Sensitivity: General

State Highway 1 - Rolleston Access Improvements

Air Quality Assessment – Package 1

Prepared for New Zealand Transport Agency Waka Kotahi
Prepared by Beca Limited

18 September 2024

Contents

Appendices

Revision History

Revision N°	Prepared By	Description	Date
A	Nicole Rubio, Mathew Noonan	Draft for client review	7 Aug 2024
B	Nicole Rubio, Mathew Noonan	Final for client	27 Aug 2024

Document Acceptance

Action	Name	Signed	Date
Prepared by	Nicole Rubio, Mathew Noonan		27 Aug 2024
Reviewed by	Graeme Jenner		27 Aug 2024
Approved by	David Albridge		18 Sept 2024
on behalf of	Beca Limited		

Glossary of Terms and Abbreviations

AADT	Annual Average Daily Traffic
AAQG	National ambient air quality guidelines
AEE	Assessment of Environmental Effects
CARP	Canterbury Regional Air Plan
CASANZ	Clean Air Society of Australia and New Zealand
CAZ	Clean Air Zone (a designed area defined in the CARP)
CO	Carbon Monoxide
CRC	Canterbury Regional Council
DEP	Dust Emission Potential (GPG Roads)
DMP	Dust Management Plan
FIDOL	Frequency, Intensity, Duration, Offensiveness, Location
GPG Dust	Good Practice Guide for Assessing and Managing Dust (2016)
GPG Industry	Good Practice Guide for Assessing Discharge to Air from Industry (2016)
GPG Roads	Good Practice Guide for the Assessment and Management of Air Pollution from Road Transport Projects (2023)
Lincoln EWS	Lincoln Broadfield electronic weather station
$\mu g/m^3$	Micrograms per cubic metre
µm	Micrometers
MfE	Ministry for the Environment
mg/m^3	Milligrams per cubic metre
NESAQ	National Environmental Standards for Air Quality
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOR	Notice of Requirement
NOx	Nitrogen oxides ($NO + NO_2$)
NZTA	New Zealand Transport Agency Waka Kotahi
Old Dunns Crossing Rd	Refers to the existing end of Dunns Crossing Rd which will be made into a cul-de-sac
PM_{10}	Particulate matter with an aerodynamic diameter of no more than 10 micrometres
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of no more than 2.5 micrometres
SDC	Selwyn District Council
SDP	Selwyn District Plan
SH1	State Highway 1
SO_2	Sulphur dioxide
the Project	the Rolleston Access Improvement Project
TSP	Total Suspended Particulate
VEPM	Vehicle Emission Prediction Model
VOC	Volatile organic compounds

Executive Summary

Overview

This Report has been prepared by Beca Limited (Beca) to inform the Assessment of Effects on the Environment (AEE) for one Notice of Requirement (NoR 1) being sought by New Zealand Transport Agency Waka Kotahi (NZTA).

The Project proposes to construct a roundabout at Dunns Crossing and Walkers Road intersection and associated works to provide roading upgrades that are necessary to respond to both existing transport deficiencies as well as provide for the forecasted future growth pressures in the area. This Report will specifically consider the actual and potential effects of the Project at the Pre-implementation and Implementation phases of this project as it related to air quality effects and recommendations to mitigate effects.

This report should be read alongside the AEE, which contains further details on the history and context of the Project. The AEE also contains a detailed description of works to be authorised within NoR, and the typical construction methodologies that will be used to implement this work. These have been reviewed by the author of this Report and have been considered as part of this assessment of air quality effects. Where a description of an activity is necessary to understand the potential effects, it has been included in this report for clarity.

Discharges to air will occur during construction of these packages, as well as the operation of the completed work. These discharges can have potential health and amenity effects. The existing residential dwellings located adjacent to the proposed upgrading work are the sensitive receptors that will potentially be most impacted. The closest dwellings will be 10m from the proposed works. Air quality at these receptors is currently impacted by vehicle emissions from existing road traffic.

Construction Discharges to Air

The primary discharge to air during construction is dust (particulate matter). The emitted dust has the potential to have adverse nuisance effects at the adjacent residential properties. The risk of dust nuisance effects being experienced at these properties, when no dust mitigation is implemented, is assessed as being low to medium (based on the CASANZ[1] classification of dust risk for motorway projects).

The risk of an amenity effect decreases with increasing separation distance. At distance of 50m or more the risk is expected to be low.

Potential adverse dust effects can be minimised by implementing standard dust control procedures such as watering. Provided these procedures are maintained any discharges during construction would not be expected to have an offensive or objectionable effect.

It is recommended that dust control procedures in both the Package 1 and Package 2 project area are implemented through the Dust Management Plan (DMP). The DMP should be compliant with Schedule 2 of the CARP and consistent with guidance provided by the MfE GPG Dust.

[1] CASANZ, 2023. *The Good Practice Guide for the Assessment and Management of Air Pollution from Road Transport Projects*.

Operational Discharges to Air

During operation of the new roundabout and flyover, the primary discharges to air will likely be vehicle emissions. The contaminants of most concern are PM_{10}, $PM_{2.5}$, and NO_2. The impact of these discharges to air has been assessed using atmospheric dispersion modelling methods.

The AERMOD dispersion model has been used to predicted maximum ground contaminant concentration. Ground level concentrations have been predicted for the 2028 'with project' traffic scenario (assuming the project is completed) and the 2028 for the 'do minimum' traffic scenario. The potential impact has been assessed by comparing predicted cumulative contaminant concentrations against relevant air quality criteria, including the NESAQ and AAQG.

The modelling results show that ambient air contaminant concentrations are unlikely to exceed the relevant air quality concentration criteria limits at any existing sensitive receptor in the Package 1 project area.

Vehicle emission rates are predicted to decrease over time as the emission performance of the national vehicle fleet improves, including the move to electric powered vehicles. Therefore, the contribution from vehicle emissions to ambient air contaminant concentrations in the Package 1 project area are also expected to decrease over time, as the emission performance of vehicle fleet improves, even though some increase in traffic volumes is predicted.

The potential air quality effects of the project are predicted to be comparable to those associated with the 'do minimum' traffic scenarios.

Overall, the results indicate that vehicle emissions from the project would not have an adverse health or environmental effect.

1 Introduction

1.1 Overview

Rolleston is one of the fast-growing townships in New Zealand. Consequently, the township is experiencing transportation pressures. The State Highway 1 (**SH1**) Rolleston Access Improvement Project (the '**Project**') is intended to improve safety at the highway intersection and connectivity of the community. For the purposes of programming, the Project is split into two packages of work, namely Package 1 and Package 2.

The New Zealand Transport Agency Waka Kotahi (**NZTA**) has commissioned Beca Limited (**Beca**) to undertake a technical assessment of the air quality impacts of the emissions from the Project.

1.2 Scope of This Report

This technical air quality assessment forms part of the Assessment of Effects (AEE) prepared in support of the Notice of Requirement (NoR) and resource consent applications for Package 1 of the Project. The assessment considers the following:

- **Construction effects:** Discharges to air during the construction of the project, and
- **Operational effects**: Discharges to air from vehicles using the upgraded road system.

Specifically, this report includes the following:

- A brief description of the proposed Package 1 developments
- A description of the nature of discharges to air during the construction and operation phases
- An assessment of the existing environment in terms of potential influences of the emissions to air from the site
- A summary of the relevant air quality criteria limits
- A description of the assessment method
- An assessment of potential effects of discharges to air during construction
- An assessment of potential effects of discharges to air during operation
- A summary of conclusions and recommendations.

1.3 Reference Documents

The assessment has been undertaken with reference to the following documents:

- *Good Practice Guide for Assessing and Managing Dust* (**GPG Dust)**. Published by Ministry for the Environment (**MfE**), 2016.
- *Good Practice Guide for Assessing Discharge to Air from Industry* (**GPG Industry**). Published by Ministry for the Environment (MfE), 2016.
- *The Good Practice Guide for the Assessment and Management of Air Pollution from Road Transport Projects* (**GPG Road**). Published by the Clean Air Society of Australia and New Zealand (**CASANZ**), 2023.
- *Guide to assessing air quality impacts from state highway projects*. Published by NZTA, 2019.

1.4 Limitations

This report has been prepared by Beca for the NZTA. Beca has relied upon the information provided by NZTA in completing this document. Unless otherwise stated, Beca has not sought to independently verify this information as provided. This report is therefore based upon the accuracy and completeness of the information provided and Beca cannot be held responsible for any misrepresentations, incompleteness, or inaccuracies provided within that information. Should any new or additional information become available, this report will need to be reviewed accordingly.

2 Project Description

2.1 Overview of the Project

The SH1 Rolleston Access Improvements is one of the transport networks to have been recognized through New Zealand's Upgrade Programme (NZUP) and is intended to respond to both existing transport deficiencies as well as provide for the forecasted future growth pressures in the area.

The project includes a number of safety improvements to intersections along SH1 through Rolleston to reduce deaths and serious injuries and better manage the forecast future growth in traffic volumes. The wider Project includes two packages:

- Package 1 - SH1 / Dunns Crossing Road Roundabout and associated works.
- Package 2 - Overpass and balance of the works.

For the purposes of this Report, Package 1 will be discussed. Package 1 involves the construction of a roundabout and associated works to support the safe transport movement along SH1, Dunns Crossing and Walkers Roads. The associated works includes the closure of Dunns Crossing Road to SH1 and provision of a new cycle/pedestrian subway. The subway will provide for a safe crossing of the State Highway at the Walkers Road / Dunns Crossing Road roundabout. The subway connects the proposed Burnham Cycleway (along Runners Road) with the Rolleston residential area and a walking and cycling connection to the expanding industrial area and shared use paths along Walkers Road and Two Chain Road.

An overview of the Package 1 alignment is shown in **Figure 2-1**. Detailed design drawings of the proposal have been submitted in support of the Assessment of Environmental Effects (**AEE**). This assessment of air quality effects has been based on the alignment shown in the detailed concept design.

Figure 2-1. Overview of the Package 1 alignment (Source: NZTA)

3 Discharges to Air

3.1 Construction Discharges to Air

3.1.1 Overview

The main discharge to air during construction will be particulate matter in the form of dust. However, products of combustion, such as sulphur dioxide (SO_2), NOx and CO, will also be discharged in the emissions from the operation of machinery and vehicles.

3.1.2 Nature of dust

Dust emissions can have both human health and amenity nuisance effects. The potential effect of dust is closely related to the particle size distribution.

The dust generated from the project construction activities would be predominantly made up of coarser size fractions (> 50 µm in diameter). These larger particles have the potential to create a nuisance effect due to soiling of surfaces (e.g. car bonnets, windowsills and washing).

A small proportion of the emitted dust would be in the form of PM_{10} and to a less extent $PM_{2.5}$ [2] which can be inhaled into the lungs. However, emissions of PM_{10} and $PM_{2.5}$ are expected to be low and unlikely to exceed any of the relevant air quality criteria concentrations at any of the nearby dwellings.

Given the above, the effects of dust emissions associated with the construction activities are likely to be limited to amenity and nuisance effects. Provided that dust mitigation measures are implemented and are subsequently effective, emissions of PM_{10} and $PM_{2.5}$ are expected to be at an acceptable level such that adverse effects are minimal.

3.1.3 Sources of dust emissions

There are several potential sources of dust (particulate) discharges during construction. These include the following:

- Excavation works
- Site grading
- Slope stabilisation works
- Wind erosion of material stockpiles
- Loading and unloading materials
- Cutting and removal of paving
- Vehicle movements on unsealed surfaces
- Dust generated by the wind from dry exposed surfaces.

The primary source of dust during construction is expected to be associated with exposed surfaces during earthwork and stockpiles.

3.1.4 Factors which Influence Dust Generation

The major factors that influence dust emissions from construction activities are:

- Wind speed across the surfaces of exposed soil, excavations, or dusty material stockpiles – the critical wind speed for entrainment of dust from surfaces is 5 m/s; above 10 m/s entrainment increases rapidly.

[2] Watson, J G et al (2000) *Fugitive dust emissions*, In WT David (Ed) Air Pollution Engineering Manual (2nd Ed, pp 117-135) NY John Wiley and Sons.

- The percentage of fine particles (fines[3]) in the material on the surface (such as material with a silt content)
- Moisture content of the material on the surface. Moisture binds particles together preventing them from being disturbed by wind or vehicle movements.
- The area of exposed surfaces. Dust potential increases with area of exposed unconsolidated material.
- Mechanical disturbances such as:
  - traffic movements on unpaved areas
  - excavation and extraction
  - loading and unloading of materials,
  - demolition activities – cutting, drilling, jackhammering, and excavators and bulldozer operations.

The potential for dust increases during dry weather and periods of strong winds (refer Section 7.3.2).

3.1.5 Dust Mitigation

To control the dust from construction activities, the contractor will be required to use recognised standard industry dust mitigation techniques. **Table 3-1** summarises standard dust control procedures that the contractor would be expected to utilise[4, 5, 6].

The dust control procedures will be implemented through a Dust Management Plan (**DMP**) and Erosion and Sediment Control Plan (ESCP).

Table 3-1. Standard dust mitigation measures

Dust Generation Activity	Dust control Measure
Earthworks	• Minimising areas of exposed surfaces (i.e. progressive construction) • Retaining as much vegetation as possible • Stabilising exposed surfaces as soon as practicable (e.g. gravelling) • Planning potentially dusty activities when weather conditions are favourable (wind speed <5 m/s and not blowing towards sensitive receptors) • Using water as a dust suppressant on working areas to keep exposed or disturbed surfaces damp as required • If mitigation methods fail, suspended or modified activities are undertaken in very dry, windy conditions • Compact all unconsolidated surfaces where practical
Stockpiles	• Using water as a dust suppressant on stockpiles to keep exposed or disturbed surfaces damp as required • Covering stockpiles which have a high dust potential • Limiting stockpile heights and slope of stockpiles to reduce wind entrainment • Considering the predominant wind direction when locating stockpiles to reduce the likely impact dust emissions will have on downwind sensitive receptors and maximising separation distances • Minimising stockpiling of dusty material as practicable

[3] Fines are defined as particles with a diameter of less than 75 µm.

[4] *Good Practice Guide for Assessing and Managing Dust* (2016) prepared by the New Zealand Ministry for the Environment

[5] *Guidance on the assessment of dust from demolition and construction* (2014) prepared by Institute of Air Quality Management, London, UK

[6] *The Good Practice Guide for the Assessment and Management of Air Pollution from Road Transport Projects (2023),* CASANZ

Dust Generation Activity	Dust control Measure
Demolition and Construction	• Using water sprays to dampen surfaces • Avoidance of cutting material where possible, and locate these activities away from sensitive receptors • Use of a covered skip when removing dusty material • Use of appropriate dust suppression methods when cutting, grinding, and sawing
Sealed Surfaces	• Regular removal of dust through washing or vacuum sweeping • Clear all spillages on sealed surfaces as soon as practicable
Vehicles, Roads, and Yard Areas	• Minimising access to the working areas to essential vehicles only • Minimise travel distances through appropriate site layout and design • Stabilising access area • Imposing vehicle speed limits of onsite and access roads (e.g. <20 km/hr) • Signage to inform drivers of onsite speed limits • Keeping unsealed site road surfaces damp with water • Regularly removing deposited debris from the sealed access road to the site • Covering loads of fine dusty materials leaving the site • Clean-up of spills as soon as reasonably practicable
General	• Regular visual monitoring of the site operations • Site management plan • Complaint response procedures

3.1.6 Vehicle emissions during construction

The operation of vehicles and machinery during construction will generate the products of combustion, which include PM_{10}, $PM_{2.5}$, NO_x, and CO. Small amounts of sulphur dioxide (SO_2) will also be emitted. However, emissions of SO_2 are directly related to the sulphur content of the fuel burnt. New Zealand diesel has a low sulphur content (less than 10 parts per million (ppm)), therefore the emission of SO_2 from vehicles will also be minimal.

Based on the expected vehicle movements, vehicle emissions will be relatively low during the construction period and well dispersed before reaching sensitive receptors.

Overall, the effects of vehicle exhaust emissions on ambient air quality, beyond the boundaries of the site, will be minimal and discharges are very unlikely to exceed air quality criteria concentration limits including those provided by ambient Air Quality Guidelines and the National Environmental Standards (refer to Section 6). These emissions have therefore not been considered further in this assessment.

3.2 Operational Discharges to Air

3.2.1 Primary pollutants

Air contaminants are discharged to the atmosphere from motor vehicles when travelling on roads. While the primary discharges are from the combustion of petrol and diesel, discharges of particulate matter also occur from brake and tyre wear.

