# B12

**VOLUME B:** AIRPORT AND SURROUNDS

# Construction and Traffic Air Emissions

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## GLOSSARY OF ABBREVIATIONS

| | |
|---|---|
| **BAC** | Brisbane Airport Corporation |
| **BoM** | Bureau of Meteorology |
| **CO** | Carbon monoxide |
| **EPA** | Queensland Government Environmental Protection Agency |
| **HC** | Hydrocarbons |
| **µm** | micrometre |
| **$\mu g/m^3$** | micrograms per cubic metre |
| **$mg/m^3$** | milligrams per cubic metre |
| **$NO_2$** | Nitrogen dioxide |
| **$NO_x$** | Nitrogen oxides or oxides of nitrogen |
| **NPR** | New Parallel Runway |
| **$O_3$** | Ozone |
| **PIARC** | World Road Association, formerly Permanent International Association of Road Congress |
| **$PM_{2.5}$** | Particulate matter with equivalent aerodynamic diameter less than 2.5 µm |
| **$PM_{10}$** | Particulate matter with equivalent aerodynamic diameter less than 10 µm |
| **ppm** | parts per million |
| **ppb** | parts per billion |
| **$SO_2$** | Sulfur dioxide |
| **TSP** | Total Suspend Particulates |
| **VOC** | Volatile Organic Compounds |
| **WHO** | World Health Organisation |

# Construction and Traffic Air Emissions

## SUMMARY OF KEY FINDINGS – AIR QUALITY

### *Baseline Conditions*

- Existing air quality in the South East Queensland region is monitored by the Queensland Government Environmental Protection Agency (EPA). The closest monitoring sites to Brisbane Airport are currently at Pinkenba and Wynnum. Until 2005, data from the now decommissioned Eagle Farm monitoring site were also representative of air quality at the Airport.
- Motor vehicles are the predominant source of air pollutant in the region. While there has been a steady increase in motor vehicle usage in the region the control of individual vehicle emissions through design rules for example, vehicle exhaust and tighter fuel regulations, has ensured that air quality has not deteriorated.
- Air quality and monitoring near Brisbane Airport indicates that air quality remains within the EPA goal apart from isolated episodes of exceedences of the air quality goal for particulate matter less than 10 microns in diameter ($PM_{10}$). These episodes can be attributed to widespread events such as dust storms or bushfires where the goal is exceeded throughout the Brisbane region.
- Wind patterns were examined at the airport and surrounds. The general wind patterns were similar at the Airport site to the wind patterns at the nearest monitoring station at Eagle Farm however wind speeds were generally greater at the Airport site.

### *Impacts – Construction*

- Construction impacts were examined both qualitatively and quantitatively using dispersion modelling.
- The qualitative assessment suggested that the implementation of dust mitigation measures will ensure that dust emissions are subject to a high level of control.
- Dispersion modelling suggested that off-site air quality impacts would be low during the construction period and that there would be compliance with the relative air quality goals at nearest residential locations.
- The total greenhouse emissions from the construction phase of the process including land clearing was estimated to be approximately 318,000 tonnes $CO_{2\text{-}e}$. The Casuarina plantations may be harvested for biomass reuse.

### *Impacts – Surface Roads*

- Dispersion modelling was used to assess the impacts in changes to traffic on surface roads as a result of construction of the NPR. The roadside dispersion modelling suggested the following:
  - Future roadside concentrations were generally lower than existing concentrations;
  - Differences between with and without the New Parallel Runway (NPR) would be small on all modelled road sections;
  - Existing and future roadside concentrations at distances representing nearest residences are anticipated to be below relevant air quality criteria.

# Construction and Traffic Air Emissions

## 12.1 Introduction

The purpose of this chapter is to assess air quality impacts associated with the NPR. The chapter focuses on the Airport and Surrounds aspect of the project which, in terms of air quality impacts, comprises the following:

- Impacts arising during construction of the NPR; and
- Impacts arising during operation as a result of changes to road surface traffic.

**Figure 12.1** shows the location of Brisbane Airport (Airport) and the NPR.

A comprehensive study of the air quality impacts from aircraft operations has been undertaken and can be found in Volume D, Chapter D6. Chapter D6 provides a detailed analysis of existing air quality, meteorology, aircraft operations and emissions. In addition, computer-based dispersion modelling was used to assess the likely air quality impacts due to aircraft operations.

There are some components of this chapter which overlap with work done as part of Chapter D6. As such, this study draws upon many aspects of Chapter D6, but in the context of construction and road surface traffic assessment.

The main air quality issue during construction work will be dust. Potential air quality impacts during construction have been discussed as well as mitigation measures for reducing dust emissions.

In addition, the equipment usage and clearing of vegetation during the construction phase will have implications in terms of greenhouse emissions.

The operation of the NPR will also result in changes to traffic on surrounding surface roads. Computer-based dispersion modelling has been carried out to predict air pollutant concentrations near selected sections of surface roads. The assessment considers air pollutants arising from vehicle emissions as well as existing levels. The potential changes to air quality near surface roads have been assessed in the context of relevant regulatory air quality criteria.

In summary, this chapter provides information on the following:

- Description of the proposal, construction activities and changes to surface traffic;
- Relevant air quality standards and goals;
- Review of the existing environment, including climatic and meteorological conditions and the existing air quality in the area;
- Assessment of dust impacts during construction;
- Assessment of air quality impacts from surface roads during operation; and
- Greenhouse issues.

## 12.2 Local Setting and Project Description

**Figure 12.1** shows the extent of area defined for the purposes of this study as the ‘study area’.

The proposed NPR consists of the following major elements:

- Extracting 15 million cubic metres (Mm$^3$) of sand from Middle Banks in Moreton Bay for land reclamation at the Airport;
- Reconstructing the existing seawall along the Moreton Bay/Airport boundary;
- Widening and strengthening of the 14/32 runway pavement;
- Constructing the NPR;
- Constructing a new dual parallel taxiway (adjacent to the runway);
- Constructing a link taxiway from the NPR to the main existing runway;
- Constructing rapid exit taxiways from the NPR to the parallel taxiway;
- Establishing new airfield lighting including approach lighting;
- Constructing a new fire station;
- Constructing a road tunnel along Dryandra Road under the link taxiway;

**Figure 12.1:** *Brisbane Airport and Surrounds.*

- Constructing new perimeter roads around the airfield;
- Constructing a new permanent drainage channel upstream of the runway;
- Constructing new airfield drainage;
- Installing new security fencing;
- Relocating power and utility services; and
- Rehabilitating the site including the use of mangroves at selected locations along drainage channels.

Construction of the NPR will occur over approximately seven years, encompassing four phases. Activities associated with each of these phases are fully described in the Environmental Impact Statement (EIS) and a summary is given below.

### 12.2.1 Construction Phase 1: Upgrade of 14/32 Runway

Phase 1 includes the upgrade of the 14/32 runway by increasing the overall formation width and strength of the pavement prior to the commissioning of the NPR. Reconstruction of an existing seawall, on Brisbane Airport Corporation's (BAC) Moreton Bay boundary, is also part of Phase 1.

In summary, Phase 1 will include:

- Fencing construction and establishing compound sites;
- Stripping topsoil;
- Extraction and hydraulic placement of sand at northern threshold of NPR and 14/32 runway and NPR;
- Vacuum consolidation of northern threshold reclamation of 14/32 runway and NPR;
- Filling and shaping runway 14/32;
- Constructing concrete pavements and paving of asphalt;
- Commissioning upgraded runway; and
- Disestablishing the construction site.

Construction activities for Phase 1 will take approximately two years and will occur six days per week between the hours of 6:30am and 6:30pm.

Approximately 90,000 cubic metres ($m^3$) of topsoil will need to be removed from the existing 14/32 runway flanks. The stripping, stockpiling and re-spreading of topsoil will have the greatest potential for dust impacts to be observed in Phase 1.

### 12.2.2 Construction Phase 2: Early Works

Phase 2 includes all the elements required to be completed before reclamation works can commence.

In summary, Phase 2 will include:

- Clearing vegetation;
- Topsoil disturbance during vegetation clearing and during site preparation activities;
- Establishing perimeter bunds and drains; and
- Demolishing any existing infrastructure within the reclamation site.

Approximately 361 hectares of vegetation will be cleared for the NPR prior to commencement of reclamation. Surface soils on the site will be disturbed during the clearing and mulching operations and through the passage of construction equipment. Materials for bund construction will be temporarily stockpiled on the site and where possible, stabilised to minimise dust generated through wind erosion. A chemical dust suppressant may be used for stabilisation of large disturbed areas.

Equipment used for construction activities in Phase 2 will include excavators, trucks, dozers and graders.

Construction activities for Phase 2 will take approximately one year and will occur six days per week between the hours of 6:30am and 6:30pm.

### 12.2.3 Construction Phase 3: Reclamation Works

Phase 3 requires the extraction of approximately 15 Mm$^3$ of unconsolidated marine sand from Middle Banks, Moreton Bay for land reclamation. This phase involves the dredging and supply of sand to the project site.

In summary, Phase 3 will include:

- Extraction of sand;
- Transportation of sand to a designated mooring site;
- Delivering sand to the NPR site by hydraulic placement;
- Rehandling sand that cannot be reached directly by hydraulic placement; and
- Leaving sand for a minimum of two to four years to enable consolidation of the ground below.

Phase 3 activities will occur 24 hours per day over a 12 to 18 month period concurrently with Phase 2. After Phase 3 is complete, the reclaimed lands will be left for three years to consolidate naturally.

### 12.2.4 Construction Phase 4: Pavement and Civil Works

Phase 4 will occur approximately three years after the completion of Phase 3 and is the final pavements and civil works phase for the project. This phase will involve the use of standard pavement construction techniques and equipment.

In summary, Phase 4 will include:

- Construction compound;
- Transportation;
- Drainage, electrical, pavements;
- Link taxiway;
- Pavement markings, lighting and signage;
- Tunnel;
- Fire station;
- Security gates, fencing and perimeter roads; and
- Decommissioning of construction site.

Pavement construction will require a large amount of material for concrete. An estimated 548,000 m$^3$ of material will need to be sourced for the sub-base, base course, selected fill, concrete, asphalt and gravel.

Phase 4 activities will occur six days per week between the hours of 6:30am and 6:30pm.

## 12.3 Air Quality Standards and Goals

In assessing the potential impacts of any project with air emissions, it is necessary to compare the air quality impacts of the project with relevant air quality goals. Air quality standards or goals are used to assess the potential for ambient air quality to give rise to adverse health or nuisance effects.

The EPA have set air quality goals as part of their Environmental Protection (Air) Policy 1997 (EPP (Air)) (EPA, 1997). The policy was developed to meet air quality objectives for Queensland's air environment as outlined in the *Environmental Protection Act 1994* (EPA, 1994). The air quality data collected by the EPA refer to Schedule 1 of the EPP (Air) which contains air quality indicators and goals that have been adopted in Queensland.

The National Environment Protection Council of Australia (NEPC) has determined a set of air quality goals for adoption at a national level, which are part of the National Environment Protection Measures (NEPM). It is important to note that the standards established as part of the NEPM are designed to be measured to give an 'average' representation of general air quality. That is, the NEPM monitoring protocol was not designed to apply to the monitoring or modelling of peak concentrations from major emission sources (NEPC, 1998).

In addition, ambient air quality objectives for Brisbane Airport are established under the Airports (Environment Protection) Regulations 1997. Under the regulations, air pollution occurs when a pollutant is present in the air in a quantity, way, condition or circumstance which is likely to cause harm to the environment or unreasonable inconvenience to a person (i) at a place other than the immediate vicinity of the source of the pollutant; or (ii) if the source is in a place to which members of the public have access – in that place. These regulations apply to sources other than aircraft, such as those pollutants that may be generated during construction or from permanent plant and equipment on the ground. These regulations also specify air emission limits for pollutants including dust, fumes and odours emitted from stationary sources as specified under Regulation 2.01. These limits are summarised in Table 1 of Schedule 1 of the Regulation and would apply to plant and equipment located on the Airport grounds, such as concrete batching plants and asphalt plants.

**Table 12.3a** lists the air quality goals for criteria pollutants noted by the Airports (Environment Protection) Regulations, EPA and NEPM that are relevant for this study.

The primary air quality objective of most projects is to ensure that the air quality goals listed in **Table 12.3a** are not exceeded at any location where there is possibility of human exposure for the time period relevant to the goal.

For the purposes of this project the most stringent air quality standards and goals for each pollutant have been adopted. These are shown in bold font.

**Table 12.3a:** Air Quality Goals Relevant to This Project.

| Pollutant | Goal | Averaging Period | Agency |
|---|---|---|---|
| Carbon monoxide (CO) | **8 ppm or 10 mg/$m^3$**<br>9 ppm or 10 mg/$m^3$ | 8 hour maximum<br>8 hour maximum | EPA<br>NEPM[1], AR1997 |
| Nitrogen dioxide ($NO_2$) | 0.16 or 320 µg/$m^3$<br>**0.12 ppm or 246 µg/$m^3$**<br>**0.03 ppm or 60 µg/$m^3$** | 1 hour maximum<br>1 hour maximum[1]<br>Annual mean | EPA, AR1997<br>NEPM<br>NEPM |
| Particulate matter less than 10 µm ($PM_{10}$) | 150 µg/$m^3$<br>**50 µg/$m^3$**<br>**50 µg/$m^3$** | 24 hour maximum<br>24 hour maximum<br>Annual mean | EPA<br>NEPM[2]<br>EPA |
| Particulate matter less than 2.5 µm ($PM_{2.5}$) (advisory only) | 25 µg/$m^3$<br>8 µg/$m^3$ | 24 hour maximum<br>Annual average | NEPM<br>NEPM |
| Total Suspended Particulate Matter (TSP) | **90 µg/$m^3$** | Annual average | EPA, AR1997 |
| Sulfur Dioxide ($SO_2$) | 0.25 ppm or 700 µg/$m^3$<br>0.20 ppm or 570 µg/$m^3$<br>0.08 ppm or 225 µg/$m^3$<br>0.04 ppm or 113 µg/$m^3$<br>0.02 ppm or 60 µg/$m^3$ | 10 minute maximum<br>1 hour maximum<br>24 hour maximum<br>24 hour maximum<br>Annual average | EPA, AR1997<br>NEPM[1], EPA, AR1997<br>NEPM[1]<br>EPA<br>NEPM, EPA, AR1997 |

[1] *One day per year maximum allowable exceedance.*

[2] *Five days per year maximum allowable exceedances AR1997: Airports (Environment Protection) Regulation 1997.*

Significance Criteria have been developed to quantify the magnitude of potential impacts from the proposed activities.  These criteria are shown in **Table 12.3b**.  It should be noted that these are not regulatory criteria, but provide a methodology for ranking the impacts of the Project.

