2011 Air Quality Progress Report

for

The City and County of Swansea

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

September 2011

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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 40ug/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, Morriston, Llansamlet, Ynystawe 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/m^3.

It is not proposed to amend the existing Swansea Air Quality Management Area 2010 at present to include these newly identified failing areas. This decision has been taken due to the atypicical meteorological conditions during 2010 coupled with the future year projections of the annual mean objective being met during 2015 within these areas. This decision is further supplemented by the requirement for additional monitoring along Newton Road to establish the exact extent of failure. Updates on the situation will be provided within future reporting and if it is thought necessary, reports will be presented to Council with the recommendation that these areas be added to the Swansea Air Quality Management Area 2010.

Potential PM_{10} exposure has also been identified resulting from proposed activity at a landfill site in Cwmrhydyceirw. However, whilst the site has been issued with a permit by the Environment Agency, activity remains limited, and further details on the operator's future intentions are awaited. In the meantime basic nuisance dust and PM_{10} monitoring works have commenced.

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 for 2009 and 2010 have indicated for the first time in recent year's compliance with the 4^{th} Daughter Directive critical threshold monitoring target value for nickel at all monitoring stations. It is envisaged monitoring at all four stations will continue for the foreseeable future to confirm continued and ongoing compliance with the 4^{th} 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 development of the plan will cease except for some Nowcaster" delivery 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.

Additionally, due to the increasing financial pressures being faced by the authority, real-time automatic measurements at the Morfa Groundhog site have 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/m^3 have been discontinued with the exception of those sites 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.

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Appendices

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 (June 2000) estimate for the population of Swansea is 230,300. The 2000 Census also indicates that 46,700 (20.3%) of the population were less than 17 years of age with 41,205 (17.9%) of the population being aged 65 or over.

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

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.

They are not intended to be as detailed as Updating and Screening Assessment Reports, or to require as much effort. However, if the Progress Report identifies the risk of exceedence of an Air Quality Objective, the Local Authority (LA) should undertake a Detailed Assessment immediately, and not wait until the next round of Review and Assessment.

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 1.1. This table shows the objectives in units of microgrammes per cubic metre $\mu g/m^3$ (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 $\mu g/m^3$	Running annual mean	31.12.2003
	5.00 $\mu g/m^3$	Annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Maximum daily running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

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 (PM_{10}), Sulphur Dioxide (SO_2) and Nitrogen Dioxide (NO_2).

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 (PM_{10}) and Sulphur Dioxide (SO_2).

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 NO_2 annual mean objective of $40\mu g/m^3$ by the compliance date of 31st December 2005.

On the 12th September 2001 the Authority declared The Hafod Air Quality Management Area (NO_2), cited as the City & County of Swansea (Hafod Air Quality Management Area (NO_2)) 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 (NO_2) 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 PM_{10} 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 NO_2 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 Morriston 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 PM_{10} in Swansea, is still being developed. The authority have purchased ten Met One E-Type light scattering PM_{10} 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 EType 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 rational 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.

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

Report	Date Completed	Internet URL
1st Stage Review	1999	http://www.swansea.gov.uk/index.cfm?articleid=5563
Brynlliw 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	
USA 2009	July 2009	
Progress Report 2010	July 2010	

Table 2 – Summary of Local Air Quality Management actions

2 New Monitoring Data

2.1 Automatic 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 ADDT for 2010 is approximately 20,100 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 Roadside[1]. 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, Morriston and Hafod DOAS). It is thought probable that this site may well sit above any inversions that form within the lower Swansea Valley and therefore, does not experience the elevated concentrations seen at the other monitoring stations during such conditions.

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

Map 1 – Aerial view of Swansea Roadside AURN

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All equipment is housed within an air-conditioned unit and operated continuously. The equipment comprises of Advanced Pollution Instruments (API) real-time analysers measuring NO_x, with Thermo FDMS units measuring PM_{10} and $PM_{2.5}$. The API gas analysers have been configured so that 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'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 recorded. All manual calibration data is then forwarded to AEA Energy and Environment to perform data management procedures. The data is then further subjected to full network QA/QC procedure's undertaken by AEA Energy and Environment 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 AEA Energy & Environment together with the calibration gases stored on site

Hourly ratified data for 2010 covering the pollutants Nitrogen Dioxide and Particulate Matter PM_{10} and $PM_{2.5}$ (FDMS) 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 SO_2 analysers are no longer collected (post 1st October 2007) or ratified by DEFRA (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 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 SO_2 data for 2010 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, only NO_2 and PM_{10} (FDMS) data are reported here for 2010

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 Roadside[2].

