, Clemow Drive, Great South Road (Sylvia Park to Princes Street), Salesyard Road, Highbrook Drive.

6.3.2 Increases in traffic

Increases in traffic flows are predicted on the strategic routes such as SH20, SH1 and Sylvia Park Road. These reflect the improved strategic access diverting traffic away from the residential and commercial areas. Minor increases are predicted on Hugo Johnston Drive, Mays Road, Panama Road, Bairds Road, O'Rorke Road and some north-south links such as Rockfield Road, Captain Springs Road and the northern part of Onehunga Mall.

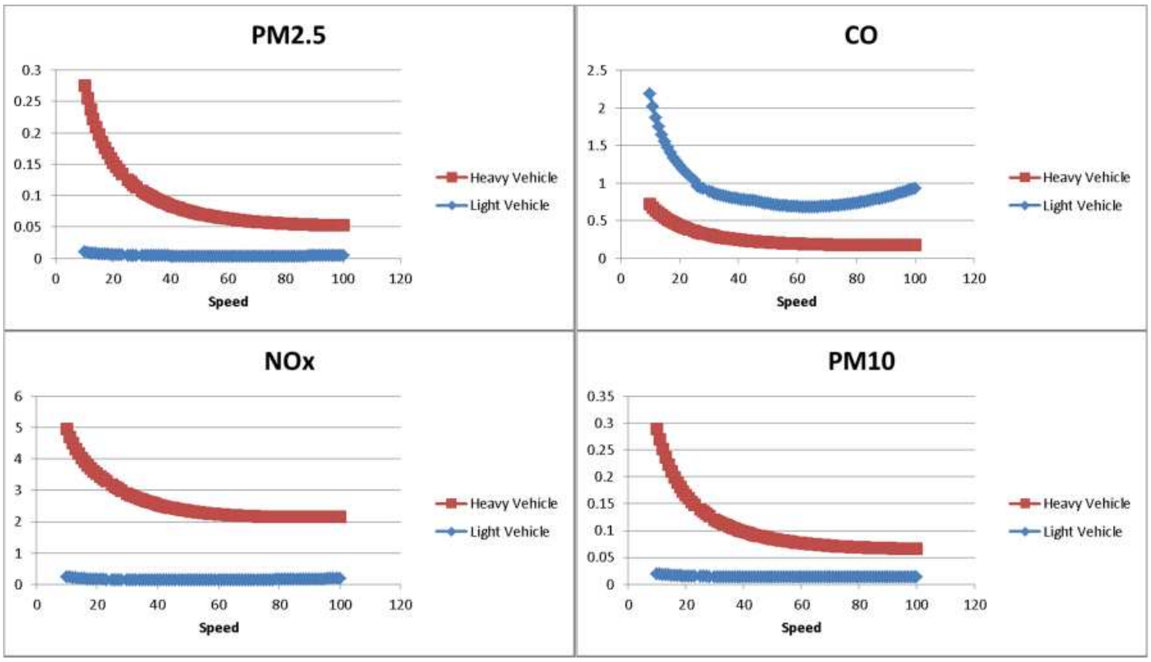
6.4 Predicted changes in emission rates

Vehicle emission factors have been derived from the Vehicle Emissions Prediction Model (VEPM) V5.1. VEPM was developed by the University of Auckland for Auckland Council, based on New Zealand vehicle fleet profiles and the best available emission factors. It is widely accepted as the appropriate tool for vehicle emission modelling in New Zealand. VEPM predicts network emissions for carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbons (VOC), nitrogen oxides (NOx), exhaust particulates ($PM_{2.5}$), brake and tyre particulates (PM_{10}) and fuel consumption based on traffic speeds.

When using VEPM, particulate matter emission factors are predicted to decrease with time due to the introduction of national controls and changes in vehicle technology, but NO_x emission factors are not projected to reduce with time.

In general, reduced traffic volumes equates to reduced emissions, however increasing speed and reducing congestion also reduces emissions of PM_{10} and NO_2. Figure 6-3 shows this trend, and also illustrates how heavy vehicle emissions are higher than light vehicles.

Figure 6-3: Trends in vehicle emissions, by vehicle type (heavy versus light vehicles) with increasing vehicle speed (g/km)



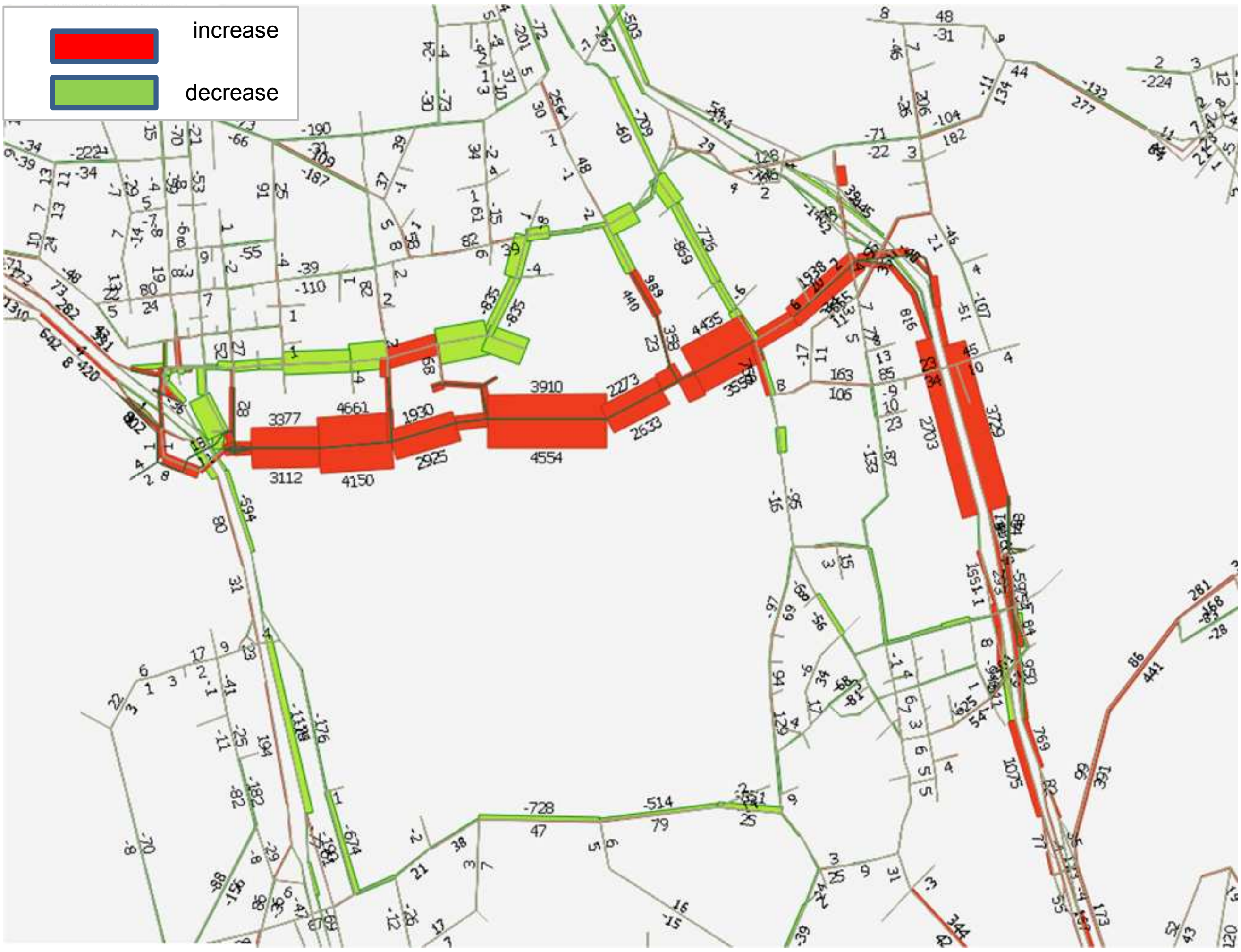
A summary of predicted mass emission rates of pollutants for each of the road corridors of interest is shown in Table B1 in Appendix B. A spreadsheet tool[21] has been used to apply the VEPM output to the output from a SATURN traffic model. Figure 6-4 and Figure 6-5 illustrate the change in the quantity of vehicle emissions across the Project extent. These maps show clearly how emissions of NOx and PM10 are forecast to increase on the strategic routes (SH1, SH20 and EWL) while there are significant reductions in emissions throughout Onehunga, and to a lesser extent Ōtāhuhu and Māngere Bridge.

6.4.1 Heavy vehicles

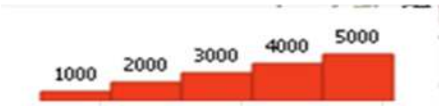
A significant feature of the existing traffic environment is the high volume of heavy vehicles. Heavy vehicles are higher emitters of pollutants than light vehicles. Figure 6-4 and Figure 6-5 include the effects on emissions brought about by EWL, due to the redistribution of heavy vehicle traffic through the Project area.

[21] Traffic and Emission Modelling, Beca Infrastructure Ltd, July 2012

Figure 6-4: Forecast change in NOx emissions (g/day) with the Project in 2026



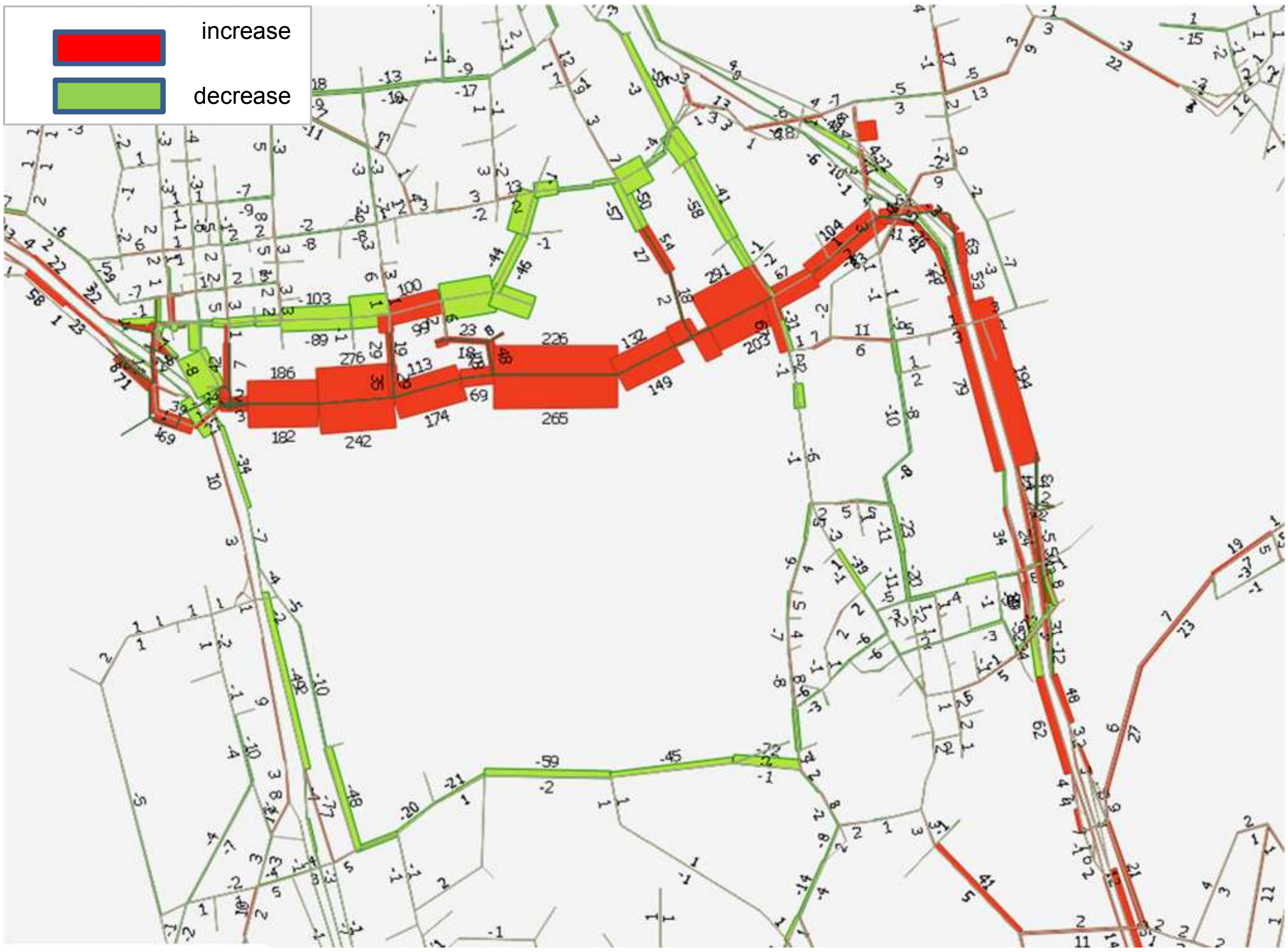
green = predicted reduction in NOx emissions, red = predicted increase in NOx emissions



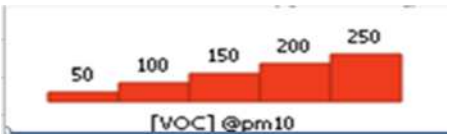
Scale: NOx g/day

The width of the bars (green and red) is proportional to the mass of daily NOx emissions for that road link.

