



2013 Air Quality Progress Report

for the

City & County of Swansea

In fulfillment of Part IV of the Environment Act 1995
Local Air Quality Management

June 2013

Local Authority Officer	Mr H. Morgan Mr P Govier
--------------------------------	-----------------------------

Department	Environment
Address	Pollution Control Division
Telephone	01792 635600
e-mail	pollution@swansea.gov.uk

Report Reference number	Swan/LAQM/ProgressReport 2013
Date	June 2013

Executive Summary

The Environment Act 1995, Part IV established a national framework for air quality management that requires all local authorities to conduct air quality reviews of their areas having had regard to any guidance issued. If the reviews undertaken indicate that the objective for any of the identified pollutants will not be met by the date for compliance then an Air Quality Management Area must be declared.

The City and County of Swansea following the first round of review and assessment concluded that there was a requirement to declare the Hafod area as an Air Quality Management Area due to exceedences of the nitrogen dioxide annual mean objective. This area was declared in September 2001 and a map outlining the area can be seen within Annexe 1.

During August 2010 and due to exceedences of the nitrogen dioxide annual mean objective being measured within the Sketty and Fforestfach areas of the authority, the Hafod Air Quality Management Area was amended by Council to include these newly identified areas and renamed the Swansea Air Quality Management Area 2010. The areas now making up the Swansea Air Quality Management Area 2010 can be seen within Annexe 2.

This report contains the latest air quality monitoring results within the City and County of Swansea. The conclusions reached are that the objectives for benzene, lead and sulphur dioxide will be met and that there is no requirement to proceed further with these pollutants. However, there is evidence that the annual mean objective for nitrogen dioxide of $40\mu\text{g}/\text{m}^3$ will continue to be exceeded within the existing Swansea Air Quality Management Area 2010. Latest monitoring undertaken also indicates newly identified areas of exceedences of the nitrogen dioxide annual mean objective outside of the Swansea Air Quality Management Area 2010 within the Mumbles, Uplands, St.Thomas and city centre areas of the authority. Several other areas also

exhibit the potential to exceed the annual mean objective as the measured annual means are within the range 37-40 ug/m³.

It is proposed to amend the existing Swansea Air Quality Management Area 2010 to include the Uplands area. This decision has been taken due to the latest monitoring results confirming the exceedences first reported within the Progress Report 2011. Mumbles, the City Centre and St.Thomas will again be subject to further monitoring and additional works to try and obtain monitoring results from the facades of flats affected at the first floor and greater levels. Revised guidance issued by DEFRA during April 2012 to predict nitrogen dioxide concentrations in future years now indicates that the annual mean objective may not be achieved until after 2020 at some sites. Updates on the situation will be provided within future reporting. Reports will now be presented to Council with the recommendation that the Uplands area be added to the Swansea Air Quality Management Area 2010 and be renamed to the Swansea (NO₂) Air Quality Management Area 2013.

The City and County of Swansea participates in the UK Heavy Metals Monitoring Network and has monitoring stations within the Glais, Clydach and Morriston areas monitoring the high level stack discharge from the nickel refinery within Clydach. During late 2007 the company installed improved abatement management on the high level stack discharge. Additional monitoring stations had been established during 2007/2008 both upwind and downwind of the release point taking the total monitoring locations to four. Two of these stations have been adopted onto the UK Heavy Metals Monitoring network. Monitoring results since 2009-2012 have indicated compliance with the 4th Daughter Directive critical threshold monitoring target value for nickel at all monitoring stations. Improvements continue to be made at the refinery and these improved abatement techniques are becoming increasingly evident within the monitoring results. It is envisaged monitoring at all four stations will continue for the foreseeable future to confirm continued and ongoing compliance with the 4th Daughter Directive critical threshold monitoring target value for nickel.

Due to budgetary restraints, progress with implementation of the measures contained within the authorities Air Quality Action Plan has been slow. Impending additional budgetary restraints may in effect mean that any further development of the plan will cease. Some Nowcaster delivery that has been undertaken, has only been possible having benefited from external funding i.e. 3 roadside message signs as part of the Swansea “Boulevard” project which aims to bridge the divide between the city centre and maritime quarter/foreshore and the funding of a further 3 additional roadside signs by the Assembly under its Tranquil, Greener and Cleaner Places grant scheme.

Additionally, due to the increasing financial pressures being faced by the authority, real-time automatic measurements at the Morfa Groundhog site ceased during early 2011. Consideration is being given to disposal of the equipment. Real time monitoring for the pollutants carbon monoxide and hydrogen sulphide have ceased at all remaining sites. Sulphur dioxide is now only measured at one location in Swansea at the St.Thomas DOAS.

The authority’s network of passive nitrogen dioxide tube monitoring has also been scaled back significantly due to budgetary pressures and the staff resources required to operate such an extensive network. All sites that have consistently returned a bias corrected annual mean below 30ug/m³ have been, or will be, discontinued with the exception of those sites within or near to the Swansea Air Quality Management Area 2010 where these sites may prove useful in assessing the benefit if any of measures taken within the AQMA.

Table of contents

1. Introduction	7
1.1 Description of Local Authority Area	7
1.2 Purpose of Progress Report	9
1.3 Air Quality Objectives	10
1.4 Summary of Previous Review and Assessments	12
2. New Monitoring Data	19
2.1 Summary of Continuous Real Time Monitoring Undertaken	19
2.2 Comparison of Monitoring Results with Air Quality Objectives	57
3. New Local Developments	170
3.1 Road Traffic Sources	170
3.1.1 Narrow Congested Streets with Residential Properties Close to the Kerb	170
3.1.2 Busy Streets Where People May Spend 1-hour or More Close to Traffic	172
3.1.3 Roads with a High Flow of Buses and/or HGV's.	174
3.1.4 Junctions	181
3.1.5 New Roads Constructed or Proposed Since the Last Round of Review and Assessment	183
3.1.6 Roads with Significantly Changed Traffic Flows	183
3.1.7 Bus and Coach Stations	201
3.1.8 Airports	205
4 Local / Regional Air Quality Strategy	229
5 Planning Applications	231
6 Air Quality Planning Policies	271
7 Local Transport Plans and Strategies	272
8 Climate Change Strategies	316
9 Implementation of Action Plans	318
10 Conclusions and Proposed Actions	346

1. Introduction

1.1 *Description of Local Authority Area*

The City and County of Swansea unitary authority covers a mixed area of extensive coastline, rural villages and the City of Swansea itself. The latest Census (March 2011) estimate for the population of Swansea is 239,000. The 2011 Census also indicates some important changes within the age profile from the previous 2000 Census:-

- **Aged under-5:** a significant growth of around 1,100 (+8.8%)
- **Aged 5-14 years** (school-age): a decline of 1,600 (-6.0%), probably due in large part to reductions in the number of births recorded in the late 1990's / early 2000's.
- **15-19 age** groups: an increase of around 1,200 (+7.8%). This could mainly reflect the increasing inflow of 18 and 19 year olds to Swansea's universities.
- **20-24:** a pronounced growth of almost 5,000 (+31.8%) over the ten-year period, again linked to increasing levels of student in-migration and initial retention, including those from elsewhere in Wales, the UK and (to some extent) overseas.
- **25-29:** a significant increase in the population of this cohort over the period by 3,100(+24.5%). This growth could be attributable to a number of factors, including economic in-migration and the retention of graduates.
- **30-39:** a moderate decrease of 1,200 (-3.8%).
- **40-49:** an increase of 9.7% (+2,900), possibly linked to the 1960s 'baby boom'.
- **50-64:** a steady increase of 8.5% (+3,500), again slightly higher than the equivalent overall rate of population increase for Swansea over the period (+6.9%)
- **Older population** (all aged 65+): an increase of 1,900 (+4.6%), indicative of an ageing population, in line with established national trends. However, population growth in the older groups has been most dramatic in the population aged over 85, which is estimated to have increased in Swansea by 900 (+18.8%) over the ten year period from around 4,900 in 2001 to 5,800 in 2011.

To the west of the City of Swansea stands the gateway to the Gower Peninsula, an officially designated Area of Outstanding Beauty that boasts wide-open beaches and rugged shorelines. To the east of the City and County of Swansea lies the only major operational traditional "heavy industry" in the

form of the Tata Steelworks complex at Port Talbot. Heavy industry has declined steadily within the boundaries of the authority during the last century. This former industrial activity has left its scars – most notably to the Lower Swansea Valley. From the early 1970's the areas once blighted by slag heaps have undergone extensive remediation and greening. New "light industry" and retail outlets have moved back into the Lower Swansea Valley following the establishment of Enterprise Zone's and industrial parks. Considerable regeneration is now ongoing within the Swansea area notably the docks re-development and within the city centre/marina area.

The major source of pollution is now vehicular. The topography of the Lower Swansea Valley is complex and it is thought that this aggravates pollution loading in the area. Swansea is connected to major road and rail links. The M4 motorway travels through northern area of the authority, connecting Swansea with Carmarthenshire in the west and to Cardiff and Bristol to the east. The major artery routes of the A483, A4067 and A48 connect Swansea city centre with the M4 motorway junctions to the north. Local traffic also use these routes as primary routes into the city centre.

Swansea is well served with rail links to the majority of the UK. The Inter-City 125 service from London Paddington terminates at Swansea. Local services operate from Swansea to mid and West Wales. A major locomotive-servicing centre operates within Swansea at Landore Diesel Sheds, primarily to service the power units of the Inter City 125 service. The majority of diesel locomotives operated by First Great Western are also serviced and maintained at this facility.

The older and established areas of Swansea comprise of traditional terraced housing. These areas tend to be, but are not exclusively within approximately 3 miles of the city centre. Areas of high density terraced housing still exist around the centres of population established during the Industrial Revolution.

As would be expected, new housing provision tends to be either of detached, or semi-detached, and during the last 20 – 30 years these developments have

mainly been located in areas greater than 3 miles away from the city centre. This trend is changing however and within the last 5 years Swansea has seen the SA1 development within the old docks area provide a springboard for new housing development both within the SA1 development site and more lately within the marina area. This regeneration is now also extending into the heart of the city centre with several residential developments taking the place of retail/business premises or occupying the upper floors of former wholly retail premises.

The Tawe Riverside Corridor Proposals will, if implemented see, the regeneration of a large section of the lower Swansea Valley from the Quay Parade bridges up to the Morfa Retail Park. This area is subject to past historical industrial contamination from primarily metals processing and has been in decline for several decades. Some sites have been developed for industrial use but large sections of land remained in the same state following the lower Swansea Valley project of the late 1970's and early 1980's. This project dealt with the legacy of contamination by clearing derelict sites and undertaking limited remediation with extensive landscaping.

1.2 Purpose of Progress Report

This report fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedences are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

Progress Reports are required in the intervening years between the three-yearly Updating and Screening Assessment reports. Their purpose is to maintain continuity in the Local Air Quality Management process.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM **in Wales** are set out in the Air Quality (Wales) Regulations 2000, No. 1940 (Wales 138), Air Quality (Amendment) (Wales) Regulations 2002, No 3182 (Wales 298), and are shown in Table 1 below. This table shows the objectives in units of microgrammes per cubic metre $\mu\text{g}/\text{m}^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Pollutant	Concentration	Measured as	Date to be achieved by
Benzene	16.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
	5.00 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Maximum daily running 8-hour mean	31.12.2003
Lead	0.5 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	0.25 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2005
Particles (PM₁₀) (gravimetric)	50 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

Table 1 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in Wales

1.4 Summary of Previous Review and Assessments

The local authority review and assessment process is multi-staged. This Authority carried out its first stage review in 1999. The conclusion reached was to progress to a second and third stage review for Benzene, Particulate Matter (PM₁₀), Sulphur Dioxide (SO₂) and Nitrogen Dioxide (NO₂).

In between these stages, the authority had to deal with, and resolve a burning, disused coal spoil tip at the former Brynlliw Colliery site. This absorbed most resources available between 1999 and 2000.

Along with all other local authorities, this authority has completed its stage 2 and stage 3 reviews. The third stage review and assessment concluded that despite the indication that the air quality objective for benzene would not be met that the declaration of an AQMA was not appropriate. Given the fundamental changes proposed to the Lower Swansea Valley's infrastructure and the technical improvements proposed in the reduction in the benzene content in fuel, it was recommended that a further benzene monitoring study be carried out for a period of at least 12 months. During the stage 3 process, it was determined that the authority would not breach the objectives laid down for Particulate Matter (PM₁₀) and Sulphur Dioxide (SO₂).

Section 83(1) of the Environment Act 1995 requires the Authority to designate as Air Quality Management Areas (AQMA's) those areas where it is likely that the standards for any of the identified pollutants would be exceeded. As a result of the detailed work carried out in the authorities' third stage review and assessment it was found that areas of the Hafod were likely to fail the NO₂ annual mean objective of 40µg/m³ by the compliance date of 31st December 2005.

On the 12th September 2001 the Authority declared The Hafod Air Quality Management Area (NO₂), cited as the City & County of Swansea (Hafod Air Quality Management Area (NO₂)) Order 2001. The Order came into force on

the 14th September 2001. Annexe 1 contains a map indicating the AQMA area.

The Stage 4 review required under Section 84(1) of the Environment Act 1995 confirmed the earlier findings and that the declaration of the Hafod AQMA was justified as several locations were projected to fail the nitrogen dioxide (NO₂) annual mean objective in 2005.

Section 84 of the Environment Act 1995 requires the formulation of a written plan in pursuit of the achievement of air quality standards and objectives within the designated AQMA and has become known as the "Action Plan". The City and County of Swansea have undertaken a considerable amount of feasibility and infrastructure work in formulating its Action Plan taking a few years to produce the completed Action Plan in December 2004.

In 2004, the authority commenced works on the second round of review and assessment. In accordance with the policy and technical guidance documents, the second round of review and assessment was carried out in two stages;

- An Updating and Screening Assessment (USA) - intended to identify aspects that have changed since the first round of review and assessment (from 1999 in Swansea's case) and identify those that require further assessment; namely
- A Detailed Assessment of those pollutants that have been identified as requiring further work and investigation

The Updating and Screening Assessment was submitted to the Welsh Assembly Government in July 2004 with a recommendation to proceed to a detailed assessment for nitrogen dioxide at identified narrow congested streets and busy junctions. The USA also concluded that particulate matter PM₁₀ should also be investigated using real-time techniques at the identified

narrow, congested streets and busy junctions, despite the then 2010 provisional objectives not being set in regulation.

A brief summary of the results and conclusions of the Detailed Assessment into NO₂ levels can also be found within the Progress Report 2004 – section 2.3.2.3 page 95. The Detailed Assessment itself was submitted to the Welsh Assembly Government during December 2005. This assessment concluded that there was no justification in declaring additional AQMA's. At the time of submission, there was a debate with the auditors and Welsh assembly Government over the bias factor used to correct the nitrogen dioxide passive diffusion tube data. The authority used the bias factor quoted by Harwell Scientifics to correct for tube bias. Whilst the Detailed Assessment report was eventually accepted by the Welsh Assembly Government and the auditors as a result of the authority providing additional supporting information and justification for the use of the Harwell Scientific bias factor it was agreed that the authority would undertake co-location studies with its chemiluminescent analysers at 3 sites namely, the Swansea AURN on Carmarthen Road, and at the Morfa and Morrison Groundhog sites. This work commenced during December 2006 and was delayed until the Swansea AURN had been relocated and commissioned to prevent any additional uncertainties. The authority has now completed these co-location tasks at all three automatic sites within Swansea and has determined a local bias factor for the correction of the passive nitrogen dioxide diffusion tubes exposed within Swansea during 2008. Further details on this area of work can be found within section 2.1.13

The Progress Report for 2004/05 was submitted for consideration during July 2005

The infrastructure required for a real-time assessment of PM₁₀ in Swansea, is still being developed. The authority have purchased ten Met One E-Type light scattering PM₁₀ dust samplers and are in the process of deploying these at the identified narrow, congested roads and busy junctions mentioned within the USA submitted in July 2004 and the Detailed Assessment. Identification of suitable sites is now complete but what has proved time consuming are the

practical considerations of the site location itself together with the provision of suitable services i.e. un-metered electricity feeds and suitable mounting points. Significant problems have been, and continue to be encountered with the operation of the E Type samplers. It is recognised that these analysers do not have formal UK type approval but due to both the expense and considerable practical considerations of deploying Rupprecht & Patashnick Co., Inc. FDMS/TEOM's, these E Type samplers will provide a more accurate assessment than use of the DMRB screening tool would be able to provide. It is thought that if the technical difficulties being experienced with the equipment can be resolved that the modelling will supplement the data collected by the E Type samplers.

Additional works underway include the collection of real-time classified counts of traffic data via the Vodafone GPRS network together with the construction of an emissions database. It is these latter items, particularly communications problems with the GPRS system that have delayed the modelling capabilities to date. The USA dated April 2006 was submitted for consideration to the Welsh Assembly Government in July 2006.

The authority undertook a further Progress Report in 2007 which was submitted to the Welsh Assembly and the auditors during July 2007. The same issues arose from this report with the auditors – the rationale behind the bias factor used to correct the passive diffusion tube was again raised despite the report clearly outlining the authorities' reasons for using the bias factor that was used to correct for tube bias. This issue as mentioned above should now have been resolved with the determination of a local Swansea bias factor

Progress Report 2008

The authority submitted its Updating and Screening Assessment 2009 to the Welsh Assembly Government during July 2009. The conclusions of this assessment were that exceedences of the nitrogen dioxide annual mean objective continued to be seen within the existing Hafod Air Quality Management Area along the Neath Road corridor, Cwm Level Road

(Brynhyfryd Cross Roads) and Carmarthen Road (Dyfatty area). Additional monitoring within the then Hafod AQMA area around the High Street Railway Station highlighted the potential of exceedence of both the annual mean and 1-hour nitrogen dioxide objectives. Monitoring from outside of the then existing Hafod AQMA identified new areas that were failing the nitrogen dioxide annual mean objective. These areas are along Gower Road in Sketty, along Carmarthen Road within Fforestfach, and at numerous sites within the city centre. The city centre area was treated with caution as at the time of submission, only the minimum 9 months of data was available for analysis. An update on the city centre monitoring for nitrogen dioxide is presented below within section 2.1.2. The authority doubled its passive nitrogen dioxide tube survey during November 2009 from 134 to 274 sites, as a result of new LAQM Technical Guidance (LAQM.TG(09)) and the conclusions reached within the USA 2009 that used the new guidance, that additional initial screening of narrow/congested streets was required where the AADT flow was greater than 5000 vehicles. Monitoring data is presented for the periods available for the 140 additional sites within section 2.1.2.

Following the USA 2009, the authority intended to amend the existing Hafod Air Quality Management Area to include these newly identified areas (Sketty and Fforestfach) along with the renaming of the declared air quality management area. All declared areas are to be collectively known as The Swansea Air Quality Management Area 2010. However, considerable delays were encountered with the mechanisms of obtaining the necessary Council Order. Details were presented before Council during August 2010. Annexe 2 contains a map indicating the adopted Swansea Air Quality Management Area 2010

Progress Report 2010

The authorities Progress Report 2010 continued to highlight and confirm exceedences of the nitrogen dioxide annual mean objective within the Sketty and Fforestfach areas of Swansea. These areas have now been included within the Swansea Air Quality Management Area 2010.

Progress Report 2011

The authorities Progress Report 2011 continued to highlight and confirm exceedences of the nitrogen dioxide annual mean objective within the Sketty and Fforestfach areas of Swansea. Additionally, other sites outside of the Swansea Air Quality Management Area 2010 in the Mumbles, Uplands, Morriston, Llansamlet and Ynystawe areas were found to be exceeding the nitrogen dioxide annual mean objective. It was stated that further monitoring would be undertaken to confirm such exceedences before any additional AQMS were declared.

Updating and Screening Assessment 2012

The authorities USA 2012 continued to highlight and confirm exceedences of the nitrogen dioxide annual mean objective within the Hafod, Sketty and Fforestfach areas of the Swansea AQMA 2010. Additionally, other sites outside of the Swansea Air Quality Management Area 2010 in the Mumbles, Uplands, Morriston, and St.Thomas areas were found to be exceeding the nitrogen dioxide annual mean objective. It was stated that the authority would consider the amendment of the Swansea Air Quality Management area 2010 and that further monitoring would be undertaken within the areas to confirm such exceedences before any additional AQMS were declared. Additional real-time chemiluminescent monitoring has not been possible. Similarly, no passive diffusion tube monitoring has been possible at first floor level within the Newton Road area of Mumbles

Details on the various stages completed by the authority in the Local Air Quality Management process are given below within table 2. Brynlliw Colliery remediation is shown for information purposes due to the delays in the LAQM process that this introduced. This was a long-term burning tip which required large scale monitoring and control.

Report	Date Completed	Internet URL
1st Stage Review	1999	http://www.swansea.gov.uk/index.cfm?articleid=5563
Brynliw Colliery Remediation	1999-2000	N/A
2nd & 3rd Stage Review	2001	http://www.swansea.gov.uk/index.cfm?articleid=5565
Declaration of Hafod AQMA	September 2001	http://www.swansea.gov.uk/index.cfm?articleid=5557
Stage 4 Review	October 2003	http://www.swansea.gov.uk/index.cfm?articleid=5568
2nd Round Review USA	July 2004	http://www.swansea.gov.uk/index.cfm?articleid=5561
Hafod AQMA Action Plan	December 2004	http://www.swansea.gov.uk/index.cfm?articleid=9930
Progress Report 2004	July 2005	http://www.swansea.gov.uk/index.cfm?articleid=9929
Detailed Assessment	December 2005	http://www.swansea.gov.uk/index.cfm?articleid=5561
Progress Report 2006	July 2006	http://www.swansea.gov.uk/index.cfm?articleid=9929
USA 2006	April 2006	http://www.swansea.gov.uk/index.cfm?articleid=5561
Progress Report 2007	July 2007	http://www.swansea.gov.uk/index.cfm?articleid=9929
Progress Report 2008	May 2008	http://www.swansea.gov.uk/media/pdf/l/3/Progress_Report_2008.pdf
USA 2009	July 2009	http://www.swansea.gov.uk/media/pdf/e/1/City_and_County_of_Swansea_USA_2009_PDF.pdf
Progress Report 2010	July 2010	http://www.swansea.gov.uk/media/pdf/2/5/Progress_Report_2010.pdf
Progress Report 2011	September 2011	http://www.swansea.gov.uk/media/pdf/d/4/Progress_Report_2011.pdf
USA 2012	September 2012	http://www.swansea.gov.uk/media/pdf/n/1/USA2012.pdf

Table 2 – Summary of Local Air Quality Management actions

The Internet addresses (URL's) that these reports can be downloaded from are given where appropriate.

2. New Monitoring Data

2.1 Summary of Continuous Real Time Monitoring Undertaken

The authority operates a network of monitoring stations, mainly located within the lower Swansea valley area. The network is a mixture of three, fixed point automatic stations, together with open path measurements from two DOAS (Differential Optical Absorption Spectroscopy) stations. Details of all automatic monitoring station are given below in table 3 with site by site operational details provided within section 2.1.1. Two of the fixed point stations (Morfa and Morriston) had datasets extending back to 2001. A summary of the commencement of measurement for each station is given below within section 2.1.8 as table 4.

Details of the Morfa Station are included for completeness but, as explained below this station was decommissioned during May 2011.

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	IN AQMA	Relevant Exposure	Distance to kerb of nearest road	Worst-case Location
Swansea Roadside AURN	Roadside	X 265322 Y 194447	NO ₂ , PM ₁₀ , PM _{2.5} CO, SO ₂	Y	Y (12m)	4m	N
Morfa Groundhog	Roadside	X 266036 Y 195406	NO ₂ , PM ₁₀ , SO ₂	Y	Y (34m)	5m	Y
Morrison Groundhog	Roadside	X 267210 Y 197676	NO ₂ , PM ₁₀ , CO, SO ₂ and Ozone	N	Y (22m)	4m	N
Cwm Level Park	Urban Background	X 265915 Y 195895	NO ₂ and Ozone	Y	N (100m)	78m	N
Hafod DOAS	Roadside	Transmitter X 265927 Y 194453 Receiver X 265991 Y 194706	NO ₂ Ozone and Benzene	Y	Y (0.3m)	1.7m	N
St Thomas DOAS	Roadside	Transmitter X 266191 Y 193655 Receiver X 266263 Y 193370	NO ₂ Ozone and Benzene	N	Y(2m) Varies along path length	1.7m	N

Table 3 Details of Automatic Monitoring Sites

2.1.1 Automatic Continuous Real Time Monitoring Sites

2.1.2 Swansea Roadside AURN, Carmarthen Road, Waun Wen

The Swansea AURN was located in the heart of the city centre on the pedestrian area of Princess Way. Due to the redevelopment of the David Evans complex, the monitoring station was scheduled for decommissioning on the 14th August 2006. The data logger failed on the 3rd August 2006 following a power surge at the site and in effect, data from the site ceased on this date as it was decided not to undertake any repairs to the data logger. Every effort had been made to re-establish the monitoring station within the city centre. However, DEFRA had amended the siting criterion which has resulted in a suitable site being unable to be identified. The station has now been relocated roadside on Carmarthen Road at Waun Wen. The Annual Average Daily Traffic flow (AADT) for 2012 was 20,832 vehicles. The relocated site is detailed and outlined below and is now sited within the boundary of the Swansea Air Quality Management Area 2010. The site has receptors close by with additional sensitive receptors in close proximity - a Nursing Home and a Primary School are within 100m of the monitoring location.

The AUN station at Princess Way had been affiliated onto the UK National Network during late 1994 and had been operational ever since until 3rd August 2006. The new roadside site has also been affiliated onto the UK National Network with data capture commencing on the 20th September 2006 at 13:00hrs. The station has been given a site classification Roadside¹. Map 1 below is an aerial view of the site and the surrounding locations. The site is located in an open aspect approximately 55m above sea level with direct views over Swansea Bay. It is therefore more exposed to the prevailing south westerly winds than the monitoring sites located on the valley floor (Morfa, Morrision and Hafod DOAS). It is thought probable that this site may well sit above any inversions that form within the lower Swansea Valley and

¹ Source LAQM.TG(09) Appendix A page A1-20 Table A1.4

therefore, does not experience the elevated concentrations seen at the other monitoring stations during such conditions.



Map 1 – Aerial view of Swansea Roadside AURN

© Crown Copyright and database right 2013. Ordnance Survey 100023509

All equipment is housed within an air-conditioned unit and operated continuously. The equipment comprises of an Advanced Pollution Instrument (API) real-time analyser measuring NO_x with Thermo FDMS units measuring PM_{10} and $\text{PM}_{2.5}$ until the 16th November 2011 when they were removed due to their unreliability and were replaced with Met One1020 BAM units on the 28th November 2011. The API gas analyser has been configured so that a daily automatic calibration is carried out (between 00:30 hours and 01:00 hours). This calibration data is automatically logged as invalid by the analyser. In addition officers from this authority performed routine monthly manual calibrations. The analyser is subjected to scrubbed internal generated zero air to assess the analyser's response to zero air. The analyser is also subjected

to traceable calibration gases at a known concentration and the response of the analyser recorded. All manual calibration data is then forwarded to Ricardo AEA (formerly AEA Energy and Environment) to perform data management procedures. The data is then further subjected to full network QA/QC procedure's undertaken by Ricardo AEA on behalf of the Department of Environment, Food and Rural Affairs (DEFRA). The station is serviced and maintained twice yearly by Enviro Technology Services Plc. In addition, the authority has a 48 hour call out response for any on-site equipment problems with Enviro Technology Services Plc. All equipment on site is fully audited twice yearly by Ricardo AEA together with the calibration gases stored on site

Hourly ratified data for 2011 covering the pollutants Nitrogen Dioxide and Particulate Matter PM₁₀ and PM_{2.5} (FDMS and BAM 1020) has been downloaded from the Air Quality Archive at http://uk-air.defra.gov.uk/data/data_selector . These data have then been imported into the OPSIS Enviman Reporter databases allowing analysis and graphical presentation.

During 2007, the UK Automatic Network underwent a review by DEFRA. During this review, numerous stations were either decommissioned from the network, or, as in the case of the Swansea AURN, a limited number of analysers from the station were kept within the UK monitoring framework. This review was undertaken by DEFRA in response to their changing EU commitments. Whilst data from the CO and SO₂ analysers are no longer collected (post 1st October 2007) or ratified by DEFRA (by the then AEA Energy and Environment), this authority had decided to continue to fund their operation and data collection. However, due to budgetary constraints and the relatively low concentrations being recorded, this authority decided to cease measurements of CO and SO₂ during October 2010. The dataset from 1st October 2007 to 27th October 2010 for the above mentioned pollutants was therefore ratified by the authority. No presentation or analysis of CO and SO₂ since 2010 is made within this report as all objectives set in regulation had previously been met comfortably for several years at the AURN site. Full details relating to these pollutants have been reported within previous LAQM

reports submitted by this authority. Therefore, only NO₂ and PM₁₀ data are reported here for 2012

The ozone analyser that was surplus to requirements at the site following the DEFRA review has been relocated at the Cwm Level Park urban background monitoring station during December 2008.

2.1.3 Morfa Groundhog

The Morfa station had been operational since August 2000 and was located in a fairly open area on a grass bank to the Morfa / Normandy roundabout which acts as a major intersection to the road network in the lower Swansea Valley. During May 2011 measurements ceased at this site due to the loss of the electricity supply to the station. The station was within the boundary of the Swansea Air Quality Management Area 2010 and had been given a site classification Roadside².

As with the majority of monitoring stations, the location finally chosen for monitoring has to be a compromise between the ideal desired location and the practicalities of siting a station of this size. It is recognised that this station having being sited adjacent to a roundabout is not ideally placed. However, in saying this, the station satisfied the majority of the monitoring criteria required by this authority with receptor locations (dwellings) being located within 35m. Due to its location in a fairly open aspect of the lower valley area, this station did not truly reflect the conditions experienced within the nearby narrow congested streets within the Neath Road corridor (see Hafod DOAS) that form part of the Swansea Air Quality Management Area 2010.

All equipment was housed within an air-conditioned unit and operated continuously. The equipment comprised of Advanced Pollution Instruments (API) real-time analysers measuring CO, SO₂ and NO_x. The R&P TEOM measuring PM₁₀ was upgraded to a Thermo FDMS unit again measuring PM₁₀

² Source LAQM.TG(09) Appendix A page A1-20 Table A1.4

on the 28th November 2006 with data capture for the FDMS unit commencing at 13:00. The API gas analysers have been configured so that a daily automatic calibration is carried out (between 00:30 hours and 01:00 hours). This calibration data is automatically logged as invalid by the data-logger. In addition officers from this authority perform routine monthly manual calibrations. The analyser's are subjected to scrubbed internal generated zero air to assess the analyser's response to zero air. The analysers are also subjected to traceable calibration gases at a known concentration and the response of the analyser and data-logger is recorded. All manual calibration data is recorded as invalid data by the data-logger and is removed from any subsequent analysis.

The station was operated and calibrated in accordance with the UK National Network Local Site Operators manual. Data has been re-scaled by the authority according to the calibration factors (monthly span and overnight/monthly zeros). The station was serviced and maintained twice yearly by Enviro Technology Services Ltd. In addition, the authority had a 48 hour call out response for any on-site equipment problems with Enviro Technology Services Plc. Since the awarding of the contract by the Welsh Assembly Government to AEA Energy & Environment to run the Welsh Air Quality Forum in April 2004, all equipment on site was fully audited yearly by AEA Energy & Environment together with the calibration gases stored on site. The L10 span gas cylinders are replaced on a regular basis and are to a certified and traceable standard.

A map showing the location of the Morfa Groundhog station is given below as map 2. The boundary of part of the existing Swansea Air Quality Management Area 2010 is shown as the black/yellow dashed line.



Map 2 Location of Morfa Groundhog Station
© Crown Copyright and database right 2013. Ordnance Survey 100023509

As mentioned above, measurements ceased at this site during May 2011. Prior to this, the CO and SO₂ measurements ceased during August 2010 due to budgetary restrictions. No presentation or analysis of data for these pollutants is made within this report as all objectives set in regulation had previously been met comfortably for several years. Full details relating to these pollutants have been reported within previous LAQM reports submitted by this authority. Therefore, no data are reported here for pre 2011 and its inclusion here is for information only.

2.1.4 Morriston Groundhog

Morriston Groundhog has been operational since September 2000 and is located adjacent to the southbound slip road to the busy A4067 dual carriageway at Morriston Underpass. The Swansea Air Quality Management Area 2010 (former Hafod AQMA) boundary is approximately one mile south of this location. Receptor locations can be found to the right of the station in the form of terraced housing. To the left of the site and on the opposite side of the dual carriageway is Morriston Primary School. The school buildings abut the red brick retaining wall to the northbound Morriston slip road exit. The

A4067 carries on for approximately one mile northbound where it meets the M4 motorway at junction 45. The station has been given a site classification Roadside³. Map 3 below is an aerial view of the site and the surrounding locations.

All equipment is housed within an air-conditioned unit and operates continuously. The equipment comprises of Advanced Pollution Instruments (API) real-time analysers measuring O₃, and NO_x. The R&P PM₁₀TEOM was upgraded to a Thermo FDMS PM₁₀ unit on the 27th October 2006 with data capture for the FDMS unit commencing at 17:00. The API gas analysers have been configured so that a daily automatic calibration is carried out (between 00:30 hours and 01:00 hours). This calibration data is automatically logged as invalid by the data-logger. In addition officers from this authority perform routine monthly manual calibrations. The analyser's are subjected to scrubbed internal generated zero air to assess the analyser's response to zero air. The analysers are also subjected to traceable calibration gases at a known concentration and the response of the analyser and data-logger is recorded. All manual calibration data is recorded as invalid data by the data-logger and is removed from any subsequent analysis.

The station is operated and calibrated in accordance with the UK National Network Local Site Operators manual. Data is re-scaled by the authority according to the calibration factors (monthly span and overnight/monthly zeros). The station is serviced and maintained twice yearly by Enviro Technology Services Ltd. In addition, the authority has a 48 hour call out response for any on-site equipment problems with Enviro Technology Services Plc. Since the awarding of the contract by the Welsh Assembly Government to Ricardo AEA (formally AEA Energy & Environment) to run the Welsh Air Quality Forum in April 2004, all equipment on site will be fully audited yearly by Ricardo AEA together with the calibration gases stored on site. The L10 span gas cylinders are replaced on a regular basis and are to a certified and traceable standard.

³ Source LAQM.TG(09) Appendix A page A1-20 Table A1.4



Map 3 - Aerial view - Morriston Groundhog
© Crown Copyright and database right 2013. Ordnance Survey 100023509

However, due to budgetary constraints and the historically relatively low concentrations being recorded, this authority decided to cease measurements of CO during April 2010, and SO₂ during October 2010. The H₂S analyser had proved highly problematic and expensive to repair and measurements had already ceased some considerable time ago. No presentation or analysis of 2010 data for these pollutants is made within this report as all objectives set in regulation have previously been met comfortably for several years. Full details relating to these pollutants have been reported within previous LAQM reports submitted by this authority. Therefore, only NO₂, Ozone and PM₁₀ (FDMS) data are reported here for 2012.

2.1.5 Cwm Level Park, Landore

The authority established a NO_x and Ozone urban background monitoring station ⁴ at Cwm Level Park, Landore during late November/ early December 2008 within the compound of its 30m Meteorological monitoring mast.

All equipment is housed within an air-conditioned unit and operates continuously. The equipment comprises of Advanced Pollution Instruments (API) real-time analysers measuring NO_x and Ozone. The API gas analysers have been configured so that a daily automatic calibration is carried out (between 00:30 hours and 01:00 hours). This calibration data is automatically logged as invalid by the data-logger. In addition officers from this authority perform routine monthly manual calibrations. The analyser's are subjected to scrubbed internal generated zero air to assess the analyser's response to zero air. The NO_x analyser is subjected to traceable calibration gases at a known concentration and the response of the analyser and data-logger is recorded. The internal span calibration is used with the ozone analyser. All manual calibration data is recorded as invalid data by the data-logger and is removed from any subsequent analysis.

The station is operated and calibrated in accordance with the UK National Network Local Site Operators manual. The station is serviced and maintained twice yearly by Enviro Technology Services Ltd. In addition, the authority has a 48 hour call out response for any on-site equipment problems with Enviro Technology Services Plc. Since the awarding of the contract by the Welsh Assembly Government to Ricardo AEA (formally AEA Energy & Environment) to run the Welsh Air Quality Forum in April 2004, all equipment on site will be fully audited yearly by Ricardo AEA, together with an audit of the calibration gases stored on site. Data is re-scaled by Ricardo AEA following the authority supplying routine monthly calibration reports. The L10 span gas cylinders (NO and NO₂) will be replaced on a regular basis and are to a certified and traceable standard.

⁴ Source LAQM.TG(09) Appendix A page A1-20 Table A1.4



Map 4 Cwm Level Park Monitoring

© Crown Copyright and database right 2013. Ordnance Survey 100023509

A map showing the location of the Cwm Level Park station is given above as map 4. The boundary of part of the Swansea Air Quality Management Area 2010 (former Hafod AQMA) is shown as the black/yellow dashed line.

There are no “major” sources close by as would be expected with the site classification, with the nearest road being nearly 80m away and having an Annual Average Daily Traffic flow (AADT) during 2012 of 13,944 vehicles. Some light industry / warehouse front the site but are insignificant as a source. Receptor dwellings are within 100m of the site.

2.1.6 The OPSIS Hafod Differential Optical Absorption Spectroscopy (DOAS) Monitoring Station

The OPSIS DOAS open path light source measures the pollutants Nitric Oxide, Nitrogen Dioxide, Ozone and Benzene along a 250-metre section of Neath Road, within the Hafod district of the lower valley area and within the Swansea Air Quality Management Area 2010 (former Hafod AQMA). These measurements take place at first floor level - a height of approximately 3 - 4

metres and less than 0.3m away from the front facade of the terraced dwellings. The DOAS transmitter ❶ is fixed externally to the front wall of a terraced dwelling that fronts onto Neath Road at one end of the open path measurement. The receiver module ❷ is located on the front wall of another dwelling that also fronts onto Neath Road at the other end of the open path measurement length. The receiver focuses the light received and transmits the light via fibre optic cable into a spectra analyser. Map 5 below shows an aerial photograph of the location of the transmitter and receiver heads. This section of Neath Road has an annual average daily traffic flow (AADT) during 2011 of 15,880 vehicles and forms the “traditional” route up/down the Swansea Valley. The whole length of Neath Road through the Lower valley area is characterised by slow moving traffic through the narrow, congested, B route corridor. Habits of a lifetime may prove difficult to break!

The transmitter emits a light beam from a xenon lamp and contains a range of wavelengths, from ultraviolet to visible. Different pollutant molecules absorb light at different wavelengths along the path between the emitter and receiver. The receiver is connected to the analyser that measures the intensity of the different wavelengths along the entire light path and converts this into concentrations for each of the gaseous pollutants being monitored.



Map 5 Hafod Opsis DOAS Monitoring

© Crown Copyright and database right 2013. Ordnance Survey 100023509

The monitoring location is allowing measurements' running parallel to the carriageway to be made of the above pollutants, as the carriageway is approximately 2 metres away from the front facade of these dwellings. The highway at this location can loosely be referred to as a "street canyon". Valid data capture commenced on the 8th January 2004 at 16:00hrs. The station has been given a site classification Roadside⁵.

The DOAS system returns data in the form cyclonic means, not always of the same averaging period - the system has been configured to measure each pollutant for a set period of time: 1 minute each for NO and Benzene and 30 seconds each for nitrogen dioxide and ozone. This gives a cycle time of approximately 3 minutes. The system stores the information as a cycle period of measurement for each pollutant within a "logger value" dataset. During the QA/QC processes that have been completed, conditions were imposed on the

⁵ Source LAQM.TG(09) Appendix A page A1-20 Table A1.4

minimum acceptable light levels and maximum standard deviations of the measurements permitted on the individual cycled means for each pollutant. The validation process produces the same cyclonic means within a separate database. All individual measurement points that have not met the QA/QC conditions (detailed below) are replaced with null values within the new dataset. The user can then compile 5 minute means from the validated dataset and undertake analysis.

- **QA/QC for NO, Nitrogen Dioxide and Ozone**

If (C1 >0 and C1 > 2 * C2 and C3 > 10) then result: = C1 else result: = C0

C0 – Null value

C1 – Pollutant Concentration

C2 – Standard Deviation of pollutant

C3 – Light Level of pollutant

- **QA/QC for Benzene**

If (C1 >0 and C1 > 2 * C2 and C3 > 40) then result: = C1 else result: = C0

C0 – Null value

C1 – Pollutant Concentration

C2 – Standard Deviation of pollutant

C3 – Light Level of pollutant

It should be noted that the data presented here represents the spatial average over the whole of the 250-meter measurement path and not a "point measurement" as seen within other "traditional or conventional" monitoring equipment/locations. It should also be noted that the DOAS methodology of monitoring does not comply with the EU Directive methods of measurement (chemiluminescent for NO₂, UV fluorescence for SO₂ etc) at present but the system has recently achieved MCERTS certification and TUV certification.

Monitoring data from the site has been subject to interruption as the property owner at the transmitter site ❶ undertook extensive renovation works to the property. The transmitter head was removed from the front façade during these works to prevent damage. The equipment was removed from the

façade of the property at 11:00 on the 22nd April 2005 and was replaced at 10:00 16th May 2006. There is therefore significant data loss for both 2005 and 2006 with in total just over a years worth of monitoring data being lost. This is frustrating and regrettable but the loss is outside of the control of this authority.

To compound and frustrate matters further an Area Renewals Project commenced during January 2008 to properties at the receiving end ② of the open path measurement. This renewal project resulted in scaffolding erected to the front facades of the terrace properties blocking the light path to the receiver between the 3rd January 2008 and July 2008. Full functionality was not restored until the site had been serviced and calibrated on the 26th August 2008.

The station is now subject to Xenon lamp changes on a quarterly basis, with zero and span calibrations now taking place on an annual basis. These works are undertaken by Enviro Technology Plc, the UK distributor for Opsis of Sweden. The frequency of zero/span calibration has been subject to discussions with Opsis as noticeable drop off in lamp intensity was noticed for the NO channel (which is deep down in the spectrum) during the 5th and 6th months after renewal. Changing the Xenon lamps every 4 months has resolved this data issue concern.

2.1.7 The Opsis St.Thomas Differential Optical Absorption Spectroscopy (DOAS) Monitoring Station

The St.Thomas OPSIS Differential Optical Absorption Spectroscopy (DOAS) has been installed during September 2005 along a 280m path length of Pentreguinea Road within the St.Thomas area to measure the pollutants sulphur dioxide, nitrogen dioxide, and ozone. Valid data capture commenced on the 12th September 2005 at 09:30am. This section of Pentreguinea Road had an annual average daily traffic flow (AADT) during 2011 of 19,440 vehicles and forms the eastside link up/down the Swansea Valley from

Whiterock bridge to Quay Parade bridges. This route is intended for use within the Action Plan to attempt traffic management during forecast pollution episodes by diverting traffic from the central Neath Road corridor

Measurements take place at a height of approximately 3-4 metres and less than 2m away from the front facade of the majority of terraced dwellings. The DOAS transmitter ❶ is fixed on top of a concrete column located north of the junction of Kilvey Terrace and Pentreguinea Road as shown in photo 1 below. The receiver module ❷ is located on top of a concrete column and site housing at the other end of the open path measurement length as shown in photo 2 below.



Photo 1 - St Thomas DOAS Transmitter



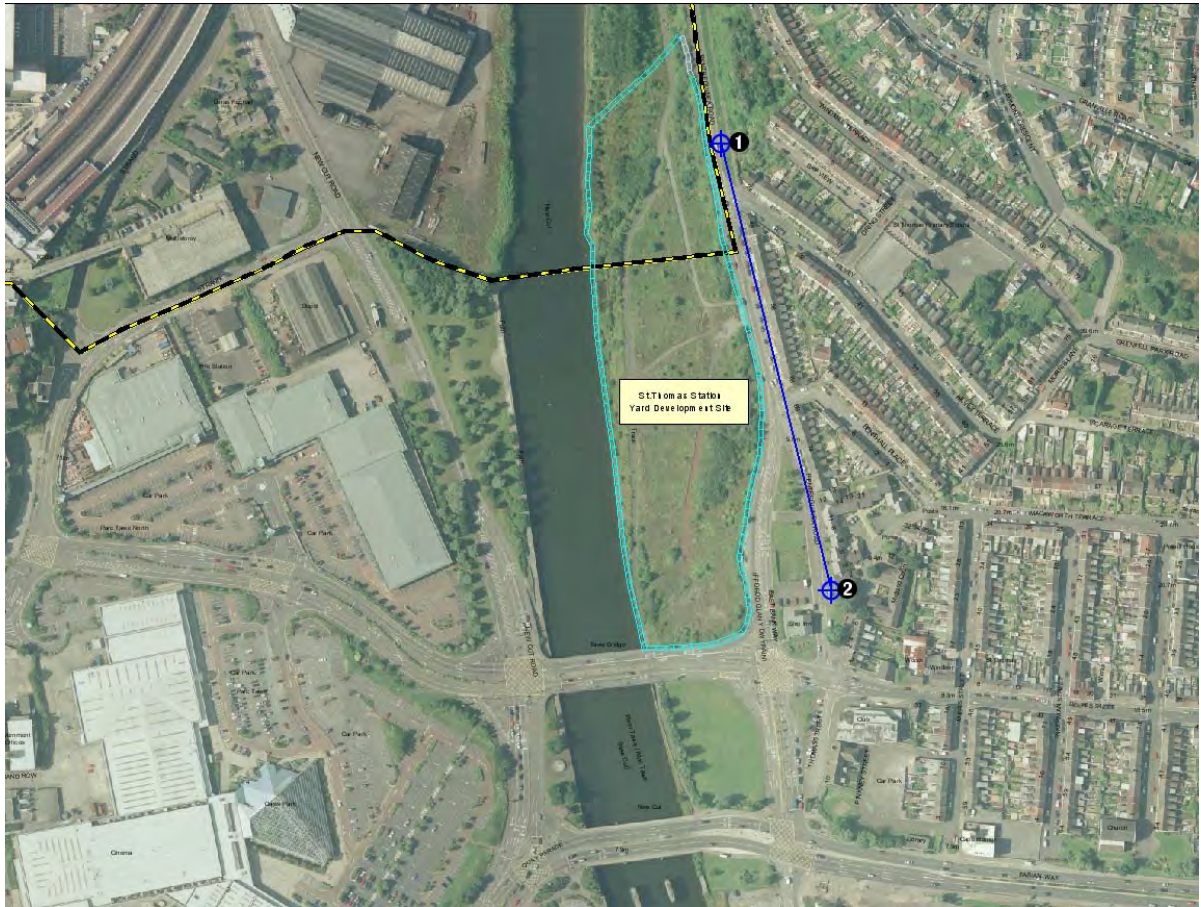
Photo 2 - St Thomas DOAS Receiver Station

The transmitter emits a light beam from a xenon lamp that contains a range of wavelengths, from ultraviolet to visible. Different pollutant molecules absorb light at different wavelengths along the path between the emitter and receiver. The receiver is connected to the analyser that measures the intensity of the different wavelengths along the entire light path and converts this into concentrations for each of the gaseous pollutants being monitored. The station has been given a site classification Roadside⁶.

The monitoring location is allowing measurements' running parallel to the carriageway to be made of the above pollutants. The location of the open path monitoring can be seen within map 6 below. The site of the transmitter lies

⁶ Source LAQM.TG(09) Appendix A page A1-20 Table A1.4

just outside of the southern boundary of the Swansea Air Quality Management Area 2010 (former Hafod AQMA). The extent of the existing order can be seen within map 6.



Map 6 – Aerial View of St.Thomas OPSIS DOAS and surrounding area

© Crown Copyright and database right 2013. Ordnance Survey 100023509

Quay Parade Bridges are to the south of this location. There are numerous dwellings located along this section of Pentreguinea Road with an application already received for residential development on the former St.Thomas Station Yard Site located between Pentreguinea Road and the River Tawe (see map 6 above). An application for formal planning consent was received during 2005 but was rejected due to the intensity of the development. It is thought that a modified scheme will be resubmitted shortly to include an element of social housing as a result of the appeal process.

The DOAS system returns data in the form cyclonic means, not always of the same averaging period - the system has been configured to measure each pollutant for a set period of time: 1 minute for Benzene and 30 seconds each

for sulphur dioxide, nitrogen dioxide and ozone. This gives a cycle time of approximately 3 minutes. The system stores the information as a cycle period of measurement for each pollutant within a “logger value” dataset. During the QA/QC processes that have been completed by this authority, conditions were imposed on the minimum acceptable light levels and maximum standard deviations of the measurements permitted on the individual cycled means for each pollutant. The validation process produces the same cyclonic means within a separate database. All individual measurement points that have not met the QA/QC conditions (detailed below) are replaced with null values within the new dataset. The user can then compile 5 minute means from the validated dataset and undertake analysis.

- **QA/QC for SO₂, Nitrogen Dioxide and Ozone**

If (C1 >0 and C1 > 2 * C2 and C3 > 10) then result: = C1 else result: = C0

C0 – Null value

C1 – Pollutant Concentration

C2 – Standard Deviation of pollutant

C3 – Light Level of pollutant

- **QA/QC for Benzene**

If (C1 >0 and C1 > 2 * C2 and C3 > 40) then result: = C1 else result: = C0

C0 – Null value

C1 – Pollutant Concentration

C2 – Standard Deviation of pollutant

C3 – Light Level of pollutant

The station is subject to Xenon lamp changes on a 6 monthly basis with zero and span calibrations now taking place on a yearly basis. These works are undertaken by Enviro Technology Plc, the UK distributor for Opsis of Sweden. The frequency of lamp change differs to that of the Hafod DOAS as this station does not measure the NO channel and as such does not suffer the drop off/degradation in lamp intensity during the 5th and 6th months of operation. Changing the Xenon lamps every 6 months does not invoke any data issue concerns at this site.

It should be noted that the data presented here represents the spatial average over the whole of the 280-meter measurement path and not a "point measurement" as seen within other "traditional or conventional" monitoring equipment/locations. It should also be noted that the DOAS methodology of monitoring does not comply with the EU Directive methods of measurement (chemiluminescent for NO₂, UV fluorescence for SO₂ etc) at present but the system has recently achieved MCERTS certification and TUV certification.

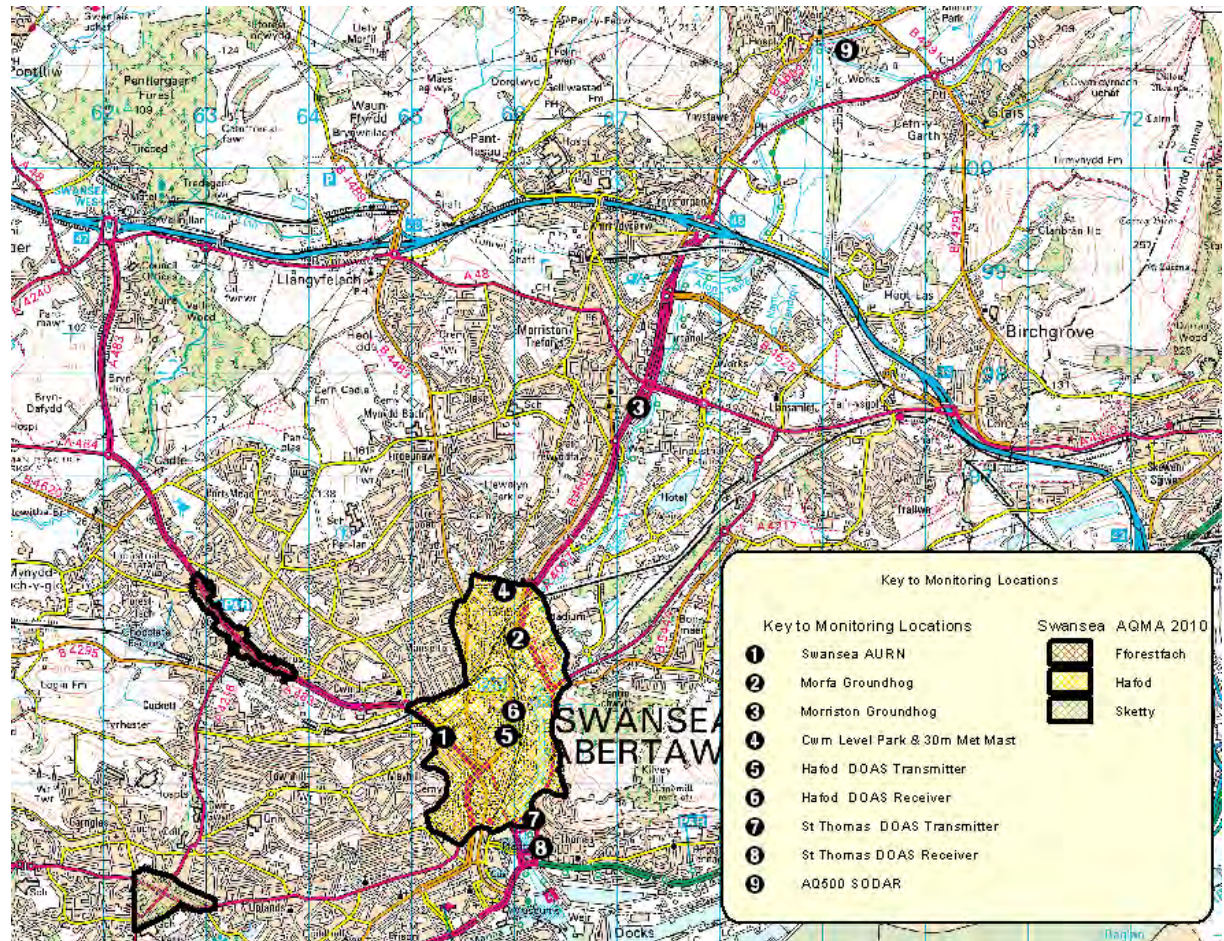
2.1.8 Summary of Automatic Continuous Real-Time Monitoring Locations.

For ease of reference and in order for the reader to familiarise themselves spatially with the locations that the City and County of Swansea undertake automatic continuous monitoring, all such sites are presented below within map 7. Also included within map 7 is the extent of the Swansea Air Quality Management Area 2010 which was declared during August 2010.

Included with this spatial view is the meteorological monitoring that is currently being undertaken within the lower Swansea Valley area. This currently includes a dedicated 30m mast at Cwm Level Park and a SODAR remote sensing instrument capable of wind speed/direction measurements every 15m up to its maximum height range of 300m located within the Vale nickel refinery in Glais further north and up the Swansea Valley. It is envisaged that this meteorological monitoring will provide the datasets required by the air quality modelling that is currently under development, with sufficient details of the meteorological conditions experienced within the complex topographical area that exists in the lower valley area.

From map 7, the reader will no doubt realise that no continuous and automatic monitoring has been, or is currently being undertaken within the Sketty and Fforestfach areas of the Swansea Air Quality Management Area 2010. This is

unlikely to change for a considerable period of time given the current budgetary restraints. Monitoring within these areas has been, and will continue to be undertaken, via passive nitrogen dioxide diffusion tubes.



Map 7 – Overview of continuous monitoring locations

© Crown Copyright and database right 2013. Ordnance Survey 100023509

Table 2 below details the commencement date of monitoring at each of the automatic sites, pollutants monitored and other site criteria details.

Site Name	Site ID	Site Type	Commencement Date of Measurements	Pollutants Monitored	IN AQMA	Relevant Exposure	Distance to kerb of nearest road	Worst-case Location
Swansea Roadside AURN	1	Roadside	20 th September 2006	NO ₂ , PM ₁₀ , PM _{2.5}	Y	Y (12m)	4m	N
Morfa Groundhog	2	Roadside	24 th July 2000	NO ₂ , PM ₁₀	Y	Y (34m)	5m	Y
Morrison Groundhog	3	Roadside	11 th October 2000	NO ₂ , PM ₁₀ , and Ozone	N	Y (22m)	4m	N
Cwm Level Park	4	Urban Back ground	(O ₃) 28 th November 2008 (NO _x) 21 st January 2009	NO ₂ and Ozone	Y	N (100m)	78m	N/A
Hafod DOAS	5	Roadside	8 th January 2004	NO, NO ₂ Ozone and Benzene	Y	Y (0.2m)	1.7m	Y
St Thomas DOAS	6	Roadside	4 th May 2005	SO ₂ , NO ₂ Ozone and Benzene	N	Y(2m) Varies along path	1.7m	N

Table 2 Automatic Continuous Measurements Commencement Dates

2.1.9 Additional Continuous Monitoring

2.1.10 Heavy Metals Monitoring

The Department of the Environment, Transport and the Regions (DETR) is funding a monitoring study to determine ambient concentrations of lead, cadmium, arsenic, mercury and nickel in the vicinity of a wide-variety of industrial processes.

The City and County of Swansea were requested to participate in this study from its inception during 1999/2000 due to the nickel refinery at Vale INCO (now Vale) being located within the authority's area at Clydach.

On the 16th July 2003 the European Commission adopted a proposal for a Directive relating to arsenic, cadmium, nickel, mercury and polycyclic hydrocarbons (PAH) in ambient air⁷. The target values of this Directive are not to be considered as environmental quality standards as defined in Article 2(7) of Directive 96/61/EC and which, according to Article 10 of that Directive, require stricter conditions than those achievable by the use of Best Available Technique (BAT). There are therefore, as yet, no binding obligations to reduce these pollutants. Ambient air concentrations of these substances only have to be monitored once emissions have passed a critical threshold.

Annexe 1 of the Directive details the target values for arsenic, cadmium, nickel and benzo(a)pyrene and these are reproduced below as table 3.

Pollutant	Target value ng/m ⁻³
Arsenic	6
Cadmium	5
Nickel	20
Benzo(a)pyrene	1

Table 3 - Target Values 4th Daughter Directive - Heavy Metals Monitoring

Glais Primary School, School Road, ② was chosen as the initial monitoring location due to its proximity to the refinery ① and for additional security issues with the equipment at the time. A Rupprecht & Patashnick Co., Inc. Partisol 2000 sampling unit, fitted with a PM₁₀ sampling inlet with a flow rate of 16.7 l/min, has been installed on a flat roof at Glais Primary School.

During July 2006, two additional monitoring locations were added: one at Coed-Gwilym Cemetery ③ upwind of the high level stack release and one at the Morryston Groundhog ⑤ some 4.1 kilometres downwind of the stack release point (see section 2.1.4 for site location of the Morryston Groundhog and section 2.1.8 for spatial location). Both additional units were Partisol 2025 units with automatic filter cartridge exchange and are fitted with PM₁₀ sampling inlets with flow rates of 16.7 l/min. Four filters are housed in the

⁷ COM 2003 (423)

main exchange drum and the unit automatically regulates weekly exposure of each filter.

During July 2007, the building that the Partisol 2000 unit was located on at Glais Primary School was demolished due to subsidence. The site was therefore decommissioned and did not become operational again until December 2007. Whilst the site was recommissioned during 2007 it ceased to form part of the UK Heavy metals monitoring Network from the 1st January 2008. However, this authority will continue to fund heavy metals monitoring at this site for the foreseeable future and have contracted NPL to undertake all analysis work.

A further site has been established to the north of the high level stack release point during November 2007 at YGG Gellionnen ④ (Welsh Primary School). The site is located on top of a flat roof within the school complex and has an uninterrupted view down to the refinery complex. This authority will continue to fund heavy metals monitoring at this site for the foreseeable future and have contracted NPL to undertake all analysis work.

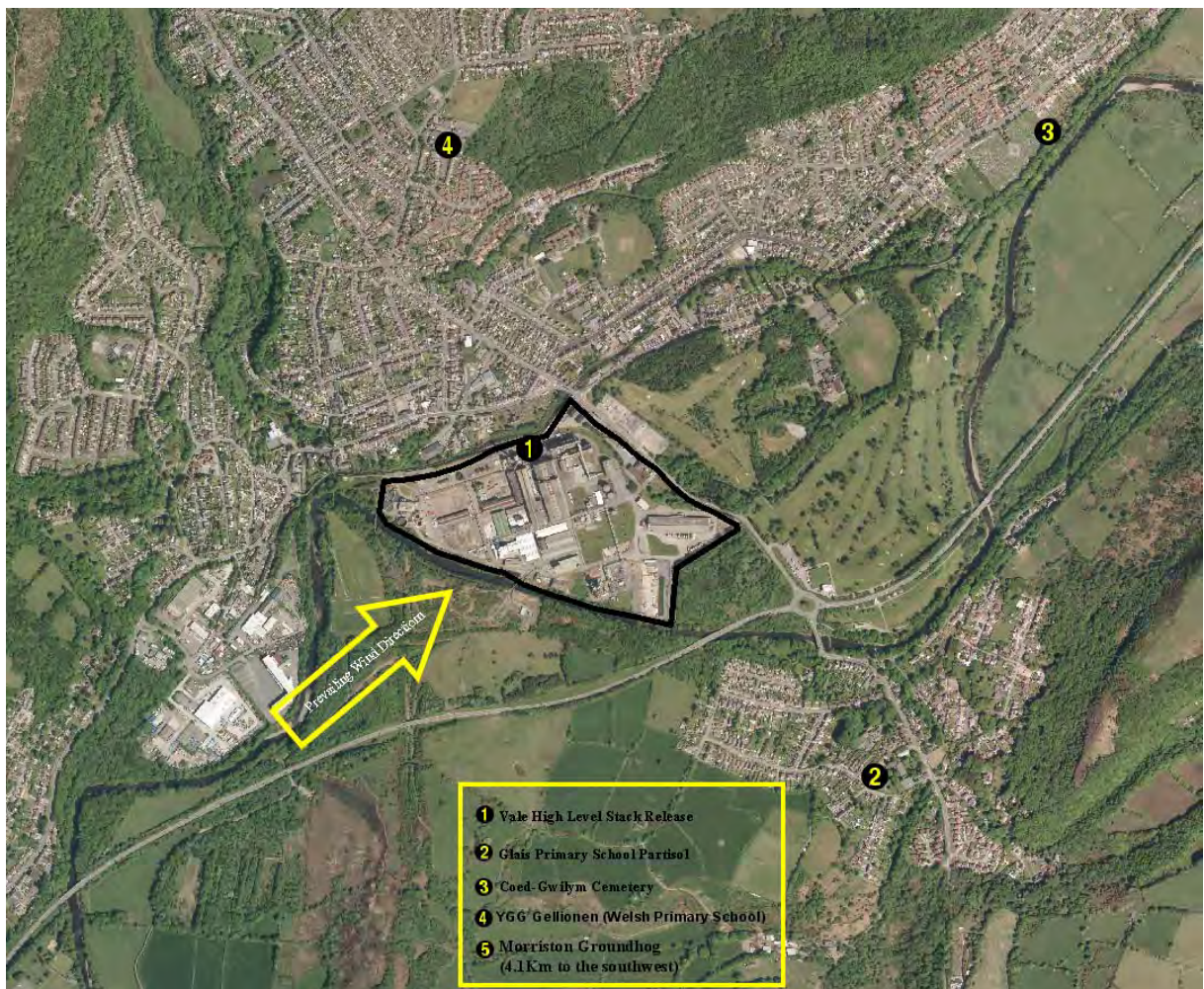
During December 2007, there were changes made to those sites that form part of the UK Heavy Metals Monitoring Network – these changes took effect on the 1st January 2008. Two monitoring locations now form part of the UK network within Swansea – these are the site upwind of the high level stack release at Coed-Gwilym Cemetery ⑤ and the site located downwind of the release point at the Morryston Groundhog ⑥. Both the sample units deployed at these sites are Rupprecht & Patashnick Co., Inc. Partisol 2000 sampling units.

The authority as stated above will continue to fund heavy metals monitoring at the Glais Primary School ② and at the YGG Gellionnen ④ (Welsh Primary School) sites. Monitoring is undertaken using Partisol 2025 units with automatic filter cartridge exchange. NPL will continue to undertake all analysis from filters exposed at these sites to maintain comparability with the analysis

undertaken from the two sites that form part of the UK heavy Metals Monitoring Network.

All monitoring locations (both UK Network sites and the two Swansea funded sites) have an Industrial classification⁸. Data continues to be captured covering the four compass points around the high level stack release point.

The location of Vale and the sampling locations can be seen within map 8.



Map 8 Heavy Metals Monitoring, Vale, Glais

© Crown Copyright and database right 2013. Ordnance Survey 100023509

Filters are exposed on a weekly basis and sent to the National Physics Laboratory (NPL) for analysis. The analysed parameters are: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Magnesium (Mn),

⁸ Source LAQM.TG(09) Appendix A page A1-20 Table A1.4

Nickel (Ni), Lead (Pb), Platinum (Pt), Vanadium (V), Zinc (Zn) and Mercury(Hg). Analysis for particulate-phase metals took place at NPL using a PerkinElmer Elan DRC II ICP-MS, following NPL's UKAS accredited procedure, which is fully compliant with the requirements of EN 14902:2005.

Upon arrival at NPL, the filters were cut accurately in half, and each portion digested at temperatures up to 220°C using a CEM Mars X microwave. The digestion mixtures used were:

- Hg & Pt: 5 ml of nitric acid and 5 ml hydrochloric acid.
- All other metals: 8 ml of nitric acid and 2 ml hydrogen peroxide.

ICP-MS analysis of the digested solutions took place using at least four gravimetrically-prepared calibration solutions. A QA standard was repeatedly analysed (after every two solutions), and the change in response of the QA standard was mathematically modeled to correct for the long-term drift of the instrument. The short-term drift of the ICP-MS was corrected for by use of an internal standards mixture (containing Y, In, Bi, Sc, Ga & Rh) continuously added to the all samples via a mixing block. Each sample is analysed in triplicate, each analysis consisting of five replicates.

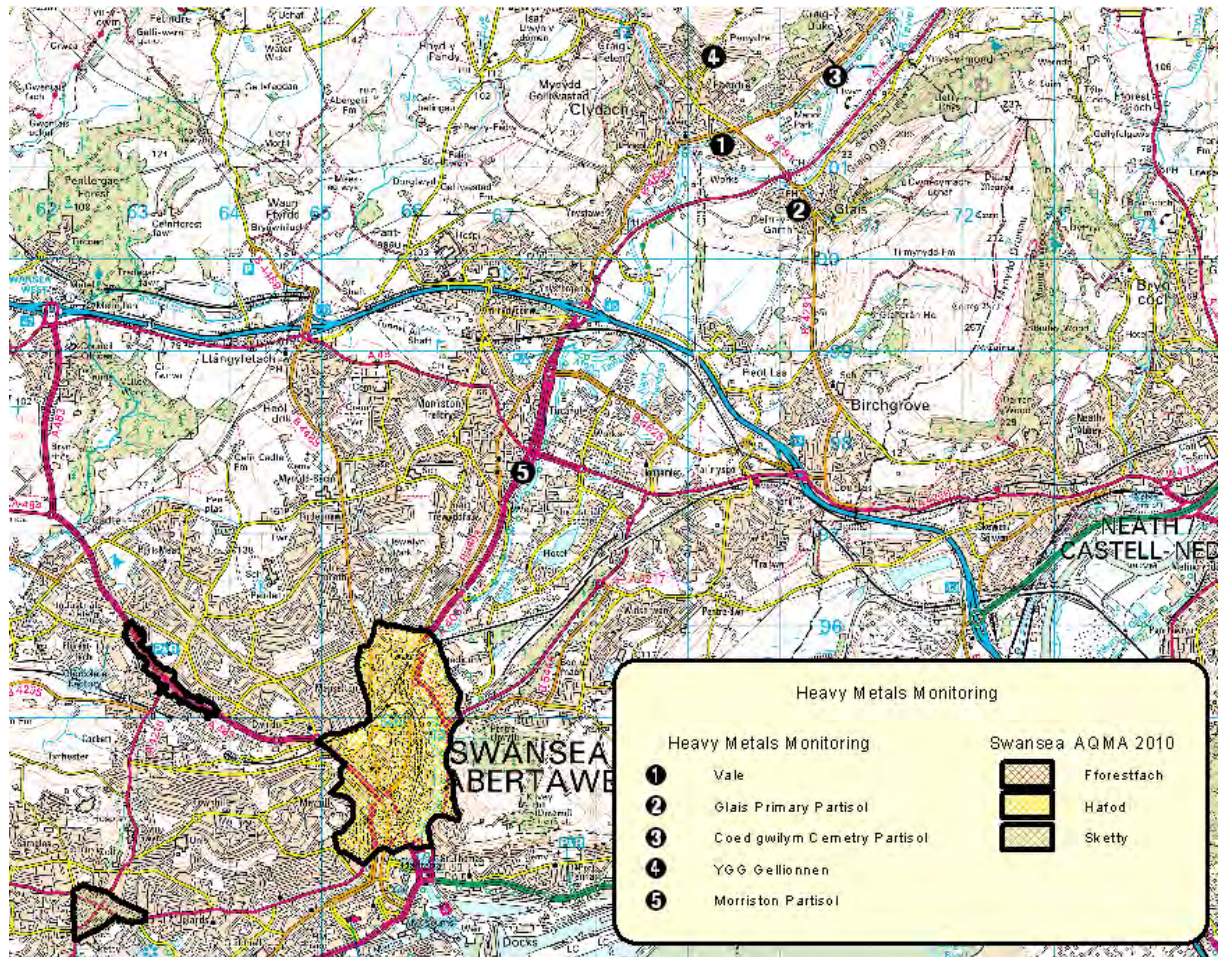
The amount of each metal in solution (and its uncertainty) was then determined by a method of generalised least squares using XGenline (an NPL-developed program) to construct a calibration curve⁹.

The uncertainty weighted mean for a series of N measurements, where the i^{th} measurement produces a value, x_i , with a measurement uncertainty, u_i , the uncertainty-weighted mean of the measurement, \bar{x}_u , would be given by:

$$\bar{x}_u = \frac{\sum_{i=1}^{i=N} \left(\frac{x_i}{u_i^2} \right)}{\sum_{i=1}^{i=N} \left(\frac{1}{u_i^2} \right)}$$

⁹ 2008 NPL Report-AS 34 (March 2009) Annual Report for 2008 on the UK Heavy Metals Monitoring Network

Again, in order for the reader to be aware spatially of the UK Heavy Metal Monitoring sites within Swansea, the monitoring locations are presented below within map 9, with the Swansea Air Quality Management Area 2010 (former Hafod AQMA) indicated for reference purposes.



Map 9 Swansea UK Heavy Metal Monitoring Sites

© Crown Copyright and database right 2013. Ordnance Survey 100023509

2.1.11 Continuous PAH Monitoring

The authority operate a continuous PAH monitoring site at the Cwm Level Park station (see 2.1.8 for location) on behalf of DEFRA and the Welsh Assembly Government using a Digitel DHA-80 Air sampling System with PM₁₀ inlet. This network has been upgraded during 2007 to provide fully compliant data for assessment of PAH under the 4th Daughter Directive and the National Assembly for Wales Statutory Instrument 2007 W 63 Environmental Protection Wales and the Air Quality Standards (Wales) Regulations 2007.

The site has been designated as urban background,¹⁰ with the purpose of the site to assess the levels of PAH before / as a consequence of, the influence of industry to the east and North of the Swansea area.

2.1.12 Non-Automatic Monitoring

The authority has operated a network of passive nitrogen dioxide diffusion tubes for several years. Some sites have provided data to the UK Non-Automatic (NO₂) Network until this network ceased to operate on a weekly and monthly basis in December 2005. The remainder of the sites form part of specific studies within areas of concern. The datasets from these studies may therefore be for a limited time frame whilst conditions are assessed.

The authority expanded the coverage of monthly exposure of passive NO₂ tubes from 71 sites to 134 sites during July 2008 with a further doubling of the survey during November 2009 from 134 to 274 sites and eventually to 291 sites during late 2009 and early 2010. This new commitment to yet more additional monitoring was as a direct result of the new LAQM Technical Guidance (LAQM.TG(09)) and the conclusions reached within the USA 2009 that additional initial screening of narrow/congested streets was required where the AADT flow was greater than 5000 vehicles. However, due to budgetary constraints introduced within the authority during April 2011 a decision was made to cease monitoring at all sites that have consistently returned a bias corrected annual mean below 30ug/m³. Monitoring ceased at these sites during May 2011 and for completeness, these sites are annotated within table 3.

Monitoring is focused primarily on roadside locations with particular emphasis in determining NO₂ levels around several busy junctions and busy/narrow/congested roads. Wherever possible, passive diffusion tubes are located directly on receptor locations – typically front façade of dwellings, mainly on front down pipes etc. Where this has not been possible, the tubes have been located on the nearest lamppost etc to the dwelling and

¹⁰ Source LAQM.TG(09) Appendix A page A1-20 Table A1.4

concentrations corrected to facade. Full details of the sites chosen are presented below within table 3 and a map showing the monitoring locations is included below as map 10. Due to the number of passive diffusion tube locations, it is not possible to label the site numbers within map10. For clarity and completeness, the additional areas that make up The Swansea Air Quality Management Area 2010 (presented to Council in August 2010) are shown within map 10.

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
1		262046	196420	Roadside	NO ₂		Y (0.1m)	3m	
2	Y	262095	196500	Roadside	NO ₂		Y (0.1m)	12m	
3	Y	262161	196513	Roadside	NO ₂		Y (0.1m)	6m	
4		262497	192857	Roadside	NO ₂	Y	Y (0.1m)	4m	
5		262548	192943	Roadside	NO ₂	Y	Y (0.1m)	3m	
6		262612	192995	Roadside	NO ₂	Y	Y (0.1m)	4.5m	
7		262691	192852	Roadside	NO ₂	Y	Y (0.1m)	2m	
8		262990	195820	Roadside	NO ₂	Y	Y (0.1m)	3m	
9		263190	195205	Roadside	NO ₂		Y (0.1m)	6m	
10		263219	195513	Roadside	NO ₂	Y	Y (0.1m)	5m	
11		263344	195474	Roadside	NO ₂	Y	Y (0.1m)	2m	
12		263680	195103	Roadside	NO ₂	Y	Y (0.1m)	2m	
13		264830	193066	Roadside	NO ₂		Y (0.1m)	8m	
14		265285	192696	Roadside	NO ₂		Y (0.1m)	2.5m	
15		265334	192608	Roadside	NO ₂		Y (0.1m)	12m	
16		265339	192534	Roadside	NO ₂		Y (0.1m)	11m	
17		265496	192408	Roadside	NO ₂		Y (0.1m)	5m	
18		265526	195807	Roadside	NO ₂	Y	Y (0.1m)	2m	
19		265597	194061	Roadside	NO ₂	Y	Y (0.1m)	5m	
20		265594	194175	Roadside	NO ₂	Y	Y (0.1m)	1.5m	
21		265634	195316	Roadside	NO ₂	Y	Y (0.1m)	2m	
22		265682	195374	Roadside	NO ₂	Y	Y (0.1m)	2m	
23		265728	195494	Roadside	NO ₂	Y	Y (0.1m)	2m	
24	Y	265760	192420	Roadside	NO ₂		Y (0.1m)	5m	
25		265845	195547	Roadside	NO ₂	Y	Y (0.1m)	3.5m	
26		265876	194318	Roadside	NO ₂	Y	Y (0.1m)	2m	
27		265922	194428	Roadside	NO ₂	Y	Y (0.1m)	2m	
28		265949	194891	Roadside	NO ₂	Y	Y (0.1m)	14m	
29		265973	195222	Roadside	NO ₂	Y	Y (0.1m)	3.5m	
30	Y	266080	192516	Roadside	NO ₂		Y (0.1m)	5m	
31		266153	196003	Roadside	NO ₂		Y (0.1m)	2.5m	
32		266209	193867	Roadside	NO ₂		Y (0.1m)	5m	
33		266236	193488	Roadside	NO ₂		Y (0.1m)	5m	
34		266272	196168	Roadside	NO ₂		Y (0.1m)	1.5m	
35		266314	193298	Roadside	NO ₂		Y (0.1m)	2m	
36		266455	193300	Roadside	NO ₂		Y (0.1m)	2m	
37	Y	266515	193213	Roadside	NO ₂		Y (0.1m)	2m	
38		266662	193181	Roadside	NO ₂		Y (0.1m)	6m	
39	Y	266905	193271	Roadside	NO ₂		Y (0.1m)	5m	
40		266951	198278	Roadside	NO ₂		Y (0.1m)	8m	
41		266953	198085	Roadside	NO ₂		Y (0.1m)	2m	
42	Y	267084	198274	Roadside	NO ₂		Y (0.1m)	5m	
43		267093	198063	Roadside	NO ₂		Y (0.1m)	2m	
44		267639	199543	Roadside	NO ₂		Y (0.1m)	23m (M4)	
45		267661	199451	Roadside	NO ₂		Y (0.1m)	10m (M4)	
46	Y	267752	193218	Roadside	NO ₂		Y (0.1m)	5m	
47	Y	267908	199773	Roadside	NO ₂		Y (0.1m)	16m	
48		268011	193101	Roadside	NO ₂		Y (0.1m)	9m	
49		268501	197329	Roadside	NO ₂		Y (0.1m)	6m	
50		268530	197419	Roadside	NO ₂		Y (0.1m)	6m	

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
51		268593	197434	Roadside	NO ₂		Y (0.1m)	5m	
52	Y	268643	197245	Roadside	NO ₂		Y (0.1m)	4m	
53	Y	268652	197508	Roadside	NO ₂		Y (0.1m)	5m	
54		268693	197416	Roadside	NO ₂		Y (0.1m)	9m	
55		268789	197420	Roadside	NO ₂		Y (0.1m)	4m	
56 *		269306	198661	Roadside	NO ₂		Y (166m)	2m	Y
57	Y	269395	199042	Roadside	NO ₂		Y (0.1m)	3m	
58		264052	192884	Roadside	NO ₂		Y (8m)	2m	Y
59		265918	194463	Roadside	NO ₂	Y	Y (0.2m)	1.5m	
60		265036	192931	Roadside	NO ₂		Y (0.1m)	2m	
61		264959	192878	Roadside	NO ₂		Y (0.1m)	2m	
62	Y	266698	195335	Roadside	NO ₂		Y (10m)	1m	Y
63		262675	192775	Roadside	NO ₂	Y	Y (6.0m)	1.5m	Y
64		262719	192840	Roadside	NO ₂	Y	Y (3.0m)	1m	Y
65		262735	192855	Roadside	NO ₂	Y	Y (0.1m)	5m	
66		262802	192829	Roadside	NO ₂	Y	Y (0.1m)	8m	
67		265903	193683	Roadside	NO ₂	Y	Y (5.0m)	1m	Y
68		265573	193432	Roadside	NO ₂		Y (0.1m)	6m	
69		265543	193450	Roadside	NO ₂		Y (4m)	3m	Y
70		266649	195435	Roadside	NO ₂		Y (7m)	1m	Y
71 **		266514	195485	Roadside	NO ₂		Y (138m)	2m	Y
72		264091	192900	Roadside	NO ₂		Y (0.1m)	18m	
73		264138	192868	Roadside	NO ₂		Y (0.1m)	9m	
74		264163	192853	Roadside	NO ₂		Y (0.1m)	12m	
75		264072	192869	Roadside	NO ₂		Y (0.1m)	8m	
76		263968	192880	Roadside	NO ₂		Y (0.1m)	9m	
77	Y	263856	192931	Roadside	NO ₂		Y (0.1m)	7m	
78		263819	192948	Roadside	NO ₂		Y (0.1m)	7m	
79		263842	192896	Roadside	NO ₂		Y (0.1m)	10m	
80	Y	263558	192833	Roadside	NO ₂		Y (0.1m)	12m	
81	Y	262940	192775	Roadside	NO ₂	Y	Y (0.1m)	8m	
82	Y	262851	192805	Roadside	NO ₂	Y	Y (0.1m)	8m	
83		262785	192838	Roadside	NO ₂	Y	Y (0.1m)	7.5m	
84		262714	192839	Roadside	NO ₂	Y	Y (0.1m)	6.5m	
85		262702	192847	Roadside	NO ₂	Y	Y (0.1m)	6.5m	
86		262704	192865	Roadside	NO ₂	Y	Y (0.1m)	4.5m	
87		262697	192798	Roadside	NO ₂	Y	Y (0.1m)	6m	
88		262605	192916	Roadside	NO ₂	Y	Y (0.1m)	4m	
89		262587	192956	Roadside	NO ₂	Y	Y (0.1m)	4.5m	
90		262631	192996	Roadside	NO ₂	Y	Y (0.1m)	4.5m	
91		262534	192950	Roadside	NO ₂	Y	Y (0.1m)	3m	
92		262545	192869	Roadside	NO ₂	Y	Y (3.0m)	4.5m	
93		263406	195534	Roadside	NO ₂		Y (0.1m)	2m	
94		263444	195572	Roadside	NO ₂		Y (0.1m)	2m	
95		262815	196090	Roadside	NO ₂		Y (0.1m)	8m	
96		262922	195950	Roadside	NO ₂		Y (0.1m)	3m	
97		262946	195902	Roadside	NO ₂	Y	Y (0.1m)	4m	

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
98		263142	195548	Roadside	NO ₂	Y	Y (0.1m)	4m	
99		263387	195332	Roadside	NO ₂	Y	Y (0.1m)	2m	
100		263470	195250	Roadside	NO ₂	Y	Y (0.1m)	4m	
101		263843	195047	Roadside	NO ₂	Y	Y (0.1m)	4m	
102		266379	193307	Roadside	NO ₂		Y (0.1m)	2m	
103		268526	197359	Roadside	NO ₂		Y (0.1m)	3m	
104		268538	197389	Roadside	NO ₂		Y (0.1m)	8m	
105		268562	197472	Roadside	NO ₂		Y (0.1m)	6.5m	
106		268496	197476	Roadside	NO ₂		Y (0.1m)	5m	
107		268765	197420	Roadside	NO ₂		Y (0.1m)	5m	
108		267608	199461	Roadside	NO ₂		Y (0.1m)	15m (M4)	
109		267510	199487	Roadside	NO ₂		Y (0.1m)	16.5 (M4)	
110		267369	199521	Roadside	NO ₂		Y (0.1m)	35m (M4)	
111		267705	199426	Roadside	NO ₂		Y (0.1M)	17m (M4)	
112		264868	192814	Roadside	NO ₂		Y (6.0M)	0.5m	Y
113		264654	192662	Roadside	NO ₂		Y (0.1m)	5.5m	
114		264622	192971	Roadside	NO ₂		Y (0.1m)	7m	
115		265031	193097	Roadside	NO ₂		Y (0.1m)	5m	
116		265192	193138	Roadside	NO ₂		Y (0.1m)	4m	
117		265288	193211	Roadside	NO ₂		Y (0.1m)	5.5m	
⊗118		265483	193385	Roadside	NO ₂		Y (17M)	7m	
119		265522	193390	Roadside	NO ₂		Y (0.1M)	2m	
120		265570	193366	Roadside	NO ₂		N (6.0M)	2m	Y
121		265706	193662	Roadside	NO ₂	Y	Y (0.1M)	3m	
122		265694	193505	Roadside	NO ₂		Y (0.5M)	3m	
123		265655	193423	Roadside	NO ₂		Y (0.1M)	4m	
⊗124		265651	193253	Roadside	NO ₂		Y (2M)	4m	
⊗125		265641	193162	Roadside	NO ₂		Y (3m)	1m	Y
⊗126		265475	193144	Roadside	NO ₂		Y (10m)	5m	
⊗127		265348	193110	Roadside	NO ₂		Y(10m)	1m	
⊗128		265297	193085	Roadside	NO ₂		N (>50m)	4.5m	
⊗129		265153	193098	Roadside	NO ₂		Y (5m)	7m	
⊗130		265139	192912	Roadside	NO ₂		Y (27m)	3.5m	Y
131		265137	192846	Roadside	NO ₂		Y(30m)	5m	
132		265229	192753	Roadside	NO ₂		Y (5M)	2m	Y
133		265350	192566	Roadside	NO ₂		Y (0.1m)	2m	
⊗134		265113	192903	Roadside	NO ₂		Y(0.1m)	4m	
^135		262605	192916	Roadside	NO ₂	Y	Y(0.1m)	4m	
^136		262612	192995	Roadside	NO ₂	Y	Y(0.1m)	4.5m	
^137		262631	192996	Roadside	NO ₂	Y	Y(0.1m)	4.5m	
138		266779	199246	Roadside	NO ₂		Y(0.1m)	3m	
139		266867	199030	Roadside	NO ₂		Y(0.1m)	1.5m	
140		266863	199009	Roadside	NO ₂		Y(0.1m)	1.5m	
141		266979	198772	Roadside	NO ₂		Y(0.1m)	2m	
142		267017	198710	Roadside	NO ₂		Y(0.1m)	2m	
143		267089	198608	Roadside	NO ₂		Y(0.1m)	2m	
144		267141	198591	Roadside	NO ₂		Y(0.1m)	2m	
145		267139	198578	Roadside	NO ₂		Y(0.1m)	2m	

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
146		267156	198571	Roadside	NO ₂		Y(0.1m)	2m	
147		267165	198580	Roadside	NO ₂		Y(0.1m)	2m	
148		267170	198564	Roadside	NO ₂		Y(0.1m)	2m	
149		267204	198561	Roadside	NO ₂		Y(0.1m)	4m	
150		267205	198545	Roadside	NO ₂		Y(0.1m)	3m	
151		267192	198518	Roadside	NO ₂		Y(0.1m)	3m	
152	Y	267081	198268	Roadside	NO ₂		Y(0.1m)	6m	
153	Y	268845	201137	Roadside	NO ₂		Y(0.1m)	2m	
154	Y	268870	201267	Roadside	NO ₂		Y(0.1m)	2m	
155		269009	201280	Roadside	NO ₂		Y(0.1m)	2.5m	
156		269059	201296	Roadside	NO ₂		Y(0.1m)	4m	
157	Y	269173	201355	Roadside	NO ₂		Y(0.1m)	4m	
158		269480	201441	Roadside	NO ₂		Y(0.1m)	3m	
159		269171	201620	Roadside	NO ₂		Y(0.1m)	5m	
160		269049	201744	Roadside	NO ₂		Y(0.1m)	3m	
161	Y	268938	201929	Roadside	NO ₂		Y(0.1m)	6.5m	
162		259553	203379	Roadside	NO ₂		Y(0.1m)	1m	
163		259287	203556	Roadside	NO ₂		Y(0.1m)	2m	
164		259195	203667	Roadside	NO ₂		Y(0.1m)	2m	
165		259149	203675	Roadside	NO ₂		Y(0.1m)	2m	
166		259148	203690	Roadside	NO ₂		Y(0.1m)	2.5m	
167		259126	203700	Roadside	NO ₂		Y(0.1m)	4.5m	
168		259115	203705	Roadside	NO ₂		Y(0.1m)	4.5m	
169		259013	203747	Roadside	NO ₂		Y(0.1m)	4.5m	
170		258971	203797	Roadside	NO ₂		Y(0.1m)	4.5m	
171		258917	203826	Roadside	NO ₂		Y(0.1m)	4.5m	
172		258887	203859	Roadside	NO ₂		Y(0.1m)	4.5m	
173		259250	203708	Roadside	NO ₂		Y(0.1m)	5.5m	
174		259253	203660	Roadside	NO ₂		Y(0.1m)	6m	
175		259251	203638	Roadside	NO ₂		Y(0.1m)	8.5m	
176		258872	203691	Roadside	NO ₂		Y(0.1m)	5m	
177		258896	203697	Roadside	NO ₂		Y(0.1m)	1m	
178		258986	203684	Roadside	NO ₂		Y(0.1m)	1m	
179	Y	259059	197831	Roadside	NO ₂		Y(0.1m)	2.5m	
180		259064	197781	Roadside	NO ₂		Y(0.1m)	1.5m	
181	Y	259010	197817	Roadside	NO ₂		Y(0.1m)	3.5m	
182		259050	197790	Roadside	NO ₂		Y(0.1m)	2m	
183		259036	197795	Roadside	NO ₂		Y(0.1m)	2.5m	
184	Y	259014	197797	Roadside	NO ₂		Y(0.1m)	5m	
185	Y	258919	197820	Roadside	NO ₂		Y(0.1m)	4.5m	
186	Y	258711	197868	Roadside	NO ₂		Y(0.1m)	4m	
187	Y	258206	198239	Roadside	NO ₂		Y(0.1m)	2.5m	
188	Y	258197	198219	Roadside	NO ₂		Y(0.1m)	6.5m	
189	Y	258270	198257	Roadside	NO ₂		Y(0.1m)	7.5m	
190	Y	258260	198237	Roadside	NO ₂		Y(0.1m)	2.5m	
191	Y	258338	198270	Roadside	NO ₂		Y(0.1m)	4.5m	
192	Y	257422	198542	Roadside	NO ₂		Y(0.1m)	5m	
193	Y	257371	198522	Roadside	NO ₂		Y(0.1m)	3.5m	
194	Y	257958	198581	Roadside	NO ₂		Y(0.1m)	4.5m	

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
195	Y	257972	198563	Roadside	NO ₂		Y(0.1m)	5m	
196	Y	258046	198558	Roadside	NO ₂		Y(0.1m)	5m	
197		258797	198701	Roadside	NO ₂		Y(0.1m)	2m	
198		258811	198701	Roadside	NO ₂		Y(0.1m)	2m	
199		254703	195764	Roadside	NO ₂		Y(0.1m)	2m	
200	Y	254582	195821	Roadside	NO ₂		Y(0.1m)	2m	
201		254522	195859	Roadside	NO ₂		Y(0.1m)	2m	
202	Y	254437	195879	Roadside	NO ₂		Y(0.1m)	4m	
203	Y	254294	195885	Roadside	NO ₂		Y(0.1m)	3.5m	
204	Y	253777	195926	Roadside	NO ₂		Y(0.1m)	4m	
205	Y	253758	195939	Roadside	NO ₂		Y(0.1m)	2.5m	
206		261565	188211	Roadside	NO ₂		Y(0.1m)	1.5m	
207		261561	188222	Roadside	NO ₂		Y(0.1m)	2.5m	
208		261541	188215	Roadside	NO ₂		Y(0.1m)	2.5m	
209		261534	188198	Roadside	NO ₂		Y(0.1m)	1.5m	
210		261516	188207	Roadside	NO ₂		Y(0.1m)	2.5m	
211		261501	188188	Roadside	NO ₂		Y(0.1m)	1.5m	
212		261486	188200	Roadside	NO ₂		Y(0.1m)	2.5m	
213		261490	188186	Roadside	NO ₂		Y(0.1m)	1.5m	
214		261315	188193	Roadside	NO ₂		Y(0.1m)	4m	
215		261299	188191	Roadside	NO ₂		Y(0.1m)	4m	
216		261276	188190	Roadside	NO ₂		Y(0.1m)	4m	
217	Y	260357	188240	Roadside	NO ₂		Y(0.1m)	4.5m	
218	Y	260384	188206	Roadside	NO ₂		Y(0.1m)	1m	
219	Y	260419	188172	Roadside	NO ₂		Y(0.1m)	2.5m	
220	Y	261194	188163	Roadside	NO ₂		Y(0.1m)	4m	
221	Y	260454	188171	Roadside	NO ₂		Y(0.1m)	4m	
222	Y	260469	188182	Roadside	NO ₂		Y(0.1m)	5m	
223	Y	266899	197354	Roadside	NO ₂		Y(0.1m)	3m	
224	Y	266881	197389	Roadside	NO ₂		Y(0.1m)	2m	
225	Y	266861	197432	Roadside	NO ₂		Y(0.1m)	2m	
226	Y	266829	197472	Roadside	NO ₂		Y(0.1m)	5m	
227	Y	266836	197484	Roadside	NO ₂		Y(0.1m)	2m	
228	Y	266779	197578	Roadside	NO ₂		Y(0.1m)	5m	
229	Y	266772	197621	Roadside	NO ₂		Y(0.1m)	2m	
230	Y	266777	197651	Roadside	NO ₂		Y(0.1m)	2m	
231	Y	268802	197666	Roadside	NO ₂		Y(0.1m)	4m	
232	Y	266825	197654	Roadside	NO ₂		Y(0.1m)	2m	
233	Y	266823	197668	Roadside	NO ₂		Y(0.1m)	4m	
234	Y	266858	197671	Roadside	NO ₂		Y(0.1m)	3m	
235	Y	266874	197657	Roadside	NO ₂		Y(0.1m)	3.5m	
236	Y	266886	197658	Roadside	NO ₂		Y(0.1m)	4m	
237	Y	266885	197676	Roadside	NO ₂		Y(0.1m)	3.5m	
238		266902	197660	Roadside	NO ₂		Y(0.1m)	3.5m	
239		266181	196022	Roadside	NO ₂		Y(0.1m)	1.5m	
240		266169	195995	Roadside	NO ₂		Y(0.1m)	1.5m	
241		266159	196013	Roadside	NO ₂		Y(0.1m)	1.5m	
242		265655	193423	Roadside	NO ₂		Y(0.1m)	4m	
243		265474	194949	Roadside	NO ₂		Y(0.1m)	4m	

Site Name	Decommissioned	OS Grid Ref Easting	OS Grid Ref Northing	Site classification	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location?
244		265466	194930	Roadside	NO ₂	Y	Y(0.1m)	2m	
245		265448	194922	Roadside	NO ₂	Y	Y(0.1m)	2m	
246		265425	194927	Roadside	NO ₂		Y(0.1m)	4m	
247		265394	194899	Roadside	NO ₂	Y	Y(0.1m)	2m	
248		265342	194894	Roadside	NO ₂		Y(0.1m)	4m	
249		265326	194871	Roadside	NO ₂	Y	Y(0.1m)	2m	
250		265274	194867	Roadside	NO ₂		Y(0.1m)	4m	
251		265263	194845	Roadside	NO ₂	Y	Y(0.1m)	2m	
252		265226	194830	Roadside	NO ₂	Y	Y(0.1m)	2m	
253		265194	194833	Roadside	NO ₂		Y(0.1m)	4m	
254		265142	194816	Roadside	NO ₂		Y(0.1m)	2m	
255		265098	194825	Roadside	NO ₂		Y(0.1m)	2m	
256		264995	194777	Roadside	NO ₂		Y(0.1m)	2m	
257	Y	254817	189135	Roadside	NO ₂		Y(0.1m)	1.5m	
258		254906	189110	Roadside	NO ₂		Y(0.1m)	1.5m	
259	Y	254949	189113	Roadside	NO ₂		Y(0.1m)	5.5m	
260	Y	254970	189116	Roadside	NO ₂		Y(0.1m)	4m	
261	Y	254991	189115	Roadside	NO ₂		Y(0.1m)	1m	
263	Y	262444	193447	Roadside	NO ₂		Y(0.1m)	6m	
264	Y	262251	193293	Roadside	NO ₂		Y(0.1m)	5m	
265		266375	198023	Roadside	NO ₂		Y(0.1m)	2m	
266	Y	266380	198043	Roadside	NO ₂		Y(0.1m)	4m	
267		266382	198028	Roadside	NO ₂		Y(0.1m)	2m	
268		266419	198053	Roadside	NO ₂		Y(0.1m)	3m	
269	Y	266458	198111	Roadside	NO ₂		Y(0.1m)	4m	
270	Y	266896	198084	Roadside	NO ₂		Y(0.1m)	2m	
271		266879	198078	Roadside	NO ₂		Y(0.1m)	1.5m	
272		266888	198074	Roadside	NO ₂		Y(0.1m)	1.5m	
273	Y	267060	198234	Roadside	NO ₂		Y(0.1m)	6m	
274		269487	201451	Roadside	NO ₂		Y(0.1m)	6m	
275		265658	194856	Roadside	NO ₂	Y	Y(2.0m)	1.5m	
276		265610	194871	Roadside	NO ₂	Y	Y(0.1m)	3m	
277		265596	194875	Roadside	NO ₂	Y	Y(0.1m)	3m	
278		265573	194882	Roadside	NO ₂	Y	Y(0.1m)	3m	
279		265555	194926	Roadside	NO ₂	Y	Y(0.1m)	1.5m	
280		265542	194980	Roadside	NO ₂	Y	Y(2.0m)	1m	
281		265542	194872	Roadside	NO ₂	Y	Y(3.0m)	1m	
282		265540	194840	Roadside	NO ₂	Y	Y(3.0m)	1m	
283		265436	195937	Roadside	NO ₂		Y(0.1m)	2m	
284		265452	195899	Roadside	NO ₂		Y(0.1m)	2m	
285		266955	197415	Roadside	NO ₂		Y(0.1m)	2m	
286		266938	197377	Roadside	NO ₂		Y(0.1m)	4m	
287		265715	193902	Roadside	NO ₂	Y	Y(0.1m)	2m	
288		265698	193878	Roadside	NO ₂	Y	Y(0.1m)	2m	
289		265702	193842	Roadside	NO ₂	Y	Y(0.1m)	2m	
290		263014	195737	Roadside	NO ₂	Y	Y(0.1m)	2m	
291		267952	193121	Roadside	NO ₂		Y(0.1m)	5m	

Table 3 Passive NO₂ Diffusion Tube Monitoring Locations

* **Site 56** is located on Ynysallan Road, Ynystawe to the frontage of a potential housing development site that would be 10-15m from the eastbound carriageways of the M4. Relevant exposure is given at present to the nearest existing dwelling within a separate development setback from the monitoring location.

** **Site 71** Copper Quarter 3 is on the frontage of an existing housing development site (construction ceased at present due to economic downturn) that will see dwellings fronting onto the access road to Morfa Retail Park and the Liberty Stadium. Relevant exposure is given at present to the nearest existing dwelling on the development site. The nearest potential dwelling within the development (setback from the monitoring location) will be within 10m of the monitoring location when construction is complete.

*** **Site 125** Army Careers Centre, City Centre – Relevant exposure is given to a block of flats over commercial premises

⊗ City centre sites along busy roads – relevant exposure is given to either restaurants where there is a Café environment or to blocks of flats. Assessment where Café environment exists is for 1 hour NO₂ objective

^Sites 135-137 are located at first floor level of properties in addition to exposure at 2.5 on the same dwelling to assess if concentrations change with height

The contract for the supply and analysis of all passive diffusion tubes has been awarded to Environmental Scientifics Group (ESG) Moorbrook Southmead Industrial Estate Didcot, Oxon. Previously this group was known as Harwell Scientifics.

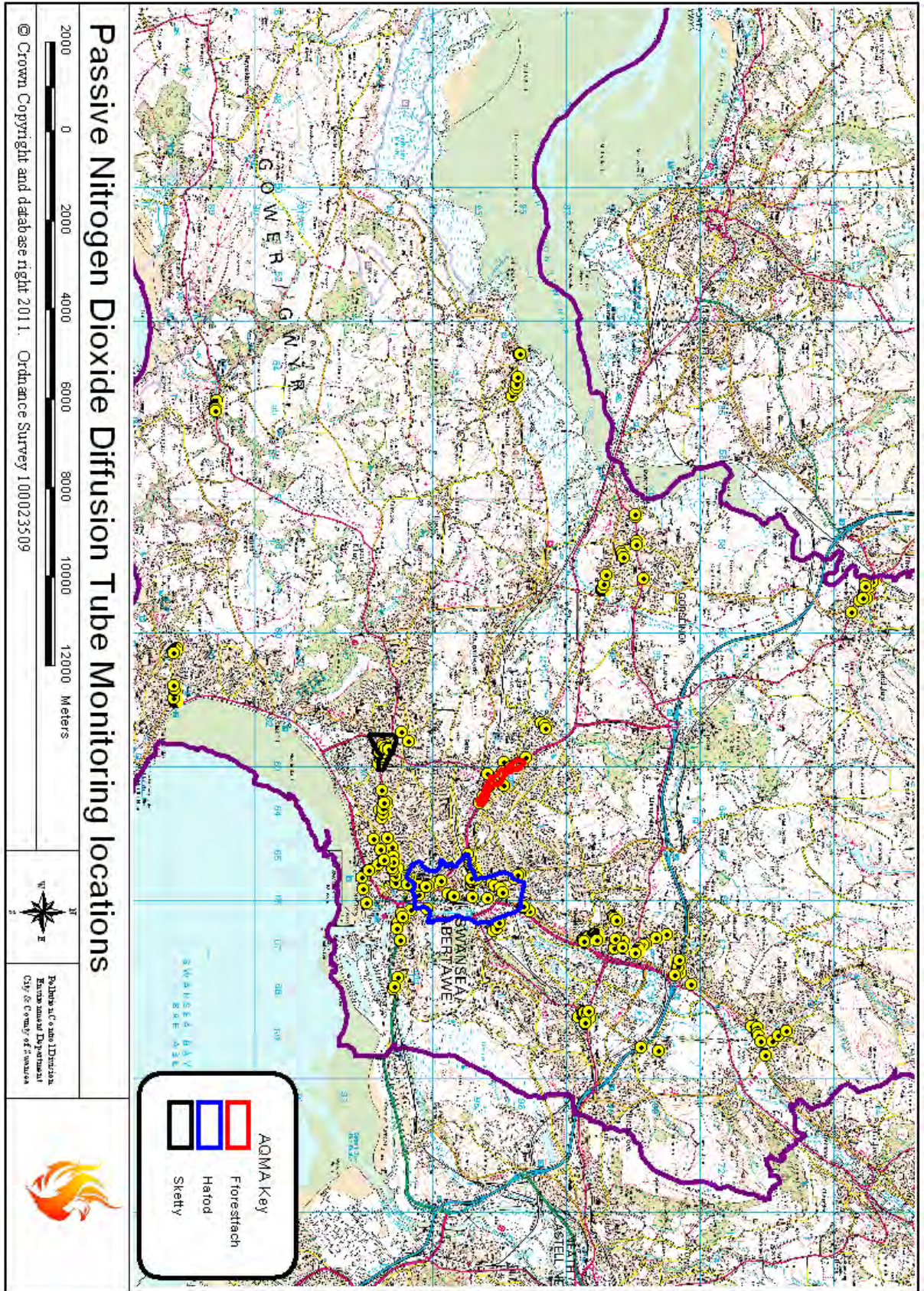
This contract laboratory has been operating for over 20 years and has extensive UKAS accreditation. In addition, all work is accredited to BS EN ISO 9001. Its predecessor the EMS Division, Harwell, carried out Swansea's original NO₂ mapping in 1985/86.

All samples have been analysed in accordance with the Harwell Scientifics standard operating procedure HS/GWI/1015 issue14. This method meets the guidelines set out in DEFRA's "Diffusion Tubes for Ambient NO₂ Monitoring: Practical Guidance". All tubes are prepared by spiking acetone:triethanolamine (50:50) onto grids prior to the tubes being assembled. The tubes were desorbed with distilled water and the extract analysed using a segmented flow auto-analyser with ultraviolet detection. The analytical methods employed by Environmental Scientifics Group follow the procedures set out in the Harmonisation Practical Guidance.

ESG take part in the Workplace Analysis Scheme for Proficiency (WASP) operated by HSL. The WASP scheme is an independent proficiency testing

scheme operated by the Health and Safety Laboratory (HSL). Each month a diffusion tube doped with nitrite is distributed to each participating laboratory; participants then analyse the tube and report the results to HSL. The nominal mass of nitrite on the doped tubes is different each month, and is intended to reflect the range encountered in actual monitoring. The latest results from Harwell Scientifics participation in the WASP scheme are enclosed as Annex 3. For the purpose of diffusion tube QA/QC in the context of Local Air Quality Management, Ricardo AEA carry out an assessment of laboratory performance for each full calendar year. This was based on the following criteria, which were agreed with DEFRA and HSL:

1. Participating laboratories must complete at least 10 of the 12 monthly WASP rounds.
2. The year's single worst result is ignored: this makes some limited allowance for one-off problems with analytical equipment etc.
3. Each laboratory's monthly standardised results are then combined to give a standard uncertainty for the full year, expressed as a relative standard deviation (%RSD)
4. The RSD must be within 15%Non-Automatic Monitoring



Map 10 – Location of passive Nitrogen Dioxide Diffusion Tubes

2.1.13 Determination of a “Swansea” bias factor

There has been great debate surrounding the use of a locally derived bias factor when correcting diffusion tubes for bias. Indeed, previous auditor’s comments have indicated that such a local derived correction factor should be obtained for Swansea. The auditor’s comments have been taken on board and for the last several years tri located diffusion tubes have been located on the sample intake at each of the authority’s chemiluminescent analyser sites at the Swansea Roadside AURN, Morfa and Morrison Groundhog sites. These co-location studies were extended during 2009 to include the urban background site at Cwm Level Park. All co-location sites will operate for the foreseeable future. This co-location work is required to be repeated yearly given the advice within section 6.3.1 of the report prepared by the then AEA Energy and Environment (now Ricardo AEA) on behalf of DEFRA and the Devolved Administrations: NO₂ Diffusion Tubes for LAQM: Guidance note for Local Authorities¹¹.

Following on from previous auditors comments dated 9th September 2010 where it was highlighted that the bias adjustment factors from the four monitoring stations mentioned above should not have been averaged to produce a “Swansea Bias Factor” it has been decided to use the result of the co-location study undertaken at the Swansea AURN to correct passive NO₂ tubes exposed during 2012.

The ratified data has been obtained for the Swansea Roadside AURN via the UK Air Quality Archive at http://uk-air.defra.gov.uk/data/data_selector. AEA Energy and Environment undertake the QA/QC work on behalf of DEFRA at the Swansea AURN site.

The bias correction to be used for diffusion tube exposure during 2012 in Swansea is therefore 0.87. A spreadsheets containing the automatic

¹¹ http://www.airquality.co.uk/archive/reports/cat13/0604061218_Diffusion_Tube_GN_approved.pdf

real-time data and the passive diffusion tube data used to derived the bias factor is shown within Annexe 4

2.2 Comparison of Monitoring Results with Air Quality Objectives

This section has been divided by pollutant and also whether the automatic monitoring location is either within, or outside of an existing AQMA as recommended in Box 5.2 of Chapter 5 of LAQM.TG(09).

2.2.1 Nitrogen Dioxide

2.2.2 Automatic Real-Time Nitrogen Dioxide Data

Measurements are undertaken with Advanced Pollution Instrumentation (API) real-time NO_x analysers and also by the DOAS systems at Hafod and St Thomas. The logged 15-minute means have been compiled into hourly averages by the software package OPSIS Enviman Reporter. In order to compile a valid hourly mean, a minimum of 3, 15-minute means were specified¹². Data capture of less than 75% for the hour therefore excludes that hour from any analysis. The derived hourly means have then been used to calculate the annual mean.

In the case of the Swansea AURN, the QA/QC procedures undertaken by Ricardo AEA have resulted in ratified hourly data expressed in µg/m³ being provided. The ratified hourly means have been used to calculate the objectives for the hourly and annual means. Hourly ratified data has been downloaded from the Air Quality Archive at http://uk-air.defra.gov.uk/data/data_selector. In the case of data from the Morriston Groundhog and Cwm Level Park sites, Ricardo AEA also undertake QA/QC procedures on behalf of the Welsh Air Quality Forum and Welsh Assembly. Hourly ratified data expressed in µg/m³ has been downloaded for the sites from http://www.welshairquality.co.uk/data_and_statistics.php. These data have then all been imported into the OPSIS Enviman Reporter databases

¹² LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-47

allowing analysis and graphical presentation. Sections 2.1.6 and section 2.1.7 refer to the data collection methodology for the Hafod and St.Thomas DOAS systems. Annual means derived for 2012 are given below within table 4 along with those for previous years 2008-2011.