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 satisfies 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, SO_2 and $NO_{x,}$. The R&P TEOM measuring PM_{10} was upgraded to a Thermo FDMS unit again measuring PM_{10} 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.

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

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

As mentioned above, measurements ceased at this site during May 2011. Prior to this, the CO and SO_2 measurements ceased during August 2010 due to budgetary restrictions. No presentation or analysis of 2010 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, only NO_2 and PM_{10} (FDMS) data are reported here for 2010.

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 Roadside[3]. 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 O_3, and NO_x. The R&P PM_{10}TEOM was upgraded to a Thermo FDMS PM_{10} 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.

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

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 AEA Energy & Environment to run the Welsh Air Quality Forum in April 2004, all equipment on site is 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.

Map 3 - Aerial view - Morriston Groundhog
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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 SO_2 during October 2010. The H_2S 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 NO_2, Ozone and PM_{10} (FDMS) data are reported here for 2010.

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. The details are reported here for information purposes only as the dataset collected to date does not provide the opportunity to meaningfully analyse any of the data collected.

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. 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 AEA Energy & Environment to run the Welsh Air Quality Forum in April 2004, all equipment on site will be fully audited yearly by AEA Energy &

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

Map 4 Cwm Level Park Monitoring

Environment together with the calibration gases stored on site. The L10 span gas cylinders (NO and NO_2) will be replaced on a regular basis and are to a certified and traceable standard.

A map showing the location of the Cwm Level Park station is given below 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, having an AADT during 2010 of 13,500 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 2010 of 14,700 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

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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 Roadside[5].

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 minimum acceptable light levels and maximum standard deviations of the measurements permitted on the individual cycled means for

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

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 NO_2, UV fluorescence for SO_2 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 ❷ 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 of 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 2010 of 20,800 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.

