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Air Quality Report

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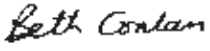
	Signature	
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Executive Summary

In 2002 the Health Protection Department of the States of Jersey Government commissioned AEA to produce a health based Air Quality Strategy for Jersey. The final draft of the Air Quality Strategy was submitted to Health Protection Services in July 2002 and comprised a screening document that consolidated much of the monitoring data collated over the preceding 5 years. The draft Strategy was presented to the former Health and Social Services Committee on the 16th September 2002 and the principles and recommendations therein were endorsed. A further revision of the Strategy was undertaken in 2003, following consultation with other departments. The revised Air Quality Strategy 2003 highlighted a number of issues pertaining to air quality on the island including:

- Emissions from the non-conforming Bellozane waste incinerator;
- Emissions from the JEC Power Station at La Collette;
- Emissions from the Islands Crematoria; and
- Emissions from road traffic; the principal source of pollutants on Jersey.

Since the publication of the Air Quality Strategy, 2003, a number of changes have taken place on the Island. Although air quality was previously recognised as a consideration in the Island Plan, 2002 and Sustainability Strategy, the introduction of the Strategic Plan 2006-2011 contained a clear commitment to improve air quality with a move towards international air quality standards.

A review of progress in implementing the Air Quality Strategy was undertaken by the Environmental Scrutiny Panel in June 2008. On the basis of the commitments outlined in the Strategic Plan, the Panel concluded that work identified had not yet been undertaken and that there was a clear and urgent need for responsibility to be clarified and the matter progressed. Subsequently the Air Quality Review presented to the States of Jersey on the 10th June 2008 provided a number of recommendations on how the States should progress, including:

(1) Define clear timescales for the implementation of an Air Quality Strategy;
(2) Consider international agreements when the Air Quality Strategy is being developed;
(3) Introduce enabling legislation that will allow Orders to be made as and when necessary;
(4) Carry out Strategic Environmental Assessment (SEA) on new developments to assess cumulative effects of development; and
(5) Develop a robust long-term monitoring programme for air quality that uses equipment and appropriate methods that meet EU standards.

AEA has been commissioned by Health Protection Services of the States of Jersey Government to provide an independent review of air quality issues on Jersey. This report addresses recommendations of the Environmental Scrutiny Panel's Air Quality Review, 2008 and provides an independent opinion on how the States should best proceed with implementing an Air Quality Strategy, developing an air quality Legislative Framework and EU compliant Monitoring Strategy that will effectively deal with local air quality issues specific to the Island.

With a number of high profile developments currently underway in the Waterfront area of St. Helier, concerns have arisen over the potential impact of these with regards to their effects on traffic levels on the local road network and subsequent pollutant levels from road transport sources. In addition this report provides a detailed assessment of the cumulative impacts of new developments on local air quality in the St. Helier area.

This air quality report addresses the following main topics:

- Section 1: Provides an overview of the current air quality issues on Jersey leading up to recommendations of the Air Quality Review, 2008;

- Section 2: Provides a brief overview of statistics for Jersey including transportation, energy use and meteorological factors affecting air quality on the Island;
- Section 3: Provides an overview of the current air quality legislative framework relating to air quality on Jersey;
- Section 4: Provides a summary of air quality monitoring undertaken on Jersey to date;
- Section 5: Provides a review of air quality legislation (UK and International) and International air quality Agreements;
- Section 6: Provides recommendations on the "way forward" in developing the States air quality Legislative Framework;
- Section 7: Provides an overview of the identification of key pollutants and relevant sources including recommendations for implementing an EU compliant monitoring strategy;
- Section 8: Provides an assessment of the cumulative impacts of new development in St. Helier; and
- Section 9: Outlines final conclusions and recommendations

Table of Contents

Glossary

AQMA	An Air Quality Management Area is an area where one or more of the air quality objectives are not expected to be met, unless action is taken to improve air quality.
AQAP	A group of measures aimed at reducing pollutant levels in an AQMA.
BTEX	Acronym that stands for benzene, toluene, ethylbenzene, and xylenes.
DEFRA	UK Government Department of the Environment, Food and Rural Affairs.
EfW	Energy from Waste, is a process of creating energy in the form of electricity or heat from the incineration of waste source.
EIA	is an assessment of the possible impact, positive or negative, that a proposed project may have on the environment; considering natural, social and economic aspects.
LAQM	Local Air Quality Management, the regime in which UK local authority Environmental Health departments are expected to review and monitor ambient air pollution and ensure it attains Government NAQS standards.
MWh	Megawatt hour, a unit of energy equal to 3,600,000,000 joules.
NAQS	National Air Quality Strategy - the overarching strategy that UK local authorities must work to comply with the UK Environment Act 1995.
Objectives	are set based on standards, economic efficiency, practicality, technical feasibility and timescale. Typically, an objective will contain a standard, a target date and may be coupled with allowable exceedences.
PM_{10}	Particles (also known as particulates) of a mean aerodynamic diameter of 10 microns. Particles of sizes $PM_{2.5}$ to PM_{10} are often referred to as the coarse fraction, $PM_{0.1}$ to $PM_{2.5}$ are referred to as fine particles and those below $PM_{0.1}$ (0.1 microns or 100 nanometres) referred to as superfine particles.
IPPC	Integrated Pollution Prevention and Control legislation originating from a EU Directive
SEA	A system of incorporating environmental considerations into policies, plans and programmes (Strategic Environmental Assessment)
Standards	are set purely (by EPAQS) on the basis of medical and scientific evidence of how each pollutant affects human health.
$\mu g\ m^{-3}$	Micrograms per cubic metre. European directives measure pollutants in $\mu g\ m^{-3}$.
μm	One μm, referred to as one micron, is a thousandth of a millimetre. For example, the particle measure PM_{10} refers to particles 10 microns or less in diameter.

1 Introduction

1.1 Overview

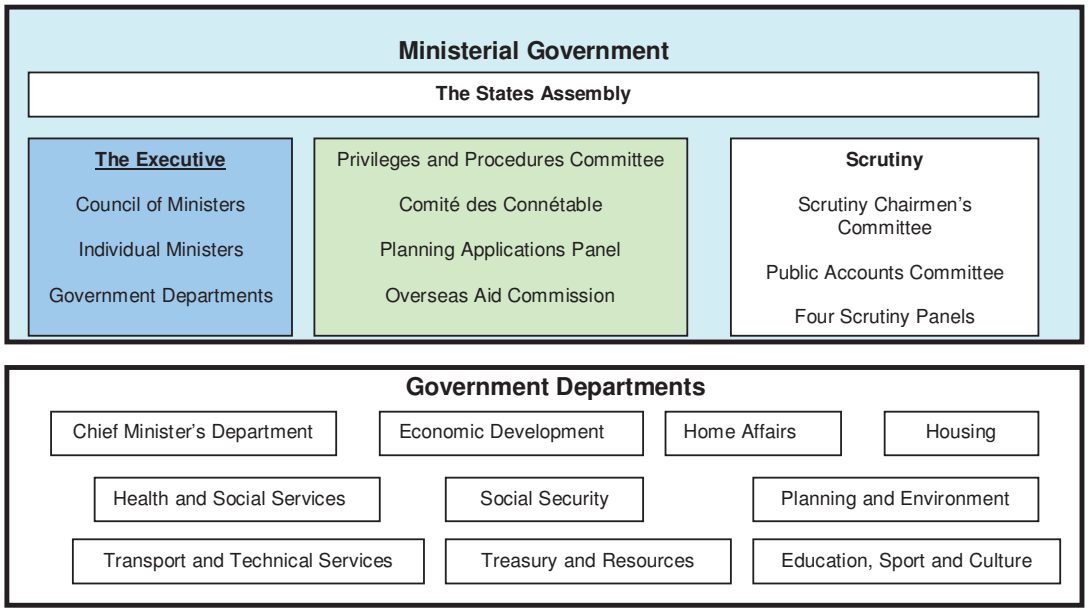
Jersey is the largest of the Channel Islands and is not part of the UK, or a Member State of the European Union. As a UK Crown Dependency, the Island is responsible for its own internal policies, with the exception of foreign policy and international relations, which remain under the jurisdiction of the UK Government. In relation to air quality, the EU Directives and Regulations are not legally binding on Jersey; however, the States of Jersey has a strategic policy to comply with the EU Environmental Standards as a minimum. In addition, the States of Jersey have committed to international obligations under the Climate Change Convention to reduce emissions of greenhouse gases (GHG).

The States of Jersey Government

The States of Jersey established a ministerial form of government in December 2005, following an independent review, the Clothier Report published in 2000. The old Committee system was replaced by a new Council of Ministers (the 'Executive'), which, working alongside Scrutiny Panels makes decisions about, and on behalf of, Jersey. This re-organisation of Jersey's government is aimed at creating a more efficient and effective government for the Island, enabling a quicker response to meet the needs of the people of Jersey, and better able to represent Jersey's interests internationally.[1]

The States Assembly is the Island's highest decision-making authority, and its decision-making powers cover the approval of new laws, but also any major policy changes. Ten Government departments fulfil the operational arms of the Government. The structure of the Assembly and the ten Government Departments is summarised in Figure 1.1.

Figure 1.1 The States of Jersey Government



[1] Ministerial Government in Jersey: A Detailed Guide (States of Jersey).

Following the establishment of the new government system, one of the earliest tasks placed on the Council of Ministers was to draw up a Strategic Plan for Jersey, outlining the Council's aims and objectives, together with a timetable for implementation.

On the 27th June 2006, the States approved a new Strategic Plan for the Island, providing the direction for all governmental work 2006-2011. Following the approval of the Plan, it is now the role of the Council to ensure that the Plan is properly and efficiently delivered through the public service.

In the States' Strategic Plan 2006-2011[2], a clear commitment to improve air quality with a move towards international air quality standards was introduced. The plan makes a further commitment under section 4.4.5. to:

"debate and implement an Air Quality Strategy including proposals for monitoring and publishing levels of local air pollution, and targets, policies and timescales for reductions in air pollution levels that reflect best practice globally (P&E)".

Air Quality on Jersey

It was previously recognised that air quality is a matter for concern in certain areas of Jersey as a result of emissions from road traffic and industrial processes (Island Plan, 2002[3] and Sustainability Strategy[4]). As a consequence in 2002 Health Protection Services, States of Jersey Government, commissioned AEA to produce a health based Air Quality Strategy for Jersey[5]. The principal aim of the Strategy was to address the following objectives:

- Provide an inventory of significant sources of local pollution and pollutants.
- Determine appropriate standards to be complied with.
- Identify those areas where the standards are exceeded.
- Establish appropriate action plans for improvement, with clear accountabilities for delivery.
- Design a monitoring programme capable of assessing the efficiency of the above action plans.
- Provide an estimate of the costs of implementing a monitoring programme.
- Raise public awareness of air quality in Jersey.

A final draft Air Quality Strategy was submitted to Health Protection Services in July 2002 and comprised a screening document that consolidated much of the monitoring data collated over the preceding 5 years. The draft Strategy was presented to the former Health and Social Services Committee on the 16th September 2002 and the principles and recommendations contained within it were endorsed. A further revision of the Strategy was undertaken in 2003, following consultation with other departments. The revised Air Quality Strategy highlighted a number of issues, which it recommended should be addressed. These included:

- Emissions from the non-conforming Bellozane waste incinerator;
- Emissions from the JEC Power Station at La Collette;
- Emissions from the Islands' Crematoria; and

[2] Strategic Plan 2006 – 2011 (States of Jersey)
[3] Island Plan 2002 (States of Jersey)
[4] Sustainable Strategy (States of Jersey)
[5] An Air Quality Strategy for Jersey 2003: A report produced for the States of Jersey

- Emissions from road traffic, the primary source of pollutants[6]

The main pollutants of concern on Jersey are benzene (90% from car refuelling and fuel storage); carbon monoxide (CO – road transport); Lead (Pb – road transport); nitrogen dioxide (NO_2 – road transport, electricity generation, shipping and domestic sources); particulates (PM_{10} – road transport) and sulphur dioxide (SO_2, particularly from industrial emissions e.g. the Bellozane waste incinerator). However, of these six pollutants, NO_2 and PM_{10} from road transport emissions present the greatest challenge to Jersey in terms of improving air quality.

A number of pollutant "hotspots" were identified on the Island including locations at Georgetown in St Saviour, Beaumont in St Peter and in St Helier: First Tower, the former Bus Station, Broad Street and La Pouquelaye. Other sites were also identified as having elevated levels of nitrogen dioxide including Le Bas Centre, Mont Felard, Robin Place, Saville Street/Rouge Bouillon and Bereford Street. From measurements undertaken at the time results indicated that European limit values set to protect human health were being exceeded at some sites.

The principal recommendation of the report was that improvements in road transport emissions would be the main issue that Jersey would have to address and an initial cost-effectiveness analysis of potential options was undertaken, highlighting the most cost effective options, including:

- Compulsory, periodic testing of vehicle emissions (MOT)
- Park and Ride schemes in St Helier
- Parking (including charges and on street parking restrictions)
- Urban bus schemes
- Vehicle scrapage subsidies
- Vehicle access limits
- Variable tax on engine size and age
- Pedestrianisation
- Alternative fuels
- Walk to school plans
- Traffic management

It was recommended that the States of Jersey carry out a feasibility study into each of these options to determine the cost effectiveness of achieving a measured air quality improvement, and to quantify other potential, socio-economic benefits and impacts. Additional recommendations were made including the need to undertake continuous monitoring for NO_2 and PM_{10}, particularly at some known pollution "hotspots" previously identified including Weighbridge, with monitoring being re-located to other areas more representative of general population exposure once compliance with the Daughter Directives was confirmed at the highest known pollution "hotspots".

1.2 Development Since the Completion of the Air Quality Strategy for Jersey 2003

Since the draft Air Quality Strategy 2003 a number of changes have taken place on the Island, including:

- The States Strategy for Solid Waste (Management) has been produced with the intent to replace the Bellozane waste incinerator with an EU compliant Energy from Waste (EfW) facility[7].

[7] Energy from Waste and Bulky Waste Facilities – Environmental Impact Statement 2007

- The JEC Power Station at La Collette currently runs for a limited period throughout the year due to the commissioning of fixed electricity supply from France, which has resulted in reducing the need for local electricity generation.

- New plant has been introduced in the crematoria, which meets current emission standards.

- A Draft Integrated Travel and Transport Plan for Jersey has been produced that contains measures aimed at reducing dependency on car use on the island.

A number of high profile developments have also recently commenced in St. Helier, which may have significant effects on air quality. Of particular significance are five new developments that have been granted planning permission in the Waterfront area of the town including:

- Development of 16 high rise blocks built on an area approximately 1500m^2, encompassing an underground car park in the Esplanade Quarter;

- Development of 4 blocks of mixed-use commercial and residential units in Castle Quays;

- Development of the EU compliant Energy from Waste facility to replace the Bellozane waste incinerator;

- Potential construction of a car park to replace residential units at Ann Court; and

- Development of mixed-use residential and commercial units at the gateway to St. Helier at Westmount Quarry.

Although Environmental Impact Assessments (EIA) have accompanied planning applications for the aforementioned developments, including assessments for air quality and traffic elements, no cumulative impact of the developments on air quality has been undertaken.

In addition, there have been significant changes in EU legislation pertaining to air quality management, including the release of the new air quality directive (Directive 2008/50/EC), which in effect replaces the Air Quality Framework Directive (96/62/EC) and the first three daughter directives (1999/30/EC, 2000/69/EC and 2002/3/EC). Further details are presented in Section 5.

1.3 The States of Jersey Strategic Plan and Progress with Implementing the States Air Quality Strategy

In the States' Strategic Plan 2006-2011, a clear commitment to improve air quality with a move towards international air quality standards was introduced. The plan makes a further commitment under section 4.4.5. to:

"debate and implement an Air Quality Strategy including proposals for monitoring and publishing levels of local air pollution, and targets, policies and timescales for reductions in air pollution levels that reflect best practice globally (P&E)".

In line with the first of these comments, during June 2008, progress on the implementation of Jersey's Air Quality Strategy was assessed in the Environmental Scrutiny Panel's Air Quality Review[8]. On the basis of the commitments outlined in the Strategic Plan, the Panel concluded that the work identified had not yet been undertaken and that there was a clear and urgent need for responsibility to be clarified and the matter progressed. Subsequently the Air Quality Review presented to the States of Jersey on the 10th June 2008 provided a number of recommendations on how the States should progress, including:

[8] Environmental Scrutiny Panel Air Quality Review 2008

- Take the Air Quality Strategy forward including proposals for monitoring, publishing levels of local air pollution, targets, policies and timescales for the reductions in air pollution levels that reflect best practice globally (P&E), and to:

    - Identify the key pollutants and their sources;
    - Clearly identify the responsibilities of the various departments to implement elements of the Strategy; and
    - Set out the framework for determining measures to improve air quality and how they are to be introduced.

In addition it was recommended that the Air Quality Strategy should:

- Define clear timetables for the introduction of the Air Quality Strategy and associated legislation;
- Consider international agreements when the Air Quality Strategy is being developed including the introduction of enabling legislation that will subsequently allow Orders to be made as and when necessary. Such Orders may include requirements for:

    - Burning of smokeless fuels in St. Helier
    - Annual emissions testing of all commercial vehicles over 5 years old
    - Setting of air quality standards not to be exceeded
    - A requirement to review air quality annually

- Carry out a Strategic Environmental Assessment (SEA) for recent new planning applications to address cumulative impacts of various new developments; and
- Introduce a long-term commitment to a programme of air quality monitoring that should include use of CEN reference or equivalent measurement methods, supported by other indicative methods (e.g. NO_2 diffusion tubes) where appropriate.

1.4 Summary of Air Quality Issues in Jersey

Emissions from road transport and industry are identified as the main sources that have the potential to impact on Jersey's air quality, with the former being the primary source of pollution on the Island. Air quality has subsequently been identified as a performance indicator in the Strategic Plan for Jersey 2006 – 2011. The current legislative framework in place on Jersey is limited with regards to dealing adequately with air quality issues on the Island which at present can only be addressed through the Statutory Nuisances (Jersey) Law 1999 and conditions for operation and licensing of facilities under the Waste Management (Jersey) Law 2005; however the States have made a clear commitment to achieve EU environmental limit values and standards in order to comply with EU legislation on air quality[9]. A programme of air quality monitoring has been undertaken on Jersey since 1997, but the majority of monitoring procedures currently in place do not use approved measurement techniques that allow direct comparison with EU limit values. With a number of high profile developments underway in the Waterfront area of St. Helier, road transport emissions including NO_2 and PM_{10} are of particular concern in relation to the cumulative impacts of development on air quality in St. Helier.

1.5 Aims and Objectives of the Report

This air quality report has been developed to assist the States of Jersey address many of the issues pertaining to air quality raised in the Strategic Plan 2006-2011 and the Environmental Scrutiny Panel's Air Quality Review 2008. The following relevant topics are addressed:

- A brief overview of statistics for Jersey.

- An overview of the current air quality legislative framework relating to air quality on Jersey

[9] An Air Quality Strategy for Jersey 2003: a report produced for the States of Jersey

- A summary of air quality monitoring undertaken on Jersey
- A review of air quality legislation (UK and International) and International air quality Agreements
- Comment on the “way forward” in developing the States air quality Legislative Framework
- Identification of key pollutants and relevant sources including recommendations for identifying and implementing measures to improve air quality through the development of an EU compliant monitoring strategy.
- Assessment of the cumulative impacts of new development in St. Helier
- Conclusions and final recommendations.

2 Statistics for Jersey

Jersey is the largest of the Channel Islands with an area of 118.2 km^2, and is divided into 12 Parishes, ranging in size from St. Clement (4.2 km^2) to St. Ouen (15.0 km^2). The island is situated 14 miles off the north-west coast of France and 85 miles from the English coast. A quarter of the Island's land mass consists of the "built environment", over half is cultivated and one sixth comprises natural vegetation.

Jersey is not part of the UK or a Member State of the EU, and holds the status of a UK Crown Dependency. As such the Island is not represented in the UK parliament, whose, Acts only extend to Jersey if expressly agreed by the Island. The legislature of the island is called the "States of Jersey", and the system of government comprises a Council of Ministers and several Scrutiny Panels as outlined in Section 1.

The island has a resident population of approximately 87,186 (2001, Census[10]), and has a vibrant tourism industry with the total number of staying leisure visitors between 2006 and 2007 estimated at approximately 375,900 and leisure day-trippers at around 94,100.

At first glance due to the lack of industry and perception by non-islanders that it is possible to walk or cycle everywhere, it would appear that Jersey does not have any air quality problems; however in reality Jersey has a culture of car dependency. In addition there is currently no equivalent Ministry of Transport test (MOT) for vehicles on the island. Jersey's capital, St. Helier, unlike many other similar sized towns in the United Kingdom has limited pedestrianisation and vehicles dominate the town centre streets.

2.1 Transportation on Jersey

The number of vehicle records on the Driver and Vehicle Standards (DVS) register surpassed 100,000 for the first time in 2005 and stood at 111,861 as at 31 December 2008. The 2008 figure represents a net increase of almost 3,900 from the previous year. The increase is the difference between new registrations (11,786), scrapped (2,586) and exported (5,266) vehicles.

Consideration must be given to the fact that many vehicles may lie unused or have been disposed of without DVS being informed. These vehicle records remain on the register and as such these figures may overstate the actual number of vehicles circulating on the roads of Jersey. The 2001 Census recorded the total number of cars/vans owned by private households as 52,577; an average of 1.48 private cars/vans per household. More recently the Jersey Annual Social Survey reported an increase in car ownership in 2008, up from 1.54 cars/vans per private household in 2005 to 1.57.

Transport to Work on Jersey (Source: JASS, 2008[11])

Over half (55%) of people who travel to work drive themselves; around one in twenty (5%) have a lift in another person's vehicle, a similarly small proportion cycle to work (8%) or catch a bus (5%). Around a fifth of people (22%) walk to work.

Transport to School on Jersey (Source: JASS, 2008)

A quarter (27%) of households in Jersey have children who attend school or nursery placement; with the mode of transport used to get to school varying according to the age of the child. Four-fifths (81%) of pre-school children go to school in private cars, two-fifths (40%) as a specific journey to the school and over a third (35%) dropped off on a parent's way to work. About a sixth (18%) of pre-school children walk to nursery.

[10] Jersey in Figures, 2008 (States of Jersey)
[11] JASS, 2008 Statistics Unit (States of Jersey)

For older age groups including those in the categories of primary school, secondary school and sixth formers, the percentage of children who travel to school by car reduces whilst school bus use increases, up to a quarter (26%) of sixth-formers. The percentage of children who walk to school remains fairly consistent at around 20% for those aged 16 or under but drops to just one in eight (12%) sixth-formers.

2.2 Energy Use on Jersey

Jersey is heavily dependent on imported energy; in 2007 virtually all of Jersey's primary energy, including 89% of electricity, was imported. In 2007 total final energy consumption (FEC) in Jersey was 183,000 toe (2.13 million MWh), a decrease of 3% on 2006. Two-thirds (65%) of all energy used in Jersey is a petroleum based product (petrol and diesel accounting for a quarter of final energy demand). Electricity accounts for over a quarter (29%) of FEC, with gas 5% and coal 1%.

Petroleum-Based Products

In recent years Jersey has seen a reduction in the use of oils (fuel oils and gas oil) used to generate electricity following the construction of the enhanced Interconnector to import electricity from the Continent. The total consumption of road fuels has remained relatively constant over the past decade reflecting a near saturation in use and improved energy efficiency.

Electricity

Electricity demand in Jersey has grown steadily over the past 16 years, by an average of about 2% per year, and total consumption in 2007, at of around 621,000 MWh, was some 37% higher than in 1991. The most dramatic change within the electricity sector has been the growth in imports. Throughout most of the 1990's imports accounted for between 40% and 60% of public electricity supply; in 2007 imported electricity accounted for 89% of the total.

Almost half of all electricity consumed in 2007, (282,200 MWh) was used within private homes, including power for heat supplied to States housing, a similar total to 2006 (296,900 MWh). Government consumption in 2007 accounted for about 9% of the total, comprising 40,800 MWh from the Jersey Electricity Company and around 13,100 MWh at Bellozane.

Energy Related Carbon Emissions

Currently Jersey's carbon emissions under the Kyoto Protocol form part of the UK allowance and so there is no specific carbon reduction targets set for the Island. In a global context carbon emissions in Jersey are extremely low. The overall *provisional* energy related carbon emissions for Jersey have fallen by about a quarter (26%) between 1991 and 2007 (from 156,000 tonnes to 116,000 tonnes). The main cause of this reduction is the switch from on-Island electricity generation to importing electricity from the Continent (this does not include carbon emissions resulting from changes in land-use or aviation).

Excluding electricity generation, whilst there have been year-on-year fluctuations, overall there has been little change in carbon emissions over the past 16 years, the 2007 level being about 4% below the 1991 level. The largest sources of energy related emissions in Jersey are now road transport, domestic and commercial energy use, including marine transport. Road emissions have decreased very gradually over the past decade as a result of greater efficiencies in engines, the phasing out of older less efficient cars and the growth in diesel use (which is marginally less carbon intensive than petrol, (but does cause other emissions to air). However, there is no evidence of significant behavioural change.

2.3 Meteorological Factors and Air Quality in Jersey

Jersey's prevailing wind directions are south-westerly, westerly or north-westerly. It is accepted that the strength of prevailing winds play a key role in preventing conditions ideal for increased air pollution. As Jersey is an Island it should be less likely to suffer from chronic air pollution episodes than inland UK towns.

Many of the streets in St. Helier are canyon type streets which means that air pollution takes longer to disperse and is less affected by wind speed and direction than say an open site.

Existing Island plans and strategies, including the Strategic Plan 2006 – 2011 acknowledge that air quality is a matter of concern, particularly at certain pollution "hotspots" including specific locations within St. Helier as a result of traffic emissions.

The States of Jersey have committed to achieving standards that are as good as or in excess of those applying in the European Union. In addition, the States of Jersey have international obligations under the Climate Change Convention to reduce emissions of greenhouse gases.

3 Current Air Quality Legislation in Jersey

The current legislative framework in place in Jersey is very limited in its ability to adequately deal with air quality issues. At present the underlying reasons for poor air quality can only be addressed through the Statutory Nuisances (Jersey) Law 1999[12] and conditions attached to licenses issued for the operation of waste facilities under the Waste Management (Jersey) Law 2005[13] ("The Waste Law"). Under the Waste Law licensed waste facilities are required to operate under the terms of their license. In addition to conditions set out dealing with potentially polluting aspects of waste management operations it also addresses issues such as air, water, and ground pollution as well as the more obvious signs of waste operations such as build-up of litter near sites, mud on roads and odour. As a Crown Dependency Jersey is not represented in the UK parliament, whose legislation only extends to Jersey if expressly agreed by the Island. The States of Jersey are committed to reflecting best practice globally[14]; within Europe Member States have agreed to comply with EU Directives and Agreements that apply a number of fundamental principles, the Precautionary Principle and the Polluter Pays Principle in particular.

- **The Precautionary Principle[15]**. The Precautionary Principle is important as the main reason for controlling air pollution is the need to protect human health. It is well established truism that prevention is better than cure and as such the Precautionary Principle necessitates the need to ensure all controls, limits and standards have an element of protection build into them to allow for any potential error.

- **The Polluter Pays Principle[16].** The Polluter Pays Principle is fundamental to the European Union's environmental policy; put simply the cost of preventing pollution or of minimising environmental damage due to pollution should be borne by those responsible for the pollution.

In developing a framework for Jersey the States of Jersey will need to consider the EU Framework Directive on ambient air quality assessment and management (96/62/EC) for the protection of human health and the environment[17]. The European Air Quality Directives (96/62/EC)[18],

- Define and establish objectives for ambient air quality in the community in order to avoid, prevent or reduce harmful effects of air pollution on human health and the environment as a whole;

- Provide recommendations for the assessment of ambient air quality in Member States on the basis of common methods and criteria;

- Provide recommendations for obtaining adequate information on ambient air quality and public dissemination; and

- Require maintenance of adequate air quality where it is good and improvements to be made in other cases

Under the Directive (96/62/EC) standards are set for sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulates (PM_{10}) and lead (Pb). Populations less than 250,000 are required to monitor at one location that is representative of where the highest pollutant concentrations are likely to

[12] Statutory Nuisances (Jersey) Law 1999: Order of Her Majesty in Council (States of Jersey)
[13] Waste Management (Jersey) Law 2005
[14] Strategic Plan 2006 – 2011 (States of Jersey)
[15] European Commission, Communication from the Commission on the Precautionary Principle, Brusells (2000).
[16] Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (ELD) establishes a framework based on the "polluter pays" principle, according to which the polluter pays when environmental damage occurs.
[17] An Air Quality Strategy for Jersey (April 2003): a report produced for the States of Jersey
[18] Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management

occur. The States of Jersey are signatories to the international obligations under the Climate Change Convention to reduce emissions of greenhouse gases[19].

The States have agreed to achieve environmental standards that reflect best practice globally[20]. It is therefore necessary that a review of relevant European environmental legislation be undertaken to ensure that the States have the opportunity to comply with this commitment. Further assessment of international air quality agreements applicable to Jersey is addressed in Section 5 of this report.

[19] United Nations Framework Convention on Climate Change (UNFCCC), approved by Council Decision 94/69/EC to achieve the stabilisation of greenhouse gas concentrations in the atmosphere at a level which prevents dangerous anthropogenic interference with the climate system.

[20] The Strategic Plan 2006-2011 ***"debate and implement an Air Quality Strategy including proposals for monitoring and publishing levels of local air pollution, and targets, policies and timescales for reductions in air pollution levels that reflect best practice globally (P&E)"***

4. Summary of Air Quality Monitoring Work Undertaken in Jersey to Date

Since 1997 AEA have worked with the States of Jersey's Health Protection Service to deliver a programme of air quality monitoring on Jersey (See Appendix 4). To date, there have been twelve annual monitoring reports providing a long-term screening dataset of pollutant concentrations. In early 2008, an automatic monitoring station was installed in the Central Market, Halkett Place, St. Helier. The automatic monitor is used to monitor nitrogen dioxide (NO_2) throughout the year. Data from automatic monitoring is supplemented by non-automatic monitoring of NO_2 and a suite of four hydrocarbon pollutants [BTEX] (benzene, toluene, ethylbenzene and xylenes). In addition Health Protection Services currently screen for particulates (PM_{10}) at two locations on the Island, Havre Des Pas and Halkett Place, St. Helier. Figure 4.1a and 4.1b, shows monitoring site locations on Jersey.

The chemiluminescence NO_2 analyser sited in Halkett Place, St. Helier is the only monitoring equipment type approved by the EU to measure against EU limit. The diffusion tube network measuring NO_2 and Hydrocarbons has limitations in that data derived using this method can only be used as an indicative screening tool and cannot be used for direct comparison with EU health based air quality limit values. Similarly, current monitoring using OSIRIS type particulate monitors can only serve as a screening method and data derived cannot be directly compared to EU health based limit values for particulates. Table 4.1 provides a summary of monitoring sites for NO_2, hydrocarbons and particulates with the most recent data compiled over 2008. Table 4.2 below provides a summary of current UK and International limit values, objectives and guidelines for the aforementioned pollutants.

With recent proposals for a number of high profile developments set to commence in the St. Helier area, and concerns over the cumulative impacts of these on local air quality, Health Protection Services have adopted a policy of requesting monitoring to be undertaken at development sites. The following section provides a summary of recent monitoring undertaken on Jersey and current trends in air pollutant concentrations.

Figure 4.1a Site Locations Outside St Helier

Figure 4.1b Sites in St. Helier town

Key:

1	Le Bas Centre	NO_2, BTEX
2	Mont Felard	NO_2
3	Les Quennevais	NO_2
4	Rue Des Raisies	NO_2
5	First Tower	NO_2
6	Weighbridge	NO_2
7	Langley Park	NO_2
8	Georgetown	NO_2
9	Clos St Andre	NO_2, BTEX
10	Union Street	NO_2
11	New Street	NO_2
12	Beaumont	NO_2
13	The Parade	NO_2
14	Maufant	NO_2
15	Jane Sandeman	NO_2
16	Saville Street	NO_2
17	Broad Street	NO_2
18	Beresford Street	NO_2, BTEX
19	La Pouquelaye	NO_2
20	Havre Des Pas	NO_2
21	Commercial Buildings	NO_2
22	Springfield Garage	BTEX
23	Airport	BTEX
24	Handsford Lane	BTEX
25	Halkett Place	NO_2, Auto
26	Seaton Place	NO_2
27	Liberation Station	NO_2

Table 4.1: Summary of Monitoring of NO_2 and Hydrocarbons on Jersey, 2008 (No. of days Exceedences between 2002 and 2007 for Particulates (PM_{10}))[21]						Bias adjusted mean μgm^{-3}	Average Concentrations (BTEX) μgm^{-3}					No. of Exceedences (days) 2002 - 2007
Site	Location	Status	Method	Description	Pollutants	NO_2	Benzene	Toluene	Ethyl Benzene	m+p Xylene	o Xylene	Particulates (PM_{10})
Weighbridge	St H	Cur	DT	R	NO_2	38						
The Parade	St H	Cur	DT	R	NO_2	25	-	-	-	-	-	-
Broad Street	St H	Cur	DT	UB	NO_2	33	-	-	-	-	-	-
Union Street	St H	Cur	DT	K	NO_2	28	-	-	-	-	-	-
New Street	St H	Cur	DT	K	NO_2	24	-	-	-	-	-	-
Halkett Place 1	St H	Cur	DT	R	NO_2	31	-	-	-	-	-	-
Halkett Place 2	St H	Cur	DT	R	NO_2	32	-	-	-	-	-	-
Halkett Place 3	St H	Cur	DT	R	NO_2	31	-	-	-	-	-	-
Halkett Place (Triplicate Tubes)	St H	Cur	Triplicates	R	NO_2	32	-	-	-	-	-	-
Halkett Place Automatic Analyser	St H	Cur	AA & OSIRIS	R	NO_2, Particulates	32	-	-	-	-	-	2004 (8) 2005 (7) 2006 (3)
Springfield Garage	St H	Cur	DT	Petrol Station	Hydrocarbons	-	4.2	21.7	3.5	11.4	4.4	-
Beresford Street	St H	Cur	DT	UB	Hydrocarbons	Disc Feb-08	1.6	6.1	1.4	4.3	1.6	-
La Pouquelaye	St H	Disc	DT	K	NO_2	Disc Feb-08	-	-	-	-	-	-
Jane Sandeman	St H	Disc	DT	UB	NO_2	Disc Feb-08	-	-	-	-	-	-
Saville Street	St H	Disc	DT	UB	NO_2	Disc Feb-08	-	-	-	-	-	-
Georgetown	(O) St H	Cur	DT	K	NO_2	32	-	-	-	-	-	-
Beaumont	(O) St H	Cur	DT	K	NO_2	37	-	-	-	-	-	-
Havre Des Pas	(O) St H	Cur	DT	K	Particulates	Disc Feb-08	-	-	-	-	-	2006 (4) 2007 (44)
Liberation Station	St H	Cur	DT	K	NO_2	32	-	-	-	-	-	-
Le Bas Centre	(O) St H	Cur	DT	UB	NO_2 , Hydrocarbons	22	1.4	5.6	1.4	4.3	1.6	-
Clos St. Andre	(O) St H	Disc	DT	ResB	Hydrocarbons	Disc Feb-08	0.8	2.1	1.0	1.5	0.5	-
Les Quennevais	(O) St H	Cur	DT	ResB	NO_2	10	-	-	-	-	-	-
Rue Des Raisies	(O) St H	Cur	DT	RB	NO_2	6	-	-	-	-	-	-
Airport	(O) St H	Cur	DT	-	Hydrocarbons	-	0.6	1.7	0.3	0.8	0.3	-
Handsford Lane	(O) St H	Cur	DT	-	Hydrocarbons	-	1.0	4.0	2.2	7.6	2.2	-
Seaton Place	St H	Disc	DT	K	NO_2	Disc Feb-08	-	-	-	-	-	-
Mont Felard	(O) St H	Disc	DT	ResB	NO_2	Disc Feb-08	-	-	-	-	-	-

[21] St. H – Monitoring sites located in St. Helier town, (O) St H - Monitoring sites located outside St. Helier town, Disc – Discontinued monitoring sites as of February 2008, Cur – Monitoring sites currently in operation, DT – Diffusion tubes, Triplicate – Triplicate diffusion tubes, AA – Automatic Analyser, OSIRIS – OSIRIS particulates monitor, K – Kerbside site, R – Roadside site, UB – Urban background site, ResB – Residential background site, RB – Rural background site

Table 4.1 contd: Summary of Monitoring of NO_2 and Hydrocarbons on Jersey, 2008 (No. of days Exceedences between 2002 and 2007 for Particulates (PM_{10})[22]						Bias adjusted mean μgm^{-3}	Average Concentrations (BTEX) μgm^{-3}					No. of Exceedences (days) 2002 - 2007
Site	Location	Status	Method	Description	Pollutants	NO_2	Benzene	Toluene	Ethyl Benzene	m+p Xylene	o Xylene	Particulates (PM_{10})
First Tower	(O) St H	Disc	DT	K	NO_2	Disc Feb-08	-	-	-	-	-	-
Langley Park	(O) St H	Disc	DT	ResB	NO_2	Disc Feb-08	-	-	-	-	-	-
Maufant	(O) St H	Disc	DT	RB	NO_2	Disc Feb-08	-	-	-	-	-	-
Commercial Buildings	(O) St H	Disc	DT	K	NO_2	Disc Feb-08	-	-	-	-	-	-

[22] St. H – Monitoring sites located in St. Helier town, (O) St H - Monitoring sites located outside St. Helier town, Disc – Discontinued monitoring sites as of February 2008, Cur – Monitoring sites currently in operation, DT – Diffusion tubes, Triplicate – Triplicate diffusion tubes, AA – Automatic Analyser, OSIRIS – OSIRIS particulates monitor, K – Kerbside site, R – Roadside site, UB – Urban background site, ResB – Residential background site, RB – Rural background site

Table 4.2: UK and International Air Quality Limit Values, Objectives and Guidelines			
Nitrogen Dioxide (NO_2)			
Guideline	**Description**	**Criteria Based On**	**Value[(1)] / μgm^{-3} (ppb)**
The Air Quality Strategy	Objective for Dec. 31st 2005, for protection of human health	1-hour mean	200 (105) Not to be exceeded more than 18 times per calendar year
Set in regulations for the whole UK	Objective for Dec. 31st 2005, for protection of human health	Annual mean	40 (21)
Not intended to be set in regulations	Objective for Dec. 31st 2000, for protection of vegetation	Annual mean NOx (NOx as NO_2)	30 (16)
EC 1985 NO_2 Directive Limit remains in force until fully repealed 01-01-2010	Limit Value	Calendar year of data: 98th percentile of hourly means	200 (105)
ED Directive on Ambient Air Quality and Cleaner Air for Europe	Limit Value for protection of human health to be achieved by Jan. 1st 2010	1-hour mean	200 (105) Not to be exceeded more than 18 times per calendar year
	Limit Value for protection of human health to be achieved by Jan. 1st 2010	Calendar year mean	40 (21)
	Limit Value (total NOx) for protection of vegetation to be achieved by July. 19th 2001	Calendar year mean	30 (16)
WHO (Non-Mandatory Guidelines)	Health Guideline	1-hour mean	200
	Health Guideline	Annual mean	40

Benzene			
The Air Quality Strategy Whole UK	Objective for Dec. 31st 2003	Running annual mean	16.25 (5)
England & Wales only	Objective for Dec. 31st 2010	Annual mean	5 (1.54)
Scotland & Northern Ireland	Objective for Dec. 31st 2010	Running annual mean	3.25 (1.0)
ED Directive on Ambient Air Quality and Cleaner Air for Europe	Limit Value. To be achieved by Jan 1st 2010	Annual calendar year mean	5 (1.5)

Particulates (PM_{10}) (gravimetric)			
The Air Quality Strategy	Objective for Dec 31st 2004	24 hour running mean	50 μgm^{-3}, not to be exceeded more than 35 times a year
All UK Authorities		Annual mean	40 μgm^{-3}
Scotland only	Objective for Dec 31st 2010	24 hour running mean	50 μgm^{-3}, not to be exceeded more than 7 times a year
		Annual mean	18 μgm^{-3}
Particulates ($PM_{2.5}$) (gravimetric) *			
	Objective for 2020	Annual mean	25 μgm^{-3} (target)
	Objective 2010 - 2020	Annual mean	15% cut in urban background exposure
EU Limit Values for PM_{10} (gravimetric) and Target Dates for Achievement			
Averaging period		Limit value μgm^{-3}	Maximum number of exceedences allowed
Daily	Objective for Jan 1st 2005	50	35
Annual	Objective for Jan 1st 2005	40	-

4.1 Summary of Current Trends in Concentrations of Pollutants Monitored in Jersey

Nitrogen Dioxide (NO_2) Diffusion Tubes

The most recent monitoring report published by AEA for Health Protection is the Air Quality Monitoring in Jersey (2008)[23] report, results for NO_2 diffusion tube sites in 2008 indicate that annual mean concentrations at all 12 monitoring sites were within the EC Directive limit value, and were generally comparable with the previous year's results.

The annual mean NO_2 concentrations (after application of a bias adjustment factor) ranged from 6 μg m^{-3} (at the rural Rue des Raisies site) to 38 μg m^{-3} at the Weighbridge site, the latter being a location in the centre of St. Helier which is used as a central bus station, and has produced the highest annual mean concentration over several previous reports. Recent monitoring undertaken in 2008 indicates that some "hotspots" e.g. Weighbridge and Beaumont (Table 4.1), although currently under the 40 μg m^{-3} limit value for the protection of human health (Table 4.2) are still close to EU limit values for annual average NO_2.

Data from long-running diffusion tube sites (Air Quality Monitoring in Jersey, 2008) confirm that levels of NO_2 at urban roadside and kerbside sites have continued to decrease since 1997. NO_2 concentrations at residential and rural background sites do not appear to show any particular trend up or down, but are generally lower than EU limit values.

Nitrogen Dioxide (NO_2) Chemiluminescence Analyser (Automatic Monitoring)

Monitoring results from the automatic monitoring site at Halkett Place, which has been in operation since January 2008 indicate that at this location the EC Directive Limit Value (and UK, Air Quality Strategy Objective) for both the 1-hour mean NO_2 concentration and the annual mean NO_2 concentration were met in 2008, and continue to be achieved during 2009 (Figure 4.2 & Table 4.2). Figure 4.3 shows a comparison between the monthly mean NO_2 concentrations measured by diffusion tubes and the automatic analyser at Halkett Place during 2008.

[23] Air Quality Monitoring in Jersey 2008: A report to Public Health Services, States of Jersey

Figure 4.2 Automatic Monitoring of NO_2 at Halkett Place, Jersey between 1st January 2009 to 7th July 2009

POLLUTANT	NO_2	NO_X
Number Very High	0	-
Number High	0	-
Number Moderate	0	-
Number Low	4470	-
Maximum 15-minute mean	437 µg m^{-3}	1171 µg m^{-3}
Maximum hourly mean	183 µg m^{-3}	579 µg m^{-3}
Maximum running 8-hour mean	82 µg m^{-3}	265 µg m^{-3}
Maximum running 24-hour mean	57 µg m^{-3}	145 µg m^{-3}
Maximum daily mean	56 µg m^{-3}	140 µg m^{-3}
Average	33 µg m^{-3}	67 µg m^{-3}
Data capture	99.1 %	99.1 %

Pollutant	Air Quality (England) Regulations 2000 and (Amendment) Regulations 2002	Exceedences	Days
Nitrogen Dioxide	Annual mean > 40 µg m^{-3}	-	-
Nitrogen Dioxide	Hourly mean > 200 µg m^{-3}	0	0
Nitrogen Oxides (NO_2)	Annual mean > 30 µg m^{-3}	-	-

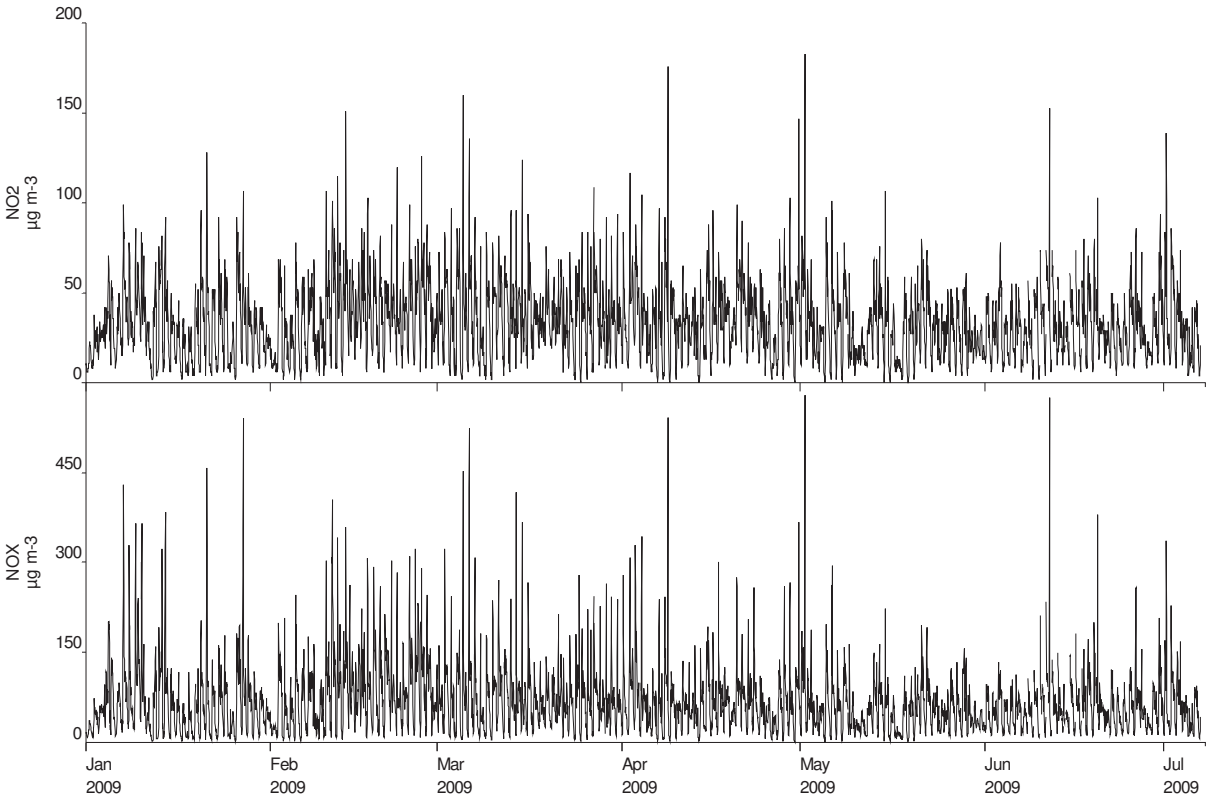
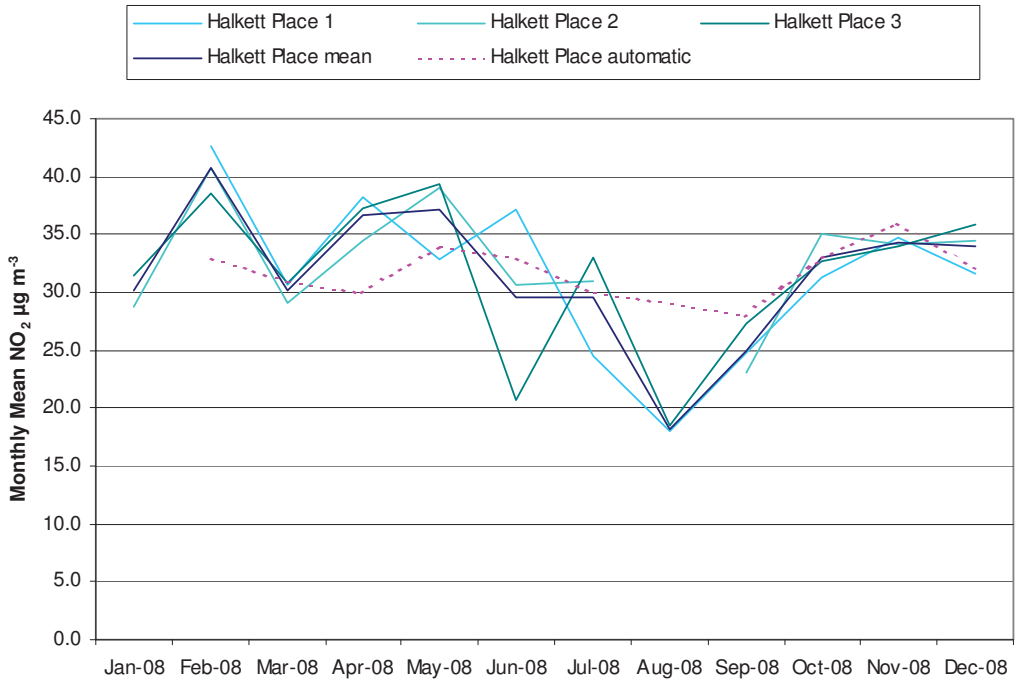


Figure 4.3 Monthly Mean NO_2 Concentrations (Diffusion Tubes and Automatic Analyser) at Halkett Place 2008



The bias adjustment factor was calculated as 0.98

Hydrocarbons (BTEX)

Of the hydrocarbon species currently monitored on Jersey, only benzene is the subject of any applicable air quality standard. The EC Directive on Ambient Air Quality and Cleaner Air for Europe sets a limit of 5 μg m^{-3} as an annual mean to be achieved by 2010. All monitoring sites on Jersey met this limit during 2008 (Tables 4.1 and 4.2).

The UK Air Quality Strategy sets the following objectives for benzene:

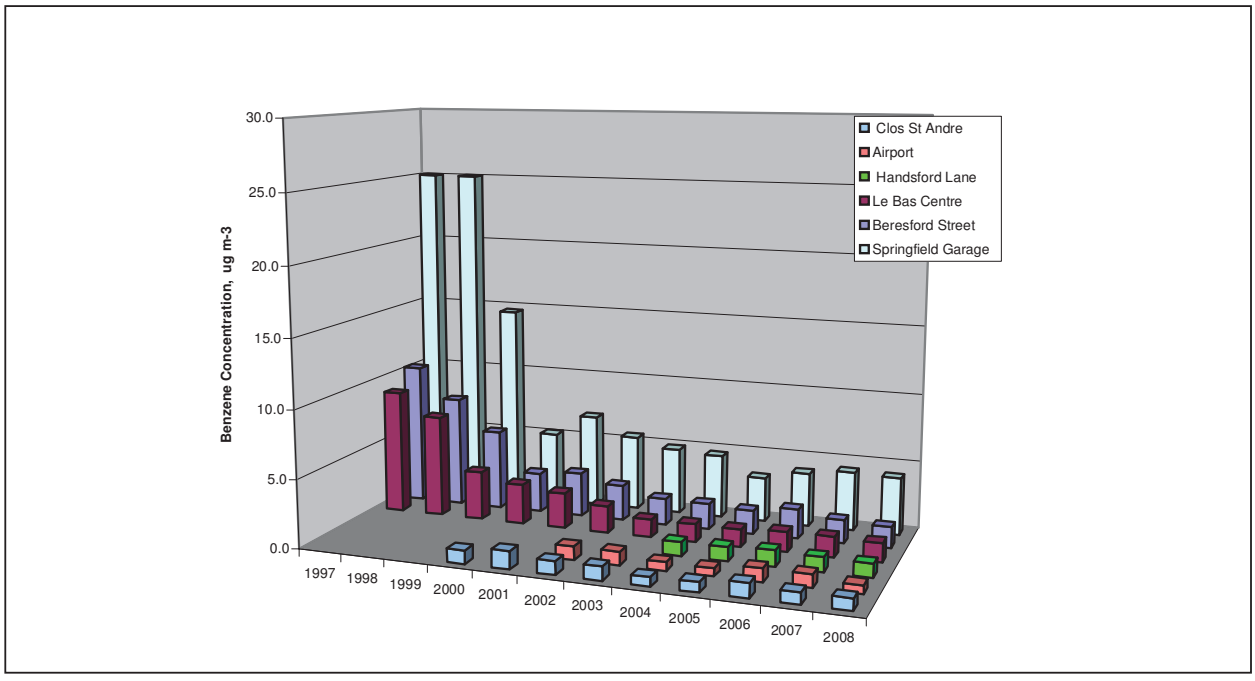
- A maximum of 16.25 μg m^{-3} (for the running annual mean), to have been achieved by 31st December 2003
- A maximum 3.25 μg m^{-3} (for the calendar year mean), to be achieved by 31st December 2010.

The annual mean benzene concentration (which can be considered a good indicator of the running annual mean) did not exceed the 2003 Objective of 16.25 μg m^{-3} at any of the Jersey sites. However, one site (Springfield Garage) had an annual mean of 4.2 μg m^{-3}: this is greater than the 2010 objective of 3.25 μg m^{-3} and as such the Springfield Garage site breaches the target Objective set under the UK Air Quality Strategy. Figure 4.4 shows trends in benzene concentrations monitored on Jersey between 1997 and 2008.

Long term trends associated with hydrocarbon species monitored on Jersey indicate that most species appear to have decreased over the ten years of monitoring and are now lower than the late 1990's. Key observations for long-term trends in hydrocarbons are:

- Benzene showed a marked drop in 2000, especially at Springfield Garage: this is due to the maximum permitted benzene content of petrol sold in the UK being reduced from 2% in unleaded (5% in super unleaded), to 1% as at 1st January 2000. Concentrations have remained stable (with small fluctuations) since 2004.
- Toluene concentrations show a downward trend over the earlier years of the survey (1997-2004) but little consistent change thereafter.
- Ethylbenzene concentrations have generally decreased, despite an unexplained increase in 2004.
- Concentrations of m+p xylene, and of o-xylene, are now generally lower than in the early years of the survey.

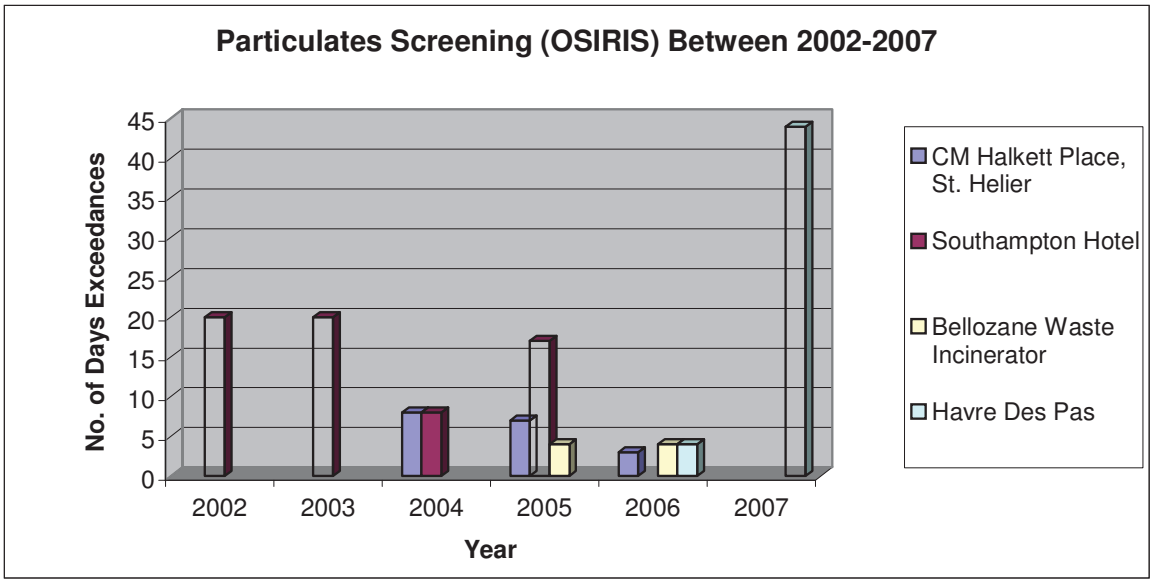
Figure 4.4 Trends in Benzene Concentrations between 1997 and 2008



Particles (PM_{10})

Health Protection Services monitor for particulates (PM_{10}) at two locations on the Island; Central Market, Halkett Place, St. Helier since 2004 and Havre Des Pas since 2006. Previously monitoring was undertaken at the Southampton Hotel, St. Helier between 2002 and 2005 and Bellozane waste incinerator between 2005 and 2006. The OSIRIS particulate monitors with PM_{10} (particulate matter with a diameter of less than 10 μm^3) filtering heads can only be used as an indicative screening tool and are not type approved for direct comparison with EU limit values.

Figure 4.5 Trends in Particulates (PM_{10}) Screening 2002-2007



Screening of particulates at Central Market, Halkett Place St. Helier has shown a steady decrease in the number of daily exceedences from 8 daily exceedences in 2004 to 3 in 2006. Monitoring undertaken at Havre Des Pas has shown a significant rise in daily exceedences from 4 in 2006 to 44 in 2007. The number of daily exceedences recorded at the Southampton Hotel site showed variation with 20 exceedences in 2002 and 2003, then a decrease in 2004 with 8 exceedences followed by an increase in exceedences to 17 in 2005. Daily exceedences at the Bellozane waste incinerator remained constant at 4 between 2005 and 2006, (Figure 4.5). Particulates, like nitrogen dioxide are potentially an urban pollution problem on Jersey and, as is the case with NO_2, it is important to undertake monitoring using EU compliant methods before the required scale of emissions reductions can be accurately calculated. It is likely that recent increases in the number of exceedences at monitoring locations on Jersey are attributable to factors such as road works, causing reduced traffic flows, increased congestion and the re-suspension of particles associated with vehicles moving through street canyons.

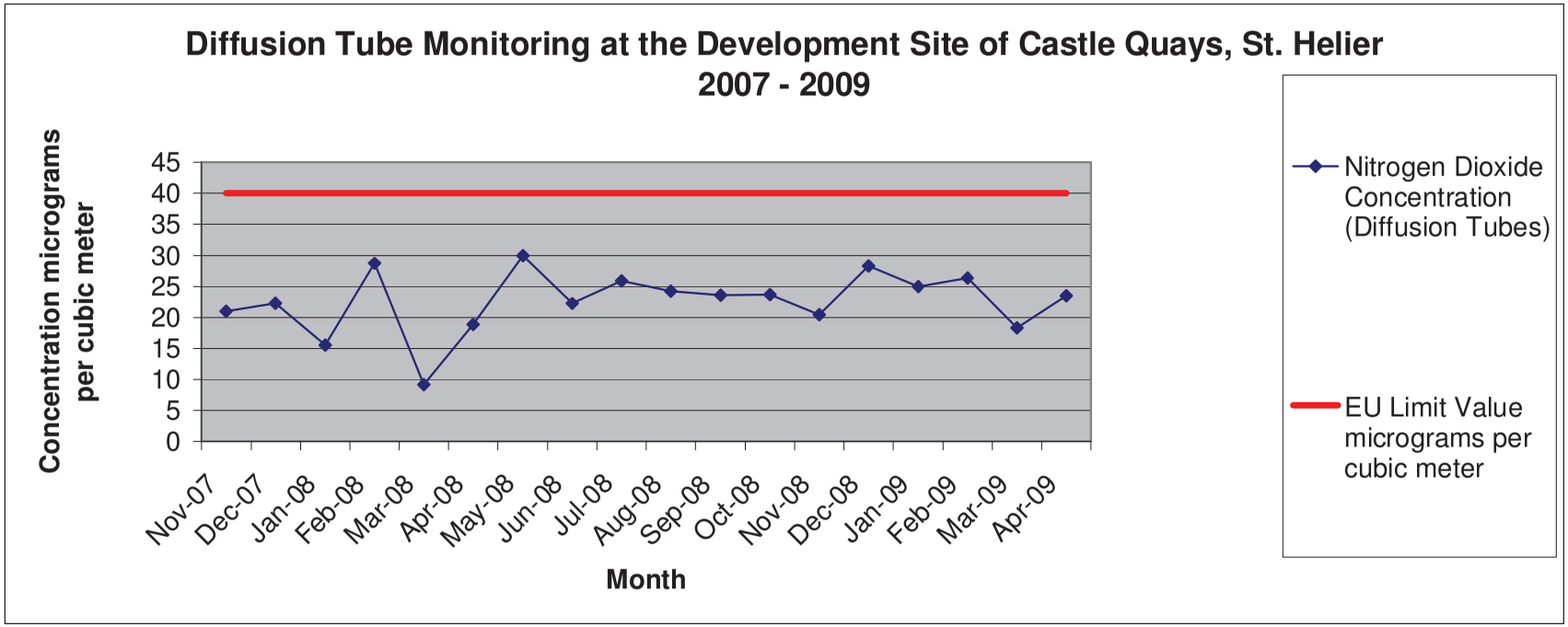
In 2008 analysis of particulate matter for the Harve de Pas monitoring site was undertaken using scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDX) (an analytical method used for elemental analysis and chemical characterization of samples). The objective of the analysis was to attempt to identify potential sources of the particulates e.g. vehicles, oil fired power station and coastal impacts.

Results of the analysis (full report Appendix 3) indicated that particles were predominantly debris from salt spray, sodium chloride (NaCl), with a small quantity of silicates. Other significant elements included copper (Cu), sulphur (S) and iron (Fe).

Monitoring at New Development Sites (St. Helier and La Collette)

A number of high profile developments have recently commenced in St. Helier that could potentially impact on local air quality. The current policy of Health Protection Services is to request diffusion tube data from applicants seeking planning permission. NO_2 diffusion tube monitoring has been carried out at Castle Quays, which lies to the south of Rue de L'Etau, and North West of Rue de Cateret at the Waterfront site, St. Helier and Ann Court where it is proposed to construct a car park to replace existing residential units. Additional monitoring for NO_2 and PM_{10} has also been undertaken at La Collette between 1 January 2009 to 7 July 2009. A summary of monitoring at these locations is shown in Figures 4.6, 4.7 and 4.8 below.

Figure 4.6 Diffusion Tube Monitoring at the Development Site of Castle Quays, St. Helier 2007 – 2009 (results not bias adjusted)



Mean concentration November 2007 to April 2009, 22.6 μgm^{-3} (results not bias adjusted)

Figure 4.7 Diffusion Tube Monitoring at the Development Site of Ann Court, St. Helier 2008 – 2009 (results not bias adjusted)

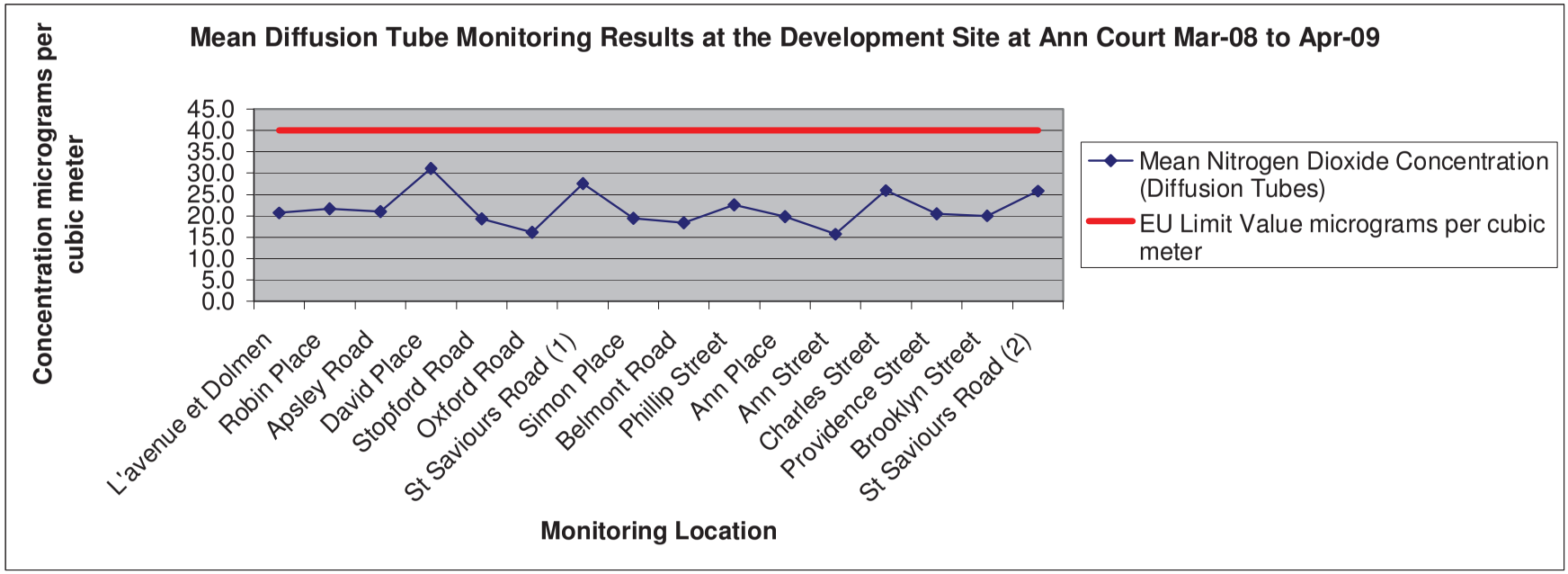
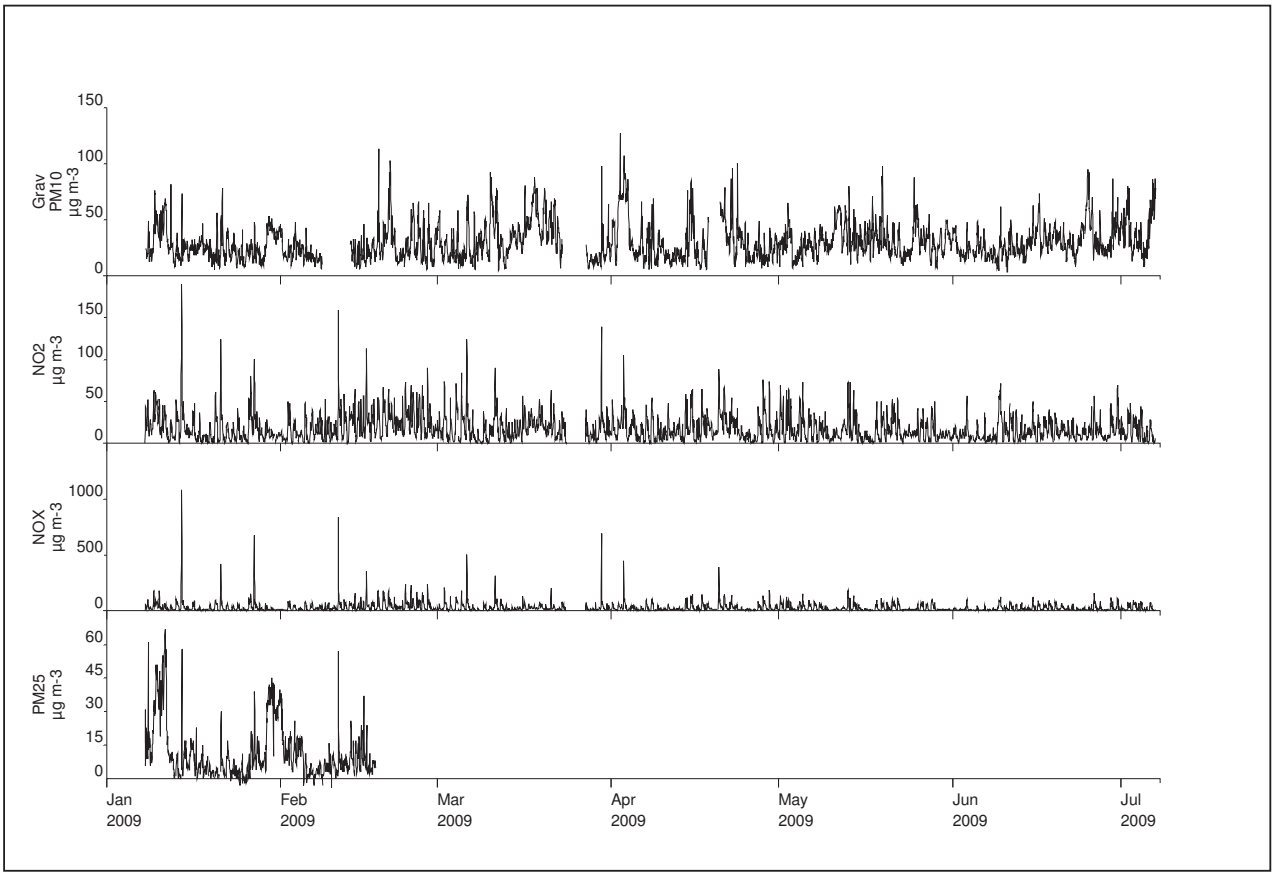


Figure 4.8 Particulates Monitoring Undertaken at the Location of La Collette between 1st January 2009 to 7th July 2009

POLLUTANT	PM_{10}*+	NO_2	NO_X	PM_{25}~
Number Very High	0	0	-	-
Number High	0	0	-	-
Number Moderate	82	0	-	-
Number Low	3912	4230	-	-
Maximum 15-minute mean	127 µg m^{-3}	202 µg m^{-3}	1144 µg m^{-3}	67 µg m^{-3}
Maximum hourly mean	127 µg m^{-3}	189 µg m^{-3}	1085 µg m^{-3}	67 µg m^{-3}
Maximum running 8-hour mean	91 µg m^{-3}	87 µg m^{-3}	341 µg m^{-3}	60 µg m^{-3}
Maximum running 24-hour mean	80 µg m^{-3}	44 µg m^{-3}	137 µg m^{-3}	48 µg m^{-3}
Maximum daily mean	78 µg m^{-3}	44 µg m^{-3}	135 µg m^{-3}	39 µg m^{-3}
Average	30 µg m^{-3}	17 µg m^{-3}	31 µg m^{-3}	12 µg m^{-3}
Data capture	89.6 %	93.8 %	93.8 %	21.3 %

* PM_{10} Indicative Gravimetric Equivalent µg m-3
+ PM_{10} instruments:
BAM using a gravimetric factor of 0.83333 for Indicative Gravimetric Equivalent from 19 December 2008 to 7 July 2009
~ PM_{25} instruments:
Non-Gravimetric BAM with a heated inlet from 19 December 2008 to 7 July 2009
All mass units are at 20'C and 1013mb
NO_X mass units are NO_X as NO_2 µg m-3

Pollutant	Air Quality (England) Regulations 2000 and (Amendment) Regulations 2002	Exceedences	Days
PM_{10} Particulate Matter (Gravimetric)	Daily mean > 50 µg m^{-3}	11	11
PM_{10} Particulate Matter (Gravimetric)	Annual mean > 40 µg m^{-3}	-	-
Nitrogen Dioxide	Annual mean > 40 µg m^{-3}	-	-
Nitrogen Dioxide	Hourly mean > 200 µg m^{-3}	0	0
Nitrogen Oxides (NO_2)	Annual mean > 30 µg m^{-3}	-	-



For the monitoring undertaken using NO_2 diffusion tubes at Castle Quays and Ann Court, results indicate that there were no exceedences over the relevant periods of the 40 μg m^{-3} objective level set for NO_2 (Figures 4.6 and 4.7). Similarly at La Collette concentrations of NO_2 over the monitoring period 1st January to 7th July 2009 were well below the objective level of 40μg m^{-3}. However 11 exceedences were recorded for particulates (PM_{10}) over the same period (Figure 4.8).

