Draft Report on Turnkey Osiris Particle Results at the Market and Southampton Hotel Sites in Jersey for 2005

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1.0 Executive Summary:

Health Protection has monitored Air Quality in Jersey since 1994. This monitoring involves Nitrogen Dioxide (NO_2), Volatile Organic Compounds (VOCs) and prior to 2002 Sulphur Dioxide (SO_2) via diffusion tubes. The reports from 1998 to 2005 for these surveys can be found at www.gov.je. In 1999 and 2002 two Turnkey Osiris particle measurement units were purchased which allowed real time particles measurement (PM_{10}). This type of measurement ie laser particle measurement has not been certified as 'equivalent' method as detailed in the Local Air Quality Management Technical Guidance LAQM.TG(03) [9] a and therefore the data produced allows for screening rather than a detailed assessment.

The units were sited at:

1. The central Market at approx 12 feet high above pavement level (ref: 2209)
2. On a balcony at the Southampton Hotel at the Weighbridge, St Helier (ref: 2113)

On the 1st August 2005 the unit ref: 2113 was relocated on top of a domestic garage on La Route de Nouaux, Bellozanne Valley to measure traffic emissions from vehicles using the valley eg driving to and from the incinerator, Jersey Coal, the Co-op warehouse. (See photograph 3 below)

Particles include dust and smoke and have a well documented respiratory effect on human health and significant sources of PM_{10} in the UK are road transport (25%), quarrying (14%), power stations (14%) and other industrial combustion (10%). In Jersey, the main source is road transport with high levels monitored mainly at road junctions and along canyon streets.

Results for 2005 for a 7 month period at the Southampton Hotel exceeded the EC and UK Air Quality objectives by 18 times and at Bellozanne for a period of 5 months 5 times . Results for a 12 month period at the Market exceeded the EC and UK Air Quality objectives 11 times. These objectives (ie Stage 2) only allow 7 exceedances per calendar year and should be complied with by 2010 in the UK.

In the recent UK Government consultation on the air quality strategy, it was noted that the European Commission is developing a new Air Quality Directive and that the Commission has recognised that continuing to pursue the indicative 2010 limit values for particles is unlikely to generate a cost effective improvement in air quality. Therefore, it seems unlikely that the 2010 objectives will ever be included in UK legislation.

The results give additional support to the importance of the Air Quality Strategy (see www.health.gov.je).

In December 2004 after a period of testing the results are now uploaded daily to Jersey Meteorological Website www.jerseymet.gov.je for easier public access. (NB currently off line)

The States of Jersey has agreed to work toward the limits set out in the EU Daughter Directive 99/30/EC which sets legally binding limit values for Nitrogen Dioxide (NO_2) Particulates (PM_{10}), Sulphur Dioxide and Lead.

Comparisons with the 2002 and 2003, 2004 data for the Southampton Site show there were less exceedances in 2004 (ie 8 in 2004: 10 months data) compared to 2002 and 2003 (ie 20 in 2003: 8 months data) and (ie 20 in 2002: 7 months data). However the results when compared against the Air Pollution Bandings indicate that air quality was worse in 2003 with 5 days of high air pollution and 3 days of very high air pollution.

At the market site levels of particles spike early morning and this can explained by the presence of delivery/refuse vehicles close to the measurement site resulting in high levels of air pollution. The market have been asked to remind all delivery companies to switch off engines as far as is practicable whilst parked.

Note: Care must be taken interpreting the results as the method of measurement is not an approved method as specified by the European Union and therefore the data provides a guide to whether the Health limits are being met or exceeded.

2.0 Particles: Sources and Health Effects

Particles 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 (ie primary particles) or formed subsequently by chemical reactions (ie secondary particles). PM_{10}, (particles are defined as having an average particle size of 10 microns in diameter (10 millionths of a metre), and have well documented respiratory effects on human health. These include effects on the respiratory and cardiovascular systems, asthma and mortality. PM_{10} particles are composed of primary combustion derived carbon-centred particles e.g. ultrafines, secondary particles from atmospheric chemistry eg ammonium nitrate, natural minerals e.g. soil, wind-blown, biological e.g. spores, bacteria and metals.

Studies have shown that most of the inflammation in the lungs could be explained by the mass of particle instilled, however, mass could not account for all of the variability in the data. It is believed the presence of metals such as iron, zinc, lead and nickel content of PM_{10} had the best association with inflammation out of all of the compositional measurements analysed. Primary particulate content of PM_{10} was also positively associated with inflammation.[2]

The Expert Panel on Air Quality Standards (EPAQS) concluded that particle air pollution episodes are responsible for causing excess deaths among those with pre-existing lung and heart disease. EPAQS also believe that any risk of lung cancer from the concentrations found in the streets of the UK is likely to be exceedingly small. However prolonged exposure for example 20 - 30 years to particles, which are likely to be combined with Polycyclic Aromatic Hydrocarbons (PAH) originating from unburnt or partially burnt fuel, is likely to be carcinogenic.

There is a wide range of human activities that produce particle emissions, including; motor vehicles (mainly diesel), solid fuel burning, industrial processes, power stations, incinerators and construction activity. The main sources of anthropogenic (ie man made) particles in Jersey are from transport, the incinerator and domestic fuel burning. The oil fired power station in Jersey only runs for a few months a year and approx 97% of Jersey's energy comes from France via 2 under sea links.

Emissions from mainland Europe may make a significant contribution to secondary particles in Jersey. The UK Airborne Particles Expert Group's findings suggest that in a typical year with typical meteorology, about 15% of the UK's total annual average PM_{10} concentrations (about 50% of secondary particles) are derived from mainland Europe. In years of higher frequency of easterly winds, with large movements of air from mainland Europe, emissions in mainland Europe account for a considerably higher proportion of PM_{10} concentrations, particularly in south and east England. No work has been carried out to try and establish the contribution of secondary particles originating from Europe onto Jersey.

A UK government Air Quality Strategy Objective and a European Community Directive regulates concentrations of PM_{IO} in the UK (see section 6). The States of Jersey has agreed to work towards the limits set out in the European Daughter Directive 99/30/EC which deals with particles, sulphur dioxide, nitrogen dioxide, and lead. The main issues around air quality in Jersey relate to local air quality and the health impacts associated with high levels monitored mainly at road junctions and along canyon streets.

The BBC reports that the amount of solar energy reaching the Earth's surface has declined significantly between the 1950s and the 1990s, apparently due to particulate air pollution. Scientists are worried that this global dimming may be disrupting the pattern of the world's rainfall. Most alarmingly, it may have led us to greatly underestimate the greenhouse effect: with particulate pollution being brought under control, a global temperature rise of 10 degrees Celsius by 2100 could be on the cards, rendering many parts of the world uninhabitable. It is interesting to see the link between local air quality and global effects. Ref: Horizon BBC2 15/01/05

http://news.bbc.co.uk/2/hi/science/nature/4171591.stm

3.0 Background

The Turnkey Osiris Particle Monitors (Optical Scattering Instantaneous Respirable Dust Indication System) (see the photograph below) were purchased in 1999 and 2002. They are designed to continuously monitor particle levels in particular Total suspended particles (TSPs), PM_{10} (Particles with an aerodynamic diameter of 10 microns) $PM_{2.5}$ and $PM_{1.0}$. The Osiris units sample particles as 15 minute averages.