A wide range of the contaminants are emitted including:

- Nitrogen oxides (NO_X) – by convention, NO_X is the sum of nitric oxide (NO) and nitrogen dioxide (NO_2)
- Particulate matter (PM), including particles smaller than 10µm in diameter (PM_{10}) and particles smaller than 2.5 µm in diameter ($PM_{2.5}$)
- Carbon monoxide (CO)
- Sulfur dioxide (SO_2)
- A wide range of hydrocarbons (HC) and volatile organic compounds (VOCs), including benzene

The pollutants of primary concern from motor vehicles emission are NO_2, PM_{10}, and $PM_{2.5}$.[7] The discharge of CO, SO_2, HC, and VOCs would be expected to have a minimal impact on ambient air quality relative to air quality concentration criteria limits. These minor contaminants have not been considered further in this assessment.

Emissions of PM_{10} and $PM_{2.5}$ can have potential health effects. PM_{10} can penetrate the upper respiratory tract and consequently has the potential to impact human health. $PM_{2.5}$ can penetrate even further into the respiratory system and is suspected of being the fraction of PM_{10} that is responsible for health impacts that can lead to an increase in morbidity and mortality in particular circumstances.

The particulate matter emitted from vehicle exhaust would be expected to be $PM_{2.5}$. The particulate matter emitted from brake and tyre wear would be expected to be between 2.5 to 10 µm in diameter (i.e. PM_{10} but not $PM_{2.5}$).

Nitrogen oxides are emitted primarily in the form of NO and the remainder in the more toxic form of NO_2. Approximately 15 - 20% of the NO_X emitted from motor vehicles would be expected to be emitted as NO_2 (referred to as ‘primary NO_2’)[8]. However, the NO emitted from vehicles will over time react with ambient ozone to form additional NO_2 (referred to as ‘secondary NO_2’) as it transported away from the road.

Peak NO_2 concentrations occur near road sources (i.e. near the curb side). At these locations, the travel time of the vehicle emission plume is in the order of seconds and little secondary NO_2 would have formed in the atmosphere. Therefore, in this assessment the maximum contribution of vehicle emissions to ambient NO_2 concentrations have been based on the primary NO_2 emissions.

3.2.2 Vehicle emission rates

Vehicle emissions rates from a road source vary in proportion to the traffic volumes. However, a range of other factors also influence emission rates including:

- The proportion of traffic which are heavy vehicles (emissions from heavy vehicles are typically substantially higher than light vehicles)
- The gradient of the road (emission rates increase with the road gradient)
- Vehicle speeds
- Traffic congestion.

---

[7] CASANZ, 2023. *The Good Practice Guide for the Assessment and Management of Air Pollution from Road Transport Projects*.

[8] NZTA, 2024. *Vehicle Emission Prediction Model*.

On average, vehicle emission rates are expected to decrease over time as vehicles with lower emissions (such as hybrid and electric models) are introduced, and older petrol and diesel-powered vehicles are retired.

In this assessment, vehicle emission rates have been calculated using the NZTA Vehicle Emission Prediction Model (**VEPM** v7.0). VEPM was specifically developed to model emissions from the New Zealand vehicle fleet. The emission rates take into the account vehicle fleet composition and how it would be expected to change over time. Vehicle emission rates are adjusted for a range of other variables including for road gradient, temperature, fuel quality, heavy vehicle load and average speed.

Four traffic scenarios have been considered in the assessment. These scenarios are as follows:

- **2028 Do minimum** – based on traffic flows for the year 2028 assuming only minimal changes are made to the roading network.
- **2028 With project** - traffic flows for the year 2028 assuming the project has been implemented (both Package 1 and 2).
- **2038 Do minimum** – based on traffic flows for the year 2038 assuming only minimal changes are made to the roading network.
- **2038 With project** – traffic flows for the year 2038 assuming the project has been implemented (both Package 1 and 2).

Vehicle emissions from main road sources have been predicted using VEPM predicted annual average daily traffic (AADT) flows, vehicle speeds and the percentage of heavy vehicles. The default VEPM vehicle fleet compositions and particulate size distributions, for brake and tyre wear, have been assumed in the model.

Figure 3-1 shows the predicted average vehicle PM_{10}, $PM_{2.5}$ and NO_2 emission rates (g/km-day) for the traffic scenario years of 2028 and 2038. The average vehicle emissions of PM_{10}, $PM_{2.5}$ and NO_2 for vehicles in 2038 are respectively predicted as 69%, 36% and 49% of vehicle emission rates of vehicles in 2028. Vehicle emission rates are also predicted to decrease with increasing vehicle speed. Therefore, higher emissions would be expected near intersections and during congested conditions.

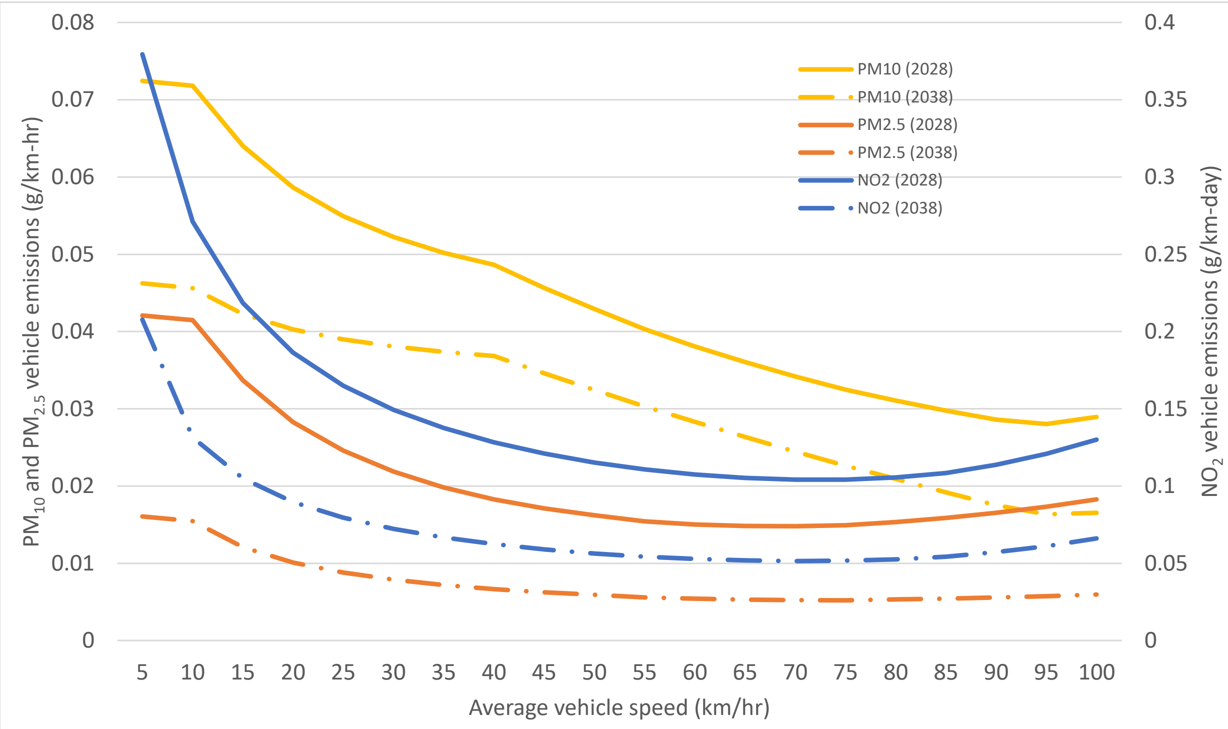

Figure 3-1. Predicted 2028 and 2038 average vehicle PM_{10}, $PM_{2.5}$ and NO_2 emission rates (g/km-day).

3.2.3 Package 1 vehicle emission rates

A summary of the predicted AADTs and daily emission rates of NO_2, PM_{10}, and $PM_{2.5}$ for the main road sources located in the Package 1 project area are summarised in **Table 3-2** and **Table 3-3** for the 2028 and 2038 traffic scenarios[9]. **Figure 3-2** and **Figure 3-3** show the location of the receptor points where the AADTs and emissions rate have been calculated.

Vehicle emission rates are predicted to decrease between 2028 and 2038 for both the 'with project' and 'do minimum' scenarios even though traffic volumes are expected to increase.

Table 3-2. Summary of the average daily contaminant emissions for the Package 1 main roads for '2028 do minimum' and '2028 With project" scenarios'

ID	Road	AADT (vehicles/day)	PM_{10} (g/km-day)	$PM_{2.5}$ (g/km-day)	NO_2 (g/km-day)	NO_X (g/km-day)
2028 Do minimum						
A	Dunns Crossing Rd	5200	235	99	770	4187
B	Walkers Rd	3010	143	71	461	2742
C	SH1 (east)	18690	639	276	1946	9407
D	SH1 (west)	20180	716	316	2136	10577
2028 With Project						
1	Dunns Crossing Rd	7240	260	80	762	3394
2	Walkers Rd	3265	142	63	402	2189
3	SH1 (east)	16680	742	345	2199	12290
4	SH1 (west)	18745	834	333	2329	12686

Table 3-3. Summary of the average daily contaminant emission for the Package 1 main roads for '2038 do minimum' and '2038 With project" scenarios'

ID	Road	AADT (vehicles/day)	PM_{10} (g/km-day)	$PM_{2.5}$ (g/km-day)	NO_2 (g/km-day)	NO_X (g/km-day)
2038 Do minimum						
A	Dunns Crossing Rd	5440	126	21	268	1114
B	Walkers Rd	4200	101	21	215	959
C	SH1 (east)	23210	577	125	1201	5482
D	SH1 (west)	20650	505	108	1063	4797
2038 With Project						
1	Dunns Crossing Rd	8130	195	28	399	1596
2	Walkers Rd	4165	96	23	217	967
3	SH1 (east)	19360	501	113	1015	4779
4	SH1 (west)	20820	509	109	1072	4836

[9] Predicted 'With project' traffic flow assumes both Package 1 and Package 2 are constructed

Figure 3-2. Location of receptor points in the Package 1 project where AADTs and contaminant emission rates are calculated for the 2028 Do minimum and 2038 Do minimum traffic scenarios

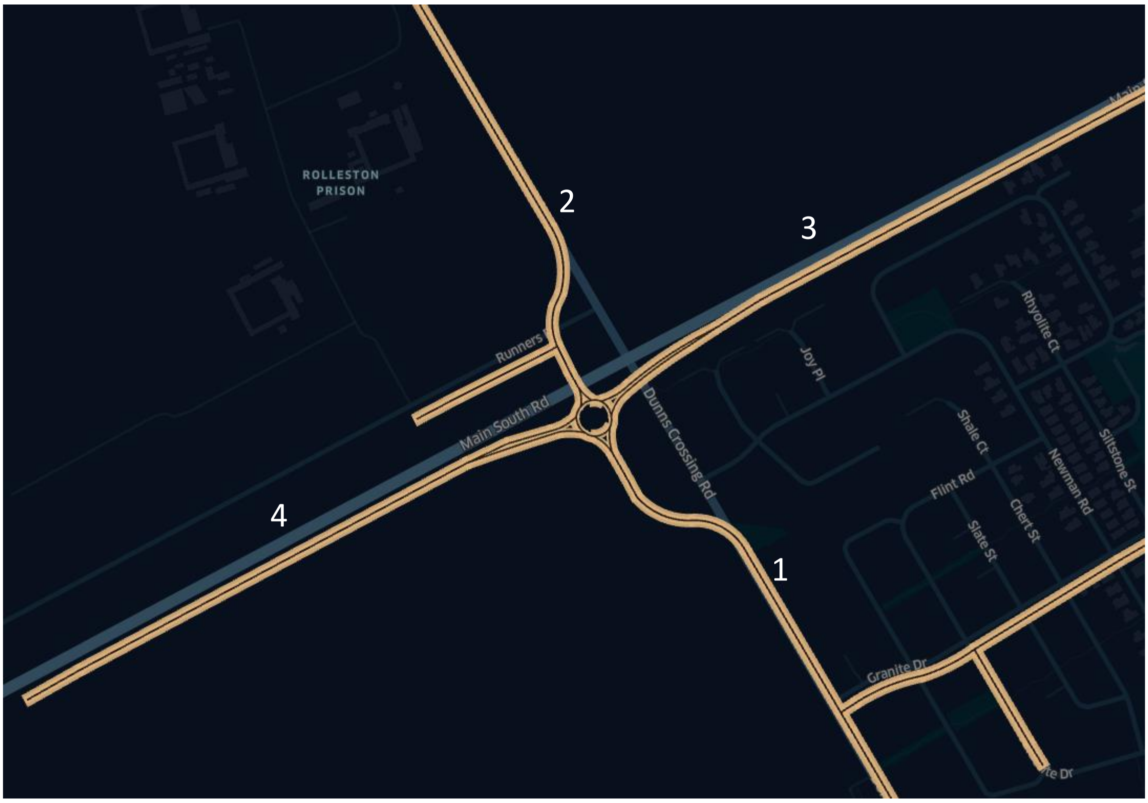

Figure 3-3. Location of receptor points in the Package 1 project area where AADTs and contaminant emission rate are calculated for the 2028 Do minimum and 2038 Do minimum traffic scenarios

4 Regulatory Status of Discharges

4.1 Construction Discharges

Under the Canterbury Air Regional Plan (CARP)[10], the relevant rules which relate to the discharges of dust during construction are the permitted activities Rule 7.32 and Rule 7.36.

4.1.1 Rule 7.32

Under Rule 7.32, the discharge of dust to air beyond the boundary of the property of origin from the construction of buildings, land development activities, unsealed surfaces or unconsolidated land, is a permitted activity provided the following conditions, where applicable, are met:

1. *The building to be constructed is less than 3 stories in height, or where the building is greater than 3 stories in height, a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and*
2. *The area of unsealed surface or unconsolidated land is less than 1000m^2, or where the area of unsealed surface or unconsolidated land is greater than 1000m^2 a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and*
3. *The discharge does not cause an offensive or objectionable effect beyond*

The contractor will be required to prepare a dust management plan (**DMP**) for the construction of Package 1. The DMP will be prepared in accordance with Schedule 2 of the CARP. Therefore, construction activities will meet Conditions 1 and 2 of Rule 7.32.

Provided industry standard dust mitigation measures are diligently implemented and maintained, the proposed construction would also be expected to comply with Condition 3 of Rule 7.32.

4.1.2 Rule 7.36

Under Rule 7.36, the discharge of contaminants into air from the outdoor storage of bulk solid materials[11] is also a permitted activity provided the following conditions are met:

1. *The discharge of dust does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2; and*
2. *The amount of material stored does not exceed 1000t when it has an average particle size of less than 3.5mm; and*
3. *Where the storage exceeds 200t, a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and*
4. *The dust management plan is supplied to the CRC on request; and*

[10] Environment Canterbury, 2017. *Canterbury Air Regional Plan Te mahere ā-rohe mō te hau o Waitaha*.

[11] means materials consisting of, or including, fragments that could be discharged as dust or particulate. These materials include but are not limited to: gravel, quarried rock, fertiliser, coal, cement, flour, rock aggregate, grains, compost and woodchip.

5. *The discharge does not occur within 100m of a sensitive activity, wāhi tapu, wāhi taonga or place of significance to Ngāi Tahu that is identified in an Iwi Management Plan.*

Under the CARP, sensitive activity is defined as an activity undertaken in:

a. a. *the area within 20m of the façade of an occupied dwelling; or*

b. *b. a residential area or zone as defined in a district plan; or*

c. *c. a public amenity area, including those parts of any building and associated outdoor areas normally available for use by the general public, excluding any areas used for services or access areas; or*

d. *d. a place, outside of the Coastal Marine Area, of public assembly for recreation, education, worship, culture or deliberation purposes.*

The construction plan has yet to be finalised but it is possible that some stockpiling will occur within 100m of a residential property. Stockpiling activities may therefore not comply with Rule 7.36 and a resource consent would be required.

4.2 Operational Discharges

Under the CARP discharges from motor vehicles are a permitted activity. Vehicle emissions are instead, regulated by central government through vehicle emission standards and fuel specifications.

The main method of control is through the Land Transport Rule: Vehicle Exhaust Emissions 2007 (the Vehicle Exhaust Emissions Rule), which is the primary control on vehicle emissions. The rule was amended in 2023 (Land Transport Rule: Vehicle Exhaust Emissions Amendment 2023).

5 Existing Environment

5.1 Surrounding Land Use

To assess air quality impacts, on the receiving environment, consideration must be given to the surrounding land uses and their sensitivity to the potential for adverse effects of air emissions on human health and amenity values.

5.1.1 Package 1

As shown on **Figure 5-1,** the Package 1 project area overlaps multiples planning zones. The land to the northeast of the proposed new intersection is zoned Medium Density Residential under the Partially Operative Selwyn District Plan (POSDP), Rolleston Prison is also located in close proximity.

The main entrance of the Prison is located approximately 260m to the northwest of the roundabout. Emissions from the proposal would be expected to have a minimal impact on air quality at any of the facility's accommodation and activity areas.