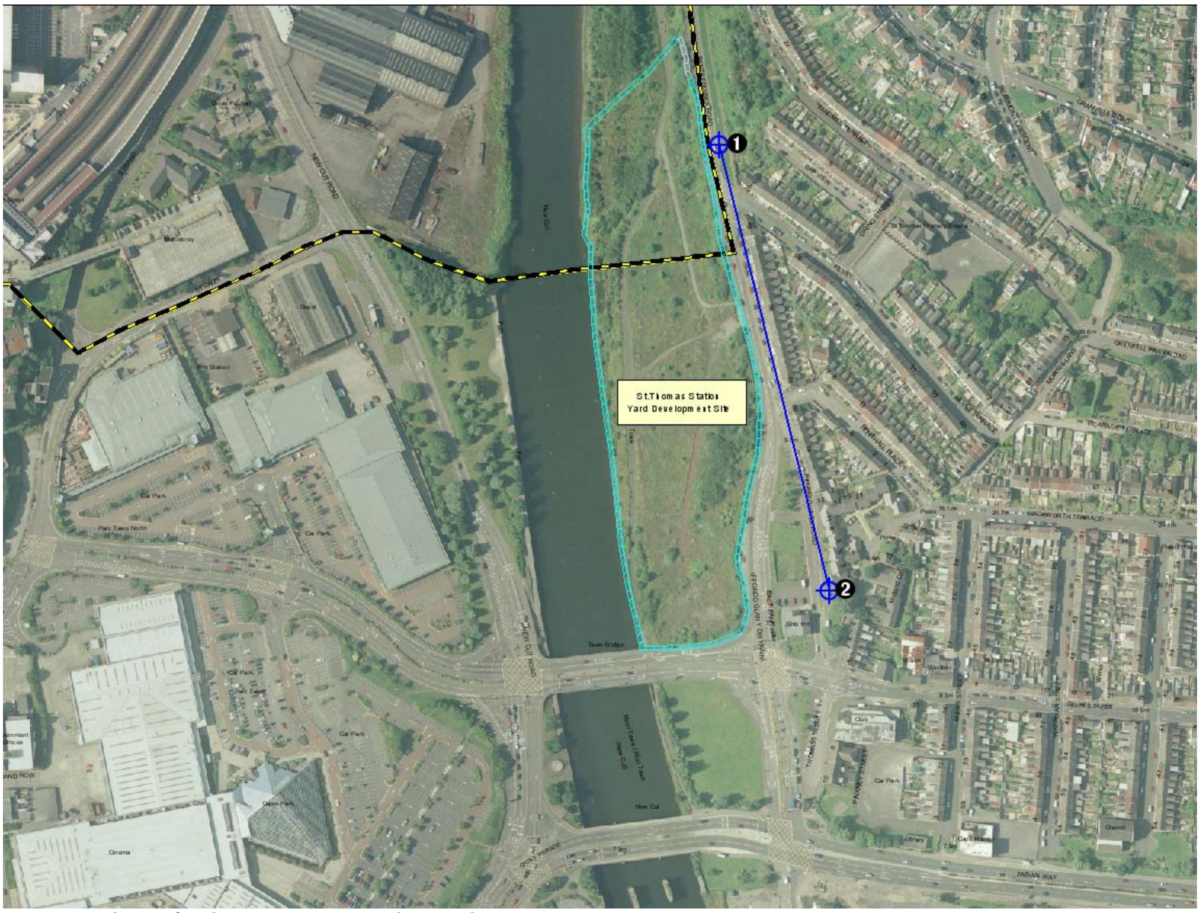
Photo 1 - St Thomas DOAS Transmitter

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 Roadside[6].

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 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.

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



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

Quay Parade Bridges are to the south of this location. Congestion extends from Quay Parade bridges up Pentreguinea Road with congestion being seen as far north as the Morfa Shopping Parc in Landore. 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 WAG Planning Panel are yet to issue its formal decision.

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 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 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

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 of lamp intensity during the 5^{th} and 6^{th} 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

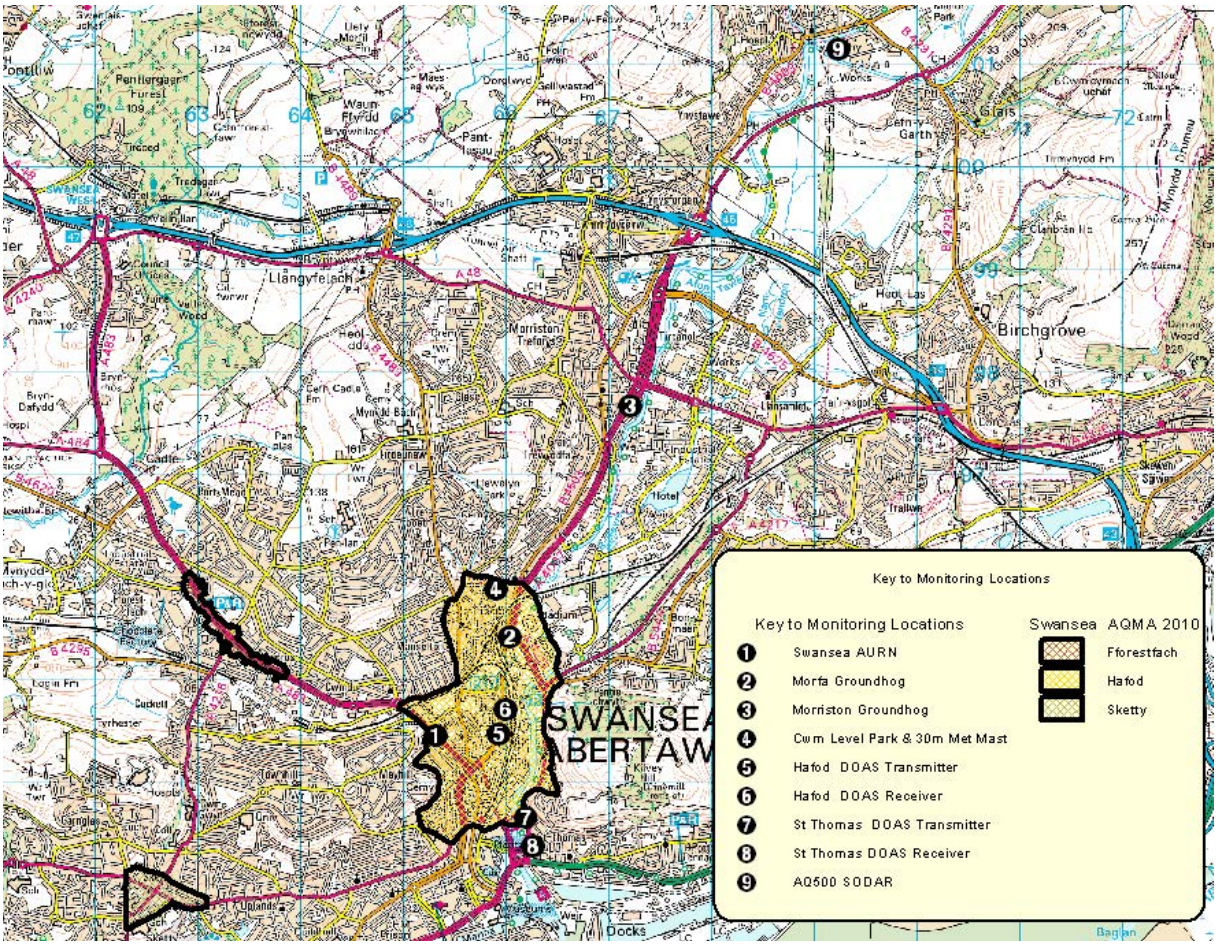
Directive methods of measurement (chemiluminescent for NO_2, UV fluorescence for SO_2 etc) at present but the system has recently achieved MCERTS certification and TUV certification.