Figure 1: The sampling sites in St Helier town centre

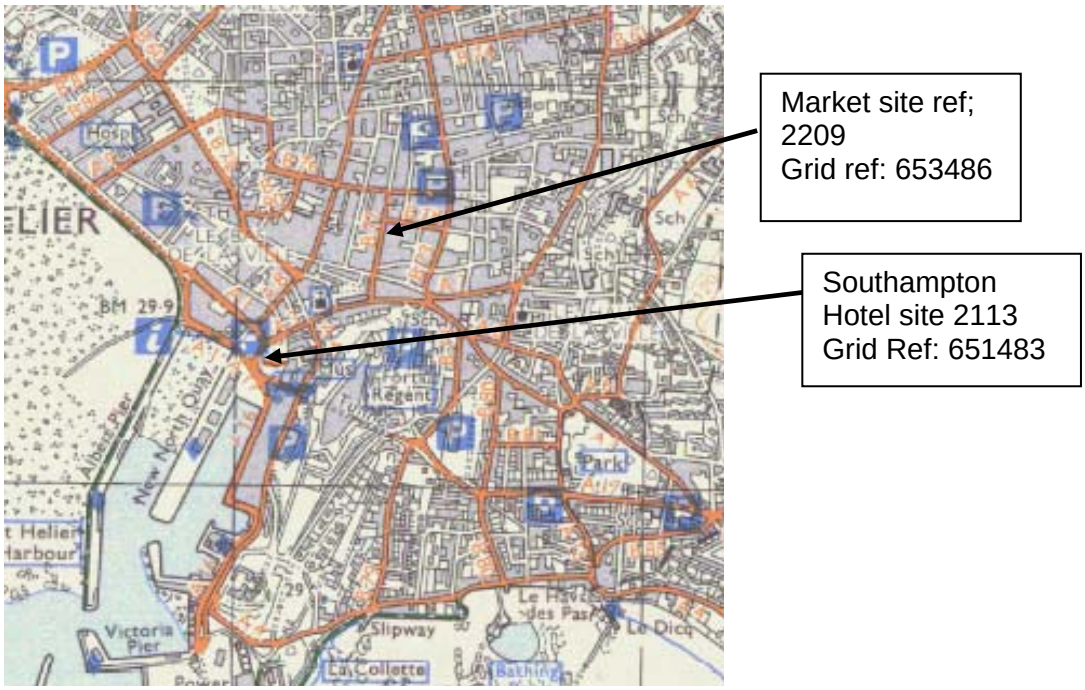


Figure 2: The Bellozanne sampling sites

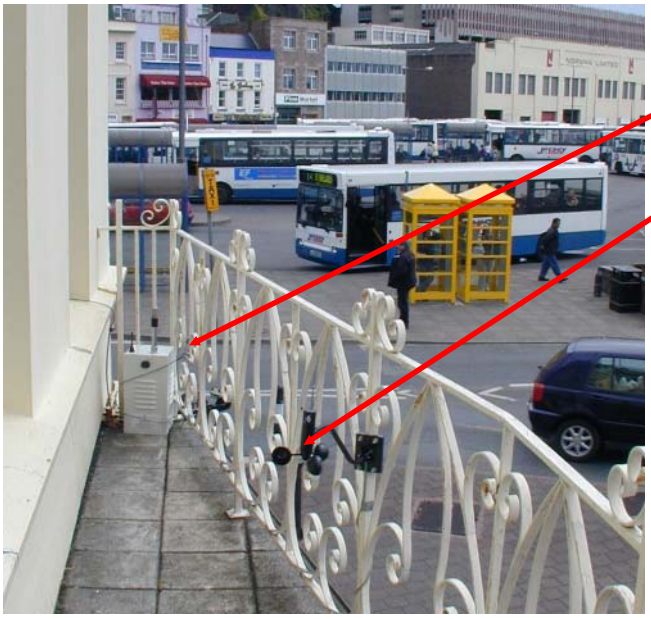
Photograph 1: The Osiris Unit

A wind direction and speed monitor at the Southampton Hotel site (see the Photograph 1 below) provided basic meteorological information ie wind speed and direction. The Osiris units are served by a GSM modem which allows Officers from this Department to dial it up at any time and download the results using the Air Q 32 Software (see Appendix 5). The data from both sites is now uploaded and emailed daily to the Jersey Meteorological Department and they are able to put it on to their website ie www.jerseymet.gov.je. (NB the web page is currently off line) This provides easier public access to the data.

The Osiris units are also fitted with a filter, which traps particles as they are sized and counted. The filter analysis allows the weight of particles to be determined and compared with the Osiris' computer calculated weight (ie to assess the accuracy of the Osiris). The analysis by TES Bretby of the filter also allows an indication of the sources of the particles and a percentage source contribution. The results are provided in section 4 and Appendix 1.

The unit at the Southampton Hotel was sited on a balcony approximately 4 m above the pavement and approximately 5 m from Mulcaster Street/Esplanade (see the photograph below).

Photograph 2: Position of the Osiris unit and weather station at the Southampton Hotel



Osiris particle monitor and weather station at the Southampton Hotel

It was decided to position the Osiris at this particular site because it is believed has generally the poorest air quality compared to the other sites in Jersey. Unfortunately the Public Services Department (now Traffic and Transport Services TTS) were not been able to provide a traffic monitor at the site. Therefore there is limited data on the speed, volume or mix of traffic using Mulcaster Street. However the Nitrogen dioxide diffusion tube sited on the Police Surveillance tower suggests that the older type buses, and taxis contributed to the poor results. Observations on site indicate that particle levels increase substantially with larger vehicles (eg lorries and buses). On the 1st August 2005 the unit ref; 2113 was relocated on top of a domestic garage on La Route de Nouaux, Bellozanne Valley to measure traffic emissions from vehicles using the valley eg driving to and from the incinerator, Jersey Coal, the Co-op warehouse. (See photograph 3 below)

Photograph 3: Position of Osiris Unit moved to Bellozanne Valley from the Southampton Hotel.

The second Osiris unit is sited at the market on Halkett Place (see photograph below) approximately 12 feet above pavement level. It is sited at this height to prevent vandalism. Studies have shown particle levels remain high within 5-6 metres from busy roads.