**Table 12.3b:** Significance Criteria for Air Emissions.

| Significance | Significance Criteria: Air Emissions |
|---|---|
| Major Adverse | Substantial exceedance of air quality goals set by the Queensland EPA and the NEPM to the extent that health and amenity would be significantly affected.<br>No opportunity to effectively reduce emissions or create a buffer zone to provide acceptable levels of impact. |
| High Adverse | High adverse effect on local air quality, in relation to short term and long term local air quality standards.<br>Predicted air quality impacts including project plus background are close to and in some instances, exceed air quality criteria.<br>Limited opportunity to reduce impacts by other emission control or buffer distances. |
| Moderate Adverse | Moderate detrimental effect on local air quality, in relation to short term and long term local air quality standards.  Predicted pollution levels consume a substantial quantity of the goal for at least one pollutant, for example, over 50 percent of the goal without taking account of background.  Some mitigation may be available, for example some design feature which affects buffer distance may help mitigate impacts. |
| Minor Adverse | Slight detrimental effect on local air quality, in relation to short term and long term local air quality standards.<br>Some increase in pollution levels above existing but relatively small percentage of consumption of the air quality goal.<br>Unlikely to be of importance in the decision making process. |
| Negligible | No appreciable impact on local air quality.  Predicted changes to air quality with the project are below the level of detection. |
| Slight Beneficial | Slight beneficial effect on local air quality, in relation to short term and long term local air quality standards.  Predicted ambient air quality concentrations with the Project result in a slight decrease in pollutant levels compared to the Do Nothing scenario.  Unlikely to be of importance in the decision making process. |

## 12.4 Existing Environment

This section describes the dispersion meteorology and existing air quality of the study area, relevant to the current assessment.

### 12.4.1 Dispersion Meteorology

The Gaussian dispersion models used for this assessment, AUSPLUME and Cal3qhcr, require information about the dispersion characteristics of the area. In particular, data are required on wind speed, wind direction, atmospheric stability class[1] and mixing height[2]. The way in which pollution from the emission sources is dispersed is dependent on the prevailing meteorological conditions. Meteorological data collected in the study area are discussed below.

The data available for the purposes of this study were collected by the Bureau of Meteorology at Brisbane Airport in 2004. **Figure 12.1** shows the weather station site. There were 8,784 hourly records which represents 100 percent of the year. These data have been prepared into a form suitable for the AUSPLUME and Cal3qhcr dispersion models.

Typically, one year of records will be sufficient to cover most variations in meteorology that will be experienced at a site, however it is important that the selected year is generally typical of the prevailing meteorology. The year 2004 was chosen for the purposes of this assessment based on the completeness of meteorological records and on the similarities of these data to other years. A comprehensive review of the meteorological data in the study area is provided in Chapter D6 the 'Airspace' document (Holmes Air Sciences, 2006).

**Figure 12.4a** shows annual and seasonal wind-rose diagrams for the Airport, based on data collected by the Bureau of Meteorology in 2004. **Figure 12.4b** shows the 2004 wind patterns at Brisbane Airport by time of day. Annually, the most common winds at this site are from the north to north-north-east, south-west to south-south-west and east-south-east to south-east. The generally north-south pattern of winds would have been an important consideration for the current alignment of the existing Airport runways and is for the proposed NPR.

In summer, winds at the Airport during the day are predominantly from the north to north-east typical as a result of the sea breeze. The sea breeze usually commences in the late morning and is well established in the afternoon. Synoptic winds from the east-south-east to south-south-east are also observed, generally in the morning before the onset of the dominant sea breeze. There are also winds from south-west sector in summer. These winds are observed mainly during the late evening and night.

In contrast, the most common winds in autumn and winter are from the south-west and south-south-west. Winter winds in the afternoon are generally from the north to north-east as a result of a winter sea breeze. In autumn, afternoon and evening winds are observed mostly from the east-south-east.

Spring exhibits a similar pattern to summer but with more winds from the south-west and south-south-west with the transition from winter.

The average wind speed in 2004 at the Airport was 4.4 meters per second (m/s) with a maximum hourly average wind speed of 13.3 m/s. Calm conditions, when hourly average winds were less than or equal to 0.5 m/s, were observed 2.2 percent of the time.

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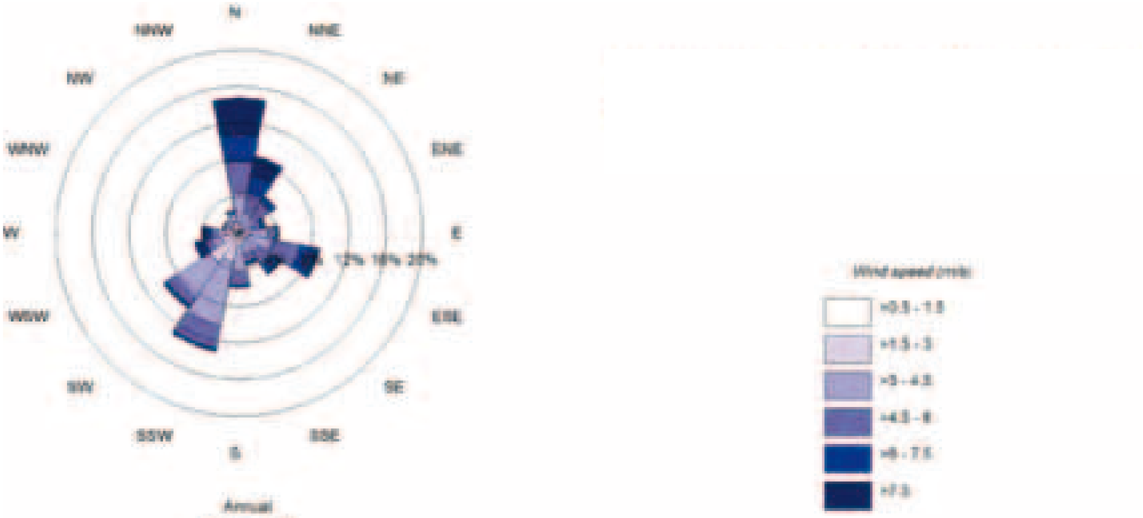
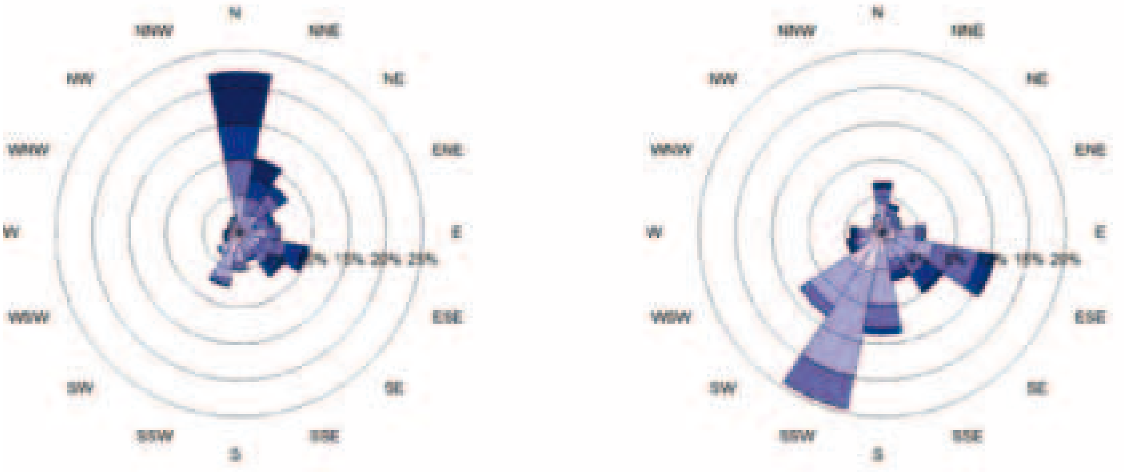
[1] *In dispersion modelling stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme, as used in this study, there are six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.*

[2] *The term mixing height refers to the height of the turbulent layer of air near the earth's surface into which ground level emissions will be rapidly mixed. A plume emitted above the mixed-layer will remain isolated from the ground until such time as the mixed-layer reaches the height of the plume. The height of the mixed-layer is controlled mainly by convection (resulting from solar heating of the ground) and by mechanically generated turbulence as the wind blows over the rough ground.*

**Figure 12.4a:** *Annual and Seasonal Windroses for Brisbane Airport (BoM 2004 Data).*

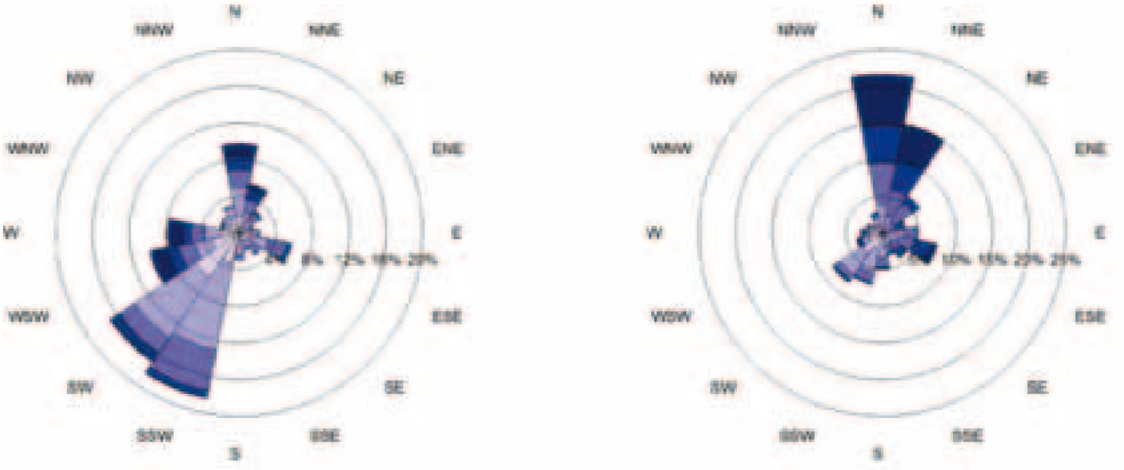


Annual
Calms = 2.2%



Summer
Calms = 1.4%

Autumn
Calms = 2.0%



Winter
Calms = 3.8%

Spring
Calms = 1.0%

**Figure 12.4b:** *Brisbane Airport Wind Patterns by Time of Day (BoM 2004 Data).*

### 12.4.2 Atmospheric Stability and Mixing Height

To use the wind data to assess dispersion it is necessary to also have available data on atmospheric stability. A stability class was calculated for each hour of the meteorological data using hourly wind speed and cloud cover information and the method of Turner (1970).

**Table 12.4a** shows the frequency of occurrence of the stability categories expected in the area. Also provided is the frequency distribution determined by the CALMET model. CALMET determines stability from cloud cover data and temperature profiles. A comprehensive discussion of the CALMET model is provided in Chapter D6 the 'Airspace' document.

It can be seen from **Table 12.4a** that, at the Airport, the most common stability class is determined to be D-class. The prevalence of D-class is due to the relatively high wind speed recorded at this site. Dispersion of pollutants is rapid under these circumstances as D-class stabilities are generally associated with strong winds.

**Table 12.4a:** Frequency of Occurrence of Atmospheric Stability Class.

| Pasquill-Gifford-Turner Stability Class | Frequency (Airport by CALMET, %) | Frequency (Airport by the Method of Turner, %) |
|---|---:|---:|
| A | 0.0 | 0.7 |
| B | 4.4 | 9.1 |
| C | 15.3 | 17.5 |
| D | 46.5 | 39.8 |
| E | 16.4 | 15.9 |
| F | 17.3 | 16.9 |
| TOTAL | 100 | 100 |

Hourly mixing height data are also required by the dispersion model. Mixing height was determined using a scheme defined by Powell (1976) for daytime conditions and an approach described by Venkatram (1980) for night time conditions.

Joint wind speed, wind direction and stability class frequency tables for the BoM 2004 airport data are presented in Appendix B12A.

### 12.4.3 Existing Air Quality

This section discusses the concept of background air pollution as it applies to this study and presents a summary of recent air quality monitoring data that can be used to estimate background pollution levels.

The EPA currently operate or has operated air quality monitoring sites at Eagle Farm, Pinkenba and Wynnum. These sites are all located within a short distance of Brisbane Airport. The locations of the monitoring sites are shown in **Figure 12.1**. Other monitoring sites within 20 km of the Airport include Rocklea, Woolloongabba, South Brisbane and Brisbane CBD.

The air quality data are available from the EPA website as monthly bulletins, annual summary and trend reports, and annual air monitoring reports to fulfill the annual reporting requirements of the National Environment Protection (Ambient Air Quality) Measure (Air NEPM).

The Eagle Farm site was located in a light industrial area at the DPI Quarantine Centre and commenced operating in 1978. The site monitored CO, $NO_x$, $O_3$, $SO_2$ and $PM_{10}$ as well the meteorological parameters wind speed and direction, temperature and humidity. Monitoring was discontinued at Eagle Farm in mid 2005.

The BP Refinery (Bulwer Island) Pty Ltd's monitoring site at Pinkenba was established in 2001, and is located on the grounds of the Pinkenba State School. The site monitors CO, $NO_x$, $O_3$, $SO_2$ and $PM_{10}$ as well the meteorological parameters wind speed and direction, temperature and humidity. Data from the Pinkenba monitoring station from January 2003 are published in the EPA's monthly bulletins.

The Wynnum monitoring station is located in a residential area close to industrial facilities in Wynnum North. From 1999 to 2001 the Wynnum monitoring station measured $O_3$, $NO_2$, $SO_2$ and $PM_{10}$ before it stopped operations. Since it recommenced operating in December 2004, the station has measured $SO_2$, $PM_{10}$ and meteorology.

The location of Eagle Farm, Pinkenba and Wynnum monitoring sites ensures that the data are representative of the variety of the land use and population densities in the project area.