A primary concern regarding new development in St. Helier is the cumulative impact of development on the local road infrastructure and subsequently local air quality; in particular NO_2 and PM_{10}. An assessment of the cumulative impacts of new development on Jersey is addressed in Section 8 of this report.

Clearly there are a number of limitations with the current monitoring programme in Jersey, most notably that it does not allow for definitive comparison with EU limit values; common practice adopted by the UK and other Member States. In addition there is currently limited legislation in place to deal with air pollution on Jersey outside the Statutory Nuisances (Jersey) Law 1999 and licence conditions under the Waste Management (Jersey) Law 2005, which makes effective implementation of any Air Quality Strategy unlikely.

The following Sections address:

- Current EU and UK legislative frameworks and international agreements and how applicable they may be to Jersey.
- Recommendations for development of an air quality legislative framework for Jersey
- Recommendations on policies, targets and timescales applicable to Jersey
- Recommendations on the development of a local air quality management regime specific to Jersey.
- Recommendations on an EU compliant monitoring strategy for Jersey

5 Review of International Air Quality Legislation and Agreements

The Environmental Scrutiny Panel's Air Quality Review 2008 recommended that the States of Jersey:

"Consider international agreements when the Air Quality Strategy is being developed including the introduction of enabling legislation that will subsequently allow Orders to be made as and when necessary".

The following section provides an overview of European Union (EU) and UK air quality legislation and provides an assessment of how applicable this legislation and other international agreements could be to the States of Jersey when developing and implementing an Air Quality Strategy for Jersey..

5.1 The World Health Organisation (WHO)

The World Health Organisation (WHO) published its Air Quality Guidelines for Europe in 1987[24]. This subsequently led to the EU and Member States working on a programme of measures designed to protect the public and environment from the affects of poor air quality. European strategy and policy largely underpin policies and strategies for delivering environmental protection in the UK and other Member States; this is equally true for air quality improvements. European standards for vehicle emissions and fuels, for example, are significant in assisting the UK to achieve the objectives for traffic-derived pollutants in the National Air Quality Strategy.

5.2 The European Union (EU) Legislative Framework

The EU established the Clean Air for Europe (CAFÉ) programme in 2001[25]. In 2005 it published a Thematic Strategy for Air Pollution setting out in broad terms the approach to be adopted to improve air quality across the EU. The approach includes:

- The adoption of air quality limit values and targets for key pollutants and dates by which they are to be met;
- The requirement to monitor and assess against these limit values and targets; and
- The requirement to develop plans and programmes to improve air quality where the limit values and targets are unlikely to be met by the requisite date.

A number of other measures have been adopted by the European Commission to help ensure that the limit values and targets are met throughout the EU. These include:

- The setting of national ceilings for emissions of a number of pollutants – the Member State is free to choose what controls to implement to meet these ceilings;
- The implementation of Integrated Pollution Prevention and Control to regulate emissions from major industrial sources; and
- The setting of emissions standards for new vehicles.

Council Directive 96/62/EC on ambient air quality assessment and management is commonly referred to as the ***Air Quality Framework Directive***. It describes the basic principles how air quality should be assessed and managed in the Member States. It lists the pollutants for which air quality standards and objectives will be developed and specified in legislation. The main aim of

[24] Air Quality Guidelines for Europe (1987) WHO Regional Publications, European Series, No 91
[25] The Clean Air for Europe (CAFE) Programme: Towards a Thematic Strategy for Air Quality

the Directive is to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants. The Directive identifies twelve pollutants for which limit or target values will be set in subsequent daughter directives. Pollutants of concern include sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter, lead, carbon monoxide (CO), benzene, ozone, polyaromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni), and mercury (Hg).

Council Directive 1999/30/EC set limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. The directive is the so-called ***First Daughter Directive***. The directive describes the numerical limits and thresholds required to assess and manage air quality for the pollutants mentioned. It addresses both PM_{10} and $PM_{2.5}$ but only established monitoring requirements for fine particles. The Directive set limit values with the aim of protecting human health and the environment as a whole.

European Parliament and Council Directive 2000/69/EC set limit values for benzene and carbon monoxide in ambient air. This is the ***Second Daughter Directive*** and established the numerical criteria relating to the assessment and management of benzene and carbon monoxide in air.

European Parliament and Council Directive 2002/3/EC related to ozone in ambient air. This is the ***Third Daughter Directive*** and established target values and long-term objectives for the concentration of ozone in air. Ozone is a secondary pollutant formed in the atmosphere by the chemical reaction of hydrocarbons and nitrogen oxides in the presence of sunlight. The directive also describes certain monitoring requirements relating to the precursors needed to create ozone, namely, volatile organic compounds and nitrogen oxides.

Council Directive 2004/107/EC related to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons (PAHs) in ambient air. This is the ***Fourth Daughter Directive*** and completes the list of pollutants initially described in the Framework Directive. Target values for all pollutants except mercury are defined, though for PAHs the target is defined in terms of concentration of benzo(a)pyrene which is used as a marker substance for PAHs generally. Only monitoring requirements are specified for mercury.

Directive 2008/50/EC[26] **is** the Directive on ambient air quality and cleaner air for Europe adopted on the 14th April 2008. It essentially merges four directives (the EU Framework Directive and the first three daughter directives) and one Council decision into a single directive on air quality. The directive sets standards and target dates for reducing concentrations of fine particles, which together with coarser particles known as PM_{10} were already subject to legislation. Under the new Directive, Member States were required to reduce exposure to $PM_{2.5}$ in urban areas by an average of 20% by 2020 based on 2010 levels. It obliges them to bring exposure levels below 20 micrograms/m^3 by 2015. Throughout their territory Member States were bound to achieve the $PM_{2.5}$ limit value set at 25 micrograms/m^3. This value must be achieved by 2015 or, where possible, 2010.

This new directive introduces new objectives for fine particles ($PM_{2.5}$)but does not change existing air quality standards. It does however give Member States greater flexibility in meeting some of the standards in areas where they have difficulty complying. Meeting PM_{10} limit values is proving challenging for 25 of the 27 EU Member States, which are exceeding limits in at least one part of their territory, only Ireland and Luxemburg are fully compliant. The new directive on air quality is one of the key measures outlined in the 2005 Thematic Strategy on air pollution adopted by the Commission in September 2005 (IP/05/1170). It establishes ambitious, cost-effective targets for improving human health and environmental quality up to 2020.

Council Decision 97/101/EC established a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States. This "EoI Decision" describes the procedures for the dissemination of air quality monitoring information by the Member States to the Commission and to the public.

[26] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

Commission Decision 2004/461/EC laid down a questionnaire for annual reporting on ambient air quality assessment under Council Directives 96/62/EC and 1999/30/EC and under Directives 2000/69/EC and 2002/3/EC of the European Parliament and of the Council. This decision specifies the format and content of Member States' Annual Report on ambient air quality in their territories.

5.3 UK Legislative Framework

The Local Air Quality Management (LAQM) framework in the UK was enacted by the Environment Act 1995, Part IV. Section 80 of the Act required the Secretary of State to 'prepare and publish a statement containing policies with respect to the assessment and management of air quality as soon as possible'. This was published as the UK National Air Quality Strategy (NAQS), quickly followed by the Air Quality Regulations 1997 (amended, 2002 and 2007). Subsequent sections of the 1995 Act require local authorities to review air quality through a phased approach to determine likely exceedences of the limits and standards set out in the UK NAQS. Where predictions indicate potential exceedences of specific pollutant objectives, local authorities are required to designate Air Quality Management Areas' (AQMAs) and prepare air quality action plans to deliver improved air quality. The UK's Air Quality Strategy for England, Scotland, Wales and Northern Ireland[27], was recently updated in 2007. The Air Quality Strategy itself is supported by detailed technical and policy guidance documentation (LAQM. TG(09)[28] and LAQM. PG(09)[29]).

Air quality is also dealt with under separate primary legislation, most notably the Environmental Protection Act 1990, the Clean Air Act 1993, the Environment Act 1995 and the Pollution Prevention and Control Act 1999; all discussed in more detail below. Under the UK system, Defra (Department for Environment, Food and Rural Affairs) and each of the Devolved Administrations are responsible for air quality management at the regional level.

The Environmental Protection Act 1990

This Act set out the responsibilities and procedures for the control of major industrial sources of pollution. Her Majesty's Inspectorate of Pollution (subsequently brought within the Environment Agency) was responsible for implementing industrial controls under Part 1 of the Act, with local authorities implementing the controls for smaller industrial sources. Part 3 of the Act set out the framework for dealing with nuisance from authorised processes.

The Clean Air Act 1993

This Act sets out the responsibilities and measures for the control of smoke emissions for sources, including domestic sources, not covered by the Environmental Protection Act 1990.

The Environment Act 1995

This Act (Appendix 1) sets the framework for air quality assessment and management in the UK. There are three key elements to this, including:

- The implementation of EU requirements to monitor air quality and to limit emissions, in particular from industrial sources and motor vehicles;
- The setting of air quality objectives for key air pollutants. These take account of EU limit values and World Health Organisation Guidelines; and
- A system of Local Air Quality Management designed to supplement national measures in local hotspots.

[27] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DEFRA, UK)
[28] Technical Guidance LAQM TG (09) (DEFRA, UK)
[29] Policy Guidance LAQM PG (09) (DEFRA, UK)

The Pollution Prevention and Control Act 1999

This Act deals with emissions from industrial processes and will eventually supersede Part 1 of the Environmental Protection Act 1990. It introduces procedures requiring permits to be issued for the operation of these processes. In England and Wales it is being implemented by the Environment Agency, with local authorities being responsible for issuing permits for smaller industrial processes. The Act covers the requirements of the EU Directive on Integrated Pollution Prevention and Control.

5.4 Recommendations Regarding the Applicability of EU and UK Legislation to the States of Jersey

Table 5.1 below outlines legislation and agreements identified by the Environmental Scrutiny Panels Air Quality Review 2008 as requiring consideration by the States of Jersey. An assessment of the suitability of this legislation in terms of the development and implementation of an Air Quality Strategy for Jersey is attached.

Table 5.1. Legislation and Agreements Identified as Requiring Consideration by the States of Jersey in the Environmental Scrutiny Panels Air Quality Review 2008.

Legislation	Appropriate for Jersey?	Reasoning
Directive 96/62/EC – Air Quality Framework Directive; Directive 1999/30/EC – First Daughter Directive; Directive 2000/69/EC – Second Daughter Directive; Directive 2002/3/EC – Third Daughter Directive; Directive 2004/107/EC – Fourth Daughter Directive; Directive 2008/50/EC	Yes	**For:** • Use legislation as foundation upon which the Jersey Air Quality Strategy can be based as requested in SR8/2008; • Ensure that Jersey formally adopt relevant air quality standards; • Adopt air quality target levels derived from the EU pollutant target levels highlighted in Appendix 1; • Monitoring of air quality against these standards using appropriately quality assured methods; • Compare the results of monitoring studies in areas with potential air quality issues and prepare plans to improve air quality where standards are exceeded; **Against:** ▪ The comprehensive coverage provided by all the associated EU Directives may be seen as an excessive cost driver on Jersey.
The Environmental Protection Act 1990; The Clean Air Act 1993; The Environment Act 1995; The Pollution Prevention and Control Act 1999.	UK legislation which meets the requirements of relevant EU Directives	**For:** • Along with delivering compliance with EU legislation, using Part IV of the Environment Act as a starting point for any legislation specific to Jersey could fast track the process of delivering Jersey's Air Quality Strategy; • Taking forward the UK model as a starting point to regulate emissions from unregulated existing sources, including industrial plant and motor vehicles, completes the holistic approach to protecting air quality; • Through adopting the UK methodology all the detailed technical guidance and research available to UK authorities could be utilised. Documents such as UK Policy Guidance LAQM.PG(09) and Technical Guidance LAQM.TG(09) are particular examples

Legislation	Appropriate for Jersey?	Reasoning
		Against: ▪ This is primary legislation relevant to the UK. The States would need to develop equivalent statutory instruments.
Protocol 3 (Sofia) Control of Emissions of Nitrogen Oxides on their Transboundary Fluxes (NOx Protocol); Protocol 4 (Geneva) Control of Emissions of Volatiles Organic Compounds of their Transboundary Fluxes (VOCs Protocol).	Yes (Ratification has already been extended to Jersey)	**For:** • These protocols focus on NO_x and VOC which are Ozone precursors; • Compliance would aid the reduction of these Ozone precursors; • The ability to share knowledge with other signatories. **Against:** • Ozone is not an impending issue on Jersey when compared to the issues of NO_2; • There are no specific targets for Jersey alone.
United Nations Framework Convention on Climate Change & Kyoto Protocol.	Yes (Ratification has already been extended to Jersey)	**For:** • Ensures that Jersey considers and adopt processes that look into what can be done to reduce Jersey's contribution to global warming and to manage the impacts of inevitable temperature increases; • Kyoto Protocol commits Member States, such as Jersey, to adopt measures that combat climate change; • By introducing the Kyoto Protocol reduction in emissions of air pollutants (SO_2, NO_x & PM_{10}) can be realised as an ancillary benefit. **Against:** • Jersey will not contribute significant amounts of Green House Gasses (GHGs) on a global scale; therefore the environmental impact of Jersey signing up to the Kyoto protocol would be questionable. However, signing up to the protocol demonstrates intention, as demonstrated by states such as Monaco, Malta and Cyprus.

Legislation	Appropriate for Jersey?	Reasoning
The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone.	No (Ratification not extended to Jersey)	**For:** • Aims to control and reduce emissions of a wide range of pollutants that can be spread between member states by atmospheric trans-boundary atmospheric transport. **Against:** • Jersey will not contribute significantly to trans-boundary air pollution.
The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs).	No (Ratification not extended to Jersey – States stated position not to seek extension of ratification)	**For:** • Aims to address global problems associated with POPs **Against:** • Jersey does not contribute significantly to global POP emissions.
The 1994 Oslo Protocol on Further Reduction of Sulphur Emissions.	No (Ratification has already been extended to Jersey)	**For:** • Aims to control sulphur emissions from a variety of sources, including industry. **Against:** • Jersey does not contribute significantly to sulphur dioxide pollution.
The 1998 Aarhus Protocol on Heavy Metals.	No (Ratification not extended to Jersey)	**For:** • Aims to control heavy metal emissions from a variety of sources, including industry. **Against:** • Jersey does not contribute significantly to emissions of heavy metals.

Legislation	Appropriate for Jersey?	Reasoning
Prevention of Air Pollution from Ships, 1997.	No	**For:** • Aims to control emissions from shipping sources. **Against:** • Jersey does not have a large shipping presence and, as such, would not significantly benefit from adopting this piece of legislation.
Stockholm Convention on Persistent Organic Pollutants, 2001.	No	**For:** • Extension to the 1998 Aarhus Protocol on Persistent Organic Pollutants, aims to address global problems associated with POPs. **Against:** • Jersey does not contribute significantly to global POP emissions.

As outlined in Table 5.1, it is not necessarily applicable for Jersey to adopt all of the legislation and Agreements considered by Environment Scrutiny Panel due to the nature and extent of the air quality issues on the Island. In order to develop and implement an effective Air Quality Strategy to deal with local air quality issues priority should be given to the primary underlying EU legislation.

As the States develop their Air Quality Strategy AEA Technology recommend using existing EU legislation on air quality as their starting point. Through compliance with the EU Framework Directive on Air Quality (96/62/EC)[30] and associated daughter directives, it would put in context the recent EU Directive (Directive 2008/50/EC); which essentially replaces the original EU Framework Directive and the first three daughter directives. It introduces further requirements relating to monitoring and targeting reductions in ambient concentrations of fine particulate matter. The EU Directives place minimum requirements on Member States in relation to the regulation of air quality. In such Member States, the Directives must be transposed into national legislation within a defined period (typically 2-3 years). As Jersey is not a Member State in its own right, there is no legal requirement to develop new legislation implementing the EU Directives in Jersey.

The Strategic Plan commits the States to move towards international air quality standards and as such should adopt EU Directive 2008/50/EC and implement air quality legislation specific to the States of Jersey.

In order to achieve this it would be appropriate for Jersey to use the UK Strategy and Local Air Quality Management regime as the template for developing the States Legislative Framework.

[30] An Air Quality Strategy for Jersey 2003: a report produced for the States of Jersey

6 Development of the States Legislative Framework

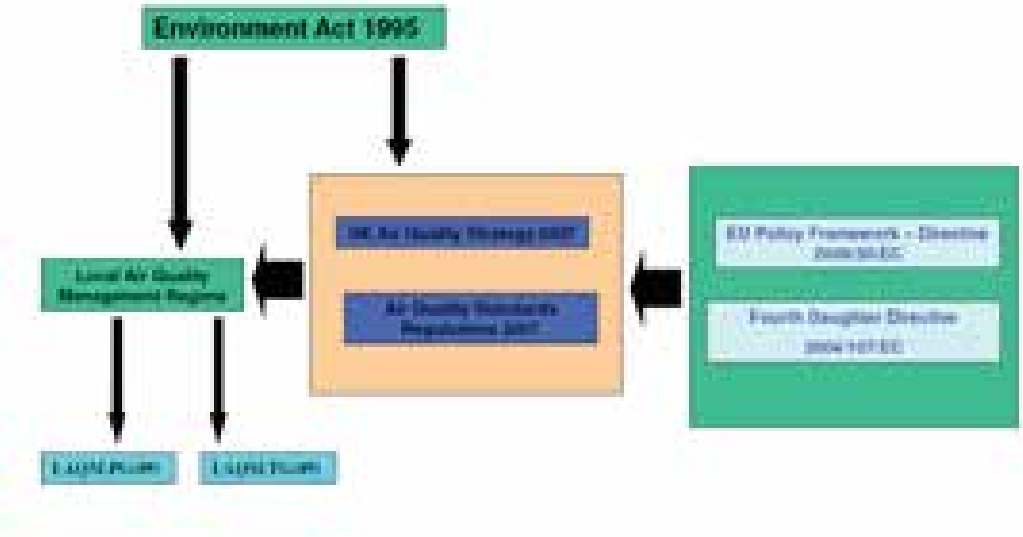
6.1 Local Air Quality Management (LAQM)

It is recommended that the requirements of the EU Directives should form the backbone of any air quality legislation developed for Jersey. Accepting that the States have no legal obligation to comply with the Directives, or report to the EU, Jersey has the option of development its own unique approach. However, given that air quality legislation relating to the Directives have been successfully implemented throughout Europe it would be a logical step for the States of Jersey to model the development of Jersey's Air Quality Strategy and enabling legislation on an existing framework that is already in place.

It would be appropriate for the States to follow a legislative and regulatory process similar to that implemented in the UK. However, it should be recognised that air quality issues on Jersey are anticipated to be relatively minor in comparison to those experienced in certain areas of the UK. Therefore some of the procedures adopted in the UK may be inappropriate for Jersey.

An outline of the relationships between the EU Air Quality Directives, UK Local Air Quality Management legislation and guidance is presented in Figure 6.1 below.

Figure 6.1 Overview of Local Air Quality Management in the UK



In the UK the Environment Act 1995 made provision for the development of a National Air Quality Strategy and a system of local air quality management. The UK Air Quality Strategy, first published in 1997, established targets for eight air pollutants: benzene, 1,3-butadiene, CO, lead, NO_2, ozone, PM_{10}, and SO_2, incorporating requirements outlined in the EU Directives, as well as more stringent national targets. In the 2007 version of the Strategy additional requirements were made in relation to concentrations of $PM_{2.5}$ and PAHs. In addition, the act assigned duties to protect and improve air quality on local authorities through the Local Air Quality Management (LAQM) regime. The regime was initiated by Part V of the Environment Act, 1995 and placed a statutory duty on local authorities to carry out periodic reviews of current and future air quality within their respective boundaries. The reviews follow Government guidance that set health-based air quality objectives for seven key

pollutants (benzene, 1,3-butadiene, CO, lead, NO_2, PM_{10}, and SO_2) and target dates by which they are to be achieved.

In order to facilitate the process, the relevant government departments in the UK (e.g. Defra) have set out a phased approach to the LAQM regime that becomes increasingly detailed and focused on air quality problems. Where an local authority identifies that a potential failure to comply with an air quality by the target date, that local authority is required to declare an Air Quality Management Area (AQMA) and prepare an air quality action plan. The air quality action plan has to outline measures that will improve local air quality. Further details on the phased nature of the LAQM process in the UK are presented in Section 6.2 below.

As the UK's Air Quality Strategy and LAQM regime has been tried and tested, it would provide a useful framework for Jersey to develop its own legislative process, enabling relevant air quality standards to be established. The UK Government has produced various pieces of guidance that have been developed in line with the UK's obligations under the relevant EU Directives. Consequently, these documents may constitute a useful source of information and guidance for the States of Jersey to develop their own Air Quality Strategy.

In order for any future Air Quality Strategy for Jersey to have a legal basis, the States will have to consider whether a new law equivalent to the UK's Environment Act should be introduced. Such a law could be developed, not only to cover local air quality management and Air Quality Strategy, but also where considered necessary legislation to cover emissions from industrial processes. The legislation could be drafted with the option for the inclusion of supplemental Orders when necessary to deal with specific air quality issues.

As identified in the Air Quality Review (2008) the introduction of such a law may include the provision for Orders specifically dealing with:

- Burning of smokeless fuels in St. Helier;
- Annual emissions testing of all commercial vehicles over 5 years old;
- Setting of air quality standards not to be exceeded; and
- A requirement to review air quality annually.

If deemed applicable and appropriate to Jersey.

6.2 Local Air Quality Assessment Framework

In line with the commitment to identify key pollutants and their sources outlined in item 4.4.5 of the Strategic Plan 2006-2011, it is recommended that a phased approach to assessment of local air quality in Jersey, similar to the UK model, be adopted. An outline of the recommended phased nature of the assessment process is presented in Table 6.1.

Table 6.1 Local Air Quality Assessment Framework

Phase	Outline of Process
1	Compilation of emissions data from various sources (transport, industrial or any other significant source) and background concentrations of relevant pollutants. On completion of this initial phase, pollutants can be discounted from the process where there is little likelihood of air quality objectives being breached or relevant target dates not being met.
2	A screening phase, using simple screening models and monitoring data should be undertaken with pollutants being discounted from the process where on more detailed examination they are unlikely to exceed air quality objectives by the relevant target date.
3	A more complex study of locations and pollutants identified in earlier stages, which may require advanced modelling and monitoring procedures, to predict specific locations of future exceedences should then be undertaken.

At each stage, current and potentially future predicted air pollution concentrations should be evaluated in the context of the risk to public exposure (against specified limit values).

On completion of a third phase assessment, and in areas identified where air quality objectives are predicted to be exceeded by the relevant target date, an Air Quality Management Area (AQMA) should be designated by legal Order (Appendix 2). Where an AQMA is designated the relevant States' departments will be required to undertake a further more detailed assessment of air quality to identify the principle sources responsible for that exceedences. They should then be obliged to produce an Air Quality Action Plan (AQAP) outlining measures that will be introduced to improve local air quality. Each of these phases should be undertaken to a timeframe specified within the Strategy.

The Action Planning process should be targeted to address the prominent sources of pollution within the identified area(s) of exceedences and include an assessment and prioritisation of proposed measures. This should include consideration of financial costs and air quality benefits, together with assessment of other potential socio-economic and environmental impacts.

Quantifiable indicators to measure the success of the air quality strategy, and in particular the success of the options adopted to improve air quality, should be made at the outset. These should include continuous monitoring of pollutant concentrations and indices relevant to the prominent sources of pollution. For example, in areas where road transport has been identified as the principal source of pollution, and measures have been implemented to reduce the contribution from such sources, information demonstrating changes in vehicle flows on relevant streets and/ or increased passenger numbers on public transport. Other indicators should be considered which include noise levels and socio-economic factors to ensure social exclusion does not develop as a result of any measures implemented. The co-ordinating role for the measurement of these indicators should be articulated in the Air Quality Strategy. The implementation of local air quality management is a function of local government in the UK. The Environmental Health profession has been leading on this and associated regulatory matters over many years; the States equivalent resource rests in Health Protection. Through an Inter-Departmental Panel on Air Quality a comprehensive knowledge of air quality across all States Departments should be developed. This should include the health impact assessment of air quality.

The mechanism for the implementation of this Air Quality Strategy should be made clear from the outset. It is recommended that the States of Jersey carry out a feasibility study to determine the cost effectiveness of achieving a measured air quality improvement, and to quantify other potential, socio-economic benefits and impacts.

Following which, adequate resources should be made available to refine the option for reduction of emissions and for the successful implementation and monitoring for indicators of success.

6.3 Industrial Sources of Air Pollution and the IPPC Directive

The remaining disproportional source of industrial emissions on Jersey is the Bellozane incinerator. The incinerator is outdated with limited pollution abatement technology. However, the old incinerator will be decommissioned and a new EU compliant Energy from Waste (EfW) facility is under construction. This will significantly reduce the pollution issues arising from incineration on Jersey. Under the Waste Management (Jersey) Law 2005 the new EfW facility will have to operate in accordance with conditions set out in its waste management licence (WID compliant). This will ensure that the new plant employs Best Available Techniques of abatement. As previously mentioned in Section 3, this will not only relate to obvious polluting aspects of waste management operations such as build-up of litter near sites, mud on roads, and odour but will also extend to issues such as air, water, and ground pollution.

The European Community Directive (96/61/EC) on Integrated Pollution Prevention and Control (the "IPPC Directive") governs releases from industrial plant to all environmental

media. The aim of the IPPC regime is to introduce a more integrated approach to achieve a high level of protection of the environment taken as a whole by preventing, or where that is not practicable, reducing emissions into the air, water and land. Under IPPC plant operators should show that they have applied the Best Available Techniques to ensure emissions are at a minimum.

Jersey has not adopted IPPC, however under Jersey Law some of the principles therein have been adopted. The IPPC regime does represent good practice and as such would assist the States of Jersey to create a more co-ordinated and integrated approach to pollution issues. The regulatory experience needed to deliver IPPC cannot be underestimated; however, the States of Jersey already has experienced IPPC enforcement officers in Health Protection and as such the technical expertise needed to deliver IPPC already exists on Island.

Best Available Techniques is defined as

> *"the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limits values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environmental as a whole."*

The Best Available Technique (BAT) approach ensures that the cost of applying techniques is not excessive in relation to the environmental protection they provide. It follows that the more environmental damage BAT can prevent, the more the regulator can justify telling the operator to spend on it before the costs are considered excessive.

6.4 Local Air Quality Management and Ecosystems

The principal aim of any legislative framework for Jersey should follow the ethos of current European Directives, namely the protection of human health; notwithstanding this point current EU and UK legislation details limit values, objectives and timescales for the protection of vegetation and ecosystems. This is particularly relevant to protect against adverse effects of pollutants such as NO_2, SO_2 and ozone.

Currently Jersey has four Ramsar sites and a number of Sites of Special Interest (SSI). Throughout Europe these areas have been given special protection under the European Union's Habitats Directive (Council Directive 92/43/EEC of 21 May 1992). They provide increased protection to a variety of wild animals, plants and habitats and are a vital part of global efforts to conserve the world's biodiversity.

The impact of pollutants such as NO_2, SO_2 and ozone on vegetation and other non-human habitats is expected to be insignificant on Jersey. Indeed there is currently no monitoring of non-human health impacts of air pollutants on the Island. The local effects of air quality are not regarded as a primary concern for areas of Jersey at this stage when compared with health aspects. At present monitoring of NO_2 is undertaken at only one rural location on Jersey, Rue de Raisies. Monitoring at this location indicates that the annual mean NO_2 concentration of 6 $\mu g\ m^{-3}$ is well within the limit value set for the protection of vegetation and ecosystems, for this particular pollutant.

6.5 Air Quality Targets and Timescales

The Air Quality Review 2008 recommended that Jersey should develop the means whereby formal limit values can be set for air pollutants of concern, and enabling legislation passed in order to deal with local air quality issues. It is recommended that like the UK, target dates should be set to meet air quality standards for pollutants of concern. Table 6.2 lists standards, objectives and timescales as outlined in the UK National Air Quality Strategy. The objectives listed relate principally to the protection of human health and meet the requirements of the EU limit values.

Table 6.2 Air Quality Objectives Included in Regulations for the Purpose of Local Air Quality Management in the UK

	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu g/m^3$	Running annual mean	31.12.2003
	5.00 $\mu g/m^3$	Running annual mean	31.12.2010
	3.25 $\mu g/m^3$	Running annual mean (Scotland)	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Max Daily Running 8-hour mean	31.12.2003
		Running 8-hour mean (Scotland)	
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Particles (PM_{10}) (gravimetric) (Scotland)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	18 $\mu g/m^3$	Annual mean	31.12.2008
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

This list of pollutants represents some of the most common air pollutants that pose a risk to human health. The EU Directive and UK Air Quality Strategy (2007) also recognise the risks associated with fine particulate matter ($PM_{2.5}$) and the potential negative impacts on human health. As a consequence, the UK Government and Devolved Administrations have introduced new objectives relating to particulate matter with an aerodynamic diameter less than 2.5 micrometers, although these objectives have not been incorporated into the regulations at present.

In Scotland an annual mean objective of 12 $\mu g\ m^{-3}$ has been set, whilst a 25 $\mu g\ m^{-3}$ has been set for the rest of the UK. However, in recognition of the non-threshold toxicity of PM, a further objective aimed at achieving a 15% reduction of concentrations in the urban background concentrations between 2010 and 2020 has been adopted, to ensure that large sections of the population benefit from improved air quality.

The development of the Air Quality Strategy should consider each of the 7 air quality pollutants identified in Table 6.1 and potentially ozone (O_3) and $PM_{2.5}$, which are included in the new Directive. However, as the States of Jersey have no obligation to comply with the EU Directives, and at present have not developed a detailed Air Quality Strategy, it would not be logical for the States to incorporate compliance dates that have already passed. It is therefore recommended that appropriate dates for compliance be identified for each of the relevant pollutants.

6.6 Responsibility for Implementation

The ability to meet European limit values hinges on successful implementation and an integrated approach on Jersey. The principal aim of improving air quality is to improve human health and consequently any Air Quality Strategy needs to be linked to environmental and health impact assessments for the Island. Health Protection Services have the experience, expertise and breadth of regulatory experience necessary to implement such a strategy for Jersey.

Health Protection, on behalf of the Medical Officer for Health and Minister for Health and Social Services should be responsible for identifying appropriate health protection standards, developing an appropriate health monitoring programme and carrying out necessary enforcement activities.

The Transport and Technical Services Department and Economic Development Department will have significant responsibility for implementing the measures identified by Health Protection to improve human health.

6.7 Additional Options for Consideration in the Development of a Legislative Framework and Strategy for Jersey

Other activities that could improve air quality on Jersey, and should be explored in Jersey's Air Quality Strategy, are outlined below:

6.7.1. Improving best practice in commercial paint spray operations. This includes the increased use of water based paints; high volume, low-pressure spray guns; high efficiency filters to be used in spray booths to aid removal of contaminants and compliance with Policy Guidance note PG6/34(96).

6.7.2. Within the industrial and commercial sectors the use of combined heat and power boilers (CHP) can result in approximately 35% reduction in primary energy usage compared to that in power stations. Currently there are five CHP boilers in Jersey, which results in a 30 – 50% reduction in carbon dioxide emissions compared to that of coal/oil fired power units.

7 Identification of Key Pollutants and their Sources

The identification of key pollutants of concern and the principal sources of emissions is the first step in developing an air quality strategy. The EU limit values list substances, the concentration of which should be evaluated. However, pollutants are typically associated with a limited range of sources; for example, emissions of sulphur dioxide are typically attributable to power generation, industry, and potentially domestic sources in areas where solid fuels are still widely utilised. A summary of some of the common sources of air quality pollutants is presented in Table 7.1

Table 7.1 Typical Sources of Air Pollution

Pollutant	Sources and health effects
Benzene	Industrial Processes and petrol combustion Benzene is classified as a carcinogen. Chronic exposure to low concentrations has been associated with cancer, central nervous system disorders, birth defects and damage to other organs such as the liver and kidney
Carbon monoxide	Road Transport is the principal source of outdoor CO. Carbon monoxide competes with O_2 for haemoglobin, reducing oxygen uptake. The affects of exposure to CO are highly dependent upon the dose, but generally result in reduced oxygen supply.
Lead	Industrial Processes. Lead can be toxic at very low doses and has been associated with a wide variety of impacts on human health, particularly in neonates. Exposure has been associated with neurological damage and impaired visual motor performance.
Nitrogen dioxide	Road Transport, power generation, shipping and domestic sources
Particulates (PM_{10})	Road Transport, Industry, power generation and background sources
Sulphur dioxide	Power generation, industrial processes, domestic.

It is recommended that the development of an Air Quality Strategy for Jersey should adopt a phased and justified approach as outlined.

There are three intrinsically linked processes which will enable the States to quantify the key pollutants of concern and their predominant sources, namely:

1. **Air Quality Monitoring**
2. **Phased air quality management assessment process; and,**
3. **Emission's Inventory**

These three processes are intrinsically linked, with information relating to the potential sources of emissions being used to develop a robust and comprehensive monitoring strategy; the results of monitoring being used to guide the air quality management process.

7.1 Air Quality Monitoring

Under the EC Air Quality Framework Directive (96/62/EC) and subsequently Directive (2008/50/EC), all Member States have to assess their existing air quality and implement a programme of monitoring. The scale of the implemented monitoring programme is dependent upon the population of the Member State, the population density, the prevalence and nature of emission sources and proximity of the general public to these sources. Under the Directives, each Member State must undertake continuous monitoring (using appropriate instrumentation) at a minimum of one site.

Monitoring data should form the backbone of any air quality assessment and should be given greater precedence over any results obtained via modelling. However, in order to be useful, monitoring data must be 'fit for purpose', meaning that:

- Monitoring sites represent likely worst-case exposure to members of the public, at relevant locations;
- A suitable monitoring method has been used;
- The data has been subjected to thorough quality assurance and control checks; and,
- Monitoring has been undertaken over a suitable period of time and has adequate data capture

Directives 96/62/EC and 2008/50/EC prescribe exactly how and where monitoring should be undertaken.

7.2 Relevant Human Exposure

Human health represents the principal driver for assessing local air quality. It is therefore reasonable to assess concentrations at locations which are relevant in terms of human exposure. The UK Air Quality Regulations make it clear that likely exceedences of the objectives should be assessed in relation to….

> ***"the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present"***

Therefore a monitoring strategy should focus on relevant locations by pollutant and averaging period rather than locations where public exposure would not be realistic. Table 7.3, adapted from the UK's Local Air Quality Management Technical Guidance (LAQM.TG (09)) provides a list of example relevant locations for specific averaging periods (e.g. annual mean).

Table 7.3 Examples of Locations Where the Air Quality Standards Should Apply

Averaging Period	Air Quality Standards should apply at:	Standards should generally not apply at:
Annual mean	Sites where members of the public are regularly exposed for long periods. For example Building façades of residential properties and sensitive receptors such as schools and hospitals	▪ Hotels ▪ Occupational premises ▪ Gardens of residential properties.
24-hour mean and 8-hour mean	All locations where the annual mean standard is relevant, plus the addition of hotels and gardens.	▪ Kerbside locations
1 hour mean	Any outdoor locations where members of the public can be reasonably expected to be located for 1hr or more.	▪ Not relevant to indoor locations or occupational exposure.
15 min mean	Any outdoor locations where members of the public can be reasonably expected to be located for 15 min or more.	

7.3 Monitoring Methodology

Any monitoring programme designed to comply with the EU Directive (96/62/EC) should incorporate the use of reference methods specified in Sections A and C of Annex VI of the Directive, or methods subject to the conditions set out in Section B of the same Annex. A summary of the reference measures for each of the pollutants outlined in the Directive are summarised in Table 7.4.

Table 7.4 Reference Methods for Pollutants Outlined in the EC Directives

Pollutant	Reference method
Sulphur dioxide	EN 14212:2005 'Ambient air quality Standard method for the measurement of the concentration of sulphur dioxide by ultraviolet fluorescence'
Nitrogen dioxide and oxides of nitrogen	EN14211:2005 'Ambient air quality — Standard method for the measurement of the concentration of nitrogen dioxide and nitrogen monoxide by chemiluminescence'
Lead	EN 14902:2005 'Standard method for measurement of Pb/Cd/As/Ni in the PM_{10} fraction of suspended particulate matter
PM_{10}	EN 12341:1999 'Air Quality — Determination of the PM_{10} fraction of suspended particulate matter — Reference method and field test procedure to demonstrate reference equivalence of measurement methods'
Benzene	EN 14662:2005, parts 1, 2 and 3 'Ambient air quality — Standard method for measurement of benzene concentrations'
Carbon monoxide	EN 14626:2005 'Ambient air quality — Standard method for the measurement of the concentration of carbon monoxide by non-dispersive infrared spectroscopy'

Automatic monitoring requires a significant commitment in terms of staff time and financial resources. In addition to purchase costs, other on costs need to be considered e.g. securing a monitoring location(s), power supply, security, service and maintenance and air conditioning. Consequently, it is recommended that the monitoring strategy should incorporate a combination of screening measures and reference methods. The application of screening methods such as nitrogen dioxide diffusion tubes would enable a wider area to be screened for likely exceedences of the defined air quality standard. Where such indicative methods indicate that concentrations for pollutants are likely to be close to the defined standard (e.g. limit value), further assessment using an approved reference method should be undertaken.

During the development of a monitoring programme, where baseline monitoring and indicative surveys are required, indicative sampling methods often represent the most appropriate methods. However, only proven and generally accepted measurement methods should be considered, and these methods should be assessed against the relevant reference method specified above.

7.4 Quality Assurance and Control

In order to use the data collected during the delivery of an air quality monitoring strategy, it is important that due regard is paid to the quality assurance, quality control (QA/QC) and data verification procedures. This will ensure that robust and reliable results are obtained. A QA/QC programme will typically include a detailed schedule of site calibrations and the ratification of data, with all procedures documented to a high standard. Where passive indicative monitoring devices are used (e.g. diffusion tubes) the samples should be analysed by a laboratory that is able to provide suitable QA/QC and meet the required data quality objectives.

7.5 Proposed Air Quality Monitoring Strategy for Jersey

Section 4.4.5 of the States' Strategic Plan 2006-2011 makes a clear commitment to 'debate and implement an Air Quality Strategy including proposals for monitoring and publishing levels of local air pollution that reflect best practice globally (P&E)'.

The States Of Jersey should use the existing EU Directive (2008/50/EC) as the basis for designing its own air quality monitoring strategy.

Requirements for Monitoring Locations and Methodologies

The Directive states that the assessment of ambient air quality should take account of the size of populations and ecosystems exposed to air quality to ensure that information collected is representative and comparable across the community. As a consequence, EU member states are typically split into relevant 'zones' and 'agglomerations' on the basis of population density and common criteria for the number and locations of measurement stations are applied. The Directive requires member States to assess concentrations of the pollutants referred to in Article V in all their zones and agglomerations, in accordance with the criteria laid down in Article VI paragraphs 2, 3 and 4, and with the criteria laid down in Annex III.

The method(s) used to assess concentrations of pollutants is dictated by whether levels of each of the specified pollutants exceed the relevant upper or lower assessment thresholds (Table 7.5).

It should be noted that formal demonstration of exceedences or compliance with an Upper or Lower Assessment Threshold, based on guidance from the Directives, can only be demonstrated using at least five years continuous monitoring data. Clearly, for Jersey this guidance cannot strictly be conformed to, owing to the limited duration of the campaigns and surveys so far undertaken. Hence, for the purpose of this preliminary assessment, a single exceedence of the Lower Assessment Threshold will trigger a requirement to monitor.

Assessment Criteria

The upper and lower assessment thresholds specified below apply to sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM_{10} and $PM_{2.5}$), lead, benzene and carbon monoxide.

Table 7.5 Upper and Lower Assessment Thresholds

POLLUTANT		HEALTH PROTECTION		VEGETATION PROTECTION
		Limit value	Limit value	
Sulphur dioxide	Upper	60 % of 24-hour limit value (75 µg/m3, not to be exceeded more than 3 times in any calendar year)		60 % of winter critical level (12 µg/m3)
	Lower	40 % of 24-hour limit value (50 µg/m3, not to be exceeded more than three times in any calendar year)		40 % of winter critical level (8 µg/m3)
Nitrogen dioxide and	Upper	70 % of hourly limit value (140 µg/m3, not to be exceeded more than 18 times in any calendar year)	80 % of annual limit value (32 µg/m3)	
	Lower	50 % of limit value (100 µg/m3, not to be exceeded more than 18 times in any calendar year)	65 % of annual limit value (26 µg/m3)	
Oxides of Nitrogen				80 % of critical level (24 µg/m3)
				65 % of critical level (19,5 µg/m3)
PM_{10}	Upper	70 % of 24 h limit value (35 µg/m3, not to be exceeded more than 35 times in any calendar year)	70 % of annual limit value (28 µg/m3)	
	Lower	50 % of 24 h limit value (25 µg/m3, not to be exceeded more than 35 times in any calendar year)	50 % of annual limit value (20 µg/m3)	
$PM_{2.5}$	Upper		70 % of annual limit value (17 µg/m3)	
	Lower		50 % of annual limit value (12 µg/m3)	
Lead	Upper		70 % of annual limit value (0,35 µg/m3)	
	Lower		50 % of annual limit value (0,25 µg/m3)	
Benzene	Upper		70 % of annual limit value (3,5 µg/m3)	
	Lower		40 % of annual limit value (2 µg/m3)	
Carbon monoxide	Upper	70 % of 8 h average limit value (7 mg/m3)		
	Lower	50 % of 8 hour limit value (5 mg/m3)		

1. In areas where the upper assessment threshold is exceeded, ambient air quality must be assessed by fixed measurements; it may be supplemented by modelling techniques and/ or indicative measurements to provide information on the spatial distribution of pollutants.
2. In zones where pollutant concentrations are below the upper assessment thresholds specified, but above the lower threshold, a combination of fixed measurements and modelling techniques/ indicative measurements may be used to assess ambient air quality.
3. In zones where concentrations of pollutants are lower than the specified lower assessment thresholds, modelling techniques or objective-estimation techniques (or both are deemed sufficient for the assessment of ambient air.

In order to quantify exposure reduction, the Directive specifies a minimum requirement to monitor concentrations (and composition – chemical speciation) of fine particulate matter ($PM_{2.5}$) at rural background location(s). This assessment of fine particulate matter at rural background locations is required under the Directive to better understand the impactsof this pollutant and to enable the development of appropriate policies.

On the basis of Jersey's estimated population circa 90,000, it is reasonable to consider the States of Jersey as a single 'zone' and apply the requirements of the Directive appropriately. With regards to determining the appropriate method to assess levels of pollutants, the ability to do this is somewhat restricted by the availability of data from air quality monitoring currently undertaken on Jersey. Existing monitoring programmes are in place for NO_2 (NO_x), PM_{10}, and benzene, thus enabling a preliminary Article 5 assessment to be undertaken in relation to each of these pollutants.

The results of monitoring for benzene, nitrogen dioxide and PM_{10} indicate that the upper threshold limits for each of these substances were exceeded in Jersey during 2008. To comply with the Directive levels of these pollutants must be determined through fixed measurements, and may be supplemented by modelling techniques and/ or indicative measurements. A recommended monitoring programme for these substances is presented in Section 7.6 below

No monitoring of ambient concentrations of sulphur dioxide, lead or carbon monoxide has been undertaken and documented on Jersey in recent years. Consequently it is not possible to compare monitored concentrations against the upper and lower thresholds. There are two possible alternatives to filling this knowledge gap, namely:

1. The first possibility would be to adopt a conservative approach and introduce a monitoring programme for sulphur dioxide, lead and carbon monoxide in addition to those required for NO_2, benzene, PM_{10} (and $PM_{2.5}$) in line with the requirements of the Directive. However, this approach would be costly in terms the procurement, implementation and maintenance of the monitoring network, which would require to be undertaken for a minimum of 5 years under the Directive.

2. Alternatively, the States could adopt a pragmatic approach, undertaking a review of the presence of likely sources of sulphur dioxide, carbon monoxide and lead on Jersey and assessing the likelihood of the limit values being exceeded.

Some monitoring of ambient SO_2, CO and lead was undertaken on Jersey in the late 1990's and early 2000s and the results compiled in the draft air quality strategy[27], together with a review of relevant sources present on the Island.

Carbon Monoxide

Carbon monoxide emissions in the UK are dominated by road transport and this is likely to be similar in Jersey; the remaining contribution usually arising from domestic heating and other

small sources. The AQS (2003)[31] reported that automatic monitoring of carbon monoxide was undertaken in February to March 2000 at Halkett Place, St Helier. During this time no exceedences of the Upper or Lower Assessment Threshold for carbon monoxide were recorded. However, high concentrations of CO were reported in 1994 in the Jersey Road tunnel, which is regularly used by pedestrians.

Review of ambient CO concentrations in the UK indicate that the limit value is unlikely to be exceeded, with no air quality management areas being declared in the UK as a result of elevated concentrations of CO. Taking this finding into consideration, together with the findings of the monitoring undertaken at Halkett Place, St Helier in 2000, it is suggested that the EU limit value for CO is unlikely to be exceeded on Jersey and that the implementation of a long-term monitoring strategy for CO is not likely to be warranted. However, the States may wish to consider undertaking short-term monitoring programme to assess ambient concentrations of CO to confirm these findings.

In relation to the elevated concentrations of CO reported in the Jersey tunnel in 1994, it is considered that as exposure in this location is likely to be limited to less than 5 min, this location is not representative and appropriate for comparison with the limit value.

Lead

No monitoring has been undertaken of this pollutant in Jersey. Emissions of lead in Jersey are likely to be dominated by road transport, although emissions are anticipated to have fallen considerably since the phasing out of leaded petrol. There are also no known significant industrial sources of lead emissions in Jersey, and it is therefore considered that emissions of lead are unlikely to be a significant issue. As monitoring data obtained from the UK indicates that concentrations of lead in ambient air are significantly below the limit values, it is likely that the same situation will exist in Jersey also.

In order to confirm this conclusion, the States of Jersey may wish to consider undertaking a short-term monitoring programme (3-6 months) to assess ambient concentrations of lead across the Island. The findings of such a study could be used to guide the need to introduce a more formalised and long-term monitoring programme for lead.

Sulphur Dioxide

In Jersey emissions of SO_2 are anticipated to be almost exclusively from solid and liquid fuel combustion, with the JEC power station and domestic heating the dominant sources. Whilst the use of the under sea link with France offers the potential to reduce the emissions from power generation on the island, the relatively small use of gas on the island for domestic heating is expected to give rise to higher emissions per capita than for the UK. The emissions from JEC's power station are currently unregulated.

Levels of SO_2 have been measured on Jersey from 1965 until the early 21st century. Results from monitoring at Clos St Andre, Le Bas Centre, Langley Park and St Brelade around the turn of the century indicated concentrations significantly below the annual average Upper and Lower Assessment thresholds. However, occasional high concentrations were recorded by monitoring undertaken at St Helier during 2000. These elevated concentrations were attributed to emissions from the JEC power station during periods of southerly winds. In recent years emissions from both the Power Station and Gas Turbine have become a potential problem. The likelihood that pollution may result from these processes should therefore be addressed on Jersey. As outlined under section 6.3 above, non-waste licensed processes such as JEC, which at present are not regulated on Jersey, should be controlled and regulated through the implementation of an IPPC regime on Jersey. This would ensure that through the application of best available techniques and practice emissions to the environment are minimised.

[31] An Air Quality Strategy for Jersey, a report produced for the States of Jersey, April 2003

With the reduction of sulphur in fuel oil and the reducedusage of Jersey Electricity's oil fired power station since the AQS report in 2003, it is anticipated that emissions of sulphur dioxide are unlikely to breech the limit values, and thus a long-term monitoring programme may not be necessary. However, it may be prudent for the States to confirm this conclusion by undertaking a short-term monitoring programme for SO_2. In the absence of any regulatory control over JEC emissions to air the need to understand stack emissions from their operation is a pressing and significant issue.

Ozone

No monitoring of ozone concentrations has been undertaken on Jersey during recent years; however, short-term monitoring was undertaken at Haut de la Garenne in 1997. In general concentrations of O_3 in Jersey are anticipated to be similar to those recorded on the UK mainland, with highest concentrations recorded in the summer months in rural locations. However, the original Air Quality Strategy stated that there is little benefit in measuring O_3, as emissions from the island will have very little impact on island ozone concentrations. However, the States may wish to confirm this conclusion by undertaking a short-term monitoring programme of O_3.

7.6 Recommendations for Air Quality Monitoring Programme

The new EU Directive prescribes exactly how and where monitoring should be undertaken.
The review of available monitoring data and relevant information for sources of relevant air quality pollutants on Jersey has indicated the requirement for the States of Jersey to undertake the formal monitoring programme in line with the EU Directive. Based on guidance provided by the Directive (Annex V) and taking into account the population of Jersey, and estimated exceedences, the following recommendations deliver minimum compliance with the Directive:

Nitrogen Dioxide

Estimated exceedences of the annual Upper Assessment Threshold for NO_2 have been identified at numerous locations across Jersey, as has an exceedence of the hourly Upper Assessment Threshold at one location. On the basis of these measurements monitoring this pollutant for the protection of human health is required. Based on guidance provided by the new Directive (Annex V) and taking into account the population of Jersey, and the estimated exceedences, the following recommendations are made for minimum compliance with the Directive:

- One fixed type approved NOx monitoring station is required at a busy roadside location within the Jersey urban area
- Diffusive sampling in close proximity to major sources (road traffic)

Jersey undertakes continuous automatic monitoring of NOx at the Central Market, Halkett Place. Recent results have demonstrated a reasonable, but not complete, measure of QA/QC, as well as data downloads and ratification. NO_2 diffusion tube monitoring is also currently undertaken at 12 locations on the island; a reduction of activity following a detailed evaluation of the average concentrations and trends over the last 10 years

Current monitoring undertaken for NO_2 on Jersey is compliant with the EU Directives with regards to ratification, polling, site location and calibration; however audits and services are only undertaken on an annual basis. For Jersey to become fully compliant the following would be required:

- Services to be undertaken on a 6 monthly basis
- Audits to be undertaken on a 6 monthly basis

Benzene

Estimated exceedences of the annual average Upper Assessment Threshold for benzene have been identified in Jersey at Springfield garage. Concentrations reported elsewhere on

the Island are lower than the Lower Assessment Threshold. The benzene diffusion tube located at Springfield garage is in a fuelling station forecourt. There are no vapour recovery systems on Jersey, and the site does not reflect population exposure. It is anticipated that this monitoring site should be relocated to the nearest sensitive receptor approximately 30m from the current site and that concentrations are likely to decrease as a result.

Based on current measurements continuous automatic monitoring of this pollutant for the protection of human health is not required on Jersey. However were the States minded to fully comply with the EU Directive table 7.8 below outlines the considerable capital expenditure required to deliver compliance. It is recommended that the BTEX survey currently in place should continue.

In order to meet full compliance with the Directive, the States would have to comply with the following monitoring recommendations:

- One fixed roadside location using continuous monitoring equipment
- Diffusive sampling in close proximity to major sources

PM_{10} and $PM_{2.5}$

The result of PM_{10} monitoring on Jersey in recent years has indicated likely exceedences of the daily mean Upper Assessment Threshold. On that basis monitoring PM_{10} for the protection of human health is necessary. Based on guidance provided by the new Directive (Annex V), the estimated exceedence level and the population of Jersey, the following recommendations are made for minimum compliance with the Directive:

- One fixed roadside location using continuous equivalent monitoring equipment
- Supplementary monitoring using indicative techniques (OSIRIS) at relevant sources.

In addition to the suggested monitoring programme for PM_{10}, in order to comply with the Directive, it is recommended that the States of Jersey monitor ambient concentrations of $PM_{2.5}$ at one rural background location. The measurement of $PM_{2.5}$ must include at least the total mass concentration and concentrations of appropriate compounds to characterise its chemical composition, including sulphate, nitrate, ammonium, sodium, potassium, chloride, calcium, magnesium, elemental carbon and organic carbon.

In order to comply with the Directive, the measurement programmes for NOx, benzene, PM_{10} and $PM_{2.5}$ should incorporate the use of reference methods specified in Sections A and C of Annex VI of the Directive, or methods subject to the conditions set out in Section B of the same Annex. A summary of the reference measures for each of the pollutants identified is presented in Table 7.6.

Table 7.6 CEN Reference Methods for Monitoring NO_X, PM_{10}, $PM_{2.5}$ and Benzene

Pollutant	Reference method
Nitrogen dioxide and oxides of nitrogen	EN14211:2005 'Ambient air quality — Standard method for the measurement of the concentration of nitrogen dioxide and nitrogen monoxide by chemiluminescence'
PM_{10}	EN 12341:1999 'Air Quality — Determination of the PM_{10} fraction of suspended particulate matter — Reference method and field test procedure to demonstrate reference equivalence of measurement methods'
$PM_{2.5}$	EN 14907:2005 'Standard gravimetric measurement method for the determination of the $PM_{2.5}$ mass fraction of suspended particulate matter'.
Benzene	EN 14662:2005, parts 1, 2 and 3 'Ambient air quality — Standard method for measurement of benzene concentrations'

The weight of evidence available suggests that concentrations of CO and SO_2 are below the lower assessment thresholds. It is also suggested there is little benefit in measuring O_3, as emissions from the island will have very little impact on island ozone concentrations. However, in addition to the recommended monitoring programmes for NO_2 (NOx), benzene, PM_{10} and $PM_{2.5}$, due to the limited data available about ambient concentrations of carbon monoxide, sulphur dioxide, lead and ozone, the States may wish to undertake a short-term study of ambient concentrations of these pollutants.

This approach would meet the requirements of Article 5 of the original Framework Directive, which required Member States to undertake a preliminary investigation of ambient air quality prior to implementing the daughter directives for NO_2, SO_2 and particulate matter. The aim of these assessments is to establish estimates for the overall distribution, and levels, of pollutants. It is also aimed at identifying additional monitoring requirements that may be necessary to fulfil obligations under the Framework and Daughter Directives.

Should the States choose to adopt this approach it is recommended that monitoring is undertaken for a period of 6 to 12 months using appropriate methodologies and QA/QC procedures. Jersey may wish to consider the use of a mobile monitoring station incorporating CEN reference techniques for SO_2, CO and lead. A summary of the reference measures for each of the pollutants identified is presented in Table 7.7.

Table 7.7 CEN Reference Methods for Monitoring SO_2, Pb and Co

Pollutant	Reference method
Sulphur dioxide	EN 14212:2005 'Ambient air quality Standard method for the measurement of the concentration of sulphur dioxide by ultraviolet fluorescence'
Lead	EN 14902:2005 'Standard method for measurement of Pb/Cd/As/Ni in the PM_{10} fraction of suspended particulate matter
Carbon monoxide	EN 14626:2005 'Ambient air quality — Standard method for the measurement of the concentration of carbon monoxide by non-dispersive infrared spectroscopy'
Ozone	EN 14625:2005 'Ambient air quality — Standard method for the measurement of the concentration of ozone by ultraviolet photometry'.

Conversely, in the absence of relevant monitoring data relating to ambient concentrations of SO_2, Pb and CO the States may wish to create measurement sites for each of these pollutants without undertaking a short-term study. Should the States wish to adopt this approach, the following recommendations are made for minimum compliance with the Directive:

- One fixed SO_2 monitoring station is required within the Jersey urban area, at a busy roadside location and close to a power generation point source.
- One fixed CO monitoring station is required within the Jersey urban area, at a busy roadside location and close to a power generation point source.
- One fixed ozone monitoring station is required within a suburban/rural location, co-located with a NOx analyser.

7.7 Indicative Costs for Air Quality Monitoring

Health Protection understand the limitations of the current monitoring programme in place on Jersey; primarily the inability to give a definitive comparison with EU limit values. The principal air quality issues on Jersey are concentrations of NOx, PM and potentially BTEX. Table 7.8 below provides some indicative costs for the recommended monitoring of these pollutants on the Island.

Table 7.8 Indicative Costs for Recommended Monitoring of Pollutants 2009

Pollutant	Cost of analysers and 1 year of operation (No staff costs included)	Comment
NOx	£7000 plus £3000 operation	For full compliance with the EU Directives, the States would be required to undertake services and audits on a 6 monthly rather than annual basis which would incur an additional cost of circa £1,500
PM_{10} & $PM_{2.5}$	£15,000-£30,000 plus £3000 operation	Should be considered for PM_{10} and $PM_{2.5}$ as the priority PM metric as it is likely to become more prominent over next few years
Diffusion Tubes	£10,000 approximately	Already in operation
Benzene	£15,000-£30,000 plus £6000 operation	As a minimum current BTEX diffusion tube survey should remain in place

7.8 Publishing levels of local air pollution

The Directive (2008/50/EC) specifies measures that must be taken by member states to ensure that information on local air quality is made available to the public, and that information is provided to the Commission in the appropriate format and timescales. As the States of Jersey are not require to report to the Commission, this section addresses the requirements outlined in the Directive for making information relating to local air quality available to the general public.

Article 26 of the Directive specifies that member states must ensure that the public and appropriate organisations such as environmental organisations, consumer organisations, health-care bodies, industrial bodies and organisations representing the interests of sensitive populations are adequately informed of the following in a timely manner:

- Ambient air quality (in accordance with Annex XVI of the Directive);
- Any extensions granted in relation to compliance with the limit values for NO_2, benzene (Article 22(1)) and PM_{10} (Article 22(2)); and,
- Any air quality action plans established to improve air quality in zones/ agglomerations where the limit or target values are exceeded (Article 23 and Article 17(2)).

This information must be provided free of charge in any easily accessible format, including via the Internet or any appropriate means of telecommunication. The Directive also states that each State must inform the public of the competent authorities responsible for air quality issues (Article 3) and make annual reports relating to all pollutants specified available to the public.

These reports should provide a summary of the concentrations of air quality pollutants reported together with a description of any exceedences of the limit values, target values, long-term objectives, information thresholds and alert thresholds, for the relevant averaging periods. This information should be combined with a summary assessment on the effects of those exceedences.

7.9 Recommendations

The States have no formal requirement to report to the EU Commission or exchange air quality information with neighbouring countries. However it would be good practice to make information regarding local air quality readily available to members of the public and relevant

organisations. The States may wish to publish the results of air quality monitoring on the States Website, together with a summary of any exceedences of relevant thresholds or limit values.

Many local authorities in the UK have benefited from developing a dedicated air quality resource website; the States of Jersey are well placed to benefit from following this approach. In addition to informing the public on current air quality issues it can also serve as a portal to educate them about how pollution can affect them, how they can help reduce levels of pollutants in the air and policy decisions affecting air quality. Indicative costs for a basic website are around £10,000; whilst a more interactive website can cost up to £30,000 depending on functionality.

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8 Cumulative Air Quality Impact Assessment of New Development Sites

8.1 Introduction

There are five new developments proposed in and around the Waterfront area of St. Helier (see Figure 8.1). These are:

- Esplanade Quarter: 16 high-rise blocks built on 1500m^2 area with an underground car park
- Castle Quay; 4 blocks of commercial /residential units
- Energy from Waste Plant: development replaces the existing Bellozane incinerator
- Ann Court: construction of a car park replacing the existing residential units
- Westmount Quarry: residential and commercial units at the gateway to St Helier

Environmental Impact Assessments (EIA) accompanied the Esplanade Quarter, Castle Quay and Energy from waste plant developments which included air quality and traffic elements and air quality assessments are to be undertaken for the Ann Court and Westmount Quarry development planning applications. However; no overall assessment of the cumulative impact of these developments on air quality has been undertaken.

This section presents an assessment of the cumulative impact of major development in and around St. Helier on air quality. It is not an exhaustive list and only those schemes listed have been included in the cumulative assessment. The following assessment does not conform to the EU Directive on Strategic Environmental Assessments (2001/42/EC), which would involve assessing other locations.

This section will:

- review pre-existing air quality information for the area;
- set out the approach taken to the assessment and the input data used;
- present a base model for 2008 verified against local monitoring data (PM_{10} and NO_2);
- undertake a 'with' and 'without' development impact assessment of air quality (PM_{10} and NO_2);
- present the results of the assessment as contour plots, comparing the results with reference to the EU limit values
- assess the uncertainty in the predicted concentrations; and
- provide an explanation of the significance of the results.

Figure 8.1: New developments in St. Helier Assessed in the Air Quality Cumulative Assessment

8.2 Proposed Developments

Esplanade Quarter Development

The proposed development is for a mixed-use scheme, including commercial, retail, residential, a hotel and self-catered apartments and open spaces.

An air quality assessment was undertaken for the proposed Esplanade Quarter Development. The assessment consisted of a local and regional pollutant assessment of the operational phase impacts of the scheme.

Concentrations of NO_2 and PM_{10} were predicted at locations in the vicinity of the proposed development site using accepted best practice UK methods. The results of the operational phase assessment indicated that no exceedences of any EU Limit values or UK air quality objectives were predicted with, or without the scheme. Slight adverse impacts were predicted for the impact of the scheme on localised NO_2 concentrations and on regional pollutants. Negligible impacts were predicted for localised PM_{10} concentrations as a result of the scheme and new exposure to air pollution, both for NO_2 and PM_{10}.

Castle Quay

Castle Quay is a mixed-use development comprising residential units, retail, catering, entertainment, offices, leisure facilities, public open space and associated car parking and access routes on land at Castle Quay on the Waterfront development area at St Helier in Jersey. The Castle Quay site lies to the south of Rue de L'Etau and North West of Rue de Cateret at the Waterfront site, St Helier, Jersey.

The site lies adjacent to the marina, which is located to the southwest and west. To the northwest is a Radisson Hotel. A leisure complex (including a cinema, night club, mass market catering and a health/sports club) is located to the northeast. Harbour Reach, a six storey residential development with retail proposed at ground level is to the South of the site. A landscaped area is located to the east.

The air quality sections of the phase 1 and phase 2 Environmental statements examined the implication of the proposed development on air quality. Potential impacts on air quality due to traffic emissions arising from operation of the site were predicted using the ADMS Roads Air Dispersion Model.

