Eastern Busway
EB2 and EB3 Residential

Air Quality Effects Assessment

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Eastern Busway

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List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AAAQT	Auckland Ambient Air Quality Targets
AADT	Annual Average Daily Traffic
AEE	Assessment of Effects on the Environment
AMETI	Auckland Manukau Eastern Transport Initiative programme
AQMS	Air Quality Monitoring Station
AUP(OP)	Auckland Unitary Plan (Operative in part) 2016
AWS	Automatic Weather Station
BPO	Best practicable option
CAQMP	Construction Air Quality Management Plan
CEMP	Construction Environmental Management Plan
CLMP	Contaminated Land Management Plan
CO	Carbon monoxide
CO_2	Carbon dioxide
DRI	Dust Risk Index
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3 Commercial/ EB3C	Eastern Busway 3 (Pakuranga Creek to Botany)
EB3 Residential/ EB3R	Eastern Busway 3 (SEART to Pakuranga Creek)
EB4	Eastern Busway 4 (link between Ti Rakau Drive and Te Irirangi Drive, Botany Town Centre Station)
EBA	Eastern Busway Alliance
ESCP	Erosion and Sediment Control Plan
GPG Dust	Good Practice Guide for Assessing and Managing Dust (MfE, 2016)
Guide AAQISHP	Waka Kotahi Guide to Assessing Air Quality Impacts from State Highway Projects, Version 2.3, 2019.
HCV	Heavy commercial vehicle
km	Kilometre(s)
km/h	Kilometres per hour
kPa	kiloPascals (unit of pressure)
m	Metre(s)
m/s	Metres per second
m^2	Square Metre(s)
m^3	Cubic Metre(s)
MfE	Ministry for the Environment
$\mu g/m^3$	Micrograms per cubic metre
µm	Micrometer (one millionth of one metre)
MSE Walls	Mechanically Stabilized Earth Walls

NES-AQ	Resource Management (National Environmental Standards for Air Quality) Regulations 2004
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NoR	Notice of Requirement
O_3	Ozone
$PM_{2.5}$	Particulate matter less than 2.5 micrometres equivalent aerodynamic diameter
$PM_{2.5-10}$	Fraction of PM_{10} that is greater than 2.5 micrometers equivalent aerodynamic diameter (less than 10 micrometres equivalent aerodynamic diameter)
PM_{10}	Particulate matter less than 10 micrometres equivalent aerodynamic diameter
RMA	Resource Management Act 1991
RRF	Reeves Road Flyover
RTN	Rapid Transit Network
SEART	South Eastern Arterial
SO_2	Sulphur dioxide
TSP	Total suspended particulate

Executive Summary

This report describes the assessment of air quality effects associated with the operation and construction of Eastern Busway 2 (EB2) and Eastern Busway 3 Residential (EB3R) sections of the Eastern Busway Project (the Project). This air quality assessment includes identification of the existing environment, relevant meteorology and topography, applicable air pollutants, and discussion of relevant regional and national policies and guidance. Potential impacts during both construction and operation of the Project are considered.

Receiving Environment

Planning zones neighbouring the EB2 and EB3R sections of the Project are dominated by urban residential land uses, with some open space zones. Sensitive receivers are located close to the proposed work areas and final Project elements.

Wind directions are prevalent from the southwest for all wind speeds, and particularly dominant from this sector for higher hourly-average wind speeds. The next most prevalent wind direction is from the northeast. Ground elevations are variable around the EB2 and EB3R sections of the Project, however the topographical features are not significant in the context of potential impacts of air emissions from the Project.

Assessment of Air Quality Effects – Construction

The main air quality impact risk associated with construction of EB2 and EB3R is the discharge of dust with associated amenity impacts. The Good Practice Guide for Assessing and Managing Dust published by Ministry for the Environment in 2016 (GPG Dust) states that effective control of visible dust helps maintain ambient levels of PM_{10} below the NES-AQ levels – in other words, management of the amenity impacts means that the potential health impacts from dust emissions are also managed.

The operation of trucks and heavy machinery during construction activities, and the use of mobile generators for power supply where needed, discharges products of diesel or fuel oil combustion into the air. However, these emissions are negligible in a regional context compared to regular emissions from the Auckland vehicle fleet using roads around the Project, and there are no confined spaces where this machinery will operate meaning that any emissions will disperse rapidly once discharged into the air. Therefore, no assessment of potential impacts from emissions of combustion-derived pollutants is necessary.

Therefore, the focus of the assessment for air quality construction impacts is on avoiding or mitigating potential nuisance and amenity impacts from dust emissions. This is consistent with the permitted activity standards in the Auckland Unitary Plan (AUP(OP) for construction-related activities.

The impact assessment of the likelihood of dust emissions impacting on sensitive receptors is conducted using the Dust Risk Index (DRI) approach recommended in the New Zealand Transport Agency (Waka Kotahi) Guide to Assessing Air Quality Impacts from State Highway Projects (Guide AAQISHP) which allows the risk of offensive or objectionable dust nuisance to be classified as low, medium or high at various sensitive receiver locations based on receiving environment attributes and nearby construction activities.

The DRI calculation is conservative – i.e. higher than likely to eventuate. Notwithstanding, the DRI approach indicates the potential for some sensitive receivers near the EB2 construction areas to have a

high risk of offensive or objectionable dust nuisance, and other locations to have a medium or low risk. All of the sensitive receivers near the EB3R construction areas are classified with a medium risk.

Diligent attention to mitigation and monitoring will be required in the high and medium risk locations to avoid significant offensive or objectionable dust impacts via the ESCP. This is proposed as a mitigation measure for the project.

The implementation of the ESCP and adaptive management of mitigation measures in response to monitoring outcomes will reduce the risk of dust emissions as recommended in the Guide AAQISHP. Any residual impacts arising as a result of dust emissions from the construction of both EB2 and EB3 are considered to be low.

Assessment of Air Quality Effects – Operation

For EB2, both traffic volumes and congestion will be reduced due to the implementation of the Project. It is concluded that implementing the EB2 section of the Project will result in lower rates of emissions of vehicle exhaust pollutants into air than with the "Do Minimum" option – imparting a beneficial impact to both local and regional air quality.

For EB3R, traffic volumes at the Project opening year 2028 are forecast to be slightly lower than in the current situation, but higher than under the "Do Minimum" option. When the reductions in fleet-weighted emission factors between now and 2028 are factored in, along with the reduction in congestion due to the implementation of the Project, it is concluded that emissions of vehicle exhaust pollutants into air over the EB3R section of the Project will be lower than under the current situation. Therefore, operation of the EB3R section of the Project is considered to have a beneficial impact to both local and regional air quality.

Mitigation – Construction

The ESCP will set out measures to minimise, so far as reasonably practicable, impacts on air quality due to dust emissions during construction. The ESCP will include requirements for:

- Dust control measures to maximise the mitigation of dust emissions
- Monitoring, including both visual and instrumental monitoring methods and relevant triggers
- Adaptive management and proactive management to modify activities and mitigation measures based on forecasted wind conditions and in response to feedback from monitoring.

Mitigation – Operation

No mitigation measures are required for the operational phase of the Project.

1 Introduction

1.1 Overview of the Eastern Busway Project

The Project is a package of works focusing on promoting an integrated, multi-modal transport system to support population and economic growth in southeast Auckland. This involves the provision of a greater number of improved public transport choices and aims to enhance the safety, quality and attractiveness of public transport and walking and cycling environments. The Project includes:

- 5km of two-lane busway
- New bridge for buses across Pakuranga Creek
- Improved active mode infrastructure (walking and cycling) along the length of the busway
- Three intermediate bus stations
- Two major interchange bus stations.

The Project forms part of the previous Auckland Manukau Eastern Transport Initiative (AMETI) programme (the programme) which includes a dedicated busway and bus stations between Panmure, Pakuranga and Botany town centres. The dedicated busway will provide an efficient rapid transit network (RTN) service between the town centres, while local bus networks will continue to provide more direct local connections within the town centre areas. The Project also includes new walking and cycling facilities, as well as modifications and improvements to the road network.

The programme includes the following works which do not form part of the project:

- Panmure Bus and Rail Station and construction of Te Horeta Road (completed)
- Eastern Busway 1 (EB1) – Panmure to Pakuranga (completed).

The Project consists of the following packages:

- Early Works Consents – William Roberts Road (WRR) extension from Reeves Road to Ti Rakau Drive (LUC60401706); and Project Construction Yard at 169 – 173 Pakuranga Road (LUC60403744).
- Eastern Busway 2 (EB2) – Pakuranga Town Centre, including the Reeves Road Flyover (RRF) and Pakuranga Bus Station **(this Assessment)**
- Eastern Busway 3 Residential (EB3R) – Ti Rakau Drive from the South Eastern Arterial (SEART) to Pakuranga Creek, including Edgewater and Gossamer Intermediate Bus Stations **(this Assessment)**
- Eastern Busway 3 Commercial (EB3 Commercial) – Gossamer Drive to Guys Reserve, including two new bridges, and an offline bus route through Burswood
- Eastern Busway 4 – Guys Reserve to a new bus station in the Botany Town Centre, including a link road through Guys Reserve.

The overall project is shown in Figure 1 below.

This assessment pertains only to the EB2 and EB3R packages.

Figure 1. Project alignment

1.2 Project Objectives

The Project objectives are:

1. Provide a multi modal transport corridor that connects Pakuranga and Botany to the wider network and increases access to a choice of transport options
2. Provide transport infrastructure that integrates with existing land use and supports a quality, compact urban form
3. Provide transport infrastructure that improves linkages, journey time and reliability of the public transport network
4. Contribute to accessibility and place shaping by providing better transport connections between, within and to the town centre
5. Provide transport infrastructure that is safe for everyone
6. Safeguard future transport infrastructure required at (or in vicinity of) Botany Town Centre to support the development of a strategic public transport connection to Auckland Airport.

The Project objectives have been considered in relation to this assessment, with those particularly relevant to the assessment being Objectives 2 and 5.

2 Proposal Description

The below is a summary of the works proposed within the EB2 and EB3R packages. Refer to the Assessment of Effects on the Environment (AEE) for additional detail on the works proposed.

2.1 Eastern Busway 2

The EB2 section of the Project commences from the intersection of Ti Rakau Drive and Pakuranga Road, connecting with EB1, and traverses west along Ti Rakau Drive to the intersection of SEART. The north-south extent of EB2 is between SEART and Pakuranga Road along Reeves Road and William Roberts Road. The main components of EB2 are described below.

2.1.1 Busway and Pakuranga Town Centre Bus Station

A segregated dedicated two-way busway is proposed along Ti Rakau Drive to provide prioritised access for bus services between Pakuranga Town Centre and Botany. From Pakuranga Road to SEART, the busway will run on the northern side of Ti Rakau Drive.

The proposed Pakuranga bus station is a key facility for services running to and from the Panmure Station Interchange, Howick, Highland Park, Eastern Beach, Bucklands Beach and Sunnyhills. The bus station will be located along the northern side of Ti Rakau Drive, on land currently occupied for Pakuranga Plaza and 26 Ti Rakau Drive. The bus station will feature two platforms and will contain a mixture of street furniture and structures, including bus shelters, electronic messaging signage and seating. New proposed pedestrian crossings will provide connections to the bus station and Pakuranga Plaza. Modifications to the Ti Rakau Drive median strip, landscaping, and general traffic lane reconfiguration will enable safe and efficient bus movement for the busway once it becomes operative.

2.1.2 Reeves Road Flyover (RRF)

The RRF will provide two general traffic lanes in each direction connecting SEART to Pakuranga Road, to reduce local traffic congestion along Pakuranga Road and Ti Rakau Drive. The RRF will start opposite Paul Place Reserve, pass over Ti Rakau Drive and Reeves Road, before finishing at a new intersection with Pakuranga Road. Traffic lanes for the RRF will be elevated and run through the centre of SEART, requiring the relocation of the SEART off-ramp to the north of the existing off-ramp.

2.1.3 Walking and Cycling Facilities

EB2 includes improvements to active transport infrastructure and connections. This includes a new cycleway, improved footpaths, and new pedestrian crossings. These works will improve the safety and connectivity of walking and cycling links across Pakuranga Town Centre.

2.1.4 Supporting Works

A range of works will be undertaken in support of the EB2 package. This includes the relocation of network utility services, new street lighting, earthworks, removal of vegetation, landscaping, stormwater upgrades, environmental restoration and mitigation and temporary construction sites.

2.2 Eastern Busway 3 Residential

The EB3R section of the busway is a continuation of EB2 from the intersection of SEART and Ti Rakau Drive, with the proposed dedicated busway proceeding centrally along Ti Rakau Drive towards Gossamer Drive and Riverhills Park in the east. EB3R will largely occur within land vested as road or land currently owned by Auckland Transport. The construction of EB3R will take a staged approach to minimize disruption to the existing road network and its users. The main components of EB3R have been described below.

2.2.1 Edgewater and Gossamer Intermediate Bus Stations

EB3R includes two intermediate bus stations on Ti Rakau Drive, located within the vicinity of Edgewater Drive and Gossamer Drive. Both stations will have separate platforms for eastbound and westbound bus movements. A range of street furniture and structures will also be constructed, such as modular bus shelters pedestrian linkages, electronic messaging signage, seating and cycling storage facilities.

2.2.2 Western Bridge Abutment

EB3R includes construction of the western bridge abutment for a new future bridge across Pakuranga Creek. The abutment will be located within the area that is currently the southeastern section of Riverhills Park. Only the bridge abutment is included in the EB3R package of works. The remaining parts of the bridge will form part of the EB3C approval package.

2.2.3 Walking and Cycling Facilities

Provision has been made for walking and cycling along the route of EB3R. This includes footpaths and uni-directional cycleways located on either side of Ti Rakau Drive from SEART to Gossamer Drive. Signalised pedestrian crossings will be provided at key intersections along Ti Rakau Drive, including adjacent to the proposed Edgewater bus station.

