Report

Technical Report to support Assessment of Environmental Effects (Notice of Requirement): Air Quality Assessment

Prepared for Auckland Transport (Client)

By Beca Carter Hollings & Ferner Ltd (Beca)

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Revision History

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Action	Name	Signed	Date
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1 Glossary of Terms

AEE	Assessment of Environmental Effects
ALWP	Auckland Council Regional Plan: Air, Land and Water (2012), which became partially operative in 2010 with further sections becoming operative in April 2012
AQNES	Resource Management (National Environmental Standards for Air Quality) Regulations 2004
CEMP	Construction Environmental Management Plan
Chainage	An imaginary line used to measure distance from a specified starting point
CRL	City Rail Link
CPO	Chief Post Office
Cut and Cover Tunnel (or box)	A form of construction for a box-shaped tunnel where a trench is excavated within which the tunnel is constructed and then the trench is backfilled and the surface restored
Diaphragm Wall	A technique for forming retaining walls by constructing a reinforced concrete wall within a trench excavation of the width of the wall.
Driven Tunnels	Tunnels constructed using mechanised tunnel boring machine (TBM).
EF	Environmental Framework
EMP	Environmental Management Plan
HAPs	Hazardous air pollutants
FIDOL	Factors used in the assessment dust or odour discharges: ▪ 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
Hazardous air pollutants	Includes fine particles (PM_{10} and $PM_{2.5}$) and a wide range of chemicals that may cause adverse effects on human health
MfE	Ministry for the Environment
MfE Dust GPG	Ministry for the Environment Good Practice Guide for the Assessment of Effects of Dust
MfE Transport GPG	Ministry for the Environment Good Practice Guide for Assessing Discharges to Air from Land Transport
mg/m^3	Milligrams per cubic metre
$\mu g/m^3$	Micrograms per cubic metre
Mined Tunnel	Tunnelling method utilising a road header or similar technology to create open underground space combined with steel and concrete lining systems and rock bolting installed in a predetermined sequence.
NAL	North Auckland Line
NoR	Notice of Requirement
NZAAQG	New Zealand ambient air quality guidelines
PM_{10}	Fine particulate matter with an aerodynamic diameter of less than 10 micrometres

$PM_{2.5}$	Fine particulate matter with an aerodynamic diameter of less than 2.5 micrometres
RAQT	Regional Air Quality Targets
Road header	An excavating machine with a rotating head mounted on crawler tracks developed for cutting a wide range of medium to hard rocks in underground mining and tunnelling.
Sensitive Receptor	Sensitive receptors include residential areas, schools, childcare facilities, hospitals and, in respect to dust discharges, office and retail premises and places of worship.
Strata (designation)	Designation of land layer between the ground surface and the sub-strata designation. This starts at a nominated distance below the surface and extends down to meet the sub-strata designation (the tunnel envelope)/
Sub-strata (designation)	Designation of land starting below the strata designation to the centre of the earth (provides for the rail tunnels)
Surface (designation)	Designation of the ground surface (including air space above the land below to the centre of the earth).
Top-down Method	In the top-down method of construction, the structural roof is constructed first and supported by embedded walls and plunged columns and the ground surface is reinstated except for access openings.
Tunnel Boring Machine (TBM)	A mechanically operated machine used to excavate a tunnel with a circular cross section through a variety of ground strata.

2 Executive Summary

Beca Carter Hollings and Ferner Ltd (Beca) has been commissioned by Auckland Transport to prepare an assessment of air quality effects in relation to the City Rail Link (CRL). The assessment of air quality effects is to support Notice of Requirement documentation (NoR), in the form of a technical report to the Assessment of Environmental Effects (AEE), for the designation of the CRL.

The City Rail Link (CRL) is a 3.4km underground passenger railway (including two tracks and three underground stations) running between Britomart station and the North Auckland Line (NAL) in the vicinity of the existing Mount Eden Station and an additional 850m of track modifications within the NAL. For ease of reference in this report, the stations included in the CRL NoR have been temporarily named Aotea Station, Karangahape Station and Newton Station. The stations will be formally named in the future.

Because it is proposed to solely operate the CRL with electric trains (with the occasional diesel-hauled freight train for maintenance purposes), there will be no adverse effects on air quality or human health arising from the operation of the CRL. Irrespective, discharges of contaminants to air from trains are specifically permitted under the Auckland Council Regional Plan: Air, Land and Water, 2012 (ALWP).

Most of the surface construction activities required for the CRL are typical of many other large projects undertaken in the Auckland city centre. The mitigation techniques to be used are standard for these activities and reflect the general requirements of the Auckland City District Plan (Isthmus and Central Area Sections).

There will be a number of ventilation stacks to provide for ventilation of the tunnels and stations during normal operations. In certain emergency situations (e.g. fire), there may also be discharges of smoke via these stacks. Such discharges do not require consent under the District Plan or the ALWP.

Due to the close proximity of sensitive receptors (which include residential premises, childcare facilities and office and retail activities) to the proposed construction areas within the designation footprint for the CRL, a high standard of dust control and management must be employed to adequately avoid or mitigate the effects of discharges of construction dust.

An Environmental Management Plan (EMP) will be developed[1], which, in addition to defining dust mitigation requirements, will also define requirements for dust monitoring. This will include details such as the frequency of visual monitoring, locations of instrumental monitoring sites, complaint response procedures and identification of persons responsible for undertaking the monitoring. The aim of this monitoring programme is to assist the control and management of discharges of construction dust from the CRL. This will be augmented by a Construction Environmental Management Plan (CEMP) which will set out the specific work plans through which mitigation measures such as dust suppression techniques will be deployed to give effect to the requirements of the EMP.

Through the use of appropriate emissions control and good on-site management, potentially adverse effects caused by discharges of contaminants into air from the construction of the CRL can be adequately avoided or mitigated.

[1] Refer to Environmental Management Framework: CRL NoR Suite of documents, Volume 3, Appendix 1

3 CRL Description

1. The City Rail Link (CRL) is a 3.4km underground passenger railway (including two tracks and three underground stations) running between Britomart station and the North Auckland Line (NAL) in the vicinity of the existing Mount Eden Station and an additional 850m of track modifications within the NAL. For ease of reference in this report, the stations included in the CRL NoR have been temporarily named Aotea Station, Karangahape Station and Newton Station. The stations will be formally named in the future.

2. A more complete description of the CRL is provided in the Assessment of Environmental Effects (AEE)[2] which supports the NoR and the Concept Design Report.[3]

3. This technical expert report has been developed by Beca to provide an independent expert assessment of the actual and potential effects associated with the proposed CRL from an air quality perspective.

4. This City Rail Link Air Quality Assessment is Appendix 7 of Volume 3 – Technical Reports, which accompany the AEE in support of NoR to be served by Auckland Transport on Auckland Council to designate the CRL for future construction, operation and maintenance. The NoR covers surface land, strata land (protection area), and sub-strata land designations within the Auckland City District Plan (both Isthmus and Central Area Sections).

5. Beca confirms that the content of this report has been written with reference to the Key Project Parameters set out in the Concept Design Report.

[2] Assessment of Environmental Effects: CRL NoR Suite of documents, Volume 2

[3] Concept Design Report: CRL NoR Suite of documents: Volume 3, Appendix 13

4 Existing Environment

4.1 Overview

1. Although the NoR relates to a designation under the District Plans, from an air quality perspective the provisions of the Auckland Council Regional Plan: Air, Land and Water (ALWP) (Auckland Council 2012) must be considered.

2. The whole CRL area lies within an Urban Air Quality Management Area under the ALWP. Existing land uses and potential sensitive activities surrounding the two broad areas where major surface works are to be undertaken differ markedly from each other.

3. Much of the proposed route runs through the heart of the Auckland city centre, an area of dense, medium and high-rise commercial office, retail, hotels and apartment-style residential developments. The sections of the CRL between Ruru Street and the NAL, which are to be constructed by cut and cover methods, run through a medium intensity area with a mixture of commercial, light industrial and residential activities. A wide range of activities are sensitive to the effects of dust discharged from construction activities, including: retail (especially food retail), offices, schools and childcare facilities, short-term residential such as hotels and general residential activities.

4.1.1 What is a sensitive receptor?

1. Areas that are regarded as sensitive to dust discharges typically have significant residential development, whereas a heavy industrial area may be relatively insensitive to some discharges. Schools, preschools, healthcare facilities and certain types of commercial activities, such as office and retail premises, may also be regarded as sensitive receptors.

2. Based on the discussion regarding particle size in the Ministry for the Environment Good Practice Guide for the Assessment of Effects of Dust (MfE Dust GPG) (discussed later in section 6.2.1 of this report) and the results of research into dust entrainment, only premises within approximately 100m of significant dust sources have been considered as potentially sensitive receptors for assessing the effects of construction dust.

4.2 Meteorology

1. There are a number of meteorological monitoring sites located within the Auckland metropolitan area, although in recent years there has only been one in or close to the Auckland city centre (Khyber Pass, located at the junction of Khyber Pass Road and Mountain Road, which closed in July 2011). Meteorological data (wind speed and direction) from this site and the three other sites within 12km of the Auckland City centre (Khyber Pass, Lincoln Road, Penrose and Takapuna) were obtained from the CliFlo database[4] Figure 1 to Figure 4 show wind roses illustrating hourly average wind speeds and directions recorded at these four sites for the years 2006 and 2007. The locations of those sites relative to the CRL area are indicated on Figure 5. Brief descriptions for each of the sites are as follows:

[4] CliFlo: NIWA's National Climate Database on the Web. http://cliflo.niwa.co.nz/. Retrieval date 21 March 2012.

- Khyber Pass – meteorological instrumentation was located on the roof of the former NIWA building immediately southeast of the junction of Mountain Road and Khyber Pass Road, approximately 13m above ground level.
- Lincoln Road – the site is located at the entrance to Henderson Intermediate School. Meteorological instruments are mounted on a 6m mast. There are a number of trees (~8-10m tall, canopy ~6m diameter) less than 8m to the west and north of the monitoring site.
- Penrose – the site is located at the Gavin Street substation on open, level ground. Meteorological instruments are mounted on a 6m mast.
- Takapuna – the site is located at Westlake Girls High School on relatively open, level ground. Meteorological instruments are mounted on a 10m mast.