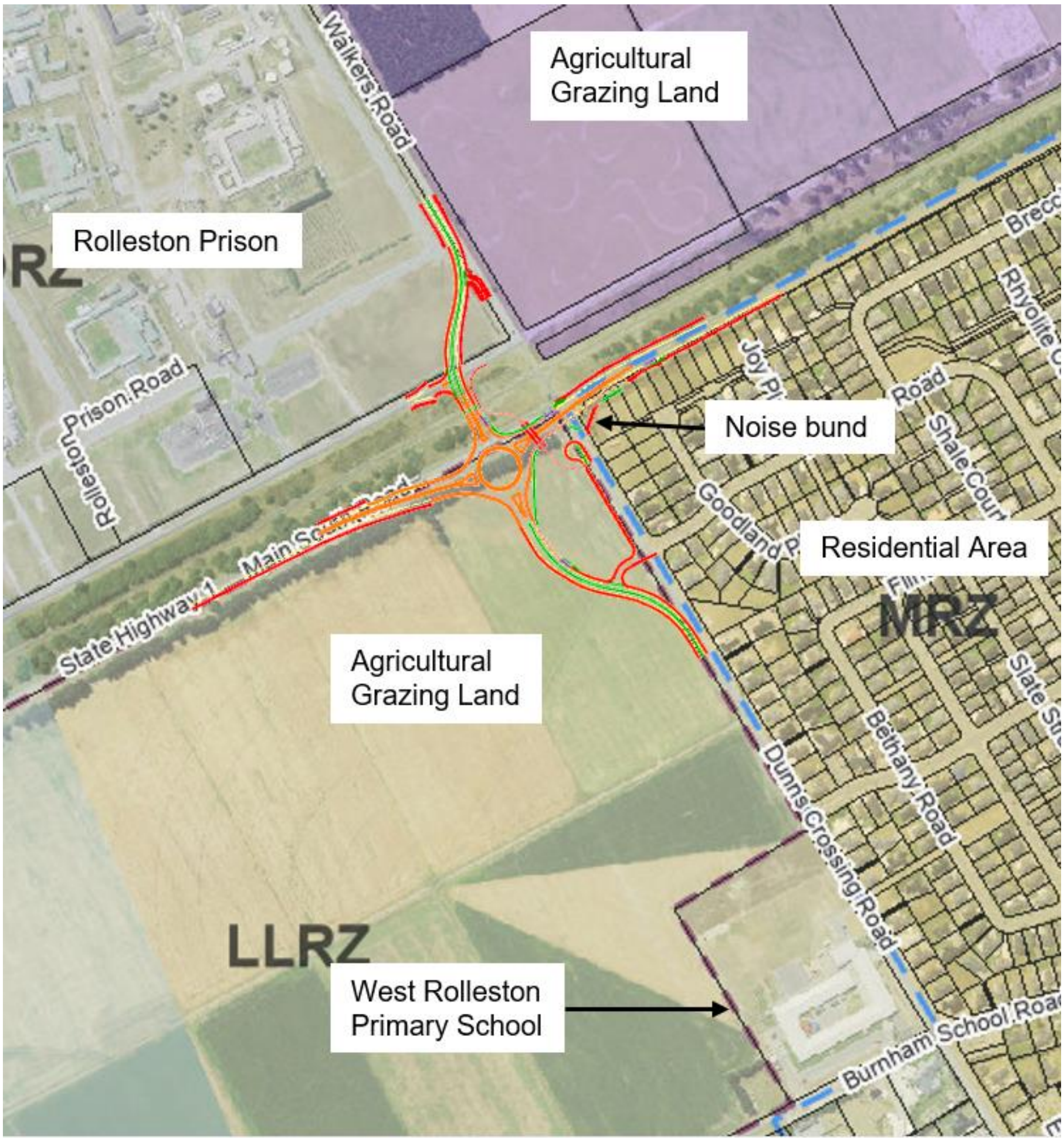

Figure 5-1. Zoning of Package 1 surrounding area (Source: Environment Canterbury Maps).

Land to the east of Dunns Crossing Rd's current alignment is zoned Medium Density Residential zone under the POSDP and used for residential purposes. The realignment of the Dunns Crossing Rd will move the road further to west of the dwellings at located at the north end of road.

An existing earth noise bund is to be retained at the eastern corner of Dunns Crossing Rd and SH1 intersection (13 Fountain Place).

West Rolleston Primary School is located approximately 670m to the southeast of SH1 on Dunns Crossing Road. The proposed roundabout will be located 590m from the school. Given the separation distance the vehicle emissions from traffic using the new roundabout would be expected to have negligible impact on air quality at the school.

Land to the northeast of the roundabout is currently used for agriculture grazing purposes and is zoned General Industrial zone under the POSDP, as rezoned under Plan Change 80. The land to the northwest of the site is zoned Corrections zone, however is subject to designation MCOR-1.

The land to the west of Dunns Crossing Rd's current alignment is used for agricultural purposes but is currently zoned Large Lot Residential zone under the POSDP, however is currently subject to appeal through Proposed Plan Change 73 to rezone to Medium Density Residential zone.

The sensitive receptors which would potentially be most impacted by the proposal are the existing dwellings located in the residential areas near the corner of the existing intersection of Dunns Crossing Rd and SH1.

There are no identified, sensitive ecological or cultural receptors in the vicinity of the Package 1 project area which may be impacted by emissions to air.

5.2 Topography

Local topography can influence the transport and dispersion of air pollutants. For example, hills and valleys can channel wind flows and influence wind speeds. The project is located on a comparative flat plain. There are no terrain features which would be expected to have any material effect on the dispersion of contaminants emitted from the project and their downwind contaminant concentrations.

5.3 Meteorology

Air pollutant concentrations are highly influenced by meteorological conditions. The most important of these parameters are wind speed, wind direction and the thermal stability of the atmosphere.

The closest meteorological monitoring station to the site is the Lincoln Broadfield electronic weather station (**Lincoln EWS**) which is located approximately 8.3 km to the southeast of the site. The winds recorded at Lincoln EWS are expected to be representative of the winds likely to occur at the site.

Figure 5-2 shows the distribution of the hourly wind speeds and wind directions recorded at the station between 1st January 2019 and 31st December 2023. The frequency distribution is tabulated in **Table 5-1**. Seasonal distribution of hourly wind speeds and wind directions is included in **Appendix A**.

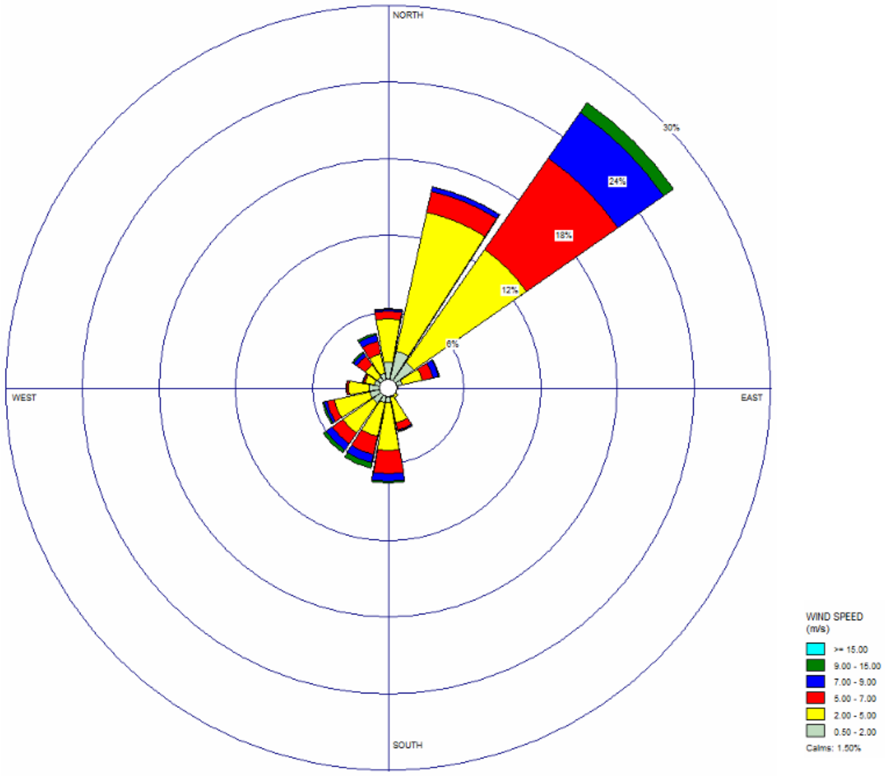

Figure 5-2. Distribution of wind direction and speed recorded at the Lincoln Broadfield EWS between the years 2019 – 2023.

Table 5-1. Summary of the percentage distribution of hourly speeds and wind direction recorded at the Lincoln Broadfield EWS between the years 2019 – 2023

Wind direction	0.5 – 2.0 m/s (%)	2.0 – 5.0 m/s (%)	5.0 – 7.0 m/s (%)	7.0 - 10.0 m/s (%)	10.0- 15.0. m/s (%)	>=15.0 m/s (%)	Total (%)
N	2.1	3.4	0.6	0.2	0.0	0.0	6.2
NNE	3.0	11.1	1.7	0.4	0.0	0.0	16.2
NE	2.5	10.7	8.7	5.0	0.3	0.0	27.2
ENE	1.2	1.5	0.9	0.5	0.0	0.0	4.2
E	0.5	0.2	0.0	0.0	0.0	0.0	0.8
ESE	0.4	0.2	0.0	0.0	0.0	0.0	0.6
SE	0.5	0.4	0.0	0.0	0.0	0.0	0.9
SSE	0.8	2.1	0.5	0.1	0.0	0.0	3.5
S	1.1	3.8	1.8	0.7	0.1	0.0	7.5
SSW	1.2	2.7	1.4	0.9	0.2	0.0	6.4
SW	1.5	2.8	1.0	0.7	0.2	0.0	6.3
WSW	1.5	2.9	0.6	0.3	0.0	0.0	5.3
W	1.5	1.6	0.1	0.0	0.0	0.0	3.3
WNW	1.2	0.7	0.1	0.1	0.0	0.0	2.1
NW	1.1	1.2	0.7	0.4	0.1	0.0	3.5
NNW	1.2	1.5	1.1	0.6	0.1	0.0	4.4
Total	**21.5**	**46.8**	**19.4**	**9.9**	**0.9**	**0.0**	**98.5**
Calms							**1.5**
Missing data							**0.0023**

The wind distribution from the 2019 - 23 dataset shows the predominance of winds from the northeast and north-northeast directions (i.e. 43% of the time). The average wind speed recorded at the Lincoln EWS station between 2019 and 2023 was 3.88 m/s.

Worst case dispersion conditions for motor vehicle emissions, when peak downwind contaminant concentration can be expected, occur during low wind speeds and stable nighttime and early morning conditions during the or early morning atmospheric conditions. Calms and low wind speed conditions are observed to occur at the Lincoln EWS for approximately 23% of time.

5.4 Rainfall

A summary of the rainfall data recorded at Lincoln EWS for the years 2019-2023 is presented in Figure 5-3. The figure shows the average monthly rainfall (in mm), and number of rain days[12] and wet days[13] per month. The average annual rainfall during the five-year period was 589 mm. The number of dry days[14], when dust is more likely to be generated, occur approximately 78% of the time or, on average, 284 days per year.

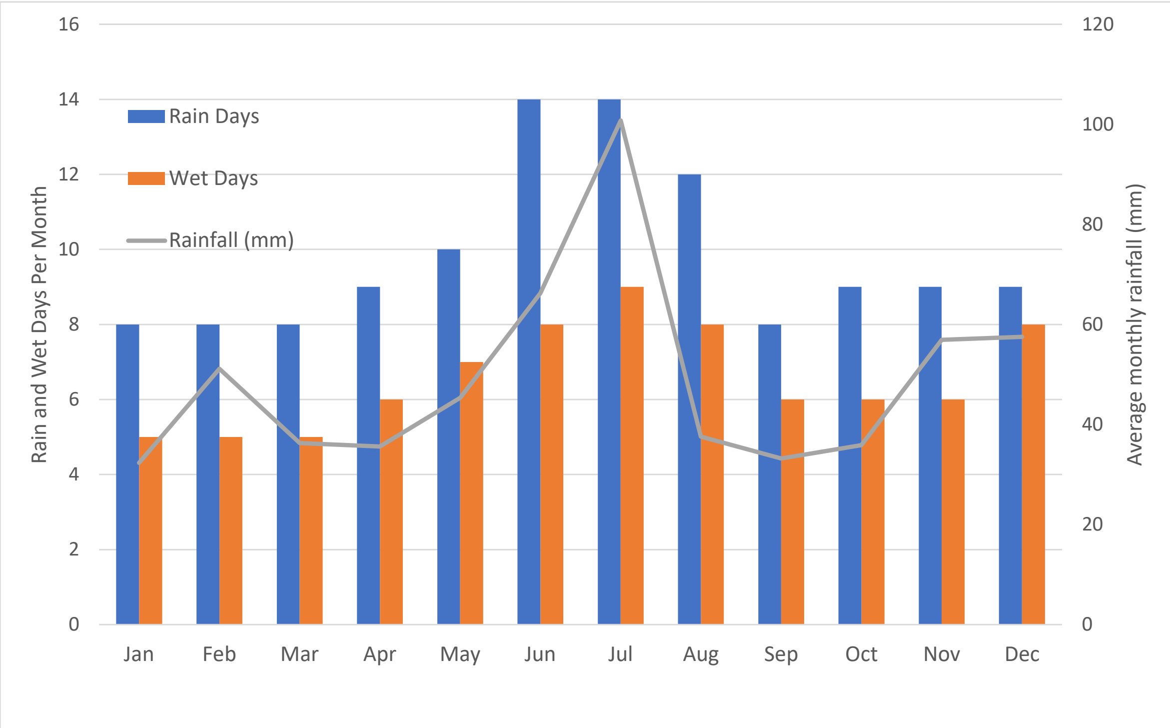

Figure 5-3. Average rainfall (mmm), rain days and wet days per month recorded at the Lincoln EWS (2019-2023)

5.5 Background Air Quality

5.5.1 Air Shed Status

Eight airsheds have been gazetted in the Canterbury region under the National Environmental Standards for Air Quality (NESAQ). The project is located outside of all these. The closest airshed, the Christchurch Airshed, is located approximately 9.7 km to the northeast of Package 1. Emissions to air from the construction and operation of the works enabled within Package 1 would not have any impact on air quality in

[12] A rain day is classified as a day with total rainfall exceeding 0.1 mm over a 24-hour period.

[13] A wet day is classified as a day with total rainfall exceeding 1 mm over a 24-hour period.

[14] A dry day is classified as a day with total rainfall of less than 1 mm over a 24-hour period.

the Christchurch Airshed. Consequently, there are no limitations to granting resource consents under Regulation 17 of the NESAQ.

5.5.2 Clean Air Zones

Seven Clean Air Zones (**CAZ**) are identified in Section 9 of the CARP[15]. In general, the CAZ surround and include specific gazetted airsheds. In these areas, more regulatory controls are placed on emissions through the CARP. The project area is located outside of the seven CAZ.

5.5.3 Background contaminant concentrations

No recent ambient monitoring of air quality contaminants including NO_2 and PM_{10} has occurred in Rolleston from which, background pollutant concentrations can be derived. The GPG Industry provides guidance on using default values for background air quality where there is no available monitoring data. In these instances, the GPG Industry recommends using the background concentrations proposed by NZTA.[16] The default values for minor urban areas are intended to provide a conservative estimate of likely background concentrations.

Table 5-2 summarises the NZTA derived background concentrations used in this assessment to calculate cumulative concentrations.

Table 5-2. Summary of background PM_{10} and NO_2 concentrations used in this assessment.

Contaminant	Averaging period	Background concentration, µg/m³
PM_{10}	24-hour	37
	Annual	14
$PM_{2.5}$	24-hour	18
	Annual	4.9
NO_2	1-hour	58
	24-hour	38

5.5.4 Industrial discharges to air

No consented air discharges from industrial sources are in the vicinity of Package 1 project area. Therefore, air quality in the vicinity of the Package 1 would not be expected to be impacted by any industrial emissions.

[15] *Canterbury Air Regional Plan, Te mahere ā-rohemō te hau o Waitaha*. October 2017

[16] *Good Practice Guide for Assessing Discharges to Air from Industry* (2016), Table 8: Default values for background concentration of carbon monoxide, sulphur dioxide, benzene, and nitrogen dioxide.

6 Air Quality Criteria

6.1 Health Effects Air Quality Criteria

Ambient contaminant concentration predictions may be compared with relevant air quality criteria concentrations to assess the potential for adverse health and/or environmental effects to occur. The MfE GPG Industry[17] sets out the order of priority for the use of various air quality assessment criteria as follows:

- Air Quality Standards contained in the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (NESAQ)
- New Zealand Ambient Air Quality Guidelines (AAQG) published by MfE (2002)
- Regional air quality guidelines and standards, if required by a regional plan
- World Health Organisation (WHO) guideline concentrations (where appropriate)
- Other international agency air quality criteria (where appropriate).