2.2.4 Associated changes the road network

The proposed changes to the road network include lane arrangement and intersection reconfigurations and changes to the parking arrangement and access to Edgewater Drive Shops. Changes are also proposed to the access arrangements for residential properties along the EB3R alignment. New westbound lanes for general traffic will be established within the land which has been acquired by Auckland Transport and will be vested as road once it becomes operative, as the busway alignment replaces the existing westbound lanes.

2.2.5 Supporting Works

A range of works will be undertaken in support of the EB3R package. This includes the relocation of network utility services, new street lighting, removal of vegetation, earthworks, landscaping, stormwater upgrades, environmental restoration and mitigation and temporary construction sites.

3 Specialist Assessment

Chapter Summary
• *This report describes the assessment of air quality effects associated with the operation and construction of EB2 and EB3R sections of the Project.* • *This air quality assessment includes identification of the existing environment, relevant meteorology and topography, applicable air pollutants, and discussion of relevant regional and national policies and guidance.*

3.1 Assessment Content

This report describes the assessment of air quality effects associated with the operation and construction of EB2 and EB3R sections of the Project.

Its purpose is to:

- Inform the AEE relating to the Notice of Requirement, and required regional consents and consents required under National Environment Standards for EB2
- Inform the AEE and district and regional consents applications for EB3R
- Identify the ways in which any adverse effects will be mitigated.

This air quality assessment includes identification of the existing environment, relevant meteorology and topography, applicable air pollutants, and discussion of relevant regional and national policies and guidance. Potential impacts during both construction and operation of the project are considered, using the following approaches:

- For construction impacts, an assessment of the potential impacts from dust during construction of EB2 and EB3R is presented
- For operational impacts, a qualitative assessment of the potential impact on ambient air quality for EB2 and EB3R is conducted by consideration of projected traffic volumes and vehicle emission factors.

3.2 Specific Project Elements

3.2.1 Elements Common to EB2 and EB3R

Construction of EB2 and EB3R will involve the following activities with potential for dust emissions:

- Removal of acquired buildings, pavements, drainage and curbs where required
- Protection or relocation of existing services
- Establishment and use of work sites and laydown areas
- Establishment and operation of aggregate yards
- Modifications to existing roads and connections:
  - Removal of existing pavements and kerb and channel
  - Earthworks for levelling, drainage works, and foundation preparation including import and spreading of engineered fill
  - Spoil handling and stockpiling or removal.
- Construction of stations:
  - Earthworks and foundation preparation
  - Preparation of pavements, site rehabilitation and landscaping.

- Construction of bridges and viaducts:
    - Earthworks and foundation preparation for piles, columns and crane pads
    - Retaining walls and engineered fill for mechanically stabilized earth walls (MSE) for abutments (approach embankments/ramps).

The proposed construction methodology for EB2 and EB3R includes the following approaches that are relevant to the generation and mitigation of dust emissions:

- Security fencing will be constructed around each works area and compound, to provide a physical barrier between the works and public
- Wheel wash facilities will be provided at works areas where appropriate to minimise the trackout of soil to local roads
- Two areas within the project footprint have been identified as key construction compounds (including site facilities, and material laydown areas). Relevant features of these areas include:
    - The proposed location of the main compound is 169 – 173 Pakuranga Road and 3 William Roberts Road. This site is also the main construction yard for the construction of EB2 and EB3R. Excavated material and aggregates will be taken by truck to the construction yard, where they will be stored for reuse or taken away. The site is subject to a separate resource consent application (Council Reference: LUC60403744) and therefore is not discussed further in this assessment
    - A satellite office for the RRF is proposed at 2 Cortina Place
        - A bentonite or polymer plant for mixing piling fluids will be established adjacent to this site (the plant will comply with the permitted activity standards in the AUP(OP)
        - If required, the bentonite plant would include equipment for mixing bentonite (a type of clay) or polymer with water, pumping the fluid to the piling site, and cleaning the used fluid for reuse by removing larger aggregate and particles
        - Activities associated with receipt, storage, handling of the dry bentonite or polymer will be managed to minimise dust emissions. After the bentonite or polymer is mixed with water, the potential for dust emissions is negligible
    - The location, size and scale of these compounds will be governed by resource consent and designation conditions
    - In addition to these compounds and satellite offices, typical construction activities (such as stockpile, laydown and assembly areas, plant and equipment storge, amongst others) will occur throughout the construction footprint
    - Site establishment activities for the construction compounds and satellite office areas will include site clearance, ground preparation and establishing erosion and sediment control measures prior to any construction activities occurring. Upon completion of the relevant works the construction compounds and satellite offices will be dis-established.
- Erosion and sediment control measures will be implemented for the project, as discussed in the Erosion and Sediment Control Technical Report, and detailed in an Erosion and Sediment Control Plan (ESCP). Aspects of these measures are also beneficial for minimisation of potential for dust emissions. These measures will include:
    - Appropriate staging of the works, to ensure earthworks are carried out in a staged manner to limit the area of exposed earth open to the elements at any one point in time

- Erosion protection by stabilisation of surfaces, including but not limited to geotextiles, aggregate stabilisation, hay mulching, grassing
    - Use of a “cut and cover” erosion and sediment control methodology wherever possible and practical. This method promotes progressively undertaking construction works, stripping topsoil and any unsuitable subsoils (to achieve suitable ground conditions) and then immediately backfilling with aggregate to the final required level
    - Use of stabilised construction entrance ways - either a sealed entrance or a stabilised pad of aggregate placed on a filter cloth base and located where construction traffic will exit or enter a construction site. Stabilised construction entranceways help to prevent site entry and exit points from becoming a source of sediment and also help to reduce dust generation and disturbance along public roads.
    - No vehicles will be allowed to leave the construction site unless tyres are clean, so that construction vehicles will not contribute to sediment deposition on public road surfaces outside the works area.

- Earthworks, including:
    - Construction of the project will involve clearing of obstructions and vegetation and earthworks within the construction footprint. The project construction footprint consists of approximately 10 ha of land-based works, and 0.5 ha of coastal works
    - After de-construction operations, where possible existing house and business foundations and driveways will be uplifted and processed to create hardfill products and reused as temporary access routes. Topsoil will be salvaged, stockpiled and reused as part of landscaping operations
    - Existing soils will be cut and reused as general fill if suitable and where not appropriate for re-use, cut material will be removed offsite to an approved facility. Fill will comprise of recycled cut soils and materials as approved and imported soils and rock materials as designed. These works will be also governed by the measures required under the Contaminated Land Management Plan (CLMP).

3.2.2 EB2

Key elements of EB2 include the Pakuranga Busway Station and the RRF. Construction of EB2 will take approximately 5 years including site establishment and enabling works.

The EB2 section will require a total cut of approximately 30,000 m^3 and a total fill of approximately 22,000 m^3. Where not appropriate for re-use, cut material will be removed offsite to an approved facility. Fill will comprise of recycled cut material and imported rock materials as designed.

The RRF is the major structural component of EB2, and includes MSE walls on each side comprising the approach embankments to the bridge:

- Western side (Abutment A, also referred to as Embankment A) duration of construction approximately 14 months
- Eastern side (Abutment B, also referred to as Embankment B) - duration of construction approximately 7 months.

The construction of these abutments will require extensive ground improvement followed by filling to create the ramps and is therefore an activity with higher potential for dust emissions over a prolonged period of time than other aspects of the EB2 construction programme.

The approximate footprints and location of the two Abutments are shown in Figure 2. This figure shows just the approximate extent of ground improvements for the abutments and does not show other road alignment work within EB2.

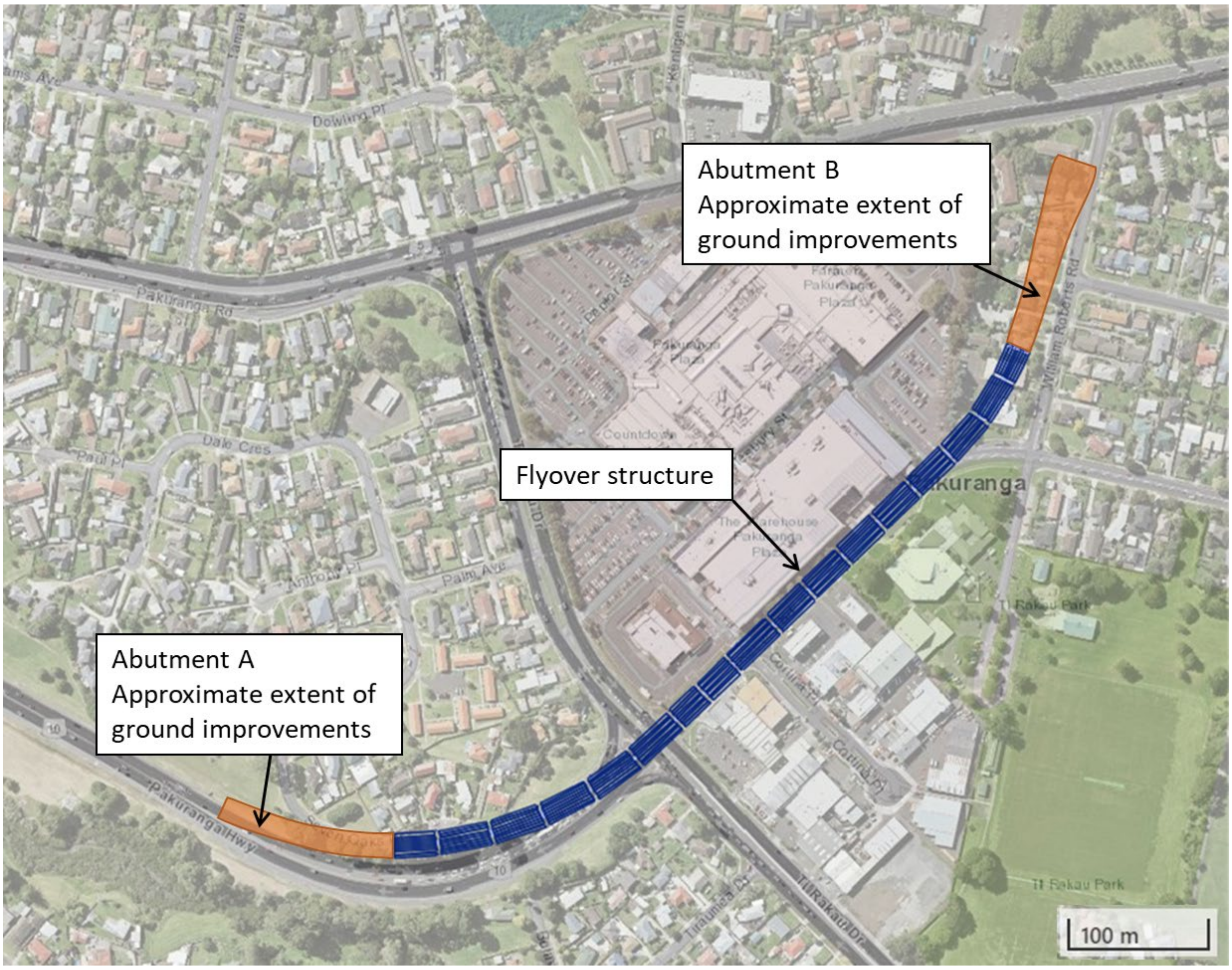

Figure 2. Indicative location of ground improvements required for Abutments A and B, Reeves Road Flyover.

3.2.3 EB3R

EB3R joins onto EB2 just south of the RRF and terminates immediately west of Pakuranga Creek/Ti Rakau Bridge. This section consists of an on-road busway, within the existing road corridor, and involves the widening of Ti Rakau Drive.

The busway itself will have an interim design proposed that terminates at Gossamer Drive, with the final bus station adjacent to Riverhills Park to be provided within the EB3C section of works. However, the construction of the final footprint area and the future western bridge abutment across Pakuranga Creek are also included in the EB3R package.

Large scale bulk earthworks are not required within this zone, as it is predominantly a road widening section. No bridges or viaducts are planned within EB3R. The EB3R section will require a total cut of approximately 20,000m^3 and a total fill of approximately 32,000m^3.

Construction of EB3R will take approximately 5 years including site establishment and enabling works and will involve the general construction activities listed in Section 3.2.1. The construction yard at 169-173 Pakuranga Road and 3 William Road will be used for bulk stockpiling of spoil and fill materials.

3.3 Reasons for Consent

Consent matters are set out in Section 7 of the EB2 AEE and Section 5 of the EB3R AEE. Consent matters relevant to this assessment relate to air discharge from potential contaminant sources and construction generated dust.

3.4 Assessment Matters

3.4.1 National Environmental Standards for Air Quality

The Ministry for the Environment (MfE) promulgated the National Environmental Standards for Air Quality (NES-AQ) as regulations under the RMA on 6 September 2004 and amended it on 1 June 2011.

The NES-AQ applies standards to five air pollutants: fine particulate (expressed as PM_{10}, see Section 4.1.2 for definitions), carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and ozone (O_3). The NES-AQ also places restrictions on home heating appliances and hazardous waste combustion, but these are not relevant to this assessment.

Whilst vehicles using the roads within the EB2 and EB3R sections of the Project discharge pollutants to air due to engine exhausts which are covered by the NES-AQ, details of concentration values and averaging periods within the NES-AQ are not relevant because of the qualitative assessment approach adopted for operational impacts in this assessment.

3.4.2 Auckland Council Unitary Plan Operative (AUP(OP))

3.4.2.1 Chapter E12 (Land Disturbance – District)

Chapter E12 (Land disturbance – District) of the Auckland Council Unitary Plan (Operative) (AUP(OP)) is relevant to the air quality assessment.

General earthworks greater than $2500m^2$ and/or greater than $2500m^3$ (relevant for this Project) are defined in Table E12.4.1 as a restricted discretionary activity. Consents for land disturbance relevant to the Project have been sought, which includes dust control.

3.4.2.2 Chapter E14 (Air Quality) Rules

The air quality rules in Chapter E14 (Air Quality) of the AUP(OP) applicable to this Project during construction or operation are summarised in Table 1. These activities have a permitted status, although activities covered by rules A82 and A83 are required to meet a list of conditions known as "permitted activity standards", otherwise the rule defaults to a restricted discretionary status. The permitted activity standards are defined in Chapter A14.6.1 of the AUP(OP) and include the following standards that are relevant to the Project:

(1) The discharge must not cause, or be likely to cause, adverse effects on human health, property or ecosystems 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.