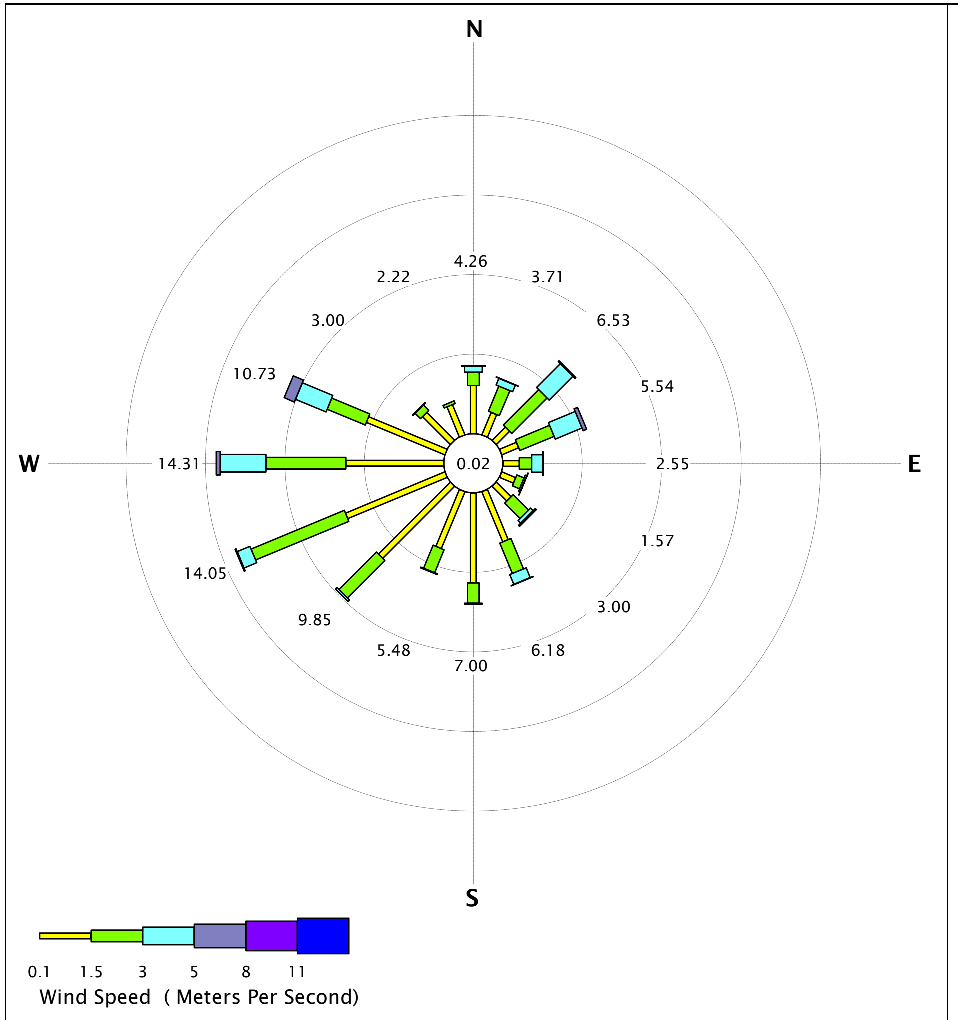


Figure 1 – Wind speeds and directions recorded in 2006-2007 at Lincoln Road, Henderson (hourly averages)

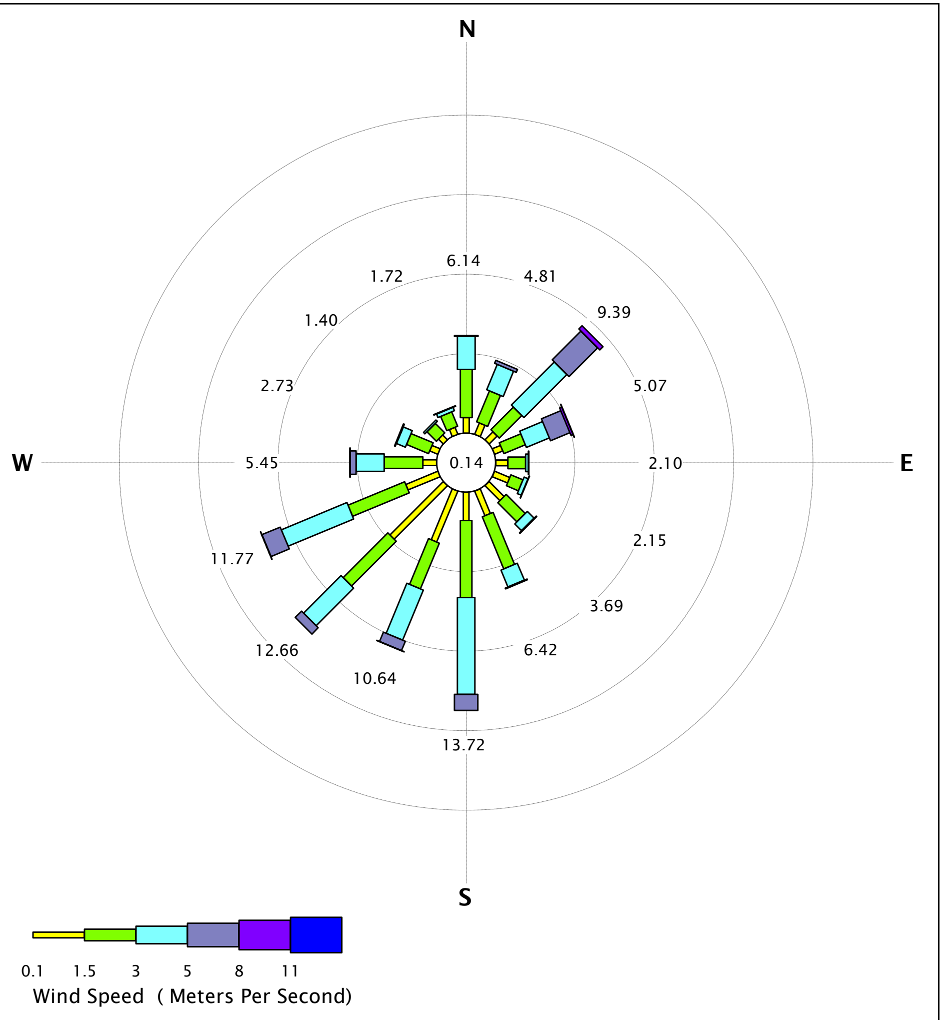


Figure 2 – Wind speeds and directions recorded in 2006-2007 at Khyber Pass (hourly averages)

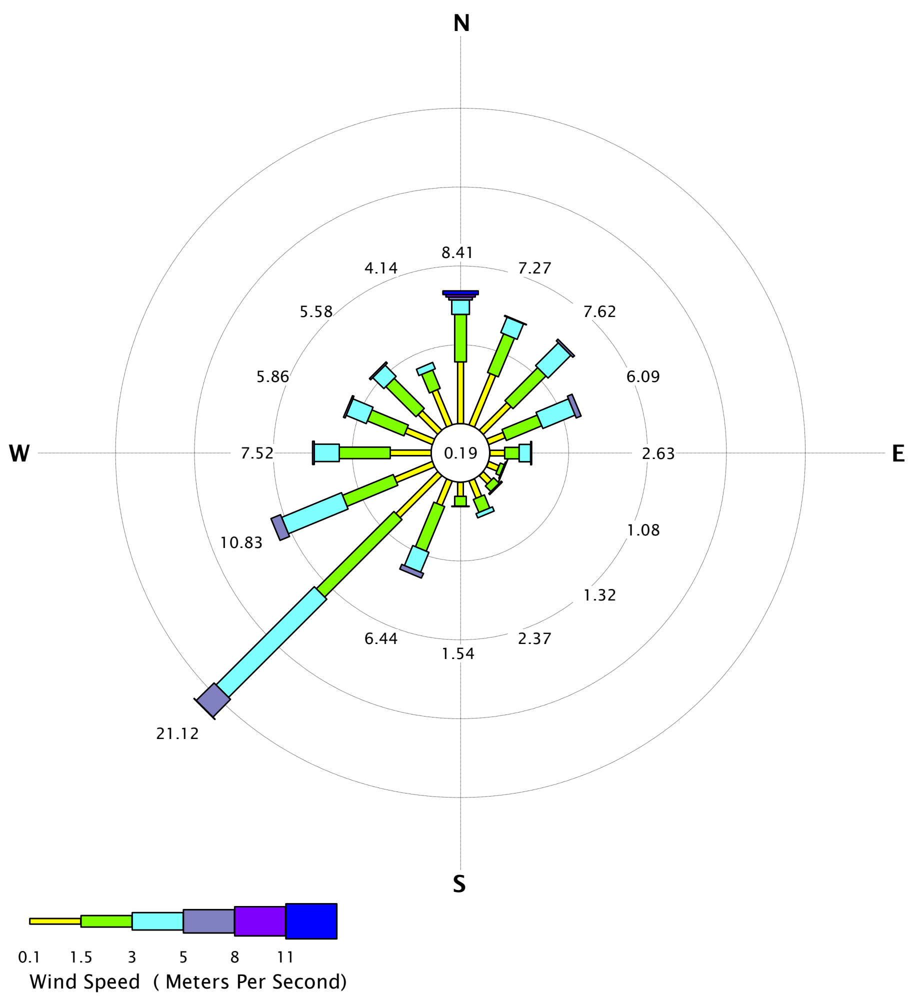


Figure 3 – Wind speeds and directions recorded in 2006-2007 at Penrose (hourly averages)

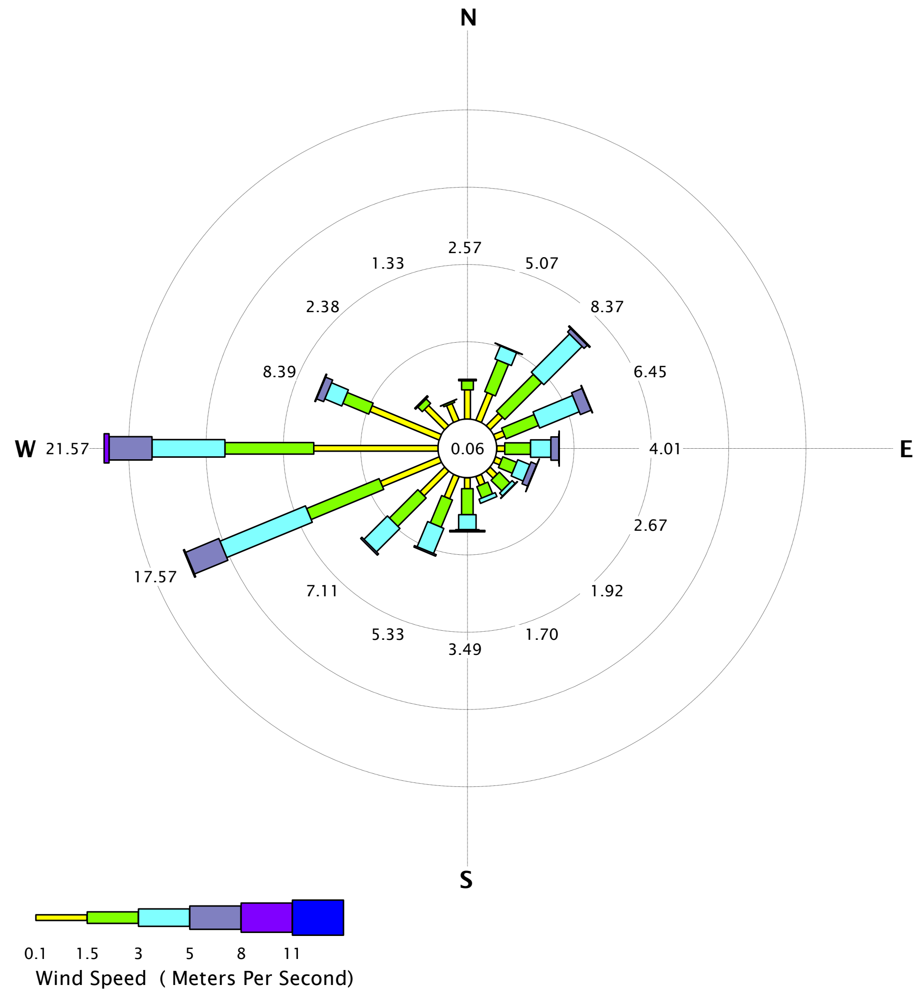


Figure 4 – Wind speeds and directions recorded in 2006-2007 at Takapuna (hourly averages)