Site ID (see table2 above)	Location	Within AQMA	Data Capture 2012 %	Annual mean (ug/m ³)				
				2008	2009	2010	2011	2012
1	Swansea AURN ** (12m)	Y	99.07%	25.6 (31.8)	26.3 (33.2)	27.8 (36.1)	25.6 (32.38)	26.0 (30.66)
2	Morfa Groundhog ** (34m)	Y	N/A	23.2 (36.5)	22.5 (36.38)	22.3 (37.7)	N/A	N/A
3	Morrison Groundhog ** (22m)	N	96.60%	23.6 (29.0)	22.3 (29.34)	22.6 (30.5)	21.1 (27.25)	23.4 (28.10)
4	Cwm Level Park ** (100m)	Y	94.97%	-	18.72	23.38	20.87	19.61
5	Hafod DOAS	Y	99.73%	58.64	53.44	58.60	57.61	52.60
6	St.Thomas DOAS	N	97.88%	34.94	34.71	45.88	40.89	38.62

Table 4 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective

** The distance to the nearest receptor location is given in brackets after the site name in the above table. The NO₂ annual mean at the nearest receptor location has been derived following guidance within TG.09 box 5.2(2) page 5-5 and also box 2.3 page 2-6. The supporting simple calculator Excel spreadsheet (Issue 4: 25/01/11) has been downloaded from <http://laqm.defra.gov.uk/documents/NO2withDistancefromRoadsCalculatorIssue4.xls>

The resulting calculated NO₂ annual mean at the receptor location due to fall off in concentration with distance from the road is given in bold for the year of consideration. The measured roadside concentration is given in brackets. Background 1k by 1k NO₂ concentrations (for 2012) were downloaded from <http://laqm.defra.gov.uk/maps/maps2010.html> and overlain on a GIS background map within Quantum GIS v1.8. The background concentration required for the calculation was obtained from the nearest 1k grid square to the monitoring station. The background concentrations shown in table 5 below were used:

Site ID (see table 4 above)	Location	Background NO ₂ Concentrations (ug/m ³)				
		2008	2009	2010	2011	2012
1	Swansea AURN)	16.9	15.9	16.3	16.3	19.57
2	Morfa Groundhog)	16.3	15.5	16.1	N/A	N/A
3	Morrison Groundhog	17.6	16.8	17.8	17.8	19.71

Table 5 NO₂ background concentrations

As the site at Cwm Level Park has an Urban Background classification, with the nearest receptor being 100m away, the annual mean presented above has not been corrected to the nearest receptor as guidance within LAQM.TG(09) (within box 2.3) indicates that the correction method within the simple calculator is setup to work at a distance of 0.1 to 50m from the kerb.

From table 4 it can be seen that the Hafod DOAS continues to experience annual mean NO₂ concentrations above the objective level. The St Thomas DOAS, marginally exceeded the annual mean objective during 2011 and then has marginally complied with the annual mean objective during 2012. However, the annual mean for 2012 is so close to the objective level that it is probably prudent to err on the side of caution and take the view that compliance is in doubt. Improvements with the more recent returned annual means to that of 2010 are possibly due to the improvements made around Quay Parade bridges during November/December 2011. The two other roadside sites at the Swansea AURN and Morrison Groundhog have seen a marginal increase in annual mean concentrations during 2012. Interestingly, the Hafod DOAS whilst continuing to see exceedences of the 1 hour objective during 2012 also continues to exhibit a downward trend in the number of hourly objective exceedences “long term” seen at the site during the period 2008-2012.

The data obtained from the Hafod DOAS is an open path, spatial measurement along a 250m path length within 0.2m of the terrace facades, running parallel to the terraced housing. On the opposite side of the road to the measurement path is a passive diffusion tube measurement site located at the Hafod Post Office (site 59 in table 7 of NO₂ tube results within section 2.3

below). The bias corrected annual mean of 53.85ug/m³ for 2012 (100% data capture) from this site also indicates exceedence of the annual mean objective within this street canyon.

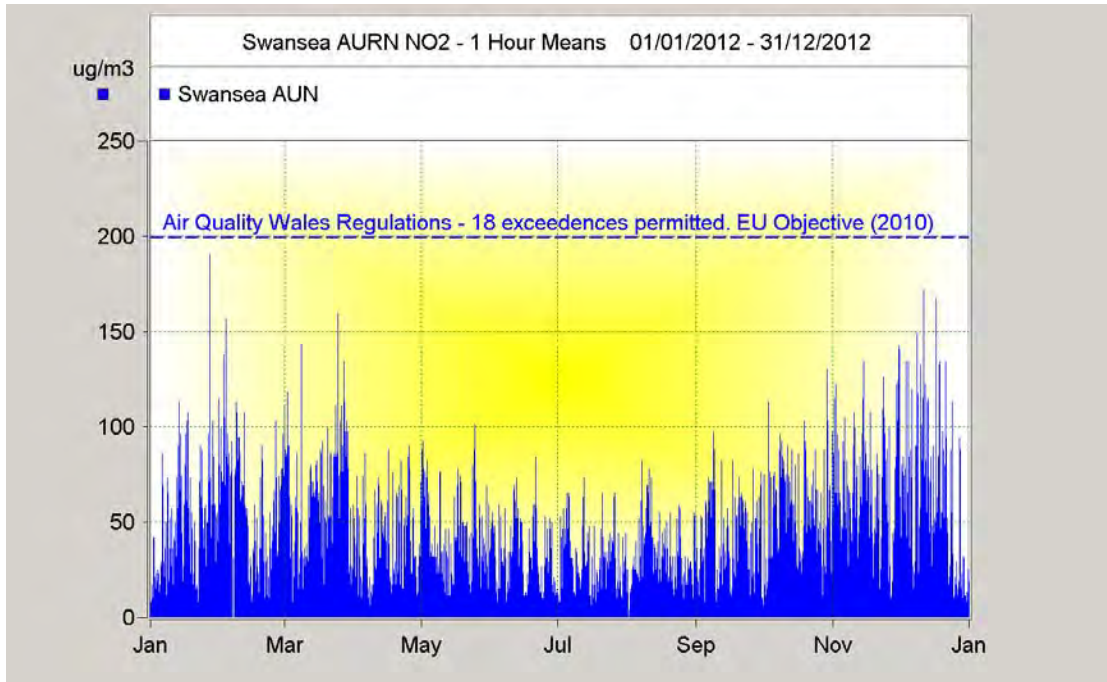
Table 5 below indicates assessments from all stations in respect of the number of exceedences of the 1-hour NO₂ objective. Where data capture rates are below 90% the 99.8th percentile is presented in brackets.

Site ID (see table 4 above)	Location	Within AQMA	Data Capture 2012 %	Number of Exceedences of hourly mean (200 µg/m ³)				
				2008	2009	2010	2011	2012
1	Swansea AURN	Y	99.07%	0	0	0	1	0
2	Morfa Groundhog	Y	N/A	1	0 **(149.0)	1	N/A	N/A
3	Morrison Groundhog	N	96.60%	1 **(123.95)	0	0	0	0
4	Cwm Level Park	Y	94.97%	-	0 **(92.0)	0	0	0
5	Hafod DOAS	Y	99.73%	7 **(199.54)	11	20 **(203.13)	16	5
6	St.Thomas DOAS	N	97.88%	0	0	0	0	0

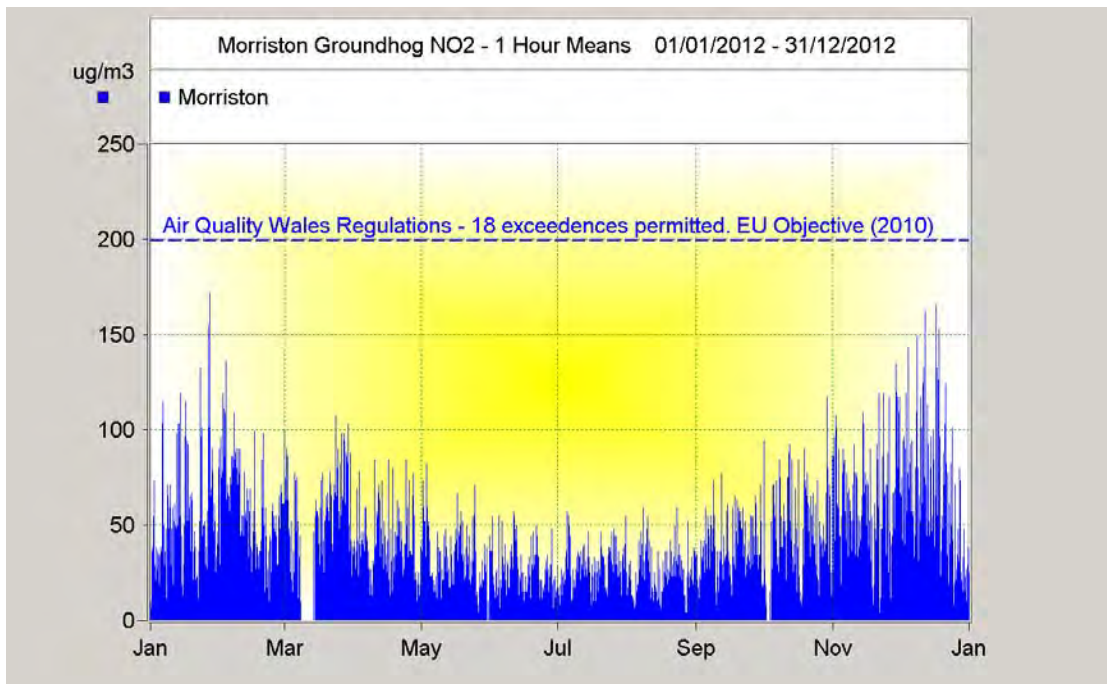
Table5 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective

** Data capture rate below 90% 99.8th percentile presented in brackets

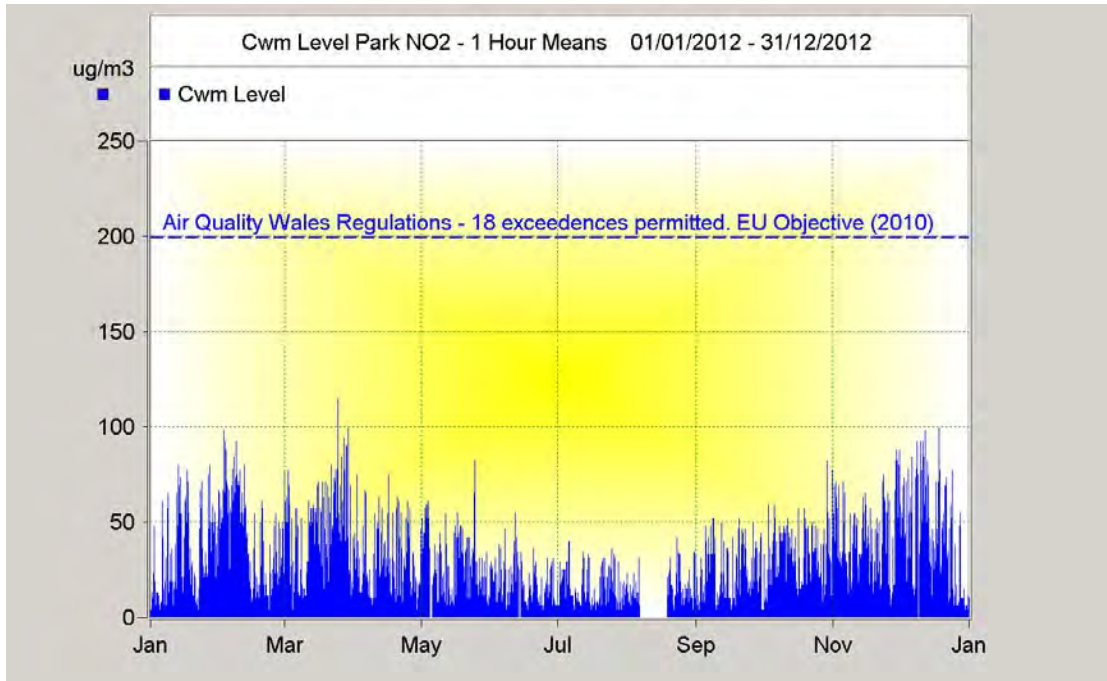
Graphs 1-5 below show the NO₂1-hour means for 2012 from the 5 automatic and continuous sites now within Swansea.



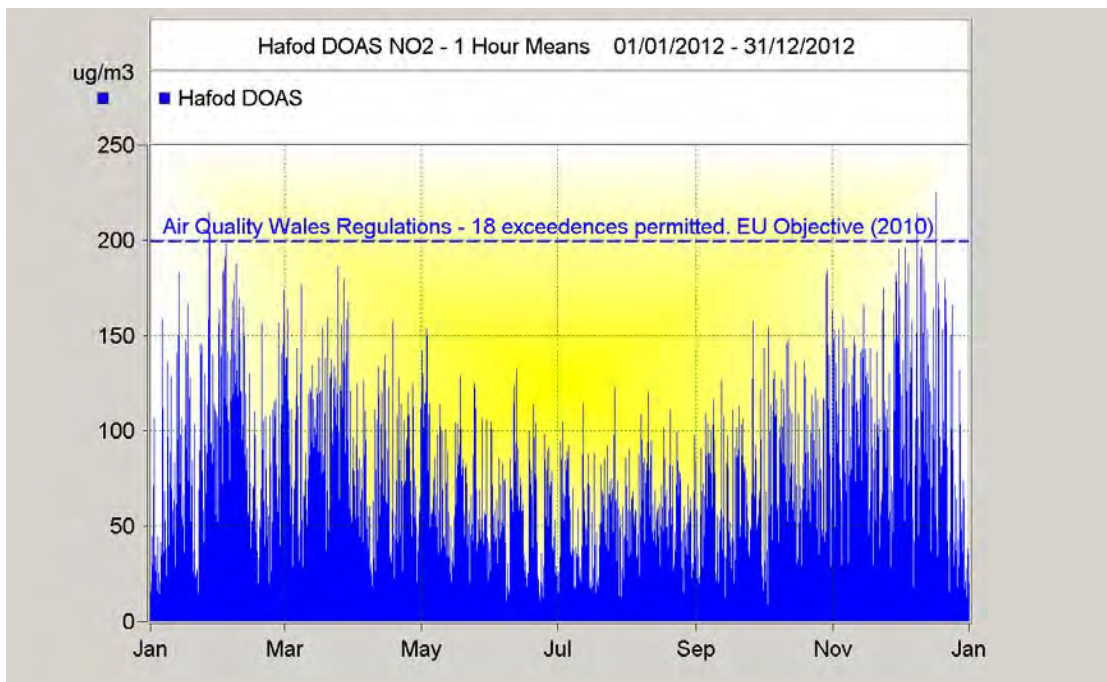
Graph 1 – NO₂ 1- hour means Swansea AURN 2012



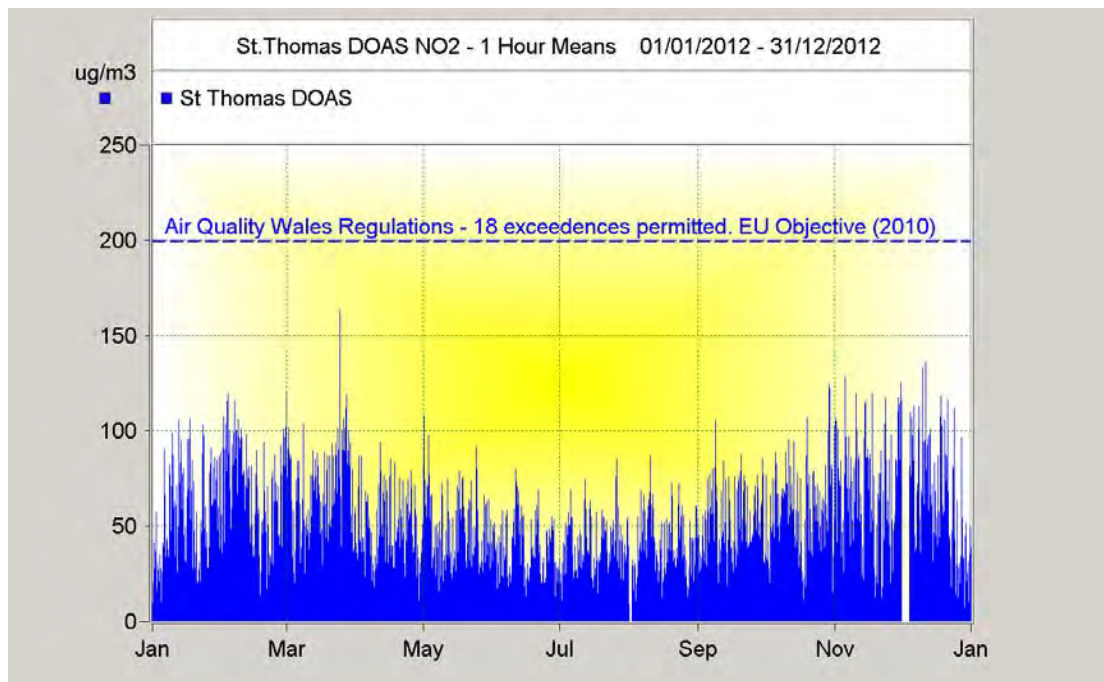
Graph 2 - NO₂ 1- hour means Morriston Groundhog 2012



Graph 3 - NO₂ 1- hour means Cwm Level Park 2012



Graph 4 - NO₂ 1- hour means Hafod DOAS 2012



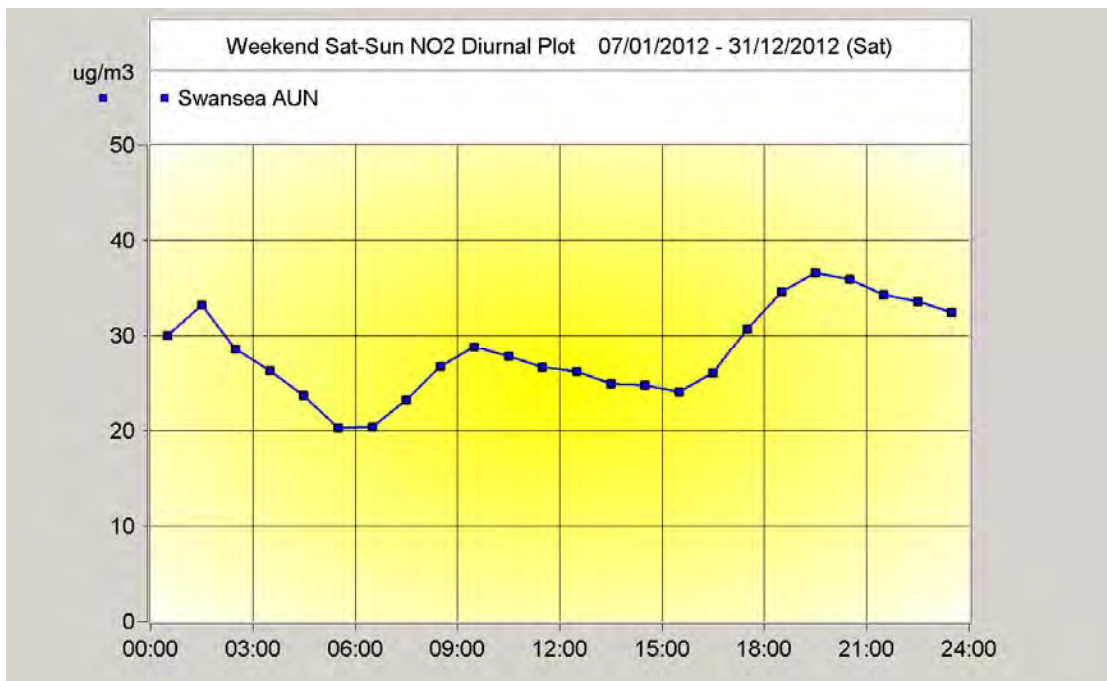
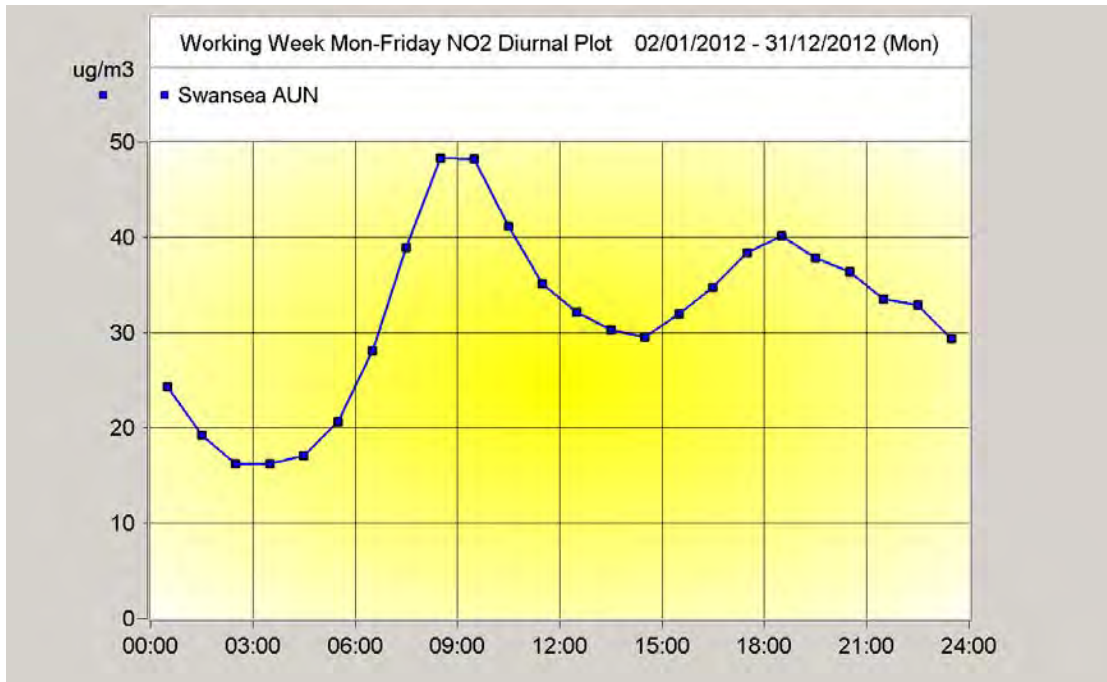
Graph 5 - NO₂ 1- hour means St.Thomas DOAS 2012

Within Graph 4 above, the hourly exceedences seen at the Hafod DOAS occurred during the winter months of January, November and December 2012. These winter months where hourly exceedences are seen are typically typified by cool, calm stable meteorological conditions overnight with the lower valley area witnessing inversions leading into the am rush hour. As has been seen previously, these inversion periods do not disperse until late morning after the am rush hour has passed.

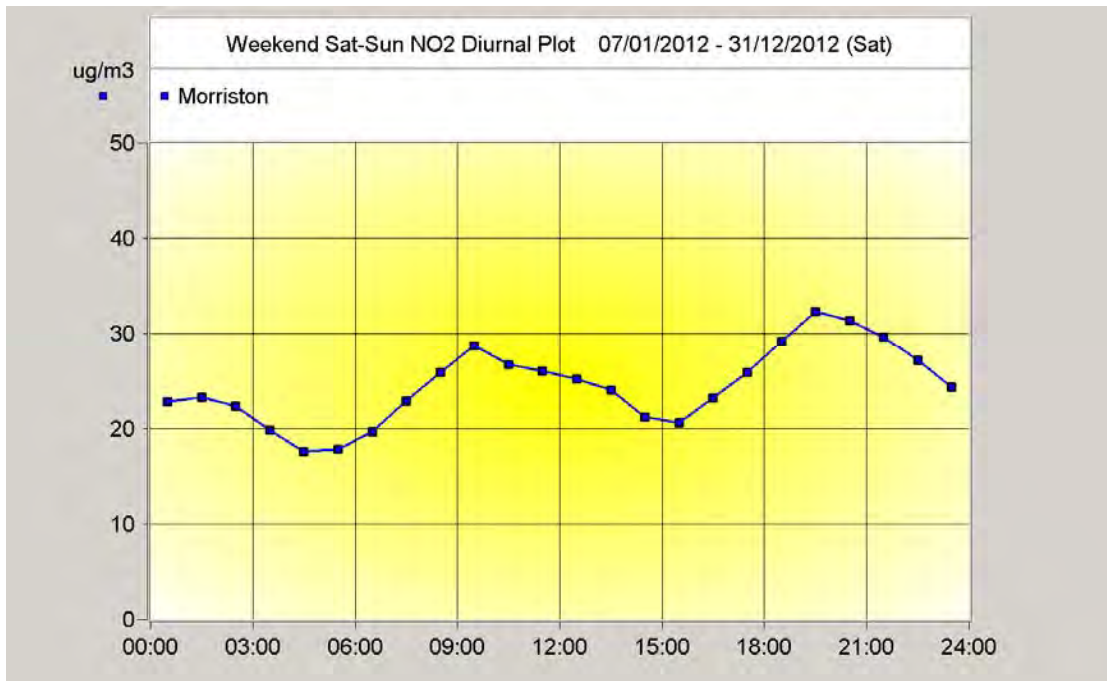
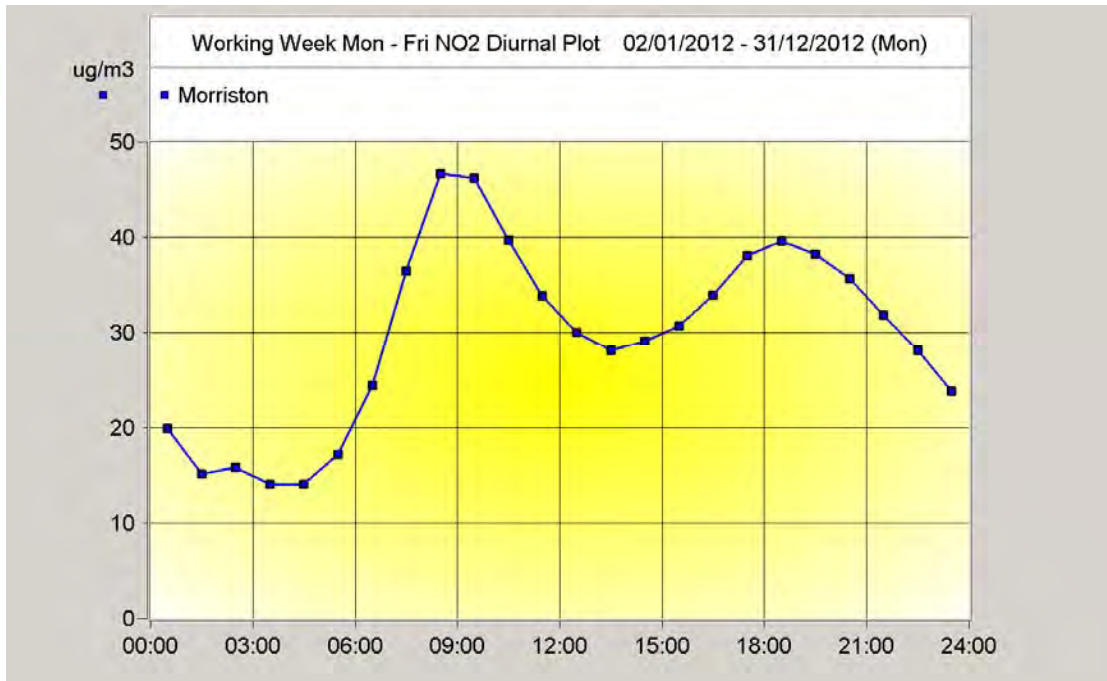
Diurnal NO₂ profiles of the working week (Mon – Fri) and the weekend (Sat – Sun) for each site are provided below within diurnal plots 1-5. Again, as would be expected, the weekday peak concentrations are seen at each site during the am period with the pm period being much smoother. The am peak is thought likely to be influenced more by the prevailing meteorological conditions during the morning period which are then dispersed before the pm period i.e. wintertime inversions. A completely different profile is obtained for the weekend period.

The weekday profiles raise the question whether the authority should, as part of its Air Quality Action Plan, concentrate efforts on reducing the NO₂ impact

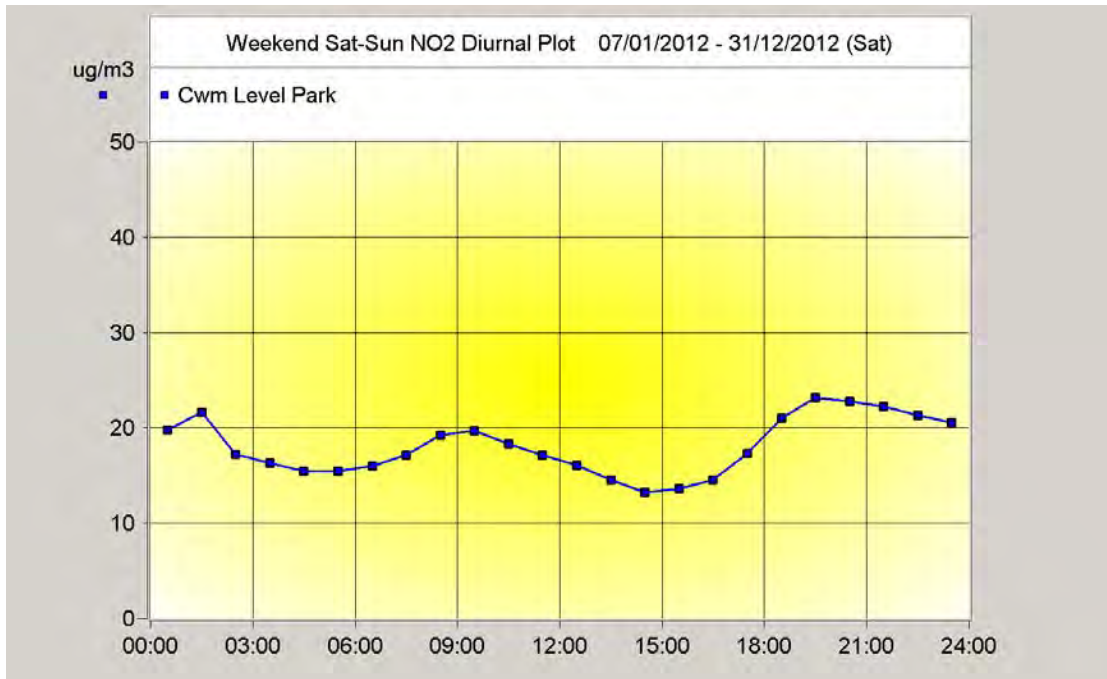
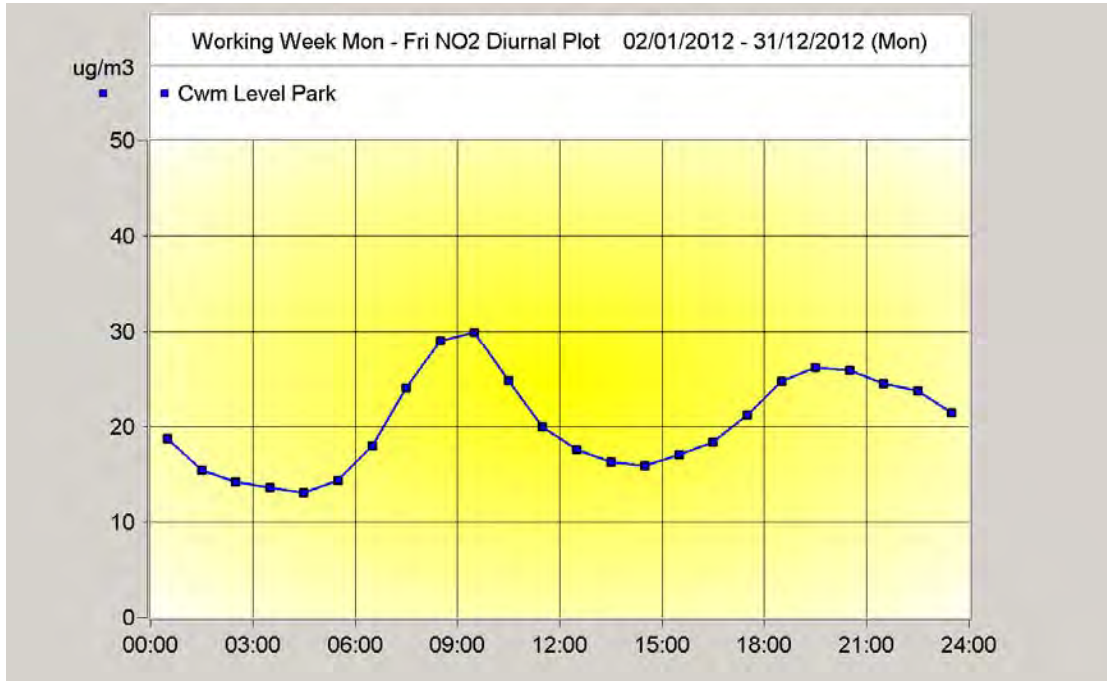
solely around the am peak traffic period of 7-10am. Thought is still being given as to what effect this may have on the overall NO₂ annual mean and 1 hour objectives and is expanded on below. Whatever traffic management measures can be introduced into the Nowcaster forecast system being developed for such situations to achieve widespread compliance with the objectives will obviously require detailed and thorough planning.



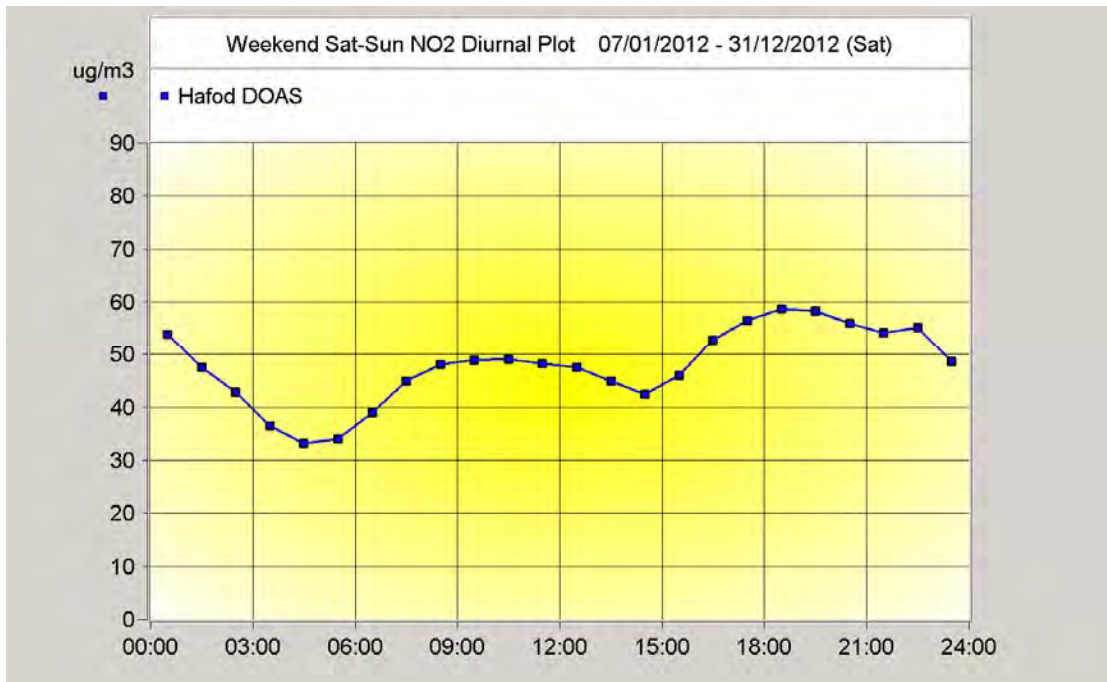
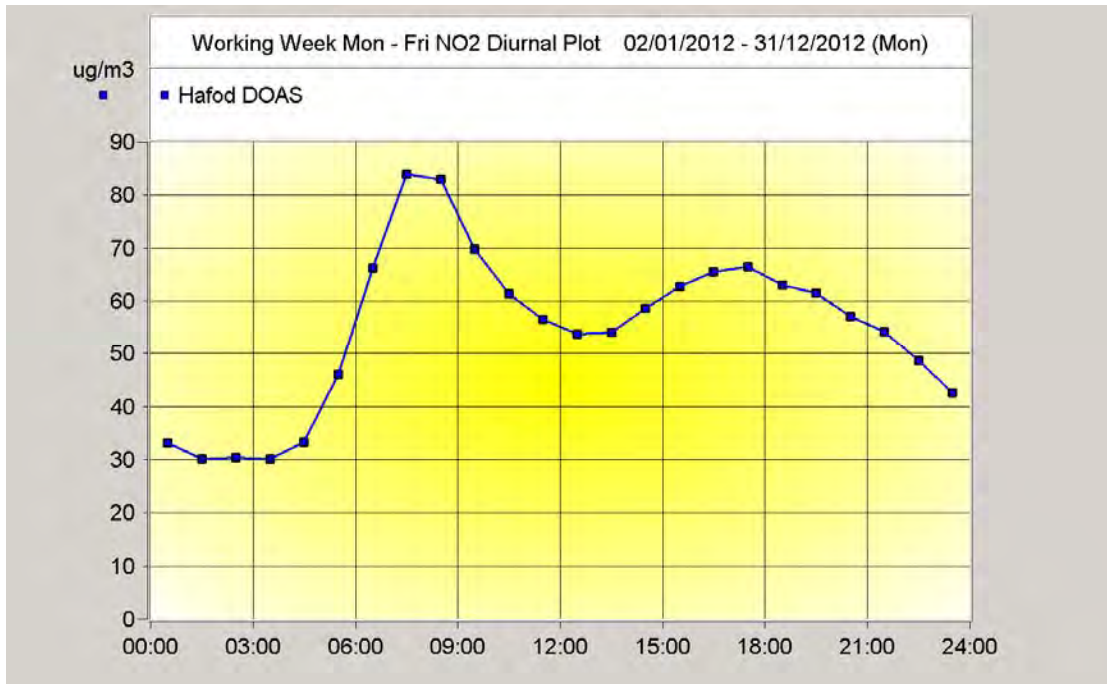
NO₂ Diurnal Profile 1 – Swansea AURN 2012 (top weekday profile, bottom weekend profile)



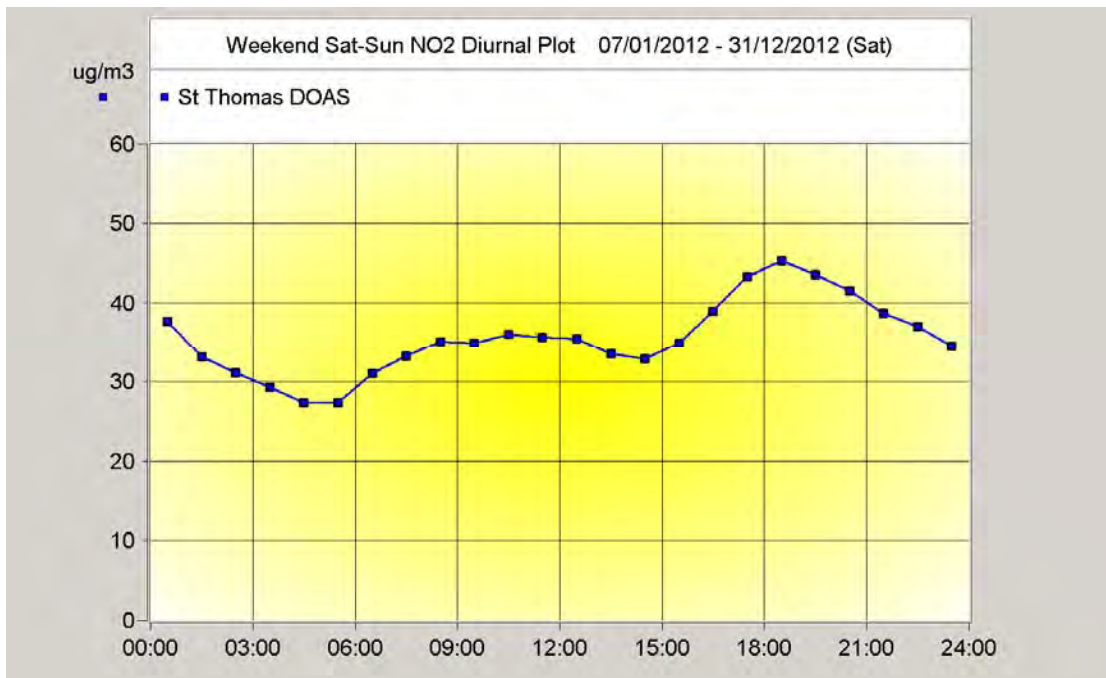
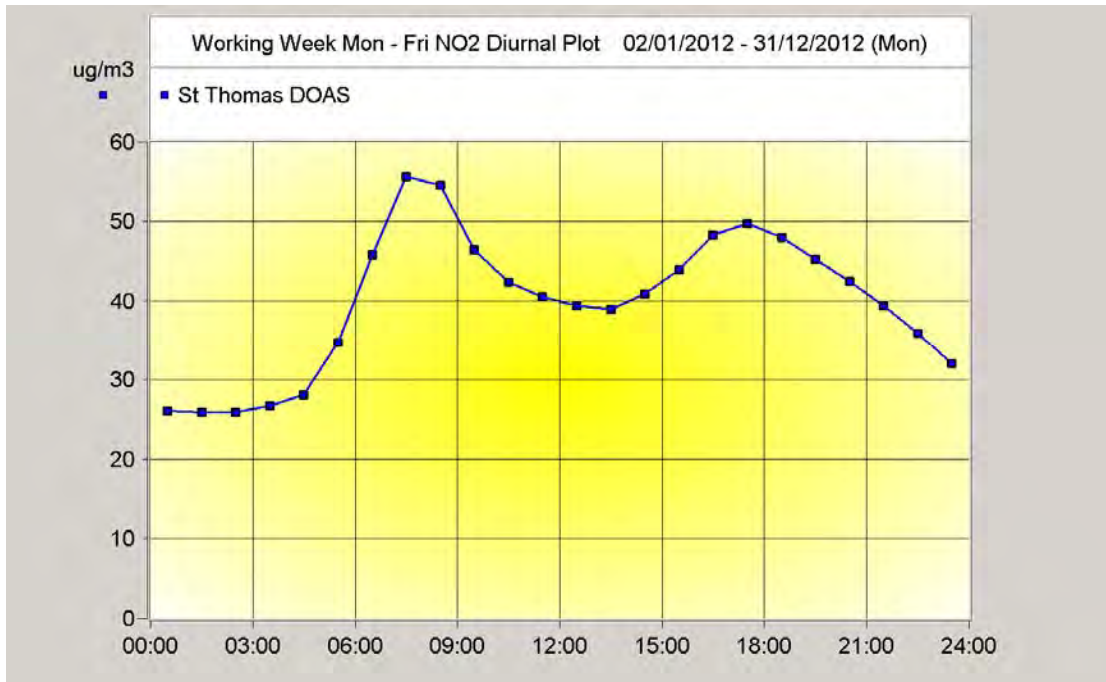
NO₂ Diurnal Profile 2 – Morryston Groundhog 2012 (top weekday profile, bottom weekend profile)



NO₂ Diurnal Profile 3 – Cwm Level Park 2012 (Urban background site) (top weekday profile, bottom weekend profile)



NO₂ Diurnal Profile 4 –Hafod DOAS 2012 (top weekday profile, bottom weekend profile)

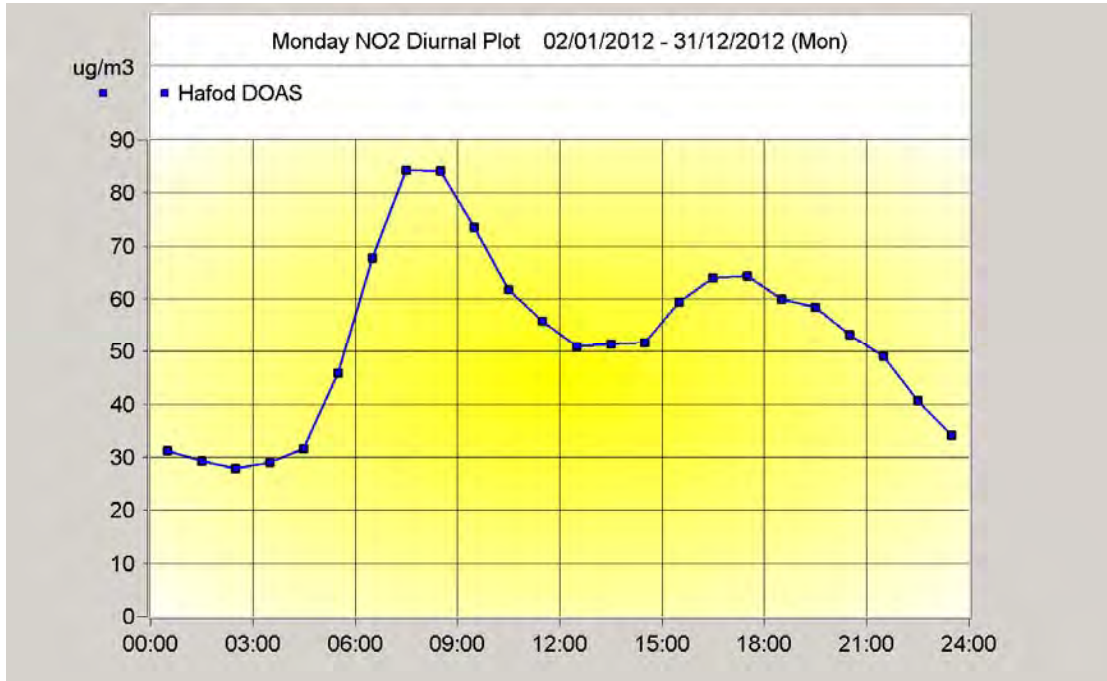


NO₂ Diurnal Profile 5 – St Thomas DOAS 2012 (top weekday profile, bottom weekend profile)

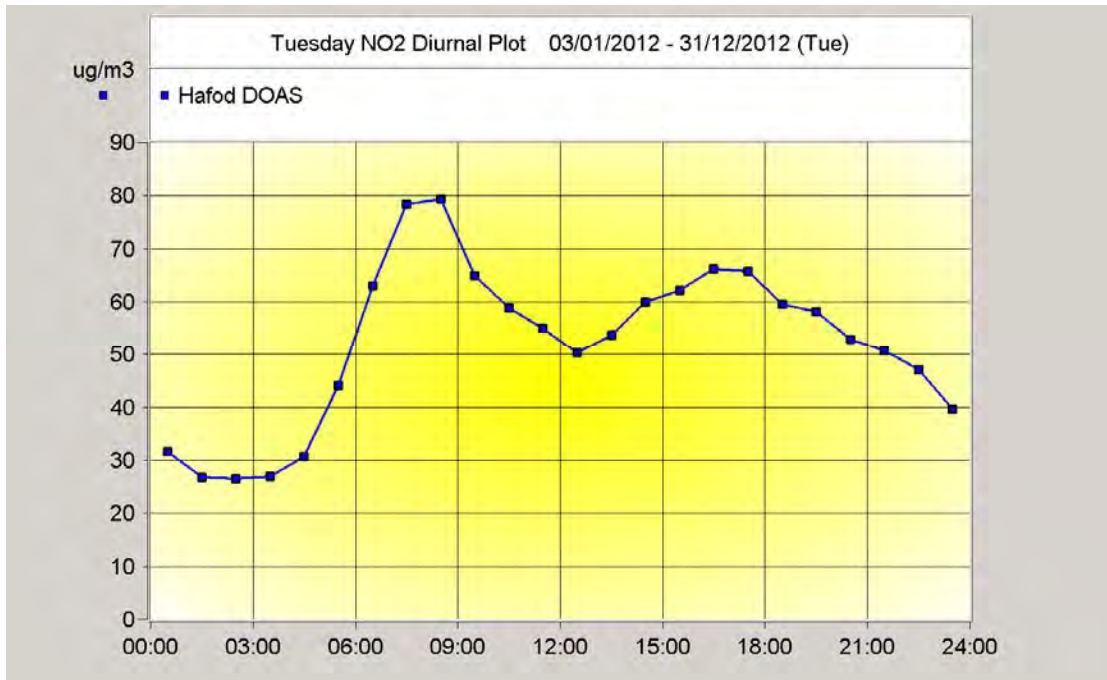
The diurnal weekday profiles obtained for the Hafod DOAS are both interesting and concerning in that can these profiles be better explained and more importantly what practicable measures would reduce the impact of the morning rush hour along this street canyon. Early thoughts are that it is envisaged that additional “source apportionment” will be required with specific emphasis on identifying the fuel being combusted and also the EURO classification and the adopted abatement technology employed within each vehicle. Obviously, the only way to accurately obtain this information is via a static ANPR camera linked to the DVLA databases. When sufficient information has been gathered, thought will then have to be given as to how interventions can be practicably be made with specific vehicle types within the fleet. On the basis of the weekday profiles below, it could be argued that whatever interventions are decided upon would apply every morning of every working day of the week in order to make any difference to the concentrations being recorded. Budgetary restrictions will delay implementation of this system. Obviously, there are individual days when elevated concentrations are higher during the pm rush hour than the am period. The profiles above and below hint of this, but the diurnal profiles indicate that the higher concentrations typically occur during the early morning rush hour.

Diurnal plot 11 is shown below for Saturdays and again is interesting for the different profile obtained primarily during the pm period. A possible explanation for this pm period is the increase in traffic associated with the sporting events held at the Liberty Stadium which is less than 0.5 miles away from the Neath Road street canyon. Whilst these sporting events tend to commence mid afternoon and finish at the latest early/late evening, the typically occurring concentrations remain until the early hours of Sunday. Whilst the Neath Road corridor is a primary route into the city centre, it is not thought the night-time trade to clubs/café/bars would solely account for these concentrations. Meteorological conditions are thought to play a part in preventing dispersion from within the lower valley area.

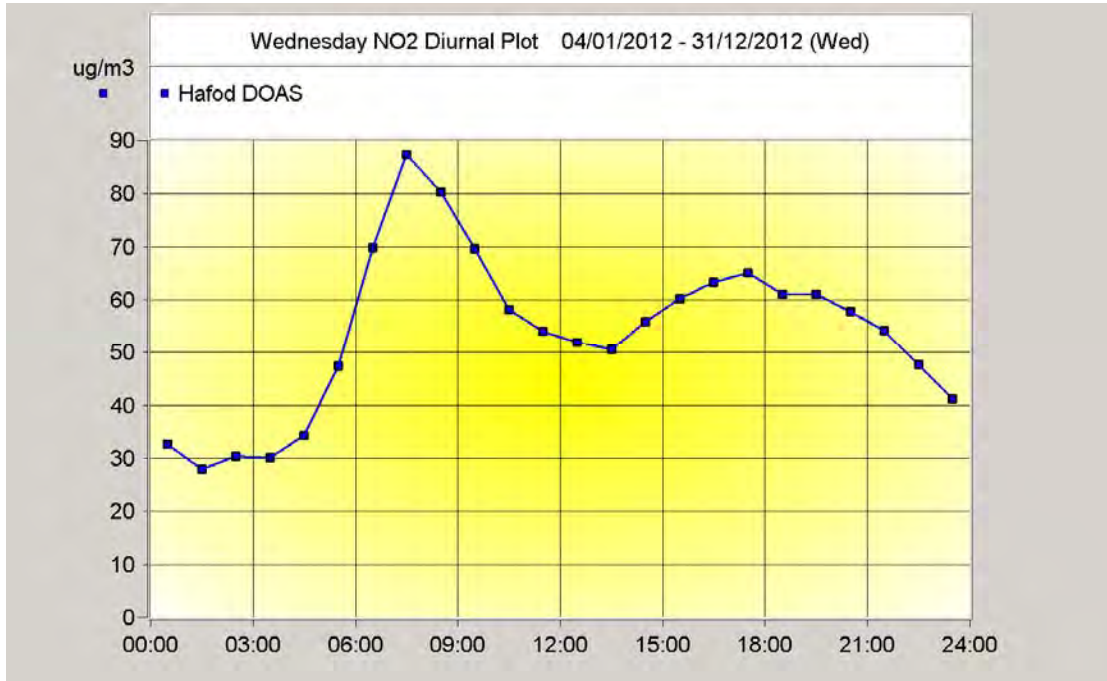
Diurnal plot 13 summarises the individual plots and makes visualisation of the data simpler.



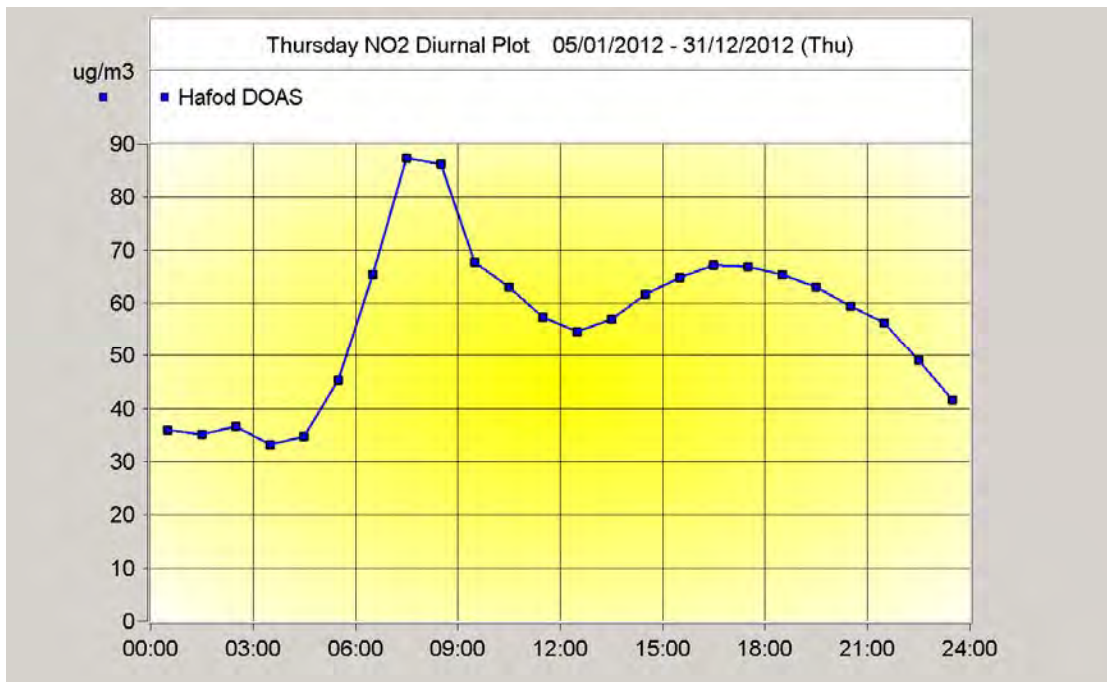
NO₂ Diurnal Profile 6 –Mondays - Hafod DOAS 2012



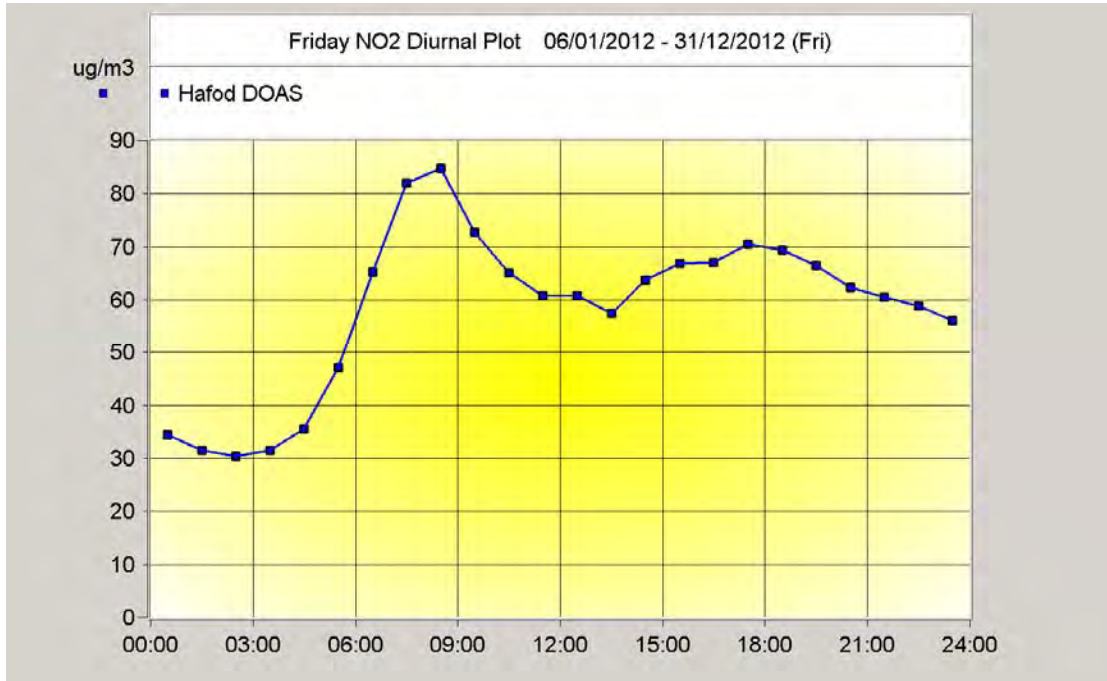
NO₂ Diurnal Profile 7 – Tuesdays - Hafod DOAS 2012



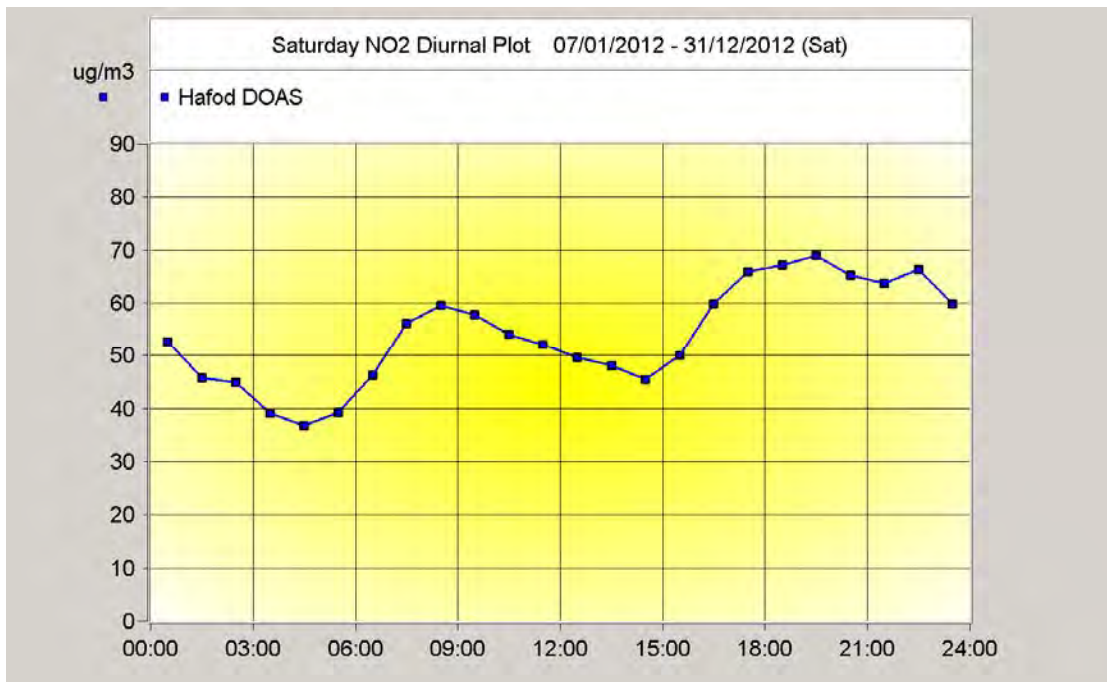
NO₂ Diurnal Profile 8 –Wednesdays - Hafod DOAS 2012



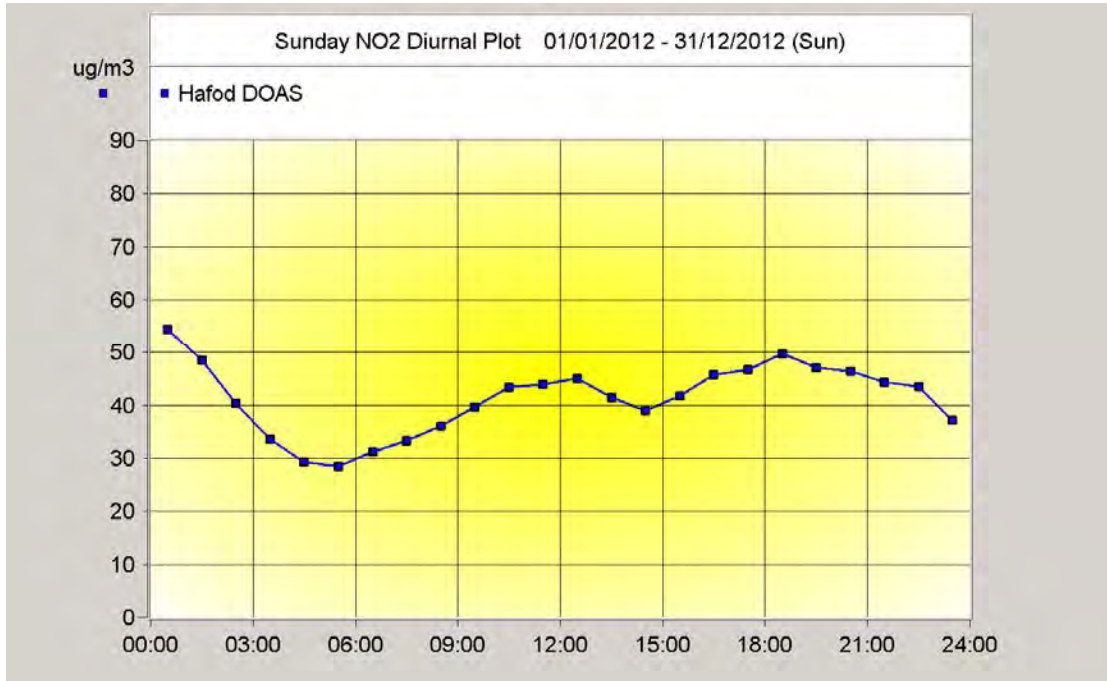
NO₂ Diurnal Profile 9 –Thursdays - Hafod DOAS 2012



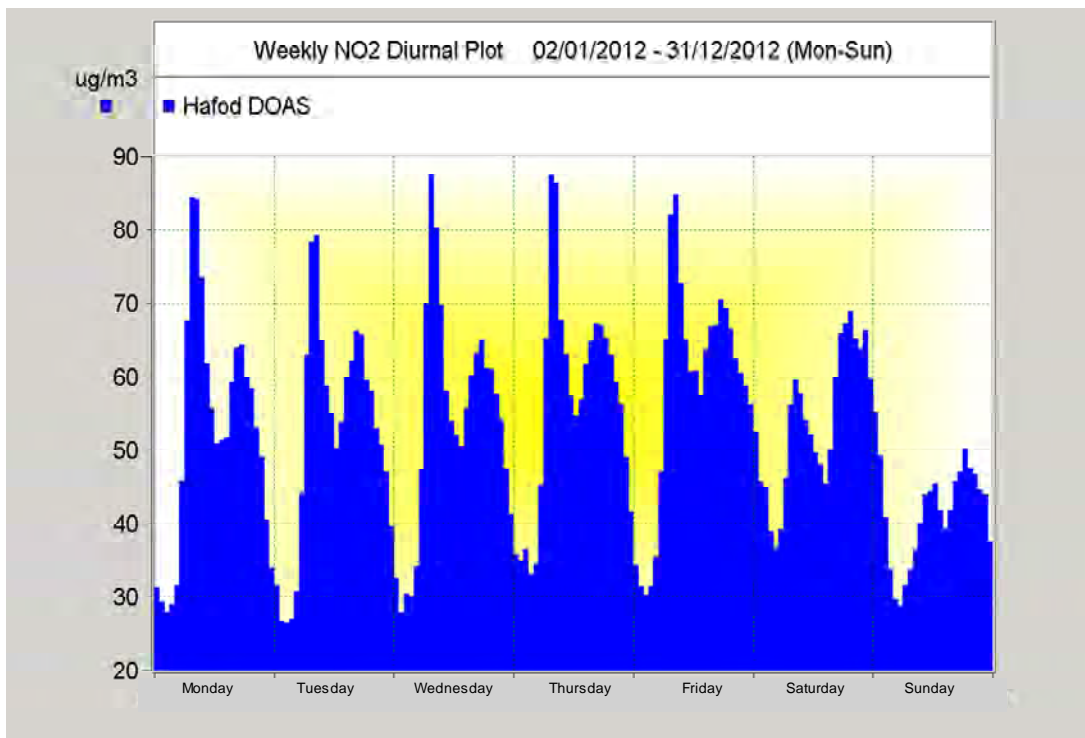
NO₂ Diurnal Profile 10 – Fridays - Hafod DOAS 2012



NO₂ Diurnal Profile 11 – Saturdays - Hafod DOAS 2012



NO₂ Diurnal Profile 12 –Sundays - Hafod DOAS 2012



NO₂ Diurnal Profile 113 – Weekly – Hafod DOAS 2012

Detailed traffic flow data for the authorities GPRS network of 44 ATC's is presented in subsequent chapters.

LAQM.TG (09) provides a method within box 2.1 page 2-4 to project measured annual mean roadside nitrogen dioxide concentrations to future years. The supporting adjustment factor table was updated during January 2012 in view of the release of updated vehicle emission factors and is obtainable from

http://laqm.defra.gov.uk/documents/ls_the_example_in_Box_2.1_TG09_correct.pdf

It is noted that in addition to the above, from

<http://laqm.defra.gov.uk/whatsnew.html> that Defra produced a further update to the previously revised future year projection guidance by way of a further note entitled "Note on Projecting NO₂ concentrations" ¹³ dated 30th April 2012. Box 2.1 page 2-4 of LAQM.TG(09) has now also been updated "live" at [http://laqm.defra.gov.uk/documents/LAQM-TG-\(09\)-Dec-12.pdf](http://laqm.defra.gov.uk/documents/LAQM-TG-(09)-Dec-12.pdf) with the latest future year adjustment factors.

The April 2012 note sets out additional alternative methods to project measured NO₂ concentrations to future years. As a result, this authority is considering the implications raised with some of the alternative methods mentioned within this note but have decided to undertake within this Progress Report the more simplistic revised approach detailed within section 2.4. This alternative projection method assumes an average national reduction trend in NO₂ concentrations of 0.68% per year at roadside stations and 0.87% reduction per year at background stations. The adjustment factors presented within table 2 of the April 2012 update are presented as the UK averages of the site classifications i.e. roadside. This newly adopted method allows the comparison of the LAQM.TG(09) (Dec12) future year projections revised guidance now issued to the additional revised note dated April 2012. This method produces a range of predicted future year concentrations as to where the NO₂ concentration is likely to lie.

¹³ <http://laqm.defra.gov.uk/review-and-assessment/modelling.html#ProjectingNO2Note> and http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

Using the above rationale, Table 6 indicates the range of predicted NO₂ concentrations in 2013 - 2020 at the 4 automatic roadside sites and the urban background site in Swansea. Where applicable, the correction derived for distance from the roadside measurement location to the nearest receptor location is given in bold within table 6. It is this figure in bold that has been used to calculate the future year projections. The actual measured roadside concentration is given in brackets for information.

Site ID	Location	Within AQMA?	Annual mean adjusted for distance from road to nearest receptor where applicable	Future Years Projection Ranges expressed in ug/m ³ (* at nearest receptor location) LAQM.TG(09) DEC12 method first, Revised April 2012 method last Predicted exceedence of annual mean objected highlighted in bold red Prediction within 3ug/m ³ of annual mean objected highlighted in bold blue								
				2012	2013	2014	2015	2016	2017	2018	2019	2020
				1	*Swansea AURN	Y	26.0 (30.66)	24.8 to 25.84	23.7 to 25.65	22.6 to 25.49	21.3 to 25.32	20.0 to 25.13
2	Morfa Groundhog	Y	N/A	-	-	-	-	-	-	-	-	
3	*Morrison Groundhog	N	23.4 (28.10)	22.4 to 23.25	21.3 to 23.08	20.3 to 22.94	19.1 to 22.79	18.0 to 22.62	16.8 to 22.47	15.6 to 22.33	14.4 to 22.18	
4	** Cwm Level Park (Urban Background)	Y	19.61	18.7 to 19.44	17.9 to 19.28	17.0 to 19.11	16.0 to 18.95	15.0 to 18.78	14.0 to 18.62	13.1 to 18.45	12.1 to 18.29	
5	Hafod DOAS	Y	52.60	50.3 to 52.27	48.0 to 51.89	45.7 to 51.56	43.0 to 51.23	40.4 to 50.85	37.7 to 50.52	35.0 to	32.4 to 49.86	
6	St.Thomas DOAS	N	38.62	36.9 to 38.38	35.3 to 38.10	33.5 to 37.86	31.6 to 37.61	29.6 to 37.33	27.7 to 37.09	25.7 to	23.8 to 36.61	

Table 6 – Predicted Future Years Roadside NO₂

** Urban background site included for sake of completeness. Revised April 2012 method includes background factors.

It is thought that table 6 above now indicates a more realistic range of predicted NO₂ concentrations in future years. In light of past experience with LAQM work and projecting future year concentrations of roadside NO₂ it would seem wise to look to the higher threshold of the range indicated as this appears to be more “real world”.

From table 6, the realistic view can be taken that the Hafod DOAS will continue to experience exceedences of the annual mean until at least 2020 given current thinking, with the St Thomas DOAS remaining at risk of exceedence of the annual mean objective as well up to 2018. All other stations exhibit existing full compliance with the annual mean objective

2.2.3 Nitrogen Dioxide Diffusion Tube Monitoring

All data presented within table 7 below has been corrected for tube bias only. No correction for tube chemistry has been applied as a result of the tri-location study carried out at the Swansea Roadside AURN chemiluminescent analyser¹⁴. In any event, all passive diffusion tubes are located roadside and no correction has been made using a roadside tri-location study derived bias correction to a passive diffusion tube with an urban background classification.

The authority has steadily increased its passive diffusion tube network over the years with the biggest increases being seen in the last 3 years. The total number of sites operational during 2012 was 246, exposed on a monthly basis. Sites 1 to 296 are reported below and form the additional monitoring outlined within the Updating and Screening Assessment 2009, with an update being made within the Progress Report 2010. These additional sites became necessary as a result of the revised guidance within LAQM.TG(09) requiring assessment of narrow/congested streets that have an annual daily flow greater than 5000 vehicles. Sites 275 to 291 represent yet more additional monitoring partly in direct response to local residents concerns following alteration of road junctions. Please note that following budgetary restraints during April 2011 a decision was made to cease monitoring at all sites that have consistently returned a bias corrected annual mean below 30ug/m³. Monitoring ceased at these sites during May 2011 and for completeness, these sites are annotated within table 3 and highlighted within the results table 7 below. Sites 292 – 296 again represented additional monitoring as a result of local developments with sites 297 – 323 commencing during July 2012 as a result of highway alterations within the Gorseinon area. Sites 297-323 only achieved a data capture of 50% for 2012 but are reported here for information.

Sites with data capture greater than 75% i.e. those that have the minimum 9 months exposure period and which exceed the annual mean are highlighted in bold red. Those sites that are close to exceeding the annual mean (between 37-40ug/m³) are highlighted in bold blue. **Table 7 indicates the bias corrected annual means including any correction necessary for distance to nearest receptor from the**

¹⁴ <http://laqm.defra.gov.uk/bias-adjustment-factors/local-bias.html>

sampling location - see table 3 for distance to nearest receptor. The relevant distance correction (where applicable) is given within table 8 for sake of completeness.

Box-Whisker Plots are provided for all sites within Annexe 5. Please note that RAW, uncorrected for bias data is presented within the box-whisker plots.

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2012 %	Annual Mean concentrations 2012 (ug/m3) Adjusted for tube bias and distance to receptor
1	262046	196420		100.00	25.18
2	262095	196500			
3	262161	196513			
4	262497	192857	Y	100.00	29.73
5	262548	192943	Y	100.00	34.06
6	262612	192995	Y	100.00	29.20
7	262691	192852	Y	100.00	49.39
8	262990	195820	Y	100.00	41.80
9	263190	195205		100.00	26.63
10	263219	195513	Y	91.67	23.40
11	263344	195474	Y	100.00	34.03
12	263680	195103	Y	100.00	43.20
13	264830	193066		100.00	28.99
14	265285	192696		100.00	25.57
15	265334	192608		100.00	26.69
16	265339	192534		100.00	30.41
17	265496	192408			
18	265526	195807	Y	100.00	44.74
19	265597	194061	Y	91.67	45.33
20	265594	194175	Y	100.00	36.65
21	265634	195316	Y	100.00	30.57
22	265682	195374	Y	100.00	31.23
23	265728	195494	Y	100.00	33.18
24	265760	192420			
25	265845	195547	Y	100.00	28.83
26	265876	194318	Y	100.00	40.31
27	265922	194428	Y	100.00	37.05
28	265949	194891	Y	100.00	30.11
29	265973	195222	Y	83.33	47.60
30	266080	192516			
31	266153	196003		100.00	33.26
32	266209	193867		100.00	31.53
33	266236	193488		100.00	32.59
34	266272	196168		100.00	31.39
35	266314	193298		91.67	33.46
36	266455	193300		100.00	31.65
37	266515	193213			
38	266662	193181		91.67	35.40
39	266905	193271			
40	266951	198278		91.67	30.47
41	266953	198085		100.00	38.32
42	267084	198274			
43	267093	198063		100.00	38.01
44	267639	199543		100.00	28.67
45	267661	199451		100.00	33.84
46	267752	193218			
47	267908	199773			
48	268011	193101		100.00	23.52
49	268501	197329		100.00	26.67
50	268530	197419		100.00	33.84
51	268593	197434		100.00	30.54

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2012 %	Annual Mean concentrations 2012 (ug/m3) Adjusted for tube bias and distance to receptor
52	268643	197245			
53	268652	197508			
54	268693	197416		100.00	34.66
55	268789	197420		100.00	33.36
^56 *	269306	198661		100.00	22.3
57	269395	199042			
^58	264052	192884		91.67	37.9
59	265918	194463	Y	100.00	53.85
60	265036	192931		100.00	35.74
61	264959	192878		100.00	40.07
62	266698	195335			
^63	262675	192775	Y	100.00	21.8
^64	262719	192840	Y	100.00	40.5
65	262735	192855	Y	100.00	24.69
66	262802	192829	Y	100.00	31.62
^67	265903	193683	Y	100.00	35.4
68	265573	193432		100.00	39.68
^69	265543	193450		100.00	42.3
^70	266649	195435		100.00	24.3
^71 **	266514	195485		100.00	23.4
72	264091	192900		91.67	25.53
73	264138	192868		100.00	33.09
74	264163	192853		100.00	29.01
75	264072	192869		100.00	41.09
76	263968	192880		100.00	27.86
77	263856	192931			
78	263819	192948		75.00	29.80
79	263842	192896		100.00	31.84
80	263558	192833			
81	262940	192775	Y		
82	262851	192805	Y		
83	262785	192838	Y	100.00	30.36
84	262714	192839	Y	100.00	36.82
85	262702	192847	Y	100.00	39.19
86	262704	192865	Y	100.00	29.33
87	262697	192798	Y	100.00	22.26
88	262605	192916	Y	83.33	33.63
89	262587	192956	Y	91.67	22.37
90	262631	192996	Y	100.00	32.77
91	262534	192950	Y	100.00	30.20
^92	262545	192869	Y	75.00	26.1
93	263406	195534		100.00	27.27
94	263444	195572		100.00	28.63
95	262815	196090		91.67	26.57
96	262922	195950		100.00	25.87
97	262946	195902	Y	100.00	34.78
98	263142	195548	Y	91.67	36.92
99	263387	195332	Y	91.67	30.27
100	263470	195250	Y	100.00	27.97
101	263843	195047	Y	100.00	27.17
102	266379	193307		100.00	29.66

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2012 %	Annual Mean concentrations 2012 (ug/m3) Adjusted for tube bias and distance to receptor
103	268526	197359		83.33	29.46
104	268538	197389		100.00	28.24
105	268562	197472		100.00	29.24
106	268496	197476		100.00	29.44
107	268765	197420		91.67	33.99
108	267608	199461		100.00	29.46
109	267510	199487		100.00	25.85
110	267369	199521		100.00	28.57
111	267705	199426		100.00	30.38
^112	264868	192814		83.33	28.1
113	264654	192662		100.00	30.42
114	264622	192971		100.00	29.07
115	265031	193097		100.00	41.89
116	265192	193138		100.00	41.49
117	265288	193211		100.00	39.32
⊗118	265483	193385		100.00	31.76
119	265522	193390		83.33	31.75
⊗120	265570	193366		100.00	44.81
121	265706	193662	Y	100.00	50.97
122	265694	193505		100.00	34.42
123	265655	193423		100.00	48.75
⊗124	265651	193253		91.67	41.93
⊗125	265641	193162		83.33	41.8
⊗126	265475	193144		100.00	41.64
⊗127	265348	193110		100.00	48.72
⊗128	265297	193085		100.00	43.18
⊗129	265153	193098		75.00	34.74
⊗130	265139	192912		100.00	42.05
⊗131	265137	192846		91.67	45.86
132	265229	192753		100.00	34.97
133	265350	192566		100.00	21.46
⊗134	265113	192903		108.33	45.67
^135	262605	192916	Y	83.33	27.71
^136	262612	192995	Y	83.33	27.59
^137	262631	192996	Y	100.00	32.39
138	266779	199246		100.00	22.58
139	266867	199030		100.00	27.75
140	266863	199009		100.00	33.92
141	266979	198772		100.00	26.27
142	267017	198710		100.00	28.80
143	267089	198608		83.33	31.52
144	267141	198591		100.00	27.80
145	267139	198578		100.00	30.31
146	267156	198571		100.00	33.13
147	267165	198580		100.00	28.97
148	267170	198564		100.00	29.82
149	267204	198561		100.00	26.36
150	267205	198545		100.00	28.45
151	267192	198518		100.00	27.14
152	267081	198268			
153	268845	201137			

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2012 %	Annual Mean concentrations 2012 (ug/m3) Adjusted for tube bias and distance to receptor
154	268870	201267			
155	269009	201280		100.00	30.05
156	269059	201296		100.00	29.16
157	269173	201355			
158	269480	201441		83.33	29.24
159	269171	201620		100.00	29.42
160	269049	201744		100.00	34.73
161	268938	201929			
162	259553	203379		100.00	28.89
163	259287	203556		100.00	22.48
164	259195	203667		100.00	28.70
165	259149	203675		100.00	20.70
166	259148	203690		100.00	24.26
167	259126	203700		100.00	23.16
168	259115	203705		100.00	21.74
169	259013	203747		100.00	21.04
170	258971	203797		83.33	17.57
171	258917	203826		108.33	24.14
172	258887	203859		91.67	26.56
173	259250	203708		100.00	19.58
174	259253	203660		100.00	16.57
175	259251	203638		100.00	15.11
176	258872	203691		100.00	12.67
177	258896	203697		100.00	14.14
178	258986	203684		100.00	12.85
179	259059	197831			
180	259064	197781		100.00	31.00
181	259010	197817			
182	259050	197790		100.00	27.58
183	259036	197795		100.00	31.04
184	259014	197797			
185	258919	197820			
186	258711	197868			
187	258206	198239			
188	258197	198219			
189	258270	198257			
190	258260	198237			
191	258338	198270			
192	257422	198542			
193	257371	198522			
194	257958	198581			
195	257972	198563			
196	258046	198558			
197	258797	198701		100.00	35.24
198	258811	198701		91.67	36.45
199	254703	195764		100.00	29.53
200	254582	195821			
201	254522	195859		100.00	28.60
202	254437	195879			
203	254294	195885			
204	253777	195926			
205	253758	195939			

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2012 %	Annual Mean concentrations 2012 (ug/m3) Adjusted for tube bias and distance to receptor
206	261565	188211		100.00	45.60
207	261561	188222		100.00	41.17
208	261541	188215		100.00	37.48
209	261534	188198		91.67	39.40
210	261516	188207		100.00	34.47
211	261501	188188		100.00	35.45
212	261486	188200		100.00	27.18
213	261490	188186		100.00	35.09
214	261315	188193		100.00	25.39
215	261299	188191		100.00	23.66
216	261276	188190		100.00	26.07
217	260357	188240			
218	260384	188206			
219	260419	188172			
220	261194	188163			
221	260454	188171			
222	260469	188182			
223	266899	197354			
224	266881	197389			
225	266861	197432			
226	266829	197472			
227	266836	197484			
228	266779	197578			
229	266772	197621			
230	266777	197651			
231	268802	197666			
232	266825	197654			
233	266823	197668			
234	266858	197671			
235	266874	197657			
236	266886	197658			
237	266885	197676			
238	266902	197660		100.00	33.13
239	266181	196022		91.67	31.18
240	266169	195995		100.00	34.40
241	266159	196013		100.00	33.21
242	265655	193423		100.00	44.28
243	265474	194949		100.00	37.40
244	265466	194930	Y	100.00	43.78
245	265448	194922	Y	100.00	41.93
246	265425	194927		100.00	28.67
247	265394	194899	Y	91.67	29.76
248	265342	194894		100.00	27.35
249	265326	194871	Y	91.67	34.74
250	265274	194867		100.00	27.17
251	265263	194845	Y	91.67	31.94
252	265226	194830	Y	100.00	30.52
253	265194	194833		100.00	25.10
254	265142	194816		91.67	25.48
255	265098	194825		91.67	21.69
256	264995	194777		100.00	40.14
257	254817	189135			

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2012 %	Annual Mean concentrations 2012 (ug/m3) Adjusted for tube bias and distance to receptor
258	254906	189110		100.00	28.30
259	254949	189113			
260	254970	189116			
261	254991	189115			
262	255056	189118			
263	262444	193447			
264	262251	193293			
265	266375	198023		66.67	29.04
266	266380	198043			
267	266382	198028		75.00	28.27
268	266419	198053		66.67	25.78
269	266458	198111			
270	266896	198084			
271	266879	198078		100.00	30.44
272	266888	198074		100.00	32.56
273	267060	198234			
274	269487	201451			
^275	265658	194856	Y	100.00	25.2
276	265610	194871	Y	50.00	32.51
277	265596	194875	Y	58.33	39.35
278	265573	194882	Y	58.33	34.70
279	265555	194926	Y	66.67	55.51
^280	265542	194980	Y	100.00	40.8
^281	265542	194872	Y	100.00	36.7
^282	265540	194840	Y	100.00	35.7
283	265436	195937		100.00	31.51
284	265452	195899		100.00	32.62
285	266955	197415		100.00	33.41
286	266938	197377		100.00	34.27
287	265715	193902	Y	100.00	29.72
288	265698	193878	Y	100.00	32.86
289	265702	193842	Y	100.00	35.86
290	263014	195737	Y	100.00	27.88
291	267952	193121		100.00	45.22
292	263833	196108		100.00	17.86
293	262302	196688		83.33	18.26
294	262342	196742		83.33	25.18
295	258998	198698		75.00	29.33
296	259054	198679		83.33	31.61
297	258957	198628		50.00	19.01
298	258985	198613		50.00	24.46
299	259010	198619		50.00	18.62
300	259043	198602		50.00	21.78
301	259054	198611		33.33	18.29
302	259088	198603			
303	259107	198582		50.00	24.24
304	259170	198554		50.00	22.27
305	259183	198561		41.67	17.28
306	259217	198544		50.00	18.07
307	259267	198520		50.00	20.65
308	259294	198507		50.00	20.79
309	259325	198492		50.00	20.37

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2012 %	Annual Mean concentrations 2012 (ug/m3) Adjusted for tube bias and distance to receptor
310	259338	198486		50.00	19.69
311	259326	198479		50.00	21.61
312	259313	198486		50.00	20.81
313	259295	198495		50.00	21.50
314	259268	198508		50.00	19.73
315	259219	198529		50.00	22.05
316	259208	198504		50.00	20.46
317	259216	198496		50.00	19.49
318	259194	198450		50.00	18.73
319	259178	198442		50.00	19.76
320	259096	198241		50.00	17.28
321	259036	198246		50.00	19.69
322	259007	198241		50.00	18.15
323	266765	193224		50.00	19.69

Table 7- Nitrogen Dioxide Passive Diffusion Tube Results 2010

* **Site 56** is located on Ynysallan Road, Ynystawe to the frontage of a potential housing development site that would be 10-15m from the eastbound carriageways of the M4. Relevant exposure is given at present to the nearest existing dwelling within a separate development setback from the monitoring location.

** **Site 71** Copper Quarter 3 is on the frontage of an existing housing development site that will see dwellings fronting onto the access road to Morfa Retail Park and the Liberty Stadium. Relevant exposure is given at present to the nearest existing dwelling on the development site. The nearest potential dwelling within the development (setback from the monitoring location) will be within 10m of the monitoring location when construction is complete.

^ Sites 135-137 are located at first floor level of properties in addition to exposure at 2.5 on the same dwelling to assess if concentrations change with height

⊗ City centre sites along busy roads – relevant exposure is given to either restaurants where there is a Café environment or to blocks of flats. Assessment where Café environment exists is for 1 hour NO₂ objective. Site 125 now corrected to relevant exposure to flats development above commercial premises.

^ See table 8 below for Correction of NO₂ for distance from road

Sites 265 and 268 have not met the minimum 75% data capture as for 4 consecutive months the tubes were missing. Alterations to the accessibility of the tubes have been made to ensure theft of tubes is prevented (moved to a greater height). Sites 276 to 279 have also not met the 75% data capture during 2012. The terraced block of housing along Pentremawr Road was the subject of a Housing Renewals Scheme and the resultant renovation works to the front elevation resulted in exposure not being possible between February and June 2012. Sites 297 to 323 commenced exposure during July 2012 to monitor the effects of highway alterations – the results are presented here for information only at present.

The distance to the nearest receptor location is given in brackets after the site name in table 3. The NO₂ annual mean at the nearest receptor location has been derived following guidance within TG.09 box 2.3 page 2-6 and use of the spreadsheet at <http://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html> (Issue 4 dated 25/01/2011).

The spreadsheet calculator has been setup to work from 0.1 to 50m only. As can be seen from table 7, the authority is aware of, and planning for future proposed domestic housing developments, by making measurements at the current nearest possible monitoring position to those developments. Unfortunately, an indication can at present only be gained to a distance of 50m from the measurement point due to the setup of the provided spreadsheet tool. Table 3 and table 7 indicate two monitoring sites (site 56 and 71) that are utilised to provide an indicative annual mean to the **nearest existing dwelling** within the development sites. Receptor locations when additional dwellings are constructed to the remainder/potential sites will be considerably closer. It could be argued that at present there is no relevant exposure at present in LAQM terms from these two monitoring locations but it is anticipated due to the developments underway that these receptor locations will be realised at some stage in the near future. Both of these locations are at a distance greater than the spreadsheet will produce corrections for. These two sites are therefore presented with corrected annuals means as if they were 50m away.

The resulting calculated NO₂ annual mean at the receptor location due to fall off in concentration with distance from the road is given below within table 8. Background 1k by 1k NO₂ concentrations (for 2012) were downloaded from <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html> and overlain on a GIS background map within Quantum GIS v 1.8.0-Lisboa The background concentration required for the calculation was obtained from the nearest 1k grid square to the monitoring site. The final derived predicted annual mean concentration at the receptor location has been included within table 7 above.

Site ID	Distance of Measurement Site from Kerb	Distance of Receptor from Kerb	NO ₂ Background Map Concentration (2012 dataset) ug/m ³	Measured 2012 Annual Mean ug/m ³ Corrected for bias	Predicted Annual Mean at Receptor ug/m ³
56	2	*166	17.96	35.71	22.3
58	4	8	17.74	42.74	37.90
63	2	6	13.40	24.77	21.8
**64	1	3	13.40	48.19	40.5
67	2	5	17.91	40.24	35.4
69	2	4	21.06	46.39	42.3
70	2	7	20.05	26.11	24.3
*71	2	*138	20.05	33.86	23.4
92	1	3	13.40	29.72	26.1
112	1	6	17.74	33.91	28.1
125	1	3	21.08	47.68	41.8
275	1	3	19.57	26.75	25.2
280	1	2	19.57	44.25	40.8
281	1	3	19.57	41.58	36.7
282	1	3	19.57	40.29	35.7

Table 8 – Correction of NO₂ for distance from road

* Calculated as if 50m

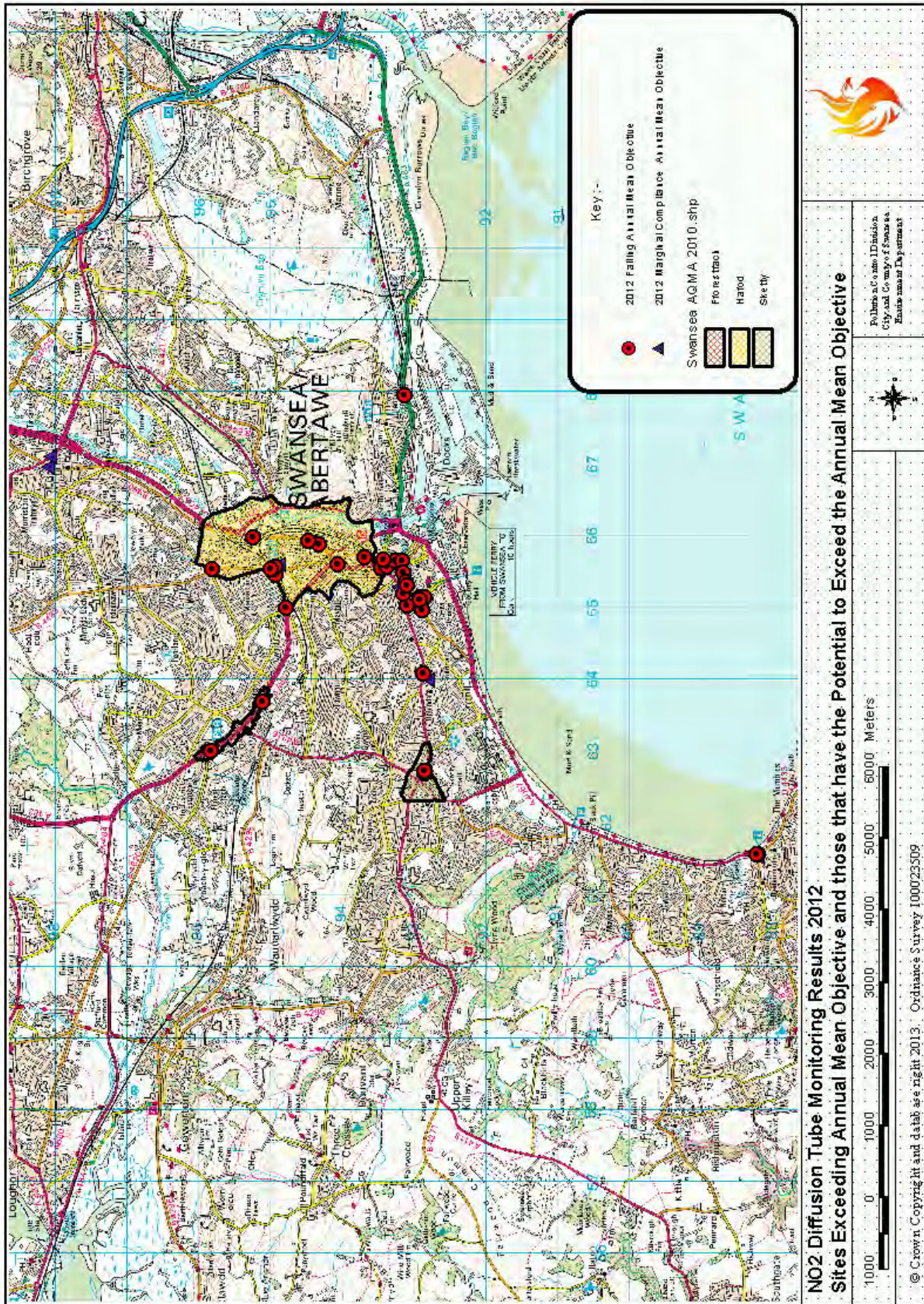
Sites 118,120,124,125,126,127,128,129,130 and 134 were sited with the main intention of assessing concentrations against the NO₂ 1-hour objective within the city centre. As discussed later, Swansea city centre has seen significant change in the road network to accommodate the Metro Service. It is thought reasonable to assess exposure to the 1 hour objective to the general population within the city centre area especially where this exposure can be related to an external café area type environment. These café environments are not set back at a distance from the kerb/road where the measurement has been made but are on the same road, at the same distance from the kerb as the measurement site, albeit at a distance either right or left from the monitoring point. Due to some siting issues, measurements were not always directly possible at the café environment. It is not thought that the method within box 2.3 of TG(09) is relevant or applicable to these locations as the café environments are at an identical distance from the kerb of the same road.

From the advice on using passive diffusion tube annual mean results¹⁵ to assess compliance with the 1 hour objective for NO₂ it is clear from the results within table 7 above, that it is unlikely that the 1 hour objective has been exceeded at any site during 2012 as all bias corrected means are below 60ug/m³. Previously (see Progress Reports 2010 and 2011 and USA 2012) sites 59, 121, 125, 126 and 127 indicated a possible exceedence of the 1-hour objective.

A map of those sites failing the annual mean objective and those with the potential to fail the annual mean objective from the 2012 passive diffusion tube data is given below as map 11.

Sites that have returned the ten highest bias corrected annual means are discussed below. For a greater understanding of conditions affecting the site/location a picture of the surrounding area is included.

¹⁵ http://laqm.defra.gov.uk/documents/NO2relationship_report.pdf



Map 11- Passive NO₂ Monitoring locations failing or having potential to fail annual mean objective 2012

Site 279 (2012 annual mean 55.51ug/m³ but with data capture of 66.6%) is located on Llangyfelach Road, Hafod within the existing Swansea AQMA 2010 area. The

diffusion tube site is located front façade of the terraced property by the signal crossing.



Photo 3 – Passive Diffusion Site 279

Llangyfelach Road narrows at this location due to the railway bridge carrying the West Wales line. To the north is a junction with Courtney Street that itself has become heavily trafficked by traffic seeking a short cut to Cwmbwrla Roundabout with access to Carmarthen Road and the A483 leading to junction 47 of the M4. Within 20m of this junction is a pedestrian crossing. To the south of the site is another junction with Pentremawr Road. Pentrehafod Comprehensive is located along Pentremawr Road. The area is heavily congested during the morning and pm periods

Site 59 (2012 annual bias corrected mean of 53.85 ug/m^3) is located façade between the Hafod Post Office and a terraced property and as mentioned above (within sec 2.2) is directly opposite the Hafod DOAS transmitter station. The DOAS transmitter can be seen to the right of the photo fixed to the front façade to the property – site 59 is directly opposite in between the Post Office and a terraced property. The junction between Neath Road with Maliphant Street and Aberdyberthi Street are controlled via traffic control signals on each arm of the junction



Photo 4 – Passive Diffusion Site 59

These signals do hinder traffic flow down Neath Road for relatively few movements emanating from the side junctions. The annual mean returned from the real-time DOAS is $52.60\mu\text{g}/\text{m}^3$ with 5 exceedences of the hourly objective being seen within the 250m open path measurement length during 2012. Whilst there has been no exceedence of the 18 permitted 1-hour exceedences during 2012, the results observed from year to year from the both real-time and passive methods are highly variable in their extent, but both methods continue to confirm exceedence of the annual mean objective. It is thought that the likelihood of a combination of conditions i.e. meteorological and/or traffic flow, leading to exceedences of the 1-hour objective occurring within this street canyon remain, and can not be ignored, therefore monitoring will continue for the foreseeable future especially in light of the continued exceedence of the annual mean objective being seen. Traffic counters are located to the north (ATC site 18 within section 3) and to the south (ATC site 6 within section 3). The AADT at these sites during 2012 was 15,840 and 15,480 respectively with an HGV content of approx 8%.

Site 121 (2012 annual bias corrected mean of $50.97\text{ ug}/\text{m}^3$) is located within the existing Swansea AQMA 2010 on High Street and is shown below in photo 5. This site is situated façade at approximately 2.5m high on a block of flats opposite Swansea High Street Railway Station and outside bus stop bays. Numerous bus

services operate outbound and inbound along this section of High Street. Data from the GPRS Automatic Traffic Counter (GPRS ATC site 22) located to the northern section of High Street (approx 150 yards north of photo location) is valid for this monitoring location and indicates a bus composition of 5.3% of the flow during 2012. If the total LDV composition is taken into consideration, the figure rises to 10.8%. These figures however, exhibit a continued downward trend not only in terms of traffic composition but also in terms of the returned bias corrected annual means from previous years for this site.

Year	Bias Corrected Mean ug/m³	Bus % Composition	Total % LDV
2008	79.3	8.7	16
2009	61.19	7.4	14.3
2010	52.33	6.5	13
2011	52.71	5.6	11.7
2012	50.97	5.3	10.8

Whilst this site lies within the existing Air Quality Management Area, changes to the road infrastructure outside High Street Railway station and subsequent relocation of bus stops etc appear, given the data above, to have impacted upon NO₂ concentrations seen in the area. This trend evident in the data shown above is surprising given past thinking and local knowledge of the area but none the less is a welcome trend.



Photo 5 – passive diffusion tube site 121

Site 7 Gower Road Sketty (2012 annual bias corrected mean of 49.39 ug/m^3) is located front façade to a terraced property close to the mini roundabout



Photo 6 – Site 7 Gower Road, Sketty

junction of Gower Road with De la Beche Road and is shown within photo 6 above. Approximately 200m north is the signal controlled junction at Sketty Cross. Significant congestion can be seen at peak times within the area. A major comprehensive school is located along De La Beche Road with over 1100 pupils on its role. A large proportion of the pupils are from outside of its



Photo 7 – View looking north to site 7

natural catchment area resulting in pupils either being bussed in or dropped off by their parents. Photo 7 above, looking north towards Sketty Cross signal controlled junction includes a view of the mini roundabout at the junction of Gower Road with De La Beche Road. Site 7 can be seen to the left of photo 7 north of this junction.

Site 123 High Street (2012 annual bias corrected mean of $48.75\mu\text{g}/\text{m}^3$) lies just outside of the existing Swansea AQMA 2010. The authority are once again actively considering locating a continuous chemiluminescent analyser into this section of High street as concerns now exist for sections of High Street that fall outside of the existing AQMA exceeding the NO_2 annual mean objective. Within the USA 2012 submitted by the authority is was mentioned that whilst discussions had commenced with the Housing Association that manage a sheltered youth residence which forms the frontage to passive diffusion tube site 123 on High Street, that due to the budget restraints currently being imposed, there was no budget to purchase either the required enclosure or Teledyne NO_x analyser. However, funding has now been

obtained and it is the authority's intention to press ahead with the installation of a real-time chemiluminescent analyser at this location.



Photo 8 – Middle section of High Street showing passive diffusion tube site 123 and surrounding locale.

The authority is aware of preliminary proposals for redevelopment of old commercial premises at several locations in this vicinity as well as being aware of the developments along the lower section of High Street. One such scheme within the middle section of High Street can be seen in photo 8 opposite passive diffusion tube site 123 - the Urban Village development commenced along High Street during early 2011 and is a mix of commercial and residential dwellings. Passive diffusion tube site 123 is opposite the development and is exhibiting a bias corrected annual mean of $48.75\mu\text{g}/\text{m}^3$ for 2012.

Details of this scheme can be found in section 5.2.10 of the Progress

Report 2011 but alterations to the approved scheme in recent years following discussions with the developers, has seen the proposals to site residential elements along the High Street frontage removed from the scheme and replaced with commercial use. Whilst again the returned annual mean for 2012 confirms an exceedance of the annual mean NO_2 objective, the trend is similar to that described above with a downward reduction in concentrations albeit a levelling off of concentration that still remain above the objective level.

Site 125 is included here to aid the discussion on NO_2 concentrations within the High Street area despite it not being one of the sites with the highest concentrations recorded during 2012. Site 125 is located in the section of Castle Street that leads into the lower section of High Street. The authority is aware of redevelopment of old commercial premises at several locations in this vicinity. One such development has

been undertaken and completed at the junction of High Street/Castle Street and College Street to convert and extend a former nightclub into residential accommodation / flats.



Photo 9 - Residential Development (right) opposite existing receptors over commercial premises (left)

The nightclub extended over existing commercial premises at ground floor level, including the Army Careers centre which forms passive diffusion tube site 125. Site 125 returned a bias corrected annual mean / corrected for distance during 2012 of $41.8\mu\text{g}/\text{m}^3$. Again, this monitoring location is located façade to the commercial premises at ground floor and is once again outside a row of bus stops. Receptors exist at present at a block of flats over commercial premises on the opposite site of the road. Between 2010 and 2012, the distance to receptor correction has been taken to be at the residential development under construction and which is now complete. It is thought that during 2012/2013 the residential accommodation will begin to see occupation. All bus traffic then feed into the lower section of High Street and passed site 123 and eventually site 121 in the upper section of High Street. As commented above with other sites, the results observed from year to year with the passive diffusion tube method employed are highly variable in their extent of

exceedence, but nevertheless continue to confirm exceedence of the annual mean objective. It is not possible to determine definitively if this variability is due solely to meteorological conditions or changes in traffic flow or to a combination of both. Previous work would indicate that the more likely explanation is a combination of the two.

Site 127 (2012 annual bias corrected mean of $48.72\mu\text{g}/\text{m}^3$) is located along the Kingsway in the heart of the city centre and was originally intended to assess concentrations against the 1-hour NO_2 objective. A café type environment exists within 10m of the monitoring site with outside



Photo 10 – Passive Diffusion Tube site 127 The Kingsway

seating for cliental provided adjacent to the busy carriageway as shown above within photo 10. In addition, the upper floors of a commercial building virtually opposite the site have recently been converted into student accommodation and can be seen to the right of photo 10 above the bus stops. No monitoring is possible in this location due to a canopy extending over the retail food outlet. The former Kingsway Post Office building is located the same side of the carriageway as site 127 and is approximately 30 meters to the north. This building has also been converted into flats during 2012. It can be argued therefore that relevant exposure to the annual mean objective exists in this locale. Monitoring will commence façade of the new flats during 2013 to assess if similar concentrations occur.

Site 29 Morfa Terrace (B4603 Neath Road) (2012 annual bias corrected mean of $47.60\mu\text{g}/\text{m}^3$) is located just off the Normandy roundabout, front façade of a terraced property. Photo 11 below is taken from the front façade looking north up the lower Swansea valley towards Normandy roundabout and



Photo 11 – Site 29 Morfa Terrace

the dual carriageway A4067 past the Liberty stadium. The Hafod DOAS and passive diffusion tube site 59 are located approximately half a mile to the south of this location on the B4603. Considerable traffic uses the B4603 past this location into/out of the city centre in preference to the A4607 Cross Valley Link road (to the right of the Liberty Stadium) over Whiterock bridges and down to Quay Parade bridges to access the city centre locations. It is this route that the authority intends to promote further as part of the Nowcaster forecast model project in preference to the B4603 route. However, old habits die hard as despite continual delays along the B4603 through the Hafod area of the city, motorists persist with this route into/out of the city centre.

Site 131 (2012 annual bias corrected mean of $45.86\mu\text{g}/\text{m}^3$) and **site 134** (2012 annual bias corrected mean of $45.67\mu\text{g}/\text{m}^3$) are located along Dillwyn Street in the heart of the city centre and are intended to assess concentrations against the 1-hour NO_2 objective as no residential dwellings are known to exist at these locations.

However, café type environments do exist at locations within 10m of the monitoring sites with outside seating for clientele provided adjacent to the busy carriageway as shown within photo 12 below.



Photo 12 – Café type street scene Dillwyn Street

There are additional café type environments to the north of the photo to the other side of the junction where a Mediterranean style restaurant provides its clientele with outside seating during good weather. Immediately behind/south of photo 12 is yet another café type environment, again located roadside at the signal controlled junction of The Kingsway with Dillwyn Road/St Helens Road. Clientele are again provided with outside seating areas during good weather to consume not only food/coffee/tea etc but also alcoholic beverages. This location is shown below as photo 13.



Photo 13 – Café environment Kingsway/Dillwyn Street

However, as NO₂ concentrations during 2012 have not exceeded 60ug/m³ there are therefore no relevant receptor locations present as the hourly NO₂ objective is unlikely to have been breached¹⁶.

Sites 206 – 213 are located around the junction of Newton Road, Mumbles with the A483 Mumbles Road, with the majority indicating a breach of the annual mean objective during 2010 when monitoring first commenced. These sites were identified during the USA 2009 as Newton Road at this location forms a narrow, congested street (mainly in summertime due to indiscriminate parking etc) with an AADT flow greater than 5000 vehicles.

¹⁶ Laxen et al July 2003 - Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites



Photo 13 – View looking south down Newton Road towards junction with A483 Mumbles Road and Swansea Bay

The junction suffers congestion mainly during the summer months due to the influx of tourists visiting both the Mumbles area and the shopping facilities along Newton Road.



Photo 14 – View looking north up Newton Road

Receptor locations exist at first floor level above commercial premises. However, whilst passive diffusion tube sites are located facade to the entrance doors to the flats in between the commercial premises, on one side of the lower section of Newton Road a canopy extends along the commercial premises at first floor level. Dispersion around passive diffusion tube sites 207, 208, and 210 may be hindered under these circumstances with the returned annual means at sites painting a false picture.

Whilst this may be true for the monitoring undertaken facade underneath the canopy, sites on the opposite side of the road (left of photo 14) do not suffer from a similar situation, with sites 206, 209 and 211 and 213.

During 2011 the authority reported within its Progress Report that exceedences of the NO₂ annual mean objective had been observed at monitoring points under the canopy at sites 208 and 210. It was further reported that exceedences observed at sites on the opposite side of the road (left of photo 14 above) do not suffer from a similar situation of poor dispersion/circulation, with sites 206, 209 and 213 exceeding the annual mean objective. Site 211 was within 0.55ug/m³ of exceeding the annual mean objective so in practical terms it was also be taken to exhibit probable exceedence of the annual mean objective. It was stated within section 10.1 Conclusions from New Monitoring Data that additional monitoring would be undertaken at 1st floor level above the canopy at façade of the flats above the commercial premise. This has not been implemented as during the risk assessment undertaken it was determined that to change the diffusion tubes would present staff with unacceptable risks both from traffic and the height of working. The monitoring sites have, and will therefore remain, he same as described above.

Results from 2012 indicate that sites 206 and 207 exceed the annual mean objective with sites 208 and 209 being within 3ug/m³ of exceeding the annual mean objective so in practical terms they can also be taken to exhibit probable exceedence of the annual mean objective. It is interesting to note that once again, it is only those sites not directly under the commercial premises canopy that have exceeded the annual mean objective during 2012.

From map 12 below showing the monitoring locations along Newton Road, it is evident that only sites closest to the junction of Newton Road and Mumbles Road are either exceeding, or have the potential to exceed the annual mean objective. The more likely cause is, as would be expected the congestion around this junction during most of the day.



Plan 1 – Newton Road Passive diffusion Tube Monitoring Sites 2012
© Crown Copyright and database right 2013. Ordnance Survey 100023509

Site 291 (2012 annual bias corrected mean of $45.22\mu\text{g}/\text{m}^3$) is located on the outbound A483 towards junction 42 of the M4. The site is located front facade of a terraced property that is within 4 meters of the A483 and close to a bus stop and is shown below to the right within photo 15.