The results show that increased traffic flow as a result of the development would have a negligible impact on air quality. The Castle Quay Phase 1 and Phase 2 developments are predicted to result in a slightly adverse impact on air quality along La Route du Port Elizabeth and air quality in the whole of the area surrounding the developments is expected to comfortably meet the air quality objectives.

Energy from Waste and Bulky Waste Facilities

The development consists of the new States Energy from Waste (EfW) facility to recover energy from Jersey's residual solid waste and a Bulky Waste Facility (BWF) to recycle or shred bulky waste for energy recovery; burning the waste to generate steam which is used to generate electricity. The facility is designed to process up to an annual capacity of 126,000 tonnes of municipal solid waste;, delivered in refuse collection vehicles. The bulky waste will be delivered to the Bulky Waste Facility and then shredded on site prior to combustion. The facility is expected to be fully operational in 2010.

The development is located on the reclamation area of La Collette, which lies to the south east of St. Helier Harbour and the town of St. Helier; bounded to the north east by Havre des Pas and east, south and west by the sea.. The site is directly south of the Jersey Electricity Company (JEC) power station, enabling some existing facilities to be shared.

The existing waste facility at Bellozane has out-of-date air cleaning technology, and it is a significant producer of air pollution on the Island. The proposed facility would process similar amounts of waste to the existing Bellozanne facility, but by using state-of-the-art air cleaning technology, it will significantly improve Jersey's emissions to air.

The flue gases released by the new facility during the combustion process would be cleaned by passing the cooled flue gases through gas scrubbers, where hydrated lime or quicklime and water would be used to remove acid gases, a spreader will feed activated carbon into the stream to enhance the capture of dioxin, mercury and other heavy metals and the flue gases will pass through fabric filters to remove dust particles. The flue gases will then be conveyed by ducts to the adjacent Jersey Electricity Company power station chimney for release to the atmosphere.

The impact of this development on the air quality of the surrounding area has been assessed in the EIA which accompanied the planning application. The air quality assessment considered the potential impacts from the proposed Energy from Waste facility, which include:

- flue gas emissions from the waste combustion process;
- nuisance odour from the feed waste handling process;
- nuisance odour and dust from the residual ash handling and disposal;
- dust and vehicle emissions during construction of the facility; and
- emissions from operational vehicles and traffic accessing the site.

An air dispersion model of both the old facility and the new was carried out; allowing a comparison emissions to be between the old and new processes.

The air quality assessment concluded that for all pollutants the new facility should have a beneficial reduced impact on the Island's air quality compared to the current facility at Bellozane. It predicted that the new facility will cause no failures of European air quality objectives or guidelines to occur.

The changes in road traffic levels associated with the introduction of operational traffic are not predicted to give rise to any significant changes in air quality during the operation of the Energy from Waste facility. Operational traffic is predicted to lead to increases in pollutant concentrations of less than 2.5% of the relevant EU limit values. The total pollutant concentrations estimated with the development in operation are well below EU limit values.

Ann Court

The proposed Ann Court development is an above ground multi-storey car park with new or refurbished housing wrapped around the building to reduce its impact on the local streetscape. The development is within the block bound by Ann Place, Ann Street, Charles Street and Providence Street, and if developed could be completed during 2010.

The car park will have 794 spaces, with frontages on Ann Place and Providence Street and will replace both Gas Place and Minden Place Car Parks. The proposed scheme includes the retention and refurbishment of the terrace of period houses on Ann Street which are Buildings of Local Interest (allowing their use as 8 homes) and the construction of 30 new social housing flats on the east and south of the site, forming the frontages to Ann Street and Charles Street. The Millennium Town Park will replace the existing Gas Place Car Park.

Ann Court is presently used as social housing which is reaching the end of its useful life and would otherwise need to be rebuilt or renovated to meet modern standards. This proposal is to replace the majority of the housing units with a multi-storey car park.

The roads immediately surrounding Ann Court (Ann Place, Ann Street, Providence Street and Charles Street) are all one-way with single lane traffic and on street parking in most locations. The streets can be classed as 'street canyons' in most circumstances, particularly with the development in place. The development is likely to increase traffic around Ann Court therefore affecting air quality in that area. An environmental impact assessment, which includes an assessment of air quality, will form part of the schemes planning application preparation.

Westmount Quarry

The redevelopment of the Westmount Quarry site assessed in this report includes rock stabilisation woks, 210 residential units in 4 blocks of up to 12 storeys, a 60-bed nursing home, 300 car park spaces, a nursery and 2,500 sq ft of commercial units.

The site is approximately 1.8 hectares lying within the urban area of St. Helier, between Westmount Road and Old St Johns Road. A Jewish cemetery is located on the eastern boundary, Park heights lies immediately to the north, Westmount Park immediately to the south-east and there are residential properties within 10m of the Quarry. The site has been partially in-filled and used as the Parish depot until March 2001; some buildings remain on site.

An Environmental Impact Assessment Scoping study has been undertaken which outlines the main potential impacts of the proposed mixed-use development on air quality as the:

- Possible high localised concentrations of particulate matter (PM_{10}) and nitrogen dioxide (NO_2) from any underground car park extraction system;
- Dust annoyance and elevated levels of PM_{10} during construction;
- Increased exposure to poor air quality due to the introduction of new dwellings; and
- Increase concentrations of PM_{10} and NO_2 arising from development traffic

The Scoping study states that the development is not expected to increase traffic flows by more that 10% which will not cause any significant effect on local air quality.

The Scoping study also outlines the scope of the air quality assessment to be undertaken to support the planning application. The air quality assessment will include an assessment of the baseline conditions, assessment of monitoring data and any modelling done for this development, confirm the suitability of the site for residential use from an air quality

perspective and an assessment of the impact of construction activities on concentrations of PM_{10} and dust complaints. No assessment of traffic generated air pollution will be included in the air quality assessment unless predicted traffic growth exceeds 10% of existing flows.

Cumulative Assessment

The developments will influence air pollution by virtue of the vehicles emissions travelling on St. Helier's road network. The Energy from Waste (EfW) facility will also contribute to air pollution concentration due to the release of flue gases.

The developments will have both adverse and beneficial impacts on air pollution concentrations in St. Helier. Adverse impacts will be experienced due to increased traffic flows as a result of the operation of the various developments; however some areas will also experience beneficial impacts due to the re-routing of traffic travelling on St. Helier's road network. For example the relocation of some commercial and retail premises to the Esplanade development and the replacement of both the Gas Place and Minden Place car parks with the Ann Court car park.

The Energy from Waste (EfW) facility will also contribute to air pollution due to the release of flue gases; however, the new facility should have a beneficial impact on air quality due to the impact of decommissioning the current out-of-date facility at Bellozanne.

Each development EIA has concluded that their contribution will have slight adverse or negligible impacts of air quality; however combined these emissions may be significant.

This assessment is a cumulative assessment of all the developments undertaken to determine whether in combination the developments will have more significant impact on air quality in St. Helier.

8.3 Air Quality Monitoring

Automatic Monitoring Sites

The assessment has considered continuous chemiluminescence NO_2 automatic monitoring data from the monitoring station situated at the Central Market, Halkett Place, St. Helier (see Figure 8.2). This automatic monitoring site started operation in January 2008. Details of the automatic monitoring site are presented in Table 8.1.

Table 8.1: Details of Automatic Monitoring Site

Site Name	Site Type	Grid Ref	Pollutants Monitored	Method
Central Market, Halkett Place	Roadside	653 486	NO_x & NO_2	Automatic chemiluminescence analyser

Table 8.2 summarises the measurements of oxides of nitrogen recorded by the automatic analyser at Halkett

Table 8.2: Continuous Monitoring Data

Period	NO_x, Concentration, $\mu g\ m^{-3}$ as NO_2	NO_2 Concentration, $\mu g\ m^{-3}$	Number of 1-Hour Means > 200 $\mu g\ m^{-3}$-	Data Capture, %
2008[32]	64	32	0	90

Monitoring started in 2008 on the 23/02/08, data capture in this period was 90%. The 1-hour mean at the Halkett Place automatic monitoring site did not exceed 200 $\mu g\ m^{-3}$ on any occasion during the year. Therefore this site meets the hourly mean EC Directive Limit Value and AQS Objective for this parameter. The annual mean concentration of 32 $\mu g\ m^{-3}$ at Halkett Place is within the EC Limit Value of 40 $\mu g\ m^{-3}$.

[32] Monitoring commenced 23rd January 2008

The assessment has also considered Osiris PM_{10} monitoring data from the monitoring stations situated at the Central Market, Halkett Place, St Helier (see Figure 8.2). Details of the monitoring sites are presented in Table 8.3.

Table 8.3: Details of Osiris Monitoring Sites

Site Name	Site Type	Grid Ref	Pollutants Monitored	Method
Central Market, Halkett Place	Roadside	653 486	PM_{10}	Osiris

Table 8.4 summarises the Osiris monitoring data.

Table 8.4: Osiris Monitoring Data, 2008

Site Name	PM_{10} Concentration, $\mu g\ m^{-3}$
Central Market, Halkett Place	25.39

In 2008 the annual mean PM_{10} concentration recorded at the Central Market monitoring location was 25.39 $\mu g\ m^{-3}$ meeting the EC Limit Value of 40 $\mu g\ m^{-3}$ for annual mean PM_{10}.

Non-Automatic Monitoring

States of Jersey operates a network of nitrogen dioxide diffusion tubes. There are currently 12 diffusion tube locations; in 2007 24 NO_2 diffusion tube sites were in use. Diffusion tubes are co-located in triplicate with the automatic monitoring site at Halkett Place; all other diffusion tubes are single. The locations of the diffusion tubes of relevance for this study are listed in Table 8.5 and shown in Figure 8.2.

From February 2007 onwards, diffusion tubes were prepared by Gradko International Ltd.

The Local Air Quality Management Technical Guidance LAQM.TG(09) states that when using diffusion tubes for indicative NO_2 monitoring, correction should be made where applicable for any systematic bias (i.e. over-read or under-read compared to the automatic chemiluminescent technique, which is the reference method for NO_2). The 2007 bias adjustment factor applied to the annual mean diffusion tube measurements was 0.87. This is based on 10 studies carried out by UK Local Authorities, using tubes of the same type and from the same supplier. It was obtained from a spreadsheet database maintained by Air Quality Consultants, available on the Web at http://www.uwe.ac.uk/aqm/review/diffusiontube290208.xls. In 2008 by co-locating diffusion tubes with the automatic monitoring site at Halkett Place, it was possible to calculate a bias adjustment factor, which could then be applied to the annual mean diffusion tube measurements.

Table 8.5: Details of Non- Automatic Monitoring Sites

Site Name	Site Type	Grid Reference	Description
Central Market, Halkett Place	Roadside	653 486	Halkett Pl., St Helier – co-located in triplicate with automatic site.
Le Bas Centre	Urban Background	658 489	
Weighbridge	Roadside	651 483	Bus station near centre of St Helier
Georgetown	Kerbside	661 480	On major road
The Parade	Roadside	648 489	General Hospital
Jane Sandeman *(Ceased Feb 2008)*	Urban background	652 494	On housing estate
Saville Street *(Ceased Feb 2008)*	Background	648 492	
Broad Street	Urban background	652 486	
Beresford Street *(Ceased Feb 2008)*	Urban background	653 486	
La Pouquelaye *(Ceased Feb 2008)*	Kerbside	654 496	On St Helier ring road.
Union Street	Kerbside	653 486	In St Helier – corner of Union St. & New St.
New Street	Kerbside	653 485	St Helier
Havre des Pas *(Ceased Feb 2008)*	Kerbside		Beside main A4 in/out of St Helier
Commercial Buildings *(Ceased Feb 2008)*	Kerbside		Commercial Buildings, St Helier
Seaton Place *(Ceased Feb 2008)*	Kerbside	648 487	
Liberation Station	Kerbside	652 485	Opposite entrance to new bus station

Kerbside: less than 1m from kerb of a busy road.
Roadside: 1-5m from kerb of a busy road.
Background: > 50m from the kerb of any major road.

Note: all grid references are from OS 1:25000 Leisure Map of Jersey and are given to the nearest 100m.

The 2007 and 2008 un-adjusted and adjusted annual mean NO_2 diffusion tube results are presented in Table 8.6

Table 8.6. NO_2 Diffusion Tube Results 2007 and 2008

Site Name	Site Type	Grid Reference	2007 Annual Mean NO_2/µg m^{-3}		2008 Annual Mean NO_2/µg m^{-3}	
			Un-adjusted Average	Bias adjusted Average	Un-adjusted Average	Bias adjusted Average
Central Market, Halkett Place (avg. of 3 tubes)	Roadside	653 486	34.3[33]	29.8	32	31
Weighbridge	Roadside	651 483	41.4	36.0	38	38
The Parade	Roadside	648 489	27.9	24.2	26	25
Jane Sandeman	Urban background	652 494	13.9	12.1	-	-
Saville Street	Background	648 492	26.3	22.9	-	-
Broad Street	Urban background	652 486	35.4	30.8	34	33
Beresford Street	Urban background	653 486	30.5	26.5	-	-
La Pouquelaye	Kerbside	654 496	35.9	31.2	-	-
Union Street	Kerbside	653 486	32.1	27.9	28	28
New Street	Kerbside	653 485	25.2	22.0	24	24
Havre des Pas	Kerbside		21.9	19.0	-	-
Commercial Buildings	Kerbside		34.7	30.2	-	-
Seaton Place	Kerbside	648 487	24.6[34]	21.4	-	-
Liberation Station	Kerbside	652 485	38.5[35]	33.5	32	32

In 2007 adjusted annual mean NO_2 concentrations ranged from 12.1μg m^{-3} (at the Jane Sandeman site) to 36 μg m^{-3} at the Weighbridge site. The latter is a location in the centre of St Helier used as a central stopping point for buses. All sites therefore met the EC Limit Value of 40 μg m^{-3} for annual mean NO_2 during 2007.

In 2008 annual mean NO_2 concentrations (after application of this bias adjustment factor) ranged from 22 μg m^{-3} (at the Le Bas Centre site) to 38 μg m^{-3} at the Weighbridge site. In 2008 all the relevant sites met the EC Limit Value of 40 μg m^{-3} for annual mean NO_2.

[33] 11 months of data
[34] 7 months of data
[35] 3 months of data

Figure 8.2: St. Helier Monitoring Sites

8.4 Assessment Methodology

The cumulative impact of the five proposed developments on air quality was assessed using ADMS 4.1 and AEA's proprietary urban model (LADS Urban).

The impacts of the five developments have been assessed for the following scenarios:

- The predicted baseline levels for NO_2 and PM_{10} in 2008;
- The predicted levels for NO_2 and PM_{10} in 2008 "with" the developments.

The assessment of impacts has been undertaken by calculating whether the NO_2 and PM_{10} levels are expected to improve, or deteriorate, at specific receptor locations as a result of the proposed developments.

Information Used to Support this Assessment

Maps

States of Jersey provided electronic OS MasterMap™ data, for the Geographical Information System (GIS) used in this assessment. The maps were used to provide details of the location of road centrelines and road widths. Individual buildings or groups of buildings (receptors) were also identified. The distance of receptors from the roads was accurately determined from the mapping.

Road Traffic Data

States of Jersey provided traffic data which best represented the cumulative impact of the five developments for the roads and junctions assessed from their Traffic Model. The data included:

- base model am and pm peak hour flows;
- forecast models for all known developments am and pm peak hour flows;
- conversion factors (peak to AADT);
- classification surveys; and
- speed surveys.

The base year for the traffic flows was assumed to be 2008.

Street Canyons

A number of streets in the vicinity of the Ann Court Development are classed as 'street canyons', however for the purposes of this modelling assessment, 'street canyons' have not been specifically modelled. Monitoring undertaken as part of the Ann Court Development does not indicate any elevated levels of NO_2 at this location. Therefore concentrations predicted by this modelling assessment, should be representative of pollutant concentrations in the vicinity, including at streets classed as 'street canyons' around the Ann Court development.

Point Sources

Data concerning the two waste facility point source emissions (the existing Bellozanne facility and the proposed La Collette Energy from Waste site) were modelled discreetly using ADMS 4.1 with data taken from the proposed La Collette Energy from Waste Site EIA (Babtie Fichtner, 2007).

Table 8.7 Summary of Point Sources Modelled Discretely and Emissions in mg/m^3

Site	Oxides of nitrogen (as NO_2)	Particulates (PM_{10})
Bellozanne Current Facility	400	50
La Collette Proposed Energy from Waste Facility	200	10

It has been assumed that all of the nitrogen oxides are released as nitrogen dioxide. This will overestimate the ground level concentration of nitrogen dioxide. Modelled emissions from point sources were then added to emissions from road traffic sources, and background

concentrations to produce concentrations of NO_2 and PM_{10} pertaining to all sources at specific receptors and as contour plots.

Emission factors

The vehicle emission factors used for national mapping were revised in 2001 by Defra and the devolved administrations[36]. The most recent finalised emission factors have been used in this Assessment.

Background Concentrations

Nitrogen Dioxide (NO_2)

An urban background nitrogen dioxide concentration of 22 µg m^{-3} for 2008 based on measurements from the Le Bas Centre diffusion tube-monitoring site was added to the modelled concentrations.

Particulates (PM_{10})

A background PM_{10} concentration of 24 µg m^{-3} for 2008 based on measurements from the Central Market Osiris monitoring data, minus modelled contributions of road and current waste facility concentrations at that location, was added to the modelled concentrations.

Overview of Modelling (Summary of the Models Used)

The air quality impact of the five developments has been assessed using our proprietary urban model (LADS Urban). There are two parts to this model:

- The *Local Area Dispersion System (LADS) model*. This model calculates background concentrations of oxides of nitrogen on a 1 km x 1 km grid.
- The *DISP model*. This model is a tool for calculating atmospheric dispersion using a 10 m x 10 m x 3 m volume-source kernel derived from ADMS 4.1 to represent elements of the road. The volume source depth takes account of the initial mixing caused by turbulence induced by the vehicles. Estimates of emissions from vehicles have been calculated using the latest (and finalised for this round of Review and Assessment) vehicle emission factors.

Concentrations of NO_2 and PM_{10} from road traffic emissions were modelled with a resolution of 10 m close to the roads as recommended in the Technical Guidance LAQM.TG (09).

Hourly sequential meteorological data for 2008 for Jersey Airport, St Peters, approximately 7 km west of St Helier was used. A surface roughness of 1 m was assumed in the modelling to represent the urban conditions common to the most exposed sites. An intelligent grid system was used with receptors at 10 m intervals on a rectangular grid within 150 m of modelled roads; more widely spaced receptors elsewhere.

All the models used in the assessment make a number of assumptions during the calculations. These include no consideration of terrain relief over the surface being modelled. Modelling of pollutant concentrations on roads can sometimes provide misleading information on produced contour maps. For example, polygons and circles on certain areas of the contour maps, e.g. roundabouts or the centres of roads can be generated. This is not a deficiency of the model; it is an artefact of the data and the use of discreet receptor points. As such, these additional features should be ignored and the wider context and implications of the contour maps be considered.

Relationships between Nitrogen Oxides and Nitrogen Dioxide

Nitrogen oxides, NO_X ($NO+NO_2$) are predominantly emitted into the atmosphere in the form of nitric oxide (NO) which is then converted to nitrogen dioxide (NO_2) through chemical processes in the atmosphere. Under most atmospheric conditions the dominant pathway for NO_2 formation is via the reaction of NO with ozone (O_3).

[36] The new set of emission factors on the NAEI website (www.naei.org.uk/emissions/index.php) approved by DEFRA and DTLR for use in emissions and air quality modelling, following consultation of the TRL Report "Exhaust Emission Factors 2001: Database and Emission Factors" by TJ Barlow, AJ Hickman and P Boulter, TRL, September 2001

LAQM.TG(09) states that recent trends in concentrations of NO_X have shown a general downward trend across urban areas, in line with the reductions in emissions from road traffic. However, measured NO_2 concentrations have not declined as expected, particularly at roadside sites; at some locations levels have actually increased in recent years.

The AQEQ report (2007) investigated these unexpected findings, and concluded that the most plausible explanation was an increased proportion of direct (or primary) NO_2 emission from road traffic, often referred to as "f-NO_2". Increased primary NO_2 emissions are associated with the greater penetration of diesel cars into the vehicle fleet, and the use of catalytically regenerative particle traps on some heavy-duty vehicles. The proportion of primary NO_2 emissions has been steadily increasing over recent years, and looks set to increase up to 2015, albeit at a slower rate.

LAQM.TG(03) outlined an approach to calculating NO_2 from NO_X concentrations at roadside sites. This approach was updated in 2007 to take account of the historic change in the proportion of primary NO_2 emissions, but it was always recognised that such an empirically-derived method was not suited to the prediction of NO_2 concentrations in future years.

LAQM.TG(09) presents a new approach to calculating NO_2 from NO_X concentrations, taking account the difference between fresh emissions of NO_X and background NO_X, the concentration of O_3, and the different proportions of primary NO_2 emission over different years. This approach has been used to calculate nitrogen dioxide concentrations from the oxides of nitrogen concentrations predicted by LADS Urban.

Validation and Verification of the Model

In simple terms, validation of the model is the process by which the model outputs are tested against monitoring results at a range of locations and the model is judged to be suitable for use in specific applications. The modelling approach used in this assessment has been validated and the LADSUrban model has been used in numerous AEA Air Quality Assessments.

Verification of the model involves comparison of the modelled results with any local monitoring data at relevant locations. Table 8.8 compares modelled predictions using LADS Urban of nitrogen dioxide concentrations with measured values at the States of Jersey monitoring sites.

Table 8.8: Comparison of Modelled and Measured Nitrogen Dioxide Concentrations at Monitoring Sites, 2008

Site	Concentration, µg m^{-3}		% Difference
	Measured	Modelled	
Central Market, Halkett Place (automatic monitor)	32	27	-17
Weighbridge	38	29	-24
The Parade	25	27	9
Broad Street	33	26	-20
Union Street	28	28	0
New Street	24	24	0
Liberation Station	32	27	-16
Halkett Place	31	27	-13

The model has provided satisfactory predictions of the measured nitrogen dioxide concentrations without adjustment and so no adjustment has been made.

Figure 8.3 shows that in 2008, the model did not exhibit any systematic under or over prediction of NO_2 concentrations. The 1:1 line is an ideal representation of modelled concentrations. Figure 3.1 illustrates that the model output was encouraging with all sites lying within the +/- 30% DQO range.

Figure 8.3: Comparison of Modelled and Measured Nitrogen Dioxide Concentrations at Monitoring Sites, 2008

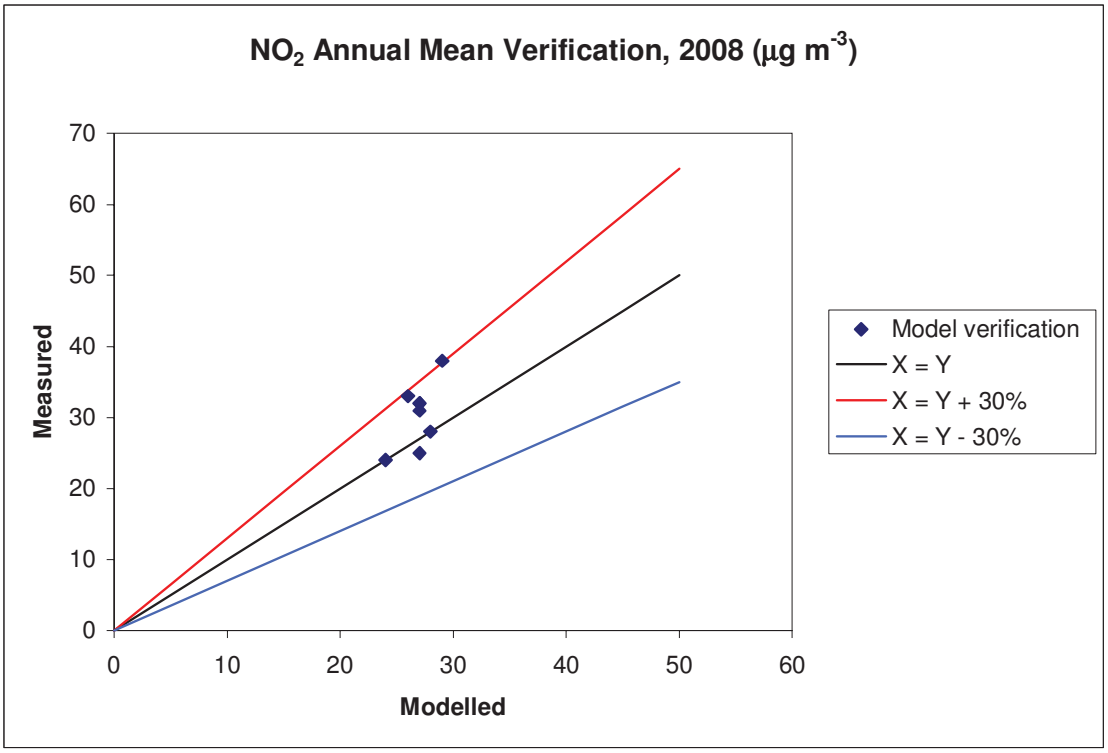


Table 8.9 compares modelled predictions using LADS Urban of particulate concentrations with measured values at the States of Jersey monitoring sites.

Table 8.9: Comparison of Modelled and Measured PM_{10} Concentrations at the Osiris Monitoring Site, 2008

Site	Concentration, µg m^{-3}		% Difference
	Measured	Modelled	
Central Market	**25**	**25**	0

The model has provided satisfactory predictions of the measured particulate concentrations without adjustment and so no adjustment has been made.

Model uncertainty

The results of dispersion modelling of pollutant concentrations are uncertain because of the uncertainties in the estimation of rates of emission, meteorological data and dispersion conditions. Table 8.10 shows confidence levels for modelled nitrogen dioxide concentrations based on a statistical analysis of a comparison of modelled and measured concentrations in London (LAQM.TG (03)). In this report, we present predicted concentrations as contour plots superimposed on a map of the local area.

The concentration values are shown in Table 8.10. Predicted concentrations in excess of 40 µg m^{-3} indicate that there is more than 50% chance of exceeding the annual average objective for NO_2. Public exposure in these areas should be considered in order to assess whether it will be necessary to declare an Air Quality Management Area for NO_2.

Table 8.10: Confidence Levels for Modelled Concentrations for Future Years

Description	Chance of Exceeding Objective	Annual Average Objective
Very unlikely	Less than 5%	< 28
Unlikely	5 to 20%	28 to 34
Possible	20 to 50%	34 to 40
Probable	50 to 80%	40 to 46
Likely	80 to 95%	46 to 52
Very likely	More than 95%	> 52

Model Limitations

This assessment concentrates on modelling annual mean concentrations. This is because it is inherently more difficult to make satisfactory predictions for short-term behaviour of pollutants than it is to model an annual mean value.

It should also be noted that the modelling process is dependant in the first instance upon projected traffic data. Where this data is subject to change, it may affect the results of the modelling process.

Due regard has been taken of all the above limitations in the following assessment.

Significance Criteria

The NSCA [now EPUK] guidance provides criteria on how to assess significance of an impact. According to the NSCA there are three aspects of the impact that need to be taken into account when determining significance:

- The magnitude of the change;
- The absolute concentrations in relation to air quality objectives; and
- The number of people exposed to the change.

Table 8.11 sets out the criteria for the magnitude of change in relation to NO_2 and PM_{10}.

Table 8.11: Criteria for the Magnitude of Change in Relation to NO_2 and PM_{10}.

Magnitude of change	Annual Mean NO_2/PM_{10}(Increase/Decrease)
Very Large	>25%
Large	15-25%
Medium	10-15%
Small	5-10%
Very Small	1-5%
Extremely small	<1%

The impact of significance can be assessed taking into account the magnitude of change, both positive and negative, and the absolute concentration in relation to the air quality objective. Table 8.12 displays the impact significance criteria.

Table 8.12: Impact Significance Criteria

Absolute Concentration in Relation to Standard	Extremely Small	Very Small	Small	Medium	Large	Very Large
Decrease with Scheme						
Above standard with scheme	Slight beneficial	Slight beneficial	Substantial Beneficial	Substantial Beneficial	Very Substantial Beneficial	Very Substantial Beneficial
Above standard without scheme Below with scheme	Slight beneficial	Moderate Beneficial	Substantial Beneficial	Substantial Beneficial	Very Substantial Beneficial	Very Substantial Beneficial
Below Standard without scheme, but not well below	Negligible	Slight beneficial	Slight beneficial	Moderate Beneficial	Moderate Beneficial	Substantial Beneficial
Well Below standard without scheme	Negligible	Negligible	Slight beneficial	Slight beneficial	Slight beneficial	Moderate Beneficial
Increase with Scheme						
Above standard without scheme	Slight Adverse	Slight Adverse	Substantial Adverse	Substantial Adverse	Very Substantial Adverse	Very Substantial Adverse
Below standard without scheme Above with scheme	Slight Adverse	Moderate Adverse	Substantial Adverse	Substantial Adverse	Very Substantial Adverse	Very Substantial Adverse
Below Standard with scheme, but not well below	Negligible	Slight Adverse	Slight Adverse	Moderate Adverse	Moderate Adverse	Substantial Adverse
Well Below standard with scheme	Negligible	Negligible	Slight Adverse	Slight Adverse	Slight Adverse	Moderate Adverse

Note: Well below the standard = 75% of the standard level (air quality objective/Limit value)

Worst-case development air quality impacts have been quantitatively assessed by modelling the effect of the developments comparing the "with" and "without" development scenarios. The resultant changes in air quality have then been assessed against the significance criteria given in Table 8.11 and 8.12.

8.5 Detailed Modelling Results

In this section, NO_2 and PM_{10} concentrations predicted for the base case (2008) and for the 'with development' scenario are presented at specific receptor locations around the developments and as a series of contour plots.

Sensitive receptors relevant to the proposed developments, such as residential dwellings, schools and hospitals have been identified using maps and information gathered from the development EIAs.

The base case assessment is defined as the annual mean concentration of NO_2 and PM_{10} that is predicted in 2008 in the absence of the five developments. The 'with development' assessment is defined as the annual mean concentration of NO_2 and PM_{10} that is predicted in 2008 with the five developments but minus the current Bellozane waste facility

Nitrogen Dioxide

Concentrations of NO_2 at the receptor locations for the base case and the 'with developments' scenario was predicted for 2008 using the modelling techniques summarised in Section 8.4. The total annual average NO_2 concentration plots for 2008 are presented in Figure 8.4 (Base) and Figure 8.5 ('With Developments').

Figure 8.4: Predicted Nitrogen Dioxide Concentrations Base

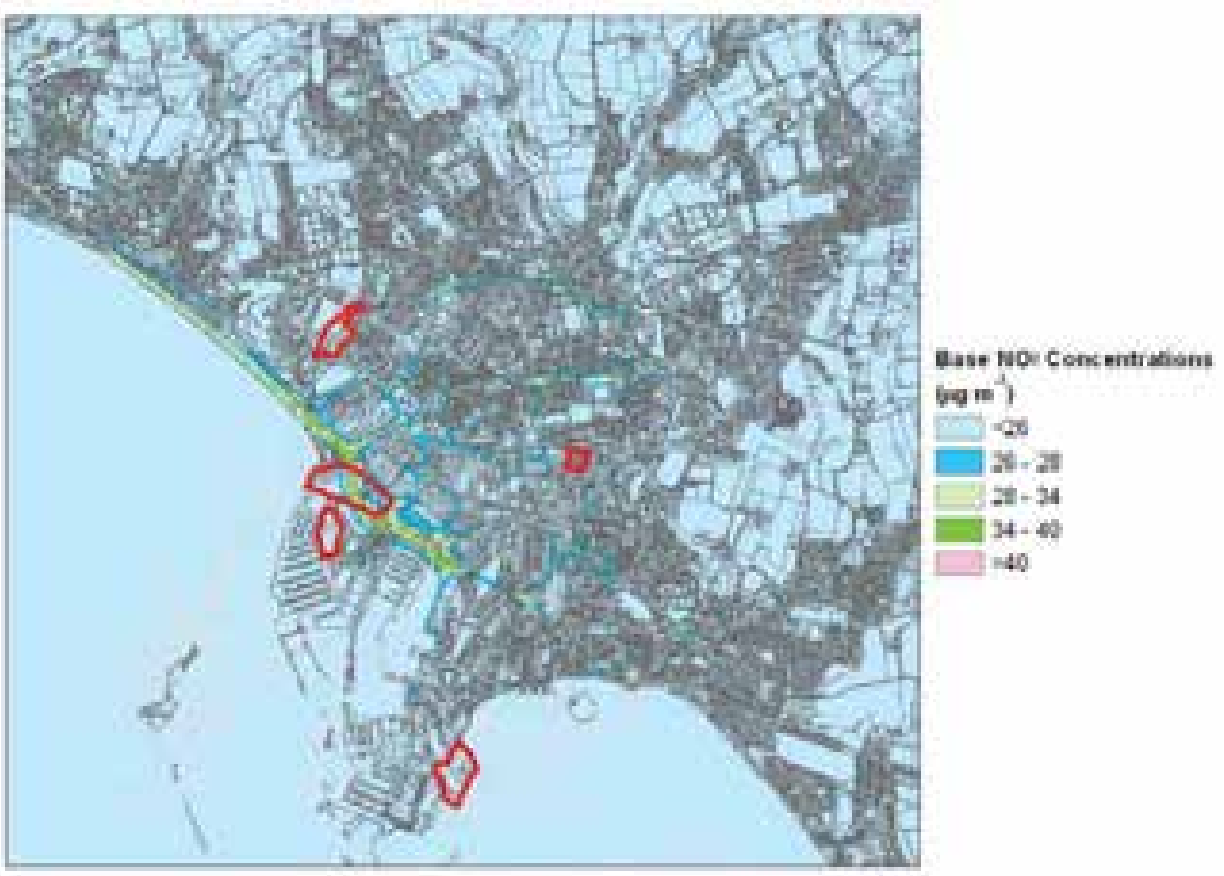
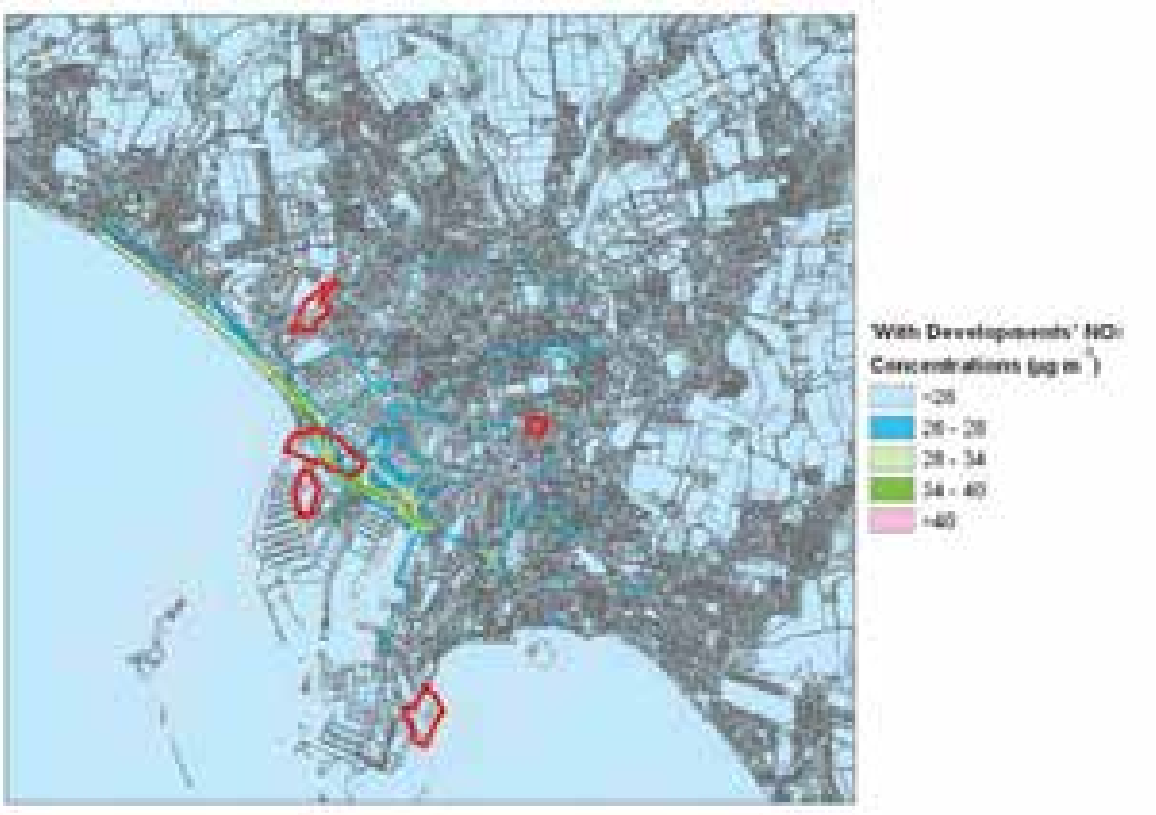


Figure 8.5: Predicted Nitrogen Dioxide Concentrations 'With Developments'



Total annual average NO_2 results for 2008 at receptor locations, both for the base case and the 'With Developments' scenario, are presented in Tables 8.13 – 8.17. Figures 8.6, 8.9, 8.12, 8.15 and 8.18 present the locations of the specific receptor locations surrounding the developments. Figures 8.7, 8.10, 8.13, 8.16 and 8.19 present the total annual average NO_2 concentration plots for the base scenario around the receptor locations and Figures 8.8, 8.11, 8.14, 8.17 and 8.20 present the total annual average NO_2 concentration plots for the 'With Development' scenario around the receptor locations.

Table 8.13: Concentrations of NO_2 at Receptor Locations Around the Esplanade Quarter and Castle Quay Developments for the Base and 'With Developments' Scenarios (see Figure 8.6)

Receptor	X	Y	$N0_2$ (μg m^{-3})		% Difference
			Base	With	
1	41378	65407	23	23	0
2	41403	65805	28	28	1
3	41425	65765	37	33	-10
4	41450	65206	23	24	2
5	41462	65440	24	25	3
6	41469	65348	24	24	0
7	41507	65689	34	33	-5
8	41543	65436	32	31	-2
9	41572	65652	26	25	-5
10	41579	65186	25	25	1
11	41602	65384	35	36	3
12	41621	65759	28	27	-2
13	41631	65583	26	27	5
14	41659	65334	30	29	-3
15	41682	65533	26	27	2
16	41775	65342	33	29	-10
17	41800	65433	26	28	7
18	41860	65220	27	27	1
19	41916	65329	30	33	10
20	41986	65243	27	27	0
21	41986	65321	28	28	2
22	42241	65044	27	27	1
23	42335	65046	36	36	0
24	42390	64947	26	26	1

Table 8.13, Figure 8.7 and Figure 8.8 show modelled nitrogen dioxide concentrations in 2008 at receptor locations around the Esplanade Quarter and the Castle Quay developments. The Table shows that the EC Limit Value of 40 μg m^{-3} for annual mean NO_2 is likely to be met at all locations in both scenarios.

The highest predicted concentration in the base scenario (2008) at a receptor location was 36 μg m^{-3} at receptor 3, situated on Esplanade between Patriotic Street and Kensington Place. The highest predicted concentration in the 'with developments' scenario (2008) at a receptor location was 37 μg m^{-3} at receptors 11 and 23; receptor 11 fronts La Route de le Libération, and receptor 23 is situated close to the tunnel and La Route du Fort roundabout.

A comparison of the base scenario and the 'with' developments scenario indicates that adverse impacts of up to 3 μg m^{-3} (10%)are likely as a result of the developments, the largest impact occurring at receptor 19, fronting Esplanade on the corner of Conway Street. An increase of 3 μg m^{-3} (10%) can be described as being of a small magnitude according to the EPUK criteria described in Table 8.11.

The comparison of the base scenario with the 'with' developments scenario indicates beneficial impacts will be experienced at some receptors in the vicinity of Esplanade Quarter and the Castle Quay developments; a decrease of up to 4 μg m^{-3} likely as a result of the developments, the largest beneficial impacts occur at receptors 3 (although still the worst predicted air quality location) situated on Esplanade between Patriotic Street and Kensington Place and 16, which fronts La Route de le Libération, where decrease of 10% are experienced. A decrease of 10% in NO_2 concentrations can be described as having a small magnitude according to the EPUK criteria described in Table 8.11.

The overall significance of the impact of the five developments on receptors in the vicinity of Esplanade Quarter and the Castle Quay developments compared with the base scenario can be described as being of slight adverse to slight beneficial significance overall according to the criteria in Table 8.12, the annual mean concentrations are predicted to be below the 40 µg m^{-3} annual mean objective at all receptors assessed.

Figure 8.6: Receptor Locations Assessed Around the Esplanade Quarter and Castle Quay Developments

Figure 8.7: Predicted Nitrogen Dioxide Concentrations Base Around the Esplanade Quarter and Castle Quay Developments

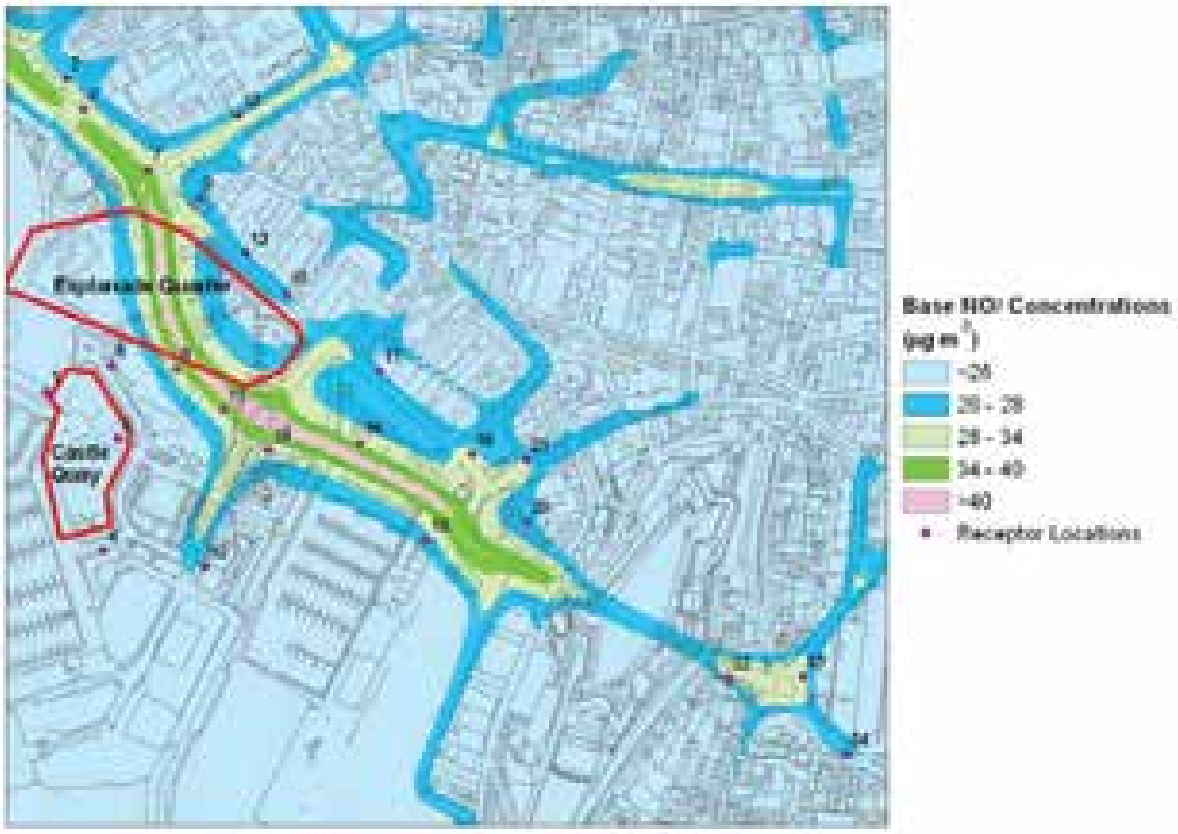


Figure 8.8: Predicted Nitrogen Dioxide Concentrations 'With Developments' Around the Esplanade Quarter and Castle Quay Developments

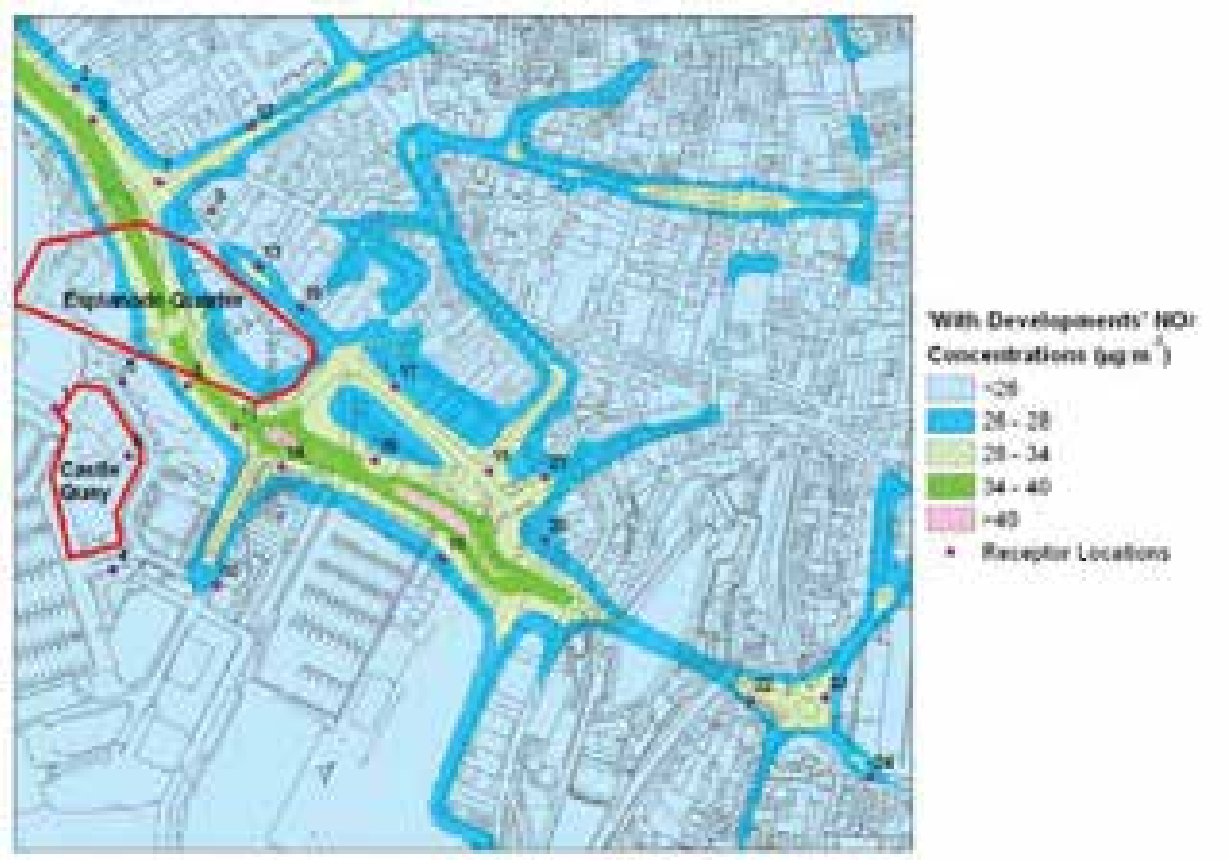


Table 8.14: Concentrations of NO_2 at Receptor Locations Around the Current Bellozane Waste Facility for the Base and 'With Developments' Scenarios (see Figure 8.9)

Receptor	X	Y	$N0_2$ (µg m^{-3})		% Difference
			Base	With	
1	40215	67494	22	22	-1
2	40614	67859	22	22	-1
3	40730	67210	22	22	0
4	40787	67048	22	22	0
5	40788	66973	23	23	0
6	40842	66364	27	27	2
7	40931	66985	22	22	0
8	41006	67140	22	22	0
9	41279	67146	23	22	-2
10	41336	67296	23	22	-2
11	41424	67460	23	22	-2
12	41427	67399	23	22	-3
13	41440	67248	23	22	-3
14	41562	66679	24	24	-2
15	41575	67198	24	23	-3

Table 8.14, Figure 8.10 and Figure 8.11 show modelled nitrogen dioxide concentrations in 2008 at receptor locations around the current Bellozane Waste Facility. The Table shows that the EC Limit Value of 40 µg m^{-3} for annual mean NO_2 is likely to met at all locations in both scenarios. The highest predicted concentration in both the base and 'with developments' scenarios (2008) was predicted to be 27 µg m^{-3} occurring at receptor 6, situated on La Route de St. Aubin approximately 770 m south of the current Bellozane Waste Facility. This location is likely to be influenced by the road traffic on La Route de St. Aubin rather than concentrations from the Waste Facility.

A comparison of the base scenario with the 'with' developments scenario, indicates that at most receptor locations assessed no impact or a slight beneficial impact of up to 1 µg m^{-3} (1-3%) is likely. A decrease of up to 3% can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11.

The overall significance of the impact of the five developments on receptors in the vicinity of the current Bellozane Waste Facility compared with the base scenario can be described as having negligible significance overall according to the criteria in Table 8.12, as annual mean concentrations are predicted to be well below the 40 µg m^{-3} annual mean objective at all receptors assessed.

Figure 8.9: Receptor Locations Assessed Around the Current Bellozane Waste Facility

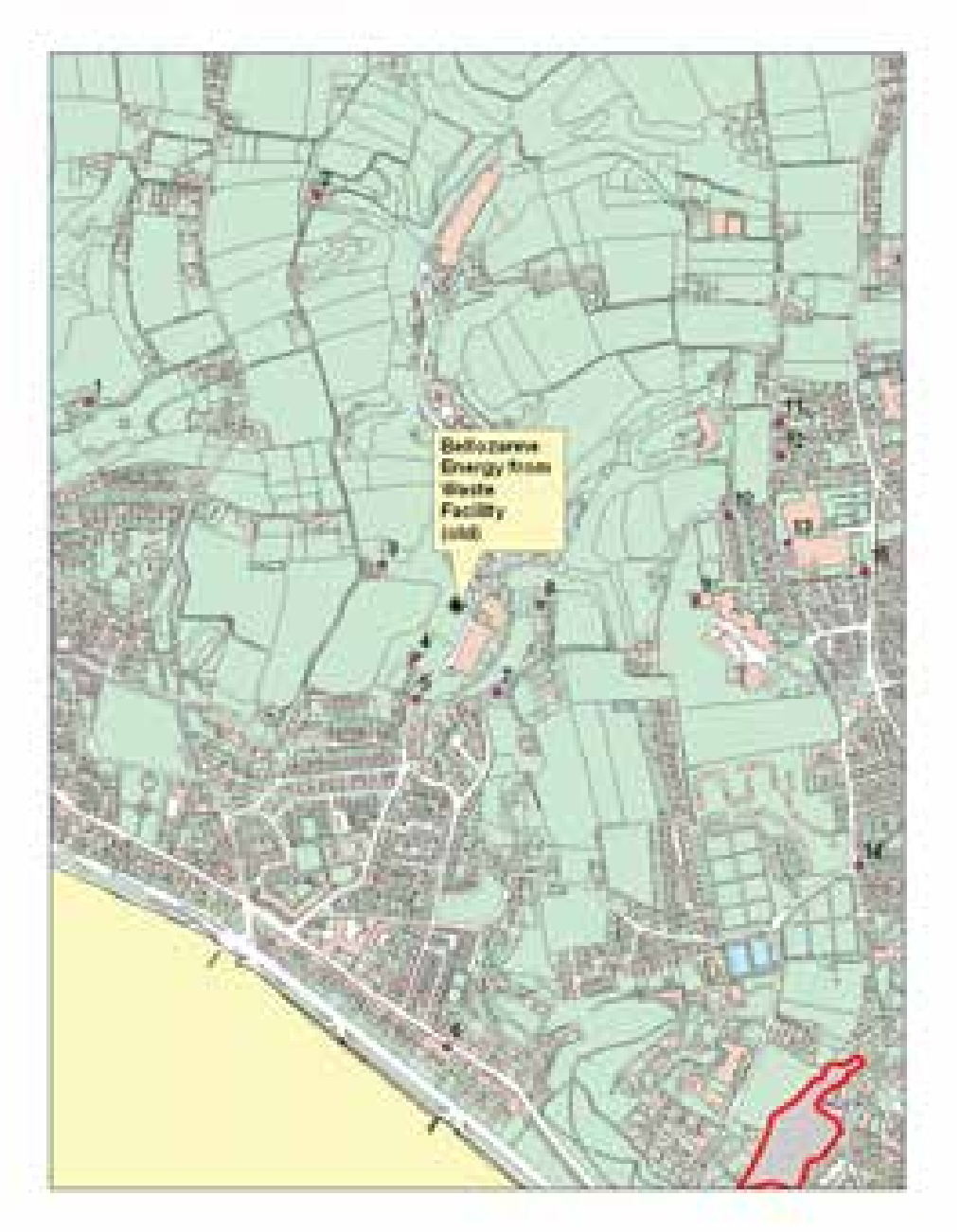


Figure 8.10: Predicted Nitrogen Dioxide Concentrations Base Around the Current Bellozane Waste Facility

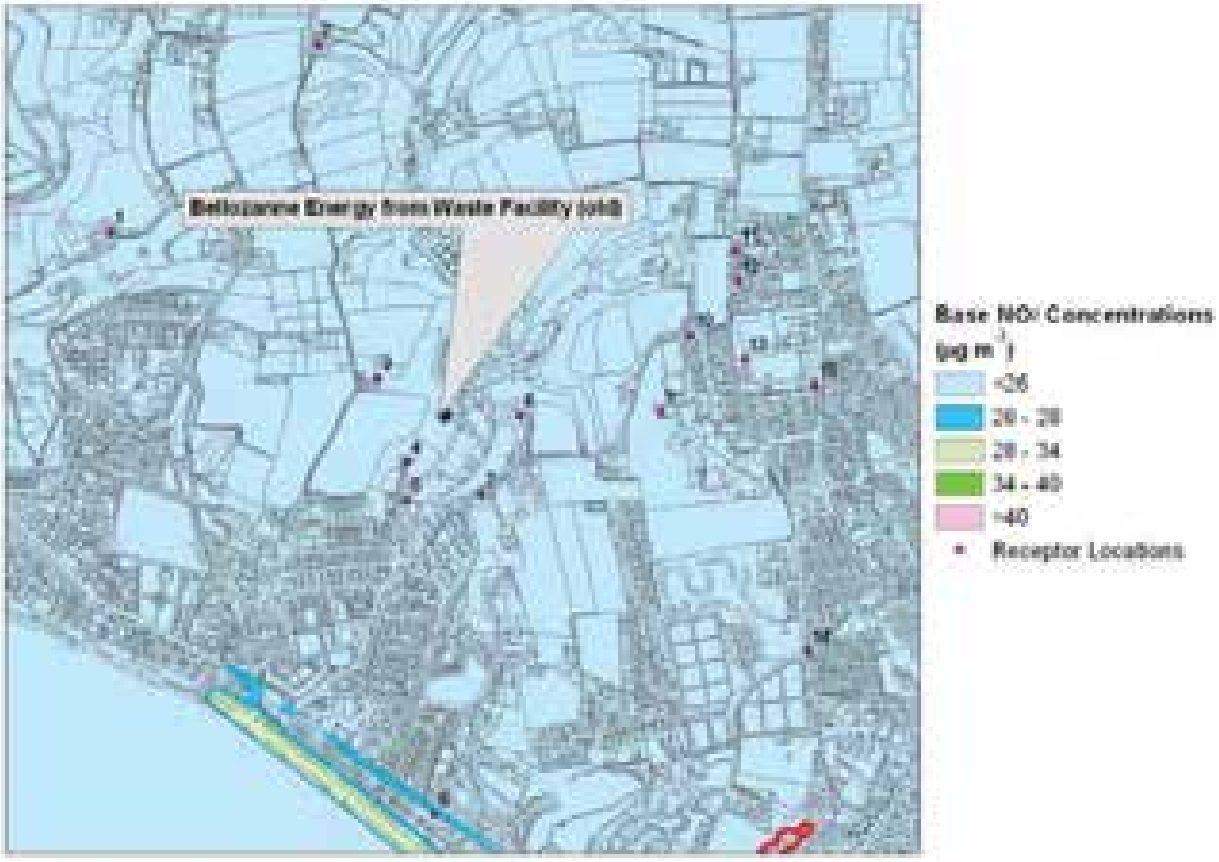


Figure 8.11: Predicted Nitrogen Dioxide Concentrations 'With Developments' Around the Current Bellozane Waste Facility

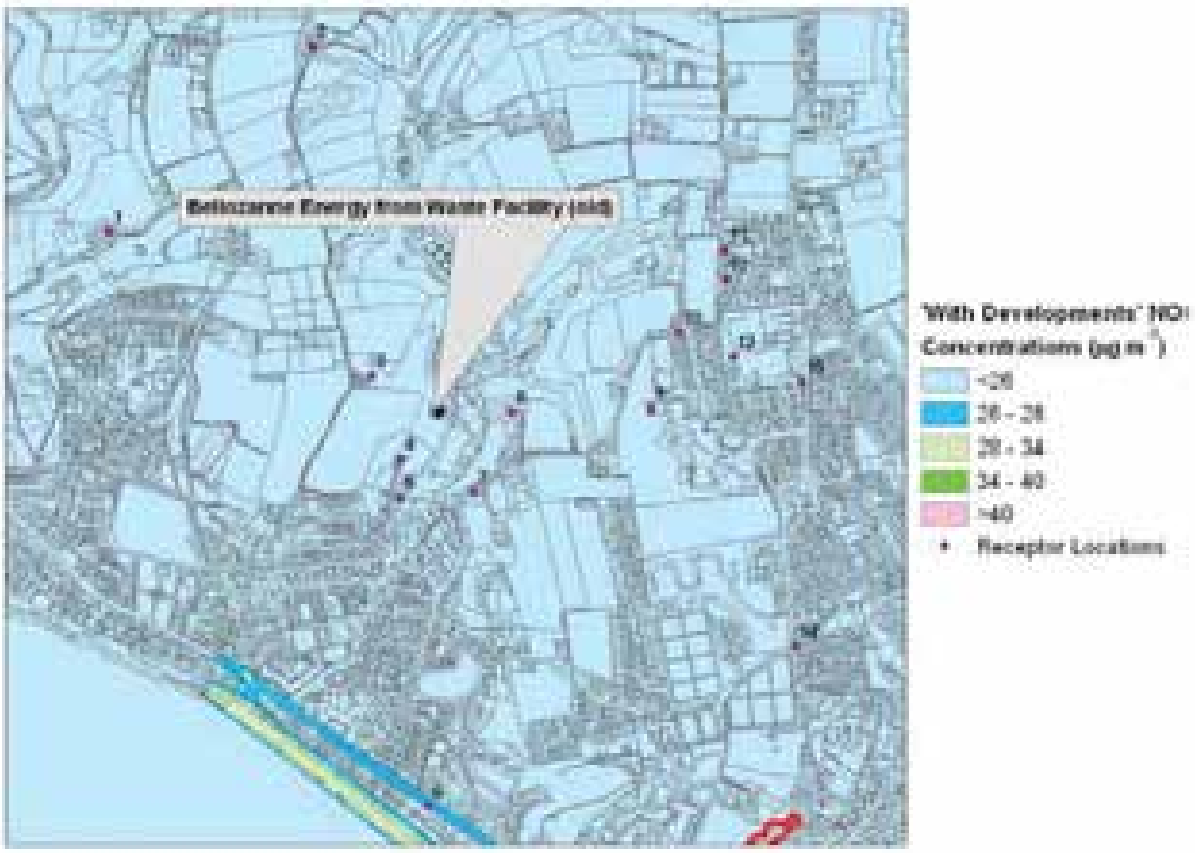


Table 8.15: Concentrations of NO2 at Receptor Locations Around the La Collette Energy from Waste Facility for the Base and 'With Developments' Scenarios (see Figure 8.12)

Receptor	X	Y	NO_2 (μg m^{-3})		% Difference
			Base	With	
1	41523	64962	23	23	1
2	41659	65227	24	24	0
3	41831	65144	24	24	1
4	41910	64793	24	24	1
5	41923	64461	23	23	0
6	41962	65051	25	25	2
7	42017	64762	23	24	1
8	42060	64612	25	25	1
9	42203	64646	28	29	2
10	42331	64833	24	24	1
11	42385	64651	26	26	2
12	42585	64718	26	26	2

Table 8.15, Figure 8.13 and Figure 8.14 show modelled nitrogen dioxide concentrations 2008 at receptor locations around the La Collette Energy from Waste Facility. The Table shows that the EC Limit Value of 40 μg m^{-3} for annual mean NO_2 is likely to be met at all locations in both scenarios. The highest predicted concentration in the base scenario (2008) at a receptor location was 28 μg m^{-3} and the highest predicted concentration in the 'with developments' scenario (2008) at a receptor location was 29 μg m^{-3}, both concentrations were predicted to occur at receptor 9 situated on the corner of Havre des Pas and Green Street approximately 380 m north east of the La Collette Energy from Waste Facility.

Table 8.15 shows that there will be an NO_2increase of up to 2% at receptor locations when comparing the base scenario with the 'with' developments scenario. An increase of up to 2% can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11. This leads to an overall significance of the impact of the five developments on receptors in the vicinity of La Collette Energy from Waste Facility being described as having negligible significance overall as annual mean concentrations are predicted to be well below the 40 μg m^{-3} annual mean objective at all receptors assessed.