Figure 6-5: Forecast change in PM10 emissions (g/day) with the Project in 2026.



green = predicted reduction in PM10 emissions, red = predicted increase in PM10 emissions



PM10 g/day

The width of the bars (green and red) is proportional to the mass of daily PM10 emissions for that road link.

6.4.2 Network effects of the Project

The net effects of the Project on vehicle emission rates have been calculated to assess the wider impacts on the Auckland airshed.

The main operational effect of the Project on the transportation network will be reduced traffic on the existing busy arterials through the suburbs of Onehunga, Mt Wellington and Ōtāhuhu. Without the Project, increased traffic and congestion would result in increased emissions and therefore exposure to air contaminants particularly for the residential suburbs within Onehunga and Ōtāhuhu. To quantify this benefit, the relative differences in the mass emissions from motor vehicle contaminants travelling on the existing network for the 'With Project' and 'Without Project' scenarios have been compared. The overall figures are summarised in Table 6-2.

Table 6-2: Summary of network changes in emissions due to the Project

Scenario	VKT/day (km)	NOx (tonnes/day)	PM2.5 (tonnes/day)	PM10 (tonnes/day)	CO (tonnes/day)
2026					
Without Project	9,871,805	4.06	0.14	0.244	14.25
With Project	9,977,866	4.08	0.14	0.243	14.33
% change	1.1%	0.5%	-0.01%	0.4%	0.6%
2036					
Without Project	10,797,756	3.75	0.11	0.221	8.93
With Project	10,957,037	3.78	0.11	0.222	8.98
% change	1.5%	0.6%	-0.3%	0.6%	0.6%

The overall kilometres travelled increases by 1.1% in the year of opening 2026 and by 1.5 % compared to Without Project in 2036. This increase in VKT is due to some induced traffic using the key strategic routes because the level of service is predicted to improve.

In 2026, the overall emissions of NOx, PM_{10} and CO are predicted to be very slightly higher once EWL is operational compared to without EWL, by 0.5%, 0.4% and 0.6% for NOx, PM_{10} and CO respectively.

What these figures shows is that although the overall kilometres travelled increases, the percentage increase in vehicle emissions is proportionally lower, which is likely to be due to the improved level of service. That is, roads with less congested traffic flows have slightly lower emissions.

Of note is the slight reduction predicted for the very fine particle component $PM_{2.5}$, by 0.01% in 2026 and 0.3% in 2036. PM_{10} emission rates include a brake and tyre wear component which is directly proportional to VKT which explains how PM_{10} can increase while $PM_{2.5}$ decreases.

6.5 Screening modelling

This section of the report considers the effects of air pollutants on HSRs due to vehicles using the EWL. The sectors of the Project which contain HSRs are:

- Sector 1 – Onehunga Mall/Onehunga Harbour Road
- Sector 5 – SH1 between Panama Road and Princes Street.

The locations where peak exposures are expected to occur within these sectors have been chosen for input to the screening model, selected based on a combination of the highest traffic volumes, highest predicted increase in emissions (as shown in Figure 6-4 and Figure 6-5), and closest proximity to dwellings. The locations of three representative HSRs (HSR1, HSR2 and HSR3) are shown in Figure 6-7 to Figure 6-9.

The Transport Agency Air Quality Screening model was also used to predict the maximum 24 hour average PM_{10} concentrations and annual average NO_2 concentrations at varying distances from the EWL alignment and SH1 to illustrate how concentrations are predicted to change. Both 2026 and 2036 With Project scenarios have been assessed. Table 6-4 summarises the predicted contribution of motor vehicle emissions to background level concentrations in 2026 and 2036.

6.5.1 Modelling results by distance from the EWL Main Alignment

Table 6-3 summarise the model inputs and Table 6-8 summarises the model results.

Table 6-3: Screening model inputs for the Project

	2026 With Project			2036 With Project		
Road link	AADT	% HCV	Avg Speed km/hr	AADT	% HCV	Avg Speed km/hr
EWL (at Onehunga Harbour Road)*	40,400	11%	50	46,900	12%	45

* Traffic volumes on EWL are highest at the SH20 connection end. AADT averages 20,000-30,000 on other sections of EWL (2026)

Table 6-4: Screening tool results with varying distance from EWL

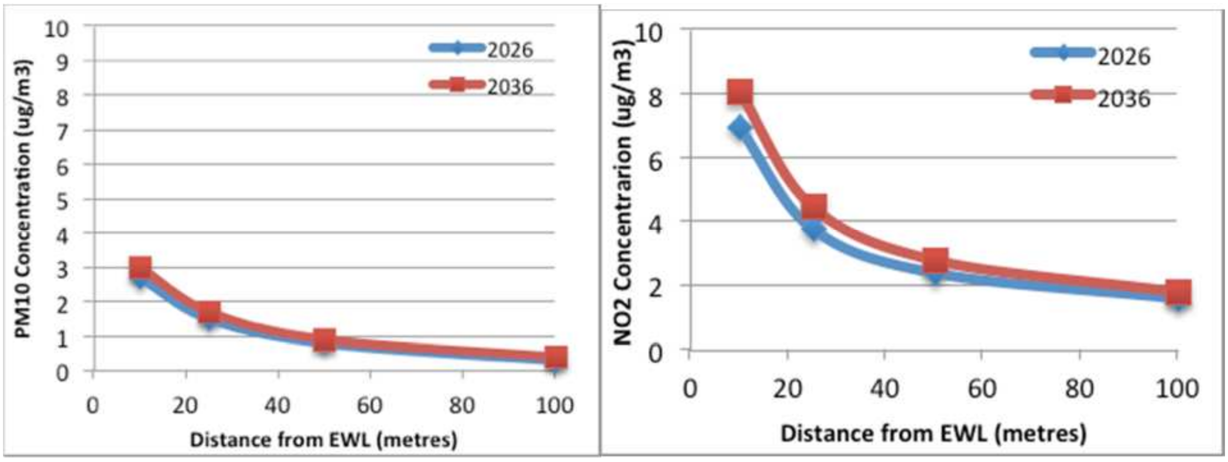
Distance from EWL	PM_{10} (µg/m^3)		NO_2 (µg/m^3)	
	2026	2036	2026	2036
10m	2.7	3.0	7.0	8.1
25m	1.5	1.7	3.8	4.5
50m	0.8	0.9	2.4	2.8
100m	0.3	0.4	1.6	1.8

Using the screening tool in this manner allows the overall trends in emission rates under all scenarios to be clearly illustrated. The results show that there is expected to be a slight increase in pollutant levels consistent with the predicted increase in vehicle numbers over the 10 year period. In the year of the Project opening, concentrations of PM_{10} and NO_2 due to the EWL Main Alignment are predicted to range from 0.3 - 2.7µg/m^3 for 24 hour average PM_{10} and 1.6 - 7.0µg/m^3 for annual average NO_2 concentrations.

10 years after opening of the Project, the concentrations in all locations are predicted to increase slightly above 2026 figures. These concentrations are based on the traffic volumes for the busiest stretch of the EWL alignment.

These results are presented graphically in Figure 6-6.

Figure 6-6: 24 hour average PM_{10} (LEFT) and annual average NO_2 (RIGHT) concentration by distance from the EWL Alignment



6.5.2 Modelling results by distance from SH1 carriageway

The screening model was used to predict the change in pollutant level with distance from SH1. Table 6-5 summarise the model inputs and Table 6-6 summarise the model results.

Table 6-5: Screening model inputs for 2026 and 2036 scenarios [22]

Road link	Year	Without Project			With Project		
		AADT	%HCV	Avg Speed km/hr	AADT	%HCV	Avg Speed km/hr
SH1 Panama St	2026	137,900	7%	68	145,900	8%	80
	2036	145,900	9%	62	160,500	9%	76

Table 6-6: Screening tool NO_2 and PM_{10} predictions by distance from edge of SH1

Distance from SH1	24 hour average PM_{10} concentration (µg/m^3)			
	2026		2036	
	Without Project	With Project	Without Project	With Project
10m	7.5	8.2	7.7	8.4
25m	4.3	4.7	4.5	4.8
50m	2.3	2.5	2.4	2.6
100m	1.0	1.1	1.0	1.1

[22] Note: The Screening tool maximum year of assessment is 2030.

Distance from SH1	Annual average NO_2 concentration (µg/m^3)			
	2026		2036	
	Without Project	With Project	Without Project	With Project
10m	23.8	25.2	25.2	27.7
25m	13.1	13.9	13.9	15.3
50m	8.4	8.8	8.8	9.7
100m	5.3	5.6	5.6	6.2

In all scenarios and in all locations within 100m of SH1 within the Project area, concentrations of PM_{10} and NO_2 are predicted to be slightly higher With Project than Without Project. Beyond 100m, the incremental difference in the scenarios is very small (0.1µg/m^3 for PM_{10} and– 0.6µg/m^3 for NO_2). This increase is due to the increase in traffic volumes which is predicted to occur through the greater connectivity brought about by the Project.

6.6 Sector 1 - HSR1

HSR1 is at 2 Onehunga Harbour Road. This apartment block will be approximately 30m from the EWL Main Alignment. The location of HSR1 is shown in Figure 6-7. As SH20 is located more than 100m from this receptor and is elevated on a bridge it has not been included in this model. The model assumes all roads and receptors are at ground level and will over predict for a bridge such as SH20 which will have better dispersion than a road at ground level.