The NESAQ came into effect in 2005 and among other things, sets out ambient air quality standards for common criteria contaminants including NO_2 and PM_{10}. The NESAQ provides for the protection of human health and are mandatory standards which have an enforceable legal status.

In February 2020, the MfE released a consultation document[18] on some proposed amendments to the NESAQ, including new standards for ambient air concentrations of $PM_{2.5}$. The new standards for $PM_{2.5}$ are proposed to be 25 µg/m^3 (24-hour average) and 10 µg/m^3 (annual average). The proposed amendments to the NESAQ are in the consultation stage and do not have any regulatory status at present. The proposed standards align with the $PM_{2.5}$ and PM_{10} AAQGs.

The NESAQ and NZAAQG are intended to apply where people are likely to be exposed over the relevant assessment period.

No regional air quality guidelines or targets are defined in the CARP.

The relevant ambient air quality assessment criteria are described in Table 6-1. It should be noted that the NESAQ define a criteria concentration limit and the number of times per year this limit is allowed to be exceeded. For instance, the 1-hour average NO_2 concentration of 200 µg/m^3 may be exceeded up to 9 hours per year, and the 24-hour average PM_{10} concentration of 50 µg/m^3 may be exceeded once per year.

Table 6-1. Relevant ambient air assessment criteria

Contaminant	Averaging period	Threshold concentration	Number of permitted exceedances	Source
PM_{10}	24-hour Annual	50 µg/m^3 20 µg/m^3	1 -	NESAQ AAQG
$PM_{2.5}$	24-hour Annual	25 µg/m^3 10 µg/m^3	1 to 3 -	NESAQ (proposed) NESAQ (proposed)
NO_2	1-hour 24-hour	200 µg/m^3 100 µg/m^3	9 -	NESAQ AAQG

[17] Ministry for the Environment "*Good Practice Guide for Assessing Discharges to Air from Industry*". 2016

[18] Ministry for the Environment "*Proposed amendments to the National Environmental Standards for Air Quality, Particulate Matter and Mercury Emissions",* February 2020.

6.2 Dust Nuisance Effects

No NESAQ air quality limits are defined for dust. The MfE GPG Dust recommends trigger levels for dust deposition, total suspended particulate (TSP) and PM_{10} concentrations. The MfE trigger limits are typically used to assess if dust, emitted from a source, would potentially have a nuisance effect. Table 6-2 summarises recommended MfE trigger levels.

Table 6-2. Summary of the MfE trigger levels for dust nuisance effects

Contaminants	Sensitivity of the Receiving Environment	Criteria
Deposited particulate	All areas	4 g/m^2/30 days (above background concentrations)
Total suspended particulate (TSP)	High	60 µg/m^3 (24-hour rolling average) 200 µg/m^3 (1-hour average) 250 µg/m^3 (5-minute average)
	Moderate	80 µg/m^3 (24-hour rolling average) 250 µg/m^3 (1-hour average)
	Low	100 µg/m^3 (24-hour rolling average)
PM_{10}	High	150 µg/m^3 (1-hour average)

7 Assessment of Effects - Construction

7.1 Potential Dust Effects

The potential adverse effects from the discharge of dust (particulate matter) include:

- Health effects from exposure to inhalable dust (PM_{10} and $PM_{2.5}$ as these finer particles can penetrate the nose and mouth if inhaled and can enter the lungs and respiratory tract).
- Nuisance effects generally associated with deposited dust and the coarser fraction of TSP such as soiling, effects on amenity and visibility.

As discussed in Section 3.1.2, construction activities typically produce larger particle sizes, which are deposited on the ground and other surfaces. As a class of material, deposited particulates have only minimal physical health impacts (due to limited penetration into the respiratory tract). However, they may cause nuisance or amenity effects in sensitive areas due to soiling of clean surfaces.

The effects of dust deposition can be subjective and is dependent on the sensitivity of the receiving environment. Some people will not be annoyed by dust, others will be annoyed, and some may find it objectionable or offensive.

Typically, the most common areas of concern from dust deposition arise at residential properties (or similar sensitive locations such as retail premises or schools) and include the visual soiling of clean surfaces, such as cars, window ledges, and household washing, as well as dust deposits on vegetation.

A small portion of the of the emitted dust will be in the form of PM_{10} and $PM_{2.5}$. However, these emissions are unlikely to exceed any of the relevant health-based air criteria concentrations.

7.2 FIDOL Factors

The GPG Dust notes that the potential for a dust discharge to cause an objectionable or offensive effect depends on the following characteristics of the dust fallout:

- The frequency of dust nuisance events.
- The intensity of events, as indicated by dust quantity and the degree of nuisance.
- The duration of each dust nuisance event.
- The offensiveness of the discharge having regard to the nature of the dust.
- The location of the dust nuisance, having regard to the sensitivity of the receiving environment.

These are known as the FIDOL factors and are used to consider whether a dust discharge has caused an offensive or objectionable effect. Essentially, whether a dust discharge leading to dust deposition causes an offensive or objectionable effect depends on how frequent it is, the sensitivity of the receiving environment and how much dust is deposited.

The FIDOL factors are also used by Canterbury Regional Council (**CRC**) to assess whether dust discharge has caused an objectionable or offensive effect (refer Schedule 2of the CARP).

7.3 Assessment Methodology

Potential dust nuisance effects have been assessed with regards to the following factors.

- The nature of the discharge to air and mitigation procedures
- The sensitivity of the receiving environment to dust nuisance effects
- The separation distance between construction work and nearby sensitive receptors
- Meteorological conditions (frequency of hours when winds speeds are greater than 5m/s during dry day)

7.3.1 Land use sensitivity to dust

The GPG Dust gives guidance on assessing the sensitivity of the receiving environment with regards to dust nuisance effects. Receptors are classified as having a high, moderate, or low sensitivity to dust. Based on the GPG Dust classification, the receptors in the project area which are considered to have a high sensitivity are the nearby residential dwellings. The CARP similarly classifies residential areas as sensitive activities.

The overall sensitivity of the receiving environment will increase as the number of dwellings, that may potentially be impacted by dust, increases.

The agricultural fields in the Package 1 project area are classified as having a low sensitivity to nuisance dust.

7.3.2 Meteorological conditions

The potential for dust to be generated from exposed unconsolidated surfaces will increase during dry days[19] when wind speeds exceed 5m/s. A t the Lincoln EWS, these conditions occur for 23.7% of the time. During the summer months, the frequency of occurrence is 32.4% of time which reduces to 12.6% of the time during the winter months.

The wind direction for the hours when wind speeds are greater than 5 m/s during a dry day is shown in Figure 7-1. The wind distributions show a clear predominance of stronger winds from the northeast direction.

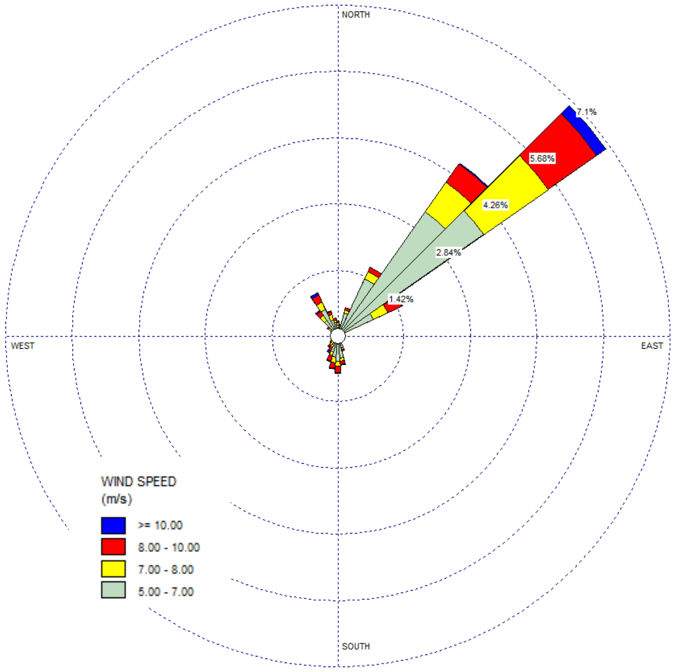

Figure 7-1. Distribution of wind speeds >5m/s during dry days

The Lincoln EWS monitoring data indicates that the meteorological conditions conducive to dust generation could occur frequently during the summer months. However, as most of the construction activities in the Package 1 project area will occur to the west of nearby residential areas, winds from the predominant northeast direction would tend to transport dust away from these sensitive receptors. The monitoring data would indicate that residential dwellings would only infrequently be downwind of the construction activities during higher wind speed conditions.

[19] A dry day is classified as a day with total rainfall of less than 1 mm over a 24-hour period.

7.3.3 Separation Distance to Sensitive Receptors

The potential impact of dust emissions from construction effects decreases with increasing distance. Most larger dust particles would be expected to deposit to the ground close to the emission source, although smaller particles can travel further.

The potential impact of dust emissions will therefore decrease with increasing downwind distance as the emitted dust either deposits on the ground or dilutes and disperses in the air environment.

An indication of the potential risk to residential dwellings experiencing a nuisance effect at different distance a roading project is provided by the CASANZ GPG Road dust risk assessment method. The GPG Road uses a qualitative method to estimate risk of dust nuisance effect being experienced based on the dust emission potential (**DEP**) of the construction project, the sensitivity of the receiving environment, and the distance the receptor is from the project[20].

The DEP of a construction project is classified as being high, medium, or low and is based on the unmitigated dust emission potential of the works.

The proposed Package 1 earthworks and construction activities are considered to have a low to medium DEP. Low DEP projects include projects where the constructed road length is less than 1 km, or a construction site area is less than 2.5 hectares. Whereas medium DEP projects include projects where the construction of road length of 1 – 2 km and construction sites have an area of 2.5 to 10 hectares.

Table 7-1 show the derived GPG Road dust nuisance risk for residential dwellings[21] located within 50m and further than 50m from construction projects with a low and medium DEP. The GPG Road dust risk associated with less sensitive commercial and industrial areas are respectively shown in Table 7-1 and Table 7-3. For these non-residential areas, the risk would be typically low to negligible.

Table 7-1. GPG Road assessment of dust nuisance effect risk to residents with distance from the earthworks and construction activities

Dust Emission Potential (DEP)	<20m	<50 m	> 50 m
Low	Low Risk	Low Risk	Negligible Risk
Medium	Medium Risk	Medium Risk	Low Risk

Table 7-2. GPG Road assessment of dust nuisance effect risk to commercial activities with distance from the earthworks and construction activities

Dust Emission Potential (DEP)	<20m	<50 m	> 50m
Low	Low Risk	Negligible Risk	Negligible Risk
Medium	Medium Risk	Low Risk	Low Risk

[20] The CASANZ method is based on the Institute of Air Quality Management (2024) '*Guidance on the assessment of dust from demolition and construction (v2.2)*'.

[21] For this assessment, it is assumed that 11 to 100 dwellings could potentially be impacted by works in the Package 1 and 2 project area.

Table 7-3. GPG Road assessment of dust nuisance effect risk to industrial activities with distance from the earthworks and construction activities

Dust Emission Potential (DEP)	<20m	<50 m	> 50m
Low	Negligible Risk	Negligible Risk	Negligible Risk
Medium	Low Risk	Low Risk	Low Risk

7.4 Package 1 Construction Effects

In the Package 1 project area, earthwork and construction work will be closest to residential properties at the northern end of on Old Dunns Crossing Rd and the properties on Fountain Place adjacent to SH1.

Although the Package 1 construction plan has yet to be finalised, the area between Old Dunns Crossing Rd and the realigned Dunns Crossing Rd may also be used as a laydown area. If this is the case, some dust would also be generated by vehicle movements, material handling and stockpiles.

However, most of the Package 1 construction works, including the new roundabout and realigned roads, will occur more than 60 to 70m from nearby residential properties. Using the GPG Road methodology, the risk of nearby dwellings experiencing dust nuisance effects from work in these areas is classified as being low.

The prevailing wind conditions at the site will help minimise the risk of residents experiencing adverse dust effects. Based on observed meteorological conditions at the Lincoln EWS, residential areas would predominantly be upwind of the proposed Package 1 work when there is a greater potential for dust generation from exposed surfaces (Section 7.3.2) thereby reducing the risk of exposure to nuisance dust.

Overall, given the proximity of residential properties to the proposed works there is some risk that these dwellings could be impacted by dust unless appropriate mitigation was implemented. Based on the GPG risk classifications, the risk to dwellings is considered low to medium when works are occurring within 50m and low when works occur at distances greater than 50m.

These risks can be minimised through the implementation and maintenance of standard dust control procedures such as those detailed in Section 3.1.5.

Other potential receptors, including Rolleston Prison and West Rolleston Primary School, are at sufficient distance from the work that any dust effects are expected to be negligible.

7.5 Summary of Construction Effects

Dust will be generated from the construction works of Package 1. The generated dust has a low to medium risk of having a nuisance effect at the closest dwellings, located adjacent to the proposed works. At distances further than 50m from the construction works, the risk is assessed as being low to negligible.

Implementing industry standard dust mitigation measures would minimise emissions to air of dust during construction and therefore potential offsite effects. Provided appropriate dust mitigation procedures are strictly implemented and maintained, any discharges during construction would not be expected to have an offensive or objectionable effect.

8 Assessment of Effects - Operational

8.1 Potential Effects

Discharge of air contaminants from motor vehicles can have potential adverse health effects if people are exposed to contaminant concentrations which exceed ambient air criteria over the prescribed averaging period. The main contaminants of concern for this project are NO_2, PM_{10} and $PM_{2.5}$.

8.2 Assessment Methodology

The air quality impact of the proposed Package 1 development during operation have been assessed using dispersion modelling methods. The AERMOD (v23132) dispersion model has been used to predict the downwind concentration of contaminants emitted from motor vehicles. The air impact has been assessed by comparing the predicted maximum contaminant concentrations against relevant air quality criteria concentrations (refer Section 6.1).

Separated dispersion models have been constructed for the Package 1 project areas.

The modelled vehicle emission rates have been based on the projected traffic flows for the years 2028 ‘with project’ and 2028 ‘do minimum’ traffic scenarios. Although traffic flows numbers are predicted to increase in 2038, vehicle emission rates are predicted to be lower as the emission performance of the vehicle fleet improves over time (refer Section 3.1). Therefore, the modelled 2028 traffic scenarios represent worst-case emission conditions, when vehicle emissions from the project are expected to have the greatest impact on ambient air quality concentrations.

A full description of the dispersion modelling methodology is provided in **Appendix B**. Key points are summarised below:

- AERMOD has been used to predict maximum PM_{10}, $PM_{2.5}$, and NO_2 concentrations associated with road sources at nearby sensitive receptors.
- The vehicle emission rates have been calculated using the VEPM v7 emission model, based on predicted 2028 traffic model predictions.
- Hourly vehicle emissions have been estimated for each road based on the weekday traffic profile observed on SH1. The same diurnal profile has been assumed for all road sources included in the model.
- Road sources have been simulated as RLINE-EXT sources in AERMOD. The RLINE-EXT source type was specifically developed by the US EPA for the simulation of vehicle emissions.
- Pollutant dispersion has been simulated for the year 2019. Modelled wind flows have been derived from observations at the Lincoln AWS meteorological monitoring station.
- The background contaminant concentrations detailed in Section 5.5.3 have been used to estimate maximum cumulative concentrations.

8.3 Package 1 Operational Effects

Table 8-1 to Table 8-6 summarise the predicted maximum PM_{10}, $PM_{2.5}$, and NO_2 concentrations at sensitive receptors which are likely to be most impacted by Package 1 based on the 2028 traffic projections. These tables show the maximum contribution from the modelled road sources and maximum cumulative concentrations including background sources.

Predicted contaminant concentration contour plots for the modelled scenario are presented in **Appendix C**.