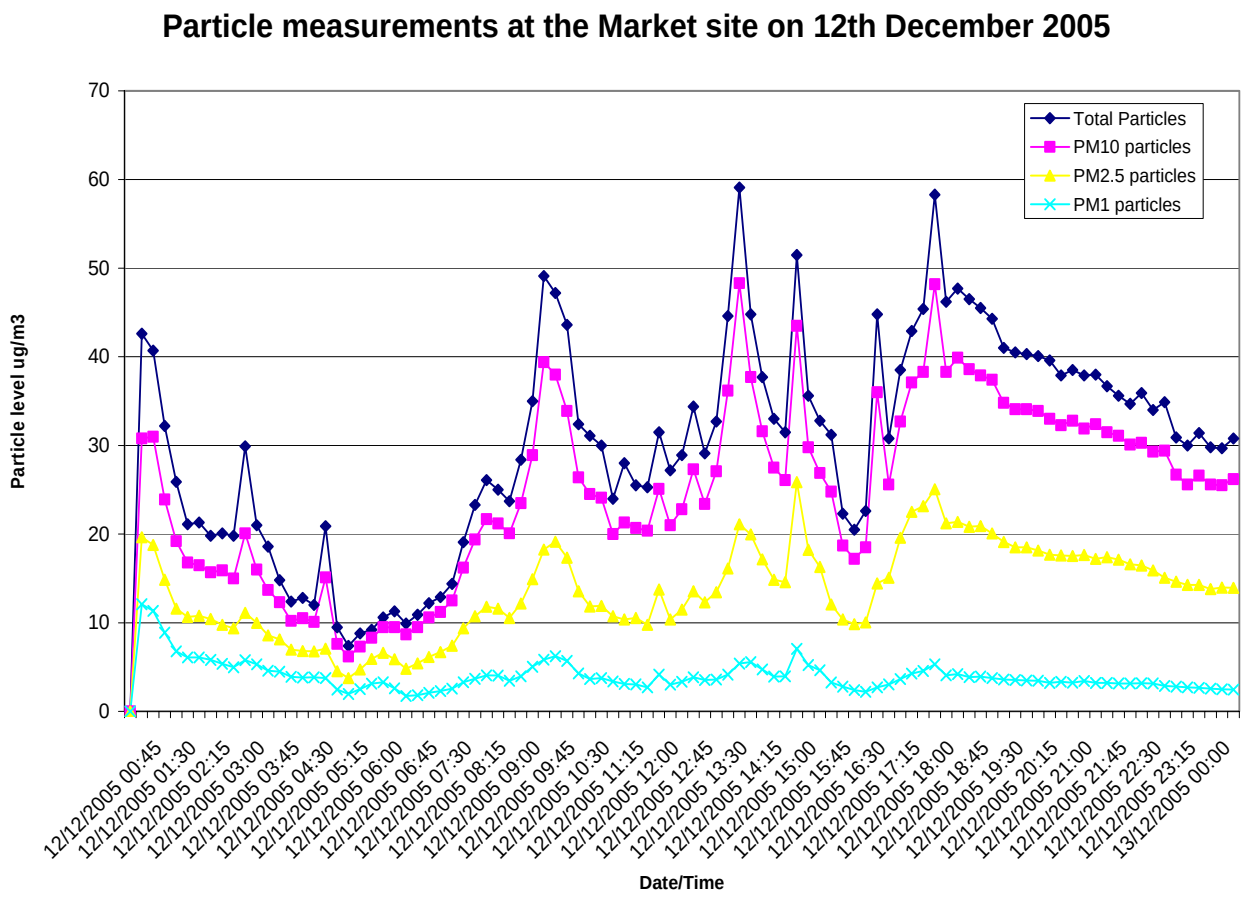
Photograph 4: The Position of the Osiris Unit at the central market Halkett Place St Helier

Osiris particle monitor at Jersey Market measuring traffic emissions on Halkett Place

4.0 Results

The particle exceedances (ie PM_{10}) and air pollution results are presented below. Unfortunately data capture was only 4 months at the Southampton site due to calibration and the unit being moved to Bellozanne Valley in August 2005. However 10 months worth of data was obtained from the market. Figure 1 below shows the particle levels over a 24 hour period for Monday 12th December 2005 ie levels of particles increase up to 9.00 am, lunch time and in the evening rush hour as expected. Particle levels follow traffic volume, mix and are influenced by speed ie congestion

Figure 1: Particle measurements (PM_{10}) at the Market Site on Monday 12th December 2005



The Turnkey Osiris Particle Monitor uses a heated inlet (50ºC) to evaporate water vapour particles which would result in inaccurate high readings, however it is believed that evaporation of volatiles/particles also occurs resulting in lower than normal results. Research has suggested that such results should be increased by up to 30% to increase their accuracy. However there are uncertainties as to whether 30% is the appropriate in all cases and areas of the UK. Details of the Osiris are provided in Appendix 1.

The relationship between meteorological conditions and particle levels is not clear. As wind speed increase particle levels reduce, however the position of the monitor at the Southampton Hotel is sheltered to northerly and north easterly winds. The monitor at the Market site is in a canyon street which reduces dispersion/dilution of particles. As wind passes over the tops of the buildings eddying effects occur which cause circular dispersion. The Bellozanne site is a more open site with greater dilution and dispersion. The traffic using this road tends to move more freely and is less subject to congestion.

The European Union requires the use of a gravimetric (filter based) method to prove compliance, and the UK has suggested that its preferred Tapered element oscillating microbalance (TEOM) measuring devices are adequate if the results are multiplied by up to 1.3. It is this blanket nationwide uplift factor which may produce false exceedances. Although the Osiris is not as accurate as the TEOM it provides useful indicative results.

At the market site levels of particles spike early morning and this can explained by the presence of delivery/refuse vehicles close to the measurement site resulting in high levels of air pollution. The market have been asked to remind all delivery companies to switch off engines as far as is practicable whilst parked.

1. Air Pollution Bandings:	As a running 24 Hour mean	Market (corrected)	Southampton	Bellozanne
Low Air Pollution:	<50 µg/m^3	304 days (282)	117(106)	90(86)
Moderate Air Pollution:	50 - 74 µg/m^3	7 (24)	7 (15)	3 (5)
High Air Pollution:	75 - 99 µg/m^3	0 (5)	3 (3)	1 (2)
Very High Air Pollution:	>= 100 µg/m^3	0	7(10)	(1)

[NB Those figures in brackets have been corrected /increased by 30 % to account for the loss of volatile particles caused by the heated inlet at the sampling head.]

According to the above guidelines air pollution levels were generally low at the three sites but there were days of moderate and high air pollution and at the Southampton site at the Weighbridge for 7 days (10 days corrected) air pollution was very high.

	Market (corrected)	Southampton	Bellozanne
2. 24 Hour daily mean: 50 µg/m3 not to be exceeded more than 35 times per calendar year by 2004 and 7 times per calendar year by 2010.	7 (311 days- 29 corrected)	17 (134 days - 27 corrected)	4 (94 days - 8 corrected)

3. Calendar Year Annual Mean: 40 µg/m3 (Stage 2: 20 µg/m3)	25.46 (corrected 33.10) 311 days	37.49 (48.73) 134 days	24.82 (32.26) 94 days

The tables above show that the PM_{10} particle results for all three sites exceeded the 24 Hour daily mean of 50 µg/m3 but not more than 35 times. The Market and Southampton results exceeded the stage 2 objective 7 times. Although all the sites comply with the Stage 1 annual mean value of 40µg/m3 they all fail the Stage 2 annual mean objective of 20µg/m3 **(Note: The annual mean results provide a guide as a full calendar year of results were not obtained**).

The results from the filters analysed by TES Bretby Ltd are shown in Appendix 1. The examination procedure (ie Scanning Electron Microscopy and Energy Dispersive X Ray analysis) is based on the assessment of approximately 40 individual particles selected at random. The estimated percentage is based on a comparison of the relative number of particles counted in each category. (See Appendix 6 for the test reports and scanning electron micrographs).

