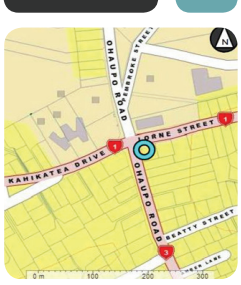
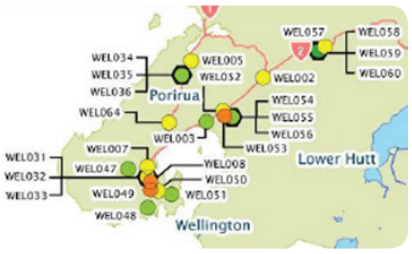
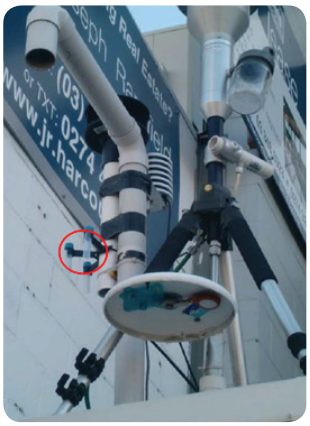
Ambient air quality (nitrogen dioxide) monitoring programme – operating manual 2012/13







NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

More information

Published 2012
ISBN 978-0-478-39485-6 (online)

If you have further queries, call our contact centre on 0800 699 000 or write to us:
NZ Transport Agency
Private Bag 6995
Wellington 6141

This document is available on the NZTA's website at www.nzta.govt.nz

Document management plan

1) Purpose

This management plan outlines the updating procedures and contact points for the document.

2) Document information

Document name	*Ambient air quality (nitrogen dioxide) monitoring programme – operating manual 2012/13*
Document number	SP/M/023
Document availability	This document is located in electronic form on the NZ Transport Agency's website at www.nzta.govt.nz.
Document owner	Rob Hannaby
Document sponsor	Carl Reller

3) Amendments and review strategy

All corrective action/improvement requests (CAIRs) suggesting changes will be acknowledged by the document owner.

	Comments	Frequency
Amendments (minor revisions)	Updates incorporated immediately they occur.	As required.
Review (major revisions)	Amendments fundamentally changing the content or structure of the document will be incorporated as soon as practicable. They may require coordinating with the review team timetable.	At least annually.
Notification	All users that have registered their interest by email to environment@nzta.govt.nz will be advised by email of amendments and updates.	Immediately.

4) Other information (at document owner's discretion)

There will be occasions, depending on the subject matter, when amendments will need to be worked through by the review team before the amendment is actioned. This may cause some variations to the above noted time frames.

5) Distribution of this management plan

Copies of this manual management plan are to be included in the NZ Transport Agency intranet at the next opportunity and sent to: webfeedback@nzta.govt.nz.

Record of amendment

Amendment number	Description of change	Effective date	Updated by

Foreword

The NZ Transport Agency (NZTA) is a crown agency responsible for, among other things, managing 11,367 kilometres of state highways. The state highway system accounts for about 12% of New Zealand's roads and around half of the 40 billion vehicle kilometres New Zealanders travel each year. Motor vehicles travelling on roads emit an array of air pollutants which can contribute to harmful effects on human health and smog formation.

Section 96(1)(a) of the Land Transport Management Act 2003 requires that the NZTA exhibit a sense of social and environmental responsibility. The NZTA promotes an accessible and safe transport system that contributes positively to New Zealand's economic, social and environmental welfare and is committed to acting in an environmentally and socially responsible manner.

Giving effect to this policy, the NZTA's Environmental Plan presents approaches and implementation plans for a range of environmental and social impacts arising from the state highway network. The specific objectives for improving air quality include:

A1. Understand the contribution of vehicle traffic to air quality

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

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

Annual assessment of vehicle emissions from the state highway network is undertaken using data gathered from selected sites using passive samplers to measure nitrogen dioxide (NO_2) as a surrogate. The overall aim is to see a decreasing trend in NO_2 concentrations measured at these sites.

This manual describes the methodology adopted in the current contract period (2012/13) for undertaking NO_2 passive sampling for monitoring air quality impacts of the state highway network. The manual outlines the objectives, principles, procedures and applications of the NZTA NO_2 national network passive sampling programme with details on who does what, how and when.

The principles outlined in this manual are also applicable to passive sampling undertaken on behalf of the NZTA for air quality monitoring used in assessing the effects of state highway asset improvement projects.

Contents

1.0 Introduction

1.1 Overview

Scope

Ambient air quality monitoring is undertaken to assess and manage potentially adverse effects that may be associated with the state highway network.

This chapter briefly covers the development of the national network from 2007 to date, outlines the purpose of this operating manual, and summarises the contents of the chapters which follow.

In this chapter

1.2 Background

Development of the network

Annual assessment of vehicle emissions from the state highway network is undertaken using data gathered from selected sites using passive samplers to measure nitrogen dioxide (NO_2) as a general proxy for air pollution from motor vehicles. In addition, passive sampling is regularly employed as a screening method to indicate existing levels of air quality when assessing state highway asset improvement projects.

The NZ Transport Agency (NZTA) instigated the national NO_2 passive monitoring programme in 2007 with 53 locations monitored throughout New Zealand, focusing mainly on state highway sites. In 2009, the network was expanded to include more background and local road sites, with a further expansion in 2010. As at the end of 2011, the network numbered 128 locations.

Roles

The successful operation of the national network is a collaborative effort between various parties as follows:

- The NZTA plays a strategic role by funding the majority of the sites and setting key indicators for performance and delivery.
- The Consultant acts on behalf of the NZTA and engages the Contractor to operate the network. The Consultant liaises with the Contractor on day-to-day issues and is responsible for highlighting any relevant or important matters that may require the NZTA's attention.
- The Contractor has the primary responsibility for operating the national network in accordance with the best practice procedures outlined in this manual and ensuring that all key indicators for performance and delivery are met to ensure high-quality data. The Contractor in turn engages a suitably qualified laboratory to analyse the passive samplers and also liaises with field contractors to undertake the exchange of tubes for sites outside of Auckland.

In previous years, the NZTA has also acted as the Consultant but is engaging Emission Impossible Ltd (EIL) to undertake this role for the 2012/13 monitoring year.

Watercare Services Ltd (WSL) has been the Contractor for the national network since its inception in 2007 and continues in this role for 2012/13.

WSL liaises with a number of field subcontractors – either network consultants engaged by the regional NZTA offices to assist with other tasks (eg Opus, Rotorua District Council Laboratory) or NZTA network asset management staff or council staff (eg Environment Canterbury) – to undertake the monthly sample exchange in locations outside of Auckland.

WSL also engages the Scientific Services Laboratory of Staffordshire County Council (SCC) to supply and analyse the exposed passive samplers.

1.3 Purpose

Purpose

This manual presents the objectives, principles, procedures and applications of passive sampling of nitrogen dioxide (NO_2) undertaken on behalf of the NZTA.

The primary emphasis in this manual is to provide details on who does what, how and when as related to the NZTA's national network of passive samplers but the principles outlined also apply to passive sampling undertaken as part of project monitoring for assessment of state highway asset improvement projects.

Intended audience

This manual has two intended audiences:

- NZTA staff who are responsible for commissioning and reporting on national network or project monitoring of NO_2 using passive sampling
- air quality providers engaged by the NZTA to undertake national network or project monitoring of NO_2 using passive sampling.

1.4 Contents

Why passive sampling is undertaken	Chapter 2 explains why passive sampling is undertaken on behalf of the NZTA and how the data are utilised.
How passive sampling works	Chapter 3 summarises how passive sampling works and its advantages and disadvantages relative to other air quality monitoring techniques.
Where passive samplers are employed	Chapter 4 outlines where passive monitoring is currently undertaken and the criteria used to decide where to locate samplers.
How the monitoring is undertaken	Chapter 5 describes the processes followed for deploying and analysing the samplers.
How the results are processed and managed	Chapter 6 reviews the data processing and quality assurance procedures followed, including the criteria used for dealing with missing or invalid data.
How the results are reported and stored	Chapter 7 discusses how the data are reported, stored and accessed.
Who is responsible for which activity	Chapter 8 covers the roles and responsibilities of all the parties involved in supporting and operating the national passive sampling network.
Who is responsible for funding the network	Chapter 9 covers how the national network is funded within NZTA and co-funding arrangements with external agencies, such as regional councils.
Reference material	Chapter 10 contains a glossary of all technical terms, a list of all abbreviations and complete bibliography of all references that appear in the manual (combined from the individual lists at the end of each chapter).
Useful examples	Chapter 11 consists of various appendices which provide useful examples of relevant documentation and reports together with details for the current field and laboratory subcontractors.

2.0 Why monitor air quality?

2.1 Overview

Introduction

This chapter describes why air quality monitoring of the state highway network is undertaken by the NZTA and how the data are utilised.

In this chapter

2.2 The NZTA's air quality objectives

The state highway system

The NZTA is a crown entity responsible for, among other things, managing 11,367 kilometres of state highways. The state highway system accounts for about 12% of New Zealand's roads and around half of the 40 billion vehicle kilometres New Zealanders travel each year (MoT 2011). Motor vehicles travelling on roads emit an array of air pollutants which can contribute to harmful effects on human health and smog formation.

The NZTA's environmental and social policy

Section 96(1)(a) of the Land Transport Management Act 2003 requires that the NZTA exhibit a sense of social and environmental responsibility. The NZTA promotes an accessible and safe transport system that contributes positively to New Zealand's economic, social and environmental welfare and is committed to acting in an environmentally and socially responsible manner.

The NZTA's Environmental Plan

Giving effect to this policy, the NZTA's Environmental Plan presents approaches and implementation plans for a range of environmental and social impacts arising from the state highway network (Transit, 2008). The specific objectives that the NZTA has for improving air quality include:

A1. Understand the contribution of vehicle traffic to air quality

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

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

NO_2 as a proxy for vehicle emissions

Motor vehicles produce a complex mix of contaminants. It is not feasible to monitor all of these, so the NZTA has identified one pollutant, nitrogen dioxide (NO_2) as a proxy for motor vehicle pollutants. This is consistent with the recommendations of the World Health Organisation (WHO 2006) which states that:

> *Nitrogen dioxide concentrations closely follow vehicle emissions in many situations, so nitrogen dioxide levels are generally a reasonable marker of exposure to traffic-related emissions.*
>
> *Health risks from nitrogen oxides may potentially result from nitrogen dioxide itself, correlated exhaust components such as ultrafine particles and hydrocarbons, or nitrogen dioxide chemistry products, including ozone and secondary particles.*

Nitrogen oxides incorporate several species that exist in the atmosphere, which collectively are referred to as NO_X and result principally from fossil fuel combustion, when nitrogen in the air that is used to burn the fuel gets oxidised. The most common NO_X compounds are nitrogen dioxide (NO_2) and nitric oxide (NO). NO is the primary product emitted directly but this is eventually oxidised by other pollutants present in ambient air to form NO_2. Motor vehicles are a major source of NO_X emissions in most parts of New Zealand.

2.2 The NZTA's air quality objectives continued

Annual assessment of the state highway network	Annual assessment of vehicle emissions from the state highway network is undertaken using data gathered from selected sites using passive samplers to measure NO_2. The overall aim is to see a decreasing trend in NO_2 concentrations measured at these sites.
Development of the national network	The NZTA national network was first commissioned in 2007. In 2007 and 2008, there were 52 locations monitored throughout New Zealand. The NZTA expanded the network in 2009 to include background and local road locations, with sampling undertaken at 86 locations. The network was further expanded in 2010 to include more local road and background monitoring sites and at the end of 2011 numbered 128 locations.
Project monitoring	All state highway asset improvement projects require an assessment of the current air quality in the project vicinity in order to evaluate the project's impacts on future air quality (NZTA 2012a). Where suitable data do not already exist, passive sampling of NO_2 is often employed as part of a specific pre-project monitoring campaign.

2.3 Comparison with guidelines

Health-based standards and guidelines

Relevant health-based standards and guidelines for NO_2 are shown in the table below, covering a range of averaging periods from short-term (1-hour) to long-term (annual) exposure.

New Zealand has 1-hour and 24-hour values for ambient NO_2 concentrations set in the National Environmental Standards (NES) and the Ambient Air Quality Guidelines (AAQG) (MfE 2002 and MfE 2011 respectively). The NES ambient limits apply anywhere in a region that is in the open air and where people are likely to be exposed. The regulations are designed to provide a guaranteed minimum level of health protection for New Zealanders. For NO_2 the NES is 200µg/m^3 (1-hour average). There is also an AAQG for NO_2 of 100µg/m^3 as a 24-hour average. There are no health-based New Zealand guidelines associated with exposure to NO_2 for periods of time longer than 24 hours. However, the WHO has an annual average guideline for NO_2 of 40µg/m^3 (WHO 2006).

NO_2 ambient air quality standards and guidelines

Contaminant	Averaging period	Standard or guideline[1]	Concentration	Annual allowable exceedance
Nitrogen dioxide (NO_2)	1-hour	NES	200µg/m^3	9
	24-hour	AAQG	100µg/m^3	–
	Annual	AAQG[2]	30µg/m^3	–
	Annual	WHO	40µg/m^3	–

NZTA assessment criteria

The passive monitoring undertaken measures monthly average NO_2 concentrations but these are not directly comparable to short-term standards and guidelines. However, a 2008 review of regional council monitoring results suggests that any site which exceeds the annual average WHO guideline is also likely to exceed the NES for NO_2 (NIWA 2008). This means that, through careful choice of sampling sites and the use of passive samplers as screening devices, locations where standards and guidelines are most likely to be exceeded due to motor vehicle emissions can be identified.

[1] Refer to the glossary for a definition of these terms.

[2] This is a critical level for protecting ecosystems and is not a health-based guideline.

2.3 Comparison with guidelines continued

NZTA assessment criteria (continued)

The WHO Global Update of Air Quality Guidelines report highlights that health effects may occur at levels below this guideline, and recommends that a lower guideline should be used if NO_2 is monitored as an indicator of overall pollution levels (WHO 2006). WHO states that:

> *Evidence from animal toxicological studies indicates that long-term exposure to nitrogen dioxide at concentrations above current ambient concentrations has adverse effects. In population studies, nitrogen dioxide has been associated with adverse health effects even when the annual average nitrogen dioxide concentration complied with the WHO annual guideline value of 40 $\mu g/m^3$. Also, some indoor studies suggest effects on respiratory symptoms among infants at concentrations below 40 $\mu g/m^3$.*
>
> *The present guideline was set to protect the public from effects on health of nitrogen dioxide gas itself. The rationale for this is that, because most abatement methods are specific to nitrogen oxides, they are not designed to control other co-pollutants and may even increase their emissions.*
>
> ***If, instead, nitrogen dioxide is monitored as a marker for the concentrations and risks of the complex combustion-generated pollution mixtures, an annual guideline value lower than 40 $\mu g/m^3$ should be used instead.***

Because the NZTA network is measuring NO_2 as a 'marker for the concentrations and risks of the complex combustion-generated pollution mixtures' (as highlighted above), it may be appropriate to consider a lower annual guideline. Although the WHO does not specify an appropriate lower annual guideline, this recommendation has been taken into consideration in the development of the NZTA criteria for assessment of passive monitoring results, which are summarised in table which follows.