Photo 15 – Site 291 Vale of Neath A483

It should be noted that few scheduled services stop and use the pull in lay bye style bus stop and that, at this location, the outbound flow of traffic is free flowing. There is

a signal controlled junction with the Swansea Docks and the A483 entrance 200 meters westwards towards the city centre. This signal controlled junction results in queuing traffic on the opposite dual carriageway of the A483 past NO₂ tube site 48 at Bevans Row. It is curious that free flow conditions outside site 291 result in an exceedence of the annual mean objective whilst queuing traffic past site 48 Bevans Row results in compliance with the objective. This is worth further investigation but initial thoughts are that this is an effect of traffic accelerating away from the signal controlled junction. It is also anticipated that the number of passive diffusion tube locations along Bevans Row will be increased to verify the findings.

Table 9 below details the annual NO₂ bias corrected annual means for sites 1-296 between 2006-2012. Sites 297 to 323 are not included in table 9 below as monitoring only commenced mid 2012 with data capture therefore only 50% for 2012. Those sites that have been decommissioned have been removed from the 2012 dataset reported (see also table 3). Whilst there is evidence of a slight overall downward trend with annual mean concentrations between 2006 and 2012, numerous sites still exhibit a breach of the annual mean objective with numerous others also showing the potential to breach the annual mean objective.

A map of those sites failing the annual mean objective and those with the potential to fail the annual mean objective from the 2012 passive diffusion tube data is given above as map 11.

As additional numerous sites have continued to exhibit bias corrected concentrations below 30ug/m³ for several years, a further decision may be made to cease measurements at these sites to both ease the workload and costs associated with this work. The exception to the above is where those sites are within, or near to, the Swansea Air Quality Management Area where these sites may prove useful in assessing the benefit if any of measures taken within the AQMA.

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$) Adjusted for bias						
				2006	2007	2008	2009	2010	2011	2012
				1	262046	196420		25.7	26.7	24.2
2	262095	196500		17.6	18.1	16.3	17.73	20.08	-	-
3	262161	196513		21.3	22.2	20.1	22.79	23.95	-	-
4	262497	192857	Y	33.7	33.9	30.8	33.25	35.07	29.97	29.73
5	262548	192943	Y	34.0	35.1	32.2	34.22	42.06	33.42	34.06
6	262612	192995	Y	31.9	32.0	29.8	28.71	34.62	29.29	29.20
7	262691	192852	Y	51.1	50.0	48.5	53.02	58.76	50.93	49.39
8	262990	195820	Y	42.2	46.0	42.4	44.59	46.81	41.81	41.80
9	263190	195205		29.9	30.3	28.6	29.00	31.41	27.65	26.63
10	263219	195513	Y	25.6	24.8	24.2	26.03	29.98	25.28	23.40
11	263344	195474	Y	40.8	39.1	37.8	37.08	43.92	37.21	34.03
12	263680	195103	Y	41.8	42.3	40.7	43.92	48.15	43.96	43.20
13	264830	193066		29.8	30.8	28.9	29.90	32.83	28.03	28.99
14	265285	192696		25.2	30.0	25.2	25.23	32.66	26.99	25.57
15	265334	192608		25.7	27.7	26.1	25.73	32.76	27.33	26.69
16	265339	192534		30.8	34.5	30.7	30.73	38.61	30.85	30.41
17	265496	192408		22.4	26.0	22.8	21.22	30.40	-	-
18	265526	195807	Y	43.1	46.4	44.9	47.87	51.23	49.10	44.74
19	265597	194061	Y	44.9	48.2	42.6	44.92	52.20	45.84	45.33
20	265594	194175	Y	40.7	40.7	39.9	42.42	45.51	37.41	36.65
21	265634	195316	Y	32.4	32.8	31.7	32.04	33.65	30.62	30.57
22	265682	195374	Y	36.6	36.6	35.7	34.57	37.93	33.73	31.23
23	265728	195494	Y	32.6	36.0	34.1	33.57	36.53	33.97	33.18
24	265760	192420		21.7	23.6	20.6	19.65	27.50	-	-
25	265845	195547	Y	29.6	28.9	27.7	29.82	31.43	28.91	28.83
26	265876	194318	Y	43.7	42.1	41.7	40.20	45.81	40.78	40.31
27	265922	194428	Y	43.5	41.3	37.8	43.14	45.39	39.95	37.05
28	265949	194891	Y	28.5	31.6	29.4	30.18	33.48	30.29	30.11
29	265973	195222	Y	58.4	58.4	56.3	52.00	53.38	53.48	47.60
30	266080	192516		22.3	24.6	20.1	21.35	25.92	-	-
31	266153	196003		33.9	33.4	32.4	32.39	37.79	31.70	33.26
32	266209	193867		32.6	34.0	31.3	32.11	38.82	33.24	31.53
33	266236	193488		32.4	32.7	31.0	30.86	38.09	32.11	32.59
34	266272	196168		35.1	36.1	32.7	31.18	39.60	34.47	31.39
35	266314	193298		39.0	38.6	35.9	36.23	40.67	40.39	33.46
36	266455	193300		33.0	34.0	31.0	30.03	34.42	33.58	31.65
37	266515	193213		26.1	26.5	24.2	23.88	28.33	-	-
38	266662	193181		33.7	35.5	33.1	35.34	39.05	37.23	35.40
39	266905	193271		27.4	26.7	25.2	25.70	28.35	-	-
40	266951	198278		28.1	29.7	28.2	28.71	31.80	27.77	30.47
41	266953	198085		39.7	33.4	37.3	41.59	41.38	40.54	38.32
42	267084	198274		28.4	31.3	34.8	43.17	38.59	-	-
43	267093	198063		35.8	35.1	34.4	36.19	42.60	34.88	38.01
44	267639	199543		29.9	28.3	29.0	29.71	28.37	30.01	28.67
45	267661	199451		34.6	39.4	35.5	37.79	43.87	33.82	33.84
46	267752	193218		17.0	16.7	16.0	15.91	17.71	-	-
47	267908	199773		24.4	24.1	23.9	25.19	26.83	-	-
48	268011	193101		24.8	24.3	25.2	23.88	27.08	23.98	23.52
49	268501	197329		28.7	29.9	29.6	29.43	32.35	28.28	26.67
50	268530	197419		39.4	39.7	35.3	37.99	41.14	35.38	33.84
51	268593	197434		32.3	30.7	32.2	30.98	34.19	30.31	30.54

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$)						
				Adjusted for bias						
				2006	2007	2008	2009	2010	2011	2012
52	268643	197245		27.3	20.9	22.5	24.20	24.42	-	-
53	268652	197508		23.7	23.4	22.9	23.67	25.93	-	-
54	268693	197416		38.6	34.3	34.6	35.44	33.14	36.31	34.66
55	268789	197420		37.1	36.2	35.3	33.50	36.93	36.10	33.36
56	269306	198661		39.4	39.1	23	22.80	22.4	21.70	22.30
57	269395	199042		16.3	15.9	15.4	15.51	15.73	-	-
58	264052	192884		41.3	41.7	33.6	34.90	41.7	32.50	37.90
59	265918	194463	Y	56.8	60.5	53.9	49.76	60.33	53.98	53.85
60	265036	192931		37.4	38.7	37.1	35.30	42.75	39.62	35.74
61	264959	192878		38.3	38.2	38.0	38.24	40.21	38.82	40.07
62	266698	195335		-	38.4	29.0	17.82	26.83	-	-
63	262675	192775	Y	-	35.4	21.6	22.00	25.9	23.20	21.80
64	262719	192840	Y	-	65.1	42.4	40.10	44.9	39.01	40.50
65	262735	192855	Y	-	37.1	27.0	26.47	29.59	25.49	24.69
66	262802	192829	Y	-	44.3	32.8	30.98	36.04	30.52	31.62
67	265903	193683	Y	-	69.3	38.2	39.80	46.3	39.40	35.40
68	265573	193432		-	42.0	34.4	34.64	41.51	39.26	39.68
69	265543	193450		-	60.8	42.1	43.60	50.9	40.80	42.30
70	266649	195435		-	38.1	23.3	22.90	25.7	24.40	24.30
71	266514	195485		-	41.8	19.9	19.80	20.9	20.10	23.40
72	264091	192900		-	-	25.1	23.86	31.40	25.52	25.53
73	264138	192868		-	-	34.0	34.62	35.36	33.17	33.09
74	264163	192853		-	-	28.9	28.76	32.85	28.19	29.01
75	264072	192869		-	-	35.1	42.09	45.19	42.01	41.09
76	263968	192880		-	-	26.1	26.30	31.70	27.01	27.86
77	263856	192931		-	-	22.8	23.14	26.89	-	-
78	263819	192948		-	-	27.5	27.83	33.17	29.09	29.80
79	263842	192896		-	-	33.0	33.95	37.13	36.77	31.84
80	263558	192833		-	-	24.8	24.34	26.53	-	-
81	262940	192775	Y	-	-	23.3	23.30	27.79	-	-
82	262851	192805	Y	-	-	26.0	24.60	28.32	25.56	-
83	262785	192838	Y	-	-	29.8	28.60	35.51	30.58	30.36
84	262714	192839	Y	-	-	37.3	37.57	39.42	36.44	36.82
85	262702	192847	Y	-	-	38.6	39.58	41.89	38.05	39.19
86	262704	192865	Y	-	-	30.8	28.90	33.25	27.94	29.33
87	262697	192798	Y	-	-	21.3	21.16	23.93	22.23	22.26
88	262605	192916	Y	-	-	37.3	35.21	38.27	32.19	33.63
89	262587	192956	Y	-	-	22.4	24.17	25.99	23.12	22.37
90	262631	192996	Y	-	-	34.2	35.74	37.93	34.43	32.77
91	262534	192950	Y	-	-	31.7	30.62	37.50	32.73	30.20
92	262545	192869	Y	-	-	32.0	34.62	33.7	28.70	26.10
93	263406	195534		-	-	29.9	30.94	33.38	31.39	27.27
94	263444	195572		-	-	29.6	31.05	30.34	29.38	28.63
95	262815	196090		-	-	29.1	28.88	34.29	28.64	26.57
96	262922	195950		-	-	27.9	28.99	31.05	29.46	25.87
97	262946	195902	Y	-	-	36.6	33.84	39.95	35.00	34.78
98	263142	195548	Y	-	-	40.5	40.62	41.01	37.29	36.92
99	263387	195332	Y	-	-	32.5	29.16	37.64	30.58	30.27
100	263470	195250	Y	-	-	28.7	28.13	31.78	26.06	27.97
101	263843	195047	Y	-	-	29.8	28.27	30.97	27.26	27.17
102	266379	193307		-	-	29.4	29.99	33.13	29.54	29.66

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$)						
				Adjusted for bias						
				2006	2007	2008	2009	2010	2011	2012
103	268526	197359		-	-	33.4	31.06	35.11	32.42	29.46
104	268538	197389		-	-	29.4	28.41	31.70	28.55	28.24
105	268562	197472		-	-	32.3	30.11	30.33	28.90	29.24
106	268496	197476		-	-	33.8	33.64	34.66	33.38	29.44
107	268765	197420		-	-	35.0	34.27	36.16	33.53	33.99
108	267608	199461		-	-	31.4	30.10	35.76	30.58	29.46
109	267510	199487		-	-	28.1	27.06	32.44	25.12	25.85
110	267369	199521		-	-	27.7	26.18	30.46	26.34	28.57
111	267705	199426		-	-	32.9	30.63	34.62	28.70	30.38
112	264868	192814		-	-	26.0	26.20	30.3	27.90	28.10
113	264654	192662		-	-	21.8	28.76	36.16	31.18	30.42
114	264622	192971		-	-	32.5	33.19	33.92	29.99	29.07
115	265031	193097		-	-	38.8	40.48	45.67	41.44	41.89
116	265192	193138		-	-	41.5	42.87	48.73	41.92	41.49
117	265288	193211		-	-	39.4	38.32	47.27	39.71	39.32
118	265483	193385		-	-	29.3	32.02	38.58	32.96	31.76
119	265522	193390		-	-	32.2	35.43	40.81	36.56	31.75
120	265570	193366		-	-	46.5	44.16	57.75	51.29	44.81
121	265706	193662	Y	-	-	79.3	61.19	52.33	52.71	50.97
122	265694	193505		-	-	39.5	37.21	47.39	37.12	34.42
123	265655	193423		-	-	54.4	51.27	51.80	50.96	48.75
124	265651	193253		-	-	44.1	46.68	51.72	45.58	41.93
125	265641	193162		-	-	51.4	59.48	50.5	42.10	41.80
126	265475	193144		-	-	38.9	48.41	62.03	41.96	41.64
127	265348	193110		-	-	40.9	37.71	61.83	56.19	48.72
128	265297	193085		-	-	41.1	42.82	51.71	42.37	43.18
129	265153	193098		-	-	36.1	35.34	40.51	35.42	34.74
130	265139	192912		-	-	53.5	42.92	43.92	43.32	42.05
131	265137	192846		-	-	58.3	46.69	50.19	46.62	45.86
132	265229	192753		-	-	32.7	32.39	39.43	36.82	34.97
133	265350	192566		-	-	26.8	27.05	33.15	30.34	21.46
134	265113	192903		-	-	50.5	45.02	47.74	49.41	45.67
135	262605	192916	Y	-	-	-	-	35.60	29.29	27.71
136	262612	192995	Y	-	-	-	-	33.32	28.09	27.59
137	262631	192996	Y	-	-	-	-	37.13	34.46	32.39
138	266779	199246		-	-	-	-	26.22	24.16	22.58
139	266867	199030		-	-	-	-	31.87	28.29	27.75
140	266863	199009		-	-	-	-	39.36	35.01	33.92
141	266979	198772		-	-	-	-	30.00	28.55	26.27
142	267017	198710		-	-	-	-	33.45	30.65	28.80
143	267089	198608		-	-	-	-	37.32	32.94	31.52
144	267141	198591		-	-	-	-	30.26	27.30	27.80
145	267139	198578		-	-	-	-	33.83	33.47	30.31
146	267156	198571		-	-	-	-	35.76	34.62	33.13
147	267165	198580		-	-	-	-	32.97	28.21	28.97
148	267170	198564		-	-	-	-	33.86	31.33	29.82
149	267204	198561		-	-	-	-	31.17	27.11	26.36
150	267205	198545		-	-	-	-	31.42	29.50	28.45
151	267192	198518		-	-	-	-	30.92	27.01	27.14
152	267081	198268		-	-	-	-	29.60	-	-
153	268845	201137		-	-	-	-	28.20	-	-

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$) Adjusted for bias						
				2006	2007	2008	2009	2010	2011	2012
				154	268870	201267		-	-	-
155	269009	201280		-	-	-	-	30.76	28.36	30.05
156	269059	201296		-	-	-	-	31.79	29.51	29.16
157	269173	201355		-	-	-	-	28.79	-	-
158	269480	201441		-	-	-	-	30.89	28.37	29.24
159	269171	201620		-	-	-	-	31.63	30.26	29.42
160	269049	201744		-	-	-	-	34.94	34.35	34.73
161	268938	201929		-	-	-	-	19.77	-	-
162	259553	203379		-	-	-	-	31.59	26.12	28.89
163	259287	203556		-	-	-	-	27.11	22.72	22.48
164	259195	203667		-	-	-	-	31.90	28.99	28.70
165	259149	203675		-	-	-	-	24.52	23.86	20.70
166	259148	203690		-	-	-	-	28.89	23.99	24.26
167	259126	203700		-	-	-	-	25.73	23.83	23.16
168	259115	203705		-	-	-	-	23.26	22.49	21.74
169	259013	203747		-	-	-	-	24.97	26.06	21.04
170	258971	203797		-	-	-	-	19.95	18.43	17.57
171	258917	203826		-	-	-	-	28.08	28.14	24.14
172	258887	203859		-	-	-	-	26.00	28.36	26.56
173	259250	203708		-	-	-	-	20.96	19.35	19.58
174	259253	203660		-	-	-	-	19.60	16.46	16.57
175	259251	203638		-	-	-	-	18.05	20.68	15.11
176	258872	203691		-	-	-	-	15.00	12.98	12.67
177	258896	203697		-	-	-	-	14.87	13.29	14.14
178	258986	203684		-	-	-	-	14.94	14.74	12.85
179	259059	197831		-	-	-	-	29.13	-	-
180	259064	197781		-	-	-	-	32.43	32.49	31.00
181	259010	197817		-	-	-	-	27.49	-	-
182	259050	197790		-	-	-	-	30.96	29.37	27.58
183	259036	197795		-	-	-	-	34.37	32.08	31.04
184	259014	197797		-	-	-	-	28.82	-	-
185	258919	197820		-	-	-	-	26.46	-	-
186	258711	197868		-	-	-	-	23.64	-	-
187	258206	198239		-	-	-	-	18.28	-	-
188	258197	198219		-	-	-	-	17.15	-	-
189	258270	198257		-	-	-	-	16.79	-	-
190	258260	198237		-	-	-	-	17.17	-	-
191	258338	198270		-	-	-	-	17.45	-	-
192	257422	198542		-	-	-	-	16.02	-	-
193	257371	198522		-	-	-	-	21.34	-	-
194	257958	198581		-	-	-	-	19.41	-	-
195	257972	198563		-	-	-	-	26.32	-	-
196	258046	198558		-	-	-	-	22.61	-	-
197	258797	198701		-	-	-	-	38.71	33.73	35.24
198	258811	198701		-	-	-	-	38.49	36.97	36.45
199	254703	195764		-	-	-	-	34.16	29.05	29.53
200	254582	195821		-	-	-	-	27.71	-	-
201	254522	195859		-	-	-	-	30.47	28.39	28.60
202	254437	195879		-	-	-	-	23.13	-	-
203	254294	195885		-	-	-	-	25.57	-	-
204	253777	195926		-	-	-	-	18.53	-	-

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$) Adjusted for bias						
				2006	2007	2008	2009	2010	2011	2012
				205	253758	195939		-	-	-
206	261565	188211		-	-	-	-	51.37	47.05	45.60
207	261561	188222		-	-	-	-	45.70	34.51	41.17
208	261541	188215		-	-	-	-	46.18	37.59	37.48
209	261534	188198		-	-	-	-	46.87	44.72	39.40
210	261516	188207		-	-	-	-	43.61	31.66	34.47
211	261501	188188		-	-	-	-	39.49	34.34	35.45
212	261486	188200		-	-	-	-	27.40	27.04	27.18
213	261490	188186		-	-	-	-	40.24	37.79	35.09
214	261315	188193		-	-	-	-	30.17	25.36	25.39
215	261299	188191		-	-	-	-	28.61	22.93	23.66
216	261276	188190		-	-	-	-	30.74	25.94	26.07
217	260357	188240		-	-	-	-	20.60	-	-
218	260384	188206		-	-	-	-	29.64	-	-
219	260419	188172		-	-	-	-	24.64	-	-
220	261194	188163		-	-	-	-	22.70	-	-
221	260454	188171		-	-	-	-	21.22	-	-
222	260469	188182		-	-	-	-	24.74	-	-
223	266899	197354		-	-	-	-	25.61	-	-
224	266881	197389		-	-	-	-	26.85	-	-
225	266861	197432		-	-	-	-	27.53	-	-
226	266829	197472		-	-	-	-	27.33	-	-
227	266836	197484		-	-	-	-	25.70	-	-
228	266779	197578		-	-	-	-	24.43	-	-
229	266772	197621		-	-	-	-	22.56	-	-
230	266777	197651		-	-	-	-	26.39	-	-
231	268802	197666		-	-	-	-	23.96	-	-
232	266825	197654		-	-	-	-	27.63	-	-
233	266823	197668		-	-	-	-	26.07	-	-
234	266858	197671		-	-	-	-	24.15	-	-
235	266874	197657		-	-	-	-	26.97	-	-
236	266886	197658		-	-	-	-	29.39	-	-
237	266885	197676		-	-	-	-	25.90	-	-
238	266902	197660		-	-	-	-	36.38	32.78	33.13
239	266181	196022		-	-	-	-	37.70	33.64	31.18
240	266169	195995		-	-	-	-	40.14	36.36	34.40
241	266159	196013		-	-	-	-	36.92	31.39	33.21
242	265655	193423		-	-	-	-	45.21	46.01	44.28
243	265474	194949		-	-	-	-	41.64	33.82	37.40
244	265466	194930	Y	-	-	-	-	47.92	38.33	43.78
245	265448	194922	Y	-	-	-	-	49.14	41.03	41.93
246	265425	194927		-	-	-	-	33.12	26.92	28.67
247	265394	194899	Y	-	-	-	-	39.76	35.47	29.76
248	265342	194894		-	-	-	-	31.71	25.22	27.35
249	265326	194871	Y	-	-	-	-	40.58	33.94	34.74
250	265274	194867		-	-	-	-	32.99	28.20	27.17
251	265263	194845	Y	-	-	-	-	38.17	30.76	31.94
252	265226	194830	Y	-	-	-	-	33.69	31.94	30.52
253	265194	194833		-	-	-	-	29.98	24.59	25.10
254	265142	194816		-	-	-	-	30.41	23.45	25.48
255	265098	194825		-	-	-	-	29.09	24.86	21.69

City & County of Swansea

Site ID	X Coordinate	Y Coordinate	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$) Adjusted for bias						
				2006	2007	2008	2009	2010	2011	2012
				256	264995	194777		-	-	-
257	254817	189135		-	-	-	-	21.32	-	-
258	254906	189110		-	-	-	-	31.14	26.30	28.30
259	254949	189113		-	-	-	-	20.10	-	-
260	254970	189116		-	-	-	-	19.06	-	-
261	254991	189115		-	-	-	-	22.75	-	-
262	255056	189118		-	-	-	-	12.93	-	-
263	262444	193447		-	-	-	-	20.38	-	-
264	262251	193293		-	-	-	-	18.44	-	-
265	266375	198023		-	-	-	-	33.26	31.81	29.04
266	266380	198043		-	-	-	-	23.98	-	-
267	266382	198028		-	-	-	-	32.14	30.76	28.27
268	266419	198053		-	-	-	-	31.05	29.00	25.78
269	266458	198111		-	-	-	-	27.34	-	-
270	266896	198084		-	-	-	-	27.21	-	-
271	266879	198078		-	-	-	-	35.52	32.38	30.44
272	266888	198074		-	-	-	-	36.22	28.91	32.56
273	267060	198234		-	-	-	-	31.92	-	-
274	269487	201451		-	-	-	-	25.97	-	-
275	265658	194856	Y	-	-	-	-	-	26.00	25.20
276	265610	194871	Y	-	-	-	-	-	36.03	32.51
277	265596	194875	Y	-	-	-	-	-	37.05	39.35
278	265573	194882	Y	-	-	-	-	-	39.11	34.70
279	265555	194926	Y	-	-	-	-	-	50.24	55.51
280	265542	194980	Y	-	-	-	-	-	37.90	40.80
281	265542	194872	Y	-	-	-	-	-	36.00	36.70
282	265540	194840	Y	-	-	-	-	-	33.80	35.70
283	265436	195937		-	-	-	-	-	30.35	31.51
284	265452	195899		-	-	-	-	-	33.28	32.62
285	266955	197415		-	-	-	-	-	37.51	33.41
286	266938	197377		-	-	-	-	-	36.68	34.27
287	265715	193902	Y	-	-	-	-	-	30.76	29.72
288	265698	193878	Y	-	-	-	-	-	33.38	32.86
289	265702	193842	Y	-	-	-	-	-	37.33	35.86
290	263014	195737	Y	-	-	-	-	-	27.86	27.88
291	267952	193121		-	-	-	-	-	41.79	45.22
292	263833	196108		-	-	-	-	-	-	17.86
293	262302	196688		-	-	-	-	-	-	18.26
294	262342	196742		-	-	-	-	-	-	25.18
295	258998	198698		-	-	-	-	-	-	29.33
296	259054	198679		-	-	-	-	-	-	31.61

Table 9 – NO₂ Annual Mean concentrations 2006- 2012

LAQM.TG (09) provides a method within box 2.1 page 2-4 to project measured annual mean roadside nitrogen dioxide concentrations to future years. The supporting adjustment factor table was updated during January 2012 in view of the release of updated vehicle emission factors and is obtainable from

http://laqm.defra.gov.uk/documents/Is_the_example_in_Box_2.1_TG09_correct.pdf

It is noted that in addition to the above, from <http://laqm.defra.gov.uk/whatsnew.html> that DEFRA have produced another update to the previously revised future year projection guidance by way of a further note entitled “Note on Projecting NO₂ concentrations”¹⁷ dated April 2012. This note sets out additional alternative methods to project measured NO₂ concentrations to future years. As a result, this authority is considering the implications raised with some of the alternative methods mentioned within this note but have decided to undertake within this Progress Report the more simplistic revised approach detailed within section 2.4. This alternative projection method assumes an average national reduction trend in NO₂ concentrations of 0.68% per year at roadside stations and 0.87% reduction per year at background stations. The adjustment factors presented within table 2 of the April 2012 update are presented as the UK averages of the site classifications i.e. roadside. This newly adopted method allows the comparison of the LAQM.TG(09) revised guidance future year projections issued during January 2010 to the additional revised note dated April 2012. This method produces a range of predicted future year concentrations as to where the NO₂ concentration is likely to lie. Using a combination of these methods the full range of future year projections are presented within table 10 below.

¹⁷ <http://laqm.defra.gov.uk/review-and-assessment/modelling.html#ProjectingNO2Note> and http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

City & County of Swansea

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m ³															
		Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012															
		2013		2014		2015		2016		2017		2018		2019		2020	
1		24	25	23	25	22	25	21	25	19	24	18	24	17	24	15	24
2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Y	28	30	27	29	26	29	24	29	23	29	21	29	20	28	18	28
5	Y	33	34	31	34	30	33	28	33	26	33	24	33	23	32	21	32
6	Y	28	29	27	29	25	29	24	28	22	28	21	28	19	28	18	28
7	Y	47	49	45	49	43	48	40	48	38	48	35	47	33	47	30	47
8	Y	40	42	38	41	36	41	34	41	32	40	30	40	28	40	26	40
9		25	26	24	26	23	26	22	26	20	26	19	26	18	25	16	25
10	Y	22	23	21	23	20	23	19	23	18	23	17	22	16	22	14	22
11	Y	33	34	31	34	30	33	28	33	26	33	24	33	23	32	21	32
12	Y	41	43	39	43	38	42	35	42	33	42	31	41	29	41	27	41
13		28	29	26	29	25	28	24	28	22	28	21	28	19	28	18	27
14		24	25	23	25	22	25	21	25	20	25	18	25	17	24	16	24
15		25	27	24	26	23	26	22	26	20	26	19	26	18	25	16	25
16		29	30	28	30	26	30	25	30	23	29	22	29	20	29	19	29
17		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Y	43	44	41	44	39	44	37	44	34	43	32	43	30	43	28	42
19	Y	43	45	41	45	39	44	37	44	35	44	32	44	30	43	28	43
20	Y	35	36	33	36	32	36	30	36	28	35	26	35	24	35	23	35
21	Y	29	30	28	30	27	30	25	30	23	30	22	29	20	29	19	29
22	Y	30	31	28	31	27	31	26	30	24	30	22	30	21	30	19	30
23	Y	32	33	30	33	29	33	27	32	25	32	24	32	22	32	20	31
24		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Y	28	29	26	28	25	28	24	28	22	28	21	28	19	28	18	27
26	Y	39	40	37	40	35	40	33	39	31	39	29	39	27	38	25	38
27	Y	35	37	34	37	32	36	30	36	28	36	27	36	25	35	23	35
28	Y	29	30	27	30	26	30	25	29	23	29	22	29	20	29	19	29
29	Y	45	47	43	47	41	47	39	46	37	46	34	46	32	45	29	45
30		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31		32	33	30	33	29	33	27	32	26	32	24	32	22	32	20	32
32		30	31	29	31	27	31	26	31	24	30	23	30	21	30	19	30
33		31	32	30	32	28	32	27	32	25	32	23	31	22	31	20	31
34		30	31	29	31	27	31	26	31	24	30	22	30	21	30	19	30
35		32	33	31	33	29	33	27	33	26	32	24	32	22	32	21	32
36		30	31	29	31	27	31	26	31	24	31	23	30	21	30	19	30
37		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38		34	35	32	35	31	35	29	34	27	34	25	34	24	34	22	34
39		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40		29	30	28	30	26	30	25	30	23	29	22	29	20	29	19	29
41		37	38	35	38	33	38	31	37	29	37	27	37	26	37	24	36
42		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43		36	38	35	37	33	37	31	37	29	37	27	37	25	36	23	36
44		27	28	26	28	25	28	23	28	22	28	21	28	19	27	18	27
45		32	34	31	33	29	33	28	33	26	33	24	33	23	32	21	32
46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
47		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48		22	23	21	23	20	23	19	23	18	23	17	23	16	22	14	22
49		25	27	24	26	23	26	22	26	20	26	19	26	18	25	16	25
50		32	34	31	33	29	33	28	33	26	33	24	33	23	32	21	32
51		29	30	28	30	27	30	25	30	23	30	22	29	20	29	19	29
52		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54		33	34	32	34	30	34	28	34	27	33	25	33	23	33	21	33
55		32	33	30	33	29	33	27	32	26	32	24	32	22	32	21	32
56		34	35	33	35	31	35	29	35	27	35	26	34	24	34	22	34
57		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58		41	42	39	42	37	42	35	42	33	41	31	41	28	41	26	41

City & County of Swansea

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m ³															
		Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012															
		2013		2014		2015		2016		2017		2018		2019		2020	
59	Y	51	54	49	53	47	53	44	52	41	52	39	52	36	51	33	51
60		34	36	33	35	31	35	29	35	27	35	26	34	24	34	22	34
61		38	40	37	40	35	39	33	39	31	39	29	38	27	38	25	38
62		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	Y	24	25	23	24	22	24	20	24	19	24	18	24	17	24	15	23
64	Y	46	48	44	48	42	47	39	47	37	47	35	46	32	46	30	46
65	Y	24	25	23	24	21	24	20	24	19	24	18	24	16	24	15	23
66	Y	30	31	29	31	27	31	26	31	24	31	23	30	21	30	19	30
67	Y	38	40	37	40	35	39	33	39	31	39	29	39	27	38	25	38
68		38	39	36	39	34	39	32	39	30	38	28	38	26	38	24	38
69		44	46	42	46	40	45	38	45	36	45	33	45	31	44	29	44
70		25	26	24	26	23	26	21	25	20	25	19	25	17	25	16	25
71		32	34	31	33	29	33	28	33	26	33	24	33	23	32	21	32
72		24	25	23	25	22	25	21	25	20	25	18	25	17	24	16	24
73		32	33	30	33	29	32	27	32	25	32	24	32	22	32	20	31
74		28	29	26	29	25	28	24	28	22	28	21	28	19	28	18	27
75		39	41	37	41	36	40	34	40	32	40	29	39	27	39	25	39
76		27	28	25	27	24	27	23	27	21	27	20	27	19	27	17	26
77		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78		28	30	27	29	26	29	24	29	23	29	21	29	20	28	18	28
79		30	32	29	31	28	31	26	31	24	31	23	31	21	30	20	30
80		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
82	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
83	Y	29	30	28	30	26	30	25	30	23	29	22	29	20	29	19	29
84	Y	35	37	34	36	32	36	30	36	28	36	26	35	25	35	23	35
85	Y	37	39	36	39	34	38	32	38	30	38	28	38	26	37	24	37
86	Y	28	29	27	29	25	29	24	29	23	28	21	28	20	28	18	28
87	Y	21	22	20	22	19	22	18	22	17	22	16	21	15	21	14	21
88	Y	32	33	31	33	29	33	27	33	26	33	24	32	22	32	21	32
89	Y	21	22	20	22	19	22	18	22	17	22	16	21	15	21	14	21
90	Y	31	33	30	32	28	32	27	32	25	32	23	31	22	31	20	31
91	Y	29	30	28	30	26	30	25	29	23	29	22	29	20	29	19	29
92	Y	28	30	27	29	26	29	24	29	23	29	21	29	20	28	18	28
93		26	27	25	27	24	27	22	27	21	26	20	26	18	26	17	26
94		27	28	26	28	25	28	23	28	22	28	21	27	19	27	18	27
95		25	26	24	26	23	26	22	26	20	26	19	26	18	25	16	25
96		25	26	24	26	22	25	21	25	20	25	19	25	17	25	16	25
97	Y	33	35	32	34	30	34	28	34	27	34	25	33	23	33	21	33
98	Y	35	37	34	36	32	36	30	36	28	36	26	35	25	35	23	35
99	Y	29	30	28	30	26	30	25	29	23	29	22	29	20	29	19	29
100	Y	27	28	26	28	24	27	23	27	21	27	20	27	19	27	17	27
101	Y	26	27	25	27	24	27	22	26	21	26	19	26	18	26	17	26
102		28	29	27	29	26	29	24	29	23	29	21	28	20	28	18	28
103		28	29	27	29	26	29	24	29	23	28	21	28	20	28	18	28
104		27	28	26	28	25	28	23	28	22	27	20	27	19	27	17	27
105		28	29	27	29	25	29	24	28	22	28	21	28	19	28	18	28
106		28	29	27	29	26	29	24	29	23	28	21	28	20	28	18	28
107		32	34	31	34	30	33	28	33	26	33	24	33	23	32	21	32
108		28	29	27	29	26	29	24	29	23	28	21	28	20	28	18	28
109		25	26	24	26	22	25	21	25	20	25	19	25	17	25	16	25
110		27	28	26	28	25	28	23	28	22	28	20	27	19	27	18	27
111		29	30	28	30	26	30	25	30	23	29	22	29	20	29	19	29
112		32	34	31	33	29	33	28	33	26	33	24	33	23	32	21	32
113		29	30	28	30	26	30	25	30	23	29	22	29	20	29	19	29
114		28	29	27	29	25	28	24	28	22	28	21	28	19	28	18	28
115		40	42	38	41	36	41	34	41	32	40	30	40	28	40	26	40
116		40	41	38	41	36	41	34	40	32	40	30	40	28	40	26	39

City & County of Swansea

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m ³															
		Left cell (white) = LAQM.TG(09) method Right cell (shaded) = Revised method dated April 2012															
		2013		2014		2015		2016		2017		2018		2019		2020	
117		38	39	36	39	34	39	32	38	30	38	28	38	26	38	24	37
118		30	32	29	31	28	31	26	31	24	31	23	30	21	30	20	30
119		30	32	29	31	28	31	26	31	24	31	23	30	21	30	20	30
120		43	45	41	44	39	44	37	44	34	43	32	43	30	43	28	42
121	Y	49	51	46	50	44	50	42	50	39	49	37	49	34	49	31	48
122		33	34	31	34	30	34	28	34	26	33	25	33	23	33	21	33
123		47	48	44	48	42	48	40	47	37	47	35	47	32	47	30	46
124		40	42	38	41	36	41	34	41	32	41	30	40	28	40	26	40
125		46	47	43	47	41	47	39	46	37	46	34	46	32	45	29	45
126		40	41	38	41	36	41	34	41	32	40	30	40	28	40	26	39
127		47	48	44	48	42	48	40	47	37	47	35	47	32	46	30	46
128		41	43	39	43	38	42	35	42	33	42	31	41	29	41	27	41
129		33	35	32	34	30	34	28	34	27	34	25	33	23	33	21	33
130		40	42	38	41	37	41	34	41	32	41	30	40	28	40	26	40
131		44	46	42	45	40	45	37	45	35	44	33	44	31	44	28	43
132		33	35	32	35	30	34	29	34	27	34	25	34	23	33	22	33
133		21	21	20	21	19	21	18	21	16	21	15	21	14	20	13	20
134		44	45	42	45	40	45	37	44	35	44	33	44	30	44	28	43
135	Y	26	28	25	27	24	27	23	27	21	27	20	27	18	26	17	26
136	Y	26	27	25	27	24	27	23	27	21	27	20	26	18	26	17	26
137	Y	31	32	30	32	28	32	26	32	25	31	23	31	22	31	20	31
138		22	22	21	22	20	22	18	22	17	22	16	22	15	22	14	21
139		27	28	25	27	24	27	23	27	21	27	20	27	18	26	17	26
140		32	34	31	33	29	33	28	33	26	33	24	33	23	32	21	32
141		25	26	24	26	23	26	21	26	20	25	19	25	18	25	16	25
142		28	29	26	28	25	28	24	28	22	28	21	28	19	27	18	27
143		30	31	29	31	27	31	26	31	24	30	23	30	21	30	19	30
144		27	28	25	27	24	27	23	27	21	27	20	27	19	27	17	26
145		29	30	28	30	26	30	25	30	23	29	22	29	20	29	19	29
146		32	33	30	33	29	32	27	32	25	32	24	32	22	32	20	31
147		28	29	26	29	25	28	24	28	22	28	21	28	19	28	18	27
148		28	30	27	29	26	29	24	29	23	29	21	29	20	28	18	28
149		25	26	24	26	23	26	22	26	20	25	19	25	18	25	16	25
150		27	28	26	28	25	28	23	28	22	28	20	27	19	27	18	27
151		26	27	25	27	24	27	22	26	21	26	19	26	18	26	17	26
152		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
153		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
154		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
155		29	30	27	30	26	29	25	29	23	29	22	29	20	29	18	28
156		28	29	27	29	25	29	24	28	22	28	21	28	19	28	18	28
157																	
158		28	29	27	29	25	29	24	28	22	28	21	28	19	28	18	28
159		28	29	27	29	26	29	24	29	23	28	21	28	20	28	18	28
160		33	35	32	34	30	34	28	34	27	34	25	33	23	33	21	33
161		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
162		28	29	26	29	25	28	24	28	22	28	21	28	19	28	18	27
163		21	22	21	22	20	22	18	22	17	22	16	22	15	21	14	21
164		27	29	26	28	25	28	23	28	22	28	21	28	19	27	18	27
165		20	21	19	20	18	20	17	20	16	20	15	20	14	20	13	20
166		23	24	22	24	21	24	20	24	19	23	17	23	16	23	15	23
167		22	23	21	23	20	23	19	23	18	22	17	22	15	22	14	22
168		21	22	20	21	19	21	18	21	17	21	16	21	14	21	13	21
169		20	21	19	21	18	21	17	20	16	20	15	20	14	20	13	20
170		17	17	16	17	15	17	14	17	13	17	13	17	12	17	11	17
171		23	24	22	24	21	24	20	24	19	23	17	23	16	23	15	23
172		25	26	24	26	23	26	22	26	20	26	19	26	18	25	16	25
173		19	19	18	19	17	19	16	19	15	19	14	19	13	19	12	19
174		16	16	15	16	14	16	14	16	13	16	12	16	11	16	10	16

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m ³															
		Left cell (white) = LAQM.TG(09) method															
		Right cell (shaded) = Revised method dated April 2012															
		2013		2014		2015		2016		2017		2018		2019		2020	
175		14	15	14	15	13	15	12	15	12	15	11	15	10	14	9	14
176		12	13	12	12	11	12	10	12	10	12	9	12	8	12	8	12
177		14	14	13	14	12	14	12	14	11	14	10	14	9	13	9	13
178		12	13	12	13	11	13	11	13	10	12	9	12	9	12	8	12
179		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
180		30	31	28	31	27	30	25	30	24	30	22	30	21	30	19	29
181		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
182		26	27	25	27	24	27	23	27	21	27	20	26	18	26	17	26
183		30	31	28	31	27	30	25	30	24	30	22	30	21	30	19	29
184		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
185		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
186		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
187		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
189		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
191		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
192		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
193		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
194		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
195		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
197		34	35	32	35	31	35	29	34	27	34	25	34	23	34	22	33
198		35	36	33	36	32	36	30	35	28	35	26	35	24	35	22	35
199		28	29	27	29	26	29	24	29	23	29	21	28	20	28	18	28
200		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201		27	28	26	28	25	28	23	28	22	28	20	27	19	27	18	27
202		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
203		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
204		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
205		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
206		44	45	42	45	40	45	37	44	35	44	33	44	30	44	28	43
207		39	41	38	41	36	40	34	40	32	40	29	40	27	39	25	39
208		36	37	34	37	33	37	31	37	29	36	27	36	25	36	23	36
209		38	39	36	39	34	39	32	38	30	38	28	38	26	38	24	37
210		33	34	31	34	30	34	28	34	26	33	25	33	23	33	21	33
211		34	35	32	35	31	35	29	35	27	34	25	34	24	34	22	34
212		26	27	25	27	24	27	22	26	21	26	19	26	18	26	17	26
213		34	35	32	35	30	34	29	34	27	34	25	34	23	33	22	33
214		24	25	23	25	22	25	21	25	19	25	18	24	17	24	16	24
215		23	24	22	23	21	23	19	23	18	23	17	23	16	23	15	22
216		25	26	24	26	23	26	21	25	20	25	19	25	17	25	16	25
217		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
218		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
219		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
220		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
221		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
223		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
224		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
225		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
226		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
227		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
229		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
230		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
231		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
232		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m ³																
		Left cell (white) = LAQM.TG(09) method																
		Right cell (shaded) = Revised method dated April 2012																
		2013	2014	2015	2016	2017	2018	2019	2020	2013	2014	2015	2016	2017	2018	2019	2020	
233			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
234			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
235			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
236			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
237			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
238			32	33	30	33	29	32	27	32	25	32	24	32	22	32	20	31
239			30	31	28	31	27	31	25	30	24	30	22	30	21	30	19	30
240			33	34	31	34	30	34	28	34	26	33	25	33	23	33	21	33
241			32	33	30	33	29	33	27	32	25	32	24	32	22	32	20	31
242			42	44	40	44	38	43	36	43	34	43	32	43	30	42	27	42
243			36	37	34	37	32	37	31	36	29	36	27	36	25	36	23	35
244	Y		42	44	40	43	38	43	36	43	34	42	31	42	29	42	27	42
245	Y		40	42	38	41	36	41	34	41	32	41	30	40	28	40	26	40
246			27	28	26	28	25	28	23	28	22	28	21	28	19	27	18	27
247	Y		28	30	27	29	26	29	24	29	23	29	21	29	20	28	18	28
248			26	27	25	27	24	27	22	27	21	26	20	26	18	26	17	26
249	Y		33	35	32	34	30	34	28	34	27	34	25	33	23	33	21	33
250			26	27	25	27	24	27	22	26	21	26	19	26	18	26	17	26
251	Y		31	32	29	32	28	31	26	31	25	31	23	31	21	30	20	30
252	Y		29	30	28	30	27	30	25	30	23	29	22	29	20	29	19	29
253			24	25	23	25	22	25	21	24	19	24	18	24	17	24	15	24
254			24	25	23	25	22	25	21	25	20	25	18	24	17	24	16	24
255			21	22	20	21	19	21	18	21	17	21	16	21	14	21	13	21
256			38	40	37	40	35	39	33	39	31	39	29	39	27	38	25	38
257			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
258			27	28	26	28	25	28	23	28	22	27	20	27	19	27	17	27
259			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
260			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
261			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
262			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
263			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
264			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
265			28	29	26	29	25	28	24	28	22	28	21	28	19	28	18	28
266			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
267			27	28	26	28	25	28	23	28	22	27	20	27	19	27	17	27
268			25	26	24	25	22	25	21	25	20	25	18	25	17	25	16	24
269			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
270			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
271			29	30	28	30	26	30	25	30	23	29	22	29	20	29	19	29
272			31	32	30	32	28	32	27	32	25	31	23	31	22	31	20	31
273			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
274			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275	Y		26	27	24	26	23	26	22	26	21	26	19	26	18	26	16	25
276	Y		31	32	30	32	28	32	27	32	25	31	23	31	22	31	20	31
277	Y		38	39	36	39	34	39	32	38	30	38	28	38	26	38	24	37
278	Y		33	34	32	34	30	34	28	34	27	34	25	33	23	33	21	33
279	Y		53	55	51	55	48	54	45	54	43	54	40	53	37	53	34	53
280	Y		42	44	40	44	38	43	36	43	34	43	32	42	29	42	27	42
281	Y		40	41	38	41	36	41	34	40	32	40	30	40	28	40	26	39
282	Y		38	40	37	40	35	39	33	39	31	39	29	39	27	38	25	38
283			30	31	29	31	27	31	26	31	24	30	23	30	21	30	19	30
284			31	32	30	32	28	32	27	32	25	32	23	31	22	31	20	31
285			32	33	30	33	29	33	27	33	26	32	24	32	22	32	21	32
286			33	34	31	34	30	34	28	33	26	33	25	33	23	33	21	32
287	Y		28	30	27	29	26	29	24	29	23	29	21	29	20	28	18	28
288	Y		31	33	30	32	29	32	27	32	25	32	24	32	22	31	20	31
289	Y		34	36	33	35	31	35	29	35	28	35	26	34	24	34	22	34
290	Y		27	28	25	28	24	27	23	27	21	27	20	27	19	27	17	26

Site ID	Within AQMA ?	Future Years Projections – Rounded to nearest whole number in ug/m ³															
		Left cell (white) = LAQM.TG(09) method								Right cell (shaded) = Revised method dated April 2012							
		2013		2014		2015		2016		2017		2018		2019		2020	
291		43	45	41	45	39	44	37	44	35	44	32	43	30	43	28	43
292		17	18	16	18	16	18	15	17	14	17	13	17	12	17	11	17
293		17	18	17	18	16	18	15	18	14	18	13	18	12	17	11	17
294		24	25	23	25	22	25	21	25	19	24	18	24	17	24	15	24
295		28	29	27	29	25	29	24	29	23	28	21	28	20	28	18	28
296		30	31	29	31	27	31	26	31	24	31	23	30	21	30	19	30

Table 10 – Future Years projections (2013-2020) NO₂ Annual Mean Concentrations

Using both methods to project forwards to 2020 it is clear that whilst the LAQM.TG(09) method indicates full compliance with the annual mean objective being seen during 2017/18, using the revised April 2012 method, paints a totally different picture, as in 2020, widespread exceedences remain, together with indications that additional numerous sites would still exhibit the potential to exceed the annual mean objective. It is thought that the April 2012 method may well paint a more realistic picture.

Given the above, it is reasonable to assume that widespread exceedences of the nitrogen dioxide annual mean objective will continue to be seen even during 2020.

2.2.4 Particulate Matter PM₁₀

Thermo PM₁₀ FDMS system were installed at all 3 sites (Swansea AURN, Morfa and Morryston Groundhogs), during part of 2011 providing equivalency with the EU reference gravimetric method¹⁸. As mentioned previously above, the Morfa Groundhog was decommissioned during early 2011 – historical data is purely included here for information. However, significant issues have arisen with the operation of the FDMS units at the Swansea AURN. Despite numerous, costly repairs, data quality and thus data capture were continually being questioned by Bureau Veritas. Following another unsuccessful repair of both the PM₁₀ and PM_{2.5} FDMS units at the Swansea AURN they were removed completely from site on the 16th November 2011 and replaced with Met One BAM 1020 PM₁₀ and PM_{2.5} units on the 28th November 2011. Data capture has not increased significantly with all particulate monitoring at the AURN site. However due to budgetary concerns the FDMS unit remains operational at the Morryston Groundhog site until its replacement with a Bam 1020 can be funded. However, it has to be said that recently there have been far fewer data quality concerns and data capture concerns with the Morryston FDMS system.

The FDMS units provide hourly integration data and have all been configured as per DEFRA's FDMS parameter protocol (as amended during February 2008). The RS232 port on the FDMS control unit allows the collection of up to 8 parameters via telemetry. The parameters collected from the FDMS units are: Volatile Mass, Non Volatile Mass, External Dew Point, Sample Dew Point, Filter loading, Pressure, Status, External Ambient Air temperature. The control unit refers to these parameters in different terminology. The PM₁₀ mass concentration is obtained via post processing of the volatile and non volatile mass parameters by creating a calculated channel within the database to subtract volatile mass from the non volatile mass.

The Met One Bam 1020 PM₁₀ has taken part in UK equivalency trials and has been deemed to be compliant with the EU reference gravimetric method subject to the application of a 1.211 offset. Each hour, a small 14C (carbon-14) element emits a constant source of high-energy electrons (known as beta rays) through a spot of

¹⁷ DEFRA and devolved administrations report UK Equivalence Program for Monitoring of Particulate Matter section 5.5.2 dated 5th June 2006 at http://www.airquality.co.uk/archive/reports/cat05/0606130952_UKPMEquivalence.pdf

clean filter tape. These beta rays are detected and counted by a sensitive scintillation detector to determine a zero reading. The BAM-1020 automatically advances this spot of tape to the sample nozzle, where a vacuum pump then pulls a measured and controlled amount of dust-laden air (16.7l/min) through the filter tape, loading it with ambient dust. At the end of the hour this dirty spot is placed back between the beta source and the detector thereby causing an attenuation of the beta ray signal which is used to determine the mass of the particulate matter on the filter tape and the volumetric concentration of particulate matter in ambient air.

Data collected from the FDMS units and BAM 1020 PM₁₀ units have an integration period of 1-hour. Hourly ratified Particulate Matter PM₁₀ data for 2012 has been downloaded from the Air Quality Archive at http://uk-air.defra.gov.uk/data/data_selector for the Swansea AURN and via the Welsh Air Quality Forum ratified datasets at http://www.welshairquality.co.uk/data_and_statistics.php for the Murrison Groundhog site. Since the Welsh Assembly Government awarded the contract to run the Welsh Air Quality Forum to AEA Energy and Environment in April 2004, all FDMS equipment on site is fully audited yearly by AEA Energy and Environment. As part of the service and maintenance contract with Enviro Technology Services Plc, each dryer unit was replaced annually until 2010 but due to budget restraints this has now ceased. Dryer units are now only replaced as and when they fail.

These hourly data have then been imported into the OPSIS Enviman Reporter databases allowing analysis and graphical presentation. The calculated hourly mean mass concentration data have then been further processed by the software package Opsis Enviman Reporter. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the calculated hourly means were specified to be present.¹⁹

The datasets collected from the FDMS / Met One BAM PM₁₀ systems are not directly comparable to the historical R&P PM₁₀ TEOM datasets even given that the use of the advised interim default correction factor (1.3) was advised to estimate the EU reference gravimetric method. This correction factor has been called into dispute by various studies at diverse locations throughout the UK each deriving differing

¹⁹ LAQM.TG(09) Annexe 1- Monitoring A1.216 page A1-48

correction factors. TEOM PM₁₀ data since 2006 has not therefore been included within table 11. These TEOM PM₁₀ data pre 2006 have last been reported within the authorities Progress Report during May 2008. It is not proposed to use the Volatile Correction Model for TEOM analysers developed by Kings College to “correct” the historical (2001-2006) R&P PM₁₀TEOM datasets at the Morfa and Morrision stations within this report. The date that the PM₁₀ FDMS systems were installed/removed from the Swansea AURN site are given below table 11 for information. Similarly, the date of provision of the BAM1020 units at the Swansea AURN is also provided for information and clarity on the instrument composition of this dataset.

Site ID (see table 4 above)	Location	Within AQMA	Data Capture 2008 %	Data Capture 2009 %	Data Capture 2010 %	Data Capture 2011 %	Data Capture 2012 %	Annual mean concentrations (µg/m ³)				
								2008	2009	2010	2011	2012
1 *	Swansea AURN	Y	98.4	97.53	98.63	62.19	97.54	17.49	17.19	15.79	14.70	17.79
2 **	Morfa Groundhog	Y	50.0	54.25	65.48	-	-	29.34	30.41	20.06	-	-
3 ***	Morrision Groundhog	N	60.1	90.68	78.36	81.64	90.38	23.46	22.53	18.67	17.96	13.86

Table 11 Results of PM₁₀ Automatic Monitoring: Comparison with Annual Mean Objective

* FDMS unit installed 26th September 2006. FDMS units removed 16th November 2011. Met One BAM 1020 unit installed 28th November 2011

** FDMS unit installed 28th November 2006. Site decommissioned May 2011

*** FDMS unit installed 27th October 2006

Site ID	Location	Within AQMA	Data Capture 2008 %	Data Capture 2009 %	Data Capture 2010 %	Data Capture 2011 %	Data Capture 2012 %	Number of Exceedences of 24-hour mean (50 µg/m ³)				
								2008	2009	2010	2011	2012
1	Swansea AURN	Y	98.4	97.53	98.63	62.19	97.54	6	4	0	5 (29.8)	4
2	Morfa Groundhog	Y	50.0	54.25	65.48	-	-	15 (45.8)	14 (45.1)	1 (30.5)	-	-
3	Morrision Groundhog	N	60.1	90.68	78.36	81.64	90.38	11 (37.2)	6	1 (29.6)	8 (30.3)	0

Table 12 Results of PM₁₀ Automatic Monitoring: Comparison with 24-hour Mean Objective

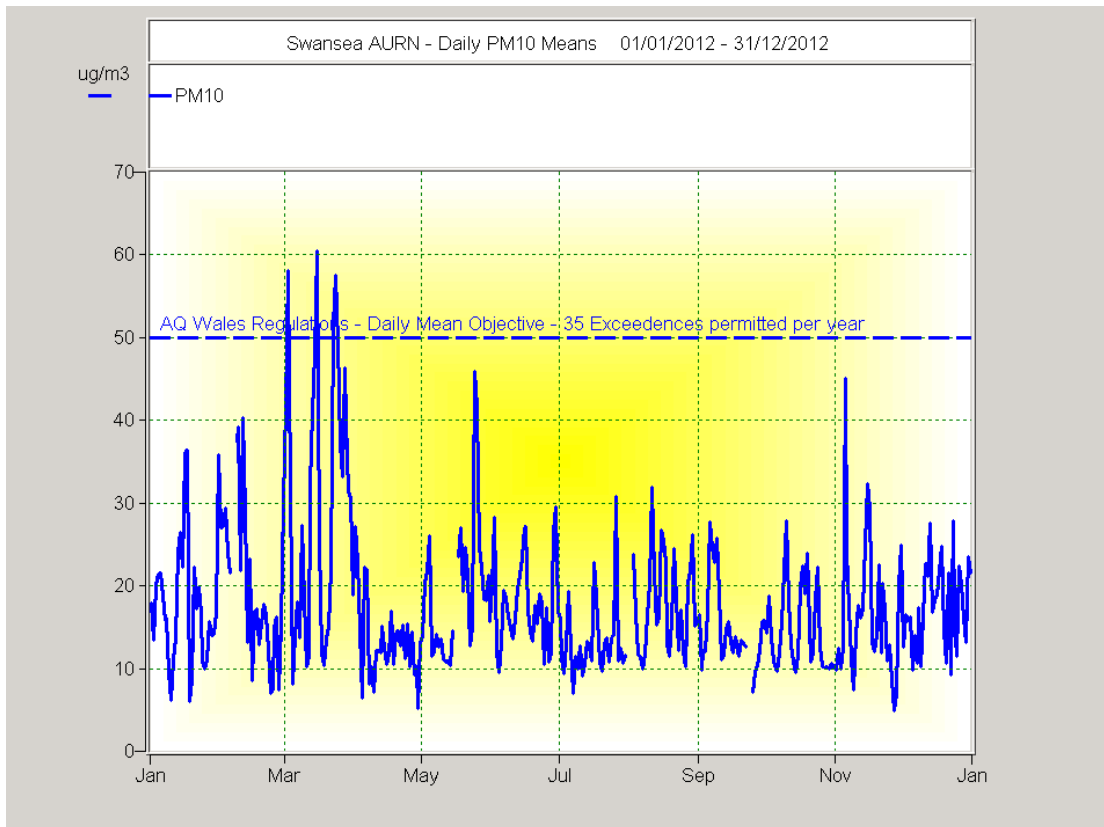
The 90th percentile's of the daily means of measurements made during 2008-2012 are presented in bold within brackets in table 12 where appropriate, as the data capture rates fall below the required 90%²⁰ due to the problematic FDMS installations at the Swansea AURN and Morrision Groundhog sites. There have been numerous problems since the installation of the Thermo Inc FDMS PM₁₀ analysers at all 3 sites during late 2006, resulting in significant periods of data loss. These issues have been

²⁰ LAQM TG(09) Annexe A1 – A1.157 page A1-34

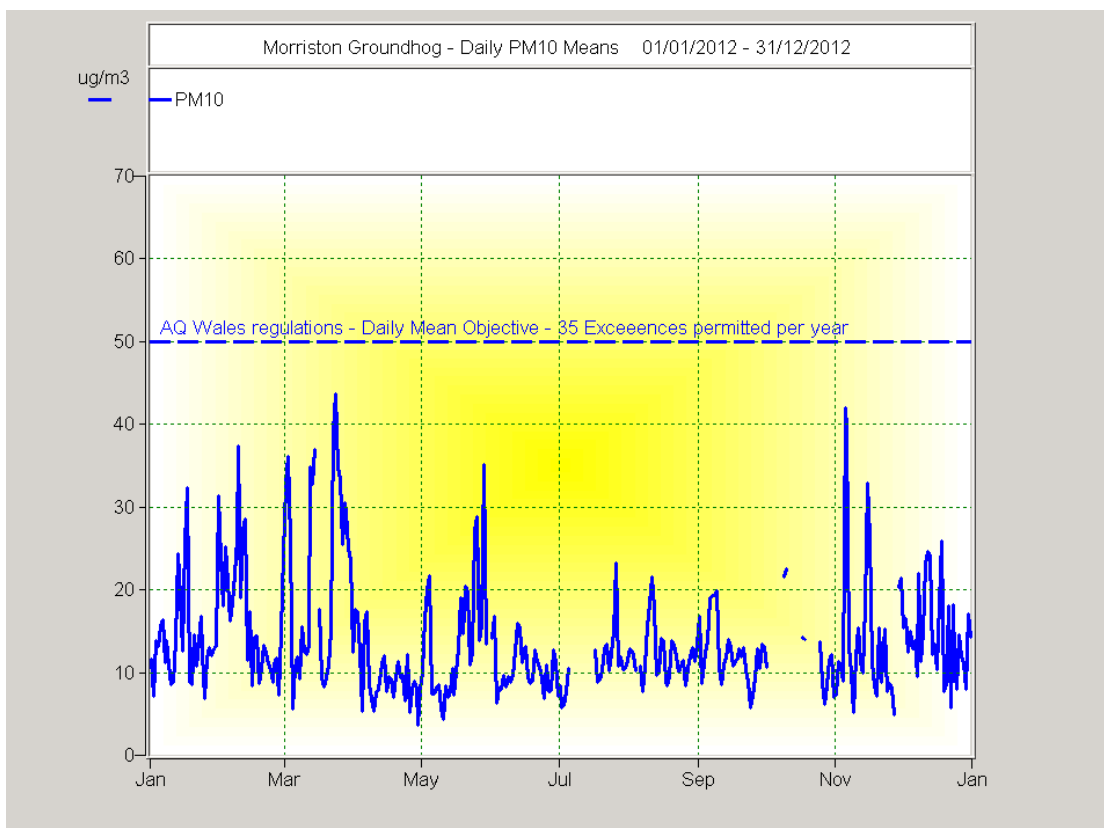
both costly and time consuming to rectify. Problems have ranged from the inability to gain a stable frequency response within the tuner board, corruption of the software within the control unit, status error codes due to ice within the chiller unit, to complete sensor unit failures. These issues have extended over the whole period of operation but as the introduction of FDMS units has increased within the UK National AURN Network, additional problems have been identified with their routine operation.

Extensive problems existed with the operation of the FDMS units within the Swansea Network as can be seen from the data capture rates above in tables 11 and 12. The volatile data from the Morfa FDMS unit was queried during 2009 and again during 2010 due to very erratic measurements being seen. These data were consistently greater than at the other two FDMS PM₁₀ stations within Swansea and therefore the calculated mass concentration being seen was consistently on average 20ug/m³ above that seen at either the Swansea AURN or Murrison units. This effect can be seen within the annual means reported within table 12 above. No fault could be traced by the service engineers during numerous visits to the site. It was not until the Welsh Air Quality Forum QA/QC audit during March 2010 identified a leak, that the problem was then identified and resolved. This single incident led to data being rejected from the 11th August 2009 to 7th April 2010. Problems continued with the reliability of the FDMS units throughout 2011 with yet more data being rejected resulting in significant data loss – during 2011 the Swansea AURN units (both PM_{2.5} and PM₁₀) saw significant data loss which ultimately drove the decision to replace the units during November 2011 with MetOne BAM1020 units. It is the intention to replace the FDMS unit at the Murrison Groundhog site once budgets permit. No decision has been made with regard to the relocation of the Morfa Groundhog unit as yet, as again, this is driven by budgetary issues.

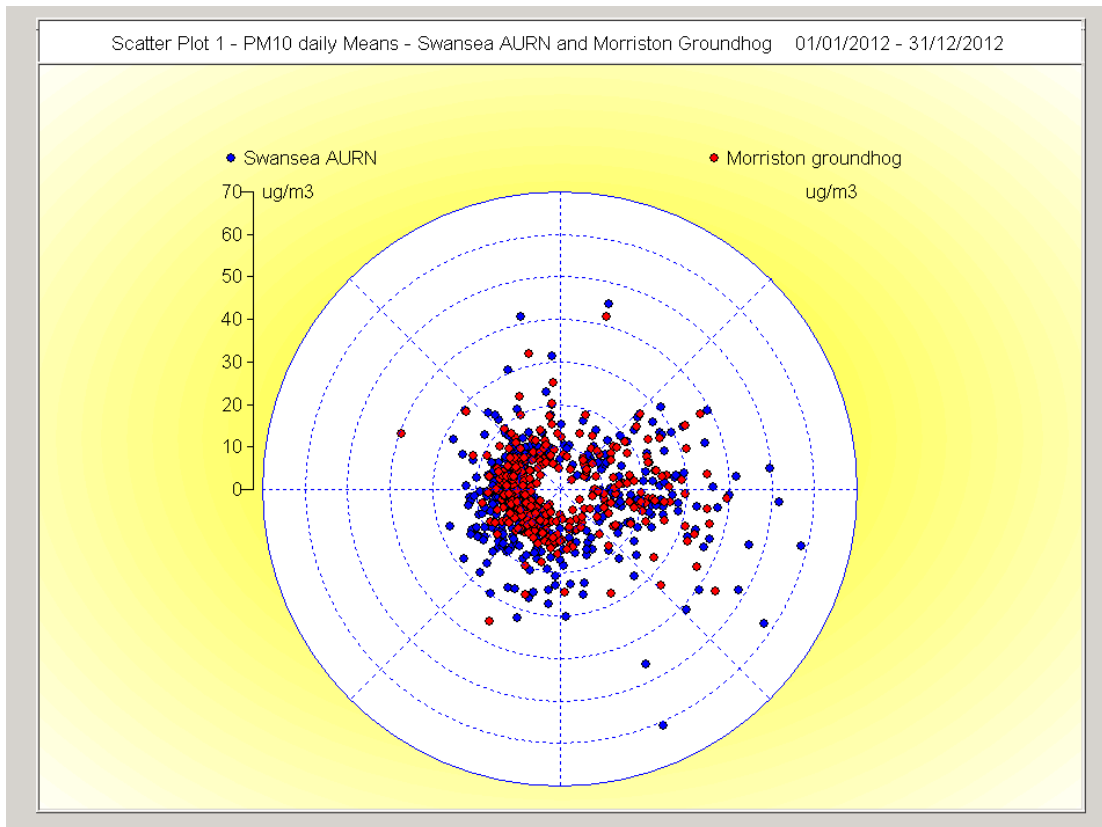
Graphs 6 and 7 below indicate the monitoring undertaken during 2012 with scatter plot 1 summarising the period of measurement.



Graph 6 – Swansea AURN 24-hour PM₁₀ concentrations 2012

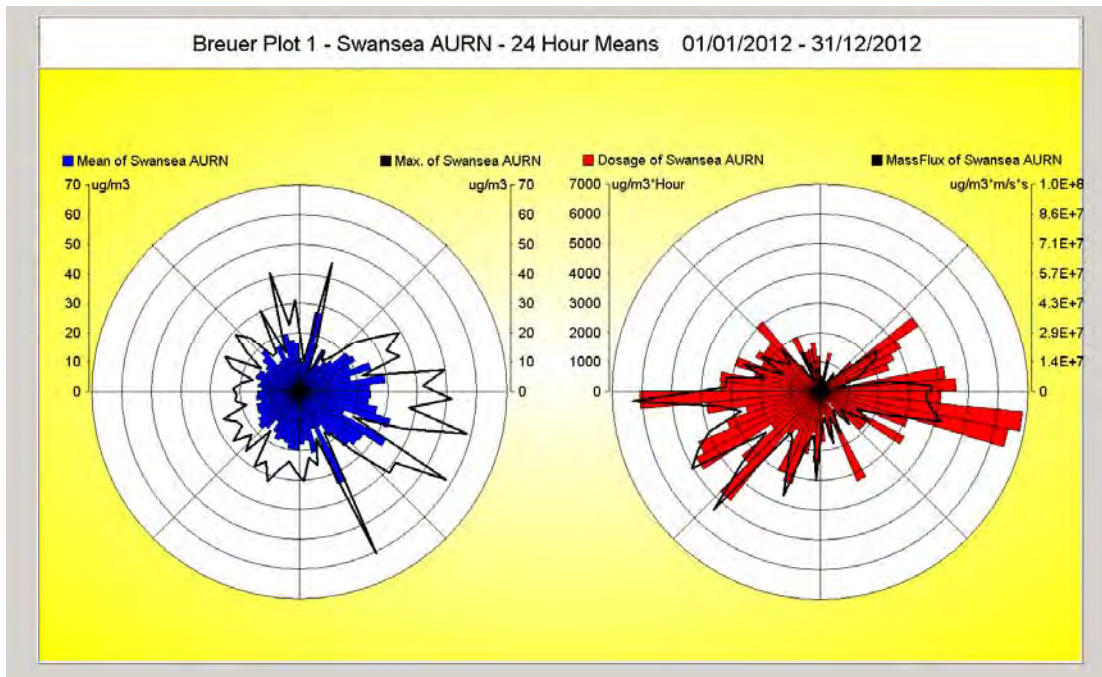


Graph 7 – Morrison Groundhog 24-hour PM₁₀ concentrations 2012



Scatter Plot 1 – PM₁₀ Daily Means 2012

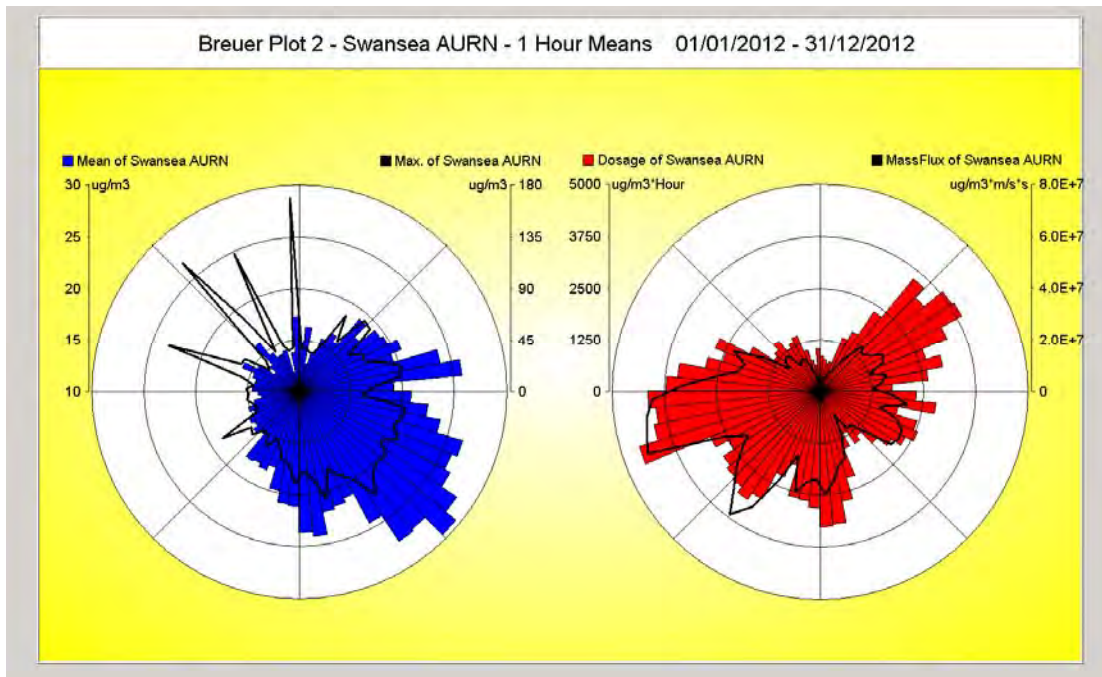
As has been seen during previous there remains a trend during 2012 albeit less pronounced than during previous years for elevated concentrations to emanate from a south-easterly direction. Daily maximum concentration are seen as emanating from the south-east quadrant but the daily means are far more universal with no visible dominant direction The Corus steelworks is located in a south-easterly direction across Swansea Bay at Port Talbot.



Breuer Plot 1 – Swansea AURN – PM₁₀ Daily Means 2012

Dosage is taken to be the accumulated time multiplied with the average value of PM₁₀. This is useful for calculations of likely exposure at these locations. Mass Flux is also indicated and is taken to be: Flux - the wind speed multiplied with the operand distributed over the wind direction. All data that has valid integrated data for all three positions are included in this calculation. (Note: The average distributed wind speed and the average distributed parameter [PM₁₀] are not used to calculate the result). The result is presented in the multiplied units of the wind speed and the parameter (PM₁₀). Mass flux is the same as flux, but the result is multiplied with the accumulated integration time. This gives the mass transport in different directions.

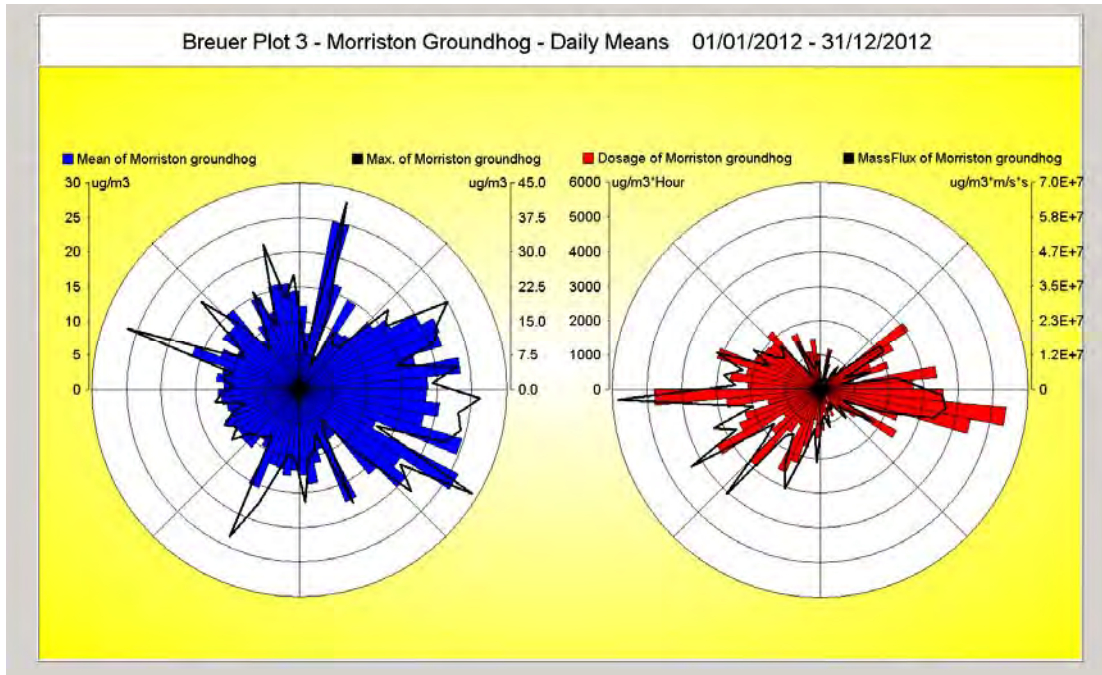
Breuer Plot 2 below presents the hourly mean concentrations at the Swansea AURN.



Breuer Plot 2 - Swansea AURN – PM₁₀ Hourly Means 2012

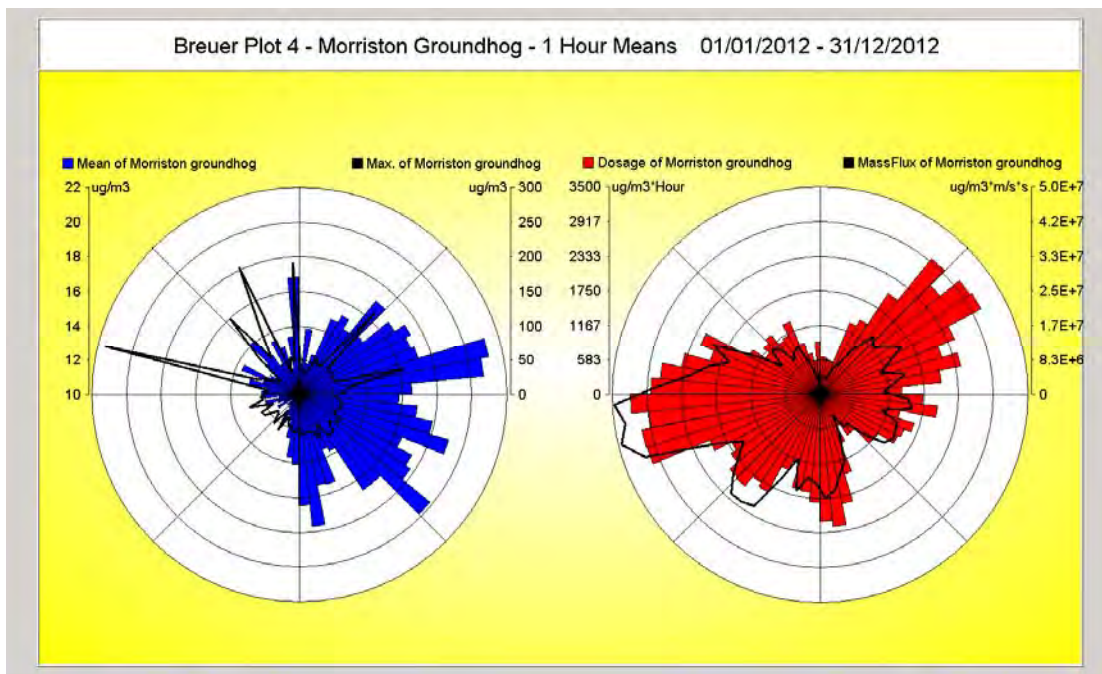
Breuer Plot 2 clearly indicates that mean hourly concentrations are dominated by sources to the south-east. However, maximum hourly concentrations are far more diverse being mainly from a north-west direction. It is thought that these maximum hourly concentrations along with dosage and mass flux probably reflect more local sources/influences during 2012.

Breuer Plots 3 and 4 below represent an identical analysis undertaken with data from the Morryston Groundhog for 2012.



Breuer Plot 3 – PM₁₀ Daily Means – Morriston Groundhog 2012

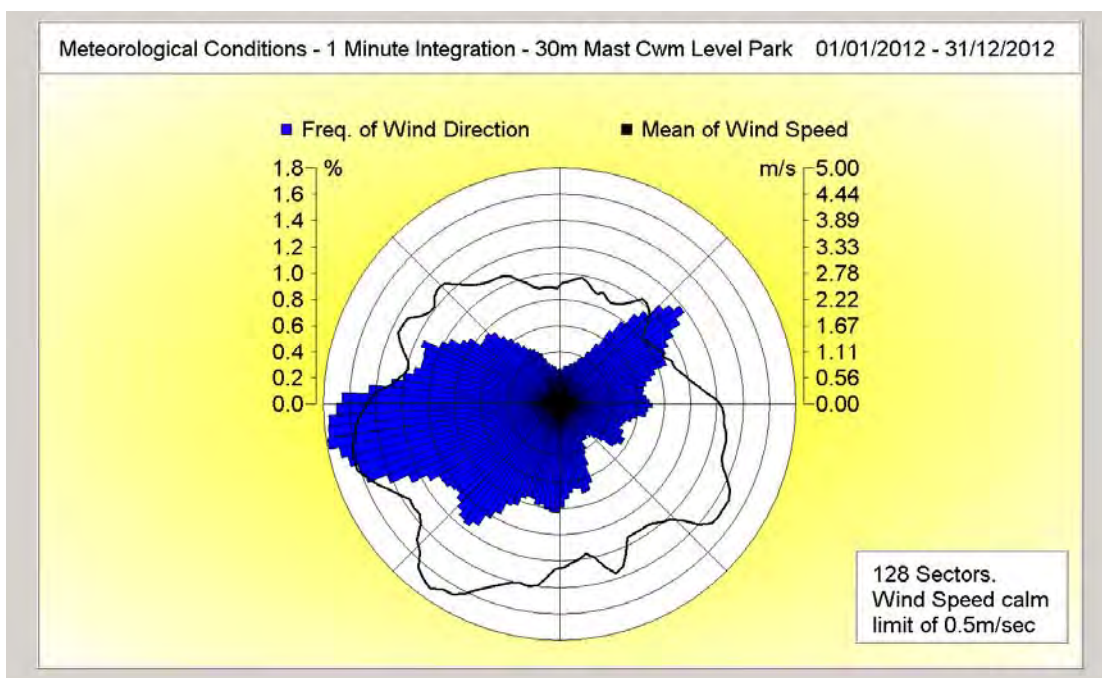
Breuer Plot 3 again hints of maximum daily mean concentrations emanating from the south-east but this signal is muted compared to previous years. Daily mean PM₁₀ data for 2012 appears far more uniformly spread around the compass.



Breuer Plot 4 – PM₁₀ Hourly Means – Morriston Groundhog 2012

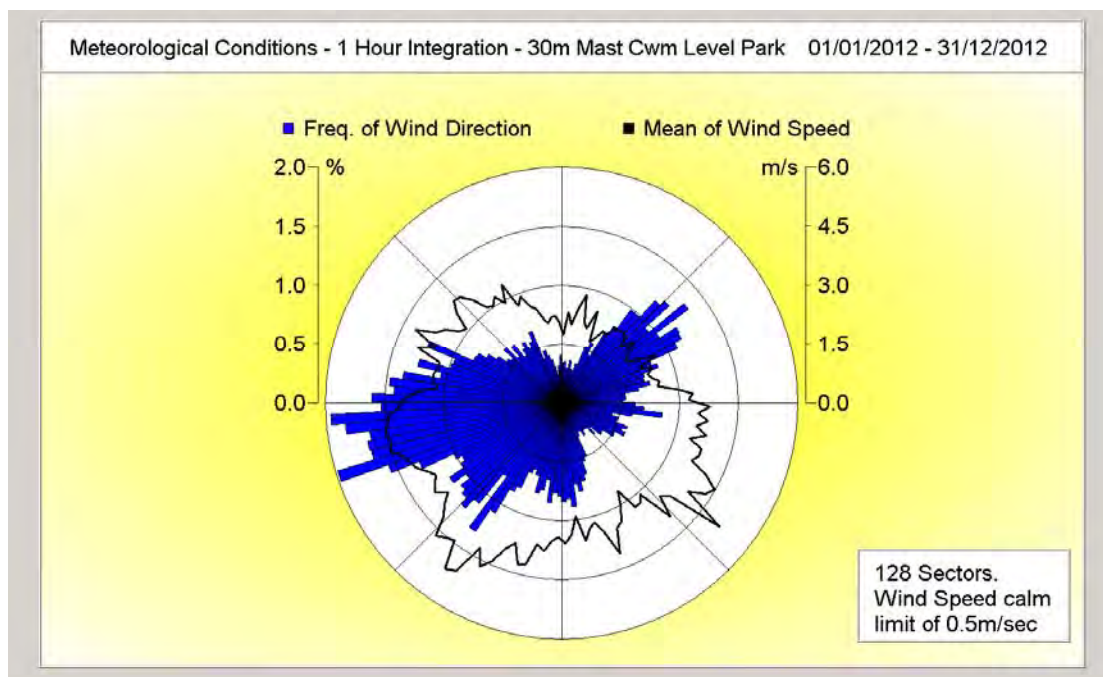
Breuer plot 4 however reemphasises the widely held belief based on previous monitoring that the south east sector is the more dominant source of PM₁₀ concentrations seen within Swansea.

Breuer Plots 5 and 6 below indicate meteorological conditions observed at the 30m Meteorological Mast at Cwm Level Park. Data is presented at 1 minute integration within Breuer Plot 5 and at 1 hour integration within Breuer Plot 6. This site is within the lower Swansea Valley and is highly representative of conditions throughout Swansea.



Breuer Plot 5 – Meteorological Conditions – 1 Minute Integration – 30m Meteorological Mast Cwm Level Park 2012

From Breuer Plots 5 and 6 below, it can be seen that 2012 can be considered meteorology as a typical or “normal” year with the wind direction being from a predominantly south-westerly direction. However, there is, once again, during winter months, significant periods of north-easterly winds. These periods of north-easterly winds have become prevalent recently are fairly indicative of the harsher winter conditions seen within the UK over the last couple of years.



Breuer Plot 6 – Meteorological Conditions – 1 Hour Integration – 30m Meteorological Mast Cwm Level Park 2012

Meteorological conditions represented within Breuer Plots 5 and 6 help explain the dosage and mass flux plots within Breuer Plots 2 and 4 above.

As can be seen from tables 11 and 12 above, **no exceedences of the annual mean objective** were seen at any of the monitoring stations. Similarly, **no breach of the 35 permitted exceedences of the 24 hour objective** was seen, **nor, where data capture was below 90% did the 90th percentile** (given in brackets after the number of exceedences) **exceed 50ug/m³**.

LAQM.TG(09) provides a method to project measured annual mean roadside PM₁₀ concentrations to future years²¹. Using this method, the following future year projections for 2015 and 2020 are presented below within table 13. In order to reach the final calculation, the following steps were taken: All steps were undertaken using the latest download data files for 2012, 2015 and 2020 from

<http://laqm.defra.gov.uk/maps/maps2010.html>

²¹ LAQM.TG(09) box 2.2 page 2-5

City & County of Swansea

Steps 1-4	Measured 2012 Conc.	2012 Background Conc.	2012 Local Road Contribution	Road Cont 2015	Road Cont 2020
Swansea AURN	17.79	14.02	3.77	0.948343	0.826101
Morriston	13.86	13.79	0.07	0.686223	0.583001

Step 5	Year Adj. Factor 2015	Year Adj. Factor 2020
Swansea AURN	0.848678447	0.73928327
Morriston	0.832129401	0.70696009

Step 6	Year Adj. Factor 2015	Year Adj. Factor 2020
Swansea AURN	3.199517744	2.787097925
Morriston	0.058249058	0.049487206

Site ID	Location	Within AQMA?	Measured Annual Mean 2012	Future Years Projections	
				2015	2020
1	Swansea AURN	Y	17.79	15.46	14.59
3	Morriston Groundhog	N	13.86	11.98	11.52

Table 13 PM₁₀ Annual Mean projections

From table 13 it can be seen that from the 2012 annual mean concentrations used to derive the 2015 and 2020 projections that the trend at both sites continues downwards. However, it should be noted that these projections are different to those presented within the USA 2012 report in that the Swansea AURN projected concentrations have increased whilst those at the Morriston Groundhog have decreased from the previous projected forecast of future year concentrations. The projections contained within table 13 are based on data capture rates for 2012 above the required 90%., whilst the projections within the USA2012 used data capture rates below the recommended 90%.

These latest projections for both 2015 and 2020 are for PM₁₀ concentrations to remain considerably below the annual mean objective

City & County of Swansea

The City & County of Swansea facilitated a research study by a group comprising: School of Earth and Ocean Sciences Cardiff University, School of Biosciences Cardiff University, and the Centre for Health and Environment Research, Department of Primary Care and Public Health, Neuadd Meirionydd into ultrafine and nanoparticles using a Dekati™ Electrical Low Pressure Impactor within a street canyon environment. The site chosen for measurements was the Hafod Post Office, Neath Road, Hafod, Swansea. This site is located within the Hafod Air Quality (NO₂) Management Area. **Full details of the study are reproduced with the permission of the group, within Annexe 7. The study confirmed the existence of an early morning diurnal pattern within the ultrafine fraction which appears to match the diurnal NO₂ pattern highlighted above within section 2.2.**

2.2.5 Sulphur Dioxide

There were major alterations to the authority's network of SO₂ analysers during 2010. These changes have been reported within the authorities Progress Report 2011 and the USA 2012 but are repeated within this report for clarity. Due to budget restrictions and with the knowledge that SO₂ concentrations have remained low for several years with no exceedence of any of the objectives, the decision was made to switch off the Advanced Pollution Instrumentation (API) real-time SO₂ analysers at the Swansea AURN, Morfa and Morryston Groundhog stations.

SO₂ is now only monitored at one location within Swansea - the St.Thomas DOAS (see sec 2.1.7 above). St.Thomas is ideally placed for this monitoring, being in close proximity to Swansea Docks with the Tata Steelworks to the south-east across Swansea Bay. This has been the traditional dominant source of SO₂ seen within Swansea since measurement of SO₂ commenced during the late 1970's.

The derived 15-minute means have been compiled into hourly averages by the software package OPSIS Enviman Reporter. In order to compile a valid hourly mean, a minimum of 3, 15-minute means were specified²². Data capture of less than 75% for the hour therefore excludes that hour from any analysis. The derived hourly means have then been used to calculate both the hourly and 24-hour objectives. In order to calculate the 24-hour mean a minimum of 75% (i.e. 18 out of 24) of the ratified hourly means were specified to be present²³

The data capture rates are presented within table 14 and, where applicable, the percentile value corresponding to the objective exceedence value is given should the data capture rate fall below 90%²⁴

Graphs 8 - 10 are presented below, representing time series measurements made during 2012 with the accompanying Breuer plot 7 providing an insight into the more likely source direction.

²² LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-47

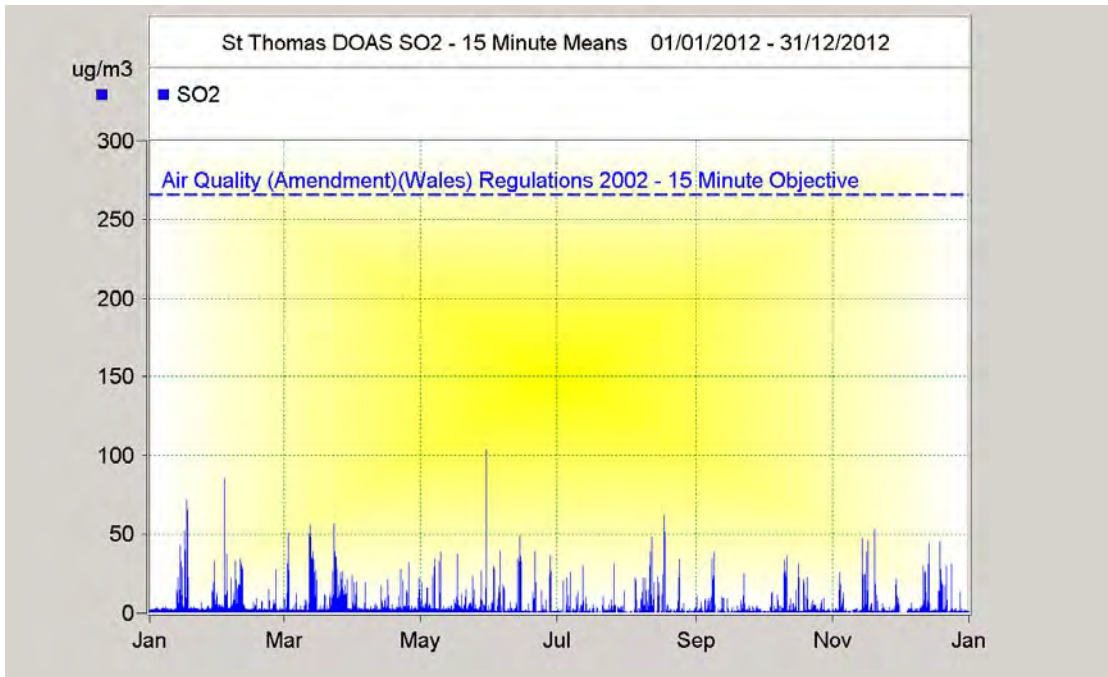
²³ LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-48

²⁴ LAQM TG(09) Annexe A1 – A1.157 page A1-34

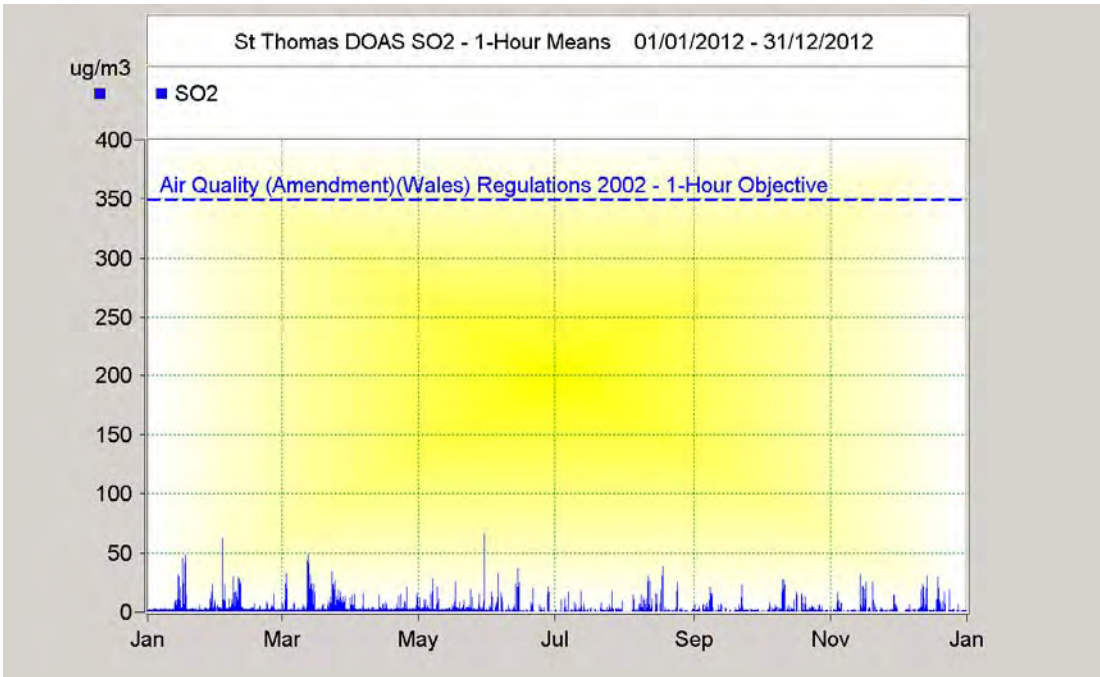
St.Thomas DOAS 2012	Max 15-Min Mean $\mu\text{g}/\text{m}^3$ ($266\mu\text{g}/\text{m}^3$)	Max 1-hour Mean $\mu\text{g}/\text{m}^3$ ($350\mu\text{g}/\text{m}^3$)	Max 24-Hour Mean $\mu\text{g}/\text{m}^3$ ($125\mu\text{g}/\text{m}^3$)
Data Capture	71.56%	73.03%	84.70%
Concentration	103.46	66.44	16.31
Exceedences	0	0	0
Date of Max	30/05/2012	30/05/2012	17/01/2012
Time of Max	08:30	08:00	00:00
2012 Percentiles	15 Minute	1 Hour	24-Hour
99.9th Percentile	47.97	-	-
99.7th Percentile	-	31.96	-
99th Percentile	-	-	13.45

Table 14 – SO₂ Concentrations 2012 St.Thomas DOAS

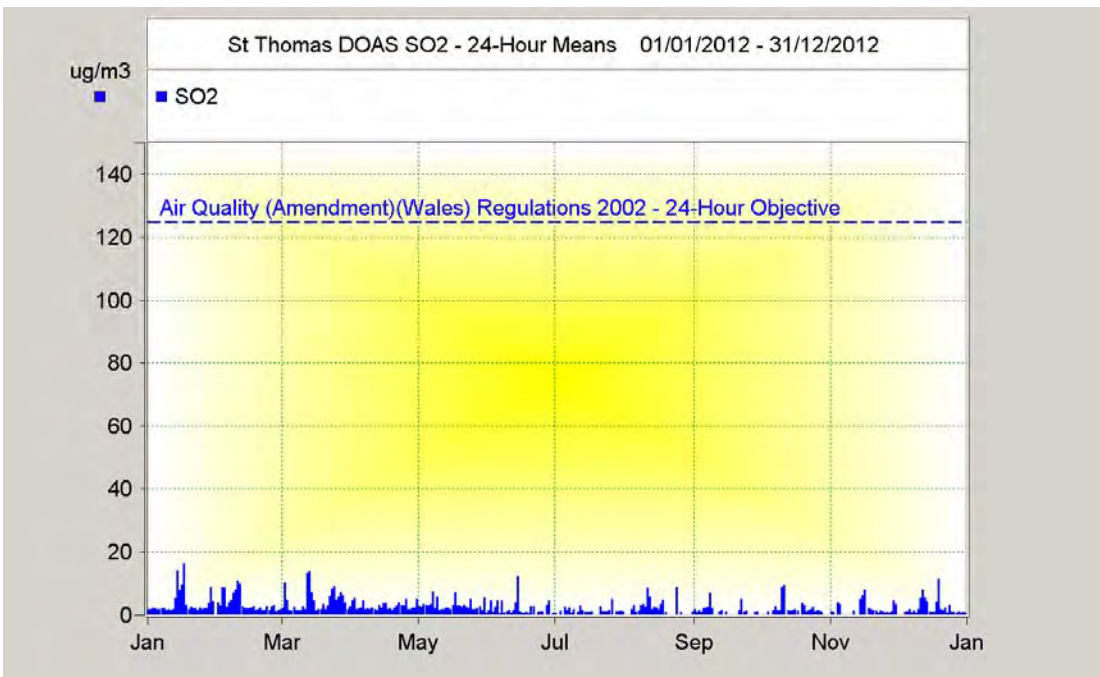
Looking at the data capture rates for 2012 within table 14 above, it could mistakenly be taken that there were operational issues with the equipment at the site. However, this impression would be incorrect. The reason for the quoted data capture rate is due to the QA/QC formulae used (see section 2.1.7 above). The SO₂ concentrations being measured during certain periods were fairly close to zero / detection limit and thus the measurement period has a standard deviation greater than twice the measured SO₂ concentration for that measurement period. Due to the standard deviation being greater than twice the measured concentration the period is rejected within the QA/QC rules due to the inherent uncertainty of the measurement.



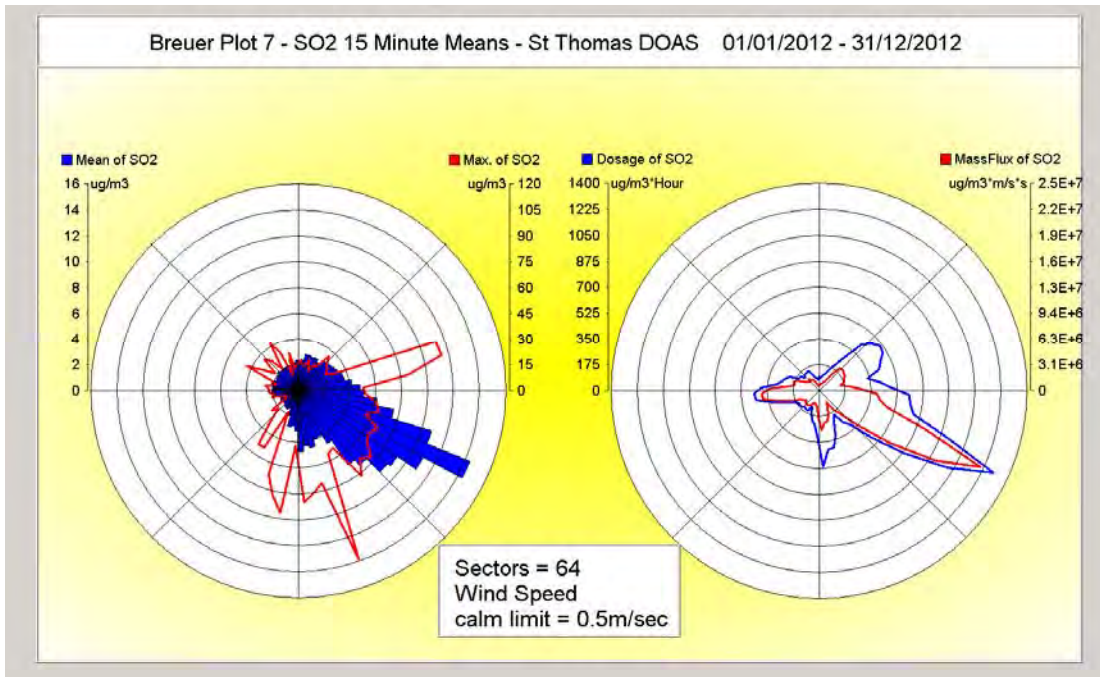
Graph 8 – 15 minute SO₂ means – St Thomas DOAS 2012



Graph 9 – 1-hour SO₂ means – St Thomas DOAS 2012



Graph 10 – 24-hour SO₂ means – St Thomas DOAS 2012



Breuer Plot 7 – 15 minute SO₂ concentrations St.Thomas DOAS 2012

From Breuer Plot 7 it is evident that whilst low SO₂ concentrations are seen in Swansea, it is clear that the south-easterly direction still dominates as has been seen during previous years as the source of the measured concentrations. Breuer Plot 7 would seem to suggest that whilst the mean concentrations are dominated by sources to the south-east, that there is likely to be another source to the south-south east which is influencing the maximum concentrations seen. This has also been noted during previous reporting. Additionally during 2012 there would appear to be an additional source as yet unidentified contributing to the maximum concentrations from the north-east. The St Thomas DOAS station is approximately half a mile from the docks area, (in a more south-south easterly direction) so it would seem likely that the docks activities contribute to maximum concentrations seen from that direction. Whilst there may be more local influences, it should be noted that there is heavy industry located to the south east of Swansea Bay in the form of the Tata Steelworks at Port Talbot. This has been the traditional dominant source of SO₂ seen within Swansea since measurement of SO₂ commenced during the late 1970's. From 2012 data this would seem to remain the case and is reinforced by examination of the dosage and Mass Flux plots within Breuer plot 7. Dosage is taken to be the accumulated time multiplied with the average value of SO₂. This is useful for calculations of likely exposure at these locations. Mass Flux is also indicated and is taken to be: Flux - the wind speed multiplied with the operand distributed over the wind direction. All data that has valid integrated data for all three positions are included in this calculation. (Note: The average distributed wind speed and

the average distributed parameter [SO₂] are not used to calculate the result). The result is presented in the multiplied units of the wind speed and the parameter (SO₂). Mass flux is the same as flux, but the result is multiplied with the accumulated integration time. This gives the mass transport in different directions.

2.2.6 Benzene

Benzene is measured in real-time at two roadside sites in Swansea with Opsis DOAS instruments. Sections 2.1.6 and 2.1.7 above outline the systems in operation at the Hafod (along Neath Road) and at St.Thomas (Pentreguinea Road) sites.

Annual means for benzene and the underlying data capture for 2008-2012 are provided below within table 15.

Site ID	Location	Within AQMA	Data Capt. 2008 %	Data Capt. 2009 %	Data Capt. 2010 %	Data Capt. 2011 %	Data Capt. 2012 %	Annual mean concentrations ($\mu\text{g}/\text{m}^3$)				
								2008	2009	2010	2011	2012
5	Hafod DOAS	Y	35%	98%	76%	75%	74%	2.28	1.88	3.69	3.10	2.66
6	St.Thomas DOAS	N	96%	88%	80%	81%	76%	2.52	1.81	3.58	3.09	2.55

Table 15 Benzene annual means 2008-2012

Significant data has been lost at these sites in previous years due to operational issues and also building renovation works in the case of the Hafod site. Analysis of the data for 2012 has once again produced data capture rates below the recommended 90%. However, this can partly be explained by the validation rules outlined within sections 2.1.6 – 2.1.7 together with some periods of measurement cycles being close to the “limit of detection” resulting in a high standard deviation of the measurement and thus rejection if the standard deviation is more than twice the concentration measured.

Graphs 11 and 12 below illustrate some high hourly “spikes” of benzene throughout the year for short periods of time at both sites, and importantly around the same time, indicating a likelihood of the same source. However, these spikes during 2012 are much reduced from hourly spikes in recent years.

Both sites show a reduction in annual mean concentrations over those reported for 2010 and 2011. Concentrations continue to remain below the annual mean objective level of $5\mu\text{g}/\text{m}^3$. It is thought that the annual mean concentrations returned for 2010 were influenced by the atypical meteorological conditions experienced during 2010, particularly during the early winter months of late 2010. However, it is thought that 2011 exhibited typical meteorological conditions and that this has been reflected within the

returned annual mean concentrations. An influence on the annual mean concentrations during 2011 (and numerous exceptionally high hourly spikes) is thought to be the tyre flock fire at a disused factory unit at Fforestfach which lasted for several weeks. No such incidents occurred during 2012 that could account for the numerous hourly spikes.

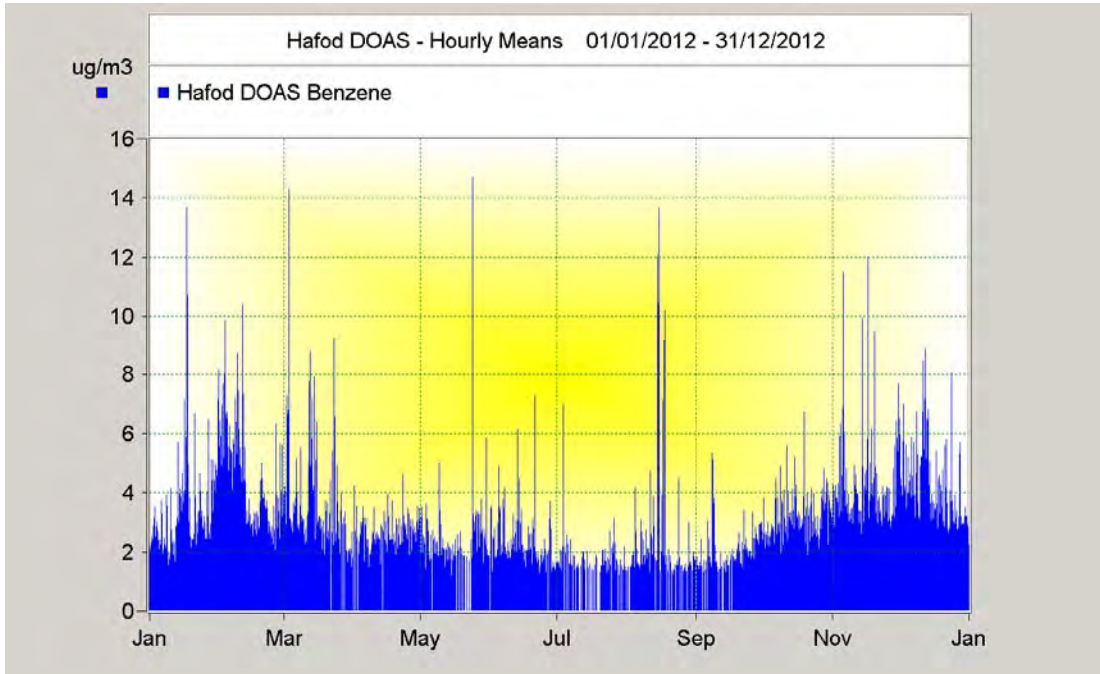
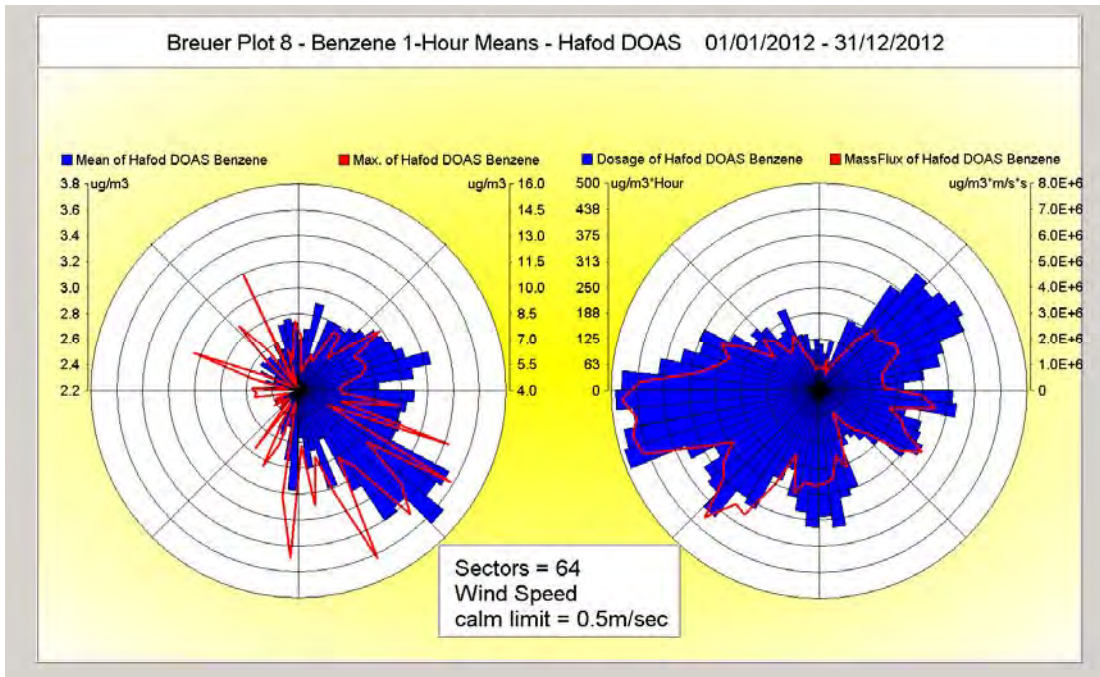


Chart 11 – Hourly Benzene concentrations Hafod DOAS 2012



Breuer Plot 8 – Hafod DOAS Benzene Hourly Concentrations 2012

Breuer Plot 8 above indicates multiple directions of sources for benzene concentrations during 2012. The more dominant source is from the south east and this is more probably associated with emissions from the heavy industry to the east of Swansea Bay. Also shown is the source to the south/south east which is thought to be from industry within Swansea Docks which influence the maximum hourly concentrations seen.