The results are as follows:

a. Market site: The filter was exposed for 4255 min and had a mass of 8.10mg. Examination revealed that the collected deposit was mainly sodium/chlorine rich (25%) which suggests sea salt is present. Other materials present included: Calcium/Sulphur rich (gypsum) (7%), carbonaceous matter (18%) associated with vehicular emissions. Care must be taken interpreting theses results as only a very small number of particles were analysed. Unfortunately the costs are prohibitive for greater in depth analysis.

b. The Southampton Hotel Site: The filter was exposed for 56700 min and had a mass of 10.44 mg. Examination revealed that the collected deposit was mainly Calcium/Aluminium/Silicon (43%) and are classified as general dirt Sodium/chlorine rich particles were present (5%) which indicates sea salt. Other materials present included: Calcium/Sulphur rich (gypsum) (10%), carbonaceous matter (7%) associated with vehicular emissions.

c. The Bellozanne Site: The filter was exposed for 54389 min and had a mass of 6.09 mg. Examination revealed that the collected deposit was mainly carbonaceous matter (45%) associated with vehicular emissions. Other materials present included Calcium/Aluminium/Silicon (8%) and are classified as general dirt, Sodium/chlorine rich particles (20%) which indicate sea salt. Other materials present included: Calcium/Sulphur rich (gypsum) (2%).

5.0 EU and UK Guidelines

In Jersey the States have agreed to work towards the European Union Directive objectives. However in the UK, air quality standards and objectives for the major pollutants are described in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000 (The National Air Quality Strategy, or NAQS)[i]. An Addendum to NAQS was published in 2003, leading to some tighter air quality objectives.

The NAQS includes air quality objectives defined under European Directives, specifically the Air Quality Framework Directive (96/62/EC) and the four so-called Daughter Directives (1999/30/EC, 2000/69/EC, 2002/3/EC and 2004/107/EC), as well as objectives derived from work by the Expert Panel on Air Quality Standards (EPAQS).The NAQS makes a clear distinction between “standards” and “objectives”.

• *Standards* are the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive subgroups; and

• *Objectives* are policy targets generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedences, within a specified timescale.

Under the EC Air Quality Framework Directive (96/62/EC), all Member States have to assess their existing air quality and implement a programme of monitoring, dependent upon population, population density, emission sources and proximity of the general public to these sources.

Under the Framework Directive, a Member State MUST undertake continuous monitoring (using appropriate instrumentation) at least ONE site.

NETCEN recommend, therefore, that the island undertakes continuous monitoring for NO_2 and PM_{10}. For the first year at least, this was at the highest known pollution "hotspot" (Weighbridge). Once compliance with the Daughter Directive(s) is confirmed at this location, the site could be relocated to an area more representative of general population exposure (eg residential or urban background)

The EU Directive also details an: (24 hour limit value)

(a) **Upper Assessment threshold**: 60% of the limit value (30µg/m^3) not to be exceeded more than 7 times in any calendar year.

(b) **Lower Assessment threshold**: 40% of the limit value (20µg/m^3) not to be exceeded more than 7 times in any calendar year.

The upper and lower Assessment thresholds are presently being exceeded. Improvement in traffic management flow reduction will be needed to ensure the Upper Assessment threshold (UAT) is not exceeded in 2010.

Air quality should improve should occur in the next few years with better engine design Euro 4/5, relocation of the bus station to the Island site and further road changes as part of the St Helier Life program and Constable Crowcroft town centre improvements.

The reviewed Air Quality Strategy and the TTS Sustainable Traffic and Transport Plan will also raise the profile of Air Pollution and measures to reduce it.

In the recent UK Government consultation on the air quality strategy, it was noted that the European Commission is developing a new Air Quality Directive and that the Commission has recognised that continuing to pursue the indicative 2010 limit values for particles is unlikely to generate a cost effective improvement in air quality. Therefore, it seems unlikely that the 2010 objectives will ever be included in legislation.

The EU and UK guidelines include:

1. Air Pollution Bandings:	As a running 24 Hour mean
Low Air Pollution:	<50 µg/m^3
Moderate Air Pollution:	50 - 74 µg/m^3
High Air Pollution:	75 - 99 µg/m^3
Very High Air Pollution:	>= 100 µg/m^3

2. 24 Hour daily mean: 50 µg/m3 not to be exceeded more than 35 times per calendar year by 31.12.2004 and 7 times per calendar year by 31.12. 2010. (NB Stage 2 Limits are under review)

3. Calendar Year Annual Mean: 40 µg/m3 (Stage 2: 20 µg/m3 to by achieved by 31.12.2010)

6.0 Comparison with other short term survey sites in Jersey and UK

Particle measurements carried out at other sites in Jersey are generally similar in magnitude to these sites. Surveys have been carried out at:

(a) Halkett Place 1997 and 2000 Jan - March: Average PM_{10} levels in 1997 and 2000 were 27mg/m^3.

(b) New Street: Levels of PM_{10} in January 2000 varied between 13 - 27 mg as a running 24 hour average and no exceedances.

(c) Savile Street: Levels of PM_{10} varied in January - February, 2001 from 21 mg/m^3 to 59 mg/m^3 as a running 24 hour average with one exceedance.

PM_{10} concentrations in Jersey were generally higher than the UK comparison sites[5] but broadly similar to those found in London and Bristol. Levels at the Weighbridge and Market sites are broadly what could be expected at a roadside location in the UK.

Particle levels from other sources such as the power station have reduced with the use of the two cable links to France (ie up to the end of September 2003 97% of electricity used in Jersey originated from France).

The Easy link coach service began on the 19th April 2003. There are 10 - 15 buses operating with poor emissions compared to the cleaner Connex buses which have Euro 3 engines. When these engines are used in conjunction with low-sulphur diesel, emissions are very low. An aim should be to fit continuously regenerating particulate traps to Euro 2 and earlier diesel engines. (The cost is approx about £2 - 3,500 per vehicle, 90% of particles can be removed).

Other options are to move towards gaseous fuels such as the vehicles operated by Jersey Gas. The availability of bio-diesel in Jersey in the near future should lead to improvements. In London the trialling of water diesel emulsion is occurring which is claimed to halve particle emissions and cut NOx (i.e. Oxides of Nitrogen) by 23%.

Other improvements include:

(A) 2 new cremators which comply with the UK Environmental Protection Act 1990 Process Guidance notes

(B) A new waste to energy plant to be built in 2007/8 with improved emissions

(C) New Building Byelaw Part L to improve insulation etc in domestic properties thereby reducing greenhouse gas emissions. Interestingly British Gas now offer a grant to improve the thermal insulation of domestic houses.

(D) Provision of further third electricity link to France reducing further the need to run the JEC oil fired power station.

(E) The growth in the usage of solar panels wind generators and heat pumps will reduce the reliance on other fossil fuels thereby reducing particle emissions from domestic premises.

Figure 2: Comparisons with the 2002, 2003, 2004 and 2005 data

The graph above shows that the number of exceedances for the Southampton site for 2004 and 2005 are lower than in 2002 and 2003. The number of exceedances increased at the Southampton site compared to the market site between 2004 and 2005. Care needs to be taken in direct comparison as the measurement periods varied.

7.0 Conclusions

1.The Turnkey Osiris particulate monitors were set up on the Southampton Hotel's balcony at the Weighbridge in May 2002 and was moved to Bellozanne Valley in August 2005, the second unit has remained at the Market, Halkett Place since June 2004. The units measure particles in real time (ie Total Suspended Particles TSP, particles of a mean aerodynamic diameter of 10 microns PM_{10}, and particles of a mean aerodynamic diameter of 2.5 microns $PM_{2.5}$ and particles of a mean aerodynamic diameter of 1 micron $PM_{1.0}$ as 15 minute averages.