**Table 12.4b:** Summary of Air Quality Monitoring Data for the Study Area.

| Pollutant and Averaging Time | 2003 | 2004 | 2005 | Air Quality Goal* |
|---|---|---|---|---|
| **Eagle Farm** | | | | |
| $NO_2$, 1 hour maximum (ppm) | 0.059 | 0.061 | - | 0.12 |
| $NO_2$, Annual average (ppm) | 0.011 | 0.013 | - | 0.03 |
| $PM_{10}$, 24 hour maximum (µg/m$^3$) | **88.4** | **79.6** | - | 50<br>(5 per year) |
| $PM_{10}$, Annual average (µg/m$^3$) | 19.7 | 22.8 | - | 50 |
| $SO_2$, 1 hour maximum (ppm) | 0.043 | 0.040 | - | 0.20 |
| $SO_2$, 24 hour maximum (ppm) | 0.007 | 0.010 | - | 0.08 |
| $SO_2$, Annual average (ppm) | 0.002 | 0.002 | - | 0.02 |
| $O_3$, 1 hour maximum (ppm) | 0.058 | 0.072 | - | 0.10 |
| $O_3$, 4 hour maximum (ppm) | 0.053 | 0.088 | - | 0.08 |
| **Pinkenba** | | | | |
| CO, 8 hour maximum (ppm) | 1.2 | 2.2 | 1.0 | 8 |
| $NO_2$, 1 hour maximum (ppm) | 0.039 | 0.057 | 0.042 | 0.12 |
| $NO_2$, Annual average (ppm) | 0.010 | 0.010 | - | 0.03 |
| $PM_{10}$, 24 hour maximum (µg/m$^3$) | **105.5** | **54.3** | **72.0** | 50<br>(5 per year ) |
| $PM_{10}$, Annual average (µg/m$^3$) | 20.0 | 21.3 | 18.9 | 50 |
| $SO_2$, 1 hour maximum (ppm) | 0.067 | 0.104 | 0.089 | 0.20 |
| $SO_2$, 24 hour maximum (ppm) | 0.009 | 0.009 | - | 0.08 |
| $SO_2$, Annual average (ppm) | 0.002 | 0.002 | 0.002 | 0.02 |
| $O_3$, 1 hour maximum (ppm) | 0.067 | 0.069 | 0.060 | 0.10 |
| $O_3$, 4 hour maximum (ppm) | 0.057 | 0.060 | 0.055 | 0.08 |
| **Wynnum** | | | | |
| $PM_{10}$, 24-hour maximum (µg/m$^3$) | - | - | **66.1** | 50<br>(5 per year) |
| $PM_{10}$, Annual average (µg/m$^3$) | - | - | 17.4 | 50 |
| $SO_2$, 1 hour maximum (ppm) | - | 0.019** | 0.051 | 0.20 |
| $SO_2$, 24 hour maximum (ppm) | - | - | - | 0.08 |
| $SO_2$, Annual average (ppm) | - | - | 0.001 | 0.02 |

* *Air quality goals presented in this table are the most stringent of the goals as discussed in section 12.3.*
** *One month of data.*

**Table 12.4b** summarises the air quality monitoring data collected by the EPA from 2003 and 2005 at Eagle Farm, Pinkenba and Wynnum. The maximum concentrations for each averaging period are shown. Values that are above the air quality goals are shown in bold print.

In 2004 and 2005 $PM_{10}$ (24 hour average) was the only pollutant with recorded levels above the associated air quality goal of 50 µg/m$^3$ at both the Pinkenba and Wynnum monitoring sites. However, these particulate matter episodes can be attributed to widespread events such as dust storms or bushfires, and the goal was not exceeded as there were less than five episodes in the year.

Data from 2001 to mid 2005 for Eagle Farm have been obtained from the EPA in the form of one-hourly average records. These data are presented graphically as time series for $NO_2$ and $PM_{10}$ in **Figures 12.4c** and **12.4d** respectively. Total $NO_2$ concentrations (**Figure 12.4c**) exhibit higher concentrations in the winter months than in the summer months.

The graph of $PM_{10}$ (**Figure 12.4d**) shows that there were occasions when the 24 hour concentrations were above the NEPM standard of 50 µg/m$^3$.

**Figure 12.4c:** *Measured Nitrogen Dioxide Concentrations at Eagle Farm.*

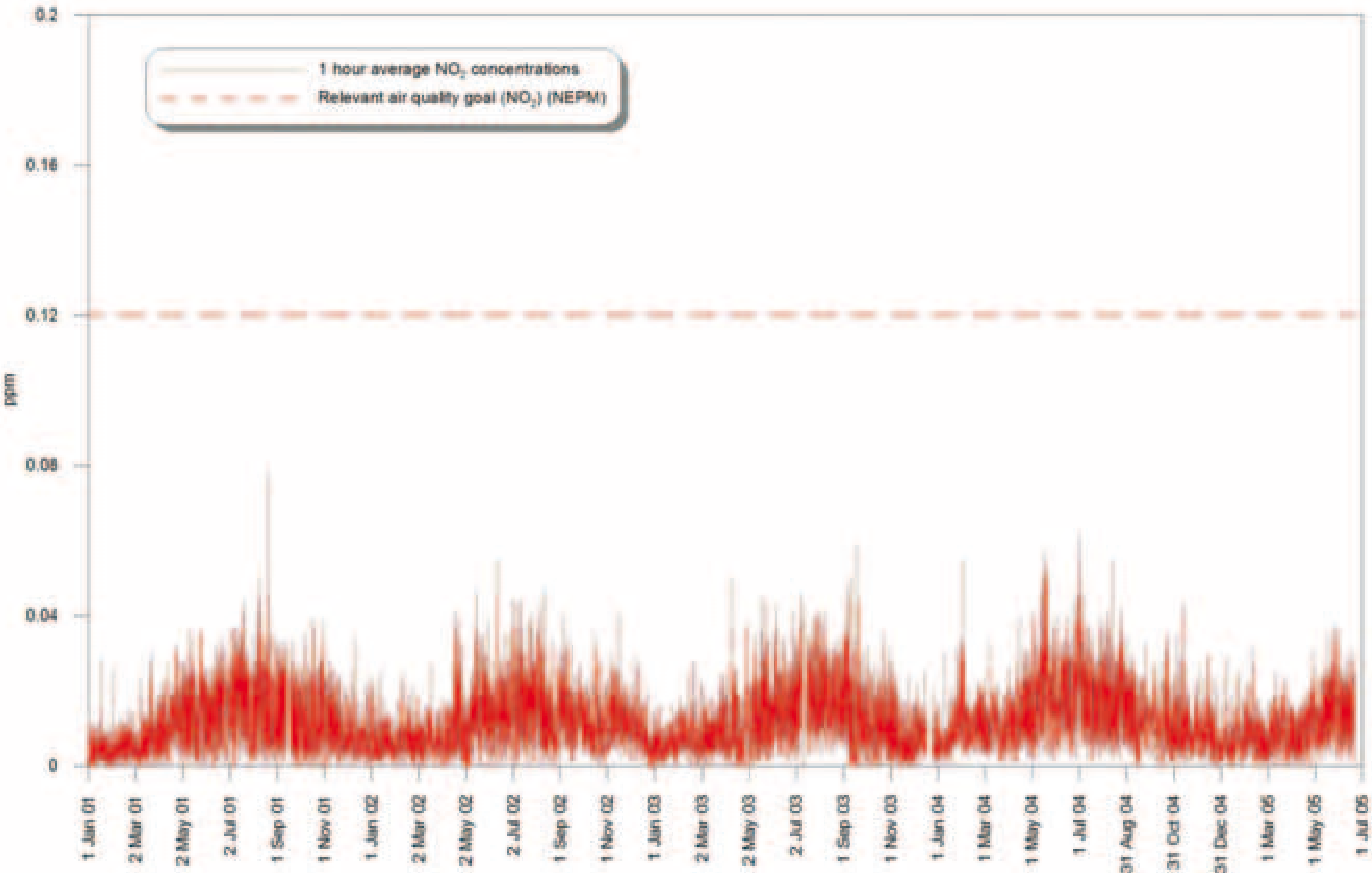
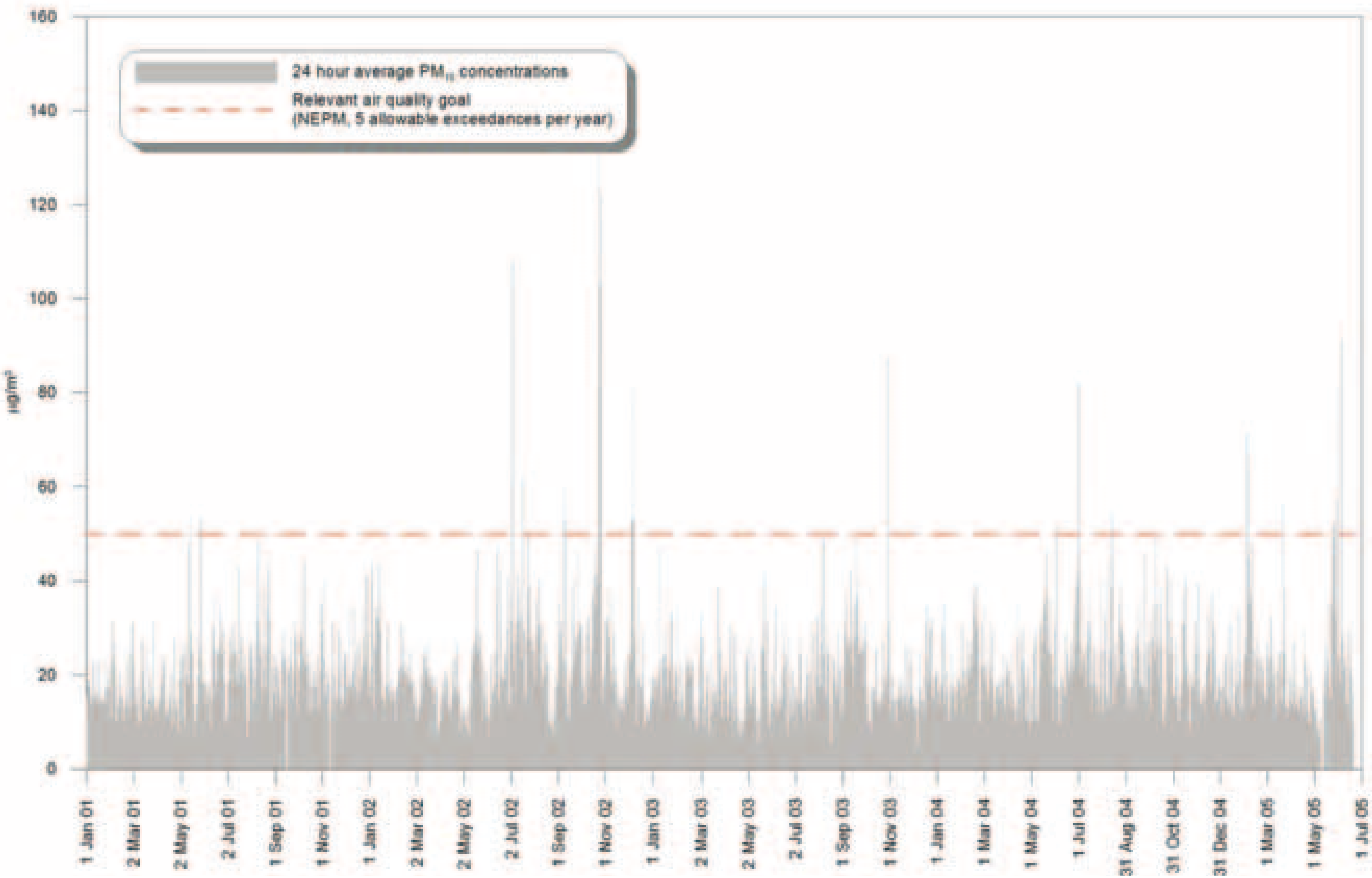


**Figure 12.4d:** *Measured Particulate Matter ($PM_{10}$) Concentrations at Eagle Farm.*



## 12.5 Construction Air Quality Impacts

This section addresses air quality impacts during the construction stage of the project. Sources of air emissions are discussed as well as potential mitigation measures.

### 12.5.1 Approach to Assessment

Air quality impacts during construction have been assessed in two ways. Firstly, a qualitative assessment has been carried out which identifies the air quality issues that may arise during construction. A discussion of the activities, in terms of dust emissions, is provided as well as the mitigation measures that can be implemented to minimise dust emissions.

In addition, dust dispersion modelling has been undertaken to gauge likely off-site impacts. The modelling has been undertaken based upon the likely construction activities and sequencing listed in Chapter A5. A conservative approach to the modelling of dust emissions during construction was adopted and the model results were compared with relevant air quality criteria to assess the impact.

### 12.5.2 Mitigation Measures

This section outlines procedures proposed for the management and control of dust emissions. The aim of the procedures is to minimise the emission of dust.

Dust can be potentially be generated from three primary sources as follows:

- Wind blown dust from exposed areas and from locations where vegetation has been cleared;
- Dust generated by excavation, earthworks and machinery activities; and
- Vehicle traffic on unpaved roads.

**Table 12.5a** and **Table 12.5b** list the different sources of wind blown and activity generated dust respectively, and the control procedures that can be typically employed.

On hot, dry, windy days (worst case emission conditions with respect to dust) the amount of dust from wind erosion can be high, and should be controlled using water sprays. It is possible that under some extreme wind conditions, construction activities would need to be stopped or relocated to areas removed from sensitive receptors.

**Table 12.5a:** Control Procedures for Wind Blown Dust.

| Source | Control Procedures |
|---|---|
| Exposed areas disturbed by removal of vegetation | Disturb only the minimum area necessary. Reshape, topsoil and rehabilitate completed areas as soon as practicable after the completion of works. |
| Material stockpiles | Maintain water sprays on stockpiles and use sprays to reduce the risk of airborne dust as required. |

**Table 12.5b:** Control Procedures for Activity Generated Dust.

| Source | Control Procedures |
|---|---|
| Dust from vehicles travelling on unsealed surfaces | Watering of active roads and traffic areas using water carts to minimise the generation of dust. To further minimise dust generation, chemical dust suppressants, increased utilisation of water carts and/or fixed irrigation can be used on selected roads to maintain high moisture levels.<br>The number of active unsealed roads should be minimised and clearly defined.<br>Obsolete roads should be rehabilitated. |
| Dust from vehicles travelling on minor roads | Development of minor roads should be limited and the locations of these should be clearly defined.<br>For example, minor roads used regularly for access should be constructed so as to minimise dust generation (well compacted select material) and watered as required.<br>Obsolete roads should be rehabilitated. |
| Topsoil disturbance | Access tracks used by earthworks equipment during their loading and unloading cycle should be watered. |
| Material stockpiling | Establishment of a cover crop over stockpiles that are not to be used in less than six months. This would minimise the potential for dust emissions due to wind erosion. |

Chemical dust suppressants have been proposed for use on roads, stockpiles and exposed areas during the construction period to minimise dust generation if required. This measure will ensure that dust emissions are subject to a high level of control.

A monitoring program would be undertaken to verify environmental performance for the duration of the construction activities.