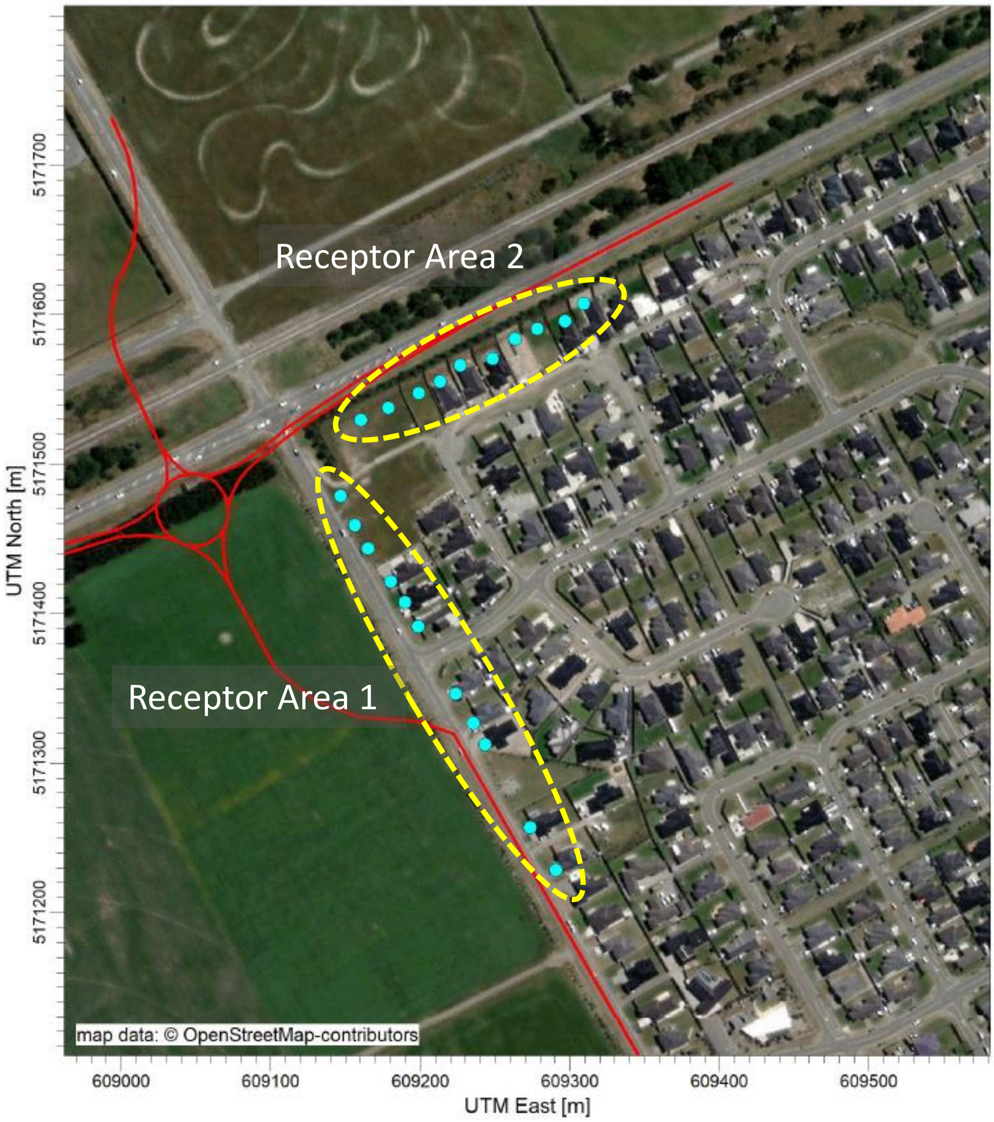

Figure 8-1 shows the location of the dwelling which are likely to be most impacted by Package 1. These receptors have been grouped into Receptor Area 1 and Receptor Area 2. The tables show the maximum concentration predicted in each of the identified receptor areas.

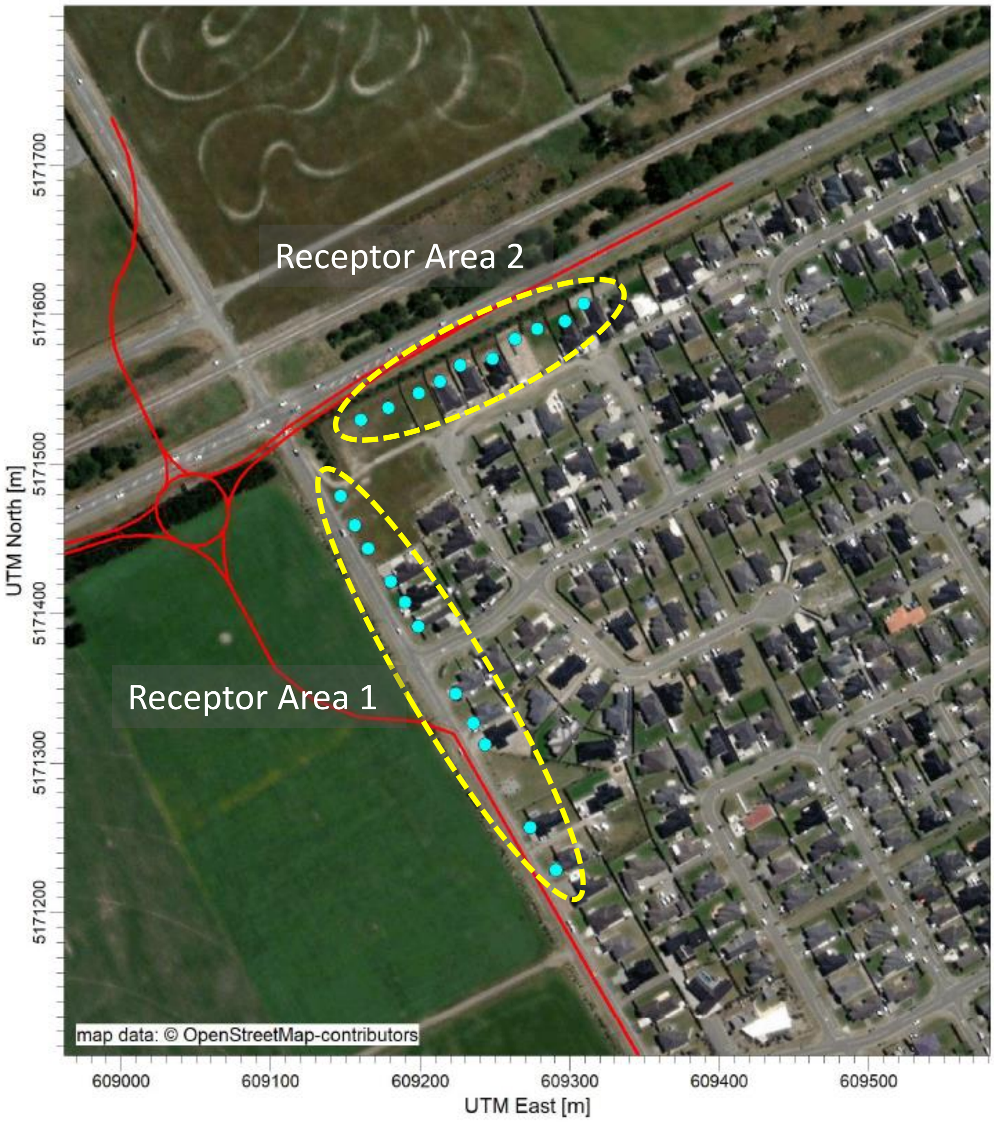

Figure 8-1. Package 1 location of sensitive receptors

8.3.1 Prediction PM_{10} Concentrations

Table 8-1. Package 1 predicted maximum 24-hour average PM_{10} concentrations (µg/m³)

Receptor Area	2028 Do minimum		2028 With Project	
	Traffic	Traffic + Background	Traffic	Traffic + Background
Receptor Area 1	1.7	38.7	2.3	39.3
Receptor Area 2	2.1	39.1	2.3	39.3
Air Quality Criteria	**50 (NESAQ)**			

Table 8-2. Package 1 predicted annual average PM_{10} concentrations (µg/m[3])

Receptor Area	2028 Do minimum		2028 With Project	
	Traffic	Traffic + Background	Traffic	Traffic + Background
Receptor Area 1	0.4	14.4	0.4	14.4
Receptor Area 2	0.6	14.6	0.7	14.7
Air Quality Criteria	**20 (AAQG)**			

8.3.2 Prediction $PM_{2.5}$ Concentrations

Table 8-3. Package 1 predicted maximum 24-hour average $PM_{2.5}$ concentrations (µg/m[3])

Receptor	2028 Do minimum		2028 With Project	
	Traffic	Traffic + Background	Traffic	Traffic + Background
Receptor Area 1	0.8	18.8	1.0	19.0
Receptor Area 2	0.9	18.9	1.1	19.1
Air Quality Criteria	**25 (proposed NESAQ)**			

Table 8-4. Package 1 predicted annual average $PM_{2.5}$ concentrations (µg/m[3])

Receptor	2028 Do minimum		2028 With Project	
	Traffic	Traffic + Background	Traffic	Traffic + Background
Receptor Area 1	0.2	5.1	0.2	5.1
Receptor Area 2	0.3	5.2	0.3	5.2
Air Quality Criteria	**10 (proposed NESAQ)**			

8.3.3 Prediction NO_2Concentrations

Table 8-5. Package 1 maximum 99.9 percentile 1-hour average NO_2 concentrations (µg/m[3])

Receptor	2028 Do minimum		2028 With Project	
	Traffic	Traffic + Background	Traffic	Traffic + Background
Receptor Area 1	22.0	80.0	29.4	87.4
Receptor Area 2	26.4	84.4	34.2	92.2
Air Quality Criteria	**200 (NESAQ)**			

Table 8-6. Package 1 maximum 24-hour average NO_2 concentrations (µg/m[3])

Receptor	2028 Do minimum		2028 With Project	
	Traffic	Traffic + Background	Traffic	Traffic + Background
Receptor Area 1	5.4	43.4	6.6	44.6
Receptor Area 2	6.4	44.4	7.0	45.0
Air Quality Criteria	**100 (AAQG)**			

8.3.4 Summary of Package 1 modelled predictions

Maximum cumulative contaminant concentrations are not predicted to exceed any of the relevant air quality criteria concentrations at any dwelling adjacent to the project area under either the 'with project' or 'do minimum' emission scenarios.

NZTA[22] recommends assessing the significance of discharges to air from a project in terms of following of the guideline limits.

- **Project Contribution** - Whether contribution from the project is predicted increase ambient air quality concentration by more than 10% of the relevant air quality
- **Cumulative Contribution** – Whether the cumulative contaminant concentration (i.e. project + background sources) is predicted to be more than 90% of the relevant air quality

The predicted maximum PM_{10}, $PM_{2.5}$, and NO_2 Project Contributions and Cumulative Contributions for Package 1 is shown in Table 8-7. The results show that similar contaminant concentrations are predicted for both scenarios with project' or 'do minimum' emission scenarios. All of the predicted maximum Project Contributions are below the NZTA guideline level of 10%. Similarly all of the predicted maximum Cumulative Contributions are below NZTA's 90% guideline level.

Overall, the vehicle emissions from the project are expected to have a negligible impact on ambient air quality concentrations when compared to the ambient air standards and guidelines and air quality concentration which would otherwise occur.

Table 8-7. Predicted Project Contribution and Cumulative Contribution for Package 1

Contaminant	Receptor	Air Quality Criteria	Project Contribution (%)	Cumulative Contribution (%)
24-hour average PM_{10}	Receptor Area 1	50	1.1%	78.6%
	Receptor Area 2		0.4%	78.6%
Annual average PM_{10}	Receptor Area 1	20	0.0%	72.0%
	Receptor Area 2		0.5%	73.5%
24-hour average $PM_{2.5}$	Receptor Area 1	25	0.8%	76.0%
	Receptor Area 2		0.8%	76.4%
Annual average $PM_{2.5}$	Receptor Area 1	10	0.0%	51.0%
	Receptor Area 2		0.0%	52.0%
1-hour average NO_2	Receptor Area 1	200	3.7%	43.7%
	Receptor Area 2		3.9%	46.1%
24-hour average NO_2	Receptor Area 1	100	1.2%	44.6%
	Receptor Area 2		0.6%	45.0%

8.4 Summary of Operational Effects

The results of the air dispersion modelling show the following:

- Vehicle emissions from the construction and operation of the project are predicted to have only a negligible impact on the air quality concentrations compared to ambient air quality criteria concentration levels in the Package 1 area.

[22] NZTA, 2019. *Guide to assessing air quality impacts from state highway projects*.

- Maximum cumulative air contaminant concentrations are not predicted to exceed any of the relevant air quality criteria at any of the impacted sensitive receptors.
- The air quality impact of the 'with project' and 'do minimum' scenarios are predicted to be similar. The modelling indicates the project would have a negligible impact at the nearby dwellings compared to what would otherwise occur.
- The impact of vehicle emissions on ambient air quality is predicted to decrease over time which would result in an improvement of air quality as the emission performance of the vehicle fleet improves, including the move to electric powered vehicles.

Overall, this assessment concludes that the operational effects of Package 1 would not have any adverse health or environmental effects.

9 Recommendations

9.1 Construction Effects

Construction work will occur near dwellings in the Package 1 project areas. The dust generated from the works may potentially have an adverse nuisance effect on residents. To mitigate this appropriate dust mitigation is proposed to be implemented and maintained throughout the project construction. It is recommended that dust mitigation is implement through DMPs for the Package 1 development. The DMPs should generally be compliant with Schedule 2 of the CARP.

9.2 Operational Effects

The maximum contribution of vehicle emissions to ambient air contaminant concentrations is predicted to be minimal (relative to ambient air quality criteria) in the Package 1 project area. The contribution from vehicle emissions to ambient predicted air quality contaminants is expected to decrease over time as the emission performance of the vehicle fleet improves.

The result of the assessment indicates that no additional mitigation of air quality effects from operation of the project is required and has not been recommended. Similarly, no ambient air quality monitoring of operational effects has been recommended.

10 Conclusions

The State Highway 1 Rolleston Access Improvement Project is intended to improve the safety of highway intersections and the connectivity of the Rolleston community. For the purposes of programming, the project is split into two packages of work, namely Package 1 and Package 2.

The primary air quality concern during construction is the emission of dust (particulate matter). The emitted dust has the potential to have an adverse nuisance effect at the residential dwellings located adjacent to the proposed works. The risk of a nuisance effect decreases with increasing separation distance. At a distance of 50m or more, the risk is expected to be low.

Potential adverse dust effects can be minimised by implementing standard dust control procedures. Provided these procedures are strictly maintained any discharges during construction would not be expected to have an offensive or objectionable effect.

It is recommended that dust control procedures in the Package 1 project area are implemented through a DMP. The DMP should generally be compliant with Schedule 2 of the CARP.

During operation, the primary discharge to air will be vehicle emissions. The contaminants of most concern are PM_{10}, $PM_{2.5}$, and NO_2. The impact of these discharges has been assessed using atmospheric dispersion modelling methods based on the 2028 traffic flows when peak vehicle emissions are predicted to occur.

The results of the modelling indicate that the air quality effects of the ‘with project’ 2028 traffic scenario (assuming the project is completed) are comparable to those predicted for the ‘do minimum’ 2028 traffic scenario. The cumulative contaminant concentrations are also not predicted to exceed the relevant air quality contaminant concentration criteria at any of the sensitive receptors in the Package 1 project area.

Vehicle emission rates are predicted to decrease over time. Therefore, the contribution from vehicle emissions to ambient air contaminant concentrations in the Package 1 project area are also expected to decrease over time, even though some increase in traffic volumes is predicted.

Overall, the results indicate that vehicle emissions from the project would <u>not</u> have an adverse health or environmental effect.

A

Appendix A – Seasonal distribution of hourly wind speeds and directions

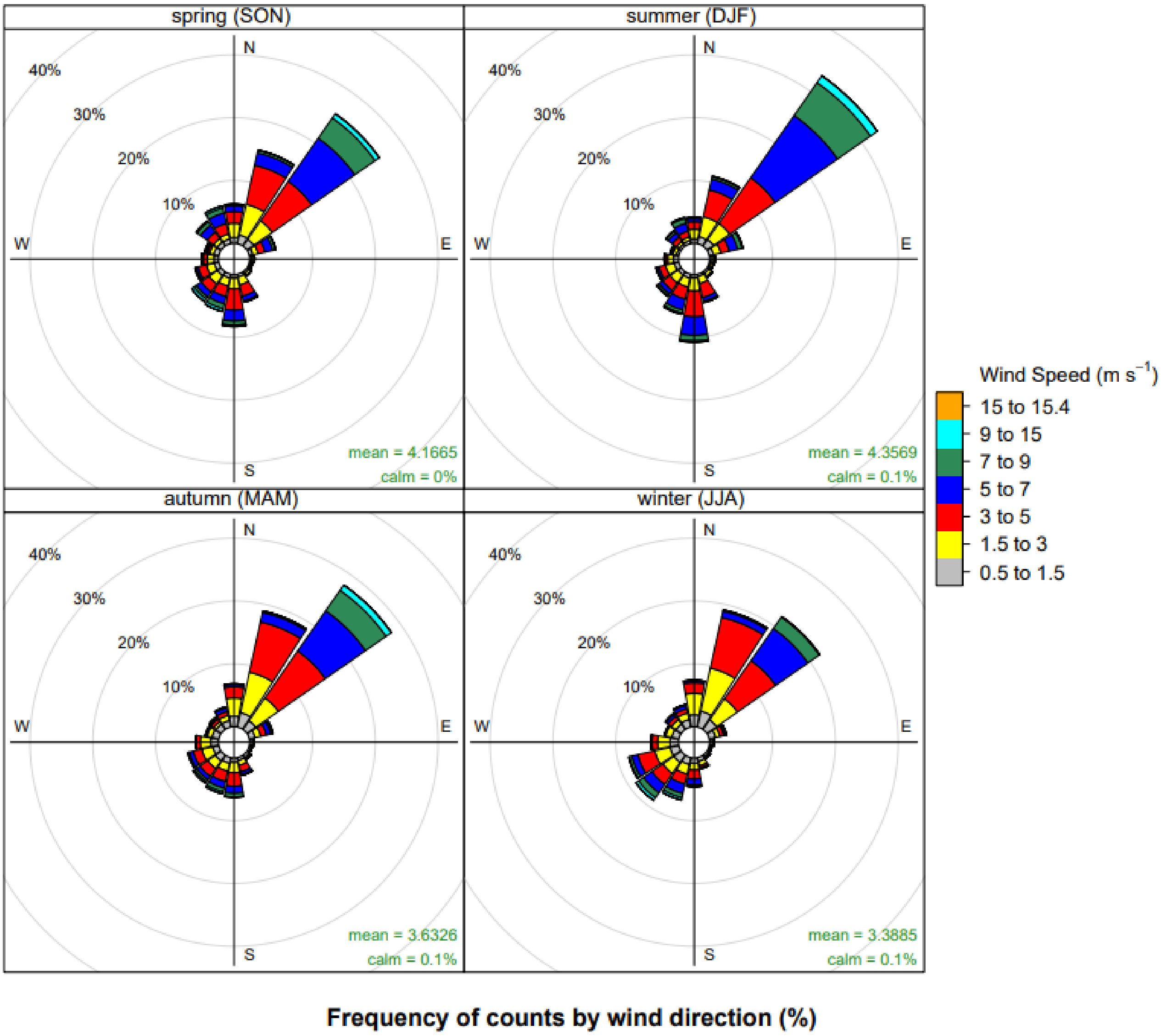

Figure A 1. Seasonal distribution of hourly wind speeds and directions (Lincoln EWS 2019-2023).