Table 1 Applicable air quality rules in AUP(OP) Chapter E14 (Air Quality)

Rule	Type of activity covered by the rule	Relevance to activities in the Project	Are the activities covered by the rule required to meet permitted activity standards?	Status of activity if not meeting permitted activity standards
A82	Demolition of buildings	Demolition of buildings	Yes	Restricted discretionary
A83	Earthworks and the construction, maintenance and repair of public roads and railways	Earthworks and Project construction	Yes	Restricted discretionary
A114	Discharges to air from the engines of motor vehicles, or from aircraft, trains, vessels (including boats) and mobile sources not otherwise specified (such as lawnmowers), including those on industrial or trade premises (excluding tunnels)	Vehicles, heavy machinery and temporary generators used during construction Vehicles using the roads comprising EB2 and EB3R during operation	No	Not applicable

The chapter also notes that:

> *"when making a determination of adverse effects in relation to odour and dust, the FIDOL factors (frequency, intensity, duration, offensiveness and location) should be used. The use of the FIDOL factors provides a framework for making an objective and consistent assessment in relation to the degree of effects. The nature of the zone, predominant types of activities within any given area and amenity provisions for each zone, precinct or overlay will be taken into account when undertaking the assessment effects on the environment."*

Further discussion on the FIDOL factors is provided in Section 4.2.1.3.

4 Methodology and Analysis

Chapter Summary
• *Particles (dust) will be the key pollutant generated and emitted into air during construction of the Project. These emissions will occur from a variety of sources and activities. Dust emitted into the air presents a risk of causing a range of impacts to human health and the environment. The focus of the assessment for air quality construction impacts is on avoiding or mitigating potential nuisance and amenity impacts from dust emissions, as the GPG Dust states that this will also mitigate the potential for adverse impacts to human health during construction* • *For construction dust impacts, the DRI approach recommended in the Guide AAQISHP has been used. The DRI method enables the risk of offensive or objectionable dust nuisance to be classified as low, medium or high at various sensitive receiver locations based on receiving environment attributes and nearby construction activities* • *For operational impacts, the potential impact on ambient air quality due to Project operation will be assessed qualitatively, by considering the projected traffic volumes and pollutant emission factors for vehicles using the roads with and without the Project*

4.1 Methodology for Assessment

4.1.1 Construction Impacts

The assessment of potential impacts during construction involved the following:

- Review of the Project description and construction information
- Review of planning zone maps and aerial photographs to identify receptors that are potentially sensitive to air quality discharges from the Project
- Analysis of representative meteorological data to contextualise the risk of downwind receptors being exposed to air pollutants from the Project during construction
- Identification of potential air quality emissions from construction of each element along the Project alignment and recommendation of appropriate mitigation measures to minimise the risk of air quality impacts to sensitive receptors.

4.1.2 Operational Impacts

The ambient air quality at sensitive receptors near the existing roads within the EB2 and EB3R sections of the Project is a combination of background air quality and existing vehicle exhaust pollutants. Vehicle emissions will continue to be present on the local roads with or without the implementation of the Project.

A qualitative assessment of the potential impact on ambient air quality due to Project operation was conducted by considering the projected traffic volumes and pollutant emission factors for vehicles using the roads with and without the Project. Following this qualitative assessment, no further detailed assessment was necessary.

4.2 Review of Potential Pollutants

Air quality impacts can include impacts on human health (such as concentrations of respirable airborne pollutants) and impacts on amenity (such as dust deposition or odour).

4.2.1 Particulate Matter / Dust

4.2.1.1 Sources

The key air pollutant relevant to construction of the project is particulate matter. Particulate matter in the atmosphere refers to a range of particle types and sizes. The particles may be emitted from natural sources such as windblown dust, sea spray and pollens; or from anthropogenic sources such as combustion of fuels, power generation, industrial activities, excavation works, unpaved roads, and the crushing and handling of materials.

Particles will be the key pollutant generated and emitted into air during construction of the project. These emissions will occur from a variety of sources and activities including:

- Mechanical disturbance of soil material (bulldozing, scraping, digging)
- Excavation, handling and stockpiling of spoil
- Demolition of existing structures
- Formation of access tracks
- Construction of foundations
- Construction of retaining walls and engineered fill
- Movement of plant and equipment across exposed, unsealed ground
- Driving trucks and light vehicles on unsealed roads
- Wind erosion of uncovered stockpiles of spoil, topsoil and/or construction and demolition materials
- High wind speeds moving across unsealed surfaces
- Vehicle and generator exhaust fumes.

Another potential dust source during construction is track-out - vehicles leaving construction sites and spreading dirt on roads around the construction site which is then dried and crushed by ongoing wheel movements and eventually entrained in air eddies and dispersed. However, this dust source is small for the Project because all site exits would have wheel wash facilities (if necessary) so that construction vehicles will not contribute to sediment deposition on public road surfaces outside the works area (see Section 7.2.2. The ESCP would include tasks for regular inspection and cleaning of exits and local roads to monitor this.

4.2.1.2 Potential Health Effects

Dust emitted into the air presents a risk of causing a range of impacts to human health and the environment. Dust can impact human respiratory and cardiovascular health and ecosystem health. In addition, dust can cause nuisance and amenity issues through soiling of surfaces.

The health effects of particles are strongly influenced by the size of the particles. Particulates are therefore classified according to their size. Particulate matter includes total suspended particulates (TSP), which can be considered as anything smaller than 100 micrometres (µm) in diameter. In practice, the large particles (i.e. greater than 20-30 µm) do not last long in the atmosphere, as they tend to fall out rapidly and settle. Particles deposited on a surface will only become individually visible at about 50 µm (MfE, 2016).

When dust particles are released into the air they tend to fall back to ground at a rate proportional to their size. This is called the settling velocity. For a particle 10 µm in diameter, the settling velocity is about 0.5 cm/sec, while for a particle 100 µm in diameter it is about 45 cm/sec in still air. In a 10-knot wind (5 m/sec), the 100 µm particles would only be blown about 10 metres away from the source while the 10 µm particles have the potential to travel about a kilometre. Fine particles can therefore be widely dispersed, while the larger particles simply settle out in the immediate vicinity of the source.

Two size categories for fine particles are recognised internationally as having the greatest potential to cause health problems due to their inhalation potential:

- PM_{10} (particles with an equivalent aerodynamic diameter of 10 µm or less): these particles are small enough to pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects
- $PM_{2.5}$ (particles with an equivalent aerodynamic diameter of 2.5 µm or less): these particles are so small they can get deep into the lungs and into the bloodstream. The PM_{10} category includes the $PM_{2.5}$ size range.

By way of comparison, a human hair is about 100 µm in width, so roughly 40 particles of diameter 2.5 µm could be placed on its width.

4.2.1.3 Potential Amenity Effects

Typical nuisance and amenity issues caused by dust may include visible dust suspended in the air outside the construction site, and the settling of dust on surfaces such as parked cars, windows or laundry.

Assessing the environmental effects of dust can be difficult given the subjective nature of these effects. People may be annoyed by dust fallout on their property, and some may find it objectionable or offensive.

The Good Practice Guide for Assessing and Managing Dust, herein referred to as the "GPG Dust" was published by MfE in 2016. The guide provides information on how to assess and manage dust emissions from sources such as quarrying, aggregate crushing, abrasive blasting, sealed and unsealed surfaces, and material stockpiles.

The GPG Dust states that nuisance effects of dust emissions are influenced by the nature of the source, sensitivity of the receiving environmental and on individual perception. For example, the level of tolerance to dust deposition can vary significantly between individuals. Individual responses can also be affected by the perceived value of the activity producing the dust. For example, people living in rural areas may have a high level of tolerance for the dust produced by activities such as ploughing or top-dressing, but a lower tolerance level for dust from quarries.

The GPG Dust refers to a group of factors known collectively as the "FIDOL" factors to characterise the potential for nuisance dust to cause an offensive or objectionable effect. These FIDOL factors are also widely used in assessing odour nuisance risk. Whether a dust event has an objectionable or offensive effect always depends on the frequency (F), intensity (I), duration (D), offensiveness/character (O) and location (L) of the dust event. These FIDOL factors are described in Table 2.

Table 2 Description of the FIDOL Factors for Nuisance Dust (from MfE (2016)).

Factor	Description

Frequency	How often an individual is exposed to the dust
Intensity	The concentration of the dust
Duration	The length of exposure
Offensiveness/character	The type of dust
Location	The type of land use and nature of human activities in the vicinity of the dust source.

Different combinations of these factors can result in adverse effects. Location is particularly important as this relates to sensitivity of the receiving environment.

Depending on the severity of the dust event, one single occurrence may be sufficient to consider that a significant adverse effect has occurred. In other situations, the event may be short enough, and the impact on neighbours sufficiently small, that the events would need to be happening more frequently for an adverse effect to be deemed to have occurred.

4.2.1.4 Focus of this Assessment

The GPG Dust states that management and control of larger size fractions (i.e., deposited dust and TSP) will, at the same time, manage and control smaller size fractions (i.e., PM_{10} and $PM_{2.5}$). The guide states that this is supported by case studies that repeatedly show that effective control of visible dust helps maintain ambient levels of PM_{10} below the NES-AQ levels.

Therefore, the focus of the assessment for air quality construction impacts is on avoiding or mitigating potential nuisance and amenity impacts from dust emissions.

4.2.2 Products of Combustion

The operation of trucks and heavy machinery during construction activities, and the use of mobile generators for power supply where needed, discharges products of diesel or fuel oil combustion into the air including carbon monoxide, nitrogen oxides, nitrogen dioxide, carbon monoxide, sulphur dioxide, and fine particulates. These same pollutants are also discharged to air by vehicles powered by fossil fuel combustion using the roads and Busway after the project becomes operational.

4.2.3 Odour

Odour is a known chemical or a mixture of chemicals that interact to produce a smell (that can be either pleasant or unpleasant).

Current and historical land uses can potentially leave a legacy of contamination. During excavation and earthworks activities, contaminated soil, rock and groundwater can be encountered, giving rise to odour and fumes which may affect amenity. Odour can also be emitted from soils containing naturally occurring chemicals, such as sulphides that when exposed to the air produce an unpleasant gas (hydrogen sulphide).

The potential for disturbance of such soils has been considered in the Contaminated Land Effects Assessment. That report concluded that while there are some isolated areas of potential contaminated land that may be encountered during Project construction, the Project is not likely to have a potential significant effect on the environment based solely on contaminated land impacts. This conclusion is due to the small scope of the potential emissions and the mitigation measures that would be developed and incorporated into the environmental management framework.

The earthworks and excavation activities in potentially contaminated sites will be carefully managed to minimise, so far as reasonably practicable, impacts on amenity and human health as a result of odour if any such emissions arise. These measures will be addressed in the CLMP.

As no potentially significant odour sources have been identified for the Project, no further assessment of potential impacts from odour is provided in this report.

4.3 Definition of Significance Criteria

The significance of air quality impact assessment results is dictated largely by the magnitude and severity of the predicted impacts. The categories for gauging severity in this assessment are described in Table 3. For dust, the relevant air quality criteria are taken to be the permitted activity standards (2) and (3) in Chapter A14.6.1 of the AUP(OP) as introduced in Section 3.4.2.2.

The categories include consideration of both cumulative impacts and incremental impacts which are defined as follows:

- Cumulative impact: The combined impact from Project emissions plus existing/background air quality
- Incremental impact: The impact from Project emissions alone without considering existing/background air quality.

Table 3: Air Quality Impact Significance Criteria

Impact severity	Description	Comments
Beneficial	Reduction in incremental or cumulative air quality impacts at local scale for parameter ‘x’.	• Changes to cumulative air quality are likely to be measurable • Targeted instrumental monitoring of key air pollutants is not required
Very low	Negligible cumulative air quality impacts at local scale determined by assessment parameter ‘x’. No detectable change in environment amenity values due to settling dust at sensitive receptors.	• Changes to cumulative air quality are likely to be undetectable or only just detected • Targeted instrumental monitoring of key air pollutants is not required
Low	Small air quality impacts at local scale. Short term, reversible changes to local environment amenity values due to settling dust at sensitive receptors.	• Incremental impacts may be higher than the “very low” severity rating, but cumulative impacts are well below the relevant air quality criteria • Targeted instrumental monitoring of key air pollutants is unlikely to be required

Medium	Small risk of cumulative air quality impacts exceeding relevant air quality criteria for discrete (sensitive) receptors. Long term but limited changes to local environment amenity values due to settling dust at sensitive receptors.	• The Project has a detrimental effect on air quality, but small risk of exceeding relevant air quality criteria at sensitive receptors • Targeted instrumental monitoring of key air pollutants may be required, depending on specific locations and magnitudes of impacts that are likely
High	Cumulative air quality impacts at local scale determined by assessment parameter 'x' approximately greater than or equal to 100 per cent of relevant air quality criteria for discrete (sensitive) receptors. Long term, major changes to local environment amenity values due to settling dust at sensitive receptors.	• Exceedances of relevant air quality criteria as a result of Project • Ongoing instrumental monitoring, reporting and air quality studies would be necessary to quantify and minimise impacts
Very high	Major cumulative air quality impact on a regional scale determined by assessment parameter 'x' being well in excess of 100% of relevant air quality criteria for discrete (sensitive) receptors. Irreversible, significant changes resulting in widespread risks to environment amenity values due to settling dust at sensitive receptors.	• Large exceedances of relevant air quality criteria as a result of Project • Risk assessment includes consideration of existing air quality – i.e. cumulative impact • Ongoing instrumental monitoring, reporting and regular air quality studies would be necessary to quantify and minimise impacts

4.4 Dust Risk Index Method for Construction Dust Impact Assessment

The Waka Kotahi Guide to Assessing Air Quality Impacts from State Highway Projects (Waka Kotahi, 2019, herein referred to as the "Guide AAQISHP") provides a method of classifying the construction air quality risk as low, medium or high, by calculating a Dust Risk Index (DRI). The DRI generates a number that identifies the risk of dust generation during construction. The greater the DRI, the higher the likelihood of dust related issues.