It is envisaged the monitoring program would be developed in consultation with the Airport Environment Officer (AEO) but would be expected to incorporate dust deposition gauges around the boundary of the site. Gauges would be located to ensure adequate coverage during the construction phases.

In addition, a real-time dust management system may include measures that would minimise high dust generating activities at times when adverse weather conditions occurred. In this context adverse weather means unfavourable winds for closest residential areas when conditions are dry. Meteorological monitoring would assist with identifying conditions conducive to high dust generation.

### 12.5.3 Air Emissions

Potential air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities. The total amount of dust generated would depend on the silt and moisture content of the soil, the types of operations being carried out, exposed area, frequency of water spraying and speed of machinery. The detailed approach to construction would depend on decisions that would be made by the successful contractor and subtle changes to the construction methods and sequences are expected to take place during the detailed design development.

All phases of construction have the potential for dust generation. Based upon the construction operations proposed and the large, open areas that would be exposed to the prevailing winds, it is likely that Phase 2 (early works) will have the greatest potential for dust impacts to be observed off-site. On this basis, total dust emissions have been estimated by analysing the activities that are likely to take place at the site during Phase 2.

Estimates of dust emissions can be made using emission factors developed by the SPCC (1983) and the US EPA. These emission factors relate to the amount of dust generated by different types of equipment and operations associated with construction work.

The most likely equipment to be used includes dozers, excavators, trucks and graders. Sources of dust during Phase 2 of the construction activities will be topsoil disturbance, loading, transportation and unloading of material for bund construction and wind erosion from exposed areas.

The description of construction activities outlined in Chapter A5 has been used to determine material quantities, equipment locations, stockpile locations and areas, activity operating hours and other details that are necessary to estimate dust emissions.

The most significant dust generating activities have been identified and the dust emission estimates are presented below in **Table 12.5c.** Details of the calculations of the dust emissions are provided in **Appendix B12B**.

**Table 12.5c:** Estimated Dust Emissions Due to Construction Activities.

| Phase 2 Construction Activities | Annual TSP Emission Rate (kg/y) |
|---|---:|
| Topsoil disturbance | 8,760 |
| Excavator/FEL loading to trucks | 3,960 |
| Hauling material for bund construction | 39,600 |
| Emplacing material into temporary stockpiles and bunds | 3,960 |
| Dozer(s) shaping bunds | 8,760 |
| Wind erosion from exposed areas | 350,400 |
| Grading roads | 1,540 |
| TOTAL | 416,980 |

For the purposes of the emission estimates, dust mitigation has only been considered for vehicles on unpaved roads. It has been assumed that a 75 percent dust control efficiency can be achieved by the application of water or dust suppressants on unpaved roads.

There will be other dust sources, such as concrete and asphalt plants, however the emissions would be expected to be less significant than emissions due to the activities listed in **Table 12.5c**. Also, proper management and suitable dust mitigation measures, for example water sprays on loading points, would ensure that dust emissions from these activities are kept to a minimum.

In addition to construction dust emissions, there will be exhaust emissions of carbon monoxide (CO), nitrogen dioxide ($NO_2$), particulate matter, hydrocarbons and trace amounts of sulfur dioxide ($SO_2$) from diesel construction equipment and vehicles. In practice, the sources of CO, $NO_2$ and $SO_2$ in construction operations are too small and too widely dispersed over a large period of time to give rise to significant concentrations of these pollutants. Therefore, these emissions are not discussed in any detail in this report. However, all construction vehicles and machinery will be required to comply with relevant fuel and emission standards. This requirement will be included in the Construction EMP.

There is a potential for odour emissions to occur from asphalt plants. These odours could occur during filling of tanks, loading of product to trucks and minor spillages of bitumen at tank loading points and of fresh asphalt at the truck loading points. In modern well-managed asphalt plants, offsite odour is generally not a significant problem.

### 12.5.4 Dispersion Modelling Methodology

Dispersion modelling has been carried out to provide an indication of air quality impacts during construction.

Offsite dust concentrations due to the Phase 2 construction activities have been predicted using AUSPLUME. AUSPLUME (Version 6.0) is an advanced Gaussian dispersion model developed on behalf of the Victorian EPA (VEPA, 1986) and is based on the US EPA's Industrial Source Complex (ISC) model. It is widely used throughout Australia and is regarded as a 'state-of-the-art' model.

The model has been configured to predict a range of dust categories; namely, $PM_{10}$ and TSP. Predictions have been compared with relevant air quality goals.

The modelling has been based on the use of three particle-size categories: 0 to 2.5 µm – referred to as $PM_{2.5}$ or fine particles (FP), 2.5 to 10 µm – referred to as CM (coarse matter) and 10 to 30 µm – referred to as the Rest.

The distribution of particles has been derived from measurements in the SPCC (1986) study. The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 4.7 percent of the TSP;
- $PM_{2.5-10}$ (CM) is 34.47 percent of TSP; and
- $PM_{10-30}$ (Rest) is 60.97 percent of TSP.

Modelling was done using three AUSPLUME source groups. Each group corresponded to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 µm. The predicted concentration in the three plot output files for each group were then combined according to the weightings in the above dot points to determine the concentration of $PM_{10}$ and TSP.

The AUSPLUME model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions on dust generating industries where wind speed is an important factor in determining the rate at which dust is generated.

For the current study the operations were represented by a series of volume sources located according to the site layout. **Figure 12.5a** shows the location of the modelled sources. Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed.

It is important to do this in the AUSPLUME model to ensure that long term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds. Light winds at a project site would correspond with periods of low dust generation (because wind erosion and other wind dependent emissions rates will be low) and also correspond with periods of poor dispersion.
If these measures are not taken the model has the potential to significantly overstate impacts.

Dust concentrations have been predicted in the vicinity of the construction areas. The terrain has been taken to be flat for the purposes of the modelling.

The modelling has been performed using the meteorological data discussed in section 12.4.1 and the dust emission estimates from section 12.5.3.

All dust sources have been modelled assuming activities emit and take place between 6am and 6pm, except for wind erosion, which has been modelled for 24 hours per day. This is a slightly conservative approach since all activities may not necessarily take place concurrently.

### 12.5.5 Dispersion Model Results

Results from the dispersion modelling are provided in **Figures 12.5b** to **12.5d**. The figures show the following:

- Predicted maximum 24 hour average $PM_{10}$ concentration;
- Predicted annual average $PM_{10}$ concentration; and
- Predicted annual average TSP concentration.

The maximum 24 hour average contour plot does not represent the dispersion pattern for any particular day, but shows the highest predicted 24 hour average concentration that occurred at each location. The maxima are used to show concentrations which can possibly be reached under the modelled conditions.

**Figure 12.5b** shows the predicted maximum 24 hour average $PM_{10}$ concentrations due to Phase 2 construction activities. At the closest residential areas of Nudgee and Nudgee Beach, the predicted concentrations are of the order of 2 $\mu g/m^3$ or less. These predicted concentrations are well below the NEPM 50 $\mu g/m^3$ goal and the impacts are therefore taken to be acceptable.

*Figure 12.5a:* Location of Modelled Dust Emission Sources for Construction Impacts.

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**Figure 12.5b:** *Predicted Maximum 24 Hour Average PM$_{10}$ Concentrations During Construction (µg/m$^3$).*

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Predicted annual average $PM_{10}$ concentrations (**Figure 12.5c**) are less than 0.5 µg/$m^3$ at the nearest residential areas to the north and north-west. This increment from construction activities is unlikely to result in exceedances of the 50 µg/$m^3$ goal, even when considering background levels. The Eagle Farm monitoring site recorded an annual average $PM_{10}$ level of 23 in 2004.

Similarly annual average TSP concentrations (**Figure 12.5d**) are predicted to be less than 0.5 µg/$m^3$ due to construction activities. This increment to off-site locations is considered to be small and unlikely to cause exceedances of the 90 µg/$m^3$ air quality goal.

## 12.6 Surface Road Air Quality Impacts

This section assesses the likely changes to air quality near surface roads in the vicinity of the Airport. Changes to air quality near surface roads will be a result of changes to traffic as a result of the NPR.

Dispersion modelling has been used for assessment purposes. The model input data, methodology and results are discussed below.

### 12.6.1 Emission Data

The most significant emissions produced from motor vehicles are CO, $NO_x$, and $PM_{10}$. These pollutants are the focus of this assessment. Estimated emissions of these pollutants are required as input to computer-based dispersion models in order to predict pollutant concentrations in the area of interest and to compare these concentrations with associated air quality goals.

The primary factors which influence emissions from vehicles include the mode of travel, the grade of the road and the mix or type of vehicles on the road. It is important to estimate pollutant emissions using as much information as is known about these factors.

The general approach to derive total pollutant emissions from a road section is simply to multiply the total number of vehicles on the road section by the pollutant emission per vehicle (the emission factor). Pollutant emission factors are typically provided in units of grams per kilometre or sometimes as grams per hour.

Vehicle emission factors for this study have been sourced from the World Road Association, referred to as PIARC (formerly the Permanent International Association of Road Congress).

PIARC is a European-based organisation focused on road transport related issues. Technical committees coordinated by PIARC regularly circulate documents on many aspects of roads and road transport.

In 1995, PIARC published a document (PIARC, 1995) as the basis of design for longitudinal tunnel ventilation systems. The document, entitled "Vehicle emissions, air demand, environment, longitudinal ventilation", also provided comprehensive vehicle emissions factors for different road gradients, vehicle speeds and for vehicles conforming to different European emission standards. Given the detailed emission breakdowns, the PIARC data are very useful for sensitivity testing, such as analysing the effect of changes to vehicle speed and road grade.

The 1995 PIARC document described the emission situation up to the year 1995. In 2004, PIARC updated the methodology and emissions information (PIARC, 2004) based on activities between 2001 and 2003. The design data are subject to ongoing review due to a steady tightening of emission standards for vehicles.

Since the PIARC emissions data are primarily based on European studies, the emission tables have been modified in this assessment to take account of the age, vehicle mix, vehicle speed, gradient of road and emissions control technology of the Australian vehicle fleet. The modified tables include emissions of CO, $NO_x$ and $PM_{10}$ by age and type of vehicle. The age of vehicles have been categorised into five periods, corresponding to the introduction of emission standards, and three vehicle type categories.

The vehicle types have been defined as follows:

- Passenger cars using petrol;
- Passenger cars using diesel; and
- Heavy goods vehicles using diesel.

***Figure 12.5c:** Predicted Annual Average PM$_{10}$ Concentrations During Construction (μg/m$^3$).*

**Figure 12.5d:** *Predicted Annual Average TSP Concentrations During Construction (µg/m³).*

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The general approach for using the PIARC data was to combine total traffic volume with percentages of vehicles in each age bracket and type category. Using these inputs, as well as road grade and speed information, total emissions for selected sections of road have been generated.

### 12.6.2 Traffic Data

Existing and projected future traffic in the vicinity of the Airport were generated by ARUP. The traffic data made available and used for the purposes of the air quality study included the following:

- Annualised Average Weekday Traffic (AAWT) for years 2004 (existing), 2015 and 2035;
- Scenarios with and without NPR for 2035; and
- Traffic volumes by hour of day (profiles) for selected road sections;

The road sections chosen for the purposes of the assessment are shown in **Table 12.6a**. Also provided in this table are the modelled AAWT data provided by ARUP.

It can be seen from **Table 12.6a** that there is a significant decrease in traffic numbers on the Gateway Motorway from 2004 to 2015. This is a result of the Gateway duplication project.

**Figure 12.6a** shows the location of the selected road sections. The road sections were chosen both on traffic volumes and the expected change in traffic due to the NPR. Although it is possible to model more road sections than presented in this report, the selected road sections cover instances of high traffic volumes or large changes to traffic volumes.

**Table 12.6a:** Road Sections and Traffic Data Used in the Dispersion Modelling.

| Section | AAWT | | | |
|---|---|---|---|---|
| | 2004 | 2015 | 2035 no NPR | 2035 NPR |
| **Kingsford Smith Drive** | | | | |
| AAWT (NB/EB) | 36,428 | 34,010 | 53,610 | 55,130 |
| AAWT (SB/WB) | 21,042 | 31,650 | 52,240 | 52,950 |
| **Gateway Motorway (south of East-West Arterial)** | | | | |
| AAWT (NB/EB) | 48,690 | 38,290 | 52,030 | 52,540 |
| AAWT (SB/WB) | 64,421 | 33,730 | 47,920 | 48,220 |
| **Gateway Motorway (north of East-West Arterial)** | | | | |
| AAWT (NB/EB) | 43,464 | 26,920 | 32,970 | 32,990 |
| AAWT (SB/WB) | 43,421 | 25,510 | 38,000 | 39,920 |
| **Gateway Motorway duplication (south of East-West Arterial)** | | | | |
| AAWT (NB/EB) | - | 27,970 | 55,240 | 61,120 |
| AAWT (SB/WB) | - | 28,900 | 56,690 | 65,280 |
| **Gateway Motorway duplication (north of East-West Arterial)** | | | | |
| AAWT (NB/EB) | - | 22,000 | 48,450 | 60,140 |
| AAWT (SB/WB) | - | 27,780 | 53,000 | 56,860 |
| **East-West Arterial Road (west of motorway)** | | | | |
| AAWT (NB/EB) | 13,031 | 39,910 | 46,830 | 48,100 |
| AAWT (SB/WB) | 20,832 | 42,340 | 48,790 | 48,590 |
| **East-West Arterial Road (east of motorway)** | | | | |
| AAWT (NB/EB) | 40,541 | 52,350 | 73,750 | 79,480 |
| AAWT (SB/WB) | 42,001 | 56,980 | 70,880 | 72,810 |
| **Airport Drive** | | | | |
| AAWT (NB/EB) | 36,059 | 12,520 | 29,930 | 41,430 |
| AAWT (SB/WB) | 26,094 | 12,450 | 16,030 | 28,670 |
| **Northern Access Road** | | | | |
| AAWT (NB/EB) | - | 51,320 | 72,320 | 81,530 |
| AAWT (SB/WB) | - | 50,730 | 79,660 | 93,610 |

*NB/EB: Northbound or eastbound*
*SB/WB: Southbound or westbound*

***Figure 12.6a:*** *Road Sections Selected for the CALINE Modelling.*

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**Table 12.6b:** Traffic Profiles for Modelled Road Sections.