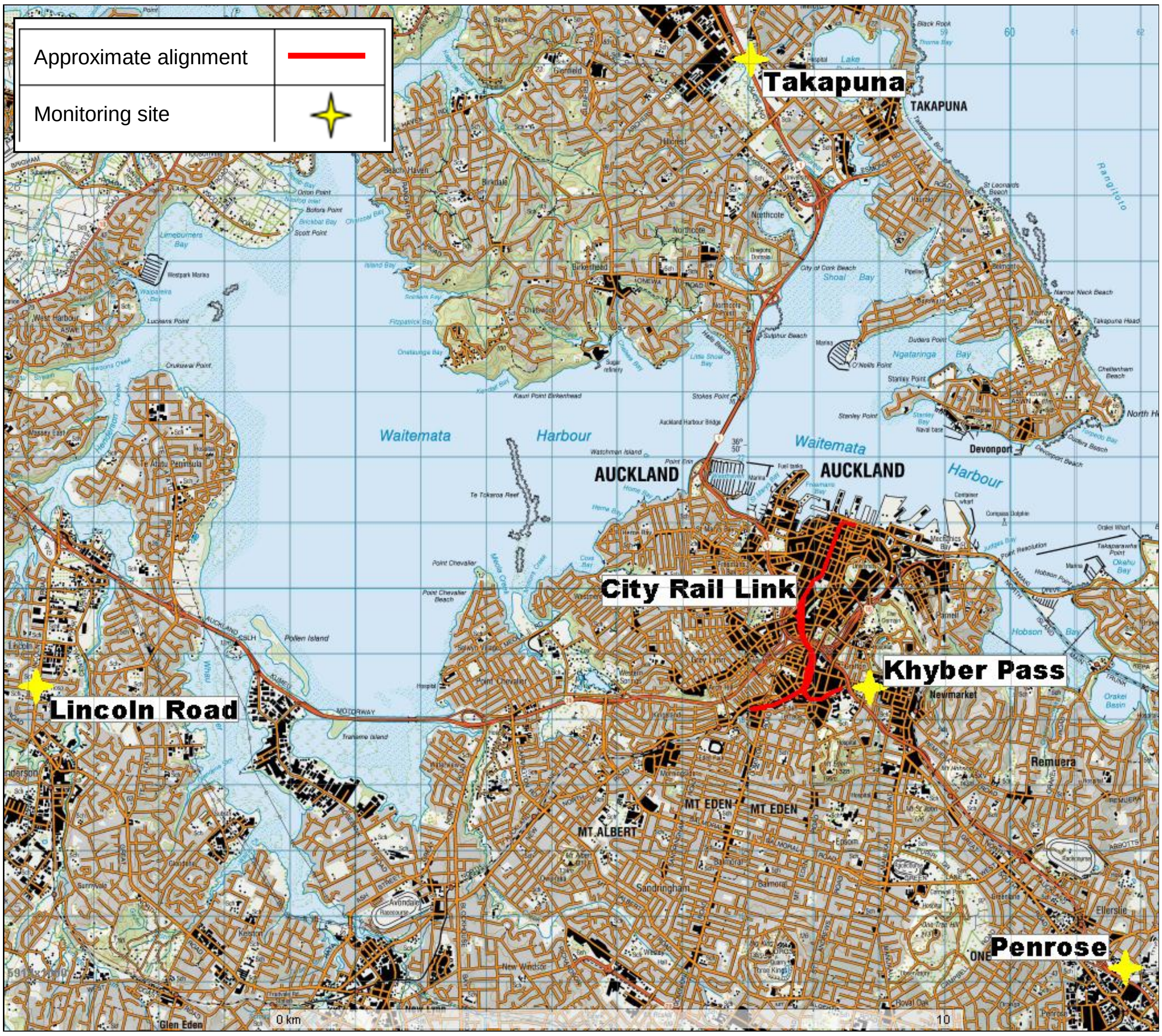


Figure 5 – Meteorological Monitoring Sites

2. An analysis of the wind speeds recorded at each of these sites indicates that, at all four sites, over 90% of recorded hourly average wind speeds were below 5 m/s and less than 1% exceeded 8 m/s. A greater proportion of average wind speeds in excess of 5 m/s were recorded at the Khyber Pass and Takapuna sites compared to Lincoln Road or Penrose, which is to be expected given the relative heights of the meteorological monitoring masts at those sites (13.8m and 10m compared to 6m). Close to ground level, interference from trees, structures and low level vegetation tends to reduce wind speeds.

3. The prevailing winds in the Auckland region tend to be from the southwestern and northeastern quarters. However, close to ground level in built-up areas – particularly in areas such as Auckland city centre with a large number of tall buildings – local wind directions are likely to be highly influenced by the local built environment.

4.3 Current Air Quality

4.3.1 Air Quality Zoning

1. The entire CRL area lies within the Auckland Metropolitan airshed, which has been gazetted as an airshed under the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (AQNES), because ambient concentrations of

PM_{10} within this zone occasionally exceed the AQNES threshold concentration of 50 µg/m^3. The CRL area is also located within the Urban Air Quality Management Area (AQMA) as defined in the ALWP.

4.3.2 Air Quality Monitoring

1. The Auckland Council operates a number of air quality monitoring sites across the Auckland region, including the four meteorological monitoring sites listed in section 4.2 and a site on Queen Street, adjacent to the junction with Wyndham Street.

2. The results of PM_{10}, NO_x and CO monitoring undertaken at these sites since 2003 are summarised in Table 1.

Table 1: Summary of continuous ambient monitoring of PM_{10}, NO_2 and CO

Parameter	Site	Monitoring period	Maximum recorded concentrations			
			99.9th centile of 1-hour averages	Running 8-hour average	24-hour average	Annual average
PM_{10}	Lincoln Rd	2003-2010	-	-	125 µg/m^3	18 µg/m^3
	Khyber Pass #	2003-2010	-	-	84 µg/m^3	22 µg/m^3
	Penrose *	2003-2010	-	-	45 µg/m^3	19 µg/m^3
	Queen St	2003-2010	-	-	54 µg/m^3	23 µg/m^3
	Takapuna	2005-2010	-	-	60 µg/m^3	20 µg/m^3
NO_2	Lincoln Rd	2003-2010	81 µg/m^3	-	53 µg/m^3	19 µg/m^3
	Khyber Pass	2003-2008	212 µg/m^3	-	121 µg/m^3	58 µg/m^3
	Penrose	2003-2010	130 µg/m^3	-	64 µg/m^3	25 µg/m^3
	Queen St	2004-2010	219 µg/m^3	-	101 µg/m^3	58 µg/m^3
	Takapuna	2003-2010	114 µg/m^3	-	57 µg/m^3	28 µg/m^3
CO	Lincoln Rd	2003-2010	5 mg/m^3	3 mg/m^3	-	-
	Queen St	2004-2010	12 mg/m^3	8 mg/m^3	-	-
	Takapuna	2003-2010	8 mg/m^3	6 mg/m^3	-	-

Notes:

* 24-hour average concentrations of PM_{10} in excess of 120 µg/m^3 recorded on 25 September 2009 at the Penrose and Takapuna sites, caused by dust blown across the Tasman Sea from dust storms in new South Wales, rather than by local or regional sources.

PM_{10} monitoring at the Khyber Pass site is undertaken on a 1 day in three basis using a gravimetric sampler.

4.4 Area by Area Description

1. The following section describes the land use and sensitive receptors within the CRL area. Section 6.2 of the report explains the derivation of the 100m zone for sensitive receptors. Although it is not possible to anticipate the specific sensitive activities that may be present when the CRL is constructed, new activities are unlikely to be more sensitive to discharges to air associated with construction activities than those currently in the CRL area.

4.4.1 Britomart Station to Aotea Station

2. This area is currently dominated by medium and high rise commercial buildings (including hotels) and street level retail premises. The area is a main transport hub for the city centre, including the Britomart Transport Centre (rail and bus stations) as well as the nearby ferry terminal).

3. The proposed location of Aotea Station, between Victoria Street and Wellesley Street, is largely an 'urban canyon', with medium to high rise buildings along both sides of Albert Street. At street level there are a range of retail activities, and several hotel frontages.

4. Sensitive receptors within 100m of cut and cover sections of the alignment in this area currently include a childcare facility (Kindercare at 29 Customs Street West), retail premises, hotels and residential dwellings (refer to Figure 6).

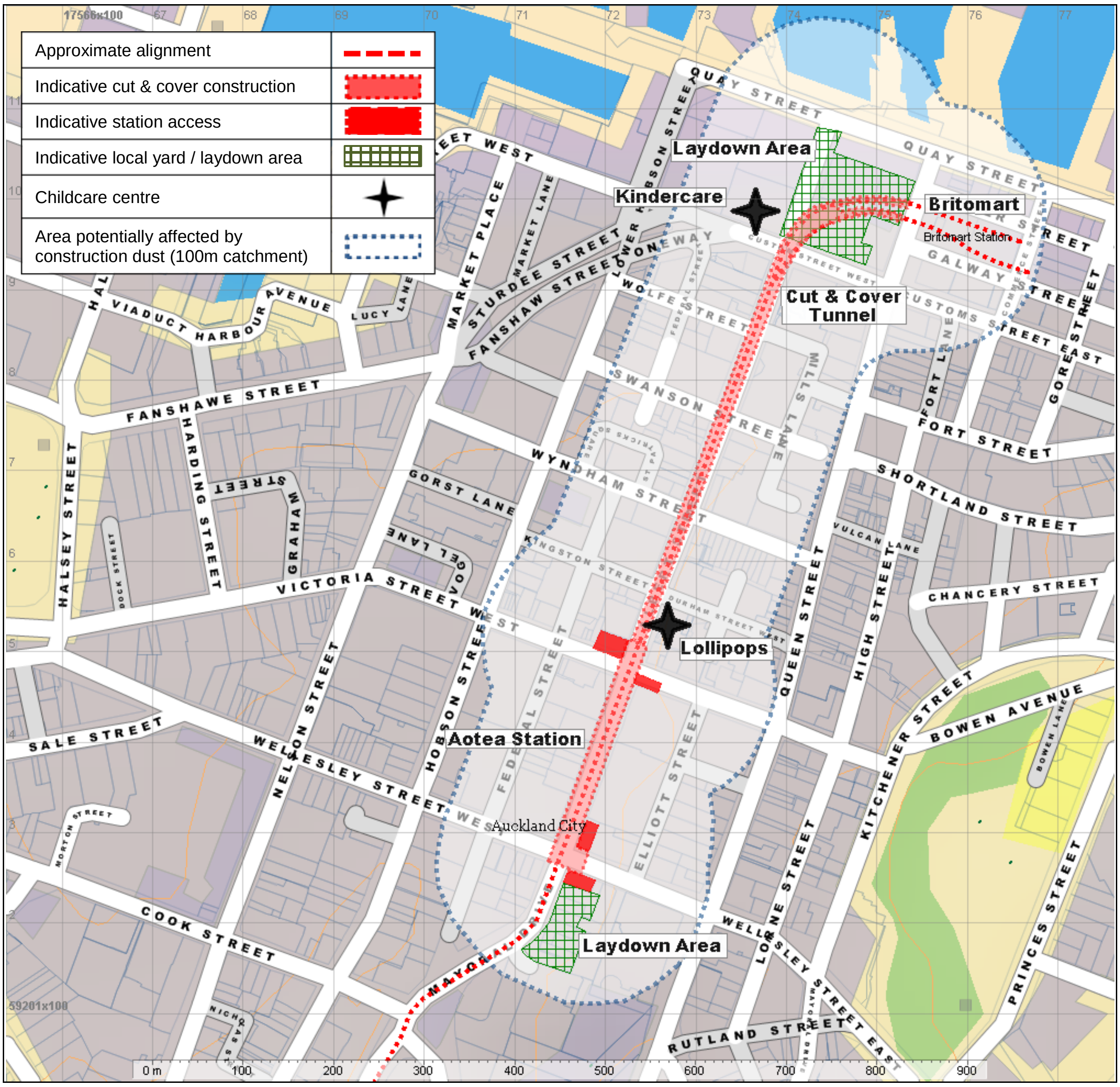


Figure 6 – Areas within 100m of cut and cover construction in the Auckland City centre

4.4.2 Karangahape Station and Newton Station

1. Surface works associated with the construction of the Karangahape Station and Newton Station will be limited to the construction of deep shafts. Therefore, the air quality receiving environment in these locations is restricted to the immediate vicinity of those access shafts. Sensitive receptors within 100m of the construction areas include retail premises, hotels and residential dwellings. There are no schools, preschools or residential healthcare facilities within 100m of either of these sites.

2. The access shafts at the Karangahape Station will be constructed in Beresford Square, between Beresford St and Pitt St, and in Mercury Lane, with the subsequent main entrance to the station located in Beresford Square (refer Figure 7). At street level, this area currently includes several small restaurants and cafes (which flank the square) as well as a number of small retail premises, low and medium rise offices and apartment blocks.