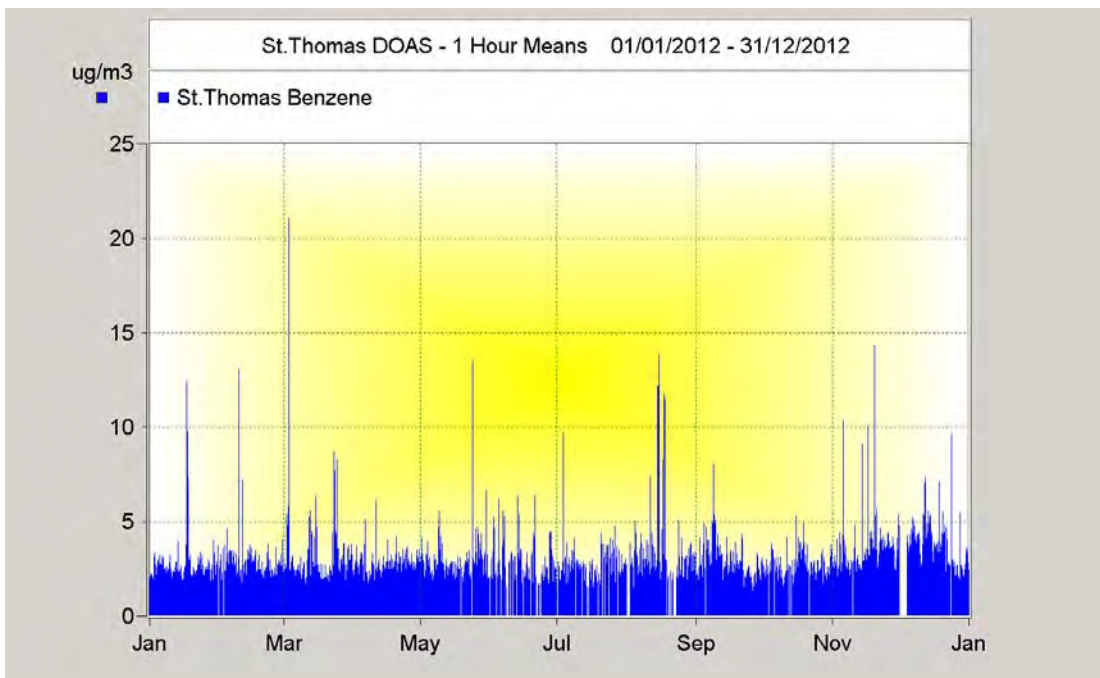
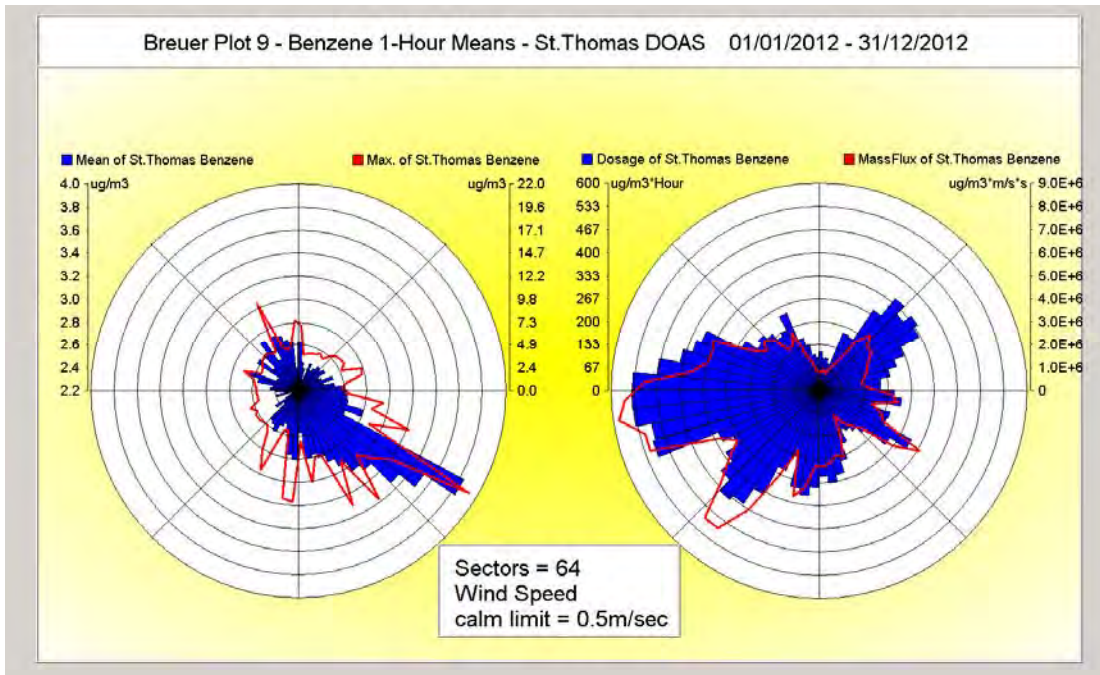


Chart 12 – Hourly Benzene concentrations St.Thomas DOAS 2012



Breuer Plot 9 – St.Thomas DOAS Benzene Hourly Concentrations 2012

Breuer Plot 9 above from St Thomas indicates definitively the primary source of mean and maximum hourly concentrations to be from source(s) to the south-east which is thought to be the heavy industry located to the east of Swansea Bay. Surprisingly, the source thought to be located to be from within Swansea Dock does not manifest itself clearly within Breuer Plot 9. The only indications of the existence of the source(s) are evident within the maximum hourly concentration seen to the south.

From table 15 above it can be seen that no annual mean exceeds 5ug/m³ at either site and compliance is, therefore, being achieved at both sites.

2.3 Other pollutants monitored

The authority has previously monitored additional pollutants (carbon monoxide and ozone) at the majority of the automatic sites. However, due to the financial restraints that the authority is now operating under, all carbon monoxide monitoring has ceased at the Swansea AURN, and Morrision Groundhog sites, resulting in no roadside carbon monoxide monitoring being undertaken within Swansea since 2009. Ozone monitoring ceased at the Swansea AURN site on the 27th November 2008 with the analyser being transferred to the Cwm Level Park monitoring site following the reorganisation of the UK Network. Ozone also continues to be measured at the Morrision Groundhog and the Hafod and St Thomas DOAS sites. Lastly, PM_{2.5} is measured at the Swansea AURN Roadside station by way of the Thermo TEOM FDMS system (co-located with Thermo TEOM FDMS PM₁₀) until November 2011 when due to continued operational issues the FDMS systems were replaced with Met One Bam 1020 units.

In addition, the authority participate in the UK Heavy Metals Monitoring Network with The Department of the Environment, Transport and the Regions (DETR) monitoring study to determine ambient concentrations of lead, cadmium, arsenic, mercury and nickel in the vicinity of a wide-variety of industrial processes. The City and County of Swansea were requested to participate in this study from its inception during 1999/2000 due to the nickel refinery at Vale Europe being located within the authority's area at Clydach. Further details and information can be found within section 2.1.10. The analysed parameters are: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Magnesium (Mn), Nickel (Ni), Lead (Pb), Platinum (Pt), Vanadium (V), Zinc (Zn) and Mercury (Hg).

2.3.1 Ozone

Whilst the objective for ozone has not been set in regulation as yet as it is seen as a national rather than local authority problem, details have been included here of the measurements made during 2012. The objective for ozone is for the 8-hour means not to exceed $100\mu\text{g}/\text{m}^3$ on more than 10 occasions with a compliance date of 31st December 2005.

Measurements are undertaken with Advanced Pollution Instrumentation (API) real-time O_3 analysers at the Cwm Level Park and Morriston Groundhog sites with the DOAS technique providing the measurements from the St Thomas and Hafod sites. The O_3 analyser from the Swansea AURN was decommissioned on the 27th November 2008 and relocated at Cwm Level Park.

Ratified datasets have been downloaded from http://www.welshairquality.co.uk/data_and_statistics.php in relation to the ozone monitoring undertaken at the Morriston Groundhog and Cwm Level Park sites. Data ratification procedures undertaken at the Hafod and St Thomas DOAS sites are described in more detail within sections 2.1.6 and 2.1.7

Hourly means have been used to calculate the 8-hour means. In order to form a valid 8-hour mean 75% of the hourly means were required to be present i.e. 6 out of every 8. Tables 16 - 19 detail the monitoring undertaken during 2012 along with previous years results.

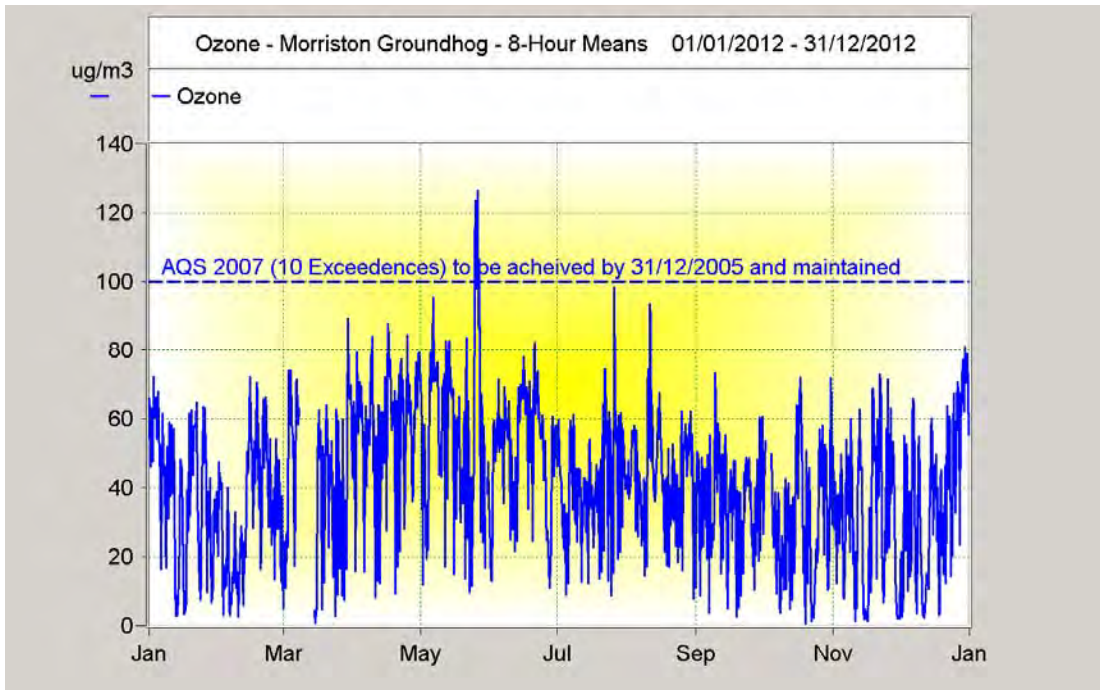


Chart 13 – Morryston Groundhog – 8-Hour Ozone means 2012

Morryston Groundhog	Max 8-hour Mean ($\mu\text{g}/\text{m}^3$)	Data capture	Exceedences of 8-hour objective $100\mu\text{g}/\text{m}^3$ (10 permitted)
2002	109.50	83.3%	3
2003	169.25	95.71%	28
2004	142.75	98%	23
2005	113.00	97.6%	1
2006	152.20	98.8 %	15
2007	114	98%	4
2008	120.75	88.43%	3
2009	103.25	89.04%	2
2010	103.5	94.34%	1
2011	104.25	90.78%	2
2012	126.50	97.63%	5

Table 16 - Morryston Groundhog Ozone 8-hour means 2002-2012

Cwm Level Park

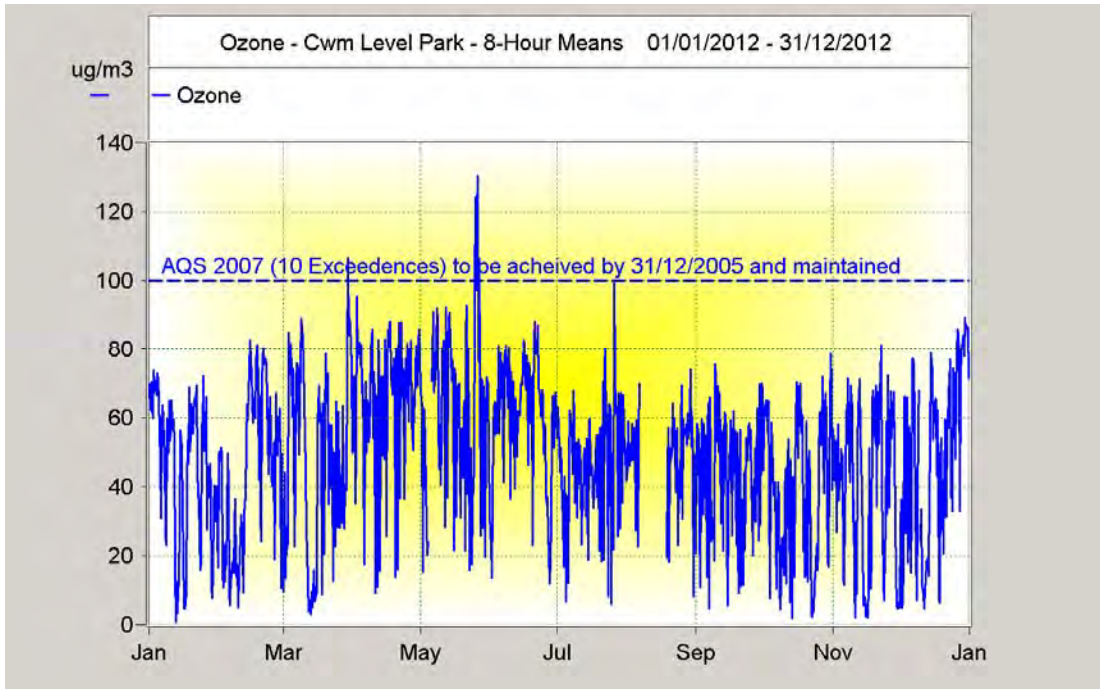


Chart 14 – Cwm Level Park – 8-Hour Ozone means 2012

Cwm Level Park	Max 8-hour Mean ($\mu\text{g}/\text{m}^3$)	Data capture	Exceedences of 8-hour objective $100\mu\text{g}/\text{m}^3$ (10 permitted)
2009	100.75	92.6%	1
2010	106.5	98.26%	1
2011	112.0	98.63	5
2012	130.25	96.17%	5

Table 17 – Cwm Level Park Ozone 8-hour means 2009-2012

Hafod DOAS

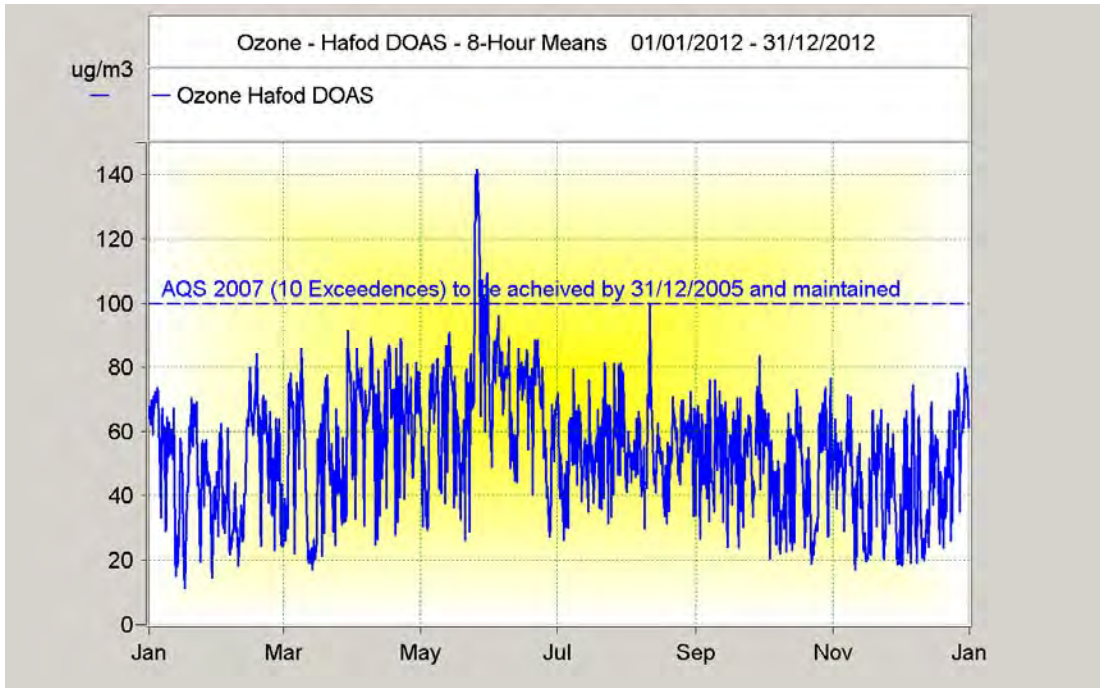


Chart 15 – Hafod DOAS – 8-Hour Ozone means 2012

Hafod DOAS	Max 8-hour Mean ($\mu\text{g}/\text{m}^3$)	Data capture %	Exceedences of 8-hour objective $100\mu\text{g}/\text{m}^3$ (10 permitted)
2006	95.95	53.7%	0
2007	87.36	82.3%	0
2008	98.96	38.5%	0
2009	118.49	94.70%	50
2010	115.53	95.98%	6
2011	102.19	99.91%	2
2012	141.71	99.6%	13

Table 18 –Hafod DOAS Ozone 8-hour means 2006-2012

St.Thomas DOAS

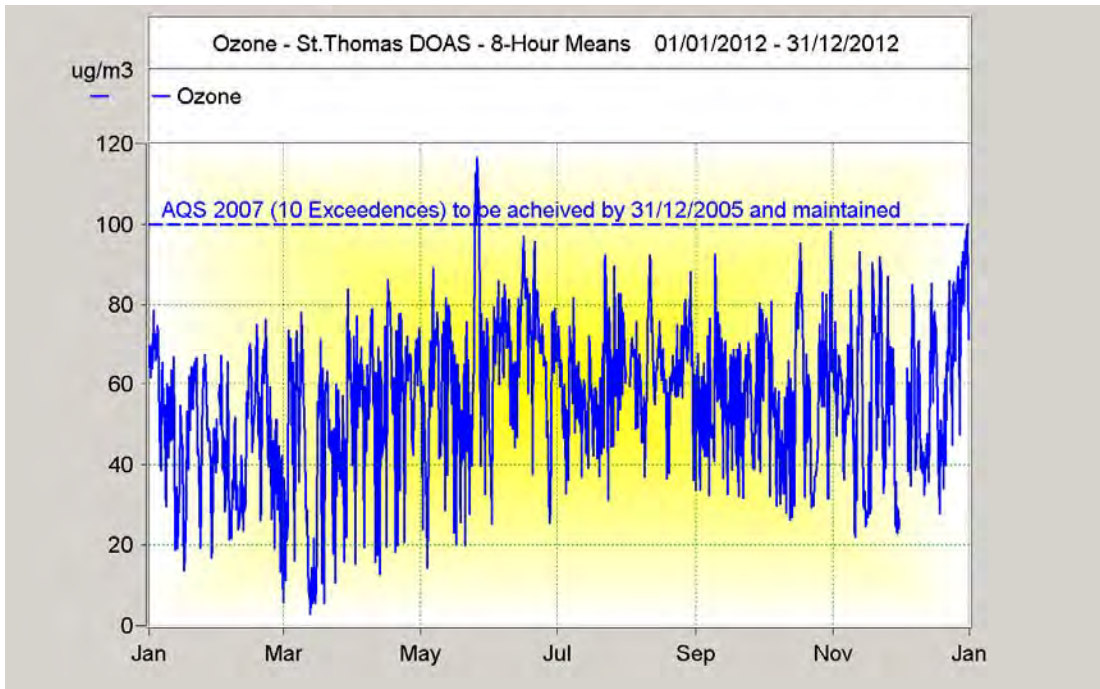


Chart 16 – St.Thomas DOAS – 8-Hour Ozone means 2012

St Thomas DOAS	Max 8-hour Mean ($\mu\text{g}/\text{m}^3$)	Data capture	Exceedences of 8-hour objective $100\mu\text{g}/\text{m}^3$ (10 permitted)
2006	150.6	94.9%	47
2007	106.4	98.7%	10
2008	127.9	99.9%	91
2009	118.93	99.4%	48
2010	120.45	99.36%	37
2011	108.90	99.54%	9
2012	116.42	98.63%	4

Table 19 – St.Thomas DOAS Ozone 8-hour means 2006-2012

It should be restated here that the DOAS technique produces a spatial measurement between the transmitter and receiver units of 250m at the Hafod DOAS site and 280m at the St.Thomas site. Whilst being located alongside roads with AADT's of 15840 and 19824 respectively during 2012, it's clear that photochemistry is not as prevalent along Pentreguinea Road, St Thomas as in past years. Given previous years monitoring exceedences, the situation has improved during 2011-2012 which is more probably as a result of meteorological conditions than any other factor as the site local has not changed significantly. The only change along the southernmost section of Pentreguinea

Road during 2011-2012 has been the formation of a gyratory around the Quay Parade bridges with alterations to the signal timings and lane disciplines etc. It has been noted that traffic appears to be travelling more freely across and around the Quay Parade bridges area since completion of the scheme. It is worth investigating if this effect on ozone concentrations is real and continues to be seen, as the annual mean results for nitrogen dioxide have trended the other way hinting at a linkage.

Compliance is being seen at both the Murrison Groundhog site and the background site at Cwm Level Park although maximum concentrations at Cwm Level Park have seen a marked increase in concentrations over previous years.

The results from the open path measurements at Hafod and St.Thomas clearly differ over the years from those made at the traditional fixed point stations and present a different picture as to what the actual levels over a much wider sampling area may actually be.

2.3.2 Particulate Matter PM_{2.5}

The Thermo FDMS PM_{2.5} system was installed upon commissioning of the relocated Swansea Roadside AURN site, and went live on the 26th September 2006.

The data collected for 2006 from the FDMS PM_{2.5} unit amounts to just over two months at best and is not reported here as the period was fraught with breakdowns and other issues. Brief operational issues that have been identified are outlined here for information as the operation of the FDMS units differs substantially from that of its predecessor the R&P Teom units.

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C²⁵. Opinions vary as to the exact optimum temperature but Swansea's experience indicates around 18-20°C to be adequate and one that is capable of being maintained relatively stably by the installed air conditioning system.

The FDMS unit provided hourly integration data and had been configured as per DEFRA's FDMS parameter protocol (as amended during February 2008). The RS232 port on the FDMS control unit allows the collection of up to 8 parameters via telemetry. The parameters collected from the FDMS units are : Volatile Mass, Non Volatile Mass, External Dew Point, Sample Dew Point, Filter loading, Pressure, Status, External Ambient Air temperature. The control unit referred to these parameters in different terminology. However, the FDMS unit would not directly produce a PM_{2.5} mass concentration. The PM_{2.5} mass concentration was obtained via post processing of the volatile and non volatile mass parameters by creating a calculated channel the software package Ophis Enviman ComVisioner.

Data collected from the FDMS unit had an integration period of 1-hour. PM_{2.5} mass concentration is obtained via post processing of the volatile and non volatile mass parameters by the software package Ophis Enviman ComVisioner. The calculated hourly mean mass concentration data have then been further processed by the software package Ophis Enviman Reporter. In order to calculate the 24-hour mean a minimum of

²⁵ UK Equivalence Program for Monitoring of Particulate Matter dated 5th June 2006 section 5.5.2

75% (i.e. 18 out of 24) of the calculated hourly means were specified to be present²⁶. LAQM.TG(09) provides no direct guidance on PM_{2.5}, except for paragraphs 3.50 – 3.53.

There have been numerous problems since the commissioning of the site in September 2006 with the installation of the Thermo Inc FDMS PM_{2.5} analyser, resulting in significant periods of data loss. During 2007, there were several periods where data has been removed from the dataset. There are: 1st – 5th January 2007; 16th - 18th January 2007; 24th – 26th January 2007; 1st -2nd March 2007; 7th – 21st May 2007 (leak test failure and uncertainty in data due to swap out of loan/replacement sensor units). These issues resulted in a ratified data capture rate of 90.7% for 2007.

Operation during 2008 saw a data capture rate of 94.81% with far fewer operational issues arising. However, significant issues were again seen within the data for 2009. Significant data has either been rejected or is absent during January, February, May-August, October and December 2009. The resulting data capture rate for 2009 is a disappointing 49.86% (daily means with 75% of 1 hour means present). During 2010, the operation of the PM_{2.5} FDMS had been queried on many occasions as the PM_{2.5} unit was reporting higher concentrations of PM_{2.5} than the PM₁₀ unit. Both FDMS units have been investigated for leaks, dryer issues, pump vacuum issues during. However, problems continued with the reliability of the FDMS from late December 2010 and throughout 2011. Data has been rejected by the UK network from the 21st December 2010 to the 14th September 2011 at 15:00.

Due to the ongoing reliability and data quality issues from the PM_{2.5} (and also PM₁₀) FDMS systems a decision was made during the summer of 2011 to remove both FDMS units. Both FDMS units were removed from site on the 16th November 2011. Met One BAM 1020 PM_{2.5} (smart Bam) and PM₁₀ units were installed on the 28th November 2011.

The Met One Bam PM_{2.5} (smart Bam) is heated and has been determined to show equivalency to the EU reference method during recent trials without the need for the application of a correction factor.^{27 28}

²⁶ LAQM.TG(09) Calculation of Exceedence Statistics A1.216 page A1-48

²⁷ http://www.metone.com/documents/Met_One_Letter_5.pdf

²⁸ http://uk-air.defra.gov.uk/reports/cat05/0606130952_UKPMEquivalence.pdf

Each hour, a small ^{14}C (carbon-14) element emits a constant source of high-energy electrons (known as beta rays) through a spot of clean filter tape. These beta rays are detected and counted by a sensitive scintillation detector to determine a zero reading. The BAM-1020 automatically advances this spot of tape to the sample nozzle, where a vacuum pump then pulls a measured and controlled amount of dust-laden air through the filter tape, loading it with ambient dust. At the end of the hour this dirty spot is placed back between the beta source and the detector thereby causing an attenuation of the beta ray signal which is used to determine the mass of the particulate matter on the filter tape and the volumetric concentration of particulate matter in ambient air.

Due to the problems experienced during 2011 the combined FDMS $\text{PM}_{2.5}$ and BAM1020 $\text{PM}_{2.5}$ hourly integrated data capture rate is 28.66%. Chart 17 below present's daily mean data for 2012. Table 20 summarises $\text{PM}_{2.5}$ data between 2007 and 2012.

It should be stated that following installation of the Bam 1020 $\text{PM}_{2.5}$ unit that data capture since installation and throughout 2012 into 2013 has vastly improved.

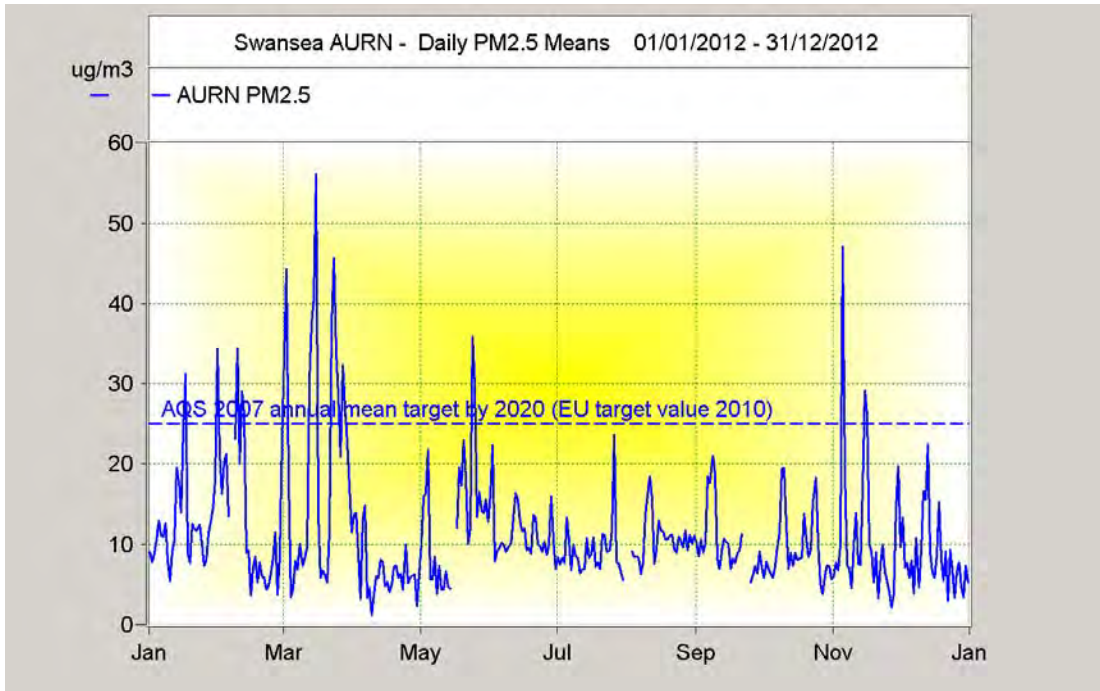


Chart 17- Swansea AURN Daily PM_{2.5} means 2012

Swansea Roadside AURN PM _{2.5}	Data capture	Annual Mean (25µg/m ³)	Max Daily Mean (µg/m ³)	Max 1-hour mean (µg/m ³)
2007	90.7%	13.84	68.9	262
2008	94.81%	12.53	70.42	202
2009	49.86%	11.84	60.54	91
2010	94.52%	8.97	33.63	102
2011	28.66%	10.33	32.04	230 *
2012	97.27%	11.45	56.17	199 **

Table 20 – Swansea AURN PM_{2.5} daily means 2007-2012

*Max 1-hour 2011 occurred on 5th November 2011

** Max 1-hour 2012 occurred on 5th November 2012

The Air Quality Strategy 2007 focuses attention on PM_{2.5} particulate matter to that of an exposure reduction approach. Between 2010 and 2020 for UK Urban Areas there is a target of 15% reduction in concentrations at urban background. The 25µg/m³ is a cap to be seen in conjunction with the 15% reduction. The current policy framework and the legislative requirement to meet EU air quality limit values everywhere in the UK tends to direct LAQM attention to localised hotspot areas of pollution. There is clear and unequivocal health advice that there is no accepted threshold effect, i.e. no recognised safe level for exposure to fine particles PM_{2.5}. For PM_{2.5}, the current policy framework is therefore not going to generate the maximum improvement in public health for the

investment made, as it focuses attention on localised hotspots only, despite much more widespread adverse effects on health being likely.

Therefore, an exposure reduction approach has been adopted for PM_{2.5} to seek a more efficient way of achieving further reductions in the health effects of air pollution by providing a driver to improve air quality everywhere in the UK rather than just in a small number of localised hotspot areas, where the costs of reducing concentrations are likely to be exceedingly high. These measurements will act to make policy measures more cost-effective and is more likely to maximise public health improvements across the general population.

The City & County of Swansea facilitated a research study by a group comprising: School of Earth and Ocean Sciences Cardiff University, School of Biosciences Cardiff University, and the Centre for Health and Environment Research, Department of Primary Care and Public Health, Neuadd Meirionydd into ultrafine and nanoparticles using a Dekati™ Electrical Low Pressure Impactor within a street canyon environment. The site chosen for measurements was the Hafod Post Office, Neath Road, Hafod, Swansea. This site is located within the Swansea Air Quality (NO₂) Management Area 2010.

Full details of the study are reproduced with the permission of the group, within Annexe 7.

2.3.3 Heavy Metals Monitoring

The Department of Environment, Food and Rural Affairs (DEFRA) is funding a monitoring study to determine ambient concentrations of lead, cadmium, arsenic, mercury and nickel in the vicinity of a wide-variety of industrial processes.

The City and County of Swansea were requested to participate in this study from its inception during 1999/2000 due to the nickel refinery at Vale (Formerly Vale INCO/ INCO Europe) being located within the authority's area at Clydach. Full details on this monitoring program can be found within section 2.1.10 above which outlines the overall monitoring program and sites chosen.

Several years of monitoring data are available and can be viewed within previous LAQM Progress Report reporting cycles undertaken online at <http://www.swansea.gov.uk/index.cfm?articleid=9929>

During August 2007, Vale INCO Europe commenced an abatement improvement program with the installation of particulate bag filters on the main high stack discharge point. Data is presented below from 2007-2012 representing the last 6 years of monitoring. Additional factors should be taken into account when viewing the monitoring data. Due to the economic downturn, Vale have operated for the last year or so at a reduced capacity primarily operating on one kiln. Whilst both the improved abatement techniques and reduced capacity are clearly seen within the data from the four monitoring stations within the City & County of Swansea's area, colleagues from Neath Port Talbot Borough Council have identified a previously unrecognised local, and now deemed significant source of nickel within Pontardawe. This source within Pontardawe was previously being masked and has only now come to light due to the increased monitoring and analysis undertaken within the Swansea valley into ambient levels of nickel. This additional work is in part being driven by the Nickel in South Wales Review Group whose membership includes the Welsh Assembly Government (Policy and Technical Services Division), DEFRA, Environment Agency Wales, AEA Technology, National Physics Laboratory together with the relevant operators and local authorities.

Annexe 1 of the Directive details the target values for arsenic, cadmium, nickel and bezo(a)pyrene and, for ease of reference these are repeated below as table 21.

Pollutant	Target value ng/m ⁻³
Arsenic	6
Cadmium	5
Nickel	20
Benzo(a)pyrene	1

Table 21 - Target Values 4th Daughter Directive - Heavy Metals Monitoring

Tables 22-26 below detail the monthly means during 2007-2011 for the **Glais Primary School** site. All results are expressed in ng/m⁻³.

Glais Primary School 2007

2007	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.75	0.14	3.68	3.7	72	1.27	29.39	4.8	0.00	0.18	4.8	0.23
Feb	0.81	0.17	2.94	3.9	151	3.19	27.01	10.0	0.00	0.83	20.3	0.03
Mar	1.07	0.25	3.19	3.6	271	5.46	20.72	8.4	0.00	1.64	15.4	0.52
April	1.32	0.30	4.64	6.7	397	10.39	16.47	14.2	0.00	3.35	41.0	0.48
May	2.37	0.99	7.18	10.1	283	5.39	21.33	27.5	0.00	1.66	15.2	0.50
June	0.52	0.10	4.82	3.5	83	2.69	50.21	3.7	0.00	2.04	17.5	0.31
July	0.44	0.07	3.07	3.3	96	2.42	46.97	2.7	0.00	1.61	12.9	0.09
Aug	-	-	-	-	-	-	-	-	-	-	-	-
Sept	-	-	-	-	-	-	-	-	-	-	-	-
Oct	-	-	-	-	-	-	-	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-	-
Dec	0.78	0.19	1.95	5.2	152	4.56	12.25	12.3	0.00	1.79	19.5	0.03
Ann Av.	1.01	0.28	3.94	5.0	188	4.42	28.04	10.5	0.00	1.64	18.3	0.27

Table 22 – Heavy Metals monitoring 2007 Glais Primary School

Significant operational issues were seen at the Glais Primary School site during 2007-2009. These issues mainly relate to data loss due to instrument faults or more lengthy periods of data loss due to the subsidence and subsequent reconstruction of the building that housed the instrument.

Glais Primary School 2008

2008	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.71	0.11	0.05	3.5	195	3.59	7.1	5.9	<0.01	1.59	6.8	0.14
Feb	1.36	0.46	5.17	7.2	224	6.93	21.0	14.0	<0.01	2.82	23.5	0.06
Mar	0.26	0.11	1.19	2.9	96	1.94	12.6	6.5	<0.01	0.79	9.1	0.03
April	0.41	0.17	1.61	5.5	139	3.10	10.6	6.3	0.01	1.42	13.5	0.04
May	0.63	0.27	1.50	4.6	285	6.83	5.7	10.1	0.01	2.28	25.1	0.05
June	0.52	0.18	1.64	5.1	209	4.41	16.9	7.3	<0.01	0.80	20.6	0.06
July	0.37	0.15	0.42	3.9	175	3.45	10.8	10.2	<0.01	0.87	16.4	0.05
Aug	0.22	0.07	0.11	3.3	81	1.76	2.9	4.5	<0.01	0.37	9.8	<0.01
Sept	0.77	0.21	0.94	5.6	294	4.52	8.6	17.3	<0.01	1.26	18.1	<0.01
Oct	0.73	0.30	0.62	8.8	247	4.03	9.8	12.3	<0.01	1.62	17.2	<0.01
Nov	1.07	0.41	0.30	9.8	109	2.96	7.7	17.9	<0.01	0.63	22.4	<0.01
Dec	-	-	-	-	-	-	-	-	-	-	-	-
Ann Av.	0.64	0.22	1.23	5.48	186.5	3.95	10.34	10.21	0.01	1.31	16.59	0.06

Table 23 – Heavy Metals monitoring 2008 Glais Primary School

Glais Primary School 2009

2009	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	-	-	-	-	-	-	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-	-	-	-	-
Mar	-	-	-	-	-	-	-	-	-	-	-	-
April	0.38	0.17	0.01	3.5	100	2.59	1.9	9.1	<0.01	1.35	53.1	<0.01
May	0.39	0.10	0.06	3.0	87	2.30	1.73	6.0	<0.01	0.94	34.9	0.01
June	0.59	0.18	0.04	7.7	169	4.51	3.8	9.2	<0.01	1.64	16.6	0.01
July	0.30	0.08	3.58	3.1	59	1.40	7.3	3.8	<0.01	1.48	8.4	0.01
Aug	0.38	0.10	0.34	3.4	96	2.06	1.4	6.8	<0.01	0.83	7.8	0.02
Sept	0.64	0.27	2.12	4.6	137	2.93	8.2	6.4	<0.01	0.60	7.9	0.01
Oct	0.69	0.19	3.28	5.1	234	4.51	6.3	9.9	<0.01	0.96	15.3	0.01
Nov	0.48	0.13	0.79	3.9	126	2.37	6.4	6.6	<0.01	1.08	10.9	0.01
Dec	0.80	0.18	0.28	4.2	136	2.36	4.7	7.6	<0.01	1.01	12.1	<0.01
Ann Av.	0.52	0.15	1.17	4.29	126.9	2.78	4.64	7.27	<0.01	1.10	18.56	0.01

Table 24– Heavy Metals monitoring 2009 Glais Primary School

Glais Primary School 2010

2010	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.73	0.20	0.40	3.6	131	2.43	4.7	9.9	<0.01	1.06	14.9	0.01
Feb	0.50	0.19	0.77	3.5	158	2.90	6.5	10.1	<0.001	1.25	11.7	0.014
Mar	0.62	0.31	1.47	4.6	266	6.79	7.1	11.9	<0.001	1.44	44.9	0.013
April	-	-	-	-	-	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-	-	-	-	-
June	-	-	-	-	-	-	-	-	-	-	-	-
July	0.45	0.08	1.75	5.46	111	2.7	7.9	5.1	<0.001	0.74	8.2	0.024
Aug	0.43	0.11	3.07	4.78	110	2.5	10.0	6.0	<0.001	0.61	8.1	0.016
Sept	0.65	0.22	1.40	9.13	160	3.4	7.9	10.9	<0.001	0.61	65.7	<0.01
Oct	0.72	0.18	1.28	5.50	152	3.7	5.9	9.9	<0.001	0.71	15.4	0.013
Nov	-	-	-	-	-	-	-	-	-	-	-	-
Dec	-	-	-	-	-	-	-	-	-	-	-	-
Ann Av.	0.58	0.19	1.45	4.73	155	3.5	7.0	9.1	<0.001	0.93	19.3	0.013

Table 25– Heavy Metals monitoring 2010 Glais Primary School

Significant operational issues were seen at the Glais Primary School site during 2010 due to instrument faults.

Glais Primary School 2011

2011	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.60	0.12	<0.01	4.33	76	1.2	11.4	6.9	<0.001	0.27	9.0	0.009
Feb	0.64	0.30	0.75	4.49	165	4.1	3.7	12.9	0.004	1.10	22.2	0.013
Mar	0.90	0.49	2.04	7.9	292	8.3	5.3	14.1	0.002	1.56	32.8	0.023
April	0.69	0.29	2.15	6.3	276	6.8	10.5	10.0	0.002	1.61	22.8	0.019
May	0.14	0.16	3.62	4.5	186	4.65	3.7	6.5	<0.001	1.48	14.5	<0.01
June	0.07	0.10	2.67	2.2	115	2.57	3.7	4.9	<0.001	0.93	13.1	<0.01
July	0.26	0.29	3.08	3.7	187	4.32	5.1	13.8	0.001	0.92	13.5	0.016
Aug	0.34	0.20	4.55	5.58	128	2.94	8.4	15.4	<0.001	0.74	11.8	0.002
Sept	0.56	0.14	4.45	4.50	121	2.84	6.0	7.3	<0.001	1.07	12.7	<0.001
Oct	0.62	0.24	3.90	7.39	274	9.19	6.1	10.1	<0.001	2.74	25.5	<0.001
Nov	0.71	0.34	2.92	5.61	180	4.37	4.2	10.3	<0.001	1.67	27.7	0.008
Dec	0.43	0.11	1.63	4.16	98	1.31	8.1	7.1	<0.001	0.22	6.0	0.005
Ann Av.	0.50	0.23	2.89	5.05	174.9	4.38	6.34	9.95	0.00	1.19	17.65	0.01

Table 26– Heavy Metals monitoring 2011 Glais Primary School

Glais Primary School 2012

2012	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.51	0.19	0.73	3.99	107.18	2.03	8.20	8.22	0.00	0.51	11.65	0.00
Feb	0.67	0.19	2.08	4.27	132.45	2.61	5.18	8.59	0.00	0.81	15.13	0.00
Mar	0.87	0.42	3.53	8.32	299.70	8.70	10.54	16.3	0.00	1.25	41.67	0.02
April	0.44	0.12	1.02	2.62	132.55	3.05	9.26	4.66	0.00	0.43	10.60	0.00
May	0.41	0.22	1.60	3.14	167.98	4.13	3.27	6.74	0.00	0.84	16.79	0.00
June	0.31	0.12	1.17	2.57	111.66	2.68	1.66	6.40	0.00	1.00	11.07	0.03
July	0.33	0.15	2.51	3.43	67.86	1.38	5.22	8.92	0.00	0.65	7.90	0.01
Aug	0.39	0.29	10.31	3.21	173.37	14.88	2.24	4.84	0.00	0.96	14.46	0.01
Sept	0.49	0.17	3.37	4.93	122.01	2.26	19.79	7.05	0.00	0.71	8.53	0.03
Oct	0.82	0.14	0.23	3.33	100.30	1.77	3.31	8.29	0.01	0.54	10.57	0.03
Nov	0.87	0.31	3.29	6.23	121.09	2.02	2.71	11.6	0.00	0.52	13.52	0.02
Dec	0.49	0.17	2.21	4.24	91.86	1.40	5.05	31.6	0.00	0.66	18.27	0.04
Ann Av.	0.57	0.21	2.30	4.28	138.6	3.47	6.79	10	0.00	0.74	15.42	0.02

Table 27– Heavy Metals monitoring 2012 Glais Primary School

Tables 28-32 detail the monthly means for the **Coed-Gwilym Cemetery site ③** between 2007 and 2012. All results are expressed in ng/m^{-3} .

Coed-Gwilym Cemetery 2007

2007	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	1.08	0.39	4.02	2.9	56	1.41	68.4	4.3	<0.01	1.17	13.1	0.07
Feb	1.02	0.25	3.71	4.3	173	3.49	39.2	11.3	<0.01	1.32	28.6	0.13
Mar	1.20	0.57	2.97	7.1	331	9.23	30.1	17.5	<0.01	2.88	50.4	0.69
April	1.04	0.27	2.58	7.2	251	7.65	9.0	11.1	<0.01	3.09	39.2	0.82
May	6.19	0.22	7.57	2.7	175	4.88	22.9	7.5	<0.01	100*	25.2	0.15
June	0.81	0.22	7.64	3.3	206	5.84	39.9	8.8	<0.01	4.24	18.5	0.08
July	0.19	0.12	3.45	2.7	69	2.19	59.6	3.7	<0.01	0.89	5.4	0.21
Aug	0.24	0.10	2.06	2.1	94	2.76	39.9	3.1	<0.01	1.22	4.5	0.32
Sept	1.06	0.23	7.20	3.9	145	4.36	34.5	27.6	<0.01	0.35	19.1	0.18
Oct	0.90	0.22	9.26	5.8	179	5.68	50.2	10.8	<0.01	1.08	18.9	0.08
Nov	1.33	0.27	4.92	8.1	112	3.06	34.6	13.0	<0.01	0.60	14.7	0.13
Dec	1.04	0.38	7.63	8.2	259	9.13	19.4	17.9	<0.01	2.56	31.0	0.09
Ann Av.	1.34	0.27	5.25	4.88	171	4.97	37.31	11.38	0	1.77	22.39	0.25

Table 28– Heavy Metals monitoring 2007 Coed-Gwilym Cemetery

- The vanadium levels measured during May were mostly extremely high. This is thought to be owing to an instrument fault affecting the first in the series of analytes to be measured, which is vanadium. These values should be treated with caution and should have a very high uncertainty attached to them. If these values appeared as part of the UK Heavy Metals Monitoring Network results they would most likely be excluded during ratification as extreme outliers

**Coed-Gwilym
Cemetery 2008**

2008	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.29	0.14	3.31	4.1	135	2.9	16.66	6.2	0.00	1.14	7.0	0.02
Feb	1.29	0.44	8.32	7.8	244	7.9	31.69	13.1	0.00	1.88	24.7	0.09
Mar	0.27	0.09	1.98	2.5	83	1.7	22.79	5.2	0.00	0.34	6.9	0.03
April	0.60	0.16	3.14	3.3	129	2.9	17.02	6.5	0.00	1.20	11.7	0.05
May	0.58	0.26	3.51	4.4	279	6.1	15.61	10.3	0.00	2.25	25.3	0.03
June	0.26	0.10	2.33	3.4	135	2.9	20.43	5.2	0.00	0.61	13.7	0.08
July	0.23	0.12	1.34	3.4	119	2.5	17.00	6.3	0.00	0.74	9.8	0.07
Aug	0.23	0.06	0.09	2.5	55	1.1	9.28	2.8	0.00	0.47	6.0	0.01
Sept	0.51	0.21	1.69	4.3	161	3.7	14.92	8.3	0.00	1.71	15.7	0.01
Oct	0.30	0.12	2.70	2.7	112	2.2	15.13	5.6	0.00	0.89	7.6	0.01
Nov	0.46	0.14	2.70	5.8	96	1.9	30.56	7.2	0.00	0.21	10.9	0.01
Dec	0.90	0.15	2.85	10.0	145	2.5	24.26	19.4	0.00	0.57	20.1	0.01
Ann Av.	0.49	0.17	2.83	4.5	141	3.2	19.61	8.0	0.00	1.00	13.3	0.04

Table 29– Heavy Metals monitoring 2008 Coed-Gwilym Cemetery

**Coed-Gwilym
Cemetery 2009**

2009	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.74	0.33	4.20	4.5	133	3.4	25.7	11.8	<0.001	0.86	15.3	0.009
Feb	0.69	0.18	6.23	5.0	139	2.6	30.1	11.3	<0.001	0.87	19.3	0.009
Mar	0.58	0.17	3.89	4.5	158	3.3	23.0	9.5	<0.001	1.34	14.0	0.006
April	0.50	0.17	2.19	3.3	186	4.2	9.60	11.5	<0.001	1.87	15.4	0.005
May	0.38	0.13	0.06	3.8	124	3.1	3.86	6.6	<0.001	1.00	11.2	0.007
June	0.57	0.19	1.52	4.4	157	4.3	9.10	8.5	<0.001	1.78	13.7	0.010
July	0.27	0.08	7.14	2.4	52	1.4	9.68	3.2	<0.001	1.49	14.9	0.004
Aug	0.32	0.09	2.98	3.1	88	2.0	4.93	5.2	<0.001	1.04	9.2	0.011
Sept	0.69	0.16	4.66	3.9	126	3.0	19.4	5.5	<0.001	0.59	6.9	0.014
Oct	0.50	0.14	4.86	4.5	190	3.7	16.3	10.4	<0.001	0.97	12.4	0.033
Nov	0.38	0.14	1.48	3.5	121	2.4	19.1	7.9	<0.001	0.65	9.4	0.020
Dec	1.76	0.68	3.91	9.2	250	4.6	21.4	30.9	<0.001	0.69	24.2	0.137
Ann Av.	0.61	0.20	3.59	4.3	144	3.2	16.0	10.2	<0.001	1.10	13.8	0.022

Table 30– Heavy Metals monitoring 2009 Coed-Gwilym Cemetery

**Coed-Gwilym
Cemetery 2010**

2010	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.87	0.24	1.71	3.5	125	2.62	10	9.5	<0.0001	0.87	13.9	0.027
Feb	0.52	0.19	3.37	3.0	134	2.61	10.8	9.9	<0.0001	0.80	10.9	0.021
Mar	0.58	0.26	2.97	3.4	248	5.62	8.43	10.3	<0.0001	1.28	26.8	0.010
April	0.84	0.32	6.62	4.4	444	11.3	8.51	11.8	<0.0001	1.43	24.9	0.055
May	0.44	0.21	1.97	3.0	177	4.38	7.22	8	<0.0001	0.80	12.7	0.012
June	0.38	0.18	2.67	3.1	171	4.01	10.1	6.1	<0.001	1.30	10.8	0.004
July	0.45	0.13	2.66	5.1	92	2.23	10.3	6.5	<0.0001	0.72	8.1	0.013
Aug	0.41	0.09	5.08	3.1	78	2.15	18.2	3.7	<0.0001	0.48	5.2	0.017
Sept	0.46	0.11	2.45	3.9	117	2.55	12.5	5.3	<0.0001	0.67	10.4	0.018
Oct	0.92	0.14	3.01	4.9	156	3.93	9.18	8.5	<0.0001	0.58	14.3	0.012
Nov	1.41	0.20	2.95	5.5	137	2.55	9.02	9.6	<0.0001	0.49	13.6	0.011
Dec	1.78	0.26	3.51	4.7	160	3.4	11.02	12.1	<0.0001	0.94	16.5	0.014
Ann Av.	0.76	0.19	3.25	3.98	168	3.91	10.48	8.4	<0.0001	0.85	13.8	0.018

Table 31– Heavy Metals monitoring 2010 Coed-Gwilym Cemetery

From August 2011, NPL changed the reporting format from a monthly overall result and weekly result to only a weekly result at the UK Network sites of which Coed-Gwilym cemetery forms a part. The annual mean presented for 2011 is that as reported by NPL within the annual report dated June 2012²⁹ with Excel being used for presentation purposes only of the monthly means between August and December 2011.

**Coed-Gwilym
Cemetery 2011**

2011	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.77	0.17	1.90	5.15	107	1.97	20.04	10.18	0.00	0.45	10.50	0.02
Feb	0.63	0.18	2.11	4.74	113	2.54	10.65	11.26	0.00	0.90	13.56	0.02
Mar	0.71	0.25	4.62	5.75	221	6.43	8.22	10.99	0.00	1.01	26.58	0.02
April	0.92	0.25	3.45	6.26	237	6.31	10.33	11.31	0.00	1.39	19.80	0.02
May	0.27	0.10	3.08	3.23	158	4.34	9.90	4.28	0.00	1.10	9.66	0.03
June	0.13	0.10	2.99	2.03	115	2.66	6.62	4.66	0.00	0.76	13.39	0.02
July	0.32	0.12	3.12	2.93	159	3.72	5.49	6.93	0.00	1.01	11.16	0.01
Aug	0.26	0.10	4.06	3.18	101	2.67	15.91	5.18	0.00	0.83	5.96	0.01
Sept	0.31	0.10	3.05	3.09	96	2.29	13.79	5.53	0.00	0.96	7.56	0.00
Oct	0.47	0.19	4.43	4.72	281	5.62	12.49	9.09	0.00	1.79	18.68	0.00
Nov	0.68	0.26	3.32	4.82	158	3.76	6.76	8.17	0.00	1.52	21.06	0.01
Dec	0.27	0.04	1.71	3.48	79	1.19	15.70	3.73	0.00	0.07	6.10	0.00
Ann Av.	0.50	0.17	3.23	4.16	157	3.78	10.91	7.88	0.00	1.04	14.3	0.01

Table 32– Heavy Metals monitoring 2011 Coed-Gwilym Cemetery

- December 2011 result based on 1 weekly filter

²⁹ http://uk-air.defra.gov.uk/reports/cat13/1206131002_Defra_UK_Heavy_Metals_Network_Annual_Report_2011_FINAL.pdf

**Coed-Gwilym
Cemetery 2012**

2012	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	-	-	-	-	-	-	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-	-	-	-	-
Mar	0.73	0.40	5.14	6.03	282.0	8.62	11.46	14.68	0.00	1.16	32.85	0.03
April	0.26	0.10	6.33	1.80	101.6	2.42	9.53	3.68	0.00	0.36	8.44	0.02
May	0.34	0.21	2.24	5.20	165.0	4.03	7.83	5.43	0.00	0.78	16.36	0.01
June	0.21	0.07	5.02	2.07	87.03	1.99	3.92	3.34	0.00	0.74	8.03	0.01
July	0.26	0.09	3.54	2.81	94.91	1.79	8.86	4.95	0.00	0.94	7.70	0.02
Aug	0.21	0.18	1.56	2.83	127.2	2.13	5.41	5.10	0.00	0.77	10.60	0.02
Sept	0.31	0.07	4.19	3.10	98.96	1.73	9.18	3.30	0.00	0.60	5.81	0.03
Oct	0.64	0.21	2.05	3.74	113.2	2.29	3.94	6.98	0.00	0.57	13.17	0.03
Nov	0.91	0.40	2.28	8.88	126.5	2.22	6.90	10.63	0.00	0.49	14.58	0.06
Dec	0.59	0.13	3.31	3.64	100.4	1.37	15.89	5.69	0.00	0.51	7.60	0.07
Ann Av.	0.44	0.18	3.58	3.88	129	2.83	8.51	6.20	0.001	0.69	12.20	0.03

Table 33– Heavy Metals monitoring 2012 Coed-Gwilym Cemetery

Tables 34-38 detail the monthly means for the **Morrleston Groundhog** site during 2007 -2012. All results are expressed in ng/m^{-3}

**Morrleston
Groundhog 2007**

2007	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg(p)
Jan	1.11	0.41	4.31	21.6	399	5.02	14.1	20.7	<0.01	1.08	23.7	0.06
Feb	1.65	0.45	4.49	32.9	848	16.38	22.2	31.2	<0.01	1.83	77.7	0.14
Mar	0.92	0.37	3.74	20.8	524	8.35	18.1	16.2	<0.01	2.15	32.7	1.09
April	2.91	0.71	9.24	37.4	1073	24.25	32.4	43.0	<0.01	18.45	85.7	1.90
May	6.69	0.06	8.01	0.6	34	1.18	0.3	1.4	<0.01	162*	9.3	0.07
June	0.84	0.29	5.10	18.1	539	10.91	18.1	18.3	<0.01	3.08	43.0	0.14
July	0.55	0.65	0.11	18.2	322	5.38	24.6	12.2	<0.01	1.19	16.5	0.23
Aug	1.04	0.57	2.21	19.1	374	6.09	21.0	11.5	<0.01	0.97	19.2	0.18
Sept	0.87	0.26	0.55	28.7	518	9.05	15.5	34.6	<0.01	1.11	29.4	0.16
Oct	0.97	0.38	1.79	34.7	617	11.56	22.9	26.7	<0.01	2.44	34.6	0.02
Nov	1.18	0.28	3.79	32.8	583	8.47	22.6	15.9	<0.01	1.12	27.9	0.03
Dec	1.29	0.39	2.65	43.4	518	8.65	8.2	36.6	<0.01	2.73	43.5	0.02
Ann Av.	1.67	0.40	3.83	25.68	529	9.61	18.3	22.37	0	3.29	36.93	0.34

Table 34 – Heavy Metals monitoring 2007 Morrleston Groundhog

* The vanadium levels measured during May were mostly extremely high. This is thought to be owing to an instrument fault affecting the first in the series of analytes to be measured, which is vanadium. These values should be treated with caution and should have a very high uncertainty attached to them. If these values appeared as part of the UK Heavy Metals Monitoring Network results they would most likely be excluded during ratification as extreme outliers.

**Morriston
Groundhog 2008**

2008	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg(p)
Jan	0.41	0.19	0.22	16.7	385	5.6	3.16	7.5	0.01	1.59	56.7	0.01
Feb	1.29	0.71	4.43	43.3	970	19.2	14.20	30.7	0.00	3.22	66.6	0.02
Mar	0.30	0.54	2.92	54.3	1223	14.5	5.57	44.9	0.00	0.93	83.1	0.04
April	0.44	0.27	1.69	32.5	399	6.0	6.81	26.3	0.01	1.25	24.4	0.05
May	0.70	0.38	1.87	54.9	471	9.7	7.49	32.5	0.01	1.93	41.9	0.05
June	0.24	0.13	1.13	19.1	331	5.0	4.81	15.3	0.00	0.65	17.5	0.11
July	0.31	0.12	0.89	12.1	348	5.7	4.24	8.1	0.00	0.72	17.2	0.05
Aug	0.18	0.09	0.82	15.5	285	3.6	2.20	6.9	0.00	0.64	12.1	0.01
Sept	0.18	0.24	2.40	18.7	463	7.0	3.40	15.3	0.00	1.88	32.8	0.01
Oct	0.38	0.25	2.20	30.8	556	8.5	13.89	16.6	0.00	1.82	26.9	0.01
Nov	0.69	0.45	3.12	34.1	568	6.7	7.36	20.4	0.00	0.35	26.3	0.01
Dec	0.94	0.22	3.08	39.9	686	8.6	18.11	21.2	0.01	0.62	32.0	0.01
Ann Av.	0.51	0.30	2.06	31.0	557	8.3	7.60	20.5	0.00	1.30	36.5	0.03

Table 35– Heavy Metals monitoring 2008 Morriston Groundhog

**Morriston
Groundhog 2009**

2009	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg(p)	Hg (v)
Jan	0.98	0.36	4.63	27.1	589	8.2	13.7	21.7	0.001	1.37	38.5	0.008	1.8
Feb	0.82	0.42	2.98	26.7	500	7.2	29.7	32.9	0.001	1.35	38.3	0.012	1.6
Mar	0.57	0.17	1.92	19.6	483	7.2	17.0	11.5	0.001	1.38	24.1	0.003	1.9
April	0.76	0.37	0.50	17.5	497	9.6	13.5	21.4	0.002	2.36	31.5	0.018	1.8
May	0.46	0.13	0.95	16.0	341	5.2	2.25	9.4	0.001	1.17	15.9	0.007	1.6
June	0.72	0.26	1.31	23.8	501	9.1	4.88	16.5	0.001	1.99	27.5	0.009	1.6
July	0.44	0.16	8.53	15.5	312	4.6	10.2	6.8	0.001	2.03	19.5	0.01	1.2
Aug	1.45	0.34	4.28	26.3	323	4.8	1.03	12.9	0.001	0.95	20.7	0.009	1.1
Sept	0.94	0.41	4.66	51.9	602	7.6	2.30	18.1	0.001	0.73	29.1	0.007	1.6
Oct	0.77	0.42	2.46	44.2	707	11.1	8.62	30.0	0.004	0.91	37.4	0.040	3.0
Nov	0.57	0.23	1.54	18.2	488	6.7	0.97	13.4	0.003	0.76	22.1	0.092	1.7
Dec	1.93	0.28	1.94	34.4	758	9.0	7.93	13.9	0.004	0.56	27.0	0.032	1.3
Ann Av.	0.87	0.30	2.98	26.8	508	7.5	9.34	17.4	0.001	1.30	27.6	0.020	1.7

Table 36– Heavy Metals monitoring 2009 Morriston Groundhog

Morrison Groundhog 2010
--

2010	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg (p)	Hg (v)
Jan	0.87	0.25	0.53	21.4	559	7.68	40.0	15.0	0.004	0.83	28.3	0.013	1.17
Feb	0.71	0.31	2.42	31.3	735	11.0	9.42	20.2	0.001	1.06	47.2	0.009	1.28
Mar	0.74	0.41	2.34	21.9	672	12.6	7.71	18.3	0.001	1.59	62.7	0.008	1.48
April	1.10	0.43	3.65	30.1	793	16.5	11.1	18.2	<0.001	1.73	52.6	0.020	1.00
May	0.65	0.31	3.17	23.0	508	7.82	9.45	12.3	0.001	0.97	38.8	0.006	1.53
June	0.47	0.28	1.81	31.0	427	7.19	10.3	15.9	0.003	1.46	29.2	0.006	1.41
July	0.70	0.21	3.00	29.0	334	5.18	6.48	15.3	0.001	0.86	17.0	0.024	1.97
Aug	0.48	0.12	3.86	32.3	371	4.70	10.4	11.4	0.002	0.67	12.5	0.015	1.84
Sept	0.78	0.18	2.77	39.4	540	8.49	14.0	13.6	0.001	1.00	26.1	0.010	1.64
Oct	0.91	0.23	2.12	58.0	540	8.36	18.0	25.7	<0.001	0.66	31.8	0.012	1.24
Nov	1.56	0.34	5.73	52.2	647	7.49	16.5	24.7	<0.001	0.65	28.9	0.008	1.90
Dec	1.50	0.46	3.05	76.4	825	9.8	28.15	24.9	0.001	0.88	46.1	0.011	1.44
Ann Av.	0.88	0.30	2.85	37.3	582	8.95	15.28	18.1	0.001	1.03	35.5	0.012	1.49

Table 37 – Heavy Metals monitoring 2010 Morrison Groundhog

Morrison Groundhog 2011
--

2011	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg (p)	Hg (v)
Jan	1.02	0.25	3.78	50.15	626	8.03	28.80	19.05	0.00	0.71	39.96	0.02	-
Feb	0.74	0.28	3.35	31.23	457	7.12	4.56	24.08	0.00	1.46	32.26	0.04	-
Mar	1.11	0.49	4.82	67.77	688	11.77	10.92	33.04	0.00	1.47	48.89	0.05	-
April	1.16	0.35	4.93	48.59	605	11.30	15.02	18.81	0.00	1.70	45.95	0.02	-
May	0.46	0.23	6.74	27.74	621	10.04	2.58	9.59	0.00	1.72	31.33	0.05	-
June	0.29	0.28	4.81	26.03	417	6.65	6.23	12.32	0.00	0.93	35.37	0.03	-
July	0.39	0.23	4.50	25.20	561	8.62	4.31	18.03	0.00	1.23	25.67	0.01	-
Aug	0.31	0.14	4.23	30.19	433	5.90	10.55	15.80	0.00	1.17	16.21	0.00	-
Sept	0.63	0.21	4.82	28.81	490	7.78	7.09	13.53	0.00	1.35	23.74	0.00	-
Oct	0.44	0.20	5.39	21.02	579	8.37	5.16	19.90	0.00	1.24	20.78	0.00	-
Nov	1.03	0.51	3.99	27.97	698	12.11	7.06	19.48	0.00	2.07	50.44	0.03	-
Dec	0.41	0.08	2.54	27.10	517	4.82	7.68	12.33	0.00	0.47	14.78	0.00	-
Ann Av.	0.78	0.33	5.29	39.61	657	10.18	9.75	21.40	0.00	1.57	38.01	0.03	-

Table 38 – Heavy Metals monitoring 2011 Morrison Groundhog

**Morrison
Groundhog
2012**

2012	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.67	0.24	2.77	22.29	504.4	6.30	7.33	14.0	0.00	0.76	29.89	0.01
Feb	0.70	0.22	5.91	26.62	479.7	5.73	5.33	11.4	0.00	0.84	23.50	0.01
Mar	1.36	0.65	6.03	27.42	852.2	16.51	11.39	27.4	0.00	1.77	64.71	0.03
April	0.30	0.14	4.59	18.29	441.1	6.32	7.25	10.1	0.00	0.60	18.54	0.01
May	0.42	0.29	3.89	15.80	439.3	7.40	3.42	10.8	0.00	1.05	24.31	0.00
June	0.38	0.14	2.37	8.83	285.0	4.29	2.49	6.59	0.00	1.05	18.52	0.00
July	0.36	0.11	1.68	16.66	349.1	4.39	3.94	5.75	0.00	1.04	13.57	0.02
Aug	0.49	0.20	2.26	11.52	347.9	4.84	3.41	6.49	0.00	1.04	17.38	0.02
Sept	0.47	0.11	1.82	20.56	481.1	5.55	7.19	8.36	0.00	0.81	14.30	0.01
Oct	0.64	0.22	3.52	22.04	537.2	6.44	3.66	10.0	0.00	0.75	20.84	0.01
Nov	1.05	0.41	7.65	37.58	655.6	7.19	6.14	17.8	0.00	0.74	31.97	0.02
Dec	0.65	1.57	1.80	29.27	640.4	6.41	6.21	11.9	0.00	0.55	21.43	0.03
Ann Av.	0.61	0.37	3.55	21.37	501.4	6.76	5.64	11.6	0.002	0.92	24.51	0.01

Table 39 – Heavy Metals monitoring 2012 Morrison Groundhog

As mentioned above within section 2.1.10 above, monitoring at the site **YGG Gellionnen** (Welsh Primary School) commenced during November 2007. There is little valid data that can be presented for 2007 so, for the sake of clarity, no data is reported here for 2007. Details of the monitoring undertaken during 2008 -2012 can be found below within tables 40 - 44.

**YGG Gellionnen
2008**

2008	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.38	0.16	1.87	4.7	202	3.59	10.4	6.2	<0.01	0.52	10.1	0.26
Feb	0.01	0.14	1.49	7.3	157	2.83	9.4	5.5	<0.01	0.39	16.8	0.06
Mar	0.06	0.08	0.61	2.8	84	1.52	6.3	4.8	<0.01	0.31	7.1	0.04
April	0.35	0.73	0.72	3.7	122	2.81	6.3	10.7	<0.01	1.13	17.4	0.07
May	0.70	0.27	1.59	5.6	350	7.37	16.8	14.3	0.01	1.97	38.0	0.05
June	0.24	0.20	1.03	3.0	133	3.01	12.3	10.5	<0.01	0.74	12.5	0.09
July	0.38	0.12	0.30	4.2	145	2.94	10.0	7.7	<0.01	0.76	11.3	0.05
Aug	0.16	0.11	1.86	2.9	77	1.36	7.7	4.3	<0.01	0.27	8.2	<0.02
Sept	0.42	0.29	0.10	4.1	188	4.23	7.1	9.7	<0.01	1.29	15.3	<0.01
Oct	0.45	0.20	0.14	5.2	144	2.90	20.8	8.8	<0.01	1.10	12.5	<0.01
Nov	0.32	0.11	0.34	4.2	76	1.54	13.9	5.3	<0.01	0.27	11.2	<0.01
Dec	0.64	0.16	0.59	4.2	129	2.08	10.9	20.8	<0.01	0.62	18.0	<0.01
Ann Av.	0.34	0.21	0.89	4.33	150.6	3.01	10.99	9.04	0.01	0.78	14.86	0.09

Table 40 – Heavy Metals monitoring 2008 YGG Gellionnen

**YGG
Gellionnen
2009**

2009	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.99	0.28	1.70	5.5	136	3.11	22.9	13.9	<0.01	1.22	20.1	<0.01
Feb	0.60	0.18	1.96	3.8	144	2.46	39.7	13.1	<0.01	1.05	18.0	<0.01
Mar	0.68	0.20	1.38	4.9	157	3.89	12.7	9.9	<0.01	1.68	19.7	0.02
April	0.73	0.20	0.01	5.1	191	5.05	20.0	14.1	<0.01	2.02	18.5	0.01
May	0.36	0.10	0.47	3.3	80	2.22	6.81	5.6	<0.01	1.14	7.9	<0.01
June	0.52	0.21	0.28	4.1	159	4.44	7.0	9.8	<0.01	1.60	12.8	0.01
July	0.32	0.10	5.29	2.3	48	1.26	10.2	4.6	<0.01	1.50	10.3	<0.01
Aug	0.31	0.10	0.91	4.2	105	2.35	12.2	5.0	<0.01	0.88	8.5	0.01
Sept	0.70	0.13	4.15	4.0	127	3.43	3.7	6.0	0.01	0.87	12.3	<0.01
Oct	0.60	0.14	0.67	4.2	174	3.55	11.7	23.5	<0.01	0.63	15.4	0.02
Nov	0.44	0.11	0.04	3.3	111	2.07	22.7	6.4	<0.01	0.50	9.8	0.02
Dec	0.80	0.15	<0.01	2.5	107	2.07	61.0	8.9	<0.01	0.24	10.0	0.01
Ann Av.	0.59	0.16	1.53	3.93	128.4	2.99	19.22	10.06	0.01	1.11	13.60	0.01

Table 41– Heavy Metals monitoring 2009 YGG Gellionnen

**YGG Gellionnen
2010**

2010	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.57	0.16	<0.01	2.1	116	2.25	34.5	10.4	<0.01	0.98	14.6	0.01
Feb	0.46	0.15	0.01	2.2	155	2.78	7.2	9.5	<0.001	0.61	15.5	0.003
Mar	0.56	0.29	0.04	3.4	202	5.26	20.3	9.3	0.011	1.24	25.0	0.011
April	0.98	0.63	<0.01	4.1	391	10.4	19.7	16.1	0.004	1.06	28.6	0.003
May	0.42	0.15	1.10	3.4	203	4.8	8.7	8.8	0.005	0.84	14.2	0.009
June	0.33	0.14	3.03	4.1	187	4.5	10.0	6.6	<0.001	1.48	12.4	<0.001
July	0.25	0.10	1.69	4.0	79	1.6	12.0	10.5	<0.001	0.48	8.5	<0.001
Aug	0.31	0.09	0.59	4.7	88	2.1	6.2	4.7	<0.001	0.41	6.3	0.001
Sept	0.41	0.11	1.54	3.8	129	3.0	11.1	5.0	<0.001	0.73	10.5	0.003
Oct	0.51	0.09	1.29	5.7	119	2.6	20.1	5.1	<0.001	0.57	9.5	0.011
Nov	0.65	0.18	0.56	4.2	117	2.9	6.8	9.0	<0.001	0.85	15.1	0.002
Dec	1.20	0.22	0.28	9.7	162	2.8	28.2	11.9	<0.001	0.57	16.0	0.016
Ann Av.	0.60	0.18	0.91	4.2	159	3.6	15.0	8.4	0.003	0.80	14.2	0.008

Table 42– Heavy Metals monitoring 2010 YGG Gellionnen

**YGG Gellionnen
2011**

2011	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	0.56	0.17	<0.01	4.5	77	1.2	13.2	7.4	<0.001	0.47	6.8	0.009
Feb	0.60	0.25	0.70	7.5	156	3.9	9.5	12.5	0.003	0.99	21.7	0.016
Mar	0.89	0.27	1.18	7.4	266	7.0	7.2	16.7	0.004	1.40	28.2	0.023
April	0.66	0.22	2.67	6.3	272	7.1	19.8	9.2	0.002	1.64	22.3	0.038
May	0.14	0.09	3.62	3.8	159	4.23	11.3	5.1	0.001	1.32	10.0	0.03
June	0.08	0.08	2.21	2.4	127	3.21	4.9	4.7	<0.001	0.89	10.9	<0.01
July	0.17	0.29	2.69	2.8	161	4.13	4.1	7.7	<0.001	0.63	12.9	0.004
Aug	0.31	0.09	4.18	2.5	121	2.88	8.0	4.4	<0.001	0.66	8.1	0.001
Sept	0.30	0.10	4.30	3.1	118	2.73	7.1	3.9	<0.001	0.97	9.4	<0.001
Oct	0.47	0.21	2.39	4.1	208	5.21	15.7	8.5	<0.001	2.14	19.3	0.002
Nov	0.71	0.27	1.86	4.1	123	3.35	9.2	12.1	<0.001	2.33	18.3	0.004
Dec	-	-	-	-	-	-	-	-	-	-	-	-
Ann Av.	0.44	0.19	2.58	4.4	162	4.08	10.0	8.38	0.00	1.22	15.27	0.01

Table 43– Heavy Metals monitoring 2011 YGG Gellionnen

**YGG Gellionnen
2012**

2012	As	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Pt	V	Zn	Hg
Jan	-	-	-	-	-	-	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-	-	-	-	-
Mar	0.70	0.31	1.58	5.03	277.9	7.77	11.37	13.1	0.00	1.31	28.87	0.01
April	0.22	0.10	1.13	1.40	60.06	1.53	4.31	3.11	0.00	0.28	7.56	0.01
May	0.29	0.18	0.41	2.51	170.7	4.20	8.42	5.29	0.00	0.85	15.19	0.00
June	0.33	0.08	0.62	2.31	92.45	2.15	4.24	4.40	0.00	0.83	10.73	0.00
July	0.16	0.08	0.28	2.55	91.47	1.70	6.24	4.21	0.00	0.85	9.65	0.02
Aug	0.20	0.20	0.11	3.25	126.7	2.70	8.23	8.31	0.00	0.85	12.08	0.01
Sept	0.16	0.06	2.30	2.82	94.28	1.56	4.08	5.11	0.00	0.63	6.08	0.01
Oct	0.34	0.13	2.20	2.32	90.60	1.73	3.08	4.95	0.00	0.50	10.01	0.01
Nov	0.52	0.30	1.19	4.42	95.86	1.45	6.45	6.82	0.00	0.62	10.72	0.02
Dec	0.44	0.13	3.04	2.30	83.75	1.22	3.17	4.16	0.00	0.62	7.90	0.01
Ann Av.	0.34	0.16	1.26	2.93	119.7	2.63	6.04	6.0	0.00	0.74	12.06	0.01

Table 44– Heavy Metals monitoring 2012 YGG Gellionnen

Table 45 presents the nickel annual means from all four monitoring sites for the years 2002-2012 where appropriate. All results are expressed in ng/m⁻³

Year	Glais Primary School ②	Coed-Gwilym Cemetery ③	YGG Gellionnen ④	Morrison Groundhog ⑤
2002	28.91	-	-	-
2003	18.14	-	-	-
2004	33.83	-	-	-
2005	19.62	-	-	-
2006	26.13	-	-	-
2007	28.04	37.31	-	18.3
2008	10.34	19.61	10.99	7.6
2009	4.64	16.0	19.22	9.34
2010	7.0	10.48	15.0	15.28
2011	6.34	10.91	10.0	9.75
2012	6.79	8.51	6.04	5.64

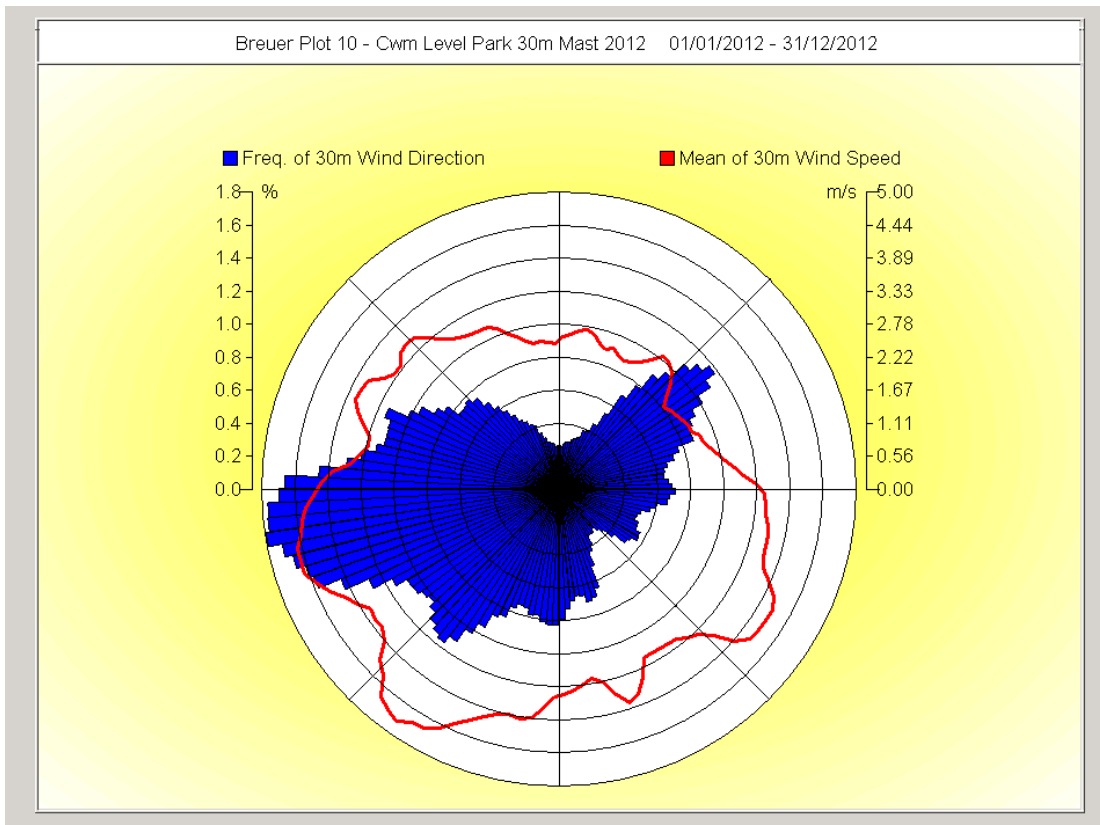
Table 45 – Swansea Nickel Annual Means 2002 – 2012

Improvements continue to be made at the Vale complex with the Main Stack Bag-house Filter continuing to efficiently abate particulate emissions, with no reported deterioration in performance. Another three emission points have been identified which would benefit from the installation of high-efficiency particulate air filters (HEPA) - these may be installed in Q3/Q4 2013. The HEPA filters that were installed in 2012 are all working as intended with no deterioration in performance. In Q1& Q2 2013 extensive work will be undertaken to the feed system to replace the ageing cladding covering the conveyors. Whilst primarily a safety risk, this was identified as a potential source of fugitive particulate emission, should the cladding have become damaged during high winds.

Whilst it is evident that nickel compliance has been achieved at all monitoring sites (both UK Network sites and the City & County of Swansea funded sites) since 2008, the 2008 result at Coed-Gwilym Cemetery and the 2009 result at the YGG Gellionnen sites (98% and 96% of the target value respectively) would still indicate a significant source. The debate on what impacts the newly identified source further up the Swansea Valley in Pontardawe has on the monitoring stations within Swansea is still ongoing but the effect of the improved abatement at the high discharge point within the Vale site can be seen from the data, albeit slightly tempered by the knowledge of a downturn in production due to the economic conditions that have been witnessed globally. The latest monitoring data from 2012 would indicate that the highest annual

mean from the four sites within the City & County of Swansea, sits at 42.5% of the target value with a continued downward trend in concentrations continuing to be evident. The situation is different within Pontardawe with one site being at 149.6% of the target value during 2012.

Breuer Plot 10 below shows the meteorological conditions recorded during 2012 at Cwm Level Park in the lower Swansea Valley.



Breuer Plot 10 – Cwm Level Park 30m Mast 2012

Conditions seen here broadly represent the wider area and indicate a prevalence of predominantly south-westerly/westerly winds. As in previous years, there is also an indication of north-easterly winds (primarily during the winter months) which would blow down the alignment of the Swansea valley, taking any concentrations from the release point(s) at Clydach and Pontardawe down to the Morriston site.

From the data available within tables 22-45 it is clear that nickel compliance has been achieved at all monitoring sites (both UK Network sites and the City & County of Swansea funded sites) since 2008

From the data available within tables 22-45, it is clear that annual mean concentrations for arsenic and cadmium at all monitoring locations fall well below the 4th Daughter Directive Target Values.

Additionally, from the data available within tables 22-45, it is clear that annual mean concentrations for lead at all monitoring locations fall well below the 0.25ug/m³ required under the Air Quality (Amendment) (Wales) Regulations 2002 to be achieved by the 31st December 2008.

PAH data analysis/ratification from the monitoring site within the compound of the 30m meteorological mast at Cwm Level Park, Landore is complete for 2012 with data thus available up to the end of December 2012. Results of all compounds measured from 2007 to December 2012 can be found by following link at:

http://uk-air.defra.gov.uk/data/non-auto-data?site_id=SWALP&network=paha&s=View+Site#site_id=SWALP&view=data - select the year i.e. 2012 and the pollutant of interest from the drop down list – each pollutant is displayed individually. Please note that PAH Digitel (solid phase) should be selected in the PAH Network dropdown box. The ability to download the monthly data exists via the “Download this data as CSV” link at the bottom right of the data table on display.

2.4 Summary of Compliance with AQS Objectives

The City & County of Swansea has measured concentrations of nitrogen dioxide during 2012 above the annual mean objective at relevant locations outside of the existing **Swansea Air Quality Management Area 2010**.

3. New Local Developments

3.1 Road Traffic Sources

Whilst the report guidance/template indicates that details should only be provided of new road traffic sources identified since the last Updating and Screening Assessment, it is thought worthwhile to repeat and update these details from those contained within the City & County of Swansea's USA 2012. This view is substantiated by the knowledge that over the past year, numerous enquiries have been received from developers and other professionals requesting sight of the latest Progress Report from the authority as they view the Progress Report as a useful information source that provides the latest up to date overview of air quality matters without having to additionally refer to the latest USA. Given this view, the details presented have been updated from those submitted within the USA 2012. This rational is also followed elsewhere within this Progress Report.

3.1.1 ***Narrow Congested Streets with Residential Properties Close to the Kerb***

In order to consider which streets fell within the definition of narrow congested streets with a traffic flow of 5000 vehicles per day,³⁰ the emissions database (EDB) which has been under development over the last several years was first examined. All road links within the EDB (circa 15,000) were exported into an Excel worksheet and index by the Annual Average Daily Traffic flow (AADT). Details held were examined where the AADT for individual road links was above 4,500 vehicles. This approach was taken as numerous counts from temporary or short duration surveys were held i.e. 1 week duration, where, underestimates of the flow could feasibly be possible due to the time of the year the survey was undertaken i.e. during the school holidays. Once individual road links were identified they were then cross referenced with those roads within the then Hafod Air Quality Management Area and discounted³¹ from further consideration.

Numerous road links were identified with flows in excess of an AADT of 4,500 but, these roads were discounted as they did not fit the fit the definition of a narrow congested

³⁰ LAQM.TG(09) USA Checklist Box 5.3 – A1 Narrow congested streets with residential properties close to the kerb

³¹ LAQM.TG(09) USA Checklist Box 5.3 – (A) Overview

street with residential properties within 2m of the carriageway on at least one side of the road.

Following this exercise, the streets listed below within table 46 were identified. These roads were not previously thought likely to present problems with the nitrogen dioxide annual mean objective but have been brought back into the scope of assessment due to the AADT requirement. The identified roads suffer congestion as defined within LAQM³² to one extent or another mainly due to parked vehicles and restricted movements.

Road Name	Area
Hebron Road	Clydach
High Street	Clydach
Lone Road	Clydach
Vardre Road	Clydach
Chemical Road	Morrison / Cwmrhydyceirw
Cwmrhydyceirw Road	Cwmrhydyceirw
Alexandra Road	Gorseinon
Belgrave Road	Gorseinon
Courtney Street	Manselton
Clyndu Street	Morrison
Morfydd Street	Morrison
Parry Road	Morrison
Newton Road	Mumbles
Highpool Lane	Newton
Parkmill Road	Parkmill
Beach Road	Penclawdd
Blodwen Terrace	Penclawdd
Sea View	Penclawdd
Station Road	Penclawdd
Bolgoed Road	Pontardulais
St Teilo Crescent	Pontardulais
Water Street	Pontardulais
Carnglas Road	Tycoch

Table 46 – Identified narrow Streets with AADT > 5000

The authorities' monthly exposure of passive nitrogen dioxide diffusion tubes was increased from 134 sites to 274 sites during November 2009 to assess locations within the above table. This work has now been undertaken and the results of monitoring are presented within tables 3 and 7 of section 2.3 above. Monitoring has found that annual mean concentrations are below the objective level at the majority but not at all of the identified locations for the two complete years of monitoring undertaken. Therefore due to financial restrictions, further monitoring ceased at those sites during May 2011 that

³² LAQM.TG(09) USA Checklist Box 5.3 – A1 Narrow congested streets approach page 5-10

had exhibited bias corrected annual means concentrations consistently below 30ug/m³. For completeness, these sites are annotated within table 3 and highlighted within the results table 7 above.

However, there are some notable exceptions, mainly Newton Road in Mumbles. The situation at Newton road is outlined within section 2.3 where further monitoring has been undertaken during 2011 and 2012. This monitoring has continued into 2012 and is likely to continue into the foreseeable future. The results of this further monitoring have confirmed the exceedence of the annual mean nitrogen dioxide objective first observed during 2010. **The authority's intentions with regard to Newton Road are outlined within section 10 – Conclusions and Proposed Actions.**

Monitoring will continue within the Pontardulais area despite several sites exhibiting annual bias corrected annual means below 30ug/m³ as a commitment was made to assess the impact of a major food retail outlet.

Monitoring has also commenced during 2012 at further sites within the Gorseinon area. A request was received from the Traffic Management Group Leader to assess the impact of a traffic calming scheme designed to reduce and remove queuing traffic along High Street, Gorseinon and direct traffic down adjacent narrow residential streets. This work started during July 2012 and remains ongoing. Data is presented within table 7 above (sites 297-323) and is for information only at present. Traffic calming works have not commenced as of March 2013 but are due to commence during the remainder of 2013.

3.1.2 *Busy Streets Where People May Spend 1-hour or More Close to Traffic*

Assessments within the city centre have already commenced following the introduction of the Metro scheme and associated changes to the city centre road network and policy initiatives to attract people to live within the city centre. The monitoring details are included within section 2.3 above and the results contained within table 7. The sites within the city centre are sites 112 - 134.

From the passive NO₂ tube survey work undertaken within the city centre during 2010/2011, several locations were showing the potential to exceed the 1-hour mean objective. In particular, sites 126 and 127 along The Kingsway, Swansea indicated during 2010 annual mean concentrations exceeding 60ug/m³ and therefore exceedences of the 1-hour NO₂ objected were thought likely.³³ These locations are either close to, or adjacent to, café environments situated on the pavement area alongside the busy roadway. However, during both 2011 and 2012, whilst concentrations remain above the annual mean objective at these sites, there has been no indication that exceedence of the 1-hour objective was likely to have been observed. In terms of LAQM it could therefore now be argued, that relevant exposure no longer exists at these locations along the Kingsway. This view is tempered by the knowledge that relevant exposure does exist at locations along the Kingsway in the form of a development comprising of student flats opposite the café environment and another block of flats approximately 50 meters on the same side of the dual carriageway that are yet to be occupied. It has proved impossible to directly monitor at the student flats location as the development has taken place above an existing retail food outlet and directly outside a series of bus stops that presents no suitable monitoring points.

Concerns also exist for sections of High Street that fall outside of the existing Swansea AQMA 2010 exceeding the NO₂ annual mean objective. The situations are described within section 2.3 above. Whilst these data are below an annual mean of 60ug/m³, there is published evidence³⁴ to support the possibility that exceedences of the 1-hour NO₂ objective may be seen with an annual mean below 60ug/m³. Statistically the chances of this occurring are low (around 5% and mainly in the south-east of England) but the possibility remains, given both the increased primary NO₂ now being seen from newer EURO diesel vehicles and the knowledge that High Street witnesses an LDV composition in the traffic flow of over 10.8% during recent years.

Planning Applications received and those proposed for numerous sites along High Street are focusing on introducing residential dwellings in the form of flats into this once commercial area. One such development (Urban Village) has commenced and is now well advanced. A brief outline is provided within section 2.3 above whilst discussing the

³³ Laxen et al July 2003 - Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites

³⁴ AEA Energy & Environment - Analysis of the relationship between annual mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective. AEAT/ENV/R/2641 may 2008

NO₂ passive tube diffusion results. Other proposals along High Street have not as yet progressed to the application stage to convert former office/vacant commercial premises mainly at 1st floor level into living accommodation.

The authority’s intentions with regard to the High Street area are outlined within section 10 – Conclusions and Proposed Actions.

3.1.3 Roads with a High Flow of Buses and/or HGV’s.

The authority now operate 53 GPRS traffic counters (5 of which are within the authorities Par & Ride sites) (4 ATC’s installed during June 2012 do not have enough data capture over the year to warrant inclusion here) that have been configured to produce a vehicle classification split into the EUR 6 basic categories as detailed below within table 47. Their location can be seen within [Annexe 6](#). These tend to be within the lower Swansea Valley area in and around the Swansea AQMA 2010 but latest deployment have seen this provision expand into other areas, mainly around some of the busier major traffic junctions. Funding is being sought to once again expand this monitoring program but within the current financial climate, significant, rapid expansion is unlikely with any expansion more likely to reflect that seen during 2012.

Vehicle class:	Description
0	Unclassified vehicles
1	Motorcycles
2	Cars or light Vans
3	Cars or light Vans with Trailer
4	Heavy Van, Mini bus, L/M/HGV
5	Articulated lorry, HGV+Trailer
6	Bus

Table 47 – EUR6 Classification scheme

Data from the ATC network has been analysed for the years 2004 – 2011 for the basic three categories from the EUR6 classification employed that are required to produce the composition of flow within LAQM.TG(09) box 5.3 Section A3 page 5-12. These details are provided separately for EUR6 classification categories 4-6 below within tables 48-50. Table 51 summarises the total HDV flows.

Heavy Van, Mini bus, L/M/HGV	2004	2005	2006	2007	2008	2009	2010	2011	2012
Site 1	5.2	4	5.1	4.8	4.1	3.5	3.6	3.8	4.1
Site 2	6	5.9	6.4	6.1	6.6	6.1	6.2	6.4	6.2
Site 3	4.1	3.2	4.3	4.5	7.4	16.2	4.7	4.8	5.0
Site 4	4	3.9	4.4	4.4	4.4	4.4	4.5	4.7	4.7
Site 5	5.6	5.3	5.6	5.8	5.9	5.4	5.6	5.5	5.8
Site 6	6.1	6.3	6.9	7.4	7.4	7.2	7.5	7.4	7.4
Site 7	3.9	3.8	4.2	4.5	4.8	4.6	4.7	4.8	4.9
Site 8	29.4	30	29.9	29.8	30.3	29.8	29.9	30.6	30
Site 9	6.4	6.2	6.4	6.6	6.2	5.8	6	6.2	6.2
Site 10	5	4.8	4.8	4.8	4.6	4.3	4.3	4.4	4.4
Site 11	5.8	5.8	6	6.5	6.9	6.3	6.9	6.5	6.9
Site 12	5.2	4.7	5.1	4.9	4.8	4.6	4.7	4.6	4.6
Site 13	4.9	4.5	4.7	4.6	4.5	4.3	4.6	4.5	4.3
Site 14	5.2	5.2	5.6	5.7	5.9	5.4	5.6	5.6	5.7
Site 15	5.4	13.5	8.4	14.4	6.1	6.1	6	6.2	6.1
Site 16	5.7	4.7	4.6	4.8	4.8	4.6	4.6	4.7	4.7
Site 17	2.2	2	4.3	4.1	5.3	5.1	5.3	5.4	5.4
Site 18	5	11	6.7	6.4	6.3	6.5	6.5	6.5	6.5
Site 19	5.6	5.4	5.6	5.7	5.7	5.4	5.6	5.7	5.6
Site 20	6	5.7	4.9	4.6	4.3	3.9	4.2	4.3	4.2
Site 21	6.1	5.8	6.4	6.5	6.7	6.5	6.5	6.7	6.8
Site 22	6.1	6.2	6.9	7	6.9	6.7	6.1	5.8	5.3
Site 23	4.7	4.5	4.8	5	4.9	4.5	4.6	4.7	4.8
Site 24	-	5.5	5.7	5.7	5.5	5.5	5.9	6.1	6
Site 25	-	4.1	4.5	6.2	6.0	5.6	5.9	6.0	5.8
Site 26	4.8	5.1	5.5	5.7	5.6	5.4	5.6	5.9	5.9
Site 27	4.3	4.5	5.1	5.5	5.7	15.6	4.5	4.6	4.4
Site 28	4.2	4.3	4.8	4.9	4.9	4.6	4.4	4.6	4.6
Site 29	4.7	4.4	4.7	4.9	4.7	4.7	4.8	5	4.8
Site 30	-	12.6	6.6	4.1	4.2	3.9	4.2	4.1	4.2
Site 31	4.1	4.1	4.4	4.6	4.7	4.7	4.8	5.1	5.1
Site 32	-	16.8	8.2	3.8	3.8	3.9	3.9	3.9	4.1
Site 33	4.1	3.9	4.2	4.4	4.4	4.5	4.6	4.5	4.6
Site 34	-	13.2	6.8	4.3	4.4	4.4	4.2	4.1	4.1
Site 35	-	37.5	13.9	5.3	5.7	4.8	5	5.1	5.2
Site 36	-	-	-	-	-	-	-	-	-
Site 37	-	3.8	3.4	3.8	3.9	3.5	3.6	3.8	3.5
Site 38	-	5.9	6.4	6.5	6.3	5.8	8.6	18.8	7
Site 39	-	4.5	4.7	4.6	5.2	4.9	5.2	5	4.8
Site 40	3	3.1	3.5	3.8	3.9	4.0	3.8	3.9	3.9
Site 41	-	2.9	2.9	2.7	3.4	3.0	3.1	3.2	3.1
Site 42	-	10.9	6.9	5.2	5.1	5.0	4.8	4.9	5
Site 43	-	4.8	5.1	5.6	5.6	5.3	5.5	5.8	6
Site 44	-	-	-	6.1	6.1	5.8	6.0	6.1	6.0

Table 48 – EUR6 Classification scheme 2004-2012 Class 4

Comments -

Site 8 located on Morfa Road, The Stand is directly outside the access road to the main City & County of Swansea transport depot and also to a small industrial estate further up Morfa Road, hence the consistent high percentage composition for this classification.

Site 35 suffered configuration problems during 2005 which failed to take into account the possibility of parked vehicles affecting the

classification. This was identified but not fully understood as to why the configuration issues with loop tuning only affected this Class 4 scheme until some time later. **Site 38** – it is not clear why the sudden increase during 2011 occurred but major gas main replacement works were undertaken along Carmarthen Road (outbound) causing significant delays along Carmarthen Road with traffic possibly diverting to avoid delays

Artic HGV + trailer	2004	2005	2006	2007	2008	2009	2010	2011	2012
Site 1	0.3	0	0.2	0	0	0.2	0.2	0.2	0.2
Site 2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Site 3	0	0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Site 4	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Site 5	0	0	0.3	0.3	0.3	0.3	0.3	0.0	0.3
Site 6	0.6	0.6	0.8	0.8	0.8	0.7	0.4	0.6	0.5
Site 7	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Site 8	2.9	2.9	1.9	1.1	1.8	2.1	2.3	2.4	2.2
Site 9	0.5	0.5	0.6	0.4	0.4	0.4	0.4	0.4	0.4
Site 10	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 11	0	0	0	0	0	0.0	0	0	0
Site 12	0.3	0.4	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Site 13	0.5	0.4	0.4	0.4	0.2	0.2	0.2	0.4	0.2
Site 14	0.2	0.2	0.3	0.3	0.1	0.2	0.3	0.3	0.2
Site 15	0	0.3	0.1	0.3	0.1	0.2	0.5	0.4	0.4
Site 16	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 17	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 18	0.3	0.8	0.2	0.4	0.2	0.5	0.6	0.6	0.5
Site 19	0.3	0.4	0.2	0.2	0.1	0.2	0.2	0.2	0.2
Site 20	0.8	0.8	0.7	0.5	0.5	0.4	0.4	0.4	0.4
Site 21	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 22	0.7	0.6	0.4	0.4	0.4	0.2	0.4	0.3	0.2
Site 23	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1
Site 24	-	0	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Site 25	-	1.1	0.5	0.4	0.3	0.3	0.4	0.4	0.4
Site 26	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2
Site 27	0.2	0.3	0.3	0.2	0.4	0.3	0.4	0.2	0.2
Site 28	0	0.2	0.2	0.2	0.2	0.4	0.4	0.4	0.4
Site 29	0	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 30	-	0.3	0.2	0.1	0.1	0.1	0.2	0.1	0.2
Site 31	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Site 32	-	0	0.1	0	0	0.0	0	0	0.2
Site 33	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 34	-	0.6	0.3	0.2	0.1	0.1	0.8	0.1	0.1
Site 35	-	1.2	0.7	0.2	0.4	0.2	0.2	0.4	0.4
Site 36	-	-	-	-	-	-	-	-	-
Site 37	-	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.3
Site 38	-	0	0.3	0	0.3	0.3	0.3	0.5	0.3
Site 39	-	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2
Site 40	0	0	0	0	0	0.0	0	0	0
Site 41	-	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 42	-	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Site 43	-	1.1	0.9	0.9	1	0.8	1	0.9	1
Site 44	-	-	-	0.4	0.4	0.4	0.4	0.4	0.4

Table 49 – EUR6 Classification scheme 2004-2012 Class 5

Comments - Again, **Site 8** is located on Morfa Road, The Stand directly outside the access road to the main City & County of Swansea transport depot and also to a small industrial estate further along Morfa Road, hence the consistent high percentage composition for this classification.

There are some sites (Sites 2,3, 4,11,32 and Site 40 that see consistent negligible artic trailer flow – these sites tend to be within areas that have no reason to see these type of vehicles within the area

Bus	2004	2005	2006	2007	2008	2009	2010	2011	2012
Site 1	0.3	0.3	1.2	1.6	1.4	1	0.8	0.6	0.4
Site 2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.3	0.2
Site 3	0.2	0.2	0.5	0.5	0.6	0.6	0.6	0.6	0.2
Site 4	0	0.3	0.5	0.7	0.7	0.7	0.7	0.5	0.2
Site 5	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Site 6	1.4	1.3	1.8	1.9	1.7	1.0	0.6	0.3	0.2
Site 7	0.5	0.4	0.6	0.8	1	0.7	1.4	0.6	0.5
Site 8	1.5	1.4	0	1.1	0	0.0	0	0	0
Site 9	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.2
Site 10	0.4	0.3	0.7	0.9	0.5	0.2	0.2	0.2	0.4
Site 11	0.8	0.8	2.7	2.9	3.4	2.9	2.9	2.9	2.9
Site 12	0.3	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Site 13	0.6	0.4	0.2	0.2	0.4	0.4	0.2	0.2	0.2
Site 14	1.5	1.3	2	2.2	1.9	1.3	1	0.9	0.8
Site 15	0.9	1	1.1	1.2	1.1	0.9	0.6	0.5	0.5
Site 16	0.7	0.2	0.3	0.3	0.4	0.3	0.2	0.2	0.2
Site 17	0.3	0.2	0.4	0.4	0.4	0.3	0.2	0.2	0.2
Site 18	1	1.6	2.1	2.1	1.7	1.3	1.3	1	0.9
Site 19	1.2	1.2	2.5	3.3	3.6	3.3	3.1	2.9	3
Site 20	1.1	1.1	1	0.9	0.9	0.9	0.9	0.9	0.9
Site 21	0.2	0.3	0.5	0.5	0.3	0.3	0.3	0.3	0.2
Site 22	3.6	3.2	6.7	8.4	8.7	7.4	6.5	5.6	5.3
Site 23	0.5	0.4	0.7	0.9	0.9	0.8	0.8	0.8	0.9
Site 24	-	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9
Site 25	-	0.7	0.5	0.8	0.8	0.8	0.9	0.9	0.9
Site 26	0.5	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5
Site 27	0.5	0.4	0.5	0.6	0.6	0.6	0.4	0.4	0.3
Site 28	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.4	0.4
Site 29	0	0.3	1.3	1.7	1.7	1.7	1.6	1.4	1.2
Site 30	-	0.8	0.8	0.8	0.8	0.8	0.6	0.7	0.7
Site 31	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.3
Site 32	-	1.3	1.3	1.4	1.4	1.2	1.2	1	1
Site 33	0.2	0.5	1.1	1.5	1.3	1.3	1.3	1	1.1
Site 34	-	1.5	1.5	1.7	1.7	1.6	0.9	0.3	0.3
Site 35	-	2	1.6	1.5	1.4	1.2	1	0.9	1
Site 36	-	-	-	-	-	-	-	-	-
Site 37	-	0.9	0.8	0.7	0.8	0.8	0.7	0.8	0.6
Site 38	-	0.7	1.6	2.1	1.8	1.0	1.2	1.8	0.8
Site 39	-	0.2	0.4	0.7	0.8	0.8	0.9	0.7	0.8
Site 40	0	0.3	0.7	0.7	0.7	0.7	0.8	0.5	0.5
Site 41	-	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.4
Site 42	-	0.8	1	1.1	1.1	1.1	1	0.8	0.8
Site 43	-	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3
Site 44	-	-	-	0.9	0.9	0.9	1.0	0.9	0.9

Comments -

Site 11 exhibits a relatively low AADT but it is evident that the fraction of class 6 buses is “significant” within the overall flow. This increased following the opening of the Liberty Stadium and Morfa Shopping complex nearby.

Site 22 has shown increased composition of buses following the developments mentioned above and the fact that all bus services now use High Street (stopping outside the main railway station) as the primary access route leading into the city centre. This effect can also be seen at **site19** Carmarthen Road which leads directly into High Street.

Table 50 – EUR6 Classification scheme 2004-2012 Class 6

Total HDV as % of Traffic Flow	2004	2005	2006	2007	2008	2009	2010	2011	2012
Site 1	5.8	4.3	6.5	6.4	5.5	4.7	4.6	4.6	4.7
Site 2	6.4	6.3	6.6	6.3	6.9	6.4	6.6	6.7	6.4
Site 3	4.3	3.4	4.8	5	8	17	5.3	5.4	5.2
Site 4	4	4.2	4.9	5.1	5.1	5.1	5.2	5.2	4.9
Site 5	5.6	5.3	5.9	6.1	6.2	5.7	5.9	5.5	6.1
Site 6	8.1	8.2	9.5	10.1	9.9	8.9	8.5	8.3	8.1
Site 7	4.6	4.3	4.9	5.4	5.9	5.4	6.2	5.5	5.5
Site 8	33.8	34.3	31.8	32	32.1	31.9	32.2	33	32.2
Site 9	7.4	7	7.4	7.4	7	6.6	6.8	7	6.8
Site 10	5.8	5.5	5.7	5.9	5.3	4.7	4.7	4.8	5
Site 11	6.6	6.6	8.7	9.4	10.3	9.2	9.8	9.4	9.8
Site 12	5.8	5.5	5.4	5.2	5	4.8	4.9	4.8	4.8
Site 13	6	5.3	5.3	5.2	5.1	4.9	5	5.1	4.7
Site 14	6.9	6.7	7.9	8.2	7.9	6.9	6.9	6.8	6.7
Site 15	6.3	14.8	9.6	15.9	7.3	7.2	7.1	7.1	7
Site 16	6.7	5.1	5.1	5.3	5.4	5.1	5	5.1	5.1
Site 17	2.6	2.4	4.9	4.7	5.9	5.6	5.7	5.8	5.8
Site 18	6.3	13.4	9	8.9	8.2	8.3	8.4	8.1	7.9
Site 19	7.1	7	8.3	9.2	9.4	8.9	8.9	8.8	8.8
Site 20	7.9	7.6	6.6	6	5.7	5.2	5.5	5.6	5.5
Site 21	6.7	6.4	7.1	7.2	7.2	7	7	7.2	7.2
Site 22	10.4	10	14	15.8	16	14.3	13	11.7	10.8
Site 23	5.5	5.1	5.7	6.1	6	5.4	5.6	5.7	5.8
Site 24	-	6.1	6.6	6.6	6.4	6.6	7	7.2	7.2
Site 25	-	5.9	5.5	7.4	7.1	6.7	7.2	7.3	7.1
Site 26	5.8	5.9	6.2	6.5	6.4	6	6.3	6.6	6.6
Site 27	5	5.2	5.9	6.3	6.7	6.5	5.3	5.2	4.9
Site 28	4.6	4.9	5.5	5.6	5.6	5.4	5.2	5.4	5.4
Site 29	4.7	5	6.2	6.8	6.6	6.6	6.6	6.6	6.2
Site 30	-	13.7	7.6	5	5.1	4.8	5	4.9	5.1
Site 31	4.7	4.6	5.1	5.3	5.4	5.4	5.5	5.8	5.6
Site 32	-	18.1	9.6	5.2	5.2	5.1	5.1	4.9	5.3
Site 33	4.5	4.6	5.5	6.1	5.9	6	6.1	5.7	5.9
Site 34	-	15.3	8.6	6.2	6.2	6.1	5.9	4.5	4.5
Site 35	-	40.7	16.2	7	7.5	6.2	6.2	6.4	6.6
Site 36	-	-	-	-	-	-	-		
Site 37	-	5.1	4.6	5	5.2	4.8	4.8	5.2	4.4
Site 38	-	6.6	8.3	8.6	8.4	7.1	10.1	21.1	8.1
Site 39	-	4.9	5.4	5.6	6.3	6	6.4	6	5.8
Site 40	3	3.4	4.2	4.5	4.6	4.7	4.6	4.4	4.4
Site 41	-	3.3	3.3	3.1	3.8	3.5	3.7	3.8	3.7
Site 42	-	12.1	8.1	6.5	6.4	6.3	6	5.9	6
Site 43	-	6.3	6.4	6.9	7	6.5	6.9	7	7.3
Site 44	-	-	-	7.4	7.4	7.1	7.4	7.4	7.3

Table 51- HDV composition from EUR6 Classification scheme 2004-2012

LAQM.TG(09) box 5.3 Section A3 page 5-12 defines roads with an unusually high proportion of HDV as ones with a HDV content greater than 20%. From table 51 it can be seen that only site 8 at Morfa Road consistently meets this definition. As explained above, there is at present no relevant exposure at this location as Morfa Road leads into an industrial estate that also houses the main transport depot for the authority.

However, this situation will change significantly within the next 6-12 months. Residential development at the former Unit Superheaters site commenced during mid 2011 mainly with single storey “town housing/link houses” to the southern/eastern edge of the site. A number of these properties are now occupied. During 2012, the developer constructed blocks of flats within the middle section of the site. Development has now focused on the remaining areas of the site that border both New Cut Road and Morfa Road directly behind the authorities’ main transport depot. It is not known whether the authority’s transportation depot will have been sold off prior to occupation of these dwellings. If not, the HDV content existing along Morfa Road will remain, become significant and therefore guidance within LAQM.TG(09) box 5.3 will become relevant. As part of a Section 106 agreement entered into with the developer a real-time chemiluminescent analyser is to be installed along the façade of proposed student flats fronting Morfa Road/New Cut Road. As time progresses, details from this new monitoring location will be incorporated within the authorities reporting. The Section 106 agreement also requires the re-siting of the ATC currently along Morfa Road – care will be taken to ensure the new chosen location is representative of its current location so that fair comparisons to the past/present traffic flows can be made whilst ensuring high data quality.

Morfa Road also falls within the development proposals of The Tawe Riverside Development Corridor. These proposals include residential developments northwards along the banks of the river Tawe, encompassing Morfa Road. These proposals have already seen the purchase and demolition of several commercial/industrial units in preparation for parts of the privately funded scheme. The economic downturn has not seen construction works commence but it is inevitable that works will commence at some stage in the coming years. It is open to debate at present as to how long the whole scheme will take to complete as it is inevitable that some commercial/industrial units will remain whilst development proceeds along Morfa Road. This ATC will allow monitoring

of the composition during the transition of the area from a commercial/industrial area to primarily, a residential area.

Significantly, once development proceeds along Morfa Road, there is an aspiration that developer contributions enable the upgrading of Morfa Road in order that it be utilised as a “relief road” for the congested section of Neath Road through the Hafod. Current design proposals have been developed into a signal controlled junction between Morfa Road and New Cut Road following rejection of all other proposals due to highways issues. Completion of this Morfa Relief Road from Whiterock bridge is a long way from fruition at the moment due to the economic situation that looks likely to prevail for several years but the authority are preparing for commencement of highway improvements to the first stage of development at the junction of Morfa Road/New cut Road during the summer of 2013.

The high HDV composition at site 38 during 2011 may be as a result of gas main replacement works along the outbound carriageway of Carmarthen Road causing traffic to divert to avoid delays and congestion. Data for 2012 indicates that flows have returned to what can be considered as “normal”. No significance has been placed on the 2011 data as an indication of likely future flows.

Site 22 High Street was approaching the 20% threshold in previous years but it should be noted that whilst relevant exposure exits within 10m along this section of High Street, the area already lies within the Hafod Air Quality Management Area as described above within section 3.3. However, again as described in section 3.3, concerns are growing in regard to the lower sections of High Street that fall outside of the Hafod AQMA that forms part of The Swansea Air Quality Management Area 2010.

Since the completion of the redevelopment works at the Quadrant Bus Station along Westway in the city centre, all bus routes now enter and egress the terminal along Westway. Residential properties exist along this route but due to funding restrictions there are no finances available to install ATC counters along Westway. Site 36 within tables 44-47 has already been identified as the proposed site at Westway.