2. Particles are associated with a range of health effects. These include effects on the respiratory and cardiovascular systems, asthma and mortality. The Expert Panel on Air Quality Standards (EPAQS) concluded that particle air pollution episodes are responsible for causing excess deaths among those with pre-existing lung and heart disease. EPAQS also believe that any risk of lung cancer from the concentrations found in the streets of the UK is likely to be exceedingly small. However prolonged exposure for example 20 - 30 years to particles, which are likely to be combined with Polycyclic Aromatic Hydrocarbons (PAH) originating from unburnt or partially burnt fuel, is likely to be carcinogenic.

3. The tables in section 6 above show that the PM_{10} particle results for all three sites exceeded the 24 Hour daily mean of 50µg/m3 but not more than 35 times. The Market and Southampton results exceeded the stage 2 objective 7 times. Although all the sites comply with the Stage 1 annual mean value of 40µg/m3 they all fail the Stage 2 annual mean objective of 20µg/m3 (Note: The annual mean results provide a guide as a full calendar year of results were not obtained). Care must be taken interpreting the results as the method of measurement is not an approved method as specified by the European Union and therefore the data provides a guide to whether the Health limits are being met or exceeded.

4. The particle results follow traffic movements as particle levels increase up to lunchtime and remain high into the afternoon. Levels at the market are also influenced by deliveries/refuse collections.

5. The relationship between meteorological conditions and particle levels is not clear. As wind speed increase particle levels reduce, however the position of the monitor at the Southampton Hotel is sheltered to northerly and north easterly winds. The monitor at the Market site is in a canyon street which reduces dispersion/dilution of particles. As wind passes over the tops of the buildings eddying effects occur which cause circular dispersion. The Bellozanne site is a more open site with greater dilution and dispersion. The traffic using this road tends to move more freely and is less subject to congestion.

6. The Osiris has a glass fibre filter which collects particle material, which was further analysed to determine the sources of the particles and percentage contribution. Examination revealed in 2005 that the collected deposit was varied including sea salt, sand, general dirt and carbonaceous matter with particle size of <10 microns associated with vehicular emissions. Care must be taken interpreting these results as only a very small number of particles (40) were analysed. Unfortunately the costs are prohibitive for greater in depth analysis.

7. PM_{10} concentrations in Jersey were generally higher than the UK comparison sites[5] but broadly similar to those found in London and Bristol. Levels at the Weighbridge,

Bellozanne and Market sites are broadly what could be expected at a roadside location in the UK.

9. Concentrations of all pollutants appear to be falling slightly with time. This is likely to be due to improved fuel composition and engine design[5]. However directive limits are becoming tighter and more health information is readily available.

10. Particle levels from other sources such as the power station have reduced with the use of the two cable links to France (ie up to the end of September 2003 97% of electricity used in Jersey originated from France).

11. The main issues around air quality in Jersey relate to local air quality and the health impacts associated with high levels monitored mainly at road junctions and along canyon streets.

12. Particles have been implicated in global dimming and highlight the relationship between local air quality and global warming.

13. Particle air pollution has improved slightly when compared to 2002 and 2003 but in the case of the Bellozanne site was worse in 2005. Care is needed in drawing conclusions as there different measurement periods.

8.0 Recommendations

1. Further long term research (until at least 2010) should be carried out to assess levels of $PM_{10}/PM_{2.5}$ in Jersey compared to traffic numbers, mix and speed and meteorological conditions to establish trends and assess compliance with the European Union Daughter Directive objectives. This forms part of the integrated Air Quality Strategy. The results are now uploaded to Jersey Mets web site www.jerseymet.gov.je for easier public access. Research should involve the use of EU type approved measurement equipment to be meaningful and allow direct comparison with the UK.

2. Traffic data (eg volume, mix and speed) should be made available to allow more meaningful comparison with particle results.

3. Further work is needed to assess the relationships between meteorological data and particle levels.

4. It is possible reductions in particle levels will occur because of the re-location of the bus station to the Island Site and road changes associated with the St Helier Street Life program.

5. A review of the Department's Air Quality Strategy is needed as soon as practicable. Raising the profile of air quality is needed.

6. Further research work should ideally be carried to assess the contribution of secondary particles from mainland France to Jersey. Also analysis should be carried out to confirm that the 30% increase in figures associated with heated inlets is correct for this particular monitoring site.

7. An aim should be to fit continuously regenerating particulate traps to Euro 2 and earlier diesel engines. (The cost is approx about £2 - 3,500 per vehicle, 90% of particles can be removed). The provision of incentives to use LPG and biodiesel fuels is recommended. A reduction in Jersey's Vehicle Registration duty (VRD) to promote the use of cleaner vehicles. Any environmental taxes introduced should be beneficial to promoting the use of cleaner vehicles.

8. Good quality data is needed to assess improvements in tends in air quality, usage of public transport etc

9. The Department' needs to liaise with interested bodies and other Departments such as Planning and Environment and Traffic and Transport services to ensure Air Quality Objectives link into the Island Plan and Sustainable Tradffic and Transport Plan.

9.0. Appendix 1: The results compared to the UK/EU standards

Results for 2005		Sites		
1. Air Pollution Bandings: (days)	As a running 24 Hour mean	Market (corrected) days	Southampton	Bellozanne
Low Air Pollution:	<50 µg/m^3	304 (282)	117(106)	90(86)
Moderate Air Pollution:	50 - 74 µg/m^3	7 (24)	7 (15)	3 (5)
High Air Pollution:	75 - 99 µg/m^3	0 (5)	3 (3)	1 (2)
Very High Air Pollution:	>= 100 µg/m^3	0	7(10)	(1)
2. 24 Hour daily mean: 50 mg/m^3 not to be exceeded more than 35 times per calendar year by 2004 and 7 times per calendar year by 2010.		7 (311 days- 29 corrected)	17 (134 days - 27 corrected)	4 (94 days - 8 corrected)
3. Calendar Year Annual Mean: 40 mg/m^3		25.46 (corrected 33.10) 311 days	37.49 (48.73) 134 days	24.82 (32.26) 94 days
4. The EU Directive also details an: (24 hour limit value)				
Upper Assessment threshold: 60% of the limit value (30µg/m^3) not to be exceeded more than 7 times in any calendar year.		Yes	Yes	Yes
Lower Assessment threshold: 40% of the limit value (20 µg/m^3) not to be exceeded more than 7 times in any calendar year.		Yes	Yes	Yes

The upper and lower Assessment thresholds are presently being exceeded. Improvement in traffic management flow reduction will be needed to ensure the Upper and lower Assessment thresholds (UAT) are not exceeded in 2010.

10.0 Appendix 2: The Turnkey Osiris Particle Monitor

Osiris stands for *Optical Scattering Instantaneous Respirable Dust Indication System*.

The Osiris is an investigational instrument that fulfils the dual role of a portable instrument or permanent installation.