NZTA assessment criteria for annual average NO_2 passive monitoring results

Contaminant	Annual average concentration	Descriptor	Notes
Nitrogen dioxide	≥40 $\mu g/m^3$	High	Identifies locations where the WHO annual NO_2 guideline is likely to be exceeded and air quality effects of motor vehicles need to be reduced.
	30 $\mu g/m^3$ to 39.9 $\mu g/m^3$	Medium	Identifies locations where air quality is degraded as a result of motor vehicle emissions and may cause adverse effects.

2.4 How the network data are utilised

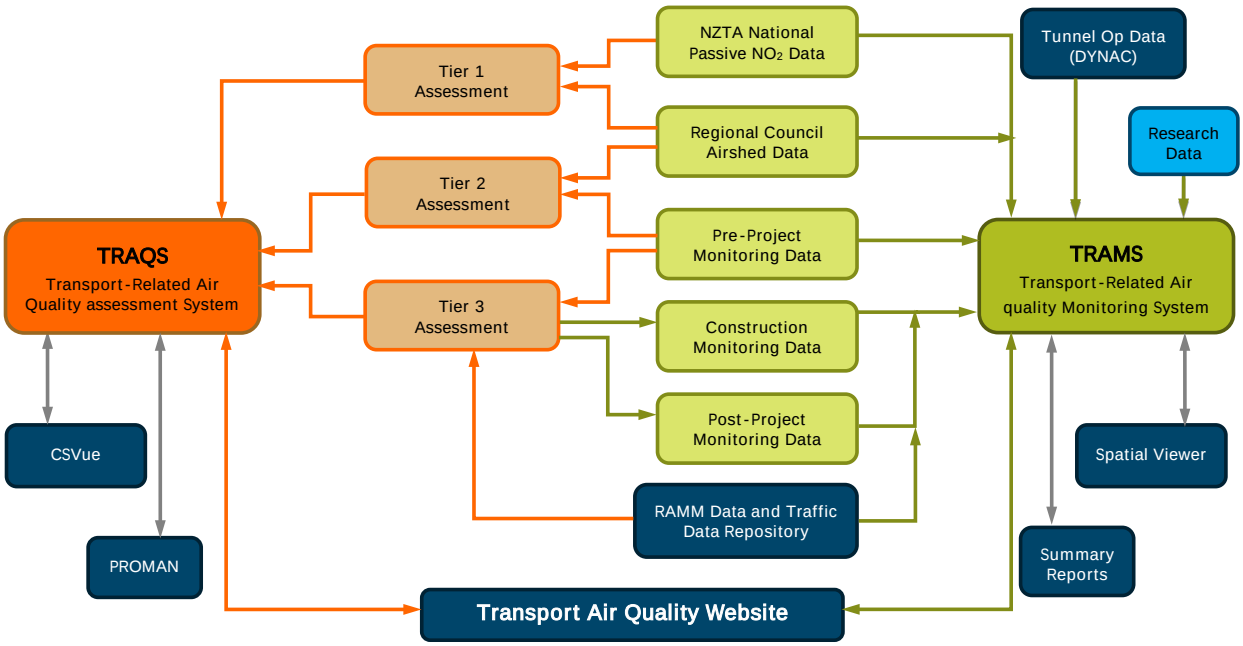
Where the network data fit into TRAMS

The NZTA funds a substantial amount of air quality measurements, predictions and assessments through projects, network management, complaint investigations and research as shown in the flowchart below.

Work is currently (2012) underway to develop a transport related air quality monitoring system (TRAMS) to collate all relevant air quality data commissioned by the NZTA (including the national passive NO_2 data) so that greater utilisation can be made of it, significantly increasing value-for-money.

Collation of data will provide the NZTA with a national overview of transport-related air quality work, allowing more informed policy development and better prioritisation and focus on critical areas of the state highway network.

Flowchart showing where the national passive NO_2 data feed into the transport related air quality monitoring system (TRAMS)



2.5 References

1. MfE (2002) *Ambient air quality guidelines, 2002 update*. Air Quality Report No 32 prepared by the Ministry for the Environment and the Ministry of Health, May 2002.
2. MfE (2011) *Resource Management (National Environmental Standards for Air Quality) Regulations 2004*. Prepared by the Ministry for the Environment, June 2011.
3. MoT (2011) *The New Zealand vehicle fleet, Annual fleet statistics 2010*. Prepared by the Ministry of Transport, dated March 2011 but updated in August 2011.
4. NIWA (2008) *The determinants of levels of secondary particulate pollution and nitrogen dioxide in urban New Zealand – Part 1*. NIWA Report AKL2008-053 prepared for the Foundation for Research, Science and Technology, July 2008.
5. NZTA (2012a). *Guide to assessing air quality effects for state highway asset improvement projects*, NZ Transport Agency, September 2012.
6. Transit (2008) *Environmental Plan, version 2.* Prepared by Transit New Zealand, June 2008. **Note**: Transit New Zealand merged with Land Transport New Zealand to form the NZ Transport Agency on 1 August 2008.
7. WHO (2006) *Air quality guidelines global update 2005: Particulate matter, ozone, nitrogen dioxide, and sulphur dioxide*. Prepared by the World Health Organisation, October 2006.

3.0 How does passive sampling work?

3.1 Overview

Introduction

This chapter summarises the operating principles of nitrogen dioxide (NO_2) passive diffusion samplers or tubes and their advantages and disadvantages relative to other air quality monitoring techniques.

In this chapter

3.2 Operating principles of passive samplers

Sampler description

The passive samplers described in this manual are nitrogen dioxide (NO_2) passive diffusion tubes (shown below).

The NO_2 passive diffusion tubes are acrylic or polytetrafluoroethylene (PTFE) tubes approximately 7cm long with an internal diameter of 1cm and machined ends to attach tight fitting caps.

Two stainless steel mesh discs coated with triethanolamine (TEA), which absorbs NO_2, are located at the closed end of the tube and held in position by an opaque coloured cap. The coloured end cap helps to prevent the degradation of the NO_2 absorbed TEA complex by sunlight. The open end of the tube has a clear or white removable cap which is used as a lid to seal the diffusion sampler before and after exposure.

Components of a passive diffusion tube

Molecular diffusion

Passive diffusion tubes collect NO_2 by molecular diffusion.

Molecular diffusion is the movement of gas molecules (NO_2) from a region of higher concentration (open end of the tube) to a region of lower concentration (absorbent end of the tube). The diffusion flow rate of NO_2 through the tube is described by Fick's first law of diffusion.

At the end of the sampling period, the resulting concentration of NO_2 is a function of the amount of NO_2 absorbed by the tube, the diffusion coefficient for NO_2 in air and the length of time the tube has been exposed (typically one month).

3.3 Advantages and disadvantages of passive sampling

Passive samplers are ideal for screening

Passive samplers have many advantages over other monitoring methods as they are affordable, simple to use, discrete and can be clipped onto most road furniture (eg road signs and street lamps).

Passive sampling techniques are 'screening' methods and are useful for spatial and temporal assessments. However, any elevated NO_2 concentrations identified by passive sampling techniques are only indicative of a potential air quality issues. These 'hot spots' would require more accurate and precise monitoring from a reference method such as the continuous chemiluminescence analyser to confirm these findings for compliance monitoring.

The following table summarises the advantages and disadvantages of passive sampling compared to other air quality monitoring methods (DEFRA 2009).

Comparison of passive sampling with other methods

Method	Advantages	Disadvantages
Passive sampling	Low cost – simple. Useful for updating and screening assessment studies, and to supplement automatic monitoring for detailed assessments.	Indicative measurements only – inferior precision and accuracy to automatic methods. Laboratory analysis required. In general, only provide weekly or longer averages.
Photochemical and optical sensor systems	Can be used portably.	Sensitivity can be low. May only provide spot measurements.
Active (semi-automatic) sampling	Low cost – relatively easy to operate (although care must be taken with filter handling and conditioning)	Usually only provide daily averages. Some methods are labour intensive. Filter conditioning and weighing may be required. Laboratory analysis may be required.
Automatic point monitoring	Provide high resolution data. On-line data collection possible.	Trained operator required. Regular calibration required. Regular service and maintenance costs.
Remote optical/long-path monitoring	Provide path or range-resolved data. Useful near sources. Multi-component measurements possible.	Relatively expensive and trained operator required. Regular calibration required. Data not readily comparable with point measurements.

3.4 References

1. DEFRA (2009) *Local air quality management, Technical guidance LAQM TG(09).* Prepared by the Department for Environment, Food and Rural Affairs, February 2009.

4.0 Where is monitoring undertaken?

4.1 Overview

Introduction

This chapter outlines where passive sampling is currently undertaken and the criteria that determine where sites are located. It also outlines the site identification/classification procedures and the required documentation.

In this chapter

4.2 Siting criteria

Overview

The sites are spread across each NZTA region and each regional council or unitary authority area throughout New Zealand.

The sites are generally intended to measure exposure to road vehicle emissions at locations:

- that are sensitive to adverse air pollution effects (ie sites are generally within 50m of either a school or residential areas)
- where elevated concentrations are most likely to occur (see the site specific 'intra-regional' criteria which follows).

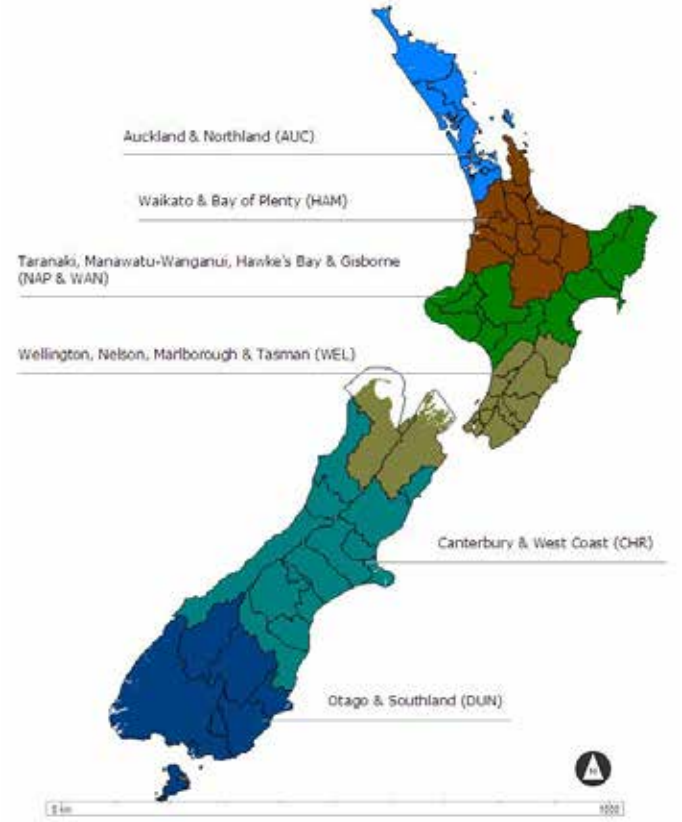
Original NZTA regional boundaries

When the national network was instigated in 2007, the NZTA had six regions which combined neighbouring regional councils or unitary authorities, as listed and displayed below:

1. Auckland and Northland (AUC)
2. Waikato and Bay of Plenty (HAM)
3. Taranaki, Manawatu-Whanganui, Hawke's Bay and Gisborne (NAP and WAN)
4. Wellington, Nelson, Marlborough and Tasman (WEL)
5. Canterbury and West Coast (CHR)
6. Otago and Southland (DUN).

These original regions were and currently are (as at the start of 2012) reflected in the first three letters of the site identification (ID) codes.

Map of original NZTA regional boundaries



4.2 Siting criteria continued

Revised NZTA regional boundaries

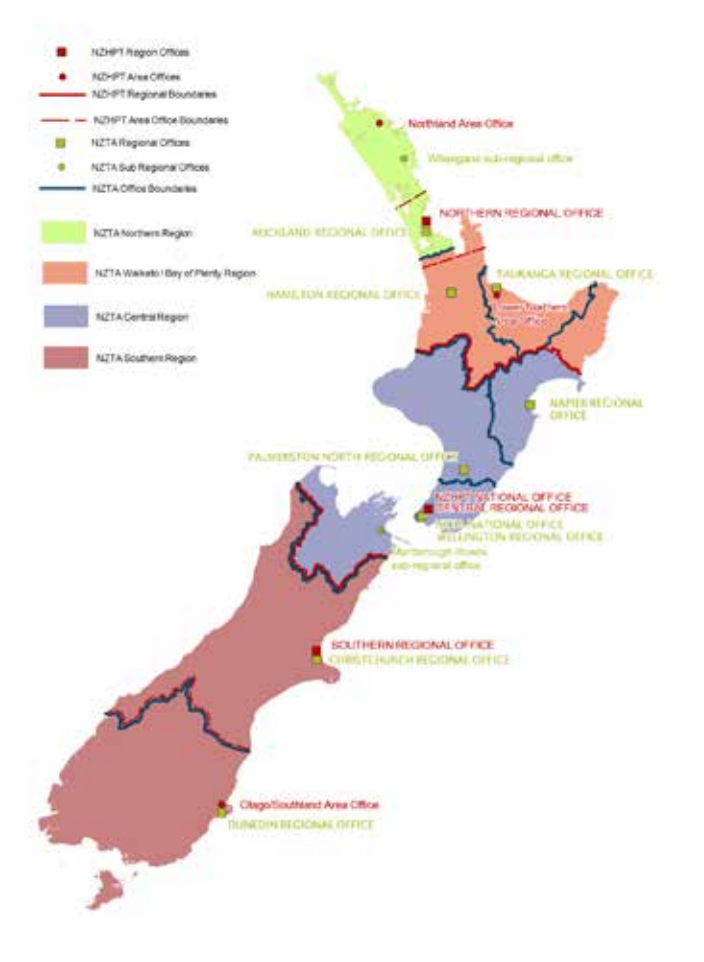
The NZTA regions were revised in 2011 and have now been amalgamated into four regions as follows and displayed below:

1. Auckland and Northland region (AUC) covers the top of the North Island from north of Auckland Council's southern border.
2. Waikato and Bay of Plenty region (HAM) reaches from the bottom of the Bombay Hills to the Desert Road summit, from just south of Mokau in the west, through the Waioeka Gorge near Opotiki, and midway along the Taupo-Napier Road.
3. Central region (CEN) stretches up from the top of the South Island (Nelson, Tasman and Marlborough) to the southern and central North Island, reaching across Taranaki, Manawatu-Whanganui, Wellington, to the Hawke's Bay and Gisborne.
4. Southern region (SOU) embraces all of the South Island except Nelson, Tasman and Marlborough.

The current site IDs will be revised at the start of 2013 (when the 2012 annual and site metadata reports are prepared). This means that:

- all NAP, WAN and WEL sites will be recoded as CEN sites
- all CHR and DUN sites will be recoded as SOU sites.