| Hour of day (Hour Ending) | Percentage of Daily Volume | | | | | | |
|---|---|---|---|---|---|---|---|
| | Kingsford Smith Drive | Gateway Motorway and Duplication (South) | Gateway Motorway and Duplication (North) | East-West Arterial Road (West of Motorway) | East-West Arterial Road (East of Motorway) | Airport Drive | Northern Access Road |
| 1 | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.5% | 0.4% |
| 2 | 0.3% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% |
| 3 | 0.3% | 0.2% | 0.2% | 0.2% | 0.2% | 0.3% | 0.2% |
| 4 | 0.4% | 0.4% | 0.4% | 0.5% | 0.5% | 0.5% | 0.4% |
| 5 | 1.0% | 1.1% | 1.1% | 1.2% | 1.2% | 1.8% | 1.1% |
| 6 | 3.2% | 3.7% | 3.7% | 3.7% | 3.7% | 5.1% | 3.7% |
| 7 | 5.8% | 6.7% | 6.7% | 6.2% | 6.2% | 5.9% | 6.7% |
| 8 | 7.5% | 7.6% | 7.6% | 7.3% | 7.3% | 6.9% | 7.6% |
| 9 | 7.4% | 7.1% | 7.1% | 7.2% | 7.2% | 6.9% | 7.1% |
| 10 | 6.6% | 6.2% | 6.2% | 5.4% | 5.4% | 5.5% | 6.2% |
| 11 | 6.0% | 5.7% | 5.7% | 5.1% | 5.1% | 5.1% | 5.7% |
| 12 | 5.9% | 5.6% | 5.6% | 5.0% | 5.0% | 5.2% | 5.6% |
| 13 | 6.2% | 5.7% | 5.7% | 5.6% | 5.6% | 5.5% | 5.7% |
| 14 | 6.5% | 5.8% | 5.8% | 5.6% | 5.6% | 5.4% | 5.8% |
| 15 | 6.8% | 6.5% | 6.5% | 6.6% | 6.6% | 5.8% | 6.5% |
| 16 | 7.0% | 7.3% | 7.3% | 7.4% | 7.4% | 6.3% | 7.3% |
| 17 | 6.9% | 7.6% | 7.6% | 8.1% | 8.1% | 6.4% | 7.6% |
| 18 | 6.9% | 7.0% | 7.0% | 8.2% | 8.2% | 6.3% | 7.0% |
| 19 | 4.8% | 5.1% | 5.1% | 5.4% | 5.4% | 5.8% | 5.1% |
| 20 | 3.5% | 3.3% | 3.3% | 3.6% | 3.6% | 4.9% | 3.3% |
| 21 | 2.4% | 2.3% | 2.3% | 2.5% | 2.5% | 3.8% | 2.3% |
| 22 | 2.0% | 1.9% | 1.9% | 2.1% | 2.1% | 2.9% | 1.9% |
| 23 | 1.3% | 1.5% | 1.5% | 1.6% | 1.6% | 1.9% | 1.5% |
| 24 | 0.9% | 1.0% | 1.0% | 1.0% | 1.0% | 1.2% | 1.0% |

Traffic by hour of day has been calculated from the total traffic in **Table 12.6a** using traffic profiles provided by ARUP. The traffic profiles are shown in **Table 12.6b**.

It has been assumed that, for all hours of the day, each road section under review carries 5 percent heavy goods vehicles. Diesel-fuelled passenger cars have been assumed to make up 2 percent of the vehicle types. While this may increase over time, and would result in higher emissions of particulate matter and lower emissions of other pollutants, the overall contribution that the passenger fleet makes to particulate and $NO_x$ emission is relatively low. Overall, fleet emissions of these pollutants are dominated by heavy-duty diesel vehicles.

Information on registered vehicle types and year of the manufacture data for Queensland has been obtained from the Australian Bureau of Statistics (ABS, 2003). **Table 12.6c** presents a summary of the percentage of vehicles by age category for modelled years, derived from the ABS data. Registered vehicles in future years have been extrapolated. In 2035 it has been assumed that the fleet will be comprised only of vehicles manufactured after 2005. As will be seen in the following section, there is a substantial decrease in estimated fleet emissions from 2004 to 2035 for all pollutants.

### 12.6.3 Estimated Emissions

Pollutant emissions have been estimated for the nine road sections discussed in section 12.6.2. No potential future improvements in vehicle technology or fuel standards have been included in the PIARC emission estimates. This will result in some overestimation of emission rates for future years. As noted above, assumed reductions in the proportion of older vehicles in the fleet will simulate some improvement to vehicle emissions in future years, but the estimates are likely to be conservative.

Traffic volume, traffic mix and traffic speed were included in the process to generate pollutant emissions for each hour of the day for each road section. Road grade has been taken to be flat for all sections. A speed of 80 km/h has been assumed for vehicles on the Gateway Motorway while for all other modelled sections, a speed of 50 km/h has been used.

**Table 12.6d** summarises the estimated pollutant emissions from each road section. Data are shown as grams per vehicle-mile (as required by the roadway dispersion model which was developed in California). The data have been presented in this way to allow the reader to easily replicate the modelling if required. Hourly emissions data were used for the dispersion modelling.

### 12.6.4 Approach to Assessment

Pollutant concentrations due to traffic on selected surface roads have been predicted using the CALINE dispersion model. Predictions have been made at various distances from the roads using the meteorological data described in section 12.4.1 and the emissions data from section 12.6.3.

The CALINE series of dispersion models has been widely used in roadway studies throughout Australia to estimate pollutant concentrations close to roadways. The models are steady-state dispersion models which can determine concentrations at receptor locations downwind of ‘at grade’, ‘fill’, ‘bridges’ and ‘cut section’ highways located in relatively uncomplicated terrain. The models are applicable for most wind directions, highway orientations and receptor locations.

Cal3qhcr is one of a number of models in the CALINE series and is an enhancement of the Cal3qhc and Caline-3 roadway models to allow real (long term) meteorological data. Model inputs also include roadway geometries, receptor locations and vehicular emission rates. The model is suitable for predictions within a few hundred metres of the roadway. Further details on the CALINE models can be found in the user manuals (US EPA website).

The main purpose of the Cal3qhcr modelling is to assess air quality impacts very close to selected roadways resulting from changes to traffic volumes for the with and without NPR scenarios.

Modelling has considered the number of lanes on each road section as well as the alignment of the road relative to north. This is important when hourly meteorological data are provided to the model. Each lane has been assumed to be 3.5 m wide.

Predictions have been made at 0, 10, 30 and 50 m from the kerb, on both sides of each road section.

Monitoring data collected by the RTA in Sydney (RTA, 1997) indicate that close to the roadways, $NO_2$ would make up from 5 percent to 20 percent by weight of the total $NO_x$. A conservative value of 15 percent by weight at 0–10 m from the roadway and 20 percent by weight at 20–50 m from the roadway has been used in the impact assessment presented in section 12.6.5. Although this information is drawn from measurements made in Sydney, the chemical processes involved in the conversion of NO to $NO_2$ will still be relevant for the study area in Brisbane.

For annual average $NO_2$ predictions it has been assumed that 65 percent of the $NO_x$ is $NO_2$. This percentage was derived from an analysis of the average $NO_2$ to $NO_x$ ratio from data collected at Eagle Farm between 2001 and 2005 (Holmes Air Sciences, 2006).

**Table 12.6c:** Vehicle Mix by Year of Manufacture.

| Age Category | QLD 2004 Fleet | | QLD 2015 Fleet | | QLD 2035 Fleet | |
|---|---|---|---|---|---|---|
| | Light | Heavy | Light | Heavy | Light | Heavy |
| Pre 1988 | 23.4 | 37.4 | 14.6 | 25.5 | 0.0 | 0.0 |
| 1988-1996 | 34.1 | 29.9 | 21.3 | 20.3 | 0.0 | 0.0 |
| 1997-2002 | 31.5 | 24.1 | 19.6 | 16.4 | 0.0 | 0.0 |
| 2003-2004 | 11.0 | 8.6 | 6.9 | 5.8 | 0.0 | 0.0 |
| Post 2005 | 0.0 | 0.0 | 37.7 | 32.0 | 100 | 100 |
| TOTAL | 100 | 100 | 100 | 100 | 100 | 100 |

**Table 12.6d**: Calculated Fleet Emission Factors for Modelled Road Sections.

| Section | Estimated Emissions (g/veh-mile) | | | |
|---|---|---|---|---|
| | 2004 | 2015 | 2035 no NPR | 2035 NPR |
| **Kingsford Smith Drive** | | | | |
| CO | 9.34 | 8.46 | 1.88 | 1.88 |
| $NO_x$ | 2.70 | 2.22 | 0.39 | 0.39 |
| $PM_{10}$ | 0.14 | 0.10 | 0.02 | 0.02 |
| **Gateway Motorway (south)** | | | | |
| CO | 6.51 | 5.91 | 1.42 | 1.42 |
| $NO_x$ | 2.75 | 2.26 | 0.40 | 0.40 |
| $PM_{10}$ | 0.11 | 0.08 | 0.02 | 0.02 |
| **Gateway Motorway (north)** | | | | |
| CO | 6.51 | 5.91 | 1.42 | 1.42 |
| $NO_x$ | 2.75 | 2.26 | 0.40 | 0.40 |
| $PM_{10}$ | 0.11 | 0.08 | 0.02 | 0.02 |
| **Gateway Motorway duplication (south)** | | | | |
| CO | 6.51 | 5.91 | 1.42 | 1.42 |
| $NO_x$ | 2.75 | 2.26 | 0.40 | 0.40 |
| $PM_{10}$ | 0.11 | 0.08 | 0.02 | 0.02 |
| **Gateway Motorway duplication (north)** | | | | |
| CO | 6.51 | 5.91 | 1.42 | 1.42 |
| $NO_x$ | 2.75 | 2.26 | 0.40 | 0.40 |
| $PM_{10}$ | 0.11 | 0.08 | 0.02 | 0.02 |
| **East-West Arterial Road (west of motorway)** | | | | |
| CO | 9.34 | 8.46 | 1.88 | 1.88 |
| $NO_x$ | 2.70 | 2.22 | 0.39 | 0.39 |
| $PM_{10}$ | 0.14 | 0.10 | 0.02 | 0.02 |
| **East-West Arterial Road (east of motorway)** | | | | |
| CO | 9.34 | 8.46 | 1.88 | 1.88 |
| $NO_x$ | 2.70 | 2.22 | 0.39 | 0.39 |
| $PM_{10}$ | 0.14 | 0.10 | 0.02 | 0.02 |
| **Airport Drive** | | | | |
| CO | 9.34 | 8.46 | 1.88 | 1.88 |
| $NO_x$ | 2.70 | 2.22 | 0.39 | 0.39 |
| $PM_{10}$ | 0.14 | 0.10 | 0.02 | 0.02 |
| **Northern Access Road** | | | | |
| CO | 9.34 | 8.46 | 1.88 | 1.88 |
| $NO_x$ | 2.70 | 2.22 | 0.39 | 0.39 |
| $PM_{10}$ | 0.14 | 0.10 | 0.02 | 0.02 |

### 12.6.5 Assessment of Impacts

The purpose of this section is to examine pollutant concentrations very close to selected surface roads. Results presented in this section show the effect of emissions from the selected surface road only and do not include contributions from other sources. An objective of this section was to compare existing near roadside pollutant concentrations with future scenarios.

**Figures 12.6b** to **12.6j** present the results showing modelled near roadside pollutant concentrations. The predictions have been made using the Cal3qhcr roadway dispersion model. Each figure provides information for a single road section and presents the predictions of CO, $NO_2$ and $PM_{10}$ concentrations at various distances from the road for existing (2004) and future cases.

Predictions have been made at the kerb and 10, 30 and 50 m from the eastern and western kerb of the road section. These predictions are useful for examining the differences between existing and future traffic scenarios.

From examination of the model results the highest pollutant concentrations for existing conditions are predicted in the vicinity of the Gateway Motorway. This may be expected, given the higher traffic volumes experienced on this road, relative to the other modelled roads. Predicted pollutant concentrations are highest at the kerb and decrease with distance from the kerb for all road sections. This shows the dispersion effect of distance from the source.

In assessing the magnitude of the predicted pollutant concentrations, an appropriate distance from the kerb should be selected based on the distance to the nearest residences. For example, the separation distance between the kerb and the nearest residences is greater for the Gateway Motorway than for many of the other selected roads. The most relevant distances from the Gateway Motorway road sections would be about 30 m while for most other sections, 10 m from the kerb would be the appropriate distance for the nearest residences.

A distance of between 10 and 30 m from each road section is usually suitable for assessment of maximum impacts at existing sensitive receptor locations. However, it is recommended that the planning of new developments on the Airport grounds including sensitive receptors such as child care centres, consider the outcomes of the dispersion modelling assessment and ensure that suitable buffer distances are adopted. This will reduce the potential for adverse air quality impacts.

The following observations were made from the surface road dispersion model predictions:

- Predicted pollutant concentrations are highest at the kerb for each road section;
- Predicted existing pollutant concentrations are highest near the Gateway Motorway sections;
- Future roadside concentrations are generally predicted to be lower than existing concentrations even though traffic volumes increase. This is due to improved vehicle emission controls, with older vehicles being phased out;
- Differences between with and without NPR in 2035 are considered to be negligible for all modelled road sections. That is, the changes to roadside air quality due to changes in Airport-related traffic are small;
- East-West Arterial Road is the only modelled section where there is a notable increase in predicted pollutant concentrations from 2004 to 2015. It should be noted that traffic volumes to and from the Airport in 2015 are the same whether the NPR is built or not;
- At distances representative of the nearest residences, the model predictions for all road sections and future years are below the associated air quality goals;
- The dispersion modelling has considered road sections with relatively high volumes of traffic. Pollutant concentrations on other, non-modelled, roadways in the vicinity of the Airport would be expected to be lower than for the assessed road sections.