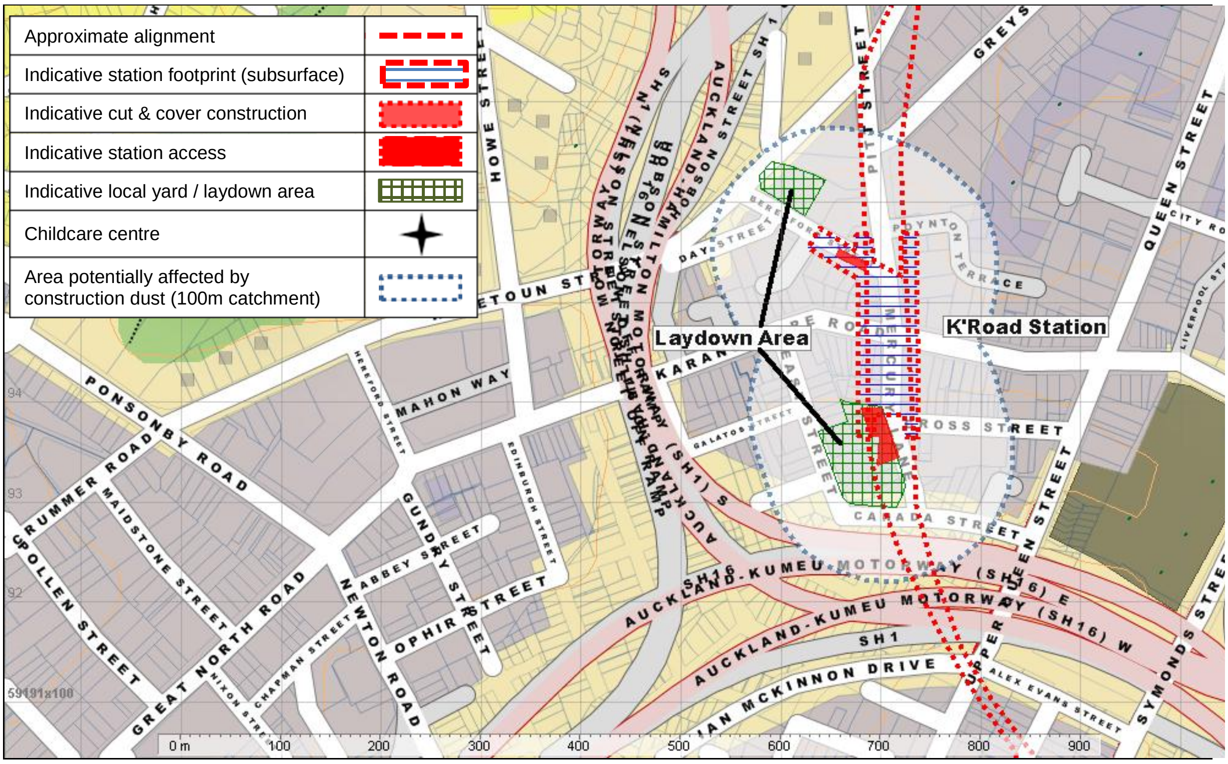


Figure 7 – Areas within 100m of cut and cover construction in the Karangahape Station area

3. The main access shaft to the Newton Station will be constructed at the southern end of Symonds Street, adjacent to the junction with Mt Eden Road, while a second access shaft will be constructed on Dundonald Street (refer to Figure 8). The subsequent main entrance will be located at the intersection of Symonds Street, New North Road and Mt Eden Road. Buildings surrounding the sites of these shafts are generally low-rise, mostly two storeys, including a range of activities, including both general and food retail, office accommodation and residential premises.

4.4.3 Newton Station to the North Auckland Line

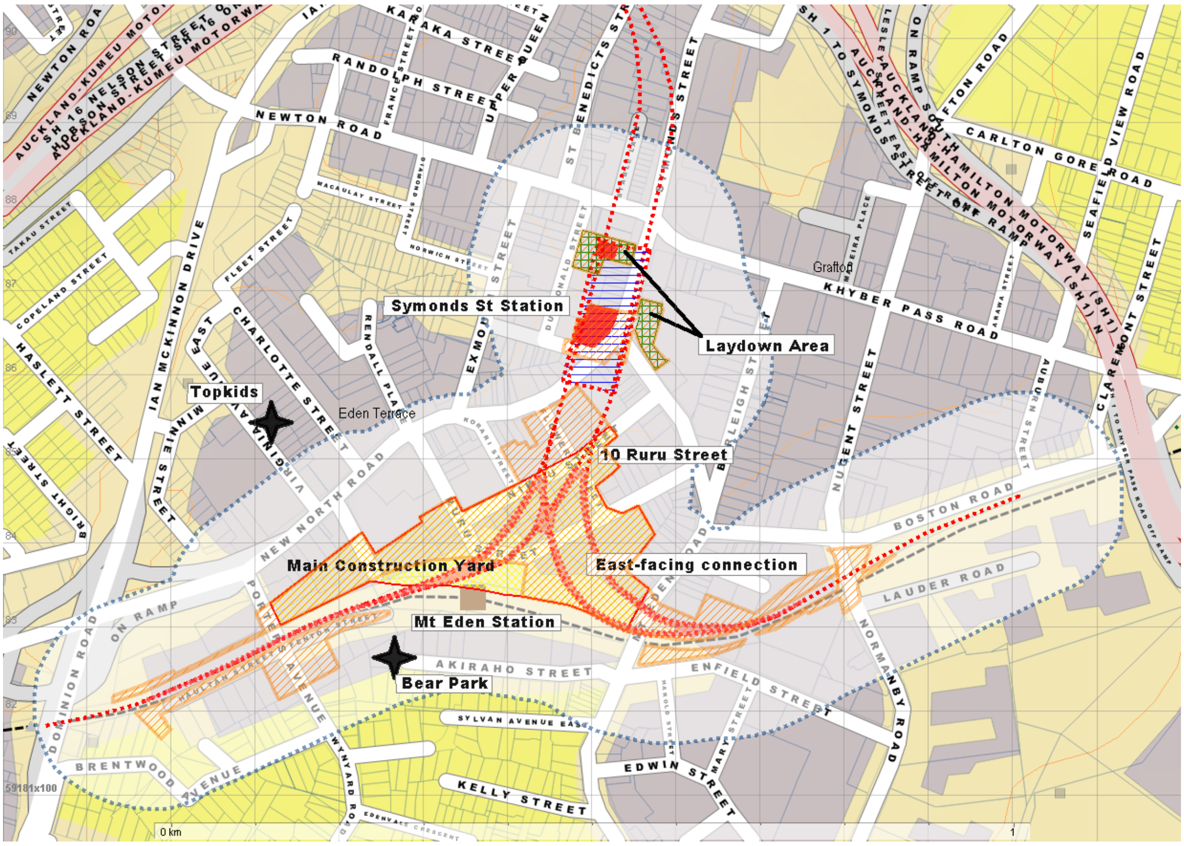
1. The area between New North Road, Mt Eden Road and the NAL is generally occupied by a range of commercial and light industrial buildings. At present, there are a very limited number of residential buildings – for example, the apartment buildings at 3 Ngahura Street and 6 Porters Avenue (which are located within the proposed designation footprint) and on

the corner of Ruru Street and Nikau Street (which are outside the proposed designation). However, the current zoning of the area, Mixed Use under the District Plan, provides for further medium density residential activity to develop in this area (Auckland Council 1999).

2. To the east of Mt Eden Road, aside from Mount Eden Prison on Lauder Road, almost all activities within 100m either side of the NAL (where the eastern arm of the CRL rises to join the NAL) are commercial or light industrial. However, as with the area to the west of Mt Eden Road, there is the potential for further residential activity to develop as this area is also zoned Mixed Use under the current Operative District Plan.

3. Commercial and light industrial activities also occupy the land immediately to the south of the NAL. However, approximately 50m to the south of the NAL between (Mt Eden Road and Dominion Road) there is a marked change in land use from commercial to established residential activities, while there is a large block of residential premises to the east of Mt Eden Road between Enfield Street and Edwin Street, the closest of which are approximately 25m south of the NAL. There are also residential premises on Brentwood Avenue immediately to the south of the NAL; however, these are over 150m west of the west-facing southern tunnel portal (at chainage 3500).

4. Specific sensitive receptors within 100m of cut and cover sections of the alignment in this area and to the main construction yard include Topkids on Virginia Avenue and Bear Park Preschool on Akiraho Street (refer to Figure 8).



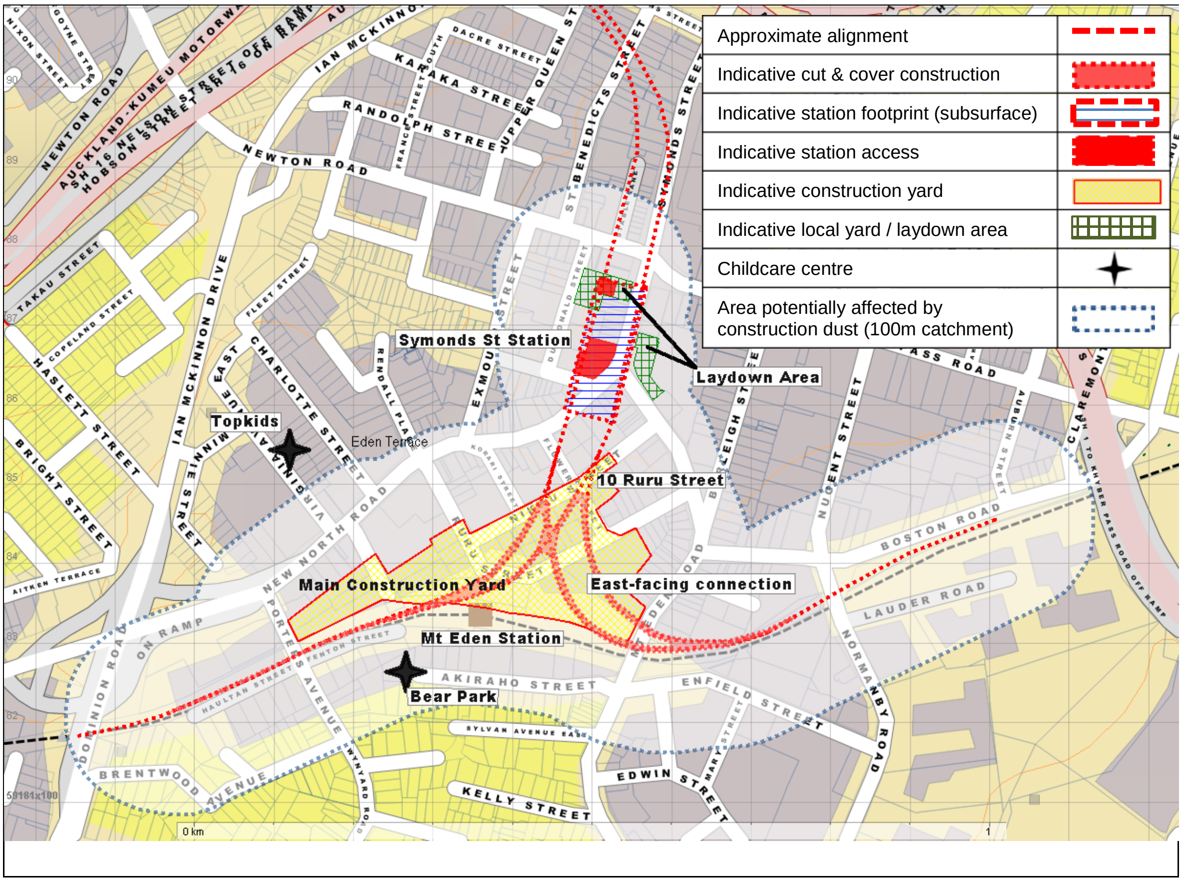


Figure 8 – Areas within 100m of cut and cover construction in Newton

5 Technical Assessment Methodology

5.1 Technical Report Methodology

1. Statutory provisions related to air discharges in the relevant District and Regional Plans are outlined in section 7 of this report. One of the key points to note from that section is that discharges to air from vehicles (including trains) are specifically permitted under the relevant Regional Plan; therefore no resource consent is required for discharges to air associated with the operation of the CRL.