Map of revised NZTA regional boundaries



4.2 Siting criteria continued

Inter-regional criteria

The inter-regional criteria used to select national network air quality monitoring sites include:

- a minimum number of sites to be included in each regional council or unitary authority area (these local authorities have general responsibility for air quality management in New Zealand)
- a number of sites in each region to reflect the risk of being exposed to elevated levels of air pollution arising from vehicles using the state highway network (these are based on the population of the main urban areas or zones in each NZTA region – called 'monitoring zones')
- non-state highway 'comparison' sites or 'site types' to be included in each monitoring zone (ie sites near local roads and in urban background locations)
- location of gazetted 'airsheds', ie areas designated by regional councils or unitary authorities that are likely to exceed the NES.

Intra-regional criteria

The intra-regional criteria used to select national network air quality monitoring sites include:

- sections of the state highway network with the highest traffic flows in the region (typically where the annual average daily traffic (AADT) count is greater than 20,000 vehicles per day)
- sections of the state highway network with elevated congestion (based on 'level of service' indicators)
- areas where NZTA roading projects were planned or under construction
- a number of state highway, local road and urban background sites based on the population within the monitoring zone (see below).

Population classes

Population is used to define the number of state highway, local road and urban background sites in each monitoring zone because it is a surrogate measure of risk to exposure from road vehicle emissions. The table below shows the number of state highway and local road sites recommended for each population range listed. At least one urban background site should be installed in each monitoring zone with a population over 45,000.

Monitoring zone population (000s)	Number of sites	
	State highway	Local
> 200	6	4
150–200	5	3
100–150	4	2
75–100	3	1
70–75	2	0
< 70	1	0

4.3 Installation requirements

Siting requirements

Once a general site location has been decided, a number of specific installation requirements must be met before the site is commissioned and passive sampling commenced.

The passive diffusion samplers should be sited to open sky, exposed to freely flowing air with no overhanging vegetation or buildings. The opening of the passive diffusion sampler must not be obstructed or exposed to extreme wind speeds during sampling (ie a building corner).

Passive diffusion sampler tubes must be positioned vertically with the white lower cap removed and the exposed end facing down during sampling as shown below. A permanent plastic tube holder can be fixed to various surfaces so that the sampler can be changed easily. The holder can be mounted at the air quality monitoring site with a cable tie or double sided tape. Spacers are not required due to the design of the holder.

The passive diffusion samplers are intended to measure exposure to road vehicle emissions and should be attached to suitable road furniture at locations that are:

- within approximately 50m of a sensitive receptor location which is sensitive to adverse air pollution effects (ie a school or residential area)
- at a height of between 2 and 5m above the ground – ideally, samplers should be placed at breathing height but to reduce vandalism they are typically placed at a height of 2 to 4m and no higher than 5m.

Orientation of an exposed passive sampler

Co-location with continuous analysers

Several sites in the national network are co-located with continuous NO_X analysers operated by the local authority to establish the accuracy of the monthly sampler results relative to the corresponding monthly continuous analyser results. The continuous NO_X analysers are operated in accordance with AS3580.5.1:2011 and are a reference method used to determine compliance with the NES.

These locations also employ triplicate passive diffusion tubes to check the precision or repeatability of the results by comparing the monthly variation between triplicate samplers.

The triplicate tubes are positioned as close as possible to the sample inlet of the continuous NO_X analyser.

4.4 Site classifications

Overview

Sites are classified by monitoring zone and site type. Each site is also allocated a unique site identification code.

Monitoring zones

NZTA monitoring zones have been established for each main urban area in New Zealand (as defined by Statistics New Zealand), as well as for Taupo, Otaki, Blenheim, Greymouth and Queenstown, and are shown in the table below.

New Zealand region	Monitoring zone	2006 population (000s)
Northland	Whangarei	49
Auckland	Auckland – Northern	248
	Auckland – Western	192
	Auckland – Central	396
	Auckland – Southern	372
Waikato	Hamilton	155
	Cambridge	15
	Te Awamutu	14
	Taupo	22
Bay of Plenty	Tauranga	109
	Rotorua	54
Gisborne	Gisborne	33
Hawke's Bay	Napier	56
	Hastings	62
Taranaki	New Plymouth	49
Manawatu-Whanganui	Whanganui	39
	Palmerston North	76
Wellington	Otaki	5
	Kapiti	37
	Upper Hutt	36
	Lower Hutt	97
	Porirua	48
	Wellington	179
Nelson & Tasman	Nelson	56
Marlborough	Blenheim	29
Canterbury	Christchurch	361
West Coast	Greymouth	10
Otago	Dunedin	111
	Queenstown	10
Southland	Invercargill	47

4.4 Site classifications continued

Site types

Monitoring sites in the NZTA national network are classified as:

1. **State highway** sites:
   - located within 100m of the road being monitored (ie the main source of vehicle emissions)
   - AADT>20,000 or known hot spot.
2. **Local road sites:**
   - located within 50m of the road being monitored
   - AADT>20,000 or known hot spot.
3. Urban **background** sites
   - located more than 100m from a state highway
   - located more than 50m from a busy local road.
   - ideally co-located with a continuous monitoring station.

Site identification code

Each site is allocated a unique code according to a site convention.

The site identification (ID) convention system is currently based on the original six NZTA regions (as shown in section 4.2). Site IDs are abbreviated using the first three letters of a main city from the NZTA regions.

The site ID numbering lists the sites in a general chronological order. For example, a new group of sites or a project is added in no particular order to the last available site ID for that particular region.

The current site IDs will be revised at the start of 2013 (when the 2012 annual and site metadata reports are prepared) to reflect the new NZTA regions.

4.5 Site metadata

Importance of metadata

Site metadata is necessary to interpret the air quality monitoring results.

The required metadata list below should be recorded for each site and the information stored electronically. The format of the site metadata reports or datasheets should be approved by NZTA and include the relevant details listed below (see appendix A for an example). The site parameters listed below are similar to those recommended in the *Good Practice Guide for Air Quality Monitoring and Data Management* (MfE 2009).

List of required metadata to be recorded for each monitoring site

Parameters	Explanation
Site identification	Consists of a three letter and three number regional system
Source name	Street name of the probable source of vehicle emissions
Site name (short)	Street name of the site
Site name (full)	Source name/street name for roadside sites and street name for background sites
Site location	Street address of site
Coordinates	New Zealand Transverse Mercator (NZTM) and New Zealand Map Grid (NZMG)
Region	Regional council or unitary authority region, eg Manawatu-Whanganui
Monitoring zone	NZTA monitoring zone, as described in section 4.4, eg Kapiti
Area	Suburb or town
Site type	State highway (SH), local road or urban background
National network	National network or non-network site
Intersection (Y or N)	Is the site within 50m of an intersection (a place where two or more roads cross at grade or with grade separation) involving a local road or a state highway or both?
SH	Relevant nearest state highway
Nearest SH	Distance to the edge of the nearest state highway (m)
Nearest SH direction	Direction of the nearest state highway
Nearest local road	Distance to the edge of the nearest local road (m)
Nearest local road direction	Direction of the nearest local road
Sensitive receptor type	Short description, ie residential housing or school name
Nearest sensitive receptor	Distance to the nearest sensitive receptor, ie a school or residential area (m)
Sensitive receptor location	Street address of the sensitive receptor
Monitoring period	Including the commissioning month and the last monitored month before decommissioning
Height	Height of the sampler location above ground (m)
Trees	Distance from the nearest tree (m)
Parameters monitored	All contaminants/variables monitored
Site notes	Additional description, eg located at a monitoring station or relocation details
Site photos	Digital image of the monitoring site and surrounding area for context
Site map	Street map showing the monitoring site location

4.6 Site relocations and decommissioning

Relocation protocols

There are times when a site may need to be relocated or decommissioned. For example, it may be the target of vandalism, prove difficult to access for monthly sampler exchanges or not be representative of the site type to be monitored.

In these situations, the NZTA will decide if a site may need to be relocated to a more appropriate location.

The following indicate the protocols that should be followed if a site is relocated. The steps recommended depend on the length of time that the site has been in operation.

- If the site is relocated **within the first four months of monitoring**, the site and corresponding data should be noted but tagged invalid. A new site record should be created for the new location but no link needs to be made to the previous site due to insufficient previous data.
- If the site is relocated **after four months of monitoring**, a new site record should be created. Site notes should be added to the site records stating the reasons for moving the sampler, the dates involved in the relocation of the site, the site ID of relocated site and the site ID of the previous location.
- If a site is relocated **after one year of monitoring**, simultaneous monitoring for a period of two months should be undertaken at the site to be decommissioned and at the new relocated site to enable some cross-comparison of results.

4.7 References

1. Statistics New Zealand. See www.stats.govt.nz/census/about-2006-census/2006-census-definitionsquestionnaires/definitions/geographic.aspx for details on urban area classifications.

2. MfE (2009). *Good practice guide for air quality monitoring and data management*. Prepared by the Ministry for the Environment, Wellington.

5.0 How is the monitoring undertaken?

5.1 Overview

Introduction

This chapter describes the processes followed for undertaking the monthly monitoring and covers all steps from placing the samplers in the field through to receiving the sample analysis results from the laboratory.

As introduced in section 1.2, the successful operation of the national network is a collaborative effort between various parties as follows:

- the NZTA
- the Consultant who liaises between the NZTA and the Contractor
- the Contractor who has the primary responsibility for operating the national network in accordance with the best practice procedures outlined in this manual.

A full description of the roles and responsibilities of each of these parties is covered in chapter 8.

This chapter focuses on the procedures undertaken by the Contractor, who for the 2012/13 monitoring period is Watercare Services Ltd (WSL). WSL liaises with a number of field subcontractors to undertake the monthly sample exchange in locations outside of Auckland. WSL also engages the Scientific Services Laboratory of Staffordshire County Council (SCC) to supply and analyse the exposed passive samplers.

All procedures outlined in this chapter should be undertaken in accordance with the *Local Air Quality Management Technical Guidance Document* (DEFRA 2009). This guidance document is abbreviated in this chapter to *LAQM TG(09)*.

In this chapter

5.2 Scheduling

General schedule

Passive sampling is undertaken on a nominal monthly basis.

The diffusion tubes should be scheduled to be exposed within ± two days of the first Wednesday of each calendar month and also allow for evenly spread exposure periods. During January, diffusion tubes should be exposed within ±2 days of the second Wednesday due to operator availability.

The annual sampling schedule is sent to the field subcontractors by the Contractor two weeks prior to the sampler installation.

Duration of monitoring

The ideal duration of sampling for an individual passive diffusion tube should be one month. The monthly exposure time should be no longer than five weeks and no shorter than three weeks to be a valid sample.

The overall duration of monitoring at a site should fit the purpose of the monitoring objective. However, LAQM TG(09*)* recommends that NO_2 diffusion tube monitoring is carried out for at least a full year calendar to make an assessment against the annual averaged guidelines (DEFRA 2009).

5.3 Field sampling procedures

Overview

In 2011/12 over 20 different field subcontractors around the country carried out the field sampling procedures. These field subcontractors include:

- NZTA network consultants, eg MWH
- NZTA network asset management staff
- council staff.

Sample checking and preparation

The Contractor (WSL), as required, sends a three monthly supply of passive diffusion samplers to the field subcontractors. Upon receipt, the samplers are inspected and then stored in a refrigerator (at 4°C). Samplers that are damaged or contaminated are not be used and are be returned immediately.

When planning a site visit, the sampling technician should take some spare samplers, end caps, cable ties and tube holders to replace any that are missing or damaged. The samplers should be used and analysed within the specified 'use by' date – usually this is within 4 months of preparation.

Sample deployment

The following procedures should be followed when deploying a new unused sampler every month:

- Remove samplers from the refrigerator on the day that they are to be installed.
- Take samplers to the site using sealable bags and ensure each sample bag is clearly labelled with the appropriate site identification number originally supplied.
- At each site, record the site identification number, and the site name on the supplied field sheet (see Appendix B for an example).
- Upon commissioning the tube holder is mounted into position via the supplied cable ties. Thread the cable tie through the holder with the smooth side facing the clip and fasten to the appropriate fixture.
- Remove the new unused sampler from the sample bag. With the sealed coloured cap on top, remove the bottom white or clear cap and clip the sampler into the holder. It is important to remember that the coloured cap is not to be removed.
- Ensure the sampler is positioned vertically with its open end downwards.
- Record the date and time of the start of the exposure period on the supplied field sheet, and sealable sample bag.
- Make a note in the 'Comments' box of any site irregularities (eg building or road works) on the field sheet.
- Record the field sampling technician's name, position and contact details responsible for the installation.
- Keep the end caps in the sealable sample bag, for use when the exposure period is completed.

5.3 Field sampling procedure continued

Sample exchange or collection

The following procedures should be followed when an exposed sampler is exchanged/collected every month:

- Transport the new batch of unexposed samplers to site, together with the end caps from the last batch, and field sheets for both batches.
- At each site, remove the exposed sampler from the sample holder and replace the end cap tightly.
- Place these removed samplers back into last month's sample bag.
- Record the time and date of the end of the exposure period on the previous field sheet, and sealable sample bag.
- Make a note of any site irregularities (building/road works,), also anything which might affect, or even invalidate, the sampler's results (for example sampler found on the ground, insects, dirt, or liquid inside the sampler) on the field sheet in the comments box.
- Record the field sampling technician's name, position and contact details responsible for the exchange.
- Store the samplers and supplied field sheet in a refrigerator until they can be returned to the Contractor to organise the analysis. This should happen as soon as possible. Samplers should be couriered overnight (ie not on Fridays) to the address detailed on the field sheet insulated in bubble wrap or equivalent packaging.

Travel blank

A travel blank is transported and analysed with each batch of samplers to ensure that contamination of the samplers has not occurred in transit. Travel blanks are transported with the samplers to be exposed and stored in a refrigerator over the sample exposure period. The travel blanks are then transported again on the collection of the exposed batch and then the entire batch is sent for analysis.

5.4 Sample shipping and analysis

Storage and shipping

After the samplers are exposed and returned to the Contractor, they are stored in a cardboard box in a refrigerator. Once all of the monthly samplers have been received, the exposure dates, times and any comments from the field sheets are manually entered into a spreadsheet or data sheets formatted by the laboratory. The hard copies of the field sheets are filed by region and stored for up to ten years at the Contractor.

The monthly used samplers are sorted by region and securely packed in a cardboard box with bubble wrap. This data sheet is sent as a hardcopy with the samplers and also via email to the laboratory. The samplers and datasheet are sent to the laboratory with additional shipping instructions such as 'samples returned for analysis', and 'non-dangerous goods'.

Analysis method

NO_2 is determined spectrophotometrically by a variation of the Saltzman reaction. Preparation of a calibration graph allows the amount of absorbed nitrite to be determined and by applying a constant factor. This is calculated from Fick's Law and using the tube dimensions and the hours of exposed, then the ambient NO_2 concentration can be calculated.