B

Appendix B – Dispersion modelling methodology

Dispersion Modelling Methodology

Model Selection

The AERMOD (v23132) dispersion model has been used to predict the downwind concentration of contaminants emitted from motor vehicles. AERMOD was run using the Lakes Environments graphical user interface AERMOD View (v12.0).

AERMOD is a steady state Gaussian dispersion model that incorporate "state-of-the-art" modelling concepts. The model uses more advanced modelling procedures than the older Gaussian models (such as AUSPLUME and ISC3), to simulate pollutant dispersion. Key differences from other models are the derivation of dispersion curves from micro-meteorological conditions, the improved treatment of terrain effects, the modelling of thermal updraft and downdrafts during daytime convective conditions, and the vertical representation of the atmosphere's structure.

AERMOD was adopted by the US EPA as its preferred regulatory model in 2005 and replaced AUSPLUME as the regulatory air dispersion model of EPA Victoria, on 1 January 2014.

AERMOD has been constantly updated since it was first published. These updates have included improvements to how the model simulates the critical low wind speed conditions and has recently incorporated RLINE-EXT sources. RLINE-EXT sources were developed by USEPA to better simulate vehicle emissions from roadways.

Model Emission Scenarios

In this assessment, vehicle emissions for the 2028 'with project' and 2028 'no minimum' traffic scenarios have been modelled for the Package 1 project area. Although traffic volumes are expected to increase in 2038, overall vehicle rates are predicted to decrease due to improvement in the vehicle fleet. Therefore, the modelled 2028 traffic scenarios represent worst-case emission conditions, when vehicle emissions from the project are expected to have the greatest impact on ambient air quality contaminant concentrations.

Modelled Emission Rates

Vehicle emission rates been been calculated using the VEPM v7.0 emission model based on the predicted ADDT traffic flows, percentage of heavy vehicles and average vehicle speeds.

Vehicle emission rates have been assumed to vary on an hour-by-hour basis based on the change in traffic volume. In this assessment, same diurnal traffic pattern (as a % of the AADT) has been assumed for all the modelled road sources. Variations in diurnal flow, to those assumed in the model, would not be expected to have any impact on the overall conclusions drawn from the model predictions.

The assumed diurnal traffic profile is shown in Figure B1. The diurnal profile has been derived from SH1 traffic counts taken at Weedons Ross Rd intersection between August and October 2023.

Emission rates have been calculated for each model road link based on an average daily vehicle flows derived from the traffic modelling. The average vehicle speed has been rounded to the nearest 5 km/hr.

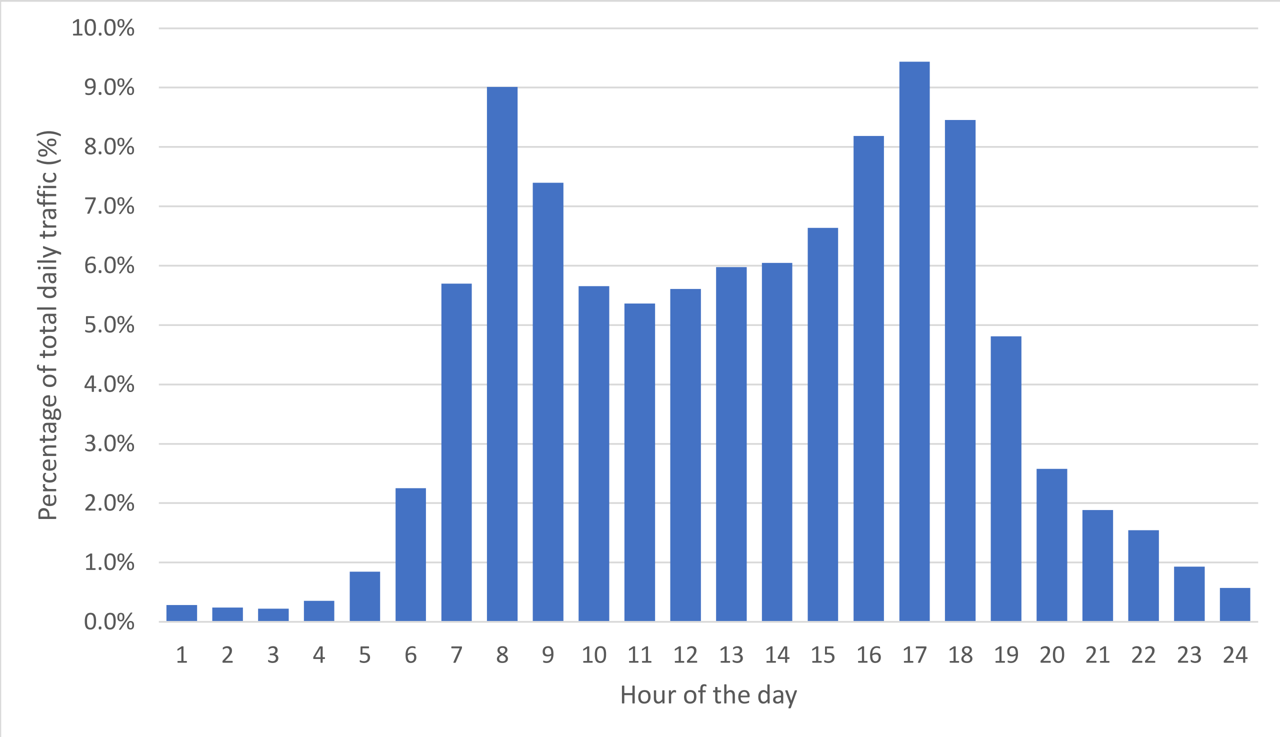

Figure B1. Modelled diurnal traffic profile (% of daily traffic volume by hour of day)

Model Configuration

Source Configuration

Road sources have been simulated as RLINE-EXT emission sources. The RLINE-EXT sources have been configured in accordance with guidance provided by the US EPA[23].

The USEPA recommends defining the width of RLINE-EXT emission sources as either, the width of the road or the width of the road plus 3m on either side. The later approach is designed to account for the mixing effect of traffic turbulence. In this assessment, the more conservative approach has been taken and the width of the road source has been used. This approach is expected to underestimate the initial mixing of the emission plume due to traffic turbulence and is therefore likely to overestimate downwind contaminant concentrations in the vicinity of the road. Each lane is assumed to have a default width of 3.5m.

The initial vertical dimension (**VD**) of the emission plume is calculated as 1.7 x the average vehicle height. For this assessment, the US EPA default average vehicle heights of 1.53m for light duty vehicles and 4.0m for heavy-duty vehicles are assumed. Based on the traffic modelling, approximately 10% of the traffic volume using SH1 is expected to be heavy vehicles. Therefore, for the modelling a VD of 3.0m (i.e. 1.7*(1.53*90%+4.0*10%)) has been assumed for all of the modelled road sources.

The initial vertical dispersion coefficient has been calculated by dividing the VD by a factor of 2.15. Therefore, the modelling has assumed an initial vertical dispersion coefficient of 1.40 m for all the modelled road sources.

The release height has been defined as half the VD, or 1.5 m.

Table B1 summarises of the modelled road source dispersion parameters.

[23] USEPA, 2021. *PM Hot-spot Guidance. Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas*

Table B1. Summary of modelled RLINE source parameters

Parameter	Value
Width (per lane)	3.5 m (default value)
Initial vertical dimension	3.0 m
Initial vertical dispersion coefficient	1.4 m
Release height	1.5 m

Package 1

The road sources included in the Package 1 2028 ‘with project’ and 2028 ‘do minimum’ dispersion models are shown in Figure B2 and Figure B3.

Figure B2. Package 1 “with project” dispersion model road sources

Figure B3. Package 1 “do minimum” dispersion model road sources

Meteorological Input

Accurate atmospheric pollutant dispersion modelling requires good meteorological information that is representative of dispersion conditions near the emission sources, which is then processed into a format that can be used by the dispersion model. For this assessment, meteorological inputs have been constructed for AERMOD using the associated US EPA meteorological model AERMET (v23132). AERMET was run using Lakes Environmental graphical user interface meteorological modelling programme AERMET View (v12).

AERMET was used to generate the surface and upper air AERMOD meteorological input files for the simulation period of 1 Jan 2019 to 31 Dec 2019. Although meteorological conditions vary between years, the modelled simulation period is representative of typical dispersion conditions in the vicinity of the site.

The AERMOD meteorological input file was developed primarily from the hourly average wind speeds and wind directions observed at the Lincoln AWS meteorological monitoring station. Additional meteorological inputs for AERMET were constructed using the TAPM (‘The Air Pollution Model’) meteorological model (v4.0.5). TAPM, developed by Commonwealth Scientific and Industrial Research Organisation (CSIRO), is a sophisticated computer model that predicts the air flows that are important to local scale air pollution, such as sea breezes, against a background of larger scale synoptic meteorological patterns.

One of the primary functions of the TAPM model's design is the provision of high-quality meteorological data for dispersion models, such as AERMOD, where suitable onsite information is not available. Validation studies conducted by CSIRO show that TAPM can accurately predict localised meteorological conditions.

Hourly average meteorological parameters for AERMET were extracted at the approximate location of the pump station site. Meteorological parameters extracted from the TAPM model were:

- Temperature
- Relative humidity
- Net radiation
- Mixing height
- Station pressure
- Temperature difference between 10 m and 25 m above ground

AERMET was configured in accordance with guidance provided by Victoria Environmental Protection Agency (Vic EPA). The predicted AERMET wind speed and wind direction distribution is shown in Figure B6.

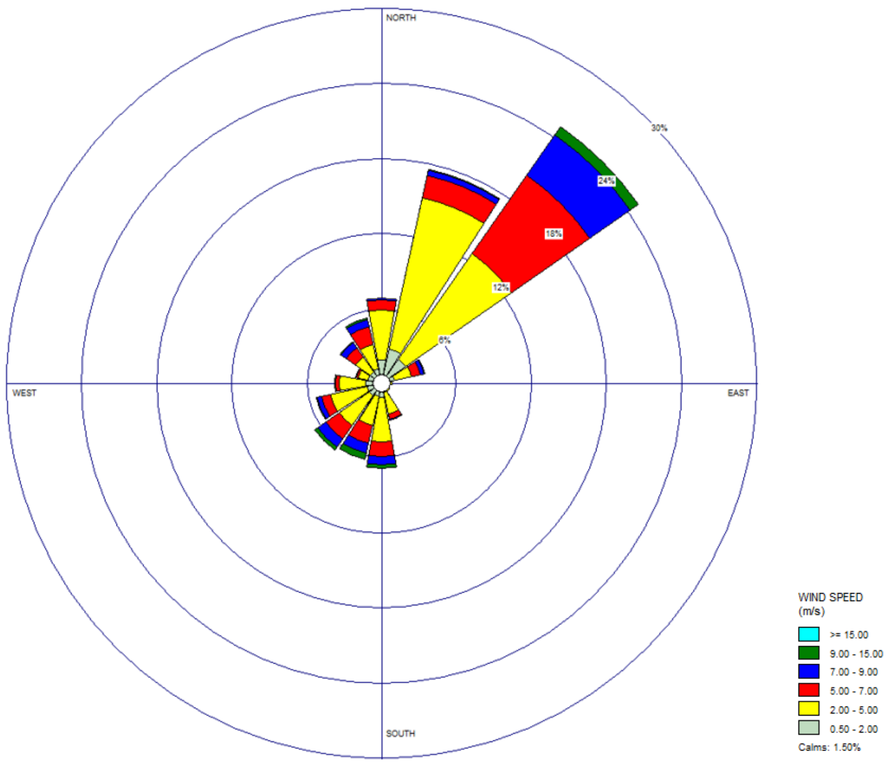

Figure B4. AERMET wind rose for 2019

Topography

The Package 1 and 2 project areas are comparatively flat. There are no significant topographical features in the project which would be expected to influence the dispersion and downwind concentrations of pollutant emitted from the modelled road sources. Therefore, terrain effects have not been included in the model.

Conversion of NO to NO_2

NO_2 is primarily responsible for the adverse health effects associated with combustion-generated NO_x emissions. The NO_2 emitted directed to air from vehicle exhausts is called **primary NO_2**. However, the emitted NO, which constitutes approximately 80-85% of NO_X emitted, may be oxidised to NO_2 in the atmosphere in the presence of oxidants such as ozone (O_3). The NO2 which is formed is called **secondary NO_2.**

The proportion of emitted NO_X, which is converted to NO_2, is determined by several factors including the following:

- The availability of ozone in the atmosphere to react with NO_2
- The proportion of NO_X which is emitted in the form of NO_2
- The reaction rate of NO and ozone
- The reverse photo-disassociation rate of NO_2 to NO and ozone in the presence of sunlight.

Peak NO_2 concentrations occur near road sources (i.e. near the curb side). At these locations, the travel time of the emitted vehicle emissions is in the order of seconds and therefore little secondary NO_2 is formed. In this assessment, the maximum contribution of vehicle emissions to ambient NO_2 concentrations at the dwelling close to the road have been assumed to be only the primary NO_2.

Cumulative Concentrations

Maximum cumulative contaminant concentrations have been calculated by summing the default background concentrations described in Section 5.5.3 with the predicted maximum contribution from the modelled road sources.

99.9 Percentile 1-hour Average Concentration

The use of 99.9 percentile, 1-hour averages is a standard dispersion modelling convention used to assess predicted pollutant 1-hour average concentrations. The 99.9 percentile 1-hour average concentration corresponds to the ninth highest 1-hour average concentrations predicted at each receptor point over the simulated meteorological year. The use of the 99.9 percentile, 1-hour average is intended to filter out improbably high concentrations that may be predicted due to extreme meteorological events. The *Good Practice Guide for Atmospheric Dispersion Modelling* (MfE, 2004) advises that the predicted 99.9 percentile concentration is the maximum ground-level concentration that is likely to occur.