Figure 8.12: Receptor Locations Assessed Around the La Collette Energy from Waste Facility Development

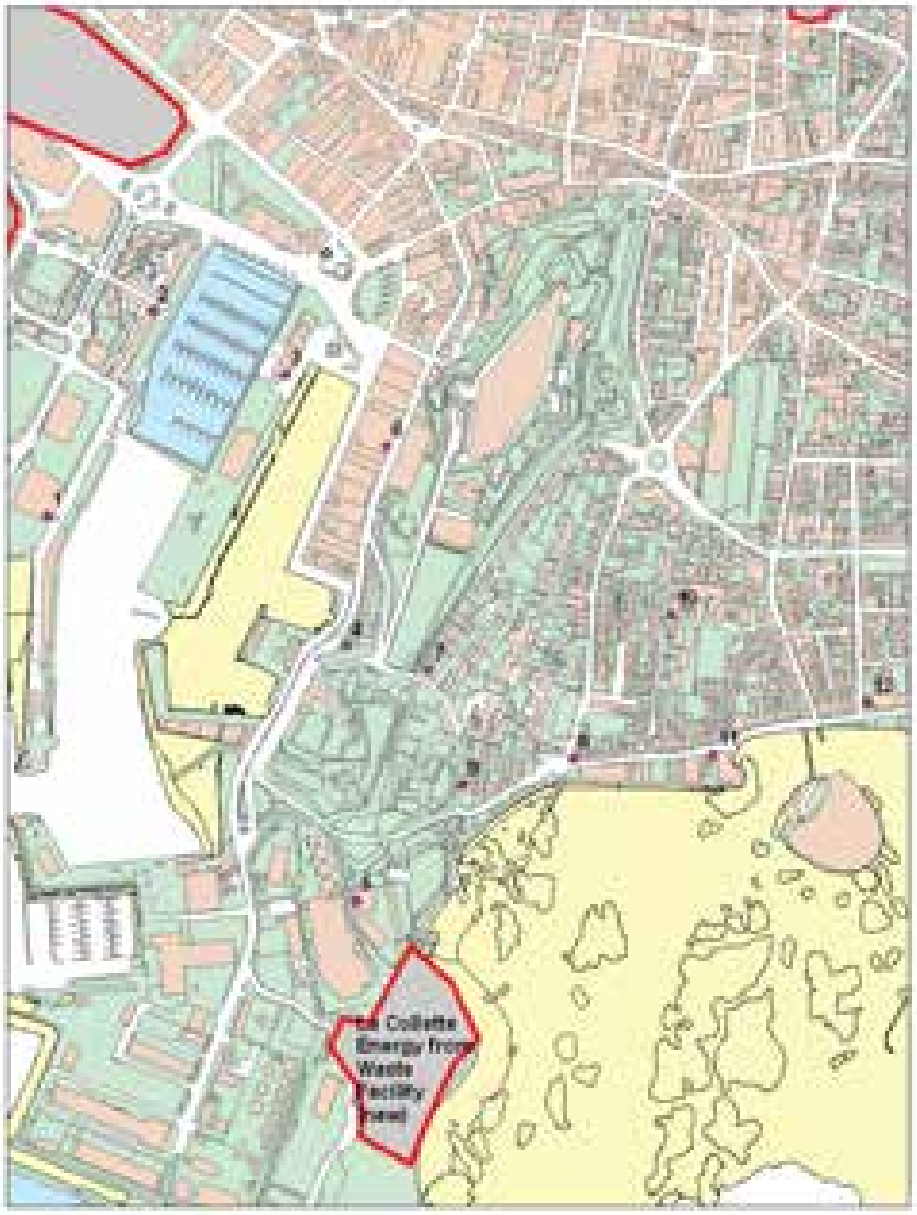


Figure 8.13: Predicted Nitrogen Dioxide Concentrations Base Around the La Collette Energy from Waste Facility Development

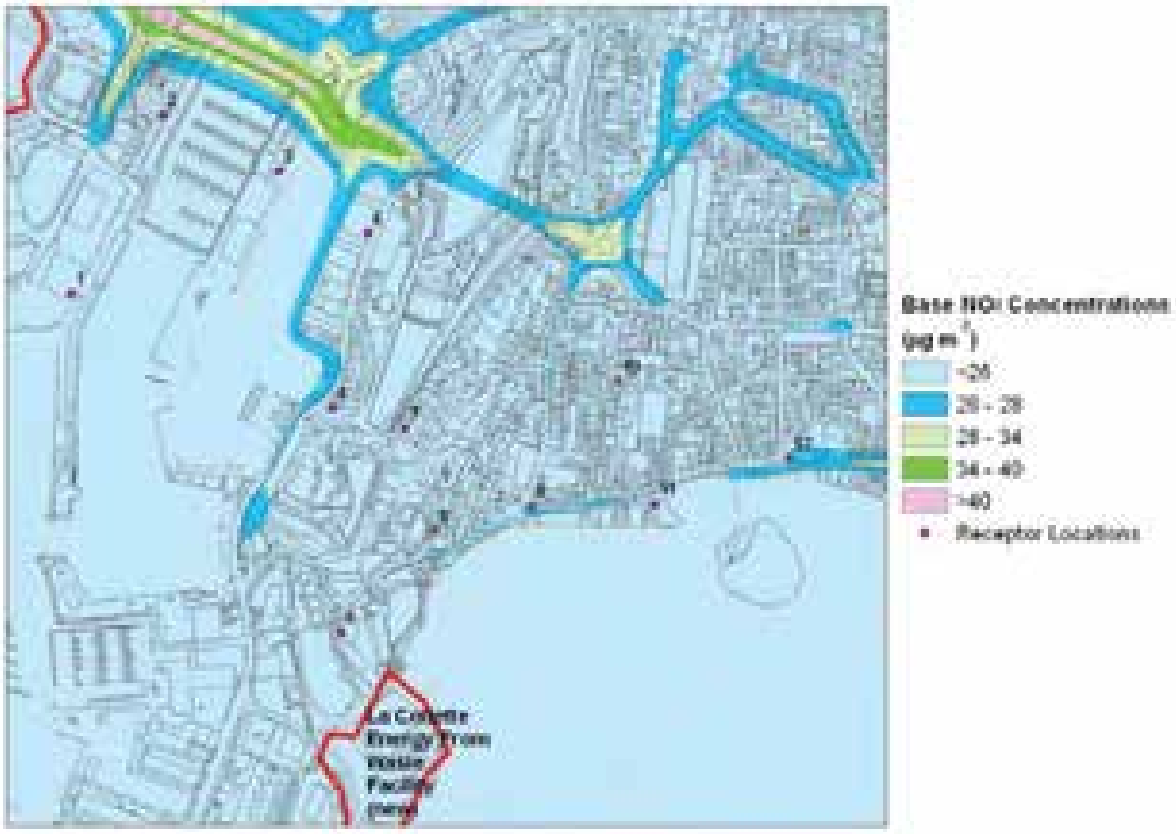


Figure 8.14: Predicted Nitrogen Dioxide Concentrations 'With Developments' Around the La Collette Energy from Waste Facility Development

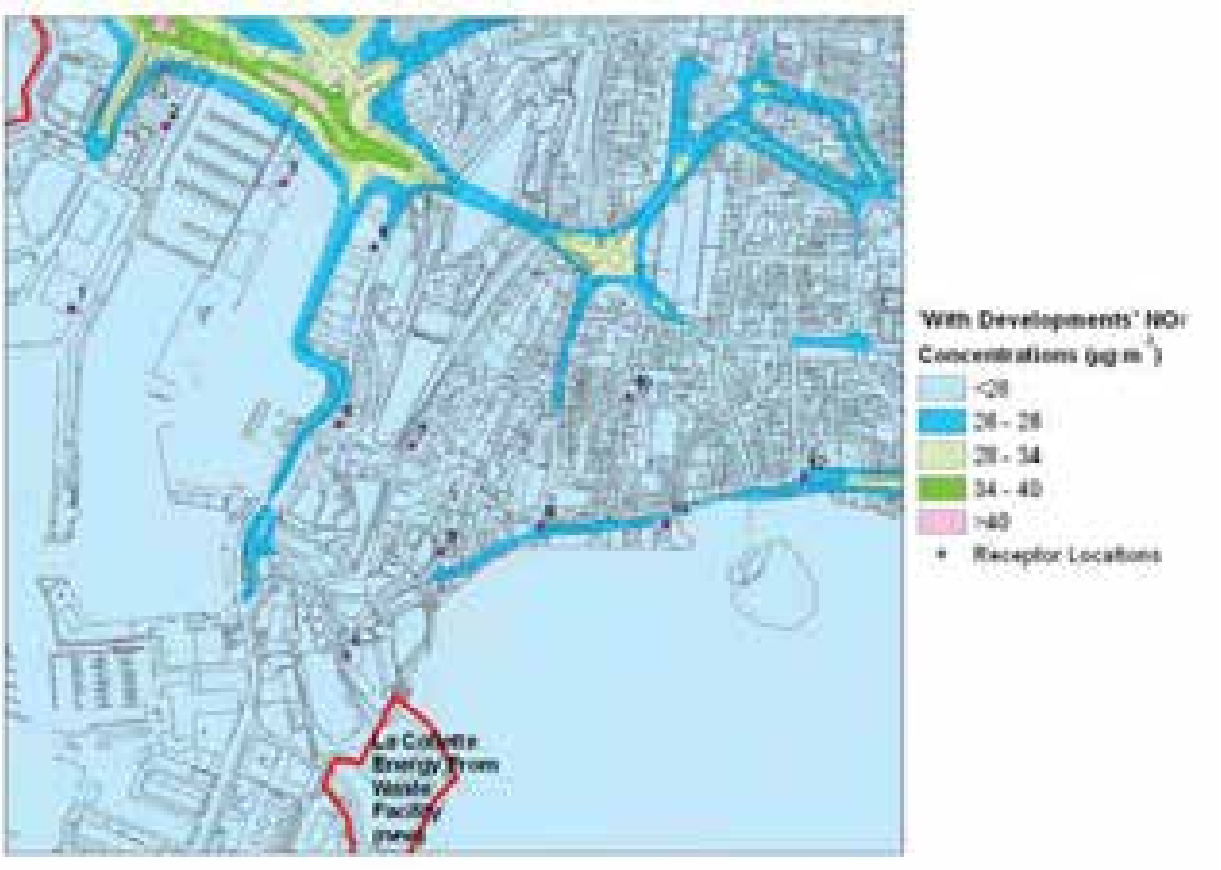


Table 8.16: Concentrations of NO_2 at Receptor Locations Around the Ann Court Development for the Base and 'With Developments' Scenarios (see Figure 8.15)

Receptor	X	Y	$N0_2$ (µg m^{-3})		% Difference
			Base	With	
1	42337	65705	25	25	0
2	42342	65854	25	25	0
3	42360	65790	26	25	-2
4	42421	65862	26	26	-1
5	42428	65648	24	24	0
6	42470	65650	25	25	1
7	42473	65598	26	26	1
8	42473	65868	29	29	-1
9	42477	65740	26	26	0
10	42506	65800	24	24	0
11	42508	65901	26	25	-1
12	42512	65969	25	24	-3
13	42520	65703	24	24	0
14	42557	65649	24	24	0
15	42562	65609	24	24	0
16	42583	65595	24	24	0
17	42597	65783	25	25	0
18	42677	65898	24	24	0
19	42716	65714	25	25	1
20	42748	65957	26	26	-1

Table 8.16, Figure 8.16 and Figure 8.17 show modelled nitrogen dioxide concentrations in 2008 at receptor locations around the proposed Ann Court development. The Table shows that the annual mean EC Limit Value of 40 µg m^{-3} for NO_2 is likely to be met at all locations in both scenarios. The highest predicted concentration in both the base and 'with developments' scenarios (2008) was predicted to be 29 µg m^{-3} at receptors 8, situated on the corner of Gas Place and L'Avenue et Dolmen du Pré des Lumières.

A comparison of the base scenario with the 'with' developments scenario, indicates that at most receptor locations assessed no impact or a slight beneficial impact of up to 1 µg m^{-3} (1-3%) is likely. A decrease of up to 3% can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11.

The overall significance of the impact of the five developments on receptors in the vicinity of the proposed Ann Court development can be described as having negligible significance overall according to the criteria in Table 8.12; annual mean concentrations are predicted to be well below the 40 µg m^{-3} annual mean objective at all receptors assessed.

Figure 8.15: Receptor Locations Assessed Around the Ann Court Development

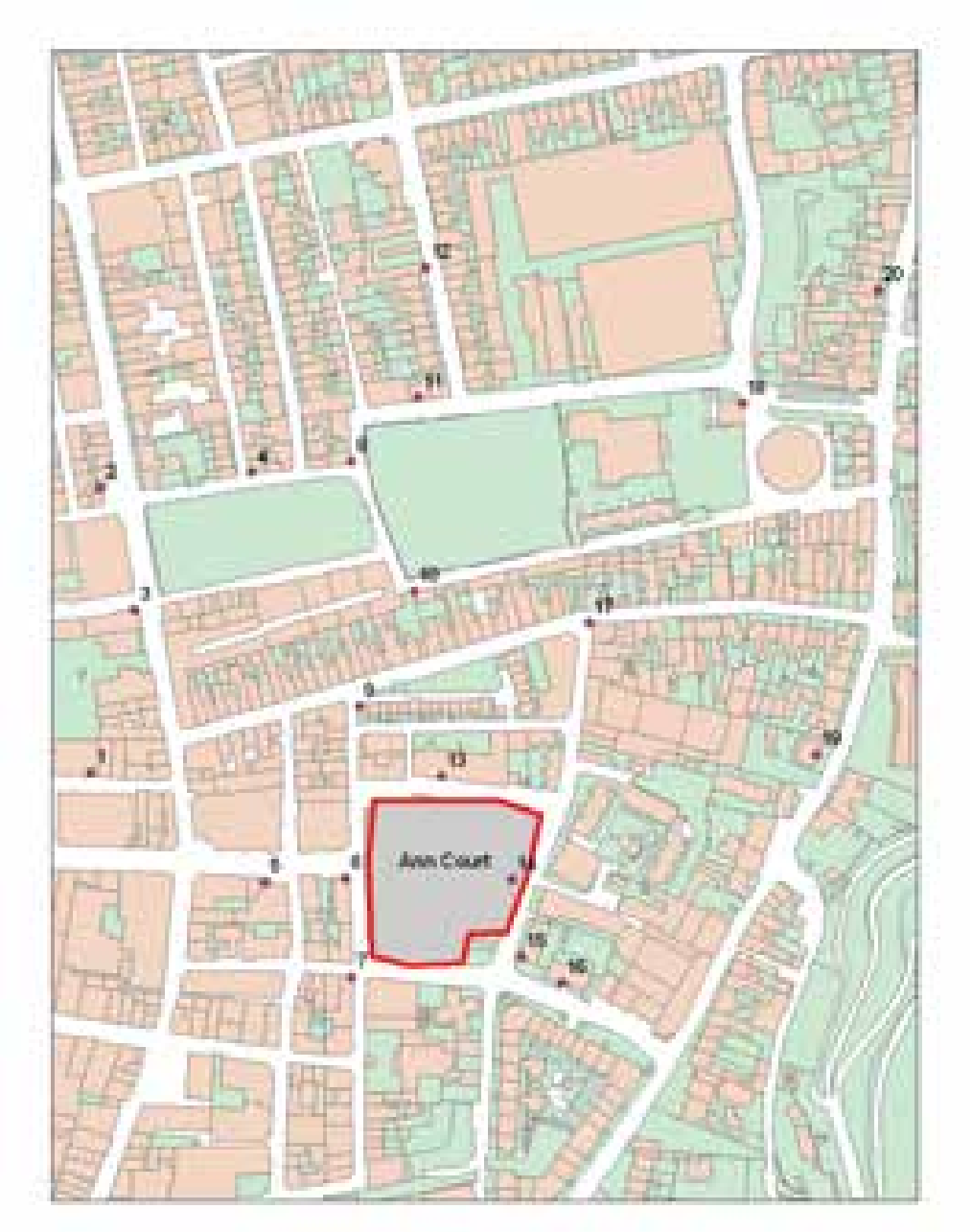


Figure 8.16: Predicted Nitrogen Dioxide Concentrations Base Around the Ann Court Development

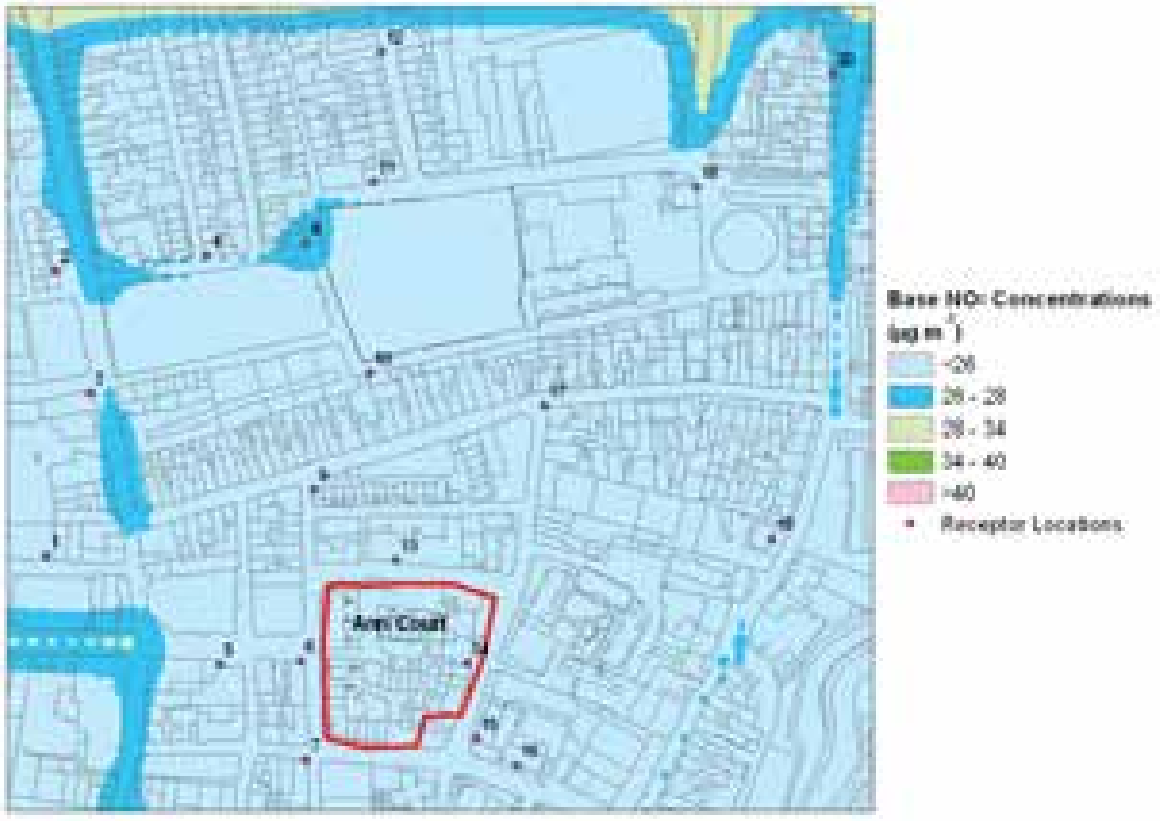


Figure 8.17: Predicted Nitrogen Dioxide Concentrations 'With Developments' Around the Ann Court Development

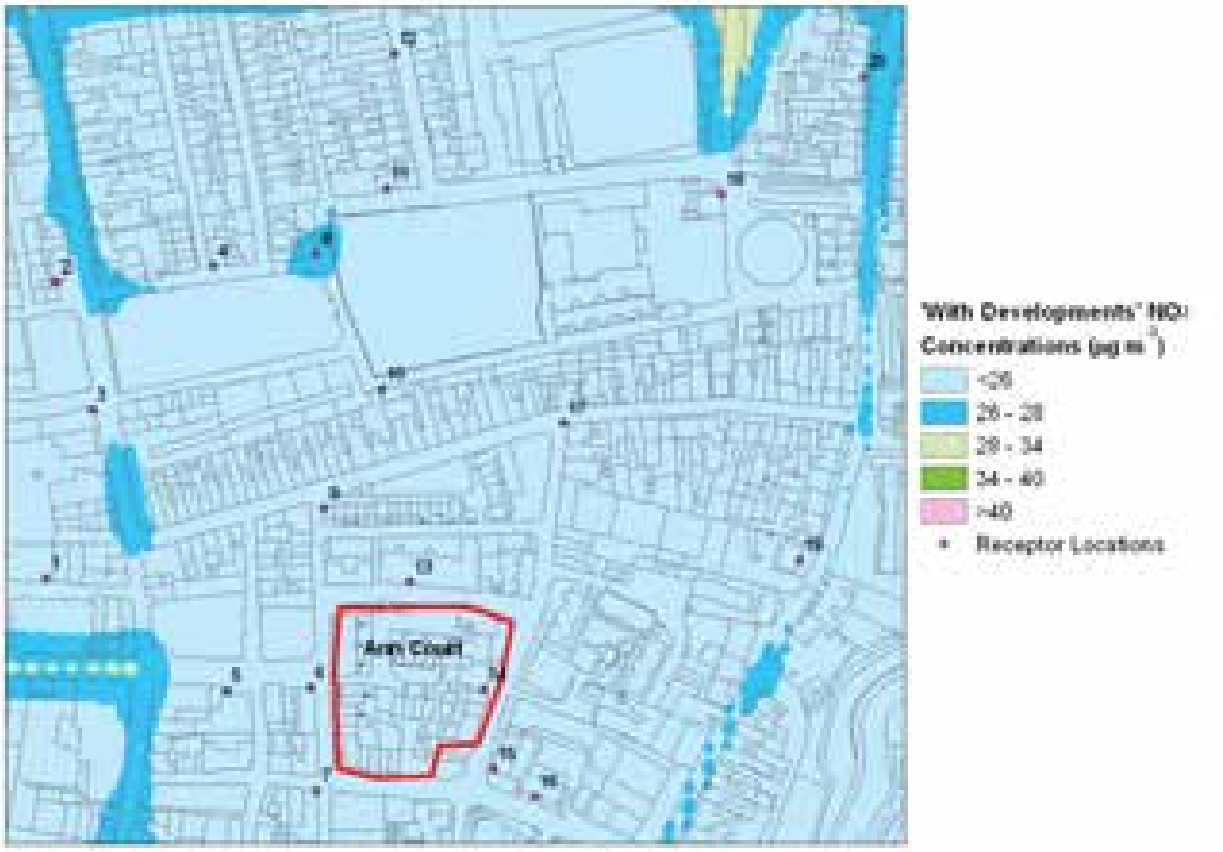


Table 8.17: Concentrations of NO_2 at Receptor Locations Around the Westmount Quarry Development for the Base and 'With Developments' Scenarios (see Figure 8.18)

Receptor	X	Y	$N0_2$ (μg m^{-3})		% Difference
			Base	With	
1	40980	66258	25	26	3
2	41271	66115	24	23	-1
3	41354	66445	23	23	-1
4	41363	65843	29	28	-5
5	41375	66356	23	23	0
6	41461	66115	23	23	-1
7	41510	65692	32	30	-6
8	41511	66513	23	23	-1
9	41551	66368	23	23	-1
10	41587	66021	29	27	-8
11	41668	65964	27	25	-6
12	41669	66358	23	23	-1

Table 8.17, Figure 8.19 and Figure 8.20 show modelled nitrogen dioxide concentrations during 2008 at receptor locations around the proposed Westmount Quarry development. The Table shows that the annual mean EC Limit Value of 40 μg m^{-3} for NO_2 is likely to met at all locations in both scenarios. The highest predicted concentration in the base scenario (2008) at a receptor location was 32 μg m^{-3} and the highest predicted concentration in the 'with developments' scenario (2008) was 30 μg m^{-3}; both concentrations were predicted to occur at receptor 7, situated on the corner of Gloucester Street and The Esplanade.

A comparison of the base scenario with the 'with' developments scenario, indicates that adverse impacts of up to 1μg m^{-3} (3%) are likely as a result of the developments, the largest impact occurring at receptor 1, situated on La Route de St. Aubin. An increase of 3% can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11.

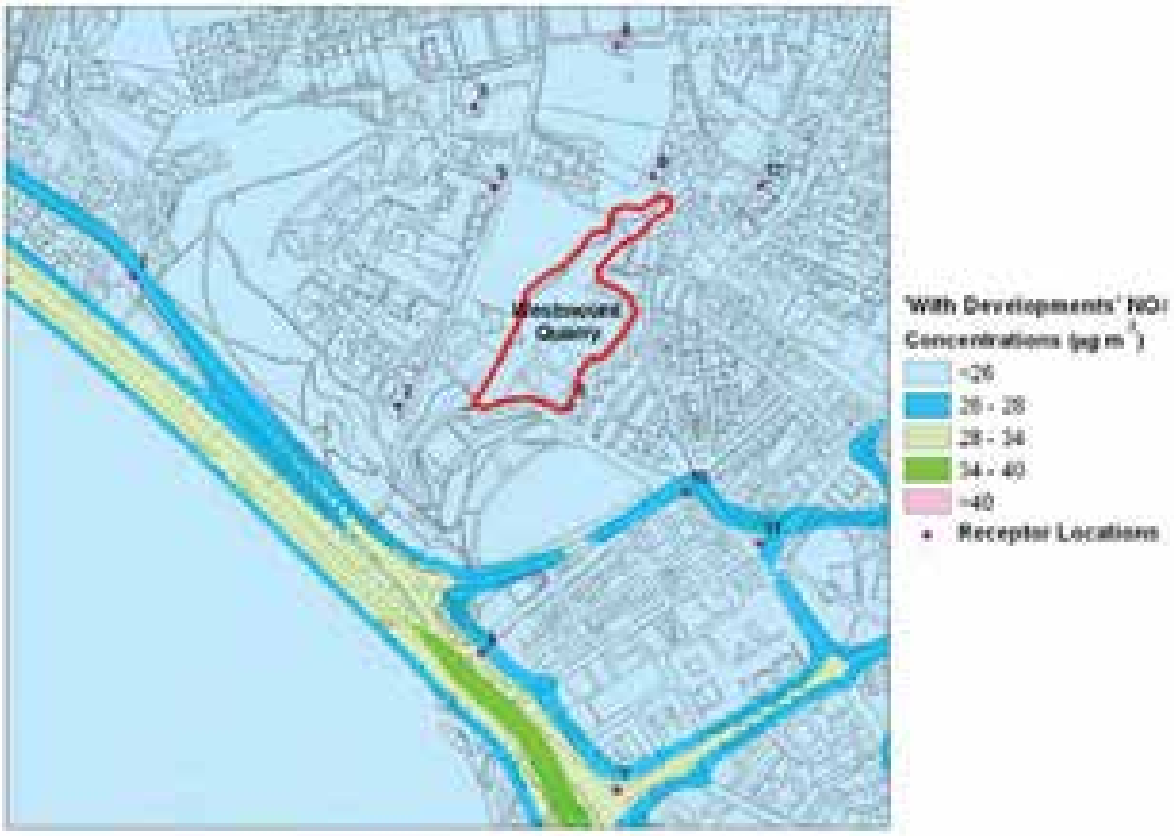
The comparison of the base scenario with the 'with' developments scenario indicates that beneficial impacts will be experienced at receptors in the vicinity of the proposed Westmount Quarry development; decreases of up to 2 μg m^{-3} are likely as a result of the development. The largest beneficial impact occurs at receptors 10 on the corner of St. Aubin's Road, and Cheapside, where a decrease of 8% will be experienced. A decrease of 8% in NO_2 concentrations can be described as having a small magnitude according to the EPUK criteria described in Table 8.11.

The overall significance of the impact of the five developments on receptors in the vicinity of the proposed Westmount Quarry development can be described as being of negligible to slight beneficial significance overall according to the criteria in Table 8.12. Annual mean concentrations are predicted to be well below the 40 μg m^{-3} annual mean objective at all receptors assessed.

Figure 8.18: Receptor Locations Assessed Around the Westmount Quarry Development

Figure 8.19: Predicted Nitrogen Dioxide Concentrations Base Around the Westmount Quarry Development

Figure 8.20: Predicted Nitrogen Dioxide Concentrations 'With Developments' Around the Westmount Quarry Development



Particulate Matter

Concentrations of PM_{10} at the receptor locations for the base case and the 'with developments' scenario were predicted for 2008 using the modelling techniques summarised in Section 8.4. The total annual average PM_{10} concentration plots for 2008 are presented in Figure 8.21 (Base) and Figure 8.22 ('With Developments').

Figure 8.21: Predicted Particulate Concentrations Base

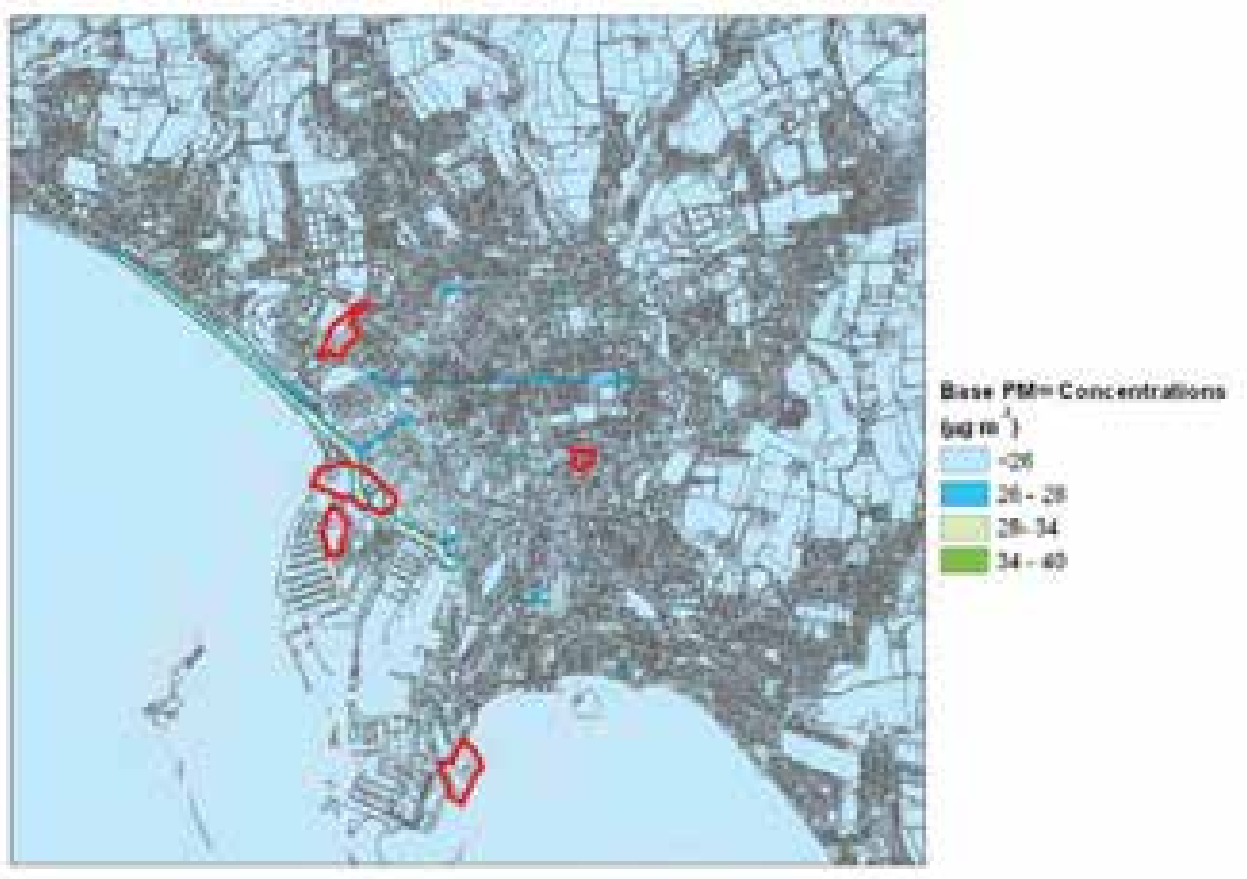


Figure 8.22: Predicted Particulate Concentrations 'With Developments'

Total annual average PM_{10} results for 2008 at receptor locations for the base case and the 'With Developments' scenario are presented in Tables 8.18 – 8.22. Figures 8.23, 8.25, 8.27, 8.29 and 8.31 present the total annual average PM_{10} concentration plots for the base scenario around the receptor locations and Figures 8.24, 8.26, 8.28, 8.30 and 8.32 present the total annual average PM_{10} concentration plots for the 'With Development' scenario around the receptor locations.

Table 8.18: Concentrations of PM_{10} at Receptor Locations Around the Castle Quay and Esplanade Quarter Developments for the Base and 'With Developments' Scenarios (see Figure 8.6)

Receptor	X	Y	PM_{10} (µg m^{-3})		% Difference
			Base	With	
1	41378	65407	24	24	0
2	41403	65805	26	26	0
3	41425	65765	31	29	-7
4	41450	65206	24	24	1
5	41462	65440	24	25	1
6	41469	65348	24	24	0
7	41507	65689	29	28	-3
8	41543	65436	27	27	0
9	41572	65652	25	25	-2
10	41579	65186	25	25	0
11	41602	65384	28	29	3
12	41621	65759	26	26	-1
13	41631	65583	25	25	2
14	41659	65334	26	26	-1
15	41682	65533	25	25	1
16	41775	65342	27	26	-4
17	41800	65433	25	25	2
18	41860	65220	25	25	0
19	41916	65329	26	27	4
20	41986	65243	25	25	0
21	41986	65321	26	26	1
22	42241	65044	26	26	0
23	42335	65046	30	30	0
24	42390	64947	25	25	0

Table 8.18, Figure 8.23 and Figure 8.24 show modelled PM_{10} concentrations in 2008 at receptor locations around the Esplanade Quarter and Castle Quay developments. The Table shows that the EC Limit Value of 40 µg m^{-3} for annual mean PM_{10} is likely to be met at all locations in both scenarios.

The highest predicted concentration in the base scenario (2008) at any receptor location was 31µg m^{-3} at receptor 3, situated on The Esplanade between Patriotic Street and Kensington Place. The highest predicted concentration in the 'with developments' scenario (2008) was 30 µg m^{-3} at receptor 23, situated close to the tunnel and La Route du Fort roundabout.

A comparison of the base scenario with the 'with' developments scenario indicates that adverse impacts of up to 1 µg m^{-3} (3-4%) are likely as a result of the developments, the largest impact occurring at receptor 19, fronting The Esplanade and the corner of Conway Street. An increase of up to 4% can be described as being of a very small magnitude according to the EPUK criteria described in Table 8.11.

The comparison of the base scenario with the 'with' developments scenario indicates that beneficial impacts will be experienced at some receptors in the vicinity of The Esplanade Quarter and the Castle Quay developments; decreases of up to 2 µg m^{-3} are likely as a result of the developments, the largest beneficial impact will occur at receptor 3 situated on Esplanade between Patriotic Street and Kensington Place, where a decrease of up to 7% will be experienced (Still the location predicted to have the worst **PM_{10}** level). A decrease of up to 7% in PM_{10} concentrations can be described as having a small magnitude according to the EPUK criteria described in Table 8.11.

The overall significance of the impact of the five developments on receptors in the vicinity of Esplanade Quarter and the Castle Quay developments can be described as being of negligible to slight beneficial significance overall according to the criteria in Table 8.12. The annual mean

concentrations are predicted to be below the annual mean objective of 40 μgm^{-3} at all receptors assessed.

Figure 8.23: Predicted Particulate Concentrations Base Around the Castle Quay and Esplanade Quarter Developments

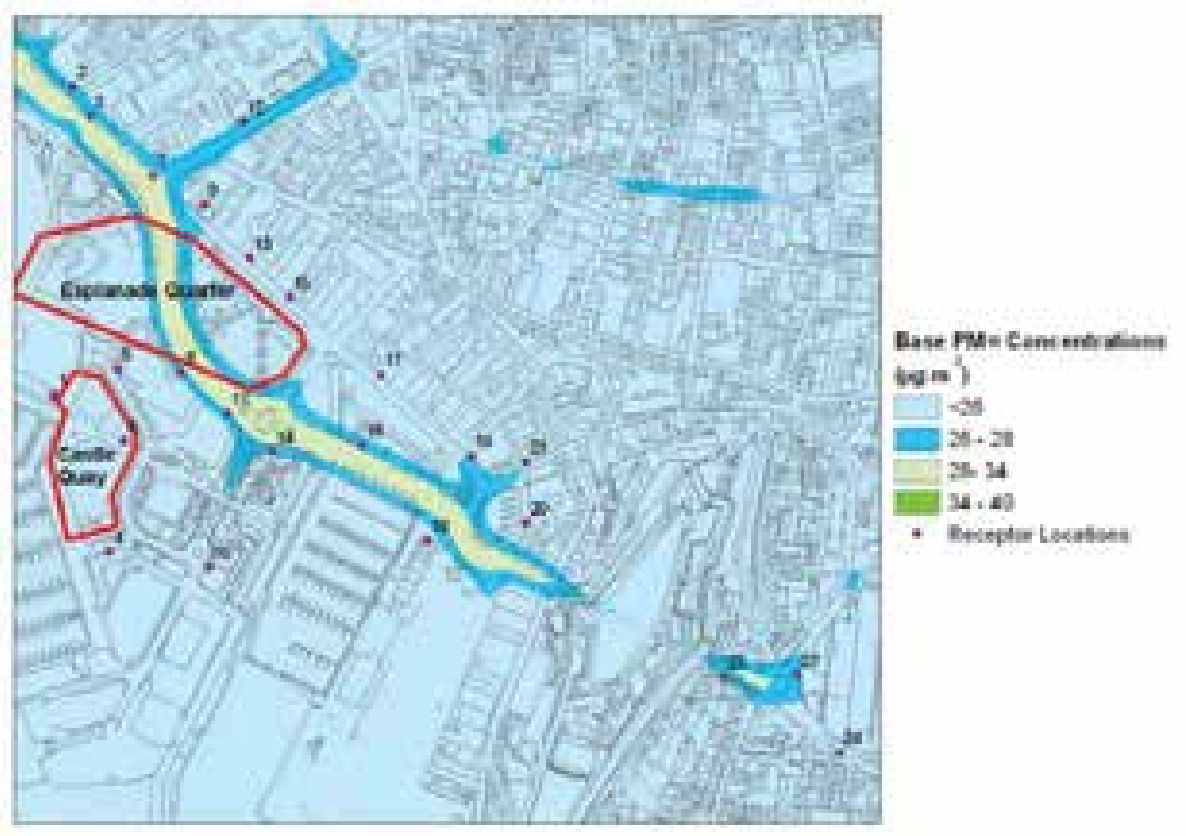


Figure 8.24: Predicted Particulate Concentrations 'With Developments' Around the Castle Quay and Esplanade Quarter Developments

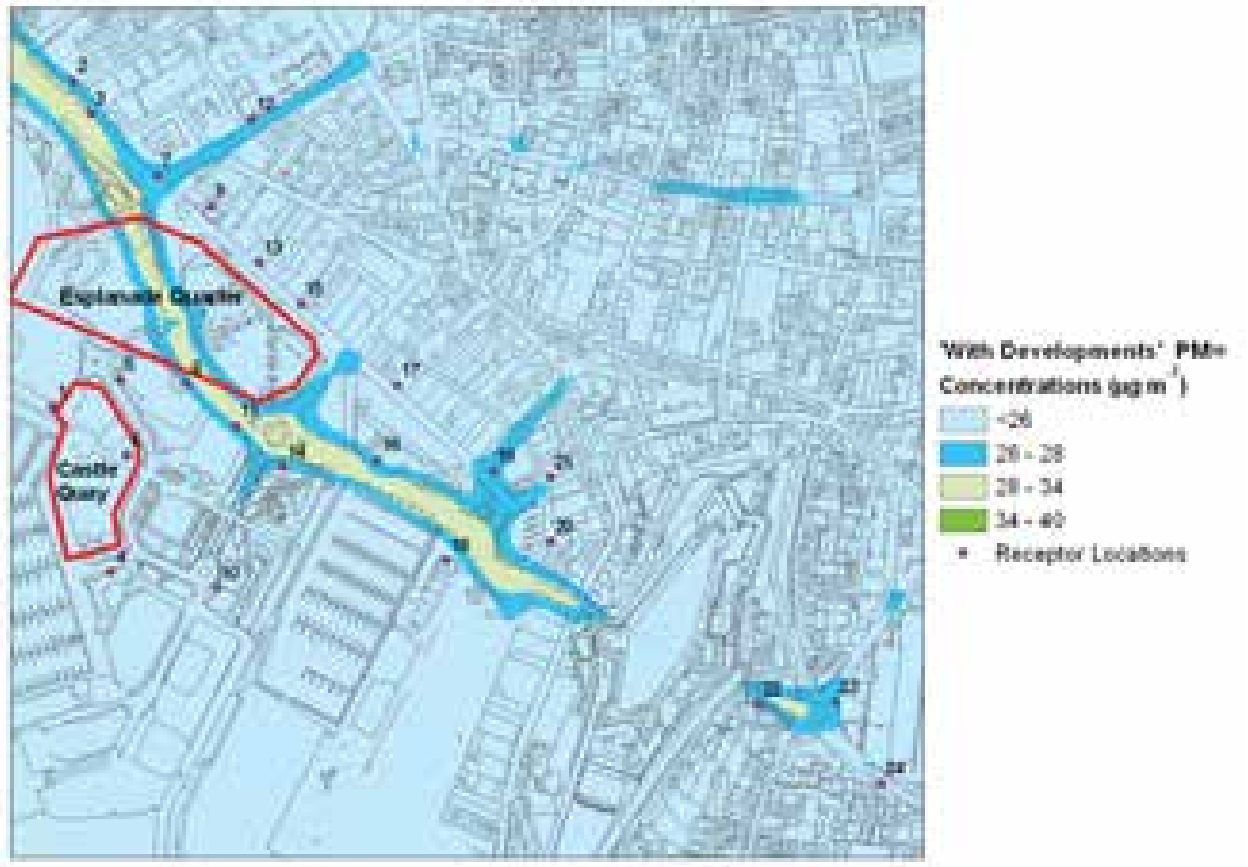


Table 8.19: Concentrations of PM_{10} at Receptor Locations Around the Current Bellozane Waste Facility for the Base and 'With Developments' Scenarios (see Figure 8.5)

Receptor	X	Y	PM_{10} ($\mu g\ m^{-3}$)		% Difference
			Base	With	
1	40215	67494	24	24	0
2	40614	67859	24	24	0
3	40730	67210	24	24	0
4	40787	67048	24	24	0
5	40788	66973	24	24	0
6	40842	66364	26	26	1
7	40931	66985	24	24	0
8	41006	67140	24	24	0
9	41279	67146	24	24	0
10	41336	67296	24	24	0
11	41424	67460	24	24	0
12	41427	67399	24	24	0
13	41440	67248	24	24	0
14	41562	66679	24	24	0
15	41575	67198	24	24	0

Table 8.19, Figure 8.25 and Figure 8.26 show modelled PM_{10} concentrations in 2008 at receptor locations around the current Bellozane Waste Facility. The Table shows that the annual mean EC Limit Value of 40 μgm^{-3} for PM_{10} is likely to met at all locations in both scenarios. The highest predicted concentration in both the base and 'with developments' scenarios (2008) was predicted to be 26 $\mu g\ m^{-3}$ at receptor 6, situated on La Route de St. Aubin approximately 770 m south of the current Bellozane Waste Facility. This location is likely to be influenced by the road traffic on La Route de St. Aubin rather than concentrations from the Waste Facility.

A comparison of the base scenario and the 'with' developments scenario, indicates that at most receptor locations assessed no impact is predicted to arise from the developments. A slight adverse impact of up to 1% is predicted to occur at receptor 6, situated on La Route de St. Aubin. An increase of up to 1% can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11 and an overall significance of negligible according to the criteria in Table 8.12. The annual mean concentrations are predicted to be well below the 40 $\mu g\ m^{-3}$ annual mean objective at receptor 6.

Figure 8.25: Predicted Particulate Concentrations Base Around the Current Bellozane Waste Facility

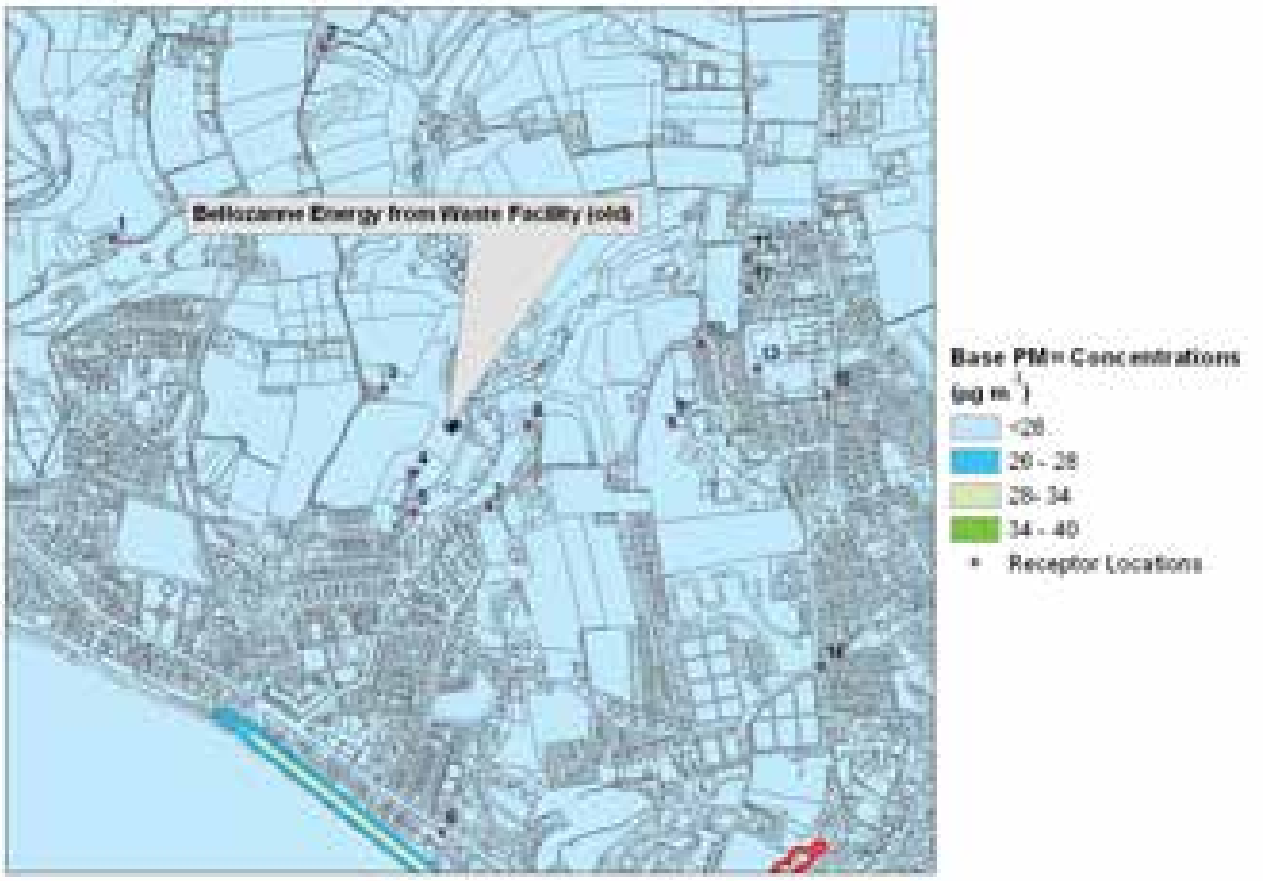


Figure 8.26: Predicted Particulate Concentrations 'With Developments' Around the Current Bellozane Waste Facility

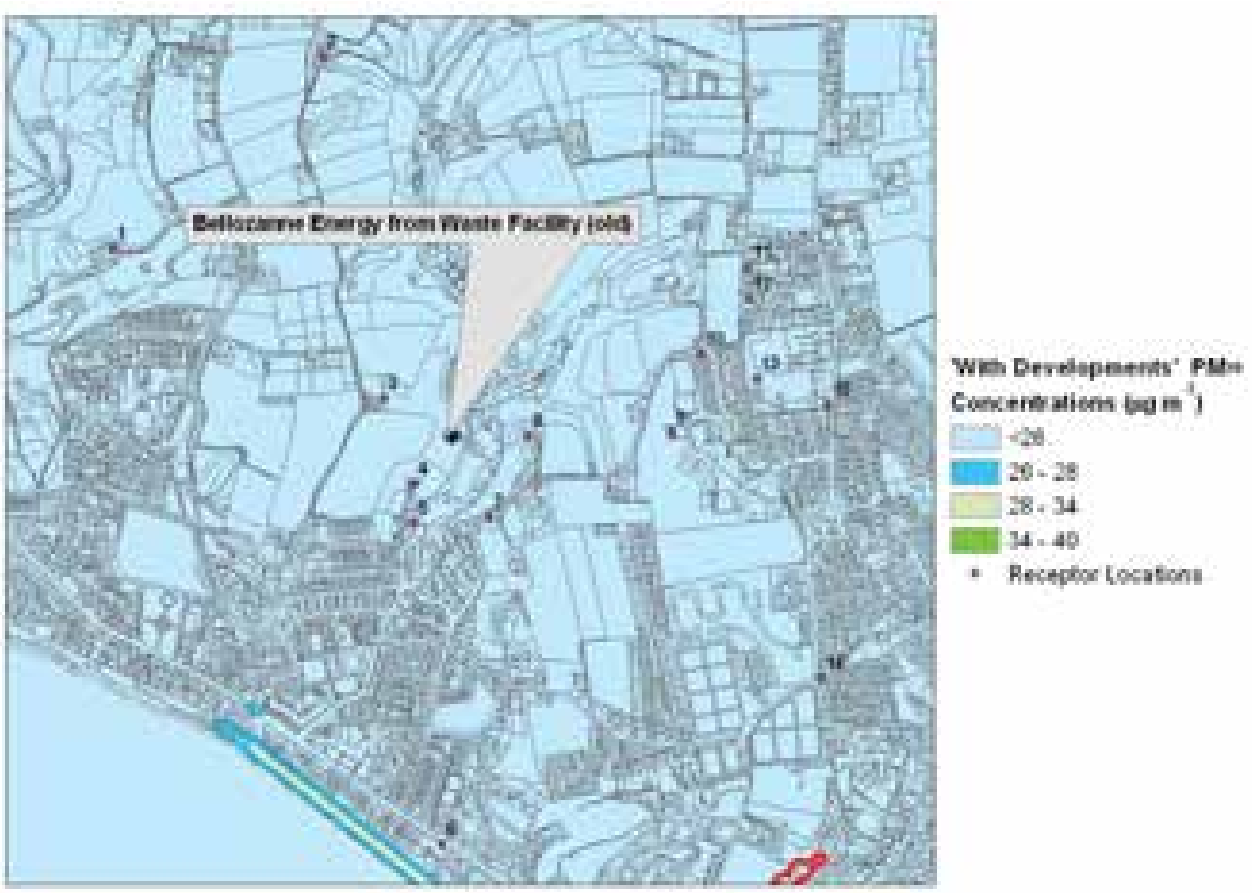


Table 8.20: Concentrations of PM_{10} at Receptor Locations Around the La Collette Energy from Waste Facility for the Base and 'With Developments' Scenarios (see Figure 8.6)

Receptor	X	Y	PM_{10} ($\mu g\ m^{-3}$)		% Difference
			Base	With	
1	41523	64962	24	24	0
2	41659	65227	24	24	0
3	41831	65144	24	24	0
4	41910	64793	24	24	0
5	41923	64461	24	24	0
6	41962	65051	25	25	1
7	42017	64762	24	24	0
8	42060	64612	25	25	1
9	42203	64646	26	26	1
10	42331	64833	24	24	0
11	42385	64651	25	25	0
12	42585	64718	25	25	0

Table 8.20, Figure 8.27 and Figure 8.28 show modelled PM_{10} concentrations for 2008 at receptor locations around the La Collette Energy from Waste Facility. The Table shows that the annual mean EC Limit Value of 40 $\mu g\ m^{-3}$ for NO_2 is likely to met at all locations in both scenarios. The highest predicted concentration in the base and 'with developments' scenarios (2008) was predicted to be 26 $\mu g\ m^{-3}$ at receptor 9, situated on the corner of Havre des Pas and Green Street approximately 380 m north east of the La Collette Energy from Waste Facility.

Table 8.20 shows that there will be an increase of up to 1% in PM_{10} concentrations at the receptor locations assessed in the vicinity of the La Collette Energy from Waste Facility when compared with the base scenario with the 'with' developments scenario. An increase of up to 1% can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11. This leads to an overall significance of the impact of the five developments on receptors in the vicinity of La Collette Energy from Waste Facility as having negligible significance overall. The annual mean concentrations are predicted to be well below the 40 $\mu g\ m^{-3}$ annual mean objective at all receptors assessed.

Figure 8.27: Predicted Particulate Concentrations Base Around the La Collette Energy from Waste Facility

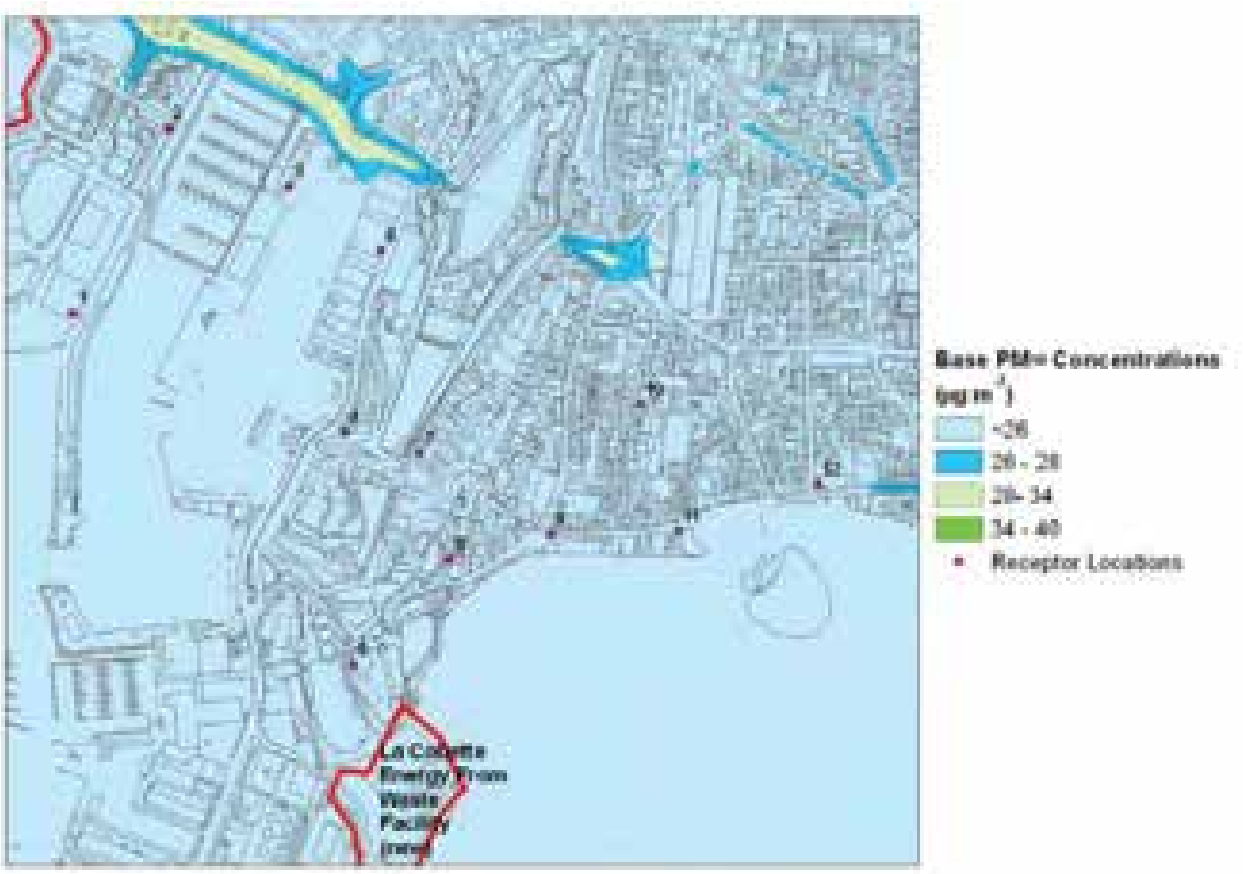


Figure 8.28: Predicted Particulate Concentrations 'With Developments' Around the La Collette Energy from Waste Facility

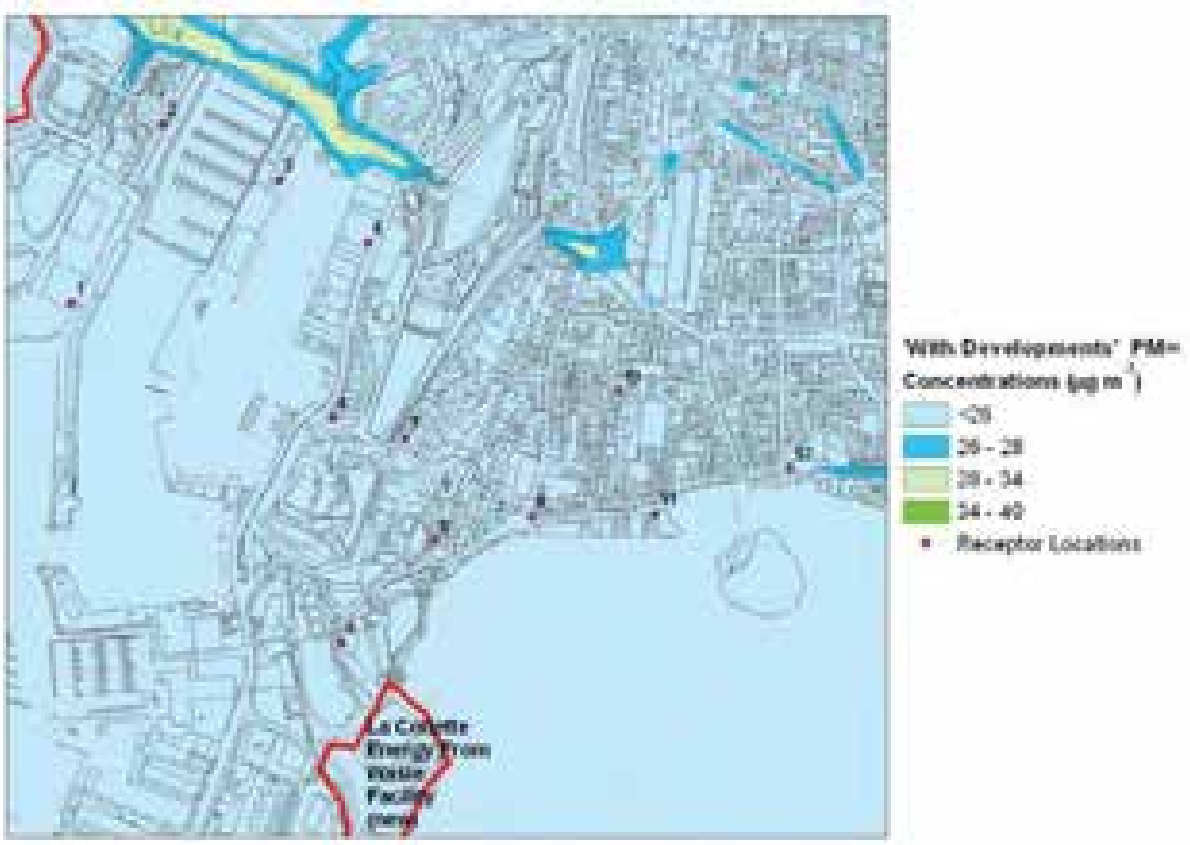


Table 8.21: Concentrations of PM_{10} at Receptor Locations Around the Ann's Court Development for the Base and 'With Developments' Scenarios (see Figure 8.7)

Receptor	X	Y	PM_{10} (µg m^{-3})		% Difference
			Base	With	
1	42337	65705	25	25	0
2	42342	65854	25	25	0
3	42360	65790	25	25	-1
4	42421	65862	25	25	0
5	42428	65648	25	24	0
6	42470	65650	25	25	0
7	42473	65598	25	25	0
8	42473	65868	27	26	-1
9	42477	65740	25	25	0
10	42506	65800	25	25	0
11	42508	65901	25	25	0
12	42512	65969	25	24	-1
13	42520	65703	24	24	0
14	42557	65649	24	24	0
15	42562	65609	24	24	0
16	42583	65595	24	24	0
17	42597	65783	25	25	0
18	42677	65898	24	24	0
19	42716	65714	25	25	0
20	42748	65957	25	25	0

Table 8.21, Figure 8.29 and Figure 8.30 show modelled PM_{10} concentrations in 2008 at receptor locations around the proposed Ann Court development. The Table shows that the annual mean EC Limit Value of 40 µg m^{-3} for PM_{10} is likely to be met at all locations in both scenarios. The highest predicted concentration in the base scenario (2008) at a receptor location was 27 µg m^{-3}; the highest predicted concentration in the 'with developments' scenario (2008) was 26 µg m^{-3}, both concentrations predicted at receptor 8, situated on the corner of Gas Place and L'Avenue et Dolmen du Pré des Lumières.

A comparison of the base scenario with the 'with' developments scenario, indicates that at most receptor locations assessed no impact or a slight beneficial impact of up to 1 µg m^{-3} (1%) is likely. A decrease of up to 1% can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11.

The overall significance of the impact of the five developments on receptors in the vicinity of the proposed Ann Court development can be described as having negligible significance overall according to the criteria in Table 8.12. The annual mean concentrations are predicted to be well below the 40 µg m^{-3} annual mean objective at all receptors assessed.

Figure 8.29: Predicted Particulate Concentrations Base Around the Ann's Court Development

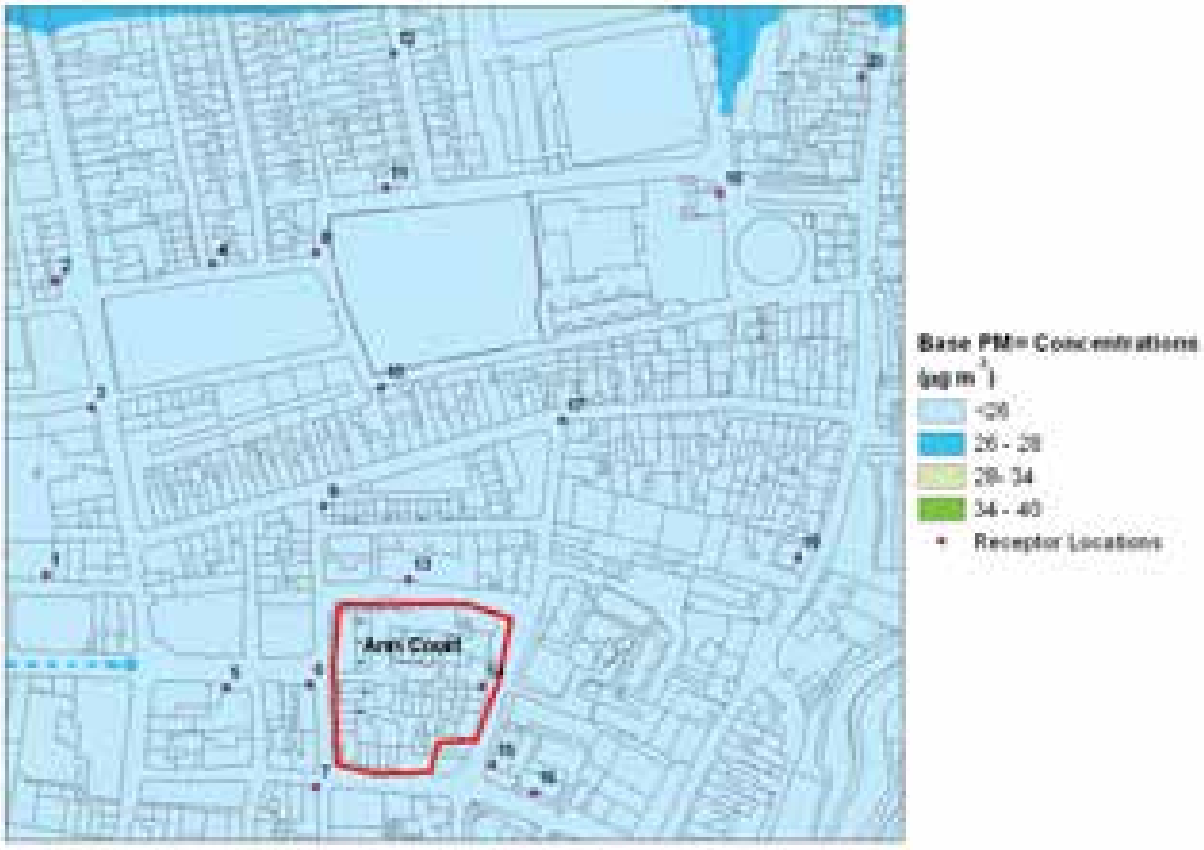


Figure 8.30: Predicted Particulate Concentrations 'With Developments' Around the Ann's Court Development

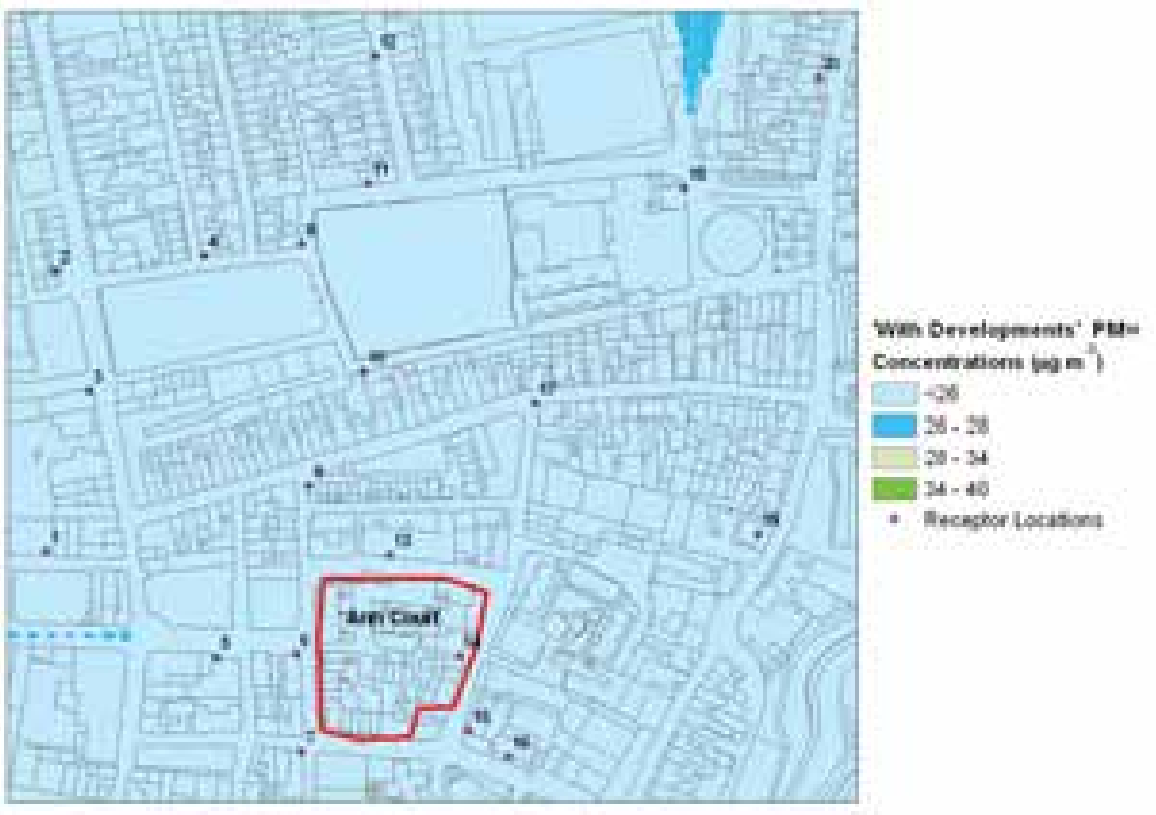


Table 8.22: Concentrations of PM_{10} at Receptor Locations Around the Westmount Quarry Development for the Base and 'With Developments' Scenarios (see Figure 8.8)

Receptor	X	Y	PM_{10} (µg m^{-3})		% Difference
			Base	With	
1	40980	66258	25	25	2
2	41271	66115	24	24	0
3	41354	66445	24	24	0
4	41363	65843	27	26	-2
5	41375	66356	24	24	0
6	41461	66115	24	24	0
7	41510	65692	28	27	-3
8	41511	66513	24	24	0
9	41551	66368	24	24	0
10	41587	66021	27	26	-4
11	41668	65964	26	25	-3
12	41669	66358	24	24	0

Table 8.22, Figure 8.31 and Figure 8.32 show modelled PM_{10} concentrations 2008 at receptor locations around the proposed Westmount Quarry development. The Table shows that the annual mean EC Limit Value of 40 µg m^{-3} for PM_{10} is likely to met at all locations in both scenarios. The highest predicted concentration in the base scenario (2008) at a receptor location was 28 µg m^{-3}; the highest predicted concentration in the 'with developments' scenario (2008) was 27 µg m^{-3}. Both concentrations were predicted to occur at receptor 7 situated on the corner of Gloucester Street and The Esplanade.

A comparison of the base scenario with the 'with' developments scenario indicates that adverse impacts of up to 1 µg m^{-3} (2%) are likely as a result of the developments. The largest impact occurrs at receptor 1, situated on La Route de St. Aubin. An increase of 2% can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11.

The comparison of the base scenario with the 'with' developments scenario indicates that beneficial impacts will be experienced at receptors in the vicinity of the proposed Westmount Quarry development; decreases of up to 2 µg m^{-3} are likely as a result of the developments. The largest beneficial impact occurs at receptor 10 on the corner of St. Aubin's Road and Cheapside, where a decrease of 4% will be experienced. A decrease of 4% in NO_2 concentrations can be described as having a very small magnitude according to the EPUK criteria described in Table 8.11.

The overall significance of the impact of the five developments on receptors in the vicinity of the Westmount Quarry development can be described as being of negligible significance overall according to the criteria in Table 8.12. The annual mean concentrations are predicted to be well below the 40 µg m^{-3} annual mean objective at all receptors assessed.