The Contractor subcontracts the sample analysis to a suitably qualified laboratory (SCC). The laboratory should meet the following criteria:

- The laboratory should have accreditation for the analysis.
- The laboratory should carry out the analysis according to the harmonised method, AEA/ENV/R/2504 Issue 1a. (AEA 2008).
- The laboratory should participate in a proficiency scheme for NO_2 tubes.

Laboratory results

The results from the laboratory are returned to the Contractor in PDF and Excel format.

All results in ppb are converted to $\mu g/m^3$ using New Zealand standard conditions of temperature (0°C) and pressure (1atm).

All air quality data are reported as New Zealand standard time (NZST).

5.5 Health and safety

Compliance with Minimum Standard Z/5

All field and laboratory procedures must be undertaken in accordance with the requirements outlined in the NZTA's *Minimum Standard Z/5 – Health and Safety Compliance Notice* (NZTA 2011).

The Consultant shall ensure that the Contractor finalises a Method Statement that covers the management of the contracted works in relation to:

- compliance with the current Health and Safety in Employment Act 1992 and other safety legislation
- traffic in or adjacent to the works
- health and safety of people including employees, subcontractors (including the contracted laboratory) and others who might be affected by the works.

Given the relatively small scale of the contract (less than $200,000) the Method Statement may be covered by standard operating procedures.

The Consultant shall be responsible for ensuring that the Method Statement is appropriate given the scale and objectives of the project.

5.6 References

1. AEA (2008) *Diffusion tubes for ambient NO_2 monitoring: Practical guidance for laboratories and users.* Prepared by AEA Energy and Environment for the Department for Environment, Food and Rural Affairs and the Devolved Administrations, February 2008.
2. DEFRA (2009) *Local air quality management, Technical guidance LAQM TG(09).* Prepared by the Department for Environment, Food and Rural Affairs, February 2009.
3. NZTA (2011) *Minimum Standard Z/5 – Health and Safety Compliance Notice, version 2.* Prepared by the NZ Transport Agency, March 2011.

6.0 How are the data processed?

6.1 Overview

Introduction

This chapter reviews the data processing and quality assurance procedures followed, including the criteria used for dealing with missing or invalid data.

All procedures outlined in this chapter should be undertaken in accordance with the *Good Practice Guide for Air Quality Monitoring and Data Management* (MfE 2009) and the *Local Air Quality Management Technical Guidance Document* (DEFRA 2009). The former is abbreviated in this chapter to the *Monitoring GPG* and the latter to *LAQM TG(09)*I.

In this chapter

6.2 Monitoring performance targets

Targets

The NZTA has a single target for measuring the performance of the monitoring undertaken for the national network as follows:

75% valid data for averaging

Where

$$\% \text{ valid data for averaging} = \frac{\text{no of valid data pts obtained} * 100}{\text{total no of data pts in the averaging period}}$$

Valid data is a measure of the quantity of the data recorded. A requirement for 75% ensures that the data are representative of what might occur at that site over a whole year – ie both winter and summer.

The LAQM TG(09) recommends a minimum data capture rate of 75% for NO_2 screening studies.

Implications

A 75% valid data target means:

- a sampler must be exposed for **at least 75% but no more than 125% of the available time in a given month to enable calculation of a monthly average**, eg for months with 31 days, the minimum exposure time is 23.25 days (558 hours) and the maximum is 38.75 days (930 hours)
- a site must have **at least two valid monthly averages for a season** to enable calculation of seasonal averages (although sampling for only two months out of three months equates to only 67% valid data, this is considered sufficient for seasonal screening)
- a site must have **at least nine valid monthly averages in a calendar year** to enable calculation of an annual average **but with valid data for at least two 'winter' and at least two 'summer' months**.

'Winter' is classified as June, July and August of the current year, while 'summer' is classified as December of the previous year with January and February of the current year.

6.3 Data review and validation

Routine monthly checks

Each month, the monthly analysis results are reviewed to examine the validity of the data. These routine checks as described below:

- Depending on the number of days in the month, the valid exposure time should typically be no longer than five weeks and no shorter than three weeks.
- All concentrations less than 10$\mu g/m^3$ and greater than 40$\mu g/m^3$ are further examined to determine the validity of the sampler.
- Concentrations less than 3$\mu g/m^3$ are rare even at urban background sites and therefore any values below this limit are considered invalid.
- The triplicate sites test for precision using the coefficient of variation (CV) (see next section) from the three individual monthly results. If the CV value is greater than 30% then one or more of the samplers is consider suspicious and is invalidated.
- If more than 5% of the individual monthly results are deemed invalid then the results for the entire batch are further investigated.
- The CV value (see next section) is calculated for each site over the calendar year to identify any suspiciously high or low values that might be invalid. If the CV value becomes greater than 40% the monthly result is further examined.

Coefficient of variation (CV) calculations

The coefficient of variation (CV), also known as the relative standard deviation, is used both to indicate the precision between individual samplers at a triplicate site and to identify outliers in the monthly data for an individual site.

The CV is calculated according to:

$$CV\ (\%) = \frac{\text{standard deviation of the sampler results} * 100}{\text{mean of the sampler results}}$$

From LAQM TG(09), diffusion tubes are considered to have 'good' precision where the CV of duplicates or triplicates, based on eight or more individual periods during the year is less than 20%, and the overall average CV of all monitoring periods is less than 10%. Diffusion tubes are considered to have 'poor' precision where the CV of four or more individual periods is greater than 20% and/or the average CV is greater than 10%. The distinction between 'good' and 'poor' precision is an indicator of how well the same measurement can be reproduced.

Since 2007, the average CV for triplicate sites in the NZTA network has been 7.9%. The CV has been less than 20% for more than 94% of the triplicate samples, indicating that the precision of the passive samplers is good.

6.3 Data review and validation continued

Further checks

Results flagged as part of the routine checks undergo additional checks, such as:

- rechecking field sheets and possibly contacting the field subcontractors for clarification
- comparing with monthly results from the previously monitored years (if available)
- contacting the laboratory to double check the results.

Correction for travel blanks

The purpose of the travel blanks is to identify possible contamination of diffusion tubes while in transit or in storage. Accordingly, the results are not meant to be routinely subtracted from those of the exposed tubes.

The travel blanks are generally close to the limit of detection of the laboratory (currently 1.1$\mu g/m^3$ for SCC) so **results are not blank corrected**.

Comparison with continuous readings

The accuracy of the passive results can be checked by a linear regression between the monthly sampler results and the corresponding monthly continuous analyser results. This is usually conducted over one calendar year. A regression equation with a slope greater than one would indicate an over-read of the passive diffusion samplers and a slope less than one would indicate an under-read of the passive diffusion samplers.

In the UK, a bias adjustment factor is used to adjust passive monitoring results to make them directly comparable with the results gained from continuous monitoring methods. This standard formula, taken from LAQM TG(09) is shown below:

$$\text{bias adjustment factor} = \frac{\text{continuous monitor } NO_2 \text{ average}}{\text{passive tube } NO_2 \text{ average}}$$

Results to date from the NZTA national network together with Auckland Council findings (ARC 2007) suggest that the relationship between passive and continuous monitoring results is not consistent. Consequently, **the application of adjustment factors is not undertaken**. For reporting purposes, the values from passive samplers are presented without any adjustment in order to maintain consistency among the passive data.

Due to differences in the methodologies, the passive results are not expected to exactly match those measured using a continuous analyser. However, data from both methods are expected to demonstrate a similar pattern in the temporal and spatial distributions.

6.4 Treatment of invalid or missing values

Criteria for classifying data as invalid

All data are treated as being valid and are retained in the data record unless there is a justifiable and defensible reason for invalidating them.

Examples of circumstances that would invalidate data for the NZTA national network include:

- sampler contaminated with dirt, insects or spiders
- sampler found on the ground
- unusual activity nearby (ie fires or significant changes in traffic flow)
- spurious results that are significantly higher or lower than expected (as explained previously).

Missing values

No monitoring record is ever complete. Inevitably, there are periods of missing data some of which are planned (eg downtime due to for sample exchange) but most of which are unforeseen.

Examples of circumstances resulting in missing data for the NZTA national network include:

- sampler went missing during the monitoring period
- sampler went missing in transit to the Contractor
- sampler returned without a sample cap.

Documentation

The reason for a particular datum being invalid or missing is recorded in the corresponding month of the monthly report. The reason for missing data is also recorded on the corresponding field sheet, datasheet and laboratory report.

All invalid or missing data are shown as a blank cell or empty entry. Data are displayed this way in the annual summary of the monthly report and in the final dataset stored in the data warehouse.

6.5 References

1. ARC (2007) *Nitrogen dioxide in air in the Auckland region*. ARC Technical publication no 346 prepared by the Auckland Regional Council, December 2007.
2. DEFRA (2009) *Local air quality management, Technical guidance LAQM TG(09).* Prepared by the Department for Environment, Food and Rural Affairs, February 2009.
3. MfE (2009). *Good practice guide for air quality monitoring and data management*. Prepared by the Ministry for the Environment, Wellington.

7.0 How are the data reported and stored?

7.1 Overview

Introduction

This chapter discusses how the data are data are reported, stored and accessed.

All procedures outlined in this chapter should be undertaken in accordance with the *Good Practice Guide for Air Quality Monitoring and Data Management* (MfE 2009) where applicable.

In this chapter

7.2 Reporting formats

Time formats

For all of the NO_2 passive data, the time and date are reported in New Zealand Standard Time (NZST) which means monitoring averaging periods are consistent irrespective of whether daylight saving is in force.

Significant figures and rounding protocols

The NO_2 results are reported up to one decimal place (or the nearest 10th of a $\mu g/m^3$), eg 35.2$\mu g/m^3$.

When the value following the significant digit is less than 5, the digit should be retained. If the value is equal to or greater than 5, the digit should be rounded up.

Examples:

20.44	rounds to	20.4
20.45	rounds to	20.5
20.46	rounds to	20.5

Results typically do not exceed three significant figures.

Implications for reporting exceedances and classifying high or medium sites

An exceedance occurs when the reported concentration is above the standard or guideline, after rounding to the significant digit. For the national network results, that means any site which reports an annual average NO_2 concentration of 40.1$\mu g/m^3$ (averaged across at least nine months in a calendar year and rounded to one decimal place) records an exceedance of the WHO annual guideline of 40.0$\mu g/m^3$.

In addition, sites are classified as 'high' or 'medium' based on their annual average NO_2 concentration (as discussed in section 2.3). This means that:

- any site which reports an annual average NO_2 concentration between 30.0$\mu g/m^3$ and 39.9$\mu g/m^3$ is classified as a 'medium' site
- any site which reports an annual average NO_2 concentration of 40.0$\mu g/m^3$ or higher is classified as a 'high' site.

7.3 Data supply

Overview

Data (in the form of Excel spreadsheets) are supplied regularly to the NZTA as follows:

- monthly data
- annual data
- site metadata.

Data are typically supplied for a calendar year (ie January to December).

Monthly data

Monthly data are issued monthly within two months of the end of the month in question. (The lag is due to the time taken to get the samplers shipped and analysed). The data are supplied in the form of an Excel workbook comprising the following:

- a series of monthly worksheets (one for each month, eg Jul12) presenting:
  - the site details
  - the length of exposure (in hrs)
  - the raw results for the month in the current year (eg Jul12)
  - the results for the same month in previous years (eg Jul11, Jul10) if available
  - any relevant comments
- an annual summary sheet for the results to date in the current calendar year (eg Monthly Summary 2012) showing:
  - the site ID only
  - the monthly validated results to date for the current calendar year
  - the CV based on the monthly results to date
  - the % valid data for the valid monthly averages to date.

See appendix C for examples.

Annual data

Annual data are issued annually, two months after receiving the last analysis report for December of the previous year. The data are supplied in the form of an Excel workbook comprising the following sheets:

- a metadata report (eg 2007–11 Metadata) with all details for all sites that have ever been in the national network (regardless of whether they are still current) covering:
  - the site ID and name
  - the northings and eastings (NZMG and NZTM)
  - the month the site was commissioned/decommissioned
  - the NZTA monitoring zone, region and area
  - the site type and distances to the nearest state highway, local road and receptors
- a series of annual summary sheets (eg Monthly Summary 2012) for each calendar year since 2007 (same as the annual sheets issued monthly).

See appendix D for examples.

7.3 Data supply continued

One-off data requests

One-off data requests should be actioned within two weeks of the request.

Site metadata

Metadata sheets (see appendix A) are issued two months after receiving the last sampling details. However, a summary of the metadata information is submitted within the first month to verify the suitability of the site.

Uploading to TRAMS

Annual data are uploaded annually into the Transport Related Air Quality Monitoring System (TRAMS) database, two months after receiving the last analysis report for December of the previous year.

The data are supplied in the following format:

- site ID
- coordinates (NZMG and NZTM)
- site name
- exposure time (hrs)
- raw results ($\mu g/m^3$)
- validated results ($\mu g/m^3$)
- percentage of valid data for the calendar year
- any relevant comments.

The intention is to eventually upload the monthly data into TRAMS so it can be accessed more easily and by a wider audience, thereby replacing the monthly data spreadsheets. This transition is scheduled to occur during the 2012/13 monitoring period.

Uploading to Spatial Viewer

Annual data are uploaded annually into Spatial Viewer, two months after receiving the last analysis report for December of the previous year.

The data are summarised into the following formats:

- NO_2 annual averages with columns for:
  - the site ID and name
  - whether part of the national network (Y)
  - the northings and eastings (NZMG only)
  - the annual average
  - the link to the metadata file as a PDF
  - explanatory comments about data validity
- NO_2 winter averages with columns the same as for the NO_2 annual average but with the winter averages for each year calculated based on monthly readings for June, July and August of that year
- NO_2 summer averages with columns the same as for the NO_2 annual average but with the summer averages for each year calculated based on monthly readings for December (of the previous year) and January and February of that year.

7.3 Data supply continued

Revising the NO_2 spatial regression model

NIWA has developed an NO_2 spatial regression model which is used to predict annual mean concentrations of NO_2 at any given location as a function of local traffic density.

This model is based on the results of NO_2 passive monitoring data from 45 NZTA sites in Auckland and is used in a screening tool to predict NO_2 concentrations as part of a Tier 2 Air Quality Screening Assessment (NZTA 2012a).

Annual data should be supplied to NIWA when available at the end of each calendar year to enable the regression equations to be checked for currency and revised if necessary in the screening tool.

7.4 Reporting

Overview

Reports are supplied regularly to the NZTA as follows:

- monthly reports
- annual reports
- site metadata reports.

Note that for:

- annual averages, the monitoring year runs from January to December
- seasonal averages, winter covers the months of June, July and August and summer covers the months of December (of the previous year), January and February.

Monthly report

Monthly reports are issued monthly within two months of the end of the month in question.

The monthly report is essentially the Excel workbook containing the monthly data as described in section 7.3 and shown in appendix C.

Annual report

Annual reports are issued annually within six months of the end of the year in question. (The lag is to enable all results to be analysed and for the preparation of the report itself.) Annual reports cover all years to date since the national network monitoring began in 2007 (eg 2007–11) and include the following chapters:

- executive summary
- introduction
- methodology
- results
- trends
- description of high NO_2 sites
- conclusions
- references
- glossary
- appendices with metadata, annual average tables, seasonal average tables, and monitoring zone maps.