**Figure 12.6b:** *Predicted Roadside Concentrations Near Kingsford Smith Drive.*

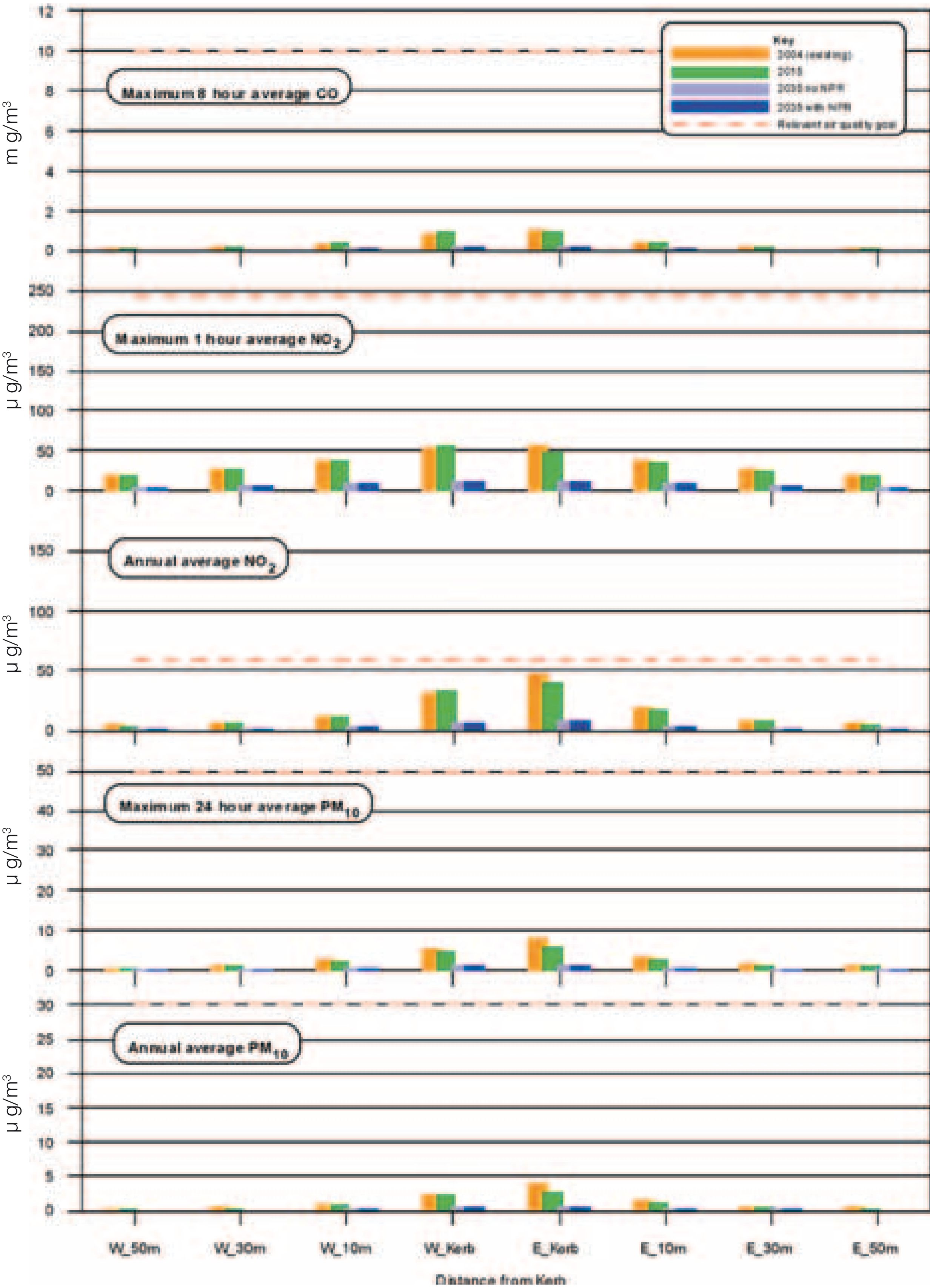


***Figure 12.6c:*** *Predicted Roadside Concentrations Near Gateway Motorway (South of East-West Arterial).*

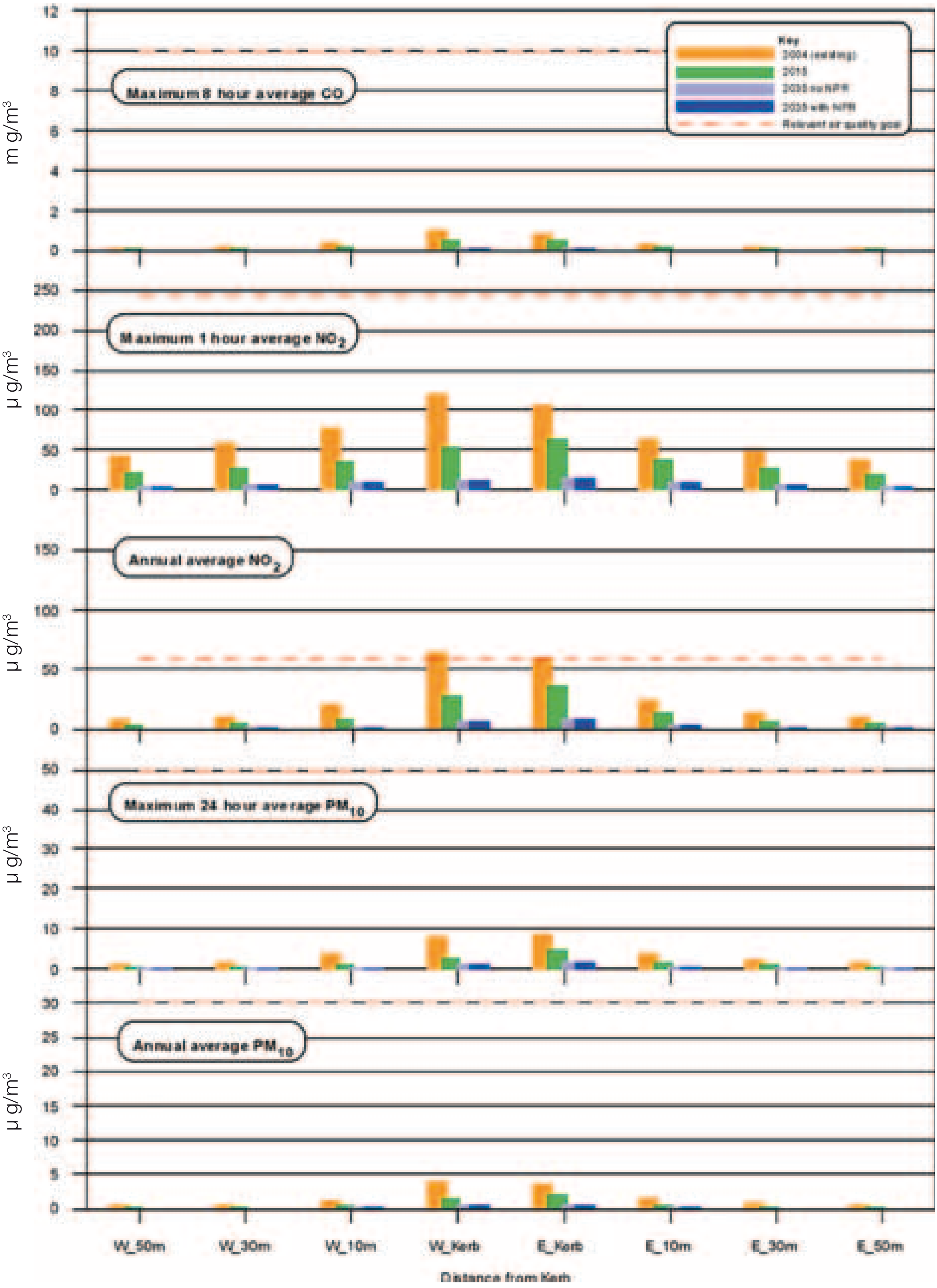


***Figure 12.6d:*** *Predicted Roadside Concentrations Near Gateway Motorway (North of East-West Arterial).*

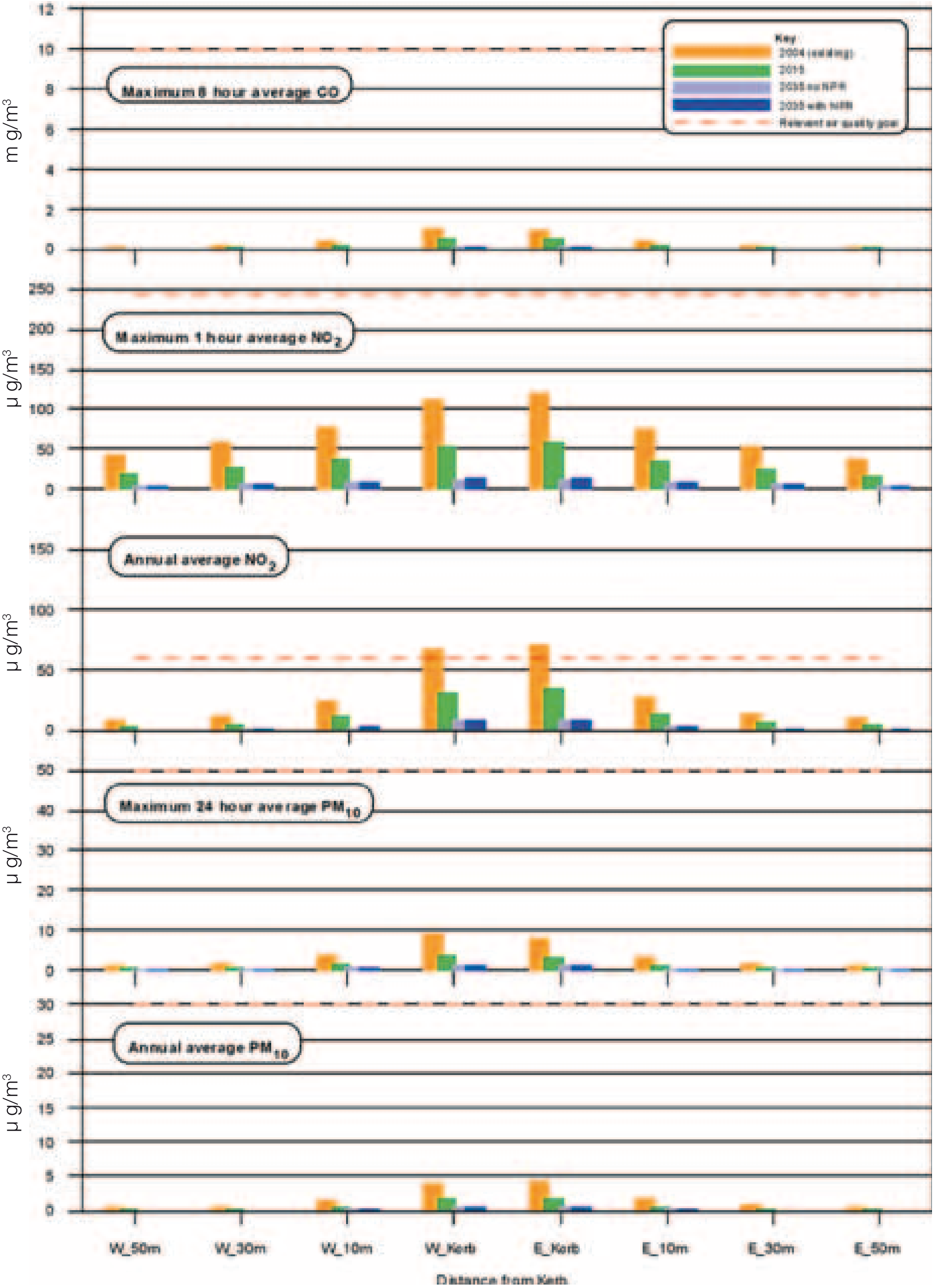