Figure 8.31: Predicted Particulate Concentrations Base Around the Westmount Quarry Development

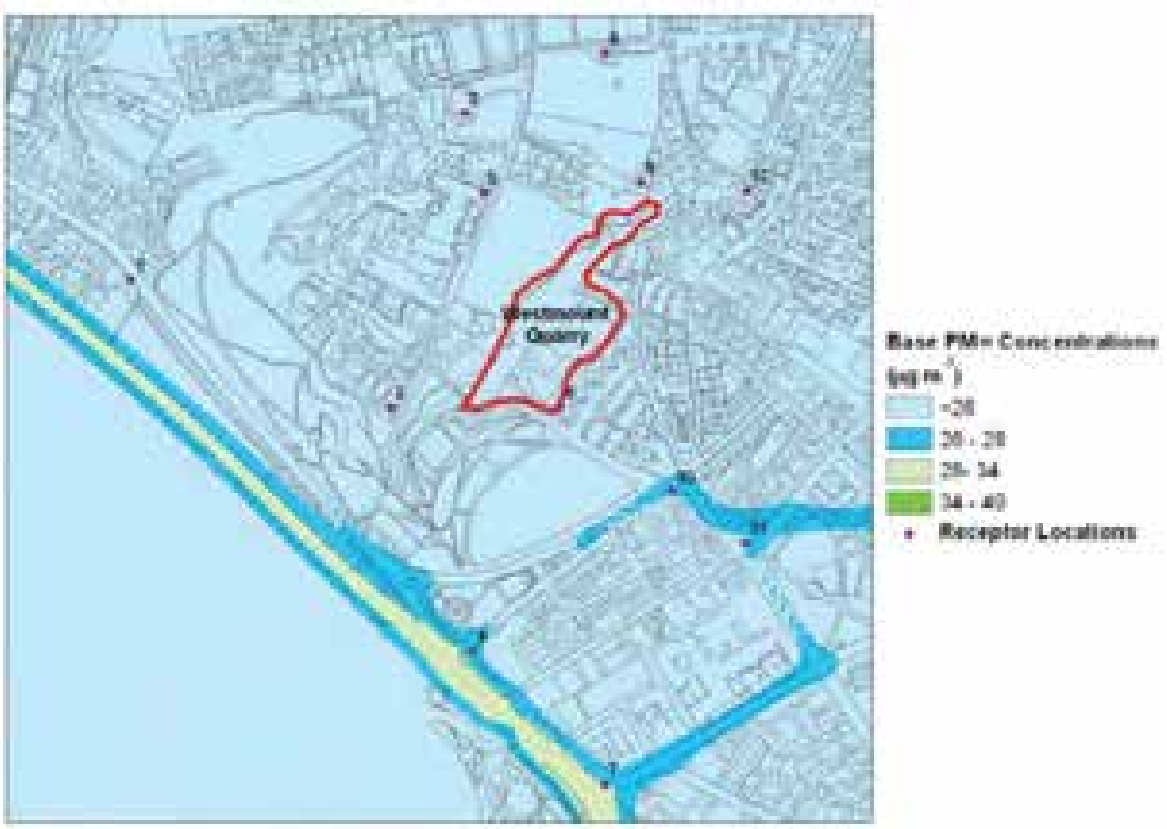
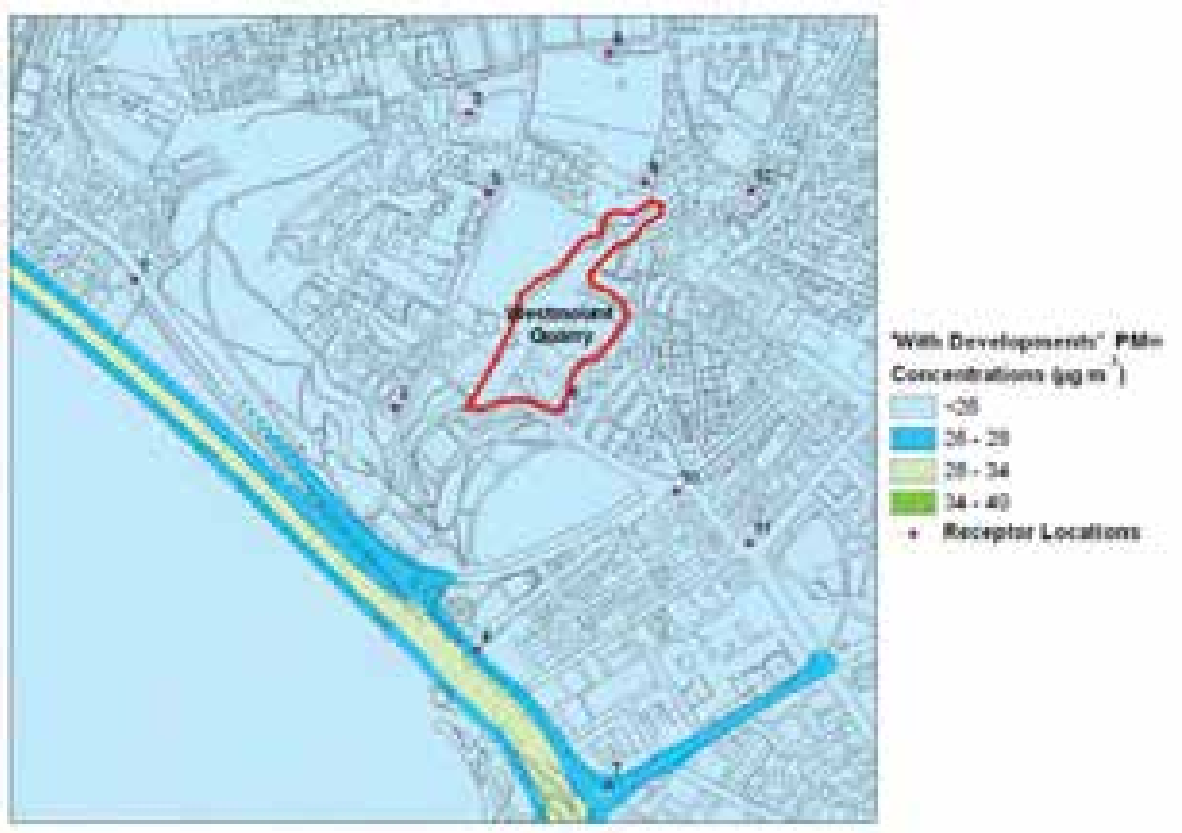


Figure 8.32: Predicted Particulate Concentrations 'With Developments' Around the Westmount Quarry Development



8.6 Conclusions

The cumulative air quality assessment was undertaken for the five identified developments proposed in and around the Waterfront area of St. Helier, Jersey. The assessment consisted of NO_2 and PM_{10} pollutant assessments for the planned developments.

The results of the assessment indicated that no exceedences of any EU Limit values were predicted in the base or 'With developments' scenarios.

Using the NSCA [now EPUK] significance criteria for assessing impacts from the five development sites, the developments are predicted to result in slight adverse impacts on localised NO_2 concentrations at some receptors situated in the vicinity of the Esplanade and Castle Quay developments.

The developments are predicted to result in negligible to slight beneficial impacts on localised PM_{10} concentrations at all receptor locations assessed.

9 Conclusions and Recommendations

Development and Implementation of an Air Quality Strategy and Legislative Framework

It is recommended that the States of Jersey develop and implement an Air Quality Strategy for Jersey.

To implement an Air Quality Strategy on Jersey to deal with the specific localised air quality issues a legislative framework is warranted. The States Strategic Plan, which defines the States' priorities from 2006 to 2011, has made a clear commitment to improve air quality; giving clear direction to move towards international air quality standards. The EU Directives currently in place and discussed in this report should form the backbone of any regime developed for Jersey. The EU Directives place a minimum requirement on Member States in relation to the regulation of air quality, including a requirement to develop enabling legislation.

It is recommended that the States follow a legislative and regulatory process similar to the UK's Air Quality Strategy and LAQM regime, utilising existing guidance notes. A phased approach to assessment should be adopted as described in Section 6.

It is recommended that the States of Jersey use the Strategy to review and reaffirm the lead department tasked with implementing the Air Quality Strategy for Jersey.

In developing a legislative framework for Jersey it is recommended that IPPC is introduced as a mechanism to control emissions from non-waste licensed premises.

Air Quality Monitoring Strategy

Although monitoring of air pollution has been undertaken since 1997 this report has confirmed the acknowledged weakness of the current monitoring programme; most notably it does not allow definitive comparison with EU Limit Values.

It is recommended that monitoring programmes are designed to comply with EU Directives; incorporating the use of appropriate CEN reference methods as identified in Section 7. As a minimum, for the protection of human health, Nitrogen Dioxide PM_{10} and $PM_{2.5}$ pollutants should be monitored using type approved instruments within a QA/QC regime that allows data to be directly compared with the relevant EU health based limits and standards. It is recommended that the current diffusion tube monitoring of BTEX continues as a minimum commitment to monitoring this group of known carcinogens.

Because concentrations of CO and SO_2 are likely to be below lower assessment thresholds, and emissions of O_3 are unlikely to have an impact on island ozone concentrations, it may not be necessary to incorporate these pollutants into a monitoring strategy for the Island. However, due to the lack of available data relating to ambient concentrations of carbon monoxide, sulphur dioxide, lead and ozone, the States should undertake a short-term study of ambient concentrations of these substances as outlined in Section 7.6. The principal priority for any monitoring strategy adopted by the States should concentrate on EU compliance with monitoring methods for NOx and PM as previously stated.

Further to the recommendations for monitoring, whilst the States have no requirement to report to the EU Commission, it is suggested that to comply with best practice the States should adopt a policy of making monitoring data freely available to the public and other relevant organisations through a dedicated air quality resource. The development and adoption of a formal Air Quality Strategy for Jersey, outlining relevant limit values and the framework targeting the assessment and improvement of local air quality, presents an early opportunity to meet these requirements. Furthermore, the development of an integrated air quality monitoring and reporting programme

including the publication of annual reports (cf. UK LAQM Regime) will fulfil many of the requirements for the dissemination of air quality information to the public.

Cumulative Air Quality Impact Assessment of New Development

A cumulative air quality assessment was undertaken for the five new or proposed developments, in and around the Waterfront. The assessment considered NO_2 and PM_{10} pollutant levels prior to and post development.

The results of the assessment indicated that no exceedences of EU Limit values were predicted in the base or 'with developments' scenarios.

Using the NSCA [now EPUK] significance criteria for assessing impacts from the five development sites, the developments are predicted to result in slight adverse impacts on localised NO_2 concentrations at some receptors situated in the vicinity of the Esplanade and Castle Quay developments.

The developments are predicted to result in negligible to slight beneficial impacts on localised PM_{10} concentrations at all receptor locations assessed.

Appendices

Appendix 1 & 2

Part IV of Environment Act 1995 Local Air Quality Management

Appendix 1

Part IV the Environment Act 1995 Local Air Quality Management

80 National air quality strategy

(1) The Secretary of State shall as soon as possible prepare and publish a statement (in this Part referred to as •the strategy••) containing policies with respect to the assessment or management of the quality of air.

(2) The strategy may also contain policies for implementing• •
(a) obligations of the United Kingdom under the Community Treaties, or
(b) international agreements to which the United Kingdom is for the time being a party, so far as relating to the quality of air.

(3) The strategy shall consist of or include• •
(a) a statement which relates to the whole of Great Britain; or
(b) two or more statements which between them relate to every part of Great Britain.

(4) The Secretary of State• •
(a) shall keep under review his policies with respect to the quality of air; and
(b) may from time to time modify the strategy.

(5) Without prejudice to the generality of what may be included in the strategy, the strategy must include statements with respect to• •
(a) standards relating to the quality of air;
(b) objectives for the restriction of the levels at which particular substances are present in the air; and
(c) measures which are to be taken by local authorities and other persons for the purpose of achieving those objectives.

(6) In preparing the strategy or any modification of it, the Secretary of State shall consult• •
(a) the appropriate new Agency;
(b) such bodies or persons appearing to him to be representative of the interests of local government as he may consider appropriate;
(c) such bodies or persons appearing to him to be representative of the interests of industry as he may consider appropriate; and
(d) such other bodies or persons as he may consider appropriate.

(7) Before publishing the strategy or any modification of it, the Secretary of State• •
(a) shall publish a draft of the proposed strategy or modification, together with notice of a date before which, and an address at which, representations may be made to him concerning the draft so published; and
(b) shall take into account any such representations which are duly made and not withdrawn.

81 Functions of the new Agencies

(1) In discharging its pollution control functions, each new Agency shall have regard to the strategy.
(2) In this section •pollution control functions••, in relation to a new Agency, means• •
(a) in the case of the Agency, the functions conferred on it by or under the enactments specified in section 5(5) above; or
(b) in the case of SEPA, the functions conferred on it by or under the enactments specified in section 33(5) above.

82 Local authority reviews

(1) Every local authority shall from time to time cause a review to be conducted of the quality for the time being, and the likely future quality within the relevant period, of air within the authority•s area.

(2) Where a local authority causes a review under subsection (1) above to be conducted, it shall also cause an assessment to be made of whether air quality standards and objectives are being achieved, or are likely to be achieved within the relevant period, within the authority•s area.

(3) If, on an assessment under subsection (2) above, it appears that any air quality standards or objectives are not being achieved, or are not likely within the relevant period to be achieved, within the local authority•s area, the local authority shall identify any parts of its area in which it appears that those standards or objectives are not likely to be achieved within the relevant period.

83 Designation of air quality management areas

(1) Where, as a result of an air quality review, it appears that any air quality standards or objectives are not being achieved, or are not likely within the relevant period to be achieved, within the area of a local authority, the local authority shall by order designate as an air quality management area (in this Part referred to as a •designated area•) any part of its area in which it appears that those standards or objectives are not being achieved, or are not likely to be achieved within the relevant period.

(2) An order under this section may, as a result of a subsequent air quality review,• •
(a) be varied by a subsequent order; or
(b) be revoked by such an order, if it appears on that subsequent air quality review that the air quality standards and objectives are being achieved, and are likely throughout the relevant period to be achieved, within the designated area.

84 Duties of local authorities in relation to designated areas

(1) Where an order under section 83 above comes into operation, the local authority which made the order shall, for the purpose of supplementing such information as it has in relation to the designated area in question, cause an assessment to be made of• •

(a) the quality for the time being, and the likely future quality within the relevant period, of air within the designated area to which the order relates; and
(b) the respects (if any) in which it appears that air quality standards or objectives are not being achieved, or are not likely within the relevant period to be achieved, within that designated area.

(2) A local authority which is required by subsection (1) above to cause an assessment to be made shall also be under a duty• •
(a) to prepare, before the expiration of the period of twelve months beginning with the coming into operation of the order mentioned in that subsection, a report of the results of that assessment; and
(b) to prepare, in accordance with the following provisions of this Part, a written plan (in this Part referred to as an •action plan•) for the exercise by the authority, in pursuit of the achievement of air quality standards and objectives in the designated area, of any powers exercisable by the authority.

(3) An action plan shall include a statement of the time or times by or within which the local authority in question proposes to implement each of the proposed measures comprised in the plan.

(4) A local authority may from time to time revise an action plan.

(5) This subsection applies in any case where the local authority preparing an action plan or a revision of an action plan is the council of a district in England which is comprised in an area for which there is a county council; and if, in a case where this subsection applies, the county council disagrees with the authority about the contents of the proposed action plan or revision of the action plan• •
(a) either of them may refer the matter to the Secretary of State;
(b) on any such reference the Secretary of State may confirm the authority•s proposed action plan or revision of the action plan, with or without modifications (whether or not proposed by the county council) or reject it and, if he rejects it, he may also exercise any powers of his under section 85 below; and
(c) the authority shall not finally determine the content of the action plan, or the revision of the action plan, except in accordance with his decision on the reference or in pursuance of directions under section 85 below.

85 Reserve powers of the Secretary of State or SEPA

(1) In this section, "the appropriate authority" means—
(a) in relation to England and Wales, the Secretary of State; and
(b) in relation to Scotland, SEPA acting with the approval of the Secretary of State.

(2) The appropriate authority may conduct or make, or cause to be conducted or made,—
(a) a review of the quality for the time being, and the likely future quality within the relevant period, of air within the area of any local authority;
(b) an assessment of whether air quality standards and objectives are being achieved, or are likely to be achieved within the relevant period, within the area of a local authority;
(c) an identification of any parts of the area of a local authority in which it appears that those standards or objectives are not likely to be achieved within the relevant period; or
(d) an assessment of the respects (if any) in which it appears that air quality standards or objectives are not being achieved, or are not likely within the relevant period to be achieved, within the area of a local authority or within a designated area.

(3) If it appears to the appropriate authority—
(a) that air quality standards or objectives are not being achieved, or are not likely within the relevant period to be achieved, within the area of a local authority,
(b) that a local authority has failed to discharge any duty imposed on it under or by virtue of this Part,
(c) that the actions, or proposed actions, of a local authority in purported compliance with the provisions of this Part are inappropriate in all the circumstances of the case, or
(d) that developments in science or technology, or material changes in circumstances, have rendered inappropriate the actions or proposed actions of a local authority in pursuance of this Part,
the appropriate authority may give directions to the local authority requiring it to take such steps as may be specified in the directions.

(4) Without prejudice to the generality of subsection (3) above, directions under that subsection may, in particular, require a local authority—
(a) to cause an air quality review to be conducted under section 82 above in accordance with the directions;
(b) to cause an air quality review under section 82 above to be conducted afresh, whether in whole or in part, or to be so conducted with such differences as may be specified or described in the directions;
(c) to make an order under section 83 above designating as an air quality management area an area specified in, or determined in accordance with, the directions;
(d) to revoke, or modify in accordance with the directions, any order under that section;
(e) to prepare in accordance with the directions an action plan for a designated area;
(f) to modify, in accordance with the directions, any action plan prepared by the authority; or
(g) to implement, in accordance with the directions, any measures in an action plan.

(5) The Secretary of State shall also have power to give directions to local authorities requiring them to take such steps specified in the directions as he considers appropriate for the implementation of—
(a) any obligations of the United Kingdom under the Community Treaties, or
(b) any international agreement to which the United Kingdom is for the time being a party,
so far as relating to the quality of air.

(6) Any direction given under this section shall be published in such manner as the body or person giving it considers appropriate for the purpose of bringing the matters to which it relates to the attention of persons likely to be affected by them; and—
(a) copies of the direction shall be made available to the public; and
(b) notice shall be given—
(i) in the case of a direction given to a local authority in England and Wales, in the London Gazette, or
(ii) in the case of a direction given to a local authority in Scotland, in the Edinburgh Gazette,
of the giving of the direction and of where a copy of the direction may be obtained.

(7) It is the duty of a local authority to comply with any direction given to it under or by virtue of this Part.

86 Functions of county councils for areas for which there are district councils

(1) This section applies in any case where a district in England for which there is a district council is comprised in an area for which there is a county council; and in this paragraph• •
(a) any reference to the county council is a reference to the council of that area; and
(b) any reference to a district council is a reference to the council of a district comprised in that area.

(2) The county council may make recommendations to a district council with respect to the carrying out of• •
(a) any particular air quality review,
(b) any particular assessment under section 82 or 84 above, or
(c) the preparation of any particular action plan or revision of an action plan,
and the district council shall take into account any such recommendations.

(3) Where a district council is preparing an action plan, the county council shall, within the relevant period, submit to the district council proposals for the exercise (so far as relating to the designated area) by the county council, in pursuit of the achievement of air quality standards and objectives, of any powers exercisable by the county council.

(4) Where the county council submits proposals to a district council in pursuance of subsection (3) above, it shall also submit a statement of the time or times by or within which it proposes to implement each of the proposals.

(5) An action plan shall include a statement of• •
(a) any proposals submitted pursuant to subsection (3) above; and
(b) any time or times set out in the statement submitted pursuant to subsection (4) above.

(6) If it appears to the Secretary of State• •

(a) that air quality standards or objectives are not being achieved, or are not likely within the relevant period to be achieved, within the area of a district council,
(b) that the county council has failed to discharge any duty imposed on it under or by virtue of this Part,
(c) that the actions, or proposed actions, of the county council in purported compliance with the provisions of this Part are inappropriate in all the circumstances of the case, or
(d) that developments in science or technology, or material changes in circumstances, have rendered inappropriate the actions or proposed actions of the county council in pursuance of this Part,
the Secretary of State may give directions to the county council requiring it to take such steps as may be specified in the directions.

(7) Without prejudice to the generality of subsection (6) above, directions under that subsection may, in particular, require the county council• •
(a) to submit, in accordance with the directions, proposals pursuant to subsection (3) above or a statement pursuant to subsection (4) above;
(b) to modify, in accordance with the directions, any proposals or statement submitted by the county council pursuant to subsection (3) or (4) above;
(c) to submit any proposals or statement so modified to the district council in question pursuant to subsection (3) or (4) above; or
(d) to implement, in accordance with the directions, any measures included in an action plan.

(8) The Secretary of State shall also have power to give directions to county councils for areas for which there are district councils requiring them to take such steps specified in the directions as he considers appropriate for the implementation of• •
(a) any obligations of the United Kingdom under the Community Treaties, or
(b) any international agreement to which the United Kingdom is for the time being a party,
so far as relating to the quality of air.

(9) Any direction given under this section shall be published in such manner as the Secretary of State considers appropriate for the purpose of bringing the matters to which it relates to the attention of persons likely to be affected by them; and• •
(a) copies of the direction shall be made available to the public; and
(b) notice of the giving of the direction, and of where a copy of the direction may be obtained, shall be given in the London Gazette.

(10) It is the duty of a county council for an area for which there are district councils to comply with any direction given to it under or by virtue of this Part.

87 Regulations for the purposes of Part IV

(1) Regulations may make provision• •
(a) for, or in connection with, implementing the strategy;
(b) for, or in connection with, implementing• •
(i) obligations of the United Kingdom under the Community Treaties, or
(ii) international agreements to which the United Kingdom is for the time being a party,
so far as relating to the quality of air; or
(c) otherwise with respect to the assessment or management of the quality of air.

(2) Without prejudice to the generality of subsection (1) above, regulations under that subsection may make provision• •
(a) prescribing standards relating to the quality of air;
(b) prescribing objectives for the restriction of the levels at which particular substances are present in the air;
(c) conferring powers or imposing duties on local authorities;
(d) for or in connection with• •
(i) authorising local authorities (whether by agreements or otherwise) to exercise any functions of a Minister of the Crown on his behalf;
(ii) directing that functions of a Minister of the Crown shall be exercisable concurrently with local authorities; or
(iii) transferring functions of a Minister of the Crown to local authorities;
(e) prohibiting or restricting, or for or in connection with prohibiting or restricting,• •
(i) the carrying on of prescribed activities, or
(ii) the access of prescribed vehicles or mobile equipment to prescribed areas,
whether generally or in prescribed circumstances;
(f) for or in connection with the designation of air quality management areas by orders made by local authorities in such cases or circumstances not falling within section 83 above as may be prescribed;
(g) for the application, with or without modifications, of any provisions of this Part in relation to areas designated by virtue of paragraph (f) above or in relation to orders made by virtue of that paragraph;
(h) with respect to• •
(i) air quality reviews;
(ii) assessments under this Part;
(iii) orders designating air quality management areas; or
(iv) action plans;
(j) prescribing measures which are to be adopted by local authorities (whether in action plans or otherwise) or other persons in pursuance of the achievement of air quality standards or objectives;
(k) for or in connection with the communication to the public of information relating to quality for the time being, or likely future quality, of the air;
(l) for or in connection with the obtaining by local authorities from any person of information which is reasonably necessary for the discharge of functions conferred or imposed on them under or by virtue of this Part;
(m) for or in connection with the recovery by a local authority from prescribed persons in prescribed circumstances, and in such manner as may be prescribed, of costs incurred by the authority in discharging functions conferred or imposed on the authority under or by virtue of this Part;
(n) for a person who contravenes, or fails to comply with, any prescribed provision of the regulations to be guilty of an offence and liable on summary conviction to a fine not exceeding level 5 on the standard scale or such lower level on that scale as may be prescribed in relation to the offence;
(o) for or in connection with arrangements under which a person may discharge any liability to conviction for a prescribed offence by payment of a penalty of a prescribed amount;

(p) for or in connection with appeals against determinations or decisions made, notices given or served, or other things done under or by virtue of the regulations.

(3) Without prejudice to the generality of paragraph (h) of subsection (2) above, the provision that may be made by virtue of that paragraph includes provision for or in connection with any of the following, that is to say• •
(a) the scope or form of a review or assessment;
(b) the scope, content or form of an action plan;
(c) the time at which, period within which, or manner in which a review or assessment is to be carried out or an action plan is to be prepared;
(d) the methods to be employed• •
(i) in carrying out reviews or assessments; or
(ii) in monitoring the effectiveness of action plans;
(e) the factors to be taken into account in preparing action plans;

(f) the actions which must be taken by local authorities or other persons in consequence of reviews, assessments or action plans;
(g) requirements for consultation;
(h) the treatment of representations or objections duly made;
(j) the publication of, or the making available to the public of, or of copies of,• •
(i) the results, or reports of the results, of reviews or assessments; or
(ii) orders or action plans;
(k) requirements for• •
(i) copies of any such reports, orders or action plans, or
(ii) prescribed information, in such form as may be prescribed, relating to reviews or assessments,
to be sent to the Secretary of State or to the appropriate new Agency.

(4) In determining• •
(a) any appeal against, or reference or review of, a decision of a local authority under or by virtue of regulations under this Part, or
(b) any application transmitted from a local authority under or by virtue of any such regulations,
the body or person making the determination shall be bound by any direction given by a Minister of the Crown or SEPA to the local authority to the same extent as the local authority.

(5) The provisions of any regulations under this Part may include• •
(a) provision for anything that may be prescribed by the regulations to be determined under the regulations and for anything falling to be so determined to be determined by such persons, in accordance with such procedure and by reference to such matters, and to the opinion of such persons, as may be prescribed;
(b) different provision for different cases, including different provision in relation to different persons, circumstances, areas or localities; and
(c) such supplemental, consequential, incidental or transitional provision (including provision amending any enactment or any instrument made under any enactment) as the Secretary of State considers appropriate.

(6) Nothing in regulations under this Part shall authorise any person other than a constable in uniform to stop a vehicle on any road.

(7) Before making any regulations under this Part, the Secretary of State shall consult• •
(a) the appropriate new Agency;
(b) such bodies or persons appearing to him to be representative of the interests of local government as he may consider appropriate;
(c) such bodies or persons appearing to him to be representative of the interests of industry as he may consider appropriate; and
(d) such other bodies or persons as he may consider appropriate.

(8) Any power conferred by this Part to make regulations shall be exercisable by statutory instrument; and no statutory instrument containing regulations under this Part shall be made unless a draft of the instrument has been laid before, and approved by a resolution of, each House of Parliament.

(9) If, apart from this subsection, the draft of an instrument containing regulations under this Part would be treated for the purposes of the Standing Orders of either House of Parliament as a hybrid instrument, it shall proceed in that House as if it were not such an instrument.

(1) The Secretary of State may issue guidance to local authorities with respect to, or in connection with, the exercise of any of the powers conferred, or the discharge of any of the duties imposed, on those authorities by or under this Part.

(2) A local authority, in carrying out any of its functions under or by virtue of this Part, shall have regard to any guidance issued by the Secretary of State under this Part.

(3) This section shall apply in relation to county councils for areas for which there are district councils as it applies in relation to local authorities.

(1) Subject to the provisions of any order under this section, this Part, other than section 80, shall not apply in relation to the Isles of Scilly.

(2) The Secretary of State may, after consultation with the Council of the Isles of Scilly, by order provide for the application of any provisions of this Part (other than section 80) to the Isles of Scilly; and any such order may provide for the application of those provisions to those Isles with such modifications as may be specified in the order.

(3) An order under this section may• •

(a) make different provision for different cases, including different provision in relation to different persons, circumstances or localities; and

(b) contain such supplemental, consequential and transitional provision as the Secretary of State considers appropriate, including provision saving provision repealed by or under any enactment.

(4) The power of the Secretary of State to make an order under this section shall be exercisable by statutory instrument; and a statutory instrument containing such an order shall be subject to annulment in pursuance of a resolution of either House of Parliament. 90 Supplemental provisions
Schedule 11 to this Act shall have effect. 91 Interpretation of Part IV

(1) In this Part• •
••action plan•• shall be construed in accordance with section 84(2)(b) above;
••air quality objectives•• means objectives prescribed by virtue of section 87(2)(b) above; ••air quality review•• means a review under section 82 or 85 above; ••air quality standards•• means standards prescribed by virtue of section 87(2)(a) above; ••the appropriate new Agency•• means• •
(a) in relation to England and Wales, the Agency;
(b)in relation to Scotland, SEPA; ••designated area•• has the meaning given by section 83(1) above;
••local authority••, in relation to England and Wales, means• •
(a) any unitary authority,
(b) any district council, so far as it is not a unitary authority,
(c) the Common Council of the City of London and, as respects the Temples, the Sub-Treasurer of the Inner Temple and the Under-Treasurer of the Middle Temple respectively, and, in relation to Scotland, means a council for an area constituted under section 2 of the [1994 c. 39.] Local Government etc. (Scotland) Act 1994; ••new Agency•• means the Agency or SEPA;
••prescribed•• means prescribed, or of a description prescribed, by or under regulations; ••regulations•• means regulations made by the Secretary of State;
••the relevant period••, in the case of any provision of this Part, means such period as may be prescribed for the purposes of that provision;
••the strategy•• has the meaning given by section 80(1) above;
••unitary authority•• means• •
(a) the council of a county, so far as it is the council of an area for which there are no district councils;
(b) the council of any district comprised in an area for which there is no county council;
(c) the council of a London borough;
(d) the council of a county borough in Wales.

(2) Any reference in this Part to it appearing that any air quality standards or objectives are not likely within the relevant period to be achieved includes a reference to it appearing that those standards or objectives are likely within that period not to be achieved.

Appendix 2

Part IV of Environment Act 1995: Example of AQMA Order

Example of an AQMA Order

Environment Act 1995 Part IV Section 83(1)

[Name of Council] AQMA Order

[Name of Council], in exercise of the powers conferred upon it by Section 83(1) of the Environment Act 1995, hereby makes the following Order.

This Order may be cited/referred to as the [name of Council] Air Quality Management Area [No1, 2,3 if more than one is being designated] and shall come into effect on [date]

The area shown on the attached map in red is to be designated as an air quality management area (the designated area). The designated area incorporates [the whole borough of said Council] or [name of street/trunk road] or [stretch of road between junction X and junction Y]. The map may be viewed at the Council Offices

This Area is designated in relation to a likely breach of the nitrogen dioxide (annual mean) objective as specified in the [Air Quality • • • • • Regulations 2007]

This Order shall remain in force until it is varied or revoked by a subsequent order.

The Common Seal of [Name of Council} was hereto affixed on [date] and signed in the presence of /on behalf of said Council

Appendix 3

Analysis of Particulate Matter (Dust) on Filter Using SEM and EDX

RESTRICTED COMMERCIAL

ANALYSIS OF PARTICULATE MATTER (DUST) ON FILTER USING SEM AND EDX

OM 08/076

A report prepared for

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16th April 2008

Summary

One 25mm GFA filter from a dust sampler in Jersey was provided for analysis. The objective of the analysis was to try to identify potential sources, for example vehicles, oil fired power station, coastal impacts, etc.

The particles on the filter were predominately debris from salt spray, small sodium chloride crystals. There was a much smaller quantity of silicate particles. However, the interpretation of the composition of the particle analyses was complicated by the composition of the filter used which had a similar composition to that which might be expected from a rock except for the presence of barium. This added to the problem in that barium interferes with the detection of vanadium. No vanadium was detected at statistically significant levels. A number of copper rich particles were detected, and there was also apparently zinc rich material present. But as zinc was present in the filter this is unlikely to be significant.

A large amount of sulphur was present in many of the particles, and many of the iron rich articles were very small and seem to be associated with the salt spray droplets.

Results

Interactive

The filter was initially examined using manual search and analysis. The vast majority of the material on the filter was sodium chloride, usually in the form of very small cubic crystals. These were often arranged as spheres (Figure 1) possibly the result of the drying of salt spray. Salt was so common that the analysis of any other grain will have a contribution from sodium chloride due to electron scattering and that many of the particles are not sufficiently large to stop the electron beam will generate X-rays from the surrounding salt crystals. The other common type of feature present was small aggregations of iron oxide (also seen in Figure 1, spectrum Figure 3). These sometimes showed the possible presence of low concentrations of copper (not visible in spectrum 3, but can be seen in the expanded spectrum 4 – Figure 4).

Of rarer occurrence were a number of particles that could be attributed to fine rock or mineral grains. Figure 4 includes a grain with high silica content (spectrum 1 marked in Figure 5 and illustrated in Figure 6), this grain is probably quartz. In the same image there was a larger more crystalline particle of iron oxide (spectrum 2 – Figure 7) which may have come from a natural source. One of the largest fragments observed (Figure 8) was probably mainly the sodium feldspar albite (Spectrum Figure 9), but there are other minerals from part of this grain indicating that it should be classed as a rock fragment. In the same field of view was a small bright particle which contained lanthanum (Figures 10 and 11).

Figure 12 shows a small sphere toward the top centre of the image. This particle may be a fly ash type particle; the spectrum (Figure 13) shows an increased level of titanium which was unusual in terms of the analysis of the particles from the filter where calcium, sulphur, silicon, aluminium were the most common elements other than sodium, chlorine and iron.

To check whether there was any contribution from the filter, a region at the edge of filter masked off from the collecting area was examined (Figure 14). The spectrum from the fibres showed the presence of sodium, aluminium, silicon, potassium, calcium, barium and zinc, as well as oxygen. This makes this type of filter not the best for type of analysis required, as it contains a large number of elements that will cause interference with any elements of interest. In particular, Barium will interfere with both titanium and vanadium. The presence of zinc in the glass fibres probably accounts for the occasional observation of zinc at trace levels.

There was no sign of any vanadium in the spectra observed, but the presence of barium in the substrate could have masked its presence.

Automated
To obtain a statistically larger particle analysis an automated particle identification and analysis run was carried out.

A total of 3479 particles were identified, of which 219 were rejected as they had an aspect ratio greater than 3, and thus, were likely to be fibres from the filter. The selection of this criterion will not have excluded all the filter fibres but the vast majority in analysis region. Although, a large number of particles recorded the presence of appreciable amounts both barium and zinc and examination of the relevant data indicated that this probably came from the substrate fibres.

Copper was noted to be present at concentrations above 3 wt % in 11 particles. In most cases the copper was associated with high iron concentrations, but with two particles the copper seemed to be present without iron.

There was one particle with an appreciable amount of chromium, in addition to iron and possibly a trace of nickel. There was only one particle that might have some vanadium but even in that case the concentration was less than twice the detection limit but there might have been others present masked by the presence of barium or titanium. There were 17 particles with appreciable titanium content. There were 790 particles with calcium concentrations above 2%, about twice the level in the filter fibres. Some of these will be from calcium carbonate, and there were three that could be ascribed to the presence of apatite (a calcium phosphate), others have a contribution from calcium sulphate. There were 10 particles with potassium concentrations greater than 10%, some of these are likely to be from potassium feldspar rock fragments and others to the possible presence of potassium chloride. However, due to the chemistry of the substrate, and ubiquitous presence of sodium chloride it is difficult to unravel the various contributions. Chlorine was present everywhere, with the lowest concentration recorded at 1.64% on a silica grain. Sulphur was equally ubiquitously present but at lower concentrations. As the substrate filter did not contain measurable sulphur content, the sulphur must be trapped amongst the particles. However, the form in which the sulphur is present is not clear. Some may be present as calcium sulphate but the nature of majority material could not be determined easily.

A plot of Na against Cl (figure 16) shows how sodium chloride dominates the particle composition distribution – that is, most points lie close to the NaCl trend line. However, the plot of aluminium against silicon shows the presence of three different trend line (Figure 17) for the non-NaCl particles. There would appear to be three types of silicate particle present. One of these is silica (high silicon low aluminium), probably quartz. It is likely that other two lines are associated with the compositions of minerals in the rock fragments, but interpretation is made difficult by the presence of the other major rock forming elements sodium, aluminium, potassium and calcium in the substrate fibres.

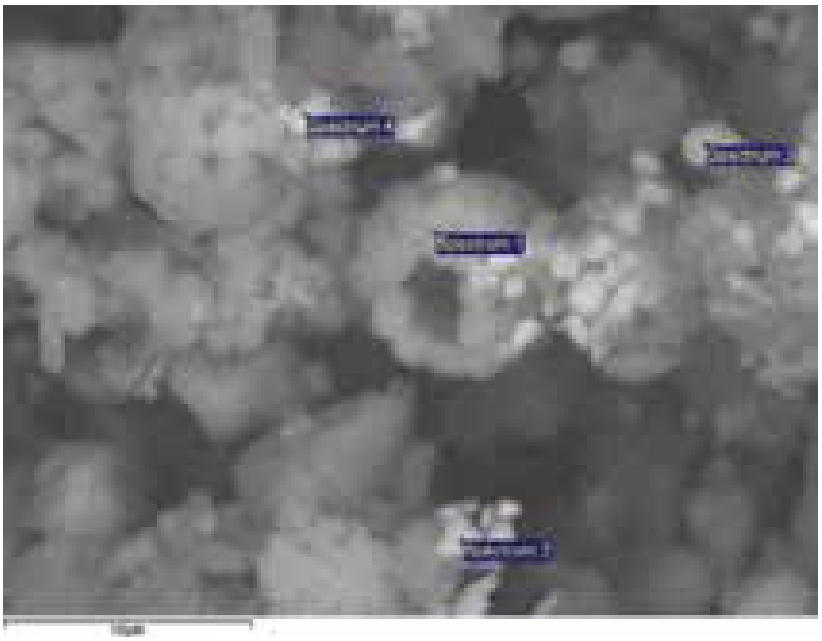

Figure 1 **Typical region showing spherical clusters of small sodium chloride crystals. The slightly brighter regions show high concentrations of iron oxide.**

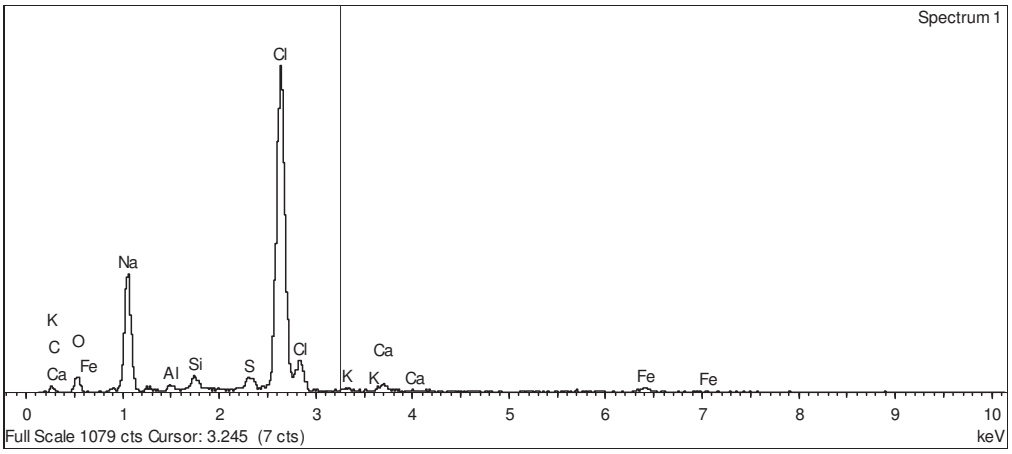

Figure 2 **Spectrum 1 from sodium chloride crystals from the position indicated in Figure 1.**

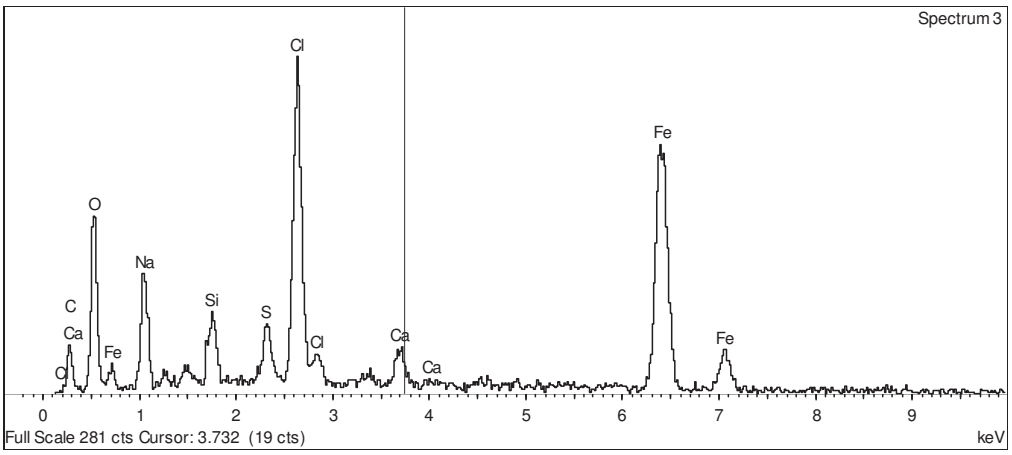

Figure 3 Spectrum from brighter material shown in Figure 1 indicating the presence of iron oxide.

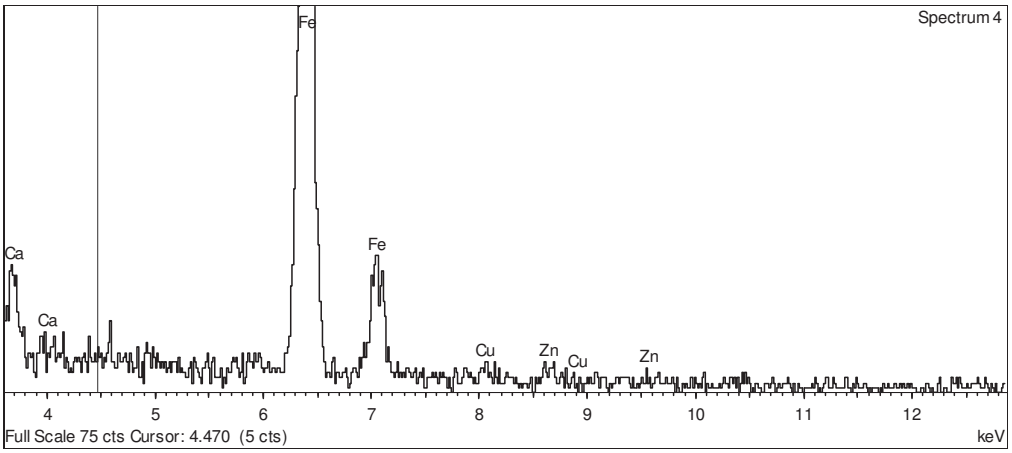

Figure 4 Spectrum from particle similar to that of spectrum 3 showing presence of traces of copper and zinc.

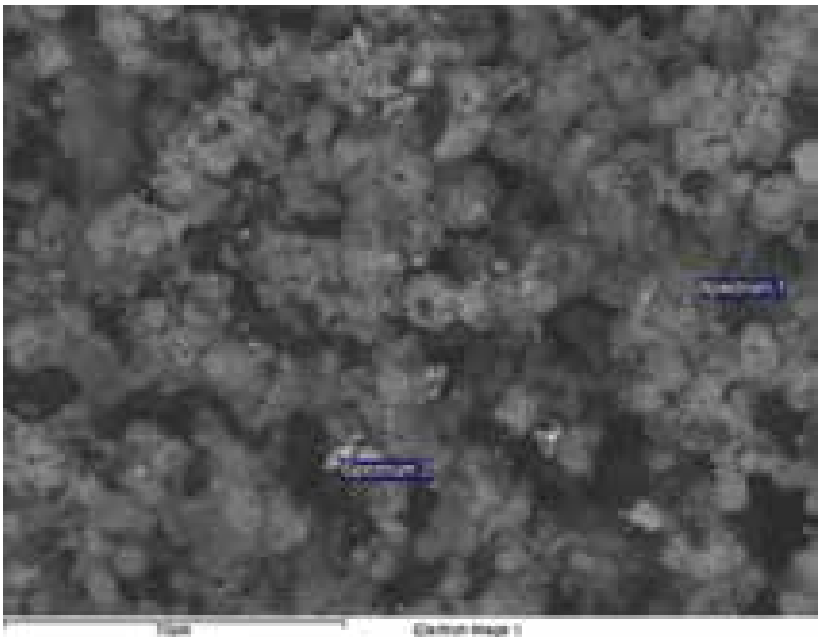

Figure 5 Typical region at lower magnification.

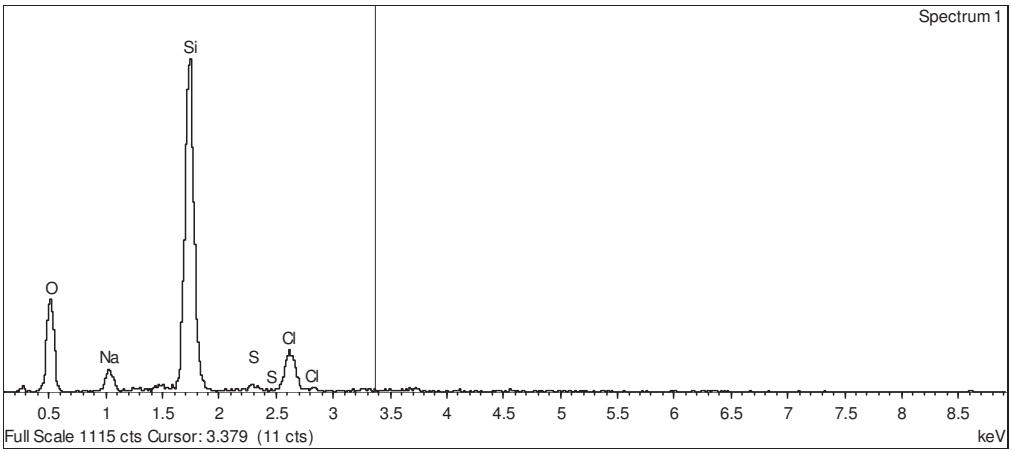

Figure 6 Spectrum of silica grain (spectrum 1 in Figure 5).

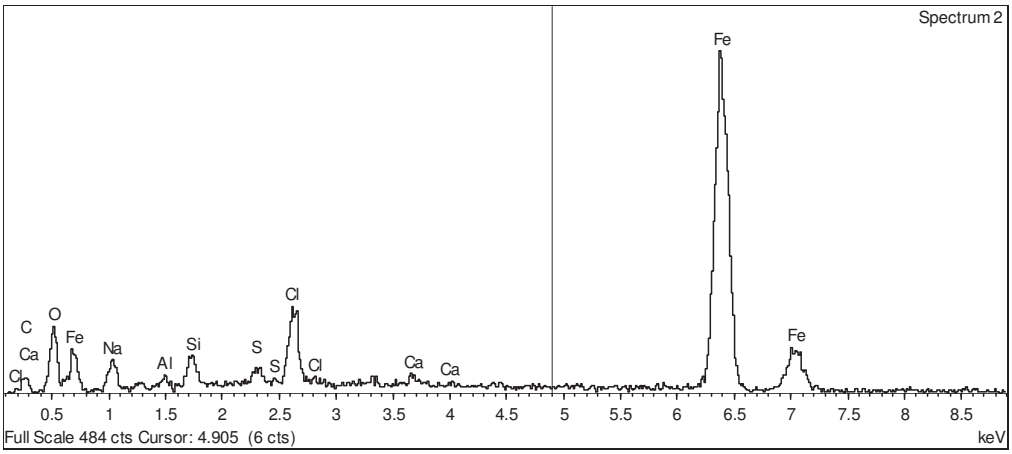

Figure 7 Spectrum from iron oxide grain (spectrum 2 in Figure 5).

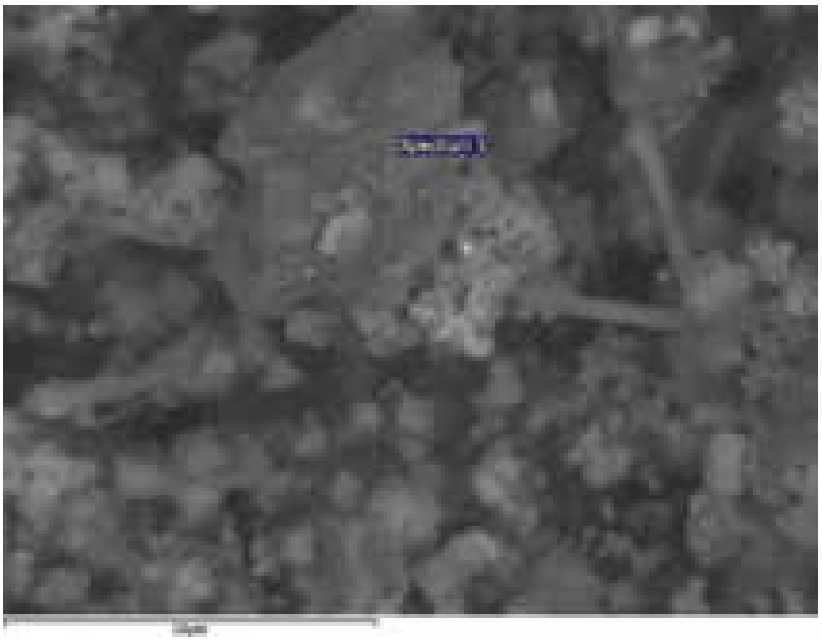

Figure 8 **Image showing larger rock fragment (probably the majority of the fragment is composed of the feldspar albite).**

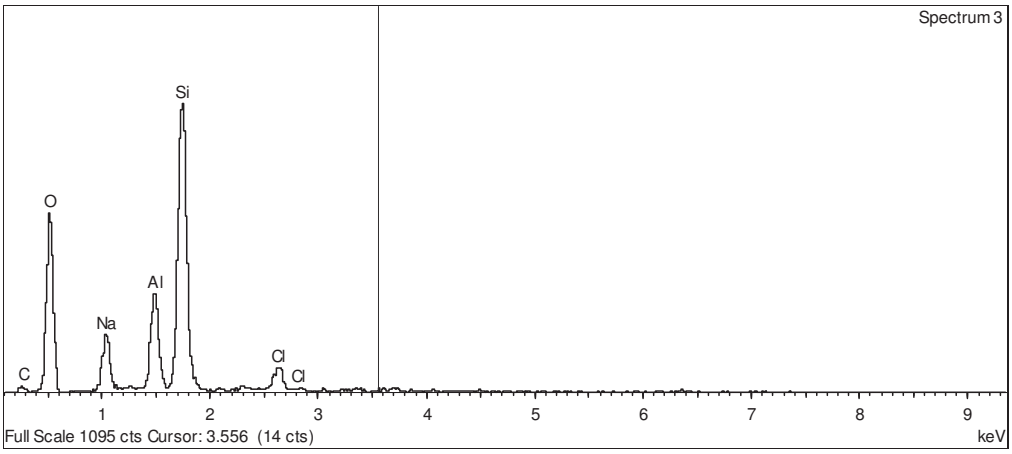

Figure 9 **Spectrum from bulk of mineral (or rock) fragment shown in Figure 8.**

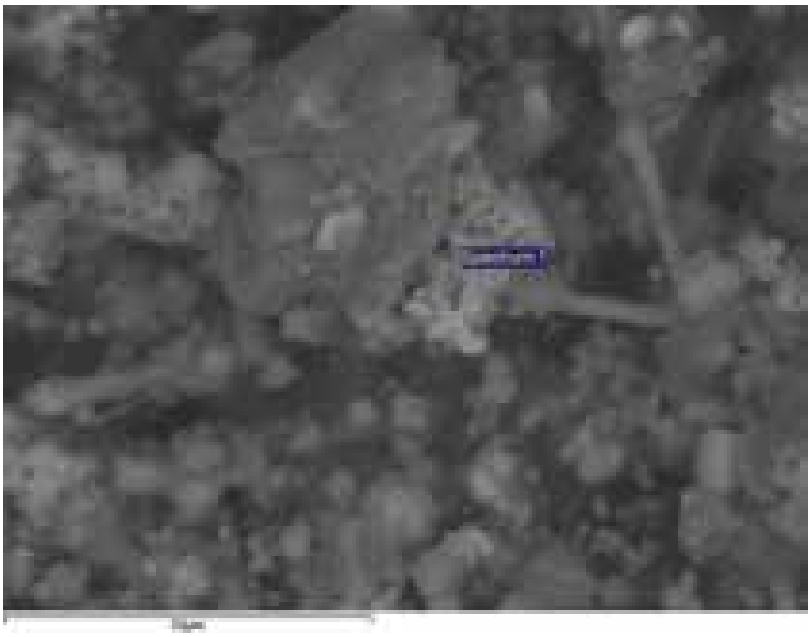

Figure 10 The same image as Figure 8 showing the location of bright spot.

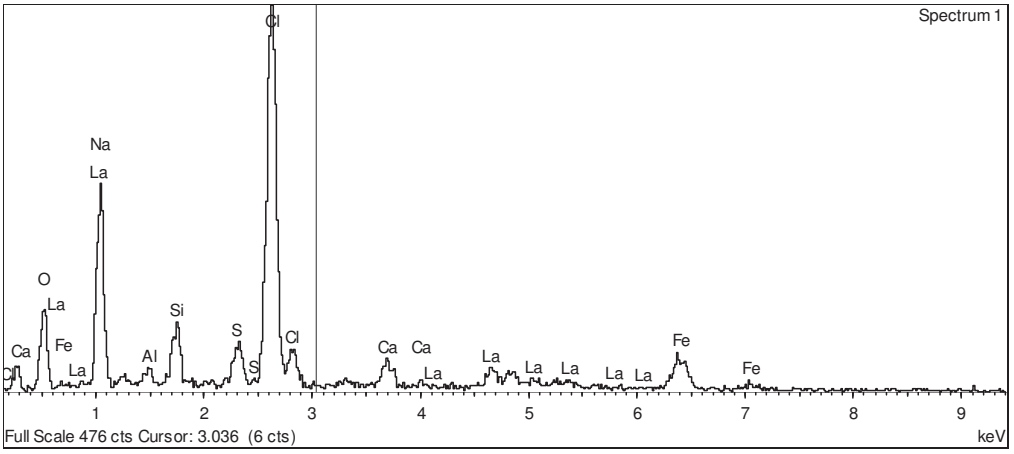

Figure 11 Spectrum from point indicated in Figure 8 showing higher than normal concentration of Lanthanum

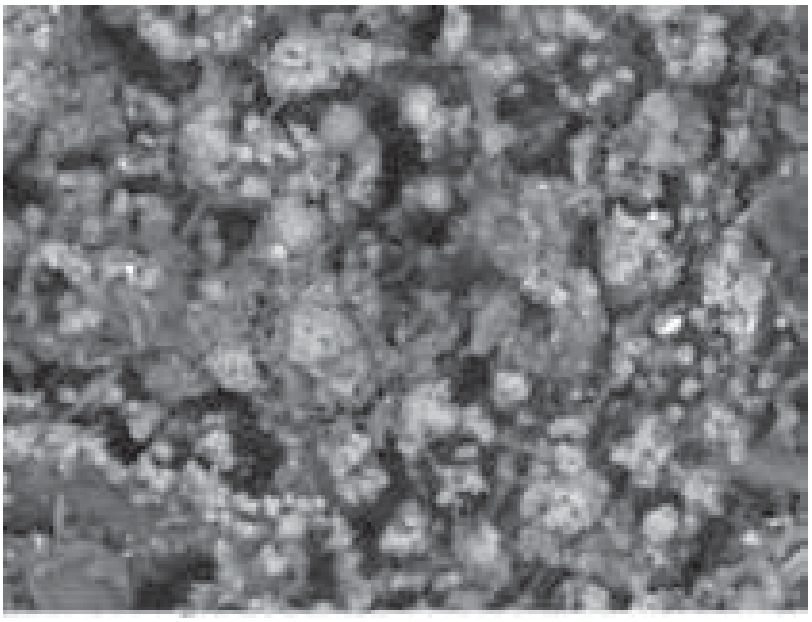

Figure 12 Possible fly ash sphere (top centre).

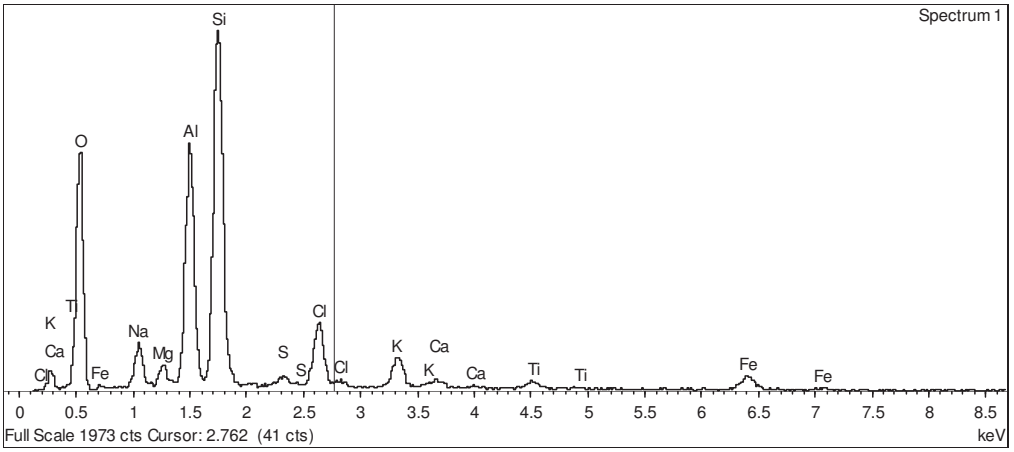

Figure 13 Spectrum from possible fly ash sphere.

Figure 14 Image of clean masked region of filter.

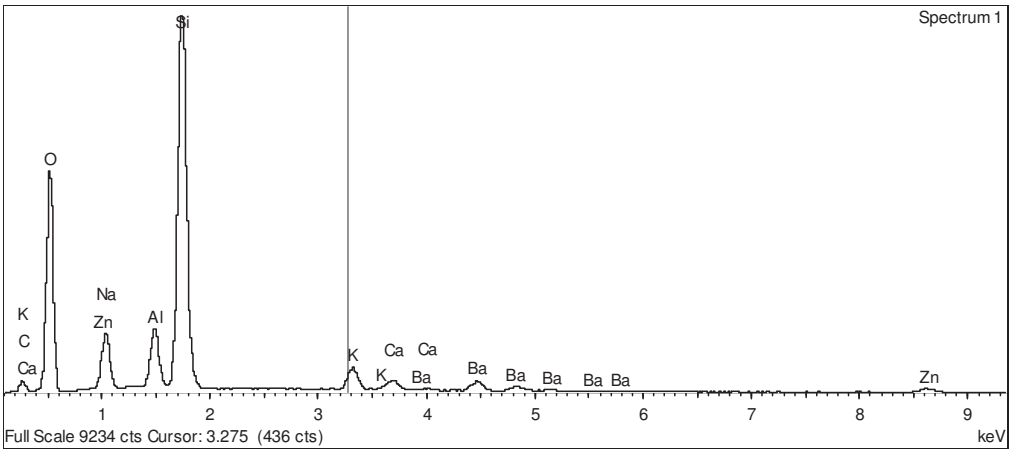

Figure 15 Spectrum from clean filter.

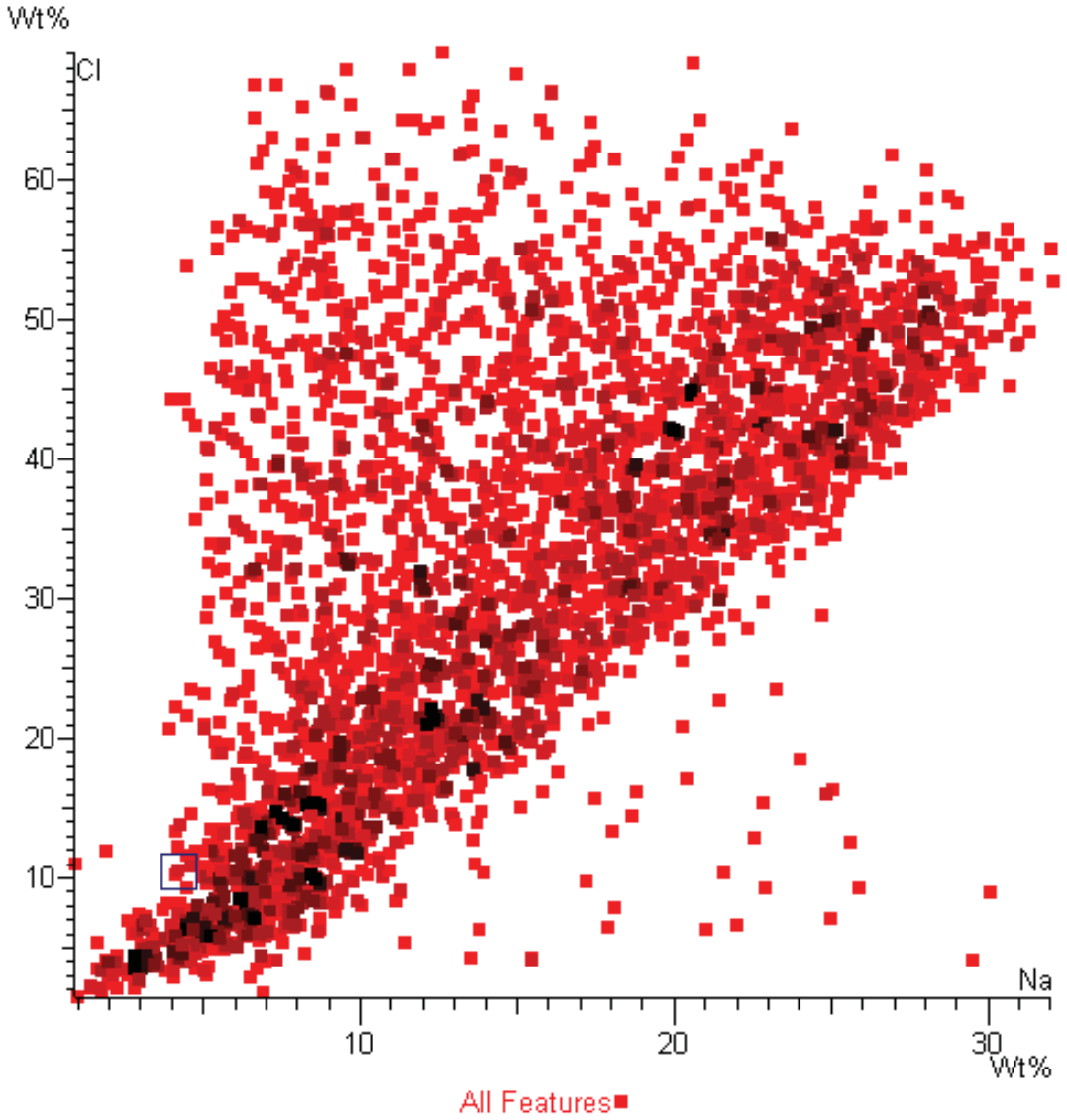

Figure 16 Plot of Sodium again chlorine for all particles.

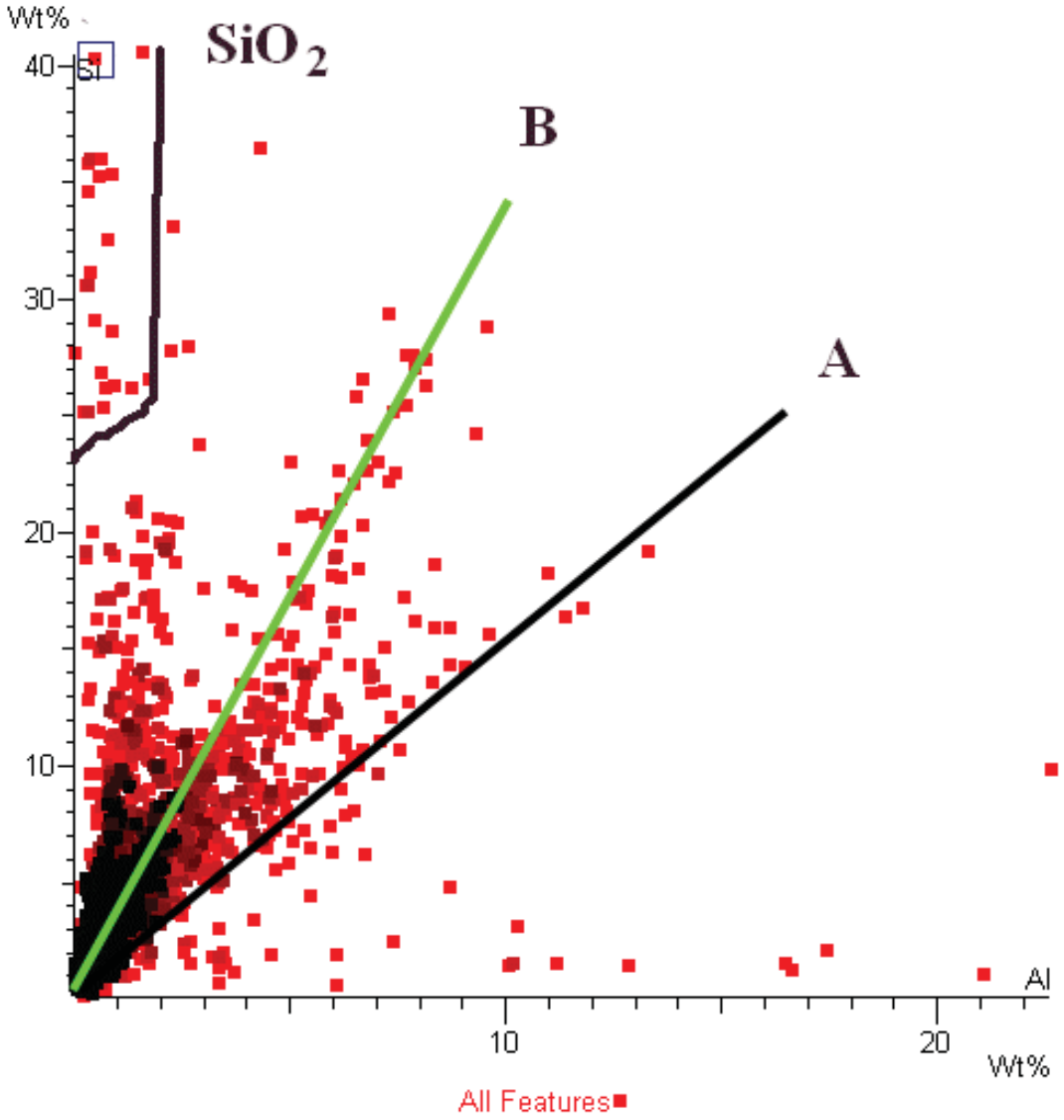

Figure 17 **Plot of Al against Si content in particles, showing two alumino-silicate trend lines A and B (possibly from rock fragments and fibres), and the silica rich region to left of black line on Si axis.**

ANNEXES

ANNEX 1

Experimental Details

Energy Dispersive X-ray Analysis (EDX)
A JEOL JSM-6480ALV SEM equipped with an Oxford Instruments INCA x-ray analysis system was used for energy dispersive X-ray analysis (EDX), was used in Low Vacuum mode to eliminate charge problems. EDX analyses the characteristic X-rays produced by the interaction between the primary electron beam and the sample. The technique identifies all elements present with atomic numbers of 5 and greater (boron) with a detection limit of approximately 0.3 weight % (approximately 1% for automated analysis).

Appendix 4

Monitoring Reports 1998 to 2008

AEAT-5271

Air Quality Monitoring in Jersey; Diffusion Tube Surveys, 1998.

Brian Stacey

April 1999

AEAT-5271

Air Quality Monitoring in Jersey; Diffusion Tube Surveys, 1998.

Brian Stacey

April 1999

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Approved by	Ken Stevenson		

Executive Summary

AEA Technology's National Environmental Technology Centre (NETCEN), on behalf of the Public Health Services of the States of Jersey, has undertaken a continuing study of air pollution in Jersey in 1998. This report presents the results of a year-long study of sulphur dioxide and hydrocarbon concentrations at a number of sites on the island, using diffusion tube samplers.