The annual reports are supplied in both MS-Word and PDF format. Examples of previous annual reports are available on the **air.nzta.govt.nz** website (NZTA 2012b).

One-off report requests

Simple one-off requests should be actioned within two weeks of the request being agreed by the NZTA (in advance).

One-off reports include as a minimum:

- an outline of sites (coordinates and a brief description of sites)
- results and associated monthly summaries.

More detailed one-off requests need to be assessed on a case-by-case basis and may be subject to cost recovery.

7.4 Reporting continued

Metadata report

Site metadata reports are issued annually within three months of the end of the year in question. (The lag is for the preparation of the report itself). Site metadata reports cover all years to date since the national network monitoring began in 2007 (eg 2007–11) and include the following:

- an overview of the monitoring sites by monitoring zones for each year
- tables summarising the metadata details for each site
- national maps showing the network sites for each year
- site metadata sheets for each individual site ordered by monitoring zone north to south across New Zealand.

The site metadata reports are supplied in both MS-Word and PDF format.

Examples of previous site metadata reports are available on the **air.nzta.govt.nz** website (NZTA 2012c).

7.5 Where the data are stored

Processed data	The final processed data are stored as monthly averages on the Contractor's data storage system, together with the site ID for easy retrieval. These data are uploaded into TRAMS every month but reviewed annually as part of the annual reporting process.
Raw data	All raw data and laboratory analysis reports are stored as annual Excel files on the Contractor's data storage system.
Site metadata	All site metadata files are stored on the Contractor's data storage system.
Data backups	All data and files stored by the Contractor on behalf of the NZTA are stored offsite, backed up every night and archived monthly.
Data access	All data held by the Contractor are treated as confidential. No data should be provided to outside parties without the prior consent of NZTA. **Note**: Some outside parties may already have access to data records but only those which are publicly available in either Spatial Viewer or TRAMS.

7.6 Peer review and change protocols

Peer review

All data and reports supplied are subject to appropriate peer review and sign-off in accordance with the Contractor's in-house quality procedures.

Change protocols

Issues occasionally surface during quality assurance, peer review and general investigation which can suggest that data previously classified as 'valid' may not be or has been reported incorrectly. Sometimes these issues only become apparent once longer data records or cross-site comparisons are available.

If concerns with the validity of data prove justified , the data are declared now invalid or amended and all of the following data records are updated accordingly:

- Contractor's processed data records
- TRAMS
- NZTA Spatial Viewer.

At the same time, the NZTA is notified of the change (and the reasons for it) in case decisions need to be made about issuing an erratum to the annual report etc.

7.7 References

1. MfE (2009). *Good practice guide for air quality monitoring and data management*. Prepared by the Ministry for the Environment, Wellington.
2. NZTA (2012b). *Ambient air quality (nitrogen dioxide) monitoring network – annual report 2007-2011*. Prepared for the NZ Transport Agency, Wellington.
3. NZTA (2012c). *Ambient air quality (nitrogen dioxide) monitoring network – site metadata report 2007-2011*. Prepared for the NZ Transport Agency, Wellington.

8.0 Who is responsible for what?

8.1 Overview

Introduction

The successful operation of the national network is a collaborative effort between various parties, principally the NZTA, the Consultant and the Contractor, but others are involved on occasion.

This chapter covers who is responsible for what in the current 2012/13 period and highlights who in particular is responsible for key decisions in the process.

In this chapter

8.2 Role of the NZTA

Overall role

The NZTA plays a strategic role in the national network by funding the majority of the sites (see section 9.2) and setting key indicators for performance and delivery of the national network by the Consultant and the Contractor.

In previous years, the NZTA has also acted as the Consultant (liaising directly with the Contractor regarding day-to-day operations) but for the 2012/13 monitoring period is engaging Emission Impossible Ltd (through their IPA Contract) to act in this role on their behalf and only bring relevant or important matters to the NZTA's attention if they require a special decision.

The responsibilities of the NZTA are outlined in the following sections.

Where monitoring is undertaken

The NZTA is responsible for:

- indicating the general location and requirements of any new sites to the Consultant
- confirming the specific location of all new or relocated sites proposed by the Contractor via the Consultant
- undertaking an annual review of all monitoring priorities and confirming sites for ongoing monitoring with the Consultant
- liaising with other stakeholders, such as regional councils, on securing approval and/or funding for co-located sites.

How monitoring is undertaken

The NZTA does not generally play an active role in decisions made regarding how the monitoring is undertaken.

The NZTA's expectation is that any decisions required are made on its behalf by the Consultant to ensure that the data are collected in accordance with the best practice procedures outlined in this manual to ensure high-quality data.

How data are processed

Aside from setting the monitoring performance target of 75% valid data, the NZTA does not generally play an active role in other decisions made regarding the data processing and quality assurance.

The NZTA's expectation is that any decisions required are made on its behalf by the Consultant to ensure that the data are processed and quality assured in accordance with the best practice procedures outlined in this manual to ensure high-quality data.

How data are reported

The NZTA is responsible for:

- defining the frequency and nature of reporting of the results and confirming these requirements with the Consultant and the Contractor
- publishing the annual and site metadata reports and making them available on the NZTA air quality website **air.nzta.govt.nz**
- supporting Spatial Viewer, TRAMS and the air quality website to enable interested parties to access the data.

8.3 Role of the Consultant

Overall role

The Consultant plays a liaison role in the national network by acting on behalf of the NZTA in the day-to-day operation to ensure that all key indicators for performance and delivery are met and are in accordance with the best practice procedures outlined in this manual to ensure high-quality data.

In previous years, the NZTA has also acted as the Consultant (liaising directly with the Contractor regarding day-to-day operations) but for the 2012/13 monitoring period is engaging Emission Impossible Ltd (through their IPA Contract) to act in this role on their behalf and only bring relevant or important matters to the NZTA's attention if they require a special decision.

The responsibilities of the Consultant are outlined in the following sections.

Where monitoring is undertaken

The Consultant is responsible for:

- working with the Contractor to ensure all site location issues are managed in accordance with the procedures outlined in this manual
- discussing the specific location of all new or relocated sites proposed by the Contractor with the NZTA
- discussing monitoring priorities and confirming sites for ongoing monitoring with the NZTA
- communicating any important issues raised by the Contractor to the NZTA
- communicating any important decisions made by the NZTA to the Contractor.

How monitoring is undertaken

Unless directed by the NZTA otherwise, the Consultant is responsible for:

- working with the Contractor to ensure all field sampling and analysis issues are managed in accordance with the procedures outlined in this manual
- communicating any important issues raised by the Contractor to the NZTA
- communicating any important decisions made by the NZTA to the Contractor.

How data are processed

Unless directed by the NZTA otherwise, the Consultant is responsible for:

- working with the Contractor to ensure all data processing and quality assurance issues are managed in accordance with the procedures outlined in this manual
- communicating any important issues raised by the Contractor to the NZTA
- communicating any important decisions made by the NZTA to the Contractor.

8.3 Role of the Consultant continued

How data are reported

Unless directed by the NZTA otherwise, the Consultant is responsible for:

- working with the Contractor to ensure all reporting issues are managed in accordance with the procedures outlined in this manual
- ensuring that all data are regularly uploaded into Spatial Viewer, TRAMS and the air quality website **air.nzta.govt.nz** to enable interested parties to access the data
- communicating any important issues raised by the Contractor to the NZTA
- communicating any important decisions made by the NZTA to the Contractor
- updating the operating manual (this document) to cover the current contract period.

8.4 Role of the Contractor

Overall role

The Contractor has the primary responsibility for operating the national network in accordance with the best practice procedures outlined in this manual and ensuring that all key indicators for performance and delivery are met to ensure high-quality data.

The Contractor liaises with the Consultant on day-to-day issues and is responsible for highlighting any relevant or important matters that may require the NZTA's attention.

Watercare Services Ltd (WSL) has been the Contractor for the national network since its inception in 2007 and continues in this role for 2012/13.

WSL liaises with a number of field subcontractors – either network consultants engaged by the regional NZTA offices to assist with other tasks (eg Opus, Rotorua District Council Laboratory) or NZTA network asset management staff or council staff (eg Environment Canterbury) – to undertake the monthly sample exchange in locations outside of Auckland.

WSL also engages the Scientific Services Laboratory of Staffordshire County Council (SCC) to supply and analyse the exposed passive samplers.

The responsibilities of the Contractor are outlined in the following sections.

Where monitoring is undertaken

The Contractor is responsible for:

- finding suitable locations for new or relocated sites which meet the NZTA's general siting criteria and recommending these to the Consultant for confirmation by the NZTA
- installing new sites, either directly or through field subcontractors
- liaising with other stakeholders, after formal approval gained by the NZTA, to undertake sampling at co-located sites
- decommissioning old sites, either directly or through field subcontractors
- advising the Consultant immediately of any issues affecting the performance of any monitoring site in the national network, eg situations which may require the site to be temporarily decommissioned or relocated
- ensuring that all supporting documentation is kept up to date and reflects the practices being undertaken.

8.4 Role of the Contractor continued

How monitoring is undertaken

The Contractor is responsible for:

- deploying and exchanging samplers on a monthly basis in accordance with the best practice procedures outlined in this manual
- sending and receiving samplers and associated documentation to field subcontractors
- subcontracting a laboratory to analyse the samplers in accordance with the best practice procedures outlined in this manual, including
  - arranging the shipping of samplers and supporting documentation to the laboratory
  - receiving final results and supporting documentation from the laboratory
  - liaising with the laboratory with any issues over the analyses
- advising the Consultant immediately of any sampling or analysis issues which may compromise the quality of the results or the timeliness of its delivery
- ensuring that all supporting documentation is kept up to date and reflects the practices being undertaken.

How data are processed

The Contractor is responsible for:

- processing the data and undertaking quality assurance in accordance with the best practice procedures outlined in this manual
- ensuring that all monitoring performance targets are being met
- advising the Consultant immediately of any data processing/quality assurance issues which may compromise the validity of the results.

Ensuring that all supporting documentation is kept up to date and reflects the practices being undertaken.

8.4 Role of the Contractor continued

How data are reported

The Contractor is responsible for:

- providing and reporting the monthly data to the Consultant/NZTA
- providing and organising metadata sheets
- providing annual data and supporting information to the Consultant/NZTA
- undertaking appropriate peer review before any data or reports are issued
- storing the raw and processed data in a database with regular and appropriate off-site backup
- uploading processed data into Spatial Viewer and TRAMS
- advising the Consultant immediately of any reporting or storage issues which may compromise the frequency or accessibility of the results
- ensuring that all supporting documentation is kept up to date and reflects the practices being undertaken.

8.5 Role of other subcontractors

Overall role

Other parties are involved in assisting with the national network as follows:

- field subcontractors for deploying and exchanging samplers (particularly for sites outside of Auckland)
- a specialist laboratory for analysing the passive samplers.

The field subcontractors comprise NZTA network consultants (eg MWH), NZTA network asset management staff and council staff, depending on the availability of resources in various areas. The cost of the services provided by the field subcontractors is generally covered by the field contractors themselves (typically as part of NZTA network management costs).

The Scientific Services Laboratory of Staffordshire County Council (SCC) has been engaged by the Contractor (WSL) as the specialist laboratory to analyse the exposed passive samplers since 2007 and continues in this role for 2012/13.

Appendix E lists the other subcontractors involved in assisting with the operation of the national network in 2012/13.

Role of field subcontractors

Field subcontractors are responsible for:

- deploying and exchanging the samplers sent by the Contractor in accordance with the best practice procedures outlined in this manual
- sending the exposed samplers together with any supporting documentation to the Contractor in a timely and agreed fashion.

Advising the Contractor immediately of any field issues which may compromise the quality of the results or the timeliness of its delivery.

Role of the laboratory

The laboratory is responsible for:

- analysing the samplers sent by the Contractor in accordance with the best practice procedures outlined in this manual
- reporting the final results together with any supporting documentation to the Contractor in a timely and agreed fashion
- advising the Contractor immediately of any analysis issues which may compromise the quality of the results or the timeliness of its delivery.

9.0 How is the network funded?

9.1 Overview

Introduction

This chapter covers how the national network is funded within NZTA and co-funding arrangements with external agencies, such as regional councils.

In this chapter

9.2 NZTA internal funding

Environment and Urban Design (EUD) funding

The national network was set up in 2007 and was initially funded solely by the Environment and Urban Design (EUD) section of the NZTA's Highways and Network Operations – Professional Services group.

The EUD team continues to fund the bulk of the network costs. Since 2011 contributions have been received from local NZTA Network Management Area (NMA) teams and a number of regional councils (RCs).

These additional contributions reflect the importance of the network to a wider group of stakeholders. The EUD team will continue to seek opportunities to expand the input of stakeholders into the network.

Network Management Area (NMA) funding

Network Management Area (NMA) funding to support the national network is currently provided by:

- Coastal Otago
- Southland
- Central Otago.

Future funding priorities

The EUD team will review the funding of the national network on an annual basis; this will be undertaken in advance of and will inform the Request For Proposal(s) for services contracted for the subsequent financial year.

9.3 External funding

Regional council (RC) funding

Initially, the national network was funded solely by the NZTA.

However, following the expansion of the network to increase the coverage and type of sites in recent years, a number of RCs have offered contributory funding.

The following councils contributed funding in 2011/12:

- Auckland Council
- Waikato Regional Council (WRC)
- Greater Wellington Regional Council (GWRC).

Both WRC and GWRC are continuing with contributory funding in 2012/13.

Acknowledgement

All third parties who contribute funding and in kind support will be acknowledged in the annual report.

10.0 Glossary and References

10.1 Overview

Introduction

This chapter contains a glossary of all technical terms, a list of all abbreviations and a complete bibliography of all references that appear in the manual.

Please note that each chapter also has the references sections (where applicable) summarising the references that relate to the particular topic under discussion.