ID	Link	Street Address	Distance to road	
			Without Project (m)	With Project (m)
HSR1	Sector 1 EWL – Onehunga Harbour Road	2 Onehunga Harbour Road	22m to Onehunga Harbour Road	16 m to Onehunga Harbour Road 30m to EWL

Figure 6-7: Sector 1- HSR1 – 2 Onehunga Harbour Road

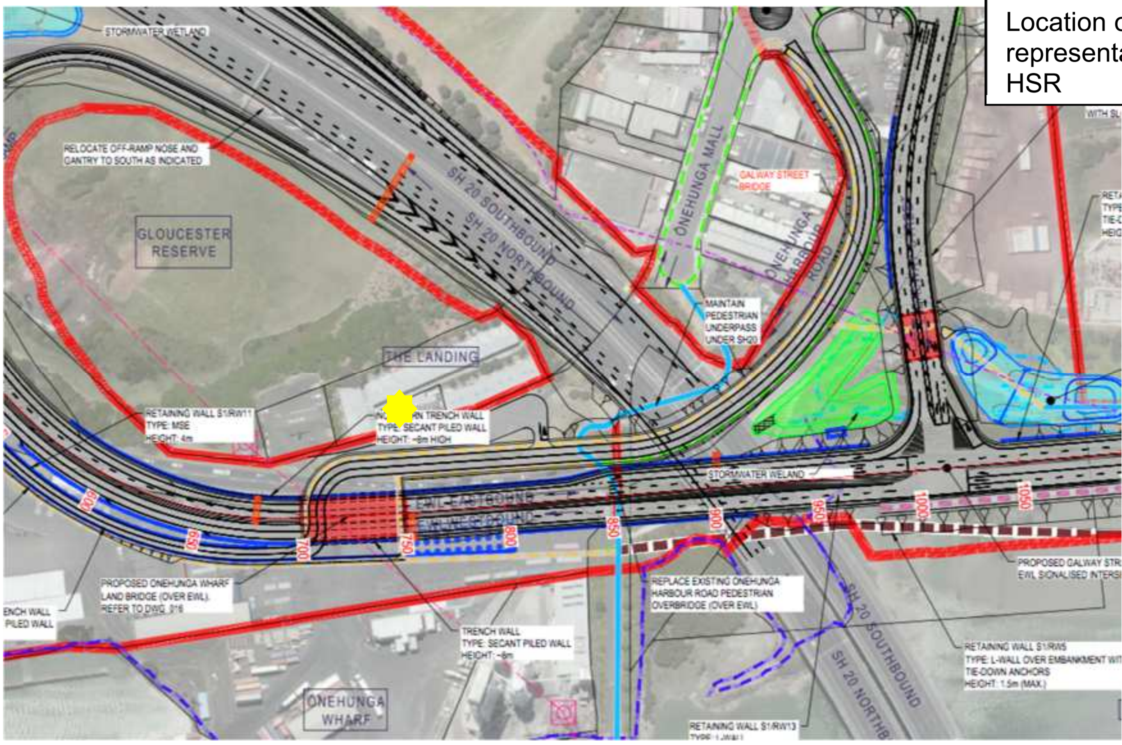


Table 6-7: Screening model inputs for Sector 1

Road link	2013			2026 Without Project			2026 With Project		
	AADT	% HCV	Avg Speed km/hr	AADT	% HCV	Avg Speed km/hr	AADT	% HCV	Avg Speed km/hr
Onehunga Harbour Road	20,400	8%	30	23,200	12%	30	300	17%	45
EWL	-	-	-	-	-	-	40,400	11%	50

Table 6-8 summarises the predicted contribution of motor vehicle emissions to background level concentrations in 2026 for Sector 1.

Table 6-8: Screening model results for Sector 1 – HSR1

Road link and assessment scenario	24hr average PM_{10} (µg/m^3)	Cumulative PM_{10} (µg/m^3)	Annual Average NO_2 (µg/m^3)	Cumulative NO_2 (µg/m^3)
2013	1.8	36.8	2.1	21.1
2026 Without Project (Wo/P)	1.3	36.3	2.4	21.4
2026 With Project (WP)	1.3	36.3	3.4	22.4
Change: 2026 WP- 2013	-0.5		1.3	
Change: 2026 WP – 2026 Wo/P	0		1.0	

In Sector 1 at HSR1, the PM_{10} concentrations with the Project compared to the Existing scenario are predicted to be 0.5µg/m^3 lower in 2026 than in 2013. This is likely to be due to the significant reduction in traffic on Onehunga Harbour Road, as traffic accesses EWL via Galway Street.

NO_2 concentrations at the Project opening year are predicted to be slightly higher (1.0 µg/m^3) with the Project when compared to Without Project.

6.7 Sector 5 - HSR2

HSR2 is a house adjacent to SH1 just south of the Panama Road bridge.

ID	Link	Street Address	Distance to road	
			Without Project (m)	With project (m)
HSR2	Sector 5: SH1 south of Panama Road	3 McLennan Road	15m	12m

Figure 6-8: Sector 5- 3 McLennan Road

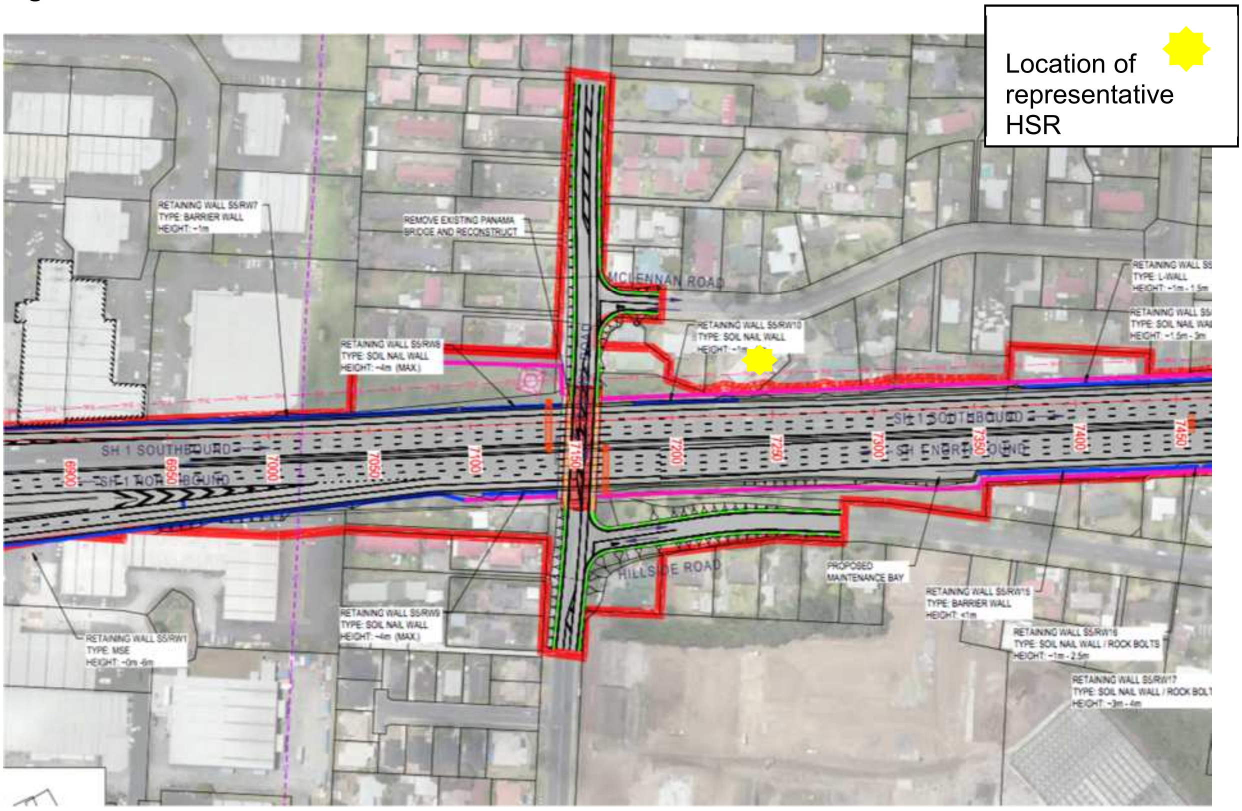


Table 6-9: HSR2: Screening model inputs for 2026 scenarios

	2013			2026 Without Project			2026 With Project		
Road link	AADT	% HCV	Avg Speed km/hr	AADT	% HCV	Avg Speed km/hr	AADT	% HCV	Avg Speed km/hr
SH1 Panama St	123,600	7%	70	137,900	7%	68	145,900	8%	80

Table 6-10 summarises the predicted contribution of motor vehicle emissions to background level concentrations in 2026 for HSR2.

Table 6-10: Screening model results for Sector 5 – HSR2

Assessment scenario	24hr average PM_{10} (µg/m^3)	Cumulative PM_{10} (µg/m^3)	Annual Average NO_2 (µg/m^3)	Cumulative NO_2 (µg/m^3)
2013 Baseline	10	45	16.4	35.4
2026 Without Project (Wo/P)	6	41	18.3	37.3
2026 With Project (WP)	7.5	42.5	22.3	41.3
Change: 2026 WP- 2013	-2.5		5.9	
Change: 2026 WP – 2026 Wo/P	1.5		4.0	

In Sector 5 at HSR1, the PM_{10} concentrations with the Project compared to the Existing scenario are predicted to be 2.5µg/m^3 lower in 2026 than in 2013 and approximately 1.5µg/m^3 higher than without the Project. NO_2 concentrations are predicted to increase regardless of whether the Project is built or not, although the increase is higher in the With Project scenario as the receptor is predicted to be 3m closer due to widening of SH1.

In the With Project 2026 scenario, the cumulative concentration of NO_2 is predicted to slightly exceed the AAAQS of 40µg/m^3.

6.8 Sector 5 - HSR3

HSR3 is a house adjacent to the Princes Street southbound on-ramp for SH1. The location of HSR3 is shown in Figure 6-9. The modelling is based on the main SH1 carriageway which carries the much larger volume of traffic. The screening model input parameters are summarised is Table 6-11.

Table 6-11: HSR3: Screening model inputs for 2026 scenarios

ID	Link	Street Address	Distance to road	
			Without Project (m)	With Project (m)
HSR3	Sector 5 SH1 – south of Princes Street Interchange	132 Ave Road East	18m to main SH1 carriageway	15m to main SH1 carriageway

Figure 6-9: Sector 5- 132 Avenue Road East

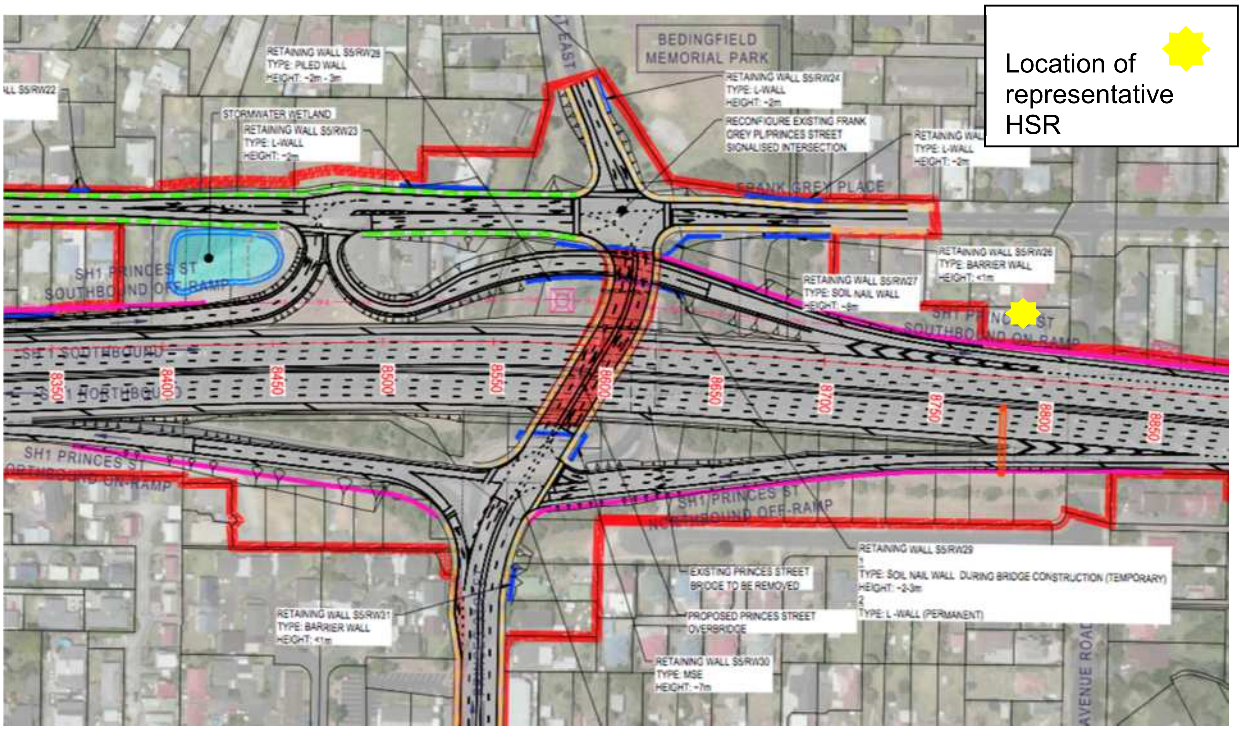


Table 6-12: Screening model inputs for Sector 5 - HSR3

Road link	2013			2026 Without Project			2026 With Project		
	AADT	% HCV	Avg Speed km/hr	AADT	% HCV	Avg Speed km/hr	AADT	% HCV	Avg Speed km/hr
SH1 south of Princes St	128,400	7%	70	143,500	8%	80	147,400	8%	80

Table 6-13 summarises the predicted contribution of motor vehicle emissions to background level concentrations in 2026 for HSR3.