C

Appendix C – Dispersion modelling results

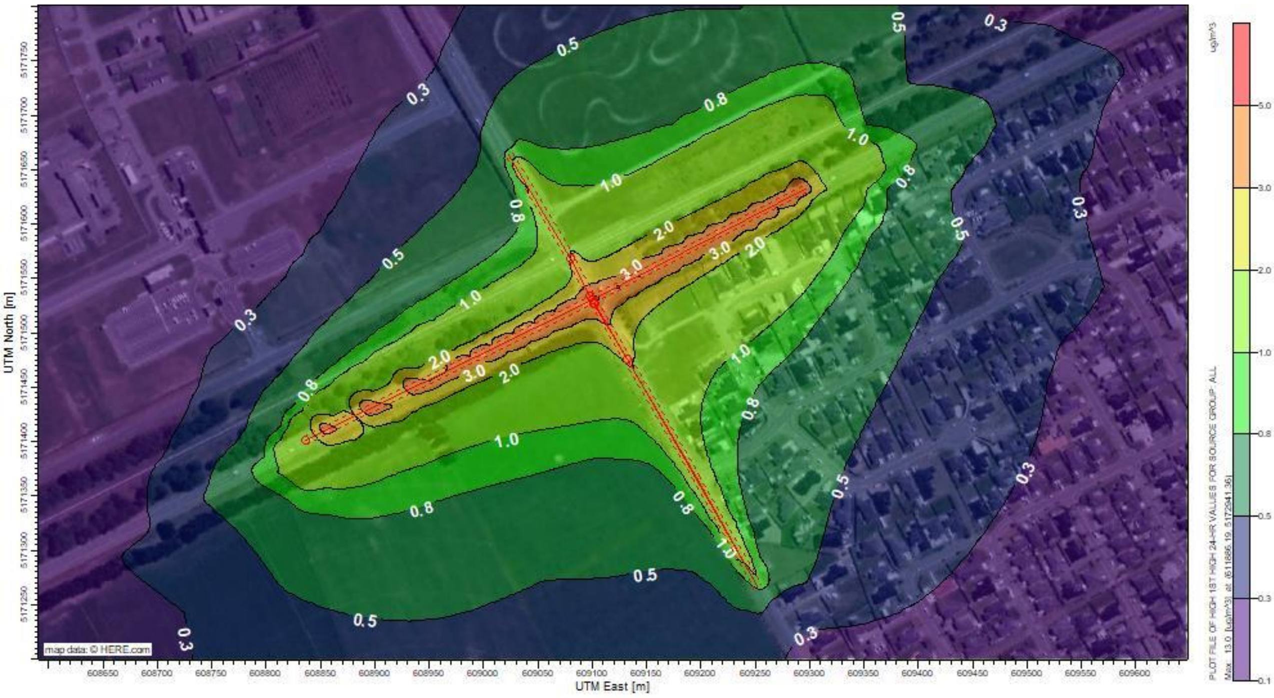

Figure C 1. Package 1 ‘Do Minimum’ predicted maximum 24-hour average PM_{10} concentrations (µg/m³)

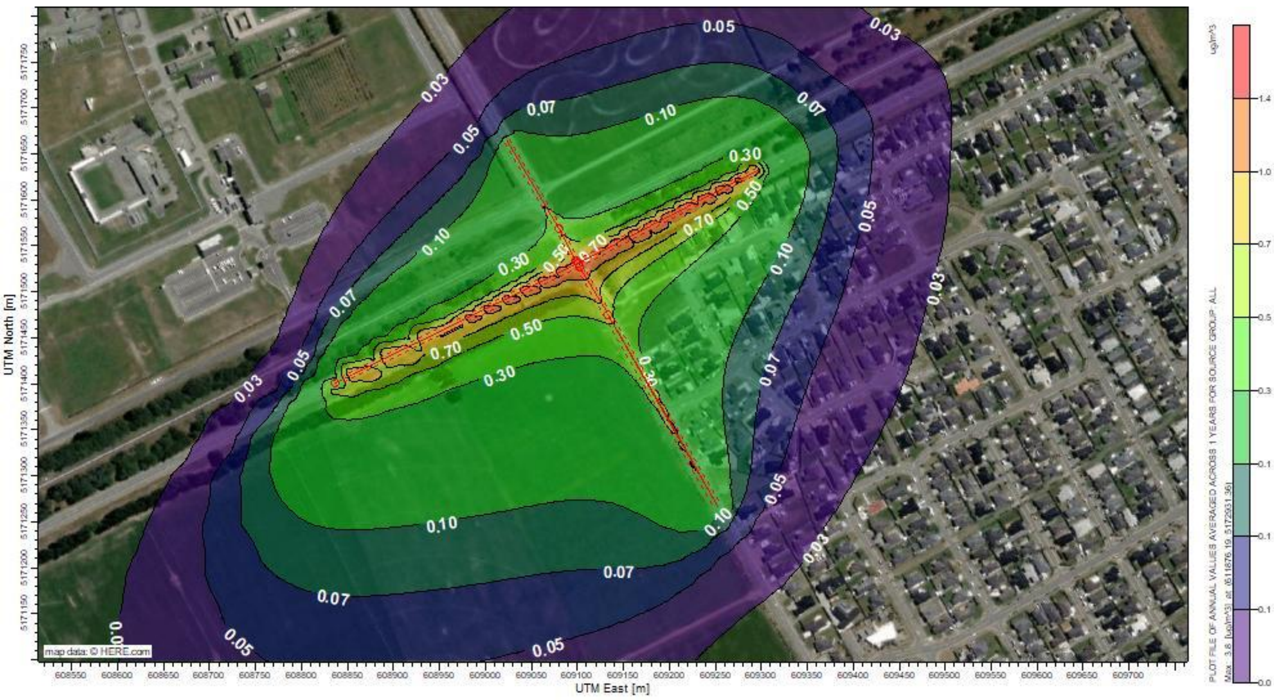

Figure C 2. Package 1 ‘Do Minimum’ predicted annual average PM_{10} concentrations (µg/m³)

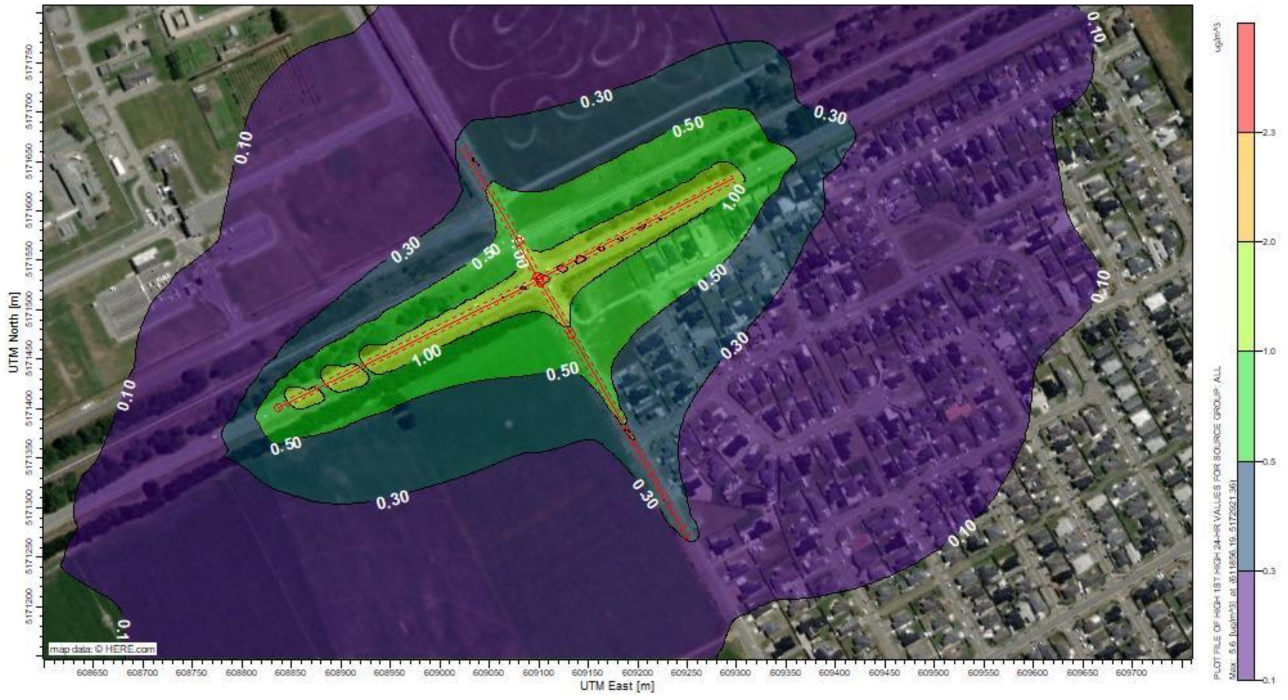

Figure C 3. Package 1 'Do Minimum' predicted maximum 24-hour average $PM_{2.5}$ concentrations (µg/m^3)

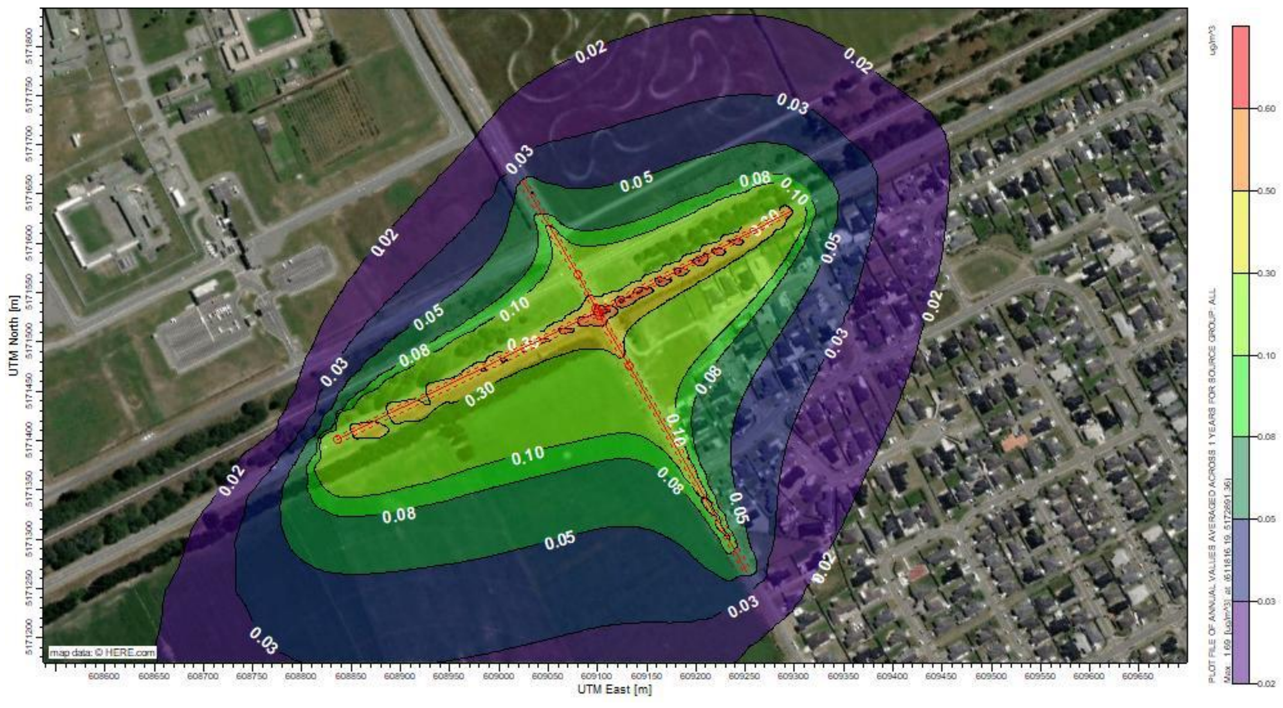

Figure C 4. Package 1 'Do Minimum' predicted annual average $PM_{2.5}$ concentrations (µg/m^3)

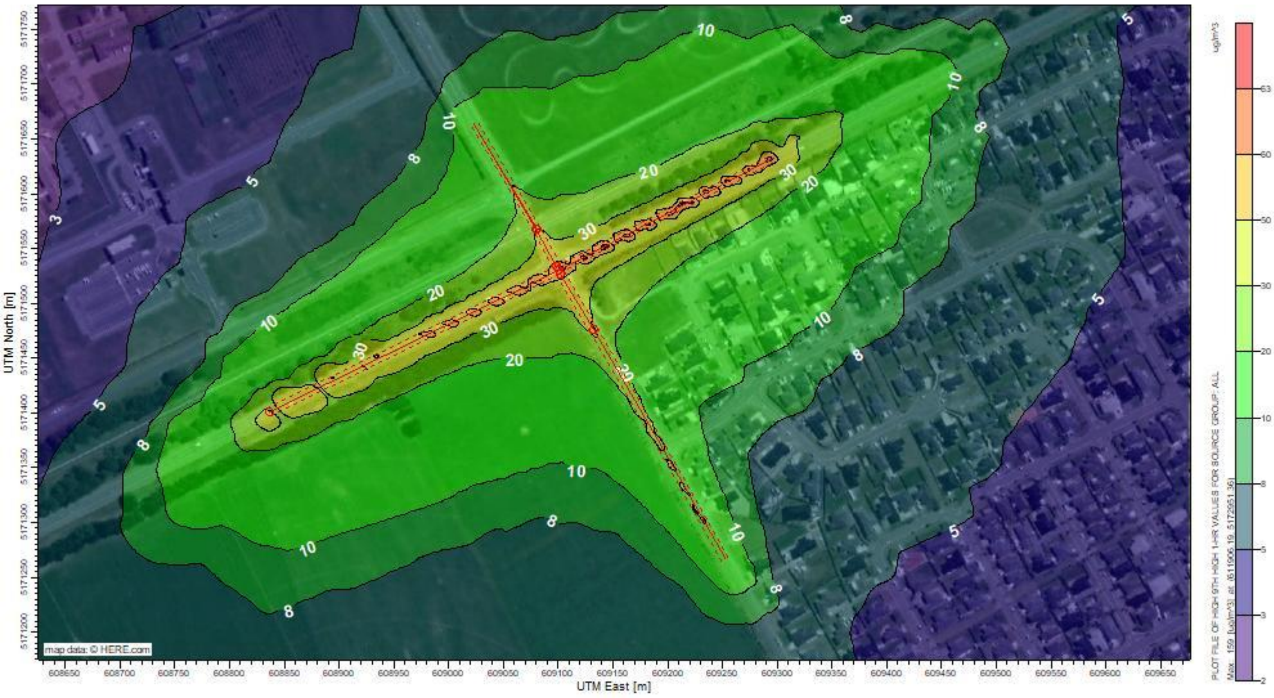

Figure C 5. Package 1 ‘Do Minimum’ maximum 99.9 percentile 1-hour average predicted annual average NO_2 concentrations (µg/m³)

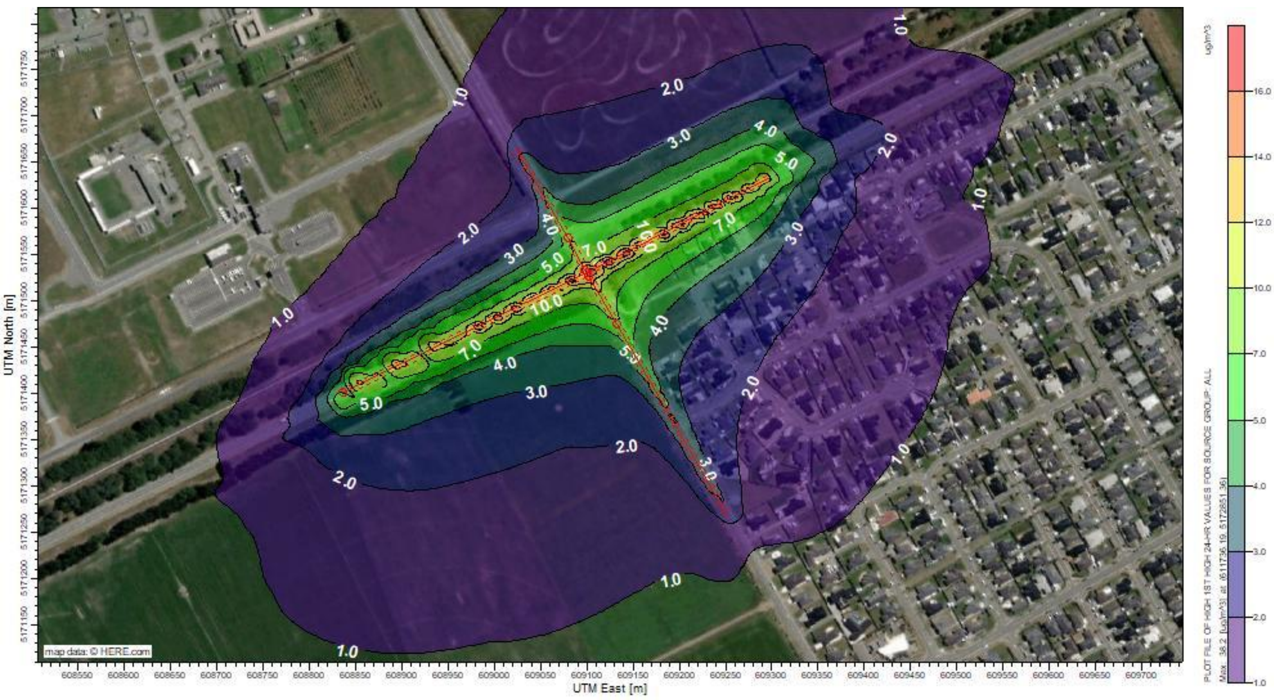

Figure C 6. Package 1 ‘Do Minimum’ maximum 24-hour average predicted annual average NO_2 concentrations (µg/m³)