The DRI is calculated using the following formula:

$$DRI = (E+P+T+WS+D+A) \times M \times WD$$

Where:

E = surface exposure	D = distance to nearest receiver
P = exposure period	A = construction activity
T = time of year	M = mitigation
WS = wind speed	WD = wind direction

The assignment of values to each of these factors depends on site-specific attributes and is described in detail in the Guide AAQISHP.

Once the DRI has been calculated for a particular location, it needs to be assigned to a risk value using the classifications in Table 12 of the Guide AAQISHP (reproduced in Table 4). Management plan recommendations in the Guide AAQISHP arising from the dust risk assessment are also summarised in Table 4.

For this Project, instead of a separate Construction Air Quality Management Plan (CAQMP), specific measures for dust mitigation and management are included within a section of the ESCP because of the extent of overlap between the dust management and erosion and sediment control management. The peer review measures recommended for any high air quality risks would be replaced in this Project by the oversight provided by Auckland Transport.

The DRI method will be used to evaluate dust impact risks for various sensitive receivers close to the EB2 and EB3R sections of the Project.

Table 4 Conversion Values for DRI to dust risk, and recommended implications, from Guide AAQISHP

DRI Value	Risk	Implication
0 to 100	Low	Construction impacts will most likely be able to be managed by generic dust and odour clauses within a construction environmental and social management plan
100 to 200	Medium	A separate CAQMP should be prepared
200 to 300	High	A separate CAQMP should be prepared. In addition, the CAQMP will require independent peer review and include a comprehensive risk-based quality assurance/quality control programme to ensure risks are appropriately managed

5 Existing Environment

Chapter Summary
• *Planning zones neighbouring the EB2 and EB3R sections of the Project are dominated by urban residential land uses, with some open space zones* • *Sensitive receivers are located close to the proposed work areas and final Project elements* • *Wind directions are prevalent from the southwest for all wind speeds, and particularly dominant from this sector for higher hourly-average wind speeds. The next most prevalent wind direction is from the northeast. Winds from the northwest and southeast sectors are uncommon* • *Low wind speeds can arise from any direction, but tend to be more frequent from the north or northeast, and the south or southwest* • *Ground elevations are variable over the EB2 and EB3R sections of the Project, however the topographical features are not considered to be significant in the context of potential impacts of air emissions from the Project.*

5.1 Sensitive Receptors

Sensitive land uses relevant to the air quality assessment for the Project include:

- Residential dwellings
- Assisted-living centres
- Childcare centres
- Hospitals and medical centres
- Schools, Colleges and University Campuses
- Community facilities – halls, gyms, churches
- Outdoor exercise and recreational facilities
- Retail – particularly in high density retail strips and open malls
- Food preparation outlets, cafes and restaurants.

This list is not exhaustive but indicates the types of land uses that are potentially sensitive to airborne or settleable particulate matter and other ambient air quality pollutants.

The presence of these types of land uses close to the construction sites for each Project element was identified through review of a range of data sources including:

- Planning zone maps
- Aerial photographs from both Google Earth and the project Graphical Information System (GIS)
- Google Street View images, accessed through Google Earth.

Figure 3 and Figure 4 show the planning zones around the EB2 and EB3R consenting boundaries. The neighbouring zones are dominated by urban residential land uses, with some open space zones.

Figure 3. Planning zones around EB2 section of Project and consenting boundaries.

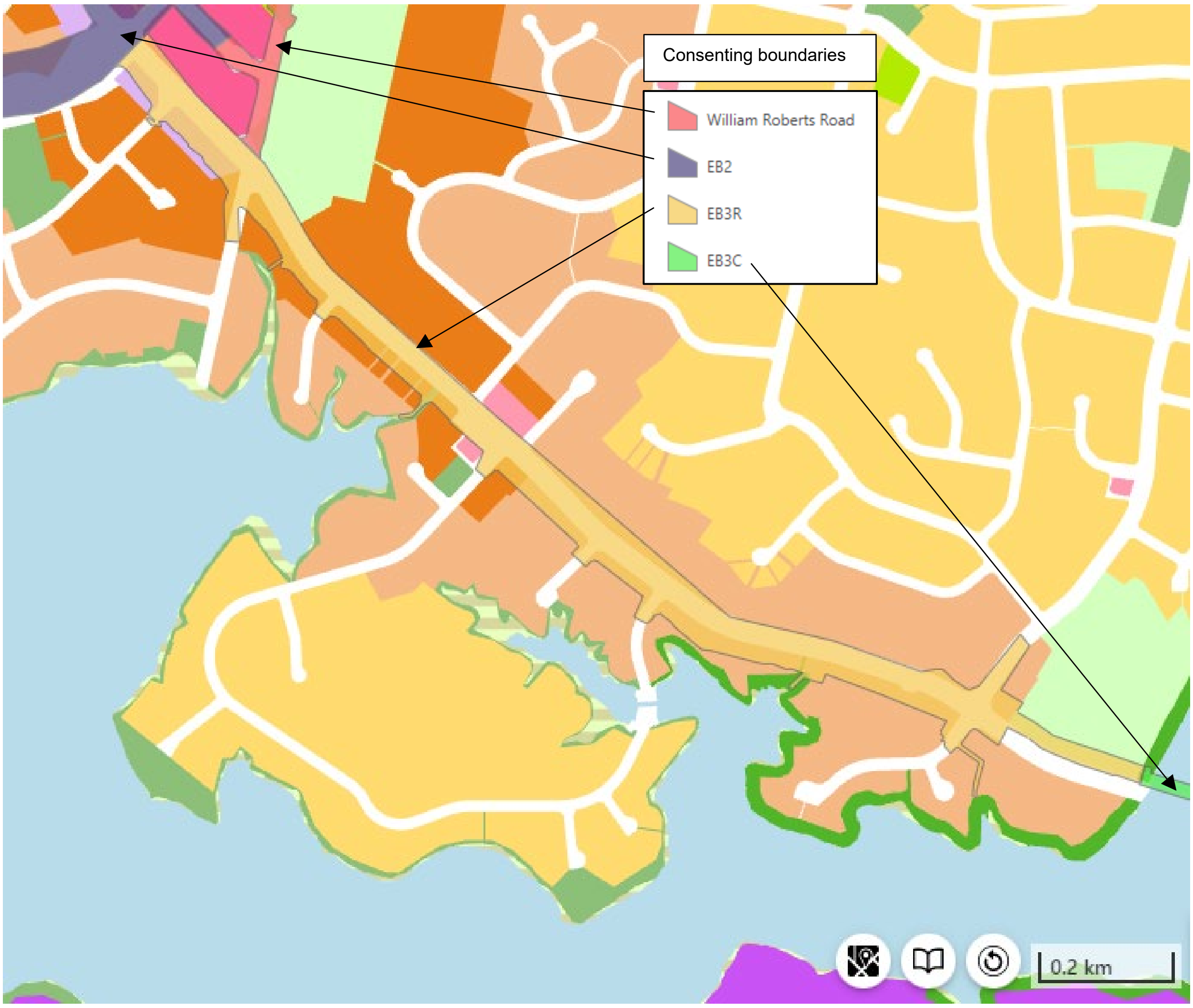

Figure 4. Planning zones around EB3R section of Project and consenting boundaries.

Zones

- Residential - Mixed Housing Suburban Zone
- Residential - Mixed Housing Urban Zone
- Residential -Terrace Housing and Apartment Buildings Zone
- Open Space - Conservation Zone
- Open Space - Informal Recreation Zone
- Open Space - Sport and Active Recreation Zone
- Open Space - Community Zone
- Business - Town Centre Zone
- Business - Neighbourhood Centre Zone
- Business - Mixed Use Zone
- Business - Light Industry Zone
- Coastal - General Coastal Marine Zone [rcp]
- Coastal - Coastal Transition Zone

5.2 Meteorology

5.2.1 Role in Impact Assessment

Meteorological conditions are important for determining the direction and rate at which emissions from a source would disperse. For dust emissions from construction activities such as those likely during construction of the Project, high wind speed conditions are important. The critical wind speed for pickup of dust from surfaces is 5 m/s (18 km/h), and above 10 m/s (36 km/h) pickup increases rapidly (AWMA, 2000). Higher wind speeds also increase dust release during handling/movement of dusty materials (such as loading spoil onto a truck using a front-end loader).

Low wind speeds are also significant as under such conditions the rate of dispersion of any released dust is slowest. During operation, low wind speeds are also a factor as the rate of dispersion of vehicle exhaust emissions is also slowest during such times.

5.2.2 Data Sources

The nearest relevant meteorological monitoring sites to the Project alignment were operated by Auckland Regional Council and then Auckland Council from 2002 to mid-2017 at Pakuranga and Penrose. The location of these two automatic weather stations (AWS) are shown on Figure 5. Both sites are sufficiently close to the Project to be assessed as representative of meteorological conditions in the vicinity of EB2 and EB3R for the purpose of this air quality assessment.

Data for hourly average wind speed and direction, and hourly wind gust speeds, was downloaded from the National Climate Database (https://cliflo.niwa.co.nz) for these two AWS.

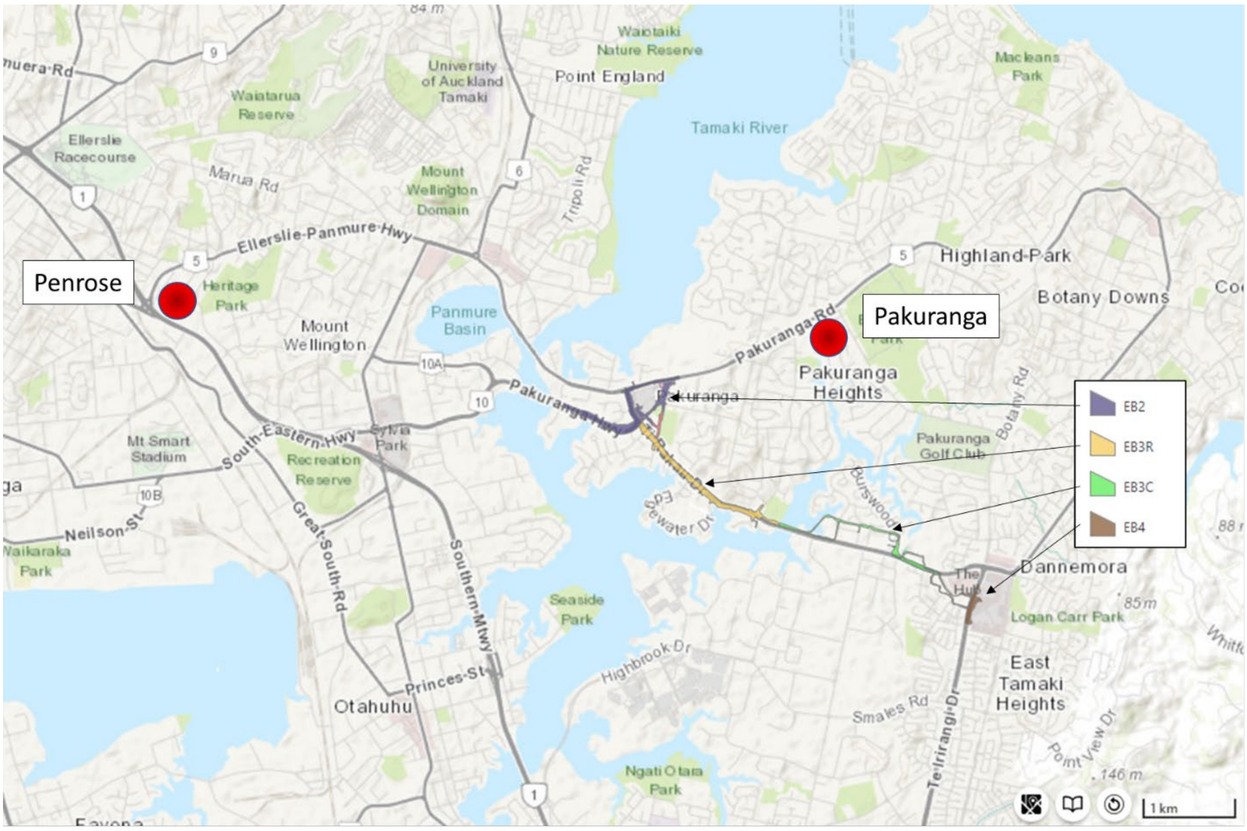

Figure 5. Meteorological monitoring station locations at Penrose and Pakuranga operated by Auckland Regional Council, 2002-2016, near the Project.

5.2.3 Wind Frequency Distributions

Windroses showing the distribution of hourly-averaged wind speeds and directions over all hours of the day and all hours of the year are shown in Figure 6 and Figure 7 for the Pakuranga and Penrose AWS respectively. The hourly-averaged wind speed distribution statistics for each AWS are summarised in Table 5.

Table 5. Hourly-average wind speed distributions for Pakuranga and Penrose AWS, January 2002 – December 2016.

Wind speed category	Pakuranga	Penrose
	Percentage of Hourly-Average Records Less Than Category	
<3.6 km/h (<1 m/s)	46.2%	19.1%
3.6-10.8 km/h (1-3 m/s)	43.9%	51.1%
10.8-18 km/h (3-5 m/s)	9.1%	25.6%
18-28.8 km/h (5-8 m/s)	0.7%	4.1%
28.8-36 km/h (8-10 m/s)	0.0%	0.1%
	Percentage of Hourly-Average Records Greater Than Category	
≥18 km/h (≥5 m/s)	0.8%	4.2%
≥28.8 km/h (≥8 m/s)	0.1%	0.1%
≥36 km/h (≥10 m/s)	0.0%	0.0%

The Pakuranga AWS site shows a greater percentage of lower wind speeds than the Penrose site. This may be due to the Pakuranga AWS being less exposed to wind than the Penrose site, or some other difference in measurement methodology. No other information is available to indicate which of the two sites is likely to be a better representation of meteorological conditions in the vicinity of the EB2 and EB3R sections of the Project.