2. The CRL will be operated by electric trains only, with only the occasional diesel-powered unit for maintenance purposes. Although resource consent under the ALWP is not required for the operation of the CRL, it is noted that, regardless, discharges to air from its operation will be negligible due to the operation of the electric trains. This report, therefore, focuses on discharges to air associated with the main construction of the CRL – principally dust, although there may be discharges of odour and/or hazardous air pollutants arising from disturbance of contaminated sites as well as discharges of vehicle exhaust pollutants from construction traffic.

3. In general, this assessment follows the approach outlined in the MfE Dust GPG (MfE 2001) and Auckland Regional Council Technical Publication 152: Assessing Discharges of Contaminants into Air – Draft (TP 152) (ARC 2002). This report largely takes the form of a desktop study. Computer modelling of discharges to air is not considered appropriate for the CRL (refer section 6).

4. A brief description of the current receiving environment has been provided in section 4. The contaminants that may be discharged into air from rail construction activities and an assessment of the environmental effects of those discharges are discussed in section 6.

5.2 Key Operational Assumptions

1. The key operational assumption in relation to air quality is that the CRL will only be operated by electric trains. Discharges into air from electric trains are negligible, being limited to minor discharges of ozone generated by electrical arcing.

2. It is understood that there will be the occasional use of diesel hauled trains for tunnel and equipment maintenance. Such operations, when they do take place, are only likely to occur at night or weekends. Due to the limited and infrequent nature of such operations and consequent discharges of contaminants into air, they will have negligible effects on air quality and have not been considered further in this assessment.

3. Although there will be a number of ventilation stacks – e.g. at each of the underground stations (Aotea, Karangahape and Newton Stations), discharges via these stacks will be related to the normal operation of the CRL (i.e. train operation and station ventilation) or to emergency venting of smoke. There is no consent requirement for these discharges under either the District Plan or the ALWP.

5.3 Key Construction Assumptions

1. The assessment of effects contained in this report is based on the indicative construction techniques outlined in the Concept Design Report. These are summarised as follows:

   - Tunnel construction:

  - Tunnels will be mined (using roadheaders) under the Chief Post Office building (CPO) between Britomart and Lower Queen Street.
  - From Lower Queen Street to Aotea Station (around chainage 750), tunnels will be constructed by cut and cover methods or top-down methods.
  - The main section of the running tunnels (between Aotea Station and Newton Station, around CH 2900m) will be constructed as two single track tunnels using a tunnel boring machine (TBM).
  - The indicative construction methodology anticipates that the TBM will be launched from the northern end of Newton Station, then pulled through and re-launched in Karangahape Station.
  - Between Newton Station and Nikau Street, tunnels will be mined, starting from the Nikau Street end.
  - Tunnel connections between Nikau Street and the NAL (both eastbound and westbound) will be constructed by cut and cover methods, rising to the surface between the current running tracks of the NAL, which will have to be moved apart to accommodate this.
- Station construction:
  - Aotea Station, located under Albert Street between Victoria Street and Wellesley Street, will be probably constructed as a top down cut and cover box. The indicative construction methodology states that construction will be staged to maintain access along Albert Street; i.e. the eastern half of this box will be constructed first, followed by the western half with traffic diverted above the eastern half (or vice versa).
  - Additional excavation will be required to the vicinity of Aotea Station to allow for the TBM to be dismantled and removed after the mining of each tunnel.
  - Karangahape Station and Newton Station will be constructed underground using road headers, accessed via deep shafts from the surface. These same shafts will subsequently be used to provide passenger access and ventilation to the stations.
  - Aotea, Karangahape and Newton stations will incorporate air extract ventilation stacks, designed for tunnel and statin ventilation during normal operations and for smoke discharge during emergency (fire) situations.
- Construction facilities:
  - Two main construction yard areas are proposed:
    - A main construction yard in the Newton area, between the NAL, Porters Avenue, New North Road and Ruru Street for (a) the support of the operation of the TBM and (b) the construction of the mined and cut and cover tunnels between the southern ends of the bored tunnels and the NAL, and associated NAL works.
    - A laydown area along one side of Albert Street, between Customs Street and Quay Street for the construction of the cut and cover tunnels between Britomart and Aotea Station, including, if development has not occurred prior, the Downtown shopping centre site.
  - The main construction yard in the Newton area will include a mobile grout batching plant to supply cement grout to the TBM and roadheaders).
  - Localised construction yards, on a smaller scale, are also likely to be provided to support the station construction of Aotea, Karangahape, and Newton stations (including cut and cover works and access shafts to Karangahape and Newton stations).

5.4 Air Quality Assessment Criteria

1. Air quality standards and guidelines are used to assess the potential for air pollutants to give rise to adverse health or nuisance effects. The MfE Good Practice Guide for Assessing Discharges to Air from Land Transport GPG (MfE Transport GPG) (MfE 2008) recommends the following order of precedence when selecting suitable assessment criteria:

- New Zealand National Environmental Standards (AQNES)
- New Zealand Ambient Air Quality Guidelines (NZAAQG)
- Regional Air Quality Targets (RAQT)
- Recognised international assessment criteria including World Health Organisation Air Quality Guidelines, United States Environmental Protection Agency Reference concentrations and California Office of Environmental Health Hazard Assessment Reference Exposure Levels.

2. Where no New Zealand standards or guidelines are available, the MfE Transport GPG allows the use of assessment criteria based on New Zealand Workplace Exposure Standards (8-hour time weighted averages) (WES-TWA), divided by 50 for low and moderately toxic hazardous pollutants or divided by 100 for highly toxic, bioaccumulative or carcinogenic hazardous pollutants. In addition, assessment criteria derived from other sources may be used if there is appropriate technical justification to support their use.

3. There are no specific assessment criteria for dust. A number of 'trigger levels' are contained in the MfE Dust GPG (MfE 2001) which are summarised in Table 2. This presents three different trigger levels for total suspended particulate (TSP), depending on the sensitivity of the receiving environment.

Table 2 – Recommended trigger levels for deposited and suspended particulate (MfE 2001)

Pollutant	Trigger Level	Averaging period	Applicability
Deposited dust	4 g/m^2	30 days	All Areas
Total Suspended Particulate	80 µg/m^3 100 µg/m^3 120 µg/m^3	24-hour 24-hour 24-hour	Highly sensitive areas Moderately sensitive areas Insensitive areas

4. The MfE Dust GPG does not offer any clear definition of sensitivity, although it does provide the following commentary:

"A sensitive area typically has significant residential development, whereas a sparsely populated rural area may be relatively insensitive to some discharges. Clearly the judgement of sensitivity will be somewhat subjective, depending on the specific circumstances in each case."

5. Given the nature of the various land uses in the vicinity of the CRL, all parts of the CRL can be considered to be in a sensitive receiving environment. The trigger levels presented in Table 2 have not been used as assessment criteria in this document as no dust dispersion modelling is not considered appropriate for assessing effects of dust discharges from fugitive sources. As discussed in section 6.6.3 of this report, the trigger values for TSP are appropriate for managing the effects of dust once construction of the CRL has commenced.

6. Suitable assessment criteria for other contaminants, such as hazardous air pollutants (HAPs), will be determined on a case by case basis. At this stage, site investigations carried out to date have identified elevated levels of benzo(a)pyrene in test boreholes on Akepiro Street (close to the NAL) and Shaddock Street, while elevated levels of arsenic

have been identified in soils under the NAL east of Mt Eden Station (AECOM 2012)[5]. Assessment criteria (NZAAQG and Auckland RAQT) for benzo(a)pyrene and arsenic are listed in Table 3. Section 6.4 of this report provides further discussion of the effects of discharges of HAPs and potential mitigation measures.

Table 3 – Air quality assessment criteria for arsenic and benzo(a)pyrene

Pollutant	NZAAQG and RAQT	Averaging period
Benzo(a)pyrene	0.0013 g/m^3	Annual
Arsenic (inorganic) (arsine)	0.0055 µg/m^3 0.055 µg/m^3	Annual Annual

[5] Contaminated Land Assessment: CRL NoR Suite of documents, Volume 3, Appendix 6

6 Assessment of Effects on the Environment

6.1 Indicative Construction Methodology

1. The construction of the CRL will entail large excavations along Albert Street and between the NAL and Nikau Street in Newton, along with deep excavations for the Karangahape and Newton stations. The remaining tunnels (between Aotea Station and Nikau Street will be bored using a TBM and roadheaders, while most of the actual construction of the Karangahape and Newton stations will be carried out underground. Some surface earthworks will be required for the realignment of the NAL (to allow for the junctions with the CRL)..

2. Overall the construction of the CRL is expected to take approximately five to six years to complete, although it is anticipated that all significant excavations and earthworks will be completed within the first three years, with the remainder of the CRL duration required for installation and testing of track, signalling and services. Whilst work can be staged concurrently in different locations, work in some areas may need to be phased as it is dependent on other works being completed first. The indicative construction methodology and the timeframe of five to six years assumes a single TBM, meaning that the two bored tunnels will have to be constructed sequentially. The Concept Design Report notes that, depending on cost and availability, two TBMs could be used, which may reduce the overall timeframe from the Project.

3. From an air quality perspective, the construction of driven or bored tunnels using a TBM has a distinct advantage in that it almost completely avoids discharges to air (except in the launching and maintenance area, located within the main construction yard in Newton).

4. The TBM tunnel linings themselves are likely to be pre-cast segments that will be trucked to the main Newton construction site as required prior to being installed. However, the construction of the CRL will necessitate the pouring of large quantities of concrete. Most of this will be trucked in (for the cut and cover sections such as Albert Street and Aotea Station). Karangahape and Newton stations will also require various quantities of concrete to be provided from the surface. The TBM will require a constant supply of cement grout to fill behind precast sections of lining once each ring of segments is erected. This will be provided by locating a temporary grout mixing plant in the main construction yard at Newton.

5. This section of the report addresses the following matters:

   - Section 6.2 summarises the main contaminants likely to be discharged into air from construction activities and the approach that has been taken to assessing the effects of these discharges.
   - Mitigation and monitoring of these effects is discussed in sections 6.3 and 6.4.
   - Section 6.7 identifies specific dust generating activities and the receiving environment on an area by area basis.
   - Sections 6.4 and 6.5 outline the issues related to discharges of odour and HAPs associated with the disturbance of contaminated sites.
   - Section 6.5 briefly outlines the issues related to engine exhaust emissions from construction vehicles.
   - For completeness, section 6 addresses effects on air quality that may arise from the operation of the CRL.

6.2 Construction Effects on Air Quality

1. The principal discharge into air from construction activities (including grout mixing) is dust. Where earthworks expose areas of contaminated soils, this may result in discharges of odour and/or hazardous air pollutants. The use of diesel-powered construction machinery will also discharge hazardous air pollutants (engine exhaust emissions). These effects are discussed in general in sections 6.2.1 to 6.2.4 of this report.

6.2.1 Dust

1. This section outlines the sources and potential effects of dust from construction activities and the principles adopted in determining the extent of those effects.

2. Exposed excavations and earthworks can be a significant source of dust. Dust can affect human health and plant life (street trees) as well as being a nuisance to the surrounding public. Material deposited on sealed public roads can also result in a dust nuisance. Rainfall, water evaporation, and wind speed, are meteorological conditions having the greatest effect on dust mobilisation.

3. Potential sources of dust and other air contaminant discharges which are liable to cause nuisance beyond the designation footprint are:

   - Dust from unsealed roads and access areas generated by trucks and other mobile machinery movements during dry and windy conditions
   - Wind entrainment of dust from dry undisturbed surfaces at wind speeds greater than 5 - 10 m/s (10 – 20 knots)
   - Excavation and disturbance of dry material
   - Loading and unloading of dusty materials to and from trucks
   - Stockpiling of materials including earthworks material placement and removal
   - Storage and handling of spoil from the driven tunnel construction
   - Cement handling.