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

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**	Road side	**20th September 2006**	NO_2, PM_{10}, $PM_{2.5}$	Y	Y (12m)	4m	N
Morfa Groundhog	**2**	Road side	**24th July 2000**	NO_2, PM_{10},	Y	Y (34m)	5m	Y
Morriston Groundhog	**3**	Road side	**11th October 2000**	NO_2, PM_{10}, and Ozone	N	Y (22m)	4m	N
Cwm Level Park	**4**	Urban Backg round	**(O_3) 28th November 2008** **(NOx) 21st January 2009**	NO_2 and Ozone	Y	N (100m)	78m	N/A
Hafod DOAS	**5**	Road side	**8th January 2004**	NO_2 Ozone and Benzene	Y	Y (0.2m)	1.7m	Y
St Thomas DOAS	**6**	Road side	**4th May 2005**	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 ploycyclic hydrocarbons (PAH) in ambient air[7]. 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 bezo(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, ❷ was chosen as the initial monitoring location due to its proximity to the refinery ❶ and for additional security issues with the equipment at the time. A Rupprecht & Patashnick Co., Inc. Partisol 2000 sampling unit, fitted with a PM_{10} 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 ❸ upwind of the high level stack release and one at the Morriston Groundhog ❺ some 4.1 kilometres downwind of the stack release point (see section 2.1.4 for site location of the Morriston 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 PM_{10} sampling inlets with flow rates of 16.7 l/min. Four filters are housed in the main exchange drum and the unit automatically regulates weekly exposure of each filter.

[7] *COM 2003 (423)*

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.