Despite the difference in wind speed distributions between the two sites, both AWS show a prevalence of winds from the southwest for all wind speeds, and winds are particularly dominant from this sector for higher hourly-average wind speeds. The next most prevalent wind direction is from the northeast, although this is much less dominant than winds from the southwest. Winds from the northwest and southeast sectors are uncommon. Low wind speeds can arise from any direction but tend to be more frequent from the north or northeast, and the south or southwest.

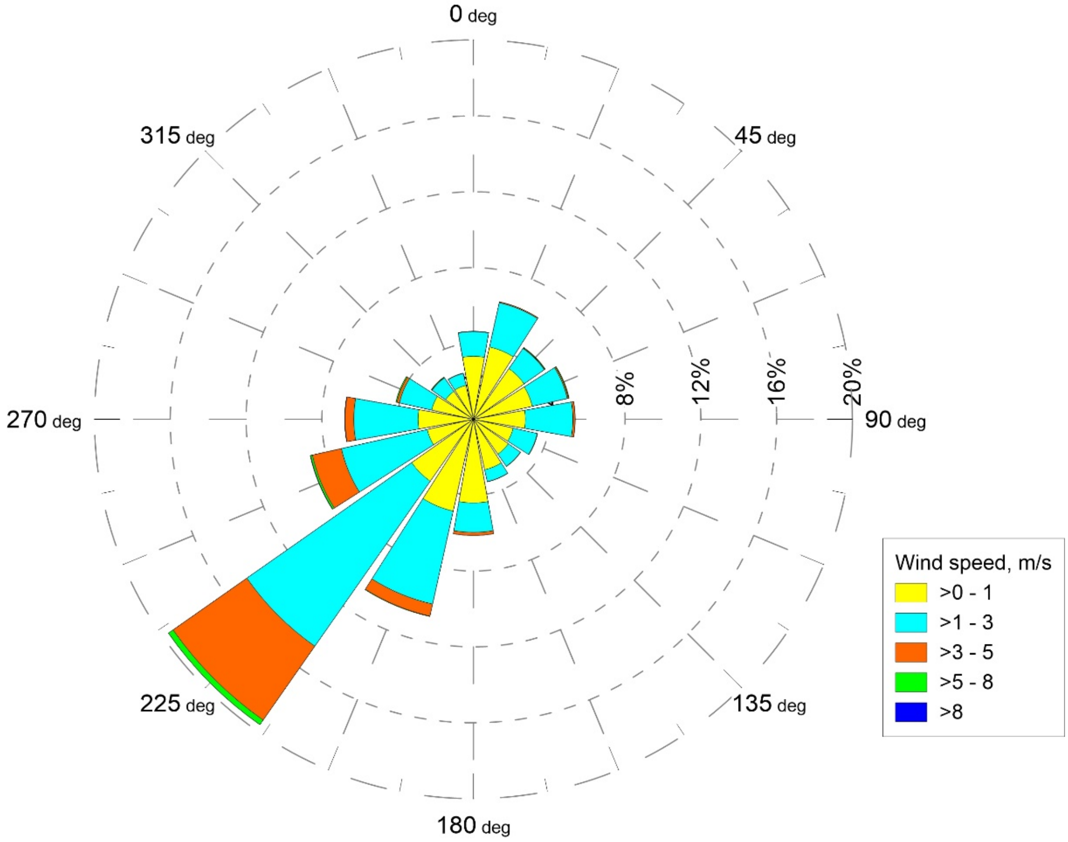

Figure 6: Windrose for Pakuranga AWS showing hourly-average wind speed and direction for all hours, January 2002 – December 2016; data source – https://cliflo.niwa.co.nz.

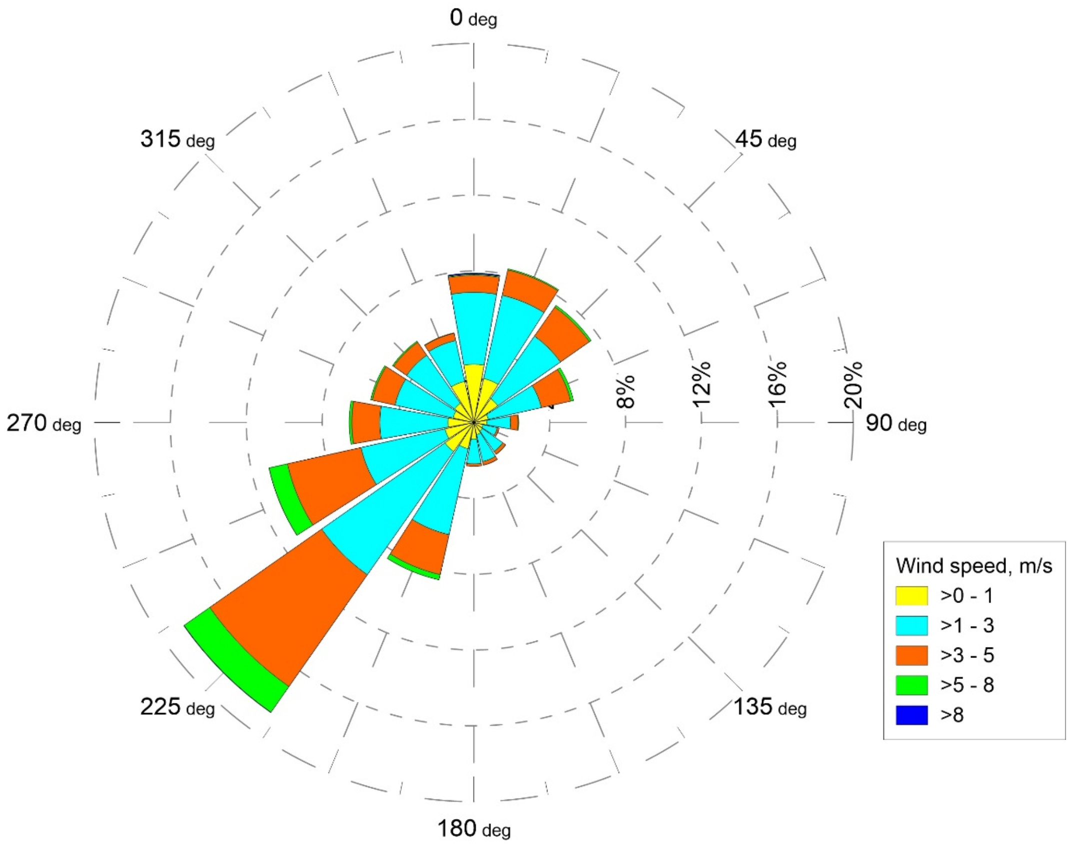

Figure 7: Windrose for Penrose AWS showing hourly-average wind speed and direction for all hours, January 2002 – December 2016; data source – https://cliflo.niwa.co.nz.

5.2.4 Interpretation

Considering the frequency and speed of winds at the Pakuranga and Penrose AWS, sensitive receptors at highest risk of exposure to windblown dust during construction would be those situated to the northeast of the various Project construction sites, and to a lesser extent those to the southwest of the construction sites.

However, some dust emissions from earthmoving vehicles can occur regardless of the wind speed. Dust emissions arising from these activities disperse most slowly under low wind speeds (especially less than about 3 m/s, the yellow and aqua-blue segments in the windroses in Figure 6 and Figure 7). This behaviour also applies to the dispersion of vehicle exhaust emissions during operation of the Project. Wind directions under these low wind speeds can be highly variable depending on local terrain and buildings.

5.3 Topography

Local topographical variations can affect localised wind flows (speed and direction) and thus dispersion of air pollutants.

Project GIS imagery and Google Streetview imagery was used to identify changes in topography that may influence air quality and the dispersion of Project emissions that need to be considered in the impact assessment.

Figure 8 and Figure 9 show topographic contours at 5m increments in and near the EB2 and EB3R sections of the Project. For EB2, the topography increases gradually in elevation towards the northeast corner of the section of the Project, and small localised variations in topography are common particularly around the coastal areas. However, there are no significant topographical features identified that could have a major impact on the dispersion of air pollutants from the Project.

For EB3R, the topography also increases to the northeast, with some hill features to the north of Ti Rakau Drive.

The topographical features described above are not considered to be significant in the context of assessment of potential air quality impacts from EB2 and EB3R.

Figure 8. Topographic contours in and near EB2, 5m intervals. Source: Project GIS.

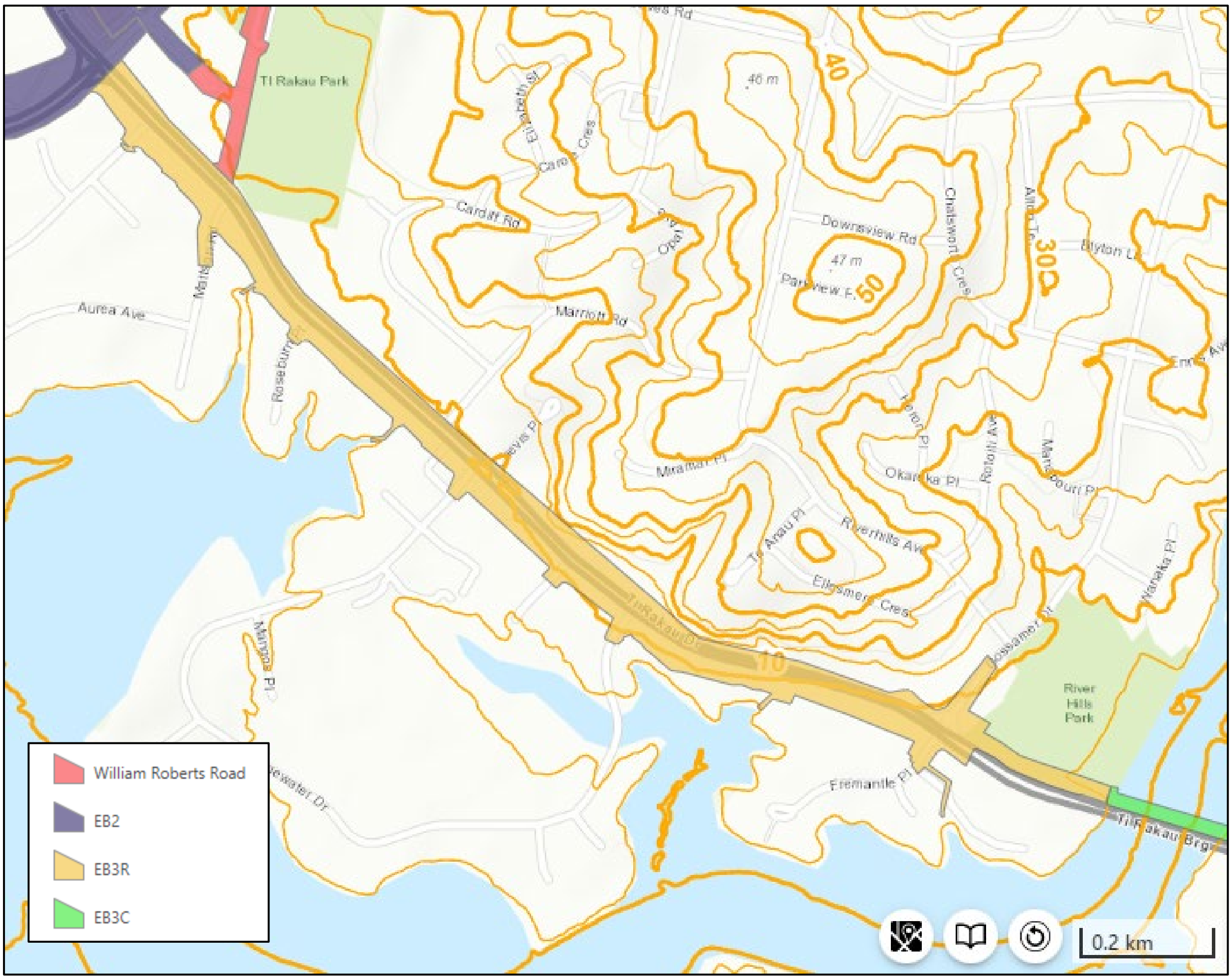

Figure 9. Topographic contours in and near EB3R, 5m intervals. Source: Project GIS.

6 Assessment of Air Quality Effects

Chapter Summary

• *Construction Effects*
  ○ *The impact assessment of the likelihood of post-mitigation residual emissions impacting on sensitive receptors is conducted using the Dust Risk Index (DRI) approach recommended in the Guide AAQISHP. The risk of offensive or objectionable dust nuisance is classified as low, medium or high at various sensitive receiver locations based on receiving environment attributes and nearby construction activities*
  ○ *The Guide AAQISHP recommends that under a medium or high risk profile, a separate construction air quality management plan (CAQMP) should be prepared. Under the high risk profile, the CAQMP requires independent peer review and close attention to management of the risks*
  ○ *For this Project, instead of a separate CAQMP, specific measures for dust mitigation and management are included within a section of the ESCP because of the extent of overlap between the dust management and erosion and sediment control management. The peer review measures recommended for any high air quality risks are provided by Auckland Transport*
  ○ *The DRI calculation is conservative – i.e., higher than likely to eventuate. Notwithstanding, the DRI approach indicates the potential for some sensitive receivers near the EB2 construction areas to have a high risk of offensive or objectionable dust nuisance, and other locations to have a medium or low risk. All of the sensitive receivers near the EB3R construction areas are classified with a medium risk*
  ○ *Diligent attention to mitigation and monitoring will be required in the high and medium risk locations to avoid significant offensive or objectionable dust impacts via the ESCP. This is proposed as a mitigation measure for the Project*
  ○ *The implementation of the ESCP and adaptive management of mitigation measures in response to monitoring outcomes will reduce the risk of dust emissions as recommended in the Guide AAQISHP. Any residual impacts arising as a result of dust emissions from the construction of EB2 and EB3R are considered to be of low significance.*
• *Operational Effects*
  ○ *For EB2, both traffic volumes and congestion will be reduced due to the implementation of the Project. It is concluded that implementing the EB2 section of the Project will result in lower rates of emissions of vehicle exhaust pollutants into air than with the "Do Minimum" option – imparting a beneficial impact to both local and regional air quality.*
  ○ *For EB3R, traffic volumes at the Project opening year 2028 are forecast to be slightly lower than in the current situation. When the reductions in fleet-weighted emission factors between now and 2028 are factored in, along with the reduction in congestion due to the implementation of the Project, it is concluded that emissions of vehicle exhaust pollutants into air over the EB3R section of the Project will be lower than under the current situation. Therefore, operation of the EB3R section of the Project is considered to have a beneficial impact to both local and regional air quality.*

6.1 Construction

6.1.1 EB2

6.1.1.1 Sensitivity of Neighbouring Properties

EB2 contains a variety of construction elements, including road widening/relocation and construction of the RRF. The risk of dust emissions therefore varies throughout this section of the Project. The property acquisitions are shown in Figure 10. Acquired properties are shown because these properties are not considered as sensitive receivers for dust emissions during construction.