4. The mobilisation and transportation of dust is dependent on dust particle size and meteorological conditions. Rainfall, rate of water evaporation and wind speed are conditions having the greatest effect on dust mobilisation. Dust generation by truck and machinery movements in dry conditions is a function of vehicle speed, number of wheels and vehicle size. Judder bars or humps to reduce vehicle speed are not recommended as they can cause spillage of loads and may damage loaded vehicles.

5. Unpaved roads and construction yard areas can be very dusty during dry weather. This can be aggravated if surfaces are allowed to get muddy during wet weather. The surfaces eventually dry out and then the mud becomes ground-up by vehicle movements creating a source of dust.

6. Dust discharges from excavations and earthworks typically fall into the larger particle sizes, generally referred to as “deposited particulates”, although there may also be a significant component in the smaller size ranges. Deposited particulates typically have an aerodynamic size range greater than about 30 microns. As a class of material such particulates have minimal physical health impact (particles have only limited penetration into the respiratory tract), but may cause nuisance in sensitive areas due to soiling. Soiling includes excessive dust deposits on houses, cars, and washing and excessive dust within houses.

7. In addition to the consideration of dust sources and factors that may influence dust generation, any assessment of the effects of dust must consider the distance that any dust may travel from the sources. In general, although construction activities can generate dust with a wide range of particle sizes, it is the larger dust particles that tend to be associated with 'dust nuisance' from construction activities. However, the larger the particle size, the less distance it will travel in light to moderate winds. The MfE Dust GPG states:

   "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 microns in diameter, the settling velocity is about 0.5 cm/sec, while for a particle 100 microns in diameter it is about 45 cm/sec, in still air. To put this into a practical context, consider the generation of a dust cloud at a height of one metre above the ground. Any particles 100 microns in size will take just over two seconds to fall to the ground, while those 10 microns in size will take more than 200 seconds. In a 10-knot wind (5 m/sec), the 100-micron particles would only be blown about 10 metres away from the source while the 10-micron 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."

8. Dust particles generated by construction activities generally fall into the larger size fractions, with an aerodynamic diameter of 100 µm or greater. It poses a nuisance potential due to soiling of surfaces and can cause irritation to eyes and nose. Because it is relatively large in size, deposited particulate usually falls out of the air within a short distance of the source and usually within 100 m to 200 m. In steady wind conditions, with average wind speeds of less than 10 m/s (typical of urban areas of Auckland – refer section 4.2), without vehicle movements, such particles would travel only a few tens of metres from the source. However, this theoretical calculation takes no account of re-entrainment of dust or of the effects of turbulent airflow, while occasional wind gusts of over 20 m/s were recorded at each of the four monitoring sites listed in section 4.2.

9. There have been a number of studies undertaken using field measurements of suspended particulate at different distances from road sources (e.g. Cowherd and Grelinger, 2003, Cowherd, Grelinger and Gebhart, 2006, Etymezian et al, 2004). Overall, the conclusions from these studies appear to be that dust travels much further under unstable atmospheric conditions than in stable conditions. These conclusions emphasise the need for effective mitigation measures to be applied, especially during hot, dry weather and in complex urban environments.

10. Based on the discussion regarding particle size in the MfE Dust GPG and the results of research into dust entrainment, it is considered that the majority of potential nuisance dust impacts would occur within 100m of the source. Some finer particles within the TSP fraction may travel considerable distances from the source. However, measures to mitigate the effects of dust within 100m of the construction activities will also provide adequate protection for receptors located further away. Therefore, for the purposes of this assessment, potentially sensitive receptors within approximately 100m of significant dust sources have been the focus for assessing the effects of construction dust. The purpose of the controls outlined in the following sections will be to prevent (if possible) or otherwise minimise the effects of dust emissions at these locations.

11. Construction work associated with the CRL may not be the only source of dust in the area. For example, other construction activities may also be occurring at the same time, while re-entrainment of road dust on existing roads (i.e. dust being picked up from surfaces by the wind) also contributes to overall dust levels.

12. The factors that determine whether or not a discharge creates a nuisance are commonly referred to as the FIDOL factors. These are frequency, intensity, duration, offensiveness and location (MfE 2001) (Auckland Council 2012). These are outlined in the MfE Dust GPG as follows:

- 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

3. Frequent low intensity discharges may create a nuisance as may infrequent intense episodes. The offensiveness of a dust discharge may be influenced by a number of factors, e.g. whether it causes staining or surface damage. Locations such as residences, schools, offices and retail premises are more sensitive to dust than industrial locations.

6.2.2 Odour

1. Rail construction and tunnelling activities in themselves are not usually regarded as a source of odour. If the construction involves disturbance of land contaminated with organic wastes (such as closed landfills) discharges of odour may occur. Such discharges, although potentially affecting amenity values, are unlikely to affect air quality or have consequential effects on human health (unless the odorous material itself is hazardous).

6.2.3 Hazardous Air Pollutants

1. Rail construction and tunnelling activities in themselves are not usually regarded as a source of HAPs. However, where the construction involves disturbance of contaminated land discharges of HAPs may occur. If such discharges occur on a large enough scale or the concentrations of HAPs are high, there is a potential for there to be adverse effects on human health.

6.2.4 Vehicle Exhaust Emissions

1. There will be discharges of engine exhaust emissions from construction traffic and machinery associated with the CRL. These will include fine particles (PM_{10} and $PM_{2.5}$), NO_x, CO and organics such as benzene. Most construction vehicles and machinery are diesel powered, and are therefore likely to emit larger quantities of PM_{10}, $PM_{2.5}$, NO_x and organics than the general vehicle fleet (which is mostly petrol driven).

2. The proposed route of the CRL follows or intersects a number of urban arterial roads. Partial closure of sections of these roads will be required while surface construction activities are undertaken. This has the potential to temporarily increase congestion on nearby roads that are used as diversion, with a consequent increase in vehicle exhaust emissions on those roads.

6.2.5 Approach to the Assessment of Construction Effects of the CRL

1. Statutory provisions related to air discharges in the relevant District and Regional Plans are outlined in section 7 of this report. The principal air quality issue in relation to rail and tunnel construction is the discharge of dust. Discharges of odour and vehicle and machinery emissions are considered to be relatively minor issues by comparison. This report,

therefore, focuses largely on the assessment, management, mitigation and monitoring of dust discharges from rail construction and tunnels.

2. Discharges of odour and vehicle related emissions are discussed briefly in sections 6.4 and 6.5. Discharges of HAPs associated with the disturbance of contaminated sites are discussed in section 6.4.

3. No attempt has been made to undertake a quantitative assessment of dust discharges from construction activities. The MfE Dust GPG recognises that there are severe limitations on the accuracy of dispersion modelling for fugitive sources such as road construction (due to uncertainties in emissions factors and to poor characterisation of localised wind turbulence and flow disturbances due to trees, buildings, or other obstructions). At best, dispersion modelling can be used to highlight the most significant sources on a site, or to identify those receptors most likely to be affected by dust discharges.

4. In consequence, the MfE Dust GPG states:

The key point to recognise with most fugitive dust sources is that nuisance effects will almost certainly occur if the sources are not adequately controlled. Rather than spending time and money on extensive (and expensive) theoretical predictions of the possible effects, it is likely to be more appropriate to put the effort into the design and development of effective dust control procedures.

5. This approach has been followed in this assessment. Dust control measures are outlined in section 6.3 will be incorporated in an Environmental Management Plan (EMP for the CRL. It is imperative that discharges of dust from construction activities are sufficiently controlled (mitigated) so any discharges are acceptable and they are not regarded as offensive or objectionable.

6.3 Dust Control and Mitigation Measures

1. Before considering the effects of dust from those specific activities that will be undertaken as part of the construction of the CRL, it is appropriate to outline the dust control and mitigation measures that may be applied. This section of the report presents a range of control and mitigation measures designed to prevent or minimise adverse dust effects on the environment and local community beyond the boundary of the designation footprint where surface works are anticipated to occur. The following section (section 6.7) considers, on an area by area basis, the specific activities that may generate fugitive dust emissions and the control and monitoring methods that should be applied to each of those activities to avoid dust nuisance. This is to be reflected in the EMP and the actual mitigation to be deployed is to be set out within the Construction Environmental Management Plan (CEMP when it is developed ahead of the construction of the CRL.

2. In general there are five primary factors which influence the potential for dust to be generated from the site. These are:

- Wind speed across the exposed surfaces
- The percentage of fine particles in exposed material
- Moisture content of that material
- The area of exposed surface
- Mechanical disturbance of material including via excavation and filling, loading and unloading of materials and vehicle movements.

3. Systems for controlling dust emissions should include methods that modify the condition of the materials so that it has a lesser tendency to lift with the wind or disturbances such as vehicle movements and methods that reduce the velocity of the wind at the surface. Watering of exposed surfaces and materials that may be disturbed is an important method of control. The MfE Dust GPG recommends that, as a general guide, the typical water requirements for dust control in most parts of New Zealand are up to 1 litre per square metre per hour.

4. Many of the construction activities to be undertaken as part of constructing the CRL are typical activities associated with the construction of large buildings. In addition, it must be emphasised that excavation of deep tunnels using a TBM will have no effect on air quality in any part of the CRL area with the exception of the area surrounding the main construction yard in Newton.

5. Potential mitigation measures to manage the effects of dust generation are outlined below. As previously noted, given the lapsing period sought for the designation, it is appropriate that the actual mitigation to be implemented is determined at detailed design during the development of the EMP and CEMP. The Environmental Management Framework associated with the NoR provides the required mitigation measures to be considered at that time.

6. The following bullet points describe measures that are generally appropriate for controlling dust from construction activities. These measures should be included in the EMP for consideration in developing the CEMP. Specific recommendations for the different construction areas are provided in section 6.7.

7. Earthworks

- The extent of earthworks carried out during dry conditions should be limited as far as practicable to a manageable surface area to minimise dust generation while being disturbed by machinery.
- Excavated areas left exposed during dry windy conditions and liable to be dusty should be watered as necessary, or preferably stabilised e.g. through metalling, grassing or mulching.
- Cleared areas not required for construction, access or for parking, if liable to cause excessive dust during windy conditions, should be stabilised e.g. through metalling, grassing, mulching or the establishment of vegetative cover.
- Haul roads and site laydowns should be metalled to minimise mud during wet conditions and dust during dry and windy conditions.
- As a last resort, if all other control measures have failed, work may be suspended in very dry, windy conditions.

8. Vehicles and Machinery

- Dust discharges from activities can be significantly reduced by using water sprinkler systems during dry conditions.
- Semi-permanent working areas and construction site access roads should be constructed with an appropriate base, kept metalled, and kept damp using watering trucks or fixed sprinkler systems.
- Vehicles leaving sites from unsealed surfaces should be washed down to remove dust and/or coagulated material where necessary.
- Should material be tracked out from the sites onto public roads, this can be removed by suction sweeper if necessary

- The maximum speed limit within sites should to be 10 km/h or less.
- Loading and unloading of trucks should be conducted in a manner which minimises the discharge of dust.

9. Formation and Maintenance of Roads, Other Accessways, and Parking Areas

- Roads, accessways, and parking areas used by vehicles and mobile machinery that are not hard paved should be kept well metalled.
- All roads, accessways, and parking areas that are liable to dry out and generate excessive dust should be regularly watered by a watering truck or by equivalent means during periods of low rainfall.
- Significant spills of materials that may cause dust when dry should be collected, swept, scraped up or hosed down as soon as practicable.