In this chapter

10.2 Terminology

Ambient air	The air outside buildings and structures (including tunnels). This does not refer to indoor air, air in the workplace, or contaminated air discharged from a source.
Airshed	An area designated by a regional council or unitary authority for the purposes of managing air quality and gazetted by the Minister for the Environment
Area	The name of the suburb the monitoring site is located in (eg Porirua).
Asset improvement projects	New and improved infrastructure for state highways as defined in the Government Policy Statement on Land Transport Funding. These covers activities related to managing and delivering a State highway capital improvement programme.
Background site	A monitoring site which is located more than 100 metres from a state highway and more than 50 metres from a busy local road.
Co-located site	Co-location is a procedure used in air quality monitoring where two or more monitors or samplers are installed in the same location so the measurements can be compared. For example, co-locating a passive sampler with a continuous monitor at the same site.
Concentration	The amount of a substance in a mixture. The concentration is usually proportional to the observable intensity of effects. For air pollution, concentration is reported as either a volumetric measure (eg parts per billion, ppb) or as a mass measure (eg micrograms per cubic metre, $\mu g/m^3$).
Continuous monitoring	A 'continuous' monitor is one that samples air at a discrete location using active air movement, ie pumping or purging. Continuous monitors are relatively expensive to buy, operate and maintain. They are used most often for compliance monitoring (ie assessing air quality against guidelines and standards for regulatory purposes) and are able to provide accurate data for averaging periods down to one-hour.
Diffusion tube	Diffusion tubes are common examples of passive samplers used in air quality monitoring. These are simple devices which consist of a grid impregnated with a chemical reagent which absorbs pollutants (eg NO_2) over the period of exposure and is then sent off to a lab to be analysed.
Emission	The release of a substance (eg an air pollutant) from a source (eg transport, industry or domestic fires). Emissions are often expressed in units per activity (eg grams per kilometre driven g/km or grams per kilogram fuel burnt g/kg).
Exceedance	An occasion when the concentration of an air pollutant exceeds a standard or permissible measurement.
Exposure	The concentration of air pollution experienced by a person for a set duration, usually expressed as a time averaged concentration (eg 1 hour average or annual average). Air quality guidelines and standards are usually set for two extremes of exposure – a short term or acute exposure level and a long term or chronic exposure level.
Guideline value	A concentration value and averaging period (over which it applies) for assessing and managing ambient air quality.
Local authority	A regional council, unitary authority or territorial local authority
Local road	A road controlled by a Road Controlling Authority other than NZTA.
Local road site	A monitoring site which is located within 50 metres of a busy local road (ie a road with an AADT>20,000 or which is known hot spot for traffic congestion).
Metadata	Metadata describes other data related to the monitoring site. It provides information such as where it is located, how far away it is from important features such as nearby roads or schools or trees etc.
Monitoring zone	Geographical zones established by NZTA for the purposes of prioritising air quality monitoring. These are based on main and satellite urban areas across New Zealand as defined by Statistics NZ.

10.2 Terminology continued

Passive sampling	A 'passive' sampler is one that is samples air at a discrete location without using active air movement, ie pumping or purging. Passive samplers are cheap and relatively easy to install but are only able to provide data for long averaging periods, such as a month, rather than daily or more frequent periods. They are more commonly used for screening rather than regulatory monitoring.
Receptor	A location where any person may be exposed to pollution from the road for 1 hour or more, irrespective of whether or not that person is considered to be sensitive to the effects of air pollution eg an industrial or commercial building.
Region	Geographical regions established by NZTA for the purpose of managing state highway assets.
Road furniture	Road furniture is a collective for objects and pieces of equipment installed on streets and roads for various purposes. It includes benches, traffic barriers, bollards, post boxes, phone boxes, streetlamps, traffic lights, traffic signs, bus stops, tram stops, taxi stands, public lavatories, fountains, watering troughs, memorials, public sculptures, and waste receptacles.
Highly sensitive receptor	A location where people or surroundings may be particularly sensitive to the effects of air pollution. Examples include residential houses, hospitals, schools, early childhood education centres, childcare facilities, rest homes, marae, other cultural facilities, and sensitive ecosystems.
Site code or ID	A unique code made up of three letters representing the NZTA region and three digits representing the number of the site in the NZTA region (eg WEL005 for the Titahi Bay Road site).
Site name	The name of the site, typically based on 'source' road (eg CMJ) and the 'receiver' address where the monitoring site is located (eg Canada Street).
Site type	The classification that applies to the site as to whether it is a state highway site, a local road site or a background site.
Source	The road or state highway most likely contributing the most to the concentrations recorded at the site.
State highway site	A monitoring site which is located within 100 metres of a state highway.
Summer	Defined for the purpose of calculating a seasonal 'summer' average as December (of the previous year), January and February.
Triplicate site	A site where three passive samplers are installed next to each other to check the precision (or repeatability) of the results. The results are used to calculate the coefficient of variation (CV) which indicates the accuracy of the samplers.
Valid data	Data that have been through a process to remove any values that do not reflect actual conditions being monitored. For example, if a sampler is damaged or vandalised during the monitoring period then the result is declared invalid and cannot be used to calculate any seasonal or annual averages covering that period.
Winter	Defined for the purpose of calculating a seasonal 'winter' average as June, July and August.

10.3 Abbreviations

AADT	Annual average daily traffic flow in vehicles per day.
AAQG	Ambient air quality guidelines, produced by the Ministry for the Environment to protect human health and ecosystems.
AC	Auckland Council, formerly known as Auckland Regional Council
AEE	Assessment of Environmental Effects
ARC	Auckland Regional Council, now known as Auckland Council
CV	The coefficient of variation, also known as the relative standard deviation, is a measure of the accuracy of passive samplers.
DEFRA	UK Department for Environment, Food and Rural Affairs
ECan	Environment Canterbury Regional Council
EUD	Environment and Urban Design section of the NZTA Highway and Network operations – Professional Services group.
GPG	Good practice guide
GWRC	Greater Wellington Regional Council
%HV	Proportion of heavy duty vehicles (ie vehicles with a gross vehicle mass of over 3.5 tonnes)
LAQM TG(09)	*Local air quality management: Technical guidance* produced by DEFRA in 2009
MfE	Ministry for the Environment
MoT	Ministry of Transport
NES	National environmental standards
NMA	Network Management Area. Contract management area used for the purpose of managing the state highway network.
NO	Nitric oxide, an air pollutant produced from the combustion of fossil fuels used in transport. NO is the primary product emitted directly but is eventually oxidised to NO_2 by other pollutants in the atmosphere.
NO_2	Nitrogen dioxide, an air pollutant produced from the combustion of fossil fuels used in transport. NO_2 can cause health effects such as retarded lung development in children and increased susceptibility to lung infections.
NO_X	Nitrogen oxides (also referred to as oxides of nitrogen) is the collective term for the group of compounds including NO and NO_2.
NZHPT	New Zealand Historic Places Trust
NZMG	New Zealand Map Grid is the old projection that has been used for 1:50,000 topographic mapping in New Zealand. It was replaced by the NZTM in 2001. The NZTA currently uses NZMG coordinates for Spatial Viewer.
NZST	New Zealand Standard Time, the time in New Zealand without any daylight saving and officially 12 hours in advance of Coordinated Universal Time (UTC).
NZTA	New Zealand Transport Agency is the agency responsible for the building and operation of New Zealand's state highway network, amongst other duties, since July 2008. Previously state highways were managed by Transit New Zealand.
NZTM	New Zealand Transverse Mercator is the future projection that will be used for New Zealand's 1:50,000 and other small scale mapping.
ppb	Parts per billion, a measure of concentration
RC	Regional council

10.3 Abbreviations continued

TRAMS	Transport-related air quality monitoring system, the NZTA database of air quality monitoring data relevant to the operation and improvement of the state highway network. TRAMS and TRAQS are due to be merged to become the Air Quality Data Warehouse in 2012/13.
TRAQS	Transport-related air quality assessment system, the NZTA database of air quality assessments undertaken for state highway asset improvement projects. TRAQS and TRAMS are due to be merged to become the Air Quality Data Warehouse in 2012/13.
$\mu g/m^3$	Micrograms per cubic metre, a unit of concentration
WHO	World Health Organisation
WRC	Waikato Regional Council

10.4 Bibliography

1. AEA (2008) *Diffusion tubes for ambient NO_2 monitoring: Practical guidance for laboratories and users.* Prepared by AEA Energy and Environment for the Department for Environment, Food and Rural Affairs and the Devolved Administrations, February 2008.
2. ARC (2007) *Nitrogen dioxide in air in the Auckland region*. ARC Technical publication no 346 prepared by the Auckland Regional Council, December 2007.
3. DEFRA (2009) *Local air quality management, Technical guidance LAQM TG(09).* Prepared by the Department for Environment, Food and Rural Affairs, February 2009.
4. MfE (2002) *Ambient air quality guidelines, 2002 update*. Air Quality Report No 32 prepared by the Ministry for the Environment and the Ministry of Health, May 2002.
5. MfE (2011) *Resource Management (National Environmental Standards for Air Quality) Regulations 2004*. Prepared by the Ministry for the Environment, June 2011.
6. MoT (2011) *The New Zealand vehicle fleet, Annual fleet statistics 2010*. Prepared by the Ministry of Transport, dated March 2011 but updated in August 2011.
7. NIWA (2008) *The determinants of levels of secondary particulate pollution and nitrogen dioxide in urban New Zealand – Part 1.* NIWA Report AKL2008-053 prepared for the Foundation for Research, Science and Technology, July 2008.
8. NZTA (2011) *Minimum Standard Z/5 – Health and Safety Compliance Notice, version 2.* Prepared by the NZ Transport Agency, March 2011.
9. NZTA (2012a). *Draft Guide to assessing air quality effects for state highway asset improvement projects*, NZ Transport Agency, September 2012.
10. NZTA (2012b) *Ambient air quality (nitrogen dioxide) monitoring network – annual report 2007-2011.* Prepared by Emission Impossible Ltd and Watercare Services Ltd for the NZ Transport Agency, June 2012.
11. NZTA (2012c) *Ambient air quality (nitrogen dioxide) monitoring network – site metadata report 2007-2011.* Prepared by Watercare Services Ltd and Emission Impossible Ltd for the NZ Transport Agency, June 2012.
12. Transit (2008) *Environmental plan, version 2.* Prepared by Transit New Zealand, June 2008. **Note**: Transit New Zealand merged with Land Transport New Zealand to form the NZ Transport Agency on 1 August 2008.
13. WHO (2006) *Air quality guidelines global update 2005: Particulate matter, ozone, nitrogen dioxide, and sulphur dioxide.* Prepared by the World Health Organisation, October 2006.

11.0 Appendices

In this chapter

Appendix A Example site metadata sheets

LABORATORY SERVICES - QUALITY SYSTEM
Ambient Air Quality Passive Monitoring: Site Checks

Client:		**Site Name:**			
Site Code:		**Date:**		**Technician:**	

Site Commissioning Details

Location

Nearest Street Address					
Area		City		Region	
Map Ref (NZMG, Geo Datum 49)		E		N	
Nearest Sensitive Receptor - Name & Street Address (e.g. school)					

Supporting Information

Date(s) Commissioned	From		To		
Photos of Site Taken	Y / N		Location Map	Y / N	

Sampler Specifications

Criteria	**Specification**	**Units**	**Site monitoring type for NZTA only**			
			SH	**Local**	**Background**	**Notes**
Nearest Major Road or SH		m	<100 m	<50 m	> 50 m	
Nearest Sensitive Receptor		m	< 50 m	< 50 m	< 50 m	
Height Above Ground		m	2 - 5 m	2 - 5 m	2 - 5 m	
Nearest Trees		m	≥10m	≥10m	≥10m	

Other Site Descriptions
(i.e. topography, buildings, possible sources, etc)

Contacts

Name	**Position**	**Telephone No. & Email**

Notes
Any Enquires Contact:
Watercare Services Limited
52 Aintree Avenue, Airport Oaks, MANUKAU 2022
Telephone: +64 9 539 7600

Appendix A Example site metadata sheets continued

Site Name

Craig Rd

Site Code

NAP001

Region & Monitoring Zone

Gisborne - Gisborne

Area

Kaiti

Site Type

SH

Source

Wainui Rd

Site Location

515 Wainui Rd
Kaiti, Gisborne

Map Reference

	Easting	Northing		Easting	Northing
NZMG	2948813	6268592	**NZTM**	2038946	5707152

Nearest Sensitive Receptor & Location

Kaiti School
517 Wainui Rd

Distance (m)
5

Nearest SH & Local Road (m) with Direction

SH 35	2	NE	LR	190	NE

National Network

Y

Intersection

N

Other Site Information

Opposite Kaiti School

Height Above Ground (m)

3.0

Nearest Tree (m)

10.0

Monitoring Note(s)

Jan-07 Commissioned

Appendix B Example field sheet

Nitrogen Dioxide Passive Sampling

NZTA NZ – AIR QUALITY MONITORING NETWORK

MONTH_____

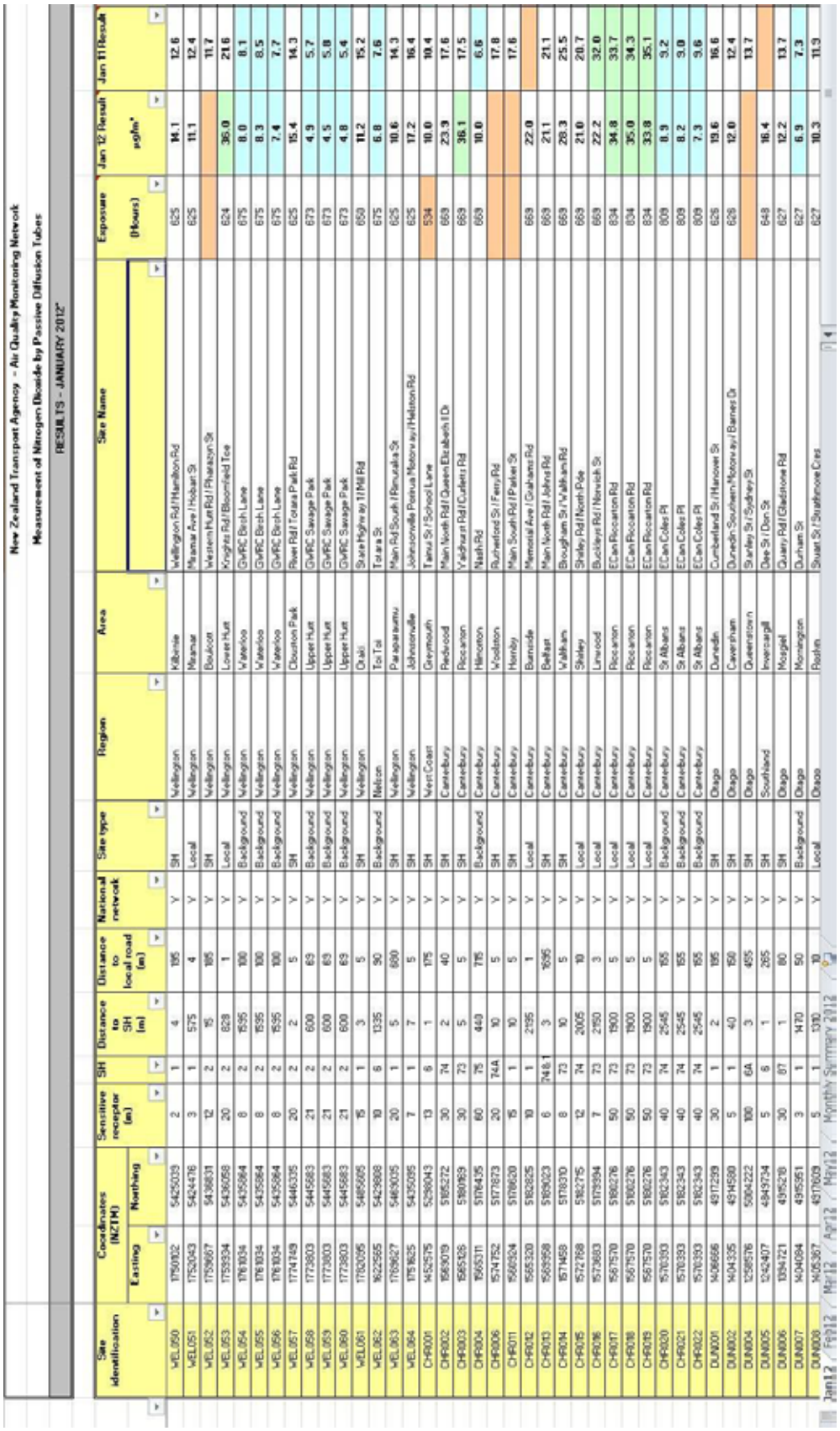
Site Name	Site Number	Start Date & Time	End Date & Time