The City and County of Swansea confirms that there are no new/newly identified roads with high flows of buses/HDVs.

3.1.4 Junctions

Guidance within LAQM.TG(09) box 5.3 Section A4 page 5-15 requires the identification of all “busy” junctions. A busy junction is defined within LAQM.TG(09) as one with more than 10,000 vehicles per day. An additional requirement is to determine if there is relevant exposure within 10m of the kerb (Swansea’s population of approx. 240,000 does not take it into the major conurbation category where relevant exposure would be within 20m of the kerb). Whilst as stated within the 2nd round of review and assessment there were several junctions that it was thought would meet the traffic volumes required, it was not thought there were receptor locations within 10m of the kerb. However, this situation has now changed with the construction of the new SA1 junction along Fabian Way and the construction of the new Tesco access road /junction following the reconstruction and expansion of its outlet at Nantyffin Road, Llansamlet

Passive nitrogen dioxide measurements are already being made around several junctions mentioned within previous reporting and these data are included within section 2.3 above.

It is thought that to measure PM₁₀ at these locations would provide more meaningful data in preference to DMRB calculations. It has proved to be not economically viable or practical to deploy Thermo FDMS PM₁₀ analysers at these locations. Therefore, alternative real-time instruments had been sourced to undertake the monitoring works that are desirable. The instruments chosen were Met One Instruments Inc. E-Type sampler (<http://www.metone.com/documents/esamplerParticulate.pdf>) It is recognised that these were not true gravimetric or type approved instruments for use on the UK network but current guidance indicates that use of the near forwards light scattering technique was suitable for screening assessments. This coupled with their ease of deployment made them an ideal alternative in these situations. It has not been possible to progress this matter since the original comments within the 2nd round USA due to

technical difficulties with the operation of the monitoring equipment. Whilst the infrastructure for the monitoring is now in place, the ETypes samplers have proved unreliable in operation. Major problems have been experienced with pump failures and other operational issues. The plans to utilise these samplers has now changed and funding was provided to source a different analyser.

The unit chosen was the [MetOne EBam PM₁₀](#)³⁵ (similar in operation to the MetOne PM₁₀ Bam1020) but not referenced for equivalency to the EU gravimetric method.



Photo 16 - SA1 PM₁₀ EBam Installation



Photo 17- Typical PM₁₀ Pump Pack



Photo 18 - SA1 PM₁₀ EBam

However, given these limitations it is thought that the PM₁₀ EBams will provide more reliable/robust data than previous instruments as considerable effort has been made to provide external pumps capable of delivering a consistent 16.7 l/min. During August 2012 five PM₁₀ EBam units were installed at Fforestfach Cross, Sketty Cross, Uplands, Westway, and SA1 junction (Port Tennant Road). Photos 16-18 above show the typical installation that has been undertaken at the SA1 junction (Port Tenant Road).

It should be noted that the nearest monitoring location may in the majority of cases be greater than 10m away from the main junction. Practical considerations i.e. power requirements have also dictated the exact siting.

The junctions with combined traffic volumes likely to be >10,000 AADT flow to be monitored by way of passive nitrogen dioxide diffusion tubes and/or PM₁₀ measurements are:

³⁵ http://www.metone.com/documents/E-BAM_Datasheet_Rev_Aug09.pdf

- a) Fforestfach Cross
- b) Sketty Cross
- c) Oystermouth Road
- d) Llansamlet Cross
- e) Quay Parade Bridges
- f) Dyfatty Junction
- g) Uplands Cross
- h) SA1 junction, Fabian Way
- i) Westway (opposite major bus station and major food retailer)

Whilst it has been possible to report the results of the NO₂ monitoring around several of these junctions, reliable long term PM₁₀ monitoring has not proved possible due to the issues described above. This has now changed with the installation of the five EBam units described above. Data from the EBams will be reported in subsequent reports once sufficient data has been gathered. It is not known if/when funding will be available to permit installation of EBams at the other five locations above.

3.1.5 New Roads Constructed or Proposed Since the Last Round of Review and Assessment

The City and County of Swansea confirms that there are no new/proposed roads within the authority's area.

3.1.6 Roads with Significantly Changed Traffic Flows

Data is available from 2006-2012 and these data are presented below within tables 51 - 57 to assess trends with the composition of the traffic flows being measured. Class 0 is intended to provide evidence of data capture as should problems be experienced within the traffic counter with classification then vehicles would manifest within this category. As can be seen within tables 51 - 57 very few operational issues have been experienced. This does not account for downtime where the loops have been

completely severed by either resurfacing works or gas main replacement works. In these situations data loss the ATC site is total.

The authority installed an additional four ATC counters during May 2012 at :

- Site 50 Gower Road, Upper Killay
- Site 51 Mumbles Road, Brynmill (A483)
- Site 52 West Street Gorseinon
- Site 53 Victoria Road, Gowerton

During May 2013 a further two ATC sites were established at:

- Site 54 Newton Road, Mumbles
- Site 55 Peniel Green Road, Llansamlet (A48)

Full details will be reported from the additional six sites above during future reporting.

2006	Percentage Vehicle Classes							AADT	AWDT
	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6		
Site 1	0.8	0.8	91.5	0.4	5.1	0.2	1.2	12072	12792
Site 2	0.0	0.7	92.4	0.3	6.4	0.0	0.2	14160	15288
Site 3	0.0	0.4	94.6	0.2	4.3	0.0	0.5	13272	14016
Site 4	0.0	0.5	94.4	0.2	4.4	0.0	0.5	10392	10848
Site 5	0.0	0.9	92.9	0.3	5.6	0.3	0.0	7728	8376
Site 6	0.0	1.3	88.7	0.5	6.9	0.8	1.8	14616	15240
Site 7	0.0	0.7	94.2	0.2	4.2	0.1	0.6	21576	22680
Site 8	0.0	3.7	63.6	0.9	29.9	1.9	0	2568	3264
Site 9	0.0	0.6	91.7	0.4	6.4	0.6	0.4	12984	13488
Site 10	0.0	0.6	93.5	0.3	4.8	0.2	0.7	21672	22992
Site 11	0.0	0.5	89.6	1.1	6	0	2.7	4368	4560
Site 12	0.0	0.6	93.8	0.1	5.1	0.2	0.1	19440	21144
Site 13	0.0	0.5	93.9	0.4	4.7	0.4	0.2	13320	15168
Site 14	0.0	0.9	90.5	0.6	5.6	0.3	2	15408	16128
Site 15	0.0	0.5	89.6	0.2	8.4	0.1	1.1	22032	23520
Site 16	0.0	0.6	94.1	0.3	4.6	0.2	0.3	27120	28968
Site 17	0.0	1.2	93.6	0.3	4.3	0.2	0.4	27336	28824
Site 18	0.0	1.4	89.5	0.2	6.7	0.2	2.1	15744	16608
Site 19	0.0	0.6	90.6	0.5	5.6	0.2	2.5	23232	24144
Site 20	0.0	0.9	92.1	0.4	4.9	0.7	1	32904	34488
Site 21	0.0	0.6	92	0.3	6.4	0.2	0.5	30528	32592
Site 22	0.0	0.7	84	1.3	6.9	0.4	6.7	10752	10896
Site 23	0.0	0.4	93.4	0.4	4.8	0.2	0.7	22656	24072
Site 24	0.0	2.2	90.8	0.2	5.7	0.2	0.7	9672	10272
Site 25	0.0	2.3	91.9	0.3	4.5	0.5	0.5	23160	24720
Site 26	0.0	0.5	92.9	0.3	5.5	0.3	0.4	22440	23664
Site 27	0.1	0.5	93	0.4	5.1	0.3	0.5	17496	18528
Site 28	0.0	0.7	93.5	0.4	4.8	0.2	0.5	13584	14352
Site 29	0.0	0.9	92.3	0.6	4.7	0.2	1.3	11208	11856
Site 30	0.0	1	91.2	0.2	6.6	0.2	0.8	21480	22728
Site 31	0.0	0.9	93.6	0.4	4.4	0.3	0.4	16416	16944
Site 32	0.0	0.4	89.8	0.1	8.2	0.1	1.3	16464	17352
Site 33	0.0	0.7	93.4	0.4	4.2	0.2	1.1	21864	22848
Site 34	0.0	0.7	90.6	0.1	6.8	0.3	1.5	17088	18048
Site 35	0.0	4.2	78.9	0.7	13.9	0.7	1.6	13656	14088
Site 36	-	-	-	-	-	-	-	-	-
Site 37	5.4	2.7	86.9	0.4	3.4	0.4	0.8	44088	45816
Site 38	0.0	0.8	90.4	0.5	6.4	0.3	1.6	8976	9576
Site 39	0.0	1.9	92.4	0.3	4.7	0.3	0.4	23664	24936
Site 40	0.0	0.7	94.9	0.2	3.5	0	0.7	10248	11040
Site 41	0.0	2	94.5	0.3	2.9	0.2	0.2	30768	32424
Site 42	0.0	0.7	91.1	0.2	6.9	0.2	1	14592	15624
Site 43	0.0	1.4	91.7	0.5	5.1	0.9	0.4	31248	33696

Table 51 – GPRS ATC Classification split 2006

City & County of Swansea

2007	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	0.6	92.8	0.2	4.8	0	1.6	11976	12696
Site 2	0.0	0.7	92.9	0.2	6.1	0.0	0.2	13824	14904
Site 3	0.0	0.4	94.4	0.2	4.5	0.0	0.5	13272	14016
Site 4	0.0	0.5	94.4	0.0	4.4	0.0	0.7	10368	10848
Site 5	0.0	0.9	92.6	0.3	5.8	0.3	0.0	7800	8472
Site 6	0.0	1.3	88.3	0.3	7.4	0.8	1.9	14952	15576
Site 7	0.0	0.7	93.8	0.1	4.5	0.1	0.8	20424	21504
Site 8	0.0	3.2	63.8	1.1	29.8	1.1	1.1	2280	2880
Site 9	0.0	0.5	92	0.2	6.6	0.4	0.4	13536	13944
Site 10	0.3	0.6	92.9	0.2	4.8	0.2	0.9	21432	22584
Site 11	0.0	0.6	89.4	0.6	6.5	0	2.9	4056	4248
Site 12	0.0	0.7	93.9	0.1	4.9	0.2	0.1	19896	21504
Site 13	0.0	0.6	93.6	0.4	4.6	0.4	0.2	13080	14856
Site 14	0.0	1.1	90.3	0.3	5.7	0.3	2.2	15072	15672
Site 15	0.0	0.5	83.3	0.3	14.4	0.3	1.2	22368	23976
Site 16	0.0	0.7	93.8	0.2	4.8	0.2	0.3	27600	29304
Site 17	0.0	1.3	93.7	0.3	4.1	0.2	0.4	27360	28728
Site 18	0.0	1.6	89.3	0.1	6.4	0.4	2.1	16200	17112
Site 19	0.0	0.7	89.9	0.1	5.7	0.2	3.3	22704	23472
Site 20	0.0	1.1	92.6	0.3	4.6	0.5	0.9	32976	34896
Site 21	0.0	0.8	91.8	0.2	6.5	0.2	0.5	30984	33000
Site 22	0.0	0.7	83.3	0.2	7	0.4	8.4	10896	11040
Site 23	0.0	0.5	93.1	0.2	5	0.2	0.9	22344	23568
Site 24	0.0	2.2	90.8	0.2	5.7	0.2	0.7	9696	10296
Site 25	0.0	1.0	91.4	0.2	6.2	0.4	0.8	12000	12600
Site 26	0.0	0.5	92.6	0.3	5.7	0.3	0.5	22584	23808
Site 27	0.0	0.9	92.6	0.2	5.5	0.2	0.6	22320	23760
Site 28	0.0	0.9	93.3	0.2	4.9	0.2	0.5	13656	14424
Site 29	0.0	0.8	92.2	0.2	4.9	0.2	1.7	11328	12000
Site 30	0.0	1	93.9	0.2	4.1	0.1	0.8	22344	23712
Site 31	0.0	1	93.3	0.3	4.6	0.3	0.4	16056	16584
Site 32	0.0	0.5	94.3	0.2	3.8	0	1.4	15984	16896
Site 33	0.0	0.7	93.1	0.1	4.4	0.2	1.5	21312	22272
Site 34	0.0	0.8	92.9	0.2	4.3	0.2	1.7	15144	16032
Site 35	0.0	3.6	89.2	0.2	5.3	0.2	1.5	12696	13152
Site 36	-	-	-	-	-	-	-	-	-
Site 37	0.0	2.6	92	0.5	3.8	0.5	0.7	47592	49728
Site 38	0.0	0.8	90.6	0	6.5	0	2.1	9240	9864
Site 39	6.0	2.1	86.1	0.2	4.6	0.3	0.7	23280	24384
Site 40	0.0	0.7	94.8	0	3.8	0	0.7	10200	10968
Site 41	0.0	2.3	94.5	0.2	2.7	0.2	0.2	30720	32280
Site 42	0.0	0.8	92.6	0.2	5.2	0.2	1.1	14904	15936
Site 43	0.0	1.5	91.2	0.5	5.6	0.9	0.4	30648	32976
Site 44	0.0	0.9	91.4	0.2	6.1	0.4	0.9	10944	11544

Table 52 – GPRS ATC Classification split 2007

City & County of Swansea

2008	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	0.9	93.4	0.2	4.1	0	1.4	10584	11232
Site 2	0.0	0.7	92.2	0.2	6.6	0.0	0.3	14472	15648
Site 3	0.0	0.4	91.4	0.2	7.4	0.0	0.6	12048	12720
Site 4	0.0	0.5	94.4	0.0	4.4	0.0	0.7	9936	10392
Site 5	0.0	0.9	92.5	0.3	5.9	0.3	0.0	7656	8304
Site 6	0.0	1.2	88.6	0.3	7.4	0.8	1.7	15528	16392
Site 7	0.0	0.8	93.2	0.1	4.8	0.1	1	20064	21264
Site 8	0.0	4.6	62.4	0.9	30.3	1.8	0	2616	3336
Site 9	0.0	0.6	92.4	0.2	6.2	0.4	0.4	12864	13272
Site 10	0.0	0.3	93.7	0.7	4.6	0.2	0.5	21312	22560
Site 11	0.0	0.6	89.1	0	6.9	0	3.4	4176	4344
Site 12	0.0	0.6	94.2	0.1	4.8	0.1	0.1	19440	21000
Site 13	0.0	0.6	94.2	0.2	4.5	0.2	0.4	12864	14616
Site 14	0.0	0.9	90.9	0.3	5.9	0.1	1.9	16368	17328
Site 15	0.0	0.6	91.9	0.2	6.1	0.1	1.1	22512	24192
Site 16	0.0	0.7	93.8	0.2	4.8	0.2	0.4	26976	28872
Site 17	0.0	0.7	93.3	0.2	5.3	0.2	0.4	27048	28680
Site 18	0.0	0.4	91.2	0.3	6.3	0.2	1.7	15744	16728
Site 19	0.0	0.8	89.7	0.1	5.7	0.1	3.6	18216	18840
Site 20	0.0	1.1	92.9	0.3	4.3	0.5	0.9	31560	33144
Site 21	0.0	0.8	91.8	0.2	6.7	0.2	0.3	30744	32976
Site 22	0.0	0.7	83	0.2	6.9	0.4	8.7	10728	10824
Site 23	0.0	0.5	93.3	0.2	4.9	0.2	0.9	22200	23544
Site 24	0.0	4	89.3	0.2	5.5	0.2	0.7	9672	10344
Site 25	0.0	0.8	91.8	0.2	6.0	0.3	0.8	14352	15192
Site 26	0.0	0.5	92.8	0.2	5.6	0.3	0.5	22440	23904
Site 27	0.0	0.7	92.4	0.2	5.7	0.4	0.6	19920	21288
Site 28	0.0	0.7	93.3	0.4	4.9	0.2	0.5	13248	14088
Site 29	0.0	0.9	92.3	0.2	4.7	0.2	1.7	11160	11832
Site 30	0.0	1	93.8	0.2	4.2	0.1	0.8	21936	23376
Site 31	0.0	1.1	93.3	0.3	4.7	0.2	0.5	15360	15888
Site 32	0.0	0.5	94.2	0.2	3.8	0	1.4	15792	16704
Site 33	0.0	0.7	93.3	0.1	4.4	0.2	1.3	21408	22488
Site 34	0.0	0.7	92.9	0.1	4.4	0.1	1.7	16824	17928
Site 35	0.0	3.3	89.1	0.2	5.7	0.4	1.4	12288	12744
Site 36	-	-	-	-	-	-	-	-	-
Site 37	0.0	1.7	92.5	0.6	3.9	0.5	0.8	45960	47712
Site 38	0.0	0.8	90.3	0.5	6.3	0.3	1.8	9144	9792
Site 39	0.0	1.7	91.8	0.2	5.2	0.3	0.8	23208	24360
Site 40	0.0	0.7	94.7	0	3.9	0	0.7	9936	10680
Site 41	0.0	1	95	0.2	3.4	0.2	0.2	29856	31512
Site 42	0.0	0.8	92.6	0.2	5.1	0.2	1.1	14976	16056
Site 43	0.8	1.5	90.2	0.5	5.6	1	0.4	29784	32232
Site 44	0.0	0.9	91.5	0.2	6.1	0.4	0.9	13344	14184

Table 53 – GPRS ATC Classification split 2008

City & County of Swansea

2009	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	1	94.1	0.2	3.5	0.2	1	11808	12552
Site 2	0.0	0.7	92.5	0.2	6.1	0.0	0.3	14448	15624
Site 3	0.0	0.4	82.5	0.2	16.2	0.2	0.6	12888	13656
Site 4	0.0	0.5	94.4	0.0	4.4	0.0	0.7	9864	10368
Site 5	0.0	1	93	0.3	5.4	0.3	0.0	7152	7680
Site 6	0.0	1.3	89.6	0.2	7.2	0.7	1.0	14232	14880
Site 7	0.0	0.7	93.6	0.1	4.6	0.1	0.7	19248	20376
Site 8	0.0	5.3	61.7	1.1	29.8	2.1	0.0	2256	2880
Site 9	0.0	0.6	92.8	0.2	5.8	0.4	0.4	12912	13368
Site 10	0.0	0.6	93.9	0.8	4.3	0.2	0.2	21624	22968
Site 11	0.0	0.6	90.2	0.0	6.3	0.0	2.9	4200	4368
Site 12	0.0	0.7	94.3	0.1	4.6	0.1	0.1	19776	21456
Site 13	0.0	0.6	94.4	0.2	4.3	0.2	0.4	12792	14568
Site 14	0.0	1	91.8	0.3	5.4	0.2	1.3	14952	15696
Site 15	0.0	0.8	91.8	0.1	6.1	0.2	0.9	20544	21864
Site 16	0.0	0.8	93.9	0.2	4.6	0.2	0.3	25656	27264
Site 17	0.0	0.8	93.4	0.2	5.1	0.2	0.3	26640	28104
Site 18	0.0	1.8	89.8	0.2	6.5	0.5	1.3	14760	15528
Site 19	0.0	0.8	90.3	0.1	5.4	0.2	3.3	21936	22776
Site 20	0.0	1.1	93.3	0.3	3.9	0.4	0.9	31680	33216
Site 21	0.0	0.9	92	0.3	6.5	0.2	0.3	27768	29616
Site 22	0.0	0.7	84.7	0.2	6.7	0.2	7.4	10320	10416
Site 23	0.0	0.6	93.8	0.2	4.5	0.1	0.8	22320	23808
Site 24	0.0	2.3	91.2	0.0	5.5	0.3	0.8	9600	10248
Site 25	0.0	0.8	92.2	0.2	5.6	0.3	0.8	14232	15096
Site 26	0.0	0.4	93.3	0.2	5.4	0.2	0.4	21768	23136
Site 27	0.0	0.3	82.2	1.0	15.6	0.3	0.6	22464	24000
Site 28	0.0	0.4	93.8	0.5	4.6	0.4	0.4	13608	14424
Site 29	0.0	0.8	92.4	0.2	4.7		1.7	11280	11928
Site 30	0.0	1	94.1	0.2	3.9	0.1	0.8	22224	23664
Site 31	0.0	1.1	93.3	0.3	4.7	0.2	0.5	15840	16392
Site 32	0.0	0.4	94.3	0.1	3.9	0.0	1.2	16152	17088
Site 33	0.0	0.7	93.2	0.1	4.5	0.2	1.3	21528	22584
Site 34	0.0	0.7	93	0.1	4.4	0.1	1.6	16872	17952
Site 35	0.0	3.1	90.7	0.0	4.8	0.2	1.2	12432	12888
Site 36	-	-	-	-	-	-	-	-	-
Site 37	0.0	1.6	92.8	0.9	3.5	0.5	0.8	47064	48888
Site 38	0.0	0.5	90.8	1.6	5.8	0.3	1.0	9144	9816
Site 39	0.0	1.3	92.5	0.2	4.9	0.3	0.8	22944	24096
Site 40	0.0	0.7	94.6	0.0	4.0	0.0	0.7	9720	10464
Site 41	0.0	0.6	95.6	0.3	3.0	0.2	0.3	30336	31992
Site 42	0.0	0.8	92.7	0.2	5.0	0.2	1.1	14832	15864
Site 43	0.0	1.4	91.5	0.5	5.3	0.8	0.4	29232	31488
Site 44	0.0	0.9	91.9	0.2	5.8	0.4	0.9	13272	14112

Table 54 – GPRS ATC Classification split 2009

City & County of Swansea

2010	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1	0.0	1	94.1	0.2	3.6	0.2	0.8	11856	12600
Site 2	0.0	0.7	92.6	0.2	6.2	0.0	0.4	13536	14616
Site 3	0.0	0.6	94.0	0.2	4.7	0.0	0.6	12792	13608
Site 4	0.0	0.7	94.0	0.0	4.5	0.0	0.7	10080	10704
Site 5	0.0	1.0	92.7	0.3	5.6	0.3	0.0	7224	7776
Site 6	1.0	2.3	87.9	0.2	7.5	0.4	0.6	11544	12264
Site 7	0.0	0.8	92.8	0.1	4.7	0.1	1.4	20832	22104
Site 8	0.0	4.6	62.1	1.1	29.9	2.3	0	2088	2664
Site 9	0.0	0.8	92.3	0.2	6	0.4	0.4	12768	13008
Site 10	0.0	1.4	93.2	0.7	4.3	0.2	0.2	20856	22224
Site 11	0.0	0.6	89.6	0	6.9	0	2.9	4152	4344
Site 12	0.0	0.8	94.1	0.1	4.7	0.1	0.1	18720	20256
Site 13	0.0	0.6	94.2	0.2	4.6	0.2	0.2	12096	13776
Site 14	0.0	1	91.8	0.3	5.6	0.3	1	14640	15432
Site 15	0.0	0.8	92	0.1	6	0.5	0.6	20784	22200
Site 16	0.0	0.8	94.1	0.2	4.6	0.2	0.2	25176	26760
Site 17	0.0	0.8	93.4	0.2	5.3	0.2	0.2	28488	30192
Site 18	0.0	1.6	89.8	0.2	6.5	0.6	1.3	14784	15648
Site 19	0.0	0.8	90.1	0.1	5.6	0.2	3.1	20136	20952
Site 20	0.0	1.2	93.1	0.3	4.2	0.4	0.9	30840	32544
Site 21	0.0	0.8	92	0.2	6.5	0.2	0.3	28968	31128
Site 22	0.0	0.8	86.2	0	6.1	0.4	6.5	5928	6048
Site 23	0.0	0.7	93.5	0.2	4.6	0.2	0.8	21792	23208
Site 24	0.0	1.9	91.1	0	5.9	0.3	0.8	8880	9480
Site 25	0.0	0.9	91.8	0.2	5.9	0.4	0.9	13488	14304
Site 26	0.0	0.5	93	0.2	5.6	0.2	0.5	20976	22200
Site 27	0.0	0.7	93.3	0.7	4.5	0.4	0.4	19344	20568
Site 28	0.0	0.4	93.8	0.6	4.4	0.4	0.4	12456	13224
Site 29	0.0	0.9	92.2	0.2	4.8	0.2	1.6	10488	11088
Site 30	0.0	1	93.9	0.2	4.2	0.2	0.6	14952	16008
Site 31	0.0	1.1	93.1	0.3	4.8	0.2	0.5	15336	15840
Site 32	0.0	0.5	94.2	0.2	3.9	0	1.2	15456	16368
Site 33	0.0	0.8	92.9	0.1	4.6	0.2	1.3	20280	21216
Site 34	0.0	0.9	92.3	0.8	4.2	0.8	0.9	15360	16344
Site 35	0.0	2	91.8	0	5	0.2	1	12024	12576
Site 36	-	-	-	-	-	-	-	-	-
Site 37	0.0	1.6	92.7	0.8	3.6	0.5	0.7	45648	47688
Site 38	0.0	0.6	87.7	1.5	8.6	0.3	1.2	7776	8352
Site 39	0.0	1.3	92.1	0.2	5.2	0.3	0.9	22248	23400
Site 40	0.0	0.8	94.6	0	3.8	0	0.8	8928	9624
Site 41	0.0	0.6	95.5	0.3	3.1	0.2	0.4	29136	31008
Site 42	0.0	0.8	93.1	0.2	4.8	0.2	1	14520	15600
Site 43	0.0	1.3	91.3	0.5	5.5	1	0.4	27264	29544
Site 44	0.0	1.0	91.5	0.2	6.0	0.4	1.0	12456	13272

Table 55 – GPRS ATC Classification split 2010

City & County of Swansea

2011	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1		1	94.2	0.2	3.8	0.2	0.6	12000	12768
Site 2		0.7	92.5	0.2	6.4	0.0	0.3	14376	15456
Site 3		0.4	94.1	0.2	4.8	0.0	0.6	12984	13800
Site 4		0.7	94.1	0.0	4.7	0.0	0.5	9720	10272
Site 5		1.0	93.5	0.0	5.5	0.0	0.0	7440	8016
Site 6		1.7	89.9	0.2	7.4	0.6	0.3	15888	16824
Site 7		0.8	93.5	0.1	4.8	0.1	0.6	20832	22320
Site 8		4.7	62.4	0	30.6	2.4	0	2040	2616
Site 9		0.7	92.1	0.2	6.2	0.4	0.4	10848	11280
Site 10		0.4	94	0.7	4.4	0.2	0.2	19440	20688
Site 11		0.6	90	0	6.5	0	2.9	4080	4272
Site 12		0.8	94.2	0.1	4.6	0.1	0.1	18072	19560
Site 13		0.6	94.1	0.2	4.5	0.4	0.2	12216	13896
Site 14		0.9	92	0.3	5.6	0.3	0.9	16200	17160
Site 15		0.9	91.9	0.1	6.2	0.4	0.5	22536	24216
Site 16		0.7	94	0.2	4.7	0.2	0.2	26208	27864
Site 17		0.7	93.4	0.2	5.4	0.2	0.2	29472	31368
Site 18		1.6	90.1	0.1	6.5	0.6	1	16320	17400
Site 19		0.8	90.2	0.1	5.7	0.2	2.9	21192	22128
Site 20		1.2	92.9	0.3	4.3	0.4	0.9	30888	32664
Site 21		0.8	91.8	0.2	6.7	0.2	0.3	30240	32592
Site 22		0.5	87.9	0	5.8	0.3	5.6	9504	9720
Site 23		0.7	93.5	0.1	4.7	0.2	0.8	20568	21888
Site 24		2.7	90.1	0	6.1	0.3	0.8	8976	9624
Site 25		0.9	91.6	0.2	6.0	0.4	0.9	13128	13944
Site 26		0.5	92.6	0.2	5.9	0.2	0.5	19800	21024
Site 27		0.4	93.8	0.6	4.6	0.2	0.4	19392	20712
Site 28		0.4	93.6	0.6	4.6	0.4	0.4	12360	13152
Site 29		1	92.1	0.2	5	0.2	1.4	9984	10608
Site 30		0.9	93.9	0.2	4.1	0.1	0.7	20424	21744
Site 31		1.4	92.6	0.3	5.1	0.2	0.5	15600	16200
Site 32		0.6	94.3	0.1	3.9	0	1	16080	17040
Site 33		0.8	93.3	0.1	4.5	0.2	1	21144	22224
Site 34		0.4	93.8	1.3	4.1	0.1	0.3	16896	18072
Site 35		1.1	92.3	0.2	5.1	0.4	0.9	13152	13752
Site 36									
Site 37		2.9	91	1	3.8	0.6	0.8	45288	47328
Site 38		0.3	77.2	1.3	18.8	0.5	1.8	9168	9864
Site 39		1.3	92.5	0.2	5	0.3	0.7	22632	23856
Site 40		0.8	94.7	0	3.9	0	0.5	9144	9840
Site 41		0.5	95.4	0.3	3.2	0.2	0.4	27336	29016
Site 42		0.8	93.2	0.2	4.9	0.2	0.8	15192	16344
Site 43		1.3	91.1	0.5	5.8	0.9	0.3	28752	31296
Site 44		0.9	91.5	0.2	6.1	0.4	0.9	12936	13800

Table 56 – GPRS ATC Classification split 2011

City & County of Swansea

2012	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	AADT	AWDT
Site 1		1.2	93.9	0.2	4.1	0.2	0.4	11712	12456
Site 2		0.7	92.8	0.2	6.2	0.0	0.2	13944	14928
Site 3		0.4	94.2	0.2	5.0	0.0	0.2	12888	13680
Site 4		0.7	94.3	0.0	4.7	0.0	0.2	9672	10248
Site 5		1.3	92.7	0.0	5.8	0.3	0.0	7512	8064
Site 6		1.6	90.2	0.2	7.4	0.5	0.2	15480	16344
Site 7		0.8	93.5	0.1	4.9	0.1	0.5	20424	21744
Site 8		5.6	62.2	0	30	2.2	0	2184	2784
Site 9		0.6	92.4	0.2	6.2	0.4	0.2	11928	12648
Site 10		0.4	93.9	0.7	4.4	0.2	0.4	19824	21072
Site 11		0.6	89.7	0	6.9	0	2.9	4224	4416
Site 12		0.8	94.2	0.1	4.6	0.1	0.1	18768	20256
Site 13		0.8	94.4	0.2	4.3	0.2	0.2	12408	14112
Site 14		1.1	92	0.3	5.7	0.2	0.8	15864	16728
Site 15		0.9	92	0.1	6.1	0.4	0.5	22080	23616
Site 16		0.7	94	0.2	4.7	0.2	0.2	26208	27768
Site 17		0.7	93.3	0.2	5.4	0.2	0.2	29112	30888
Site 18		1.7	90.3	0.2	6.5	0.5	0.9	15840	16824
Site 19		0.8	90.2	0.1	5.6	0.2	3	20832	21696
Site 20		1.1	93.3	0.2	4.2	0.4	0.9	31704	33480
Site 21		0.8	91.8	0.2	6.8	0.2	0.2	29640	31800
Site 22		0.7	88.4	0.2	5.3	0.2	5.3	10512	10656
Site 23		0.6	93.5	0.1	4.8	0.1	0.9	20736	22056
Site 24		3	89.9	0	6	0.3	0.9	8040	8568
Site 25		0.9	91.9	0.2	5.8	0.4	0.9	13320	14040
Site 26		0.6	92.6	0.2	5.9	0.2	0.5	20784	22008
Site 27		0.3	94	0.7	4.4	0.2	0.3	20688	22104
Site 28		0.4	93.6	0.6	4.6	0.4	0.4	12408	13176
Site 29	2.9	0.7	89.8	0.2	4.8	0.2	1.2	9912	10512
Site 30		0.9	93.7	0.2	4.2	0.2	0.7	20424	21816
Site 31		1.1	93	0.3	5.1	0.2	0.3	14712	15216
Site 32		0.6	94	0.2	4.1	0.2	1	15072	15864
Site 33		0.8	93.2	0.1	4.6	0.2	1.1	20472	21360
Site 34		0.4	93.9	1.2	4.1	0.1	0.3	16464	17496
Site 35		1.3	91.9	0.2	5.2	0.4	1	12480	13008
Site 36									
Site 37		0.8	93.8	1	3.5	0.3	0.6	29736	31176
Site 38		0.5	90.1	1.3	7	0.3	0.8	8952	9600
Site 39		1.3	92.7	0.2	4.8	0.2	0.8	21960	22968
Site 40		0.8	94.8	0	3.9	0	0.5	9264	9888
Site 41		0.5	95.6	0.3	3.1	0.2	0.4	28680	30480
Site 42		0.9	92.9	0.2	5	0.2	0.8	15192	16272
Site 43		1.3	90.9	0.5	6	1	0.3	28080	30456
Site 44		0.9	91.5	0.2	6.0	0.4	0.9	12720	13488

Table 57 – GPRS ATC Classification split 2012

To assess if the AADT has changed significantly over the period 2006-2012, data is presented below in table 58.

City & County of Swansea

Site	AADT 2006	AADT 2007	AADT 2008	AADT 2009	AADT 2010	AADT 2011	AADT 2012	% Growth 2012 over 2009 Base year	% Growth 2012 over 2010 Base year	% Growth 2012 over 2011 Base year
1	12072	11976	10584	11808	11856	12000	11712	-0.81	-1.21	-2.40
2	14160	13824	14472	14448	13536	14376	13944	-3.49	3.01	-3.01
3	13272	13272	12048	12888	12792	12984	12888	0.00	0.75	-0.74
4	10392	10368	9936	9864	10080	9720	9672	-1.95	-4.05	-0.49
5	7728	7800	7656	7152	7224	7440	7512	5.03	3.99	0.97
6	14616	14952	15528	14232	11544	15888	15480	8.77	34.10	-2.57
7	21576	20424	20064	19248	20832	20832	20424	6.11	-1.96	-1.96
8	2568	2280	2616	2256	2088	2040	2184	-3.19	4.60	7.06
9	12984	13536	12864	12912	12768	10848	11928	-7.62	-6.58	9.96
10	21672	21432	21312	21624	20856	19440	19824	-8.32	-4.95	1.98
11	4368	4056	4176	4200	4152	4080	4224	0.57	1.73	3.53
12	19440	19896	19440	19776	18720	18072	18768	-5.10	0.26	3.85
13	13320	13080	12864	12792	12096	12216	12408	-3.00	2.58	1.57
14	15408	15072	16368	14952	14640	16200	15864	6.10	8.36	-2.07
15	22032	22368	22512	20544	20784	22536	22080	7.48	6.24	-2.02
16	27120	27600	26976	25656	25176	26208	26208	2.15	4.10	0.00
17	27336	27360	27048	26640	28488	29472	29112	9.28	2.19	-1.22
18	15744	16200	15744	14760	14784	16320	15840	7.32	7.14	-2.94
19	23232	22704	18216	21936	20136	21192	20832	-5.03	3.46	-1.70
20	32904	32976	31560	31680	30840	30888	31704	0.08	2.80	2.64
21	30528	30984	30744	27768	28968	30240	29640	6.74	2.32	-1.98
22	10752	10896	10728	10320	5928	9504	10512	1.86	77.33	10.61
23	22656	22344	22200	22320	21792	20568	20736	-7.10	-4.85	0.82
24	9672	9696	9672	9600	8880	8976	8040	-16.25	-9.46	-10.43
25	23160	12000	14352	14232	13488	13128	13320	-6.41	-1.25	1.46
26	22440	22584	22440	21768	20976	19800	20784	-4.52	-0.92	4.97
27	17496	22320	19920	22464	19344	19392	20688	-7.91	6.95	6.68
28	13584	13656	13248	13608	12456	12360	12408	-8.82	-0.39	0.39
29	11208	11328	11160	11280	10488	9984	9912	-12.13	-5.49	-0.72
30	21480	22344	21936	22224	14952	20424	20424	-8.10	36.60	0.00
31	16416	16056	15360	15840	15336	15600	14712	-7.12	-4.07	-5.69
32	16464	15984	15792	16152	15456	16080	15072	-6.69	-2.48	-6.27
33	21864	21312	21408	21528	20280	21144	20472	-4.91	0.95	-3.18
34	17088	15144	16824	16872	15360	16896	16464	-2.42	7.19	-2.56
35	13656	12696	12288	12432	12024	13152	12480	0.39	3.79	-5.11
36	-	-	-	-	-	-	-	-	-	-
37	44088	47592	45960	47064	45648	45288	29736	-36.82	-34.86	-34.34
38	8976	9240	9144	9144	7776	9168	8952	-2.10	15.12	-2.36
39	23664	23280	23208	22944	22248	22632	21960	-4.29	-1.29	-2.97
40	10248	10200	9936	9720	8928	9144	9264	-4.69	3.76	1.31
41	30768	30720	29856	30336	29136	27336	28680	-5.46	-1.57	4.92
42	14592	14904	14976	14832	14520	15192	15192	2.43	4.63	0.00
43	31248	30648	29784	29232	27264	28752	28080	-3.94	2.99	-2.34
44	-	10944	13344	13272	12456	12936	12720	-4.16	2.12	-1.67

Table 58 AADT Percentage Growth 2006-2012

* Site 25 was counting 4 lanes (dual carriageway) of traffic in 2006. However, due to impending network changes (Carmarthen Road Park & Ride site) the site was relocated to count 2 lanes of outbound traffic only during January 2007. Site 44 was established at the same time on the other side of the dual carriageway to count inbound traffic on the remaining 2 lanes

No significance should be taken from the data presented within table 58 above for sites 6, site 22 or 30 for 2010 data comparisons as these sites were affected by either gas main replacement works or resurfacing works with total data loss for significant periods. Similarly, site 37 data for 2012 has been affected by highway alterations as part of the Boulevard scheme and is not indicative of any trend.

The only site where an upward trend can be accounted for is at site 38 which saw an increase in flow during 2011 due to traffic taking an alternative route up along Pentregthin Road to avoid delays caused by gas main replacement works along Carmarthen Road. Flows appear to have returned to normal during 2012 so again, no significance should be placed on the growth figures presented within table 58 for site 38.

Guidance within LAQM.TG(09) box 5.3 Section A6 page 5-18 defines a “large” increase in traffic flow to be one greater than 25%. This level of growth has been seen between 2005 and 2006 at several sites but between 2007- 2012, there is no evidence to determine that such an increase has been seen at any of the GPRS ATC’s.

The Swansea Metro project aims to transform public transport in Swansea by introducing the new concept StreetCar vehicle, on a route with signalled priority at key sections between Morriston Hospital and Singleton Hospital, via the City Centre.

It now runs on-street, from Morriston Hospital to Singleton Hospital via the City Centre and Oystermouth Road stopping at many key destinations, including:

- Morriston Hospital,
- Woodfield Street, Morriston
- High Street Station,
- Kingsway,
- the new Quadrant Interchange (see section 3.8 below)
- County Hall,
- University and Singleton hospital.

Signalled priority will be provided at key locations, including:

- Martin Street roundabout,

- Cwm Level roundabout,
- Normandy Road roundabout,
- the proposed Landore Express Route
- and in the City Centre, with the detailed design being carried out in-house

In order to enable the Swansea Metro to run, considerable works to the existing road network were required. Some of these works required at Cwm Level and Normandy Road roundabouts lie within the existing Hafod Air Quality Management Area. The road network surrounding these key roundabouts has been altered to provide priority to the Metro service by way of signal controlled access.

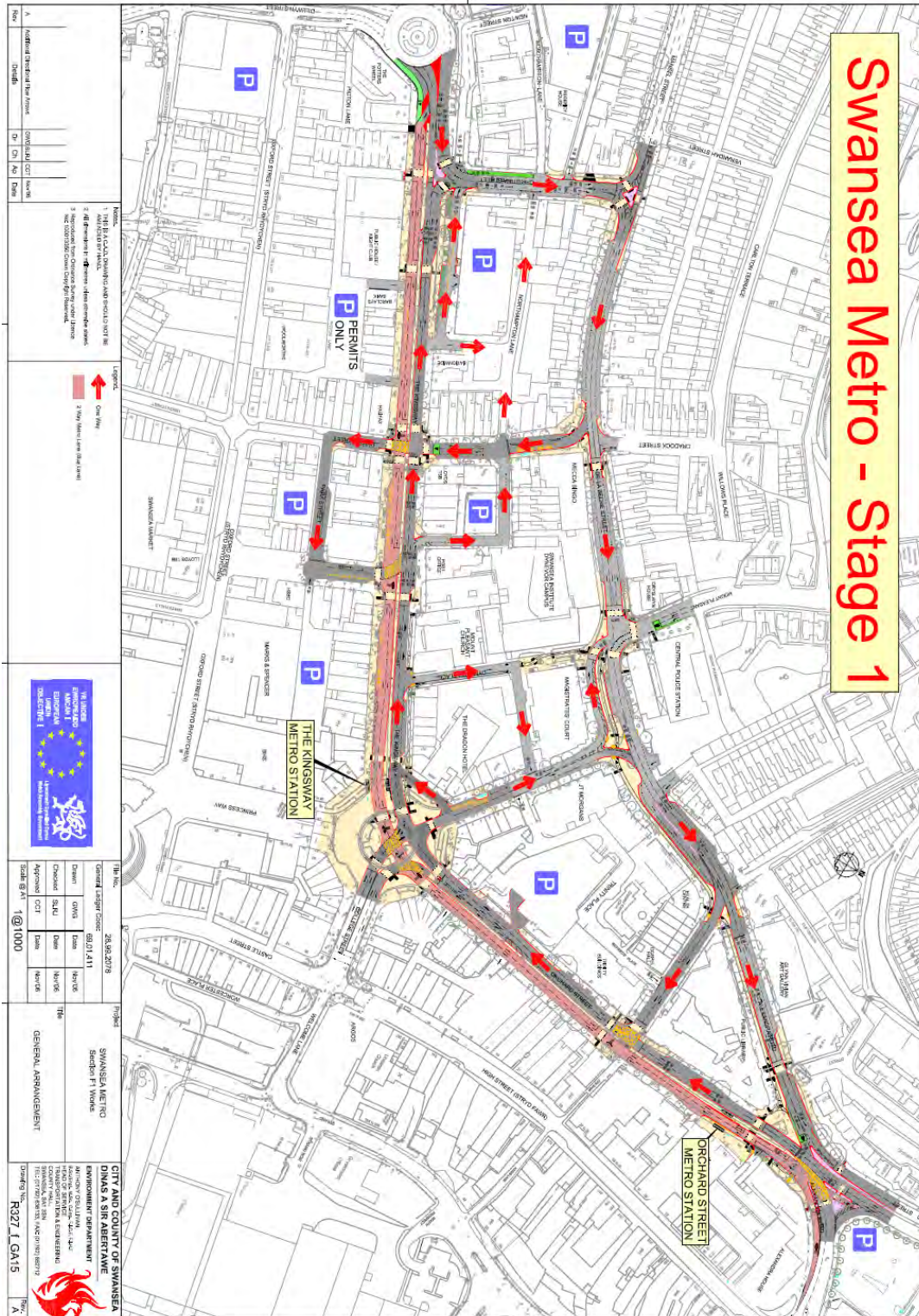
The first phase of these works started within the Kingsway area of the city centre during the summer months of 2006. Plans of the works completed as part of phase 1 can be seen below as maps 12 and 13.

Phase 2 of the Metro scheme (see map 14) commenced during July 2007 to extend the provision from the Kingsway down along Westway, linking into the Quadrant Transport Interchange (see section 3.8 below) and to the new Civic Centre on Oystermouth Road. Phase 2 was completed during late 2008/early 2009.

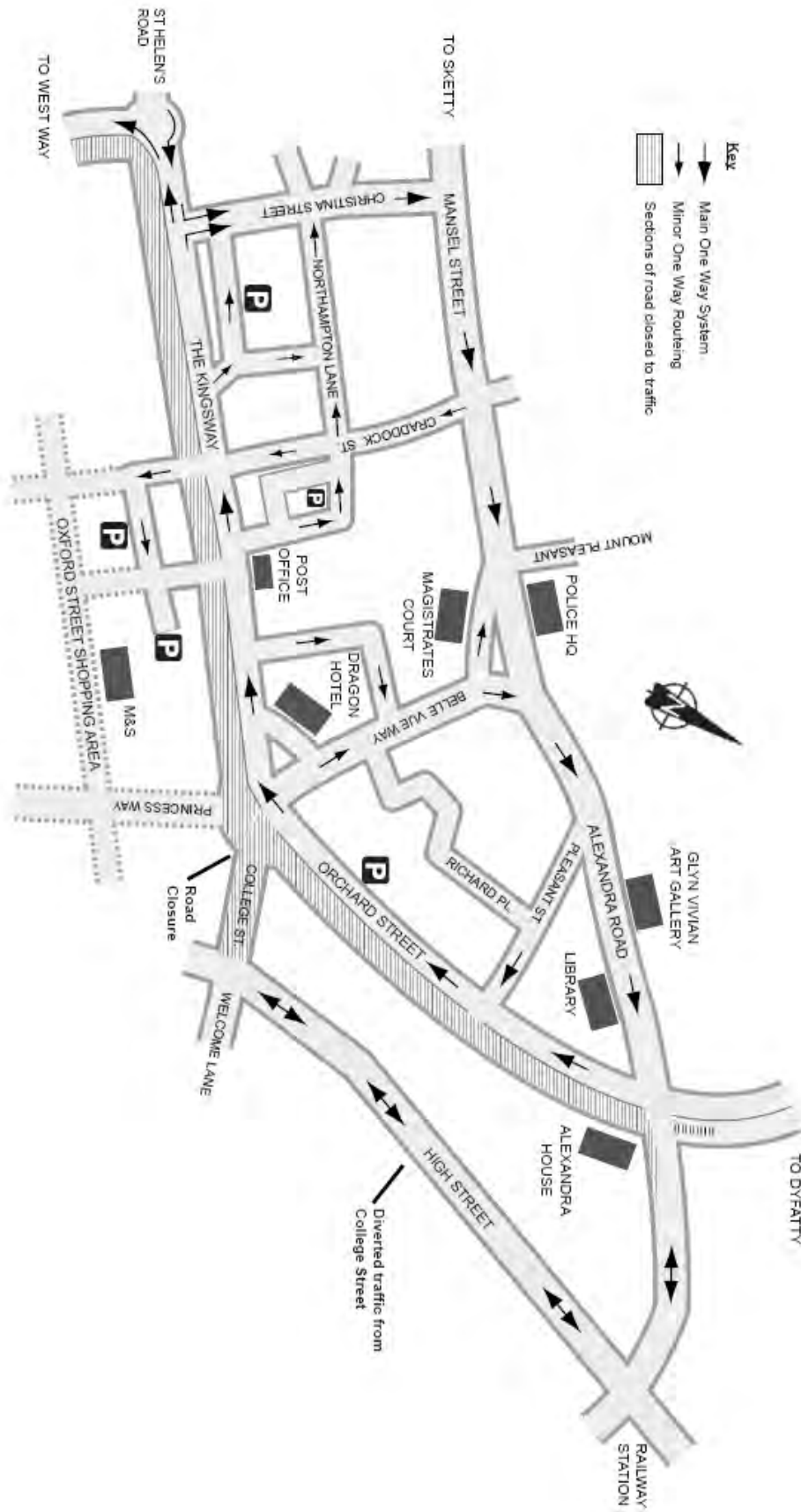
Phase 2 has seen major changes to the traffic flow within the city centre area. As yet, no GPRS ATC's have been installed along the affected routes to assess any pattern changes but discussions have already taken place and sites identified to enable suitable monitoring of traffic flows. Unfortunately, due to budgetary constraints no orders have been placed with the equipment suppliers as yet. Some of the work being undertaken with regard to the passive diffusion tube survey work is aimed at assessing what, if any impact this change in traffic flow within the city centre is having with NO₂ levels – in particular to the 1-hour objective in view of several café type environments that exist within the city centre. This work is outlined within section 2.3 above.

Installation of ATC site 36 (Westway) has been awaiting the completion of the redevelopment of the Quadrant Interchange (Sec 3.8 below) as access and egress roadways from the new interchange will require consideration and monitoring. However,

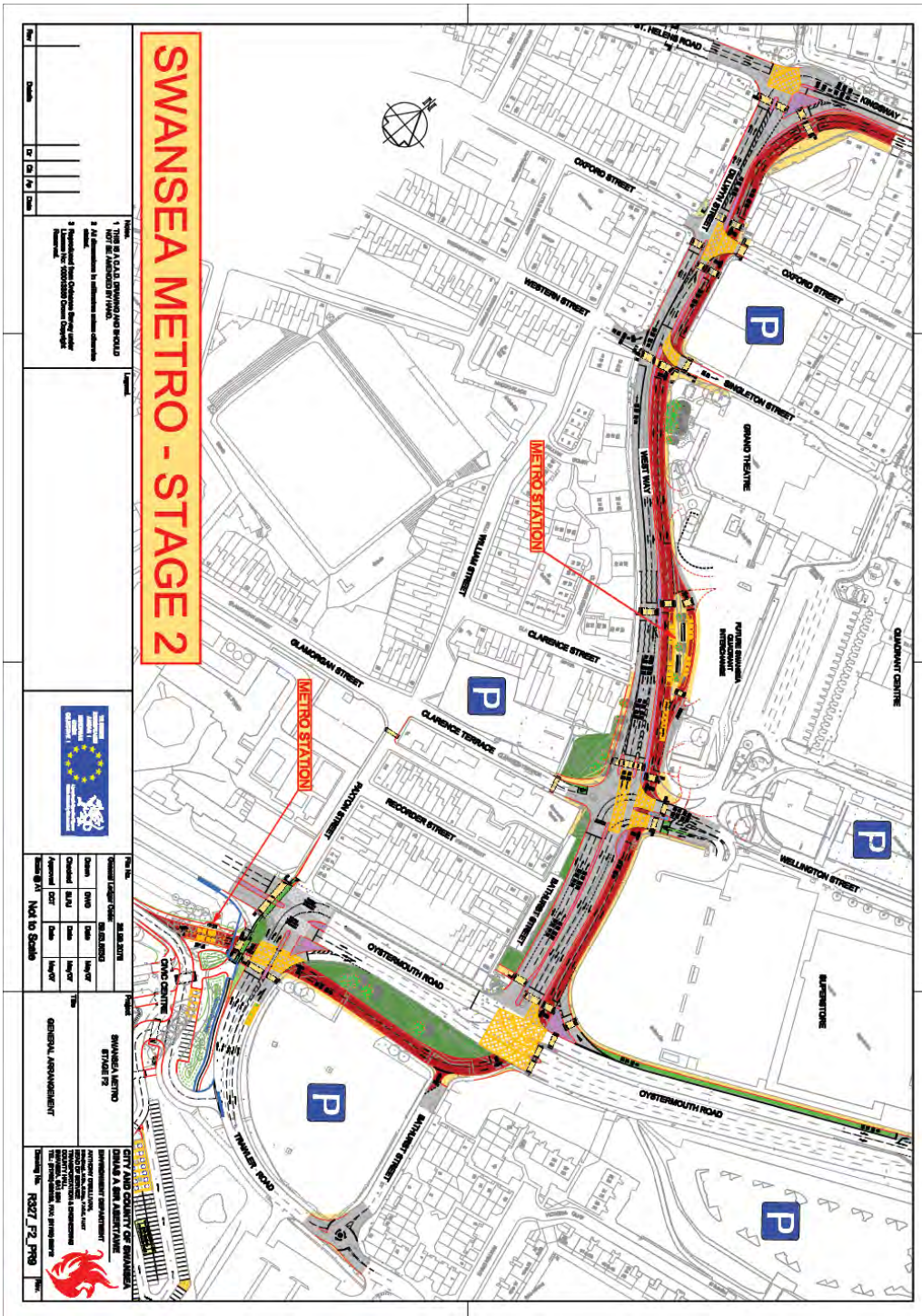
the same budgetary constraints now evident within the authority may see this planned monitoring site delayed for several years or even cancelled.



Map 12 – Swansea Metro Phase 1



Map 13 Swansea Metro Phase 1



Map 14 – Phase 2 Swansea Metro Project

Funding is being sought to enable the installation of GPRS ATC's within the city centre area but with the current budgetary restraints being faced by the authority, this is unlikely to be realised.

The Swansea Boulevard Project

As part of the delivery of the City Centre Strategic Framework, Consultants were engaged to produce a Concept, Design and Implementation Study in relation to the European Boulevard which was agreed by Cabinet in December 2008.

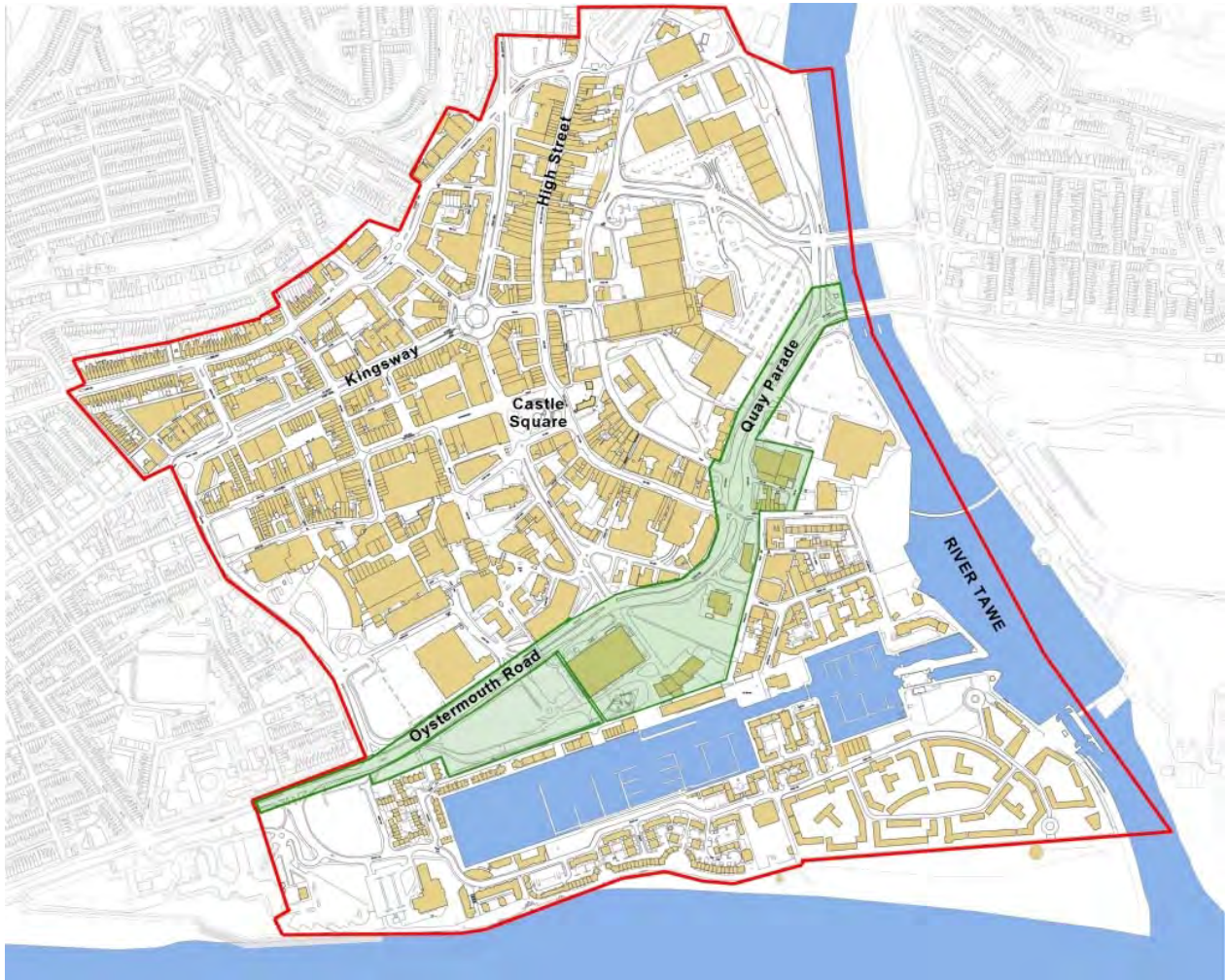
The project is to create a "boulevard" from the river bridges to the Civic Centre which provides a step change in perceptions of this gateway corridor from an urban freeway to a vibrant tree lined city street which allows the connection of the City Centre to the Maritime Quarter. The Boulevard will encourage high quality architectural design, excellent public realm and landscape and provide an effective balance between its role as the key artery into the City Centre and increased pedestrian movement and permeability.

The reconfiguration of the Tawe Bridges was completed in December 2011. This constituted phase 1 of the Boulevard project and was required in order to create additional highway capacity to accommodate pedestrian, cycle and public transport enhancements along the Boulevard.

Phase 2 of the Boulevard scheme is programmed to commence in January 2013 and will cover the section between the Leisure Centre to Wind Street, with Phase 3 following in January 2014 covering Wind Street to the Tawe Bridges.

The works to Phase 2 and 3 will construct the following enhancements:

- upgrading the public realm with high quality materials being used throughout;
- introduction of a bus lane between Princess Way and Wind Street;
- enhanced pedestrian/cycle crossings (toucan);
- widened footways;
- installation of a shared use path on the southern footway;
- trees to be planted in the footways and central reserve;
- lighting and CCTV upgrades;
- telematics upgrade;
- closure of minor junctions and accesses



Swansea Boulevard project

© Crown Copyright and database right 2013. Ordnance Survey 100023509



Sketch 1 Swansea Boulevard project

The City and County of Swansea confirms that there are no new/newly identified roads with significantly changed traffic flows.

3.1.7 Bus and Coach Stations

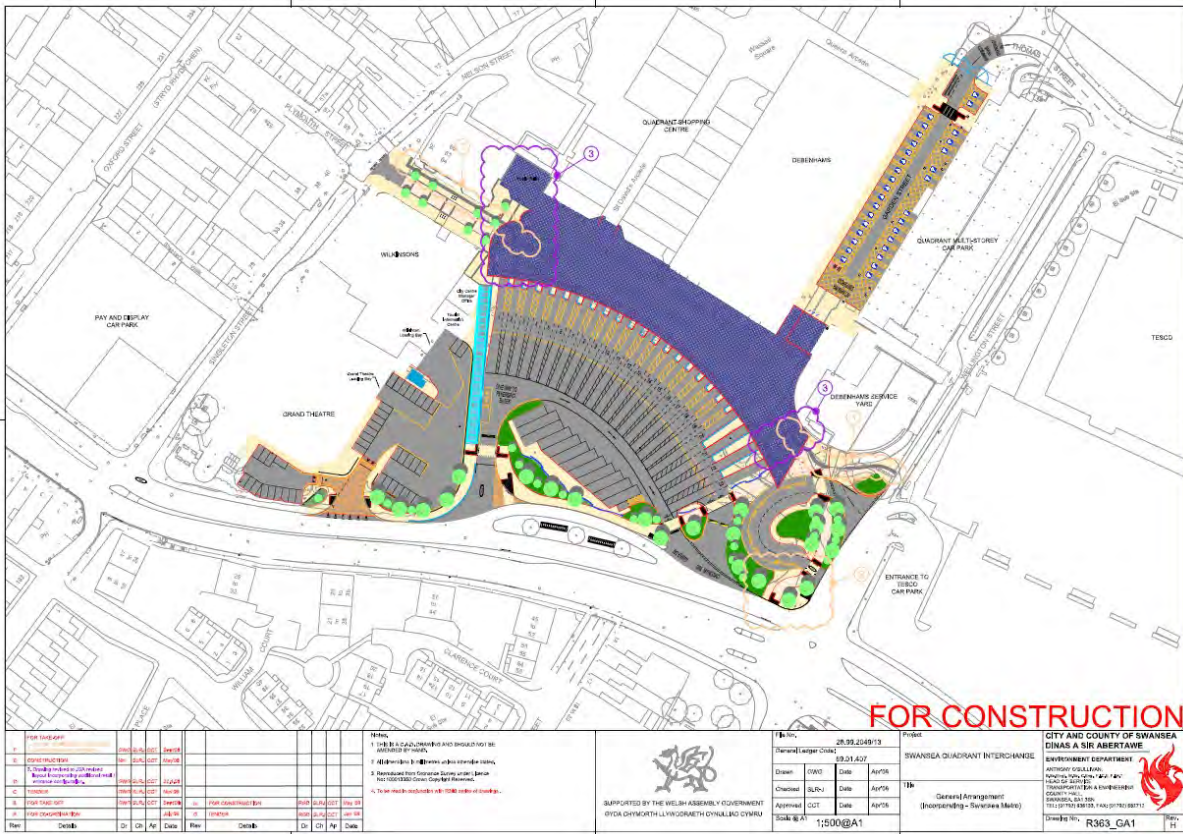
Quadrant bus station

The City and County of Swansea has now completed a scheme to replace the old Quadrant bus station with a modern Transport Interchange to cater for both buses and coaches, including Swansea Metro vehicles, on a larger footprint. The old Quadrant bus station was outdated in terms of passenger convenience, comfort and security. The Council's aspiration was for a modern transport interchange with high standards of cleanliness and security. The refurbishment of the Quadrant bus station was identified as a high priority in the Swansea Local Transport Plan 2000 – 2005 and was completed during November/December 2010.

Sketch 1 indicates a schematic layout of the scheme with artist's impressions of the façade given below as sketches 2-4. A plan of the development area is given below as map 15.



Sketch 2 Quadrant Transport Interchange off Westway, Swansea



Map 15 – Quadrant Transport Interchange off Westway, Swansea



Sketch 3 Quadrant Transport Interchange



Sketch 4 Quadrant Transport Interchange

Blocks of flats can be seen opposite the completed Quadrant Interchange. These blocks tend to be occupied by the elderly with warden accommodation. A basic Screening Assessment had been started during 2008 in front of one of the blocks of flats to assess both PM_{10} and NO_2 . The PM_{10} light scattering analyser had suffered numerous breakdowns with the result that little meaningful data is available. Provision of a Thermo PM_{10} FDMS is not feasible due to the practical siting criteria issues to be resolved as well as the costs that would be incurred. Assessment of the new facility is required and will require both traffic counts and PM_{10} measurements to be undertaken. A MetOne EBam PM_{10} analyser was installed on Westway during August 2012 (see Sec 3.5 above) and a PM_{10} assessment will now be made in future reporting. A photo of the site is shown below as photo 19. The MetOne EBam location is labelled within photo 19. Funding to provide a permanent GPRS ATC (site 36) is still being sought.



Photo 19 – Westway MetOne EBam PM_{10} Monitoring Location

Outline of scheme

The main components of the scheme comprised the following elements:

- 20 bus bays,
- 3 coach stands
- 2 Swansea Metro “stations” on Westway.
- 12 lay-over spaces
- Modern coach station facility to serve the long distance services,
- Enhanced passenger concourse with support facilities.
- Safe access to and from West Way
- New staff and office facilities
- Travel Shop (Information/ticket sales area.)
- Shop mobility Facility. In the Garden Street tunnel area
- Associated Retail Units.
- Enhanced links into the Quadrant shopping area.
- Improved access to the Grand Theatre and Wilkinson’s service areas
- Taxi rank for 9 vehicles
- Short stay parking for 5 cars (Passenger pick-up) adjacent to the coach area
- Passenger drop-off area

Movements of buses in and out of the interchange will be capable of being monitored when GPRS ATC site 36 (et al) is installed along Westway.

At present, there is existing relevant exposure within approximately 25m of the curtilage of the development. From guidance contained within LAQM.TG(09) box 5.3 section A7 page 5-19 relevant exposure is required to be assessed either within 10m of any part of the bus station where buses are present or within 20m if the bus/coach station is within a major conurbation. Major conurbation is not defined within box 5.3 section A7 page 5-19 but it is defined as a population greater than 2 million within box 5.3 Sections A3 and A4 pages 5-12 to 5-15. Major conurbation is therefore, in this scenario, taken to be the same meaning given within sections A3 and A4, which in the case of Swansea, with a population of just under a quarter of a million clearly does not apply.

3.2 Other Transport Sources

3.2.1 Airports

Swansea does have a small airport located at Fairwood Common, Upper Killay that has previously been used as a “regional airport”. However, guidance within LAQM.TG(09) box 5.4 Section B1 page 5-21 indicates that assessment for NO₂ will only be required should relevant exposure exist within 1000m of the airport boundary and if the total equivalent passenger throughput exceeds 10 million passengers per annum. Freight traffic is minimal.

There are receptor locations within 500m of the airport boundary but clearly the airport does not see passenger numbers in excess of 10 million per annum.

The City & County of Swansea confirm there are no airports meeting the assessment criteria in the Local Authority Area.

3.2.2 Railways (Diesel and Steam Trains)

3.2.3 Stationary Trains

Landore Diesel Sheds is a major servicing centre primarily for Inter City 125 high-speed trains (HST) and is located within the Swansea Air Quality Management Area 2010. The site operates on a 24 hour seven day a week basis. An aerial view of the site is shown below as map 16 indicating the proximity of domestic dwellings to the site

Site activities can be broadly classified into two categories: maintenance and servicing. Maintenance tends to occur within the sheds themselves. Here, engines are repaired, maintained and tested. It is not uncommon for several HST engine units to be under test at the same time. Exhaust emissions are vented through cowl housings to the roof of the sheds.



Map 16 – Landore Diesel Sheds and Surrounding Area

© Crown Copyright and database right 2013. Ordnance Survey 100023509

Maintenance operations involve the routine cleaning and refuelling of the HST units in dedicated sidings. Extensive warm up periods are mandated prior to movement of the HST train back out and onto the main line.

Guidance within LAQM.TG(09) requires the identification of locations where diesel locomotives are regularly stationary for periods of more than 15 minutes³⁶. This is clearly the case at Landore Diesel Sheds but the guidance also indicates exposure potential for regular outdoor exposure to members of the public within 15m of the stationary locomotives. The nearest façade of any dwelling is approximately 35m from the servicing bay. There is also a public “open grassed area” within approximately 40 m of the servicing bays.

Observations at this location have indicated very infrequent use by the general public. Bearing in mind that the majority of servicing occurs during the night-time hours it is concluded that there is no relevant exposure from this activity at this location. A similar view has been formed over the use of the main shed complex.

³⁶ LAQM.TG(09) Box 5.4 Section B2 Approach 1 page 5-22

An identical view has also been formed for the activities currently undertaken at Swansea Central railway Station. Inter City 125 units and other diesel locomotives are left running during periods leading up to the scheduled service departures. However, there is no regular outdoor exposure of members of the public within 15m of the stationary locomotives. It should be noted that a development on the former Unit Superheaters site at The Strand proposes several 5 story block of apartments/student flats. These apartments when complete will overlook the main platform area at Swansea Central Railway Station. The impact of the rail activities will be assessed once these apartments are complete and occupied.

“Sprinter services” are offered to/from several local stations both on the mainline Swansea – Paddington London line and also the West Wales line. However, these sprinter services are not stationary at these very local stations for periods of 15 minutes or more. Consequently, their impact is minimal

3.2.4 Moving Trains

Guidance within LAQM.TG(09) box 5.4 Section B2 – Approach 2 page 5-23 indicates a number of criteria to determine suitable assessment. The main Swansea to Paddington London rail line is listed within table 5.1 indicating rail lines with heavy traffic of diesel passenger trains. In addition, approach 2 requires identification of whether the background annual mean NO₂ concentration is above 25ug/m³. In order to answer this question, use has been made of the 1k by 1k background maps from <http://laqm.defra.gov.uk/maps/maps2010.html>. The text file for NO₂ background concentrations for 2012 has been imported into Arcview 3.3 GIS and examined. If the background NO₂ 1k by 1k concentrations are indexed in descending order it can be seen that the maximum 1k by 1k grid square (266500 196500) for 2012 returns a value of 25.28ug/m³. If this grid point is plotted it can be seen that the centre of the 1k by 1k grid square is just north of the main Swansea to Paddington London line in the Plasmarl area of Swansea. The next highest 1k by 1k grid square (265500 193500) for 2012 is 21.08ug/m³ and is located just north of Alexandra Road in the city centre and is approximately 270m from Swansea Central Railway station.

Local knowledge of the path of the Swansea to Paddington London railway line would also indicate that there is no potential for **long-term** exposure within 30m of the edge of the tracks.

The above views have been supplemented by examination of the LAQM Support website at <http://laqm.defra.gov.uk/supporting-guidance.html> which includes an item under Supplementary Guidance - "**Guidance on assessing emissions of railway locomotives**". The link http://laqm.defra.gov.uk/documents/Railway_Locomotives_100209.pdf contains an Adobe PDF document entitled – Guidance on Assessing Emissions from Railway Locomotives dated 10th February 2009. This document details within table 1 the rail lines with a heavy traffic of diesel passenger trains. The Paddington to Swansea line is listed. Table 2 of the document lists 35 local authorities where the 2008 background NO₂ concentration is expected to exceed the threshold for assessment of 25 ug/m³. The City and County of Swansea were not one of the 35 local authorities identified.

In view of the above, there is no requirement to proceed further with a Detailed Assessment for NO₂ at locations within 30m of the Swansea to Paddington London railway line.

3.2.5 Ports (Shipping)

Swansea is Associated British Ports (ABP's) most westerly South Wales port and has developed a trade base with North and Western Europe, the Mediterranean and also with Northern Ireland and the Irish Republic. The port's major cargo-handling trade is receiving and shipping steel cargoes for Tata. It is equipped with a wide range of heavy-duty handling equipment offering quayside cranes and a range of forklift trucks with capacities of up to 40 tonnes. Other traffics include containers, forest products, bulk cargoes, liquid bulks and general/project cargoes. The port can accommodate vessels up to 30,000 dwt.

Guidance within LAQM.TG(09) box 5.4 Section B3 Shipping page 5-24 requires the determination on the number of ship movements per year and also to establish if there is relevant exposure either within 250m of the quayside and manoeuvring areas should shipping movements be between 5000 – 15000 per year or exposure within 1km of the

quayside and manoeuvring areas should shipping movements exceed 15000 per year. Enquiries with the Port Health Authority indicate that during 2012 there were a total of 441 vessels visiting the port which equates to 880 total shipping movements (two vessels came into port but never left !). If the local tug fleet is also taken into consideration this would still not bring the number of movements to above the 5000 threshold required for assessment.

For sake of completeness, there are residential properties located on Bevans Row, Port Tenant within 230m of the Kings Dock quayside. An ever increasing number of residential flats are being constructed on the nearby SA1 development sites. At present these new residential units are outside of the scope of assessment and are likely to remain so given the decreasing number of shipping movements seen at the port. A continuing decrease in movements has been observed during recent years and this has been compounded by the Swansea-Cork ferry ceasing operation from the port during 2011.

3.3 Industrial Sources

3.3.1 Industrial Installations

3.3.2 New or Proposed Installations for which an Air Quality Assessment has been carried out.

For information, during November 2007 the Secretary of State granted planning permission for Prenergy Power Limited to operate a renewable energy power station capable of generating some 350 MW of electricity within Neath Port Talbot.³⁷ The process will involve the combustion of approximately 2.5 to 3 million tonnes of woodchip per annum. The plant has not been constructed yet.

An environmental statement was provided and dispersion modelling was carried out using ADMS. This work stated that the impacts of carbon monoxide, nitrogen dioxide, PM₁₀ and sulphur dioxide would be insignificant in respect of the Air Quality Objectives.

³⁷ Source Neath Port Talbot Council

Further dispersion modelling work was required as part of the Environment Agency permit application. Neath Port Talbot council have accepted the conclusions of the Environmental Statement. The location of the Prenergy Power Ltd site is shown below as map 17.



© Crown Copyright and database right 2013. Ordnance Survey 100023509

Map 17 Location of Prenergy site within Neath Port Talbot

Vale, Clydach

Proposals by Vale (see map 8 within section 2.1.10 for location and surrounding area) to develop an energy from waste Pyrolysis Plant at its refinery at Clydach in the Swansea valley may have air quality impacts locally. Whilst Planning Permission has been granted and a permit issued for operation by the now Natural Resources Wales, the project is on hold at present due to the economic downturn. Regular updates will be provided in future reporting.

3.3.3 Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been Introduced

The City & County of Swansea confirms that there are no industrial installations with substantially increased emissions or new relevant exposure in their vicinity within its area or nearby in a neighbouring authority.

3.3.4 New or Significantly Changed Installations with No Previous Air Quality Assessment

The City & County of Swansea confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

3.3.5 Major Fuel (Petrol) Storage Depots

There are no major fuel (petrol) storage depots within the Local Authority area.

3.3.6 Petrol Stations

Guidance contained within LAQM.TG(09) indicates that there is some evidence that petrol stations will emit sufficient benzene to put the 2010 $5\mu\text{g}/\text{m}^3$ objective at risk if the throughput exceeds 2000m^3 of petrol, especially if combined with higher levels from a nearby busy road³⁸. A busy road is defined as one with more than 30,000 vehicles per day. The guidance goes on to indicate that relevant exposure within 10m of the fuel pumps should also be present if the above criterion is met.

Details from the Authorisations held by the authority have been examined. There are twenty nine authorised petrol filling stations within the authority's area, with fourteen of these having a throughput greater than 2000m^3 . Of these fourteen stations, seven are fitted with stage 2 vapour recovery, with the remainder being fitted with stage 1 vapour recovery. Relevant exposure was examined for each location using ArcView GIS ver

³⁸ LAQM.TG(09) Box 5.5 Section C3 petrol Stations page 5-40

3.3, whereby 10m radius were plotted from the actual pumps to access if relevant exposure existed. Of the 14 petrol stations examined, relevant exposure does not exist at any, but, as in the case of previous rounds of review and assessment, two cases deserve explanation.

One petrol filling (Mumbles Road, Blackpill) station meets the above criteria (throughput, traffic flows and relevant exposure) to have warranted further investigation. For the sake of completeness the second station (Sketty Filling Station, Gower Road) partially meets the criteria (throughput and relevant exposure).

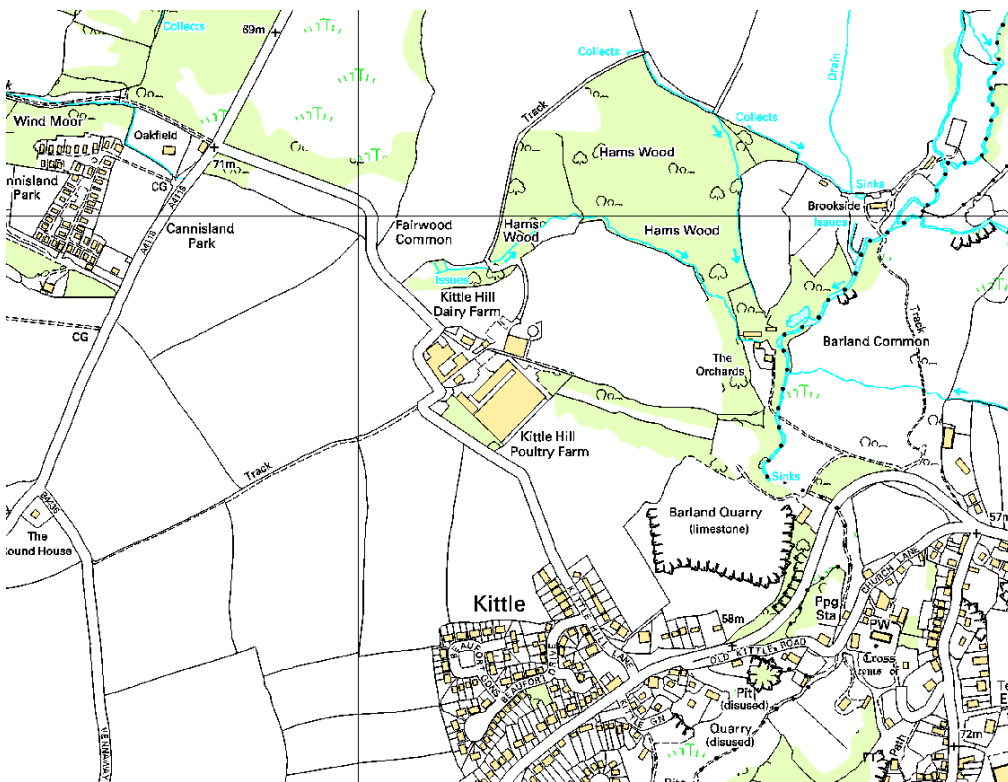
During previous assessment works (USA July 2004) it was established that whilst both of these filling stations have dwellings located within 10m of the fuel pumps, these properties have been purchased by the fuel companies and have been left vacant. These arrangements were negotiated with the relevant fuel companies many years ago, particularly to resolve late night noise nuisance complaints.

A major food retail outlet located in Gorseinon has indicated their intention to construct a petrol station to the existing rear car park of the outlet. The nearest dwellings are though to be located greater than 10m away from the proposed location of the nearest pump but a doctor's surgery may be within this distance. Despite this surgery not being a relevant receptor in terms of LAQM, the authority will seek to resolve any potential issues once a planning application is received.

The City & County of Swansea confirms that there are no petrol stations meeting the specified criteria within the local authority area

3.3.7 Poultry Farms

LAQM.TG(09) contains guidance on assessing potential exceedences of the PM₁₀ objectives associated with emissions from poultry farms. Guidance is contained within box 5.5 Section C4 page 5-41. There are two poultry farms located within the authority's area. The first at Kittle Hill Farm is shown below within Maps 18 and 19.



© Crown Copyright and database right 2013. Ordnance Survey 100023509

Map 18 – Location of Kittle Hill Poultry Farm, Kittle, Gower, Swansea



Map 19 – Aerial view – Kittle Hill Poultry Farm, Kittle, Gower, Swansea

© Crown Copyright and database right 2013. Ordnance Survey 100023509

Previously under the Environment Agency permit application granted during 2007 up to a total of 400,000 chicken laying hens were permitted to be housed, split over 3 sheds containing approx. 100,000 birds each with a deep litter pit system of waste collection. However the Environment Agency during May 2011 granted a PPC permit (Ref JP3838KF) to permit up to 400,000 birds to be housed. However, information to hand indicates that the operators only intend to house 295,680 birds at present due to a planning restriction. As indicated within map 19 above, the direction of the mechanical ventilation of the sheds is in a south easterly direction between the sheds and then finally out, over a field adjacent to the premises. The nearest domestic receptor/dwelling is approximately 290m from the sheds. However, there is relevant exposure from a residential property that forms part of the farm itself. There is therefore, relevant exposure within 100m of the sheds housing the birds. There have been previous historical complaints regarding dust from local residents but these were not substantiated. Numerous complaints have also been received regarding noise from the ventilation system.

Whilst there is relevant exposure as defined by LAQM.TG(09) box 5.5 Section C4 page 5-41 at Kittle Hill Farm itself, **the number of housed birds remains below the assessment threshold**. In addition, a separate establishment at Highfield Poultry Farm, Parkmill, Gower, Swansea, now receives birds a few days old which are then taken

away to a farm in Pembrokeshire for completion. Map 20 below indicates the proximity of this establishment to local residential properties.



Map 20 – Highfield Poultry farm, Parkmill, Gower.

© Crown Copyright and database right 2013. Ordnance Survey 100023509

Previously under the Environment Agency permit application granted during 2007 up to a total of 120,000 birds were permitted to be housed within several sheds that are provided with mechanical ventilation. The current EA PPC permit (Ref VP3039UR) repeats this number of permitted birds at this establishment. However, only 105,000 birds are currently on site. Residential properties are within 80m of the sheds at Highfield Poultry Farm with the proprietor’s residence being located within 15m of the sheds.

There have been numerous historical complaints regarding noise from the ventilation system. Again, whilst there is relevant exposure as defined within LAQM.TG(09) box 5.5 Section C4 page 5-41 at Highfield Poultry Farm itself, **the number of housed birds falls below the assessment threshold.**

3.4 Commercial and Domestic Sources

3.4.1 Biomass Combustion – Individual Installations

3.4.2 Swansea Leisure Centre

There is a wood-chip biomass burner installation at the new LC2 Leisure Centre. However, due to control issues, the burner has never operated

The City & County of Swansea confirms that there are no longer any Biomass Combustion – Individual installations meeting the specified criteria within the local authority area

3.4.3 Biomass Combustion – Combined Impacts.

LAQM.TG(09) outlines within Section D.1b of chapter 5 a method to assess the impact of small, domestic biomass combustion. It has been noticed through conversations held with colleagues within Building Control that a record of domestic biomass installations is held where those installations have been undertaken by a HETAS approved installer of an approved HETAS appliance.

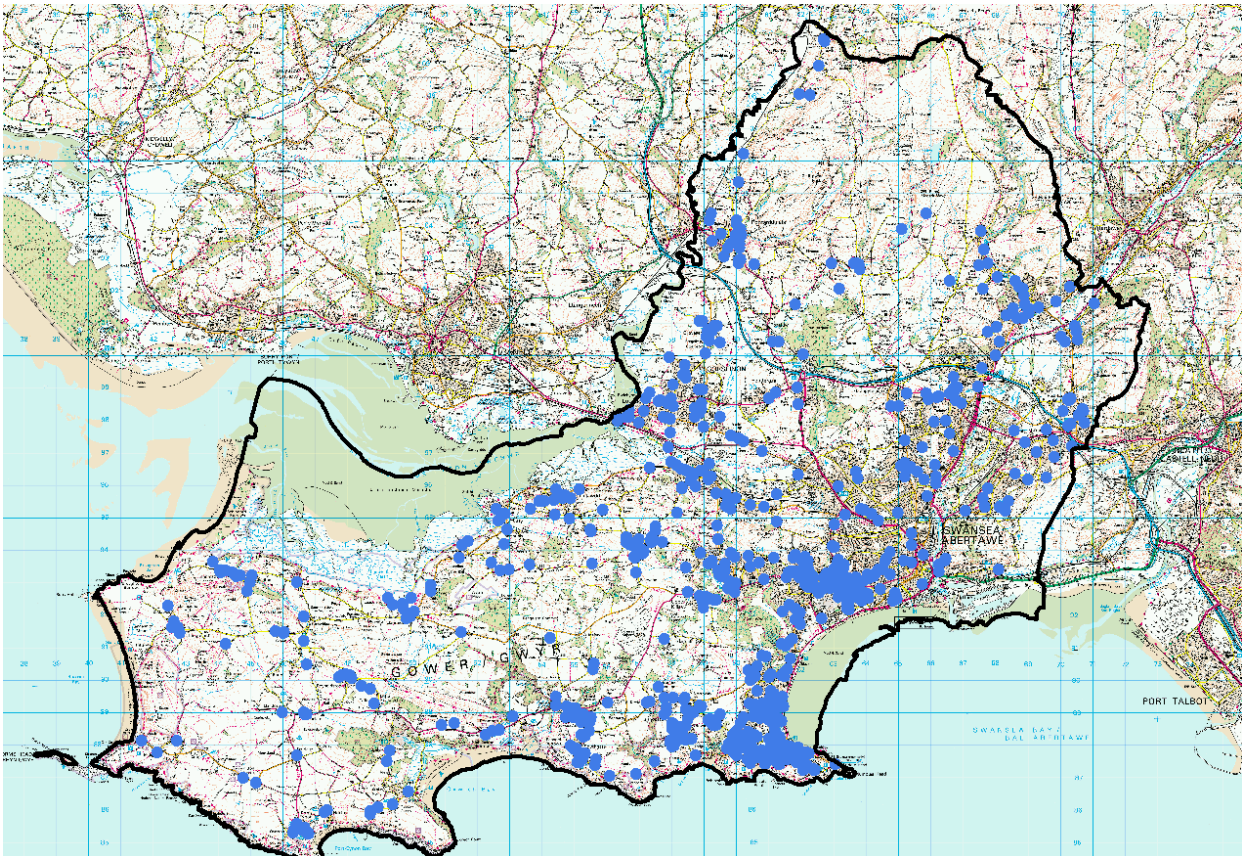
HETAS Ltd approval of appliances consists of assessment of a type test report from a Notified Laboratory to the relevant BSEN supported by the manufacturer's production control, followed by periodic surveillance of the product as appropriate. HETAS Ltd also checks manufacturers Installation and Operating Instructions to confirm that they meet UK Building Regulations and conform to UK practice. While the appliance remains in the Guide, this surveillance continues, to ensure that the product remains the same as the original unit tested. Any solid fuel appliance that was approved at the time of manufacture, and which was subsequently installed, maintains its approved status even if at a later date the model is removed from the Guide. New units of the model, produced after removal from the Guide are, however, not approved as they will have been produced at a time when the product surveillance by HETAS Ltd had ceased. It would

not, therefore, be possible to ensure that the new units were the same as the unit originally tested.

Building Control has supplied a list of notifications received under the above scheme, complete with Ordnance Survey easting and northing coordinates to allow plotting within ArcView 3.3 GIS system. The only problem found is that the description on the registration doesn't specifically state the type of appliance i.e. wood burners. It is thought that wood-burners are the more likely installation to be registered within domestic premises. With this limitation in mind and accepting the scope of description, the complete list has been plotted so that an understanding of the spatial distribution of appliances can be made. It is important to recognise that it is probable that appliances have been purchased and installed by home owners themselves or installers that do not "comply" with the above scheme and that the situation may be different to that presented within map 21 below.

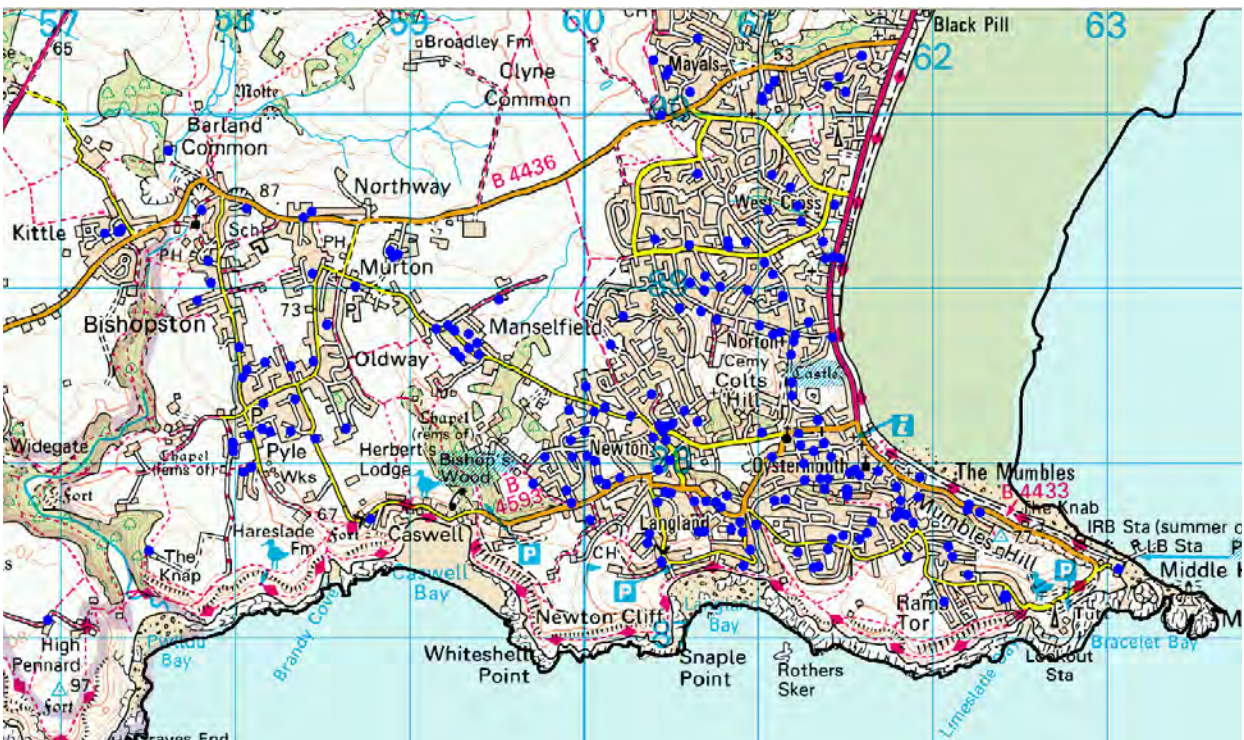
As can be seen from map 21 there are several distinct clusters which, for the purposes of this report are assumed to be primarily wood-burning appliances. The major cluster is within the affluent area(s) of Mumbles, Bishopston, Langland and Mayals of south-west Swansea. The authority investigated 20 complaints during 2011 relating to nuisance from "wood-burning appliances". During 2012 the number of complaints received and investigated was 22. Over 50% of the complaints during both 2011 and 2012 emanated from the above mentioned areas. The majority of the complaints related to smoke nuisance where flue terminals were not extended sufficiently or poorly sited.

For information, map 22 indicates the location of installations within the above areas.



© Crown Copyright and database right 2013. Ordnance Survey 100023509

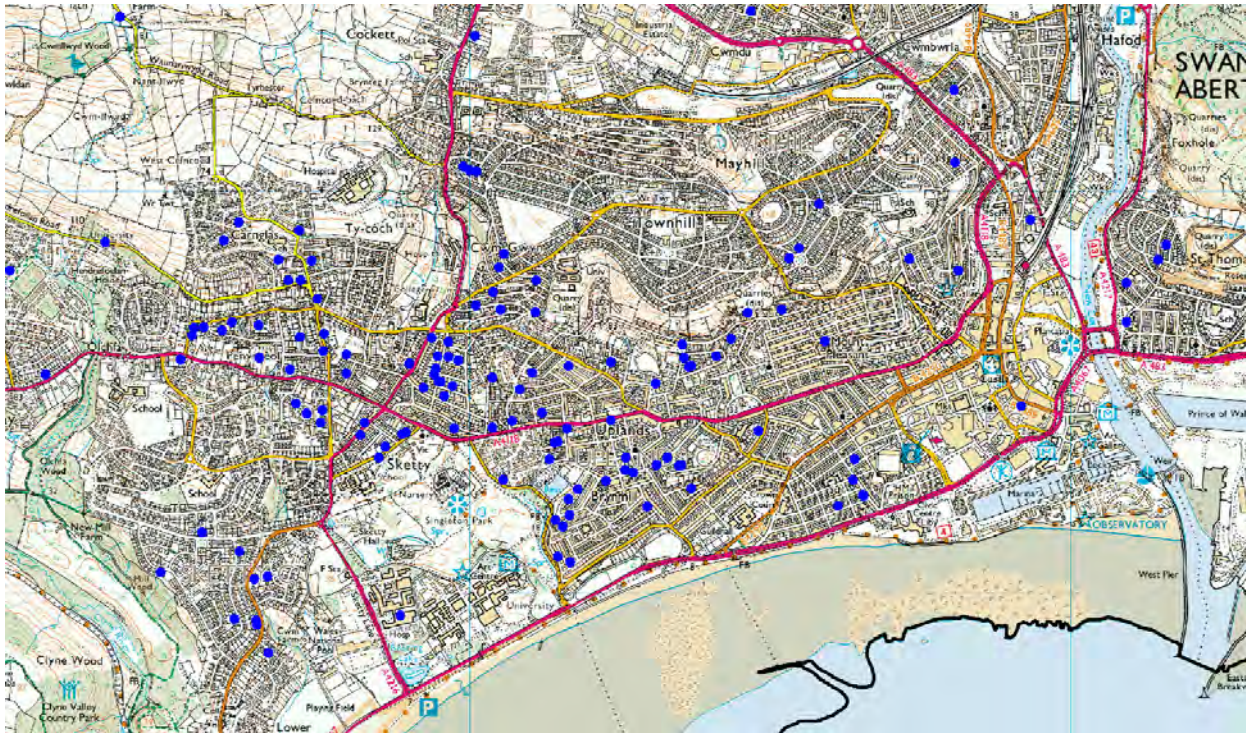
Map 21 – Biomass Combustion



Map 22 © Crown Copyright and database right 2013. Ordnance Survey 100023509

From map 21 another cluster of installations can be seen within what appears at first to be the city centre. However, map 23 indicates that the vast majority of this cluster is

within areas just outside of the city centre, primarily within Tycoch, Sketty, Brynmill and Uplands.

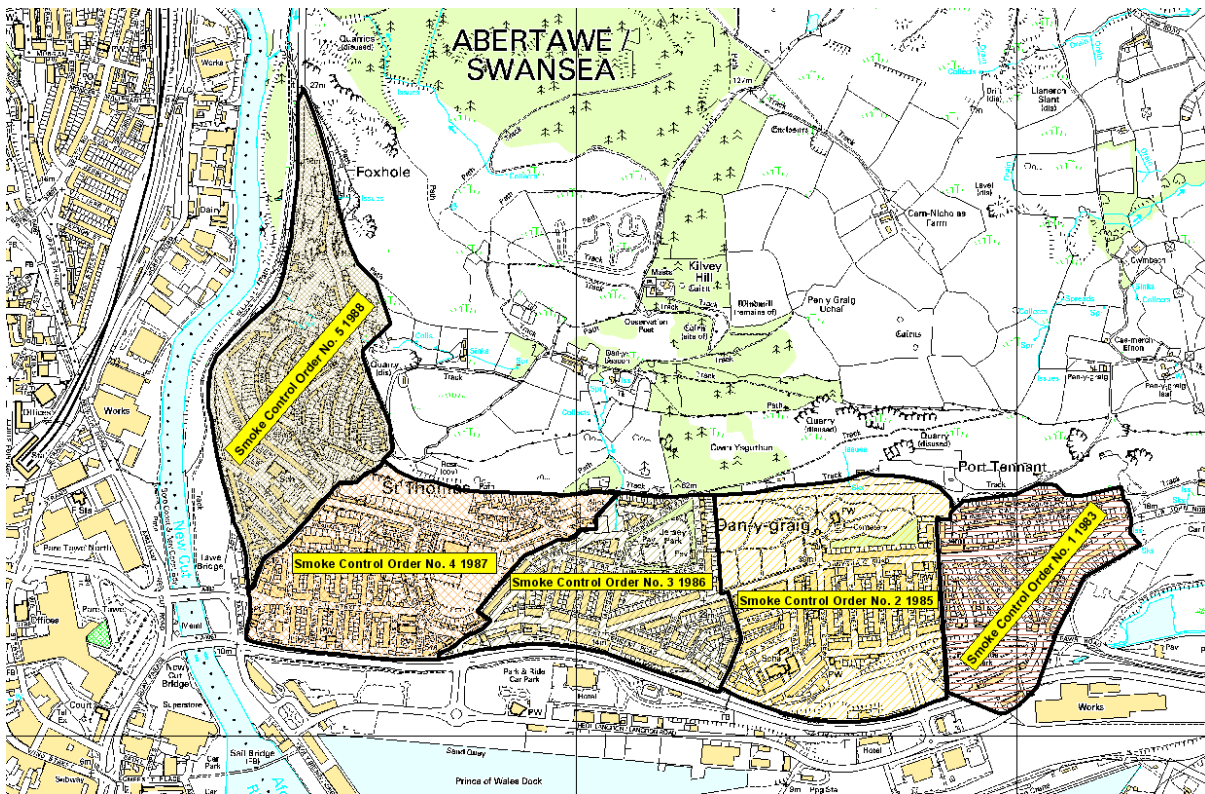


It is clear from the basic spatial picture presented above that in order to undertake the screening as required by LAQM.TG(09) Box D.1b that details need to be clarified on the type of installation. However, the number of installations within individual 500m by 500m squares is not thought likely to lead to unacceptably high PM₁₀ concentrations. This view is supported by comments within LAQM.TG(09) box D.1b (PM₁₀ Overview) but it is recognised that more details are required to undertake the screening method as described within LAQM.TG(09). Discussions will continue with Building Control to establish a method of appliance identification within the installation notifications that are received by the authority. These discussions have not as yet, reached any conclusions on how the reporting of these installations can be improved.

3.4.4 Domestic Solid-Fuel Burning

Swansea City Council, the predecessor to the City and County of Swansea, declared 5 Smoke Control Areas within the Port Tennant and St.Thomas areas between 1983 and 1988 – these Orders can be seen below within map 24.

Whilst these orders limited the burning of solid fuel in approved appliances to smokeless solid fuels, the tradition of burning solid fuel has dramatically declined within Swansea over the last two decades, not solely because of the declaration of the Smoke Control Areas but as part of the national trend away from coal to natural gas consumption as a domestic fuel. This trend continues to this day. Therefore, despite smokeless solid fuel having a similar sulphur content to coal, the burning of such fuels in any approved appliances that may remain in these areas is thought to be minimal.



© Crown Copyright and database right 2013. Ordnance Survey 100023509

Map 24 – City & County of Swansea Smoke Control Orders 1-5

Guidance within LAQM.TG(09) requires the identification of significant areas of domestic coal burning. Significant areas of domestic coal burning are given as a density of premises burning coal exceeding 50 per 500 by 500 meter area³⁹. Local knowledge would indicate that there are no longer any areas within Swansea that have this density of domestic coal burning. This situation has not altered from the previous Updating and Screening Assessments/Progress Reports submitted.

The actual number of properties within the City and County of Swansea’s area that burn solid fuel as the primary fuel for central heating is given as 4,398 within the 1997 Welsh

³⁹ LAQM.TG(09) box 5.8 section D2 page 5-51

Household Information Survey published in 2000. This equates to 4.9% of properties within Swansea. For completeness, the number of properties burning fuel oil as their primary source of heating is given as 1,759, which equates to 2% of properties. The figures for the whole of Wales are 7.4% and 5.3% respectively. In reality, the number of properties that burn solid fuels has in all probability, reduced significantly from those published in the Welsh Household Information Survey.

The City & County of Swansea confirms that there are no areas where the burning of Domestic Solid Fuel meets the specified criteria within the local authority area

3.5 New Developments with Fugitive or Uncontrolled Sources

Following the rationale mentioned elsewhere within this report, details previously reported are reproduced here for completeness. Guidance within LAQM.TG(09) box 5.10 Section E page 5-53 indicates an approach to adopt to assess fugitive sources of PM₁₀ from a number of sources including quarrying, landfill sites, coal and material stockyards, or materials handling. Where dust is emitted, a proportion, (typically about 20%) will be present as PM₁₀. The guidance indicates that relevant exposure “near” to the sources of dust emission be established. Near is defined as within 1000m if the 2004 objective PM₁₀ annual mean background concentration taken from background maps is greater than or equal to 28µg/m³, within 400m if the 2004 objective PM₁₀ annual mean background concentration taken from background maps is greater than or equal to 26µg/m³, and within 200m for any background.

Based on the 1k by 1k grid squares background PM₁₀ maps downloaded for 2012 from <http://laqm.defra.gov.uk/maps/maps2010.html> , and after indexing the field Total_PM₁₀ it can be seen that the maximum 1k by 1k grid square (266500 195500) background concentration is 14.98ug/m³. Therefore, “near” is taken to be the latter distance i.e. 200m.

3.5.1 Tir John Landfill Site

LAQM.TG(09) Section E.1 of box 5.10 expands on the issue of relevant exposure if exposure is within 50m of an offsite road used to access the facility. These sections of road which may extend up to 1000m from the site entrance are considered to be near, as long as the background concentration is above $25\mu\text{g}/\text{m}^3$ and there are visible deposits on the road. Map 25 below shows the situation currently at Tir John landfill site. There is very marginal relevant exposure within 50m from the main access road at properties on Wern Terrace, Port Tennant (shown by red circle). In addition, the former Marcroft Engineering site has been developed over recent years to provide numerous new properties. As of March 2013, it would appear that the vast majority of the site is now complete with only a small parcel to the south west section available for any additional construction. The development can be seen below within the Ordnance Survey MasterMap data as map 25. Newly constructed properties to the east of the development are now within the 50m radius from the haul/ access road. Obviously, when the development is fully completed, dozens of new properties will fall within the 50m radius (red circles) from the access road. At present, as the maximum background PM_{10} concentrations do not exceed $26\mu\text{g}/\text{m}^3$ anywhere within the authority's area and, as there are no visible deposits on the road, these locations can be discounted. This view is reinforced by knowledge that no complaints have been received from either existing or the new residents surrounding the landfill site.



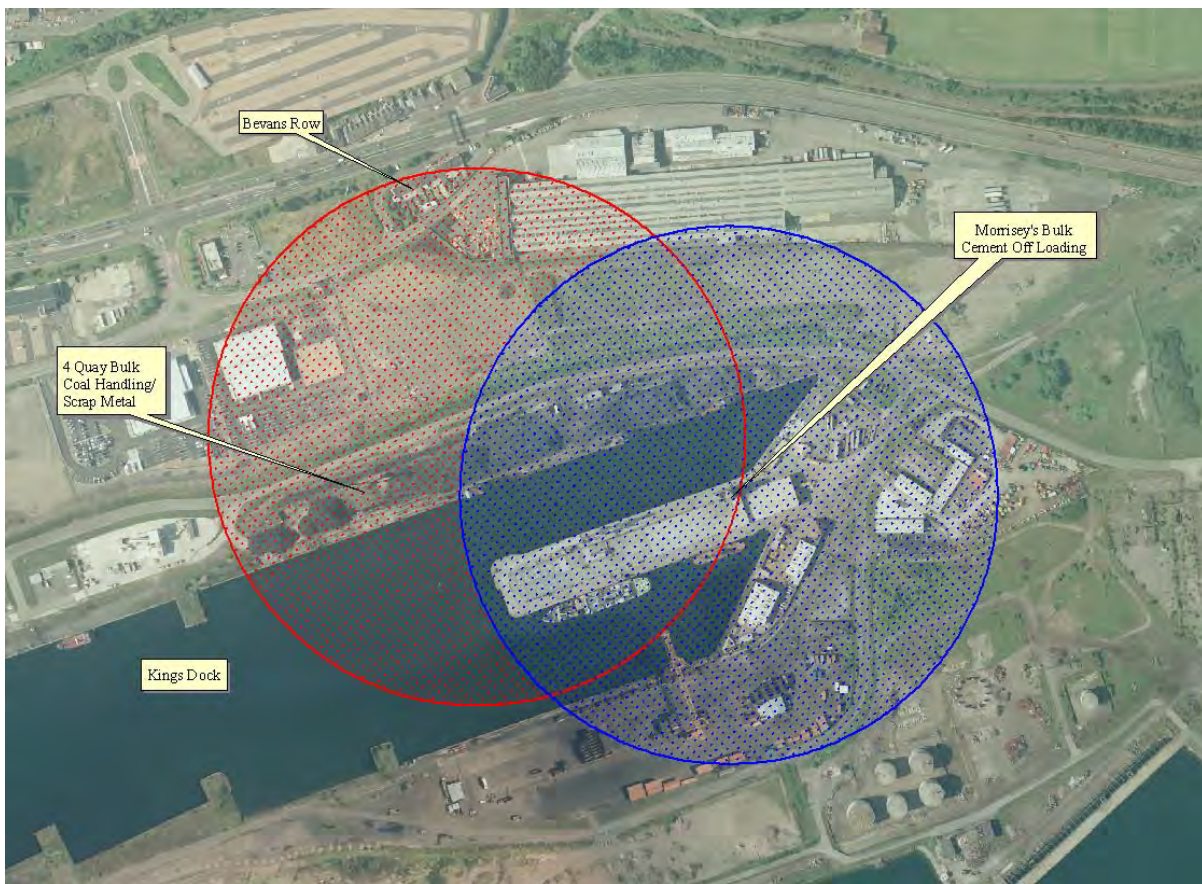
Map 25 –Tir John Landfill Site, Port Tennant, Swansea

© Crown Copyright and database right 2013. Ordnance Survey 100023509

There are no receptor locations within 200m of the main landfill area (blue circle). The Environment Agency (since April 2013 in Wales now Natural Resources Wales) refused to issue a permit for the ongoing use of Tir John to the LAWDC – Swansea Waste Disposal Company as a landfill site. The site therefore ceased operation for several years, pending an appeal by the LAWDC. The LAWDC subsequently won the appeal and the site is now once again fully operational. However, during 2012 the LAWDC was disbanded and the operations at Tir John have been brought back under the direct control of the authority.

3.5.2 ABP Port of Swansea

There are operations carried out within the ABP Port of Swansea that have the potential for fugitive emissions i.e. 4 Quay bulk coal-handling facility and Morrissey's Cement Bulk off loading facility both located around the Kings Dock. The Port Health Authority regulates both of these operations. Map 26 below identifies both these activities at Kings Dock. 4 Quay handles a bulk coal handling facility on the dock side.

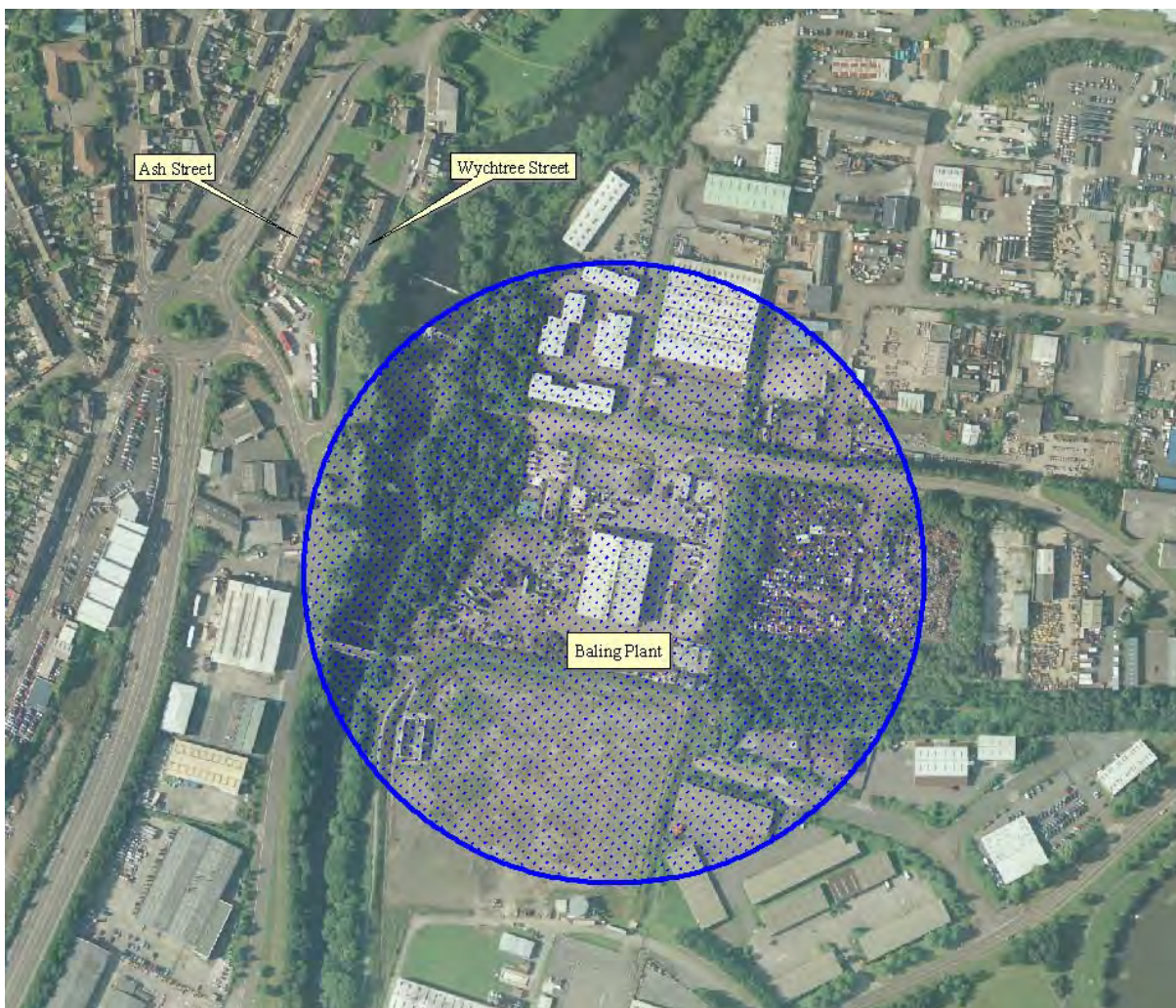


Map 26 – Location of 4 Quay and Morriseys Bulk Cement Kings Dock, Swansea
© Crown Copyright and database right 2013. Ordnance Survey 100023509

Lately stockpiles of scrap metal are also handled on 4 Quay. Receptor locations at Bevans Row, Port Tenant are located within 200m of the bulk coal/metal stockpiles (red circle). Litigation several years ago, resulting from an action from residents of the wider Port Tenant community resulted in a High Court judgement ruling in favour of the operators. It is not intended to revisit this issue in the light of the complete lack of dust complaints from Bevans Row. Morrisey's cement bulk off loading facility has been the subject of enforcement actions by the Port Health Authority to affect abatement techniques. Negative pressure systems, combined with a new bagging plant and construction of internal walls within the offload area have now negated the previous substantial fugitive emissions from the offload process. There is no relevant exposure within 200m of the bulk cement offload operations (blue circle).