10. Stockpiles and Spoil Heaps

- Spoil is generally proposed to be removed from the driven tunnels via fixed conveyors onto stockpiles, prior to being trucked off site.
- Stockpiles of topsoil, sand, and other materials liable to dry out and generate significant dust during windy conditions, should be monitored and options such as dampening, allowing piles crust over, or covering, will be considered as appropriate.
- Stockpile margins should be defined to minimise spread onto access areas.
- Drop heights should be minimised to the extent practicable during stockpiling activities to minimise dust generation.
- In areas with ongoing dust issues or in close proximity to sensitive receptors, water sprays and/or sprinklers should be considered to suppress and control dust generated from the site.
- Water spraying requires uniform application rates consistent with evaporation rates. Water application rates, and therefore the capacity of the water spray system, should be carefully evaluated during the design phase and documented within CRL specifications for implementation via the EMP.
- The TBM will generate large quantities of fine spoil. The most appropriate method to control dust discharges from this is to undertake all storage and handling within and enclosed building in the main construction yard in Newton.

11. Wind Fencing

- Wind break fencing (e.g. shade cloth) of suitable length, height and porosity reduces prevailing wind speed and therefore the impact of dust on surrounding areas. This is most effective for relatively small areas, such as the access shafts for Karangahape and Newton stations, but may be less so for extensive areas where winds tend to be relatively unimpeded within the activity area.

12. Cement Grout Mixing

- The grout mixing plant will be located close to the southern end of the tunnels within the main construction site in Newton. Discharges into air from grout mixing include dust from the handling of cement powder. Almost all of this material falls into larger particle sizes, generally with an aerodynamic diameter greater than 30-50µm.
- Cement dust is basically calcium oxide (CaO), which is highly alkaline when dissolved in water and can be corrosive to skin. Discharges of cement dust into air can be avoided through enclosed transport, storage and handling. Good practice for cement handling

includes venting of displaced air via filter units. Cement silos (if used on site) should also be fitted with pressure relief valves (to avoid over-pressurisation) and high fill alarms.

6.4 Odour and Hazardous Air Pollutants

1. Given the location of the CRL, it is possible that a number of contaminated historic industrial or other sites may be impacted. For example, bitumen from coal gas manufacture has historically been used as a sub-base for road construction, while the Newton area has seen a range of industrial activities over the years. Dust from earthworks in these areas may be contaminated with hazardous material, while odour may be discharged if, for example, oil based wastes or putrescible materials are exposed. This will be a consideration for surface and cut and cover works associated with the construction of the CRL, but not for the construction of the driven tunnels or of the Karangahape Road and Newton stations, since these take place in deeper, undisturbed rock.

2. Elevated concentrations of benzo(a)pyrene have been identified in soils samples taken from test boreholes on Shaddock Street and Akepiro Street (refer to the Contaminated Land Assessment). Given the nature of activities that have been undertaken in that area, it is likely that further contamination will be identified once construction of the CRL commences.

3. There is also potential for asbestos waste to be identified during the construction of the CRL, along with asbestos materials in buildings that have to be demolished to make way for the CRL. Measures for safe removal and disposal of asbestos will be referenced in the EMP, and will need to be detailed in the CEMP where they will require input from specialist contractors in asbestos handling.

4. The extent of any potential effects depends on the nature, volume and concentration of the actual discharge, details of which are not known at this stage. Measures to mitigate the effects of such discharges, which should be included in the EMP, would include:

   - Temporary cessation of earthworks activities in the event that they disturb odorous or hazardous material and temporary covering of the exposed material
   - Use of odour suppressant sprays
   - Management of any excavations in such a way that:
   - Odorous material is removed from the site as quickly as possible once exposed
   - Hazardous material is removed from the site without discharging dust beyond the boundary of the specific construction site.

5. Most of these control methods are similar to those generally required to mitigate the effects of dust emissions, but will have to be applied more rigorously in areas where identified soil contamination may pose a risk to human health.

6. Where the nature of the contaminant(s) is/are such that they pose a significant risk of adverse effects on human health, monitoring using TSP instruments may be appropriate, but using lower, risk-based, thresholds than for uncontaminated dust. Instruments used for this purpose should be designed to also collect dust samples on filters for subsequent analysis.

7. Further evaluation of the risks and potential consequences of encountering potentially contaminated material will be required once any such sites on the proposed route of the CRL are further defined.

6.5 Vehicle Exhaust Emissions

6.5.1 Construction Traffic

1. Excessive smoke and odour from diesel-fuelled trucks, generators and other machinery is primarily caused by poor engine maintenance. Failure to maintain air filters, fuel filters, and fuel injectors to manufacturer's specifications may cause excessive black smoke and objectionable odour.

2. Excessive smoke and odour discharges from trucks, earth moving machinery and generators, while unlikely, could cause comments from neighbours under adverse meteorological conditions if vehicles and machinery are not well maintained. Contractors should be required, e.g. through the EMP, to keep trucks and machinery used on-site appropriately maintained. Although it may be desirable to require contractors to only use machinery that meets specific emissions standards (e.g. Euro 3 or Euro 4), in practice this is likely to be unrealistic given the scale and duration of the CRL.

6.5.2 Temporary Traffic Management

1. The Concept Design Report identifies several areas of the CRL where construction activities will require partial or complete road closures, for periods ranging from 13 months to over three years. This may cause a temporary increase in congestion on nearby roads.

2. As noted in section 6.2.4 of this report, increased traffic congestion will result in an increase in vehicle exhaust emissions from traffic on those roads. It should be noted, however, that any such effects will be temporary, and are likely to be no different in scale (albeit of longer duration) from those caused by partial road closures associated with many other construction projects.

6.6 Monitoring

6.6.1 Overview

1. A dust monitoring programme should be implemented during the construction and earthworks phases of the main construction of the CRL. As with the various mitigation measures described above, this should be included in the EMP for use in developing the detailed requirements of the CEMP. The objective of this programme would be to identify conditions where dust nuisance may occur, and to assess the effectiveness of mitigation and control measures included in the CEMP in minimising dust emissions and, consequently, to indicate where additional control measures may be required.

2. Monitoring methods described in this section are based on current knowledge and experience. They should be considered alongside any new methods that may have become available when construction of the CRL commences.

3. Visual and instrumental monitoring alone will not be sufficient to effectively and adequately control the effects of dust discharges from the construction areas; rather, they should be seen as part of a package, along with, for example, good management practices, checks and audits. Visual and instrumental monitoring are tools to inform the management of dust emissions from the construction sites, with site management practices both reacting to observations of increased discharges and being proactively updated to prevent such discharges in the future. An EMP will be developed, which will contain full details of the proposed monitoring, including frequency of visual monitoring, locations of instrumental

monitoring sites, complaint response procedures and identification of persons responsible for undertaking the monitoring.

4. Bucket deposition gauges may be used to monitor deposited dust, while TSP can be monitored by gravimetric samplers or continuous analysers[6]. Although a trigger level for deposited dust is included in both the MfE Dust GPG (MfE, 2004) and the ARC's Technical Publication 152: Assessing Discharges of Contaminants into Air (Draft) (TP152) (ARC 2002), the ARC's guidance given in TP152 does not generally recommend the use of this trigger level except for vegetation monitoring. As any measurements are averaged over 30 days, it is difficult to distinguish the contribution of various sources over the long sampling period (ARC 2002). Rather than using deposition gauges (and in addition to regular visual monitoring of potentially dusty activities), it is proposed that dust discharges from operational areas of the site are monitored using continuous particulate monitors (e.g. particulate monitors fitted with a TSP inlet, coupled with continuous wind speed, wind direction and temperature monitors).

5. Continuous TSP monitoring can also be used as a surrogate for direct monitoring of HAPs in areas where contaminated material is being excavated. In such cases, site specific TSP trigger concentrations would be developed, based on the concentrations of HAPs found in the soil and the appropriate assessment criteria for those HAPs.

6.6.2 Visual Monitoring

1. The primary form of monitoring of dust from construction activities is visual, since this can (and should) be undertaken by every person working in each construction area. Specific checks will be required of:

   - Weather forecasts and weather conditions for strong winds and rainfall to plan appropriate dust management response
   - Operating sites and surrounding areas for evidence of dust discharges
   - Operational areas for dampness and amount of exposed surface area
   - Stockpiles for enclosure, covering, stabilisation or dampness
   - Windbreak fences
   - Operation of water spray systems
   - Operation of wheel wash equipment
   - Cement handling.

2. In addition to these, procedures should be in place for responding to complaints and incidents.

6.6.3 Instrumental Monitoring

1. In addition to visual monitoring, continuous instrumental monitoring will be required for discharges of TSP from the construction of the CRL. The location of the monitoring sites will depend on the scale of the construction activity in the area, the expected duration of the activity, the sensitivity of the surrounding areas and the availability of suitable monitoring sites. However, given the overall scale and duration of the CRL, continuous (i.e. real-time)

[6] The equipment used for TSP measurements is generally designed to collect all particles from less than 0.1 µm up to about 100 µm in diameter

TSP monitoring will probably be needed at a number of locations (although it is envisaged that some monitors may be moved as construction progresses). The two areas where the construction activity has the greatest potential to generate dust and where sensitive locations are nearby are as follows:

- Cut and cover tunnel construction between Britomart and Aotea Station
- Main construction yard and surface rail construction in Newton.

2. A real-time TSP monitor should be located at each of the above areas, along with a meteorological station which measures wind direction, wind speed and temperature. While a single, fixed monitor may be suitable in the vicinity of the main construction yard in Newton, a portable instrument will be more appropriate for the extended work sites between Britomart and Aotea Station.

3. Where possible, the locations selected for the TSP and meteorological monitoring sites should be selected as far as is practicable to comply with the requirements of:

   - AS/NZ 3580.1.1:2007 Method for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment
   - AS 2923:1987 Ambient Air – Guide for the Measurement of Horizontal Wind for Air Quality Applications.

4. In some CRL locations, e.g. along Albert Street, it is unlikely that any potential monitoring location would comply with these requirements. It is more important that the specific locations selected reflect the actual activities being undertaken and their proximity to sensitive receptors

5. The monitoring system(s) selected must be capable of meeting the following minimum requirements:

   - TSP monitors should be able to produce a near continuous measurement of TSP concentrations and be able to calculate 1 hour and 24 hour average concentrations, for comparison to CRL trigger values based on the MfE TSP Trigger Values listed in Table 2 and/or for comparison to appropriate surrogate values for HAPs.
   - The outputs from the TSP monitors and the meteorological stations must be able to be monitored remotely by the environmental management team for the CRL and/or the lead contractor(s), and be set to produce an alarm when trigger values are approached. Alarms should activate a pager or cell phone.
   - Outputs from the monitors should be continuously recorded.
   - Where TSP monitoring is required as a surrogate for the direct monitoring of HAPs from the excavation of contaminated soils, the monitoring unit must also be capable of collecting dust samples on filters for later analysis.

6. CRL specific trigger values will have to be developed for each monitoring location, based on the assessment criteria and trigger values outlined in section 5.4, depending on the contaminants likely to be discharged (i.e. dust or specific HAPs) and the location of the monitoring site with respect to sensitive receptors.

7. Procedures for responding to alarms will be set out in the EMP. As a minimum, these will include investigation and recording of the cause of the alarm and, if appropriate, actions taken to deal with the cause of the dust discharge.

6.7 Assessment of Construction Effects of the CRL

1. Table 4 presents a summary of activities in the various areas of the route that have the potential to discharge contaminants to air and suggests indicative measures (as described in previous sections) that could be put in place to appropriately mitigate these effects. It should be noted that during detailed design and construction, further assessment will be undertaken to confirm the control measures that will be detailed within the EMP.

2. Given the scale and duration of operations (a five to six year construction programme on multiple sites), it is not possible to state with certainty that all potential effects of dust discharges will be prevented or that incidents of dust nuisance will never occur. However, with effective controls and monitoring in place, as outlined in this report and contained in an EMP, any effects that are not avoided should be adequately mitigated.

3. Development of the overall CRL is at the Concept Design stage. There will also be the opportunity within future stages of design to implement design controls that would assist in further reducing the risk of adverse effects.