Table 6-13: Screening model results for Sector 5 – HSR3

Assessment scenario	24hr average PM_{10} (µg/m³)	Cumulative PM_{10} (µg/m³)	Annual Average NO_2 (µg/m³)	Cumulative NO_2 (µg/m³)
2013 Existing	9.3	44.3	15.1	34.1
2026 Without Project (Wo/P)	5.8	40.8	16.9	35.9
2026 With Project (WP)	6.7	41.7	19.5	38.5
Change: 2026 WP- 2013	-2.6		4.4	
Change: 2026WP – 2026 Wo/P	0.9		2.6	

PM_{10} concentrations are predicted to be lower than existing levels for both future Project scenarios (With and Without). This is likely to be influenced by the vehicle emissions model predictions of improved fuel efficiency and forecast changes in the vehicle fleet. The current New Zealand vehicle fleet has a large component of old vehicles which were brought into the country before the vehicle emissions standards were introduced. It is forecast that by 2026 the majority of these will have been scrapped. The increase in PM_{10} concentrations at HSR3 in Sector 5 due to the Project is predicted to be 0.9µg/m³. The corresponding increase in NO_2 concentrations is 2.6µg/m³. The estimated cumulative concentrations (Project and background) are not predicted to exceed the AQNES criteria of 50µg/m³ for 24 hour average PM_{10} concentrations or the WHO guideline of 40µg/m³ for annual NO_2 concentrations.

6.9 Summary of operational air quality effects

Three significant features of the Project which impact existing and future air quality are:

- The Project area has a relatively high volume of heavy vehicles. Heavy vehicles are higher emitters of pollutants than light vehicles;
- SH1 and SH20 within the Project extent have some of the largest vehicle flows of any road in New Zealand; and
- The proposed EWL alignment travels through a low sensitivity area of light and heavy industrial land use.

The Project will bring about a redistribution of heavy vehicle traffic through the Project area. It is predicted to encourage heavy vehicles to use the strategic routes rather than short–cutting through the local suburbs to avoid congestion on the existing routes. This is forecast to have a positive air quality impact in these sensitive residential areas, which have high numbers of HSRs including some schools and early childhood centres which are located on existing busy arterials (e.g. Church Street).

Overall, the total number of kilometres travelled within the Project extent is predicted to increase slightly (1.1% - 1.5%) with the Project, due to induced traffic using the key strategic routes because the level of service is predicted to improve. This corresponds to a small increase in overall emissions of NOx and

PM_{10} once EWL is operational compared to without EWL, by 0.5%, 0.4% and 0.6% for NOx, PM_{10} and CO respectively.

The Transport Agency Air Quality Screening Tool has been used to estimate the localised effects of the Project, where the increase in traffic and vehicle emissions is most significant. Three representative locations where peak exposures are expected were selected (HSR1 in Sector 1, HSR2 and HSR3 in Sector 5), based on the highest traffic volumes and closest proximity to dwellings. The air quality screening model is a coarse tool based on conservative assumptions, intended to provide a worst case assessment of air quality risk from a single road. For this reason, the results have been interpreted with a degree of caution, and while useful for comparing scenarios to understand trends, it is likely to overstate the cumulative effects which include background concentrations.

In the year of the Project opening, maximum concentrations of PM_{10} and NO_2 due to the EWL Main Alignment are predicted to range from 0.3µg/m^3 (at 100m) to 2.7µg/m^3 (at 10m) for 24 hour average PM_{10} and 1.6µg/m^3 (at 100m) to 7.0µg/m^3 (at 10m) for annual average NO_2 concentrations. The maximum contribution from the EWL Main Alignment is predicted to be 5.4% of the AQNES PM_{10} threshold and 17.5% of the NO_2 guideline.

There are a small number of dwellings in Sector 1 close to the Neilson Street Interchange. At this location, the Project has a relatively neutral effect on the air quality environment. This is achieved through diverting more than 20,000 vehicles/day off Onehunga Harbour Road, which is predicted to slightly decrease PM_{10} emissions and slightly increase NO_2 emissions due to the EWL. The highest cumulative concentrations of air pollutants (i.e. including the contributions from background sources, and existing roads) are predicted to be lower than the relevant standards and guidelines.

In Sector 5, SH1 roadside PM_{10} concentrations are modelled in 2026 to increase by 0.9µg/m^3 and NO_2 concentrations by 2.6µg/m^3 as a result of the Project. The cumulative concentration of NO_2 is predicted to slightly exceed the annual WHO guideline in 2026 for one of the With Project scenarios. As this screening model is conservative, it is considered unlikely that the increase in pollutants arising from vehicle traffic due to EWL in this location will exceed the NO_2 guidelines. However, air quality standards or guidelines are not designed to be "pollute up to" levels and these results are an indication that guidelines levels may be approached in some localised spots in the future both with or without the Project.

The Project has been optimised to improve traffic flows across the Project area, which has an associated benefit of reducing congestion related vehicle emissions in some sensitive areas. SH1 between Panama Road and Princes Street currently has dwellings lining both sides of the motorway within close proximity (10-20m). Around both interchanges, as they would be modified through the Project, some of the houses which are closest to the motorway and therefore most exposed to vehicle emissions will need to be removed to develop the Project. While driven by other Project requirements, reducing the number of dwellings located very close to the motorway is also beneficial from an air quality perspective.

7 Predicted Project Construction Air Quality Effects

7.1 Overview of construction impacts

The potential air quality impacts of the construction activities include:

- Dust arising from construction activities, vehicle movements and wind entrainment from unsealed surfaces;
- Hazardous air pollutants from the disturbance of contaminated soils including landfills;
- Odour and landfill gas from the disturbance of closed landfills; and
- Engine exhaust emissions from construction vehicles.

In accordance with the Transport Agency AQ Guide, the potential air quality risk associated with road construction has been determined on the basis of:

- The number of HSRs within 200m of the route in Sector 5;
- The scale of earthworks having a total site area greater than 10,000m^2; and
- The requirement to disturb potentially contaminated Hazardous activities and industries list (HAIL) classified sites (mainly in Sectors 1-3) during construction.

As the Project is classified as having a high air quality risk arising from construction activities due to the above aspects, appropriate management and mitigation options are required. The framework for management of construction environmental effects is described in Part H of the AEE. The relevant features of this framework are:

- An overarching Construction Environmental Management Plan (CEMP);
- A series of topic specific management plans, which will include a Construction Air Quality Management Plan (CAQMP) and a Contaminated Land Management Plan (CLMP) as sub-plans under the CEMP for the designations and resource consents (as applicable).

As described in Section 5.2.1, the definition of HSRs is based on health effects and sensitive ecosystems. On this basis, the industrial and commercial land uses close to the proposed construction activities are not classified as HSRs. Some commercial activities have the potential to be sensitive to dust effects. Examples of such commercial activities are car showrooms or spraypainters requiring dust free environments. However, at the time of writing this assessment, no such activities have been identified within 200m of the construction footprint.

7.2 Construction methodology

The main construction elements of the Project are:

- New interchange layout at Neilson Street;
- Construction of the foreshore embankment;
- Viaduct structures through Anns Creek area;
- Widening of Sylvia Park Road and construction of new on and off-ramps to SH1;
- Replacement of the Panama Road overbridge; and
- Widening of SH1 and construction of a new interchange layout at Princes Street.

A detailed description of the staging/sequencing for construction is provided in the AEE. Key points of relevance to this construction air quality assessment are as follows:

- Construction is planned to occur over a 7 year period;

- Construction yards will be local to each of these main work areas;
- The indicative cut and fill volumes (Table 7.1) show that bulk earthworks will mainly involve filling activities, which will include bringing engineered fill into the site, and reuse of cut material where possible. These figures do not include site clearance and topsoil stripping;
- Large quantities of the cut materials excavated are likely to be contaminated due to historic landfilling, reclamation and industrial land use;
- A number of closed municipal landfills will be disturbed, including Galway Street and Pikes Point East and West landfills; and
- Known asbestos contaminated areas will be required to be excavated.

Table 7-1: Earthworks – Indicative cut and fill volumes for the total Project

Cut and fill	Quantity (approx.)
Imported fill	800,000 m^3
Reused marine sediments from within embankment footprint	450,000 m^3
Cut to waste	200,000 m^3

7.3 Effects of dust

The construction of the Project will entail relatively large scale earthworks. Exposed earthworks and vehicle movements over exposed surfaces can be significant sources of dust.

Dust can affect human health and plant life along the edge of the earthworks area, can be a nuisance to the surrounding public, and can contribute to sediment loads by dust depositing in areas without sediment control measures. The potential health effects of dust are closely related to particle size. The human health effects of airborne dust are mainly associated with PM_{10}, because these are small enough to be inhaled.

Total Suspended Particulate (TSP) is the particle size fraction that is most commonly monitored in New Zealand for the assessment of dust impacts. TSP is considered to be any particle smaller than 100 µm (microns) in diameter. Nuisance effects can be caused by particles of any size, but are most commonly associated with those larger than 20µm (Dust Good Practice Guide[23]) because they will settle and deposit on surfaces. Deposited particulates have minimal physical health impact, but may cause nuisance in sensitive areas due to soiling. Soiling includes excessive dust deposits on (and within) houses, cars and washing. Because it is relatively large in size, deposited particulate usually falls out of the air within a short distance of the source and usually within 100m to 200m.

7.4 Effects of contaminated soil

Where potentially contaminated soils are disturbed, discharges of contaminated dust may cause adverse effects on human health. These effects could occur through either direct inhalation or ingestion, - (i.e. eating produce or drinking water that has been contaminated).

Due to the historic reclamation and industrial land use in the Project area, particularly within Sectors 1-3, there are a large number of sites that are either known to be contaminated or have been identified as

[23] Good Practice Guide for Assessing and Managing Environmental Effects of Dust Emissions, Ministry for the Environment, 2001.

potentially contaminated. The range of contaminants that have been identified, to date, through the soil contamination investigations[24] includes arsenic, copper, zinc, lead and hydrocarbons.

In addition, there are a number of closed landfills where uncontrolled filling historically occurred. Where these areas are disturbed, there is the potential for discharges of odour, and/or hazardous air pollutants.

As the contaminants that have been identified are likely to be adsorbed[25] onto soil particles, the methods to avoid dust nuisance will also be effective in minimising the effects of the discharges of hazardous air pollutants. Provided the recommended measures are included in a CAQMP and are implemented, the potential for adverse effects due to discharges of contaminated dust from the Project is extremely low.

7.5 Effects of Asbestos Containing Materials (ACM)

The Southdown Reserve area is also known to be contaminated with asbestos and at the site adjacent to the reserve (141-199 Hugo Johnston Drive) excavations in the order of 1,700m^3 are required to form a new wetland area. The CLA[26] also identifies a number of other locations with potential risk of ACM based on the historic land use. The area surrounding this location includes the Mighty River Power Co-generation Plant site, KiwiRail land, Southdown Reserve and commercial warehouses.