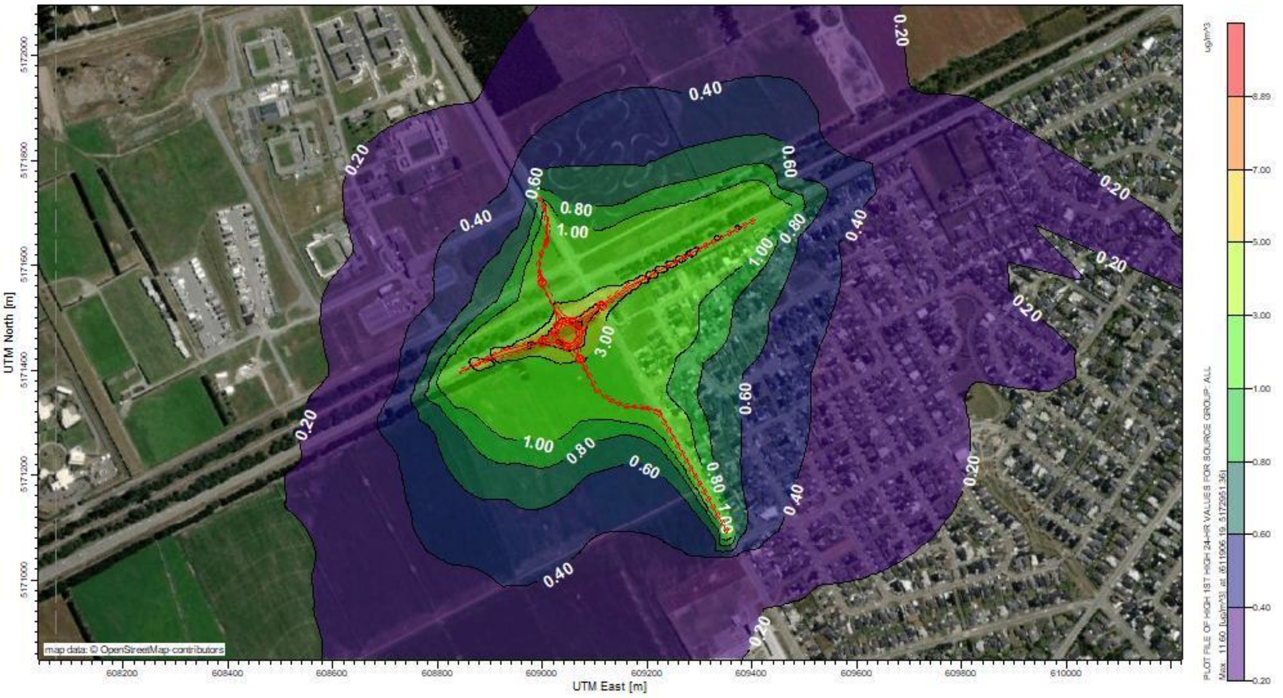

Figure C 7. Package 1 'With Project' predicted maximum 24-hour average PM_{10} concentrations (μg/m³)

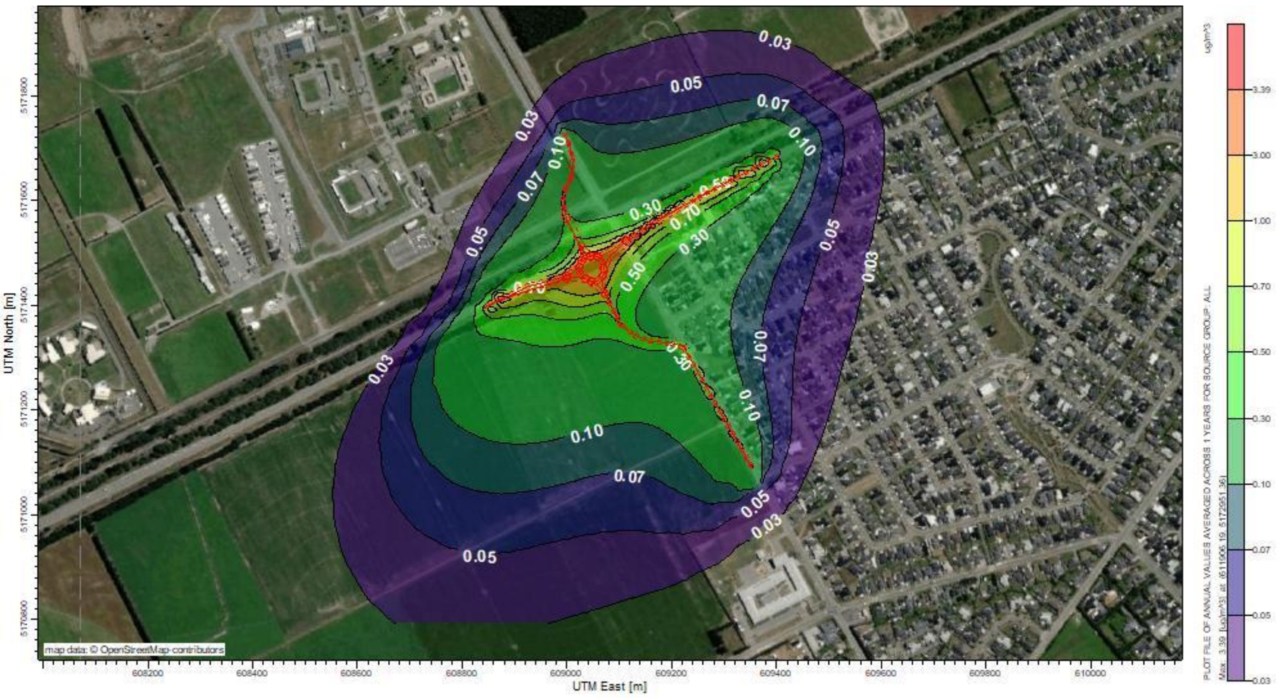

Figure C 8. Package 1 'With Project' predicted annual average PM_{10} concentrations (μg/m³)

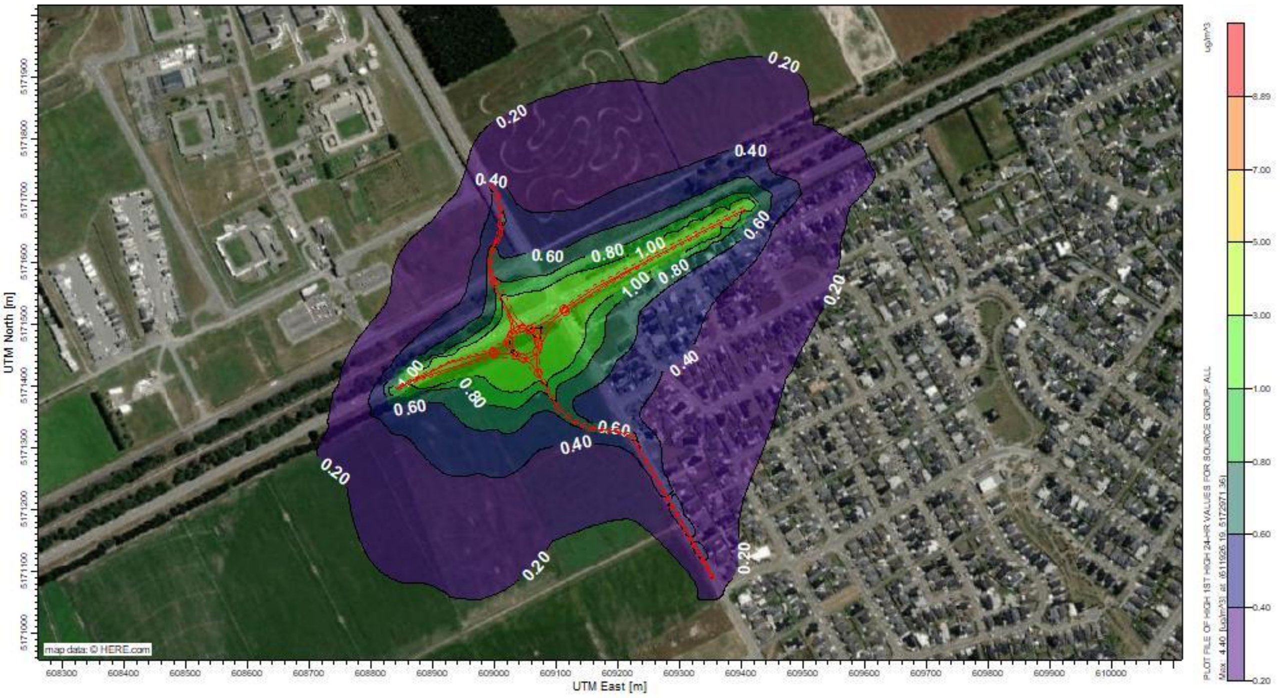

Figure C 9. Package 1 ‘With Project’ predicted maximum 24-hour average $PM_{2.5}$ concentrations (µg/m^3)

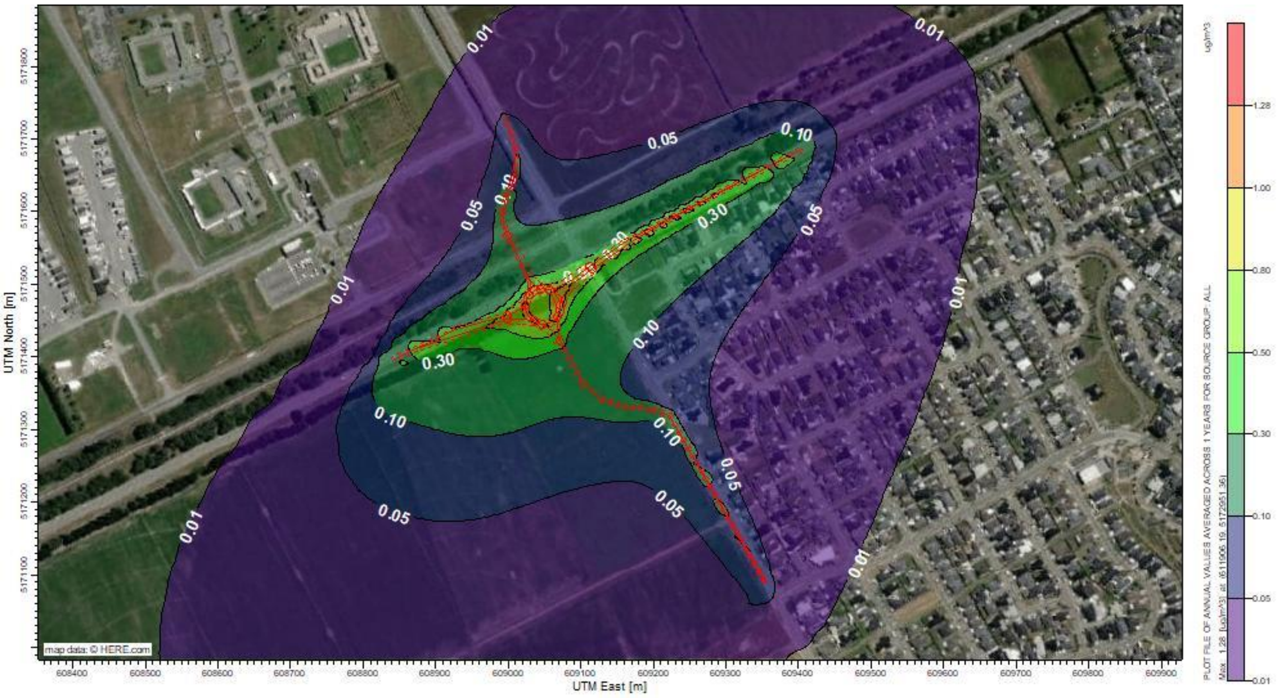

Figure C 10. Package 1 ‘With Project’ predicted annual average $PM_{2.5}$ concentrations (µg/m^3)

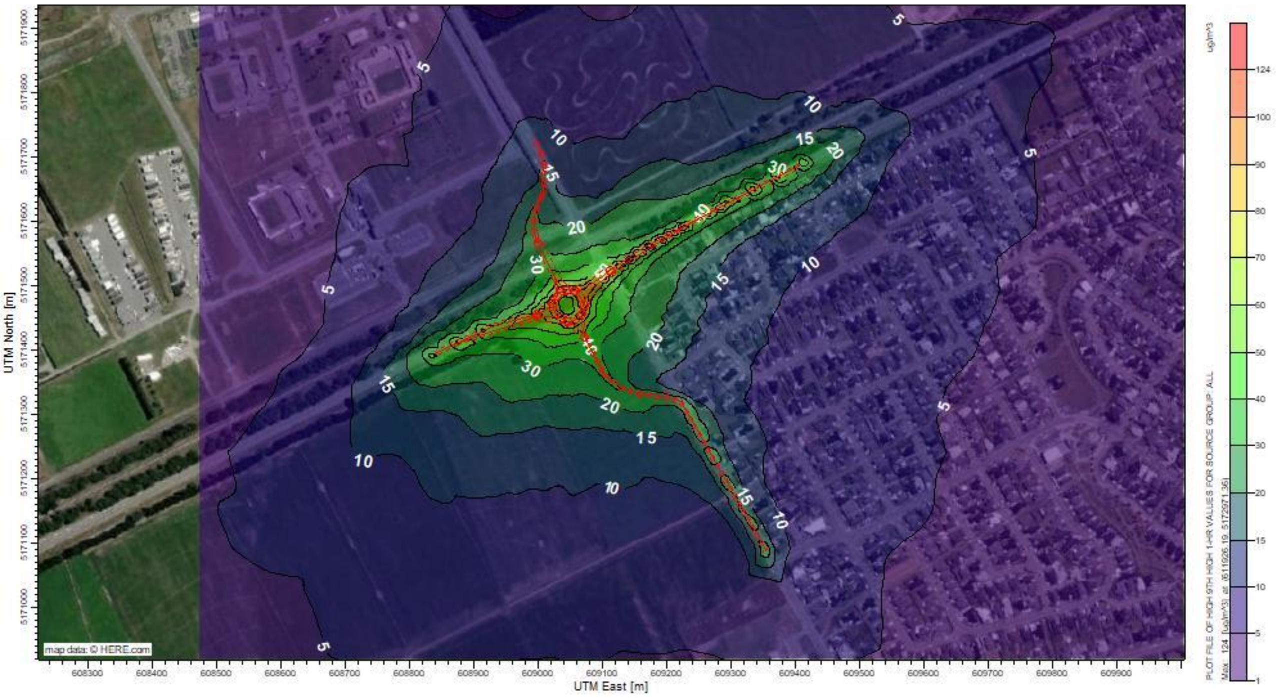

Figure C 11. Package 1 'With Project' maximum 99.9 percentile 1-hour average predicted annual average NO_2 concentrations (µg/m³)

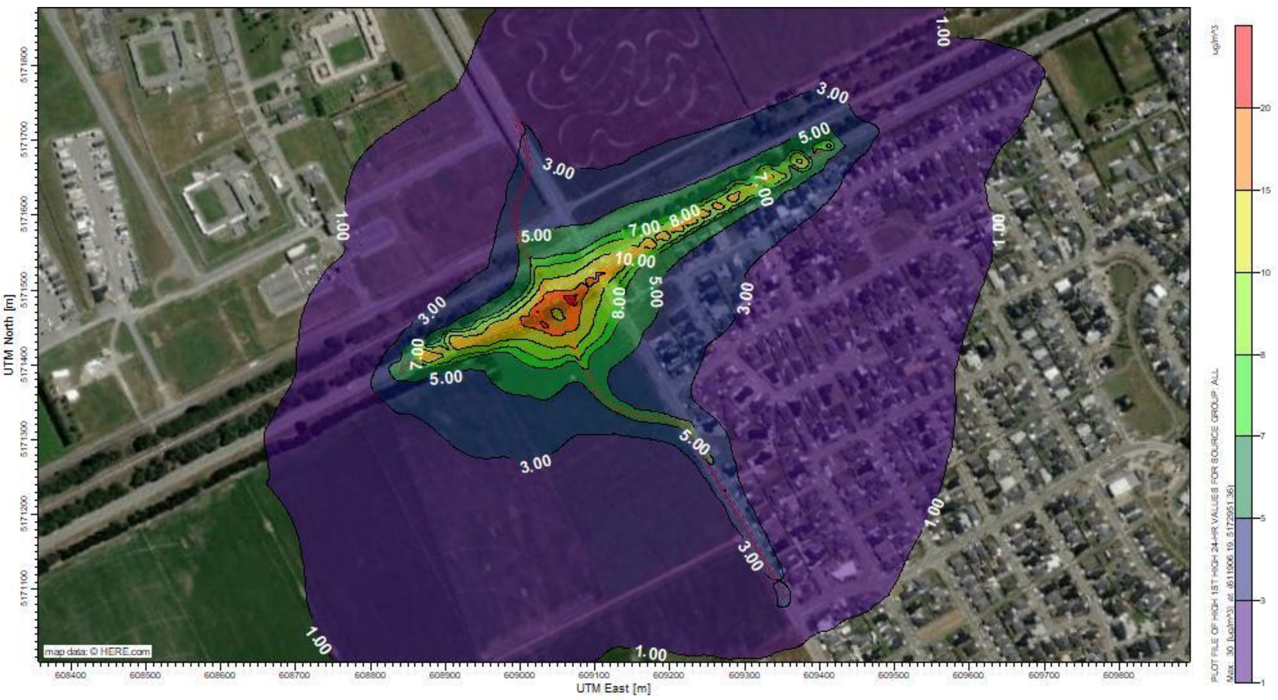

Figure C 12. Package 1 'With Project' maximum 24-hour average predicted annual average NO_2 concentrations (µg/m³)