4. Given the scale and duration of construction activities, it is possible that there will be adverse effects caused by discharges of dust from the construction of the CRL. However, most of the surface construction activities are typical of many other large projects undertaken in the Auckland city centre, and the mitigation techniques to be used are standard for this type of project. Therefore, the actual adverse effects will be no more than minor.

Table 4 – Summary of Contaminant Generating Activities on an Area Basis

Area	Summary of Activities	Recommended Management Controls and Monitoring
Britomart Station to Aotea Station	This represents the largest extent of excavations and surface operations involved in the construction of the CRL. Most of the construction activities in this area will be typical of most city centre type multi-storey construction, albeit on over a somewhat larger area. Most activities specific to the CRL, including the construction of diaphragm walls, underpinning of buildings, ground improvement and dismantling of the TBM, will not cause significant discharges of dust. The only additional activity, specific to the CRL, with a potential to cause discharges into air is the cut and cover excavation between Queen Elizabeth Square and Aotea Station; however, even this will use construction techniques that are typical of city centre type multi-storey construction. Excavations through the road sub-base in this area may disturb contaminated material (gasworks waste) historically used as fill material. Specific work activities between Lower Queen Street and Lower Albert Street depend on whether the Downtown Shopping Centre site still requires redevelopment. If not, construction activities will be limited to Queen Elizabeth Square and, possibly, a laydown area in Lower Albert Street. If redevelopment is still required, the site would be used as a work and laydown area for construction. The main potential dust generating activities is this area are expected to be completed within three years of the Project commencing, with activities along Albert Street (except for Aotea Station itself) undertaken in stages from north to south.	Water sprays or water trucks to keep trafficked surfaces damp Windbreak netting to reduce wind speeds across the surface Enforcement of vehicle speed limits on site A wheel wash or truck washing facility at the site exit (s) Availability of road sweeping to remove tracked material. Visual dust monitoring Provision of portable continuous dust monitoring
Karangahape Station and Newton Station	Surface construction in these areas will be limited to two deep shafts at each station, with a similar footprint to the construction of a typical city centre type multi-storey building. The main potential dust generating activities is these areas are expected to be completed within three years of the Project commencing.	Windbreak netting to reduce wind speeds across the surface Availability of road sweeping to remove tracked material Visual dust monitoring

Area	Summary of Activities	Recommended Management Controls and Monitoring
Newton Station to the NAL	Construction in this area will be centred on the main construction yard north of the NAL in Newton. Construction of the CRL in this area and the development of this yard will involve the demolition of a number of existing light industrial and commercial buildings. As with each of the other construction areas for the CRL, most of the activities to be undertaken in this area will be typical of most city centre type multi-storey construction; however, the scale will be substantially greater – the yard itself is estimated to require an area of approximately 6.6 hectares. Within the construction yard, the main activities with a potential to cause dust discharges are the cement handling associated with the grout mixing plant, storage and handling of spoil removed from the driven, cut and cover and mined tunnels, and vehicle movements. The most significant potential dust sources will be wind-entrainment of dust within the contractors' yard itself, wind entrainment of dust from spoil heaps, dust generated through handling spoil, cement handling and vehicle movements. Because of the size of this site, more attention may be required to dust control measures than in other parts of the CRL. However, the actual measures to control construction dust in this area will be different from those required for the Britomart to Aotea Station section of the CRL. Excavations in this area may disturb contaminated soils from previous industrial activities. The main potential dust generating activities is these areas are expected to be completed within four years of the Project commencing. Cement grout manufacture and TBM spoil handling facilities will be required for about 18 months (less if two TBMs are used), from about 18-20 months after commencement of the Project. Given the proximity of the residential apartment block on the corner of Nikau and Ruru Streets to the main construction yard, the layout of the yard should aim to provide a 'buffer zone' between dust generating activities and the apartment block.	Water sprays or water trucks to keep trafficked surfaces damp Metalling or (preferably) hard surfacing of yard and haul roads Enclosed transport, storage and handling of spoil from TBM operations Windbreak netting to reduce wind speeds across the surface Enforcement of vehicle speed limits on site A wheel wash or truck washing facility at the site exit(s) Enclosed transport, storage and handling of cement Availability of road sweeping to remove tracked material Visual dust monitoring Provision of portable continuous dust monitoring Site layout to provide buffer for sensitive receptors

6.8 Assessment of Operational Effects of the CRL

1. The discharge of contaminants into air from trains is a Permitted Activity in the ALWP. The CRL is designed to be operated by electric trains only. Diesel trains will not be permitted to use the route other than for essential maintenance work. The only contaminant that may be discharged into air from the operation of electric trains is a small amount of ozone generated by electrical induction. Discharges of ozone from electric trains are insignificant. Therefore, the operation of the CRL will have no direct adverse effects on air quality or human health.

2. There may be ventilation stacks at each of the intermediate stations (Aotea, Karangahape and Newton) and (possibly) at the junction between the east-facing and main west-facing connections to the NAL, depending on the ventilation requirements of the CRL. Discharges to air associated with the normal operation of the CRL will have only minimal adverse effects, due to the operation of the CRL with electric trains.

3. The ventilation system is designed to maintain in-station air quality, and in the event of an emergency scenario such as a fire, to control the spread of fire smoke, enabling safe passenger egress under fire conditions and to facilitate an effective emergency response.

4. There may be indirect air quality benefits arising from a reduction in road traffic, but these would be difficult to quantify. The CRL Objectives (as set out in the AEE) include the optimisation of public transport patronage potential to and from the city centre and to encourage use of passenger rail services.

5. Local air quality in the vicinity of major roads (i.e. within 200m of those roads) is heavily influenced by traffic volumes and speeds on those roads. Where traffic congestion is reduced, air quality is expected to be improved, however these improvements may be small and are extremely difficult to quantify or measure. Any reduction in road traffic across the region may reduce the overall discharge of greenhouse gases in the region. However, any assessment of the likelihood or scale of such reductions is beyond the scope of this report.

7 District and Regional Plan Provisions

1. Future consent requirements for the CRL are detailed in the AEE. Air quality related resource consent requirements are briefly outlined below.

7.1 District Plans

1. The Isthmus and Central sections of the Auckland City Council District Plan ("District Plan") also contain provisions relating to discharges of contaminants to air, as summarised in Table 5.

Table 5 – Summary of District Plan Provisions

Provision	Comment
ISTHMUS SECTION	
Part 4A – Common Rules **E. Maintenance and Condition of Land and Buildings** *(d) All sites with unsealed or dust contaminated yards or roadways shall implement effective and appropriate dust control procedures.* *(e) No activity shall generate more than 60 micrograms per cubic metre of dust or air suspended particulate matter, as measured over any 5 day period at any boundary of the site.*	This is discussed in section 6.3 of this report and will be addressed through the EMP. Provided the trigger levels for deposited and suspended particulate are complied with (refer section 5.4), dust discharges from the construction of the CRL are unlikely to breach this requirement.
Part 5A – Natural Resources: Air *The Council has assumed a substantial part of the functions, powers and duties of the Regional Council in relation to the discharge of contaminants into the air. The Plan adopts specific measures through its rules to avoid, reduce or mitigate the adverse effect of any air contaminant including odours, fumes, dusts, gases, liquids or solids.* ***Environmental Outcome**:* *Maintenance, and where necessary, enhancement of the district's air quality.*	Aside from the common rules referred to above, there are no specific requirements of any rule in the District Plan that would require consent for discharges to air from the construction or operation of the CRL. The aim of the mitigation and monitoring measures described in sections 6.3 to 6.6 of this report is to mitigate the effects of any discharges of contaminants to air.
CENTRAL SECTION	
Part 15 – General Provision: Odour and Air Pollution *The Council recognises its responsibility to deal with odour and other air pollution problems and will be guided by any national or regional standards and rules or authoritative national or international guidelines relating to odour or other air pollutants. At the appropriate time the Council will consider promoting variations to the Plan to introduce district rules to deal with odours and other air pollutants. In the interim the Council will control odour and other air pollution problems using the provisions of the Resource Management Act 1991, including sections 15, 17, 104(1)(a) and 108.* *Throughout both plans, there is generally the following disclaimer on any consideration of a proposed new activity "New activities may be subject to conditions relating to water discharges and air pollution and emissions to prevent, or reduce to an acceptable level, any detrimental effect the activity may have on the environment."*	This does not impose any specific requirements. Conditions may be imposed on the designation relating to discharges of contaminants into air.

7.2 Regional Plan

1. In addition to the designation, resource consents may be required under the ALWP for the discharge of contaminants into air (i.e. dust and odour) from construction activities and cement grout mixing. Rules 4.5.56 and 4.5.57 of the ALWP state:

   4.5.56 The discharge of contaminants into air from earthworks or from the construction, maintenance and repair of roads (road works) that does not comply with Rule 4.5.49 is a Restricted Discretionary Activity.

   4.5.57 The discharge of contaminants into air, through a bag filter system, from

   (b) The mixing of cement powder with other materials to manufacture concrete or concrete products at a rate exceeding a total production capacity of 110 tonnes per day is a Restricted Discretionary Activity.

2. Rule 4.5.49 states:

   The discharge of contaminants into air from earthworks or from the construction, maintenance or repair of roads (road works) is a Permitted Activity, subject to conditions (a) to (c) of Rule 4.5.1.

3. Conditions (a) to (c) of Rule 4.5.1 are:

   (a) That beyond the boundary of the premises where the activity is being undertaken there shall be no noxious, dangerous, offensive or objectionable odour, dust, particulate, smoke or ash; and

   (b) That there shall be no noxious, dangerous, offensive or objectionable visible emissions; and

   (c) That beyond the boundary of the premises where the activity is being undertaken there shall be no discharge into air of hazardous air pollutants that does, or is likely to, cause adverse effects on human health, ecosystems or property;….

4. It is noted that these resource consent requirements will be confirmed and, if required, will be sought at a later stage (following either preliminary or detailed design).

5. The discharge of engine exhaust emissions from construction vehicles is a permitted activity under Rule 4.5.3 of the ALWP, which states:

   The discharge of contaminants into air created by motor vehicle, aircraft, train, vessel and lawnmower engines including those located on industrial or trade premises is a Permitted Activity.

6. Section 104(2) of the RMA (which relates to the processing of resource consents) states:

   When forming an opinion for the purposes of subsection (1)(a), a consent authority may disregard an adverse effect of the activity on the environment if a national environmental standard or the plan permits an activity with that effect

7. Therefore, in consideration of the resource consent requirements, no formal consideration need be given to the effects of vehicle exhaust emissions from construction traffic (but has been considered for the purposes of the NOR in section 4.6 above).

8. There are no rules in the ALWP relating to discharges to air from tunnels or ventilation stacks. Discharges to air from trains are specifically described as a Permitted Activity under Rule 4.5.3.

8 Summary and Conclusions

1. Because it is proposed to solely operate the CRL with electric trains, there will be no adverse effects on air quality or human health arising from the operation of the CRL.

2. Construction of the driven tunnels using a TBM will avoid discharges of dust along most of the route of the CRL, with the exception of possible discharges in the main construction yard in Newton.

3. Most of the surface construction activities required for the CRL are typical of many other large projects undertaken in the Auckland city centre, and the mitigation techniques to be used are standard for these activities.

4. Due to the close proximity of sensitive receptors (which include residential premises, childcare facilities and office and retail activities) to the proposed CRL designation footprint for the CRL, a high standard of emissions control and management must be employed to adequately avoid or mitigate the effects of discharges of construction dust.

5. An EMP will be developed during the detailed design of the CRL, which, in addition to defining dust mitigation requirements, will also define requirements for dust monitoring. This will include details such as the frequency of visual monitoring, locations of instrumental monitoring sites, complaint response procedures and identification of persons responsible for undertaking the monitoring. The aim of this monitoring programme is to assist the control and management of discharges of construction dust and hazardous air pollutants from the CRL.

6. Through the use of appropriate emissions control and good on-site management, adverse effects that may otherwise be caused by discharges of contaminants into air from the construction of the CRL can be adequately avoided or mitigated.

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