Residential and commercial properties are located in close proximity to all parts of the construction areas. The relevance of locations annotated A to F on Figure 10 is highlighted due to the proximity of these locations to construction areas with potentially higher dust emissions:

A – Houses on Dale Crescent (outside of the permanent acquisition and temporary occupation boundaries) are downwind of the construction area for Abutment A of the RRF under the prevailing southwesterly wind direction. The nearest house (19 Dale Crescent) is about 40m from the Abutment under the southwesterly wind, and less than 20m from the new Pakuranga Highway offramp alignment. Houses on Dale Crescent, Palm Ave and Ti Rakau Drive in this area are also downwind of the construction works required for the new Pakuranga Station under a northeasterly wind

B - Annotation B identifies the Te Tuhi Centre for the Arts (Centre) at 13 Reeves Road (Figure 11). The Centre comprises a café and contemporary art gallery. The Centre is downwind of the proposed works area at 2 Cortina Place under the prevailing southwesterly wind direction, and is in close proximity to other construction areas although not under prevailing winds

C - Houses on William Roberts Road and Ayr Road in the vicinity of Annotation C are downwind of the construction area for Abutment B of the RRF under prevailing wind conditions

D - This location is downwind of the proposed construction yard under the prevailing southwesterly wind conditions and is part of the St Kentigern College grounds (Figure 12). However, the location is not considered to be sensitive to dust because the location is park land. In addition, the construction yard is the subject of a separate consent application, and the effects of the yard are therefore not relevant to the effects of this consent application

E - At the location annotated "E" there is also an outdoor strip mall between the Plaza buildings along Aylesbury Street (Figure 13), with retail shops and services

F1/F2 - With the exception of location "E", the Pakuranga Plaza shopping centre is generally not considered to be a sensitive location for dust. This is because the land use comprises either carparking, or retail with limited openings and controlled indoor environments (Figure 14 (F1) and Figure 15 (F2)).

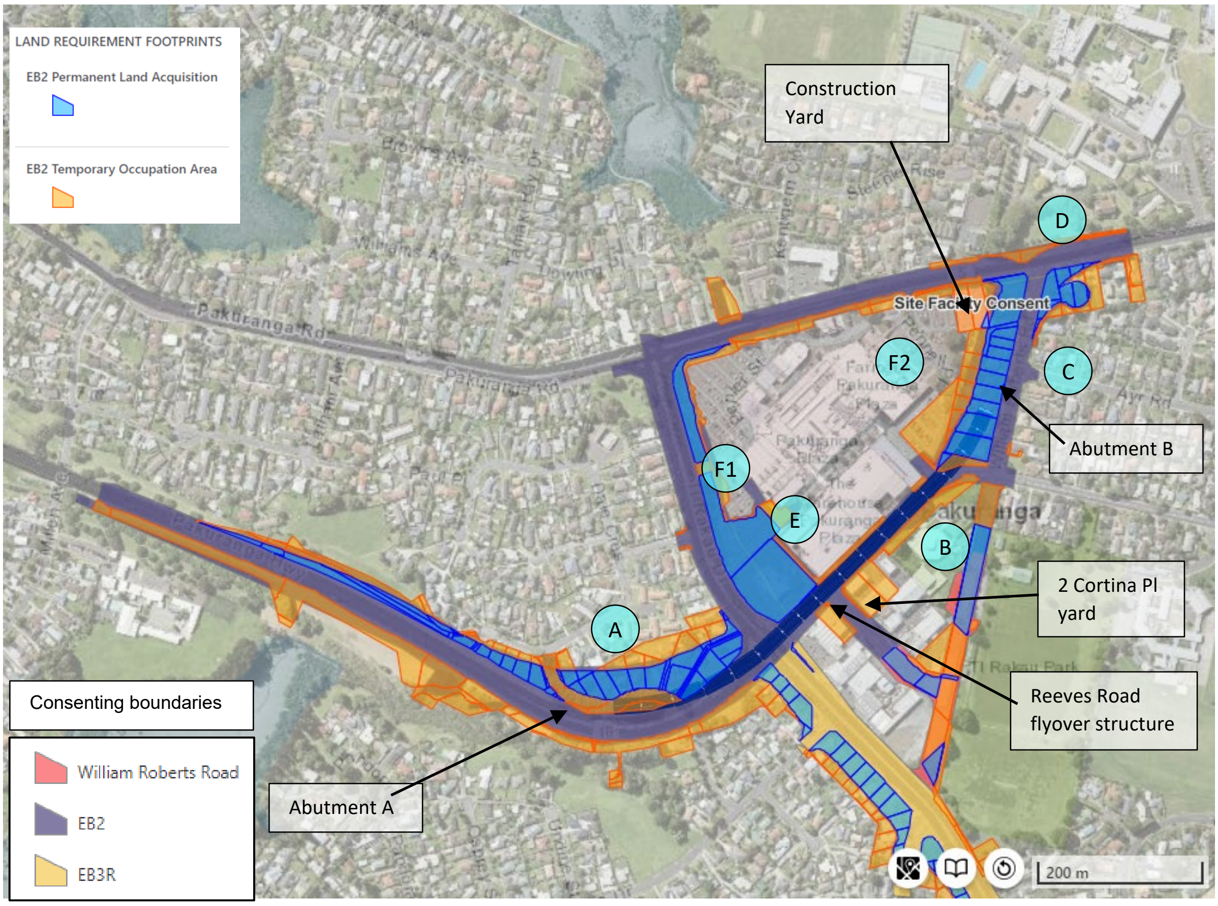

Figure 10. EB2 section of the Project and Property Acquisitions.

Figure 11. Location B - Te Tuhi Centre for the Arts (left), view from Reeves Road/Aylesbury Street intersection looking southwest; imagery from Google Maps Street View, image taken December 2019.

Figure 12. Location D - St Kentigern College grounds (park, and chapel (right)), view from intersection of Pakuranga Road and William Roberts Road looking north; imagery from Google Maps Street View, image taken August 2020.

Figure 13. Location E - Aylesbury Street mall within Pakuranga Plaza complex; imagery from Google Maps Street View, image taken September 2018.

Figure 14. Location F1 - southwest face of Pakuranga Plaza, from Ti Rakau Drive/Aylesbury Street intersection looking northeast; imagery from Google Maps Street View, image taken September 2018.

Figure 15. Location F2 - northeast face of Pakuranga Plaza, from Pennell Place carpark looking southwest; imagery from Google Maps Street View, image taken November 2015.

6.1.1.2 Dust Risk Index

Table 6 details the calculation of the DRI for EB2, for the receiving environments annotated A, B, C and E[1] described in Section 6.1.1.1 as well as for the generic receiving environment at other locations near the construction areas for EB2.

The DRI calculation is conservative – i.e., higher than likely to eventuate. Notwithstanding, the DRI calculated for receiving environments annotated A and C is greater than 200, indicating a high risk of offensive or objectionable dust nuisance (from Table 4). Diligent attention to mitigation and monitoring will be required in these locations to avoid significant offensive or objectionable dust impacts. At locations B and "generic", the DRI is less than 200 indicating a medium risk of offensive or objectionable dust. At location E, the dust risk is rated as low because the DRI is lower than 100.

Mitigation and monitoring methods for dust emission control during construction of EB2 will be included in the ESCP. This is discussed further in Section 7. The ESCP will include requirements for:

- Dust control measures to maximise the mitigation of dust emissions
- Monitoring, including both visual and instrumental monitoring methods
- Adaptive management and proactive management to modify activities and mitigation measures based on forecasted wind conditions and in response to feedback from monitoring.

[1] As described in Section 6.1.1.1, the locations annotated D, F1 and F2 are not considered to be sensitive receiving environments, and therefore are not included as specified locations in the DRI table.

Table 6 Calculation of DRI for EB2 (see Guide AAQISHP for definition and range of values to select).

Factor	Commentary	Value selected at specified location				
		A	**B**	**C**	**E**	**All other (generic)***
Surface exposure (E)	Only a small portion of the EB2 surface will be upwind of any sensitive receptor. Therefore, a value of 1 is appropriate in most circumstances. A value of 5 is selected for location A, given the larger scale of construction around Abutment A.	5	1	1	1	1
Exposure period (P)	The overall construction duration is more than 1 year, however with the exception of location A individual sensitive receptors will be close to exposed areas and active construction zones for much shorter periods.	20	10	10	10	10
Time of year (T)	The construction activities could occur at any time of year.	10	10	10	10	10
Wind speed (WS)	The area is not especially exposed, due to the extent of urban development and mature trees. Therefore, a factor of 50 is considered to be appropriate, but probably conservative (i.e., high).	50	50	50	50	50
Distance to the nearest receiver (D)	Sensitive receivers are typically less than 50m from the work areas, so a value of 100 is appropriate except where shown.	100	100	100	50**	100
Construction activity (A)	Construction activities will vary over the course of the construction period and at different locations. The construction activities anticipated in working areas downwind of the sensitive receptors under prevailing southwesterly winds has been used to select the activity factor.	100	50	100	20	50
Mitigation (M)	It is assumed that mitigation will control between 50-90% of the dust, and therefore a value of 0.8 is appropriate.	0.8	0.8	0.8	0.8	0.8
Wind direction (WD)	Sensitive receptors may be downwind of the construction area under prevailing wind conditions.	1	1	1	1	1
Calculated DRI	DRI = (E+P+T+WS+D+A) × M × WD	228	176.8	216.8	80.8	72.8

* Worst case assessment for all other potentially sensitive locations around the EB2 construction areas.

** This value has been downgraded due to the retail outlets being considered less sensitive to dust than residential land uses.

6.1.1.3 Potential for Residual Impacts

The implementation of the ESCP and adaptive management of mitigation measures in response to monitoring outcomes will reduce the risk of dust emissions as recommended in the Guide AAQISHP. With reference to Table 3, any residual impacts arising as a result of dust emissions from the construction of EB2 are considered to be low.

6.1.2 EB3R

6.1.2.1 Sensitivity of Neighbouring Properties

EB3R is essentially a road-widening section and the risk of dust emissions from construction activities is consistent along the length of the EB3R alignment. The extent of EB3R and the required property acquisitions are shown in Figure 16. Acquired properties are shown because these properties are not considered as sensitive receivers for dust emissions during the construction works of EB3R.

Residential properties are located along the length of the alignment, generally in a northeast or southwest direction from the proposed works area. Wind directions are prevalent primarily from the southwest and secondly from the northeast. These wind directions have the potential to disperse dust emitted from the work sites towards the houses on either side of Ti Rakau Drive. However, the orientation of Ti Rakau Drive minimises the quantity of dust that may be dispersed towards any one sensitive receiver, because the alignment runs perpendicular to the prevailing wind directions therefore exposing a minimum working area to each sensitive receptor.

Figure 16. EB3R section of the Project and Property Acquisitions.

6.1.2.2 Dust Risk Index

Table 7 details the calculation of the DRI for EB3R. This DRI calculation applies to all sensitive receptors along the EB3R alignment. The calculation is conservative – i.e., higher than likely to eventuate. The calculated DRI is 177, indicating a medium risk of offensive or objectionable dust (from Table 4). However, this rating is likely to overstate the risk for most receptors, due to each receptor only being close to a small cross-section of the overall EB3R alignment (meaning that the frequency and duration factors from the FIDOL factors are much lower for most houses near EB3R, compared to when a receptor is close to a fixed construction location).

Table 7 Calculation of DRI for EB3R (see Guide AAQISHP for definition and range of values to select).

Factor	Commentary	Value selected
Surface exposure (E)	The full area of EB3R surface exposure is potentially up to 7 hectares if the entire temporary occupation area was exposed at the same time. However, only a small portion of this surface will be upwind of any sensitive receptor. Therefore, a value of 1 is appropriate.	1
Exposure period (P)	The construction duration is likely to be more than 1 year, however individual sensitive receptors will be close to exposed areas and active construction zones for much shorter periods. A value of 10 is selected.	10
Time of year (T)	The construction activities could occur at any time of year.	10
Wind speed (WS)	The area is not especially exposed, due to the dense urban development and mature trees. Therefore, a factor of 50 is considered to be appropriate, but probably conservative (i.e., high).	50
Distance to the nearest receiver (D)	Houses are located along Ti Rakau Drive, less than 50m from the work areas.	100
Construction activity (A)	Construction activities will vary over the course of the construction period. The majority of activities would be similar to “pavement construction” and/or “fill shaping and compaction”, and a factor of 50 is considered to be appropriate.	50
Mitigation (M)	It is assumed that mitigation will control between 50-90% of the dust, and therefore a value of 0.8 is appropriate.	0.8
Wind direction (WD)	Sensitive receptors may be downwind of the construction area under prevailing wind conditions.	1
Calculated DRI	DRI = (E+P+T+WS+D+A) × M × WD	177

Mitigation and monitoring methods for dust emission control during construction of EB3R will be included in the ESCP. This is discussed further in Section 7. The ESCP will include requirements for:

- Dust control measures to maximise the mitigation of dust emissions
- Monitoring, including both visual and instrumental monitoring methods
- Adaptive management and proactive management to modify activities and mitigation measures based on forecasted wind conditions and in response to feedback from monitoring.

6.1.2.3 Potential for Residual Impacts

The implementation of the ESCP and adaptive management of mitigation measures in response to monitoring outcomes will reduce the risk of dust emissions as recommended in the Guide AAQISHP. With reference to Table 3, any residual impacts arising as a result of dust emissions from the construction of EB3R are considered to be low.