3.5.3 Waste Management Facility – Baling Plant

The LAWDAC operated the Baling Plant off Ferryboat Close, Morriston Enterprise Park until the authority disbanded the LAWDAC during 2012 and took back complete operational control of the facility during 2012. The facility handles all domestic waste arising within Swansea as well as being the main recycling centre within Swansea. Domestic waste is transported into the Baling plant pending its bulk transportation to Tir John Landfill site. Map 27 shows the proximity of the facility to the nearest receptor locations.



Map 27 – Baling Plant, off Ferryboat Close, Morriston Enterprise Park

© Crown Copyright and database right 2013. Ordnance Survey 100023509

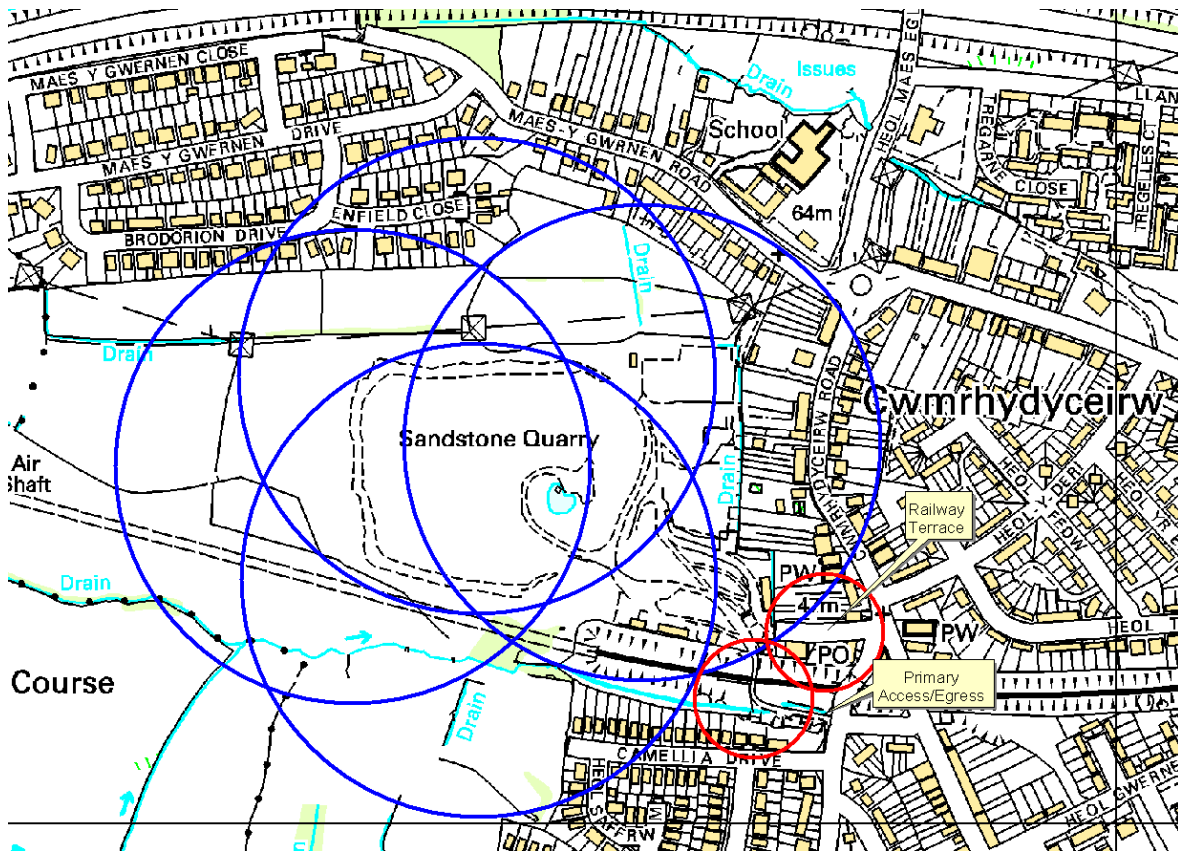
There have been numerous complaints of odour spanning several years, resulting mainly from the composting activities at the facility, but no substantive dust complaints.

In any case, with reference to LAQM.TG(09) box 5.10, there are no receptors within 200m of the centre of the facility (blue circle).

3.5.4 Waste Management Facility – Cwmrhydyceirw Quarry

Cwmrhydyceirw Quarry has previously been used as a landfill site up until the late 1990's for low grade industrial as well as domestic waste arising. However, following the refusal of the Environment Agency to issue a permit for its operation, the facility closed. The facility remained dormant with low maintenance aftercare operations being undertaken until the site was purchased by new operators. Following protracted negotiations between the Environment Agency and the new owners, a permit was issued for deposits of waste to recommence following extensive preparatory works. These preparatory works included the excavation of previously deposited material, construction of suitable lined cells with the excavated waste being replaced within the new lined cells. Following completion of the new cells, new waste will be permitted to be deposited. These preparatory works obviously had the potential to emit substantial fugitive emissions as well as odour nuisance. Discussions commenced with the operators to establish what monitoring and local liaison was required with local residents. Receptor locations are within 200m. Map 28 below indicates the proximity of dwellings to the facility. 200m radiuses (blue circles) have been taken from the boundary of each side of the facility. Properties at Brodorion Drive, Enfield Close, Maes-y-Gwernen Drive, Cwmrhydyceirw Road, Railway Terrace, Camellia Drive and Heol Saffrwm are within 200m of the operations. For sake of completeness, the main access and egress from the site is from a lane just north of Camellia Drive. There is another access route into the site via Railway Terrace but it was not envisaged that this route would be used due to terraced dwellings fronting directly onto this access route. 50m radius are indicated from these access/egress roads (red circles) but as the background PM₁₀ levels (against the 2004 objective) are below 25ug/m³ they are not considered to be "near".⁴⁰

⁴⁰ LAQM.TG(09) Box 5.10 Section E.1 Fugitive and uncontrolled sources page 5-53



Map 28 – Cwmrhydyceirw Quarry, Cwmrhydyceirw

© Crown Copyright and database right 2013. Ordnance Survey 100023509

As stated within previous reporting, it is not proposed to proceed to a detailed assessment at this stage as the timescale of operations (both remediation and active deposition) are not as yet fully known. The site has once again become totally inactive since 2011. It is now not known what the current owners intentions are with regard to the future use of the site.

The authority commenced a monitoring program during 2010 to assess nuisance dust in the immediate vicinity of the quarry as well as the installation of three real time Etype PM₁₀ analysers upwind of the quarry to enable a preliminary screening of the operations to be made. Etype analysers had been deployed at Cwmrhydyceirw Primary School and within the curtilage of the site behind properties along Cwmrhydyceirw Road at the site boundary during June 2010. A third was planned at a property at Enfield Close These Etype analysers have proven problematic in use elsewhere within Swansea and in light of complete inactivity at the site they were withdrawn from site late 2012 with all nuisance dust slide exposure also ceasing.

Once the authority becomes aware of the owners intentions with the site an update will be provided within any future reporting.

3.6 Operational Opencast Coal Mines or Quarries

There are no operational opencast coal mines or quarries within the Swansea area

The City & County of confirms that there are no new or newly identified local developments which may have an impact on air quality within the Local Authority area.

4 Local / Regional Air Quality Strategy

Air quality was highlighted in the *Swansea Environment Strategy: Time to Change*, which was published by Swansea Environmental Forum (SEF) in 2006. One of the Strategy's five themes is Sustainable Transport and Air Quality – the combination of these two issues reflecting the fact that transport is the main cause of air pollution problems in Swansea. Two of the twenty two strategic priorities in the document relate to air quality – ST3: *Improve air quality and reduce air pollution* and ST4: *Improve air quality monitoring and reporting mechanisms*. A number of air quality measures are also used as indicators for the Strategy.

The Strategy and accompanying biennial action plans are reviewed every two years and in both the 2010 and 2012 reviews, strategic priority ST3 received a red RAG status and ST4 an amber status. The most recent review summary report commented that *“Whilst the monitoring of air pollution in Swansea is still at a high standard, air quality remains a major concern and the Swansea Air Quality Management Area has been extended.”*

The Swansea Environment Strategy and associated action plans and reviews can be accessed from the Swansea Environmental Forum website:
www.swanseaenvironmentalforum.net.

In 2008, air quality was also selected as one of five local environmental issues identified by SEF as requiring greater prioritisation and wider collaboration in order to effect progress. In 2009, SEF convened a task group of officers from various council departments and services to share information on air quality issues and draft an air quality improvement action plan. The task group meetings were chaired by the Director of Environment (who is also chairperson of SEF).

The draft air quality improvement action plan lists eight aims, in order of priority:

1. Develop traffic management systems to reduce air quality impacts
2. Improve monitoring and reporting of air quality
3. Ensure air quality issues are considered in planning processes and major development schemes

4. Reduce the direct impact of the council and partner organisations on air quality
5. Reduce the impact on air quality from journeys to schools
6. Encourage improvements to public transport
7. Arrange research projects to support air quality improvement schemes
8. Reduce air pollution from other sources

Various specific actions were proposed to address these aims and updates on progress with these actions were discussed at air quality task group meetings in 2010 and 2011.

In February 2011, the air quality task group invited Prof. Ronan Lyons of Swansea University Medical School to present on urban design and health. This stimulated much discussion and interest was expressed in a number of potential research projects and initiatives.

In March 2011, Swansea Environmental Forum organised a seminar on Low Emission Zones with speakers from Cardiff University School of Medicine, AEA environmental consultants and the local authority. This was well attended by a variety of stakeholders including hauliers and bus companies, and there was constructive discussion about the potential for an LEZ scheme in Swansea.

Though the task group did not meet during 2012, SEF plans to reconvene the group in 2013.

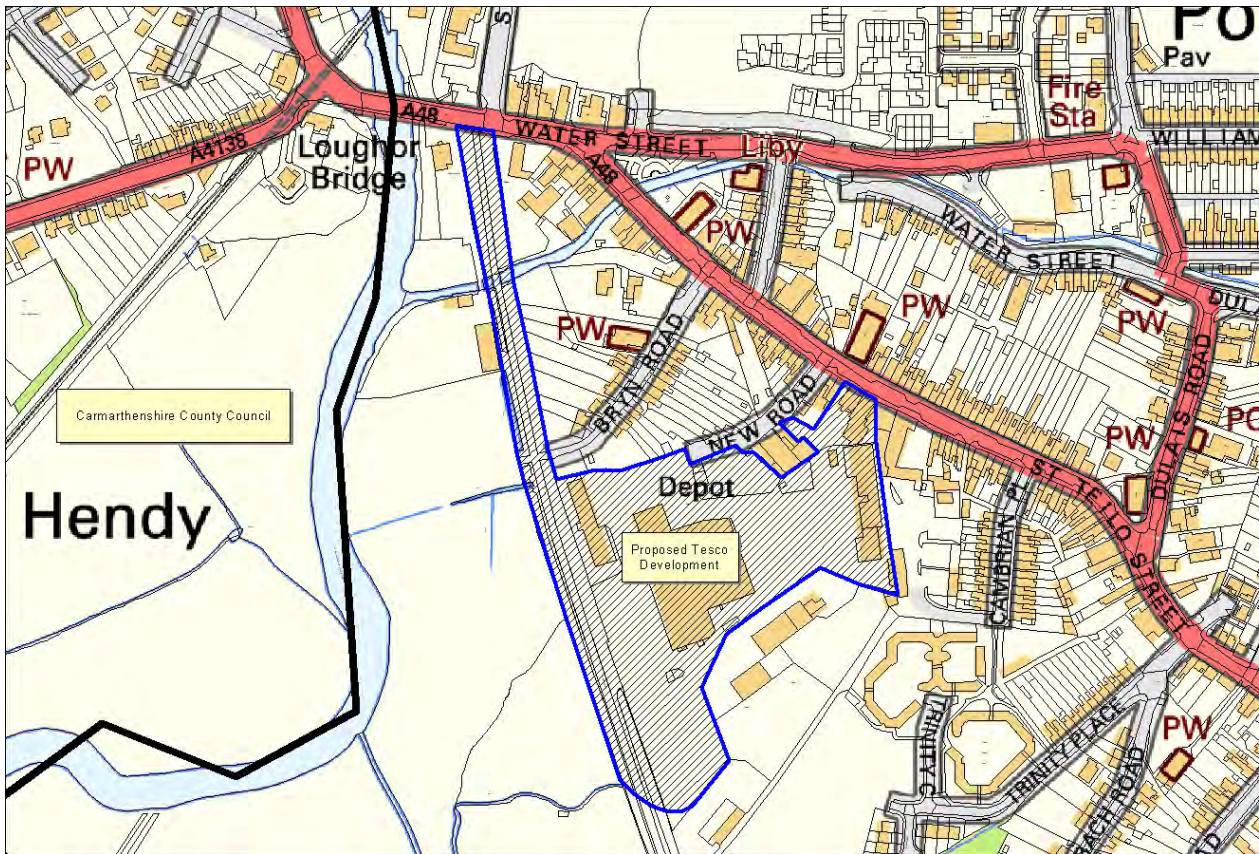
5 Planning Applications

Prior to the economic downturn nationally over the last couple of years, Swansea had seen in the preceding years, a substantial amount of interest in development of both green field sites and brown field sites. The catalyst for this upsurge in development was undoubtedly the DIEN (Department of Innovation Enterprise and Networking – formally the Welsh Development Agency) led redevelopment of the old docklands within Swansea Port that has become known as the SA1 development. This major investment site has seen developers submitting Planning Applications both within the SA1 area and more lately outside of that area but to the main within the influence zone of the SA1 development.

Details of all major projects known of are summarised below as some developments have the potential to impact upon air quality. In the main, these impacts have largely been resolved through the planning process. Some development sites have been completed while others remain either in the early stages of construction or of the planning processes. These details have previously been reported fully within the Updating and Screening Assessments and Progress Reports. Some application site details are repeated here where they are significant, where works have just commenced or works are nearing completion or works have been completed.

5.1 Tesco Stores, Pontardulais

The application sought full planning permission for the construction of a Class A1 Retail Food Store which would provide a gross total floorspace of 4,168 sq. metres (44,874 sq.ft.) with associated parking (324 spaces) and servicing, petrol filling station / car wash and the formation of a new vehicular access along the line of a disused railway line incorporating a new signalled controlled junction on Station Road (A48), a roundabout at the junction of Iscoed Road (A4138) and Fforest Road (A48), a pedestrian link to St Teilo Street and associated landscaping works. The proposed development would involve the demolition of the existing former industrial buildings on the site (previously occupied by the SWALEC Depot) and it is indicated that the proposal is for a Tesco food / retail store which would provide up to 294 full and part-time employment opportunities. Map 29 below outlines the proposed development site.



Map 29 Proposed Tesco Development, Pontardulais, Swansea.

© Crown Copyright and database right 2013. Ordnance Survey 100023509

The planning application was accompanied by a Design and Access Statement, Retail Assessment, Transport Assessment, Bat Survey, Flood Risk Assessment, Noise Assessment, Energy Strategy Report, Landscape Supporting Statement and Ground Investigation Report.

The Retail Assessment examines the relevant issues in the context of national and local policy guidance, assesses the qualitative and quantitative need for the development and evaluates the associated benefits and costs that the store would bring to the area. It states that the proposal is to provide a modern supermarket that would offer the local community of Pontardulais and the wider catchment area a wider variety of choice in terms of retail provision. The store would aim to stop local residents from travelling further afield to meet their retail needs and would result in linked trips being made to businesses in Pontardulais shopping centre (St. Teilo Street); enhancing and safeguarding the vitality and viability of Pontardulais as a shopping centre. The provision of a short, direct and attractive link between the store and town will facilitate linked pedestrian trips between the two.

The proposed development involves the demolition of the existing retail properties at Nos. 80 – 82 St Teilo Street, in order to create a dedicated direct pedestrian link between the town centre and the proposed retail store. The proposed pedestrian link would incorporate an area of landscaped public space. The retail store's car park would provide additional short term public parking in close proximity to the town centre, and it is proposed that a car park management plan be implemented in order to allow the use of the car park by all shoppers visiting the town centre.

The proposal was subject to a screening opinion under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 prior to the submission of the planning application to assess the requirement for an Environmental Impact Assessment (E.I.A.) to accompany the application. It was concluded that the proposed development would be unlikely to raise any significant environmental issues of more than of local importance, and that the scale of the store would not exceed the tolerances within the E.I.A. Circular (02/99) which indicates that an EIA is more likely to be required for proposals to redevelop land on a greater scale if the site is greater than 5 hectares or would involve more than 10,000 m² of new commercial floor space. It was therefore considered that an Environmental Impact Assessment was not required.

In anticipation of the development and the requirements within LAQM.TG(09) to assess narrow and congested roads, a network of passive diffusion tubes has been established within the town centre/St.Teilo Street area of Pontardulais. These tubes numbered 163-178 are included within section 2.3 above. Monitoring commenced during November 2009 with a full year of monitoring being obtained during 2010 pre store opening. As can be seen from the results presented within table 9 full compliance with the annual mean objective is currently being seen at all monitoring locations for 2011 and 2012.

It is intended to cease NO₂ passive diffusion tube monitoring within the Pontardulais town centre area (sites 163-178) at the end of 2013 after having 3 years post opening of the store when a final assessment of any impact resulting from the store to be made.

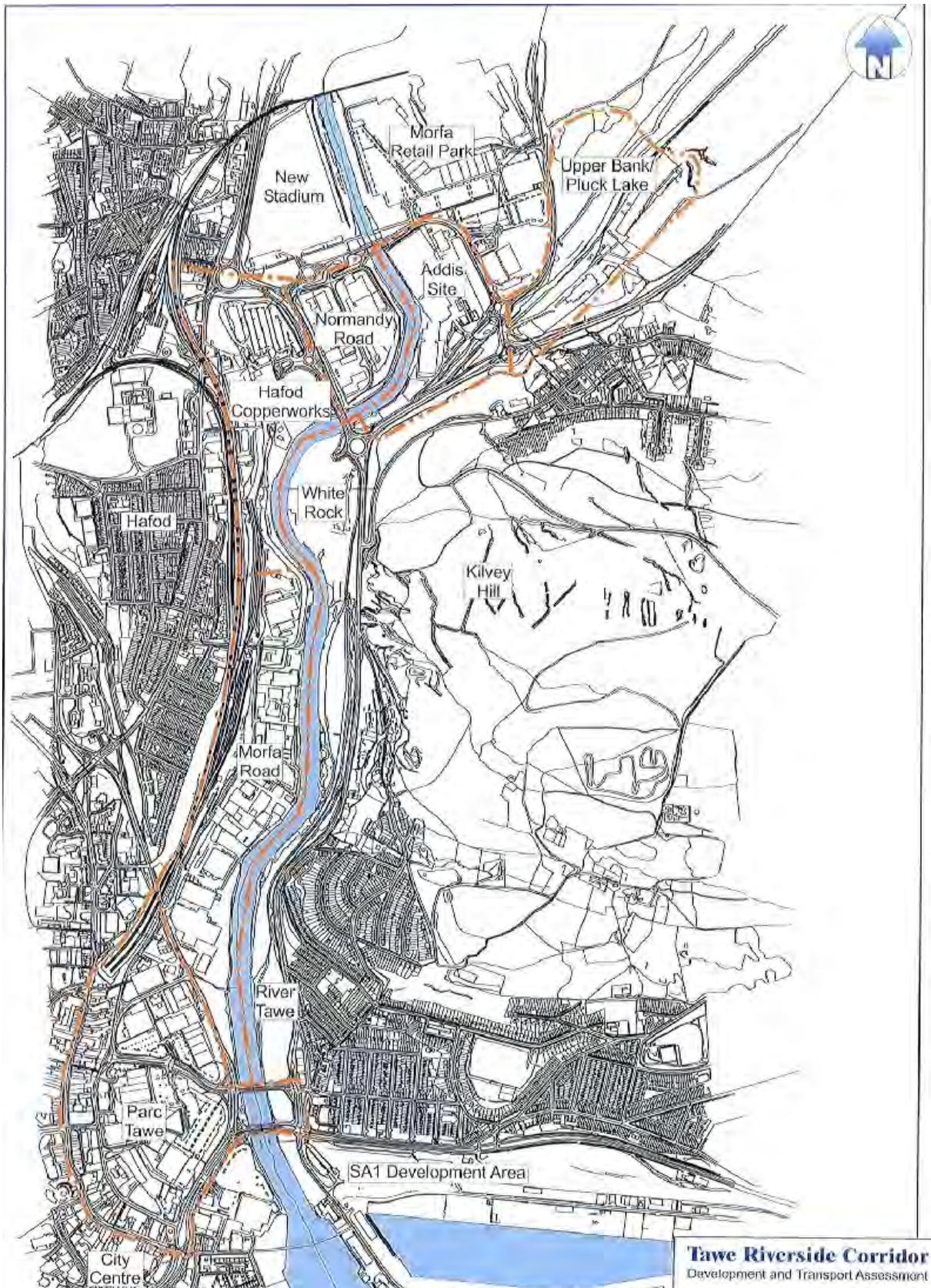
5.2 The Tawe Riverside Development Corridor

Proposals for the Tawe Riverside Development span a large area of former derelict industrial land and currently occupied commercial sites from Quay Parade Bridges up to, and beyond the new Liberty Stadium and Morfa Retail Park area of the lower Swansea Valley. The proposals include some housing development sites as well as mixed use sites. All details relating to this development corridor are identified and discussed here as to split the developments may detract from the overall scale of the proposals and significance that the authority is placing on the regeneration of the lower Swansea Valley/Tawe Riverside area. The development area can be seen within map 30 below⁴¹. The Morfa Road and Hafod Copperworks proposals fall within the existing Swansea Air Quality Management Area 2010.

The River Tawe Corridor provides a series of distinct locations linked by the river and its rich industrial past. The Tawe forms part of the Swansea Waterfront concept, which is of national importance. The concept seeks to integrate the City Centre, Maritime Quarter, SA1 and the River Tawe corridor to allow the creation of a high density, mixed use, modern core for the City. The riverside corridor area provides the next significant opportunity to create a new place in the City for living, working and visiting, capitalising on the heritage importance of the area, which is a key theme linking the development of the area, and the potential of the river for visual interest, leisure and recreation. The Tawe Corridor provides a new sector of the city between the Waterfront and City Centre and links the modern developments at Morfa to the City Centre.

These proposals have the potential to impact significantly on air quality both within the existing Swansea Air Quality Management Area 2010 and outside. An internal working group has been established in order that discussions can take place on how the air quality issues raised can be addressed as air quality objections have already been tabled in respect to certain parts of the master plan.

⁴¹ Tawe Riverside Corridor Study Development and Transport Assessment Final Report June 2006
Hyder Consulting



Map 30 Tawe Riverside Development Corridor.

© Crown Copyright and database right 2013. Ordnance Survey 100023509

The Corridor is of immense importance in terms of its industrial past. The development area comprises the western edge of the former Hafod and Morfa Copperworks, which

merged in 1924 and were acquired by Yorkshire Imperial Metals in 1957, and are therefore widely known as the YIM site. It lies on the west bank of the River Tawe, bounded to the west by the Swansea Canal, which was established in 1794-8 to open up the coal trade from the head of the Swansea Valley. Its presence encouraged the establishment of other industries, such as Hafod and Morfa Copperworks. No longer profitable by 1902, it became disused and finally closed in 1931. It was infilled, both naturally and deliberately, and was complete by the 1970s. Sections higher up the valley, at Clydach and Pontardawe, were still “wet” in 1988. In 2002, a study was undertaken by Atkins Consultants on the restoration of the Swansea and Neath-T Tennant Canals. This developed a range of proposals for restoration, although it was not proposed to restore the canal within the development area to a working waterway given that significant sections are no longer in place.

Hafod Copperworks was established in 1810, the adjoining Morfa Works dating from 1828. A video detailing the history of the area has been compiled and can be viewed at https://www.youtube.com/watch?feature=player_embedded&v=ZpNgDYLQW7A

At its peak in the mid 19th century, Hafod was the largest copperworks in the world, with the greatest output. Morfa’s output followed closely behind and between them, the 13 copperworks in the Lower Swansea Valley accounted for 90% of the world’s copper production.

The two works merged in 1924 and were acquired as Yorkshire Imperial Metals in 1957. Copper working ceased in 1980 and the site was acquired by (then) Swansea City Council. Much of it was cleared. The A4067/A4217 Cross Valley Link Road was carried through the centre of the site in the early 1990s, and light industrial units established in the eastern half. In the 2000s, part of the site was occupied by the Landore Park-and-ride scheme.

To the south of these copperworks, between Morfa Road and the River Tawe, were a number of other industries. These were largely established in the 19th century although the Cambria Pottery, at the south end of the development area, dates from 1720. It was disused by 1868 and has now gone. This area lay between the Swansea Canal and the River Tawe and was a natural site for a series of coal wharves, and wet- and dry-docks. Other industries developed in this area during the 19th century including a foundry, a nickel-cobalt works and a phosphate works. Many of them had closed by the earlier 20th

century. The canal, wharves and docks were progressively disused and infilled during the 20th century, and much redevelopment took place, mainly comprising light industrial units. An area to the south, between Morfa Road and the River Tawe, during the 19th century, was the site of a number of subsidiary industries including two large and important potteries, in addition to the coal wharves and dry docks that served the port of Swansea.

The area is of crucial importance to the later history and development of Swansea. The Hafod and Morfa Works, two 19th century copperworks were, during the mid 19th century, the largest in the world, with the greatest output. Hundreds were employed in these industries, and housed in purpose-built densely packed back-to-back terraced housing - notably, the Hafod area.

The area is also an important feature of the urban landscape. It is one of the very few assemblages of 18th-19th century industrial buildings that survive in Swansea. There are 11 listed buildings within the development area, and two Scheduled Ancient Monuments, alongside the incomplete remains of a large number of other structures and features.

The structural remains within the development area are not limited to listed buildings and Scheduled Ancient Monuments. There are the remains of further former structures, and former surfaces, which together increase the Group Value of the site. The extensive use of local building stone (Pennant sandstone), and indigenous copper slag blocks, are an important contribution to the 'sense of place'. The geometry of the area and its relationship with the Swansea Canal and the river, is also important, and is still well preserved.

The protection of the surviving remains is seen as "the last chance" to preserve and interpret the industrial copper heritage of Swansea.

5.2.1 Summary of Area Strategies

The strategies for the development and regeneration of the parts of the development area are in summary:

Morfa Distributor Road

- The introduction of a new road between the A4067 (Hafod Site) to the Strand and New Cut Road (Morfa Road site) to have a “distributor route” function to serve development in the area, enabling maximum development opportunities with minimum environmental impact, particularly on industrial heritage;

Morfa Road Area

- Altering the balance of uses in the Morfa Road area from light and heavy industry and dereliction, which ignores the river frontage, to a high quality mixed area of residential, commercial and light industrial uses. The development would thus capitalise on the superb riverside setting, the proximity of the area to the City Centre and waterfront and also celebrate and interpret the heritage of the area.

Hafod Copperworks Area

- An integrated, mixed use development of Hafod Copperworks, which:
- preserves heritage structures, interprets industrial history and finds new uses for heritage buildings, to ensure the heritage importance of the area is fully celebrated;
- capitalises on the stunning waterfront location and strategic proximity to the stadium by the introduction of a hotel and restaurant/ bar/ café uses, bringing economic vitality back to the river frontage by day and evening;
- provides for water transport links and recreation, in particular a ferry stop to enable the site to be linked to the Swansea Waterfront and the National Museum;
- provides for park and ride links to the City Centre; and
- provides a high quality living environment with strengthened links to the existing Hafod community.

Normandy Road Industrial Estate

- The retention of Normandy Road Industrial Estate as a location for employment and industry, whilst visually enhancing the site, reducing the visual impact on adjacent land uses and investing in improvements to properties to raise the quality of the estate.

Addis Site

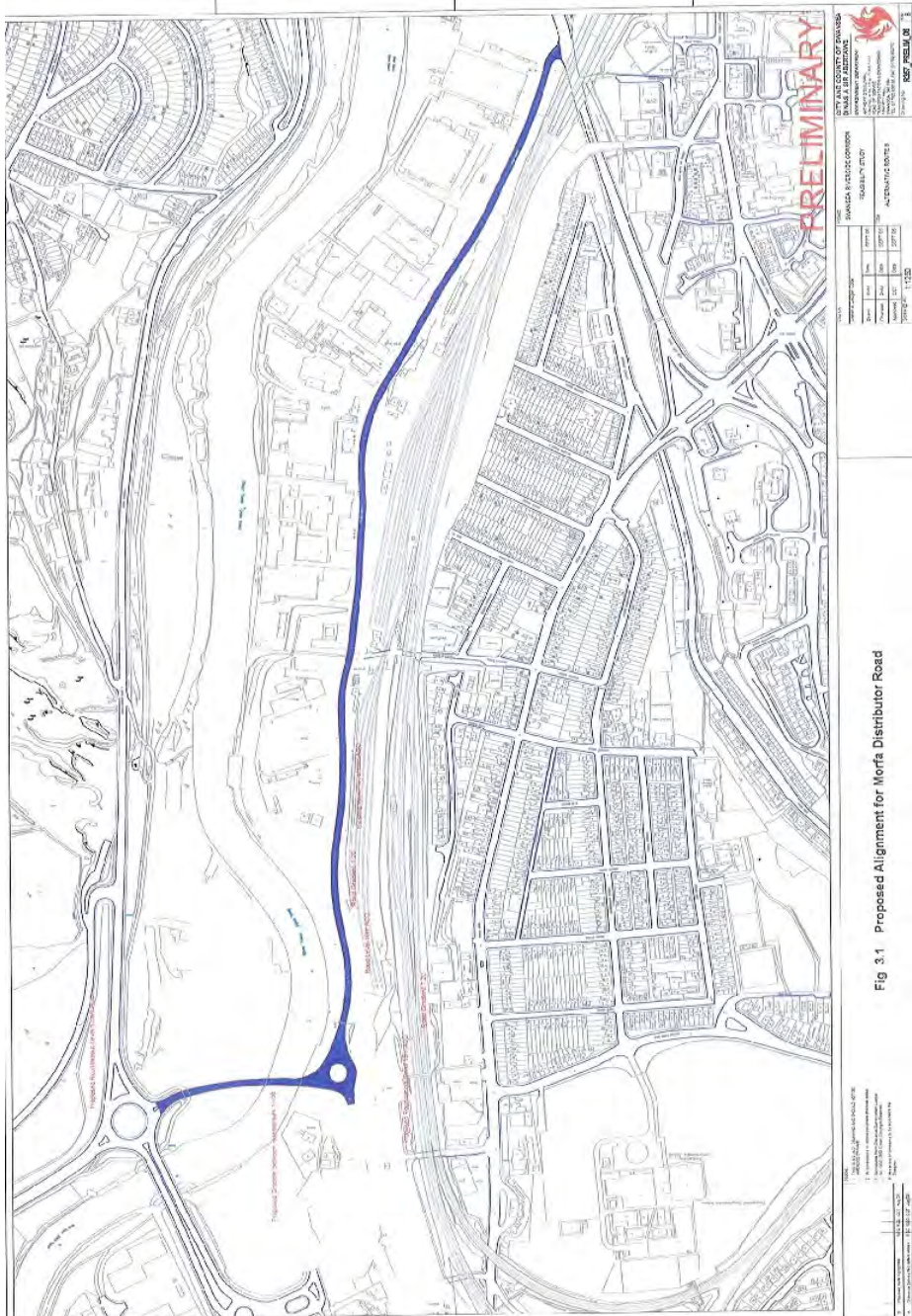
- The redevelopment of the Addis site for residential uses as the next stage in forming a truly mixed use and high quality part of the riverside – with leisure, retail, industrial and residential uses, whilst respecting the heritage importance of the site. Development of this site commenced during 2006 with the former factory units being demolished and the site remediated. Construction works commenced late 2006/early 2007 but ceased during 2009 due to the economic downturn. In 2010 works recommenced at the site with several new blocks being erected since.

Upper Bank/ Pluck Lake

- Encouraging a compatible mix of land uses to regenerate the Upper Bank site, removing the current areas of dereliction and contributing to the regeneration of the wider area;
- Accommodating the objectives and future plans of the Swansea Vale Railway Company and recognising the heritage value of the site; and
- Recognising the amenity importance of Pluck Lake and Kilvey Woodland, whilst bringing selective development into the area to improve the attractiveness of the site.

5.2.2 Morfa Distributor Road

The City and County of Swansea is proposing to introduce a new road from the vicinity of the existing junction between the B4603 and A4067 (Hafod Site) to the Strand and New Cut Road (Morfa Road site).



Map 31 Morfa Distributor Road Preliminary Alignment Proposals
 © Crown Copyright and database right 2013. Ordnance Survey 100023509

It is intended that the road would have a “distributor route” function aiming to serve development in the area. Map 31 above shows the Distributor Road preliminary proposals. An alignment for a route directly southwards through the Hafod Copperworks

Site has been included and protected within the Swansea development plans as far back as 1992. Alternatives to this route have been investigated by the Highway Authority as part of the development proposals. This is to ensure that the route chosen enables maximum development opportunities in the Hafod/ Morfa Road area with minimum environmental impact, particularly on industrial heritage, as well as providing the distributor road.

An option of a crossing of the river from White Rock was proposed and is detailed within map 30 above. However, funding for the required new river crossing bridge could not be secured, rendering this option impracticable. This preliminary route was considered to have less impact on the heritage of the Hafod Copperworks Site and enable more coherent development of the Hafod Site. The two options of the protected route and a White Rock alignment were presented to CADW, who have expressed the preliminary view (in a letter dated 31 March 2006) that: *“Of the two options being considered, CADW would support Option 2 (White Rock), which goes some way towards respecting the integrity of the Hafod-Morfa site and its relationship with the Swansea Canal and associated features”*.

However, the new proposed alignment for the distributor route is now to modify the roundabout serving the Landore Park and Ride site with the construction of a short access link to join up with the existing Morfa Road by the Bernard Hastie site. This proposal will negate the requirement of a river crossing. Discussions have taken place with CADW who appreciate the difficulties experienced. Tentative approval for this proposal have been secured from CADW subject to detailed archaeological investigatory works being undertaken as the proposed route crosses the structures defining the old canal walls. Whilst any works would cause loss of archaeological features, a pragmatic approach has been taken by CADW in that should the proposed developments along the corridor not take place, then contributions for the renovation of the existing buildings would not be forthcoming. These existing above ground structures have important historical associations with the heavy metals industrial past of Swansea and will be lost for future generations should definitive restoration works not take place within the next decade due to their existing dilapidated condition.

It is anticipated that any Distributor Road could accommodate bus services, subject to the provision of a new service along the route.

It is envisaged that the link under the railway from Maliphant Street would become for pedestrian and cyclists only, and be enhanced. This could include painting or cladding of the underside of the bridge in a light colour, a shared surface for cyclists and pedestrians which also allows emergency access, new signing and lighting.

At the southern end of the proposed Distributor Road, works are also proposed on New Cut Road and The Strand. These works envisaged the provision of a gyratory carriageway layout (as previously proposed in Transport Grant Applications). The draft gyratory layout was illustrated as map 32 in the Progress Report 2011. In summary, it involved a gyratory whereby traffic from the Distributor Road would only be able to travel left onto New Cut Road and would enter Morfa Distributor Road only from The Strand. The intention was to minimise traffic queuing and delays at the southern end of the route and also thereby manage levels of air pollution.

However, more recent thinking has moved away for the gyratory concept as the modelling undertaken has proved conflicts with the existing Quay Parade bridges area/intersection. The latest proposals are to provide signal controlled junction at the bottom of Morfa Road with New Cut Road.

5.2.3 Morfa Road Area

Morfa Road presents a significant opportunity for redevelopment, capitalising on the riverside setting, the proximity of the area to the City Centre and waterfront and also to celebrate and interpret the heritage of the area.

The strategy for the regeneration of the area is to alter the balance of uses from light and heavy industry and dereliction, which ignores the river frontage, to a high quality mixed area of residential, commercial and light industrial uses.

While the land uses provide the framework for development, it is envisaged that the City and County of Swansea will take a flexible view of the use of each site, taking into account any changes in the market situation and the aspirations of land owners. Thus in

the longer term, should market conditions change, the majority of the sites in the area may be redeveloped for housing and this is also considered to be acceptable.

The strategy is to be achieved through the provision of a master plan that sets the framework for investment by the private and public sector in the area and is shown within map 32 below.



**Morfa Road Masterplan
Figure 4.1**

The overall design concept is for:

- a mixed use development of individual sites according to land ownerships;
- the prime focus of each development site being orientated towards the river;
- a network of routes for pedestrians focussed on the riverside walkway/ cycleway with links through the sites at key locations to Morfa Road;
- a secondary focus to development sites to the centre of each site, giving a more intimate scale to the living environment. The central parts of site would be the location for any community facilities and local open space;
- traffic access from Morfa Distributor Road into each site. Within the sites, residential development in accordance with the 'Home Zone' principle of shared pedestrian and vehicular surface, designed for a speed of 10 mph.

The master plan incorporates the following elements:

- An upgraded Morfa Road to a distributor road standard, linking from the north between the Hastie Site and the railway. The road link is proposed to have a limited number of junctions, the locations for which have been chosen to enable phased development in accordance with the various land ownerships.
- A riverside walkway and cycle route of minimum width of 6 metres. This would provide continuous access from Parc Tawe through to the Hafod Site. A footpath is in place for the majority of the route at present, with the exception of the Swansea Industrial Components site. Moreover it is currently impassable in places due to overgrowth and there is no barrier to protect users along the river edge.
- The provision of a new pedestrian and cycle bridge across the Tawe between the areas of open space south of the Unit Superheaters site, across to the St Thomas Station Site. This, together with a similar facility shown for the Hafod Site, would enable use of both sides of the

river bank, connecting to the National Cycle Route on the east bank and link the Morfa Road area to the St Thomas community;

- Mixed-use development of the sites including approximately 360 homes, enhancement and some new development of light industrial uses and trade counter uses; retention of the Dragon Arts Centre facility and approximately 23,000 m² of office space. Specifically:
 - Residential development of the Unit Superheaters, Swansea City Highways Depot and Hastie site (7.3 ha, approximately 360 dwellings at a density of 50/ha);
 - Light industrial uses or trading counter uses on the Bevan and Gladeborough sites, involving a mix of enhancement of existing buildings and new development (2.7 ha, approximately 13,500 m² of industrial/ trading space);
 - Office development of the former dairy site, average of three storeys (1.55 ha, approximately 23,250 m² gross floor area);
 - Retention of the Dragon Arts Centre facility;
 - Light industrial uses on the Swansea Industrial Components site, possibly comprising a single large factory unit of 5,500 m²/ 60,000 sq ft; and
 - Retention of light industrial units on the GLT Exports site.

The master plan also illustrates the potential for an element of local needs convenience shopping, open space, and a public house/ café making up part of the overall development as illustrated.

Works commenced during late 2010 /early 2011 to the area formally occupied by Unit Superheaters and continues to see the development progress during 2012/2013. This site fronts New Cut Road and Morfa Road and is adjacent to the existing Council transport unit at Pipehouse Wharf.

5.2.4 Hafod Copperworks Site

The Hafod Copperworks Site or Yorkshire Imperial Metals (Y.I.M.) Site is a site of international importance in industrial history and has the potential to help tell the story of Swansea's development over the past three hundred years, provide a place for public enjoyment of the riverside, and a new place for living and working.

The site has lain largely vacant for several decades however, the industrial monuments are deteriorating and certain buildings are at serious risk of loss. The site is the last opportunity to preserve and interpret the City's industrial history.

The strategy for Hafod Copperworks is for an integrated, mixed use development which:

- preserves heritage structures, interprets industrial history and finds new uses for heritage buildings;
- capitalises on the waterfront location and strategic proximity to the stadium by the introduction of a hotel and restaurant/ bar/ café uses, bringing economic vitality back to the river frontage by day and evening;
- provides for water transport links and recreation, in particular a ferry stop to enable the site to be linked to the Swansea Waterfront and the National Museum;
- provides for park and ride links to the City Centre; and
- provide a high quality living environment with strengthened links to the existing Hafod community.

The strategy is to be achieved through the master plan that sets the framework for development of the site. The overall design concept for the Hafod Copperworks site aims to:

- create a stimulating contrast between the dispersed historic buildings and structures and contemporary architecture and activities, all set in a consistent landscape theme;

- exploit the riverfront and differences in level to create memorable views and a sense of drama;
- establish a pattern of mixed uses which will help create vitality, day and evening, particularly on the waterfront;
- organise linkages into and through the site which will be convenient, safe and secure;
- maximise the development potential of the key riverside site; and
- minimise the potential impact of the railway.

A master plan has been developed for the Hafod site, based on the proposed route of the distributor road with the crossing from White Rock and can be seen below in map 33.



**Hafod Copperworks Site Masterplan
Figure 5.1**



Map 33 Hafod Copperworks Development Site

The main elements are:

- a new river crossing for traffic with an alongside pedestrian and cycle route, from White Rock to a roundabout junction south of the Musgrove Engine House;
- an extension to the existing park and ride scheme (300 additional spaces);
- Mixed use waterfront development – a mixed development of apartments, hotel and public house/ restaurant;

- High density housing on two sites either side of the former canal route (approximately 100 units);
- Restoration of the canal as a landscape and heritage feature with a walk along the route;
- Creation of a public space on the river front, giving setting to the Engine Houses and a location for a river ferry stop;
- Continuous walking and cycling route from the footbridge south along the riverfront;
- The consolidation and re-use of the listed buildings and Scheduled Monument within the site:
 - Further development of the Museum Stores for public access, with car parking and pedestrian routes from Neath Road;
 - Consolidation and refurbishment of the Laboratory and Canteen Buildings for commercial use, such as eating and drinking;
 - Consolidation and interpretation of the Musgrove Engine House for public access; and
 - Commercial uses in the Vivian Engine House.

The master plan sets out the potential form of development, but within the framework there is some flexibility to respond to demands for other uses. In particular, there may be potential demand for alternative uses, such as:

- Student and potential key worker accommodation;
- A residential care home;
- Social low cost and specialist housing, including older person accommodation, family accommodation and special needs bungalows.

A new doctor's surgery/medical centre to replace one surgery potentially requiring relocation in the Hafod.

5.2.5 Normandy Road Industrial Estate

Normandy Road is an industrial estate lying to the east of the Hafod Site and the south of the Liberty Stadium and Morfa Retail Park. It is almost fully developed and bounded by the river on the eastern boundary, the A4217 to the west and stadium to the north. The estate is occupied predominately by industrial premises, with the exception of the Territorial Army premises and a three-storey office block. The estate is visually prominent in an area, which has seen considerable recent development.

It is considered that the industrial estate serves an important function in providing premises close to the city centre, and it would neither be desirable or easily achievable (given the large number of occupiers and leases with the local authority) to comprehensively redevelop the estate. The buildings are however relatively dated and the estate could benefit from selective redevelopment and refurbishment. The location of the industrial estate is shown below as map 34.



Map 34 Normandy Road Industrial Estate

The site is not proposed for comprehensive redevelopment and therefore the proposals involve a package of environmental improvements rather than a master plan for the site. The strategy for the future of Normandy Road is therefore to:

- Retain the site as a location for employment and industry;
- Visually enhance the site and reduce the visual impact on adjacent land uses;
-

5.2.6 Addis Development Site

The Addis site occupies a strategic location adjacent to the Morfa Retail Park. The site was formally occupied by the Addis factory, which produced plastic household goods. It was acquired by PMG Developments Ltd who sought planning permission for the redevelopment of the site for residential uses. The redevelopment of the site for residential will be the next stage in forming a truly mixed use and high quality part of the riverside – with leisure, retail, industrial and residential uses, whilst respecting the heritage importance of the site (notably the listed industrial building and Bascule bridge)

A planning application was submitted in January 2006 by Holder Matthias Architects for the redevelopment of the site with construction of 564 residential units including:

- 8 no five storey blocks of 296 residential apartments along the riverside;
- 146 apartments in 2 and 3 storey blocks;
- 122 terraced 2 and 3 storey dwellings; and
- retention of the listed building in the centre of the waterfront area, with future uses to be determined.

The application includes for access, car parking (including undercroft), landscaping, open space and infrastructure works including a new riverside cycle path/ walkway.

The overall design concept is to develop a strong river frontage with blocks of apartments and a new riverside walkway and cycleway, graduating eastwards to lower rise two and three storey town houses and terraces. The development uses the principles of a home zone, with access within the site as shared surface between pedestrians and vehicles. The housing design has the majority of properties fronting directly onto the street with gardens to the rear in courtyards/ enclosed spaces. Images of what the development may look like are included as Figures 1 and 2.⁴² The Master plan for the site produced for the application is included as map 35.

⁴² Images courtesy of Hyder Consulting Final Report Tawe Riverside Corridor June 2006



Works commenced during late 2006/early 2007 with the five story blocks closest to the A4217 (blocks E, F, G and H). During late 2007 the first of these blocks were occupied. Development has recommenced after a short period of inactivity during 2011 due to uncertainty within the housing sector as a result of the financial crisis. Further areas of the site have now been cleared during 2012 and construction of other dwellings within the overall scheme is well advanced



Map 35 Addis Development Site

5.2.7 Upper Bank/Pluck Lake

Upper Bank represents one of the few predominantly underused sites in the area occupying a key location overlooking the redeveloped area of Liberty Stadium and Morfa Retail Park. The opportunity now exists to regenerate the site, connecting to the key development land and transport links in the area, whilst promoting a mix of different land uses.

The last remaining section of the Swansea Vale Railway runs through the centre of the site and is occupied by the Swansea Vale Railway Society. The Society has a vision to create a Railway Heritage Centre. The majority of the Upper Bank site is however in a state of considerable dereliction. The adjacent Pluck Lake area is an important amenity area and ecological resource.

The strategy for the future development of the site is to:

- encourage a compatible mix of land uses to regenerate the site, removing the current areas of dereliction and contributing to the regeneration of the wider area;
- accommodate the objectives and future plans of the Swansea Vale Railway Company and recognise the heritage value of the site;
- recognise the amenity importance of Pluck Lake and Kilvey Woodland, whilst bringing selective development into the area to improve the attractiveness of the site;

The overall design concept for the Upper Bank/ Pluck Lake site aims to:

- maximise the commercial development potential of the site;
- exploit the differences in level to provide attractive views out from the site to the west;
- establish a pattern of viable mixed uses which will create an attractive living environment and complement the regeneration of the wider area;
- enhance the role of the site in telling the story of Swansea's industrial heritage;
- improve linkages to the Pentrechwyth community and the Kilvey Community Woodland.

The master plan for the site is illustrated in map 36 below and includes:

- A new access westwards from a proposed roundabout junction on Nantong Way;

- A mix of affordable and general housing, totalling approximately 125 units;
- A roundabout junction providing access into the housing areas and railway heritage area;
- Relocation of the Railway Society operations with provision to enable future phases of development of a heritage centre; and
- Potential development site for a hotel south of Pluck Lake

The master plan as proposed would release a significant parcel of brownfield land for housing development. The area of housing land identified on the plan would amount to 3.19 hectares.

The site is proposed to include a small food store (approximately 10,000 sq ft) and associated parking, serving the immediate local area and offering a different product to the Morrison's superstore within the retail park.

The site would be sensitively integrated with the adjacent rail land and the amenity of the future occupiers will be safeguarded from any of the potential impacts of the rail activity by close attention to a green buffer between the two.



Map 36 Upper Bank/Pluck Lake Development Site

The master plan includes the provision of an area to safeguard the future operations and expansion of the Railway Society site. The proposal includes the recommendation that the site redevelopment includes for implementation of Phase 1 works (by negotiation between the Railway Society and City and County of Swansea) to enable the Railway Society to continue their current operations of upgrading the remaining section of the Swansea Vale Railway and restoring the locomotives and rolling stock within a covered modern industrial unit. The proposals would also enable the Society to fully explore the feasibility of establishing a shuttle service between the two terminals at Upper Bank. This will require basic facilities at either terminal, but will help to establish a revenue stream for the Society and the impetus to progress subsequent phases.

Site clearance commenced during early 2013 in preparation for implementation of the scheme. It is not known at this stage when construction works will commence or what section of the overall scheme will commence first.

5.2.8 Urban Village, High Street

The application sought full planning permission for a mixed use redevelopment of 212 – 222 High Street and land at The Strand (53 – 72) comprising:

- Construction of part 4 storey/part 5 storey block to High Street incorporating up to 9 no. retail (Class A1) and food and drink units (Class A3) at ground floor level with first, second and fourth storey offices (Class B1) and third storey residential use (Class C3) or alternative first and second storey residential (Class C3);
- Construction of 6 storey central residential block (Class C3);
- Construction of part single storey, part 3 storey extension to northern elevation and single storey extension to western elevation and external alterations to Kings Lane warehouse and use of building for creative cluster activities or office use (primarily Class B1 and ancillary uses);
- 3 storeys of car parking to The Strand elevation incorporating creative cluster block with first and second floor venue (Class A3/D2) and creative cluster activities (primarily Class B1 and ancillary uses) or alternative office use (Class B1), with 4 storeys of creative cluster activities or office use above (primarily Class B1 and ancillary uses) or alternative residential use (Class C3);
- Construction of part 9 storeys part 10 storeys residential block above 3 storey car park;
- Single storey bike store/substation enclosure;
- Enclosed refuse store;
- Associated infrastructure works, means of enclosure and landscaping.

This development and previous similar applications are known as the 'Urban Village' proposals. The application was supported by the following information:

- Planning Statement (December 2009)
- Design and Access Statement including Sunlight and Daylight Assessment (December 2009)
- Design and Access Statement Addendum (March 2010)
- Townscape and Visual Impact (January 2010)
- Phase 1 Habitat and Protected Species Scoping Report (October 2009)

- Transport Assessment (December 2009)
- Noise Impact Assessment (December 2009)
- Air Quality Assessment (December 2009)
- Archaeological Assessment (April 2003)
- Historical Site Investigation Data (November 2009)
- Site Investigation Factual Report (October 2009)
- Flood Consequence Assessment (December 2009)
- Retail/Office BREEAM – Outline Prediction
- Code for Sustainable Homes Target Credits
- Wind Tunnel Testing (May 2007)
- Comments on Proposed Revisions with Respect to Street Level Wind Environment (February 2010).

The application site covers an area of approximately 0.67 hectares and is bound to south by Kings Lane, to the west by High Street, to the east by The Strand and to the north by 'Champers' a bar/nightclub.

The topography varies considerably across the site with High Street being set approximately 9 metres above The Strand. At the High Street Level, the site also falls approximately 1.3 metres from the north to the south.

The site can be described as comprising three main parts: the High Street; The Strand; and the warehouse.

Other than 'Crumbs Café' building at 222 High Street, the land at High Street has been cleared of the commercial premises previously occupying the site over a number of recent years.

The warehouse, which dates from the late 1860s, is the only building on the site, other than 'Crumbs café' that has not been demolished. It is accessed from Kings Lane but is not presently in operational use. King's Lane itself is a narrow highway linking High Street and The Strand.

The planning application sought permission for the following range of uses (with the flexibility to be interchangeable within agreed parameters during the first ten years after occupation of the buildings):

- Residential dwellings;
- A1 retail with potential for A3 food and drink uses;
- B1 office space;
- A3/D2 entertainment uses;
- Creative cluster activities with ancillary uses.

In physical terms, the proposal includes a number of distinct elements. Along High Street a 66m long linear block is proposed to infill the existing gap along this frontage. The building along High Street would be 4 storeys high other than in the central section where it would rise to 5 storeys, in order to provide variety. This block is designed to appear as a collection of individual buildings with narrow frontage widths as per the established character of High Street.

Two separate courtyards are proposed to be accessed from the High Street. The southern courtyard (also accessed off Kings Lane) is the public courtyard giving access to the refurbished warehouse and 'creative cluster' area. The northern courtyard is private for residents to access the residential blocks. The courtyards are at High Street level with three levels of parking below, taking advantage of the approximate 9m level change down to The Strand.

The Strand frontage is designed as three large scale buildings coming down to ground level, making reference to the warehouse buildings that characterised this area along the original course of the River Tawe. The Strand frontage would effectively extend up to 13 storeys in height (approximately 42m).

It is proposed that the High Street block, Creative Cluster block and Warehouse could be adapted to a variety of set uses. The alternative uses relate to different buildings and different stories within each building. In summary:

High Street Block

- Level 03 (Ground floor from High Street) – A1/A3 Retail and Food and Drink uses
- Levels 04, 05 and 06 – B1 Office or residential uses

Creative Cluster Block

- Level 03 – A3/D2 uses and Creative Cluster uses
- Levels 04, 05, 06 and 07 – Creative Cluster or B1 Offices or C3 Residential Uses;

Warehouse Block

Levels 02, 03 and 04 – Creative Cluster uses or B1 Office use

Other than that which is shown within the Creative Cluster Block, it is not intended that different uses would be accommodated together on any particular floor at the same time.

It is proposed to deliver the scheme through a rolling programme of implementation, which is anticipated to come forward as follows:

1. The High Street block;
2. The Car Park and Residential blocks;
3. The Creative Cluster; and finally,
4. The Warehouse.

The Urban Village Creative Cluster element of the proposal comprises a series of buildings focused around a courtyard. It is intended that the Creative Cluster activities will take place within the Creative Cluster building and the Kings Lane Warehouse. The Creative cluster building will also include an A3/D2 bar/entertainment venue which fronts onto The Strand.

The “Creative Cluster” concept is an emerging model that sees the bringing together of a range of Creative businesses as a Cluster. The idea of a Creative Cluster is a well established concept in a number of cities where it has been tested over many years. The model varies between developments, but typically brings together very flexible office and

working space provision in a place where businesses often enjoy synergy amongst each other.

Within the creative cluster it is envisaged that a number of activities will be undertaken.

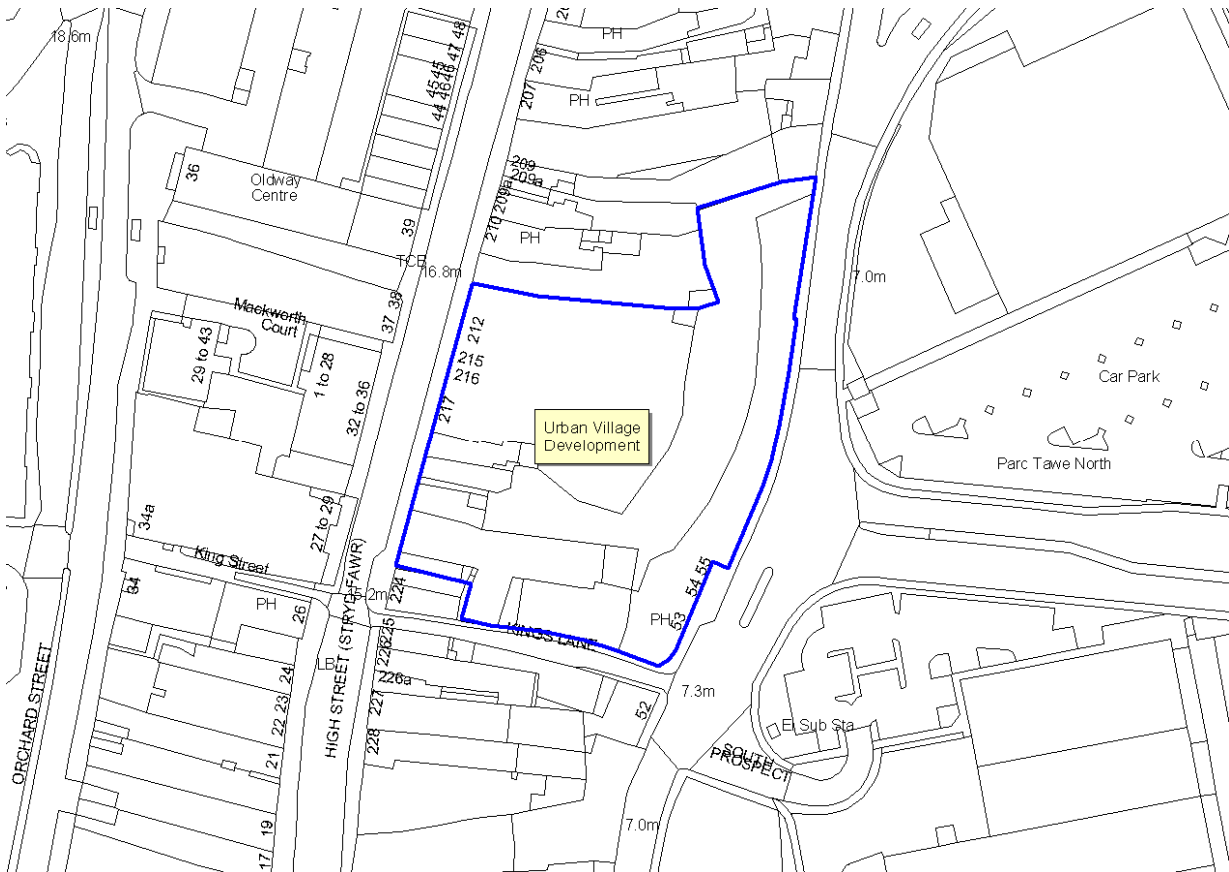
The list below sets out the range of such activities:

- Advertising and Marketing;
- Architecture;
- Arts and antiques;
- Crafts;
- Design;
- Designer fashion;
- Film and video;
- Interactive leisure software;
- Performing arts;
- Photography;
- Publishing;
- Music; and,
- Software and computer services.

The types of potential uses that could be included within the Creative Cluster from this list of activities would fall within Use Class B1. In addition to this, it is envisaged that the creative cluster will also include an element of ancillary uses which complement and support the activities which will take place. These could include:

- Non-residential education and training facilities;
- Exhibition space; and,
- A café.

All 76 units within the residential blocks are proposed as being affordable housing, whilst the 15 units within the High Street block could come forward as affordable housing or open market housing. Map 37 below outlines the extent of the development.



Map 37 Urban Village Development, High Street

© Crown Copyright and database right 2013. Ordnance Survey 100023509

From a regeneration perspective the authority sees this proposal as a key driver of regeneration for the city centre and for the High Street in particular. It has a sound strategic fit with the City Centre Strategic Framework document and in particular the mix of uses including offices, the creative cluster and the residential will bring much needed activity and vibrancy to High Street. Furthermore the proposals for the High Street frontage at ground level repairs the broken fabric of the street and puts the traditional retail use back. The authorities Regeneration Department see it as important that this ground floor retail use is protected and continues and that a letting strategy based on specialist destination type retailing should be encouraged. Furthermore the applicant is looking for flexibility of use between office and residential use, but from a regeneration perspective the authority wish to encourage the office use as this brings much needed workers into to the city. Additionally, this policy would not encourage greater population exposure in an area that indicates that it is likely to exceed the NO₂ annual mean objective. Section 2.2.3 above outlines the recent NO₂ monitoring undertaken in the area surrounding (see site 123) the development. The notable effect of the development is to create or enhance the canyon effect of this section of High Street. This can be seen

within photo 8 above which was taken during the construction phase and photo 20 below



showing the completed development. The development is now complete. As mentioned elsewhere, passive diffusion tube monitoring will continue along this and other sections of High Street for the foreseeable future. The authority has an aspiration to locate a real time chemiluminescent NO_x analyser along High Street. As yet it is unclear if funding can be found to include two monitoring sites around existing passive sit 121 as well as site 123. It is thought more likely that real-time monitoring should be located where the highest annual mean has been recorded – in this case that would be outside of this section of high Street but outside site 121 in a section of High Street to the north of this development (see photo 5 within section 2.2.3

Photo 20 – Completed Urban Village Development – High Street Facade

above)

5.2.9 Persimmon Homes Development, Pontardulais

The application sought reserved matters approval for the comprehensive residential redevelopment of the “brownfield” site of the former Clayton and Teilo Works which were granted outline planning permission on 15th June, 2005 and 5th December, respectively. The former industrial site is adjacent to the residential properties in Water Street and Tyn-y Bonau Road and abuts the David Matthews industrial site to the west. The new Tesco's development outlined within section 5.1.2 of the Progress Report 2011 lies just to the south west. Cumulative impacts were thought possible within the centre of Pontardulais which lies approx. 150 metres to the south west of these sites. Map 38 outlines the development site.

This current application seeks the joint residential redevelopment of both Clayton and Teilo Work's sites with a residential layout comprising a total of 220 residential units,

consisting of 121 dwellings and 99 residential apartments. The dwellings would consist predominantly of two storey three and four bedroomed detached, semi-detached and terraced properties with a proportion (28) of three storey and two and a half storey (18) townhouses. The residential apartments would be accommodated within 8 three storey blocks within the development with a small proportion (6) of flats situated above garage blocks. The vehicular access would be obtained from Water Street and High Street allowing for a linked access through the site with a 'Village Green' area in the centre of the layout which would provide a focal point for the development.



Map 38 Persimmon Homes Development, Pontardulais

© Crown Copyright and database right 2013. Ordnance Survey 100023509

Vehicular access is obtained from a new junction off Water Street and a further new access off High Street. Visibility at both access points is acceptable and within the recommended guidelines. The site layout plan in the main indicates a conventional estate road layout with standard carriageway width and footways on both sides. Standard methodology was used to assess the traffic generation of the development and the affect of this additional traffic on the surrounding highway network, and this was

covered in detail under the Transport Assessment submitted with the outline consent. The affect of development traffic on 8 local junctions was previously assessed. This encompassed all junctions on the one-way system through that part of Pontardulais. All junctions tested indicated that there would be no adverse affect on the ability of the junctions to accommodate the additional traffic movements and all junctions in the test should operate satisfactorily.

Parking facilities have been provided through the site, in a mixture of parking courts, driveways and garages and would be provided in accordance with Council's adopted parking guidelines. Parking is predominately contained to the side or rear of the properties to reduce the visual impact. Cycle stores have also been provided for the residents within the proposed apartment blocks.

The internal road layout has been designed in accordance with the Highway Authority guidelines with the grid pattern of the road network reflecting the urban character of the site and provides access to a series of private drives and courtyards. The main road network is characterised by properties fronting directly onto the street. Served off the main network are a series of home-zones and private drives. The development proposal has been agreed in principle at outline stage and the Head of Transportation & Engineering accepted the conclusions of the TIA which accompanied the Outline Planning Permission which indicated that the proposed development would not have a detrimental impact upon the operation of the existing highway network and will not adversely effect local highway safety conditions and therefore raises no highway objection.

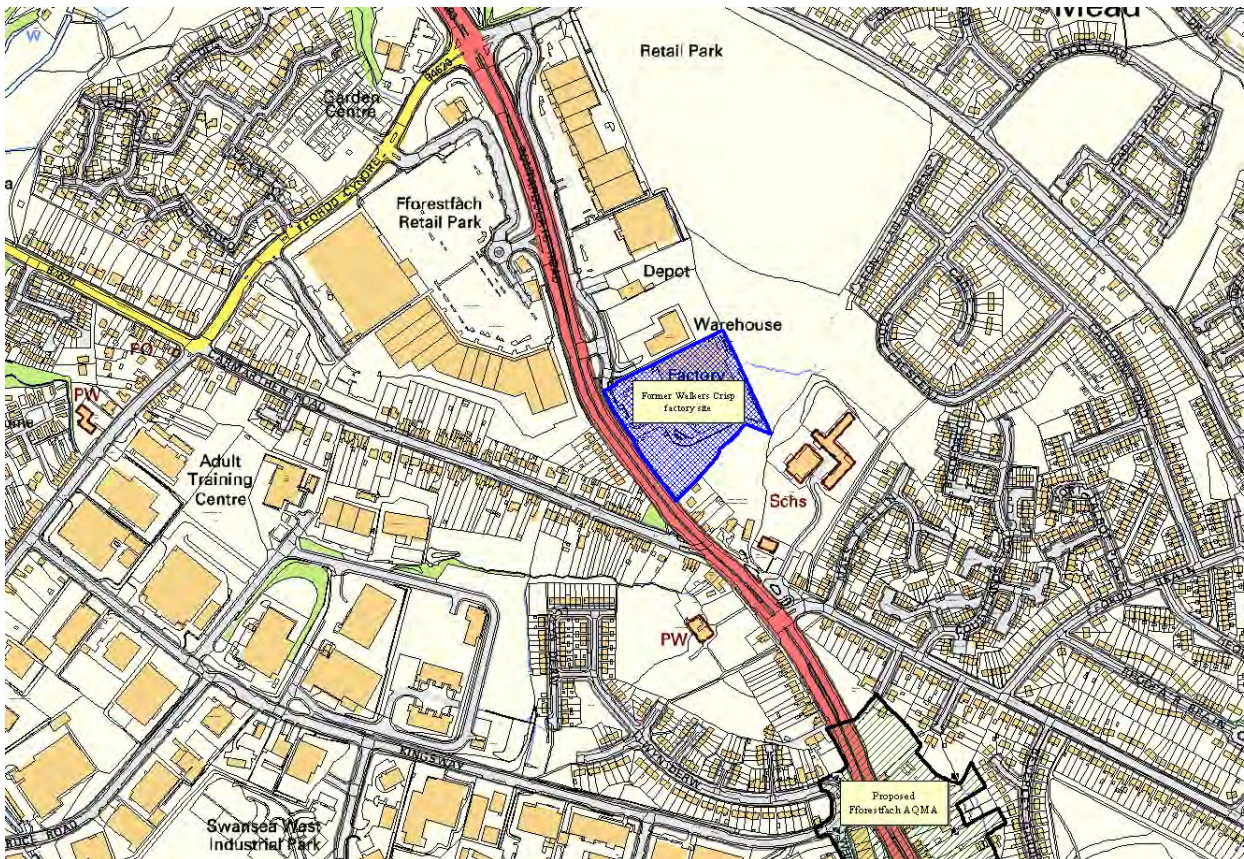
Approval had been given and demolition/construction works commenced late 2006. A limited number of the dwellings were first occupied during 2007. Development and occupation has continued apace with the development being completed during late 2011 / early 2012. The above is outlined due to concern over the cumulative impacts of this development and that of the Tesco retail outlet located within Pontardulais. The authority has undertaken extensive passive diffusion tube monitoring within the Pontardulais Town centre area to assess any detrimental impact. It is pleasing to note that passive diffusion tube sites 162-178 have shown full compliance with the annual mean objective

during 2010-2012. Having now established that there is no impact from either development, monitoring will cease at these sites at the end of 2013

5.2.10 Former Walkers Crisp Factory, Pontardulais Road

The proposals for this former industrial complex include partial demolition of the rear portion of the existing factory building, to provide 107 residential dwellings (comprising 12 detached dwellings, 14 semi-detached dwellings, 3 blocks of 14 no. terraced dwellings, 4 blocks of 67 no. flats) parking and associated works.

The site fronts onto the busy A483 and north of the boundary of the Fforestfach Air Quality Management Area that itself forms part of the Swansea Air Quality Management Area 2010. The site is adjacent to the Pontardulais Road Retail Park and opposite the Parc Fforestfach Retail Park with the Swansea West Industrial Park located off the A483 approximately 550m to the south. Map 39 below outlines the proposed development site. As of early 2013, the development has not commenced.



Map 39 Proposed Development of former Walkers Crisp factory site

© Crown Copyright and database right 2013. Ordnance Survey 100023509

5.2.11 Liberty Stadium Expansion

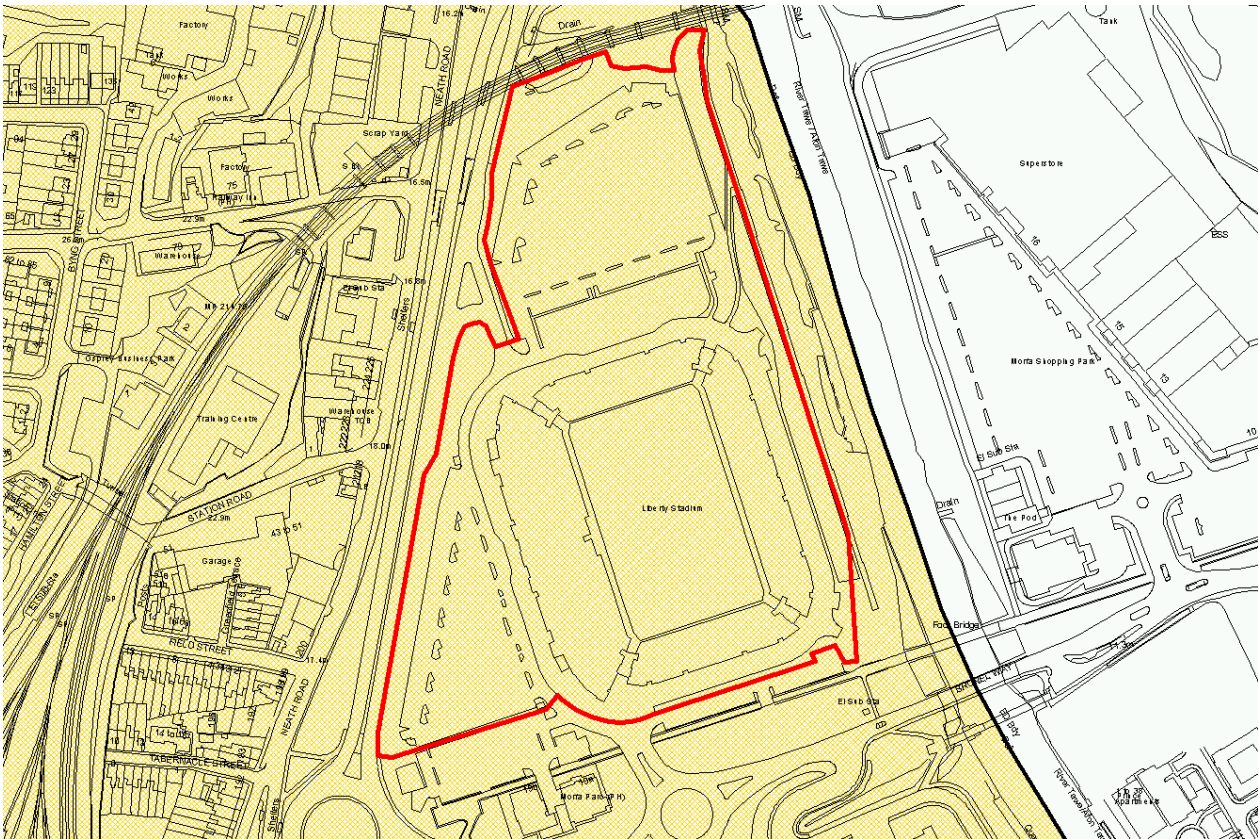
A Planning Application has been submitted by Swansea City AFC (ref 2013/0554) to expand the Liberty Stadium, Landore, Swansea from 21,600 seats to 34,000 seats.

The proposed development is planned to be split over three phases:-

- Phase 1 provides an additional 3,844 seats and will be completed in time for the start of the 2014/2015 season.
- Phase 2 will provide a further 4,718 seats and will be available for the start of the 2015/16 season
- Phase 3 will provide an additional 3,383 seats and will be constructed after the 2015/16 season.

The application site lies within the Swansea Air Quality Management Area 2010 and has the potential to generate additional traffic movements on match days. Air quality considerations are being dealt with by way of the Travel Plan submitted as part of the application. The primary aim is to intercept travelling spectators some distance away from the stadium area and direct them to Park and Ride sites – both home and away supporters. Numerous items are under consideration including discounting the park and ride as part of season tickets etc. The application is currently being assessed and further updates will be provided in due course.

A map of the proposed development location is given below as map 40. The Swansea 2010 Air Quality Management Area is highlighted as the shaded area.



Map 40 Proposed Development of Liberty Stadium

© Crown Copyright and database right 2013. Ordnance Survey 100023509

6 Air Quality Planning Policies

Policy EV40 has been inserted within the authorities Unitary Development Plan. In particular, sub policies within policy EV40 seek to clarify the authority's position with regard to air quality considerations.

1.8.8 Pollution may cause significant damage to human health, quality of life, residential amenity, and the natural and historic environment. This policy seeks to ensure that developments that would result in unacceptable high levels of noise, light or air pollution are appropriately located away from residential areas, other sensitive developments and areas of landscape, natural environment and heritage importance. The policy also seeks to ensure that incompatible development and land uses are not located close to existing sources of potential pollution.

1.8.9 The adverse effects of pollution are an important consideration when determining planning applications. When assessing new development proposals the Council will seek to minimise the impact of pollution of all kinds, and where possible planning conditions will be used to minimise environmental harm. The Council will look to the statutory environmental agencies to use their anti pollution legislative powers to monitor and enforce against discharges, noise, etc.

Planning permission will not be granted for development that would be harmful to air quality by virtue of emissions from the development itself or the additional new traffic movements it would generate. Neither will permission be granted where a development is proposed that would increase the number of exposed individuals in an area likely to fail UK air quality objectives (proposed or in Regulations). This may be a declared Air Quality Management Area (AQMA), or an area that might become an AQMA if the application were to be granted.

7 Local Transport Plans and Strategies

LAQM.TG(09) sections 4.37 – 4.39 indicates guidance on the inclusion within Progress Reports to those measures within the Local Transport Plan (LTP) that specifically relate to bringing about air quality improvements. Within Wales, the LPT has been replaced with the Regional Transport Plan (RTP). The South West Wales Integrated Transport Consortium (SWWITCH) is one of the four transport consortia in Wales, all of which are required to produce a Regional Transport Plan. The SWWITCH consortia region relevant to the City & County of Swansea includes a partnership with the neighbouring authorities of Neath Port Talbot County Borough Council, Carmarthenshire County Council and Pembrokeshire County Council.

SWWITCH have produced an RTP that whilst stating it is relevant between 2010-2015 the plan is intended to provide a long term strategy for the period up to 2025 with a 5 year period of projects helping to achieve that strategy. The plan cannot be delivered by SWWITCH alone as it will require good partnership working between a range of public and private sector agencies who influence the demand for transport, or who help to meet that demand. There will inevitably be changes in priorities over the years as SWWITCH seek to deliver new access needs or take advantage of opportunities that may occur over time but the objectives and broad strategy will remain the same.

A summary of the SWWITCH Regional Transport Plan (2010-2015) is included below together with the latest RTP Progress Report within section 7.9. The full document can be reached on line at <http://www.swwitch.net/rtp.aspx> where the four parts to the document can be downloaded

7.1 Introduction, Vision and Objectives

Good access is an essential element for a good quality of life. Good access can be provided when services and facilities (such as health care, employment, education, and leisure) are brought directly to users, or when reliable, integrated and accessible transport is available to take users to those services and facilities. Good access helps to achieve strategic aims of Government at all levels, including:

- Improving economic activity
- Raising skill levels
- Healthier and more active individuals and communities
- Increasing social inclusion

The Welsh Assembly Government (WAG) has set out high level aspirations for Wales in the One Wales Agenda and in the Wales Spatial Plan. WAG has also adopted a Wales Transport Strategy which seeks to provide the national framework for improved access to help deliver One Wales.

The South West Wales Integrated Transport Consortium (SWWITCH) is one of the four transport consortia in Wales, all of which are required to produce a Regional Transport Plan (RTP) which will help to deliver, in their regions, the outcomes and strategic priorities set out in the Wales Transport Strategy. The RTPs must also support the aspirations of the Wales Spatial Plan and other national and regional strategies on the economy, sustainable development and the environment.

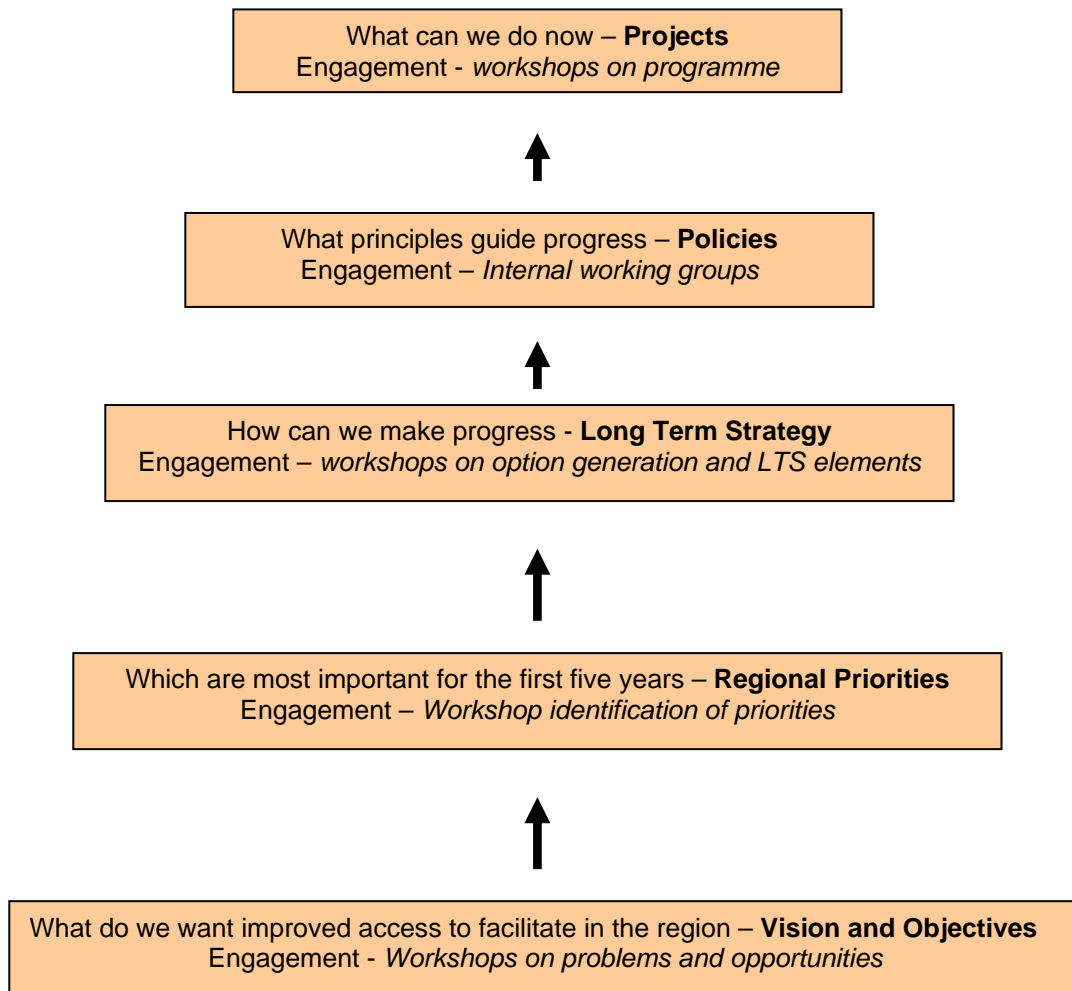
WAG set out guidance for the format and general content of the RTP and introduced a new appraisal mechanism, The Welsh Transport Planning and Appraisal Guidance (WelTAG), to be used to ensure that at strategic and programme levels, the RTP is always focused on delivering its objectives. There is also a statutory requirement on the consortia to carry out a Strategic Environmental Assessment (SEA) on the RTP.

7.2 Consultation

The RTP Guidance, WeITAG and the SEA all stress the importance of stakeholder participation at all stages of the development of an RTP. SWWITCH has focused time and energy on working with a wide range of stakeholders to ensure that the RTP will deliver a policy framework and the practical projects necessary to support improved access to, from and within South West Wales. Figure ES1 below shows the stages of the RTP and the stakeholder interaction initiated by SWWITCH. In addition to the extensive range of workshops and consultation sessions, more formal research was also critical to the RTP development and this included:

- Strategic Level Accessibility Assessment – using the computer based mapping system Accession™
- Travel Pattern Research – involving 7 day travel diaries completed by more than 2000 residents in the region
- Public Transport Passenger Satisfaction surveys – involving users and non users of public transport
- Local Authority “Citizens’ Panels” – with demographically representative samples responding to specific questions on transport

Figure ES1 – RTP Stages and Engagement



The RTP Strategy and Policies cover all aspects of access and transport and will provide a framework for the transport activities of public, private and voluntary sector organisations in South West Wales. The RTP is also a bidding document for a programme of capital transport expenditure to help deliver improved access. However the programme does not include transport responsibilities of WAG (although SWWITCH does make recommendations about WAG priorities) or commercial organisations which SWWITCH cannot directly influence. In addition, the Programme does not include revenue projects, which are an essential part of providing good access in the region.

7.3 Key transport issues in the region

The South West Wales region is diverse geographically, demographically and economically, and includes congested urban areas, isolated rural communities and a wide variation in between. It also includes National Park areas and the Gower Area of Outstanding Natural Beauty (AONB).

Despite the diversity, many similar access problems exist and these have been highlighted during regional consultation on the Wales Spatial Plan (WSP) and the RTP.

The following key transport issues, which have arisen repeatedly during consultation, have formed the basis for the development of the RTP.

- **Road traffic volumes** in the region have grown considerably during the last decade resulting in pressures in terms of unreliable journey times, increased congestion, reduced air quality, increased noise, vibration and carbon emissions.
- **Road safety issues** raise public concerns and whilst there has been a general reduction in serious injuries and deaths from road traffic collisions, there are wide variations across the region and for particular road users categories
- **Car Ownership and use** has increased rapidly although there are disparities across the region. Those with cars are able to participate in a far wider range of opportunities than those reliant on public transport, walking or cycling
- **Public Transport** provision broadly matches population distribution with higher frequency services and better coverage to the south and east of the region where the majority of the population lives, and less extensive provision in the more sparsely populated rural areas. Rail, bus and coach services are provided by private sector companies through a mixture of

commercial operation and subsidised services. Physical access to bus and rail services and rolling stock remains a barrier to mobility impaired in some locations

Other key transport facilities and services which have influenced the RTP development include:

- **Freight operation** is an essential contributor to the economy but is planned and delivered by the private sector within European and UK legislative processes
- **Ports and Shipping** facilitate the movement of passengers and freight to and from the region and are a critical link in the national supply chain network
- There are three small **Airports** in the region: Swansea, Pembrey and Withybush. They do not currently play a strategic role or provide scheduled services, but they all have the potential to be developed to serve small niche markets for business and leisure travel.

Taking into consideration all of the problems and concerns highlighted by formal research or the input of stakeholders during consultation, SWWITCH developed and adopted a vision for improved access and transport in the region.

7.4 RTP Vision

Our Vision for South West Wales is to improve transport and access within and beyond the region to facilitate economic development and the development and use of more sustainable and healthier modes of transport.

The vision was developed into specific objectives for the region. There were originally nine objectives, but these were amended as a direct result of stakeholder feedback and the seven RTP objectives shown below encapsulate what SWWITCH wants the RTP strategy, policies and programme to deliver.

The objectives are critical as they formed the starting point for all further stakeholder appraisal and decision making. The consultation on strategic options, on developing and appraising a long term strategy and on the priorities for the RTP programme, all focused on what would provide best fit with the RTP objectives. Similarly outline monitoring proposals and the future development of indicators and targets will focus on how well the RTP objectives are being met. This objective led approach is an essential element of the WelTAG process that SWWITCH has embedded throughout the RTP development.

RTP Objectives

1. To improve access for all to a wide range of services and facilities including employment and business, education and training, health care, tourism and leisure activities
2. To improve the sustainability of transport by improving the range and quality of, and awareness about, transport options, including those which improve health and well being
3. To improve the efficiency and reliability of the movement of people and freight within and beyond South West Wales to support the regional economy
4. To improve integration between policies, service provision and modes of transport in South West Wales
5. To implement measures which make a positive contribution to improving air quality and reducing the adverse impact of transport on health and climate change, including reducing carbon emissions
6. To implement measures which help to reduce the negative impact of transport across the region on the natural and built environment including biodiversity
7. To improve road safety and personal security in South West Wales

The extensive work with stakeholders also highlighted key opportunities and challenges for the future, including:

Opportunities

- Further development on improving the range of alternative (to the private car) transport options

- Increasing emphasis on raising awareness and marketing sustainable transport and multi modal ticketing
- New technology facilitating reduced demands for travel and cleaner vehicles and fuels
-

Challenges

- Climate change and reducing carbon emissions
- Reliance on fossil fuels with finite supplies and market uncertainties
- Capital and Revenue funding for essential transport projects and sustainable and integrated services

Options and Long Term Strategy

Following adoption of the RTP vision and objectives the next stage of the RTP was to examine high level options for achieving the objectives and the development and appraisal of a long term strategy to provide a framework for policies and practical actions to improve access and transport.

Option generation and appraisal

A number of different planning scenarios were tested through stakeholder workshops to stimulate debate and determine which would result in most progress towards the RTP objectives.

The scenarios/options used were as follows:

- **Car is King – This scenario involves developing a strategy and programme to support car use.**
- **Hearts & Minds – This scenario focuses on encouraging more use of sustainable travel and the reduction of non-essential travel.**
- **Demand Restraint – This scenario involves actions to restrict private car use.**

- **Planning the Future – This scenario involves land-use planning being integrated with other policies to reduce the need for the private car and to provide for more sustainable transport.**
- **Public Transport Rules – This scenario supports the growth, development and use of public transport.**
- **Mix & Match – This scenario involves a combination of the above.**

The outcome of the consultation on option generation was that for the region as a whole the “Mix and Match” option, involving a range of measures, was considered the only realistic approach.

7.5 Long Term Strategy

The development and appraisal of a long term strategy to achieve RTP objectives was again an interactive process with sustained stakeholder engagement. Stakeholders were asked to consider a range of potential strategy elements and to add extra ones if they felt some had been missed. They were then asked to rank the elements in order of priority with the highest ranking being the elements most likely to achieve the objectives.

The results from all the stakeholder sessions were amalgamated and priorities were examined in detail by SWWITCH. Some of the prioritised long term strategy elements were directly related to issues which SWWITCH cannot directly influence. This could be because they are in the commercial domain (for example sustainable freight and fuels) or they are directly controlled by WAG (the Rail network and services and Strategic East/West road links). Additionally some of the prioritised elements directly related to revenue expenditure. Whilst revenue funding is critical to delivering improved access and transport and this is highlighted throughout the RTP, the main focus of the RTP is securing capital investment on transport infrastructure and services.

Taking the issues in the above paragraph into account, the results of the Long Term Strategy consultation were appraised in the context of the high level aspirations set out in One Wales and the Wales Spatial Plan and the strategic priorities of the Wales

Transport Strategy. This resulted in the adoption by SWWITCH of the following long term strategy priorities:

RTP Long Term Strategy

- **Improving land use and transportation planning** – through the use of Accessibility Planning to ensure that development is put in the right place.
- **Improving strategic east/west road and rail links**– to create more reliable internal connectivity and improved connectivity with rest of Wales, the UK and European neighbours.
- **Improving Strategic Bus Corridors** – to create more reliable and attractive connectivity between key settlements.
- **Promoting integration** – to encourage more sustainable travel choices and reduce the barriers to interchange
- **Improving safety in transport** – to reduce personal injuries and fears for personal safety.
- **Providing more and better information** - to raise awareness on the range and use of sustainable transport options
- **Improving linkages between key settlements and strategic employment sites** - to create a range of attractive passenger transport and walking and cycling opportunities linking key settlements with their hinterlands and with strategic employment sites.
- **Improving the efficiency of the highway network** – through a range of appropriate mechanisms including demand restraint.

SWWITCH has developed more specific strategy proposals for four types of areas within the region. These areas are not specifically defined and are intended to reflect the different strategic priorities that will be needed across such a diverse region. The areas are:

- Swansea Urban Area
- Strategic Corridors
- Key Settlements and their hinterlands

- Rural areas

7.6 RTP Policies and Component Strategies

The improvements that the RTP seeks to make to access and transport are not simply about specific projects or service improvements. It is also about:

- the way in which services are planned
- the partnership approach to development and delivery
- the integration between strategies, policies and actions

The overarching policy of the RTP is to improve access to facilitate a good quality of life and a viable and thriving regional economy. This will be achieved through a range of physical, policy and revenue based measures. However, more detailed specific policies have been developed and set out according to the Wales Transport Strategy Strategic Priorities. These are shown below:

Reducing Greenhouse gas emissions and other environmental impacts from transport

- **Policy E1** – SWWITCH will work collaboratively to ensure that new development is located where it will reduce reliance on private motoring. For existing land allocations the emphasis will be on securing realistic alternatives to single car occupancy as part of the development process.
- **Policy E2** – SWWITCH will facilitate and promote improved rail and bus services, walking, cycling and car sharing to encourage modal shift and improve air quality
- **Policy E3** – SWWITCH will work collaboratively with a wide range of organizations in South West Wales to encourage take up and development of travel planning to reduce single occupancy car commuting
- **Policy E4** – SWWITCH will work collaboratively to encourage more sustainable freight distribution through better use of rail, intermodal facilities and ports.

Integrating local transport

- **Policy IT1** – SWWITCH will develop improved interchange facilities, including Park and Ride schemes, to reduce the barriers to multi modal journeys
- **Policy IT2** – SWWITCH will work collaboratively to encourage the development and take up of smartcards and other multi modal ticketing opportunities
- **Policy IT3** – SWWITCH will develop user friendly sustainable travel information to support multi modal journeys
- **Policy IT4** – SWWITCH will facilitate joined up working between agencies and organisations that provide transport to reduce barriers to more sustainable travel behaviour
- **Policy IT5** – SWWITCH will work with agencies and organisations that provide transport to reduce barriers including those which prevent people with impairments from using public transport
- **Policy IT6** – SWWITCH will develop a range of transport options to meet the access needs of those living in areas with no appropriate public transport
- **Policy IT7** – SWWITCH will integrate Strategic and Local Transport networks to promote sustainable access to the coast and countryside for tourists and residents

Improving access between key settlements and sites

- **Policy KS1** – SWWITCH will develop improved public transport services, including unconventional and innovative forms of public transport, to link key settlements and their hinterlands with strategic corridors and strategic and local employment sites
- **Policy KS2** – SWWITCH will improve the journey time reliability on and safety of the road network between key settlements and from them to strategic and local employment sites
- **Policy KS3** – SWWITCH will improve walking and cycling links within and between key settlements, including the development of Safe Routes in the Community.

- **Policy KS4** – SWWITCH will promote sustainable transport options to reduce car dependency for local journeys and improve local air quality

Enhancing International Connectivity

- **Policy IC1** – SWWITCH will work with the Welsh Assembly Government through the National Transport Plan programme to improve the Trunk Road Network to facilitate journey time reliability and support the regional economy
- **Policy IC2** – SWWITCH will press for improvements to the rail network in and beyond South West Wales into Sewta and TraCC to encourage more inward investment and support modal shift for passengers and freight
- **Policy IC3** – SWWITCH will work collaboratively to facilitate more reliable, effective and sustainable movement of people and freight to, from and through our ports
- **Policy IC4** – SWWITCH will work with the Welsh Assembly Government, Sewta and TraCC to support the development of good access to regional and national airports in the UK, especially by public transport

Increasing Safety and security

- **Policy SS1** – SWWITCH will seek to reduce the number of road casualties and collisions through improved traffic management
- **Policy SS2** – SWWITCH will work collaboratively to promote safe behaviour by all road and rail users
- **Policy SS3** – SWWITCH will encourage and facilitate more use of public transport, walking and cycling to increase footfall in our local communities and reduce anti social behaviour

WAG has asked consortia to identify priorities for those transport areas which will be delivered by the National Transport Plan, namely Trunk Road, Rail and Revenue priorities. SWWITCH recognises the importance of investment in these areas to the success of the RTP and has adopted the following priorities.

Rail Priorities

Description	Detail	Priority
Improvements to Rail Services West of Swansea	<ul style="list-style-type: none"> Redoubling the line west of Swansea to secure improved services to West Wales including <ul style="list-style-type: none"> 3 trains per hour between Swansea, Gowerton, Llanelli and Carmarthen Hourly services from Carmarthen to Milford Haven 5 trains per day to Fishguard Harbour 	1
Improving Rail Services to Cardiff, Bristol and London	<ul style="list-style-type: none"> Reducing the journey times to Cardiff, London and beyond Improving access to and facilities at mainline stations drawing on all sources including National Station Improvement Programme funds and EU Convergence funding 	2
Improving the access to and use of rail services	<ul style="list-style-type: none"> Five trains per day on the Heart Of Wales Line (HOWL) Improving the Swanline service Developing new stations where justified and reviewing the long term role of smaller stations Maintenance and development of the South West Wales Community Rail Partnership 	3

Trunk Road Priorities

Description	Detail	Priority
Trunk Road Commitments	<ul style="list-style-type: none"> A40 Penblewin to Slebech A40 The Kell A477 St Clears to Red Roses A 40 Llandewi Velfrey to Penblewin A483 Llandeilo bypass 	1
M4 and Trunk Road priority measures	<ul style="list-style-type: none"> M4 junction improvements to reduce congestion and improve connectivity Consideration of Park and Share sites near to M4 junctions Signalisation of Pensarn roundabout in Carmarthen A48 at Cross Hands improvements Trunking of: <ul style="list-style-type: none"> A4138 - between M4 and Llanelli A483 - Fabian Way corridor 	2
A 40 improvements	<ul style="list-style-type: none"> Improvements to the A40 west of St Clears including dualling if the business case is proven Access from the A40 to the proposed Carmarthen west link road 	3
Trunking and De- Trunking	<ul style="list-style-type: none"> Trunking of: <ul style="list-style-type: none"> A485/6 - Carmarthen to Synod Inn A476 between Cross Hands and Ffairfach accompanied by a subsequent de-trunking of the A483 from Pont Abraham through Ammanford to Ffairfach/Llandeilo De-Trunking of: <ul style="list-style-type: none"> A40 Salutation Square to Withybush Roundabout 	4

Revenue Priorities

Description	Detail	Priority
Support for existing levels of service	<ul style="list-style-type: none"> Maintenance funding to ensure that existing facilities are retained in first class condition Maintain current levels of support for existing rail services, bus services and community transport schemes in the region 	1
Support for improved services	<ul style="list-style-type: none"> Increased maintenance funding to include new infrastructure Improved and additional bus services focusing on delivering the WSP access aspirations and the Accessibility Strategy Rail services – improvements to services in terms of new rolling stock or extra services will require additional WAG revenue funding through the Wales Rail Franchise Development of new unconventional public transport services including community transport schemes and pump priming social enterprise schemes 	2
Supporting Behavioural change	<ul style="list-style-type: none"> Sustainable Towns scheme development including awareness raising, campaigns and information, Personalised Travel Planning projects Ticketing initiatives Better targeting of the Concessionary fares scheme to meet the needs of young people, job seekers, elderly and disabled people who do not benefit from the current concessionary scheme. 	3
Support for pump priming and sustaining capital projects	<ul style="list-style-type: none"> Revenue implications of capital projects like Park and Ride Revenue impacts of improved parking enforcement 	4

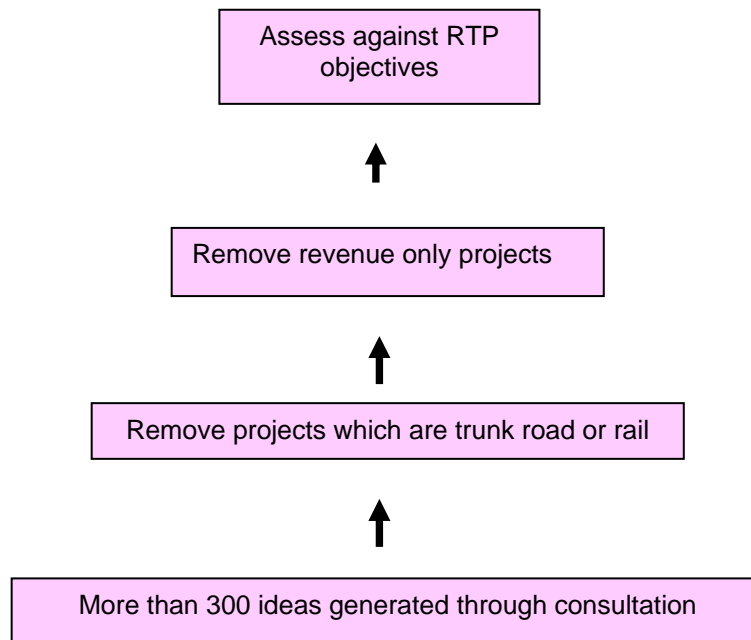
SWITCH has also developed a series of component strategies providing a more comprehensive framework for the development and delivery of transport and access in the future. The component strategies relate to:

- Freight
- Public Transport
- Land Use Planning
- Traffic Management
- Smarter Choices
- Parking
- Road Safety
- Maintenance
- Accessibility
- Walking and Cycling

7.7 RTP Programme

Once SWWITCH adopted objectives and a long term strategy, there was further detailed consultation and appraisal of a programme of projects to help deliver them. Stakeholders were encouraged to put forward any projects which they considered would help achieve the overarching objectives and more than 300 project ideas were put forward. These were assessed or “filtered” as shown in Figure ES2 below.

ES2 – Filtering Stakeholder Project Ideas



This process resulted in a pool of 120 projects which were published for formal consultation in the Draft RTP in July 2008. Responses to the consultation highlighted some additional projects and there was some consolidation of others so that the number of projects remained at 120.

SWWITCH used a prioritisation process, which was in line with WelTAG appraisal and which assessed all projects against the following criteria:

- Policy fit – RTP objectives and strategy
- Value for Money – broad brush assessment of cost vs benefits
- Deliverability – technical, economic, political
- Regional Impact – did the project have strategic or very localised impacts

All 120 projects in the programme pool were appraised against these criteria and 75 projects met the threshold and now form the RTP programme. These projects are shown on the table ES 1 below.

To construct a meaningful 5 year programme from the 75 projects SWWITCH has assessed which are most likely to be capable of delivery within 5 years and grouped similar projects together. This is important to ensure that benefits are achieved across the whole region and that there is flexibility within the programme. This means that delays in one project will not jeopardise the delivery of the whole programme as funding can be switched to another project within the same group or tranche of projects.

Table ES 1 – Projects which met the appraisal threshold

Project	Project
Quadrant Bus Station Interchange	Metro
Outstanding commitments on Carms TG schemes	Port Talbot PDR completion of 1A & B
Port Talbot PDR Stage 2	Swansea High Street station Improvements
Carmarthen Railway Station Improvements	Landore Park and Ride extension
Road Safety package	Carmarthen Road bus priority measures
Carmarthen to Swansea Bus Corridor Package	Pembroke to Milford Haven Bus Corridor
Haverfordwest to Milford Haven Bus Corridor	Swansea west Park and Ride Site
Port Talbot to Swansea Bus Corridor	Swansea Valley to City Centre Bus Corridor
Neath (Llandarcy) to Swansea Bus Corridor	Port Talbot to Neath Bus Corridor
Cross Hands Economic Link Road	Bridge improvements package on A4382 Llanwrda, Lampeter
Develop Valleys Cycle Network and Connect 2 routes	Haverfordwest to Tenby via Pembroke Bus Corridor
Llanelli Bus Station Improvements / Interchange	Milford Haven Railway Station Integrated Transport Interchange
Fishguard Bus Focal Point	Carmarthen Park & Ride
Pembroke Dock Bus/Rail Interchange	New Road Access to Morriston Hospital
Haverfordwest to Tenby via Narberth Bus corridor	Introduce sustainable towns concept
Lifestyle Changes Walking and Cycling	Re-open Goodwick station as a Bus/Rail interchange
More variable message signing	Southern Strategic Route - A477 jct to Energy Site Corridor
Port Talbot Parkway	City Centre urban cycle network
Improve Oystermouth Road corridor (European Boulevard)	Haverfordwest to Fishguard via St David's Bus Corridor
Haverfordwest to Fishguard via Letterston Bus Corridor	Fishguard to Cardigan Bus Corridor
Ammanford to Cross Hands Bus Corridor	Tenby Bus Focal Point
Llanelli Railway Station Improvements	Clynderwen Railway Station Improvements
Newcastle Emlyn Bus Focal Point	Sw'sea Air Quality Package including Hafod Transport Scheme

Park and Share sites close to M4 junctions	North/south cycle route in Pembrokeshire
North Carms - Ceredigion Link Road	Pencader Bus Focal Point
Llandeilo Bus Focal Point	Drefach Bus Focal Point
Carmarthen West Link	Carmarthen East Link
Northern Distributor Network - Bulford Road Link	Baglan Energy Park Link Bridge
Neath Railway Station Improvements	Capital Enhancement schemes for community transport
Llanelli Park and Ride	Blackbridge Access Improvement
Multi Modal Freight Facility - Margam Wharf	Pontardawe Cross Valley Link Bridge
Gowerton Station	St. David's Pedestrian links
Pembroke Community Regeneration Scheme Phases 1 & 2	Carmarthen Bus Station
Waterston Bypass	Access to Kenfig Industrial Estate
Ammanford Distributor Road	Swansea west Access Road
Strategic Bus Corridors around Swansea	Tenby Park and Ride
Investigate light rail schemes	Morfa Distributor Road
Coed Darcy southern link	

Please note these projects are not arranged in order of priority

The RTP guidance requires consortia to specify three separate RTP programmes depending upon the level of funding which is made available to each consortium over the 5 year period. Legacy schemes are included in the programme but not in the total programme costs on the assumption that they will be top sliced at a national level. The three separate programmes are:

- A do minimum level programme (based on current levels of investment) and for the RTP this would be £109m.
- A second best level and this would total £151m
- A preferred level totalling £191m

Table ES 2 below shows the summary five year programme for each of the three programme options. Full details are in Chapter 4 (pages 74 - 80) available online at <http://www.swwitch.net/rtp.aspx>

Table ES2 - Summary of 3 programme options

Option One - Do Minimum option - £109 million

Project/scheme	Year 1 2010/11 000s	Year 2 2011/12 000s	Year 3 2012/13 000s	Year 4 2013/14 000s	Year 5 2014/15 000s	5 year total 000s
Bus Corridors (23%)	3,000	5,000	5,000	6,000	6,000	25,000
Park and Ride development (12%)	2,000	2,000	3,000	3,000	3,000	13,000
Transport Interchanges (18%)	2,000	4,000	4,000	5,000	5,000	20,000
Sustainable and Healthy travel (7%)	1,000	1,000	2,000	2,000	2,000	8,000
Economic Regeneration Infrastructure (39%)	3,000	10,000	10,000	10,000	10,000	43,000
Totals	11,000	22,000	24,000	26,000	26,000	109,000

Option Two – Second best option - £151 million

Project/scheme	Year 1 2010/11 000s	Year 2 2011/12 000s	Year 3 2012/13 000s	Year 4 2013/14 000s	Year 5 2014/15 000s	5 year total 000s
Bus Corridors (19%)	3,000	6,000	6,000	7,000	7,000	29,000
Park and Ride development (11%)	2,000	3,000	4,000	4,000	4,000	17,000
Transport Interchanges (15%)	2,000	5,000	5,000	5,000	5,000	22,000
Sustainable and Healthy travel (7%)	1,000	1,000	2,000	3,000	3,000	10,000
Economic Regeneration Infrastructure (48%)	3,000	15,000	20,000	20,000	15,000	73,000
Totals	11,000	30,000	37,000	39,000	34,000	151,000

Option Three – Preferred option - £191 million

Project/scheme	Year 1 2010/11 000s	Year 2 2011/12 000s	Year 3 2012/13 000s	Year 4 2013/14 000s	Year 5 2014/15 000s	5 year total 000s
Bus Corridors (17%)	3,000	6,000	8,000	8,000	8,000	33,000
Park and Ride development (10%)	2,000	3,000	4,000	5,000	5,000	19,000
Transport Interchanges (14%)	2,000	5,000	5,000	7,000	7,000	26,000
Sustainable and Healthy travel (5%)	1,000	1,000	2,000	3,000	3,000	10,000
Economic Regeneration Infrastructure (54%)	3,000	20,000	30,000	30,000	20,000	103,000
Totals	11,000	35,000	49,000	53,000	43,000	191,000

Whatever level of funding is available during the first 5 year programme, there will be a need for flexibility to react to outside developments and priorities in the region.

Delivery and Monitoring

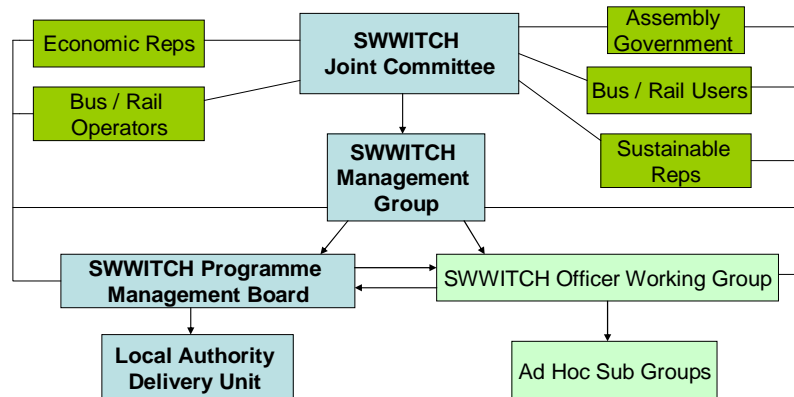
Delivery

If appropriate mechanisms are not in place to ensure that forthcoming funding results in efficient and successful delivery, the stakeholder participation, the background research and the work that has been involved in developing the RTP will have been to no avail. In addition achieving the RTP objectives is much more than capital projects alone and many of the stakeholders who helped develop the RTP will be key partners in delivering the integrated and high quality access that is needed in the region, in particular:

- Internal Local Authority colleagues from Environment, Planning, Economic Development, Housing, Education, Leisure Departments etc
- National Park Authorities
- Health Care planners and providers
- Transport Operators, commercial and voluntary
- Large Employers
- Transport User organisations
- Various Fora with wide ranging audiences

The four SWWITCH Authorities have a good track record in delivering a wide range of schemes and SWWITCH intends to build on existing project management and delivery processes. This is seen as more efficient and effective than the creation of a new, separate project management/delivery structure. SWWITCH proposes a Programme Management Board comprising the project managers from each Local Authority along with the SWWITCH Coordinator and chaired by a Director or Head Of Service. This board would be responsible for ensuring progress of the programme and agreeing any shift of funding across the programme that may arise due to potential delays to specific projects. The board will report through the SWWITCH structure as shown.

SWWITCH Programme Management



Monitoring

It is critical that SWWITCH monitors the progress of the RTP, both in terms of outputs (for example how many bus stations were improved, how many kms of cycleway were built) and in terms of outcomes (for example is there an increase in bus service patronage or improvements to the reliability of journey times).

SWWITCH commissioned a Monitoring Action Plan in 2003 which proposed a series of Key Performance Indicators including:

- Public transport accessibility
- Bus and traffic journey times
- Bus and traffic journey time reliability
- Bus and rail passenger satisfaction
- Environmental impacts
- Road Safety

Road Safety statistics are collected by all local authorities and there is good historical information to allow trends to be analysed. SWWITCH carried out bus and rail user satisfaction surveys in 2005 and in 2006/7 Travel Pattern Research and Congestion Mapping studies were completed as part of the RTP development.