The instrument is housed in a sturdy die cast metal box with internal rechargeable battery. The external power source was connected for the long term monitoring. The internal memory was used to record PM_{10}, $PM_{2.5}$, $PM_{1.0}$ and Total Suspended Particles (TSP) as 15 minute averages for the monitoring periods. Each 24 hour period is saved in a folder for downloading to a computer and analysing with the Air Quality Programme for Windows. The Air Quality programme allows the data to be graphed and copied into Microsoft Excel for further analysis.

The instrument measures and records the concentration of airborne particles using a proprietary laser (nephelometer). An internal pump continuously draws an air sample through the nephelometer which analyses the light scattered by individual particles as they pass through a laser beam. These same particles are then collected on the reference filter. The nephelometer's dedicated microprocessor can analyse the individual particles even if there are millions of them per litre. This allows the size fractions to be determined at concentrations up to several milligrams/m^3.

The light scattered by the individual particles is converted into an electrical signal which is proportional to the size of the particle. A unique feature of the Turnkey nephelometer is that only light scattered through very narrow angles 10 degrees or less is measured. At this narrow angle the amount of light scattered is virtually the same for say black diesel or white limestone particles of the same size. That is, it doesn't depend on the material composition of the particle. On the other hand, the easier to measure right angle 90° scatter used by some earlier scattering instruments is highly dependant on material composition with white particles apparently scattering much more light than black ones of the same size.

The light scattered by airborne particles can be thought of as consisting of three components. Light reflected from the surface of the particle, light refracted through the particle and light which is diffracted from its original path by the presence of the particle. The intensity of the light scattered by reflection or refraction strongly depends on the type of particle. Thus a white limestone particle will reflect much more light than a black diesel fume particle of the same size. On the other hand the diffracted component depends only on the size of the particle and is independent of its material composition.

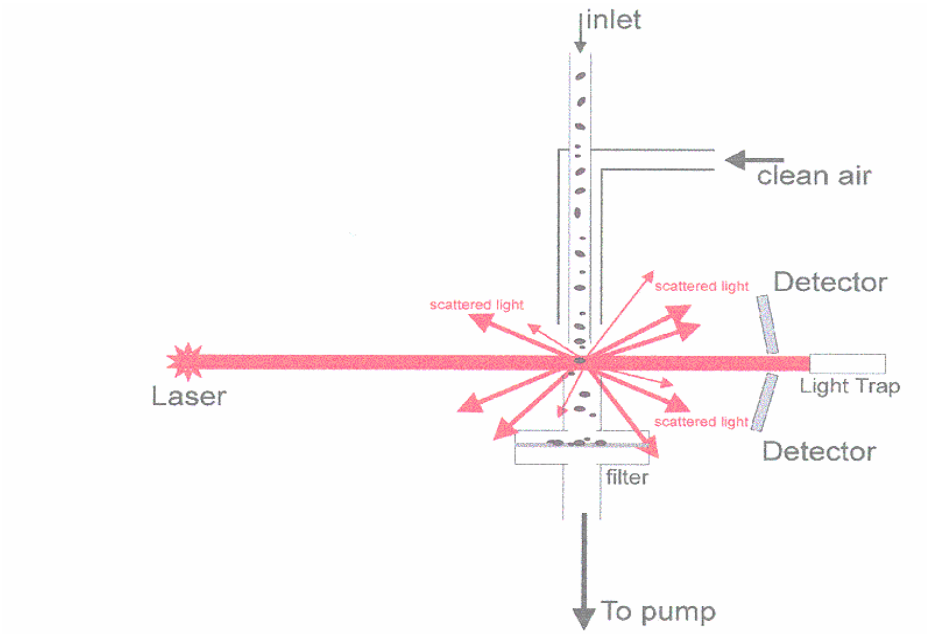
For irregularly shaped particles, light, which is reflected and refracted, tends to be scattered over all possible directions. The diffracted component, however, tends to be scattered only through very small angles. For example, for a 5 micron diameter particle, 90% of the diffracted light is scattered by less than 10 degrees from the original direction of the light beam.(42)

The intensity of the light pulse is therefore an indicator of particle size, from this the microprocessor is able to calculate the expected mass of the particle. It assumes the material density of the particle is 1.5 grams per cc, which for most airborne dusts is a

good approximation but the mass calibration factor can be adjusted to compensate for different material types.

Having evaluated the mass of the particle, the microprocessor then evaluates the likely chance of deposition of the particle according to the sampling convention being used (PM_{10}, thoracic, and so on) as shown in figure 19 below. Thus for the thoracic convention a 6 micron particle has an 80.5% chance of deposition, hence only this percentage of its evaluated mass is accumulated.(42)

Diagram of the Osiris particle monitor



11.0 Appendix 3: Relationship between the European transfer reference sampler and other PM10 sampling methods [9]

Monitoring of PM10 in the UK networks has, to date, been largely founded on the use of the TEOM analyser. A concern with the TEOM instrument is that the filter is held at a temperature of 50°C in order to minimise errors associated with the evaporation and condensation of water vapour. This can lead to a loss of the more volatile particles (such as ammonium nitrate etc).

The EU limit values and the UK objectives are based upon measurements carried out using the European transfer reference sampler, or equivalent. This is a gravimetric sampler, where the particulate material is collected onto a filter, and subsequently weighed. The filter is therefore held at fluctuating ambient conditions during the period of exposure. Whilst there will inevitably be some losses of volatile species from the filter (dependant upon the ambient temperature), these will be less than from the TEOM.

The Government and the Devolved Administrations have been investigating the relationship between the TEOM and the reference sampler, using co-located instruments at 6 sites in the UK. These studies have shown that the TEOM adjustment factor is site specific, and varies both from season to season, and from year to year. Because of this **an interim default adjustment factor of 1.3** has been proposed for the UK. This approach is supported by other studies carried out in other EU countries, and appears to also apply to ß-attenuation instruments with a heated manifold.

For the purpose of the next round of review and assessment, authorities should bear in mind the issues set out below:

• Measurements of PM10 concentrations carried out using the European transfer reference sampler, or equivalent, are directly comparable with the UK objectives and EU limit values, and no data correction is necessary. There are, however, important QA considerations to bear in mind, regarding the handling and weighing of filters.

• Measurements of PM10 concentrations carried out using a TEOM or ß-attenuation instrument, operating with a heated manifold, should be adjusted by multiplying the data by 1.3 to estimate gravimetric equivalent concentrations.

• Measurements of PM10 concentrations carried out using other sampling methods (e.g. optical analysers, or gravimetric samplers that have not been certified as 'equivalent') will need to be considered carefully, particularly if they are being used in a Detailed Assessment, and the concentrations measured are close to the objectives. Authorities with such analysers are advised to contact the relevant Helpdesk (Box 1.1).

• It is not recommended that authorities carry out local intercomparison studies between the transfer reference sampler and other samplers for the purpose of review and assessment. Where such studies are carried out, it is **essential** to carry out the comparison over at least 6 months, including a summer and winter period. Any adjustment factors derived may be both season and site specific, and cannot simply be used to adjust data at other sites, in other years.

Authorities are advised to contact the relevant Helpdesk (Box 1.1) before embarking on intercomparison studies.

• The method of sampling is **critical** to the result. In all cases, authorities should explicitly state the method of sampling, and report all original and ‘adjusted’ data.