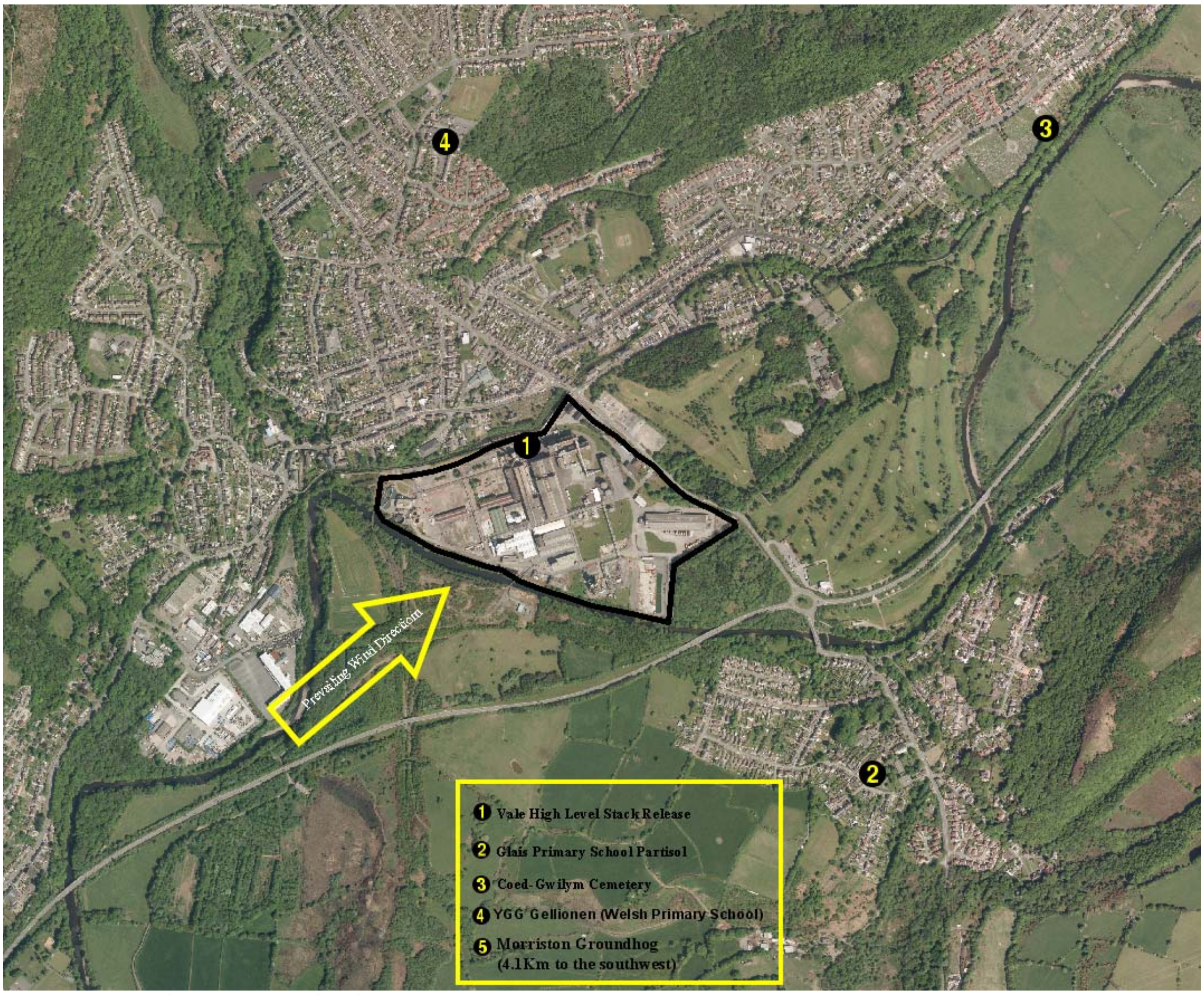
A further site has been established to the north of the high level stack release point during November 2007 at YGG Gellionnen ❹ (Welsh Primary School). The site is located on top of a flat roof within the school complex and has an uninterrupted view down to the refinery complex. This authority will continue 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 ❸ and the site located downwind of the release point at the Morriston Groundhog❺. 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 ❷ and at the YGG Gellionnen ❹ (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 classification [8]. 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

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), 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 complaint with the requirements of EN 14902:2005.

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

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 curve[9].