6.1.3 Cumulative Effects

The potential for cumulative effects related to construction dust emissions is expected to be low. Whilst emissions from both EB2 and EB3R may occur at the same time, the two parts of the Project are not both downwind of sensitive receptors under prevailing (southwesterly or northeasterly) wind conditions. In addition, there are no other known significant background sources of dust emissions nearby.

Therefore, no change to the DRI or the FIDOL factors for sensitive receptors occurs when both parts of the Project are considered cumulatively with each other and with background dust sources.

6.1.4 Non-Dust Air Quality Impacts during Construction

The operation of trucks and heavy machinery during construction activities, and the use of mobile generators for power supply where needed, discharges products of diesel or fuel oil combustion into the air including NO_x, CO, SO_2 and PM_{10} and $PM_{2.5}$.

There are no confined spaces where this machinery will operate over the Project, and for vehicles and mobile plant operating at the surface any emissions of products of combustion will disperse rapidly once discharged into the air. The Project-related emissions of these contaminants in a regional context is negligible compared with the day-to-day Auckland vehicle fleet using roads around the Project, and no specific assessment of potential impacts from emissions of combustion-derived pollutants is necessary.

6.2 Operation

6.2.1 EB2

6.2.1.1 Traffic Volumes

Current and projected opening year traffic volumes on the roads comprising EB2 were provided by the Project's traffic engineers and are summarised in Table 8. The table provides traffic volume estimates expressed as annual average daily traffic (AADT – vehicles per day averaged over a year) for three scenarios:

- Current situation
- Opening Year (2028) Do Minimum – assumes the Project does not proceed
- Opening Year (2028) With Project – the Project is implemented.

At opening year, AADT with Project is 19% less than the current situation, and 17% less than under the Do Minimum scenario. The AADT under the Do Minimum scenario is also less at opening year than the current situation, but only by 2%.

Table 8 Comparison of AADT for current situation and 2028 Do Minimum and With Project scenarios – EB2

EB2 Link		Combined Eastbound and Westbound AADT*		
Start of section	**End of section**	**Current situation**	**Do Minimum (without Project) Opening Year 2028**	**With Project Opening Year 2028**
Pakuranga Rd	Aylesbury	34,200	38,150	20,095
Aylesbury	Reeves Rd	36,800	38,669	22,372
Reeves Rd	Tiraumea Dr	36,800	34,604	39,770
Tiraumea Dr	William Roberts Extension	40,100	33,873	38,257
Totals		147,900	145,296	120,494
Percentage of current situation			98%	81%
Percentage of Opening Year Do Minimum				83%

* AADT – annual average daily traffic (vehicles per day averaged over a year)

6.2.1.2 Vehicle emissions

New Zealand's database of vehicle emissions is the Auckland Council and Waka Kotahi Vehicle Emission Prediction Model (VEPM). The VEPM is updated regularly in response to changes to vehicle emission standards and testing data, the composition and age of the New Zealand vehicle fleet, changes to vehicle emission reduction usage such as catalytic converters, and government policy changes. The latest version of VEPM, version 6.3, was released in early 2022 (Metcalfe J & Peeters S, 2022).

In each update to the VEPM, the emission factors fluctuate slightly, either increasing or decreasing from version to version. Consistently, the VEPM forecasts large reductions in vehicle emission factors from current year until 2050 which would offset increases in traffic flows. This reduction in vehicle emissions is likely to be even larger when the government's new policy for electric vehicle usage is incorporated into the model.

The VEPM can also be used to test the likely changes in vehicle emissions for modifications in road design that result in changes to average vehicle speeds. Vehicles emit more pollutants per kilometre of travel at lower speeds than at higher speeds. This is exacerbated in congested conditions when travel is stop-start. Table 9 illustrates the improvements in pollutant emissions forecast by VEPM for 2028 for average speeds of 20-50 kilometres per hour. Increasing average vehicle speeds results in lower emissions of pollutants to air in the vehicle exhaust, as well as lower emissions of fine particles from brake and tyre wear, lower fuel consumption rates, and lower rates of emission of carbon dioxide.

Modelling of detailed emission rates for the Do Minimum and Project scenarios is beyond the scope of a qualitative assessment. Notwithstanding, it is apparent that any modification to road design that reduces congestion and increases average vehicle travel speeds, such as would be achieved by the Project, will result in a reduction in the discharge of air pollutants from vehicles.

Table 9 Comparison of fleet weighted emission factors for vehicle operation as a function of average vehicle speed - forecast from VEPM 6.3 for 2028

Average speed, kilometres per hour	Pollutants in vehicle exhaust, grams per kilometre Year - 2028						Fuel consumption, litres per kilometre	PM_{10}* from brake and tyre wear, grams per kilometre
	CO*	VOC*	NO_x*	NO_2*	CO_2*	$PM_{2.5}$*		
20	0.78	0.044	0.90	0.16	323	0.022	13.1	0.028
30	0.64	0.034	0.70	0.13	266	0.017	10.8	0.028
40	0.64	0.031	0.58	0.12	235	0.014	9.5	0.028
50	0.62	0.028	0.51	0.11	216	0.013	8.8	0.025

* CO – carbon monoxide

CO_2 – carbon dioxide

NO_x – nitrogen oxides

NO_2 – nitrogen dioxide

VOC – volatile organic compounds

$PM_{2.5}$ – particulate matter with aerodynamic diameter less than 2.5 microns

PM_{10} - particulate matter with aerodynamic diameter less than 10 microns

It is also noted that VEPM forecasts significant reductions in vehicle emissions per km travelled in future, even without yet factoring in likely increases in proportion of EV in the Auckland fleet in the future due to recent government policy announcements – VEPM version 6.3 assumes fleet electric vehicle composition of 2% for cars, 0.22% for light commercial vehicles, 0.02% for heavy commercial vehicles, and 0.05% for buses. This means with the passing of time, vehicle emissions from traffic using EB2 will continue to reduce even more than currently predicted by VEPM.

6.2.1.3 Background air quality and cumulative impacts

Vehicle emissions throughout Auckland are a significant contribution to ambient air quality in the Auckland region (Auckland Council, 2019). As a consequence of the reduction in vehicle emissions predicted by VEPM, air quality in the Auckland region is likely to gradually improve over the coming decades. This means that background air quality experienced by sensitive receptors close to EB2 will also gradually improve, meaning that cumulative impacts of EB2 will also reduce over time.

6.2.1.4 Discussion and Conclusion

With both traffic volumes and congestion reducing due to the implementation of the Project, it is concluded that implementing the EB2 section of the Project will result in lower rates of emissions of vehicle exhaust pollutants into air than with the “Do Minimum” option – imparting a beneficial impact to both local and regional air quality.

6.2.2 EB3R

6.2.2.1 Traffic Volumes

Current and projected opening year traffic volumes on the roads comprising EB3R were provided by the Project's traffic engineers and are summarised in Table 8 for the same scenarios as introduced above for EB2.

At opening year, the forecast AADT with Project for EB3R is higher than under the Do Minimum scenario, due to higher commuter use of Ti Rakau Drive following the modifications in road design. However, the forecast AADT with Project for EB3R is slightly less than under the current situation, and average vehicle speeds are anticipated to be higher with Project than in the current situation.

Table 10 Comparison of AADT for current situation and 2028 Do Minimum and With Project scenarios – EB3

EB3R Link		Combined Eastbound and Westbound AADT*		
Start of section	End of section	Current situation	Do Minimum (without Project) Opening Year 2028	With Project Opening Year 2028
Mattson Rd / WRR ext	Marriot Rd	39,000	33,528	38,018
Marriot Rd	Edgewater Dr West	37,900	34,175	39,205
Edgewater Dr West	Edgewater Dr East	37,300	32,556	36,488
Edgewater Dr East	Gossamer Dr	37,700	31,924	36,470
Totals		151,900	132,183	150,181
Percentage of current situation			87%	99%
Percentage of Opening Year Do Minimum				114%

* AADT – annual average daily traffic (vehicles per day averaged over a year)

6.2.2.2 Vehicle emissions and background air quality

The discussion of vehicle emissions and background air quality for EB3R is the same as that provided for EB2 in Sections 6.2.1.2 and 6.2.1.3 above. In addition, due to the projected traffic volumes with Project in 2028 being only slightly lower than the current situation, it is relevant to compare the VEPM fleet-weighted emission factors for 2022 versus 2028. The 2022 emission factors from VEPM are shown in Table 11, and should be compared with the data for 2028 provided above in Table 9. The comparison is also shown visually in Figure 17. It is clear that substantial reductions in average pollutant emissions per vehicle are anticipated between now and 2028.

Table 11 Comparison of fleet weighted emission factors for vehicle operation as a function of average vehicle speed - forecast from VEPM 6.3 for 2022

Average speed, kilometres per hour	Pollutants in vehicle exhaust, grams per kilometre Year - 2022						Fuel consumption, litres per kilometre	PM_{10}* from brake and tyre wear, grams per kilometre
	CO*	VOC*	NO_x*	NO_2*	CO_2*	$PM_{2.5}$*		
20	1.53	0.125	1.01	0.17	347	0.022	14.1	0.036
30	1.21	0.096	0.80	0.14	285	0.017	11.6	0.029
40	1.17	0.082	0.68	0.12	250	0.014	10.1	0.024
50	1.11	0.071	0.60	0.11	229	0.013	9.3	0.021

* CO – carbon monoxide

CO_2 – carbon dioxide

NO_x – nitrogen oxides

NO_2 – nitrogen dioxide

VOC – volatile organic compounds

$PM_{2.5}$ – particulate matter with aerodynamic diameter less than 2.5 microns

PM_{10} - particulate matter with aerodynamic diameter less than 10 microns

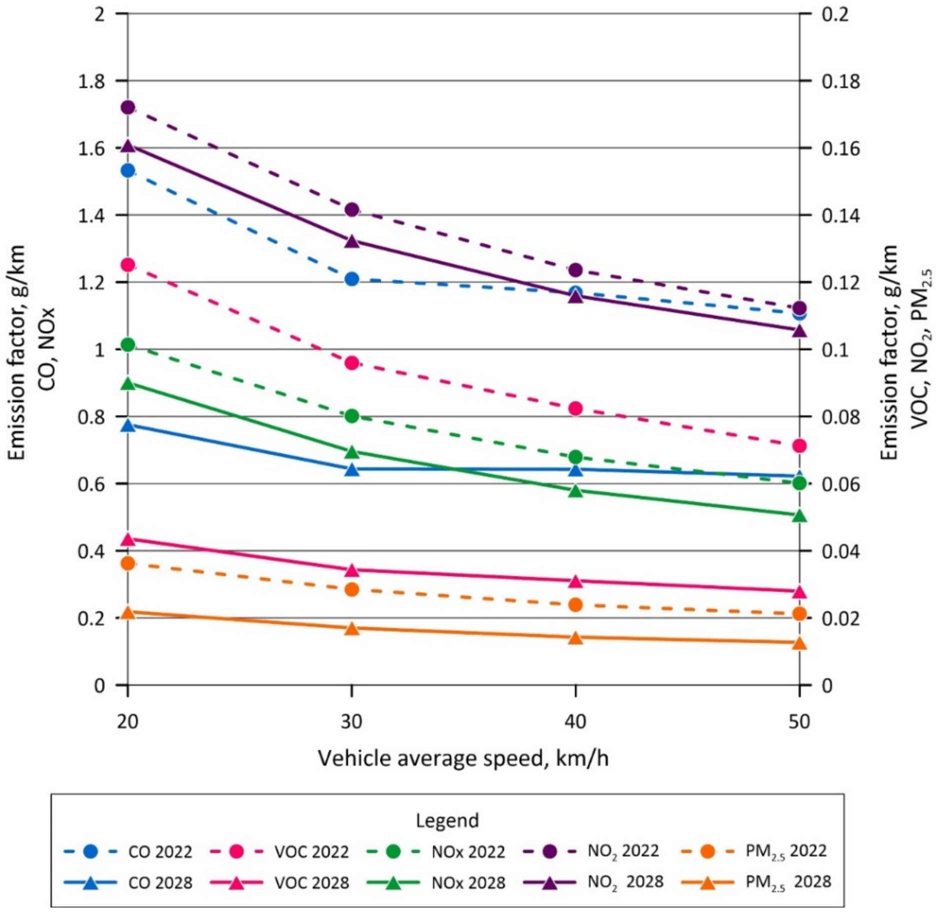

Figure 17. Comparison of VEPM version 6.3 fleet-weighted emission factors for vehicle exhaust pollutants, showing data for both 2022 and 2028 forecasts as a function of average vehicle speed.

6.2.2.3 Discussion and Conclusion

Traffic volumes across EB3R at the Project opening year 2028 are forecast to be slightly lower than in the current situation. However, when the reductions in fleet-weighted emission factors between now and 2028 are factored in, along with the reduction in congestion due to the implementation of the Project, it is concluded that emissions of vehicle exhaust pollutants into air over the EB3R section of the Project will be lower than under the current situation. Therefore, operation of the EB3R section of the Project is considered to have a beneficial impact to both local and regional air quality.