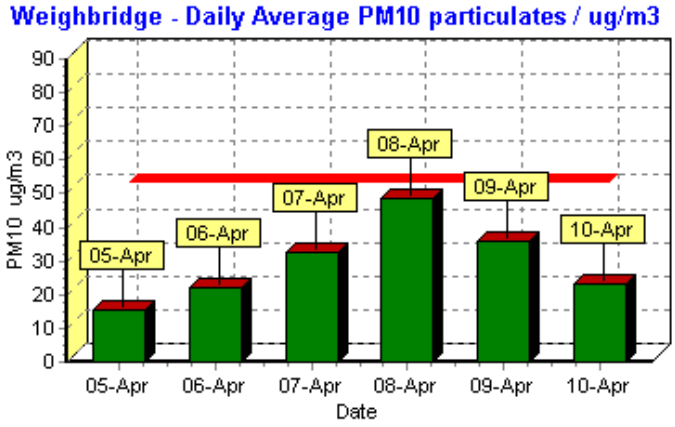
12.0 Appendix 4: Sources of particles

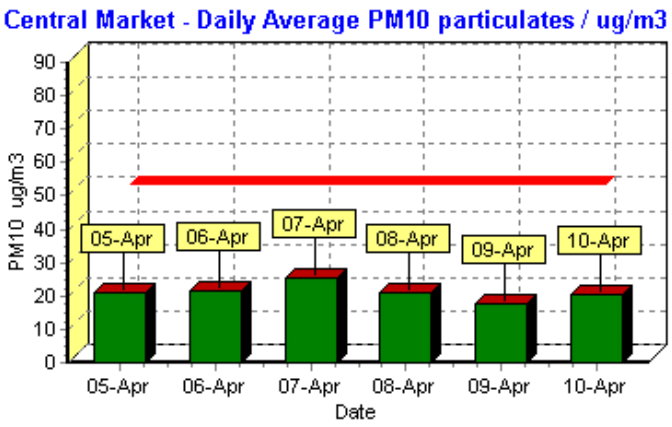
Box 8.1: Approximate contributions to PM_{10} concentrations (2002)

Type of particle	Source location	Main source categories	Main source types	Typical contribution to annual mean concentration ($\mu g/m^3$ gravi.)
Coarse 2.5-10µm	Immediate local (very close)	Traffic	resuspended dusts tyre wear	1 - 6
		Industry	fugitive dusts stockpiles quarries construction	variable, up to 5
	Urban background	Traffic	resuspended dusts tyre wear	1 - 2
		Industry	fugitive dusts stockpiles quarries construction	variable, up to 2
	Regional (including distant sources)	Natural	resuspended dust/soil sea salt biological	2 - 3 1 - 2 1
Fine <2.5µm	Immediate local (very close)	Traffic	vehicle exhaust	1 - 4
		Industry	combustion industrial processes	variable
		Domestic	coal combustion	variable
	Urban background	Traffic	vehicle exhaust	1 - 4
		Industry	combustion industrial processes	variable, up to 8
		Domestic	coal combustion	variable, up to 8
	Regional (including distant sources)	Secondary	power stations industrial processes vehicles	4 - 8
		Primary (Imported)	power stations vehiclesw industrial processes	1 - 2
		Natural	sea salt	<1

13. Appendix 5: Example of the Air Quality Information on Jersey Meteorological's Website: www.jerseymet.gov.je

Latest 24 hr average PM10 readings from the Weighbridge and Market sites, St. Helier





Note 1) The exceedances at the Market site are partly due to deliveries and refuse collection operations on Halkett Place. Delivery and refuse vehicles have been ask to switch their engines off as far as possible in this area.

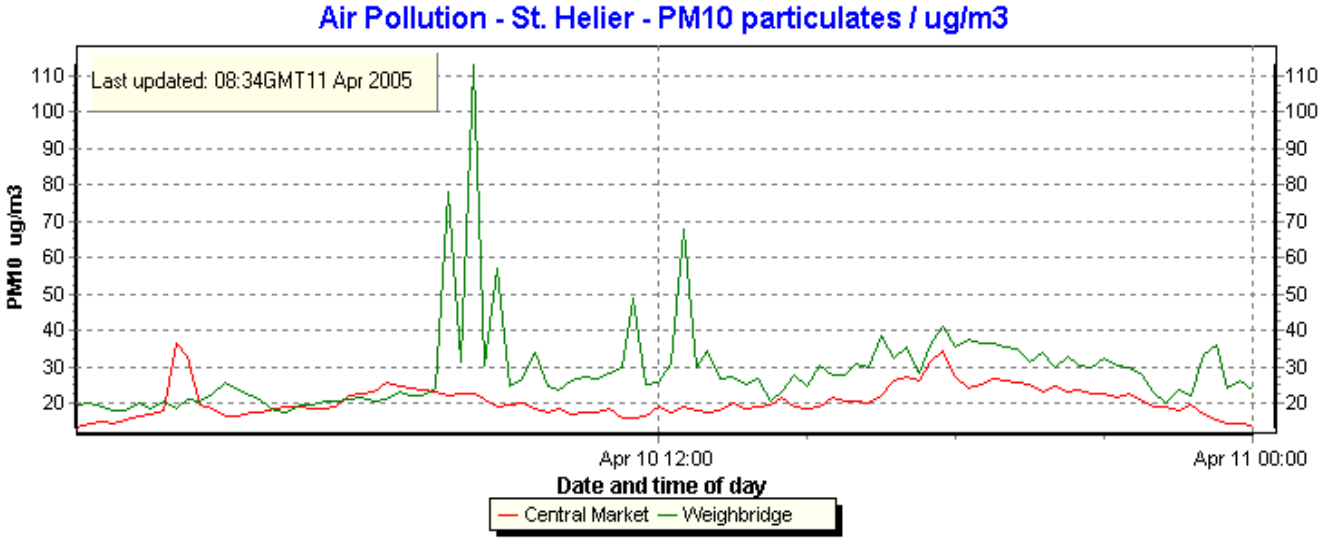
2) The Weighbridge exceedances are due to the refurbishment of the Pomme d'Or Hotel and the

storage and use of materials, cement dust etc nearby.

The following table of Air Pollution Bandings gives an assessment of the impact on health of individuals who are sensitive to Air Pollution.

Air Pollution Bandings: PM10s as a running 24 hour mean and Impact on Human Health		
Air Pollution Band	**PM10 concentration**	**Effects**
Low Air Pollution	<50 µg/m^3	Effects are unlikely to be noticed by individuals who know they are sensitive to air pollutants.
Moderate Air Pollution	50 - 74 µg/m^3	Mild effects, unlikely to require action, may be noticed amongst sensitive individuals.
High Air Pollution	75 - 99 µg/m^3	Significant effects may be noticed by individuals and action to avoid or reduce these effects may be needed (e.g. reducing exposure by spending less time in polluted areas outdoors). Asthmatics will find that their 'reliever' inhaler is likely to reverse the effects on the lung.
Very High Pollution	>= 100 µg/m^3	The effects on sensitive individuals described for 'High' levels of pollution may worsen.

Latest near real time PM10 readings from the Weighbridge and Market sites, St. Helier:-



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The Health Protection Department in consultation with the Environment and Public Services Department have produced Jersey's first draft

Air Quality Strategy which is available from the Department or via the Resources section of www.health.gov.je.