However, limited progress overall has been made in establishing baseline

information, largely due to the costs associated with data collection and analysis and monitoring. The RTP will require a more holistic and sustained approach.

The Wales Transport Strategy sets out a number of indicators which WAG will use to measure progress towards outcomes. WAG is also developing a Wales Transport Monitoring Strategy which will provide a framework for consistent monitoring across Wales, whether it is carried out at Consortia, WAG or Local Authority level.

The Table ES3 below sets out SWWITCH monitoring proposals. It can be seen that much more work is needed to assess baselines and establish trends. SWWITCH does have serious concerns about the availability of data, the costs of collection and the capacity for ongoing analysis.

Targets have not been identified at this stage, as it is not appropriate without establishing a baseline and trends.

WeITAG

SWWITCH has applied the principles of the Welsh Transport Planning and Appraisal Guidance (WeITAG) throughout the development of RTP. Each stage has been subject to stakeholder engagement and scrutiny and the RTP objectives have formed the backbone of the appraisal process to ensure that the strategy, policies and projects which make up the RTP will help to deliver the objectives and vision for South West Wales.

Stage 1 strategy appraisal was completed prior to the publication of the draft RTP in summer 2008. Stage 1 project appraisal was carried out after the public consultation once a programme pool of 120 projects was confirmed.

Table ES 3 – SWITCH Monitoring Proposals

RTP Objective	Indicator	Data Source	Baseline
1	<ul style="list-style-type: none"> • Accessibility: maps/stats • Car access • public transport access • Key Connectivity analysis 	<ul style="list-style-type: none"> • Accessibility planning software (Accession), Traveline database 	<ul style="list-style-type: none"> • RTP appendix J and K
2	<ul style="list-style-type: none"> • Public awareness of transport options • Public perception of quality of transport options • Patronage of bus & train services • Public satisfaction with bus and rail services • Cycle usage 	<ul style="list-style-type: none"> • Surveys • Surveys • Operators • Surveys, operator market research data • Cycle counters 	<ul style="list-style-type: none"> • Some baseline survey data (2005)
3	<ul style="list-style-type: none"> • Journey time reliability <ul style="list-style-type: none"> • buses • cars • HGVs 	<ul style="list-style-type: none"> • ITIS data 	<ul style="list-style-type: none"> • To be established
4	<ul style="list-style-type: none"> • Passenger satisfaction about bus rail integration 	<ul style="list-style-type: none"> • surveys 	<ul style="list-style-type: none"> • To be established
5	<ul style="list-style-type: none"> • Number of AQMAs • Air pollution index 	<ul style="list-style-type: none"> • Local authority air quality monitoring 	<ul style="list-style-type: none"> • Established LA monitoring
6	<ul style="list-style-type: none"> • Proportion of transport schemes having an adverse impact on national and built environment 	<ul style="list-style-type: none"> • Environmental Impact Assessments 	<ul style="list-style-type: none"> • To be established
7	<ul style="list-style-type: none"> • Road casualty stats • KSIs • Child KSIs • Slight injuries per 100m vehicle kms • Public perception of personal safety related to transport use 	<ul style="list-style-type: none"> • Local authority data 	<ul style="list-style-type: none"> • Established LA monitoring

Stage 2 project appraisal has not yet been completed for a number of reasons including:

- The time taken to appraise fully RTP projects at Stage 2 level
- Securing agreement on what level of appraisal each project or package of projects should be subject to
- The costs of detailed investigations for projects or packages

The stage 2 appraisals will be completed during the next 6 to 9 months and this will allow the prioritisation of projects in the programme. The outcomes of these appraisals will be included in the first Annual Progress Report of the RTP in 2010.

7.8 Strategic Environmental Assessment (SEA)

SWWITCH has considered the environmental implications arising from policy and projects as an integral part of the RTP development. The Appropriate Assessment screening required as part of the Habitats Regulations has similarly been a key consideration during the appraisal of the programme for the RTP.

There has been a detailed consultation process throughout with the statutory SEA stakeholders (Environment Agency, Countryside Council for Wales and Cadw) to ensure that SWWITCH not only meets the legal requirements of the legislation, but incorporates the principles of protecting and enhancing the environment at the heart of the RTP development and ultimately during its delivery.

The SEA statement is published as a separate document to the RTP (due to its size and technical nature) and Chapter 7 provides a summary of the process undertaken (viewable at <http://www.swwitch.net/rtp.aspx>).

7.9 RTP Progress Report 2010/11

TRANSPORT POLICY AND PLANNING CONTEXT

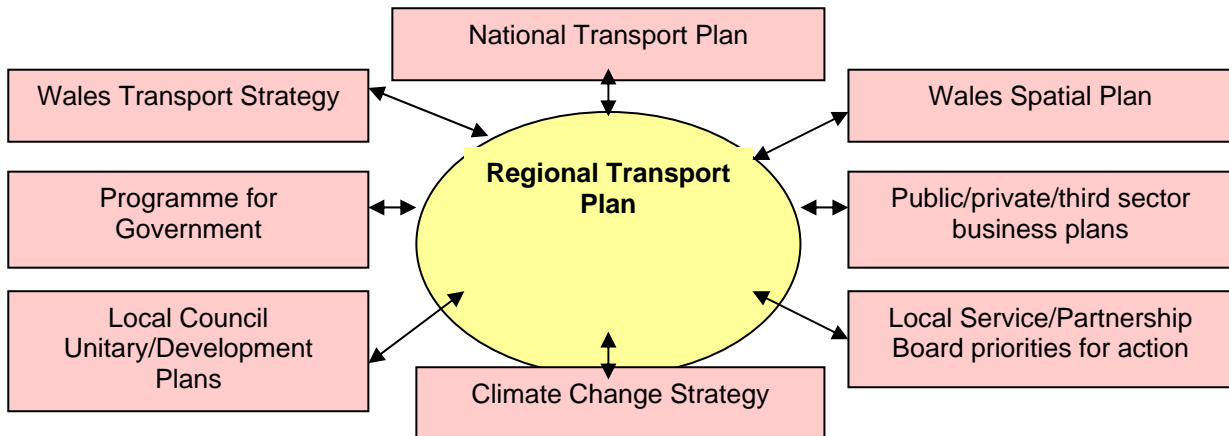
Introduction

“Progress in Partnership”, The Regional Transport Plan (RTP) for South West Wales (2010 – 2015) was prepared between 2006 and 2009 with input from a wide range of stakeholders. The plan adhered to the Welsh Government guidance on RTP development and had synergy with relevant national and local strategies and plans.

That synergy is as strong almost three years on as shown in Figure One below.

The SWWITCH RTP was approved by the Welsh Government (WG) in 2009 and now provides the foundation for transport policy and investment decisions across South West Wales.

Figure One – Synergies of the RTP



From April 2010, RTP capital funding has been provided to transport consortia to help deliver the RTP programme. In September 2011, SWWITCH submitted its first Annual Progress Report (APR) which detailed changes/progress during the 2010/11 year.

This is the second SWWITCH APR and it relates to the 2011/12 financial year. This APR highlights changes during that year and the delivery of the RTP programme in 2011/12.

External Changes in the last year

There have been a number of changes since the last APR as follows:

- Prioritisation of the National Transport Plan (NTP) - 2011
- Programme for Government - 2011
- Annual Progress Report on the Climate Change Strategy – 2012
- The “Simpson” Compact - collaboration agenda 2011

In Summer 2011, in the context of the continuing downward pressure on public sector finances, the Minister announced a review and prioritisation of the NTP. He sought input from a range of interested stakeholders and SWWITCH along with other transport consortia in Wales contributed to that process. In December 2011, the Minister re-launched a prioritised NPT. For the SWWITCH region, there was little change in terms of the proposed number and timing of investments.

In 2011 the WG set out a new Programme for Government which included aims, key actions on improvements, monitoring and evaluation, long term challenges, departmental responsibilities and key partners in the process.

Transport and access as cross cutting issues were not specific headings within the programme, but it did include actions and commitments to continuing improvements in terms of:

- NTP
- Safe Routes in Communities
- Bus services in general and Traws Cymru and Bwcabus in particular

- Rail electrification, Network Rail accountability and the Wales & Border franchise
- The Highways & Transportation Bill (now the Active Travel Bill)

The first APR on the Climate Change Strategy was published in March 2012 and chapter 5 deals with emission reduction in the transport sector. An update is provided on each of the key measures set out in the Strategy which includes:

- Sustainable Travel Centres and Personalised Travel Planning
- Development of Strategic Modal Interchanges
- Promotion of Walking and Cycling
- Investment in Bus and Rail services
- Promotion of Eco driving

The APR details recommendations from the Climate Change Commission to the WG in three specific areas; a clear investment strategy for Wales; support for electric vehicle charging infrastructure and the recommendations of the European Commission white paper on transport and aligning Welsh strategy for transport with that paper.

The WG response is to highlight in the APR where there are synergies in terms of policy, strategy and interventions and to explain, when there is divergence in Wales, why that is the case.

The WG and Local Authorities in Wales reached agreement in Autumn 2011 on a Compact. This covers all service areas and focuses on encouraging more collaborative working between departments and across administrative boundaries. Transport, already working collaboratively through the regional transport consortia, has a “head start” in this field and this has been recognised and encouraged by the Minister.

The transport section of the Compact committed the WG to work with Local Authorities to review the interface between the Trunk Road Agencies and the Regional Transport Consortia’s constituent Authorities and between highway engineering services to support the consistent and coherent planning, management and delivery of strategic highway services. It also committed the consortia to investigate and develop some “quick win” projects.

SWITCH has been actively involved in and supportive of the collaboration process to date and further details on SWITCH “quick win” projects is included in Appendix One of the APR.

Internal Changes in the last year

The RTP is a five year document (2010 – 2015) based on a longer term vision and strategy (up to 2025) and the APR does not change the direction or focus of the plan. However, it provides an opportunity to highlight changes that have occurred in the last year.

Current transport issues

Traffic levels in South West Wales continue to show a slight decline since the RTP was submitted. This is consistent with the general trend across Wales as

shown in Table One below.

Table One – SWWITCH Traffic Levels 2007 – 2010

Billion vehicle kms travelled				
Area	2007	2008	2009	2010
Carmarthenshire	1.97	1.96	1.92	1.89
Neath Port Talbot	1.39	1.35	1.33	1.28
Pembrokeshire	1.09	1.11	1.10	1.08
Swansea	1.76	1.73	1.69	1.66
Wales	28.41	28.35	27.95	27.43

However, despite the lower traffic levels, transport related air quality problems remain a growing problem in the region with the City & County of Swansea having extensive areas subject to an Air Quality Management Area (AQMA). Llandeilo in Carmarthenshire has recently been declared as an AQMA. It is also likely that an area in both Pembroke and Haverfordwest Town Centres will be declared in the near future.

The impact of the economic situation on all levels of public sector finances also means that the RTP delivery expectations need to be revised. When the RTP was developed, consortia were asked to develop three levels of programme, with the lowest value of these being based on Transport Grant spend across the region in the previous five years.

In SWWITCH this resulted in a "do minimum" programme over five years with a total value of £109 million, split over the two years of RTP delivery to date, as follows:

- 2010/11 - £11million – actual grant £4.909million
- 2011/12 - £22million – actual grant £4.370million

Predictably, with the RTP funding to date totalling 28% of the expected funding, it has not been possible to create the number and range of transport improvements predicted and it is not expected that outputs and outcomes will match RTP aspirations.

The public sector funding squeeze is mirrored by a continuing retraction of the commercial bus service network This has an impact on the delivery of the RTP and most importantly on vulnerable citizens, often living with the daily impacts of poverty and for whom public transport is the only way they can access services and facilities necessary for a good quality of life.

These negative issues mean there is now more work to be done. Each pound of RTP and other funding needs to be spent to maximum effect, more effort is needed to encourage commercial or social enterprise development for innovative public transport options and more emphasis placed on promoting the more sustainable and low cost access modes, such as walking, cycling and car sharing.

The RTP Programme pool

SWITCH RTP delivery is managed by the Programme Management Group (PMG). The way in which SWWITCH PMG works is explained in Appendix Two of the APR.

As reported in the 2010/11 APR, the original RTP programme pool had been revised from 75 to 57 projects and subsequently four new projects were admitted to the programme, making a total of 61 projects.

Three more new projects were admitted to the programme pool in September 2012 as follows:

- Fishguard Town Centre Access Improvements
- Swansea Vale Stadium Park and Ride
- Towy Valley Transport Corridor Concept

SWWITCH PMG is currently reviewing the RTP programme again, because of the new projects and also the completion of other projects delivered during the last two years. But also, in the context of further decreases in transport funding in Wales in the order of 5-10% year on year for the next three years.

Community Transport Capital Enhancement Grant (CEG)

In 2011/12, SWWITCH introduced a small pot of funding for Community Transport (CT) Operators. Working with the Community Transport Association, SWWITCH developed guidance and a bidding process and encouraged CT operators to bid for funding to help improve or expand their vehicle fleet, or to improve efficiency through IT updates or software packages to support scheduling.

The CT sector response was pleasing in terms of the quality, scale and scope of bids. The full details of the use of the grant and the impact it has had on the service operators can provide to users is set out in Appendix Three.

Road Safety Grant

From 2011/12 Road Safety Grant (RSG) has been allocated via the consortia. This has helped to build on the collaborative working on road safety already generated by the establishment of the SWWITCH Regional Road Safety Group and has meant that opportunities for tapping into economies of scale and the sharing of best practice have grown.

Linkages with Strategic Planning

Local Authority planning colleagues were engaged in the RTP development to ensure synergy with the evolving Local Development Plans (LDP). Those plans have continued to develop at varying rates but the relationship and interaction between the land use strategies/ development proposals and the RTP remains pivotal in securing sustainable and integrated access.

SWWITCH Councils continue to use the RTP vision, objectives and strategy as foundations to the LDP process and more detail is included in Appendix Four. Also included is an outline of major planning applications in the region approved since the last APR which have potentially significant transport implications.

Summary

The SWWITCH RTP submission in 2009 was not the finishing line, it was the starting block for the drive to improve transport and access in South West Wales. The principles of the RTP, the vision and long term strategy remain unchanged,

but the RTP has and will continue to evolve to address current needs and changing demands.

Figure Two on Page 11 demonstrates the linkages between the 2011/12 RTP delivery programme and the RTP vision and objectives.

CAPITAL SPEND 2011/12

RTP

SWWITCH was allocated £4.37million in 2011/12. This funding was fully spent and a further £300k was made available by WG during the financial year to support legitimate additional expenditure arising from project delivery.

There were a number of changes to the project proposals and spend as set out in the original 2011/12 Delivery Plan and in particular:

- Fishguard & Goodwick station
- Cross Hands Economic Link Road
- Access to Kenfig Industrial Estate

Plan One on Page 14 shows the location of all 2011/12 RTP projects whilst Table Two shows the original and final allocations by project and highlights any match funding available.

Further detail on individual projects, plans, photographs and explanations for the changed allocations are set out in Appendix Five.

Figure Two – Synergy between 2011/12 Programme delivery and the RTP vision and objectives

Our Vision for South West Wales is to improve transport and access within and beyond the region to facilitate economic development and the development and use of more sustainable and healthier modes of transport.

2011/12 PROJECT	RTP OBJECTIVES SUPPORTED
Port Talbot to Swansea Bus corridor	1/2/3/4/5/6
Landore Express Bus way	1/2/3/4/5/6
Haverfordwest to Tenby via Pembroke Dock Bus corridor	1/2/3/4/5/6
Haverfordwest to Tenby via Narberth Bus corridor	1/2/3/4/5/6
Haverfordwest to Cardigan Bus corridor	1/2/3/4/5/6
Carmarthen to Swansea Bus corridor	1/2/3/4/5/6
Ammanford to Cross Hands Bus corridor	1/2/3/4/5/6
Carmarthenshire rural interchanges	1/2/3/4/5/6/7
Community Transport Grant	1/2/4
Llanelli station interchange	1/2/3/4
Pembroke Dock Interchange	1/2/3/4
Milford Haven Interchange	1/2/3/4
Fishguard & Goodwick station	1/2/3/4
Amman Valley Cycleway	1/2/5/6/7
North South Multi User route (Pembrokeshire trail)	1/2/5/6/7
Walking and Cycling Linkages (Lifestyle changes)	1/2/5/6/7
Cycling (Connect2 schemes)	1/2/5/6/7
Boulevard project	1/2/3/4/5/6/7
Waterston/ Blackbridge Access Improvements	1/3/7
Access to Kenfig Industrial Estate	1/3/7
Cross Hands Economic Link Road	1/3/7
Carmarthen West Link Road	1/3/7
RTP Preparatory works	1/2/3/4/5/6/7
RTP monitoring and programme management	N/A

RTP OBJECTIVES

1. To improve access for all to a wide range of services and facilities including employment and business, education and training, health care, tourism and leisure activities
2. To improve the sustainability of transport by improving the range and quality of, and awareness about, transport options, including those which improve health and well being
3. To improve the efficiency and reliability of the movement of people and freight within and beyond South West Wales to support the regional economy
4. To improve integration between policies, service provision and modes of transport in South West Wales
5. To implement measures which make a positive contribution to improving air quality and reducing the adverse impact of transport on health and climate change, including reducing carbon emissions
6. To implement measures which help to reduce the negative impact of transport across the region on the natural and built environment including biodiversity
7. To improve road safety and personal security in South West Wales

Road Safety Grant

SWITCH was allocated £1.03million in 2011/12 and that funding was fully spent on delivering schemes to improve road safety throughout the region. Further details are included in Appendix Six and some key outputs are shown below:

Engineering

- Installation of Vehicle Activated Signs
- 20mph zones introduced
- Junction treatments
- Anti skid treatment as “hot spots”
- Carriageway markings to reduce speed

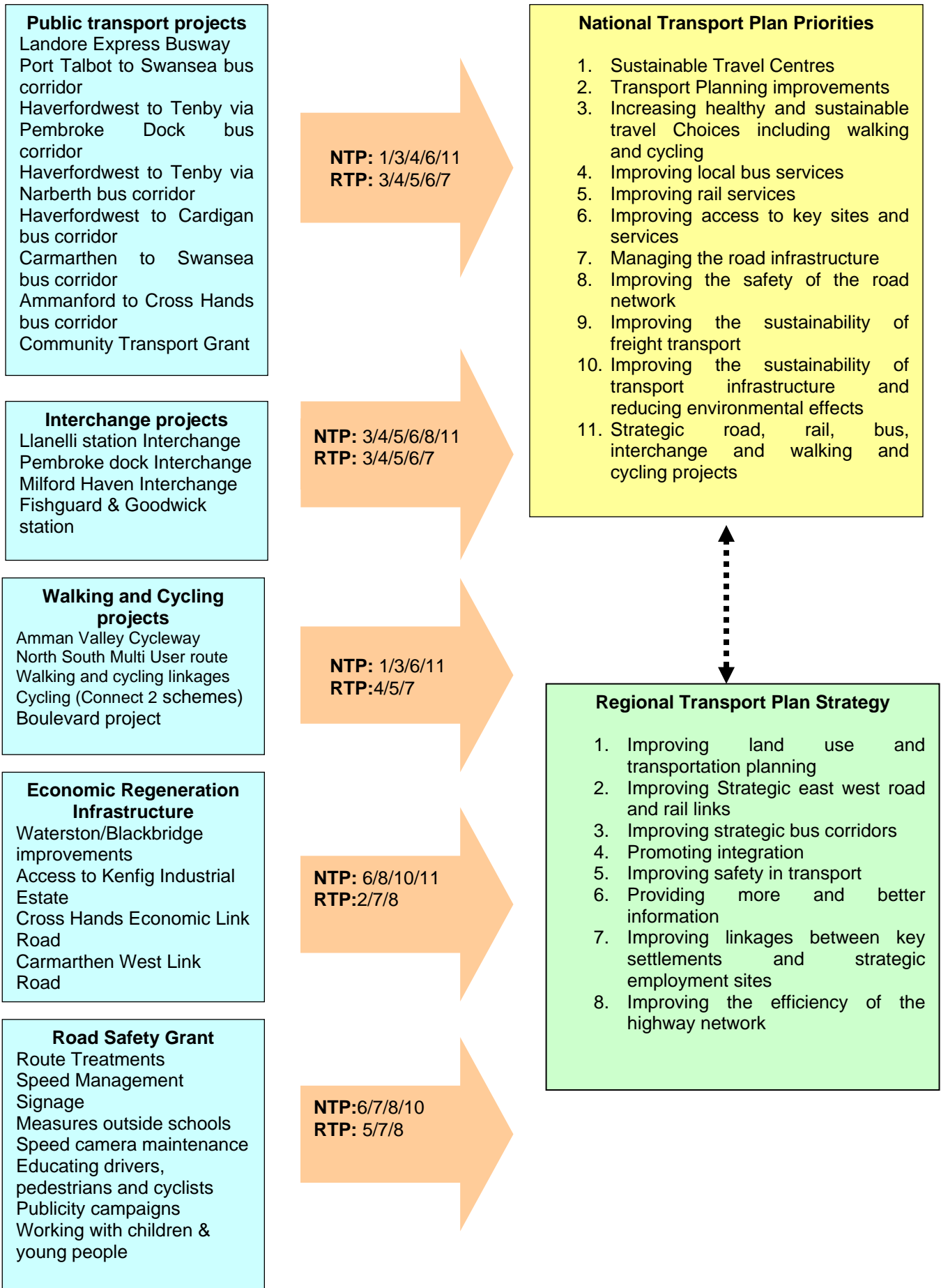
Education, Training and Publicity

- Bikesafe course attended by 84 motorcyclists
- Pass Plus Cymru attended by 526 students across the region
- Kerbcraft
- Children’s Traffic Clubs and Junior Road Safety Officer clubs
- Transitional Learning
- First Bike on scene
- Car Seats
- Primary and secondary school theatre
- General publicity campaigns

Synergy between the Capital Programme and Strategic Priorities

The Regional Transport Plan was developed to help deliver the objectives of the Wales Transport Strategy and the priorities of the National Transport Plan at a regional level. This means that projects arising from the RTP are intrinsically linked to national and regional priorities. This also applies to Road Safety Grant capital projects which facilitate a safe environment for all transport modes and road users and revenue projects which improve actual and perceived safety for road users.

Figure Three – Link between NTP/RTP priorities and the 2011/12 Capital Programme





ENVT1285

© Crown copyright and database rights 2011 Ordnance Survey 100023392

Table Two – 2011/12 RTP Delivery – Allocation and Spend by Project

Project	Initial Allocation (£k)	Final Allocation (£k)	Match funding (in addition to RTP funding)
Port Talbot to Swansea Bus corridor	400	98.5	
Landore Express Bus way	50	6.7	
Haverfordwest to Tenby via Pembroke Dock Bus corridor	115	39.1	
Haverfordwest to Tenby via Narberth Bus corridor	160	37.1	£50k from Sustainable Travel Centres funding
Haverfordwest to Cardigan Bus corridor	110	5.5	£120k from Sustainable Travel Centres funding
Carmarthen to Swansea Bus corridor	80	91.3	
Ammanford to Cross Hands Bus corridor	175	141.2	
Carmarthenshire rural interchanges	250	106.6	
Community Transport Grant	40	38.6	
Llanelli station interchange	50	59.1	
Pembroke Dock Interchange	335	231	
Milford Haven Interchange	150	213	
Fishguard & Goodwick Station	0	425	
Amman Valley Cycleway	265	138.1	
North South Multi User route (Pembrokeshire Trail)	45	60.9	£299k from Rural Development Plan funding
Walking and Cycling Linkages (Carms CC)	75	62.3	
Cycling (Connect2 schemes)	265	263	
Boulevard project	300	343	£3m from European Convergence funding
Waterston/ Blackbridge Access Improvements	300	380	
Access to Kenfig Industrial Estate	400	996	
Cross Hands Economic Link Road	350	479.1	
Carmarthen West Link Road	50	57.3	
RTP Preparatory works	300	291	
RTP monitoring and Programme Management	105	116	
Regional Total	4,370	4,679	

Transport improvements which are not RTP funded

There are a few projects which were identified by stakeholders and following the filtering process were included in the RTP programme, but which have drawn on or are using other funding pots for delivery. These include the Harbour Way Project (Port Talbot Peripheral Distributor Road), Swansea High Street Station and the Bulford Road Link.

Although these projects are not funded through the RTP, they do form a critical part of the drive to improve access to, from and within the region. They all form part of a strategic east west corridor supporting the efficient and timely movement of passengers and freight within and across the region. This in turn helps to support and stimulate economic activity and reduce deprivation in the region,

Further detail on these projects is included in Appendix Seven.



Photographs show construction ongoing on the Harbour way project and Swansea High Street Station after project completion

Preparatory Works Projects

As set out in Table Two, £300k was allocated for Preparatory Works Projects (PWP) in 2011/12. This funding is intended to get RTP projects at an early stage of development ready for delivery. Activities undertaken using PW funding include assessment and surveys, outline and detailed designs, consultation and development of costs, risk registers and expected outcomes.

Table Three below shows the 2011/12 PWP where:

- Projects 1 & 2 are bus projects
- Projects 3 & 4 are walking/cycling/sustainable transport projects
- Projects 5 & 6 are interchange projects
- Project 7 is a park and ride project
- Projects 8 & 9 are economic regeneration projects

Table Three – 2011/12 Preparatory Works Projects

Preparatory Works Projects	Final Allocation (£k)	Linkages to national and regional priorities	
		NTP	RTP
1.Llandeilo to Swansea Bus Corridor	2.95	1/3/4/6/11	3/4/5/6/7
2.Neath to Swansea Bus Corridor	25		
3.Walking & Cycling Linkages	10	1/3/6/11	4/5/7
4.Sustainable Towns Concept	35		
5.Port Talbot Central Interchange	50	1/3/4/6/8/11	3/4/5/6/7
6.Goodwick Station	20		
7.Tenby Park & Ride	20	1/3/6/11	4/7/8
8.Cross Hands Economic Link Road	62.05	6/8/10/11	2/5/7/8
9.Morfa Distributor Road	65.59		
TOTAL	290.59		

Of the nine PW projects in 2011/12, five are included in the 2012/13 delivery programme. Others have not been taken forward as yet, partly because the available RTP budget was lower than expected and also because some projects in 2011/12 were continued into 2012/13.

However, all the work was valuable in creating a pool of projects which have moved beyond the preparatory stage and are ready to enter the programme (as Pre Delivery or Delivery schemes) when the budget is sufficient.

Managing the RTP programme pool

As set out in the 2010/11 APR, SWWITCH PMG “mapped” all programme pool projects to determine at what key stage particular projects were and the forward milestones/gateways to delivery. For those projects funded in 2011/12 Table Four on Page 18 shows the key stage at the end of the financial year.

Clearly within the current financial constraints it has not proved possible to complete many projects and as for year one of the RTP delivery, it has been more about moving projects forward and trying to ensure that SWWITCH has a number of projects ready to deliver with all the necessary land, permissions, detailed design and approvals in place, when funding becomes available.

Link between 2011/12 Delivery and the current year

Table Five on Page 19 shows the link between the 2011/12 RTP funding and the SWWITCH Delivery Plan for 2012/13. This confirms the continuation of a number of projects from last year (as would be expected with the current financial constraints) and also the further development of some projects which were at preparatory works stage in 2011/12.

Table Four – RTP Delivery 2011/12 – Progress of projects through Key Stages and Gateways

Project	KSA1	KSA2		KSA3	KSA4		KSA5	KSA6		KSA7		KSA8		
	Identification of Problem WelTAG stage 1 Coarse options	Detailed options appraisal Extended WelTAG 1 or stage2		Develop detailed project design	Statutory processes		Contractor selection	Award of Contract		Opening and Handover		Project completion		
Port Talbot to Swansea Bus corridor			Entry into programme pool			Gateway 1 & 2			Gateway 3		Gateway 4			
Landore Express Bus way														
Haverfordwest to Tenby via P/ Dock Bus corridor								Part						
Haverfordwest to Tenby via Narberth Bus corridor														
Haverfordwest to Cardigan Bus corridor														
Carmarthen to Swansea Bus corridor							Part	Part		Part		Part	Part	Part
Ammanford to Cross Hands Bus corridor							Part	Part		Part		Part	Part	Part
Carmarthenshire rural interchanges							Part	Part		Part		Part	Part	Part
Llanelli station interchange							Part	Part		Part		Part	Part	Part
Pembroke Dock Interchange														
Milford Haven Interchange														
Fishguard & Goodwick Station														
Amman Valley Cycleway					Part		Part	Part		Part		Part	Part	
North South Multi User route														
Walking and Cycling Linkages								Part		Part		Part	Part	
Cycling - Connect2 schemes								Part		Part		Part	Part	
Boulevard project														
Waterston/ Blackbridge Access					Part		Part							
Access to Kenfig Industrial Estate														
Cross Hands Economic Link Road							Part	Part		Part		Part	Part	Part
Carmarthen West Link Road														

Table Five– Link between 2011/12 RTP Delivery and 2012/13 Allocations

Project	Final Allocation (£k)	2012/13 RTP Allocation (£k)
Port Talbot to Swansea Bus corridor	98.5	450
Landore Express Bus way	6.7	0
Haverfordwest to Tenby via P/ Dock Bus corridor	39.1	0
Haverfordwest to Tenby via Narberth Bus corridor	37.1	170
Haverfordwest to Cardigan Bus corridor	5.5	0
Carmarthen to Swansea Bus corridor	91.3	100
Ammanford to Cross Hands Bus corridor	141.2	150
Carmarthenshire rural interchanges	106.6	200
Community Transport Grant	38.6	50
Llanelli station interchange	59.1	50
Pembroke Dock Interchange	231	50
Milford Haven Interchange	213	100
Fishguard & Goodwick Station	425	0
Amman Valley Cycleway	138.1	200
North South Multi User route (Pembrokeshire Trail)	60.9	0
Walking and Cycling Linkages (Carms CC)	62.3	150
Cycling (Connect2 schemes)	263	0
Boulevard project	343	200
Waterston/ Blackbridge Access Improvements	380	700
Access to Kenfig Industrial Estate	996	0
Cross Hands Economic Link Road	479.1	250
Carmarthen West Link Road	57.3	0
RTP Preparatory works	291	
Morfa Distributor Road		250
Port Talbot Central Interchange		200
Neath to Swansea Bus Corridor		0
Tenby Park & Ride		0
Sustainable Towns Concept		0
Cross Hands Economic Link Road		See above
Llandeilo to Swansea Bus corridor		0
Carms Walking & Cyling Linkages		See above

REVENUE SPEND 2011/12

The maximum revenue allocation available to SWWITCH in 2011/12 was £150k. a separate sum of £75k was available for supporting the Travel Plan Co-ordinator and part time Travel Plan Officer. Revenue support for the SWWITCH Travel Plan Officer is only provided because the SWWITCH Travel Plan Co-ordinator works to days per week supporting the Welsh Government on All Wales Travel Plan work.

Table Six on Page 20 shows the detail of the original and actual budget spend for both core SWWITCH revenue funding and the Travel Plan revenue allocation. Table Seven on Page 21 demonstrates how the activities and functions supported by revenue funding link with the NTP and RTP.

Core and travel plan revenue funding is also used to support the planning and delivery of other (non RTP) funding streams to support transport improvements. Further detail is included in Section Five on Supporting Information but funding streams includes:

- Sustainable Travel Centres
- National Station Improvement Plan
- Valleys Cycle Network (European Convergence funding)
- Rural Development Plan

Table Six– SWWITCH Revenue budgets 2011/12

SWWITCH Core Budget Elements	Budget allocation (£)	Actual spend (£k)	SWWITCH Travel Plan Budget Element	Budget allocation (£)	Actual spend (£k)
<u>Direct Staff Costs:</u> Salaries, national insurance, pension contributions	89	101	<u>Direct Staff Costs:</u> Salaries, national insurance, pension contributions	53.4	51.9
<u>Indirect Staff Costs:</u> Travel, training, Telephones, stationary, fees, rent and leases, insurance	9.5	8.57	<u>Indirect Staff Costs:</u> Travel, training, Telephones, stationary, fees, rent and leases, insurance	9.5	8.4
<u>IT:</u> Hardware, Software, licenses	1.8	1.5	<u>IT:</u> Hardware, Software, licenses	6	6.95
<u>Operational costs:</u> Translation, printing, Hire of facilities, Consultation, publicity	24.7	19.1	<u>Operational costs:</u> Translation, printing, Hire of facilities, Consultation, publicity	6.1	6.9
<u>External Commissions:</u> Policy or project development	25	12.5			
Total	150	142.7*	Total	75	74.16

* WG commissioned and paid a Consultant on behalf of SWWITCH, thus claim was lower than allocation although the full £150k was utilised for the region.

The SWWITCH core revenue funding also supports overall RTP programme management. This is in the context of Officer time where it is estimated that 40% of the SWWITCH Co-ordinator's time and 30% of the SWWITCH Liaison Officer's time is spent on programme management.

However, individual project management is not supported by SWWITCH revenue funding. The individual projects are managed by Project Officers within the individual Local Councils or, where a project is cross boundary, by a collaborative working group of Project Officers.

Table Seven– Link between transport priorities and functions supported by revenue funding

NTP and RTP priorities	Function supported by revenue funding							
	Transport planning	Funding applications	Management, administration	Scheme development	Programme management	Financial Management	Collaboration	External partnerships
Improving land use and transportation planning	√	√	√	√	√	√	√	√
Sustainable Travel Centres, increasing healthy and sustainable travel choices	√	√					√	√
Promote integration	√	√	√	√	√	√	√	√
Provide more and better information	√	√	√	√	√		√	√
Improving rail services	√	√	√	√	√	√	√	√
Improving strategic bus corridors and local bus services	√	√	√	√	√	√	√	√
Improving access to key sites and services including strategic employment sites	√	√	√	√	√	√	√	√
Improving the sustainability of freight transport	√						√	√
Improving the sustainability of transport infrastructure and reducing environmental effects	√	√		√	√		√	√
Improving the efficiency of the highway network and managing the road infrastructure	√	√					√	√
Improving safety in transport and the safety of the road network	√	√	√	√	√	√	√	√
Strategic road, rail, bus, interchange and walking and cycling projects	√	√	√	√	√	√	√	√

The 2011/12 RTP capital works do have revenue implications for each Local Council in terms of maintenance liabilities. As part of accepting the RTP grant each Council has accepted those liabilities.

Aside from ongoing maintenance some projects have more specific revenue implications as follows:

- Swansea Bus Station project – staff costs, security, cleaning and utilities – these costs are being met by charging bus operators for each departure from the bus station and also by income from rentals of office space and toilets
- Haverfordwest to Tenby bus corridor – ongoing revenue support is required as a critical element of the overall improvements. This funding has been provided by Pembrokeshire County Council
- North South Multi User route – revenue support of approximately £1k was required additional monitoring of the route. This funding was provided by Pembrokeshire County Council

MONITORING UPDATE

In the 2010/11 APR SWWITCH set out the revised monitoring plan adopted for the first 2-3 years of the RTP. This monitoring plan is still valid for 2011/12, however, as stated in the last APR there are still some uncertainties over the environmental monitoring and indicators and they may be practically measured over the lifetime of the RTP. Additionally, it was not possible to repeat the SWWITCH Travel Pattern Research in 2011/12 and so some of the indicators or sub indicators cannot be directly compared with the baseline set out last year. Proxies have been used where appropriate.

Full details on RTP monitoring are set out in Appendix Eight and “headline” outputs of the 2011/12 monitoring are as follows:

Regional Transport plan (RTP) Indicators - Data Availability 2011/12

- 13 out of 30 indicators have been successfully updated with new data
- 4 out of 30 indicators have new baseline data - accessibility indicators - 1A, 1B, 1C & 1D
- 4 out of 30 indicators require a methodology to be finalised
- 9 out of 30 indicators cannot be updated at the time of writing as there is no published or updated data sources, particularly the absence of updated Bus Passenger and SWWITCH Household Surveys

Headlines (improving)

- 3B - % of rail services within 10 minutes of scheduled time - punctuality improving on both FGW and Arriva services
- 5C – Greenhouse gas emissions from transport - decline in total CO2
- 7A – No. of people killed in road collisions - year-on-year reduction since 2009
- 7G – No. of crimes per 100,000 rail passenger journeys - crime has reduced at stations with higher numbers of annual passengers (e.g. Llanelli, Carmarthen, Neath, Swansea, Milford Haven)

Headlines (declining)

- 5A – No. of AQMAs where transport is the primary cause - AQMAs are the same but potentially larger areas

- 7D – Rate of death and seriously injured for pedestrians and cyclists - increase in accident rate for both pedestrians and cyclists

Other Headlines

- 1F – Strategic Employment Sites Key Connectivity - general decline, although some site-specific improvements in connectivity
- 7B – No. of people seriously injured in road collisions - decline since 2009, although marginal increase since 2010
- 7C – No. of children killed or seriously injured - decline since 2009, although marginal increase since 2010

As stated in the 2010/11 APR, monitoring is an ongoing process, which should support continuous improvements in the planning, management and delivery of projects. The monitoring life cycle set out in last year's APR remains a key mechanism to ensure that outputs and outcomes linked to RTP objectives are secured. However, the level of RTP monitoring clearly relates to the investment made and so expectations in terms of outputs and outcomes have to be adjusted accordingly.

Scheme level monitoring has also been carried out in 2011/12 on bus corridors, in terms of cycling and walking and also to determine travel times over key links (journey time reliability surveys). The results of all this work are included in Appendix Eight.

Traffic Management Compliance

The Traffic Management Act (2004) specifies network management duties intended to help Local Councils reduce congestion on, and disruption to, the road network. The RTP included in the Appendices (Appendix P pages 102 – 105) detail on ongoing work within each Local Council. All SWWITCH Councils were fully compliant with the Traffic Management Act in 2011/12.

Strategic Environmental Assessment (SEA) and Habitats Regulations Assessment (HRA) Monitoring

The RTP and SEA monitoring were closely linked to avoid duplication of measurements and ensure consistency in reporting. Progress on the SEA monitoring is included in Appendix Eleven.

A few projects were flagged up as areas of concern by the SEA/HRA process and where these were part of the 2011/12 delivery the detail of additional work undertaken is set out in Appendix Eight.

SUPPORTING INFORMATION

Partnership approach

The RTP was developed through collaborative working by the four SWWITCH area Councils and a wide range of stakeholders. The RTP is also the result of other partnerships, cross boundary to SWWITCH, between some or all of the constituent Councils and Councils from other consortia areas. This shows the clear emphasis within SWWITCH of “making the connections” to improve access and transport.

Full Details on collaborative working are included in Appendix Nine and key projects/partners include:

- Travel Planning Fora
- Community Transport Association
- Economic Fora, south west and east Wales
- Sustrans
- Community Rail Partnerships across Wales and Association of Community Rail Partnerships
- National Station Improvement Programme, Network Rail, Arriva Trains Wales
- Rural Development Partnerships
- Welsh Local Government Association
- Local health boards especially Hywel Dda and Abertawe Bro Morgannwg
- Bwcabus project

Links between RTP spend and Strategic outputs

Appendix Ten includes details of how the RTP spend in 2010/11 and the projected 2011/12 spend relates to strategic outputs of the Wales Spatial Plan and also the Strategic Regeneration Areas, where applicable.

SWITCH Decision making processes

Details of the structures and decision making processes which support the RTP delivery process are included in Appendix Eleven.

7.9.8 Summary

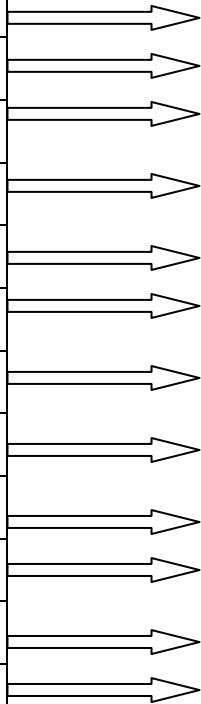
The RTP is not static, it is an ongoing process. As needs and circumstances change, the RTP will evolve within the framework of the objectives and strategy developed through extension stakeholder engagement. This APR provides an update to changes and delivery during 2010/11. The following sections of the APR deal with specifics in terms of delivery and an RTP monitoring update.

Figure Two below summarises the linkages between the 2010/11 grant expenditure and the RTP vision and objectives.

Figure Two – Link between RTP Vision and Objectives and 2010/11 delivery

Our Vision for South West Wales is to improve transport and access within and beyond the region to facilitate economic development and the development and use of more sustainable and healthier modes of transport.

PROJECT	OBJECTIVES SUPPORTED
Swansea Bus Station Interchange	1/2/3/4/5/6
Swansea Metro	1/2/3/4/5/6
Landore Express Busway	1/2/3/4/5/6
Haverfordwest –Tenby strategic bus corridor	1/2/3/4/5/6
Carmarthen to Swansea strategic bus corridor	1/2/3/4/5/6
Amman Valley Cycleway	1/2/5/6/7
Carmarthen Rural Interchanges	1/2/3/4/5/6/7
Pembroke Dock Interchange	1/2/3/4
Milford Haven Interchange	1/2/3/4
North-South Multi User route in Pembrokeshire	1/2/3/5/6
RTP monitoring	N/A
RTP Preparatory work	1/2/3/4/5/6/7



- RTP OBJECTIVES**
1. To improve access for all to a wide range of services and facilities including employment and business, education and training, health care, tourism and leisure activities
 2. To improve the sustainability of transport by improving the range and quality of, and awareness about, transport options, including those which improve health and well being
 3. To improve the efficiency and reliability of the movement of people and freight within and beyond South West Wales to support the regional economy
 4. To improve integration between policies, service provision and modes of transport in South West Wales
 5. To implement measures which make a positive contribution to improving air quality and reducing the adverse impact of transport on health and climate change, including reducing carbon emissions
 6. To implement measures which help to reduce the negative impact of transport across the region on the natural and built environment including biodiversity
 7. To improve road safety and personal security in South West Wales

8 Climate Change Strategies

Climate change was highlighted in the Swansea Environment Strategy: Time to Change, which was published by Swansea Environmental Forum (SEF) in 2006.

The SEF Built Environment and Energy Subgroup (BEES) was formed in 2005 to support the development of aspects of the Swansea Environment Strategy, including carbon management issues. In the same year, Swansea Council's Sustainable Development Unit produced a Sustainable Energy Action Plan (SEAP) for Swansea (published in 2008).

The SEAP set out a vision for Swansea's carbon future and included the UK targets for carbon reduction, four strategic aims based upon resilient evidence and wide consultation, and a programme of actions to reduce Swansea's use of fossil fuels and carbon emissions by increasing energy efficiency and developing renewable energy technology capacity in the region.

Also in 2008, both carbon management and climate change adaptation were chosen by SEF as two of the five issues which it believed were too difficult to progress without greater prioritisation and wider collaboration. In 2010, SEF initiated a carbon management task group (a subgroup of BEES) to develop proposals for a new project which would seek to measure and reduce the carbon footprint for Swansea, and promote low carbon initiatives.

The Low Carbon Swansea project was established in 2011 with the following aim:

To develop a coordinated, integrated and sustainable approach to reducing carbon emissions across all sectors in the City and County of Swansea area

The Project's primary outcome will be a measurable reduction of carbon emissions level to or exceeding national targets. The Project outputs will include:

- the establishment of a new carbon management partnership that meets on a regular basis;
- an audit of existing low carbon activity in Swansea;

City & County of Swansea

- a new energy or carbon management action plan for Swansea;
- a programme of seminars, training workshops and public events to raise awareness of climate change, to increase understanding of the opportunities for and benefits of reducing carbon emissions and to encourage greater collaboration towards a Low Carbon Swansea;
- a significant increase in the number of low carbon projects and carbon reduction activities in Swansea and
- a notable increase in inward investment for carbon reduction initiatives in Swansea.

The initiative was adopted as a Swansea Local Service Board project and has received funding from Environment Agency Wales and the Welsh Government, enabling SEF to employ a project manager for two years from April 2012. A Low Carbon Swansea Partnership has been formed, initially involving representatives of LSB bodies and other major public sector organisations. The partners provided data for a carbon footprinting baseline study, which was commissioned in collaboration with Carbon Trust Wales. Seven successful partnership meetings were held (Dec2011 to Mar2013); facilitating information exchange and encouraging collaboration between organisations. A second tranche of data is now being collected, the partnership is being widened to include large commercial organisations and the project is also engaging community organisations.

The Low Carbon Swansea project website is lowcarbonswansea.weebly.com.

9 Implementation of Action Plans

The authority submitted its Action plan in relation to the Hafod Air Quality Management Area in December 2004. Delays were incurred in the formulation of the plan due to the extensive planning and consultation works that were thought vital to delivering a workable plan.

The Action Plan detailed 10 action points to be taken forward by the authority. The authority intends to take these action points forward with the now Swansea Air Quality Management area 2010. Progress against each of these action points are briefly summarised within the table below and each action point expanded on below.

As a result of the considerable testing and development works that have taken place, coupled with ever dwindling resources, progress, it has to be admitted, has been slow.

It is imperative that it is recognised and understood, that further expansion and development of the system will be severely restricted if not cancelled, by a combination of the existing budgetary constraints, and the further impending and likely severe cuts in local government funding following spending reviews.

Summary of Action Plan Progress

No.	Measure	Focus	Planning phase	Implementation phase	Indicator	Progress to date	Progress in last 12 months	Estimated completion date
1	Traffic management on Neath Road	Improve safety, environment and facilities for pedestrians, cyclists and bus users	2005	Ongoing – dependant upon funding for the Hafod Integrated Transport Study		Provision of some bus stops and shelters. Gateway treatment undertaken	none	unknown
2	Park & Ride Provision	Effect modal shift	2004-onwards	2005-2007	Increased uptake in Park & Ride	3 site completed and operational along with dedicated express bus routes	Consider 4 th site to west of city	3 sites completed by 2007
3	Improved Bus Provision	Effect modal shift	2004	2004 – to date	Increased patronage figures	Achieved	Ongoing provision	N/a
4	Bus Corridor Enhancements	Effect modal shift		2004-2009	Increased patronage figures	Achieved	Metro Service introduced along route between Morriston and Singleton Hospitals	N/a
5	Enhancement of Bus and Rail Stations	Effect modal shift		2004-2009	Increased patronage figures	Swansea High Street Transport Interchange completed during 2004. Quadrant Bus station redevelopment completed	Quadrant Bus station redevelopment completed	
6	Safe Routes to School	Reduce car usage around schoolsites				Numerous schemes implemented	none	Achieved

City & County of Swansea

No.	Measure	Focus	Planning phase	Implementation phase	Indicator	Progress to date	Progress in last 12 months	Estimated completion date
7	Vehicle Emissions testing	Reduce number of polluting vehicles	2005	2005		None due to costs/manpower to be incurred	None	N/a
8	Quay Parade Bridges Improvements	To make more effective use of the existing highway network by improving traffic flows/reduction in congestion around bridges/junctions	2005		Reduced congestion		Scheme completed	
9	City & County of Swansea Vehicle Fleet							
10	Traffic Management Systems with Air Quality Monitoring Feedback	Development of computer modelling/forecast system that will aid management of traffic flows before/during/after forecasted pollution episodes	2004-12	2004 - 2014	Reduced Congestion/Modal shift/Improved air quality within areas	Considerable but certain items remain outstanding	Additional 3 Variable Message Signs installed – grant funding provided by welsh assembly	Unknown

- **Action Point 1 - Traffic Management measures on Neath Road**

The majority of measures identified for this action point depend upon funding being made available to undertake the recommendations of the Integrated Hafod Transport Study. Some identified action points have been completed and have been undertaken as part of phase 1 works in relation to the Landore Park & Ride Express Bus Route scheme. Items completed as part of this scheme include:

- Provision of some bus stops and shelters
- Gateway treatment to entrance to Neath Road from the Normandy Road roundabout
- Creation of traffic control point

All other identified action points within the Action Plan remain outstanding at present. The recommendations of the Hafod Integrated Transport Study are to be phased in after the renewals program being undertaken along Neath Road as part of the Hafod Renewals Program if funding can be established. This program is undertaking complete renovation of both domestic and commercial properties within the Hafod. As these works entailed extensive building works taking over part of the footway/highway with scaffolding, skips etc along Neath Road, it has been decided to undertake the Hafod Integrated Transport Study works after the renovation works are complete, as to do so earlier would result in the damage of any finished surfaces.

However, identification of the relevant funding is now proving a major issue in taking this action point forwards. It is unknown at present if the Transport Study recommendations will ever be implemented. The Action Plan initially indicated a target of December 2005.

- **Action Point 2 - Park and Ride provision**

Provision of Park & Ride is seen as a fundamental element of Swansea's Transportation Strategy. Significant progress has been made in respect to this action point:

- Landore and Port Tennant Park and Ride sites are now fully operational.
- Fforestfach Park & Ride was opened during November/December 2006 and with the site becoming fully operational during February 2008. Map 41 below shows the location on the A483 Carmarthen Road.



Map 41 Location of Fforestfach Park and Ride Site

© Crown Copyright and database right 2013. Ordnance Survey 100023509

Patronage statistics for 2005-2012 show the continued popularity of the park and ride provisions provided by the authority but figures for 2012 continue to show a drop in previous year's usage.

Table 59 shows the total vehicles using the facilities at the 3 sites during 2005-2010.

Site	Total Spaces	2007	2008	2009	2010	2011	2012
Landore	550	137,825	133,025	137,232	121802	131101	116839
Fabian Way	550	122,530	125,737	116,954	107043	123732	104915
Fforestfach	449	43,880	64,134	66,581	67,241	66890	60445

Table 59 Park & Ride Vehicle Usage Figures 2005-2012

- ❑ Phase 1 of the dedicated express bus route serving the Landore Park and Ride site has been completed. Phase 2 was due to commence during September 2005 but did not commence until April 2008 and is now complete.
- ❑ The construction of a new dedicated express bus route into the city centre from the Fabian Way Park and Ride site was completed during 2007/early 2008. Phase 1 of the express bus route crossed over the A483 Fabian Way at the site of an old railway bridge, which has now been removed. This crossing has been replaced with a "sail-bridge" during 2007. The express bus route then runs parallel at ground level, adjacent to and parallel with the inbound carriageway of the A483 to Quay Parade Bridges.
- ❑ There are proposals for the provision of a fourth park and ride site to serve the west of the city including the Gower. These plans are at a very early stage with identification of and acquisition of land now taking place with the aim of easing the pressure on the additional western AQMA's.

All other identified action points within the Action Plan remain outstanding and were not complete by the indicated target of December 2005.

• **Action Point 3 - Improved Bus Provision**

The action points contained within the Action Plan were to the main being achieved upon submission of the Action Plan. However, in order to continue to achieve these aims, the authority continues to:

- ❑ Use its revenue budget to ensure that most areas have at least a minimum level of service.
- ❑ Make use of the National Assembly's Bus Subsidy Grant to ensure breaks in service are kept to a minimum

- Promote bus priority routes
- Fund a local concessionary bus fares scheme for certain categories of people
- Provide free unlimited bus travel within the authorities area for elderly people

The identified action points within the Action Plan are being achieved now but ongoing provision remains desirable.

- **Action Point 4 - Bus Corridor Enhancements**

Progress made to date includes:

- Transport Grant funded improvements to A48 Bus priority Demonstration Corridor completed during early 2005
- Bus priority proposals for Neath Road being reviewed. Works have been completed during 2009 for a new concept Metro service linking Morriston Hospital with the city centre and Singleton Hospital (see 3.7 above) The aim is to provide advantages of modern tram at modest costs. The service uses the Landore express bus route, thereby avoiding much of Neath Road. Bus priority has been introduced at key junctions along the route.
- Variable Message displays installed along a number of trial routes to improve dissemination of travel information to passengers. These trials have been abandoned due to vandalism issues.
- Accessibility to bus services for residents who are disabled or who suffer from limited mobility increased, following Transport Grant funding to raise kerb levels along with the provision of road markings and bus clearway orders at bus stops.
- Bus shelters upgraded on a number of routes

The identified action points within the Action Plan are being achieved now but ongoing provision and enhancements remain desirable.

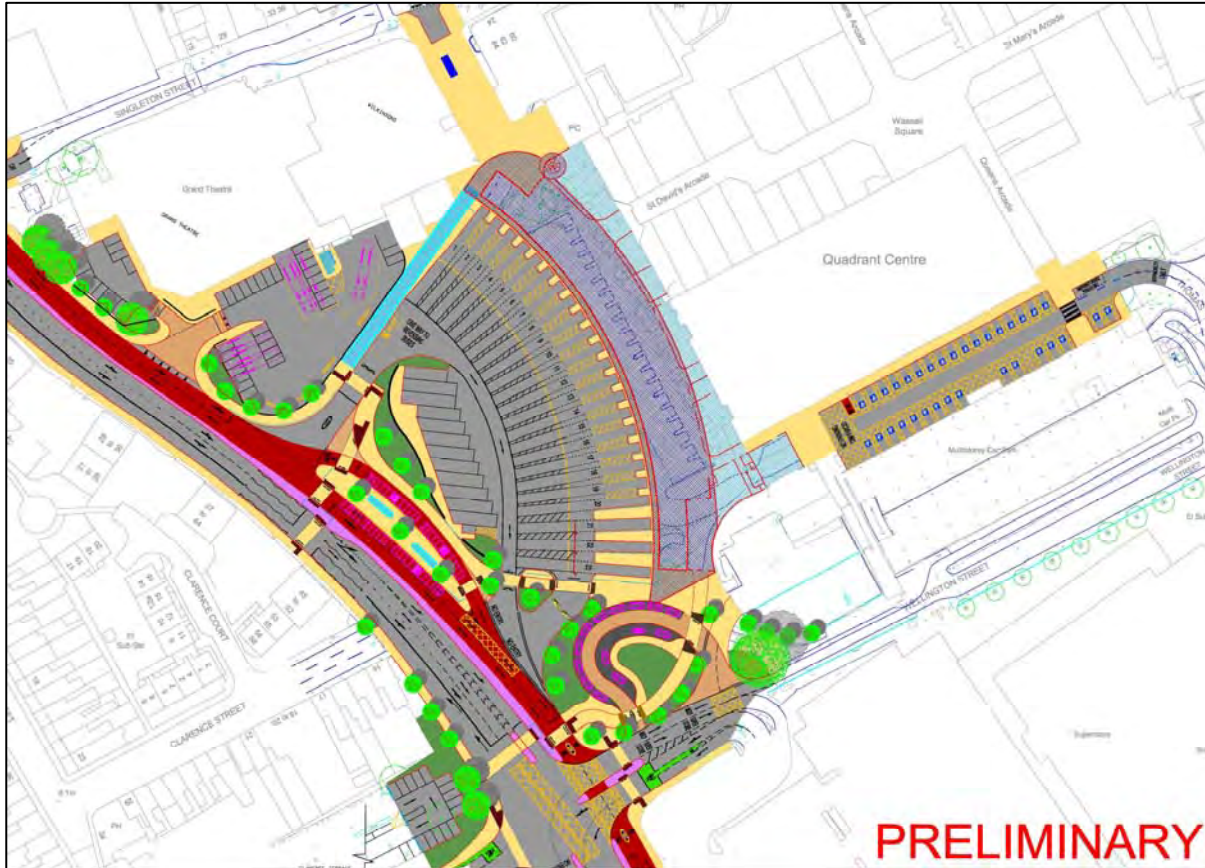
- **Action Point 5 - Enhancements of Bus and Rail Stations**

Progress made to date includes:

- Swansea High Street Transport Interchange was completed during March 2004. Funded through a combination of Transport Grant and Objective 1 funding, this scheme has provided improved access to the railway station by bus, taxi, and on foot, together with a new public realm, improved security and improved parking facilities.
- Discussion ongoing with network rail and Arriva Trains Wales on how to improve passenger facilities at the station itself.

Quadrant Transport Interchange

The City and County of Swansea has prepared a scheme to replace the existing Quadrant bus station with a modern Transport Interchange to cater for both buses and coaches, including Swansea Metro vehicles, on a larger footprint. The Quadrant Interchange scheme has been accepted for Transport Grant funding by the Welsh Assembly Government. The current bus station was outdated in terms of passenger convenience, comfort and security. The Council's aspiration is for a modern transport interchange with high standards of cleanliness and security. The refurbishment of the Quadrant bus station was identified as a high priority in the Swansea Local Transport Plan 2000 – 2005. However, delays have been encountered with not only procedures involving the compulsory purchase of land but also with ensuring the necessary funding is fully in place prior to commencement of works. Map 43 indicates the provisional scheme with artist's impressions of the façade given below.



Map 44 Transport Interchange off Westway, Swansea.

© Crown Copyright and database right 2011. Ordnance Survey 100023509





Outline of scheme

The main components of the scheme comprised the following elements:

- 20 bus bays,
- 3 coach stands
- 2 Swansea Metro “stations” on Westway.
- 12 lay-over spaces
- Modern coach station facility to serve the long distance services,
- Enhanced passenger concourse with support facilities.
- Safe access to and from West Way
- New staff and office facilities
- Travel Shop (Information/ticket sales area.)
- Shopmobility Facility. In the Garden Street tunnel area
- Associated Retail Units.
- Enhanced links into the Quadrant shopping area.
- Improved access to the Grand Theatre and Wilkinson’s service areas
- Taxi rank for 9 vehicles
- Short stay parking for 5 cars (Passenger pick-up) adjacent to the coach area
- Passenger drop-off area

- **Action Point 6 - Safe Routes to School**

Safe Routes to School has been delivered in Swansea for the last 6 years with numerous schemes undertaken.

- Currently, Safe Routes to school schemes have been developed at:
 - Clydach,
 - Brynhyfryd,
 - Pennard,
 - Birchgrove.
 - Gowerton Comprehensive and its Primary feeder schools
 - Penllergaer
 - Whitestone Primary
 - Oystermouth Primary
 - Newton Primary

The aim again, is to encourage more pupils to walk and cycle to school through improved facilities, the introduction of traffic calming measures, together with complementary educational work and road safety training.

The focus of this work with schools is now based on the development of school travel plans. These have previously been prepared for YGG Bryniago (Pontardulais), Penllergaer Primary, Penyrheol Primary (Gorseinon), Whitestone Primary (West Cross), Oystermouth Primary and Newton Primary. In addition, travel plans are in the process of development for Manselton Primary, Plasmarl Primary, Crws Primary, Cwmbwrla Primary, Hafod Primary, Pentrepoeth Juniors, Bishopston Primary, Knelston Primary, Mayals Primary, Sketty Primary. These travel plans will provide the basis for both infrastructure and educational work.

- **Action Point 7 - Vehicle Emissions Testing**

No additional progress has been made with respect to this action point. However, the equipment had, until recently, been kept serviced and calibrated until budgetary pressures forced a review. The primary reasons for the lack of progress are:

- No funding for Policing costs
- Lack of staff resources due to the labour intensive nature of the work.
- The Welsh Assembly Government fund for this purpose was not offered to the City & County of Swansea.

- **Action Point 8 - Quay Parade Bridges Improvements**

Savell Bird & Axon (SBA) was commissioned to develop traffic models and to investigate highway and transport solutions in the City Centre. This commission was designed to test the Boulevard proposals and key findings indicate that significant public realm and pedestrian connectivity benefits can be achieved without affecting the existing capacity for drivers.

The Tawe Bridges poses a significant capacity constraint to the strategic highway network, which is clearly largely due to the severance imposed by the River Tawe. SBA identify that the current Tawe Bridges are a significant impediment to free flowing traffic during peak hours which occur largely because of:

- **long and inefficient traffic light cycle time of 144 seconds;**
- **poor pedestrian crossing facilities;**
- **Congestion problems particularly along the northern bridge to/from Pentreguinea Road where there is uneven lane usage.**

The City Centre Transport Model recommends that the reconfiguration of the existing infrastructure, including the two bridges, can produce significant highway capacity improvements including significant reductions in existing overall delay. These capacity improvements are not only necessary to improve the present operation of the bridges but also to accommodate future planned development within the city

centre area. The improvements to the bridges are critical to the delivery of the Boulevard concept, and without it the Boulevard scheme is unlikely to be able to achieve the ambition of improving pedestrian movement and upgrading the environmental setting whilst not significantly affecting vehicular flows.

The capacity of a junction is commonly measured by 'degrees of saturation', this is a measure of how much demand it is experiencing compared to its total capacity. A value of 100% means that demand and capacity are equal and no further traffic is able to progress through the junction. Values over 85% indicate that the approach to a junction is suffering from traffic congestion, with queues of vehicles beginning to form. Currently in the AM peak 8 out of the 11 links around the bridges operate above the 85% limit with 2 above 100%. In the PM peak, 6 out of the 11 sequences operate above 85% limit with 2 of these being above the 100% level.

At peak times therefore the river bridges are operating beyond their capacity. In terms of traffic growth, the development proposed around the City Centre will significantly increase demand at the river bridges. If no improvements are made, and the predicted growth in traffic to 2020 occurs, there will be severe congestion at peak times with long queues tailing back from every arm of the junction. Congestion on this scale would inhibit the city centre's capability to function and attract inward investment.

Reconfiguration Options

The City Centre Transport Model considered many iterative options for reconfiguration of the Tawe Bridges eleven of which were tested in full. Of these fully tested options two were shown to operate most efficiently and provide the greatest capacity improvements.

Option 3 provides an arrangement which involves a two way section of traffic flow across the southern bridge deck with all remaining movements travelling clockwise around the remainder of the junction. This option delivers significant improvements to all users including motorists, pedestrians and public transport users as well as

creating capacity to enable the future City Centre redevelopment. The proposed layout for Option 3 is included in map 45 below

Option 7 provides a full gyratory operation utilising both the north and south bridge within this movement. This option would require the provision of additional lanes to the Tawe Bridges junctions, but provides the best capacity benefits at the Tawe Bridges junction.

Comparison of Options 3 and 7

A Transyt model has been used to assess Swansea’s city centre road network. Transyt is a software model to assess and optimise the performance of networks of road junctions by assigning ‘cost’ against vehicle stops and delays.

The following table compares the "total delay" for all vehicles in the network passing through the junction during a peak hour. This figure provides an aggregate position for the whole junction and allows a comparison to be undertaken to assess the implications of different scenarios. The 2009 base position figures reflect the current situation and indicate that at peak times the junction is saturated with significant congestion and long queues on most arms. The figures for Options 3 and 7 reflect the changes in the capacity and efficiency of the junction based upon projected increased traffic levels in 2020. The key results of the TRANSYT analysis for the AM and PM peaks can be seen in the table below.

Summary of Transyt Output

Total Delay	AM Peak Total Delay	PM Peak Total Delay
2009 - Base position	209	200
2020 - No improvement	242 (+ 16%)	248 (+ 24%)
2020 - Part Gyratory (Option 3)	109 (- 48%)	183 (- 9 %)
2020 - Full Gyratory (Option 7)	138 (- 34%)	268 (+ 34%)

In summary, the bridges are currently operating significantly beyond their capacity and congestion will worsen as traffic levels grow as a consequence of traffic generated by new developments. A do-nothing approach cannot be considered as by 2020 the AM peak delay will worsen by 16% and the PM peak by 24%.

As indicated in the table above, based on projected traffic levels in 2020 in comparison with the 2009 baseline position, Option 3 will produce a 48% improvement in the efficiency of the junction in the AM peak, and 9% improvement in the PM peak. Option 7 will produce a 34% improvement in the efficiency of the AM peak but would result in a 34% deterioration against the baseline position in its efficiency in the PM peak.

Option 3 therefore provides more capacity benefits and future proofing than Option 7.

Conclusion

The River bridges are currently operating significantly beyond their capacity in the AM and PM peaks which causes traffic congestion across the City. If nothing is done to address this then by 2020 the situation will worsen by between 16% in the AM peak and 24% in the PM peak.

Option 7 is the best of the full gyratory options identified. By 2020 this could bring improvements in the AM peak, but will make matters significantly worse in the afternoon. Most importantly Option 7 would create more congestion in the PM than if the bridges were left as they are now.

Option 3, the part gyratory, provides significant improvements in both the AM and PM peak hours. **This scheme has now been completed. Flows around the junction have improved. Latest air quality monitoring would appear to paint an improving picture but it is too early to form firm conclusions at present.**

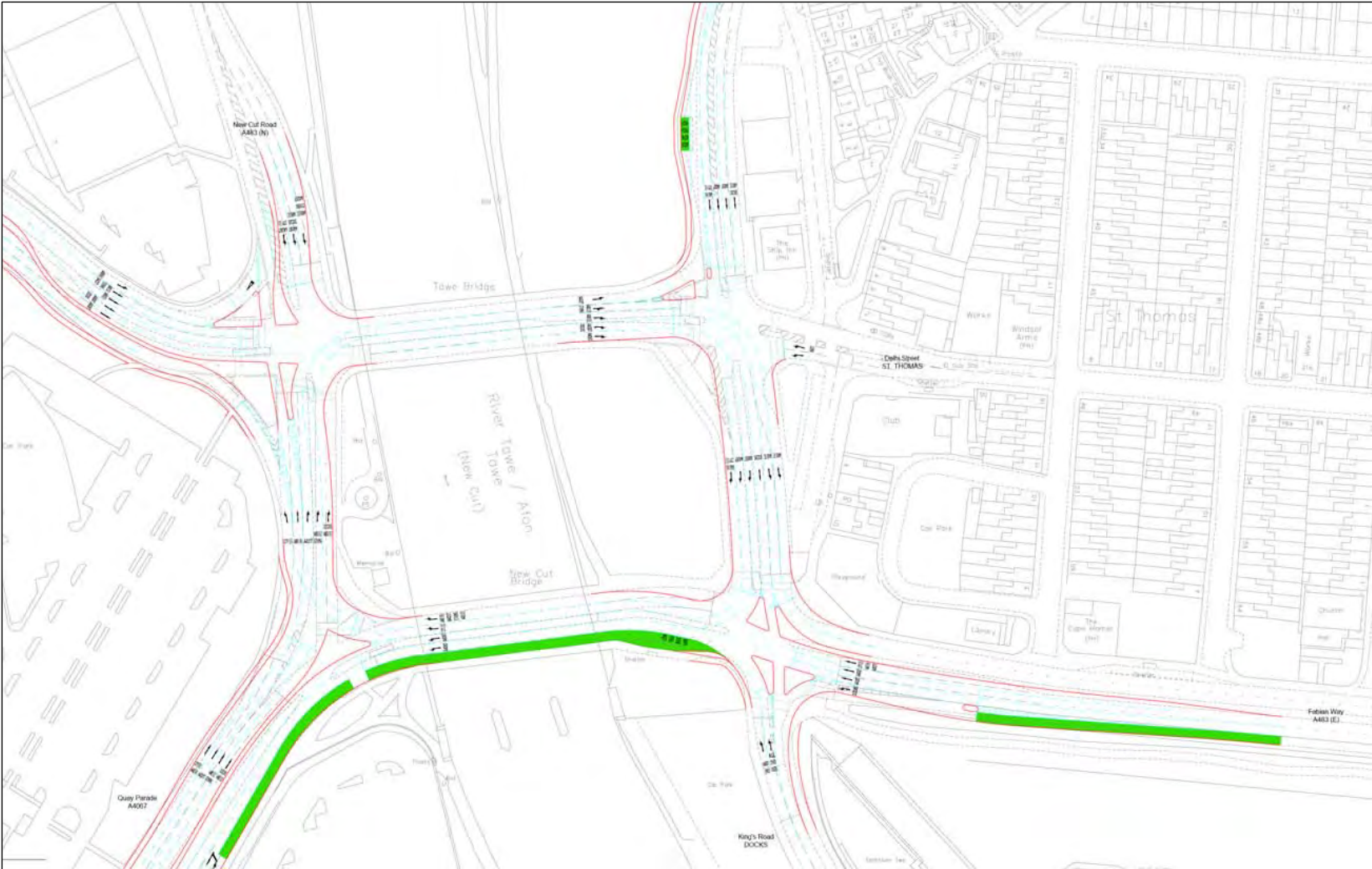
TRANSYT Output for Tawe Bridges (AM Peak: 0800-0900; 2020+)

LINK	Option 6		Option 7		Option 9		Option 10		Option 11		Option 3		Base 2009	
	Cycle time 116s		Cycle time 106s		Cycle time 116s		Cycle time 110s		Cycle time 110s		Cycle time 78s		Cycle time 144s	
	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)
Parc Tawe exit	92	14	91	12	85	11	89	12	95	13	54	11	102	20
New Cut Rd (southbound)	70	6	56	5	61	6	58	5	51	5	74	11	103	18
Northern bridge	89	16	81	16	66	16	75	15	64	14	68	23	88	18
Pentreguinea	144	97	92	15	94	17	112	35	102	24	55	16	87	34
Delhi St	84	5	77	4	-	-	80	5	-	-	47	2	90	9
Eastbank	85	15	85	7	82	8	67	4	60	12	89	26**	82	14**
Fabian Way westbound	99	34	93	25	104	44	90	25	76	20	87	21	98	64
South bridge westbound	71	11	86	16	92	17	92	17	94	18	87	35	76	41
South bridge right turn	60	13	56	12	56	14	54	13	58	12	90	31	-	-
New Cut Road northbound	68	8	59	9	59	10	58	10	59	9	59	10	99	28**
South bridge eastbound	-	-	-	-	-	-	-	-	-	-	94	23	93<<	31
Quay Parade eastbound	70	19	84	21	81	22	83	22	78	20	78	13	75<<	28
Total Delay pcu.hr/hr	311		138		172		173		141		109		209	

Development)

TRANSYT Output for Tawe Bridges (PM Peak: 1630-1730; 2020+)

LINK	Option 6		Option 7		Option 9		Option 10		Option 11		Option 3		Base 2009	
	Cycle time 116s		Cycle time 106s		Cycle time 116s		Cycle time 110s		Cycle time 110s		Cycle time 84s		Cycle time 144s	
	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)	DOS %	Q (Pcu)
Parc Tawe exit	164	165	94	18	89	15	103	26	89	16	90	31	100	22
New Cut Rd (southbound)	92	8	58	6	53	5	51	5	54	5	89	14	100	15
Northern bridge	83	13	73	8	39	15	65	17	64	11	80	39	86	19
Pentreguinea	150	93	135	57	85	12	203	97	84	13	57	17	72	23
Delhi St	66	3	74	4	-	-	68	4	-	-	59	3	73	5
Eastbank	91	15**	85	13	94	17**	52	12	59	7	98	48**	51	18
Fabian Way westbound	104	39	101	34	213	203	150	148	225	229	100	46**	87	26
South bridge westbound	81	13	88	17	97	25**	93<<	20**	92<<	20**	98	60**	79	42
South bridge right turn	51	7	54	7	44	8	38<<	6	38<<	6	91	28	-	-
New Cut Road northbound	73	9	66	9	65	9	63	9	61	10	76	12**	96	28**
South bridge eastbound	-	-	-	-	-	-	-	-	-	-	89	19	85	44
Quay Parade eastbound	75	14	70	15	77	15	81	16	79	16	78	13	82	31
Total Delay pcu.hr/hr	572		268		630		710		707		183		200	



Map 45 - Option 3 Adopted layout now completed and operational
© Crown Copyright and database right 2013. Ordnance Survey 100023509

- An air quality monitoring station along Pentreguinea Road has been established with measurements commencing during September 2005. The system measures the pollutants nitrogen dioxide, sulphur dioxide, ozone, benzene, along a 280-meter open path. The system comprises of a transmitter and a receiver. The transmitter shines a xenon lamp along the path length to the receiver module where the light is focused and transmitted down a fibre optic cable and into a spectra analyser where the measurements take place. The system is now providing spatial data over the 280-meter path length.



Photo 8 - St Thomas DOAS Transmitter



Photo 9 - St Thomas DOAS Receiver Station

- **Action Point 9 - City & County of Swansea Vehicle Fleet**

Improvements are ongoing within the fleet of vehicles operated by the authority as the authority proactively manage down the environmental impact of a 750 vehicle fleet operation within the Council's area. Latest developments/initiatives include,

- A robust time based maintenance and inspection regime that specifies oil and filter changes twice a year
- A vehicle renewals programme that consolidates technological advancements within the fleet, and maintains an appropriate mechanical condition and age profile
- Detailed consultation with users on specifications to ensure maximised utility for the supplied vehicle
- A replacement component strategy that “ builds in “ disposal and recycling requirements for tyres, oils, batteries, cleaning products, asbestos free linings etc

City & County of Swansea

- Specifying Euro 5 compliant engines on new heavy commercial vehicles and Euro 4 on light commercials
- Specifying AdBlue nitrous oxide reduction systems for new heavy commercial vehicles
- Introduction of Bio Diesel to the Council's fuel stocks
- Introduction of vehicle tracking to monitor and improve vehicle utility and reduce mileage
- Trial of magnets to improve fuel system efficiency
- Establishing carbon footprint database to monitor and improve impact of vehicle operations

The authority actively enforces a “good neighbour “approach in terms of the Council's driver conduct, vehicle operations and parking arrangements.

- **Action Point 10: Traffic Management Systems with Air Quality Monitoring Feedback.**

Considerable efforts are being made to ensure that all data feeds into the system under development operate reliably. The major data feeds are:

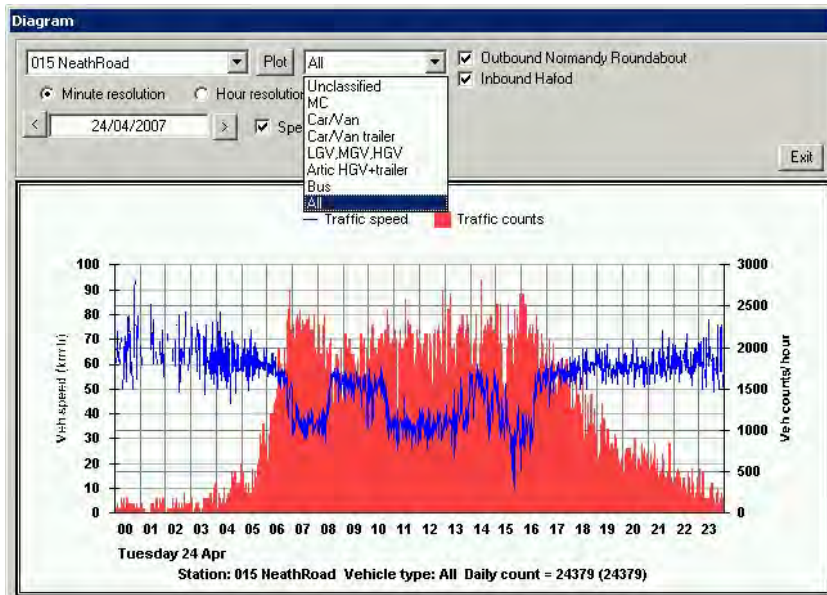
- ◆ Vehicle by Vehicle Traffic flow
- ◆ Ambient Air Quality Monitoring data
- ◆ Meteorological forecast

A total of 55 GPRS vehicle by vehicle (VbV) automatic traffic counters have been installed and commissioned and data quality is being assessed - see map 46 below for the location of the existing 55 GPRS traffic counters. Additional temporary surveys are underway within "local streets" for a period of one week to establish basic flow information.

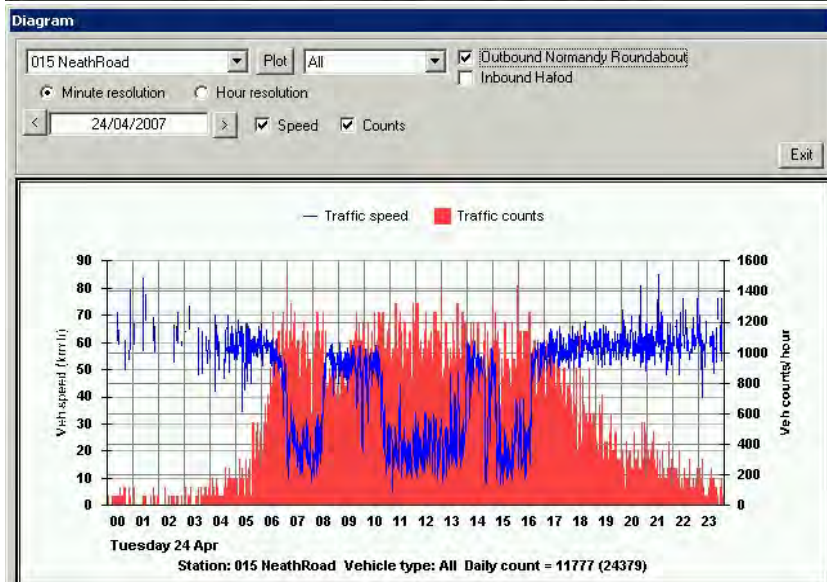
The GPRS automatic traffic counters transmit data to an FTP server every 5 minutes. The vehicle by vehicle data is compiled into 1 minute integration and stored within databases linked to the emissions database (EDB). An example of the information that is now available to both the models and for dissemination to local radio media traffic bulletins (i.e. detection of congestion forming) is given below.

All vehicles are classified into the EUR6 classification scheme at point of detection as well as the speed of the vehicle. This information has again been provided for use within the modelling under development.

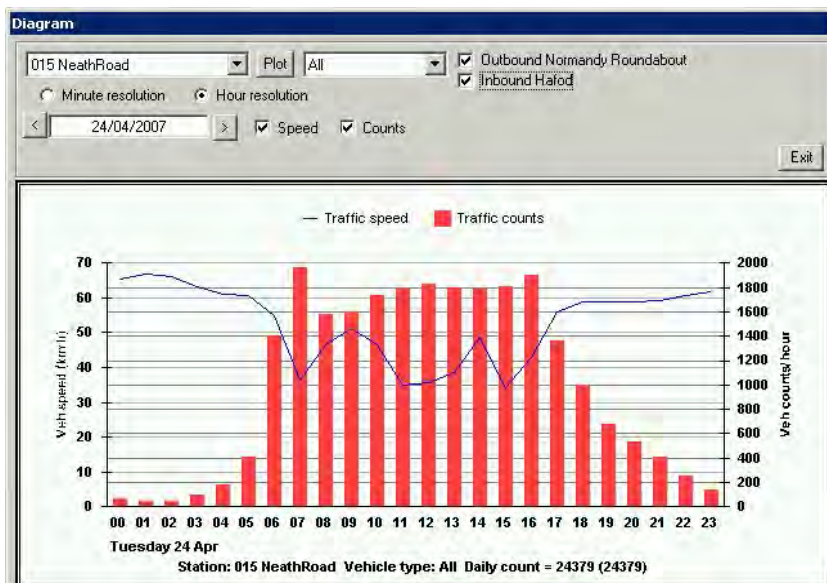
City & County of Swansea



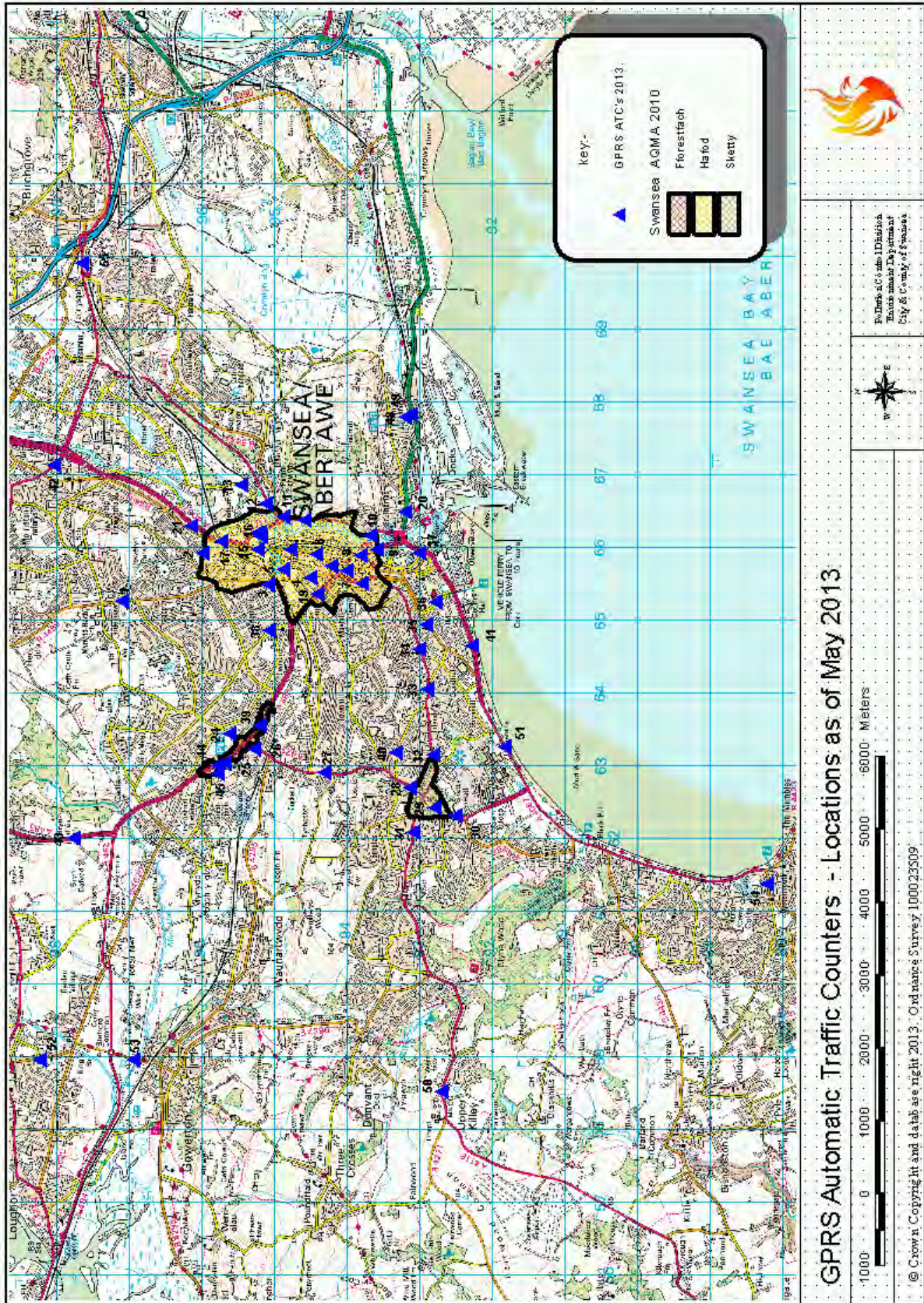
ATC 15 Neath Road is located opposite Morfa Terrace on the B4603. The AADT for 2006 is 20,544 with the AWDT being 21,864. 1 minute resolution traffic flow data enables detection of congestion in almost “real-time”.



The direction of formation of congestion can be established by separation of the directions. Here the congestion can be seen within the outbound lane. Notice the 3 significant periods of slow moving vehicles during the AM, midday and PM periods.



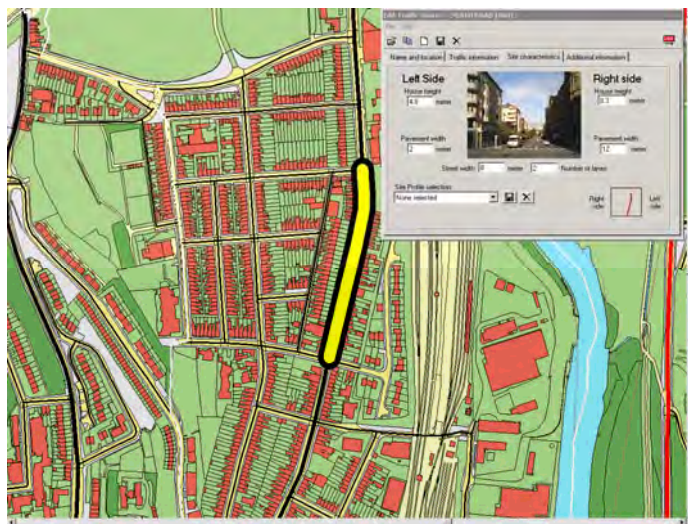
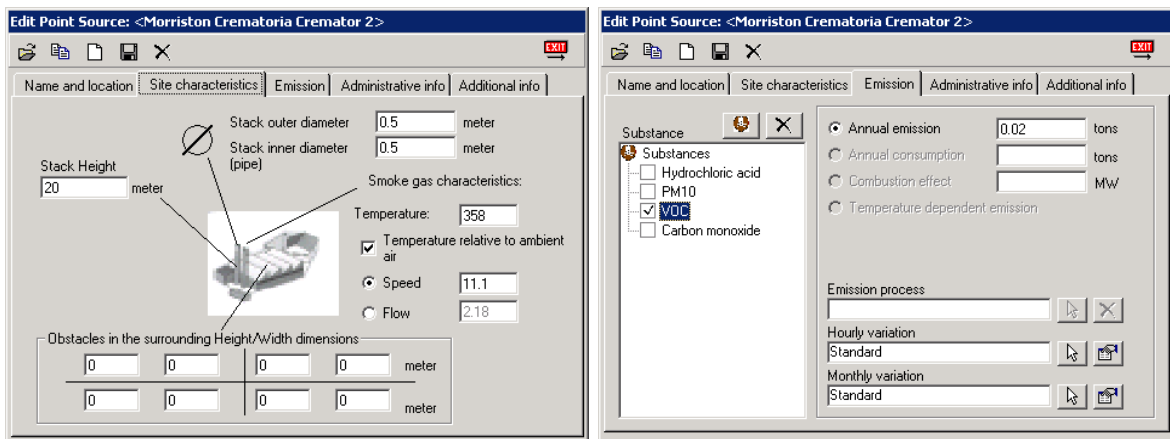
This 1 hour data integration view does not enable easy detection of these significant congestion periods



Map 46 - Location of GPRS Automatic Traffic Counters 2013

© Crown Copyright and database right 2013. Ordnance Survey 100023509

- Discussions have commenced to develop an interface to manage the dissemination of information to local media i.e. traffic bulletins and roadside signage. This system will receive output predictions from Nowcaster and will take logical decisions upon what messages are disseminated to the local news media as well as the variable message signs located initially within the lower Swansea valley. Discussions are ongoing with regard to the specification of the variable message signs.
- Emissions data is being collated and inputted into an emissions database (EDB) which will be central to the system. The information required is extensive and includes all point source /area/grid emissions sources.



Every road link is in process of being classified and the details inputted into the EDB in order that the model understands the local geometry and conditions influencing dispersion in that road link. Width of road/pavement and building heights are being provided as parameters into the emissions

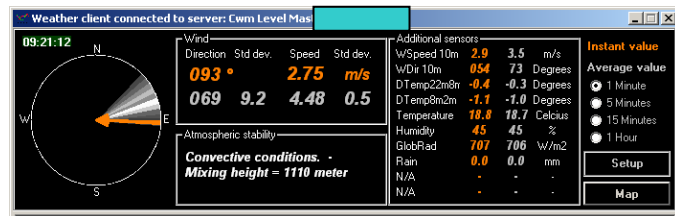
database.

- Installation of a dedicated 30m meteorological mast at Cwm Level Park within the lower Swansea Valley to provide high quality temperature and wind profiles data in the lowest atmospheric layer in the valley into the models.



Meteorological parameters measured

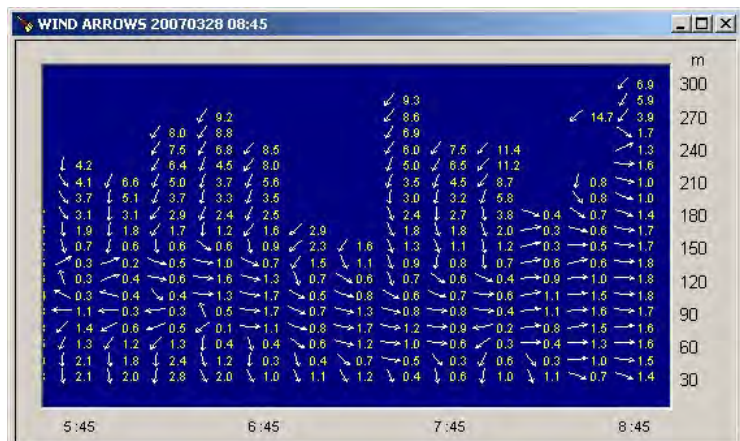
- Wind Speed at 30m
- Wind Direction at 30m
- Global Radiation at 30m
- Wind Speed at 10m
- Wind Direction at 10m
- 22m Differential Temperature
- 8m Differential Temperature
- 2m Absolute Temperature
- 2m Relative Humidity
- Rainfall



- Installation of an AQ500 “Wind Profiler” within the lower Swansea Valley.



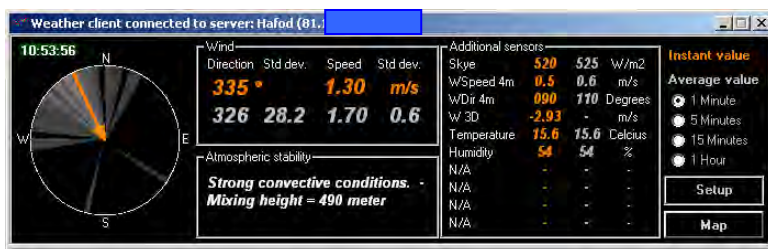
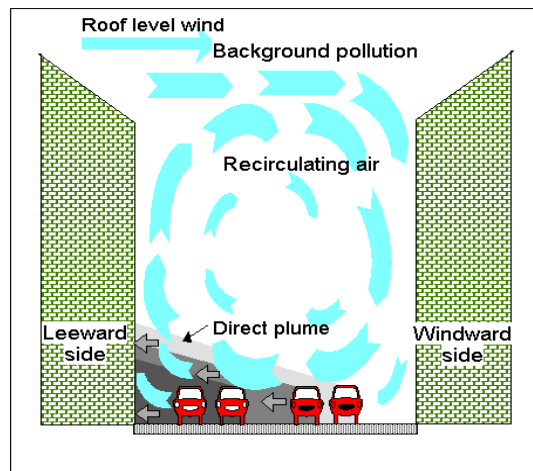
This equipment measures the wind speed and wind direction in 15m “layers” up to its maximum height of 300m.

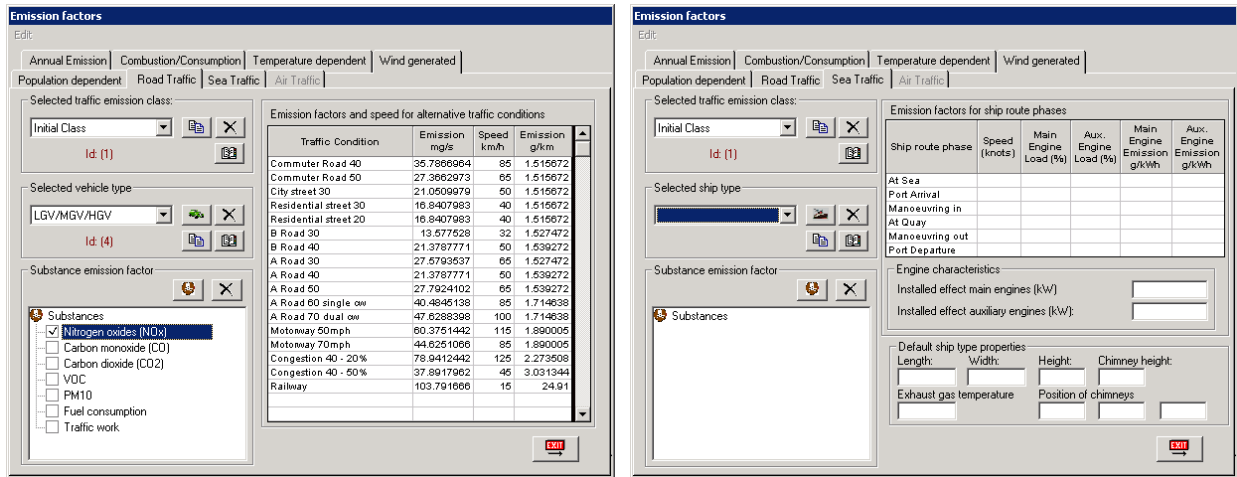


- Establishment of a street canyon meteorological station within Neath Road. This station has been fixed to the front elevation of the Hafod Post Office opposite the open path air quality measurements being undertaken by the Hafod DOAS. This station will supply the meteorological information to validate Nowcaster and other modelling output/predictions/forecasts within street canyon environments.

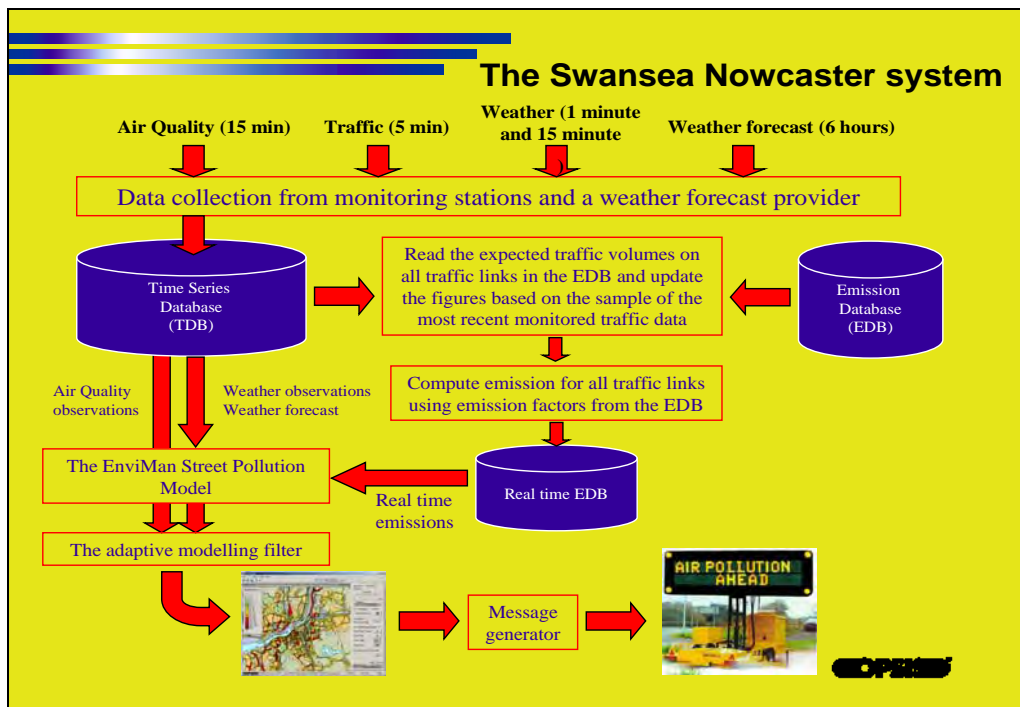
Meteorological parameters measured

- Global Radiation
- Wind Speed 5m above roof ridge level
- Wind Direction 5m above roof ridge level
- Horizontal Wind Speed at first floor level
- Horizontal Wind Direction at first floor level
- Vertical Wind Speed at first floor level
- Air Temperature at first floor level
- Relative Humidity at first floor level





- Development of emission factors for all modes of transportation.
- A schematic of the system under development is shown below



Schematic 1 - Swansea Nowcaster Traffic Management System

- Additional air quality monitoring stations have been installed within St.Thomas (see action point 8 above)
- The Nowcaster model interface with the system under development is still undergoing customisation to allow unattended import of all required datasets and

automatic operation and output of predictions. This is taking longer than anticipated and is dependant upon funding streams being made available.

- An interface is being developed to allow local media and the public to view the live Nowcaster mapping predictions – they will be able to view the statistics for the nearest traffic counter, look at the air quality forecast for the roads and even chart the data if they wish.
- The system will send emails to local media i.e. The Wave, Swansea Sound, Real Radio and even national stations (Radio 2,3,4 etc) for use in their traffic forecasts. The system can detect traffic congestion in almost real time from the ATC network data and broadcast this information via email etc
- In addition, messages will be sent to roadside signs to try and encourage a certain % of the traffic flow to divert from the failing area/ congested area and also to provide additional information regarding detected congestion/planned road works notifications etc. An example VMS sign is shown below

Swansea Traffic Info Sign
Layout example 090316-3



2200x1200

VENTIRO
Document: NSL2297 - Swansea_Signlayout_090316-3.ai
Jan Tuomi
Ventiro AB, 2009-03-16

As a result of the budgetary restraints, it is not known when the entire infrastructure previously identified as major and critical elements of the Action Plan (the roadside variable message signs) will be funded. This “final hurdle” would have a capital cost in the region of £300,000 - £500,000 for the third phase of sign deployment.

10 Conclusions and Proposed Actions

10.1 Conclusions from New Monitoring Data

Nitrogen Dioxide (Passive Diffusion Tube Data)

Exceedences of the annual mean objective continue to be seen within the existing Swansea Air Quality Management Area 2010 along the Neath Road corridor, Cwm Level Road (Brynhyfryd Cross Roads) and Carmarthen Road (Dyfatty area).

Additionally exceedences continue to be seen within the Fforestfach and Sketty areas of the AQMA. Additional monitoring within the AQMA area around the High Street Railway Station has highlighted the exceedence of the annual mean objective.

Monitoring from outside of the existing Swansea AQMA 2010 has identified new areas that are failing the annual mean objective. Numerous locations within the city centre are failing the annual mean objective. However, monitoring during 2012 has indicated that exceedences of the 1-hour objective have not been seen around the café type environments along the Kingsway and Dillwyn Street areas. One site (site 75) within the Uplands area (at the junction of Brynymor Crescent and Uplands Terrace) has indicated exceedence of the annual mean objective during 2010 -2012. This site is situated between the city centre and the Sketty area which forms part of the Swansea AQMA 2010. Continued monitoring along Newton Road within the Mumbles area has shown an improving picture with only two sites closest to the junction with Mumbles Road now showing during 2012 an exceedence of the annual mean objective. These sites are free of the complications caused by a canopy over commercial premises where there are flats at first floor level above the canopy structure on one side of Newton Road. Monitoring at the receptor locations at first floor level above the canopy has still not been possible to check compliance. The situation along Newton Road is exacerbated by tourism traffic during the summer months. Other sites along Newton Road (on both sides of the road) have indicated the potential to exceed the annual mean objective during 2011 - 2012. The situation along Newton Road is discussed and outlined within section 2.2.3, plan1 and photos 13 and 14.

City & County of Swansea

Sites in Morriston at Woodfield Street, Clase Road and Martin Street (sites 41, 43 and 285) indicate marginal compliance with the annual mean objective during 2012 and remain at risk of exceedence. Sites at Nantyffin Road Llansamlet (site 50) and another in Ynystawe at a property (site 45) overlooking junction 45 of the M4 have now shown compliance with the annual mean objective during both 2011 and 2012.

Site 35 within the St Thomas area (Delhi Street) indicated exceedence of the annual mean objective during 2011 but during 2012 has shown full compliance. This maybe due to the improvements made with the gyratory system around the Quay Parade bridge area. Site 291 (Vale of Neath Road) on the outbound A483 towards the M4 has shown exceedence of the annual mean objective during 2012. This site is discussed in section 2.2.3 above (see photo 15).

Additional monitoring undertaken outside of the exiting Swansea AQMA 2010 has identified sites with the potential to exceed the annual mean objective (being within the 37-40ug/m³ range). These sites will continue to be monitored to establish trends.

Annual mean NO₂ future year projections made for 2012 to 2020 using both the updated January 2012 guidance as outlined within LAQM.TG(09) and a further update note from DEFRA entitled "Note on Projecting NO2 concentrations"⁴³ dated April 2012 has shown that using both methods to project forwards to 2020 it is clear that whilst the LAQM.TG(09) method indicates full compliance with the annual mean objective being seen as early as 2016, using the revised April 2012 method, paints a totally different picture, as in 2020, widespread exceedences remain, together with indications that additional numerous sites would still exhibit the potential to exceed the annual mean objective. It is thought that the April 2012 method may well paint a more realistic picture.

Nitrogen Dioxide Real Time Continuous Automatic Monitoring Data

Compliance with both the annual mean and hourly objectives were seen at the Swansea AURN and Morriston Groundhog monitoring stations during 2012. However, real-time open path monitoring along Neath Road, Hafod (Hafod DOAS)

⁴³ <http://laqm.defra.gov.uk/review-and-assessment/modelling.html#ProjectingNO2Note> and http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

continues to show exceedence of the annual mean objective. The number of exceedences of the hourly NO₂ objective have reduced against the permitted 18 from 16 during 2011 to 5 during 2012. During 2011, the annual mean objective was exceeded at the other open path monitoring location at the St.Thomas DOAS monitoring station along Pentreguineau Road. But during 2012 marginal compliance has been observed. This would tie into the result obtained for site 35 (Delhi Street) which is within 75m of the DOAS path and is another indication of the probable success of the gyratory now operational at Quay Parade bridges.

Annual mean NO₂ future year projections made for 2012 to 2020 using both the updated January 2012 guidance as outlined within LAQM.TG(09) and a further update note from DEFRA entitled "Note on Projecting NO₂ concentrations"⁴⁴ dated April 2012 indicate continued full compliance with both objectives at suitable receptor locations at the Swansea AURN and Morriston Groundhog sites. However, using the original LAQM.TG(09) method at the Hafod and St Thomas DOAS sites indicates that the Hafod DOAS will see compliance with the annual mean objective during 2017 with compliance at the St Thomas DOAS being seen as early as 2012. If the further updated note from DEFRA dated April 2012 is used then a different outlook is obtained. Compliance with the annual mean objective at the Hafod DOAS site is not seen even within 2020, with compliance being put back with the annual mean objective at the St Thomas DOAS until 2015. Again, it is thought that the April 2012 method may well paint a more realistic picture.

Sulphur Dioxide Real Time Continuous Automatic Monitoring Data

No exceedences of any of the objectives have been observed within Swansea for several years. Measurements are now only made from the St.Thomas DOAS due to budgetary restraints.

Carbon Monoxide Real Time Continuous Automatic Monitoring Data

No exceedence of the objective has been observed within Swansea since monitoring commenced. Monitoring ceased during 2009/2010 due to budgetary restraints.

⁴⁴ <http://laqm.defra.gov.uk/review-and-assessment/modelling.html#ProjectingNO2Note> and http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

Particulate Matter PM₁₀

No exceedences of the annual mean objective were seen at any of the monitoring stations during 2012. Similarly, no breach of the 35 permitted exceedences of the 24 hour objective was seen, nor, where data capture was below 90% did the 90th percentile (given in brackets after the number of exceedences in table 12) exceed 50ug/m³. For the first time in several years, PM₁₀ data capture has been above the 90% required by LAQM.TG(09) giving added confidence to the monitoring results.

Projections made to 2015 and 2020 show compliance with the annual mean objectives at all sites – indeed, there is remarkable harmony between the projected PM₁₀ concentrations in 2020.

Benzene

No exceedence of the objective has been observed within Swansea since monitoring commenced.

Ozone

Compliance with the UK objective (not set in regulation) has been seen at all monitoring stations during 2012 except for at the Hafod DOAS. Whilst ozone is considered a national rather than local problem, there does appear to be some local influence evident within the data from the street canyon at the Hafod DOAS during 2012. Ozone will continue to be measured for the foreseeable future.

Heavy Metals Monitoring

Monitoring from 4 points around a high level stack release point at the Vale Inco, Clydach nickel refinery during 2012 have shown **nickel** concentrations below the 4th Daughter Directive annual mean target value following improved abatement at the release point. However, compliance with the 4th Daughter Directive was marginal at the YGG Gellionnen site during 2009. As previous years monitoring have shown variability with recorded concentrations of nickel at one or more sites, it is envisaged that monitoring will continue at all four sites (two UK network funded, two local authority funded) to assess future trends post improved abatement under different meteorological conditions. It should be noted that the downward trend in

concentrations first seen 2009/2010 appears to be real and is highly likely to be as a result of the improvements made to abatement. Yet more improvements are planned in the near future which should see the recorded concentrations fall even further.

From the data available, it is clear that annual mean concentrations for **arsenic and cadmium** at all monitoring locations fall well below the 4th Daughter Directive Target Values.

Additionally, from the data available, it is clear that annual mean concentrations for **lead** at all monitoring locations fall well below the 0.25ug/m³ required under the Air Quality (Amendment) (Wales) Regulations 2002 to be achieved by the 31st December 2008.

10.2 Conclusions relating to New local Developments.

Proposals to develop the Tawe Riverside development Corridor may have air quality implications within a wide area of the lower Swansea valley. However, these concerns may be offset by provision of the Morfa Distribution Road and the improvements already being seen around the Quay Parade bridges area. Due to the continued economic downturn it may prove to be many years before the aspirations of the scheme as a whole are realised in full or part. Regular updates will be provided as and when significant developments occur.

The proposals by Vale to develop an energy from waste Pyrolysis Plant at its refinery at Clydach in the Swansea valley may have air quality impacts locally. Whilst Planning Permission has been granted and a permit issued for operation by the now Natural Resources Wales the project is on hold at present again, due to the economic downturn. Regular updates will be provided in future reporting.

10.3 Proposed Actions

Reports will be presented to Council to consider the variation of the existing Swansea Air Quality Management Area 2010 to include the Uplands Crescent area within the Uplands area along with the existing failing areas.

The authority intends to locate a real-time chemiluminescent analyser within the High Street area of the city centre prior to year end 2013.

Additional monitoring will be undertaken at façade of new flats within the Kingsway area of the city centre to determine if NO₂ annual mean concentration replicate those seen in the areas where monitoring around the café type environments have established no exceedence of the one-hour objective but indicate exceedence of the annual mean objective.

Additional monitoring will be undertaken along Fabian Way and Bevans Row to gain an understanding of the impacts of the signal controlled junction at SA1. The phasing of this junction will be altered to assess impacts. In addition, discussions will be undertaken with Associated British Docks to reopen alternative access/egress points into SA1 to ease flows at the main SA1 junction.

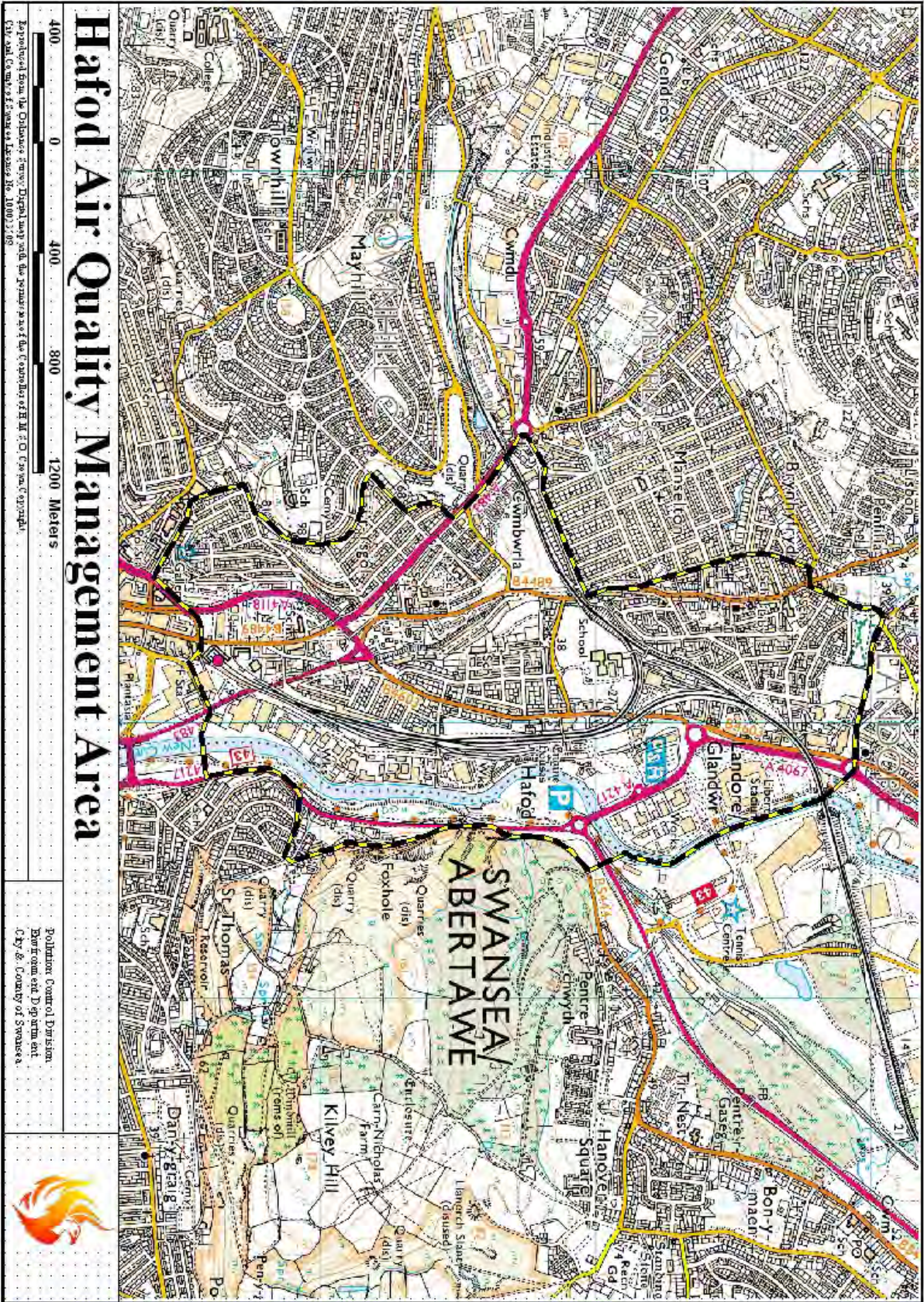
It is still the intention despite improving conditions at the Newton Road/Mumbles Road to undertake monitoring at the first floor flats along Newton Road to determine the extent of failure. Whilst this action has been proposed within previous reporting, practical issues have delayed implementation.