**Figure 12.6e:** *Predicted Roadside Concentrations Near Gateway Motorway Duplication (South of East-West Arterial).*

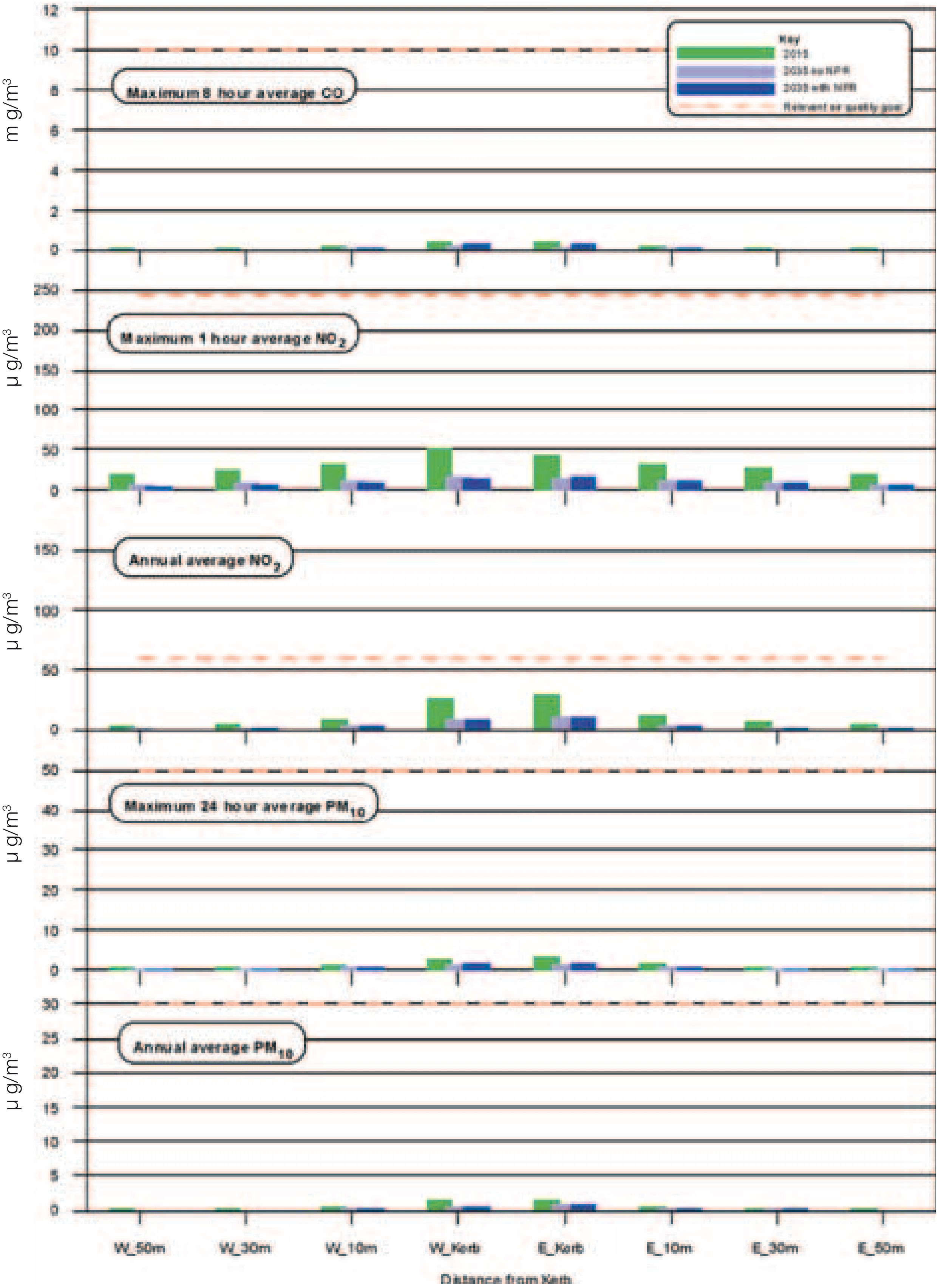


**Figure 12.6f:** *Predicted Roadside Concentrations Near Gateway Motorway Duplication (North of East-West Arterial).*

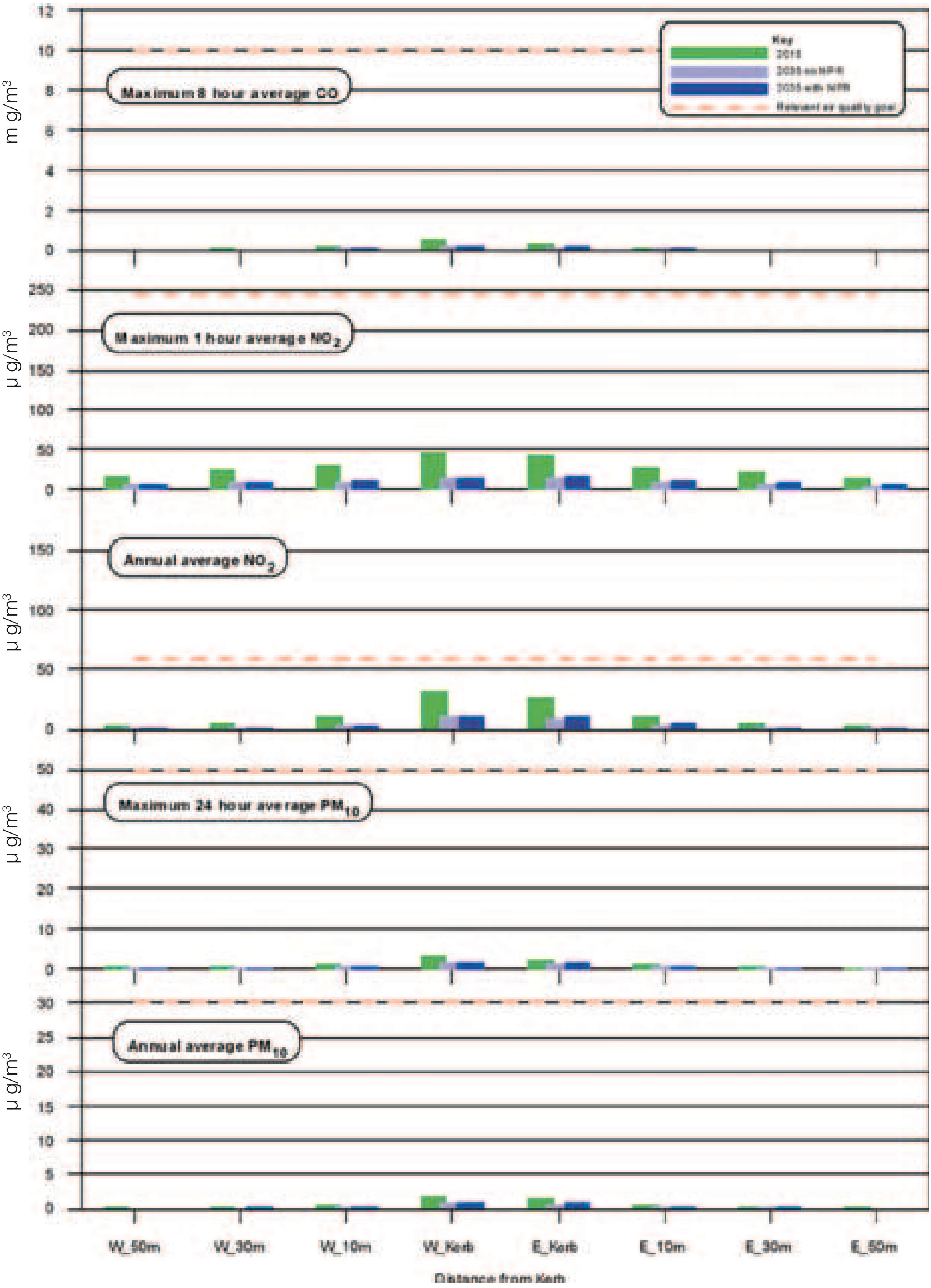


***Figure 12.6g:*** *Predicted Roadside Concentrations Near East-West Arterial (West of Motorway).*

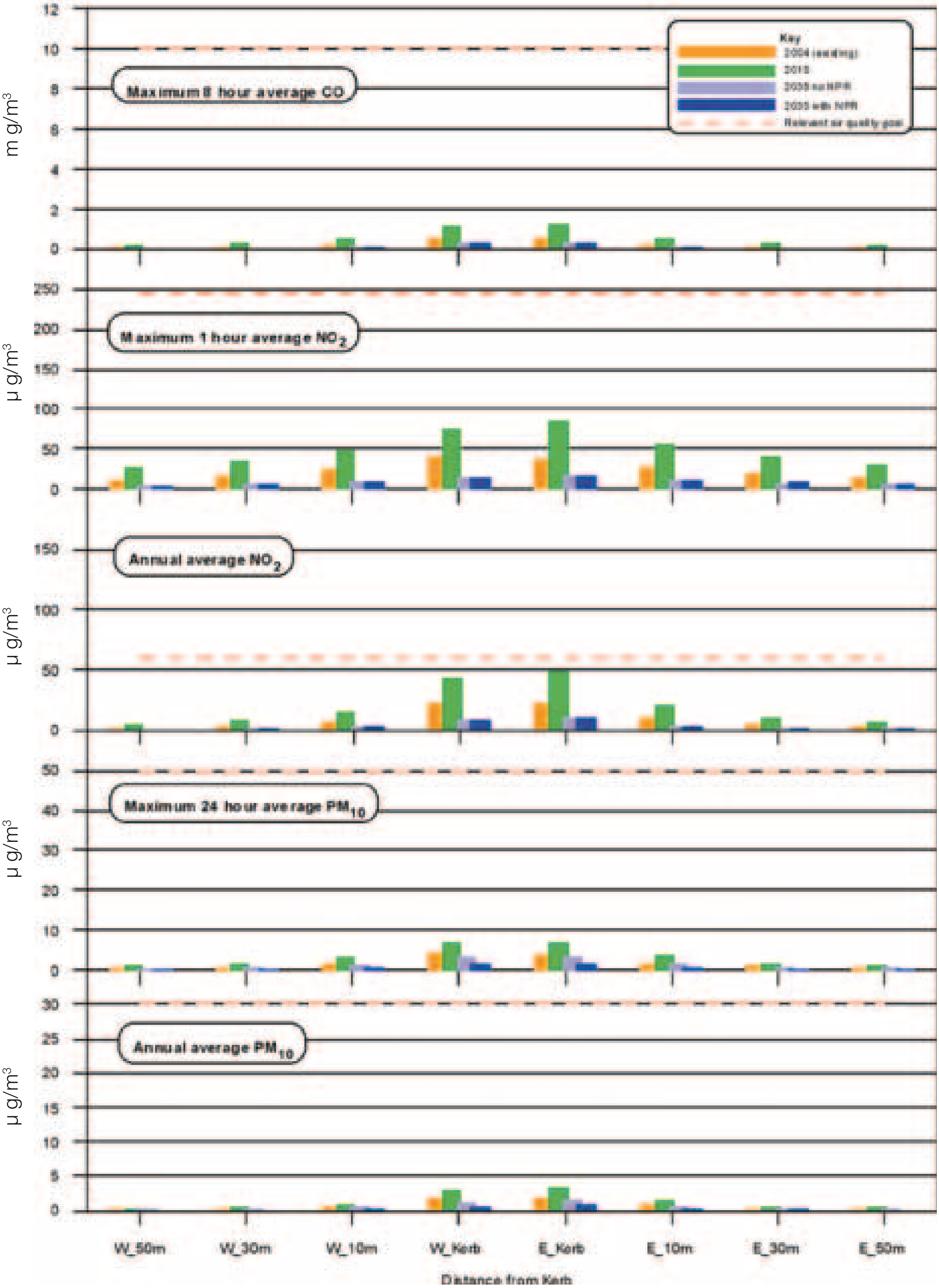


*Figure 12.6h:* Predicted Roadside Concentrations Near East-West Arterial (East of Motorway).