Comments

Technician Name	Contact Details

Please return to:
Watercare Services Limited
52 Aintree Avenue, Airport Oaks, AUCKLAND
Attention: Kath McLeod
DD: (09) 539 7790

Appendix C Example monthly data spreadsheets



New Zealand Transport Agency – Air Quality Monitoring Network

Measurement of Nitrogen Dioxide by Passive Diffusion Tubes

RESULTS - JANUARY 2012*

Site Identification	Coordinates (NZTM) Easting	Coordinates (NZTM) Northing	Sensitive receptor (m)	SH	Distance to SH (m)	Distance to local road (m)	National network	Site type	Region	Area	Site Name	Exposure (Hours)	Jan 12 Result µg/m³	Jan 11 Result
WEL050	1750002	5425039	2	1	4	195	Y	SH	Wellington	Kilbirnie	Wellington Rd / Hamilton Rd	625	14.1	12.6
WEL051	1752043	5424476	3	1	575	4	Y	Local	Wellington	Miramar	Miramar Ave / Hobart St	625	11.1	12.4
WEL052	1750667	5436831	12	2	15	185	Y	SH	Wellington	Brooklyn	Western Hutt Rd / Pharazyn St			11.7
WEL053	1759394	5436058	20	2	828	1	Y	Local	Wellington	Lower Hutt	Knights Rd / Bloomfield Tce	624	36.0	21.6
WEL054	1761034	5435864	8	2	1595	100	Y	Background	Wellington	Waterloo	GWRC Birch Lane	675	8.0	8.1
WEL055	1761034	5435864	8	2	1595	100	Y	Background	Wellington	Waterloo	GWRC Birch Lane	675	8.3	8.5
WEL056	1761034	5435864	8	2	1595	100	Y	Background	Wellington	Waterloo	GWRC Birch Lane	675	7.4	7.7
WEL057	1774749	5446395	20	2	2	5	Y	SH	Wellington	Clouston Park	River Rd / Totara Park Rd	625	15.4	14.3
WEL058	1773803	5445883	21	2	600	69	Y	Background	Wellington	Upper Hutt	GWRC Savage Park	673	4.9	5.7
WEL059	1773803	5445883	21	2	600	69	Y	Background	Wellington	Upper Hutt	GWRC Savage Park	673	4.5	5.8
WEL060	1773803	5445883	21	2	600	69	Y	Background	Wellington	Upper Hutt	GWRC Savage Park	673	4.8	5.4
WEL061	1760095	5465095	15	1	3	5	Y	SH	Wellington	Otaki	State Highway 1 / Mill Rd	650	11.2	15.2
WEL062	1622565	5423898	10	6	1335	30	Y	Background	Nelson	Toi Toi	Totara St	675	6.8	7.6
WEL063	1769627	5463095	20	1	5	680	Y	SH	Wellington	Paraparaumu	Main Rd South / Paruruhi St	625	10.6	14.3
WEL064	175825	5435095	7	1	7	5	Y	SH	Wellington	Johnsonville	Johnsonville Porirua Motorway / Helston Rd	625	17.2	16.4
CHR001	1452575	5296043	13	8	1	175	Y	SH	West Coast	Greymouth	Tainui St / School Lane	534	10.0	10.4
CHR002	1563079	5185272	30	74	2	40	Y	SH	Canterbury	Redwood	Main North Rd / Queen Elizabeth II Dr	669	23.9	17.6
CHR003	1565326	5180989	30	73	5	5	Y	SH	Canterbury	Riccarton	Yaldhurst Rd / Curletts Rd	669	36.1	17.5
CHR004	1565311	5176435	60	75	440	175	Y	Background	Canterbury	Hillmorton	Nash Rd	669	10.0	6.6
CHR006	1574752	5177873	20	74A	10	5	Y	SH	Canterbury	Woolston	Rutherford St / Ferry Rd			17.8
CHR011	1568624	5178629	15	1	10	5	Y	SH	Canterbury	Hornby	Main South Rd / Parker St			17.6
CHR012	1565320	5182825	10	1	2195	1	Y	Local	Canterbury	Burnside	Memorial Ave / Grahams Rd	669	22.0	
CHR013	1565958	5189023	6	74B.1	3	1695	Y	SH	Canterbury	Belfast	Main North Rd / Johns Rd	669	21.1	21.1
CHR014	1571458	5178370	8	73	10	5	Y	SH	Canterbury	Waltham	Brougham St / Waltham Rd	669	28.3	25.5
CHR015	1572768	5182775	12	74	2005	10	Y	Local	Canterbury	Shirley	Shirley Rd / North Pde	669	21.0	20.7
CHR016	1573683	5179394	7	73	2150	3	Y	Local	Canterbury	Linwood	Buckleys Rd / Norwich St	669	22.2	32.0
CHR017	1567570	5180276	50	73	1900	5	Y	Local	Canterbury	Riccarton	ECan Riccarton Rd	834	34.8	33.7
CHR018	1567570	5180276	50	73	1900	5	Y	Local	Canterbury	Riccarton	ECan Riccarton Rd	834	35.0	34.3
CHR019	1567570	5180276	50	73	1900	5	Y	Local	Canterbury	Riccarton	ECan Riccarton Rd	834	33.8	35.1
CHR020	1570393	5182343	40	74	2545	155	Y	Background	Canterbury	St Albans	ECan Coles Pl	809	8.9	9.2
CHR021	1570393	5182343	40	74	2545	155	Y	Background	Canterbury	St Albans	ECan Coles Pl	809	8.2	9.0
CHR022	1570393	5182343	40	74	2545	155	Y	Background	Canterbury	St Albans	ECan Coles Pl	809	7.3	9.6
DUN001	1486666	4917299	30	1	2	195	Y	SH	Otago	Dunedin	Cumberland St / Hanover St	626	19.6	16.6
DUN002	1404395	4914590	5	1	40	150	Y	SH	Otago	Dunedin Southern Motorway / Barnes Dr		626	12.0	12.4
DUN004	1258676	5064222	100	6A	3	455	Y	SH	Otago	Queenstown	Stanley St / Sydney St			13.7
DUN005	1242407	4843734	5	8	1	265	Y	SH	Southland	Invercargill	Dee St / Don St	648	16.4	
DUN006	1394721	4956216	30	87	1	80	Y	SH	Otago	Mosgiel	Quarry Rd / Gladstone Rd	627	12.2	13.7
DUN007	1404084	4956561	3	1	1470	50	Y	Background	Otago	Momington	Dunham St	627	6.9	7.3
DUN008	1405367	4917609	5	1	1310	10	Y	Local	Otago	Roslyn	Stuart St / Strathmore Cres	627	10.3	11.9

Jan12 / Feb12 / Mar12 / Apr12 / May12 / Monthly Summary 2012

Appendix C Example monthly data spreadsheets continued

New Zealand Transport Agency – Air Quality Monitoring Network

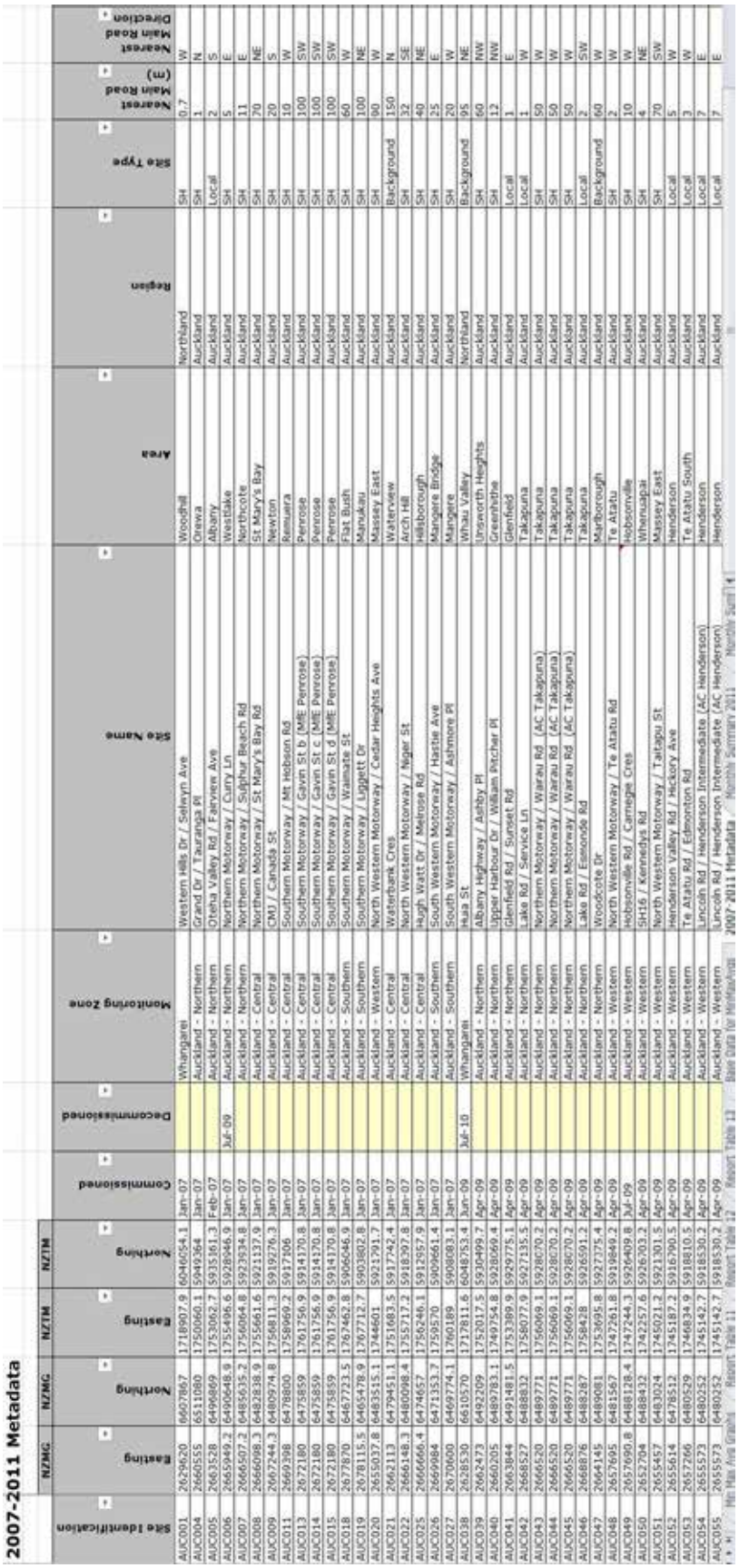
Measurement of Nitrogen Dioxide by Passive Diffusion Tubes

MONTHLY RESULTS - 2012

Site ID	Results (µg/m³) Jan-12	Feb-12	Mar-12	Apr-12	May-12	Average	CV (%)	% Valid Data
WEL035	6.2	9.6	10.5	11.3	15.2	**10.6**	**30.7**	100.0%
WEL036	7.2	10.5	11.6	13.1	14.7	**11.4**	**24.9**	100.0%
WEL047	9.1	10.4	11.5	12.0	15.1	**11.6**	**19.3**	100.0%
WEL048	6.3	7.7	8.6	9.9	12.3	**9.0**	**25.5**	100.0%
WEL049	24.9	29.9	35.5	45.0	42.8	**35.6**	**23.8**	100.0%
WEL050	14.1	19.2	21.4	22.8	28.6	**21.2**	**24.9**	100.0%
WEL051	11.1	10.6	12.7	13.1	19.0	**13.3**	**25.2**	100.0%
WEL052		15.7	18.5	26.6	27.5	**22.1**	**26.6**	80.0%
WEL053	36.0	24.8	27.7	32.2	30.4	**30.2**	**14.1**	100.0%
WEL054	8.0	11.9	12.0	17.6	17.3	**13.4**	**30.5**	100.0%
WEL055	8.3	11.3	11.2	16.2	17.8	**13.0**	**30.3**	100.0%
WEL056	7.4	11.6	11.4	16.4	17.2	**12.8**	**31.5**	100.0%
WEL057	15.4	18.6	16.4	23.5	24.6	**19.7**	**21.1**	100.0%
WEL058	4.9	6.8	7.2			**6.3**	**19.5**	60.0%
WEL059	4.5	6.8	7.7			**6.3**	**26.1**	60.0%
WEL060	4.8	5.4	8.0			**6.1**	**28.0**	60.0%
WEL061	11.2	14.5	16.7	19.1	23.1	**16.9**	**26.8**	100.0%
WEL062	6.8	10.3	12.3	15.6	19.9	**13.0**	**38.6**	100.0%
WEL063	10.6	14.6	15.3	17.8	18.0	**15.3**	**19.7**	100.0%
WEL064	17.2	22.2	23.4	25.4	26.9	**23.0**	**16.2**	100.0%
CHR001	10.0	10.3	13.7	15.7	17.8	**13.5**	**25.1**	100.0%
CHR002	23.9	26.4	31.3	36.5	41.8	**32.0**	**22.9**	100.0%
CHR003	36.1	20.4	27.7		45.4	**32.4**	**33.3**	80.0%
CHR004	10.0	11.4	15.7	19.5	25.5	**16.4**	**38.4**	100.0%
CHR006		24.3			43.8	**34.1**	**40.5**	40.0%
CHR011		25.0	27.5	33.4	39.0	**31.2**	**20.1**	80.0%
CHR012	22.0	26.3	32.4	35.1	40.4	**31.2**	**23.2**	100.0%
CHR013	21.1	26.7	27.8	35.4	45.8	**31.4**	**30.4**	100.0%
CHR014	26.3	31.1			39.4	**32.9**	**17.5**	60.0%
CHR015	21.0	23.0	26.5	32.4	40.8	**28.7**	**27.9**	100.0%
CHR016	22.2	27.4	34.7	37.5	49.9	**34.3**	**30.8**	100.0%
CHR017	34.8	40.5	43.0	45.0	46.9	**42.0**	**11.2**	100.0%
CHR018	35.0	39.7	42.7	44.8	48.5	**42.1**	**12.1**	100.0%
CHR019	33.8	40.6	43.9	43.7	47.6	**41.9**	**12.3**	100.0%
CHR020	8.9	12.0	13.3	17.0	23.7	**15.0**	**37.9**	100.0%
CHR021	8.2	10.5	14.4	16.0		**12.3**	**29.1**	80.0%
CHR022	7.3	10.8	13.3	16.3	25.7	**14.7**	**47.6**	100.0%
DUN001	19.6	27.0	33.2	31.9	38.9	**30.1**	**24.1**	100.0%
DUN002	12.0	14.3	16.2	16.9	17.3	**15.3**	**14.3**	100.0%
DUN004			26.6	29.7	25.4	**27.2**	**8.1**	60.0%
DUN005	16.4	24.7	28.6	31.9	38.4	**28.0**	**29.3**	100.0%
DUN006	12.2	17.5	21.9	24.6	27.2	**20.7**	**28.7**	100.0%
DUN007	6.9	10.8	11.9	15.0	15.1	**11.9**	**28.4**	100.0%
DUN008	10.3	14.4	16.9	19.8	20.0	**16.3**	**24.9**	100.0%