You can get further information on air pollution in the UK from:
www.airquality.co.uk/archive/index.php

This web page produced in association with:
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Le Bas Centre
St Saviours Road
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Tel: 01534 623712
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Email: jer@cieh.org.uk

14.0 Appendix 6 TES Bretby Ltd test reports and scanning electron micrographs.

a. Bellozanne Valley Site

TES Bretby

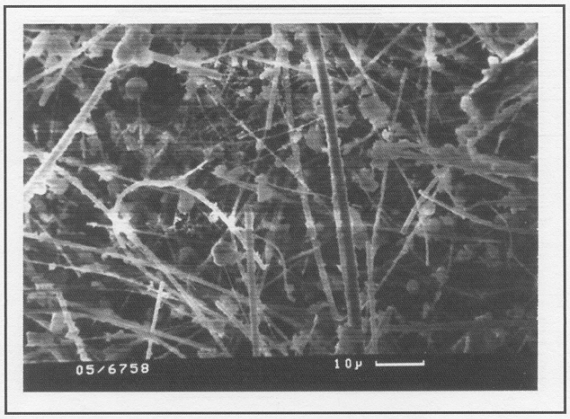
TEST REPORT

UKAS TESTING 1205

OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDS

Mr A M Irving Health Protection Public Health Services Le Bas Centre St Saviours Rd St Helier Jersey JE1 4HR	**Report Number**: **Job Number**: **Date Received**: **Date Analysed**: **Sample Description**: **TES Sample ID Number**: **Issue Date**: **Page**:	ED/AD/15313/SEM/0001, Rev. 0 ED/AD/15313 01 December 2005 12 December 2005 Glass Fibre filter – Bellozane Valley ED/AD/0506758 13 December 2005 1 of 1



Identification of Dust Gauge / Environmental Deposits by SEM/EDS Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Calcium / Sulphur Rich *	2	Plant / Animal Fragments	15	Silicon Rich #	5
Calcium / Aluminium / Silicon Rich	8	Carbonaceous matter	45	Potassium./ Aluminium / Silicon Rich	5
Sodium / Chlorine Rich $	20				

** This suggests calcium sulphate (gypsum) is present.*
 # This suggests silica (sand) is present.
$ This suggests sodium chloride (salt) is present.
The other mineral particles may be classified as general dirt.

The examination procedure is based on an assessment of 40 individual particles selected at random.
The estimated percentage is based on a comparison of the relative number of particles counted in each category.

TES Bretby does not accept responsibility for the sampling associated with the results reported above.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

b. Central Market Site

TES Bretby

TEST REPORT

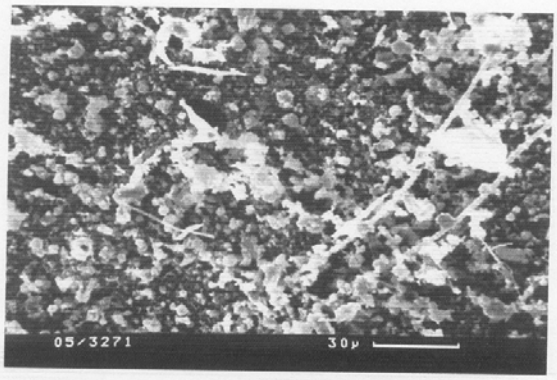
UKAS TESTING 1458

OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDXA

Mr A M Irving
Health Protection
Public Health Services
Le Bas Centre
St Saviours Rd
St Helier
Jersey
JE1 4HR

Report Number: ED/AD/14734/SEM/0001
Job Number: ED/AD/14734
Date Received: 09 June 2005
Date Analysed: 14 June 2005
Sample Description: Market Site – Halkett Site M1
TES Sample ID Number: ED/AD/0503271
Issue Date: 5 July, 2005
Page: 2 of 2



Identification of Dust Gauge / Environmental Deposits by SEM/EDXA Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Calcium / Sulphur Rich *	7	Plant / Animal Fragments	13	Iron Rich	5
Calcium / Aluminium / Silicon Rich	12	Carbonaceous matter	18	Potassium./ Aluminium / Silicon Rich	7
Aluminium / Silicon Rich	13	Sodium / Chlorine Rich $	25		

** This suggests calcium sulphate (gypsum) is present.*
$ This suggests sodium chloride (salt) is present.
The other mineral particles may be classified as general dirt

c. The Southampton Hotel Site

TES Bretby

TEST REPORT

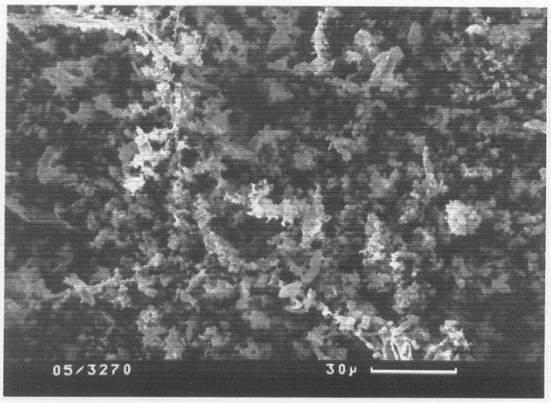
UKAS TESTING 1458

OCCUPATIONAL HYGIENE & ENVIRONMENTAL MONITORING LABORATORY

RESULTS OF EXAMINATION BY SEM-EDXA

Mr A M Irving
Health Protection
Public Health Services
Le Bas Centre
St Saviours Rd
St Helier
Jersey
JE1 4HR

Report Number: ED/AD/14734/SEM/0001
Job Number: ED/AD/14734
Date Received: 09 June 2005
Date Analysed: 14 June 2005
Sample Description: Southampton Hotel – On Balcony S1
TES Sample ID Number: ED/AD/0503270
Issue Date: 5 July, 2005
Page: 1 of 2



Identification of Dust Gauge / Environmental Deposits by SEM/EDXA Method Number SEMDG7

Forty particles were analysed individually; the results are shown below.

Category	Estimated %	Category	Estimated %	Category	Estimated %
Calcium / Sulphur Rich *	10	Plant / Animal Fragments	5	Silicon Rich #	8
Calcium / Aluminium / Silicon Rich	43	Carbonaceous matter	7	Iron / Aluminium /Silicon Rich	5
Aluminium / Silicon Rich	15	Sodium / Chlorine Rich $	5	Potassium./ Aluminium / Silicon Rich	2

** This suggests calcium sulphate (gypsum) is present.*
$ This suggests sodium chloride (salt) is present.
 # This suggests silica (sand) is present
The other mineral particles may be classified as general dirt

15.0 References

1. The Air Quality Strategy for England, Scotland,, Wales and Northern Ireland. Working Together for Clean Air. January 2000. Cm 4548, SE 20003/3 and NIA 7. The Stationery Office Ltd.

2. Adverse Health Effects of Particulate Air Pollution V. Stone, J.H. Lightbody, L. Hibbs, C.L.Tran, M. Heal, and K. Donaldson. Napier University, University of Edinburgh

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9. Jersey's Official OS Leisure Map 1:25 000 States of Jersey Planning and Environment Department

10. LAQM. TG(03) Part IV of the Environment Act 1995 Local Air Quality Management

11. EU Directive 96/62/EC on Ambient Air Quality Assessment and Management (The Air Quality Framework Directive)

12. EU Daughter Directive 99/30/EC.