A total of 8 sulphur dioxide (SO_2) tube sites and 5 hydrocarbon tube sites (measuring benzene, toluene, ethyl benzene and xylene, BTEX) were used for the surveys, in a range of different locations on the island. The choices of monitoring locations ensured that any contribution from major pollution sources, for example petrol stations or the power station, could be assessed during the surveys. In addition, general background concentrations were assessed.

The monitoring surveys took place between 10th December 1997 and 17th December 1998. The SO_2 tubes were exposed for 4 week periods, while the BTEX tubes were exposed for two weeks. The tubes were changed by Technical Officers of the Environmental Health Section on the island. Diffusion tubes provide an averaged concentration of the pollutant measured; over 4 weeks for the SO_2 tubes, 2 weekly in the case of the BTEX tubes.

The results from the SO_2 survey showed that average concentrations were generally low. Highest average concentrations were found in St Helier during the winter months. Annual average concentrations were lowest in rural areas, but below 5.1 ppb at all sites.

Average concentrations of benzene were found to be highest at the site closest to the petrol station, where the greatest emissions of this pollutant are likely to occur. The hydrocarbon survey results for 1998 were relatively low throughout the year, with only a small number of episodes that were higher than background concentrations. Annual average benzene concentrations were below 2.5 ppb for all sites except the fuel station, which was 7.7 ppb.

The data from the Jersey sites have been compared with the 1997 Jersey survey data, as well as to data from a number of representative sites in the UK Automatic Monitoring Networks, and to current UK, EC and WHO air quality standards and guidelines. Generally, the average results in Jersey are broadly similar to the sites in the UK used for the comparison.

Contents

1 Introduction

AEA Technology's National Environmental Technology Centre (NETCEN), on behalf of States of Jersey Public Health Services, has undertaken a programme of air quality monitoring in Jersey during 1998, using passive diffusion tube samplers.

Average ambient concentrations of sulphur dioxide (SO_2) and a range of hydrocarbon species (benzene, toluene, ethyl benzene and three xylene compounds, collectively described as BTEX) were measured. SO_2 was measured at 8 sites on the island, BTEX was measured at 5 locations in St Helier.

This report presents the results obtained from this survey, and compares the data from Jersey with a selection of UK monitoring stations and relevant air quality monitoring standards and guidelines.

2 Site Locations, Pollutants Monitored and Methodologies

2.1 SITE LOCATIONS

The monitoring strategies for the two diffusion tube surveys were broadly similar; to target sites where concentrations were expected to be high, and compare these with background locations.

For the SO_2 survey, 8 sites were chosen:

1.	Le Bas Centre	(urban background)
2.	Langley Park	(residential background)
3.	St Brelade (Quennevais School)	(residential background)
4.	St Martin	(rural)
5.	Territorial Army	(adjacent to power station)
6.	Roseville Street	(urban, downwind from power station)
7.	Plat Douet Road	(urban, downwind from power station)
8.	St Thomas	(rural, downwind from power station)

In February, the sites at the Territorial Army and St Thomas were moved to:

9.	La Hougue	(rural, downwind from power station)
10.	Les Huriaux	(rural, downwind from power station)

Five sites were used for the hydrocarbon survey:

1.	Le Bas Centre	(urban background)
2.	Beresford Street	(urban roadside)
3.	Springfields Garage	(urban roadside, fuel filling station)
4.	Elizabeth Lane	(urban background, paint spraying process)
5.	La Collette	(urban background, close to power station and harbour)

The site at La Collette was commissioned on 26th February.

All of the tubes were located on wooden blocks that were fixed to walls or posts, approximately 8 - 10 feet above the ground. The locations of the tube sites are presented in Figures 1a and 1b.

2.2 POLLUTANTS MONITORED

2.2.1 Sulphur Dioxide

Sulphur dioxide is formed during the combustion of fuels that contain sulphur. The most significant source of this pollutant is fossil fuelled power generators, although diesel engines, domestic solid fuel burners and a number of chemical processes also produce SO_2.

SO_2 is a respiratory irritant, and is toxic at high concentrations. It is also a major precursor in the formation of acid rain.

2.2.2 Hydrocarbons

There are many sources of hydrocarbon emissions; methane for example, is a naturally occurring gas, while xylene compounds are synthetic and used in many applications, for example as a solvent in paint.

The diffusion tube samplers used in the study measure a number of aromatic hydrocarbon species; benzene, toluene, three xylene compounds (ortho-xylene, and combined meta- and para- xylene), and ethyl benzene. All of these compounds are toxic at high concentrations; benzene is particularly well known for its carcinogenic properties.

2.2.3 Methodologies

Both the SO_2 and BTEX monitoring surveys were conducted using passive diffusion tube samplers. These are small (50 - 75cm) tubes, which contain a chemical that adsorbs the pollutant of interest. Pollutants in the atmosphere can “diffuse” through the specially designed tube onto the adsorbent by a process known as Fick’s Law of Diffusion.

The tubes were supplied in a sealed condition prior to exposure. The lower end of the tube was uncapped and the tube deployed on site for a period of time, after which the tube was re-capped and returned for analysis. Local Technical Officers of the Environmental Health Section changed all tubes.

The SO_2 tubes were changed every 4 weeks, while the BTEX tubes required more frequent changes, every 2 weeks. The tubes were returned for analysis at the NETCEN analytical laboratory facility, which calculated the average pollutant concentration for the exposure periods.

The diffusion tube sampling methodologies provide data that are accurate to ± 20% for SO_2 and ± 20% for BTEX. The limits of detection for each method are: 0.4 ppb for SO_2 and 0.1 ppb for BTEX. It should be noted that tube results that are close to the limit of detection (~ 4 ppb for SO_2 and ~ 1 ppb for BTEX) will have a higher level of uncertainty associated with them.

3 Air Quality Standards and Guidelines

In the UK, concentrations of SO_2 are regulated by an EC Directive. The Directive sets limit values which are mandatory, and guide values which are intended to provide increased protection to human health and the environment. The Directive requires monitoring to be conducted over a whole year; limit and guide values are based on a full year of measurements. The limit and guide values of the EC Directive are summarised in Appendix 1.

In 1996, the World Health Organisation published revised interim guidelines for SO_2. These revised guidelines have been set using currently available scientific evidence on the effects of air pollutants on health and vegetation. The WHO guidelines are advisory only, and do not carry any mandatory status. The guidelines are summarised in Appendix 1.

The UK Department of the Environment, Transport and the Regions (DETR) uses air quality bands for a number of pollutants, to describe air quality on daily bulletins to the general public. The bands for SO_2 are summarised in Appendix 1. There are no air quality bands for any of the hydrocarbon species.

The DETR has published health-effects based standards and objectives for SO_2 and benzene. These guidelines are set at levels which are thought to present minimal risk to the population, including those particularly sensitive to poor air quality. The guidelines are set as part of the UK National Air Quality Strategy, and are summarised in Appendix 1.

4 Results and Discussion

4.1 PRESENTATION OF THE RESULTS

The monthly results for each site in the SO_2 diffusion tube survey are presented in Table 1 below, and a graphical representation of the data is provided in Figure 2. The fortnightly results for the BTEX tube survey are presented for each site in Tables 2 - 6 below. Graphs of the BTEX data from each site are provided in Figures 3 - 7, while a comparison of the benzene concentrations at the sites is presented in Figure 8.

Table 1 - Monthly Average SO_2 data, Jersey 1998

	10 Dec 15 Jan	15 Jan 12 Feb	12 Feb 12 Mar	12 Mar 9 Apr	9 Apr 7 May	7 May 4 Jun	4 Jun 2 Jul	2 Jul 4 Aug	4 Aug 27 Aug	27 Aug 30 Sep	30 Sep 22 Oct	22 Oct 19 Nov	19 Nov 17 Dec
Le Bas	4.3	8.1	3.9	7.8	4.2	2.9	4.9	4.0	2.7	5.7	5.9	2.9	5.9
Langley Park	3.3	4.5	2.2	3.7	2.6	2.5	1.2	1.2	1.0	2.5	2.1	2.7	3.2
St Brelade	6.5	3.3	14.7	2.5	2.8	1.2	1.0	0.5	0.7	2.4	1.0	2.5	5.9
St Martin	1.3	4.1	0.4	3.1	1.8	0.6	0.6	1.2	1.0	1.9	0.5	4.9	4.3
Plat Douet Rd	4.8	5.3	5.5	3.9	5.9	1.6	2.0	2.1	3.2	3.0	-	4.3	15.8
Roseville St	10.0	6.5	9.4	7.4	3.2	3.1	2.0	2.4	3.5	3.5	3.3	7.4	5.1
La Hougue	-	-	1.5	3.7	2.0	2.0	1.2	3.3	2.2	2.2	1.3	2.5	3.8
Les Huriaux	-	-	1.5	3.7	2.0	1.8	1.8	2.8	2.2	6.7	1.0	2.3	3.0
St Thomas	0.5	4.5	-	-	-	-	-	-	-	-	-	-	-
Terr. Army	3.8	4.3	-	-	-	-	-	-	-	-	-	-	-

NOTES: All concentrations are parts per billion, ppb

Table 2 - Average Jersey Hydrocarbon data, Beresford Street 1998

Date	Benzene, ppb	Toluene, ppb	Ethylbenzene, ppb	m+p Xylene, ppb	o Xylene, ppb
10 Dec - 18 Dec	6.5	11.8	2.0	5.9	2.2
18 Dec - 15 Jan	4.0	6.3	1.0	2.9	1.2
15 Jan - 29 Jan	3.7	5.4	0.9	3.3	1.3
29 Jan - 12 Feb	4.8	7.4	1.4	4.4	0.4
12 Feb - 26 Feb	3.0	6.2	1.2	3.8	1.4
26 Feb - 12 Mar	1.9	3.7	0.7	1.7	1.0
12 Mar - 26 Mar	1.7	4.0	0.8	1.9	1.0
26 Mar - 9 Apr	3.3	5.7	1.0	2.3	1.1
9 Apr - 23 Apr	2.1	3.5	0.6	1.6	0.6
23 Apr - 7 May	2.0	3.1	0.5	1.4	0.6
7 May - 22 May	1.1	3.4	0.6	1.6	0.6
22 May - 4 Jun	2.3	4.6	0.7	1.9	0.8
4 Jun - 18 Jun	1.7	3.4	0.6	1.5	0.7
18 Jun - 2 Jul	1.9	4.2	0.7	1.7	0.7
2 Jul - 16 Jul	1.8	3.7	0.7	1.6	0.7
16 Jul - 4 Aug	2.1	4.5	0.7	1.9	0.7
4 Aug - 13 Aug	2.1	4.1	0.6	1.6	0.7
13 Aug - 27 Aug	2.2	5.1	0.8	2.1	1.0
27 Aug - 10 Sep	2.1	4.9	0.8	2.0	0.8
10 Sep - 30 Sep	1.3	3.8	0.6	1.9	0.8
30 Sep - 8 Oct	1.8	4.0	1.6	3.8	3.4
8 Oct - 22 Oct	1.2	2.3	0.4	0.9	0.8
22 Oct - 5 Nov	2.3	3.9	0.7	1.4	1.0
5 Nov - 19 Nov	3.3	5.8	0.9	2.1	1.1
19 Nov - 3 Dec					
3 Dec - 17 Dec	3.3	6.5	1.0	2.5	1.1

Table 3 - Average Jersey Hydrocarbon data, Le Bas Centre 1998

Date	Benzene, ppb	Toluene, ppb	Ethylbenzene, ppb	m+p Xylene, ppb	o Xylene, ppb
10 Dec - 18 Dec	6.4	7.6	1.2	4.3	1.6
18 Dec - 15 Jan	2.8	11.6	1.2	2.6	1.3
15 Jan - 29 Jan	3.9	4.6	1.0	3.3	0.5
29 Jan - 12 Feb	5.9	8.6	1.4	5.1	1.8
12 Feb - 26 Feb	3.0	6.0	1.1	2.7	1.4
26 Feb - 12 Mar	1.9	3.7	0.7	1.7	0.9
12 Mar - 26 Mar	1.9	3.9	0.7	2.1	0.8
26 Mar - 9 Apr	2.6	4.5	0.9	2.5	1.0
9 Apr - 23 Apr	2.1	3.0	0.6	1.4	0.6
23 Apr - 7 May	1.7	2.5	0.4	1.1	0.4
7 May - 22 May	0.7	2.0	0.3	1.0	0.4
22 May - 4 Jun	1.9	3.3	0.6	1.5	0.6
4 Jun - 18 Jun	1.5	3.2	0.7	1.5	0.7
18 Jun - 2 Jul	1.7	3.5	1.1	2.1	0.8
2 Jul - 16 Jul	1.0	2.6	0.4	1.3	0.5
16 Jul - 4 Aug	1.4	3.1	0.5	1.3	0.5
4 Aug - 13 Aug	1.7	3.0	0.6	1.2	0.6
13 Aug - 27 Aug	1.7	3.9	0.6	1.7	0.9
27 Aug - 10 Sep	1.9	3.8	0.7	1.4	0.7
10 Sep - 30 Sep	1.6	3.6	0.8	1.1	0.5
30 Sep - 8 Oct	1.0	1.6	0.3	0.6	1.3
8 Oct - 22 Oct	0.8	1.8	0.3	0.8	0.6
22 Oct - 5 Nov	1.9	3.0	0.5	1.1	1.0
5 Nov - 19 Nov	2.8	5.0	0.8	1.9	1.1
19 Nov - 3 Dec	2.4	4.7	0.6	1.7	0.8
3 Dec - 17 Dec	2.7	5.7	0.9	2.3	1.0

Table 4 - Average Jersey Hydrocarbon data, Springfields Garage 1998

Date	Benzene, ppb	Toluene, ppb	Ethylbenzene, ppb	m+p Xylene, ppb	o Xylene, ppb
10 Dec - 18 Dec	12.0	17.3	2.5	7.8	3.5
18 Dec - 15 Jan	5.3	9.9	1.5	4.8	2.0
15 Jan - 29 Jan	8.9	10.9	1.5	5.1	2.0
29 Jan - 12 Feb	13.5	16.2	2.3	6.7	2.8
12 Feb - 26 Feb	8.4	14.0	2.1	5.8	2.3
26 Feb - 12 Mar					
12 Mar - 26 Mar	7.5	11.4	1.9	5.2	1.8
26 Mar - 9 Apr	8.7	10.1	1.4	4.2	1.5
9 Apr - 23 Apr	6.7	9.0	1.0	3.0	1.1
23 Apr - 7 May	6.7	10.3	1.2	3.6	0.9
7 May - 22 May	5.2	8.5	1.0	2.7	1.0
22 May - 4 Jun	7.9	12.0	1.3	3.7	1.4
4 Jun - 18 Jun	7.3	12.4	1.5	4.2	1.6
18 Jun - 2 Jul	8.6	15.4	2.0	5.2	2.0
2 Jul - 16 Jul	9.1	16.1	2.2	5.1	1.8
16 Jul - 4 Aug	9.2	16.2	1.8	5.1	1.8
4 Aug - 13 Aug					
13 Aug - 27 Aug	9.8	15.3	1.5	4.3	1.7
27 Aug - 10 Sep	6.4	12.6	1.4	3.8	1.5
10 Sep - 30 Sep	5.8	12.8	1.4	4.0	1.5
30 Sep - 8 Oct	2.8	4.6	0.6	1.3	1.4
8 Oct - 22 Oct	3.8	6.6	0.8	1.9	0.9
22 Oct - 5 Nov	6.6	8.6	1.0	2.4	1.2
5 Nov - 19 Nov	8.4	13.2	1.5	3.8	1.6
19 Nov - 3 Dec	8.4	14.3	1.5	4.0	1.6
3 Dec - 17 Dec	8.7	16.6	1.8	5.0	2.1

Table 5 - Average Jersey Hydrocarbon data, Elizabeth Lane 1998

Date	Benzene, ppb	Toluene, ppb	Ethylbenzene, ppb	m+p Xylene, ppb	o Xylene, ppb
10 Dec - 18 Dec	5.5	6.9	1.0	2.2	1.3
18 Dec - 15 Jan	1.7	3.1	0.4	1.5	0.4
15 Jan - 29 Jan	3.1	3.7	0.6	2.2	0.6
29 Jan - 12 Feb	4.4	7.5	1.4	4.8	1.3
12 Feb - 26 Feb	2.9	7.8	2.0	4.5	2.0
26 Feb - 12 Mar	1.4	3.6	1.1	1.6	1.0
12 Mar - 26 Mar	1.8	4.4	0.7	1.6	0.8
26 Mar - 9 Apr	3.2	7.5	2.1	3.2	1.4
9 Apr - 23 Apr	1.2	2.3	0.4	1.1	0.4
23 Apr - 7 May	1.1	2.1	0.4	0.9	0.3
7 May - 22 May	1.4	3.4	0.6	1.4	0.6
22 May - 4 Jun	1.5	3.9	0.7	1.5	0.6
4 Jun - 18 Jun	1.1	2.4	0.5	1.0	0.4
18 Jun - 2 Jul	0.7	3.2	0.6	1.6	0.5
2 Jul - 16 Jul	1.1	2.9	0.5	1.2	0.5
16 Jul - 4 Aug	0.9	2.7	0.4	1.1	0.4
4 Aug - 13 Aug	0.6	1.4	0.3	0.8	0.3
13 Aug - 27 Aug	1.1	3.1	0.4	1.1	0.6
27 Aug - 10 Sep	1.3	3.2	0.5	1.1	0.5
10 Sep - 30 Sep	1.0	2.8	0.4	1.1	0.4
30 Sep - 8 Oct	1.0	1.9	0.3	0.6	1.1
8 Oct - 22 Oct	0.7	1.4	0.3	0.6	0.8
22 Oct - 5 Nov	1.1	1.6	0.5	0.6	1.2
5 Nov - 19 Nov	1.9	4.2	0.6	1.4	1.1
19 Nov - 3 Dec	6.6	38.9	1.3	2.1	1.3
3 Dec - 17 Dec	1.6	3.7	0.5	1.2	0.5

Table 6 - Average Jersey Hydrocarbon data, La Collette 1998

Date	Benzene, ppb	Toluene, ppb	Ethylbenzene, ppb	m+p Xylene, ppb	o Xylene, ppb
10 Dec - 18 Dec					
18 Dec - 15 Jan					
15 Jan - 29 Jan					
29 Jan - 12 Feb					
12 Feb - 26 Feb					
26 Feb - 12 Mar	1.4	2.1	0.6	1.4	0.6
12 Mar - 26 Mar	1.5	2.4	1.1	1.3	0.7
26 Mar - 9 Apr	1.7	3.0	0.5	1.1	0.6
9 Apr - 23 Apr	1.8	1.6	0.2	0.6	0.3
23 Apr - 7 May	1.0	1.1	0.2	0.7	0.2
7 May - 22 May	1.4	2.7	0.4	1.0	0.4
22 May - 4 Jun	0.6	1.8	0.3	0.9	0.4
4 Jun - 18 Jun	1.7	1.4	0.3	0.7	0.3
18 Jun - 2 Jul	0.7	2.4	0.4	0.9	0.4
2 Jul - 16 Jul	0.6	1.9	0.3	0.7	0.5
16 Jul - 4 Aug	0.8	2.1	0.4	0.8	0.3
4 Aug - 13 Aug	2.3	6.8	1.8	4.3	2.0
13 Aug - 27 Aug	0.6	1.7	0.3	0.8	0.5
27 Aug - 10 Sep	1.1	2.0	0.4	0.7	0.3
10 Sep - 30 Sep	0.9	2.0	0.3	0.6	0.3
30 Sep - 8 Oct	0.9	1.4	0.3	0.4	0.9
8 Oct - 22 Oct	0.5	0.7	0.2	0.3	0.8
22 Oct - 5 Nov	1.1	1.6	0.3	0.6	0.3
5 Nov - 19 Nov	1.4	2.8	0.8	1.1	0.6
19 Nov - 3 Dec	1.2	1.7	0.4	0.7	0.4
3 Dec - 17 Dec	1.1	1.9	0.4	0.8	0.4

The average SO_2 and BTEX concentrations for the survey period (December 96 - December 97) are presented in Table 7 below:

Table 7 - Survey average diffusion tube concentrations, 1998

Site	SO_2, ppb	Benzene, ppb	Toluene, ppb	Ethyl Benzene, ppb	Ortho Xylene, ppb	Meta/Para Xylene, ppb
Le Bas Centre	4.8	2.3	4.2	0.7	1.9	0.9
Beresford Street	-	2.5	4.9	0.9	2.3	1.0
Springfields Garage	-	7.7	12.3	1.5	4.3	1.7
Elizabeth Lane	-	1.9	5.0	0.7	1.6	0.8
La Collette	-	1.2	2.1	0.5	1.0	0.5
Langley Park	2.5	-	-	-	-	-
St Brelade	3.5	-	-	-	-	-
St Martin	2.0	-	-	-	-	-
Plat Douet Road	4.8	-	-	-	-	-
Roseville Street	5.1	-	-	-	-	-
La Hougue	2.3	-	-	-	-	-
Les Huriaux	2.6	-	-	-	-	-
St Thomas*	2.5	-	-	-	-	-
Territorial Army*	4.1	-	-	-	-	-

**St Thomas and TA sites only operational for first two months of 1998*

4.2 DISCUSSION OF THE RESULTS

4.2.1 Sulphur Dioxide

The diffusion tube results show that, on the whole, average concentrations of SO_2 on the island are relatively low. Monthly average concentrations varied from a maximum of 15.8 ppb at Plat Douet Road during late November / early December, to less than 1 ppb on a number of occasions at a few of the sites.

Highest average concentrations were found at the sites in St Helier, and in the general area to the north-east of the power station. The data in Table 1 and the Figure 2 plot show that average SO_2 concentrations were highest at all sites during the winter months, and generally very low for the remainder of the year.

The annual average concentrations were below 5.1 ppb at all the sites. Average concentrations at the Langley Park site were found to be the lowest of all the urban sites, while the highest annual average was found at the site at Roseville Street. Average concentrations at the rural sites (St Martin / La Hougue / Les Huriaux) were found to be amongst the lowest of the results.

Data capture was very high; only 1 of the 104 tubes deployed (~1%) was lost.

4.2.2 Hydrocarbons

The diffusion tube results show that, on the whole, average hydrocarbon concentrations at the background and kerbside locations on the island are relatively low. Average concentrations at the filling station were found to be significantly higher, but within expected limits for this type of site. Fortnightly average benzene concentrations varied from a maximum of 13.5 ppb at Springfields Garage for two weeks in February, to a minimum of 0.5 ppb at La Collette for two weeks in October. At the sites at Le Bas, Beresford Street, La Collette and Springfields Garage, the ratios of average concentrations of benzene, toluene, ethyl benzene and xylene compounds indicate that, as would be expected, road traffic is a major contributor to ambient pollution levels. The data from the Elizabeth Lane site is significantly different from this pattern, indicating that another source may be contributing to concentrations in this area.

Highest average concentrations were found at the filling station in St Helier. Average hydrocarbon concentrations at the Le Bas Centre, Beresford Street and Elizabeth Lane sites were found to be lower, and broadly comparable to each other. Average concentrations at the site at La Collette were found to be the lowest measured on the island due, at least in part, to the relatively isolated position of this site

The Elizabeth Lane site had a significant “unusual” episode in 1998. For two weeks during late November / early December, the average concentration of toluene was significantly higher than the background average. These results were exceptional; the other four sites did not show the same behaviour for this period, so it is possible that this episode may well be a result of the paint spraying process close to the tube site.

Average hydrocarbon concentrations at the Le Bas Centre and La Collette sites revealed no unusual pollution episodes. The data from the sites show that average concentrations at La Collette are slightly lower than typical background concentrations, as would be expected for a location well away from the main town centre.

Average hydrocarbon concentrations at the Beresford Street site revealed one slightly elevated xylene episode during early October. The reason for this result is not known. The data from the site show that average concentrations are slightly higher than typical background concentrations, as would be expected for a roadside location.

The site at the Springfields Garage filling station is markedly different from the other three sites. It is very close to a major emission source which, in the UK is classified as a Part B industrial process. As a result, average hydrocarbon concentrations were significantly higher than at the other sites. Average concentrations of most pollutants were relatively constant throughout the year, except for a period in October, when slightly lower concentrations were seen. This trend is generally consistent with the other sites on the island, and coincides with a period of high winds and Atlantic weather systems moving across the country.

The annual average concentrations for the three "typical" sites were below 5 ppb for all pollutants. In contrast, average concentrations of all pollutants at the filling station site were found to approximately twice as high as the other sites. As would be expected, average concentrations were highest at the roadside and lowest in background locations.

Data capture was very high; only 3 of the 125 results (~2.5%) were lost. One tube was lost at Beresford Street in November, and one tube was lost at Springfields Garage in August. Data from one tube at the Springfields Garage site during February were found to be very low, and have been rejected as possibly unreliable. These data have not been included in the report.

4.3 COMPARISON WITH STANDARDS AND GUIDELINES

4.3.1 Sulphur Dioxide

The standards and guidelines for concentrations of SO_2 are presented in Appendix 1. As the tubes only provide a four week average concentration, it is not appropriate to compare the results against the 10 and 15 minute means, or the 24 hour means. However, the Jersey tube results have been compared with the EC annual mean Limit and Guide Values and the WHO annual mean health guideline. This comparison shows that the annual average concentrations at all 8 sites deployed on the island were well below the standards and guidelines for SO_2. On the basis of these results, it is unlikely that any of the remaining guidelines would be regularly exceeded on the island.

4.3.2 Hydrocarbons

Of the range of hydrocarbon species monitored, benzene is the only pollutant with a health guideline, set by the Expert Panel on Air Quality Standards (EPAQS) and the UK Department of the Environment, Transport and the Regions (DETR). The 5 ppb running annual mean guideline was only exceeded at the filling station site, a phenomenon that also occurs at filling

stations in the UK. The annual average concentrations at the three remaining sites were well below this guideline value, though a number of individual tube results at Le Bas Centre, Elizabeth Lane and Beresford Street were higher than 5 ppb. On the basis of the data collected to date, it is unlikely that the general population will be exposed to concentrations of benzene that regularly exceed the 5 ppb health guideline.

4.4 COMPARISON WITH UK MONITORING DATA

Tables 8 and 9 below show how the data from the Jersey studies compare with a selection of UK monitoring stations.

The sites used for the comparison are as follows:

- London Bloomsbury (SO_2) - in a park square approximately 1 mile from Euston Rail Station
- Bristol Centre (SO_2) - close to the central shopping area and the city ring road
- Cardiff Centre (SO_2) - in the main pedestrianised shopping area of the city
- Lullington Heath (SO_2) - rural site on the south coast near Eastbourne
- Southampton Centre (SO_2 and benzene)
- Harwell (benzene) - rural site in South Oxfordshire
- Bristol East (benzene) - located on the grounds of a school in the east of the city
- Cardiff East (benzene) - a residential site to the east of the city
- London UCL (benzene) - close to a road on the grounds of University College London

Table 8 - Comparison of Sulphur Dioxide Annual Average Data

Site	Annual Average, ppb
Le Bas Centre	4.8
Langley Park	2.5
St Brelade	3.5
St Martin	2.0
La Hougue	2.3
Roseville Street	5.1
Les Huriaux	2.6
Plat Douet Road	4.8
London Bloomsbury	7
Bristol Centre	3
Cardiff Centre	3
Southampton Centre	3
Lullington Heath	1.4

This table shows that, on the whole, average SO_2 concentrations in St Helier are significantly lower than the London site, broadly comparable to the other urban locations used in the comparison. In addition, the annual averages from the rural sites on the island are in good agreement with the Lullington Heath average.

Table 9 - Comparison of Benzene Annual Average Data

Site	Annual Average, ppb
Le Bas Centre	2.3
Beresford Street	2.5
Elizabeth Lane	1.9
Springfields Garage	7.7
La Collette	1.2
London UCL	1.2
Bristol East	1.0
Cardiff East	1.0
Southampton Centre	1.5
Harwell	0.3

This table shows that the annual average benzene concentrations at the three "typical" sites in Jersey are broadly similar but slightly higher than the UK monitoring station averages used for the comparison. There are a number of possible explanations for these results, as noted below

1. The UK hydrocarbon monitoring stations are located in relatively quiet background areas, to assess general exposure as opposed to peak exposure. The majority of the UK sites are broadly comparable in environment to the Elizabeth Lane site in Jersey.
2. The diffusion tubes used in the survey are known to overread slightly with respect to continuous analysers under certain conditions. In particular, windy weather can cause the tubes to significantly overestimate ambient concentrations.

When viewed in this perspective, the Jersey hydrocarbon data show good agreement with the UK monitoring sites.

By reference to similar BTEX diffusion tube studies undertaken previously in the UK, all of the annual average concentrations found on the island (including Springfields Garage) are within expected limits for the types of site locations.

4.5 COMPARISONS WITH PREVIOUS SURVEYS

Tables 10 and 11 below present comparisons of the 1998 and 1997 results:

Table 10 – Comparison of SO_2 results

Site	1998, ppb	1997, ppb
Le Bas Centre	4.8	4.0
Plat Douet Road	4.8	5.2
St Brelade	3.5	3.4
St Martin	2.0	2.9
Roseville Street	5.1	4.5
Langley Park	2.5	2.8
La Hougue	2.3	-
Les Huriaux	2.6	-
Territorial Army	(2.5)	2.4
St Thomas	(4.1)	2.1

Comparison of the top six sites shows that concentrations of SO_2 have not changed significantly over the last two years: averages at Le Bas Centre and Roseville Street have risen slightly, while the other four sites have lower or similar results for 1998. Data for the TA and St Thomas sites cannot be readily compared to previous datasets, as they were only operational for two months in 1998.

Table 11 – Comparison of benzene results

Site	1998	1997
Le Bas Centre	2.3	2.8
Beresford Street	2.5	3.2
Elizabeth Lane	1.9	1.9
Springfields Garage	7.7	7.7
La Collette	1.2	-

Annual average concentrations at the two central St Helier sites have dropped slightly in 1998, while the petrol station and Elizabeth Lane site averages are the same as the result in 1997. These results are within expected parameters: conditions at the petrol station and background site would not be expected to change significantly from year to year, while the average concentrations at the two central sites will be more dependant upon vehicle movements.

5 Conclusions

1. AEA Technology's National Environmental Technology Centre has undertaken a year long diffusion tube monitoring study in Jersey, on behalf of the States of Jersey Public Health Services. A total of 8 sulphur dioxide (SO_2) tube sites and 5 hydrocarbon tube sites (measuring benzene, toluene, ethyl benzene and xylene, BTEX) were used for the surveys, in a range of different locations on the island.

2. The monitoring surveys took place between 10th December 1997 and 17th December 1998. The SO_2 tubes were exposed for 4 week periods, while the BTEX tubes were exposed for two weeks. Technical Officers of the Environmental Health Section changed the tubes on the island. Diffusion tubes provide an averaged concentration of the pollutant measured; over 4 weeks for the SO_2 tubes, 2 weekly in the case of the BTEX tubes.

3. The results from the SO_2 survey showed that average concentrations were generally low. Highest average concentrations were found in St Helier during the winter months. Annual average concentrations were lowest in rural areas, but below 5.1 ppb at all sites.

4. Average concentrations of benzene were found to be highest at the site closest to the petrol station, where the greatest emissions of this pollutant are likely to occur. The annual average benzene concentration at Springfields Garage (7.7 ppb) exceeded the EPAQS and DETR recommended guideline of 5 ppb. Annual average benzene concentrations at the remaining three sites were below 2.5 ppb.

5. In general terms, average concentrations of SO_2 and BTEX in Jersey are broadly similar to those found in urban areas of the UK, and have not changed significantly from the results obtained in 1997

6 Acknowledgements

NETCEN gratefully acknowledge the help and support of the staff of the States of Jersey Environmental Health Services, Planning and Environment and Public Services, in the completion of this monitoring study.

Appendices

CONTENTS

Appendix 1
Air Quality Standards

Air Quality Monitoring in Jersey; Diffusion Tube Surveys, 1999

March 2000

Air Quality Monitoring in Jersey; Diffusion Tube Surveys, 1999

March 2000

Title	Air Quality Monitoring in Jersey; Diffusion Tube Surveys, 1999
Customer	Public Health Services, States of Jersey
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Executive Summary

AEA Technology Environment has undertaken a programme of air quality monitoring on Jersey, on behalf of the Public Health Services of the States of Jersey. This report presents the results of the third consecutive year of monitoring, the period 17th December 1998 to 16th December 1999.

Diffusion tube samplers were used to monitor sulphur dioxide (SO_2) at thirteen sites, nitrogen dioxide (NO_2) at three sites, and hydrocarbons at seven sites. Monitoring sites were selected to include areas likely to be affected by specific emission sources (such as petrol stations or the power station or waste incinerator), as well as general background locations.

SO_2 and NO_2 diffusion tubes were exposed for 4-week periods, while hydrocarbon (BTEX) tubes were exposed for 2-week periods. The tubes were supplied and analysed by AEA Technology Environment, and changed by Technical Officers of Jersey's Environmental Health Section.

The results from the 1999 SO_2 survey showed that average concentrations remained generally low. They were consistent with previous years' results, and with results from automatic SO_2 monitoring stations in the UK. Typical annual average SO_2 concentrations were below 5.2 ppb, and lower still in rural areas. One site, Mont Felard Hotel, exhibited unusually high SO_2 results during March - May 1999. It is thought that this is due to SO_2 emissions from a local source such as an oil-fired boiler: further investigation is recommended.

Diffusion tube monitoring of nitrogen dioxide began in the latter part of 1999. The data obtained so far indicate that annual means are likely to be within the standard of 21ppb set by the UK Air Quality Strategy and the European Commission. However, further monitoring is required before conclusions can be drawn.

Average concentrations of hydrocarbons were generally low throughout the year, except at the two sites close to petrol stations. In particular, high concentrations of hydrocarbons, especially toluene and xylenes, were measured at the indoor Stopford Road site. The annual mean concentrations of toluene and of xylenes were an order of magnitude higher at Stopford Road than at any other site. Concentrations of m+p xylene were consistently above the estimated odour threshold for these compounds. It is recommended that further investigation be carried out at this location.

Annual mean benzene concentrations were less than the UK Air Quality Standard of 5ppb (which applies to the running annual mean) at all sites. Benzene concentrations at the five sites not associated with petrol stations were broadly similar to those measured at comparable sites in the UK.

Five of the hydrocarbon sites were included in previous years' surveys: 1999 results were comparable with those obtained in previous years. The three years' data gathered from the five

long-running BTEX sites appear to show a decreasing trend in ambient concentrations of all the measured BTEX species except m+p xylene.

Contents

1 Introduction

1.1 BACKGROUND

AEA Technology Environment, on behalf of the States of Jersey Public Health Services, has undertaken a further programme of air quality monitoring on the island of Jersey in 1999. This is the third in a series of annual monitoring programmes that began in 1997.

The pollutants measured were sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and a range of hydrocarbon species (benzene, toluene, ethyl benzene and three xylene compounds, collectively termed BTEX). Average ambient concentrations were measured using passive diffusion tube samplers. SO_2 was measured at 13 sites on the island, NO_2 was measured at three sites, and BTEX at 7 sites.

This report presents the results obtained in the 1999 survey, and compares the data from Jersey with relevant air quality standards and guidelines, data from selected UK monitoring stations and previous years' monitoring programmes.

1.2 OBJECTIVES

This survey followed on from those in 1997[1] and 1998[2]. The objective, as in the previous surveys, was to monitor at sites where pollutant concentrations were expected to be high, and compare these with background locations. The monitoring sites used therefore included some background sites investigated during previous studies, together with new locations where there was a need to investigate air quality.

2 Details of Monitoring Programme

2.1 POLLUTANTS MONITORED

2.1.1 SO_2

Sulphur dioxide (SO_2) is formed during the combustion of fuels containing sulphur. The most significant source of this pollutant is fossil fuelled power generation, although diesel engines, domestic solid fuel burners and a number of chemical processes also produce SO_2.

SO_2 is a respiratory irritant, and is toxic at high concentrations. It is also damaging to ecosystems and a major precursor in the formation of acid rain.

2.1.2 NO_2

A mixture of nitrogen dioxide (NO_2) and nitric oxide (NO) is emitted by combustion processes. This mixture of oxides of nitrogen is termed NO_X. NO is subsequently oxidised to NO_2 in the atmosphere. NO_2 is an irritant to the respiratory system, and can affect human health. Ambient concentrations of NO_2 are likely to be highest in the most built-up areas,

especially where traffic is congested, or buildings either side of the street create a " canyon" effect, impeding the dispersion of vehicle emissions.

2.1.3 Hydrocarbons

There are many sources of hydrocarbon emissions. Methane, for example, is a naturally occurring gas, while xylene compounds are synthetic and used in many applications, for example as a solvent in paint. A range of hydrocarbons are found in vehicle fuel, and occur in vehicle emissions. In most urban areas, vehicle emissions would constitute the major source of hydrocarbons, in particular benzene. Also, there is the potential that they may be released to the air from facilities where fuels are stored or handled (such as petrol stations).

A wide range of hydrocarbons is emitted from both fuel storage and handling, and from fuel combustion in vehicles. It is not easy to measure all of these hydrocarbon species (particularly the most volatile) without expensive continuous monitoring systems. However, there are four moderately volatile species, all of which may be associated with fuels and vehicle emissions, which are easy to monitor using passive samplers. These are benzene, toluene, ethyl benzene and xylene. They are not the largest constituents of petrol emissions, but due to their moderate volatility they can be monitored by diffusion tubes. Diffusion tubes are available for monitoring this group of organic compounds, and are known as "BTEX" tubes.

(i) Benzene
Of the organic compounds measured in this study, benzene is the one of most concern, as it is a known human carcinogen; long-term exposure can cause leukaemia. It is found in petrol and other liquid fuels, in small concentrations. In urban areas, the major source is vehicle emissions. Benzene concentrations in ambient air are generally between 1 and 5 ppb.

(ii) Toluene
Toluene is also found in petrol in small concentrations. Its primary use is as a solvent in paints and inks, and is a constituent of tobacco smoke. It has been found to adversely affect human health. Typical ambient concentrations range from trace to 3.8 μg m^{-3} (1.0 ppb) in rural areas, up to 204 μg m^{-3} (54 ppb) in urban areas, and higher near industrial sources. There are no recommended limits for ambient toluene concentrations, although there are occupational limits for workplace exposure[3]: the occupational 8-hour exposure limit (OEL) is 50ppm (50,000ppb).
The best estimate for the odour threshold of toluene has been reported[4] as 0.16ppm (160ppb).

(iii)ethyl benzene
Again, there are no limits for ambient concentration of ethyl benzene, although there are occupational limits relating to workplace exposure[3], of 100 ppm over 8 hours, and 125 ppm over 10 minutes. Ambient concentrations are highly unlikely to approach these levels.

(iv)xylene
Xylene exists in ortho (o), para (p) and meta (m) isomers. Occupational limits relating to workplace exposure, are 100 ppm over 8 hours, and 150 ppm over 10 minutes. Xylene, like toluene, can cause odour nuisance near processes (such as vehicle paint spraying) which emit it. Its odour threshold varies according to the isomer, but the best estimate for the odour threshold of mixed xylenes is 0.016ppm (16 ppb)[4].

2.2 AIR QUALITY STANDARDS AND GUIDELINES

2.2.1 World Health Organisation

In 1995, the World Health Organisation published revised interim guidelines[5] for SO_2 and NO_2. These revised guidelines were set using currently available scientific evidence on the effects of air pollutants on health and vegetation. The WHO guidelines are advisory only, and do not carry any mandatory status. They are summarised in Appendix 1. There are WHO guidelines for SO_2 (10-minuute, 24-hour and annual means), and NO_2 (hourly and annual means) but not benzene.

2.2.2 European Community

Throughout Europe, ambient air quality is regulated by EC Directives. These set limit values which are mandatory, and in some cases also guide values which are intended to provide increased protection to human health and ecosystems. The previously existing EC Directives covering SO_2 and NO_2 have recently been updated, as part of the first Daughter Directive[6]. The existing and new limits are summarised in Appendix 1.

2.2.3 UK Air Quality Strategy

The UK Air Quality Strategy has set limits and objectives for a range of pollutants including SO_2, NO_2 and benzene[7]. These are also summarised in Appendix 1.

2.3 METHODOLOGIES

The survey was carried out using diffusion tubes for SO_2, NO_2 and BTEX. These are "passive" samplers, i.e. they work by absorbing the pollutants direct from the surrounding air and need no power supply.

Diffusion tubes for SO_2 and NO_2 consist of a small plastic tube, approximately 7 cm long. During sampling, one end is "open" (or covered by a thin membrane in the case of SO_2) and the other closed. The closed end contains an absorbent for the gaseous species to be monitored, in this case SO_2 or NO_2. The tube is mounted vertically with the open (or membrane) end at the bottom. Ambient SO_2 or NO_2 diffuses up the tube during exposure, and is absorbed as sulphate or nitrate respectively. The average ambient pollutant concentration for the exposure period is calculated from the amount of pollutant absorbed.

BTEX diffusion tubes are different in appearance to SO_2 and NO_2 tubes. They are longer, thinner, and made of metal rather than plastic. These tubes are fitted at both ends with brass Swagelok fittings. A separate “diffusion cap” is supplied. Immediately before exposure, the Swagelok end fitting is replaced with the diffusion cap. The cap is removed after exposure, and is replaced with the Swagelok fitting. BTEX diffusion tubes are very sensitive to interference by solvents.

Diffusion tubes were prepared by AEA Technology, and supplied to local Technical Officers of Jersey's Public Health Services, who carried out the tube changing. The tubes were supplied in sealed condition prior to exposure. The tubes were exposed at the sites for a period of time.

After exposure, the tubes were again sealed and returned to AEA Technology for analysis. In this study, SO_2 and NO_2 tubes were exposed in 4-weekly batches, BTEX tubes were exposed in 2-weekly batches.

The diffusion tube methodologies provide data that are accurate to $\pm$ 20% for SO_2, $\pm$ 25% for NO_2, and $\pm$ 20% for BTEX. The limits of detection are 0.4 ppb for SO_2, 0.2 ppb for NO_2 and 0.1 ppb for BTEX. It should be noted that tube results that are less than 10 x the limit of detection will have a higher level of uncertainty associated with them.

2.4 MONITORING SITES

SO_2 monitoring was carried out at a total of 13 sites during 1999. Initially, there were 8 sites in use (those used in the 1998 survey). However, in April 1999 four of these (Plat Douet, La Hougue, Roseville Street and Les Huriaux) were discontinued. They had run for a full year, and the results indicated that SO_2 levels were not high enough to constitute a problem at any of these locations. It was decided to investigate elsewhere, and the four sites were replaced by the following: Mont Felard, First Tower, Weigh Bridge and Georgetown. A further site, Clos St Andre, was added in July 1999. Table 1. shows all the SO_2 sites used in the 1999 survey.

Table 1. SO_2 Monitoring sites

Site number	Site Name	Description
S1	Le Bas Centre	Urban background
S2	Langley Park	Residential background
S3	St Brelade (Quennevais School)	Residential background
S4	Rue des Raisies	Rural background
S5	Roseville Street *(until Apr 1999)*	Urban, downwind from power station
S6	Plat Douet Road *(until Apr 1999)*	Urban, downwind from power station
S7	La Hougue *(Feb 1998 - Apr 1999)*	Rural, downwind from power station
S8	Les Huriaux (*Feb 1998 - Apr 1999)*	Rural, downwind from power station
S9	Mont Felard Hotel *(from Apr 1999)*	Residential background, to SW of waste incinerator & 20m from busy road junction.
S10	First Tower *(from Apr 1999)*	Kerbside site on major road.
S11	Weigh Bridge *(from Apr 1999)*	Bus station near centre of St Helier.
S12	Georgetown *(from Apr 1999)*	Kerbside site near major road.
S13	Clos St Andre *(from Apr 1999)*	Residential area near Bellozane Valley refuse incinerator.

NO_2 monitoring was added to the survey in July 1999. Three sites were selected. These are shown in Table 2.

Table 2. NO_2 Monitoring sites

Site number	Site Name	Description
N1	Clos St Andre	Residential area near Bellozane Valley refuse incinerator.
N2	L'Avenue et Dolmen	Urban background close to ring road.
N3	Robin Place	Urban background

The 1999 survey began with the same five BTEX sites used in 1997 and 1998. These are shown in Table 3. The aim was to investigate sites likely to be affected by different emission sources, and compare these with background sites. Sites BTEX 1 to BTEX 5 were the same as those used in 1998. The sites at Beresford Street and Le Bas Centre were intended to monitor hydrocarbon concentrations at an urban background and urban roadside location respectively. The Elizabeth Lane site is close to a paint spraying process, and the Springfields Garage site is located by a fuel filling station, both possible sources of hydrocarbon emissions. La Collette is close to the power station and harbour.

Table 3. BTEX Monitoring sites

Site number	Site Name	Description
BTEX 1	Beresford Street	Urban roadside
BTEX 2	Le Bas Centre	Urban background
BTEX 3	Elizabeth Lane	Urban background near paint spraying process
BTEX 4	Springfields Garage	Urban background near fuel filling station
BTEX 5	La Collette	Urban background close to power station and harbour
BTEX 6	Stopford Road	Indoor site, at house between two petrol stations.
BTEX 7	Clos St Andre	Residential area near Bellozane Valley refuse incinerator.

BTEX 6 and BTEX 7 were started up in July 1999. BTEX 6, Stopford Road, is an indoor monitoring site, inside a house situated between two petrol stations. Although the fuel storage tanks of the neighbouring petrol stations have been tested and are reported to be free from leaks, the residents have complained of odour in their lounge, which is at basement level. The other "new" site, BTEX 7, is located at Clos St Andre, near the Bellozane Valley waste incinerator. This site replaced BTEX 5 (La Collette).

3 Results and Discussion

3.1 SULPHUR DIOXIDE

3.1.1 Summary of SO_2 Results

The monthly results for each SO_2 monitoring site are shown in Table 4, with a graphical representation in Figure 2.

Ambient SO_2 concentrations at most sites on Jersey were predominantly low during 1999, at all sites except Mont Felard Hotel, which is discussed separately below. Monthly averages ranged from below the detection limit of around 0.4ppb, up to 9.8ppb. Annual mean SO_2 concentrations range from 2.1 to 5.1 ppb.

At Mont Felard Hotel, some unusually high SO_2 concentrations were detected: 53.3ppb during the period 10 March - 8th April 1999, and 67.8ppb during the period 8th April - 6th May 1999. These measurements are likely to be genuine. However, they are suspiciously high, and it is likely that the site was affected by emissions from a nearby source during these months. The most likely source is an oil-fired combustion process such as a boiler.

Otherwise, average SO_2 concentrations were highest in the winter months, December 1998 to February 1999. They remained low (less than 6ppb) for the rest of the year. This is consistent with the seasonal pattern found in the 1997 and 1998 surveys. A total of 149 SO_2 tubes were deployed, of which just 3 were lost, giving 99% data capture.

3.1.2 Comparison with SO_2 Standards and Guidelines

The standards and guidelines for SO_2 are presented in Appendix 1. Because of the known health effects of this pollutant, many of the limits for SO_2 are based on short averaging periods, such as 15-minute or 24-hour means. As diffusion tubes only provide a four-week average concentration, it is not possible to compare the results from this study against limits relating to shorter periods.

(i) The WHO'S 1995 revised guidelines contain the following guidelines for the protection of human health:

- A guideline of 175ppb for the 10-minute mean.
- A guideline of 44ppb for the 24-hour mean.
- A guideline of 17ppb for the annual mean.

Diffusion tube data can only be compared with the annual mean guideline.1999 annual mean SO_2 results for all Jersey sites (including Mont Felard) are within this value.

(ii) EC Directive 1999/30/EEC [6](the first Daughter Directive) contains the following limits for SO_2.

- A limit of 132 ppb for the hourly mean, for protection of human health, not to be exceeded more than 24 times per calendar year and to be achieved by 1 January 2005.

- A limit of 47 ppb for the 24-hour mean, for protection of human health, not to be exceeded more than 3 times per calendar year and to be achieved by 1 January 2005.
- A limit of 8ppb for the annual (calendar year) and winter (October to March) mean SO_2 concentration, for the protection of ecosystems. This is to be achieved by July 2001. It is only applicable in rural areas.

Diffusion tube data can only be compared with the latter - the ecosystem protection limit. This is only applicable to the rural sites, La Hougue and Les Huriaux, but all the sites except Mont Felard had annual means well below the guideline of 8ppb.

Winter means were also calculated, for the eight sites operating over the period 30 September 1998 to 10 March 1999. These were all within the limit of 8ppb. Indeed, it was rare for individual tube results to exceed this value. The five sites which began operation during spring or summer of 1999 (with the exception of Mont Felard) do not at this stage show signs of being likely to exceed the limit.

(iii) The UK Air Quality Strategy contains the following standards for SO_2, intended for protection of human health. They are similar to those contained in the EC Directive above, with an additional standard for the 15-minute mean.

- A limit of 100ppb for the 15-minute mean, for protection of human health, not to be exceeded more than 35 times per year, and to be achieved by 31 December 2005.
- A limit of 132 ppb for the hourly mean, for protection of human health, not to be exceeded more than 24 times per calendar year and to be achieved by 31 December 2004.
- A limit of 47 ppb for the 24-hour mean, for protection of human health, not to be exceeded more than 3 times per calendar year and to be achieved by 31 December 2004.
- A limit of 8ppb for the annual (calendar year) and winter (October to March) mean SO_2 concentration, for the protection of ecosystems. This is to be achieved by 31 December 2000. This is applicable in rural areas.

As above, it is only possible to compare diffusion tube results directly with the ecosystem protection limits relating to the annual and winter mean. Again, means for calendar year 1999 and winter 1998-99 were all within this limit.

Table 4.SO_2 Diffusion Tube Results 1999, Jersey. Concentrations in ppb.

Site	From: To:	17/12/98 - 14/1/99	14/1/99 - 11/2/99	11/2/99 - 10/3/99	10/3/99 - 8/4/99	8/4/99 - 6/5/99	6/5/99 - 3/6/99	3/6/99 - 1/7/99	1/7/99 - 29/7/99	29/7/99 - 26/8/99	26/8/99 - 23/9/99	23/9/99 - 21/10/99	21/10/99 - 18/11/99	18/11/99 - 16/12/99	An m
Le Bas Centre		7.4	7.5	5.1	2.3	3.5	2.6	1.2	4.1	4.9	2.4	2.0	3.4	5.3	
Langley Park		6.3	4.3	2.6	2.0	4.5	3.9	0.6	2.7	0.6	2.0	1.0	2.8	2.0	
uennevais School		3.5	5.1	3.4	1.8	2.2	1.4	1.4	1.8	2.0	nd	0.4	1.6	1.8	
Rue des Raisies		3.6	-	2.1	0.4	1.8	1.4	-	2.0	1.6	nd	nd	2.6	3.5	
Roseville Street		9.8	7.3	7.2											
Plat Douet Road		5.5	5.5	7.9											
La Hougue		5.9	2.6	2.8											
Les Huriaux		4.1	3.7	3.2											
Iont Felard Hotel					53.3	67.8	1.4	0.4	2.9	2.0	0.8	nd	2.0	1.4	
First Tower					1.6	3.3	1.8	0.6	3.7	5.5	2.9	1.6	3.0	2.4	
Weigh Bridge					2.7	2.8	2.7	1.0	4.7	1.2	1.2	1.2	2.6	2.9	
Georgetown					2.7	3.5	2.7	1.6	2.4	2.9	1.8	nd	-	7.4	
Clos St Andre									3.7	2.0	3.1	1.6	3.6	2.0	

Averages for Roseville Street, Plat Douet Road, La Hougue and Les Huriaux are for the period 12 March 1998 - 10 March 1999. See 1998 report for individual monthly means prior to December 1998.

Averages for Mont Felard, First Tower, Weigh Bridge, Georgetown and Clos St Andre are based on months available.

nd = not detected, i.e. below the detection limit.

3.1.3 Comparison with UK SO_2 Data

Table 5 shows how the SO_2 data from the 1999 Jersey survey compares with a selection of UK air quality monitoring stations using automatic (UV fluorescence) SO_2 analysers.

The sites used for comparison are as follows:

- London Bloomsbury - an urban centre site, located in a small park in Central London, surrounded by heavy traffic and tall buildings.
- Plymouth Centre - an urban non-roadside site, in the centre of a coastal city.
- Lullington Heath - a rural site on the South Coast of England near the town of Eastbourne.
- Harwell - a rural site in the south of England, within 10km of a power station.

Table 5 - Comparison of SO_2 in Jersey with UK Sites

Site	Annual average SO_2, ppb *(17 Dec 1998 to 16 Dec 1999 unless specified)*
Diffusion Tubes	
Le Bas Centre	4.0
Langley Park	2.7
Quennevais School	2.2
Rue des Raisies	2.1
Roseville Street	*5.0 (Mar 98 - Mar 99)*
Plat Douet Road	*5.1 (Mar 98 - Mar 99)*
La Hougue	*2.7 (Mar 98 - Mar 99)*
Les Huriaux	*2.9 (Apr - Dec 99)*
Mont Felard Hotel	*14.7 (Apr - Dec 99)*
First Tower	*2.6 (Apr - Dec 99)*
Weigh Bridge	2.3 *(Apr - Dec 99)*
Georgetown	3.1 *(Apr - Dec 99)*
Clos St Andre	2.7 *(Jul - Dec 99)*
UK Automatic Sites	
London Bloomsbury	5.0
Plymouth Centre	2.0
Lullington Heath	1.2
Harwell	1.0

The annual means for Roseville Street, Plat Douet Road, La Hougue and Les Huriaux (which ceased operation in March 1999) are based on the year 12 March 1998 to 10 March 1999. Table 5 shows that (with the exception of Mont Felard), the annual mean SO_2 concentrations measured on Jersey are comparable with those measured at similar sites in the UK.

3.1.4 Comparison with previous years' SO_2 results

Table 6 presents a comparison of the annual means obtained in the 1997 -1999 surveys. This is based only on the three sites which have been in operation for the full period of monitoring: Le Bas, Langley Park and Quennevais School, St Brelade.

Table 6. Comparison of Annual Mean SO_2 Concentrations 1997 - 1999.

Site	1997 ppb	1998 ppb	1999 ppb
Le Bas Centre	4.0	4.8	4.0
Langley Park	2.8	2.5	2.7
St Brelade (Quennevais School)	3.4	3.5	2.2

Concentrations of SO_2 appear not to have changed substantially at these three sites, remaining less than 5ppb at all three.

3.2 NITROGEN DIOXIDE

3.2.1 Summary of NO_2 Results

NO_2 monitoring began at Clos St Andre on 30 June 1999, and at two further sites, L'Avenue et Dolmen and Robin Place on 21 October 1999. The data obtained so far are summarised in Table 7, and presented graphically in Figure 3.

Table 7. NO_2Diffusion Tube Results, Jersey, 1999. Concentrations in ppb.

Site	30/6 - 29/7	29/7 - 26/8	26/8 - 23/9	23/9 - 21/10	21/10 - 18/11	18/11 - 16/12
Clos St Andre	7.5	-	7.0	8.9	11.0	10.3
L'Avenue et Dolmen	-	-	-	-	15.5	16.9
Robin Place	-	-	-	-	19.0	18.8

3.2.2 Comparison with NO_2 Standards and Guidelines

The standards and guidelines for NO_2 are shown in Appendix 1.

The WHO guideline[5] for NO_2 is that the annual mean should not exceed 21-26 ppb. So far, all the four-week averages obtained have been less than 21 ppb. Therefore, the data obtained so far (especially at Clos St Andre) do not indicate that this guideline is likely to be exceeded. However, further monitoring will be necessary to confirm this.

The 1985 EC Directive 85/203 for NO_2 [8] specifies that the 98th percentile of hourly averages over any calendar year should not exceed 105 ppb (200 μg m^{-3}). To obtain measurements directly comparable with this guideline, expensive automatic monitoring would be necessary. However, in urban areas there is a well-documented ratio of 2.5 between the 98th percentile of hourly averages, and the annual mean. The annual mean is therefore widely used as a surrogate statistic for assessing compliance with the EC Directive limit; the limit is likely to be exceeded

where the annual mean is greater than 41.8 ppb - in practice, the value of 40 ppb is used. The use of this surrogate statistic enables simple, low cost techniques such as diffusion tubes to be used. Again, the data obtained so far do not indicate that this surrogate for the annual mean is likely to be exceeded.

EC Directive limits for NO_2 have recently been updated, as part of the first Daughter Directive[6]. The new limits are as follows:

- 105 ppb (200 $\mu g\ m^{-3}$) as an hourly mean, not to be exceeded more than 18 times per calendar year. To be achieved by 1 January 2010.
- 21 ppb (40 $\mu g\ m^{-3}$) as an annual mean, for protection of human health. To be achieved by 1 January 2010.
- There is also a limit for total oxides of nitrogen (NO_X), of 16 ppb (30 $\mu g\ m^{-3}$) as an annual mean, for protection of vegetation (relevant in rural areas).

The UK Air Quality Strategy contains standards for NO_2, which are very similar to the EC Daughter Directive limits above: the only differences being the more stringent dates by which they must be attained. These are as follows:

- 105 ppb (200 $\mu g\ m^{-3}$) as an hourly mean, not to be exceeded more than 18 times per calendar year. To be achieved by 31 December 2004.
- 21 ppb (40 $\mu g\ m^{-3}$) as an annual mean, for protection of human health. To be achieved by 31 December 2004.
- 16 ppb (30 $\mu g\ m^{-3}$) as an annual mean, for total oxides of nitrogen (NO_X), for protection of vegetation (relevant in rural areas). To be achieved by 31 December 2000.

As discussed above, the initial indications are that the annual mean will be within 21ppb, although there is not yet sufficient data to be certain.

It appears likely that the annual mean NO_2 concentrations at L'Avenue et Dolmen and Robin Place will be in excess of the 16ppb limit for protection of vegetation. However, these are both urban background sites, not rural, so the vegetation protection limit is not applicable in either case.

3.2.3 Comparison with UK NO_2 data

The UK Nitrogen Dioxide Survey monitors this pollutant at around 1200 sites across the UK using diffusion tubes. However, this survey concentrates on urban, not rural, areas; sites are categorised as;

- Kerbside, 1-5m from the kerb of a busy road
- Intermediate, 20-30m from the same or an equivalent road
- Urban background, more than 50m from any busy road.

The national annual averages for 1999 are not yet available. However, data for 1998 are useful for comparison, as these are unlikely to have changed substantially. National averages for 1998 were 23 ppb for kerbside sites, 15 ppb for intermediate sites, and 12 ppb for urban background sites.

It is recommended that more data is obtained (especially from L'Avenue et Dolmen and Robin Place) before comparisons with other sites are attempted.

3.3 HYDROCARBONS

3.3.1 Summary of Hydrocarbon Results

Results of the hydrocarbon survey for the seven sites are shown in Tables 7 to 13 respectively. Graphical representations are shown in Figures 4 to 10.

Table 7. Hydrocarbon results at Beresford Street, 1999

Exposure Period	Benzene ppb	Toluene ppb	Ethyl Benzene ppb	m+p Xylene ppb	o Xylene ppb
17/12/98 - 30/12/98	2.6	3.1	0.8	2.2	1.1
30/12/98 - 14/1/99	2.0	4.0	0.6	1.7	0.8
14/1/99 - 28/1/99	1.4	3.7	0.5	1.7	0.7
28/1/99 - 11/2/99	1.8	4.4	0.7	2.0	0.8
11/2/99 - 25/2/99	2.3	4.5	0.7	1.7	1.3
25/2/99 - 9/3/99	2.6	4.9	0.6	1.3	0.9
9/3/99 - 25/3/99	2.0	4.5	0.6	1.7	0.7
25/3/99 - 8/4/99	2.1	4.5	0.7	1.8	0.7
8/4/99 - 22/4/99	2.0	3.7	0.6	1.6	0.7
22/4/99 - 6/5/99	2.1	4.2	0.7	1.9	0.7
6/5/99 - 20/5/99	0.9	2.7	0.4	1.4	0.6
20/5/99 - 3/6/99	3.4	2.5	0.4	1.3	0.7
3/6/99 - 17/6/99	1.0	3.4	0.6	1.9	0.8
17/6/99 - 1/7/99	1.0	3.1	0.5	1.6	0.7
1/7/99 - 15/7/99	0.9	2.7	0.4	1.4	0.6
15/7/99 - 29/7/99	-	-	-	-	-
29/7/99 - 12/8/99	nd	nd	nd	nd	nd
12/8/99 - 26/8/99	0.7	3.0	0.4	1.4	0.6
26/8/99 - 9/9/99	1.2	2.9	0.5	1.2	0.5
9/9/99 - 23/9/99	1.4	3.8	0.7	1.5	0.6
23/9/99 - 7/10/99	1.2	3.6	0.5	1.6	0.7
7/10/99 - 21/10/99	3.8	5.9	1.2	2.4	0.8
21/10/99 - 4/11/99	1.1	1.1	0.5	1.5	0.6
4/11/99 - 18/11/99	1.4	2.0	0.6	1.8	0.7
18/11/99 - 2/12/99	2.3	6.1	1.2	3.1	1.2
2/12/99 - 16/12/99	1.4	3.2	0.7	1.7	0.7
Average	1.8	3.6	0.6	1.7	0.8

nd = not detected, i.e. below the limit of detection.