11. References

- i. City & County of Swansea Progress Report 2006
- ii. City & County of Swansea Updating & Screening Assessment 2006
- iii. City & County of Swansea Progress Report 2007
- iv. City & County of Swansea Progress Report 2008
- v. City & County of Swansea Updating and Screening Assessment 2009
- vi. City & County of Swansea Progress Report 2009
- vii. City & County of Swansea Progress Report 2010
- viii. City & County of Swansea Progress Report 2011
- ix. City & County of Swansea Updating and Screening Assessment 2012
- x. Technical Guidance LAQM.TG(09) and subsequent updates
- xi. Air Quality (Wales) Regulations 2000, No. 1940 (Wales 138)
- xii. Air Quality (Amendment) (Wales) Regulations 2002, No 3182 (Wales 298)
- xiii. Analysis of the relationship between annual mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective AEAT/ENV/R/264 Issue 1 May 2008

Appendix 1

Hafod AQMA



Hafod Air Quality Management Area

400 0 400 800 1200 Meters

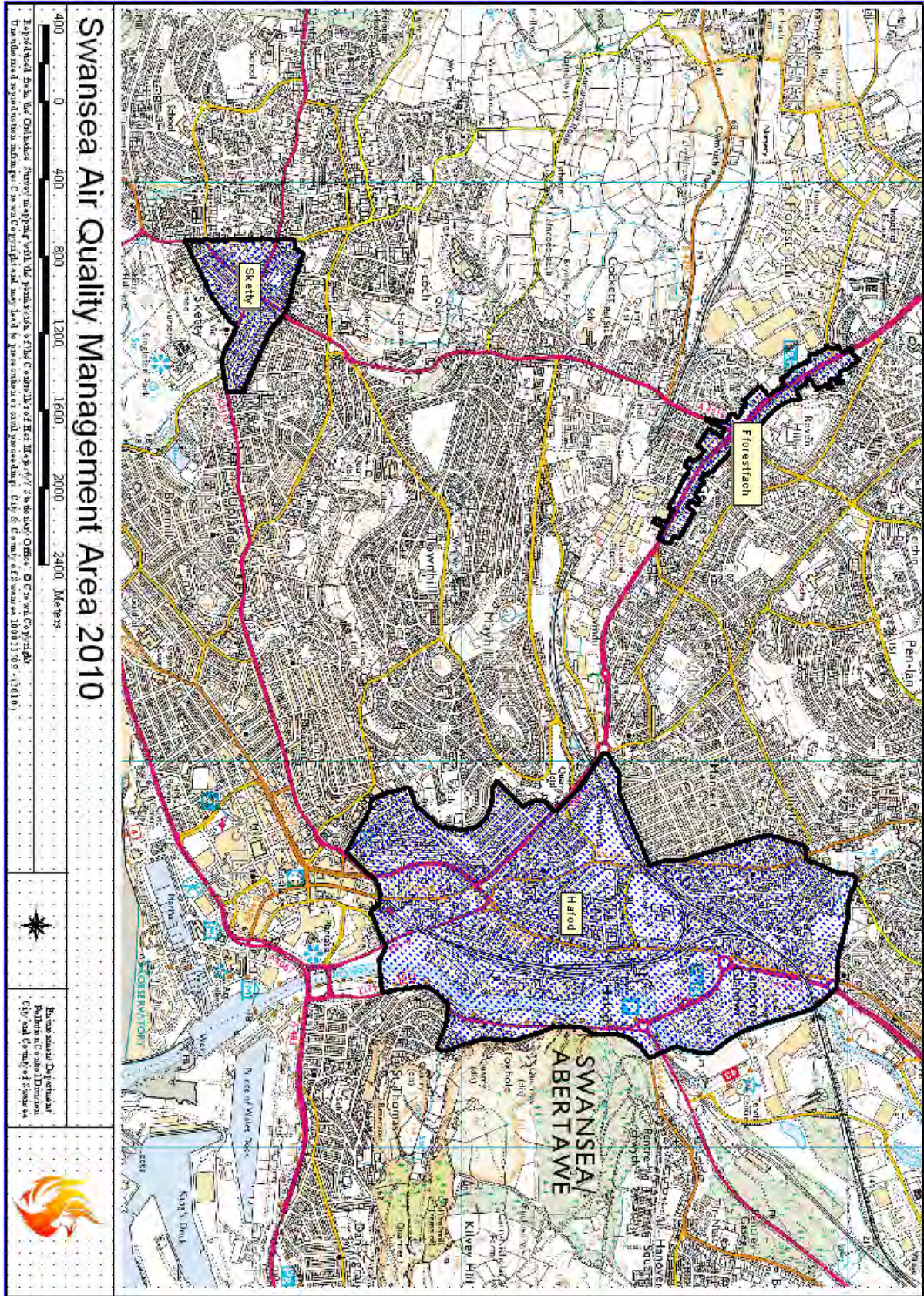
Reproduced from the Ordnance Survey Digital map with the permission of H.M.S.O. © Crown Copyright.
City and County of Swansea Licence No. 10002108

Pollution Control Division
Department of Environment
City & County of Swansea



Appendix 2

Swansea AQMA 2010



Appendix 3

Environmental Scientific Group

WASP Results

Current best 4 from 5 current Z-score average: 0.14

Year	WASP Round	Period	Samples Dispatched	Results Deadline	HSL Calculations (Pre-Sendout)		Harwell Analysis						HSL Calculations (Pre-Sendout)		Harwell Analysis						
					Sample A Calculated Spiked Value	Measured Value	Tubes A			Tubes B			Sample B Calculated Spiked Value	Measured Value	Tubes B			Tubes B			
							Result Tube 1	Result Tube 2	Average	Standard Deviation	RSD	Z-Score			Result Tube 1	Result Tube 2	Average	Standard Deviation	RSD	Z-Score	
2011	115	Sept-Dec																			
	114	Jul-Aug																			
	113	Apr-Jun																			
	112	Jan-Mar																			
	111	Sept-Dec																			
2010	110	Jul-Aug																			
	111	Apr-Jun																			
	109	Jan-Mar																			
	108	Oct-Dec																			
2009	107	Jul-Sept																			
	106*	Jul-Sept																			
	106*	Jul-Sept																			
	105	Apr-Jun																			
	104	Jan-Feb																			
2008	103	Sept-Dec																			
	102	Jun-Aug																			
	101	Apr-Jun																			
	100	Jan-Mar																			
2007	99	Oct-Nov																			
	98	Jul-Sept																			
	97	Apr-Jun																			

All Results In ug

Results disputed. Results in yellow are official results

Appendix 4

Tube bias tri-location studies

• Swansea Roadside AURN tri-location

Tri located tubes were exposed on the sample intake, synchronised for exposure for the monthly period to match the exposure on/off timings as suggested by the Welsh Air Quality Forum exposure calendar (mirrors the old UK monitoring network). All results were entered into the spreadsheet provided by AEA Energy and Environment⁴⁵ to determine tube bias as well as checking the accuracy and precision of the diffusion tube measurements. The results can be seen below.

Checking Precision and Accuracy of Triplicate Tubes

From the AEA group

Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	11/01/2012	01/02/2012	49.6	37.4	49.0	45	6.9	15	17.1
2	01/02/2012	29/02/2012	46.3	37.0	49.7	44	6.6	15	16.3
3	29/02/2012	29/03/2012	48.0	49.2	35.2	44	7.8	18	19.3
4	29/03/2012	25/04/2012	24.6	28.6	27.2	27	2.0	8	5.0
5	25/04/2012	30/05/2012	34.1	30.2	33.7	33	2.1	7	5.3
6	30/05/2012	27/06/2012	23	50.5	25.9	33	15.1	46	37.5
7	27/06/2012	01/08/2012	25.7	22.7	25.5	25	1.7	7	4.2
8	01/08/2012	05/09/2012	19.6	26.2	24.8	24	3.5	15	8.6
9	05/09/2012	26/09/2012	30.6	32.9	13.9	26	10.4	40	25.8
10	26/09/2012	24/10/2012	37.1	38.2	37.1	37	0.6	2	1.6
11	24/10/2012	07/12/2012	47.2	48.7	47.8	48	0.8	2	1.9
12	07/12/2012	09/01/2013	45.4		48.1	47	1.9	4	17.2
13									

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Automatic Method	
Period Mean	Data Capture (% DC)
38.49	99.1
37.88	95.23
45.68	99.86
24.00	99.69
27.53	99.76
21.63	99.7
19.31	99.05
21.79	96.67
26.92	99.6
33.51	99.4
40.93	99.72
36.46	99.37

Data Quality Check	
Tubes Precision Check	Automatic Monitor Data
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Poor Precision	Good
Good	Good
Good	Good
Poor Precision	Good
Good	Good
Good	Good
Good	Good

Overall survey --> Good precision Good Overall

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%

Bias calculated using 10 periods of data

Bias factor A **0.87 (0.83 - 0.92)**

Bias B **15% (8% - 21%)**

Diffusion Tubes Mean: **37 μgm^{-3}**

Mean CV (Precision): **9**

Automatic Mean: **33 μgm^{-3}**

Data Capture for periods used: 99%

Adjusted Tubes Mean: **32 (31 - 34) μgm^{-3}**

Precision **10 out of 12 periods have a CV smaller than 20%**

Accuracy (with 95% confidence interval)
WITH ALL DATA

Bias calculated using 12 periods of data

Bias factor A **0.87 (0.79 - 0.95)**

Bias B **16% (5% - 26%)**

Diffusion Tubes Mean: **36 μgm^{-3}**

Mean CV (Precision): **15 caution**

Automatic Mean: **31 μgm^{-3}**

Data Capture for periods used: 99%

Adjusted Tubes Mean: **31 (28 - 34) μgm^{-3}**

Jaume Targa, for AEA
Version 04 - February 2011

Bias correction factor 1 – Swansea Roadside AURN 2012

The derived bias correction factor of 0.87 (0.83-0.92) has been calculated despite two diffusion tube data periods having a coefficient of variation above 20%. Accuracy (with 95% confidence interval) indicates a bias B factor using 10 periods of data of 15% (8% - 21%)

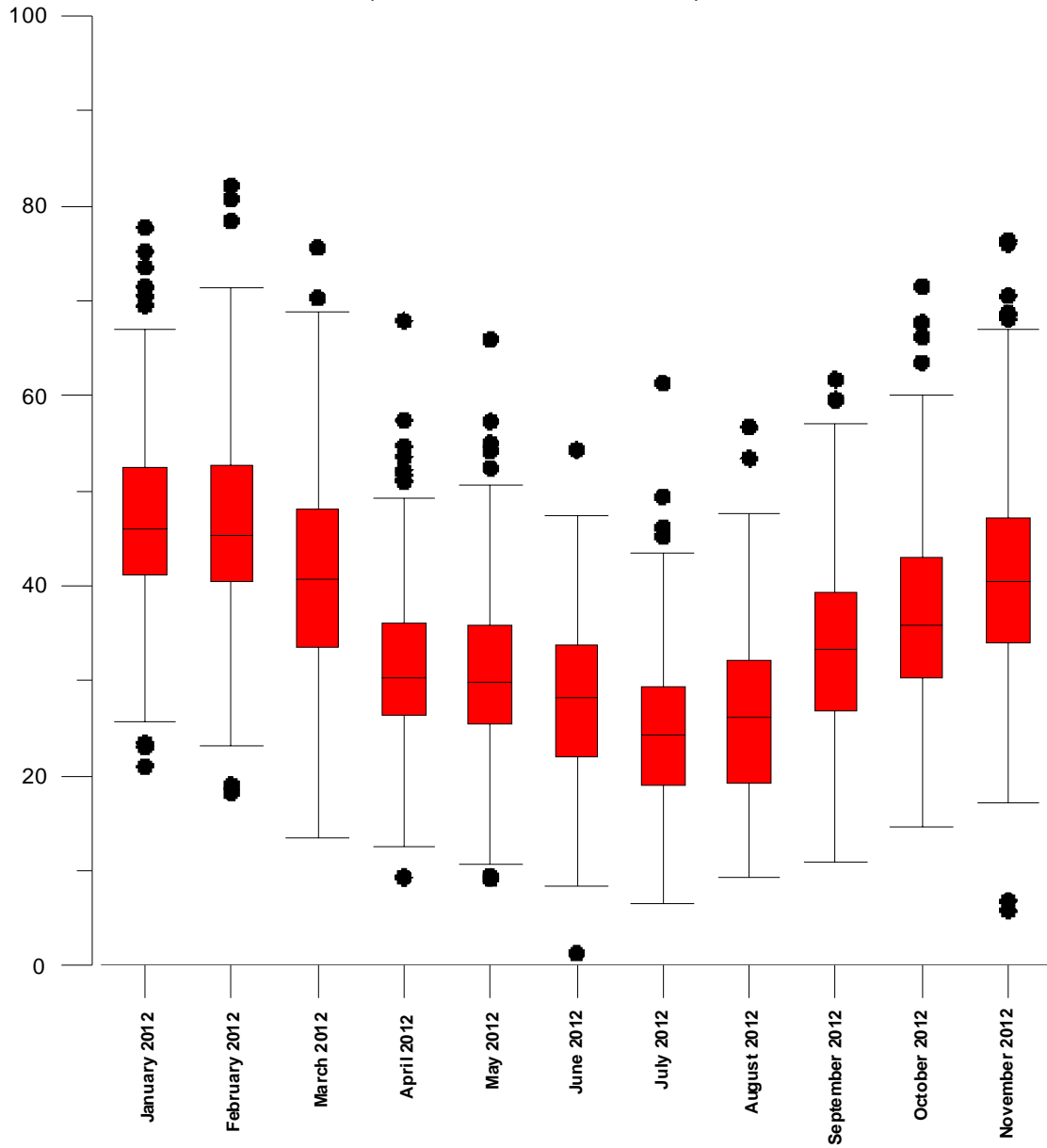
⁴⁵ http://www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

Appendix 5

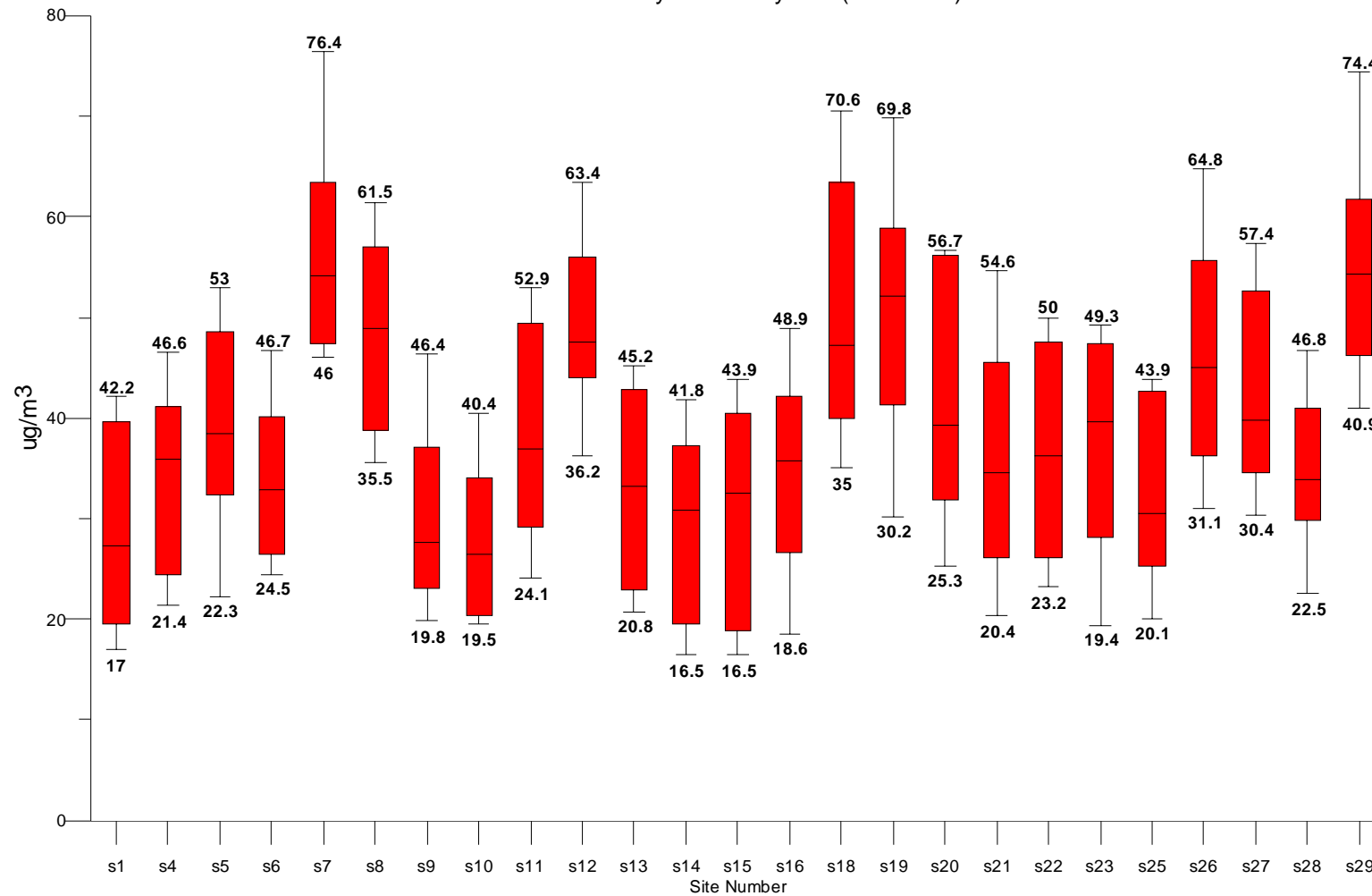
Nitrogen Dioxide Passive Diffusion Tube Data (RAW - uncorrected)

Box-Whisker Plots

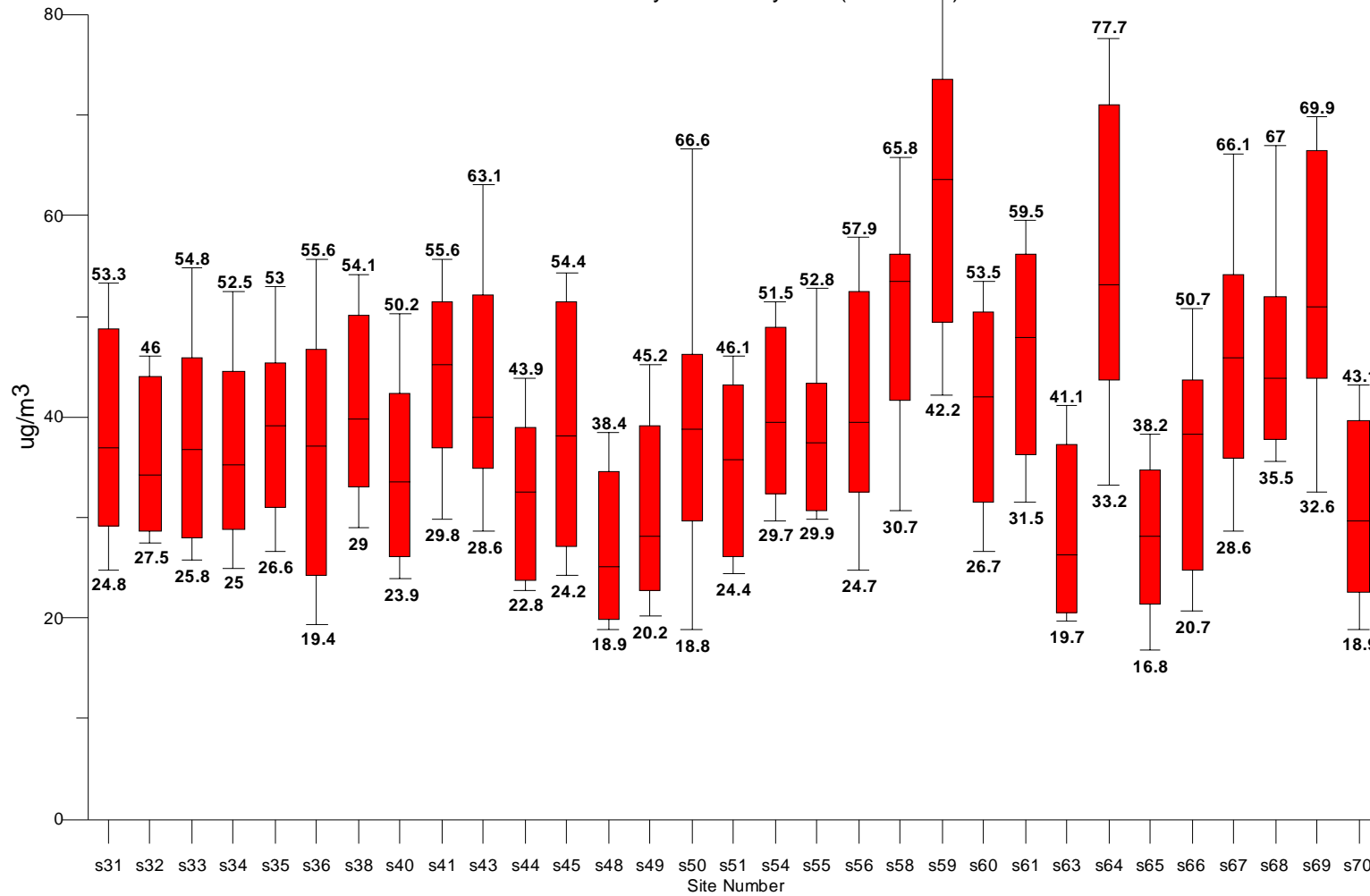
Box-Whisker Plot - All Sites by Month
Passive NO₂ Diffusion Tube Results - 2012
(Raw data - Sites 1-322)



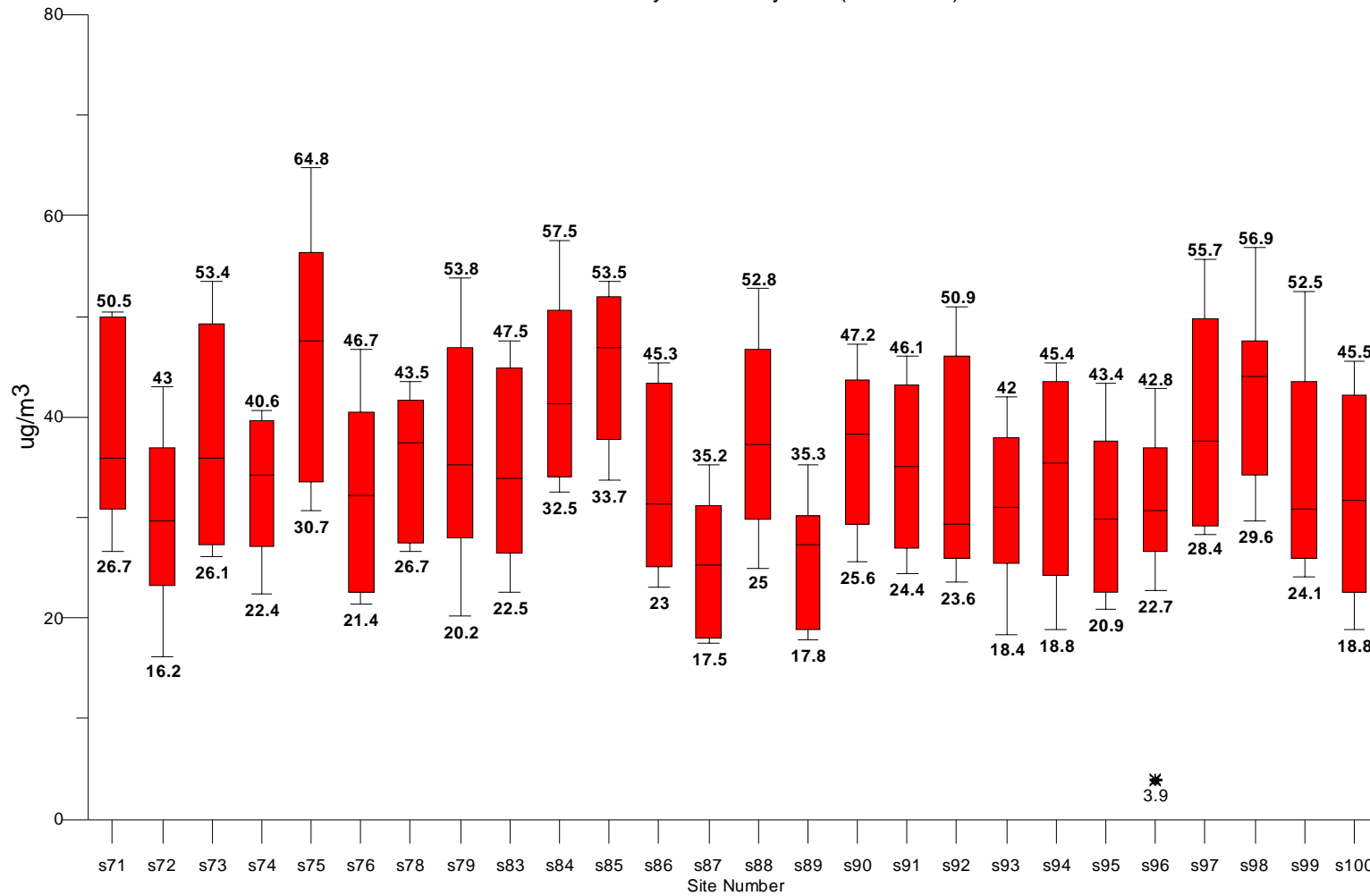
Box-Whisker Plot - Sites 1 to 29
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)



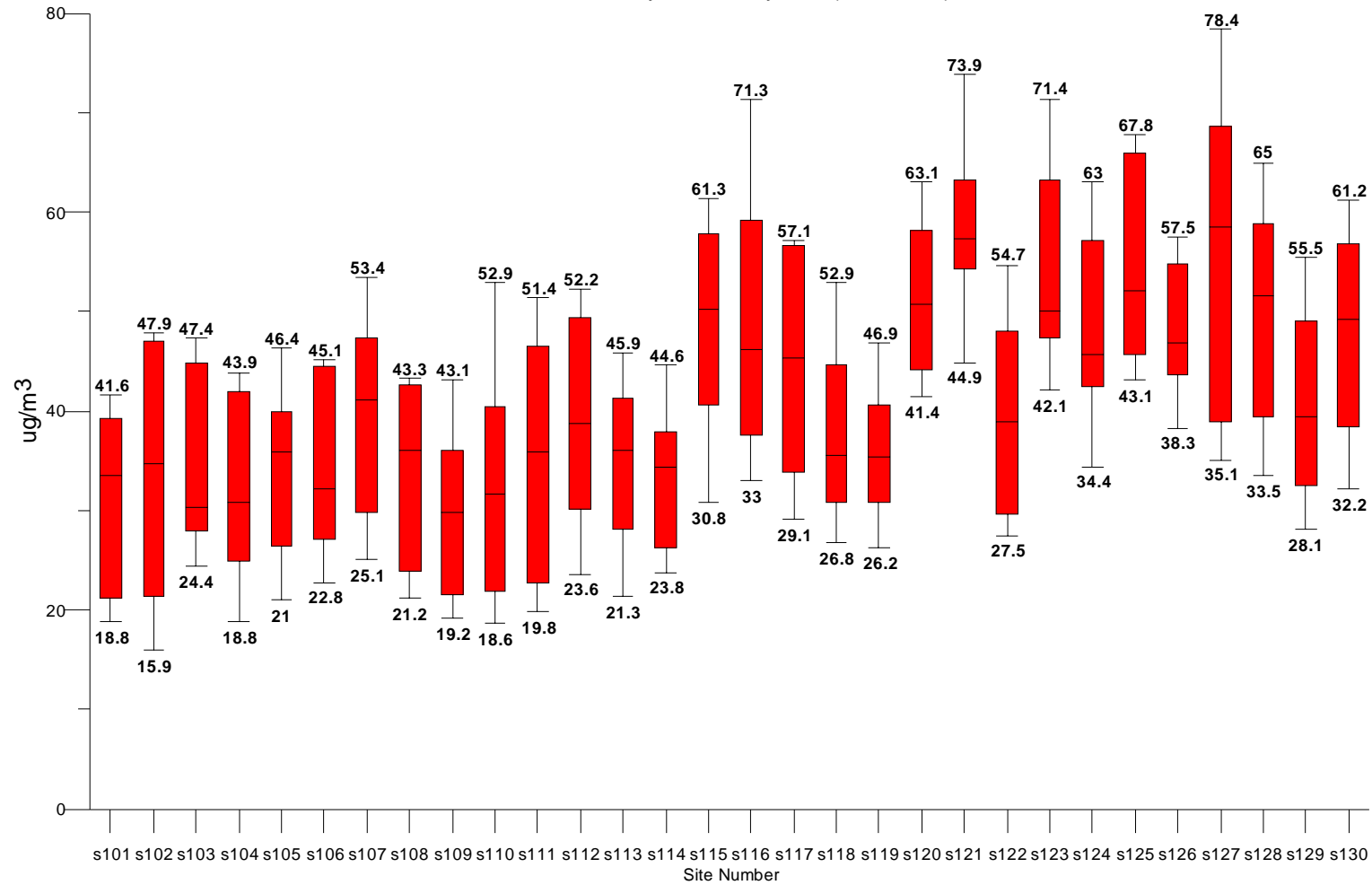
Box-Whisker Plot - Sites 31 to 70
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)



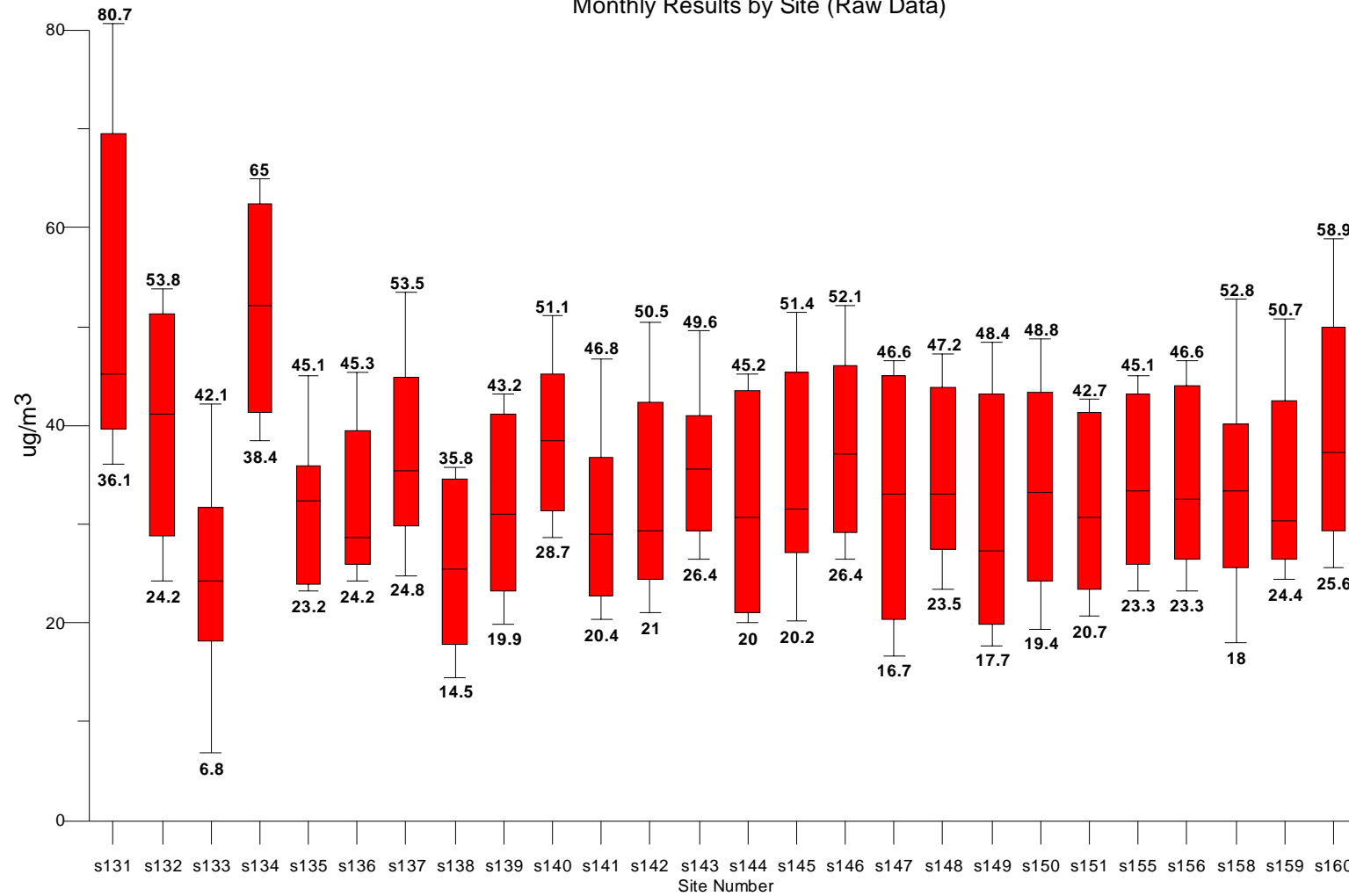
Box-Whisker Plot - Sites 71 to 100
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)



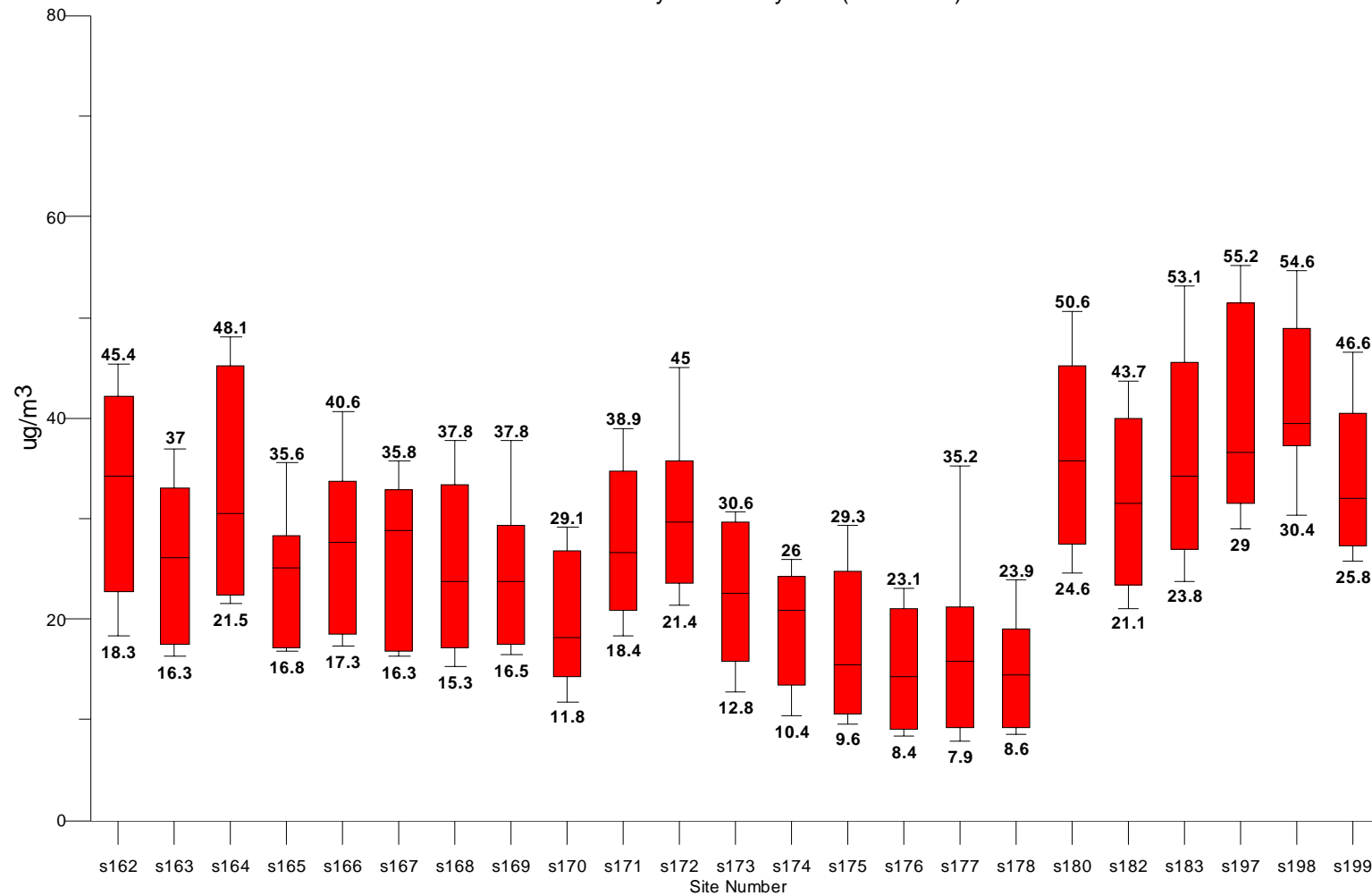
Box-Whisker Plot - Sites 101 to 130
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)



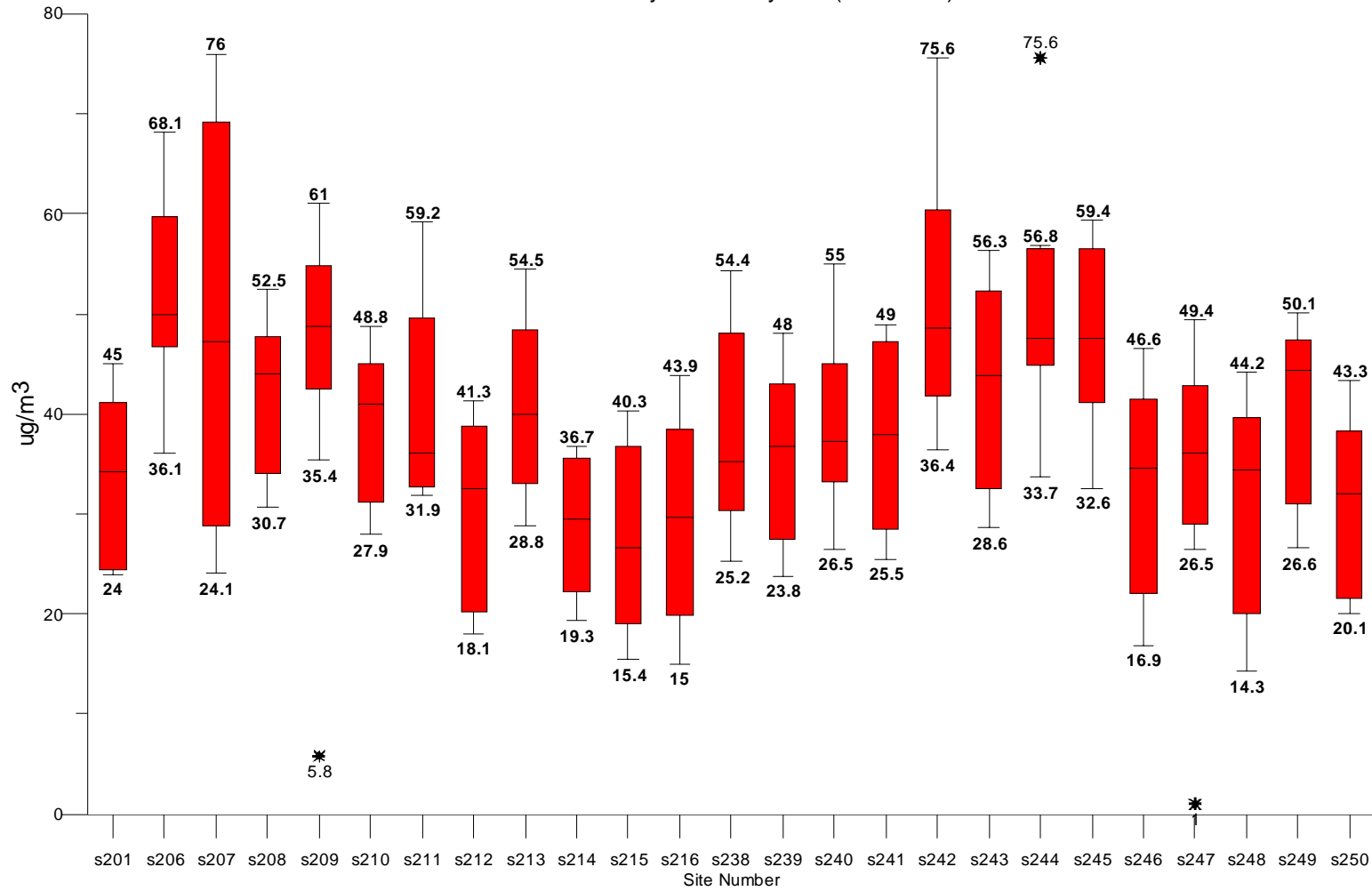
Box-Whisker Plot - Sites 131 to 160
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)



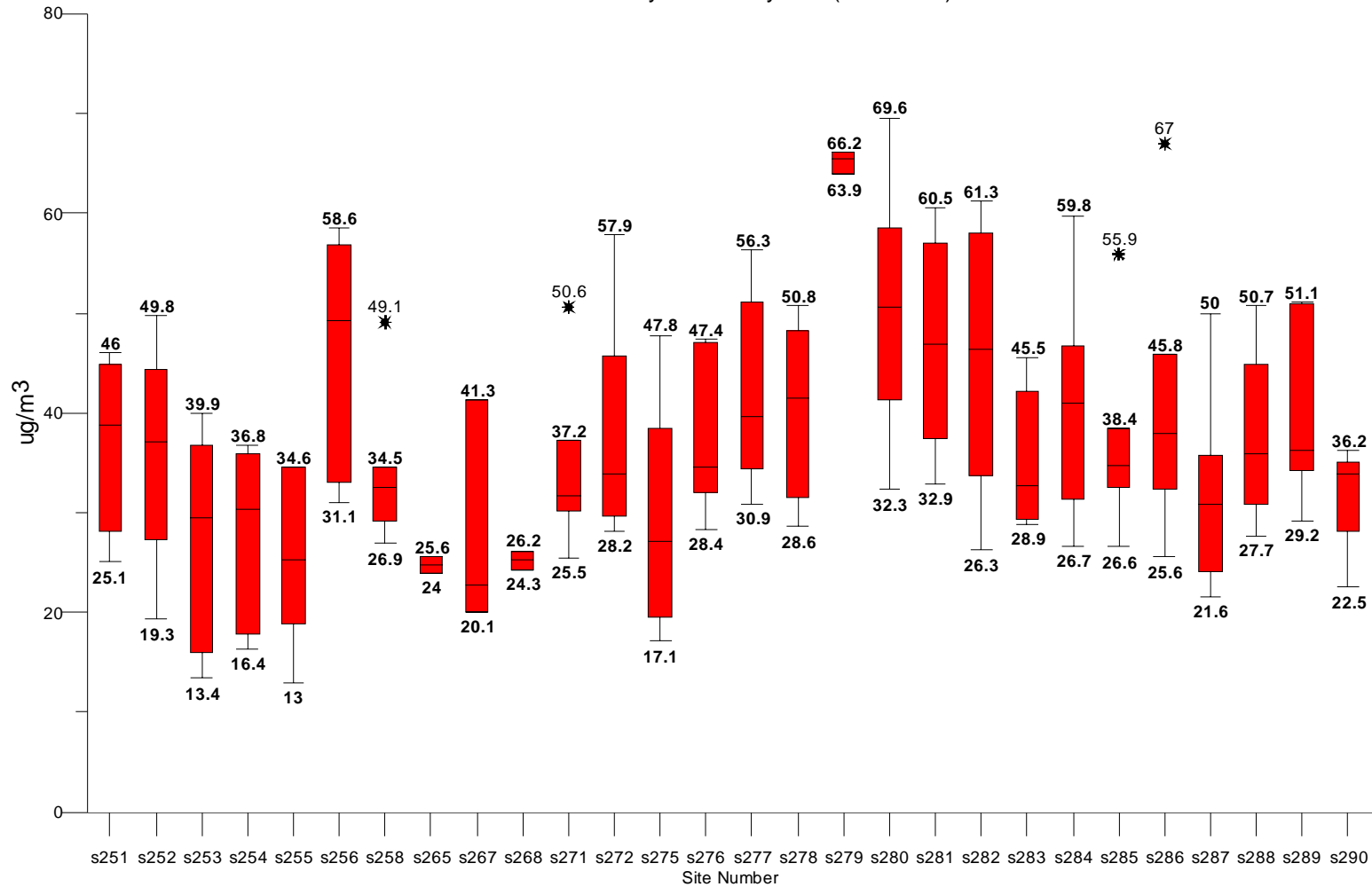
Box-Whisker Plot - Sites 162 to 199
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)



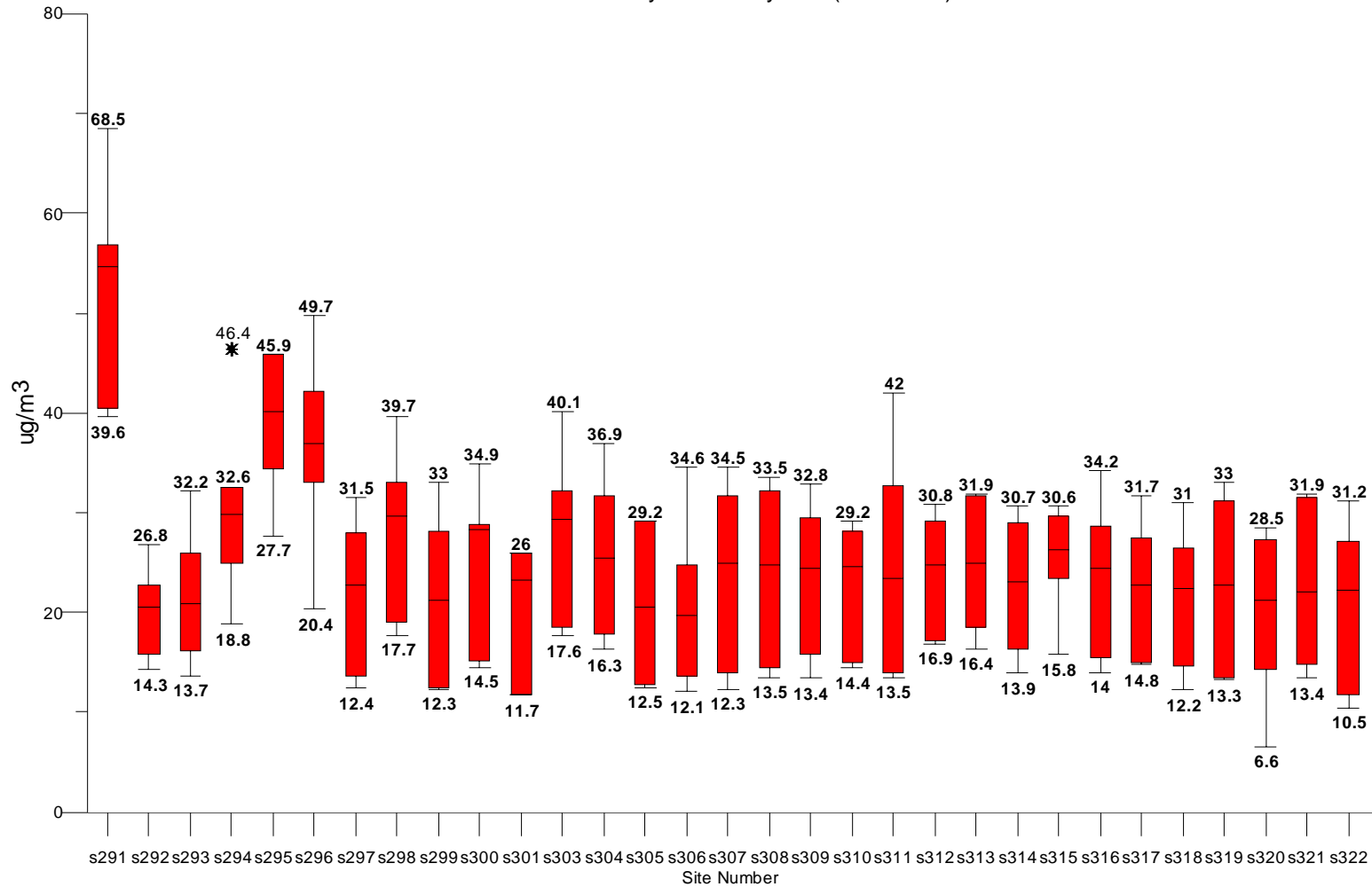
Box-Whisker Plot - Sites 201 to 250
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)



Box-Whisker Plot - Sites 250 to 290
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)

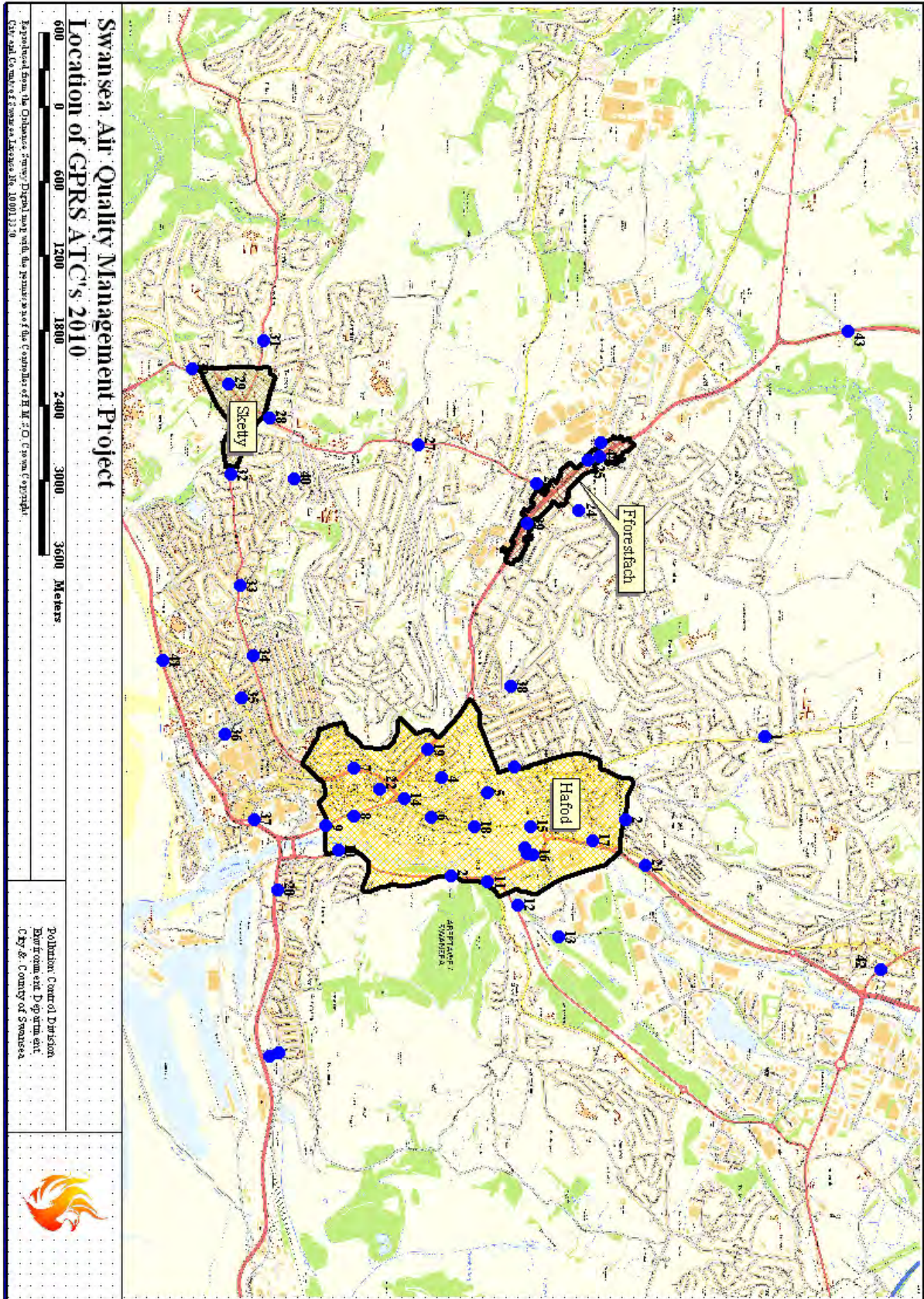


Box-Whisker Plot - Sites 291 to 322
 Passive NO₂ Diffusion Tube Results 2012
 Monthly Results by Site (Raw Data)



Appendix 6

Automatic Traffic Counter Locations



Appendix 7

AIRBORNE PARTICLES IN SWANSEA, UK: THEIR COLLECTION AND CHARACTERISATION

AIRBORNE PARTICLES IN SWANSEA, UK: THEIR COLLECTION AND CHARACTERISATION

Heather Price¹, Robert Arthur³, Keith Sexton², Clive Gregory³, Bastiaan Hoogendoorn³, Ian Matthews³, Tim Jones¹, Kelly Bérubé²

¹School of Earth and Ocean Sciences, Cardiff University, Park Place, Cardiff, CF10 3YE, Wales, UK

²School of Biosciences, Cardiff University, Museum Avenue, Cardiff, CF10 3US, Wales, UK

³Centre for Health and Environment Research, Department of Primary Care and Public Health, Neuadd Meirionydd, 4th Floor, Heath Park, Cardiff, CF14 4YS, Wales, UK

Abstract

Urban air particulate matter has previously been associated with a variety of adverse health effects. It is now the smallest particles, ultrafine or nanoparticles, which are linked to the greatest health effects. The physicochemistry of these particles is likely to provide information regarding their toxicity. Therefore, the aim of this study was to further the understanding of the heterogeneous and changing particle concentrations in urban air, in conjunction with gaining an understanding of the physicochemistry of the particles.

A Dekati™ Electrical Low Pressure Impactor was used to collect the particles and real-time data in a busy traffic corridor in Swansea, Wales over a period of ten non-consecutive weeks. Particle concentrations in the street canyon were analysed and particle physicochemistries investigated using a variety of techniques.

Particle number concentrations were found to vary both diurnally and from day to day in the traffic corridor. Of all particles, the nano–fine size fraction was consistently identified in the highest concentrations (maximum: 140,000 particles cm⁻³). Particle physicochemistry was found to vary as a function of size, with larger particles exhibiting a greater variety of morphologies (and consequently particle types) and associated metals.

Background

Air pollution is not a new problem. Pollution episodes have been noted since Roman times, with evidence of small-scale scientific atmospheric pollutant investigations as early as the seventeenth century (Kretzschmar, 2007). However it took one-off events such as the Meuse Valley fog in Belgium, 1930 (Nemery et al., 2001) and the Great London smog of 1952 (Whittaker et al., 2004; Davis et al., 2002; Elsom, 1987) to incontrovertibly link airborne particle matter to adverse health effects. These events served as a wake-up call, leading to technological improvements, funding and research (Donaldson, 2003). It is now the smallest particles, nano- or ultrafine particles, generally defined as particles with at least one dimension below 100nm (Donaldson et al., 2001; Oberdörster et al., 2005), that are being linked with the greatest health effects in epidemiology studies, in vitro studies and to a large extent, in vivo studies (Donaldson et al., 2001; Brown et al., 2001, Oberdörster et al., 2005). Whilst this association is now well established, the actual causes of adverse health effects continue to be debated, and are not well understood.

Over the range of particle sizes, it is nanoparticles that have consistently been found in the highest concentrations in urban air (Tuch et al., 2003; Ketzel et al., 2004; Mejía et al., 2007). Concentrations in urban air have repeatedly been found to reach levels of 104-5 particles cm⁻³ (Kittelson et al., 2004) during peak traffic flow periods. This causes concern that at these high particle levels the human body clearance mechanisms cannot work efficiently at removing particles (Oberdörster, 1995); leading to particles remaining in contact with cell surfaces for longer periods of time. This persistent contact or “particle

overload" has been highlighted as a potential contributing factor when assessing the toxicity of airborne particles.

The issue is complicated by the variety of particles that populations are exposed to on a daily basis. Urban air particles are a complicated and heterogeneous mix (e.g. Donaldson et al., 2005), combining a wide range of particle characteristics such as size, morphology, surface reactivity, biopersistence and chemistry in every sample. This emphasises the importance of fully characterising particulates in all investigations (e.g. Harrison and Yin, 2000).

This study used an interdisciplinary approach to investigate particle physicochemistry within a traffic canyon. Particles were collected using a DekatiTM Electrical Low Pressure Impactor (ELPI) into twelve size fractions. The collection was completed at two locations; an urban air traffic canyon and a rural background location. Due to the small masses in each of the collected size fractions, they were then combined into three analysable size fractions (7-615nm, 616- 2.39 μ m, 2.4 μ m- 10 μ m). The three size fractions were physicochemically evaluated using tools including Field Emission- Scanning Electron Microscopy (FE-SEM) and Inductively Coupled Plasma- Mass Spectrometry (ICP-MS).

Methods

Site details

Particle collection was completed at two localities; an urban air site, and a rural control site. Neath Road in Swansea, Wales, UK was the urban collection site. Neath Road is a main commuter traffic route into Swansea City, and a recognised traffic hotspot (Figure 1). The area has been designated an Air Quality Management Area (AQMA) based upon its pollutant concentrations. Traffic levels are high (~18,000 per day) due to the road forming a main commuter zone between Swansea and Neath. Swansea is also an old industrial port city, which has been undergoing a process of urban renewal for a number of years. The locality was therefore expected to consist of a cocktail of particle types that were contributed by the main sources; urban, industrial and marine. Sampling was completed over a period of ten non-consecutive weeks during one season (therefore reducing the impact of seasonal- related meteorological differences) between 05/12/07 and 28/02/08, resulting in both particle collections and real-time particle data.

The traffic corridor is orientated NNE- SSW, with the predominant wind direction in a similar trajectory (NE-SW). Small-scale industrial sites are located city-wide; however the predominant wind direction (blowing straight from the sea and onto the site) reduces the impact of local industry. Port Talbot to the south east represents the most substantial industrial area in the vicinity, potentially contributing particles dependent upon the wind direction.

Brecon, the rural control site is located approximately 42km north-east of Swansea. Sampling lasted for a period of three weeks; producing only a one week usable sample due to an atypical dust storm (correlated to an event originating from the Sahara), and a neighbour's bonfire. While achieving the one week usable particulate sample, a local mains power failure resulted in no real-time data collection.

Instrumentation

Particles were collected using a Dekati™ Electrical Low Pressure Impactor (ELPI). The ELPI is an inertial-based cascade impactor, which accumulates both real-time particle data and particle collections onto substrates. It divides particle data into 12 size fractions, from 7nm to 10µm, 3 of which are within the 'nano' size range, and particle collections from 30nm to 10µm. ELPI cut-off diameters (Keskinen et al., 1992) and particle concentration profiles (Zervas and Dorlhène., 2006) have been confirmed in previous studies. A flow rate of 30 l/min was maintained using a Sogevac Leybold vacuum pump. The ELPI stages were loaded with 25mm aluminium foil substrates. Substrates were weighed using a microbalance (Sartorius Micro SC-2) pre- and post-sampling to determine the particulate mass. Substrates were not coated with grease (as recommended by the manufacturers) in order to reduce contamination during subsequent ICP-MS analyses (Fujitani et al., 2006). The equipment set-up on-site included the collection head, teflon tubing, ELPI, pump, and laptop for equipment control and data collection.

Statistical testing

Graphing and statistical testing was completed using Microsoft Excel, with SPSS (version 16) used for non-parametric particle analysis and Spearman's Rank Correlation Coefficient.

Particle characterisation

Analytical electron microscopy

In preparation for Field Emission- Scanning Electron Microscopy (FE-SEM), the aluminium foil substrates were cut into sections. Approximately one-eighth of each collection foil was used for analysis. Epoxy resin (Araldite™) was used to attach the foil substrate sections to 12.5mm aluminium SEM stubs (Agar Scientific). Samples were then coated with gold using a sputter coater (Bio-Rad SC500). Samples were imaged using a Philips XL30 FE-SEM. A range of working conditions in secondary electron mode were utilised to maximise image quality, including a working distance of 5mm- 10mm, accelerating voltages 5-20kV, spot size 4 and a gold foil aperture.

Particle extraction

Particles were removed from the foil substrates for further physicochemical analysis using a novel freeze-drying technique.

Onto each aluminium foil, 900µl of molecular biology grade water was pipetted. The foil and water were then frozen. Once fully frozen, the ice discs were peeled from the foils using ceramic tweezers. Samples were freeze-dried at -40oC (Model: Edwards Pirani 10) until no ice remained in the samples, a process taking varying lengths of time from overnight, to periods of two or three days depending upon sample size. Samples were combined into three size fractions (30nm- 615nm, 616nm- 2.39µm, 2.4µm- 10µm) in order to provide samples large enough for analysis, representing 'nano-fine', 'fine' and 'fine-coarse' particle size fractions. The accuracy of the particle removal technique has been assessed (Figure 2). Figure 2 compares the particle recovery efficiencies between the three size fractions. Percentage particle recovery is ascertained by weighing substrates before/ after sampling to find total particle mass, and after extraction to find the particle mass that has been removed from the substrate. Particle percentage recovery

therefore represents the mass percentage removed from the substrate using the extraction, in comparison with the original particle mass.

Particle removal using this technique is proven to be efficient (up to 98% particle recovery), removing the majority of the particle mass from the collection substrates. These removal efficiencies are comparable (or more efficient than) than those from other studies. Hartz et al. (2005) obtained a 60- 85% mass recovery using a solvent- based extraction process. Jones et al. (2006) recovered 80% of particles with an initial wash of particles collected onto Polyurethane Foam (PUF) substrate. Further washing provides recoveries of up to 95%, comparable with this study.

Due to the high removal rates, particles removed using this methodology are considered to be representative of the particle sample as a whole. It is shown that particle removal is most effective in the middle size fraction, a factor likely to be closely related to a larger initial mass and volume in this size fraction, combined with similar substrate adherence areas to the smallest and largest size fractions, reducing the relative percentage of particles in contact with the substrate.

ICP-MS analysis

Samples were digested for ICP-MS analysis using a CEM MDS-200 microwave system. Particle samples (n=2) were washed into teflon-coated composite vessels using 5ml 70% nitric acid. The samples were digested using an existing programme developed for refractory carbon-based particulate matter (Jones et al., 2006). The microwave programme consists of a stepped increase in pressure to 80psi for a period of 20minutes, with a corresponding temperature rise to 180oC. The programme lasts for approximately 2.5 hours, including warm up and cool down periods. Samples were then diluted to a level of 10µg/ml (dependent upon their original weight) using deionised (>18ΩM) H₂O. Raw data was corrected for blanks and controls accordingly.

Results

Real-time particle data

After processing the raw data using ELPIvi software, it is seen that throughout the daily cycle, on both weekdays (Figure 3 [a- c]) and Sundays (Figure 3 [d- f]), particle number concentrations are consistently highest in the smallest size fraction (D50% 7nm). In this size fraction, particle number concentration peaks at 140,000 particles cm⁻³.

During the weekday averages, there is a consistent daily concentration profile which is replicated in all three analysed size fractions. The profile is characterised by a steep rise in particle numbers during the morning rush hour. Interestingly, whilst all three size fractions show this trend, particle numbers in the coarse size fraction (2.4µm- 10µm; Figure 3c) do not begin to increase until 08:30am, compared to a 06:00am increase identified in the two smaller size fractions. Similarly, the evening rush hour signal identified in the two smaller size fractions (7nm- 2.39µm) which begins at 15:00pm, does not begin in the coarse size fraction until 17:00pm.

During weekdays, the “night-time” particle concentrations (18:30- 06:30) are significantly lower (95% conf.) than “daytime” particle concentrations (06:30- 18:30) in the two smaller particle size fractions (7nm-

2.39 μ m). When considering the coarse size fraction (2.4 μ m- 10 μ m), this statistical difference (95% conf.) is not identifiable.

In contrast to the weekday data, Sunday particle number concentrations peak at 38,000 particles cm⁻³ at 20:30pm. The smallest (7nm- 615nm) and largest (2.4 μ m- 10 μ m) measured size fractions do not show a significant difference in particle number concentrations between “daytime” and “night-time” hours (95% conf.). In contrast, the middle size fraction does indicate number concentration variation between day and night-time hours (95% conf.).

Averaged data across the week (Monday- Sunday; Figure 4) illustrates the daily particle concentration profile differences at Neath Road, Swansea. Outputs for Monday- Thursday are consistent in terms of profile shape and magnitude in the smallest size fraction (7nm- 615nm). This profile pattern begins to break down on Friday and Saturday, and by Sunday, the original number concentration profile has broken down completely, with smaller magnitudes and a different profile shape, with a particle concentration low during the morning replacing the number concentration high identified in the weekday data.

Fine (616nm- 2.39 μ m) and Coarse (2.4 μ m- 10 μ m) particles do not have a similar weekly concentration distribution to the smallest size fraction. The consistency of the number concentration profile (Monday- Thursday) identified in the smallest size fraction is not repeated in these size fractions. Instead, concentration profiles are generally more poorly defined, with occasional time periods appearing to be synchronised with the finest size fraction. In both larger size fractions, particle concentrations are higher from 12:00pm Saturday to 00:00am Sunday than on the Wednesday and Thursday, which contain some extreme particle concentration lows, for example Thursday (14:30pm), potentially a product of meteorological conditions. Physicochemistry of collected particles

FE-SEM

As shown in Figure 5, particle morphology, and consequently type, increased in variability as particle size increased. Particles in the smallest size fraction (30- 615nm) have a consistent morphology of spherical to sub-spherical particles. In the middle size fraction, a combination of agglomerated spherical/ sub-spherical particles and more sheet-like platy grains dominate. The largest size fraction (2.4 μ m - 10 μ m) exhibits much greater particle variability, with a range of particle morphologies visible (Figure 5e, f), agglomerated spherical/ sub-spherical particles, platy grains, cubic morphologies, larger spherical particles and large near-spherical particles with nodules.

ICP-MS

The ICP-MS elemental analysis confirmed that iron, zinc and magnesium were the most abundant elements in the particles (Figure 6). Element concentrations were found to vary with respect to particle size, but differently between elements, for example, iron and magnesium were found to increase in concentration with increasing particle size, compared to nickel and lead, which had the highest elemental concentrations in the smallest size fraction.

In terms of average PM₁₀ concentration, elements were identified in the descending concentration order Fe> Zn> Mg> Ni> Cu> Cr> Ba> Mo> Pb> Mn> Ti> V> Zr> Co> Cd.

Associations were identified between a number of elements using Spearman's rank correlation coefficient including Fe and Cu, Fe and Ba, Fe and Mn, Mg and Co, Ni and Ba, Cu and Ba, Cu and Mn, Ba and Mn to a 0.01 confidence level.

Discussion

Particle data analysis

Throughout the 24-hour sampling period shown in Figure 3, the highest particle concentrations are found in the smallest particle size fraction, particles 7nm- 615nm. These findings reinforce work completed by others, for example in Brisbane (Mejia et al., 2007) where peak particle concentrations were below 30nm (82- 90% of particles). A study in two German cities, Erfurt and Leipzig (Tuch et al., 2003), found the highest particle concentrations in the 10nm- 20nm size range; whilst an urban air study focussed upon Copenhagen (Ketzel et al., 2004) and lasting several years placed the particle concentration maximum between 20nm- 30nm. This particle concentration maximum is attributed to the traffic contribution at these urban sites (Mejia et al., 2007; Ketzel et al., 2004; Shi et al., 1999). The findings within the Swansea traffic corridor are therefore comparable with those found in other locations, and the concentration maximum, combined with what is known about the street canyon can confirm that whilst the input of particles from other sources (for example industrial and marine) will contribute to the particle totals, vehicles are the dominant sources of particles at Neath Road in Swansea.

Particle concentrations throughout the day in the traffic corridor are high (mean: 52,000 particles cm⁻³) when compared against some urban areas sampled in similar studies. The German two city study (Tuch et al., 2003) found a particle concentration maximum of 40,000 particles cm⁻³, whilst the Copenhagen study (Ketzel et al., 2004) found an average of only 7,700 particles cm⁻³ during a three month investigation period. A study completed in Rouen, France (Gouriou et al., 2004) using an ELPI found average particle concentrations below 50,000 particles cm⁻³; if particular external factors were combined, concentrations in the range of 106 particles cm⁻³ were sometimes obtained. This distribution is similar to the situation in the Swansea traffic corridor. Whilst the mean averages at 52,000 particles cm⁻³, specific events happening over timescales as short as seconds are influencing and dramatically increasing the particle concentrations observed in the traffic corridor at particular times, leading to concentration peaks of up to 140,000 particles cm⁻³ in the nano-fine size fraction. A Three European City study (Ruuskanen et al., 2001) obtained similar results, with an Erfurt peak at 188,000 particles cm⁻³ during the morning rush hour.

On weekdays, days dominated by traffic, all size fractions are identified as having a traffic-responsive profile. That is, it is possible to identify a morning and afternoon rush hour signal. The coarse size fraction was found to have a later rush hour peak (both morning and afternoon). This finding could be explained by the rapid sensitivity of nanoparticles to vehicle exhaust particles, as previously identified by Rodriguez et al. (2007), in a study carried out in Milan, Barcelona and London. Nanoparticles were found to vary extremely quickly and significantly in response to traffic, a finding reinforced in a study of urban air particle concentrations in Helsinki (Buzorius et al., 1998), where individual vehicles were found to affect the observed particle concentrations.

A number of studies have found that particle concentrations are higher during the day, and are linked to the vehicular particle source and its predominance during daytime hours (Buzorius et al., 1998; Laasko et al., 2003); as seen in the Swansea traffic corridor. Some studies (for example Rodríguez et al., 2007) have investigated further to find that the difference between daytime and night-time concentrations is much more pronounced in the nano-fine range; a result also found in this study on weekdays. On days not dominated by traffic sources (Sunday), this nanoparticle day-night variation was not significant, reinforcing traffic as a source of the smallest particles. This continuity between day and night-time particle number concentrations on Sundays could also be contributed to by the lack of industry and other related sources of particles on the weekend.

The morning rush hour peak has been identified in this study, a finding also seen in a study at Marylebone Road (Harrison and Jones, 2005). A daily pattern, with nanoparticle peaks between 8am and 9am, and 4pm and 5pm identified in the German Two City study (Tuch et al., 2003) correlates with the nanoparticle morning and afternoon rush hour peaks identified in Swansea on weekdays. A link between nanoparticle concentrations and solar radiation has previously been identified (Shi et al., 2001); perhaps explaining the sustained nanoparticle numbers observed at Neath Road between morning and afternoon rush hour peaks.

The difference in particle concentrations and distributions identified at the Neath Road collection site between weekdays and weekends has also been identified in other studies (Buzorius et al., 1998), and is attributable to a reduction in commuter traffic and to an extent, industrial processes during the weekends. This result has not been consistent for all studies (Mejia et al., 2007), perhaps due to a reduced importance of commuter traffic-sourced particles in the study, and the dominance of other sources.

Identifiable in the Neath Road data is reduced particle number concentrations in the fine and coarse size fractions during Wednesday and Thursday, and increased particle number concentrations on Saturday and Sunday. If the smallest size fraction (7nm- 615nm) is taken to be representative of the particle number profile predominantly as a result of traffic, this finding reinforces that particles in the middle and largest size fractions are contributed to by a variety of sources other than traffic exhaust, perhaps road dust, marine particles and industrial particles (Moreno et al., 2004).

The week-long study at Neath Road traffic corridor identified variability in particle concentration signals for different days of the week, especially emphasised in the smallest size fraction, particles between 7 and 615nm. Different particle signals were also identified in a study carried out in Milan, Barcelona and London (Rodríguez et al., 2007), a finding explained by the importance of semi-volatile compound condensation in urban areas. In contrast, a study at three sites within Birmingham, England (Shi et al., 1999) found that despite variable weather conditions, particle concentrations and distributions measured varied only negligibly. Day to day particle concentration and distribution variances at Neath Road can be assumed to be dependent upon traffic compositional, volume changes or meteorological differences. Further work is required to elucidate the relative contribution of each component.

Physicochemistry of collected particles

Carbonaceous material was found to be dominant in all size fractions; as identified from the FESEM imaging (nano-sized spherical to sub-spherical particles found singularly or in aggregates; Figure 5). Results from a characterisation analysis of particulate matter collected on the coast of Sicily (Rinaldi et al., 2007) agree with this finding, especially in the size range 50- 140nm. In this study, the smallest measured size fraction (30nm- 615nm) was also found to have the highest carbonaceous material of all the measured size fractions. These study findings are in agreement with others including those completed in Pasadena, California (Hughes et al., 1998), Milwaukee, Wisconsin (Lough et al., 2005), Belfast (urban), London (urban) and Harwell (rural) in the UK (Jones and Harrison, 2005). The large contribution of carbonaceous soot nanoparticles to the samples, whether as individual particles (or small groupings of particles) in the smallest size fraction, or larger agglomerates in the middle and largest size fraction reaffirms traffic exhaust particles as the main particle source in the street canyon. The large contribution of traffic exhaust particles to total particle concentrations in urban settings is well documented (e.g. Bérubé et al., 2008).

Particles of cubic morphology, as recognised using FESEM imaging (Figure 5), can be identified as marine-derived halite crystals (Jones and Bérubé, 2007), due to the proximity of the sampling site to the sea and the predominant wind direction (Figure 1). Those particles with perfect cubic morphology are likely to have grown in situ on the collection substrate, whilst more damaged particles are likely to have origins of either marine processes or road salting (Moreno et al., 2004). The combined factors of proximity to the sea and comparatively stable weather conditions suggests a predominance of marine-derived halite crystals.

Large (coarse size fraction) spherical particles with nodules covering the surface are attributed to biogenic processes, confirmed by their behaviour beneath the FESEM beam (Bérubé et al., 2008).

FESEM imaging identified sheet-like particles in the largest size fraction. These particles (2.4- 10µm) are identified as mineralogical particles, perhaps derived from local or more distant areas of exposed crust and soil (Bérubé et al., 2008).

Due to the naturally variable wind directions encountered during a sampling period, the origin of industrial-generated perfect spherical particles may be local (within Swansea) or wind-blown from a distance (for example Port Talbot to the south- east). Spherical particles are common in both urban and industrial air (Moreno et al., 2004).

The metals identified in the particle samples (ICP-MS analysis) were found to increase in variety with increasing particle size, as found also in the Milwaukee study (Lough et al., 2005). PM10 was found to contain more metals than PM2.5, perhaps due to the greater variety of contributing sources to the larger size fractions; including crustal, traffic, biological and technogenic-type sources. In another study, investigation of analytical SEM images identified that particles under 1µm predominantly consist of traffic-derived soot (Baulig et al., 2004). Other studies have found a more bimodal distribution of elements within

particulate samples, for example a peak in the nano-size fraction, and a peak in the particle size range 3.2- 5.6µm as found in a study conducted in southern Taiwan (Lin et al., 2005).

Iron was found to be the most abundant metal in the particles in agreement with results from other physicochemical analysis studies (Hughes et al., 1998; Lough et al., 2005; Baulig et al., 2004).

Some elements identified by ICP-MS analysis can be identified as partly arising from diesel emissions, for example Fe, Ca, Si, Mg and Mn (Wang et al., 2003) a number of these elements are also associated with crustal components, for example Fe, Ca, Si, Mg (Lough et al., 2005). This highlights the fact that source apportionment is extremely complicated, with different studies identifying different tracers for the same source, and different sources for the same tracer or combination of tracers.

The elemental concentrations identified in this study (ICP-MS analysis; Figure 6) are much lower than in London 1950s particulate samples (Whittaker et al., 2004). Comparisons include 157ppm Fe concentration at Neath road and 19,294µg g⁻¹ London 1955 sample, and 1.3ppm Mn concentration at Neath Road and 508 µg g⁻¹ from the London 1955 samples. Additionally, in a paper by Shao et al. (2007), outdoor Beijing particulate matter was collected and analysed by ICP-MS. Levels of 17ppm Mn in the Beijing air can be compared with 39ppb (Neath Road). Therefore total metal concentrations of particulate matter from urban Swansea air are lower than concentrations identified in historic studies (Whittaker et al., 2004) and in rapidly developing countries (Shao et al., 2007). This finding is to be expected (Donaldson, 2003) due to improved legislation and current British technological requirements, and more local factors including meteorological conditions, road usages and the prevalence of local polluting industries.

Metal concentration ordering at the Neath Road collection site (Fe> Zn> Mg> Ni> Cu> Cr> Ba> Mo> Pb> Mn> Ti> V> Zr> Co> Cd) can be compared to those in the literature for urban locations (Whittaker et al., 2004 (Fe> Pb> Cu> Mn> V> As> Co); Chandra Mouli et al., 2006 (Fe> Mn> Ni> Cu> Pb> Co); da Silva et al., 2008 (Cu> Pb> Ni. Sb> Ce)). The difference between the concentration orders of metals at different sites highlights the importance of local factors; including geography, meteorology and variability of sources and source compositions. Correlations were identified between some of the metals analysed by ICP-MS (p>0.01). These correlations may indicate the same or similar elemental sources, for example correlation between Ba and Ni may be associated with road exhaust emissions (Dongarrà et al., 2007).

Summary and Conclusions

Particulate matter within the Neath Road street canyon, Swansea, Wales was studied for particle concentration variations and particle physicochemical properties. The particle concentrations within the traffic corridor were found to be consistently highest in the smallest size fraction, with particle concentrations and daily patterns comparable to previous studies in this field. Evening and weekend concentrations of particles were significantly lower than daytime particles, highlighting the role of traffic exhausts as a primary and influential provider of the smallest (and most abundant) particles.

Generally, with increasing particle size, particle morphology and type increased in variability, with particles in the nanoparticle-range being dominated by traffic exhaust particles. The associated metal content increased in both amount and variety of types with increasing particle size. The ICP-MS analyses generally added to and reinforced results from the FESEM and were useful in providing bulk elemental analysis.

Figures

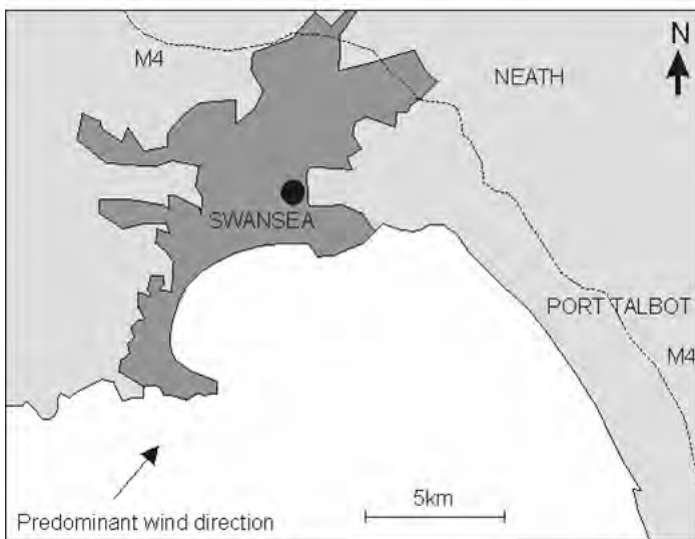


Figure 1. Location map showing the Neath Road, Swansea sampling site (black circle) in relation to surrounding feature

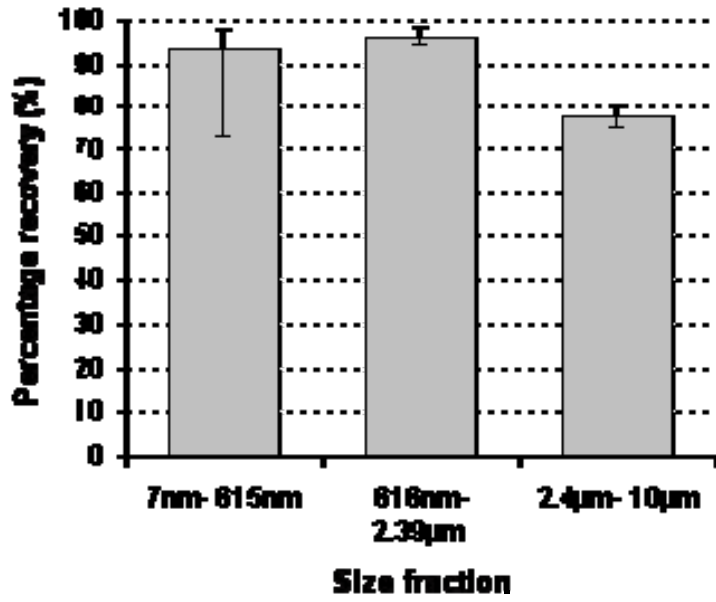


Figure 2. Particle mass extraction efficiency for the three analysed size fractions (30nm- 615nm, 616nm- 2.39µm, 2.4µm- 10µm). Error bars indicate the range of recovery efficiencies measure

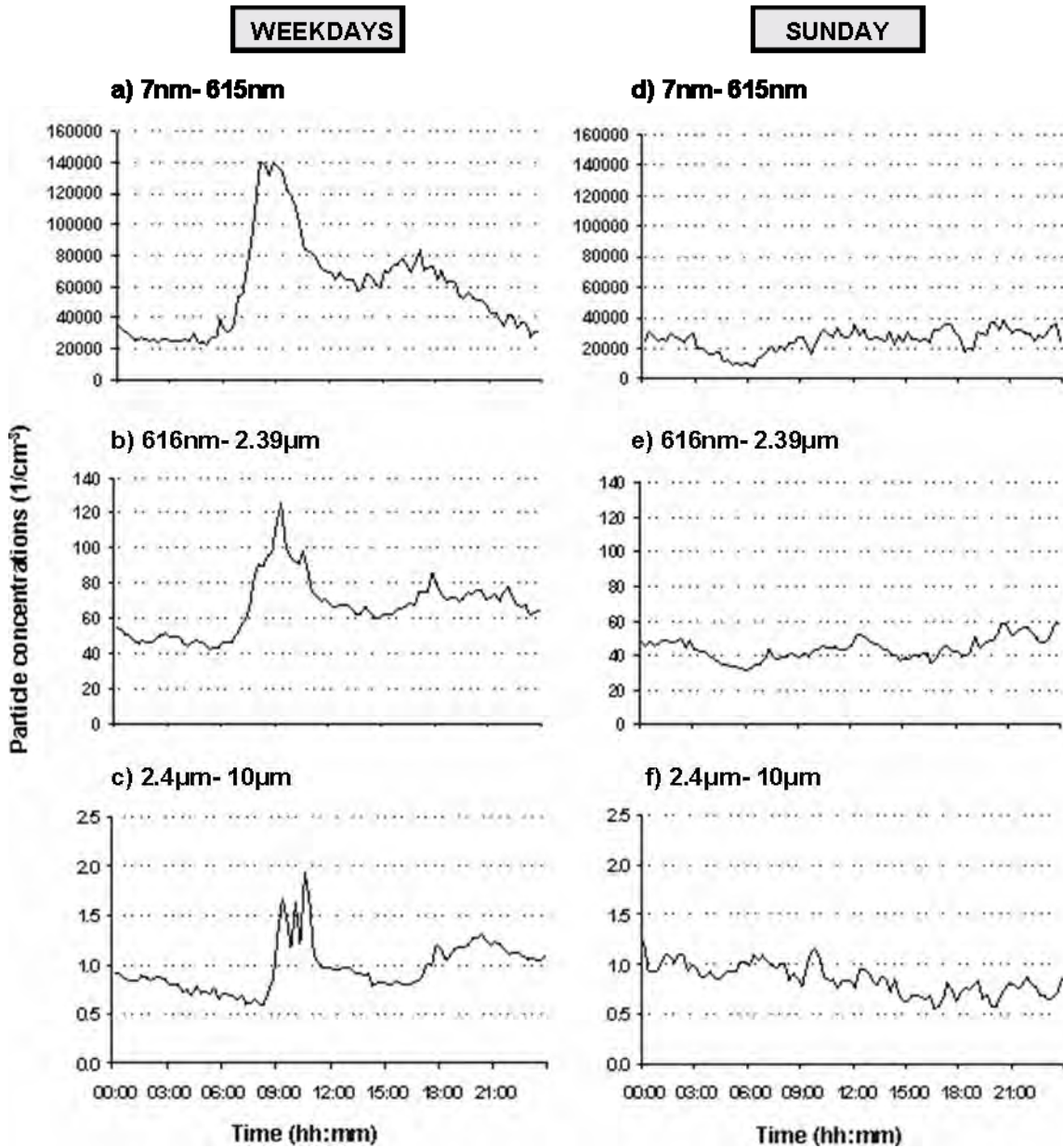


Figure 3. Average daily particle concentration profile in Neath Road traffic corridor for (1) weekdays and (2) Sundays in three size fractions (a) 7nm- 615nm, (b) 616nm- 2.39µm, (c) 2.4µm- 10µm

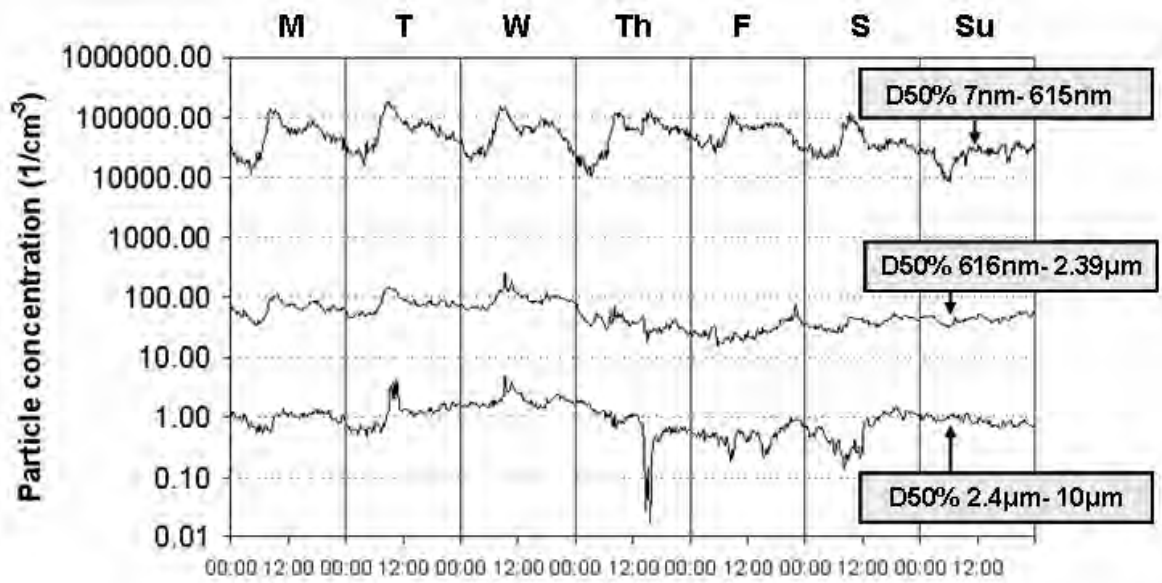


Figure 4. Average weekly particle concentration profile for Neath Road, Swansea

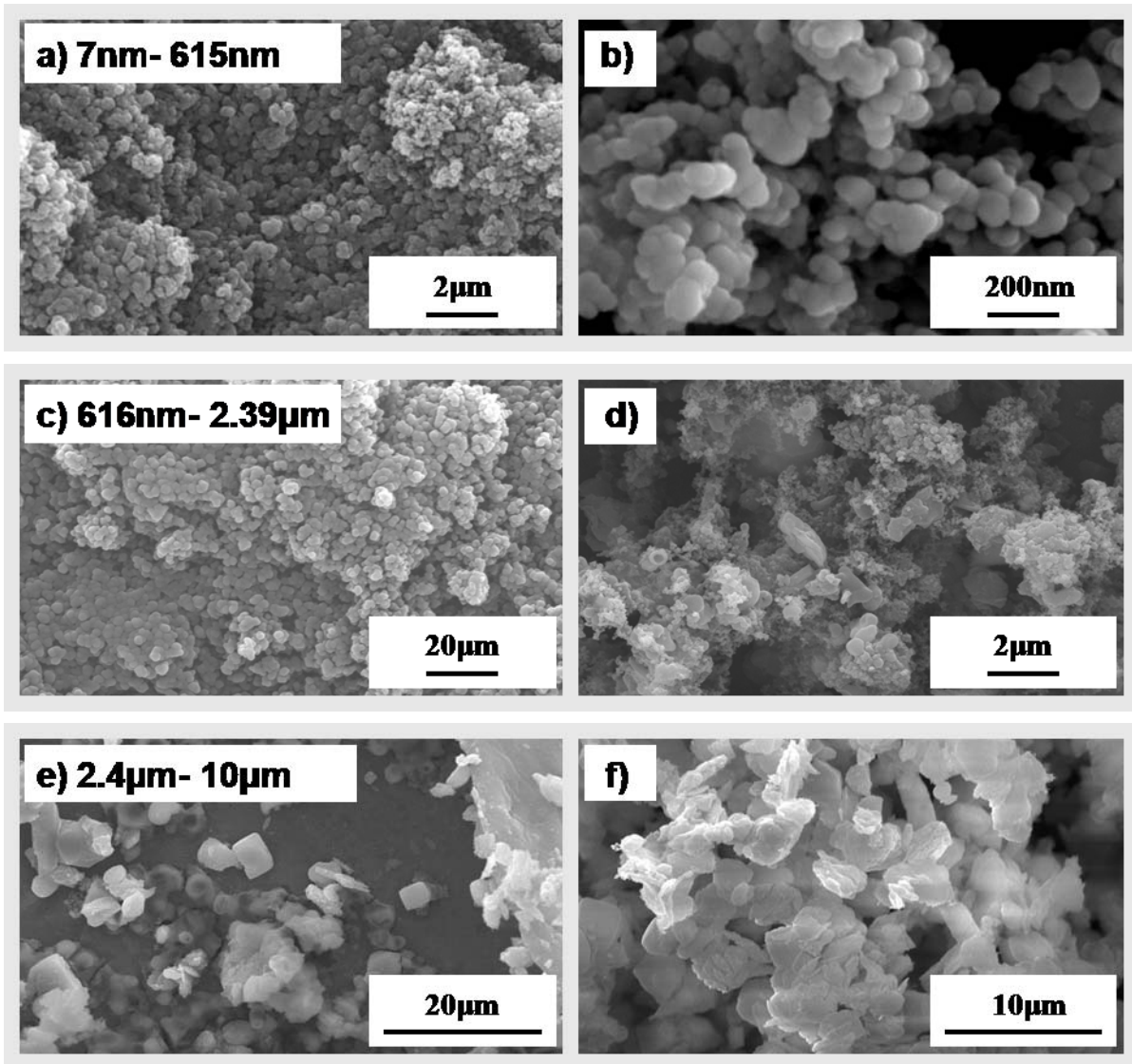


Figure 5. FE-SEM images of particles in the three measured size fractions collected in Neath Road, Swansea

(a) Particles in the 30- 615nm size range. (b) Close-up view of the 30- 615nm particle size range. (c) Particles in the middle size fraction (616nm- 2.39µm), at a large-scale view. (d) Closer view of particles in the middle size fraction. (e) Particles in the largest size fraction (2.4µm- 10µm). (f) Closer view largest size fraction

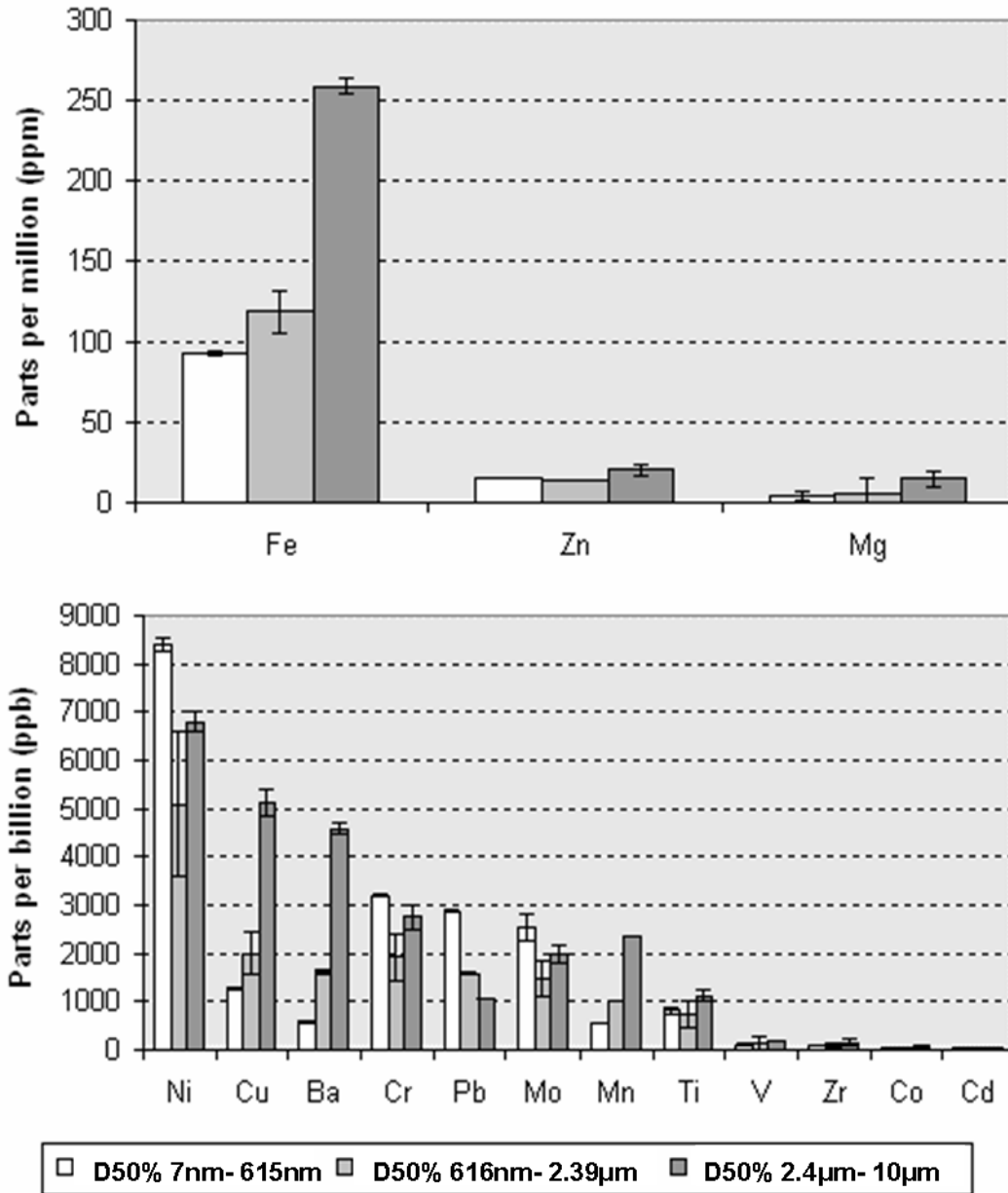


Figure 6. ICP-MS elemental analysis of the three analysed size fractions

Bars represent the three different analysed size fractions (white= D50% 30nm- 615nm; light grey= D50% 616nm- 2.39µm; dark grey= D50% 2.4µm- 10µm), top graph showing elements in parts per million (ppm) concentrations and bottom graph showing elements in parts per billion (ppb) concentrations. Error bars represent one standard deviation either side of the mean.

Acknowledgements

This research was funded by the National Environment Research Council (NERC).

References

Baulig, A., Poirault, J-J., Ausset, P., Schins, R., Shi, T., Baralle, D., Dorlhene, P., Meyer, M., Lefevre, R., Baeza-Squiban, A., Marano, F. 2004. Physicochemical characteristics and biological activities of seasonal atmospheric particulate matter sampling in two locations of Paris. *Environ. Sci. Technol.* 38: 5985- 5992.

BéruBé, K., Jones, T., Jones, C. 2008. Environmental Particles: a breath of fresh air? *In focus*.9: 6- 17.

Brown, D.M., Wilson, M.R., MacNee, W., Stone, V., Donaldson, K. 2001. Size- Dependent Proinflammatory Effects of Ultrafine Polystyrene Particles: A Role for Surface Area and Oxidative Stress in the Enhanced Activity of Ultrafines. *Toxicol. Appl. Pharmacol.* 175: 191- 199.

Buzorius, G., Hämeri, K., Pekkanen, J., Kumala, M. 1998. Correlation studies of urban aerosol number concentration. *J. Aerosol. Sci.* 29: S595- S596.

Chandra Mouli, P., Venkata Mohan, S., Balaram, V., Praveen Kumar, M., Jayarama Reddy, S. 2006. A study on the trace elemental composition of atmospheric aerosols at a semi-arid urban site using ICP-MS technique. *Atmos. Environ.* 40: 136- 146.

Davis, D.L., Bell, M.L., Fletcher, T. 2002. A look back at the London smog of 1952 and the half century since. *Environ. Health Perspect.* 110: 734- 735.

Donaldson, K., Stone, V., Clouter, A., Renwick, L., MacNee, W. 2001. Ultrafine particles. *Occup. Environ. Med.* 58: 211- 216.

Donaldson, K. 2003. The biological effects of coarse and fine particulate matter. *Occup. Environ. Med.* 60: 313- 314.

Donaldson, K., Tran, L., Jimenez, L., Duffin, R., Newby, D., Mills, N., MacNee, W., Stone, V. 2005. Combustion-derived nanoparticles: A review of their toxicology following inhalation exposure. *Part. Fibre Toxicol.* 2.

Dongarrà, G., Manno, E., Varrica, D., Vultaggio, M. 2007. Mass levels, crustal component and trace elements in PM10 in Palermo, Italy. *Atmos. Environ.* 41:7977- 7986.

Elsom, D. 1987. *Atmospheric Pollution*. 1st ed. Basil Blackwell Ltd publishers. 197- 202.

- Fujitani, Y., Hasegawa, S., Fushimi, A., Kondo, Y., Tanabe, K., Kobayashi, S., Kobayashi, T. 2006. Collection characteristics of low-pressure impactors with various impaction collection substrate materials. *Atmos. Environ.* 40: 3221- 3229.
- Gouriou, F., Morin, J. -P., Weill, M.-E. 2004. On-road measurements of particle number concentrations and size distributions in urban and tunnel environments. *Atmos. Environ.* 38: 2831- 2840.
- Harrison, R.M., Yin, J. 2000. Particulate Matter in the atmosphere: which particle properties are important for its effects on health? *Sci. Total Environ.* 249: 85-101.
- Harrison, R.M., Jones, A.M. 2005. Multisite study of particle number concentrations in urban air. *Environ. Sci. Technol.* 39: 6063- 6070.
- Huff Hartz, K.E., Weitkamp, E., Sage, A.M., Allen, R.R., Donahue, N.M. 2005. A relative rates method for evaluation of organic aerosol aging kinetics. AAAR Annual conference.
- Hughes, L.S., Cass, G.R., Gone, J., Ames, M., Olmez, I. 1998. Physical and chemical characterization of atmospheric ultrafine particles in the Los Angeles area. *Environ. Sci. Tech.* 32: 1153-1161.
- Jones, A.M., Harrison, R.M. 2005. Interpretation of particulate elemental and organic carbon concentrations at rural, urban and kerbside sites. *Atmos. Environ.* 39: 7114- 7126.
- Jones, T., Moreno, T., Bérubé, K., Richards, R. 2006. The physicochemical characterisation of microscopic airborne particles in southWales: A review of the locations and methodologies. *Sci. Total Environ.* 360: 43-59.
- Jones, T., Bérubé, K. 2007. Mineralogy and Structure of Pathogenic Particles. In: *Particle Toxicology*, eds. K. Donaldson and P. Borm, pp. 13- 46. Taylor and Francis.
- Keskinen, J., Pietarinen, K., Lehtimäki, M. Electrical Low Pressure Impactor. *J. Aerosol Sci.* 23: 353- 360.
- Ketzel, M., Wählin, P., Kristensson, A., Swietlicki, E., Berkowicz, R., Nielsen, O.J., Palmgren, F. 2004. Particle size distribution and particle mass measurements at urban, near-city and rural level in the Copenhagen area and Southern Sweden. *Atmos. Chem. Phys.* 4: 281- 292.
- Kittelson, D.B., Watts, W.F., Johnson, J.P., Remerowki, M.L., Ische, E.E., Oberdörster, G., Gelein, R.M., Elder, A., Hopke, P.K., Kim, E., Zhao, W., Zhou, L., Jeong, C. -H. 2004. On-Road Exposure to Highway Aerosols. 1. Aerosol and Gas Measurements. *Inhal. Toxicol.* 16: 31-39.

Kretzschmar, J.G. 2007. Fifty years air pollution research and policy in the EU. *Air pollution* XV. 101: 3- 13.

Laasko, L., Hussein, T., Aarnio, P., Komppula, M., Hiltunen, V., Viisanen, Y., Kulmala, M. 2003. Diurnal and annual characteristics of particle mass and number concentrations in urban, rural and Arctic environments in Finland. *Atmos. Environ.* 37: 2629- 2641.

Lin, C-C., Chen, S-J., Huang, K-L., Hwang, W-I., Chang-Chien, G-P., Lin, W-Y. 2005. Characteristics of metals in nano/ ultrafine/ fine/ coarse particles collected beside a heavily trafficked road. *Environ. Sci. Technol.* 39: 8113- 8122.

Lough, G.C., Schauer, J.J., Park, J., Shafer, M.M., Deminter, J.T., Weinstein, J.P. 2005. Emissions of metals associated with motor vehicle roadways. *Environ. Sci. Technol.* 39: 826- 836.

Mejía, J.F., Morawaska, L., Mengersen, K. Spatial variation in particle number size distributions in a large metropolitan area. 2007. *Atmos. Chem. Phys. Discuss.* 7: 17147- 17177.

Moreno, T., Jones, T.P., Richards, R.J. 2004. Characterisation of aerosol particulate matter from urban and industrial environments: examples from Cardiff and Port Talbot, South Wales, UK. *Sci. Tot. Environ.* 334- 335: 337- 346.

Nemery, B., Hoet, P.H.M., Nemmar, A. 2001. The Meuse Valley Fog of 1930: An air pollution disaster. *Lancet* 357 (9257): 704- 708.

Oberdörster, G. 1995. The NTP Talc Inhalation study: a critical appraisal focused on lung particle overload. *Regulat. Toxicol. Pharmacol.* 21: 233- 241.

Oberdörster, G., Oberdörster, E., Oberdörster, J. 2005. Nanotoxicology: An Emerging Discipline Evolving from Studies of Ultrafine Particles. *Environ. Health. Perspect.* 113: 823- 839.

Rinaldi, M., Emblico, L., Decesari, S., Fuzzi, S., Facchini, M.C., Librando, V. 2007. Chemical characterization and source apportionment of size- segregated aerosol collected at an urban site in Sicily. *Water Air Soil Pollut.* 185: 311- 321.

Rodríguez, S., Van Dingenen, R., Putaud, J.-P., Dell'Acqua, A., Pey, J., Querol, X., Alastuey, A., Chenery, S., Ho, K.-F., Harrison, R., Tardivo, R., Scarnato, B., Gemelli, V. 2007. A study on the relationship between mass concentrations, chemistry and number size distribution of urban fine aerosols in Milan, Barcelona and London. *Atmos. Phys. Chem.* 7: 2217- 2232.

Ruuskanen, J., Tuch, Th., Ten Brink, H., Peters, A., Khlystov, A., Mirme, A., Kos, G.P.A.,

- Brunekreef, B., Wichmann, H.E., Buzorius, G., Vallius, M., Kreyling, W.G., Pekkanen, J. 2001. Concentrations of ultrafine, fine and PM_{2.5} particles in three European cities. *Atmos. Environ.* 35: 3729-3738.
- Shao, L., Li, J., Zhao, H., Yang, S., Li, H., Li, W., Jones, T., Sexton, K., BeruBé, K. 2007. Associations between particle physicochemical characteristics and oxidative capacity: an indoor PM₁₀ study in Beijing, China. *Atmos. Environ.* 41: 5316- 5326.
- Shi, J.P., Khan, A.A., Harrison, R.M. 1999. Measurements of ultrafine particle concentration and size distribution in the urban atmosphere. *Sci. Total. Environ.* 235: 51- 64.
- Shi, J.P., Evans, D.E., Khan, A.A., Harrison, R.M. 2001. Sources and concentrations of nanoparticles (<10nm diameter) in the urban atmosphere. *Atmos. Environ.* 35: 1193- 1202.
- da Silva, L., Sarkis, J.E., Zanon Zotin, F.M., Carneiro, M.C., Neto, A.A., da Silva, A., Cardoso, M.J.B., Monteiro, M.I.C. 2008. Traffic and catalytic converter- Related atmospheric contamination in the metropolitan region of the city of Rio de Janeiro, Brazil. *Chemosphere* 71: 677- 684.
- Tuch, T. M., Wehner, B., Pitz, M., Cyrys, J., Heinrich, J., Kreyling, W.G., Wichmann, H.E., Wiedensohler, A. 2003. Long-term measurements of size-segregated ambient aerosol in two German cities located 100km apart. *Atmos. Environ.* 37: 4687- 4700.
- Wang, Y-F., Huang, K-L., Li, C-H., Mi, H-H., Luo, J-H., Tsai, P-J. 2003. Emissions of fuel metals content from a diesel vehicle engine. *Atmos. Environ.* 37: 4637- 4643.
- Whittaker, A., Bérubé, K., Jones, T., Maynard, R., Richards, R. 2004. Killer smog of London, 50 years on: particle properties and oxidative capacity. *Sci. Total Environ.* 334-335: 435- 445.
- Zervas, E., Dorlhène, P. 2006. Comparison of Exhaust Particle Number Measured by EEPS, CPC and ELPI. *Aerosol Sci. Technol.* 40: 977- 984.