7 Mitigation

Chapter Summary
• *The ESCP for the project will set out measures to minimise, so far as reasonably practicable, impacts on air quality due to dust emissions during construction* • *Monitoring for dust outside the construction site boundaries will comprise a combination of visual observations, stakeholder communications, and instrumental monitoring* • *Real-time instrumental monitoring is recommended only where the risk of dust nuisance has been assessed as "high". The only location where such monitoring of ambient dust concentrations is recommended is for EB2 in the proximity of the location annotated "A" on Figure 10 (Dale Crescent)* • *The Contractor(s) responsible for construction of EB2 and EB3R will adopt an adaptive management approach to dust mitigation. If monitoring triggers are exceeded, potential causes of the dust emissions will be identified, and additional control measure implemented to reduce the level of dust emissions* • *The Contractor(s) will also adopt a proactive management approach comprising daily and weekly review of planned activities and forecasted environmental conditions to identify whether any particular construction activities planned need to be rescheduled or monitored more closely than usual, or whether additional mitigation controls are required to proactively address potential risks of impacts from dust* • *No mitigation measures are required for the operational phase of the Project.*

7.1 Good Practice Guidance for Construction Dust Management

7.1.1 Good Practice Guide for Assessing and Managing Dust

Section 5 of the GPG Dust outlines good practice management and control of dust emissions. The following management and control practices that are potentially relevant to the construction of this Project are recommended in the GPG Dust:

- Site planning
  - Location of dust sources within the site and their orientation in relation to prevailing winds and sensitivity of the downwind receptors
  - Presence of separation distances to the site boundary and to sensitive land uses
  - Need for screening, such as by shelter belts, earth bunds or natural topography.
- Site design
  - Raw materials
  - Flow of materials and vehicles through the site
- Operating procedures
  - Implement a preventative maintenance programme to minimise equipment failure and unplanned downtime
  - Take dust management seriously – educate staff about the importance of regulatory compliance and good management for achieving compliance
  - Have a regime of good housekeeping
  - Conduct dusty operations during weather conditions that minimise emissions wherever possible, particularly where no other mitigation option is available (e.g., avoid windy dry weather days for ground stripping)
  - Procedures and the effects that they mitigate should be clearly described in a site/dust/construction management plan for the site; staff responsible for implementing the management plan should be clearly identified

- Dust emissions from paved surfaces
    - Controlling the movement and handling of fine materials to prevent spillages onto paved surfaces
    - Minimising mud and dust track-out onto paved surfaces from unpaved areas by using rumble strips or wheel and vehicle wash facilities
    - Regularly cleaning paved surfaces, using a mobile vacuum sweeper or a water flushing system
    - Controls on vehicle movements
        - Speed limits
        - Limit loads to minimise spillages
        - Cover dusty loads or used enclosed bins
    - Wind reduction controls
- Non-paved surfaces (including unsealed roads)
    - All of the measures listed above for paved surfaces
    - Wet suppression during dry windy periods, using a water cart and/or fixed sprinklers
    - Use of chemicals to enhance crusting in conjunction with wet suppression
    - Re-vegetation of exposed surfaces that are to be left undisturbed for sufficient periods of time, e.g., Hydro-seeding or use of geotextiles
    - Surface improvements, such as paving or laying low-silt aggregate
    - Controls on vehicle movements as above, plus minimise travel distances onsite through site layout design.
- Stockpiles and material handling
    - Wet suppression using sprinklers
    - Grass and/or chemical suppressants for inactive stockpiles
    - Covered storage of fine material
    - Limiting the height and slope of the stockpiles to reduce wind entrainment. Take advantage of other site features (e.g., noise bunds) to enhance sheltering
    - Limiting drop heights from conveyors, loaders or other equipment transferring material to and from stockpiles
    - Wind breaks
        - Wind speed near the pile surface is the primary factor affecting particle uptake from stockpiles
        - Windbreaks (horticultural cloth supported on poles, or planted trees) are almost as effective as a solid wall in reducing wind speeds, when constructed to the following specifications:
            - height equal or greater than the pile height
            - length equal to the pile length at the base
            - located at a distance of one pile height from the base of the pile.

- Bunding (e.g. concrete bunding) can be very effective in controlling dust from stockpiles provided that the bunds are located facing away from the prevailing wind direction and that the bund walls are at least one third higher than the maximum height of the stockpile.

7.1.2 Transport Agency Guide to Assessing Air Quality Impacts from State Highway Projects

While the Project is not a state highway project, the potential for air emissions during construction is similar. Therefore, the performance criteria and assessment methods recommended in the Guide AAQISHP for construction dust are considered to be relevant.

The Guide AAQISHP states that options for managing construction effects generally involve minimising emissions from earthworks, unpaved surfaces, paved surfaces, vehicles travelling in, to and from the construction area, and material stockpiles. Options suggested are similar to those listed above from the GPG Dust, and include:

- Wet suppression of unpaved areas using water carts or sprinklers
- Limiting vehicle speeds using unpaved surfaces, e.g., to 15 km/h
- Controlling the use of local roads by construction vehicles
- Covering loads and storage areas with tarpaulins or enclosures
- Locating storage areas away from sensitive areas or using water sprays to control dust
- Minimising travel distances
- Using wheel and truck wash facilities at site exits
- Installing wind break fencing at appropriate locations.

7.2 Construction

7.2.1 Dust Management

The ESCP for EB2 and EB3R will set out measures to minimise, so far as reasonably practicable, impacts on air quality due to dust emissions during construction. In addition to the management measures, the ESCP will detail stakeholder communication requirements, monitoring methods and actions that arise from the results of analysing that information.

The GPG Dust includes advice for information to be included when addressing dust management during construction. Items recommended to be included in the ESCP are:

- Key personnel and contact addresses/numbers
- Complaints contact persons and response protocols
- Process description and method of operation
- Methods of mitigation and operating procedures, including maintenance and contingency
- Monitoring, including methods and record keeping
- Staff training
- System review and reporting procedures.

The ESCP would be dynamic in nature and the methods detailed in the plan would be an ongoing management tool. The ESCP would be subject to regular revision and update as required in response to audits, technology improvements, incidents, changes in legal requirements and new data or information obtained through monitoring activities to ensure that all reasonably practicable construction air quality monitoring and management measures are being implemented throughout the works.

The ESCP should:

- Identify the main sources of dust, and the location of sensitive receptors
- Set out how the project would control the emission of dust into the atmosphere during construction utilising the good practice measures outlined in the GPG Dust, the Guide AAQISHP, and any other relevant guidance
- Include a monitoring plan that outlines:
  - Monitoring methods and actions that arise from the results of analysing that information (as per Sections 7.2.2 and 7.2.3).
  - Environmental performance indicators for each type of monitoring and the triggers that enable responsive and timely intervention and modification of site activities in response to elevated air quality measurements, or adverse meteorological and environmental conditions when required
  - Procedures to be followed after trigger alerts are activated, to enable responsive and timely intervention and mitigation
- Describe processes for identifying opportunities for continual improvement in management of air quality impacts from construction
- Describe a process for daily and weekly check-list style review of planned activities and forecasted environmental conditions at the start of each day and week, to identify whether any particular planned construction activities need to be rescheduled or whether additional mitigation controls are required (such as additional watering of dry surfaces).

7.2.2 Monitoring

7.2.2.1 Summary of Monitoring Methods

Monitoring for dust outside the construction site boundaries will comprise a combination of visual observations, stakeholder communications, and instrumental monitoring.

The monitoring methods will include:

- Targeted community monitoring, such as regular visits with nearby sensitive receptors and company hot lines for community members to report dust impacts which would trigger investigations and timely corrective actions onsite
- Visual monitoring, such as (but not limited to):
  - Checking internal and external access road surfaces for tracked dust that requires cleaning
  - Checking effectiveness and maintenance of truck rumble grids and wheel wash
  - Checking integrity of shelter fences
  - Inspecting surfaces outside the site boundary near sensitive receptors for signs of dust deposition
  - Observations of visible dust suspended in air carrying beyond site boundary
  - Closed-circuit television (CCTV) monitoring of boundaries and/or dust sources.

- Real-time instrumental monitoring (see Section 7.2.2.2).

This monitoring would serve several purposes including:

- Provide early notice of potential issues (early in the construction phase before earthworks reach full scale) so they could be investigated and mitigated before they become actual impacts
- Inform the contractor of ongoing issues that initiate investigation and implementation of any additional mitigation measures – as per Section 7.2.3
- Provide a real-time alert in the case of monitoring data exceeding trigger levels
- When combined with wind monitoring data, provide supporting information to diagnose the cause of dust emissions.

Real-time instrumental monitoring is recommended only where the risk of dust nuisance has been assessed as “high”, and such monitoring of ambient dust concentrations is recommended for EB2 in the proximity of the location annotated “A” on Figure 10. This location is representative of the highest risk for off-site dust nuisance within EB2. Sensitive receptors near EB3R are assessed to have a medium risk DRI, and instrumental monitoring is not considered necessary (although visual and community feedback monitoring will still be conducted). Instrument monitoring will only be required while construction of the western Abutment of the RRF is carried out, however a period of monitoring during the preceding summer would be beneficial to measure background air quality if practicable.

7.2.2.2 Real-Time Instrumental Monitoring

The risk of amenity impacts from settling dust has traditionally been assessed by measuring deposited dust and using dust deposition criteria expressed as the mass of dust settling over unit area over a period of 30 days. However, problems with using monthly-averaged criteria for dust deposition are widely recognised. These traditional dust deposition measurement methods require a long averaging period of a month so that experimental error in the test data is minimised; and no reliable dust deposition measurement methods are available for shorter term measurements. Whilst assessment of dust deposition against the monthly average criteria provides evidence of long term trends in dust deposition, the data is available too slowly to be used as a real time proactive management tool. In addition, dust deposition can cause amenity impacts over much shorter timeframes than a month, even over a matter of hours, during events when elevated levels of TSP are emitted (such as high wind speeds).

These issues with deposition monitoring are recognised in the Dust GPG. The Dust GPG recommends that where instrumental monitoring is warranted due to dust nuisance risk, either TSP or PM_{10} can be monitored, and trigger limits are recommended as shown in Table 12. Due to the presence of background PM_{10} from the existing traffic and local airshed, monitoring for TSP is more appropriate than PM_{10} for the Project.

The Dust GPG notes the following points in relation to the recommendations for instrumental monitoring and trigger limits:

- These triggers are intended to be used for the proactive management of dust on site. They are not intended to be used for enforcement because exceedance of trigger levels does not necessarily infer an adverse effect offsite

- The TSP trigger levels have been successfully used to control dust on Waka Kotahi road construction projects and have also been found effective by regional councils and independent consultants at reducing dust complaints on other sites (e.g., quarries)
- The PM_{10} trigger level is based on international best practice for control of dust from construction and demolition activities
- Swift implementation of dust control measures following the suggested trigger levels being approached or exceeded should also help manage adverse health effects and prevent exceedance of the PM_{10} NES-AQ
- Dust issues are exacerbated under dry, windy conditions, so trigger levels for wind and rain conditions are also provided.

Table 12 Trigger levels for TSP instrumental monitoring for receiving environment of high sensitivity. From GPG Dust Table 4.

Trigger	Averaging Period	Value Recommended
Short term	5 minute	250 µg/m^3
Short term	1 hour	200 µg/m^3
Daily (for managing chronic (i.e., long term) dust only)	24 hours (rolling average)	60 µg/m^3
Wind warning	1 minute	10 m/s (during two consecutive 10-minute periods)
Rain warning	12 hours	No rain in previous 12 hours
Visible dust (measured by operator/site manager observations, and/or CCTV camera).	Instantaneous	Visible dust crossing the boundary

7.2.3 Adaptive Management and Proactive Management

7.2.3.1 Adaptive Management

The Contractor(s) responsible for construction of EB2 and EB3R will adopt an adaptive management approach to dust mitigation. If monitoring triggers are exceeded, potential causes of the dust emissions will be identified, and additional control measures implemented to reduce the level of dust emissions. Examples of specific control measures that could be undertaken for activities that are identified as the source of a trigger include the following:

- Increased use of water to dampen surfaces
- Improved cleaning of hardstand surface around stockpiles, and/or reduce stockpile size
- Relocate sources of dust within the construction site (such as stockpiles), if possible
- Reduce double-handling of spoil and drop-heights
- Increase extent or quality of hardstand surfacing on site, and/or seal hardstand surfaces if not already done
- Further reduce vehicle speeds in areas where wheel-driven dust is an issue – if that cannot be remedied by watering, sweeping, sealing or hardstand surfacing
- Construct additional windbreaks, or make existing windbreaks taller and/or more solid
- Provision to reduce work intensity (or temporarily stop work)
- Modify the type of earthmoving or excavation equipment used if this is found to be a significant source.

7.2.3.2 Proactive Management

The ESCP will document a process for daily and weekly review of planned activities and forecasted environmental conditions to identify whether any particular construction activities planned need to be rescheduled or monitored more closely than usual, or whether additional mitigation controls are required to proactively address potential risks of impacts from dust. Factors that may be considered during this process include:

- Forecasted wind speeds and directions
- Recent and forecasted rain
- Specific upcoming construction activities.

7.3 Operation

The assessment of potential air quality impacts during Project operation indicates that operation of the EB2 and EB3R sections of the Project will have a beneficial impact on air quality. Therefore, no mitigation measures are required within the Project design.

8 Recommendations and Conclusions

8.1 Construction Impacts

The main air quality impact risk associated with construction of EB2 and EB3R is the discharge of dust with associated amenity impacts. The GPG Dust states that effective control of visible dust helps maintain ambient levels of PM_{10} below the NES-AQ levels – in other words, management of the amenity impacts means that the potential health impacts from dust emissions are also managed.

The operation of trucks and heavy machinery during construction activities, and the use of mobile generators for power supply where needed, discharges products of diesel or fuel oil combustion into the air. However, these emissions are negligible in a regional context compared to regular emissions from the Auckland vehicle fleet using roads around the Project, and there are no confined spaces where this machinery will operate meaning that any emissions will disperse rapidly once discharged into the air. Therefore, no assessment of potential impacts from emissions of combustion-derived pollutants is necessary.

Therefore, the focus of the assessment for air quality construction impacts is on avoiding or mitigating potential nuisance and amenity impacts from dust emissions. Without controls, the temporary and localised dust emissions associated with construction of EB2 and EB3R have the potential to impact on local amenity. The ESCP for the project will set out measures to minimise, so far as reasonably practicable, impacts on air quality due to dust emissions during construction. The ESCP will include requirements for:

- Dust control measures to maximise the mitigation of dust emissions
- Monitoring, including both visual and instrumental monitoring methods and relevant triggers
- Adaptive management and proactive management to modify activities and mitigation measures based on forecasted wind conditions and in response to feedback from monitoring.

With these control measures in place, the risk of offensive or objectionable effects arising as a result of dust emissions from the construction of EB2 is considered to be low.

Similarly, the risk of offensive or objectionable effects arising as a result of dust emissions from the construction of EB3R is also considered to be low.

8.2 Operation Impacts

The operation of the EB2 and EB3R sections of the Project will have a beneficial impact on air quality. No mitigation measures are required for the operational phase of the Project.

9 References

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