Table 8. Hydrocarbon results at Le Bas Centre, 1999

Exposure period	Benzene ppb	Toluene ppb	Ethyl Benzene ppb	m+p Xylene ppb	o Xylene ppb
17/12/98 - 30/12/98	1.9	4.0	0.6	1.6	1.2
30/12/98 - 14/1/99	1.5	2.8	0.5	1.2	0.8
14/1/99 - 28/1/99	1.2	3.6	0.5	1.6	0.6
28/1/99 - 11/2/99	1.4	4.2	0.6	1.7	0.8
11/2/99 - 25/2/99	2.1	4.2	0.6	1.5	1.0
25/2/99 - 9/3/99	2.2	3.7	0.5	1.5	0.5
9/3/99 - 25/3/99	1.5	3.5	0.5	1.4	0.5
25/3/99 - 8/4/99	0.9	2.6	0.4	1.2	0.5
8/4/99 - 22/4/99	1.7	3.0	0.5	1.4	0.5
22/4/99 - 6/5/99	1.3	2.2	0.4	1.0	0.4
6/5/99 - 20/5/99	0.4	1.0	0.2	0.5	0.3
20/5/99 - 3/6/99	0.6	1.7	0.3	1.0	0.4
3/6/99 - 17/6/99	0.6	1.8	0.3	1.0	0.4
17/6/99 - 1/7/99	0.7	2.0	0.3	1.1	0.5
1/7/99 - 15/7/99	0.7	1.9	0.3	1.0	0.4
15/7/99 - 29/7/99	0.5	1.4	0.3	0.8	0.4
29/7/99 - 12/8/99	0.6	1.0	0.3	1.2	0.4
12/8/99 - 26/8/99	0.6	2.6	0.4	1.2	0.5
26/8/99 - 9/9/99	0.9	2.2	0.4	0.9	0.5
9/9/99 - 23/9/99	1.0	2.6	0.5	1.1	0.4
23/9/99 - 7/10/99	0.8	3.9	0.4	1.1	0.5
7/10/99 - 21/10/99	0.7	1.9	0.3	0.8	0.4
21/10/99 - 4/11/99	0.9	4.2	0.9	1.9	0.7
4/11/99 - 18/11/99	1.2	5.7	1.1	1.9	0.8
18/11/99 - 2/12/99	1.8	4.2	0.8	2.2	0.9
2/12/99 - 16/12/99	1.2	2.6	0.5	1.4	0.5
Average	1.1	2.9	0.5	1.3	0.6

Table 9. Hydrocarbon results at Elizabeth Lane, 1999

Exposure period	Benzene ppb	Toluene ppb	Ethyl Benzene ppb	m+p Xylene ppb	o Xylene ppb
17/12/98 - 30/12/98	2.2	3.7	0.6	1.0	1.3
30/12/98 - 14/1/99	0.7	0.9	0.2	0.4	1.1
14/1/99 - 28/1/99	0.5	1.5	0.2	0.6	0.3
28/1/99 - 11/2/99	1.2	5.3	0.7	2.1	0.8
11/2/99 - 25/2/99	1.6	4.2	0.5	1.2	0.8
25/2/99 - 9/3/99	1.5	2.7	0.4	0.9	0.8
9/3/99 - 25/3/99	1.4	5.0	0.6	1.7	0.5
25/3/99 - 8/4/99	1.0	3.3	0.4	1.1	0.4
8/4/99 - 22/4/99	1.1	2.4	0.4	1.0	0.4
22/4/99 - 6/5/99	1.9	7.3	1.0	1.6	1.4
6/5/99 - 20/5/99	0.5	2.0	0.3	1.0	0.4
20/5/99 - 3/6/99	2.9	8.4	1.2	3.6	1.4
3/6/99 - 17/6/99	1.3	2.6	0.3	1.1	0.6
17/6/99 - 1/7/99	0.6	2.1	0.3	1.0	0.4
1/7/99 - 15/7/99	0.5	2.2	0.3	1.1	0.4
15/7/99 - 29/7/99	0.5	2.1	0.4	1.2	0.5
29/7/99 - 12/8/99	0.4	2.1	0.3	0.9	0.3
12/8/99 - 26/8/99	0.5	3.0	0.4	1.3	0.4
26/8/99 - 9/9/99	0.8	2.6	0.4	0.9	0.4
9/9/99 - 23/9/99	0.7	3.6	0.4	1.1	0.4
23/9/99 - 7/10/99	0.6	3.8	0.4	1.2	0.4
7/10/99 - 21/10/99	0.9	6.8	0.5	1.7	0.6
21/10/99 - 4/11/99	0.8	2.1	0.5	1.3	0.5
4/11/99 - 18/11/99	1.2	1.3	0.5	1.3	0.5
18/11/99 - 2/12/99	-	-	-	-	-
2/12/99 - 16/12/99	0.9	1.5	0.3	0.7	0.3
Averages	1.0	3.3	0.5	1.2	0.6

Table 10. Hydrocarbon results at Springfields Garage, 1999

Exposure period	Benzene ppb	Toluene ppb	Ethyl Benzene ppb	m+p Xylene ppb	o Xylene ppb
17/12/98 - 30/12/98	6.6	13.1	1.5	4.2	1.7
30/12/98 - 14/1/99	4.7	9.5	1.1	3.1	1.3
14/1/99 - 28/1/99	4.2	9.9	1.0	2.9	1.3
28/1/99 - 11/2/99	4.9	17.0	1.5	4.6	2.0
11/2/99 - 25/2/99	6.6	12.1	1.3	3.2	1.7
25/2/99 - 9/3/99	6.5	12.2	1.3	3.3	1.9
9/3/99 - 25/3/99	5.7	11.1	1.1	3.3	1.2
25/3/99 - 8/4/99	7.7	13.7	1.4	4.1	0.1
8/4/99 - 22/4/99	6.6	11.6	1.3	3.9	1.4
22/4/99 - 6/5/99	3.6	7.3	0.9	2.6	1.0
6/5/99 - 20/5/99	3.3	8.2	1.1	3.6	1.4
20/5/99 - 3/6/99	-	-	-	-	-
3/6/99 - 17/6/99	3.8	9.4	1.2	3.7	1.5
17/6/99 - 1/7/99	4.3	10.1	1.2	3.7	1.5
1/7/99 - 15/7/99	3.4	8.5	1.0	3.1	1.2
15/7/99 - 29/7/99	4.0	10.7	1.3	3.7	1.5
29/7/99 - 12/8/99	3.7	11.9	1.5	3.6	1.7
12/8/99 - 26/8/99	3.0	10.9	1.3	4.3	1.5
26/8/99 - 9/9/99	3.7	9.4	1.2	3.3	1.3
9/9/99 - 23/9/99	3.8	11.7	1.4	3.5	1.4
23/9/99 - 7/10/99	4.7	17.4	2.0	6.2	2.6
7/10/99 - 21/10/99	4.3	10.2	1.1	3.7	1.6
21/10/99 - 4/11/99	3.4	6.3	1.2	3.3	1.3
4/11/99 - 18/11/99	3.8	7.4	1.2	3.6	1.3
18/11/99 - 2/12/99	4.2	12.9	1.8	5.4	2.1
2/12/99 - 16/12/99	1.2	11.0	1.6	4.3	1.7
Averages	4.5	10.9	1.3	3.8	1.5

Table 11. Hydrocarbon results at La Collette, 1999

Exposure period	Benzene ppb	Toluene ppb	Ethyl Benzene ppb	m+p Xylene ppb	o Xylene ppb
17/12/98 - 30/12/98	1.3	2.0	0.4	0.7	1.3
30/12/98 - 14/1/99	0.6	1.1	0.2	0.5	0.5
14/1/99 - 28/1/99	1.0	2.7	0.3	0.8	0.4
28/1/99 - 11/2/99	0.9	1.9	0.3	0.8	0.4
11/2/99 - 25/2/99	1.1	1.8	0.4	0.7	0.6
25/2/99 - 9/3/99	1.1	1.8	0.5	0.9	1.4
9/3/99 - 25/3/99	0.9	2.1	0.4	1.2	0.4
25/3/99 - 8/4/99	0.5	1.6	0.2	0.7	0.3
8/4/99 - 22/4/99	0.9	1.6	0.3	0.8	0.4
22/4/99 - 6/5/99	1.0	2.0	0.3	0.8	0.4
6/5/99 - 20/5/99	0.3	1.2	0.2	0.7	0.3
20/5/99 - 3/6/99	0.6	2.9	0.4	1.0	0.4
3/6/99 - 17/6/99	0.4	1.2	0.2	0.6	0.3
17/6/99 - 1/7/99	0.4	1.5	0.3	0.8	0.3
Averages	0.8	1.8	0.3	0.8	0.5

Table 12. Hydrocarbon results at Stopford Road, 1999

Exposure period	Benzene ppb	Toluene ppb	Ethyl Benzene ppb	m+p Xylene ppb	o Xylene ppb
1/7/99 - 15/7/99	2.5	16.9	1.6	8.6	4.7
15/7/99 - 29/7/99	4.5	64.4	6.5	40.4	20.6
29/7/99 - 12/8/99	5.3	83.2	8.2	46.2	26.3
12/8/99 - 26/8/99	3.9	57.2	4.0	25.8	13.4
26/8/99 - 9/9/99	1.7	15.1	1.5	10.3	6.1
9/9/99 - 23/9/99	4.3	76.2	11.9	72.3	46.4
23/9/99 - 7/10/99	2.0	21.9	2.2	16.7	10.0
7/10/99 - 21/10/99	2.4	10.8	0.9	5.1	3.5
21/10/99 - 4/11/99	-	-	-	-	-
4/11/99 - 18/11/99	4.2	27.0	3.8	20.2	11.0
18/11/99 - 2/12/99	3.9	25.6	3.3	16.4	8.4
2/12/99 - 16/12/99	1.3	19.0	2.2	11.6	6.2
Averages	3.3	37.9	4.2	24.9	14.2

Table 13. Hydrocarbon results at Clos St Andre, 1999

Exposure period	Benzene ppb	Toluene ppb	Ethyl Benzene ppb	m+p Xylene, ppb	o Xylene, ppb
1/7/99 - 15/7/99	0.3	0.6	0.0	0.3	0.2
15/7/99 - 29/7/99	0.7	0.8	0.2	0.3	1.3
29/7/99 - 12/8/99	0.2	0.9	0.2	0.4	0.2
12/8/99 - 26/8/99	0.3	1.9	0.5	0.6	0.3
26/8/99 - 9/9/99	0.6	1.1	0.3	0.5	0.2
9/9/99 - 23/9/99	0.4	2.1	0.4	1.9	1.2
23/9/99 - 7/10/99	0.6	0.9	0.2	0.4	0.2
7/10/99 - 21/10/99	0.7	1.1	0.2	0.5	0.2
21/10/99 - 4/11/99	0.6	0.6	0.3	0.7	0.3
4/11/99 - 18/11/99	0.8	0.9	0.4	0.8	0.3
18/11/99 - 2/12/99	0.9	1.2	0.3	0.6	0.2
2/12/99 - 16/12/99	1.0	1.5	0.3	0.5	0.2
Averages	0.6	1.1	0.3	0.6	0.4

The diffusion tube results show that average outdoor hydrocarbon concentrations in Jersey remain generally low. The exception is the indoor site at Stopford Road. Annual average hydrocarbon concentrations are shown in Table 14.

Table 14. Summary of Average Hydrocarbon Concentrations, Jersey, 1999

Site	Benzene, ppb	Toluene, ppb	Ethyl Benzene, ppb	m+p Xylene, ppb	o Xylene, ppb
Beresford Street	1.8	3.6	0.6	1.7	0.8
Le Bas Centre	1.1	2.9	0.5	1.3	0.6
Elizabeth Lane	1.0	3.3	0.5	1.2	0.6
Springfields Garage	4.5	10.9	1.3	3.8	1.5
La Collette	0.8	1.8	0.3	0.8	0.5
Stopford Road	3.3	37.9	4.2	24.9	14.2

Clos St Andre	0.6	1.1	0.3	0.6	0.4

Highest average concentrations of benzene were found at Springfields Garage and Stopford Road; elsewhere, average concentrations were low - less than 2ppb. Two-week average concentrations of toluene were below 5ppb at all sites except the two associated with petrol storage - Springfields Garage and Stopford Road - where concentrations were substantially higher.

Of particular concern is the Stopford Road site. This indoor site, located in a basement level room in a resident's house, exhibited the highest concentrations of toluene, ethyl benzene and xylenes, by a substantial margin. The odour threshold of toluene is estimated as 160ppb: two-weekly average concentrations of toluene reached 50% of this value: it is therefore possible that the toluene odour threshold may have been exceeded for shorter periods within the exposure period. The situation is worse in the case of xylene. The estimated odour threshold for xylene is 16ppb[4]: a factor of 10 lower. The annual mean xylene concentration at Stopford Road was measured as 24.8ppb - well above this odour threshold. The measurements made using BTEX tubes support the resident's claims of odour nuisance - xylene appears to be present at concentrations above the odour threshold the majority of the time.

It has been established that the underground fuel storage tanks at the petrol stations either side of the affected house are not leaking. One possible explanation for the high concentrations of hydrocarbons measured in the rooms below ground level, is that the soil has been contaminated by spillage or leakage of fuel at some time in the past, possibly many years ago. Hydrocarbons from the soil may be entering the basement-level room through the walls. However, it must be emphasised that this is only a theory and it is recommended that further investigation is carried out.

3.3.2 Comparison with Hydrocarbon Standards and Guidelines

Of the range of hydrocarbon species monitored, only benzene is the subject of any applicable air quality standards. The UK Air Quality Strategy sets an objective for the running annual mean of 5ppb, to be achieved by 31 December 2003. The annual mean benzene concentration (which can be considered a good indicator of the running annual mean), did not exceed 5ppb at any of the sites, though some individual tube results at Springfields Garage and Stopford Road were above this value.

There are no air quality standards relating to toluene or xylene. However, the indoor measurements at Stopford Road show some individual tube results of up to 83ppb for toluene, and 72ppb for m+p xylene. It is recommended that some further monitoring (perhaps of the type used to assess workplace exposure) should be carried out at this location.

3.3.3 Comparison with UK Benzene Data

Table 15 compares the benzene data from the 1999 Jersey survey with a selection of automatic UK air quality monitoring stations .

The sites used for comparison are as follows:

- London UCL - in the grounds of University College London, close to a road.
- Bristol East - in the grounds of a school, to the east of the city.
- Cardiff East - a residential site to the east of the city.
- Harwell - a rural site in the south of England, within 10km of a power station.

Table 15 - Comparison of benzene in Jersey with UK Sites

Site	Annual average benzene, ppb *(17 Dec 1998 to 16 Dec 1999 unless specified)*
Diffusion Tubes	
Beresford Street	1.8
Le Bas Centre	1.1
Elizabeth Lane	1.0
(Springfields Garage	4.5)
La Collette	0.8 (*Dec 98 - Jul 99)*
(Stopford Road	3.3 (*Jul - Dec 99)*)
Clos St Andre	0.6 *(Jul - Dec 99)*
UK Automatic Sites - calendar year 1999	
London UCL	1.1
Bristol East	0.8
Cardiff East	1.3
Harwell	0.3

Results from the urban and rural background site on Jersey are broadly similar, but slightly higher than, comparable urban and rural background measurements from the UK. This is similar to the findings of the 1998 survey. In the previous report it was noted that diffusion tubes can over-read compared to continuous analysers for a number of reasons, including windy weather.

Springfields Garage and Stopford Road are shown in brackets, as they are close to petrol stations and therefore not comparable with any of the UK automatic sites. They exhibited annual mean benzene concentrations substantially higher than those measured at UK automatic sites. However, most automatic sites are deliberately sited well away from petrol stations.

3.3.4 Comparison with Previous Years' Hydrocarbon Data

Five of the sites (Beresford Street, Le Bas Centre, Elizabeth Lane, Springfields Garage and La Collette) have been used in previous year's BTEX monitoring programmes. The 1999 hydrocarbon concentrations were consistent with previous years, and in some cases lower. Table 16 illustrates the 3-year trends for these sites only. Stopford Road and Clos St Andre are not included as there are only 6 months data for these sites.

Table 16. Comparison of Hydrocarbon Concentrations, Jersey, 1997 - 1999.

	benzene, ppb	toluene, ppb	ethyl benzene, ppb	m+p xylene, ppb	o-xylene, ppb
Beresford Street					
1997	3.2	5.4	1.2	1.2	2.7
1998	2.5	4.9	0.9	1.0	2.3
1999	1.8	3.6	0.6	1.7	0.8
Le Bas Centre					
1997	2.8	4.5	1.2	1.0	2.2
1998	2.3	4.2	0.7	0.9	1.9
1999	1.1	2.9	0.5	1.3	0.6
Elizabeth Lane					
1997	1.9	4.4	1.4	1.7	2.2
1998	1.9	5.0	0.7	1.6	0.8
1999	1.0	3.3	0.5	1.2	0.6
Springfields Garage					
1997	7.7	12.5	1.9	1.9	4.3
1998	7.7	12.3	1.5	1.7	4.3
1999	4.5	10.9	1.3	3.8	1.5
La Collette					
1997	-	-	-	-	-
1998 (Mar-Dec)	1.2	2.1	0.5	0.5	1.0
1999 (Dec-Jul)	0.8	1.8	0.3	0.8	0.5

Annual mean concentrations of most hydrocarbon species have decreased over the three years of monitoring. The exception appears to be m+p xylene, which has shown an increase in 1999 at all sites except Elizabeth Lane.

3.3.5 Concentration Ratio Analysis

It has been found by the Photochemical Oxidant Review Group (ref. PORG 1993)[9] that where the main source of organic pollutants is vehicle exhaust, the ratios of the concentrations are as follows:

- Toluene: benzene - 2.0
- m+p xylene: benzene - 1.8.

Where the main source is petrol evaporation, the ratios of the concentrations are different:

- Toluene: benzene - 2.4
- m+p xylene: benzene - 1.6.

Table 17 Ratios of Hydrocarbon Concentrations

Ratios of Hydrocarbons	Toluene:benzene	m+p xylene: benzene
Beresford Street	2.05	0.97
Le Bas Centre	2.58	1.15
Elizabeth Lane	3.15	1.18
Springfields Garage	2.45	0.84
La Collette	2.31	1.00
Stopford Road	11.59	7.60
Clos St Andre	1.92	1.06
Typical for vehicle exhaust	2	1.8
Typical for petrol evaporation	2.4	1.6

The Jersey sites do not exhibit the typical ratios expected. In particular, the measured m+p xylene : benzene ratios (except at Stopford Road) are below those predicted for either case. However, the results do highlight the anomaly of Stopford Road, where relatively high levels of toluene and xylenes were measured.

4 Conclusions

1. AEA Technology Environment's National Environmental Technology Centre has undertaken a year-long diffusion tube monitoring study in Jersey, on behalf of the States of Jersey Public Health Services. This was the third such study. Diffusion tubes were used to monitor SO_2 at 13 sites, NO_2 at 3 sites and hydrocarbons (benzene, toluene, ethyl benzene and xylene, collectively termed BTEX) at 7 sites. The sites were located at a range of different locations on the island, including some which had been used in previous studies and some new sites.
2. The study continued from the end of the 1998 study, running from 17th December 1998 to 16th December 1999. SO_2 and NO_2 tubes were exposed for 4-week periods, while the BTEX tubes were exposed for 2-week periods.
3. The results from the SO_2 survey were consistent with previous years' data, and were generally low. Annual mean concentrations were less than 5.2 ppb at all sites, with one exception, Mont Felard Hotel.
4. Mont Felard Hotel appeared to exhibit unusually high average SO_2 concentrations (over 50ppb) during March - May 1999. Concentrations for the rest of the year were normal. The unusually high results distorted the annual mean (14 ppb). It is likely that the anomalous results were caused by emissions from a localised source of SO_2, such as the chimney of an oil-fired heating boiler.

5. All other sites had annual mean SO_2 concentrations comparable with automatic monitoring sites in the UK, and comparable with those measured on Jersey during the previous two years.
6. NO_2 monitoring began in the latter part of 1999. So far there is insufficient data for reliable comparison with air quality standards and guidelines relating to the annual mean. However, on the basis of the data currently available it is estimated that the annual mean NO_2 concentration at all 3 sites will be within 21ppb.
7. All sites had annual mean benzene concentrations less than 5ppb, although some individual 2-week means from Springfields Garage and Stopford Road (the two sites near petrol stations) did exceed this value.
8. Concentrations of toluene and xylenes at the domestic indoor Stopford Road site were substantially higher than at any others, including Springfields Garage.
9. Measured concentrations of m+p xylene at the Stopford Road site, inside a basement-level domestic living room, consistently exceeded the estimated xylene odour threshold. This therefore supports the resident's claim of odour nuisance and it is recommended that further investigation is carried out at this site to establish the source of the high hydrocarbon concentrations.
10. Five of the BTEX sites (Beresford Street, Le Bas Centre, Elizabeth Lane, Springfields Garage and La Collette) were used in the 1997 and 1998 BTEX monitoring programmes. Results for 1999 were consistent with those from previous years. Results from all three years appear to show a decreasing trend in BTEX hydrocarbon concentrations, with the exception of m+p xylene.

5 Acknowledgements

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6 References

1. Air Quality Monitoring in Jersey; Diffusion Tube Surveys 1997. B Stacey, report no. AEAT-3071, March 1998.
2. Air Quality Monitoring in Jersey; Diffusion Tube Surveys 1998. B Stacey, report no. AEAT-5271, April 1999.
3. EH40/97. Occupational Exposure Limits 1997. Health & Safety Executive. HMSO, ISBN 0-7176-1315-1.
4. Odour Measurement and Control - an update. Editors M Woodfield & D Hall. AEA Technology report AEA/CS/REMA/-038 ISBN 0 85624 8258. August 1994.

5. WHO Update and Revision of Air Quality Guidelines for Europe, Bilthoven Netherlands, 11-14 October 1995.
6. Council Directive 1999/30/EEC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. 22 April 1999.
7. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, August 1999 consultation document, Department of the Environment, Transport and the Regions.
8. EC Directive 85/203/EEC on Nitrogen Dioxide. 1985.
9. PORG (1993) Ozone in the United Kingdom 1993, Third Report of the UK Photochemical Oxidants Review Group, ISBN 0-7058-1683-4.

Appendices

CONTENTS

Appendix 1
Air Quality Standards

CONTENTS

National and International Ambient Air Quality Guidelines and Standards for NO_2, SO_2, and Benzene

Nitrogen Dioxide

Guideline Set By	Description	Criteria Based On	Value / ppb (μgm^{-3})
UK Government	LOW Air Pollution		< 150 (287)
- Air Pollution Bandings	MODERATE Air Pollution	1-hour mean	150 - 299 (287 - 572)
	HIGH Air Pollution		300 - 399 (573 - 763)
	V HIGH Air Pollution		>= 400 (764)
- The Air Quality Strategy[1]	Objective for Dec. 31st 2005	1-hour mean	105 (200) not to be exceeded more than 18 times per calendar year
	Objective for Dec. 31st 2005	Annual mean	21 (40)
European Community[2]		Calendar year of data:	
	Limit Value	98%ile of hourly means.	104.6 (200)
	Guide Value	98%ile of hourly means.	70.6 (135)
	Guide Value	50%ile of hourly means.	26.2 (50)
Daughter Directive[3]	Limit Value	1 hour mean	105 (200) not to be exceeded more than 18 times per calendar year
	Limit Value	Calendar year annual mean	21 (40)
	Limit Value (NO_x)	Calendar year annual mean	16 (30)
World Health Organisation[4]	Health Guideline	1-hour mean	110 (200)
(Revised Guidelines)	Health Guideline	Annual mean	21 (40)
United Nations Economic Commission for Europe	Vegetation Guideline	Annual mean	15 (29)

(1) The Air Quality Strategy.for England, Scotland, Wales and Northern Ireland. January 2000. ISBN 0-10-145482-1
(2) Council Directive 85/203/EEC
(3) Council Directive 1999/30/EC
(4) Conversions between $\mu g\ m^{-3}$ and ppb given by WHO

Sulphur Dioxide

Guideline Set By	Description	Criteria Based On	Value / ppb (µgm^{-3})
UK Government	LOW Air Pollution		< 100 (266)
- Air Pollution Bandings	MODERATE Air Pollution	15-minute mean	100 - 199 (266 - 531)
	HIGH Air Pollution		200 - 399 (532 - 1063)
	V HIGH Air Pollution		>= 400 (1064)
- The Air Quality Strategy[1]	Objective for Dec. 31st 2005	15-minute mean	100 (266) not to be exceeded more than 35 times per calendar year
	Objective for Dec. 31st 2004	1 hour mean	132 (350) not to be exceeded more than 24 times per calendar year
	Objective for Dec. 31st 2004	24 hours (daily mean)	47 (125) not to be exceeded more than 3 times per calendar year
	Objective for Dec. 31st 2000	Calendar year annual mean	8 (20)
	Objective for Dec. 31st 2000	Winter mean	8 (20)
European Community[5]	Limit Value	Pollution Year (median of daily values)	30 (80) if smoke[6] > 34 45 (120)if sm. <= 34
	Limit Value	Winter (median of daily values Oct-Mar)	49 (130)if sm. > 51 68 (180)if sm. <= 51
	Limit Value[7]	Pollution Year (98%ile of daily values)	94 (250)if sm. > 128 131 (350)if sm. <= 128
	Guide Value	Pollution Year (mean of daily values)	15 - 23 (40 - 60)
	Guide Value	24 Hours (daily mean value)	38 - 56 (100 – 150)
Daughter Directive[8]	Limit Value	1 hour mean	132 (350) not to be exceeded more than 24 times per calendar year
	Limit Value	24 hours (daily mean)	47 (125) not to be exceeded more than 3 times per calendar year
	Limit Value	Calendar year annual mean	8 (20)
	Limit Value	Winter mean	8 (20)
World Health Organisation[4] **(Revised Guidelines)**	Health Guideline	10-minute mean	175 (500)
	Health Guideline	24-hour mean	44 (125)
	Health Guideline	Annual Mean	17 (50)
United Nations Economic Commission for Europe	Vegetation Guideline	Daily mean	26 (70)
	Vegetation Guideline	Annual mean	7.5 (20)

(5) Council Directive 80/779/EEC
(6) Limits for black smoke are given in 1gm^{-3} for the BSI method as used in the UK.
The limits stated in the EC Directive relate to the OECD method, where OECD = BSI / 0.85.
(7) Member states must take all appropriate steps to ensure that three consecutive days do not exceed this limit value.
(8) Council Directive 1999/30/EC

Benzene

Guideline Set By	Description	Criteria Based On	Value / ppb ($\mu g\ m^{-3}$)
UK Government - Air Pollution Bandings	-	-	-
- The Air Quality Strategy[1]	Objective for Dec. 31st 2003 Target for Dec. 31st 2005	Running annual mean Running annual mean	5 (16.25) 1 (3.25)
European Community	-	-	-
World Health Organisation	-	-	-
United Nations Economic Commission for Europe	-	-	-

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Air Quality Monitoring in Jersey; Diffusion Tube Surveys, 2000

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Executive Summary

AEA Technology Environment has undertaken a programme of air quality monitoring on Jersey, on behalf of the Public Health Services of the States of Jersey. This report presents the results of the fourth consecutive year of monitoring, the period 5th January 2000 to 3rd January 2001.

Diffusion tube samplers were used to monitor sulphur dioxide (SO_2) at one site, nitrogen dioxide (NO_2) at 19 sites, and hydrocarbons at six sites. Monitoring sites were selected to include areas likely to be affected by specific emission sources (such as petrol stations or the power station or waste incinerator), as well as general roadside and background locations.

All diffusion tubes were exposed for four-week periods. The tubes were supplied and analysed by Harwell Scientifics Ltd., and changed by Technical Officers of Jersey's Environmental Health Section.

The results from the limited 2000 SO_2 survey indicate that average concentrations remain generally low. They were consistent with previous years' results, and with results from automatic SO_2 monitoring stations in the UK. Annual average SO_2 concentrations were 2.2 ppb, at the monitoring site used.

Diffusion tube monitoring of nitrogen dioxide was expanded significantly in 2000. The results for 2000 show that annual means at six sites exceeded the annual mean standard of 21 ppb set by the UK Air Quality Strategy and the European Commission. It is possible but unlikely that the hourly average standard was also exceeded at some sites in 2000.

Average concentrations of hydrocarbons were generally low throughout the year. Annual mean benzene concentrations were less than the UK Air Quality Standard of 5ppb (which applies to the running annual mean) at all sites. The EC Daughter Directive limit value of 1.5 ppb for benzene was slightly exceeded at the Springfields Garage site. Benzene concentrations at the five sites not associated with petrol stations were broadly similar to those measured at comparable sites in the UK.

Five of the hydrocarbon sites were included in previous years' surveys: 2000 results were comparable with those obtained in previous years. The four years' data gathered from the five long-running BTEX sites appear to show a decreasing trend in ambient concentrations of all the measured BTEX species except m+p xylene.

Contents

Appendices

1 Introduction

1.1 BACKGROUND

AEA Technology Environment, on behalf of the States of Jersey Public Health Services, has undertaken a further programme of air quality monitoring on the island of Jersey in 2000. This is the fourth in a series of annual monitoring programmes that began in 1997.

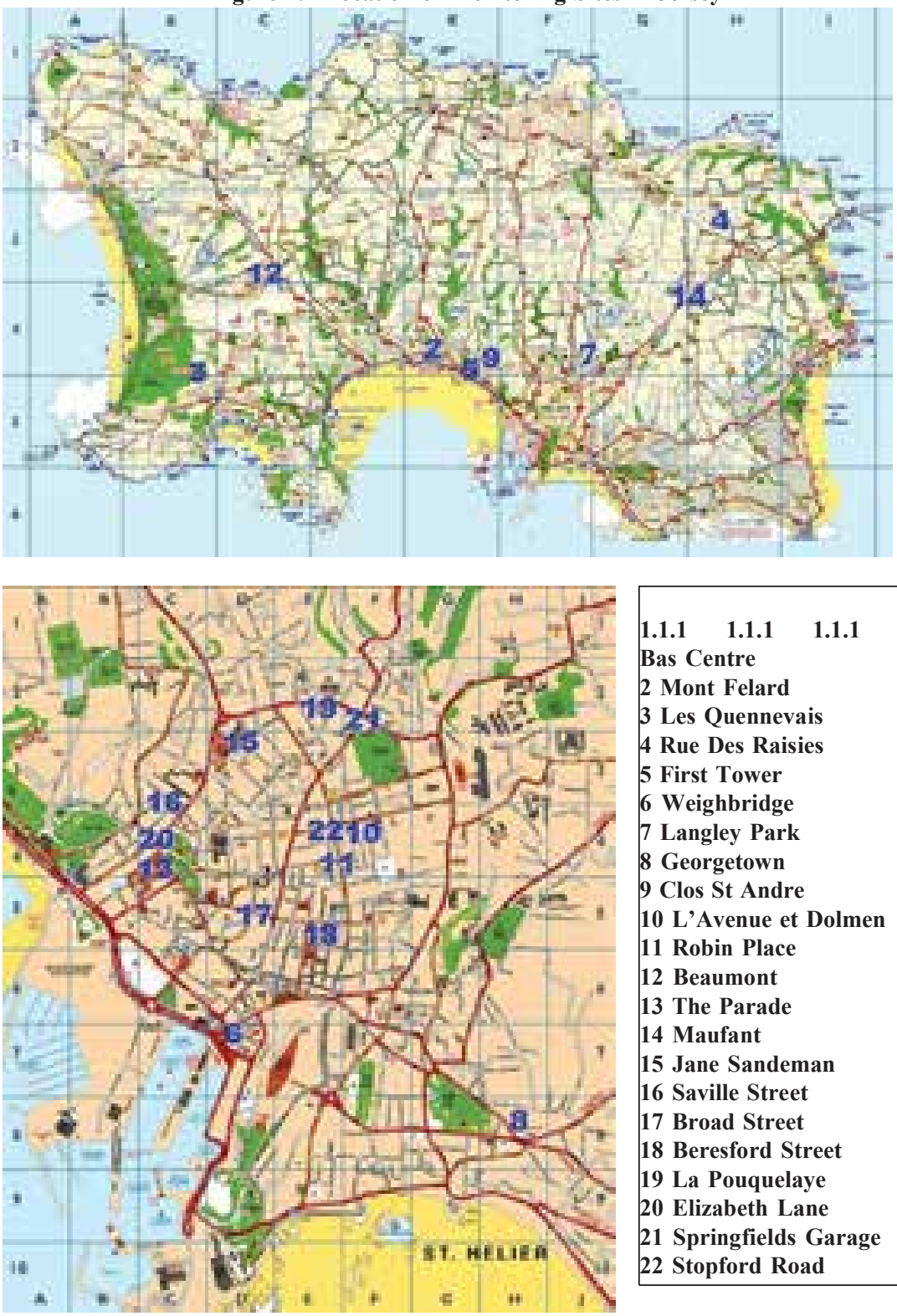
The pollutants measured were sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and a range of hydrocarbon species (benzene, toluene, ethyl benzene and three xylene compounds, collectively termed BTEX). Average ambient concentrations were measured using passive diffusion tube samplers. SO_2 was measured at one site on the island, NO_2 was measured at 19 sites, and BTEX at six sites. Monitoring locations are shown in Figure 1.1

This report presents the results obtained in the 2000 survey, and compares the data from Jersey with relevant air quality standards and guidelines, data from selected UK monitoring stations and previous years' monitoring programmes.

1.2 OBJECTIVES

This survey followed on from those in 1997[1], 1998[2] and 1999[3]. The objective, as in the previous surveys, was to monitor at sites where pollutant concentrations were expected to be high, and compare these with background locations. The monitoring sites used therefore included some background sites investigated during previous studies, together with new locations where there was a need to investigate air quality.

Figure 1.1 Location of Monitoring Sites in Jersey



1.1.1 1.1.1 1.1.1 1 Le Bas Centre
2 Mont Felard
3 Les Quennevais
4 Rue Des Raisies
5 First Tower
6 Weighbridge
7 Langley Park
8 Georgetown
9 Clos St Andre
10 L'Avenue et Dolmen
11 Robin Place
12 Beaumont
13 The Parade
14 Maufant
15 Jane Sandeman
16 Saville Street
17 Broad Street
18 Beresford Street
19 La Pouquelaye
20 Elizabeth Lane
21 Springfields Garage
22 Stopford Road

2 Details of Monitoring Programme

2.1 POLLUTANTS MONITORED

2.1.1 SO_2

Sulphur dioxide (SO_2) is formed during the combustion of fuels containing sulphur. The most significant source of this pollutant is fossil fuelled power generation, although diesel engines, domestic solid fuel burners and a number of chemical processes also produce SO_2.

SO_2 is a respiratory irritant, and is toxic at high concentrations. It is also damaging to ecosystems and a major precursor in the formation of acid rain.

2.1.2 NO_2

A mixture of nitrogen dioxide (NO_2) and nitric oxide (NO) is emitted by combustion processes. This mixture of oxides of nitrogen is termed NO_X. NO is subsequently oxidised to NO_2 in the atmosphere. NO_2 is an irritant to the respiratory system, and can affect human health. Ambient concentrations of NO_2 are likely to be highest in the most built-up areas, especially where traffic is congested, or buildings either side of the street create a " canyon" effect, impeding the dispersion of vehicle emissions.

2.1.3 Hydrocarbons

There are many sources of hydrocarbon emissions. Methane, for example, is a naturally occurring gas, while xylene compounds are synthetic and used in many applications, for example as a solvent in paint. A range of hydrocarbons are found in vehicle fuel, and occur in vehicle emissions. In most urban areas, vehicle emissions would constitute the major source of hydrocarbons, in particular benzene. Also, there is the potential that they may be released to the air from facilities where fuels are stored or handled (such as petrol stations).

A wide range of hydrocarbons is emitted from both fuel storage and handling, and from fuel combustion in vehicles. It is not easy to measure all of these hydrocarbon species (particularly the most volatile) without expensive continuous monitoring systems. However, there are four moderately volatile species, all of which may be associated with fuels and vehicle emissions, which are easy to monitor using passive samplers. These are benzene, toluene, ethyl benzene and xylene. They are not the largest constituents of petrol emissions, but due to their moderate volatility they can be monitored by diffusion tubes. Diffusion tubes are available for monitoring this group of organic compounds, and are known as "BTEX" tubes.

(i) Benzene

Of the organic compounds measured in this study, benzene is the one of most concern, as it is a known human carcinogen; long-term exposure can cause leukaemia. It is found in petrol and other liquid fuels, in small concentrations. In urban areas, the major source is vehicle emissions. Benzene concentrations in ambient air are generally between 1 and 5 ppb.

(ii) Toluene

Toluene is also found in petrol in small concentrations. Its primary use is as a solvent in paints and inks, and is a constituent of tobacco smoke. It has been found to adversely affect human health. Typical ambient concentrations range from trace to 3.8 μg m^{-3} (1.0 ppb) in rural areas, up to 204 μg m^{-3} (54 ppb) in urban areas, and higher near industrial sources. There are no recommended limits for ambient toluene concentrations, although there are occupational limits for workplace exposure[4]: the occupational 8-hour exposure limit (OEL) is 50ppm (50,000ppb).
The best estimate for the odour threshold of toluene has been reported[5] as 0.16ppm (160ppb).

(iii) Ethyl benzene
Again, there are no limits for ambient concentration of ethyl benzene, although there are occupational limits relating to workplace exposure[4], of 100 ppm over 8 hours, and 125 ppm over 10 minutes. Ambient concentrations are highly unlikely to approach these levels.

(iv) Xylene
Xylene exists in ortho (o), para (p) and meta (m) isomers. Occupational limits relating to workplace exposure are 100 ppm over 8 hours, and 150 ppm over 10 minutes. Xylene, like toluene, can cause odour nuisance near processes (such as vehicle paint spraying) which emit it. Its odour threshold varies according to the isomer, but the best estimate for the odour threshold of mixed xylenes is 0.016ppm (16 ppb)[5].

2.2 AIR QUALITY STANDARDS AND GUIDELINES

2.2.1 World Health Organisation
In 1995, the World Health Organisation published revised interim guidelines[6] for SO_2 and NO_2. These revised guidelines were set using currently available scientific evidence on the effects of air pollutants on health and vegetation. The WHO guidelines are advisory only, and do not carry any mandatory status. They are summarised in Appendix 1. There are WHO guidelines for SO_2 (10-minuute, 24-hour and annual means), and NO_2 (hourly and annual means) but not benzene.

2.2.2 European Community
Throughout Europe, ambient air quality is regulated by EC Directives. These set limit values which are mandatory, and in some cases also guide values which are intended to provide increased protection to human health and ecosystems. EC Daughter Directives covering SO_2, NO_2 and benzene have recently been published[7,8]. The limit values are summarised in Appendix 1.

2.2.3 UK Air Quality Strategy
The UK Air Quality Strategy has set limits and objectives for a range of pollutants including SO_2, NO_2 and benzene[9]. These are also summarised in Appendix 1.

2.3 METHODOLOGIES

The survey was carried out using diffusion tubes for SO_2, NO_2 and TEX. These are passive samplers, i.e. they work by absorbing the pollutants direct from the surrounding air and do not need a power supply.
Diffusion tubes for SO_2 and NO_2 consist of a small plastic tube, approximately 7 cm long. During sampling, one end is open (or covered by a thin membrane in the case of SO_2) and the other closed. The closed end contains an absorbent for the gaseous species to be monitored, in this case SO_2 or NO_2. The tube is mounted vertically with the open (or membrane) end at the bottom. Ambient SO_2 or NO_2 diffuses up the tube during exposure, and is absorbed as sulphate or nitrate respectively. The average ambient pollutant concentration for the exposure period is calculated from the amount of pollutant absorbed.

TEX diffusion tubes are different in appearance to SO_2 and NO_2 tubes. They are longer, thinner, and made of metal rather than plastic. These tubes are fitted at both ends with brass Swagelok fittings. A separate diffusion cap is supplied. Immediately before exposure, the Swagelok end fitting is replaced with the diffusion cap. The cap is removed after exposure, and is replaced with the Swagelok fitting. TEX diffusion tubes are very sensitive to interference by solvents.

Diffusion tubes were prepared by Harwell Scientifics Ltd for AEA Technology, and supplied to local Technical Officers of ersey s ublic Health Services, who carried out the tube changing. The tubes were supplied in sealed condition prior to exposure. The tubes were exposed at the sites for a period of time. After exposure, the tubes were again sealed and returned to Harwell Scientifics for analysis. In this study, SO_2 and NO_2 tubes were exposed in four-weekly batches. TEX tubes were previously exposed in two-weekly batches but, based on examination past results, this was changed to four-weekly for 2000.

The diffusion tube methodologies provide data that are accurate to _ 20 for SO_2, _ 25 for NO_2, and _ 20 for TEX. The limits of detection are 0.4 ppb for SO_2, 0.2 ppb for NO_2 and 0.1 ppb for TEX. It should be noted that tube results that are less than 10 x the limit of detection will have a higher level of uncertainty associated with them.

2.4 MONITORING SITES

SO_2 monitoring was carried out at a only one site during 2000 (Table 2.1) compared with the 13 sites in use during 1999. The SO2 survey was essentially discontinued in 2000 because results from previous studies have indicated that concentrations in ersey are significantly below the relevant limit and guideline values and not generally a cause of concern. The Clos St Andre site was retained because it is in a residential area near a waste incinerator

Table 2.1 SO_2 Monitoring sites 2000

Site Name	Grid Ref	Description
Clos St Andre	638499	esidential area near ellozanne alley refuse incinerator.

NO_2 monitoring was added to the survey in uly 1999 and three sites were selected initially. In 2000, this was expanded to 19 sites which are shown in Table 2.2. Eight new sites, which commenced in ay 2000, are being operated as part of the UK National Nitrogen Dioxide Diffusion Tube Survey.

Table 2.2. NO_2 Monitoring sites 2000

No	Site Name	Grid Ref	Description
1	Le as Centre	658489	Urban ackground
2	ont elard	629501	esidential background, to SW of waste incinerator 20m from busy road junction.
3	Les Quennevais	579496	esidential ackground
4	ue Des aisies	689529	ural ackground
5	irst Tower	636497	Kerbside site on major road.
6	Weighbridge	651483	us station near centre of St Helier.
7	Langley ark	660501	esidential ackground
8	eorgetown	661480	Kerbside site near major road.
9	Clos St.Andre	638499	esidential area near ellozanne alley refuse incinerator.
10	L Avenue et Dolmen	656490	Urban background close to ring road
11	obin lace	656489	Urban ackground
12	eaumont (*from 2/5/00*)	597516	Kerbside
13	The arade (*from 2/5/00*)	648489	Intermediate site at the eneral Hospital
14	aufant (*from 2/5/00*)	683512	ackground site in aufant illage
15	ane Sandeman (*from 2/5/00*)	652494	Urban ackground on Housing Estate
16	Saville Street (*from 2/5/00*)	648492	ackground
17	road Street (*from 2/5/00*)	652486	Kerbside
18	eresford Street (*from 2/5/00*)	653486	Urban background
19	La ouquelaye (*from 2/5/00*)	654495	Kerbside

The 2000 survey monitored TEX at six of the seven sites used in 1999. These are shown in Table 2.3. The aim was to investigate sites likely to be affected by different emission sources, and compare these with background sites. The sites at eresford Street and Le as Centre were intended to monitor hydrocarbon concentrations at an urban background and urban roadside location respectively. The Elizabeth Lane site is close to a paint spraying process and the Springfields arage site is located by a fuel filling station, both possible sources of hydrocarbon emissions. TEX 6, Stopford oad, is located by a house situated between two petrol stations. or the 1999 survey this tube was located inside the house to investigate reports of odours by the residents. TEX 7 is located at Clos St Andre, near the ellozane alley waste incinerator. This site replaced TEX 5 (La Collette).

Table 2.3. BTEX Monitoring sites

No	Site Code	Site Name	Grid Ref	Description
	TEX 1	eresford Street	653486	Urban roadside

	TEX 2	Le as Centre	658489	Urban background
21	TEX 3	Elizabeth Lane	648292	Urban background near paint spraying process
22	TEX 4	Springfields arage	656495	Urban background near fuel filling station
23	TEX 6	Stopford oad	656491	Urban background site, at house between two petrol stations.
	TEX 7	Clos St Andre	638499	esidential area near ellozanne alley refuse incinerator.

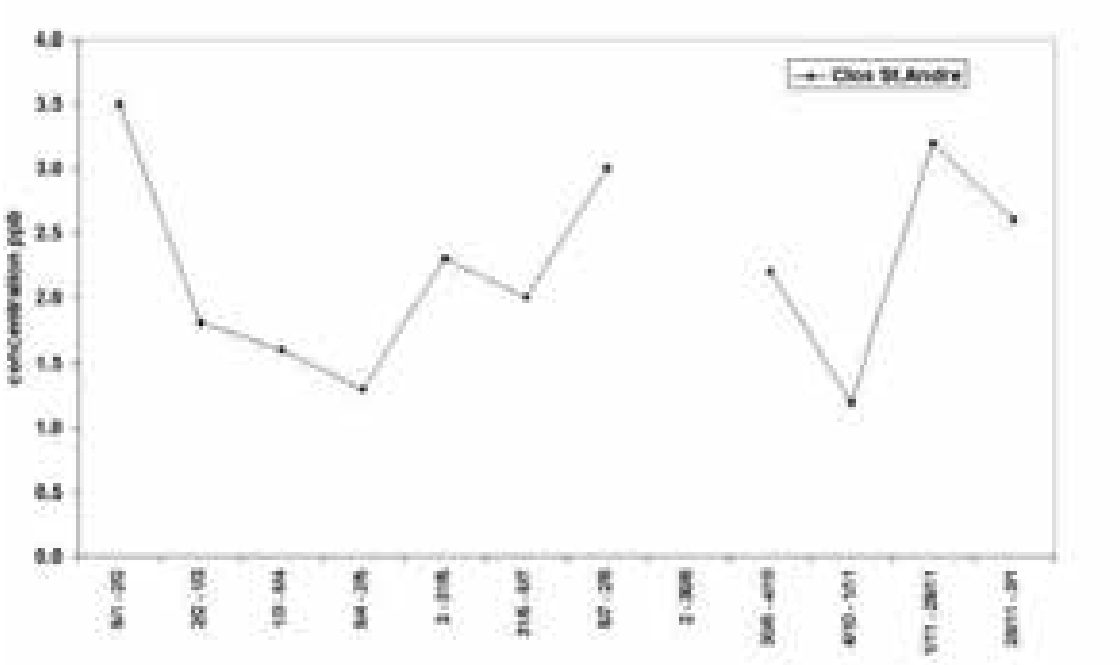
3 Results and Discussion

3.1 SULPHUR DIOXIDE

3.1.1 Summary of SO_2 Results

The monthly results for the Clos St Andre site are shown in Appendix 2 Table A1, with a graphical representation in igure 3.1

Figure 3.1 Monthly mean sulphur dioxide concentrations 2000



onthly averages ranged from 1.2 ppb to 3.5 ppb, and the annual mean SO_2 concentrations was 2.2 ppb.

3.1.2 Comparison with SO_2 Standards and Guidelines

The standards and guidelines for SO_2 are presented in Appendix 1. ecause of the known health effects of this pollutant, many of the limits for SO_2 are based on short averaging periods, such as 15-minute or 24-hour means. As diffusion tubes only provide a four-week

average concentration, it is not possible to compare the results from this study against limits relating to shorter periods.

(i) The WHO S 1995 revised guidelines contain the following guidelines for the protection of human health:
A guideline of 175ppb for the 10-minute mean.
A guideline of 44ppb for the 24-hour mean.
A guideline of 17ppb for the annual mean.

Diffusion tube data can only be compared with the annual mean guideline. 2000 annual mean SO_2 results for the Clos St Andre site are within this value.

(ii) EC Directive 1999 30 EEC [7](the first Daughter Directive) contains the following limits for SO_2.
A limit of 132 ppb for the hourly mean, for protection of human health, not to be exceeded more than 24 times per calendar year and to be achieved by 1 anuary 2005.
A limit of 47 ppb for the 24-hour mean, for protection of human health, not to be exceeded more than 3 times per calendar year and to be achieved by 1 anuary 2005.
A limit of 8ppb for the annual (calendar year) and winter (October to arch) mean SO_2 concentration, for the protection of ecosystems. This is to be achieved by uly 2001. It is only applicable in rural areas.

Diffusion tube data can only be compared with the latter - the ecosystem protection limit. This is only applicable to rural sites and does not apply to Clos St Andre. However, the annual mean of 2.2ppb was well below this limit value.

(iii) The UK Air Quality Strategy contains the following standards for SO_2, intended for protection of human health. They are similar to those contained in the EC Directive above, with an additional standard for the 15-minute mean.
A limit of 100ppb for the 15-minute mean, for protection of human health, not to be exceeded more than 35 times per year, and to be achieved by 31 December 2005.
A limit of 132 ppb for the hourly mean, for protection of human health, not to be exceeded more than 24 times per calendar year and to be achieved by 31 December 2004.
A limit of 47 ppb for the 24-hour mean, for protection of human health, not to be exceeded more than 3 times per calendar year and to be achieved by 31 December 2004.
A limit of 8ppb for the annual (calendar year) and winter (October to arch) mean SO_2 concentration, for the protection of ecosystems. This is to be achieved by 31 December 2000. This is applicable in rural areas.

As above, it is only possible to compare diffusion tube results directly with the ecosystem protection limits. Again, the Clos St Andre annual mean of 2.2ppb was well below this limit value.

3.1.3 Comparison with UK SO_2 Data

Table 3.1 shows how the SO_2 data from the 2000 ersey survey compares with a selection of UK air quality monitoring stations using automatic (U fluorescence) SO_2 analysers.

The sites used for comparison are as follows:

London loomsbury - an urban centre site, located in a small park in Central London, surrounded by heavy traffic and tall buildings.

lymouth Centre - an urban non-roadside site, in the centre of a coastal city.

Lullington Heath - a rural site on the South Coast of England near the town of Eastbourne.

Harwell - a rural site in the south of England, within 10km of a power station.

Table 3.1 - Comparison of SO_2 in Jersey with UK Sites

Site	Annual average SO_2, ppb 2000
Diffusion Tubes	
Clos St Andre	2.2
UK Automatic Sites	
London loomsbury	3.0
lymouth Centre	3.0
Lullington Heath	0.9
Harwell	1.3

Table 3.1 shows that the annual mean SO_2 concentration measured at Clos St Andre on ersey is comparable with those measured at urban sites in the UK.

3.1.4 Trends in sulphur dioxide concentrations

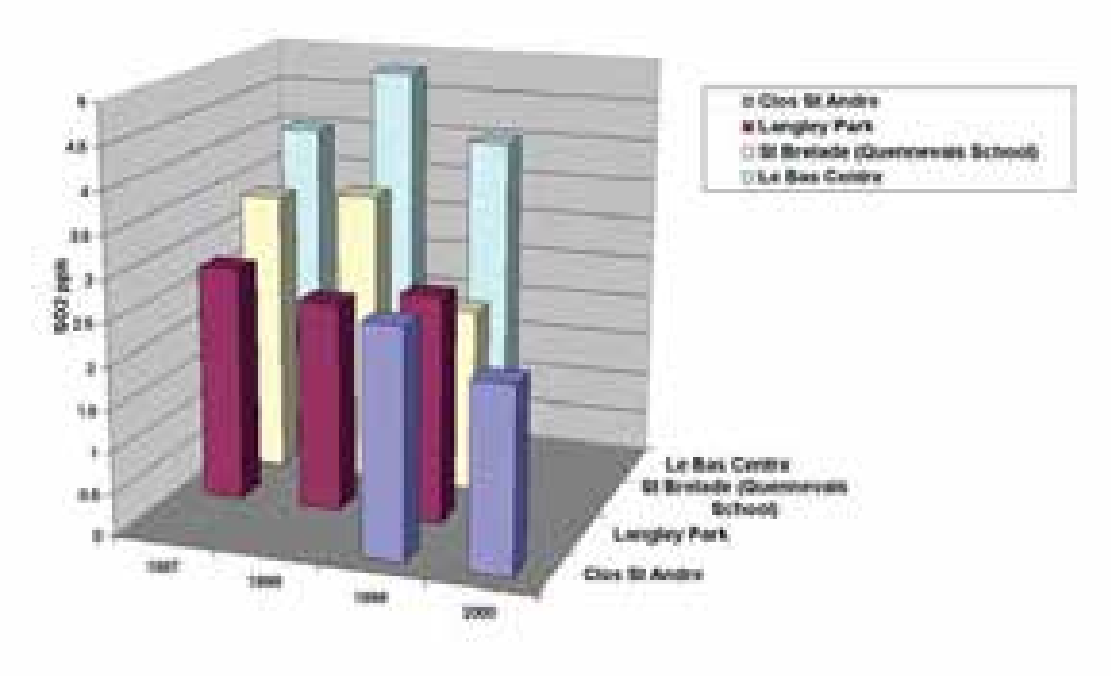
onitoring of sulphur dioxide has been carried out long term at three sites. Table 3.2 and igure 3.2 show average SO2 concentrations for the period 1997 to 2000 at these sites as well as the concentrations measured at the current site. The table shows that SO_2 concentrations measured in ersey have remained constant or decreased over the period, and are well below the standards and guidelines for that pollutant.

Table 3.2 Comparison of Mean SO_2 concentrations 1997-2000

	SO_2 ppb			
Site	**1997**	**1998**	**1999**	**2000**
Clos St Andre			2.7	2.2
Le asCentre	4.0	4.8	4.0	
Langley ark	2.8	2.5	2.7	
St relade (Quennevais School)	3.4	3.5	2.2	

incomplete data set

Figure 3.2 Trends in sulphur dioxide concentrations 1997-2000



3.2 NITROGEN DIOXIDE

3.2.1 Summary of NO_2 Results

The data obtained so far are summarised in Appendix 2 Table A2, and presented graphically in igure 3.3 (kerbside sites) and igure 3.3a (background sites).

Figure 3.3 Monthly mean nitrogen dioxide concentrations (kerbside sites) 2000

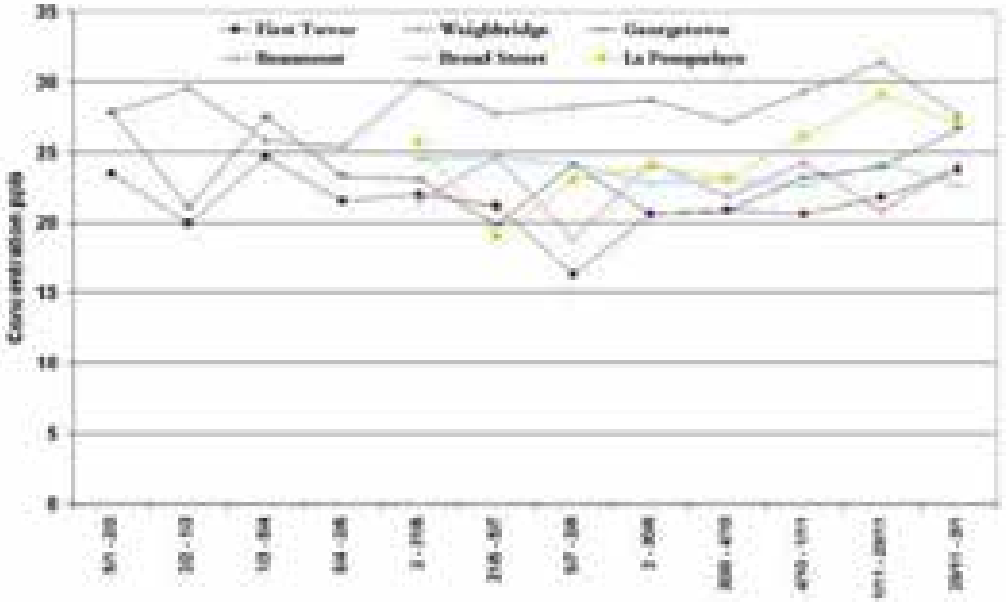
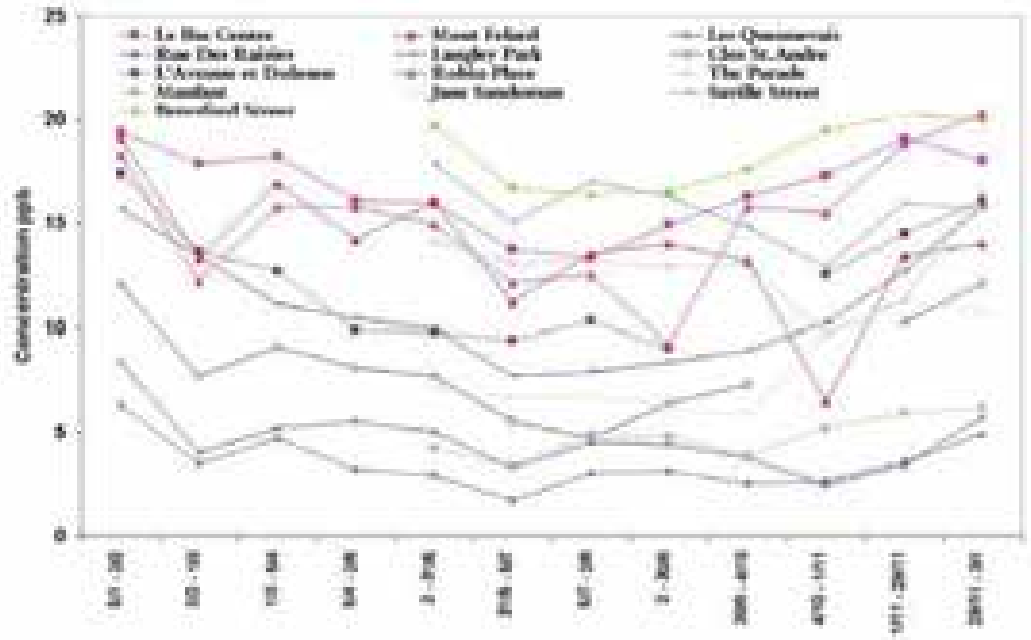


Figure 3.3a Monthly mean nitrogen dioxide concentrations (background sites) 2000



3.2.2 QA/QC of Diffusion Tube Results

The bias in the diffusion tube concentrations analysed by Harwell Scientifics was plus 4.2 in 1999 relative to concentrations recorded by an automatic analyser. (Summary esults from the UK NO2 Network ield Intercomparison Exercise DET , 1999). This means that diffusion tube measurements may be up to 4 lower on average compared to the continuous monitor. The Harwell Scientifics data are considered to be of acceptable quality based on the requirement of the National NO_2 diffusion tube survey i.e. the bias in results from the

intercomparison study is within 25 . The data can reasonably used to give an indication of current and future NO_2 concentrations.

3.2.3 Comparison with NO_2 Standards and Guidelines

Annual mean concentrations are summarised in Table 3.3

Table 3.3 Annual average NO_2 concentrations 2000

Site	NO_2 ppb
Le as Centre	16.7
ont elard	13.8
Les Quennevais	4.6
ue Des aisies	3.5
irst Tower	**21.4**
Weighbridge	**28.2**
Langley ark	11.0
eorgetown	**23.5**
Clos St.Andre	8.3
L Avenue et Dolmen	11.3
obin lace	15.1
eaumont	**22.6**
The arade	13.0
aufant	4.8
ane Sandeman	8.0
Saville Street	15.7
road Street	**23.6**
eresford Street	18.3
La ouquelaye	**24.6**

or these sites only eight months of data were available However, this should provide a good approximation to the annual average.

The standards and guidelines for NO_2 are shown in Appendix 1.

The WHO guideline[6] for NO_2 is that the annual mean should not exceed 21 ppb. This uideline value was exceeded at six sites in 2000.

EC Directive limits for NO_2 have recently been updated, as part of the first Daughter Directive[7]. The new limits are as follows:

105 ppb (200 μg m^{-3}) as an hourly mean, not to be exceeded more than 18 times per calendar year (approximately equivalent to the 99.8th percentile of hourly means). To be achieved by 1 anuary 2010.

21 ppb (40 μg m^{-3}) as an annual mean, for protection of human health. To be achieved by 1 anuary 2010.

There is also a limit for total oxides of nitrogen (NO_X), of 16 ppb (30 μg m^{-3}) as an annual mean, for protection of vegetation (relevant in rural areas).

The UK Air Quality Strategy contains standards for NO_2, which are very similar to the EC Daughter Directive limits above: the only differences being the more stringent dates by which they must be attained. These are as follows:

105 ppb (200 μg m^{-3}) as an hourly mean, not to be exceeded more than 18 times per calendar year. To be achieved by 31 December 2005.

21 ppb (40 μg m^{-3}) as an annual mean, for protection of human health. To be achieved by 31 December 2005.

16 ppb (30 μg m^{-3}) as an annual mean, for total oxides of nitrogen (NO_X), for protection of vegetation (relevant in rural areas). To be achieved by 31 December 2000.

The relationship between the annual mean and the 99.8th percentile of 1-hour means (equivalent to 18 exceedences per year) is uncertain, and is subject to the prevalence of specific meteorological conditions in any given year. To take into account the uncertainty, it may be assumed that at sites where road traffic emissions are the dominant influence, the 99.8th percentile will not exceed 5 times the annual mean concentration at background sites and 3.5 times the annual mean at roadside kerbside sites. rovided that the area is **not** subject to the influence of local industrial stack emissions, it can be generally assumed that the 99.8th percentile objective is unlikely to be exceeded in 2005 if the annual mean objective is not breached (LAQ T 4(00))[11].

The annual mean objective was exceeded at six sites in ersey in 2000. The maximum annual concentration in 2000 was 28.2 ppb recorded at the Weighbridge Site. Since this is a roadside site, the 99.8th percentile of hourly means can be estimated as 98.7 ppb. Is therefore possible but unlikely that the hourly mean objective was exceeded at any locations in ersey.

3.2.4 Comparison with UK NO_2 data

3.2.4.1 Comparison with data from the UK National NO2 Diffusion Tube Survey

The UK Nitrogen Dioxide Survey monitors this pollutant at around 1200 sites across the UK using diffusion tubes. However, this survey concentrates on urban, not rural, areas sites are categorised as

Kerbside (K), 1-5m from the kerb of a busy road
Intermediate (I), 20-30m from the same or an equivalent road
Urban background ( ), more than 50m from any busy road.

The national annual averages for 2000 are not yet available, therefore data for 1999 have been used for comparison. Table 3.4 shows data for 1999 measured at sites in London and south west England. The data indicate that the concentrations measured made in ersey are typical of those for UK urban areas.

Table 3.4- Comparison of NO_2 in Jersey with UK National Survey Sites

Site	Site Type	NO2 ppb
WEST INSTE 2N	I	20
WEST INSTE 3N		18
WEST INSTE 5N		21
WEST INSTE 1N	K	27

TO QUA 1N	K	22
TO QUA 2N	I	22
TO QUA 3N		14

3.2.4.2 Comparison with data from the UK Automatic Monitoring Network.
Table 3.5 shows annual average concentrations measured using an automatic chemiluminescent analyser at a range of sites in the UK Automatic onitoring Network.

Table 3.5 Comparison of NO_2 in Jersey with UK Automatic Sites

Site	Annual average NO_2, ppb 2000
London loomsbury	31
lymouth Centre	13
Lullington Heath	6.3
Harwell	6.5

The annual average concentrations measured in ersey are similar to those for urban and rural sites in the UK in 2000.

3.2.5 Trends in nitrogen dioxide concentrations

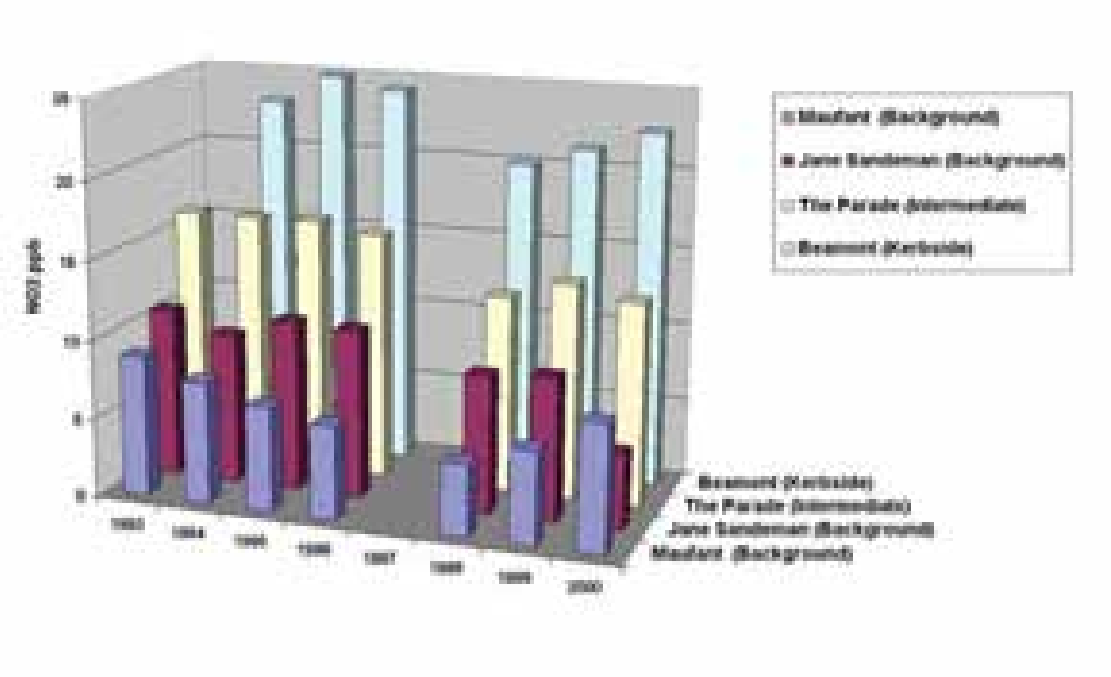
Nitrogen dioxide diffusion tube monitoring has been undertaken in ersey since 1993 as part of the UK Nitrogen Dioxide onitoring Network. Annual average concentrations for four long term sites are shown in Table 3.5 and igure 3.4. The data show that NO_2 concentrations have remained stable or decreased slightly over the period.

Table 3.5 nitrogen dioxide concentrations (ppb) 1993 -2000

	1993	1994	1995	1996	1997	1998	1999	2000
aufant (ackground)	9	8	7	6	n d	5	6	8
ane Sandeman (ackground)	11	10	11	11	n d	9	9	5
The arade (Intermediate)	16	16	16	16	n d	13	14	13
eaumont (Kerbside)		23	25	24	n d	20	21	23

n d no data
incomplete data set

Figure 3.4 Trends in nitrogen dioxide concentrations 1993-2000



3.3 HYDROCARBONS

3.3.1 Summary of Hydrocarbon Results

esults of the hydrocarbon survey for the seven sites are shown in Appendix 2 Tables A3 to A8 respectively. raphical representations are shown in igures 3.5 to 3.10.

The diffusion tube results show that average outdoor hydrocarbon concentrations in ersey remain generally low. Annual average hydrocarbon concentrations are shown in Table 3.7.

Table 3.7 Summary of Average Hydrocarbon Concentrations, Jersey, 2000

Site	Benzene, ppb	Toluene, ppb	Ethyl Benzene, ppb	M+p Xylene, ppb	o Xylene, ppb
eresford Street	0.9	3.7	0.8	2.3	0.9
Le as Centre	0.9	3.3	0.7	1.9	0.7
Elizabeth Lane	0.7	3.3	0.7	1.8	0.6
Springfields arage	1.6	9.2	1.8	5.0	2.0
Stopford oad	1.2	8.4	1.8	5.3	2.2
Clos St Andre	0.3	0.9	0.2	0.6	0.2

Highest average concentrations of benzene were found at Springfields arage and Stopford oad. Average concentrations were less than 2 ppb at all sites.

onthly average concentrations of toluene were below 5ppb at all sites except the two associated with petrol storage - Springfields arage and Stopford oad.