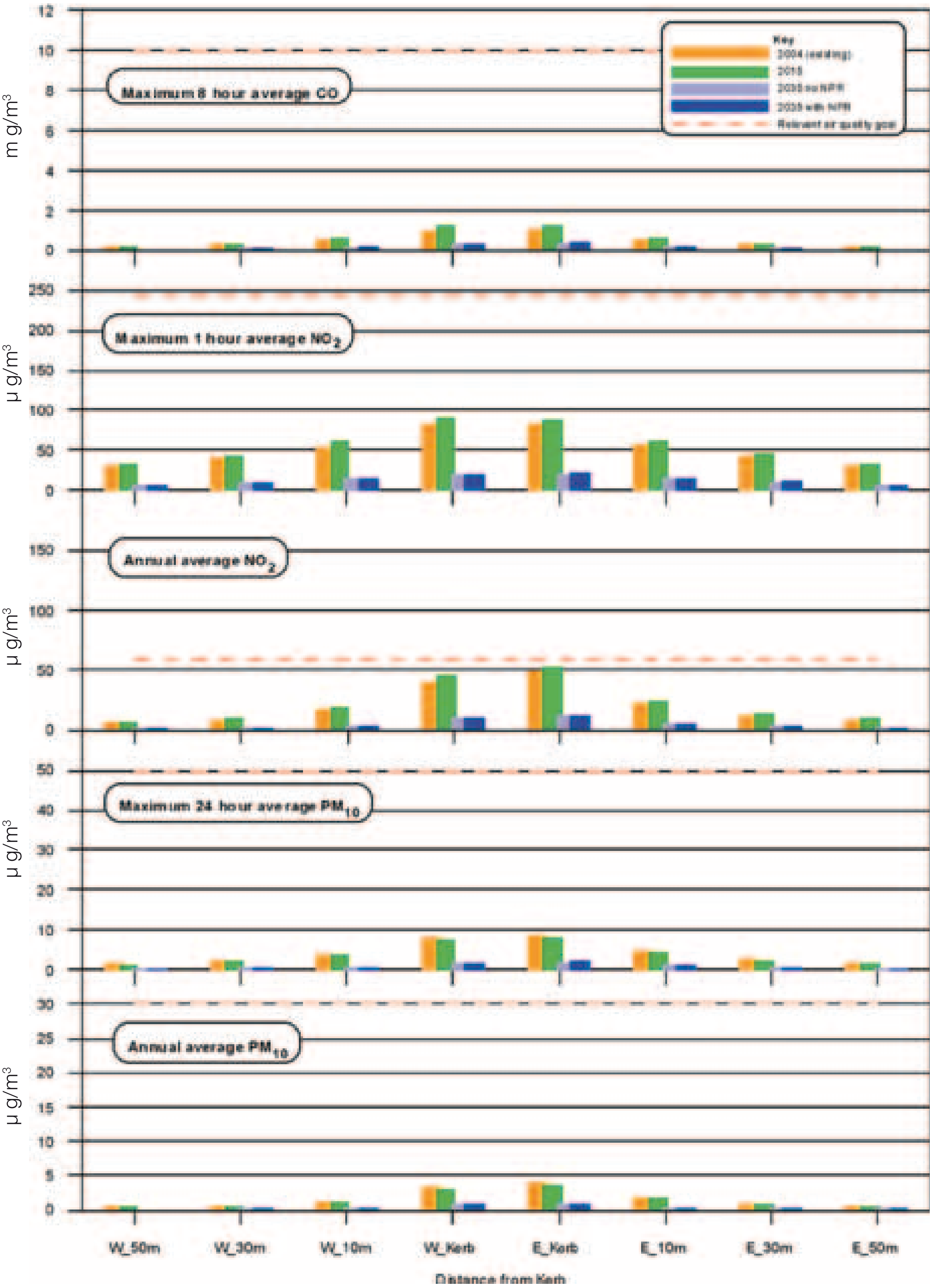


**Figure 12.6i:** *Predicted Roadside Concentrations Near Airport Drive.*

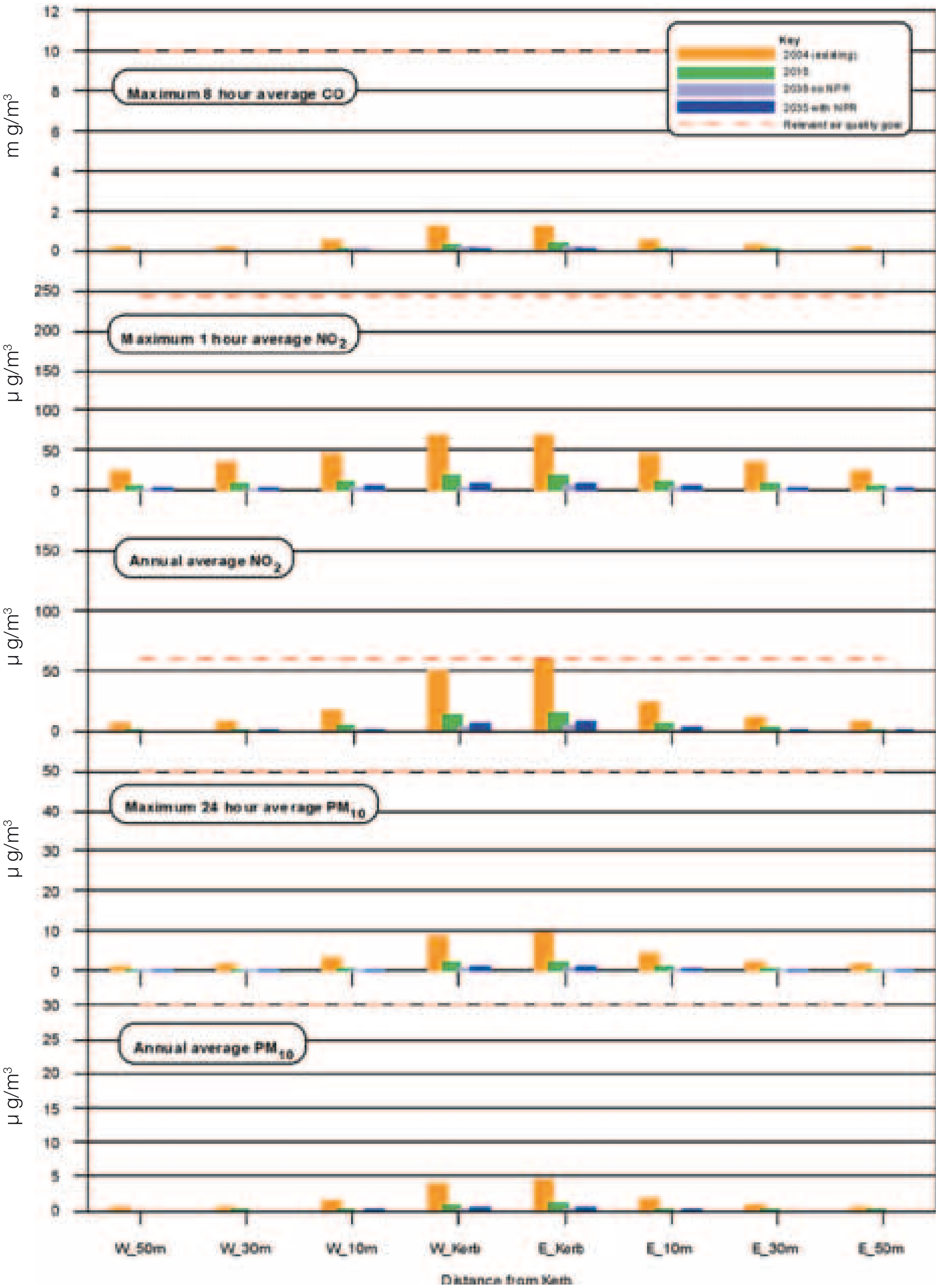
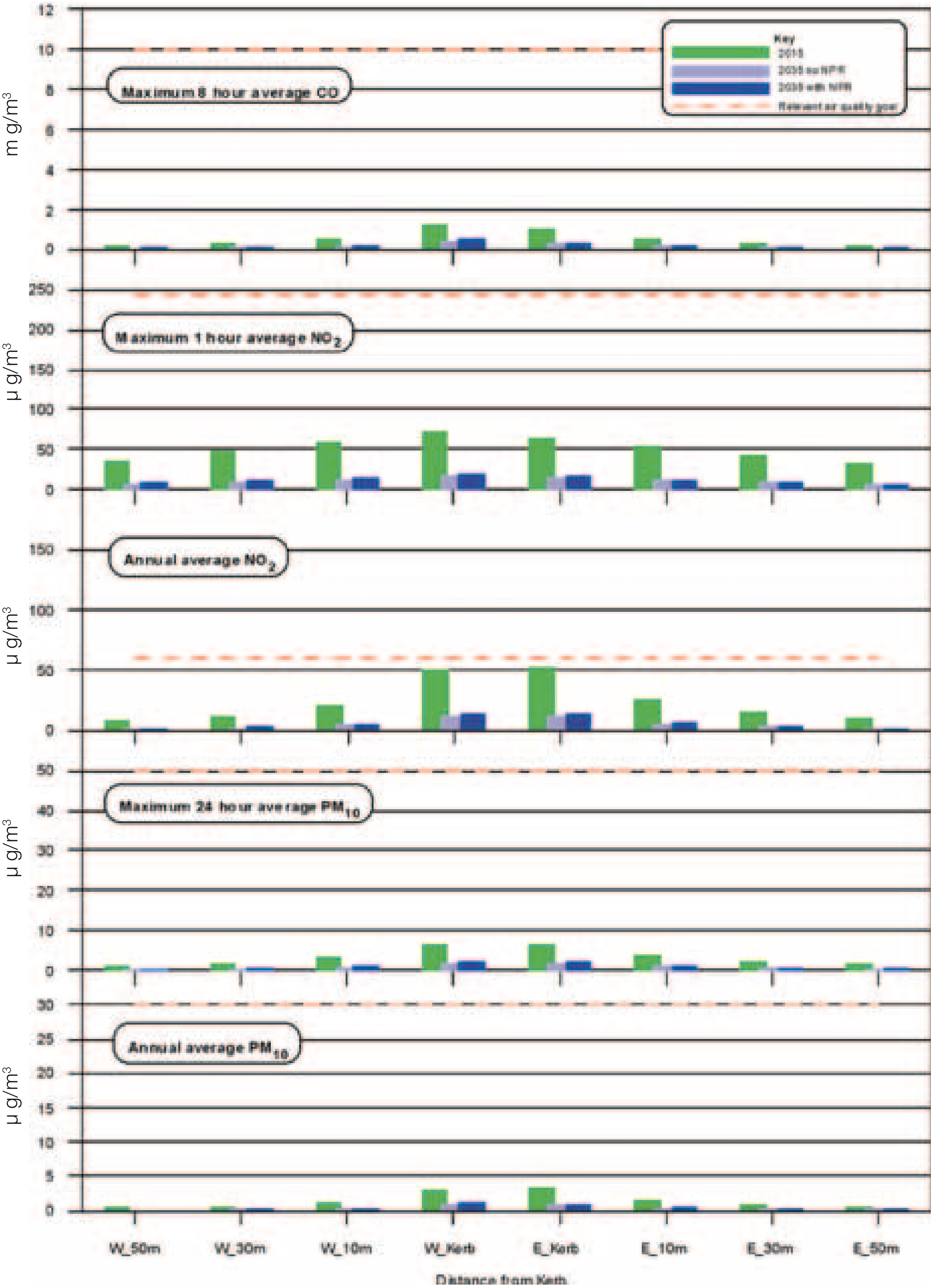


**Figure 12.6j:** *Predicted Roadside Concentrations Near Northern Access Road.*



Vehicle emission estimates for future years have only been based on a higher fraction of the fleet that will conform to the most recent emission and fuel standards. For the purposes of this assessment, there has been no consideration of further changes and improvements to vehicle emissions in the future. This adds an additional level of conservatism to the model predictions for future (that is, 2015 and 2035) scenarios.

## 12.7 Greenhouse Issues

BAC has been a member of the Greenhouse Challenge Plus Program since 2001 and reports on greenhouse gas emissions on an annual basis. In 2005 the net emissions were equivalent to 43,881 tonnes of $CO_2$.

During the construction phase of the NPR there will be additional emissions of greenhouse gas due to:

- On-site fuel consumption;
- Additional electrical power usage; and
- Land clearing.

Maunsell have estimated the fuel consumption in litres for various phases of construction as shown in **Table 12.7a**.

**Table 12.7a:** Estimated Fuel Consumption During Construction Phase.

| Construction Phase | Fuel in Litres |
|---|---:|
| Phase 1 | 7,134,850 |
| Phase 2 | 2,002,008 |
| Phase 3 | 10,397,640 |
| Phase 4 | 28,430,825 |
| Dredging (heavy fuel oil) | 21,600,000 |
| Dredging (marine diesel oil) | 2,700,000 |
| Approximate TOTAL fuel usage | 72,265,532 |

The power usage for the various components of the construction plant and equipment has been estimated and is shown in **Table 12.7b**.

**Table 12.7b:** Estimated Power Usage From Construction Plant and Equipment.

| Description | Power Usage (GWhours) |
|---|---:|
| Asphalt plant | 0.57 |
| Concrete plant | 0.38 |
| Pug mills | 1.17 |
| Construction camp | 1.12 |
| Vacuum pumps | 0.77 |
| TOTAL | 4.0 |

In terms of land clearage, **Table 12.7c** summarises the types of vegetation and approximate area that will be cleared as part of the NPR project.

**Table 12.7c:** Summary Of Vegetation and Area To Be Cleared During Construction.

| Vegetation Communities of the Project Area | Area Within Project Area (ha) |
|---|---:|
| Casuarina plantation | 209 |
| Open grassland | 36 |
| Mangroves | 94 |
| Salt-marsh | 18 |
| Freshwater wetlands and sedge communities | 3 |
| Eucalypt open forest | 1 |
| TOTAL | 361 |

The Australian Greenhouse Office (AGO, 2005) provides a methodology for calculating greenhouse emissions from liquid fuel and end-user power consumption. For automotive diesel fuel, marine diesel fuel and heavy fuel oil the emission factors are 2.7, 2.8 and 3.0 tonnes of $CO_{2\text{-e}}$ per kilolitre of fuel consumed respectively. For power consumption in Queensland in 2005, the full fuel cycle emission factor is 1.155 kg $CO_{2\text{-e}}$/kWh.

The AGO document does not provide details of $CO_2$ emission calculations for land clearing. This was previously provided but has been superseded by a National Carbon Accounting System (NCAS) tool kit. For the purposes of this assessment, some assumptions have been made to obtain an approximate emission factor for the land clearing component of the project. This information has been drawn from various technical reports (AGO 1999; AGO 2002; AGO 2003).

**Table 12.7d** summarises the factors which have been used to calculate the $CO_2$ emissions from the land clearing.

**Table 12.7d:** Summary of Assumptions Used for Land Clearing Greenhouse Calculations.

| Vegetation | Biomass (Tonne / ha) | Tonne Carbon / ha* | Tonne $CO_2$ Emissions / Tonne Carbon |
|---|---|---|---|
| Casuarina plantation*** | 108 | 54 | 0 |
| Open grassland | 2.5 | 1.25 | 3.67 |
| Mangroves | 282 | 141 | 3.67 |
| Salt-marsh | 282 | 141 | 3.67 |
| Freshwater wetlands and sedge communities | 282 | 141 | 3.67 |
| Eucalypt | 108 | 54 | 3.67 |
| Carbon in soil | - | 130** | 3.67 |

* *Assuming 50 percent of biomass is carbon.*
** *Based on maximum carbon content for uncleared land in South East Queensland.*
*** *The casuarina was planted with intent to be harvested for reuse.*

It has been assumed that the carbon loss from the soil would be 30 percent. The below ground biomass associated with the cleared vegetation would decay over a number of years. The total emissions have been included in the calculations.

The total greenhouse emissions from the construction phase of the project are summarised in **Table 12.7e**.

BAC is a member of the Australian Greenhouse Office's Greenhouse Challenge Plus Program. As a part of the commitment to reduce greenhouse gas emission (GGE), BAC will identify mitigation options to be implemented during construction to reduce GGE. This may include setting targets for contractors to reduce GGE compared with normal best practice operations using just fossil fuels for power supply, mobile plant, machinery and vehicles. Targets set would need to be realistic and cost effective, and may include options such as the purchase of green power or the use of biofuels.

The Casuarina plantations on-site were planted following the construction of Brisbane Airport with the intention that they would be harvested when the NPR was constructed and therefore, the harvesting does not count as land clearing. It is likely the timber will be used as biomass in a nearby biomass powerstation. Preliminary investigations have indicated the potential viability of this option. The calculations have made conservative assumptions about carbon content in the plantations and carbon loss from the soil. It should be noted that calculations have not taken account of the counterbalancing consideration that mangroves are potentially a source of non-$CO_2$ greenhouse emissions, namely methane and nitrous oxide (Allen et al, 2003).

**Table 12.7e:** Summary of Greenhouse Gas Emissions for Construction Phase.

| Component | Details | Emission Factor | Emission (t $CO_2$-e) |
|---|---|---|---|
| Automotive diesel fuel usage | 47,965 kl | 2.7 t $CO_{2-e}$/kl | 129,507 |
| Marine diesel fuel usage | 2,700 kl | 2.8 t $CO_{2-e}$/kl | 7,560 |
| Heavy fuel oil usage | 21,600 kl | 3.0 t $CO_{2-e}$/kl | 64,800 |
| Power consumption | 4 x $10^6$ kWh | 1.115 kg $CO_{2-e}$/kWh | 4,460 |
| Land clearing | 361 ha | 280 t $C0_2$/ha (average) | 59,820 |
| Carbon loss from soil | 361 ha | 143 t $CO_2$/ha | 51,623 |
| TOTAL | - | - | 317,770 |

## 12.8 Conclusions

This study has assessed the air quality impacts of the proposed NPR at Brisbane Airport. The focus of the study was on the 'Airport and Surrounds' with particular emphasis on construction impacts, changes to traffic on surface roads and GGE.

Construction impacts were examined both qualitatively and quantitatively, using dispersion modelling. The qualitative assessment suggested that the implementation of dust mitigation measures proposed will ensure that dust emissions are subject to a high level of control. Dispersion modelling suggested that off-site air quality impacts would be low during the construction period and that there would be compliance with relevant air quality goals at nearest residential locations.

Dispersion modelling was used to assess the impacts of changes to traffic on surface roads as a result of constructing the NPR. The roadside dispersion modelling suggested the following:

- Future roadside concentrations would generally be lower than existing concentrations because of improvements in vehicle emissions with the phasing out of older vehicles;
- Differences between with and without NPR would be negligible on all modelled road sections; and
- Existing and future roadside concentrations at distances representing nearest residences are anticipated to be well below relevant air quality criteria.

Emissions of greenhouse gases during the construction period have been estimated to be up to 317,770 tonnes of $CO_2$-e. BAC is a member of the Australian Greenhouse Office's Greenhouse Challenge Plus Program. As a part of the commitment to reduce GGE, BAC will identify mitigation options to be implemented during construction to reduce GGE. These options will include where practical setting targets for contractors to reduce GGE compared with normal best practice operations using just fossil fuels for power supply, mobile plant, machinery and vehicles.

GGE associated with the land clearing of the casuarina plantations will be abated by either the timber being used as biomass fuel in a biomass power station or sold as timber or woodchip.

Based on the assessment, a summary of potential impacts is provided in **Table 12.8**.

**Table 12.8:** Air Quality Assessment Summary Matrix.

| **EIS Area: Air Quality**<br>**Feature / Description** | **Current Value + Substitutable Y:N** | **Description of Impact** | | | **Additional Compensation (Beyond Standard Practice)** | **Residual Impact** |
|---|---|---|---|---|---|---|
| | | **Impact** | **Mitigation Inherent in** | **Significance Criteria** | | |
| Air quality due to construction activities. | Measurement data suggests acceptable air quality at off-site sensitive receptor locations.<br>Not substitutable. | Temporary small increases to off-site dust levels during the construction period. | Dust mitigation measures such as the watering of haul roads, covering of loads, water sprays on stockpiles and loading points. | Minor<br>-ve, D, C, T, ST | Management plans which may include altering construction activities during weather conditions conducive to high dust generation. | Minor<br>-ve, D, C, T, ST |
| Air quality due to changes in surface road traffic. | Measurement data suggests acceptable air quality at off-site sensitive receptor locations.<br>Not substitutable. | Negligible increases to roadside pollutant concentrations near some road sections. | Conservative approach to estimating vehicle emissions. Expected improvements to future vehicle emissions. | Negligible<br>-ve, D, C, P, LT | Nil | Negligible<br>-ve, D, C, P, LT |

***Key:***

*Significance Criteria: Major, High, Moderate, Minor, Negligible*

*+ve, -ve (positive, negative)*

*D, I (direct, indirect)*

*C, P, T (cumulative, permanent, temporary)*

*ST, MT, LT (short term, medium term, long term)*

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