Jan12 | Feb12 | Mar12 | Apr12 | May12 | Monthly Summary 2012

Appendix D Example annual data spreadsheets



2007-2011 Metadata

Site Identification	NZMG Easting	NZMG Northing	NZTM Easting	NZTM Northing	Commissioned	Decommissioned	Monitoring Zone	Site Name	Area	Region	Site Type	Nearest Main Road (m)	Nearest Main Road Direction
AUC001	2629620	6607867	1718907.9	6046054.1	Jan-07		Whangarei	Western Hills Dr / Selwyn Ave	Woodhill	Northland	SH	0.7	W
AUC004	2660555	6511080	1750060.1	5949364	Jan-07		Auckland - Northern	Grand Dr / Tauranga Pl	Orewa	Auckland	SH	1	N
AUC005	2663528	6496869	1753062.7	5935161.3	Feb-07		Auckland - Northern	Oteha Valley Rd / Fairview Ave	Albany	Auckland	Local	2	S
AUC006	2665949.2	6490648.9	1755496.6	5928046.9	Jan-07	Jul-09	Auckland - Northern	Northern Motorway / Curry Ln	Westlake	Auckland	SH	5	E
AUC007	2666507.2	6485635.2	1756064.8	5923934.8	Jan-07		Auckland - Northern	Northern Motorway / Sulphur Beach Rd	Northcote	Auckland	SH	11	E
AUC008	2666098.3	6482838.9	1755661.6	5921537.9	Jan-07		Auckland - Central	Northern Motorway / St Mary's Bay Rd	St Mary's Bay	Auckland	SH	70	NE
AUC009	2667244.3	6480974.8	1756811.3	5919276.3	Jan-07		Auckland - Central	CMJ / Canada St	Newton	Auckland	SH	20	S
AUC011	2669398	6478800	1758969.2	5917306	Jan-07		Auckland - Central	Southern Motorway / Mt Hobson Rd	Remuera	Auckland	SH	10	W
AUC013	2672180	6475859	1761756.9	5914170.8	Jan-07		Auckland - Central	Southern Motorway / Gavin St b (ME Penrose)	Penrose	Auckland	SH	100	SW
AUC014	2672180	6475859	1761756.9	5914170.8	Jan-07		Auckland - Central	Southern Motorway / Gavin St c (ME Penrose)	Penrose	Auckland	SH	100	SW
AUC015	2672180	6475859	1761756.9	5914170.8	Jan-07		Auckland - Central	Southern Motorway / Gavin St d (ME Penrose)	Penrose	Auckland	SH	100	SW
AUC018	2677870	6467723.5	1767462.8	5906046.9	Jan-07		Auckland - Southern	Southern Motorway / Waimate St	Flat Bush	Auckland	SH	60	W
AUC019	2678115.5	6465478.9	1767712.7	5903802.8	Jan-07		Auckland - Southern	Southern Motorway / Liggett Dr	Manukau	Auckland	SH	100	NE
AUC020	2659037.8	6483515.1	1744601	5921791.7	Jan-07		Auckland - Western	North Western Motorway / Cedar Heights Ave	Massey East	Auckland	SH	90	W
AUC021	2662113	6479451.1	1751683.5	5917742.4	Jan-07		Auckland - Central	Waterbank Cres	Waterview	Auckland	Background	150	N
AUC022	2666148.3	6480098.4	1755717.2	5918397.8	Jan-07		Auckland - Central	North Western Motorway / Niger St	Arch Hill	Auckland	SH	32	SE
AUC025	2666666.4	6474657	1756246.1	5912957.9	Jan-07		Auckland - Central	Hugh Watt Dr / Melrose Rd	Hillsborough	Auckland	SH	40	NE
AUC026	2669984	6471353.7	1759570	5909661.4	Jan-07		Auckland - Southern	South Western Motorway / Hastie Ave	Mangere Bridge	Auckland	SH	25	E
AUC027	2670000	6469774.1	1760189	5908083.1	Jan-07		Auckland - Southern	South Western Motorway / Ashmore Pl	Mangere	Auckland	SH	20	W
AUC038	2628530	6610570	1717811.6	6048753.4	Jun-09	Jul-10	Whangarei	Huia St	Whau Valley	Northland	Background	95	NE
AUC039	2662473	6492209	1752017.5	5930499.7	Apr-09		Auckland - Northern	Albany Highway / Ashby Pl	Unsworth Heights	Auckland	SH	60	NW
AUC040	2660205	6489783.1	1749754.8	5928069.4	Apr-09		Auckland - Northern	Upper Harbour Dr / William Pitcher Pl	Greenhithe	Auckland	SH	12	NW
AUC041	2663844	6491481.5	1753389.9	5929775.1	Apr-09		Auckland - Northern	Glenfield Rd / Sunset Rd	Glenfield	Auckland	Local	1	E
AUC042	2668527	6488832	1758077.9	5927135.5	Apr-09		Auckland - Northern	Lake Rd / Service Ln	Takapuna	Auckland	Local	1	W
AUC043	2666520	6489771	1756069.1	5928070.2	Apr-09		Auckland - Northern	Northern Motorway / Wairau Rd (AC Takapuna)	Takapuna	Auckland	SH	50	W
AUC044	2666520	6489771	1756069.1	5928070.2	Apr-09		Auckland - Northern	Northern Motorway / Wairau Rd (AC Takapuna)	Takapuna	Auckland	SH	50	W
AUC045	2666520	6489771	1756069.1	5928070.2	Apr-09		Auckland - Northern	Northern Motorway / Wairau Rd (AC Takapuna)	Takapuna	Auckland	SH	50	W
AUC046	2668876	6488267	1758428	5926591.2	Apr-09		Auckland - Northern	Lake Rd / Esmonde Rd	Takapuna	Auckland	Local	2	SW
AUC047	2664145	6489081	1753695.8	5927375.4	Apr-09		Auckland - Northern	Woodcote Dr	Murrborough	Auckland	Background	60	W
AUC048	2657695	6481567	1747261.8	5919849.2	Apr-09		Auckland - Western	North Western Motorway / Te Atatu Rd	Te Atatu	Auckland	SH	2	W
AUC049	2657690.8	6480128.4	1747244.3	5926409.8	Jul-09		Auckland - Western	Hobsonville Rd / Carnegie Cres	Hobsonville	Auckland	SH	10	W
AUC050	2652704	6488432	1742257.6	5926703.2	Apr-09		Auckland - Western	SH16 / Kennedys Rd	Whenuapai	Auckland	SH	4	NE
AUC051	2655457	6483024	1745021.2	5921301.5	Apr-09		Auckland - Western	North Western Motorway / Taitapu St	Massey East	Auckland	SH	70	SW
AUC052	2655614	6478512	1745187.3	5916790.5	Apr-09		Auckland - Western	Henderson Valley Rd / Hickory Ave	Henderson	Auckland	Local	5	W
AUC053	2657266	6480529	1746834.9	5918810.5	Apr-09		Auckland - Western	Te Atatu Rd / Edmonton Rd	Te Atatu South	Auckland	Local	3	W
AUC054	2655573	6480252	1745142.7	5918530.2	Apr-09		Auckland - Western	Lincoln Rd / Henderson Intermediate (AC Henderson)	Henderson	Auckland	Local	7	E
AUC055	2655573	6480252	1745142.7	5918530.2	Apr-09		Auckland - Western	Lincoln Rd / Henderson Intermediate (AC Henderson)	Henderson	Auckland	Local	7	E

Appendix D Example annual data spreadsheets continued

New Zealand Transport Agency - Air Quality Monitoring Network
Measurement of Nitrogen Dioxide by Passive Diffusion Tubes
MONTHLY RESULTS - 2011

Results (µg/m³)

Site ID	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11
AUC001	17.1	15.6	24.4		27.1	33.8	31.2	26.5	33.1	31.2	28.9
AUC004	9	7.5	9.1	9.8	12.8	13.8	13.7	10.2	12.5	13.6	9.7
AUC005	23.6	16.6	22.6	29.6	30.8	30.1	38.3	28.0	41.8	35.8	32.4
AUC007	18.6	23.6	29.7	29.3	42.1	29.6	33.4	21.4	35.7	35.9	19.5
AUC008	19.6	20.5	26.4	29.9	35.4	31.5	30.4	29.7	30.4	35.3	22.1
AUC009	24.4	34.8	39.4	40.8	43.1	45.4	50.7	51.3	59.0	46.4	45.3
AUC011	19.7	27.6	30.3	37.4	40.5	37.6	47.7	45.9	50.9	42.0	35.3
AUC013	12.4	23.5	27.8	32.7	35.6	29.0	41.7	39.5	41.7	37.9	29.0
AUC014	15.5	22.5	26.3	32.0	31.4	34.2	42.5	31.9	42.5	36.7	28.2
AUC015	13.1	23.3	26.3	30.2	33.6	30.8	40.7	40.0	39.3	34.3	27.3
AUC018	17.2	25.3	29.5	32.0	28.7	33.1	41.5	43.1	46.2	36.9	
AUC019	14.3	13.9	17.8	25.3	22.9	31.9	32.1	29.2	27.0	27.1	24.8
AUC020	7.6	11.2	14.0	16.6	16.7	17.2	19.8	19.5	24.4	18.4	15.8
AUC021	9.7	11.1	15.4	22.0	23.5	20.5	22.0	20.2	22.2	20.8	17.3
AUC022	19.9	23.4	28.7	31.6	39.7	34.7	39.2	40.5	43.0	38.8	34.7
AUC025	11.8	16.2	14.9	20.3	22.1	28.7	26.0	26.3	22.4	25.7	24.3
AUC026	13.5	13.7	21.4	28.4	31.8	27.1	32.3	26.0	25.7	32.2	24.3
AUC027	15.6	16.6	24.4	29.1	29.6	32.7	40.4	32.4	35.0		28.6
AUC039	9.8	12.7	13.8	16.0	16.9	20.2	24.2	14.4	23.0	20.5	16.0
AUC040	7.8	11.5	10.0	15.5	13.4	17.1	20.8	17.2	19.3		19.7
AUC041	14.2	12.9	17.7	21.1	27.4	23.4	24.5	17.8	22.1	25.8	18.4
AUC042	21	21.7	28.9	32.7	35.9	39.2	38.8	36.5	36.9	40.2	32.3
AUC043	13.1	21.2	25.7	27.6	31.7	33.6	39.7	41.8	40.6	33.5	30.3
AUC044	13.8	14.9	25.1	30.0	31.3	34.3	35.9	41.4	42.0	35.2	30.5
AUC045	12.3	20.4	26.6	26.6	31.7	36.9	41.5	42.9	36.0	30.9	29.8
AUC046	14.2	24.1	26.9	28.5	29.4	32.9	38.1	40.7	42.5	35.1	28.0
AUC047	8	8.3	12.7	13.2	16.2	16.9	18.7	15.6	18.4	14.7	11.3
AUC048	12.5	16.0	25.6	25.6	28.1	32.8	39.9	36.6	41.7	32.4	21.1
AUC049	8.8	13.3	13.6	16.1	20.1	21.7	26.2	15.9	18.8	16.4	11.2
AUC050	10.9	11.2	16.9	16.3	19.0	20.0	16.1	20.0	17.1	19.5	14.0
AUC051	8.9	11.4	14.6					25.5	29.5	22.5	18.7
AUC052	10.8	13.9	18.0	21.0	26.6	26.0	22.2	22.2	23.3	21.0	20.2
AUC053	16	22.7	27.4	30.0	35.9	41.1	42.8	42.5	45.2	42.5	38.2
AUC054	10.6	9.6	18.6	22.2	24.0	23.2	27.4	18.8	19.8	19.2	16.9
AUC055	12.9	12.4	15.0	20.6	23.9	21.6	25.1	16.1	23.2	22.7	17.1
AUC056	12	13.5	19.2	19.5	25.9	22.0	23.6	19.2	19.0	20.3	16.0
AUC057	6.4	4.5	10.0	12.1	12.2	14.7	13.7	11.6	11.4	11.3	9.0
AUC058	5.4	6.9	6.9	11.8	12.0	15.6	14.5	10.5	10.8	11.0	8.7
AUC059	5.3	4.5	9.2	11.5	13.2	16.1	14.0	11.4	11.1	12.1	5.3
AUC060	29	28.9	34.0	37.5	39.7	46.2	48.2	44.2	46.9	48.0	42.2
AUC061	21.5	22.3	26.5	33.1	35.4	42.4	38.8	39.2	38.3	41.8	35.4
AUC062	13.1	21.7	23.3	28.3	27.7	27.3	33.9	33.5	41.2	29.1	22.4
AUC063	27.7	31.1	42.8	39.7	46.5	43.8	44.2	42.9	47.4	42.4	40.5
AUC064	18.6		29.9	28.8	27.7	36.8	37.5	33.7	31.6		30.5

Max Ave Graphs | Report Table 11 | Report Table 12 | Report Table 13 | Base Data for Max Ave | 2007-2011 Metadata | Monthly Summary 2011 | Monthly Summ 1

Appendix E List of other subcontractors in 2012/13

Field subcontractor details

The field subcontractors responsible for sample exchange in different areas in 2012/13 are as follows:

Area	Field subcontractor
Whangarei (Northland)	NZTA
Silverdale (PSMC 002)	Transfield Services
Greenlane (Auckland)	Beca
Hamilton (West Waikato)	Opus
Te Awamutu (PSMC 006)	Transfield Services
Taupo (Central Waikato)	Opus
Rotorua (Rotorua)	Rotorua District Council Laboratory
Tauranga (Tauranga)	Inroads
Gisborne (Gisborne)	Opus
Napier (Hawke's Bay)	Opus
Whanganui (West Whanganui)	MWH
Wellington (Wellington)	MWH until Sept 2012 then NZTA
Wellington (Wellington)	Greater Wellington RC
Nelson (Nelson Tasman)	Opus
Blenheim (Marlborough Roads)	Opus
Greymouth (West Coast)	Opus
Christchurch (North Canterbury)	Opus
Christchurch (North Canterbury)	Environment Canterbury RC
Dunedin (Coastal Otago)	MWH
Queenstown (Central Otago)	Opus
Invercargill (Southland)	Opus

Laboratory details

The following analytical laboratory is subcontracted in 2012/13 for the analysis of the exposed passive samplers:

Scientific Services Laboratory
Staffordshire County Council (SCC)
Stafford
United Kingdom