Intact asbestos-containing material is not a high risk as potential health problems only occur if asbestos fibres become airborne. Asbestos fibres must become airborne and be present in sufficient concentration to pose a health hazard. Asbestos fibres, once airborne, are easily inhaled and carried into the lower regions of the lung. After long-term repeated exposure, these fibres can cause a range of health effects including fibrotic lung disease (asbestosis), lung cancer, pleural plaques, mesothelioma and changes in the lining of the chest cavity. People are more likely to experience asbestos-related diseases when they are exposed to higher concentrations of asbestos, are exposed frequently and over long periods of time.

The construction workers who will be uncovering and handling the asbestos directly are most at risk of exposure to airborne asbestos fibres. These construction workers will require appropriate personal protective equipment and training in handling the materials.

7.6 Effects of landfill gas and odour

The contaminated land investigations indicate methane levels are present in groundwater monitoring boreholes within the Project area. Thirteen wells were monitored for gases at locations where fill was encountered. Three of these boreholes contained hazardous methane concentrations as well as high concentrations of hydrogen sulphide. Borehole monitoring data is attached in Appendix D. As the landfills are closed, there are likely to be existing minor, diffuse landfill gas discharges. Due to dispersion and diffusion, landfill gas is not expected to be discharged beyond the boundary of the works at hazardous concentrations.

The main air quality effects associated with landfill disturbance include:

- Landfill gas release, which poses a safety risk to construction workers due to the explosion risk; and

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[24] *Volume 3: Technical Report 17 - Contaminated Land Assessment*

[25] Adsorption is the adhesion of modelcules to a surface

[26] Appendix B of Technical Report 17 – Preliminary Site Investigation

- Odour release, which poses a risk of nuisance or amenity effects.

Landfill gas is about 50% methane and 50% carbon dioxide and water vapour (by volume). Depending on the types and age of the waste, landfill gas may also contain small amounts of nitrogen, oxygen, hydrogen and organic compounds which are potentially hazardous such as benzene and toluene.

Methane is not generally considered a toxic gas however it is extremely flammable even in low concentrations when mixed with other chemicals. It is colourless and odourless at room temperature and is also an asphyxiant in confined spaces, as it will displace oxygen.

Hydrogen sulphide (H_2S) may be generated by anaerobic matter within the landfills. H_2S is also toxic and flammable at high concentrations. At low concentrations it has a pungent odour, commonly described as "rotten eggs". 10 ppm is the workplace exposure limit (eight hour time-weighted average). Odour may be also be generated by hydrocarbon contaminated soils particularly when first exposed.

Odour, H_2S and methane levels will be managed and monitored in accordance with procedures to be set out in the CAQMP. In accordance with regulatory requirements, there is a requirement that any odour associated with construction activities will not result in "*odour that is offensive, objectionable or noxious*" beyond the boundary of the works (designation).

In assessing the noxious, dangerous, offensive or objectionable adverse effects of the potential discharge of odour from landfill disturbance, the frequency, intensity, duration, offensiveness and location (FIDOL) have been considered:

- Frequency, intensity and duration: No significant odour impacts are expected during most of the construction period, however potential odour effects could occur in some locations for the duration of earthworks in the contaminated locations. Such potential effects would be infrequent and of short duration (i.e. days);
- Offensiveness: Discharge of H_2S, other odorous landfill gas components or hydrocarbons are commonly regarded to be offensive; and
- Location: The majority of the receiving environment through Sectors 1- 3 has low sensitivity to effects of discharges to air. The Onehunga Sports football club is based at Waikaraka Park. This area is moderately sensitive as it would typically be occupied at weekends and for short periods of time (hours). There may be some localised odour effects at times when excavations in contaminated areas/landfills takes place. The CAQMP will specify actions, monitoring procedures and contingency measures if offensive odour discharges occur.

In summary, there is a potential for offensive or objectionable odour to be discharged during construction. Potential adverse effects can be mitigated provided appropriate management and mitigation measures are specified in the CAQMP and adhered to by the contractor. Recommended odour monitoring and management controls are outlined in Section 8.2.1.

7.7 Construction traffic

Construction vehicles will generally use routes along Church Street, Neilson Street and SH20 and, less frequently, other local roads. The total number of construction truck movements which is estimated to be required for spoil removal is in the order of 60 per day on Neilson Street, 110/day during construction of the embankment and 40 trucks/day during each of the other construction stages.

By comparison, approximately 5000 truck movements per day use Church Street currently. Compared to emissions from "normal" traffic flows, the air quality impacts of construction traffic vehicle emissions are not considered significant. Given the volumes of traffic that already use roads in the vicinity of the Project, it is considered that the additional traffic generated by construction activities will not result in a measurable increase in concentrations of vehicle-related pollutants at locations close to highly sensitive receptors.

7.8 Concrete batching

7.8.1 Description of the activity

The construction of the Project embankment will require large quantities of fill. The current proposal is to source this from excavated marine sediments, which will then be stabilised with cement to form mudcrete. The concrete batching plant and mudcrete operation including a pugmill and cement storage will be located in the Waikaraka Park construction yard. This is the main yard for construction activities associated with the foreshore embankment.

The scale of the operation will be production of approximately 1,000 tonnes of mudcrete per day.

The Onehunga Sports football club is based at Waikaraka Park. These sports fields are considered moderately sensitive to reduced air quality amenity (i.e. dust and odour). The main construction yard will be located within the undeveloped area south of the existing sports fields.

The manufacture of mudcrete involves mixing, in carefully controlled proportions, Portland cement or a mixture of cement materials in powder form together with aggregates, marine sediments and water. The proportions chosen are determined by the performance or composition necessary to meet the specification or performance requirements of the final product. Small amounts of admixtures may be included to modify the properties of the mix.

Aggregates will be transported to the site via truck and trailer units and unloaded into ground storage bays. Aggregate from ground storage bays will be transferred into a receiving hopper by front end loader, and then into a weigh hopper by belt conveyors and enclosed gravity feed. Aggregate is then transferred from the weigh hopper to the mixing drum by belt conveyor.

Cement will be delivered to site in bulk tankers, and transferred into fully enclosed silo(s) by compressed air feed. Displaced air from each silo is vented to air via a bagfilter unit mounted on top of the silo. Cement is transferred from silo(s) to an enclosed cement weigh hopper and then to the mixing drum by enclosed gravity feed and enclosed screw conveyor. Displaced air from the cement weigh hopper is vented to atmosphere via a bag filter.

Cement, sediment and water are loaded together into a mixing drum. Once a slurry has been formed to the correct proportions, this will be emptied either into the drum of a truck mixer unit for transport and use within the Project.

7.8.2 Discharges into air and emissions controls

Discharges into air from concrete batching include dust from aggregates and cement powder. Almost all of this material falls into larger particle sizes, generally with an aerodynamic diameter greater than 30-50μm.

Aggregate dust is usually inert, only causing nuisance (amenity) effects. However, cement dust is basically calcium oxide (CaO), which is highly alkaline when dissolved in water and can be corrosive to skin.

The main sources of aggregate dust are the storage and handling of dry, fine aggregates (e.g. sand). Effective emissions control can be achieved by partial enclosure of load hoppers, conveyors and storage bays (to minimise wind entrainment of dusty materials), and the use of water sprays and regular sweeping of sealed yard areas.

Recommended controls to mitigate potential discharges to air from the operation of the concrete batching plant are detailed in Section 8.1.5.

7.8.3 Assessment of effects of concrete batching

Concrete batching has the potential to generate fugitive discharges of dust, a fraction of which is likely to be PM_{10}. In practice, most of the material used on site has a considerably larger particle size – cement dust typically has an aerodynamic diameter in the range 30µm to 50µm, while sand and aggregates are larger still. Dust particles larger than about 20-30µm in aerodynamic diameter have the potential to cause localised 'dust nuisance' e.g. soiling of surfaces. The potential health effects of PM_{10} are described in Section 6.2.1.

Provided the appropriate emissions controls and good on-site management as described in Section 8.3, are implemented, adverse effects of discharges to air from the concrete batching plant will be adequately avoided or mitigated.

7.9 Summary of construction air quality effects

The potential air quality impacts of the Project construction activities include:

- Dust arising from construction activities including a concrete batching plant;
- Odour, and landfill gas, including methane and H_2S gas from the disturbance of closed landfills;
- Hazardous air pollutants from the disturbance of contaminated soils including landfills; and
- Engine exhaust emissions from construction vehicles.

In Sector 5, due to the close proximity of HSRs (mainly dwellings and one resthome), a high standard of emissions control and management will be employed to adequately avoid or mitigate the effects of discharges of construction dust.

A dust monitoring programme is proposed, based on regular visual monitoring in all areas, continuous monitoring of TSP when works are occurring in contaminated soils, continuous meteorological monitoring at one Project location and prompt responses to complaints from the public and regulatory authorities.

There is a potential for offensive or objectionable odour to be discharged during disturbance of contaminated soils and of the closed landfills at Galway Street and Pikes Point East/West. Recommended odour monitoring and management controls have been outlined. Potential adverse effects can be mitigated provided appropriate management and mitigation measures are specified in the CAQMP and adhered to by the contractor. Adverse effects are likely to be minor due to the lack of HSRs within Sectors 1 - 3 and the generally lower amenity expectations in a light/heavy industrial area.

Some of the constituents of landfill gas are toxic and highly flammable. These pose a localised risk to the construction workers. A range of possible controls to manage the risks of landfill gas release during construction are described in *Volume 3: Technical Report 17-Contaminated Land Assessment, Appendix C.*

Any asbestos found during excavation works must be handled and removed by specialist contractors. Appropriate management and controls as described in *Volume 3: Technical Report 17-Contaminated Land Assessment, Appendix D*

Compared to emissions from "normal" traffic flows, the air quality impacts of construction traffic vehicle emissions are not considered to be significant.

A CAQMP will be prepared in accordance with the requirements of the designation and consents. Once finalised, this plan will detail methods to be used to mitigate discharges of odour, dust and hazardous pollutants to air from the construction of the Project.

Through the use of appropriate emissions control and good on-site management, adverse effects caused by discharges of contaminants into air from the construction of the Project are able to be adequately avoided or mitigated so as to be contained within the Project site boundaries.

8 Recommendations

8.1 Construction air quality controls, mitigation and contingency measures

Construction management measures have been recommended in the following sections to minimise adverse air discharge effects during construction. These measures should form the basis for mitigation to be implemented through the conditions and subsequent details developed in the Construction Environmental Management Plan (CEMP) prepared by the contractor. The detailed mitigation will be described in the CEMP when it is developed for the Project.

8.1.1 Dust mitigation

The basic mitigation measures to manage the effects of dust generation are outlined in Table 8-1. The purpose of the controls outlined in the following sections will be to prevent (if possible) or otherwise minimise the effects of dust emissions on HSRs. Key factors that influence the degree of any adverse effects from construction dust include the:

- Extent and duration of earthworks (including excavations) at any specific site;
- Proximity of the earthworks to houses; and
- Effectiveness of control and mitigation measures.

Rainfall, water evaporation and wind speed are the meteorological conditions which have the greatest effect on dust mobilisation and therefore control should focus on these aspects. The site-specific weather patterns as they relate to dust management are discussed in Section 5.3.1.

Table 8-1: Proposed Dust Control Measures

Dust generating activity	Dust Control Measures
Formation and Maintenance of Roads, Accessways, and Parking Areas	• Roads, accessways, site laydowns and parking areas during construction will be kept well-metalled and regularly watered during dry periods • Significant spills of materials that may cause dust during construction will be cleaned up as soon as practicable.
Earthworks	• Exposed areas of earthworks are to be minimised • When loading trucks, materials are to be dropped from as low height as possible • Prior to any cut and fill activity, areas will be pre-watered • Excavated areas and cleared areas are to be stabilised immediately, or if not able to, watered as necessary • If control measures fail, work shall be suspended in very dry, windy conditions • The site is to be watered at the end of each working day, except in rainy weather conditions • Cleared areas not required for construction, access or parking shall be stabilised if liable to cause excessive dust during windy conditions. Methods may include wetting with polymer additives to facilitate crusting, metalling, grassing, mulching or the establishment of vegetative cover.