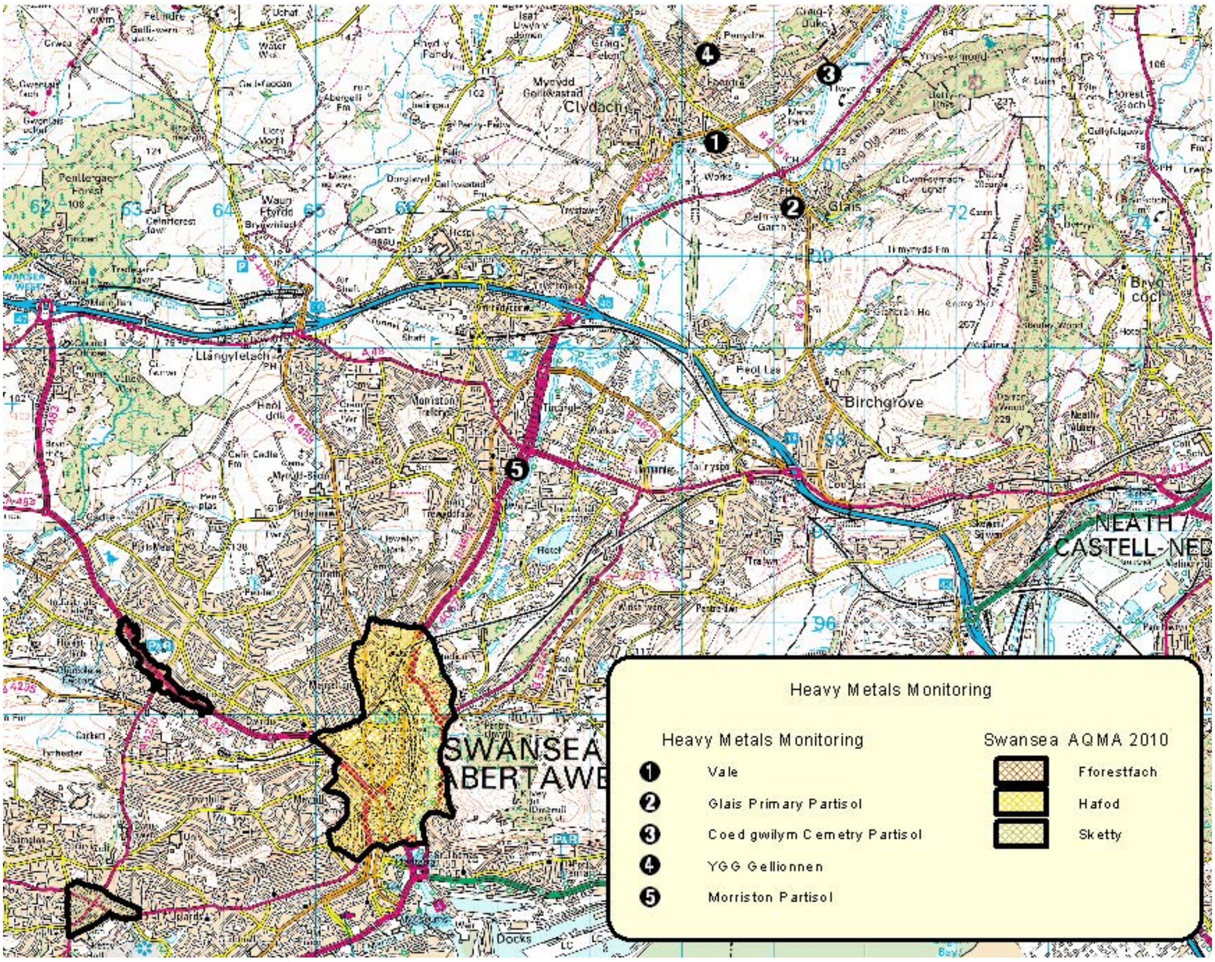
The uncertainty weighted mean for a series of N measurements, where the i^{th} measurement produces a value, x_i, with a measurement uncertainty, u_i, the uncertainty-weighted mean of the measurement, $\bar{x}_u$, would be given by:

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

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

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

the Swansea Air Quality Management Area 2010 (former Hafod AQMA) indicated for reference purposes.



Map 9 Swansea *UK Heavy Metal Monitoring Sites*

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 PM_{10} inlet. This network has been upgraded during 2007 to provide fully complaint 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

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

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 (NO_2) 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 NO_2 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.