Figure 3.5 Monthly mean hydrocarbon concentrations Beresford Street 2000

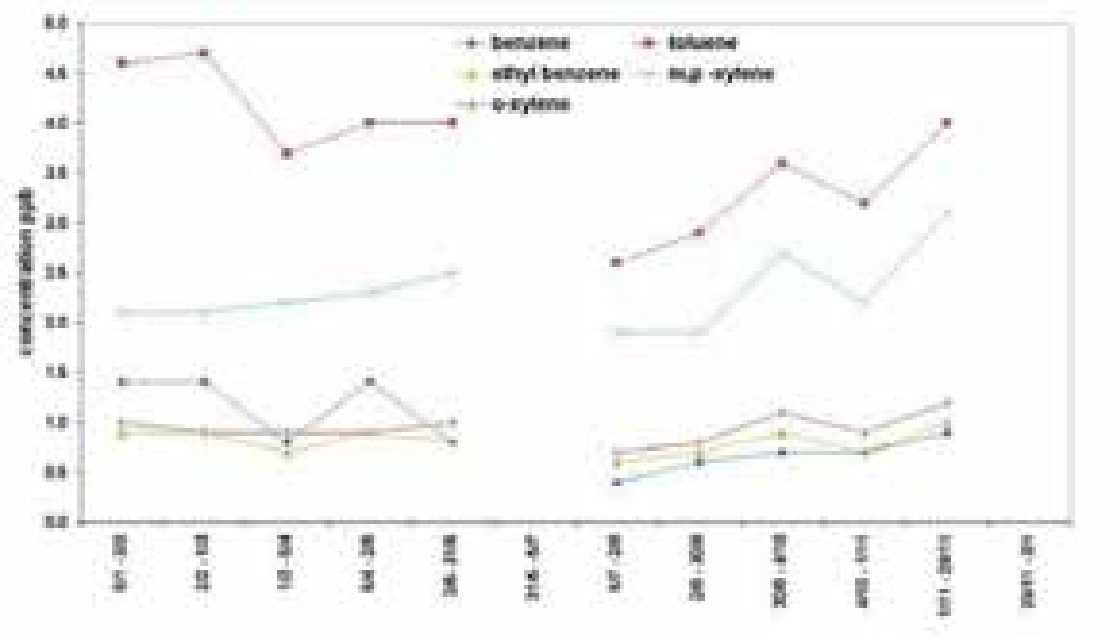


Figure 3.6 Monthly mean hydrocarbon concentrations Le Bas Centre 2000

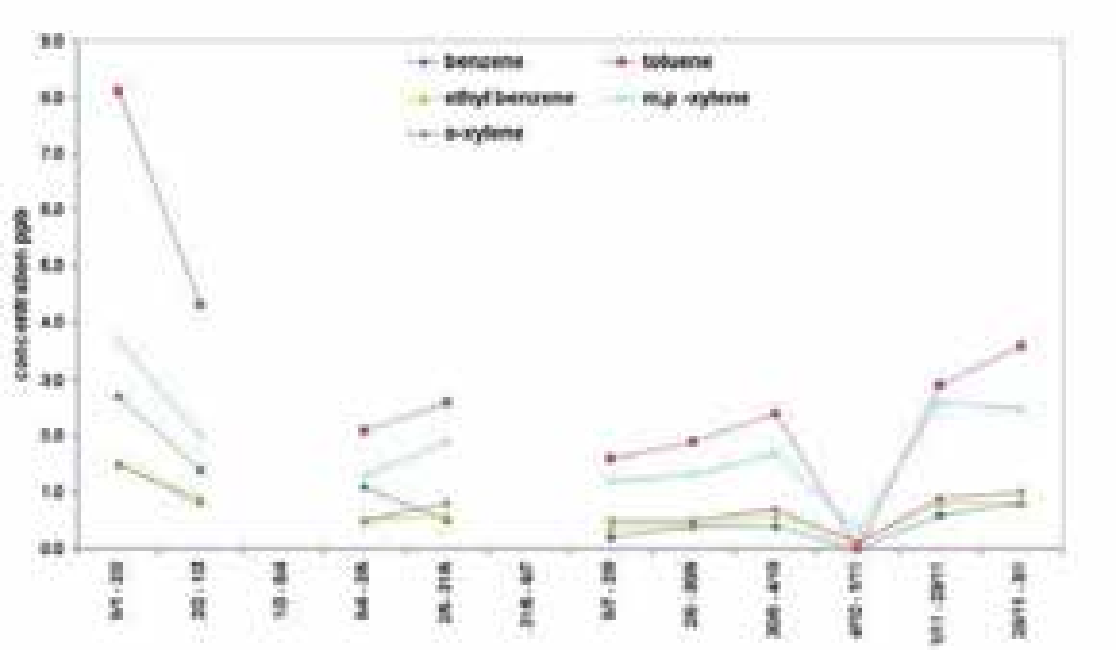


Figure 3.7 Monthly mean hydrocarbon concentrations Springfields Garage 2000

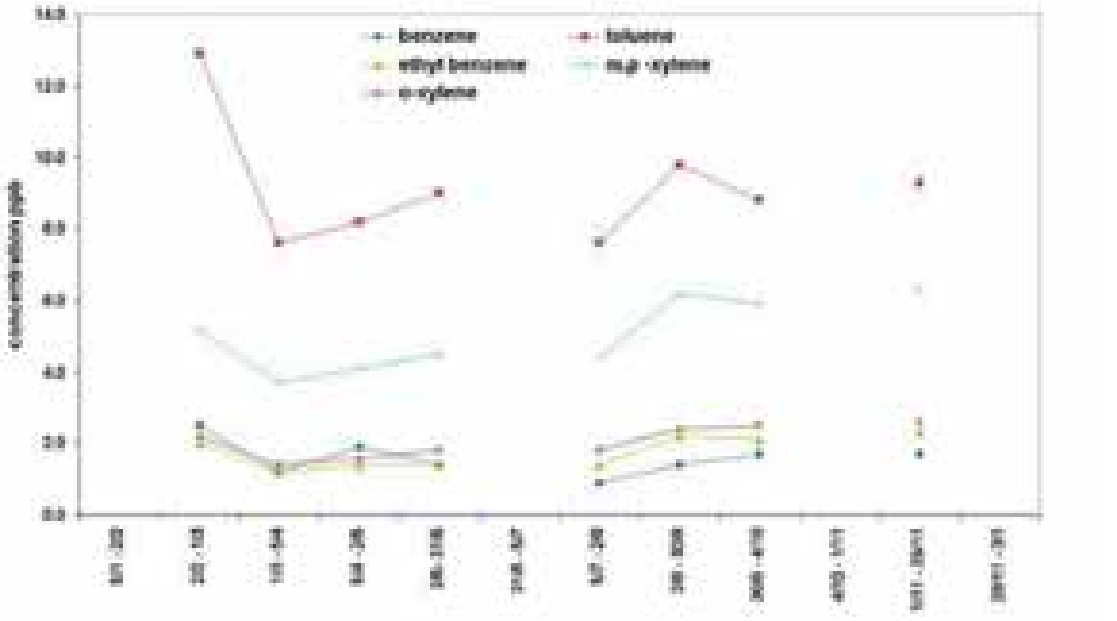


Figure 3.8 Monthly mean hydrocarbon concentrations Elizabeth Lane 2000

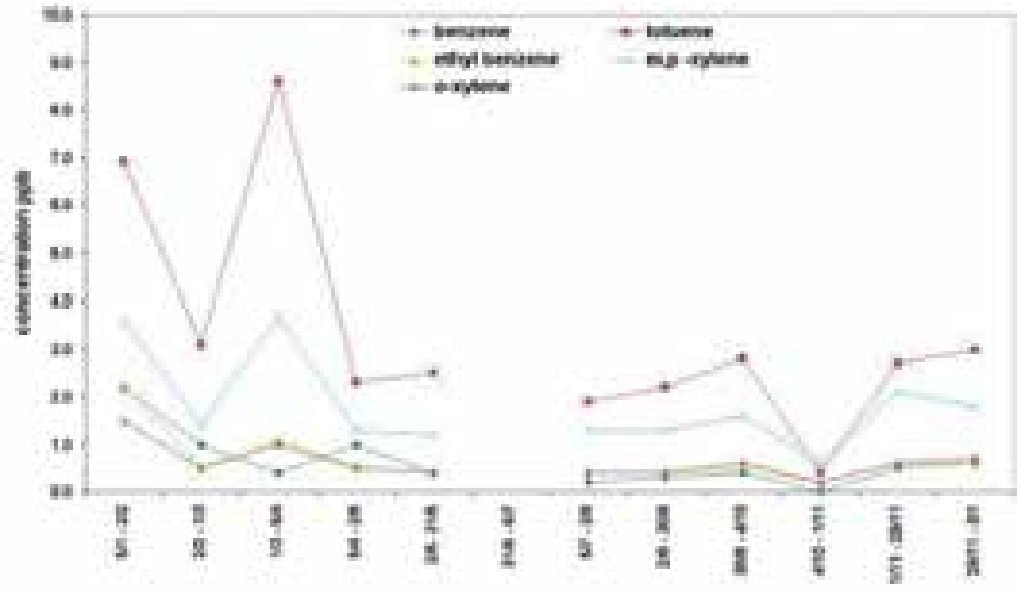


Figure 3.9 Monthly mean hydrocarbon concentrations Stopford Road 2000

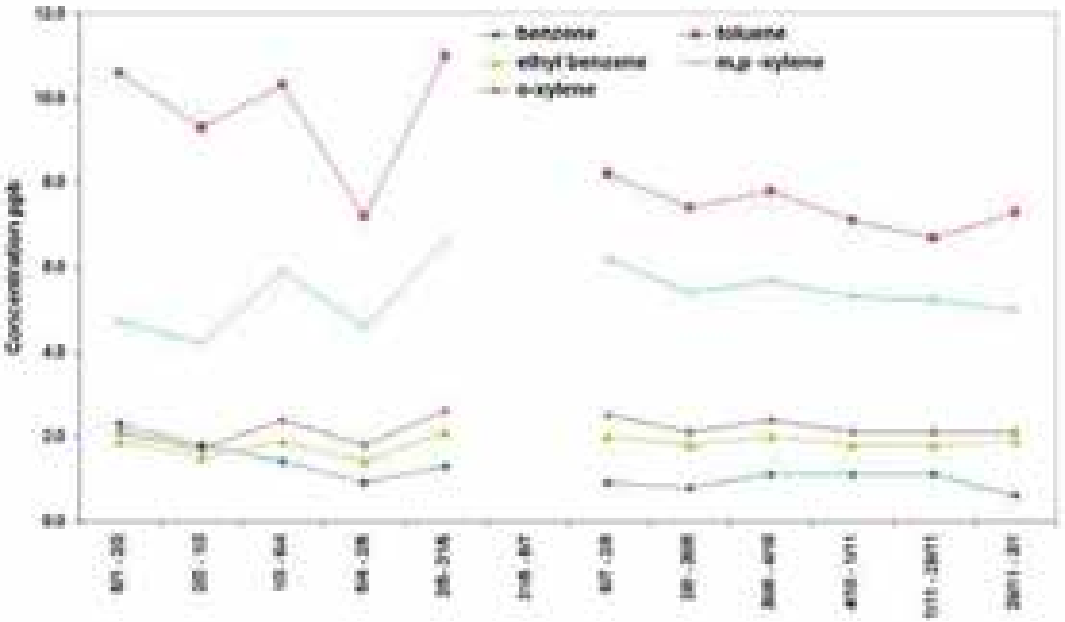
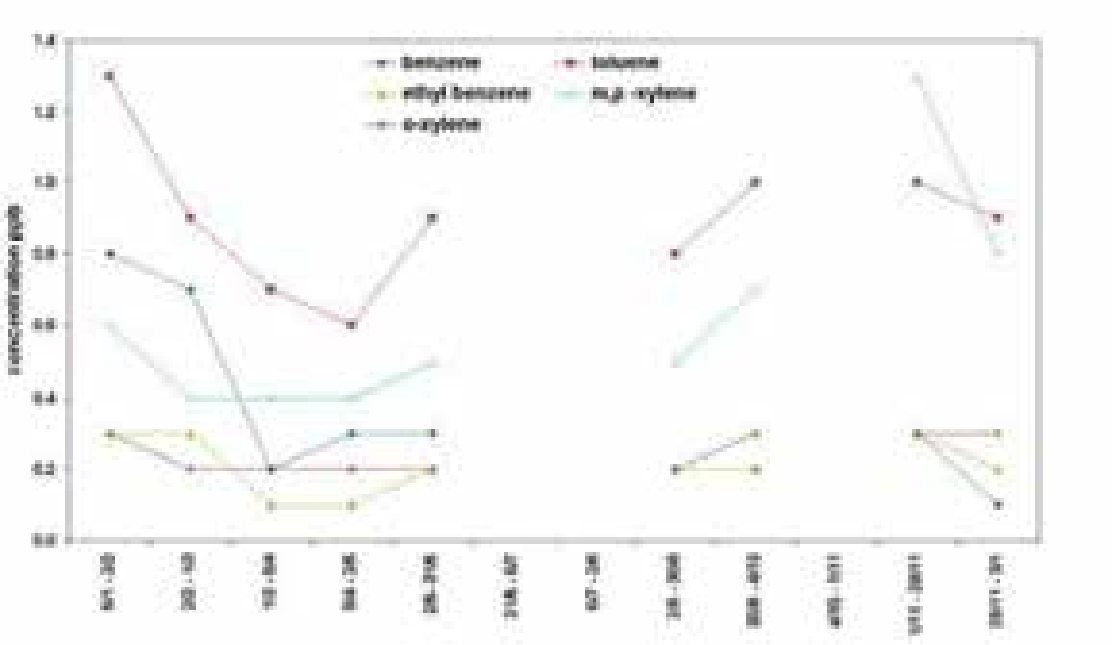


Figure 3.10 Monthly mean hydrocarbon concentrations Clos St Andre 2000



3.3.2 Comparison with Hydrocarbon Standards and Guidelines

Of the range of hydrocarbon species monitored, only benzene is the subject of any applicable air quality standards. The UK Air Quality Strategy sets an objective for the running annual mean of 5ppb, to be achieved by 31 December 2003. The annual mean benzene concentration (which can be considered a good indicator of the running annual mean) did not exceed 5ppb at any of the sites.

The EC Daughter Directive sets a limit value of 5 gm^{-3} (1.5 ppb) to be achieved by 2010. This limit value was slightly exceeded at the Springfield arage site in 2000.The maximum monthly mean benzene concentration recorded was 2.5 ppb at Springfields arage.

3.3.3 Comparison with UK Benzene Data

Table 3.8 compares the benzene data from the 1999 ersey survey with a selection of automatic UK air quality monitoring stations.

The sites used for comparison are as follows:

London UCL - in the grounds of University College London, close to a road.
ristol East - in the grounds of a school, to the east of the city.
Cardiff East - a residential site to the east of the city.
Harwell - a rural site in the south of England, within 10km of a power station.

Table 3.8- Comparison of benzene in Jersey with UK Sites

Site	Annual average benzene, ppb 2000
Diffusion Tubes	
eresford Street	0.9
Le as Centre	0.9
Elizabeth Lane	0.7
Springfields Garage	*1.6*
Stopford Road	*1.2*
Clos St Andre	0.3
UK Automatic Sites - calendar year 2000	
London UCL	0.6
ristol East	0.5
Cardiff East	0.6
Harwell	0.2

esults from the urban and rural background sites on ersey are broadly similar, but slightly higher than, comparable urban and rural background measurements from the UK. This is similar to the findings of the 1999 survey. In the previous report it was noted that diffusion tubes can over-read compared to continuous analysers for a number of reasons, including windy weather.

Springfields arage and Stopford oad are shown in italics, as they are close to petrol stations and therefore not comparable with any of the UK automatic sites. They exhibited annual mean benzene concentrations higher than those measured at UK automatic sites (with the exception of the kerbside site in London s arylebone oad). However, most UK automatic hydrocarbon monitoring stations are deliberately sited well away from petrol stations.

3.3.4 Trends in hydrocarbon concentrations

our monitoring sites (eresford Street, Le as Centre, Elizabeth Lane, Springfields arage have been in operation since 1997. The hydrocarbon concentrations measured in 2000 were consistent with previous years, and in some cases lower. Table 3.9 illustrates the four-year trends for these sites.

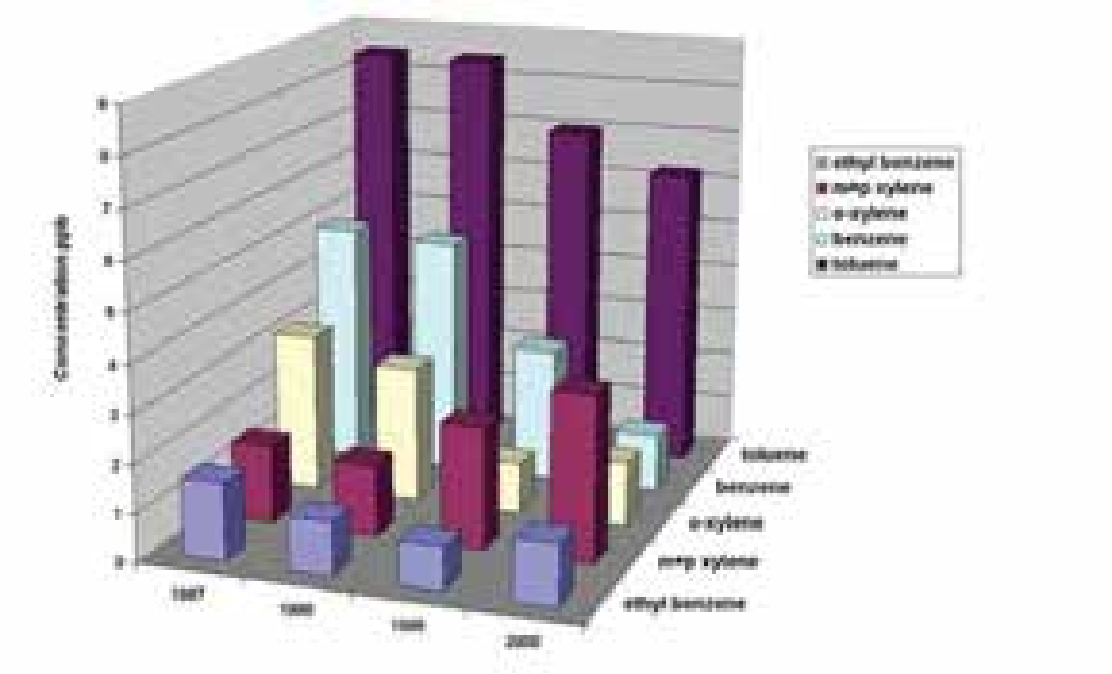
Table 3.9 Comparison of Hydrocarbon Concentrations, Jersey, 1997 - 1999.

	benzene, ppb	toluene, ppb	ethyl benzene, ppb	m p xylene, ppb	o-xylene, ppb
eresford Street					
1997	3.2	5.4	1.2	1.2	2.7
1998	2.5	4.9	0.9	1.0	2.3
1999	1.8	3.6	0.6	1.7	0.8
2000	0.9	3.7	0.8	2.3	0.9
Le as Centre					
1997	2.8	4.5	1.2	1.0	2.2
1998	2.3	4.2	0.7	0.9	1.9
1999	1.1	2.9	0.5	1.3	0.6
2000	0.9	3.3	0.7	1.9	0.7

	benzene, ppb	toluene, ppb	ethyl benzene, ppb	m p xylene, ppb	o-xylene, ppb
Elizabeth Lane					
1997	1.9	4.4	1.4	1.7	2.2
1998	1.9	5.0	0.7	1.6	0.8
1999	1.0	3.3	0.5	1.2	0.6
2000	0.7	3.3	0.7	1.8	0.6
Springfields arage					
1997	7.7	12.5	1.9	1.9	4.3
1998	7.7	12.3	1.5	1.7	4.3
1999	4.5	10.9	1.3	3.8	1.5
2000	1.6	9.2	1.8	5.0	2.0
Stopford oad					
1999	3.3	37.9	4.2	24.9	14.2
2000	1.2	8.4	1.8	5.3	2.2

igure 3.11 show the concentration averaged over all sites for each year. Annual mean concentrations of most hydrocarbon species have remained constant or decreased over the four years of monitoring. In particular, benzene concentrations have decreased by up to 80 over the period. The exception is m p xylene, which has shown an increase over the last two years. Concentrations of toluene and xylene decreased significantly in 2000 at Stopford oad from the levels recorded in 1999. This was because the Stopford road site in 1999 was located indoors to investigate possible leakage of fumes into residential properties. The 2000 site was located outdoors.

Figure 3.11 Trends in hydrocarbon concentrations 1997-2000



3.3.5 Concentration Ratio Analysis

It has been found by the hotochemical Oxidant eview roup (ref. O 1993)[10] that where the main source of organic pollutants is vehicle exhaust, the ratios of the concentrations are as follows:

Toluene: benzene - 2.0

m p xylene: benzene - 1.8.

Where the main source is petrol evaporation, the ratios of the concentrations are different:

Toluene: benzene - 2.4

m p xylene: benzene - 1.6.

Table 3.10 shows ratios of these pollutants for ersey in 2000.

Table 3.10 Ratios of Hydrocarbon Concentrations 2000 data

atios of Hydrocarbons	Toluene:benzene	m p xylene: benzene
eresford Street	4.1	0.62
Le as Centre	3.7	0.58
Elizabeth Lane	4.7	0.55
Springfields arage	5.8	0.54
Stopford oad	7.0	0.63
Clos St Andre	3.0	0.67
Typical for vehicle exhaust	2	1.8
Typical for petrol evaporation	2.4	1.6

The ersey sites do not exhibit the typical ratios expected for either case. The toluene to benzene ratio has generally increased compared to 1999.

4 Conclusions

AEA Technology Environment s National Environmental Technology Centre has undertaken a year-long diffusion tube monitoring study in ersey, on behalf of the States of ersey ublic Health Services.

This was the fourth such study. Diffusion tubes were used to monitor SO_2 at one site, NO_2 at 19 sites and hydrocarbons (benzene, toluene, ethyl benzene and xylene, collectively termed TEX) at six sites. The sites were located at a range of different locations on the island, including some which had been used in previous studies and some new sites.

The study continued from the end of the 1999 study, running from 5 anuary 2000 to 3 anuary 2001. All tubes were exposed for four-week periods.

SO_2 tube results

The results from the SO_2 survey were consistent with previous years data, and were generally low. The annual mean concentration was 2.2 ppb at the Clos St Andre site.

The annual mean SO_2 concentration was comparable with automatic monitoring sites in the UK, and comparable with those measured on ersey during the previous two years.

NO_2 tube results

onitoring began in the latter part of 1999 and the number of sites was increased to 19 in 2000. The annual mean NO_2 concentration at six sites exceeded the 21ppb annual mean standard. It is possible, but not likely, that the hourly mean standard was also exceeded at some sites.

The annual mean NO_2 concentrations were comparable with those made at diffusion tube and automatic monitoring sites in the UK, and comparable with those measured on ersey during the year.

Hydrocarbon tube results

All sites had annual mean benzene concentrations less than the 5 ppb standard of the UK Air Quality Strategy. The annual mean benzene concentration at Springfields arage slightly exceeded the EC Directive limit value of 1.5 ppb.

easured concentrations of toluene and xylene have decreased significantly at the Stopford oad site compared with 1999. This was because the Stopford road site in 1999 was located indoors to investigate possible leakage of fumes into residential properties

ive of the TEX sites (eresford Street, Le as Centre, Elizabeth Lane, Springfields arage and La Collette) were used in the 1997, 1998 and 1999 TEX monitoring programmes. esults for 2000 were consistent with those from previous years. esults from all four years appear to show a decreasing trend in TEX hydrocarbon concentrations, with the exception of m p xylene.

5 Recommendations

1. easurements of NO_2 at Weighbridge suggest that the UK Air Quality Strategy Annual ean Objective (21 ppb) may be exceeded in 2005. It is recommended that the States of ersey undertake a monitoring survey, using automatic analysers, to investigate this further. This survey could also be used to investigate concentrations of carbon monoxide and $_{10}$ dust, which are not possible to measure with diffusive samplers.

2. The diffusion tube surveys present an excellent picture of how average pollution concentrations are distributed around the island, and the trends in these levels from year to year. However, these results are retrospective in many ways, because the results are only obtained **after** any pollution episodes have occurred. The States of ersey should consider funding a permanent continuous monitoring station, the results from which will offer the Island overnment a number of advantages

   Islanders can be provided with rapid information about air quality. Dissemination of this type of information could be helpful to those people who are particularly sensitive to pollution exposure (eg asthma sufferers).

   The data from these analysers can be directly compared with data from EC member states monitoring networks, subject to suitable data quality and control procedures.

   The accuracy of measurements from the diffusion tube networks carry a high uncertainty, and are not completely appropriate for use in determining compliance with Objectives or Directives, nor for determining policy.

1. The States of ersey should give consideration to undertaking a programme of eview and Assessment of air pollution on the island, as implemented by the Department of the Environment, Transport and the egions in the UK. This work would provide a detailed breakdown of what pollution sources exist on the island, and where these are likely to have the greatest impact. This knowledge would allow the Island ovenrment to devise appropriate action plans.

6 Acknowledgements

AEA Technology Environment gratefully acknowledges the help and support of the staff of the States of ersey Environmental Health Services, lanning, Environment and ublic Services, in the completion of this monitoring study.

7 References

1. Air Quality onitoring in ersey Diffusion Tube Surveys 1997. Stacey, report no. AEAT-3071, arch 1998.

2. Air Quality onitoring in ersey Diffusion Tube Surveys 1998. Stacey, report no. AEAT-5271, April 1999.

3. Air Quality onitoring in ersey Diffusion Tube Surveys 1999. Stacey, A Loader - report no. AEAT-EEQ0191, arch 2000.

4. EH40 97. Occupational Exposure Limits 1997. Health Safety Executive. H SO, IS N 0-7176-1315-1.

5. Odour easurement and Control - an update. Editors Woodfield D Hall. AEA Technology report AEA CS E A -038 IS N 0 85624 8258. August 1994.

6. WHO Update and evision of Air Quality uidelines for Europe, ilthoven Netherlands, 11-14 October 1995.

7. Council Directive 1999 30 EEC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. 22 April 1999.

8. Council Directive 2000 69 EC relating to limit values for benzene and carbon monoxide in ambient air 13 December 2000

9. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Department of the Environment, Transport and the egions. anuary 2000, IS N 0 10 145482-1

10. O (1993) Ozone in the United Kingdom 1993, Third eport of the UK hotochemical Oxidants eview roup, IS N 0-7058-1683-4.

11. eview and Assessment: ollutant Specific uidance, LAQ . T 4(00). Department of the Environment, Transport and the egions . ay 2000 IS N 1 85112 387 3

Appendices

CONTENTS

Appendix 1
Air Quality Standards

National and International Ambient Air Quality Guidelines and Standards for NO_2, SO_2, and Benzene

Nitrogen Dioxide

uideline Set y	Description	Criteria ased On	alue ppb (gm^{-3})
UK Government	LOW Air ollution		150 (287)
- Air Pollution Bandings	ODE ATE Air ollution	1-hour mean	150 - 299 (287 - 572)
	HI H Air ollution		300 - 399 (573 - 763)
	HI H Air ollution		400 (764)
- The Air Quality Strategy[1]	Objective for Dec. 31st 2005	1-hour mean	105 (200) not to be exceeded more than 18 times per calendar year
	Objective for Dec. 31st 2005	Annual mean	21 (40)
European Community[2]		Calendar year of data:	
	Limit alue	98 ile of hourly means.	104.6 (200)
	uide alue	98 ile of hourly means.	70.6 (135)
	uide alue	50 ile of hourly means.	26.2 (50)
Daughter Directive[3]	Limit alue	1 hour mean	105 (200) not to be exceeded more than 18 times per calendar year
	Limit alue	Calendar year annual mean	21 (40)
	Limit alue (NO_x)	Calendar year annual mean	16 (30)
World Health Organisation[4] **(Revised Guidelines)**	Health uideline	1-hour mean	110 (200)
	Health uideline	Annual mean	21 (40)
United Nations Economic Commission for Europe	egetation uideline	Annual mean	15 (29)

(1) The Air Quality Strategy.for England, Scotland, Wales and Northern Ireland. anuary 2000. IS N 0-10-145482-1
(2) Council Directive 85 203 EEC
(3) Council Directive 1999 30 EC
(4) Conversions between μg m^{-3} and ppb given by WHO

Sulphur Dioxide

uideline Set y	Description	Criteria ased On	alue ppb (gm^{-3})
UK Government	LOW Air ollution	15-minute mean	100 (266)
- Air Pollution Bandings	ODE ATE Air ollution		100 - 199 (266 - 531)
	HI H Air ollution		200 - 399 (532 - 1063)
	HI H Air ollution		400 (1064)
- The Air Quality Strategy[1]	Objective for Dec. 31st 2005	15-minute mean	100 (266) not to be exceeded more than 35 times per calendar year
	Objective for Dec. 31st 2004	1 hour mean	132 (350) not to be exceeded more than 24 times per calendar year
	Objective for Dec. 31st 2004	24 hours (daily mean)	47 (125) not to be exceeded more than 3 times per calendar year
	Objective for Dec. 31st 2000	Calendar year annual mean	8 (20)
	Objective for Dec. 31st 2000	Winter mean	8 (20)
European Community[5]	Limit alue	ollution ear (median of daily values)	30 (80) if smoke[6] 34 45 (120)if sm. 34
	Limit alue	Winter (median of daily values Oct- ar)	49 (130)if sm. 51 68 (180)if sm. 51
	Limit alue[7]	ollution ear (98 ile of daily values)	94 (250)if sm. 128 131 (350)if sm. 128
	uide alue	ollution ear (mean of daily values)	15 - 23 (40 - 60)
	uide alue	24 Hours (daily mean value)	38 - 56 (100 150)
Daughter Directive[8]	Limit alue	1 hour mean	132 (350) not to be exceeded more than 24 times per calendar year
	Limit alue	24 hours (daily mean)	47 (125) not to be exceeded more than 3 times per calendar year
	Limit alue	Calendar year annual mean	8 (20)
	Limit alue	Winter mean	8 (20)
World Health Organisation[4] (Revised Guidelines)	Health uideline	10-minute mean	175 (500)
	Health uideline	24-hour mean	44 (125)
	Health uideline	Annual ean	17 (50)
United Nations Economic Commission for Europe	egetation uideline	Daily mean	26 (70)
	egetation uideline	Annual mean	7.5 (20)

(5) Council Directive 80 779 EEC
(6) Limits for black smoke are given in 1gm^{-3} for the SI method as used in the UK.
The limits stated in the EC Directive relate to the OECD method, where OECD SI 0.85.
(7) ember states must take all appropriate steps to ensure that three consecutive days do not exceed this limit value.
(8) Council Directive 1999 30 EC

enzene

uideline Set y	Description	Criteria ased On	alue ppb (μg m^{-3})
UK Government - Air Pollution Bandings	-	-	-
- The Air Quality Strategy[1]	Objective for Dec. 31st 2003 Target for Dec. 31st 2005	unning annual mean unning annual mean	5 (16.25) 1 (3.25)
European Community	To be met by 2010	Annual mean	1.5 (5)
World Health Organisation	-	-	-
United Nations Economic Commission for Europe	-	-	-

Appendix 2
Diffusion Tube Data

CONTENTS

Table A1. SO_2 Diffusion Tube Results 1999, Jersey. Concentrations in ppb.

Date On	05 01 00	02 02 00	01 03 00	05 04 00	02 05 00	31 05 00	05 07 00	02 08 00	30 08 00	04 10 00	01 11 00	29 11 00	Aver
Date Off	02 02 00	01 03 00	05 04 00	02 05 00	31 05 00	05 07 00	02 08 00	30 08 00	04 10 00	01 11 00	29 11 00	03 01 01	
02, ppb													
os St Andre	3.5	1.8	1.6	1.3	2.3	2.0	3.0		2.2	1.2	3.2	2.6	2.

Table A2. NO_2 Diffusion Tube Results, Jersey, 2000. Concentrations in ppb.

Date On	05 01 00	02 02 00	01 03 00	05 04 00	02 05 00	31 05 00	05 07 00	02 08 00	30 08 00	04 10 00	01 11 00	29 11 00	Av
Date Off	02 02 00	01 03 00	05 04 00	02 05 00	31 05 00	05 07 00	02 08 00	30 08 00	04 10 00	01 11 00	29 11 00	03 01 01	
02, ppb													
as Centre	19.4	17.9	18.2	16.1	16.0	13.7	13.3	14.9	16.3	17.3	19.1	18.0	1
ont elard	19.1	13.3	16.9	14.2	16.0	11.2	13.5	14.0	13.2	6.5	13.4	14.0	1
s Quennevais	8.4	4.0	5.2	5.5	5.0	3.3	4.5	4.4	3.8	2.4	3.4	5.7	
e Des aisies	6.3	3.5	4.7	3.2	2.9	1.7	3.0	3.1	2.5	2.6	3.6	4.9	
st Tower	23.5	19.9	24.7	21.5	22.0	21.2	16.3	20.6	20.9	20.6	21.8	23.7	2
eighbridge	27.8	29.6	25.8	25.4	30.0	27.7	28.2	28.7	27.2	29.3	31.4	27.6	2
ngley ark	15.7	13.4	11.1	10.4	10.0	7.7	7.9	8.4	8.9	10.2	12.7	15.8	1
orgetown	27.9	21.1	27.5	23.3	23.1	19.8	24.1	20.6	20.8	23.2	23.9	26.7	2
os St.Andre	12.0	7.7	9.1	8.1	7.7	5.5	4.7	6.4	7.3		10.2	12.1	
Avenue et	17.4	13.6	12.7	9.9	9.8	9.4	10.3	9.0	0.1	12.5	14.5	16.1	1
olmen													
obin lace	18.3	12.2	15.8	15.8	14.9	12.1	12.5	9.2	15.8	15.5	18.8	20.3	1
aumont					21.5	24.7	18.8	24.3	21.9	24.3	20.8	24.2	2
e arade					14.1	13.1	13.2	12.9	13.0	9.7	11.3	16.5	1
aufant					4.2	3.4	4.9	4.8	3.9	5.2	5.9	6.2	
he Sandeman					7.1	6.7	6.8	6.2	5.8	9.8	11.2	10.7	
ville Street					17.9	15.0	17.0	16.3	14.8	12.9	16.0	15.7	1
oad Street					24.5	24.6	24.2	22.8	23.1	22.6	24.2	22.6	2
resford Street					19.7	16.7	16.4	16.5	17.6	19.5	20.3	20.0	1
ouquelaye					25.7	19.0	23.0	24.0	23.1	26.1	29.1	27.1	2

Table A3. Hydrocarbon results at Beresford Street, 2000

Exposure period	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
05 1 00 02 2 00	1.4	4.6	0.9	2.1	1
02 2 00 01 3 00	1.4	4.7	0.9	2.1	0.9
01 3 00 05 4 00	0.8	3.7	0.7	2.2	0.9
05 4 00 02 5 00	1.4	4	0.9	2.3	0.9
02 5 00 - 31 5 00	0.8	4	0.8	2.5	1
31 5 00 - 05 7 00					
05 7 00 02 8 00	0.4	2.6	0.6	1.9	0.7
02 8 00 - 30 8 00	0.6	2.9	0.7	1.9	0.8
30 8 00 - 04 10 00	0.7	3.6	0.9	2.7	1.1
04 10 00 - 01 11 00	0.7	3.2	0.7	2.2	0.9
01 11 00 - 29 11 00	0.9	4	1	3.1	1.2
29 11 00 - 03 01 01					
Average ppb	**0.91**	**3.73**	**0.81**	**2.3**	**0.94**

Table A4. Hydrocarbon results at Le Bas Centre, 2000

Exposure period	benzene	toluene	Ethyl benzene	m,p -xylene	o-xylene
05 1 00 02 2 00	2.7	8.1	1.5	3.7	1.5
02 2 00 01 3 00	1.4	4.3	0.9	2.0	0.8
01 3 00 05 4 00					
05 4 00 02 5 00	1.1	2.1	0.5	1.3	0.5
02 5 00 - 31 5 00	0.5	2.6	0.6	1.9	0.8
31 5 00 - 05 7 00					
05 7 00 02 8 00	0.2	1.6	0.4	1.2	0.5
02 8 00 - 30 8 00	0.4	1.9	0.4	1.3	0.5
30 8 00 - 04 10 00	0.4	2.4	0.6	1.7	0.7
04 10 00 - 01 11 00	nd	nd	0.1	0.3	0.1
01 11 00 - 29 11 00	0.6	2.9	0.8	2.6	0.9
29 11 00 - 03 01 01	0.8	3.6	0.8	2.5	1.0
Average ppb	**0.9**	**3.3**	**0.7**	**1.9**	**0.7**

Table A5. Hydrocarbon results at Elizabeth Lane, 2000

Exposure period	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
05 1 00 02 2 00	2.2	6.9	2.2	3.6	1.5
02 2 00 01 3 00	1.0	3.1	0.5	1.4	0.5
01 3 00 05 4 00	0.4	8.6	1.1	3.7	1.0
05 4 00 02 5 00	1.0	2.3	0.5	1.3	0.5
02 5 00 - 31 5 00	0.4	2.5	0.4	1.2	0.4
31 5 00 - 05 7 00					
05 7 00 02 8 00	0.2	1.9	0.4	1.3	0.4
02 8 00 - 30 8 00	0.3	2.2	0.4	1.3	0.4
30 8 00 - 04 10 00	0.4	2.8	0.5	1.6	0.6
04 10 00 - 01 11 00	nd	0.4	0.2	0.6	0.2
01 11 00 - 29 11 00	0.5	2.7	0.6	2.1	0.6
29 11 00 - 03 01 01	0.6	3.0	0.6	1.8	0.7
Average ppb	0.7	3.3	0.7	1.8	0.6

Table A6. Hydrocarbon results at Springfields Garage, 2000

Exposure period	**benzene**	**toluene**	**ethyl benzene**	**m,p -xylene**	**o-xylene**
05 1 00 02 2 00					
02 2 00 01 3 00	2.5	12.9	2.0	5.2	2.2
01 3 00 05 4 00	1.2	7.6	1.2	3.7	1.4
05 4 00 02 5 00	1.9	8.2	1.4	4.1	1.6
02 5 00 - 31 5 00	1.4	9.0	1.4	4.5	1.8
31 5 00 - 05 7 00					
05 7 00 02 8 00	0.9	7.6	1.4	4.4	1.8
02 8 00 - 30 8 00	1.4	9.8	2.2	6.2	2.4
30 8 00 - 04 10 00	1.7	8.8	2.1	5.9	2.5
04 10 00 - 01 11 00					
01 11 00 - 29 11 00	1.7	9.3	2.3	6.3	2.6
29 11 00 - 03 01 01					
Average ppb	**1.6**	**9.2**	**1.8**	**5.0**	**2.0**

Table A7. Hydrocarbon results at Stopford Road, 2000

Exposure period	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
05 1 00 02 2 00	2.3	10.6	1.9	4.7	2.1
02 2 00 01 3 00	1.8	9.3	1.5	4.2	1.7
01 3 00 05 4 00	1.4	10.3	1.9	5.9	2.4
05 4 00 02 5 00	0.9	7.2	1.4	4.6	1.8
02 5 00 - 31 5 00	1.3	11.0	2.1	6.6	2.6
31 5 00 - 05 7 00					
05 7 00 02 8 00	0.9	8.2	2.0	6.2	2.5
02 8 00 - 30 8 00	0.8	7.4	1.8	5.4	2.1
30 8 00 - 04 10 00	1.1	7.8	2.0	5.7	2.4
04 10 00 - 01 11 00	1.1	7.1	1.8	5.3	2.1
01 11 00 - 29 11 00	1.1	6.7	1.8	5.2	2.1
29 11 00 - 03 01 01	0.6	7.3	1.9	5.0	2.1
Average ppb	**1.2**	**8.4**	**1.8**	**5.3**	**2.2**

Table A8. Hydrocarbon results at Clos St Andre, 2000

Exposure period	benzene	toluene	ethyl benzene	m,p -xylene	o-xylene
5 1 00 - 2 2 00	0.8	1.3	0.3	0.6	0.3
2 2 00 - 1 300	0.7	0.9	0.3	0.4	0.2
1 3 00 - 5 4 00	0.2	0.7	0.1	0.4	0.2
5 4 00 - 2 5 00	0.3	0.6	0.1	0.4	0.2
2 5 00- 31 5 00	0.3	0.9	0.2	0.5	0.2
31 5 00- 5 7 00					
5 7 00 - 2 8 00					
2 8 00- 30 8 00	0.2	0.8	0.2	0.5	0.2
30 8 00- 4 10 00	0.2	1.0	0.2	0.7	0.3
4 10 00- 1 11 00					
1 11 00 - 29 11 00	0.3	1.0	0.3	1.3	0.3
29 11 00 - 3 1 01	0.1	0.9	0.2	0.8	0.3
Average ppb	**0.3**	**0.9**	**0.2**	**0.6**	**0.2**

Issue DRAFT

Air Quality Monitoring, St Helier, Jersey, February to March 2000.

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Executive Summary

AEA Technology s National Environmental Technology Centre (NETCEN) has been contracted by the ublic Health Services and the Department of lanning and uilding Services of the States of ersey to undertake a study of air quality. This is a follow on programme of monitoring, which has been compared agai nst a similar study carried out during 1997. The monitoring assessed concentrations of vehicle related pollution at a kerbside site in St Helier. This report presents the data obtained from this monitoring survey.

In order to produce results comparable to the 1997 study the monitoring station was located in the same position as the 1997 study. The location was in Halkett lace, St Helier, next to the Indoor arket goods entrance. The immediate environment around the monitoring station was a narrow canyon street, approximately 10 metres wide with a single lane of traffic travelling south past the site. The sampling height for the analysers was approximately 3 metres, comparable in height to similar monitoring stations in operation in the UK.

The purpose built NETCEN mobile laboratory was used for the survey, and took place from 24th ebruary to 30th arch 2000. The pollutants monitored were nitrogen dioxide and nitric oxide (NO_2 and NO together described as NOx), carbon monoxide (CO), sulphur dioxide (SO_2) and fine particulate matter ($_{10}$). All data from the analysers were stored on datalogging equipment and subsequently retrieved at the end of the survey. Staff from the ublic Health Services of the States of ersey visited the site on a daily basis to ensure the continued satisfactory operation of the analysers.

In general, vehicle related pollutant concentrations (NOx, CO and $_{10}$) were found to be directly related to traffic density highest during rush hour periods and lowest during the night. Concentrations of SO_2, which is not emitted from vehicles in large quantities, were found to be very low.

Average pollutant concentrations during the monitoring period in Halkett lace were: NO 26ppb (parts per billion), NO_2 21ppb, CO 1.6ppm (parts per million), SO_2 5ppb and $_{10}$ 27 g m^3 (microgrammes per cubic metre). These results were found to be broadly comparable or slightly lower than those recorded during the 1997 survey.

The data from the St Helier kerbside site have also been compared to data from a number of representative sites in the UK Automatic Urban onitoring Network, and to current UK and EC air quality standards and guidelines. enerally, these results are comparable to roadside sites and urban background sites in London, but higher than rural and suburban sites.

Contents

1 Introduction

AEA Technology's National Environmental Technology Centre (NETCEN) has been contracted by Public Health Services and the Department of Planning and Building Services of the States of Jersey to undertake an extensive study of air quality in Jersey during 2000. Two monitoring surveys are being conducted;

- An ongoing study of nitrogen dioxide, sulphur dioxide and hydrocarbon concentrations using diffusion tube samplers and
- A month long period of measurements of vehicle related pollution at a kerbside site in St Helier.

This report presents the results of the kerbside monitoring, which took place from 24th February to 30th March 2000. This survey repeats the monitoring undertaken in Halkett Place in winter 1997. The monitoring was undertaken to investigate if changes to the traffic flow in the town, coupled with improvements in fuel technology and cleaner cars, has had any appreciable effect on air pollution levels. As with the previous study, this monitoring period was chosen for measuring kerbside concentrations, rather than the busier summer periods, because vehicle related pollution episodes are more likely to occur in the winter, during foggy or cold, calm weather. Summer pollution episodes can be dispersed more effectively by more favourable weather conditions.

Pollutants monitored were nitrogen dioxide and nitric oxide (NO_2 and NO together described as NOx), carbon monoxide (CO), sulphur dioxide (SO_2) and fine particulate matter (PM_{10}). All data from the analysers were stored on data-logging equipment and subsequently retrieved at the end of the survey. Staff from the Public Health Services of the States of Jersey visited the site on a daily basis to ensure the continued reliable operation of the equiment.

Data from the survey have been ratified in accordance with the quality assurance and control procedures used in the UK Department of the Environment, Transport and the Regions Automatic Urban Monitoring Network, and are directly comparable in quality to those data. This report presents the results obtained from this survey and compares the results with a selection of UK monitoring stations and relevant air quality monitoring standards and guidelines.

2 Site Location, Pollutants Monitored and Methodologies

2.1 SITE LOCATION

The monitoring station was located in Halkett Place, St Helier, next to the Indoor Market goods entrance. This road was chosen as it is a busy thoroughfare and an area where

pedestrians spend a significant amount of time. For two weeks of the monitoring period, the traffic flow past the monitoring site was assessed, and found to be in the region of -7000 vehicles per day. During peak times, queues of traffic may well build up past the site. It is expected that monitoring data at this location should represent the worst levels of pollution a pedestrian would encounter in the town.

The immediate environment around the monitoring station was a narrow canyon street, approximately 10 metres wide with a single lane of traffic travelling south past the site. The sampling height for the analysers was approximately 3 metres, comparable in height to similar monitoring stations in operation in the UK. The location of the monitoring station is presented in figure 1.

2.2 POLLUTANTS MONITORED

2.2.1 Nitric Oxide and Nitrogen Dioxide, NO and NO_2

Oxides of Nitrogen, of which NO and NO_2 are the ma or components, are products of combustion. NO (and small quantities of NO_2) is formed during the burning of fossil fuels in motor vehicles, domestic heating, power generation and a wide number of other processes. NO_2 is mainly formed by subsequent reactions of NO with other compounds in the atmosphere.

Nitrogen dioxide is a respiratory irritant, and is toxic at high concentrations. It is also a ma or precursor in the formation of acid rain and photochemical smog. Nitric oxide is not thought to be harmful to human health at ambient concentrations, and no standards or guidelines have been set for this pollutant.

A UK government Air uality Strategy Ob ective and a European Community Directive regulates concentrations of NO_2 in the UK. The UK Department of the Environment, Transport and the Regions (DETR) has defined air quality bands, which are used to describe air quality to the general public. A detailed breakdown of the guidelines and Directive are presented in Appendix 1.

2.2.2 Carbon Monoxide, CO

Carbon monoxide is formed during the inefficient burning of fuels, most notably from vehicles or poorly functioning domestic heating.

CO has a strong affinity for haemoglobin, the oxygen carrying substance in blood. Prolonged exposure to high concentrations of CO is fatal; while reduced levels of exposure can cause a number of other oxygen starvation-related health ailments.

A UK government Air uality Strategy Ob ective regulates concentrations of CO in the UK. The DETR has defined air quality bands, which are used to describe air quality to the general public. These guidelines are presented in Appendix 1.

2.2.3 Sulphur Dioxide, SO_2

Sulphur dioxide is formed during the combustion of fossil fuels, which have a high sulphur content, e.g. wood, coal and certain mineral oils including diesel. In recent years, emissions of SO_2 have decreased in the UK with the establishment of smokeless ones and the use of cleaner fuels, to the extent that the most likely ma or sources of SO_2 on the island will be industrial processes such as power generation and incineration.

SO_2 is a respiratory irritant, which is toxic at high concentrations. It is also a ma or precursor in the formation of acid rain.

A UK government Air uality Strategy Ob ective and a European Community Directive regulates concentrations of SO_2 in the UK. The DETR has defined air quality bands, which are used to describe air quality to the general public. A detailed breakdown of the guidelines and Directive are presented in Appendix 1.

2.2.4 Particulate Matter, PM_{10}

Particulates in the atmosphere originate from a wide variety of sources. They take the form of dust; smoke of very small liquid or solid particles called aerosols. Particles may be either emitted directly into the atmosphere or formed subsequently by chemical reactions. PM_{10} particles are defined as having an average particle si e of 10 microns in diameter (10 millionths of a metre), and have well documented respiratory effects on human health. There is a wide range of human activities that produce particulate emissions, including; motor vehicles (mainly diesel), solid fuel burning, industrial processes, power stations, incinerators and construction activity.

A UK government Air uality Strategy Ob ective and a European Community Directive regulates concentrations of PM_{10} in the UK. The DETR has defined air quality bands, which are used to describe air quality to the general public. A detailed breakdown of the guidelines and Directive are presented in Appendix 1.

2.3 METHODOLOGIES

The monitoring survey was carried out using Advanced Pollution Instruments (API) NOx and SO_2 instruments, a Monitor abs analyser was used for the measurements of CO, and PM_{10} was measured with an R P TEOM particulate analyser. These analysers are typical of those used within the UK Automatic Urban Network. All the instruments output a voltage, which can be directly related to concentrations of the pollutant in the atmosphere.

Output voltages from the analysers were scanned every 10 seconds by a datalogger, which used these values to calculate and store 1 -minute averages. The data was retrieved at the end of the survey. It was not possible to establish a telemetry link to the site, because the system used by NETCEN utilised an analogue mobile telephone. As the service for this network was disconnected on the island in 1999, it was not posssible to obtain a signal on the phone. As a result, staff from the Public Health Services of the States of Jersey visited the site on a daily basis to ensure that the analysers were functioning correctly, and reported any faults back to NETCEN for action.

The NOx, CO and SO_2 instruments were calibrated at the beginning and end of the monitoring period. Chemical scrubbers were used to provide a clean air sample, and standard gas cylinders to provide span gas. Data from the instruments were scaled according to the instrument responses from these two point calibrations. The cylinders used were calibrated at the NETCEN as Standards Calibration aboratory (SC). NETCEN's SC holds UKAS accreditation (ab. no. 0401) for the calibration of NO, NO_2, SO_2 and CO gas mixtures, and for the calibration of NOx, SO_2 and CO air pollution analysers on site. Using these cylinders and procedures to calibrate the analysers in Jersey ensures that the survey data are traceable to national metrology standards.

Data from the study are accurate to within for CO, 10 for SO_2, and 11 for NOx. hile it is not possible to reliably determine the accuracy of the particulate analyser, the precision of the instrument is within 4 g m^3.

3 Air Quality Standards and Guidelines

In January 2000, the UK overnment published a new Air uality Strategy containing air quality ob ectives for four of the five pollutants measured in Halkett Place (NO_2, CO, SO_2 and PM_{10}). The ob ectives are based on the first EC Daughter Directive and or the recommendations made by the Expert Panel on Air uality Standards (EPA S). The ob ectives provide policy targets by outlining what the overnment considers current measures should deliver.

In the UK, EC Directives also regulate concentrations of PM_{10}, NO_2 and SO_2. The Directives set limit values, which are mandatory, and guide values, which are intended to provide increased protection to human health and the environment. The Directives require monitoring to be conducted over a whole year; limit and guide values are based on a full year of measurements. Because pollution levels vary dramatically throughout the year, it is not wholly appropriate to compare data from this program against Directives. However, for information, the limit and guide values of the Directives are summarised in Appendix 1.

The UK DETR also uses air quality bands for a number of pollutants, to describe air pollution levels (O , MODERATE, HI H or ER HI H), on daily bulletins to the general public. These bands are summarised in Appendix 1.

4 Results and Discussion

4.1 PRESENTATION OF THE RESULTS

Table 1 presents a range of statistics for the pollutants measured at Halkett Place for the period 24th February to 30th March 2000. Hourly average time series graphs of these data are shown in figure 2.

For information, the units of measurement used in the report are;

NO	ppb, parts per billion (10^9)
NO_2	ppb, parts per billion
SO_2	ppb, parts per billion
CO	ppm, parts per million
PM_{10}	g m^3, microgrammes per cubic metre

The location of the monitoring site in Halkett Place was chosen to represent the worst case scenario for any vehicle related pollution levels likely to occur on the island. Halkett Place is a narrow canyon street; because of this any pollution caused by passing vehicles is unlikely to disperse quickly,when compared to a larger road in an open environment. For areas on the island where the roads are more open or have fewer cars, air quality should be much better than at Halkett Place.

An automatic traffic count was carried out by Public Services Department during the monitoring period, to assess the flow of vehicles along Halkett Place. The results are presented in Appendix 2. The traffic count showed that average of 900 vehicles per weekday travel past the monitoring station with a daily average, over the sampling period, of around 00 vehicles per day.

Table 1 Basic Statistics of the Air uality Data for Halkett Place, 24th February to 30th March 2000

	NO ppb	NO_2 ppb	NOx ppb	CO ppm	SO_2 ppb	PM_{10} g m^3
Arithmetic mean	2	21	47	1.		27
Max. 1-hour avg.	73	4	9	.	49	139
Max. -hour avg.		33	1	4.4	29	9
Max 24-hour avg.	39	30	3	3.0	14	3
Data capture		4	4	94	94	9

During the monitoring programme, a number of significant data losses occurred. The ma or data gaps are summarised below

Nine days of NOx data were re ected as a result of instrument failure. The analyser fro e during normal operation on 29th February, and ceased to measure ambient pollution. It was not immediately obvious that the analyser was malfunctioning, which is why so much data had to be re ected during ratification. The instument was reset during a routine check by Public Health Services Staff on the 9th March.

Three days of PM_{10} data were lost as a result of a power failure. The analyser main fuse blew on 14th March at the same time as the power interruption. The power cut was detected at the routine check of the site on the 1 th, and the power was restored, but, because of the non-standard nature of the fuse assembly, it could not be replaced by Public Health Services staff. The fuse was replaced by NETCEN on the 17th March.

In the following discussion, the data will be compared with air quality measurements at DETR national air quality monitoring network stations in the south of England. The variation of pollution levels compared to the 1997 results will also be discussed, and the measurements will be compared with current UK and EC air quality standards guidelines. Finally a number of periods of relatively elevated concentrations in Halkett Place will be reviewed.

Table 2 comparison of data obtained from the 1997 study

	NO ppb		NO_2 ppb		NOx ppb	
	1997	2000	1997	2000	1997	2000
Arithmetic mean	40	2	2	21		47
Max. 1-hour avg.	317	73	113	4	3	9
Max. -hour avg.	1		7	33	22	1
Max 24-hour avg.	119	39		30	1 0	3

	CO ppm		SO_2 ppb		PM_{10} g m^3	
	1997	2000	1997	2000	1997	2000
Arithmetic mean	1.4	1.			27	27
Max. 1-hour avg.	11.	.	107	49	297	139
Max. -hour avg.	.	4.4	2	29	1 1	9
Max 24-hour avg.	3.	3.0	34	14	94	3

Comparison of the 1997 data with the 2000 data reveals that for all pollutants, maximum concentrations in 2000 were much lower than those recorded three years earlier. For CO, SO_2 and PM_{10}, mean concentrations were very similar to the earlier study, while NOx averages were all lower in 2000.

These results, especially the maximum data, suggest that pollution levels were generally well suppressed, with very few classical episodes during the survey period. ith the exception of

NOx, the fact that average levels have remained relatively constant suggests that conditions within Halkett Place have remained quite similar in the three years since the original survey.

eather patterns for the month generally encouraged good dispersion; either a series of low pressure systems moving through Northern Europe, bringing windy conditions to the island, or high pressure systems moving in from the South- est, bringing in relatively clean air. These weather patterns were markedly different to the 1997 survey, when conditions were generally calm and cold for a significant proportion of the monitoring study. As a result, it is difficult to reliably assess any differences in the two datasets, particularly the reduced maximum concentrations in 2000. In order to try to put the results into perspective, it will be necessary to compare the Jersey data with other sites in the UK.

4.2 COMPARISION W ITH UK MONITORING STATIONS

Tables 3 and 4 show how data measured in Halkett Place compare with measurements made at UK national air quality monitoring stations for the corresponding period. A series of stacked timeseries plots, showing data from Halkett Place in relation to these sites, is presented in figures 3 to .

The locations and site descriptions of the national sites used are given below

ough Navar	IH0 4	A remote site in a clearing within a forestry plantation (used for rural PM_{10} data)
ullington Heath	T 3 01	A rural site, on a high plateau km from the south coast. Immediate area is a NCC heathland.
ondon A3 bypass is and is	T 193 3	Ad acent to the A3 Kingston Bypass (-lane carriageway). Traffic flow along the approximately 112,000 vehicles per day generally fast and free flowing with little congestion.
eamington Spa	SP319 7	An urban background site, located in a quiet cul-de-sac close to the town centre
Bristol Centre	ST 94732	Pedestrianised walkway (ower Castle St), 43m from a busy road (used for PM_{10} data in S England).
Exeter Roadside	S 92991	ocated 3m from the kerb of ueen St. A canyon street, close to a road unction. Traffic flow approx. 10,000 vehicles day.
ondon Brent	T 200 40	An urban background site in the grounds of a school in North ondon.

A breakdown of site classifications is provided in Appendix 2.

Table 3.Comparision of Jersey data with national monitoring sites, January-February 1997 and March 2000

Site	Parameter	NO_2 ppb		CO ppm		SO_2 ppb		PM_{10} g m^3	
		1997	2000	1997	2000	1997	2000	1997	2000
Jersey kerbside	Mean	2	21	1.4	1.			27	27
	Max	113	4	11.	.	107	49	297	139
ondon Sutton	Mean	2	-	1.	-		-	27	-
	Max	133	-	12.3	-		-	11	-
ondon A3	Mean	-	31	-	0.7	-	-	-	24
	Max	-	10	-	3.2	-	-	-	12
Bristol Centre	Mean	-	-	-	-	-	-	2	23
	Max	-	-	-	-	-	-	147	1
Exeter	Mean	22	22	1.	1.1	3	2	-	-
	Max	1		24.	4.4	1	20	-	-
Brent	Mean	24	1	0.9	0.3		2	2	22
	Max	99	7	11.7	2.7	177	21	101	131
eamington Spa	Mean	2	1	0.4	0.4	3	2	21	20
	Max	94	4	12.	1.9	4	17	1	1 3
ough Navar	Mean	-	-	-	-	-	-	9	10
	Max	-	-	-	-	-	-	4	117
ullington Heath	Mean	9	9	-	-	2	1	-	-
	Max	2		-	-	22	21	-	-

Table 4 ratio of average concentrations

Sites	NO_2	CO	SO_2	PM_{10}
Jersey Kerbside ondon A3	0. 1	2.29 1	-	1.13 1
Jersey Kerbside Exeter (Bristol PM_{10})	0.9 1	1.4 1	2. 1	1.17 1
Jersey Kerbside Brent	1.17 1	.33 1	2. 1	1.23 1
Jersey Kerbside eamington Spa	1.31 1	4.00 1	2. 1	1.3 1
Jersey Kerbside ullington Heath (N PM $_{10}$)	2.33 1	-	1	2.7 1

Table NO to NO_2 ratios

Site	Ratio
Jersey	1.23 1
ondon A3	2.1 1
Exeter	1. 1
Brent	0.7 1
eamington Spa	0.3 1
ullington Heath	0.13 1

From these data, the following general observations can be made

1. SO_2 concentrations in Jersey, while still very low, were higher than at the UK sites used for the comparison. Peak concentrations at all sites except Exeter were much lower in 2000 than the corresponding 1997 datasets.
2. PM_{10} concentrations in Jersey were also higher than the comparison sites, but were broadly similar to those found in ondon and Bristol. Peak concentrations in 2000 were higher than in 1997, for all sites except Jersey.
3. CO concentrations in Jersey were relatively low, but still higher than the comparison sites. The data was closest in values to the canyon roadside site in Exeter. Peak concentrations at all sites were lower in 2000.
4. NO_2 concentrations were lower in Jersey than at the two roadside sites, but higher than the other comparison sites. Peak concentrations were lower in 2000 at all sites except ullington Heath.

. enerally, average concentrations of NOx, CO and SO_2 at all sites were found to be lower in 2000 than in 1997. Average PM_{10} concentrations at many sites were found to be slightly lower in 2000, but peak concentrations of this pollutant were generally higher in contrast with the observations found at Halkett Place.

. Average concentrations of PM $_{10}$, CO and SO_2 in Jersey were higher than any of the other sites used for the comparison. Average concentrations of NO_2 in Jersey were lower than two of the five comparison sites.

Most of these observations can be explained in terms of the differences between the environments the measurements were made in.

As has been well documented before, Halkett Place is a narrow canyon street, and as such, any pollution generated in the street is likely to disperse poorly. In contrast, the roadside site

in ondon is much more open, allowing pollutants to disperse more easily. To confirm this, the ondon A3 site, despite having traffic flows 20 times higher than Halkett Place, has an average NO_2 concentration ust 0 higher than the Jersey site, while average CO concentrations in ondon were actually lower than at Halkett Place. It would appear that, based on the results presented above, emissions of CO have not changed significantly since the 1997 survey.

Particulate concentrations at Halkett Place were found to be similar to those found at the 1997 survey, while the averages at the comparison sites had all dropped slightly since 1997. This observation may arise for a number of reasons

1. Additional nearby sources (eg domestic fuel burning, docks, power station)
2. Differences in fuel composition (eg ultra low sulphur fuels)
3. Higher average vehicle speeds on the mainland (as vehicles are less efficient at low speeds)
4. Possibility of a higher proportion of poorly maintained vehicles on the island (as there are no formal annual MoT-type tests undertaken).

Average and peak SO_2 concentrations on the island continue to be slightly higher than on the mainland. As found in 1997, there were a number of periods during the survey when SO_2 levels became quite elevated, while other pollutants (excepting occasional PM_{10} correlation) remained largely unaffected. This result suggests that there may be a number of sources of SO_2 on the island which are influencing measurements. From the evidence collected to date, the impact of these sources does not appear to have changed significantly since the initial survey in 1997.

In summary, it would appear that typical air pollution levels in Halkett Place are broadly what could be expected at a roadside location in the UK. It appears that while concentrations of CO, SO_2 and PM_{10} were relatively low throughout the monitoring period, they were noticably higher than the UK comparison site. This could have been due to differences in meteorology, but without an extensive, long term comparison, it will not be possible to confirm this.

4.3 COMPARISON WITH STANDARDS AND GUIDELINES

In January 2000, the UK overnment published a new Air uality Strategy containing air quality ob ectives for four of the five pollutants measured in Halkett Place (NO_2, CO, SO_2 and PM_{10}). The ob ectives are based on the first EC Daughter Directive and or the recommendations made by EPA S. The ob ectives provide policy targets by outlining what the overnment considers current measures should deliver.

In the UK, EC directives regulate ambient air quality concentrations for particulate matter, nitrogen dioxide and sulphur dioxide. In addition the DETR has defined air quality standards for PM_{10}, NO_2, SO_2 and CO. NO is not thought to be harmful to health at concentrations experienced in the ambient environment and therefore there are no air quality standards or guidelines for this pollutant.

As the States of Jersey are not part of the EC, and are not governed under UK mainland law, the air quality standards and guidelines are not legally enforceable at present. However a comparison with the current guidelines provides a useful indication of the air quality on the

island, providing a useful input into future air quality and traffic management strategies. A summary of these various standards and guidelines is provided in Appendix 1.

During the monitoring period the hourly mean standard for NO_2 was not exceeded, although the average value of 21ppb is the same as both the DETR and EC standard value. Both the UK Strategy and EC Directives require monitoring to be undertaken over a full calendar year to reliably determine compliance. However, on the basis of these results it is unlikely that any of the limit values would be exceeded at this site. According to the DETR air quality bandings the NO_2 levels for the entire monitoring period were in the 0 band.

The SO_2 UK strategy and EC Directive limit and guide values were not exceeded at this site although, as with NO_2, a full year of monitoring is required to determine compliance. It is unlikely that any of the SO_2 standards or guidelines would be breached at this site.

For CO, the UK strategy concentration was not exceeded during the monitoring period.

The UK 24-hour running average information standard for PM_{10} was exceeded on 17 occasions during the monitoring period. The standard is widely exceeded at national monitoring sites in the UK; for example during the monitoring period the guideline was exceeded 14 times at ondon Brent and 17 times at Bristol Centre. This standard is used for forecasting and bulletins to the general public.

The UK and EC fixed 24-hour standard for PM_{10} was exceeded on 2 occasions over the monitoring period. In order for compliance to be achieved, the standard cannot be exceeded more than 3 times per year. This standard is based on gravimetric collection methods, which the TEOM analyser can underestimate by up to 30 , depending upon the enviroment being monitored. The result quoted above uses rescaled TEOM data from Jersey, to estimate the number of exceedences of this standard. As with the running 24 hour standard, it is regularly exceeded in the UK. For the same period, it was exceeded once in Bristol, twice in Brent and times at A3 Roadside. A full year of monitoring is required to ensure compliance with this standard.

4.4 PERIODS OF ELEVATED POLLUTANT CONCENTRATIONS

4.4.1 Sunday 27th February 2000

The highest concentrations of SO_2 (49ppb) were noticed during this period. inds throughout the day were generally brisk (10 knots in the morning, reaching 30 knots by the end of the day) and south to south westerly, suggesting that the source may hae been in the region of the harbour power station.

4.4.2 Friday 3rd March 2000

An interesting period of elevated PM_{10} concentrations was in the early hours of Friday March 3rd. The peak hourly averaged PM_{10} concentration was recorded at hour beginning 0700 MT at 11 g m^3 whilst levels of other pollutants remained at background levels. Initial

investigations suggested that the dust could be linked with the eruption of the Icelandic volcano Hekla the previous weekend, but subsequent modelling has also indicated that the source could have been Saharan dust storms.

4.4.3 Saturday 4th March 2000

During the evening, elevated concentrations of SO_2 (2 ppb), CO (ppm) and PM_{10} (139 g m^3) were noted. inds were generally light (-10 knots), northerly in origin. It is not clear why this elevated period occurred; there is no traffic data available for this period, and winds were from a direction not usually associated with elevated pollution levels. It is possible that these elevated levels arise as a result of local activities (heating, vehicles etc.), but it is worth noting that a number of the UK monitoring locations showed similar trends in the NO_2 and CO data. It is therefore possible that these data are part of a more widespread episode.

5 Conclusions

1. AEA Technology's National Environmental Technology Centre has undertaken a short study of air pollution levels at the kerbside in Halkett Place, St. Helier, as part of a wider programme of monitoring on the island. Monitoring took place between 24th February and 30th March 2000. Concentrations of NOx, CO, SO_2 and PM_{10} particles, were measured using continuous automatic analysers, located in a mobile laboratory.

2. The location used in Halkett Place was the same as that used for an earlier study in 1997, and is likely to represent the worst case environment for exposure to traffic related air pollution. Approximately -7000 vehicles use this road every day, and because of the canyon-type environment, any pollutants emitted by vehicles are likely to be slow to disperse.

3. Concentrations of vehicle related pollutants (NOx, CO and PM_{10}) were found to be similar to comparable sites of the UK mainland, while levels of SO_2 on the island were found to be somewhat higher. Average concentrations for the survey were NO_2 - 21 ppb, CO - 1. ppm, SO_2 - ppb, PM_{10} - 27 μg m^{-3}. Concentrations of CO, SO_2 and PM_{10} were found to be similar to those found at the site in 1997, while NO_2 levels in 2000 were approximately 20 lower than in 1997. These trends are broadly reflected in the UK mainland data, where peak and average concentrations for most pollutants were also lower in 2000. Average concentrations of CO, SO_2 and PM_{10} at Halkett Place were higher than any of the comparison sites, while levels of NO_2 at the UK roadside were higher than at Halkett Place.

4. The surveys undertaken in 1997 and 2000 show how differences in weather conditions at the time of monitoring have a marked effect on measured air pollution levels. eather during the 2000 survey generally allowed good dispersion of pollutants, contrasting with the calmer, colder, foggy conditions that were experienced more often during the 1997 survey. In order to get a complete picture of air pollution levels on the island, a long term programme of continuous monitoring should be considered.

. Comparison of the data against air pollution standards showed that concentrations of CO and SO_2 were below recommended maximum levels. Concentrations of PM_{10} were higher than the standard on 2 occasions, out of a permissible 3 for a year. Average NO_2 concentrations for the survey were the same as the annual average standard level.

. In order to determine full compliance with these standards, and to obtain a fuller picture of air pollution levels on the island, a longer term continuous monitoring programme should be considered, and integrated with the existing diffusion tube surveys.

Appendices

CONTENTS

Appendix 1
Air Quality Standards and Guidelines

CONTENTS

Appendix 2
Site Classifications

CONTENTS

Air Quality Monitoring in Jersey; Diffusion Tube Surveys, 2001

March 2002

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March 2002

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Executive Summary

AEA Technology Environment has undertaken a programme of air quality monitoring on Jersey, on behalf of the Public Health Services and Planning and Environment Department of the States of Jersey. This report presents the results of the fifth consecutive year of monitoring, the period 3rd January 2001 to 3rd January 2002.

Diffusion tube samplers were used to monitor nitrogen dioxide (NO_2) at nineteen sites, sulphur dioxide (SO_2) at one site, and hydrocarbons at six sites. Monitoring sites were selected to include areas likely to be affected by specific emission sources (such as petrol stations or the waste incinerator), as well as general background locations.

SO_2, NO_2 and hydrocarbon diffusion tubes were exposed for periods of 4 or 5 whole weeks, corresponding to the monthly exposure periods used in the UK NO_2 Network. The tubes were supplied and analysed by Harwell Scientifics Ltd, and changed by Technical Officers of Jersey's Environmental Health Section.

Annual mean NO_2 concentrations at four roadside sites in built-up areas exceeded the value of 21ppb, set as a Limit Value by Directive 1999/30/EEC (to be achieved by 2010), and as a standard by the UK Air Quality Strategy, to be achieved by 31 December 2005. The highest annual mean of 26ppb was measured at the Weighbridge site at a bus station. Annual mean concentrations at urban and residential background sites were mostly well below 21ppb.

SO_2 was measured at a single monitoring site, at Clos St Andre (near the Bellozanne Valley waste incinerator). Concentrations were low, and remain consistent with those measured by the more extensive surveys of earlier years. The annual mean was 2.6ppb.

Annual mean benzene concentrations were less than the UK Air Quality Strategy standard of 5ppb (which applies to the running mean and is to be achieved by the end of 2003) at all sites, including those near petrol stations. However, the EC 2nd Daughter Directive annual mean limit value of 1.5ppb (which is to be achieved by 2010) was exceeded at Springfields Garage, and Stopford Road, both of which are near petrol stations. Benzene concentrations at the 4 sites not associated with petrol stations were broadly similar to those measured at comparable sites in the UK.

Four of the hydrocarbon sites have been in operation since 1997. The five years' data from these four long-running hydrocarbon sites appear to show a decreasing trend in ambient concentrations of all the measured species except m+p xylene, which by contrast appears to be increasing at most sites.

Contents

Appendices