Dust generating activity	Dust Control Measures
Stockpiles and Spoil Heaps	• Stockpiles of materials are to be monitored visually and options to prevent dust considered e.g. cover, let crust over, dampen if stockpile is in active use or vegetate if inactive • Locate and orientate stockpiles to maximise wind sheltering as much as possible • Drop heights for stockpiles are to be minimised.
Vehicles, Machinery and Generators	• Vehicles leaving site from unsealed surfaces are to be washed down to remove dust • A suction sweeper will be used to remove any material tracked onto public roads if necessary • Regulate maximum speed limit onsite (15km/h in dry and windy conditions). Signage to inform drivers on site • Loads of fine materials are to be covered.

8.1.2 Mitigation of dust arising from contaminated soils

Recommended controls for dust discharges from contaminated sites are similar to those required for discharges from other sites. Soils should be adequately wetted and dust controlled during the removal of the known or potentially contaminated materials.

In addition to those measures outlined in Table 8-1, the contaminated soils will require specific management measures. Additional controls relevant to the CLMP should include:

- Where practicable, material will be excavated and placed directly in trucks for off-site disposal at appropriately licenced facilities;
- Contaminated material stockpiled on site will be covered and/or wetted to manage dust discharges;
- Trucks used to transport material will be covered by tarpaulin or clean soil/fill to reduce the potential odour effects as the material is being transported;
- Installing odour fences when there are significant areas of excavation, being multiple high level spray nozzles that provide a perfumed mist downwind;
- Use of an odour masking agent or deodoriser on to the surface of odorous material as it is encountered. Such a deodoriser can be applied by backpack pressurised sprayer;
- Open areas should be minimised as much as possible at all times, including ensuring that odorous sources are covered or temporarily backfilled when not excavating.

8.1.3 Mitigation of potential landfill gas discharges

Methods for mitigation of methane emissions focus on diversion of the gas. A range of possible controls to manage the risks of landfill gas release during construction are described in *Volume 3: Technical Report 17 - Contaminated Land Assessment, Appendix C*.

For example, in the event that safe levels are exceeded during construction, the installation of a cut-off trench up-gradient from the location of the exceedance is an effective method for diversion of methane and other landfill gases. In general, the trench would be one excavator bucket wide (~ 1m), excavated to the depth of the screen in the well with the exceedance and backfilled with poorly graded gravel that would create a preferential pathway of the methane to the surface. The length of the trench would vary according to site conditions and available space.

8.1.4 Mitigation of potential ACM discharges

Any asbestos found during excavation works must be handled and removed by specialist ACM contractors. The controls must ensure that asbestos fibres are not discharged beyond the boundary of the construction site. Appropriate monitoring and management controls are detailed in *Volume 3: Technical Report 17 - Contaminated Land Assessment, Appendix D.*

8.1.5 Mitigation of concrete batching plant discharges

The following controls are recommended to mitigate potential discharges to air from the operation of the concrete batching plant:

- Similar controls on fugitive dust should be applied to concrete batching plant as to other operating areas of the contractors' yards, including the use of water on aggregate stockpiles and areas used for vehicle movement (fixed water sprays or water trucks) and windbreak fencing where appropriate;
- Discharges of cement dust into air can be controlled through enclosed transport, storage and handling. Good practice for cement handling includes venting of air displaced from silos via filter units as required in the CAQMP. The bag filter units to be installed on the cement silos will be designed to current best practice, which is expected to be a reverse-pulse jet type baghouse, or equivalent;
- Cement silos will also be fitted with pressure relief valves (to avoid over-pressurisation) and high fill alarms. The seating of pressure relief values and operation of these alarms will be checked regularly (refer CAQMP);
- Any spills which do occur should be cleaned up as soon as detected by sweeping or vacuuming;
- Bulk cement is to be transported, handled and stored in fully enclosed systems with any displaced air being discharged via bag filter units; and
- All bulk deliveries of cement are to be made during operating hours, so that site staff can oversee the delivery.

8.2 Monitoring

8.2.1 Odour monitoring

Odour monitoring will be required:

- If significant odour discharges occur onsite (i.e. offensive odour is observed during earth moving);
- While contaminated soils are being excavated and loaded into trucks; and
- If there are complaints regarding odour from construction activities.

This should take the form of 'odour scout' monitoring along the site boundaries between the suspected source(s) and HSRs as well as upwind of the suspected source(s). The aim of this monitoring is to assess the effectiveness of odour control and mitigation measures.

8.2.2 Dust monitoring

A dust monitoring programme will be implemented during the earthworks phases of the development. The objective of this programme would be to assess whether the mitigation and control measures implemented through the CAQMP are effective in minimising dust emissions particularly where contaminated soils are exposed.

The two methods for monitoring dust discharges are visual and instrumental. Both types of monitoring are effective tools to inform the management of dust emissions from construction sites.

Site management practices should be both reactive and proactive to observations of increased discharges. They should be being proactively updated to prevent such discharges in the future.

The locations of the monitoring sites will depend on the scale of the construction activity in the area, the expected duration of the activity, the sensitivity of the surrounding areas and the availability of suitable monitoring sites. Given that the prevailing winds are from the southwest during summer months (when the greatest risk of dust discharges occurs), continuous monitors should preferably be located on the north-eastern side of the construction footprint, as close to the boundary of the designation as practicable.

The specific monitoring systems have not yet been selected. However, specifications for the TSP monitoring systems would include:

- Near continuous measurement and recording of TSP concentrations with outputs as 1 hour and 24 hour average concentrations;
- The ability to collect filters for subsequent analysis for hazardous air pollutants, where monitoring is carried out in the vicinity of known or identified contaminated sites. This is included as a precautionary measure – e.g. if subsequent analysis identifies significantly higher contaminant loads in soils than previously measured; and
- The outputs from the TSP monitors and the meteorological stations must be able to be monitored remotely, and be set to produce an alarm when trigger values are approached. Alarms should activate a pager or cell phone.

8.2.3 Hazardous air pollutants

Asbestos monitoring and management controls are detailed in *Volume 3: Technical Report 17 - Contaminated Land Assessment, Appendix D*. Monitoring for other discharges of hazardous air pollutants from contaminated sites is not proposed, as it is considered that these can be appropriately managed through implementation of the CAQMP. Provision should be made in the instrumental TSP monitoring programme for dust filter samples to be collected so that they may be analysed at a later date if required.

8.3 Summary of Recommended Mitigation

It is recommended that the conditions require:

- A CAQMP to be prepared by the contractor. This plan should detail methods to be used to mitigate discharges of odour, dust and hazardous pollutants to air from the construction of the Project. The recommended methods are outlined in Section 8.1.
- Particulate monitoring during construction be carried out in locations where known or suspected contaminated materials require disturbance;
- Trigger levels for dust from contaminated sites be assessed as part of detailed site investigations and incorporated into the CAQMP;
- Odour monitoring (in the form of 'odour scout' boundary monitoring) be carried out while contaminated soils are being excavated and loaded into trucks;
- A CLMP to be prepared by the contractor. The CLMP shall contain monitoring methods for to manage the discharge of contaminants to air during works at contaminated sites and landfills;
- Monitoring and management controls for asbestos handling and disposal to be detailed in the CLMP. Any asbestos found during excavation works must be handled and removed by specialist contractors; and
- That the dust risk index method (as detailed in the Transport Agency Air Quality Guide), be used during the Project implementation phase to determine specific dust management measures. The dust risk index assesses the risk of dust generation based on site and construction methodology specific factors such as time of year, whether the construction area is exposed to prevailing winds, what the exposure period for unstabilised surfaces is and the type of construction activity.

9 Conclusion

The positive effects of the Project includes reduced levels of traffic congestion and reduction in the use of residential streets (Onehunga and Ōtāhuhu) by heavy vehicles accessing Auckland's main industrial hub. This is likely to have a consequent reduction in vehicle emissions on existing busy roads within the Project extent. As many of these roads currently experience high volumes of heavy vehicles, these reductions are particularly beneficial for local air quality.

The highest increase in vehicle emission concentrations due to the completion of the Project are predicted to occur at receptors close to SH1, due to the additional lane in each direction creating an increase in predicted traffic volumes. The PM_{10} AQNES is not predicted to be exceeded at these locations, however NO_2 concentrations have the potential to approach the annual average guideline level at the dwellings adjacent to the main carriageway in the future.

Construction of the Project will entail significant earthworks, which can be a source of dust. Disturbance of closed landfills, known asbestos contaminated areas and historically contaminated sites have the potential to discharge odour, landfill gas, and hazardous air pollutants. A range of control measures have been identified that demonstrate how the construction contractor should implement these measures to achieve the permitted activity standards.

Some of the cut materials to be excavated during construction are likely to be contaminated due to historic landfilling, reclamation and industrial land use including a known asbestos disposal area which will be required to be excavated. There is a potential for offensive or objectionable odour to be discharged during disturbance of contaminated soils and the closed landfills at Galway Street and Pikes Point East/West. Recommended odour monitoring and management controls have been outlined.

Any asbestos found during excavation works must be handled and removed by specialist contractors and with monitoring and management controls implemented as described in *Volume 3: Technical Report 17 - Contaminated Land Assessment, Appendix D*

A CAQMP will be prepared, once the conditions of any designation and consents are known. Once finalised, this plan will detail methods to be used to mitigate discharges of odour, dust and hazardous pollutants to air from the construction of the Project.

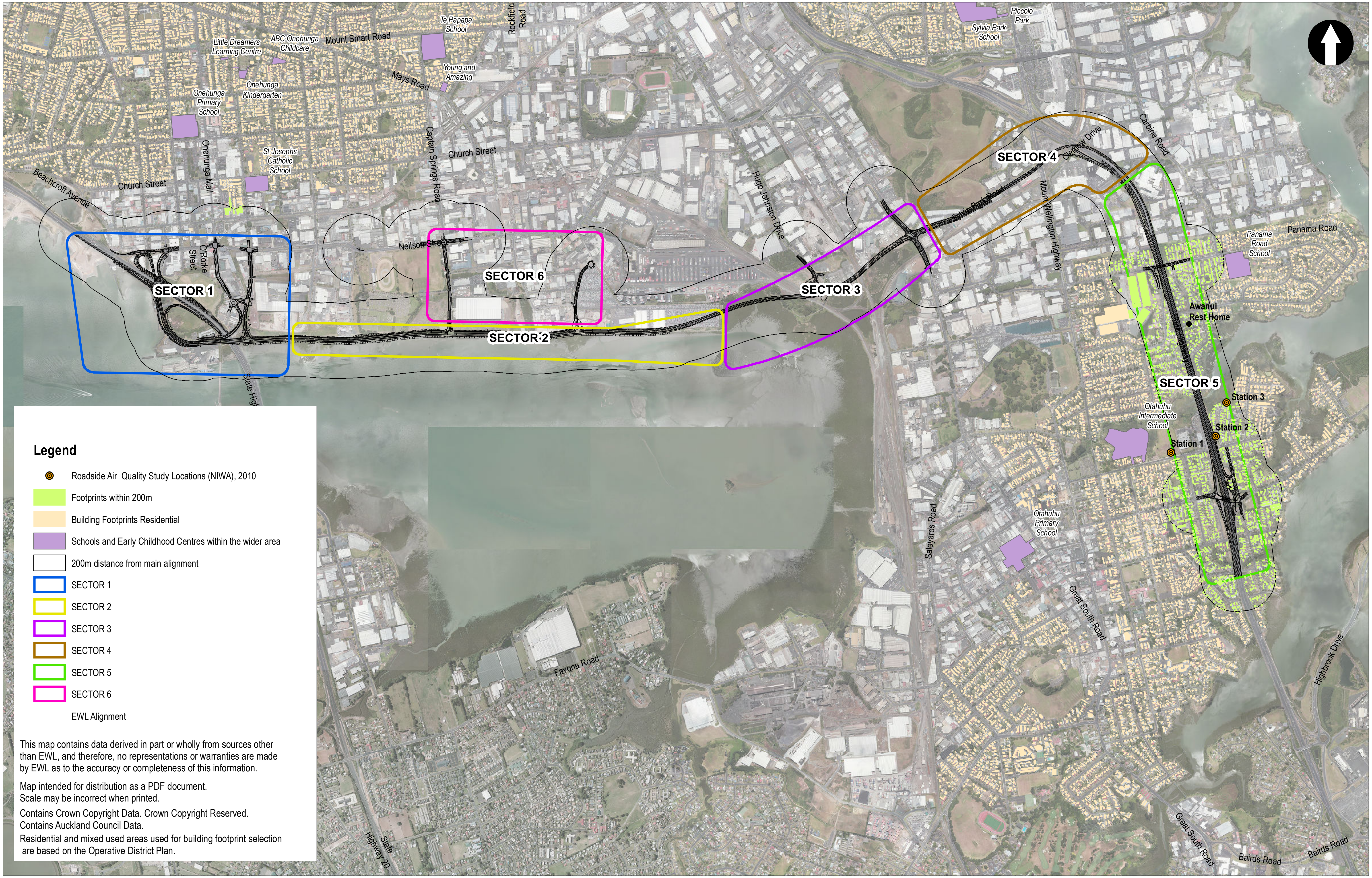
Overall, this report concludes that:

- The overall kilometres travelled increases by 1.1-1.5% with the Project, which is due to some induced traffic using the routes because the level of service is predicted to improve;
- The total quantity of health related emissions of NOx and fine particulates forecast to be emitted from vehicles within the Project area increases slightly, by 0.5% and 0.4% for NOx, and PM_{10} respectively;
- The maximum increase in vehicle emissions from the EWL Main Alignment is predicted to be 5.4% of the AQNES PM_{10} threshold and 17.5% of the NO_2 guideline. Ten years after opening of the Project, the concentrations in all locations are predicted to increase slightly above 2026 figures;
- Residents and other highly sensitive receivers such as schools and childcare centres which are located close to existing busy roads including Church Street, Onehunga Mall, Mt Smart Road and Mt Albert Road are predicted to experience some improvement in air quality as a result of the Project;
- Residents living close to SH1 between Panama Road and Princes Street will experience a small increase in ambient concentrations of vehicle contaminants. SH1 roadside PM_{10} concentrations are modelled to increase by 0.9 - 1.5µg/m^3 and NO_2 concentrations by 2.6 - 4.0µg/m^3 as a result of the Project;

- The cumulative concentration of NO_2 is predicted to slightly exceed the annual WHO guideline in 2026 for one of the With Project scenarios. The screening model is conservative, however, these results are an indication that guideline levels may be approached in some localised spots adjacent to SH1 both with and without the EWL; and
- Provided that appropriate dust control measures are implemented, any adverse effects on air quality arising from the construction of the Project will be minor and the permitted activity standards can be achieved.

Appendix A

Figures A1, A2 and A3: Residential Land Use within the Project



This map contains data derived in part or wholly from sources other than EWL, and therefore, no representations or warranties are made by EWL as to the accuracy or completeness of this information.

Map intended for distribution as a PDF document.
Scale may be incorrect when printed.

Residential and mixed used areas used for building footprint selection are based on the Operative District Plan.

No	Issued Status	Drawn	Check'd	App'd	Date
A	ISSUED FOR INFORMATION ONLY	BAP	CN	CN	08/11/16

DISCLAIMER
The information shown on this drawing is solely for the purpose of supporting application under the RMA for resource consents and/ or designations.
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This Drawing must not be used for construction.

NZ TRANSPORT AGENCY WAKA KOTAHI

East West Link

Drawn	Drafting Check	Reviewed Design Manager	Approved Alliance Manager
Designed	Design Check		
Scale: 1:20,000	Original Size: A3	Contract No PA4041	

Drawing Title: AIR QUALITY
Existing Environment and EWL Project Extent

Drawing Number: GIS-AEE-AQ-001
Rev No. A

Plot Date: 8/11/2016 Plotted by: Ben Peyton File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\AirQuality\Drafts\GIS-AQ-AEE-001-AirQuality_Residential_MU_Properties.mxd

No	Issued Status	Drawn	App'd	Check'd	Date
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Designed	Design Check		
Scale: 1:8,000	Original Size: A3	Contract No PA4041	

Drawing Title: **AIR QUALITY Existing Environment and EWL Project Extent**

Drawing Number: GIS-AEE-AQ-002 | Rev No. A

Plot Date: 8/11/2016 Plotted by: Ben Peyton File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\AirQuality\Drafts\GIS-AQ-AEE-002-AirQuality_Residential_MU_Properties_Sector1.mxd

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NZ TRANSPORT AGENCY WAKA KOTAHI — East West Link

Drawn	Drafting Check	Design Manager Reviewed	Approved Alliance Manager
Designed	Design Check		
Scale: 1:11,000	Original Size: A3	Contract No PA4041	

Drawing Title: AIR QUALITY Existing Environment and EWL Project Extent

Drawing Number: GIS-AEE-AQ-003 — Rev No. A

Plot Date: 8/11/2016 Plotted by: Ben Peyton File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\AirQuality\Drafts\GIS-AQ-AEE-003-AirQuality_Residential_MU_Properties_Sector5.mxd

Appendix B

Vehicle emissions data for corridors of interest

Table B1: Forecast change (+/-) in vehicle emissions with the Project in 2026

Corridor	VKT km/day	CO kg/day	VOC kg/day	NOx kg/day	PM2.5 kg/day	PM brake and tyre kg/day	PM 10 kg/day
Other	- 18,427	- 28.34	- 1.83	- 8.54	- 0.28	- 0.19	- 0.46
Neilson St Galway to Church St	- 23,044	- 23.89	- 2.08	- 19.44	- 0.69	- 0.25	- 0.94
Neilson St Onehunga SH20 to Galway end	- 4,694	- 12.38	- 1.18	- 4.76	- 0.26	- 0.05	- 0.30
Selwyn St	236	0.06	- 0.01	- 0.28	- 0.02	0.00	- 0.02
Onehunga Mall	- 677	- 1.23	- 0.11	- 0.44	- 0.02	- 0.01	- 0.02
Galway St north of Neilson St	- 504	- 1.92	- 0.17	- 0.38	- 0.02	- 0.01	- 0.03
Church St Beachcroft to Neilson St	- 293	- 1.32	- 0.08	1.03	0.04	- 0.00	0.03
Church St Neilson to SEART	- 10,688	- 25.04	- 2.40	- 10.01	- 0.51	- 0.11	- 0.62
Mays Rd	180	0.16	0.01	0.00	- 0.00	0.00	- 0.00
Onehunga Mall south/Onehunga Harbour Rd	- 7,064	- 13.64	- 1.27	- 4.91	- 0.24	- 0.07	- 0.32
EWL Galway to GSR	118,040	144.42	10.95	51.50	1.75	1.19	2.94
Beachcroft	- 626	- 3.12	- 0.27	0.16	- 0.00	- 0.01	- 0.01
SH1 Mt Well to Otahuhu	31,613	29.01	0.32	13.68	0.27	0.32	0.59
SH1 Mt Otahuhu to Highbrook	9,718	13.33	0.99	4.77	0.16	0.10	0.26
SH1 Mt Highbrook to East Tamaki	1,461	8.02	0.94	1.81	0.12	0.02	0.13
Princes St Gt South Rd to SH1	- 2,851	- 0.86	- 0.05	- 2.89	- 0.10	- 0.03	- 0.13
Panama Rd	447	0.01	- 0.01	0.07	0.00	0.00	0.00
Hellabys Road	850	1.45	0.12	0.31	0.01	0.01	0.02
Bairds Rd	5,349	9.68	0.91	1.06	0.07	0.05	0.12
Highbrook Drive	2,722	7.71	0.72	1.79	0.09	0.03	0.12
Frank Grey place/Trenwith St	- 456	- 2.74	- 0.22	- 0.71	- 0.04	- 0.00	- 0.05
Great South Rd, Sylvia Park to Princes St Otahuhu	- 3,423	- 4.94	- 0.48	- 3.56	- 0.15	- 0.04	- 0.18
Atkinson Ave/Mt Wellington Hway: Princes St to Sylvia Park Road	- 3,089	- 9.04	- 0.86	- 1.50	- 0.10	- 0.03	- 0.13
Favona Road/Kaka St	- 6,024	- 15.95	- 1.51	- 2.48	- 0.17	- 0.06	- 0.23
SH20 Hillsborough to Neilson St	16,085	30.59	2.84	6.15	0.27	0.16	0.43
SH20 Neilson St to Rimu Road	- 1,961	- 11.84	- 1.16	- 2.38	- 0.13	- 0.02	- 0.15
Gt South Rd Church St to Sylvia Park Rd	- 1,221	9.34	1.15	0.80	0.15	- 0.01	0.14
Gt South Rd Church St Station Road	- 7,114	- 12.71	- 1.14	- 3.85	- 0.19	- 0.07	- 0.26
Hugo Johnston Place	2,953	3.36	0.25	1.47	0.05	0.03	0.08
Mt Smart Road/Station Road: Mays to Gt Sout	- 4,362	- 10.41	- 0.95	- 1.43	- 0.09	- 0.04	- 0.13
O'Rorke Road	484	0.54	0.05	0.49	0.02	0.01	0.02
EWL Galway to SH20	14,413	14.30	0.92	4.43	0.10	0.14	0.24
Mt Smart Rd: Royal Oak to Mays	- 2,768	- 4.95	- 0.43	- 0.85	- 0.04	- 0.03	- 0.07
Sylvia Park Road	5,854	7.66	0.56	2.76	0.09	0.06	0.15
Avenue Road/Water St Otahuhu	- 2,548	- 4.21	- 0.34	- 0.64	- 0.03	- 0.02	- 0.05
High St Otahuhu	383	0.79	0.06	- 0.17	- 0.01	0.00	- 0.01
Saleyards/Walmsley rd Otahuhu	- 2,165	- 8.16	- 0.75	- 1.25	- 0.10	- 0.02	- 0.12
Mahunga Drive	- 727	- 0.23	- 0.01	- 0.64	- 0.02	- 0.01	- 0.03
Sum	106,061	83.51	3.45	21.18	- 0.01	1.04	1.03

VKT – vehicle kilometres travelled

Appendix C

Statutory Assessment Matters

Assessment matters

Resource Management Act 1991 (RMA)

The purpose and principles of the RMA are set out in Sections 5 to 8 of that Act. Of particular relevance to the assessment of effects of discharges into air from land transport activities are Sections 5(1) and 5(2), which state:

"(1) The purpose of this Act is to promote the sustainable management of natural and physical resources

(2) In this Act, sustainable management means managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic and cultural wellbeing and for their health and safety while –

(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) Avoiding, remedying or mitigating any adverse effects of activities on the environment."

Section 7 of the RMA requires consent authorities to give particular regard to those matters listed in the section. In the case of discharges into air from this Project, the following matters are considered relevant: maintenance and enhancement of amenity values (Section 7(c)) and maintenance and enhancement of the quality of the environment (Section 7(f)).

In the context of this Project, amenity values may be affected by discharges of construction dust and odour, while the quality of the environment is described in the context of effects on human health.

Regional (and unitary) councils have primary responsibility for air quality management in New Zealand and under the RMA provisions can develop regional plans that include controls on discharges into the air. The relevant regional plan requirements as they relate to air discharges are described in more detail below for:

- Motor vehicles (mobile sources) and
- Construction of roads.

Proposed Auckland Unitary Plan (PAUP) Decisions Version (19 August 2016)

The PAUP contains policies and rules relating to air quality impacts from mobile sources. Discharges to air from motor vehicles are a permitted activity (Table E14.4.1 (A114). The following air quality policies are relevant to the Project:

E14.3 (1)

Protect human health by requiring that air discharges do not cause ambient air quality to exceed the Auckland ambient air quality standards.

Construction air quality assessment criteria

Under the PAUP, the discharge of contaminants into air from earthworks and the construction, maintenance and repair of public roads is a permitted activity, providing the activity meets the relevant permitted activity standards. The general permitted activity controls are as follows:

PAUP General standard E14.6.1.1

The following standards apply to all permitted activities that discharge contaminants into air except for:

- *Mobile sources; and*
- *Fire-fighting and other emergency response activities.*

1) *The discharge must not contain contaminants that cause, or are likely to cause, adverse effects on human health, property or the environment beyond the boundary of the premises where the activity takes place.*
2) *The discharge must not cause noxious, dangerous, offensive or objectionable odour, dust, particulate, smoke or ash beyond the boundary of the premises where the activity takes place.*
3) *There must be no dangerous, offensive or objectionable visible emissions.*
4) *There must be no spray drift or overspray beyond the boundary of the premises where the activity takes place.*

The activity of concrete batching is regulated under the following rules:

PAUP E14.4.1 Activity table

(A85)	Manufacture of concrete at a rate up to 110 tonnes/day	P	P	P	P	P
(A86)	Manufacture of concrete at a rate of more than 110 tonnes/day where discharges to air are through a bag filter system	RD	RD	RD	RD	RD
(A87)	Manufacture of concrete at a rate of more than 110 tonnes/day where discharges to air are not through a bag filter system	D	D	D	D	D

As the concrete batching plant will be producing approximately 1000 tonnes/day, the activity is a full discretionary activity and requires a resource consent.

Land Transport Management Act

The Land Transport Management Act 2003 (LTMA) sets out requirements for the operation, development and funding of the land transport system. Section 94 of the LTMA states that the objective of the Transport Agency is to "*undertake its functions in a way that contributes to an affordable, integrated, safe, responsive, and sustainable land transport system.*" The functions of the Transport Agency in the context of this proposal are set out in Section 95(1) of the LTMA, while Section 96 sets out the operating principles of the Transport Agency. The specific principle that applies to this assessment is set out in Section 96(1)(a)(i), as follows:

"(1) In meeting its objective and undertaking its functions, the [Transport Agency] must—

(a) exhibit a sense of social and environmental responsibility, which includes—

(i) avoiding, to the extent reasonable in the circumstances, adverse effects on the environment; and …"

NZ Transport Agency Environmental Plan

The Transport Agency Environmental Plan (Version 2 in 2008) sets out how the Transport Agency's obligations under the LTMA are to be exercised in practice through the following air quality objectives:

"A1 Understand the contribution of vehicle traffic to air quality.

A2 Ensure new State highway projects do not directly cause national environmental standards for ambient air quality to be exceeded.

A3 Contribute to reducing emissions where the State highway network is a significant source of exceedances of national ambient air quality standards."

A number of methods are specified to give effect to these objectives, for example: route selection, easing congestion and improving traffic flow.

This assessment of effects considers the requirements of these objectives, in particular objective A2, in the context of the proposed Project.

Appendix D

Landfill gas monitoring well data

East West Link Alliance Memorandum

To:	Camilla Needham	**Date:**	12 Aug. 16
From:	Wijnand Udema	**Our Ref:**	
Copy:			
Subject:	Contaminated Land Air quality Investigation		

1 Contaminated Land Air Related Issues

1.1 Landfill gas

1.1.1 *Rationale for Landfill Gas Assessments*

The purpose of the landfill gas investigations was to provide indicative data on what might be encountered during construction activities on the landfill areas within the alignment.

The investigations were undertaken in conjunction with the geotechnical / environmental well installations and are not intended as a comprehensive assessment of land fill gas along the alignment.

1.1.2 *Landfill Gas Investigation* Methodology

The landfill gas investigations comprised the following:

- Installation of gas taps on selected monitoring wells that were installed for geotechnical and environmental investigation purposes. Where possible, wells with screen intervals within the unsaturated zone were selected for monitoring
- A Geotechnical Instruments GA5000 was used to measure methane, carbon monoxide, carbon dioxide, hydrogen sulphide, temperature, gas flow and atmospheric pressure
- Landfill gas measurements were undertaken over a range of atmospheric conditions
- In addition, to the monitoring, landfill gas and explosivity (LEL and UEL) was also measured during the drilling investigation programme

1.1.3 Results

Table 1 provides a summary of the landfill gas monitoring results.

The take aways from the data includes:

- Elevated concentrations of methane measured at some locations
- Elevated methane generally coincides with depleted oxygen and notable concentrations of hydrogen sulphide
- Flows of land fill gas were low

From the data, the following conclusions can be drawn:

- Explosive concentrations of methane (5-15% methane) may be encountered during disturbance of the landfills during construction
- Asphyxiation risks may be present in oxygen depleted environments
- Hydrogen sulphide risks to human health may be present
- Measured low flows of landfill gas may indicate relatively low risk, however it should be noted that the land fill composition is likely to variable, and larger flows may be encountered in different areas of the land fill or under certain groundwater and atmospheric conditions.

		Gas measurements							
		Gas Flow	Gas Meter Balance	Relative Pressure	Carbon Monoxide	Hydrogen sulfide	Methane	Oxygen	Carbon Dioxide
Location Code	Sampled Date	L/hr	%	mB	ppm	ppm	%	%	%
BH2001	26/05/2016	0.2	70	0.03	0	1	18	0	12
BH2023	11/07/2016	1.1	51.6	0.41	1	0	24.2	13.7	10.5
BH2031	24/05/2016	0	77.4	0.07	3	0	0.1	22.3	0.1
BH2032	18/05/2016	0.1	77.4	-0.22	1	0	0	22.4	0.2
BH2032	7/07/2016	8.3	78.6	0.05	0	0	0	21.2	0.2
BH4002	24/05/2016	0	72.6	4.54	1	0	7	19.6	0.8
BH4011	24/05/2016	0	78.3	0.67	4	0	0	21.4	0.4
BH4011A	24/05/2016	0.1	77.5	0.03	2	0	0	22.3	0.1
BH5001	19/05/2016	-0.1	77.5	0.02	2	0	0	17.4	5.1
BH5001	7/07/2016	0.1	84.3	-0.09	0	0	0	9.3	6.4
BH5004	18/05/2016	0.1	76.9	-0.21	1	0	0.3	22.4	0.4
BH5004	7/07/2016	0.3	89	0.07	0	0	0	3.2	7.8
BH5005	19/05/2016	0	76.2	0.52	2	0	0.9	21.8	1.1
BH5005A	19/05/2016	-0.02	77.9	0.05	2	0	0	21.9	0.2
BH5005A	7/07/2016	4.6	78.7	0.62	0	0	0	21.1	0.2
BH5006	19/05/2016	-0.3	77.9	0.07	1	0	0	21.1	1
BH5006	7/07/2016	-11.2	78.6	-0.7	0	0	0	20.8	0.6
BH5007	18/05/2016	0	6.9	-0.16	2	18	58.4	0	34.7
BH5007	7/07/2016	0.2	0	0.09	0	23	70.2	0	32.1
BH5008	21/05/2016	0	0	0.31	2	0	70.9	0	32.3

Table 1: Landfill gas monitoring results

Monitoring well location plan is attached

Contaminated Soils

The concentrations of contaminants in soil collected from investigation boreholes and test pits along the alignment were not considered to pose a risk to human health in the context of soil disturbance and associated inhalation of contaminated dust. It should be noted however, that unidentified areas of contamination may be present along the alignment, and as such a prudent approach to dust control for the entire alignment is recommended.

Typical earth works dust controls such as wetting down, use of hay / hydroseeding, and application of dust suppressants are considered to provide adequate dust control for contaminated soil

Odour

Odour is likely to be generated during earth works through the landfill areas, excavation of anaerobic sediments and other unidentified areas of heavily contaminated soil (e.g. petroleum hydrocarbons or solvents). It is recommended that a contingency plan is put in place for odour management, in event that it is required.

Asbestos

Asbestos is present in soil at a number of locations along the alignment, with the most notable being the Pikes Point and Galway Street landfills, and the asbestos dump site located at the end of Hugo Johnston. It is also considered likely that asbestos contamination will be present in soil at other locations along the alignment. Special controls will need to be put in place to manage health risks associated with asbestos contamination in soil during disturbance. Suggested asbestos controls are covered in Technical Report 17 Contaminated Land Assessment.

Recommendations

Based upon the findings of the contaminated land investigations, we recommend that:

- A detailed landfill gas investigation, including flows, is undertaken to assess potential risks associated with landfill gas prior to construction
- The contractor develops a site specific management plan to manage risks associated with landfill gas
- A contingency plan is developed for odour management, in the even that it is required
- A construction related asbestos management plan is developed to manage risks associate with asbestos in soil

Regards

Wijnand Udema
Contaminated Land Lead

Laura Bell
Senior Environmental Scientist

Appendix E

Example of AQ Screening Model Inputs and Outputs

Air quality calculator

Project name: East West Link

Project notes: Modelling results by distance from EWL Main Alignment @10 metres

This calculation was made at 11:17 14/09/2016. The calculation can be reopened at this web page.

AADT:	40400vpd	PM_{10} 24hr average:	35µg/m³
Heavy vehicles:	11%	NO_2 annual average:	19µg/m³
Vehicle speed:	50km/h	Area unit name or ID:	
Distance to receptor:	10m		
Assessment year:	2026		

PM_{10}	**24hr average**	**NO_2**	**Annual average**
Assessment guideline (NES):	50.0µg/m³	Assessment guideline (WHO):	40.0µg/m³
Road contribution:	2.7µg/m³	Road contribution:	7.0µg/m³
Road contribution to guideline:	5%	Road contribution to guideline:	17%
Background air quality:	35.0µg/m³	Background air quality:	19.0µg/m³
Cumulative contributions:	37.7µg/m³	Cumulative contributions:	26.0µg/m³
Cumulative contribution to guideline:	75%	Cumulative contribution to guideline:	65%

Air quality calculator

Project name: East West Link

Project notes: Modelling results by distance from EWL Main Alignment @100 metres

This calculation was made at 11:19 14/09/2016. The calculation can be reopened at this web page.

AADT:	40400vpd	PM_{10} 24hr average:	35µg/m³
Heavy vehicles:	11%	NO_2 annual average:	19µg/m³
Vehicle speed:	50km/h	Area unit name or ID:	
Distance to receptor:	100m		
Assessment year:	2026		

PM_{10}	**24hr average**	**NO_2**	**Annual average**
Assessment guideline (NES):	50.0µg/m³	Assessment guideline (WHO):	40.0µg/m³
Road contribution:	0.3µg/m³	Road contribution:	1.6µg/m³
Road contribution to guideline:	1%	Road contribution to guideline:	4%
Background air quality:	35.0µg/m³	Background air quality:	19.0µg/m³
Cumulative contributions:	35.3µg/m³	Cumulative contributions:	20.6µg/m³
Cumulative contribution to guideline:	71%	Cumulative contribution to guideline:	51%

This tool estimates air quality near roads by combining the contribution of the road with the background air quality to arrive at a cumulative concentration. The model is designed to provide a conservative assessment of air quality risk from a single road for two air pollutants. Reference should be made to the "Air quality screening model - Users' notes" for details of the methodology. In addition to the standard terms and conditions for use of this website, the NZ Transport Agency does not accept any responsibility or liability whatsoever, whether in contract, tort, equity or otherwise, for any action taken as a result of reliance placed on this tool, or for any error, inadequacy, deficiency, flaw in or omission in the tool.