Monitoring is focused primarily on roadside locations with particular emphasis in determining NO_2 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 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	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	262095	196500	Roadside	NO_2		Y (0.1m)	12m	
3	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	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	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	266515	193213	Roadside	NO_2		Y (0.1m)	2m	
38	266662	193181	Roadside	NO_2		Y (0.1m)	6m	
39	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	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	267752	193218	Roadside	NO_2		Y (0.1m)	5m	
47	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	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	268643	197245	Roadside	NO_2		Y (0.1m)	4m	
53	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	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	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	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	263558	192833	Roadside	NO_2		Y (0.1m)	12m	
81	262940	192775	Roadside	NO_2	**Y**	Y (0.1m)	8m	
82	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	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 (5m)	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	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	267081	198268	Roadside	NO_2		Y(0.1m)	6m	
153	268845	201137	Roadside	NO_2		Y(0.1m)	2m	
154	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	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	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	259059	197831	Roadside	NO_2		Y(0.1m)	2.5m	
180	259064	197781	Roadside	NO_2		Y(0.1m)	1.5m	
181	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	259014	197797	Roadside	NO_2		Y(0.1m)	5m	
185	258919	197820	Roadside	NO_2		Y(0.1m)	4.5m	
186	258711	197868	Roadside	NO_2		Y(0.1m)	4m	
187	258206	198239	Roadside	NO_2		Y(0.1m)	2.5m	
188	258197	198219	Roadside	NO_2		Y(0.1m)	6.5m	
189	258270	198257	Roadside	NO_2		Y(0.1m)	7.5m	
190	258260	198237	Roadside	NO_2		Y(0.1m)	2.5m	
191	258338	198270	Roadside	NO_2		Y(0.1m)	4.5m	
192	257422	198542	Roadside	NO_2		Y(0.1m)	5m	
193	257371	198522	Roadside	NO_2		Y(0.1m)	3.5m	
194	257958	198581	Roadside	NO_2		Y(0.1m)	4.5m	

Site Name	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	257972	198563	Roadside	NO_2		Y(0.1m)	5m	
196	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	254582	195821	Roadside	NO_2		Y(0.1m)	2m	
201	254522	195859	Roadside	NO_2		Y(0.1m)	2m	
202	254437	195879	Roadside	NO_2		Y(0.1m)	4m	
203	254294	195885	Roadside	NO_2		Y(0.1m)	3.5m	
204	253777	195926	Roadside	NO_2		Y(0.1m)	4m	
205	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	260357	188240	Roadside	NO_2		Y(0.1m)	4.5m	
218	260384	188206	Roadside	NO_2		Y(0.1m)	1m	
219	260419	188172	Roadside	NO_2		Y(0.1m)	2.5m	
220	261194	188163	Roadside	NO_2		Y(0.1m)	4m	
221	260454	188171	Roadside	NO_2		Y(0.1m)	4m	
222	260469	188182	Roadside	NO_2		Y(0.1m)	5m	
223	266899	197354	Roadside	NO_2		Y(0.1m)	3m	
224	266881	197389	Roadside	NO_2		Y(0.1m)	2m	
225	266861	197432	Roadside	NO_2		Y(0.1m)	2m	
226	266829	197472	Roadside	NO_2		Y(0.1m)	5m	
227	266836	197484	Roadside	NO_2		Y(0.1m)	2m	
228	266779	197578	Roadside	NO_2		Y(0.1m)	5m	
229	266772	197621	Roadside	NO_2		Y(0.1m)	2m	
230	266777	197651	Roadside	NO_2		Y(0.1m)	2m	
231	268802	197666	Roadside	NO_2		Y(0.1m)	4m	
232	266825	197654	Roadside	NO_2		Y(0.1m)	2m	
233	266823	197668	Roadside	NO_2		Y(0.1m)	4m	
234	266858	197671	Roadside	NO_2		Y(0.1m)	3m	
235	266874	197657	Roadside	NO_2		Y(0.1m)	3.5m	
236	266886	197658	Roadside	NO_2		Y(0.1m)	4m	
237	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	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	254817	189135	Roadside	NO_2		Y(0.1m)	1.5m	
258	254906	189110	Roadside	NO_2		Y(0.1m)	1.5m	
259	254949	189113	Roadside	NO_2		Y(0.1m)	5.5m	
260	254970	189116	Roadside	NO_2		Y(0.1m)	4m	
261	254991	189115	Roadside	NO_2		Y(0.1m)	1m	
263	262444	193447	Roadside	NO_2		Y(0.1m)	6m	
264	262251	193293	Roadside	NO_2		Y(0.1m)	5m	
265	266375	198023	Roadside	NO_2		Y(0.1m)	2m	
266	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	266458	198111	Roadside	NO_2		Y(0.1m)	4m	
270	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	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 NO_2 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 NO_2 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 Harwell Scientifics of 551 South Becquerel Avenue, Harwell International Business Centre, Didcott, Oxon.

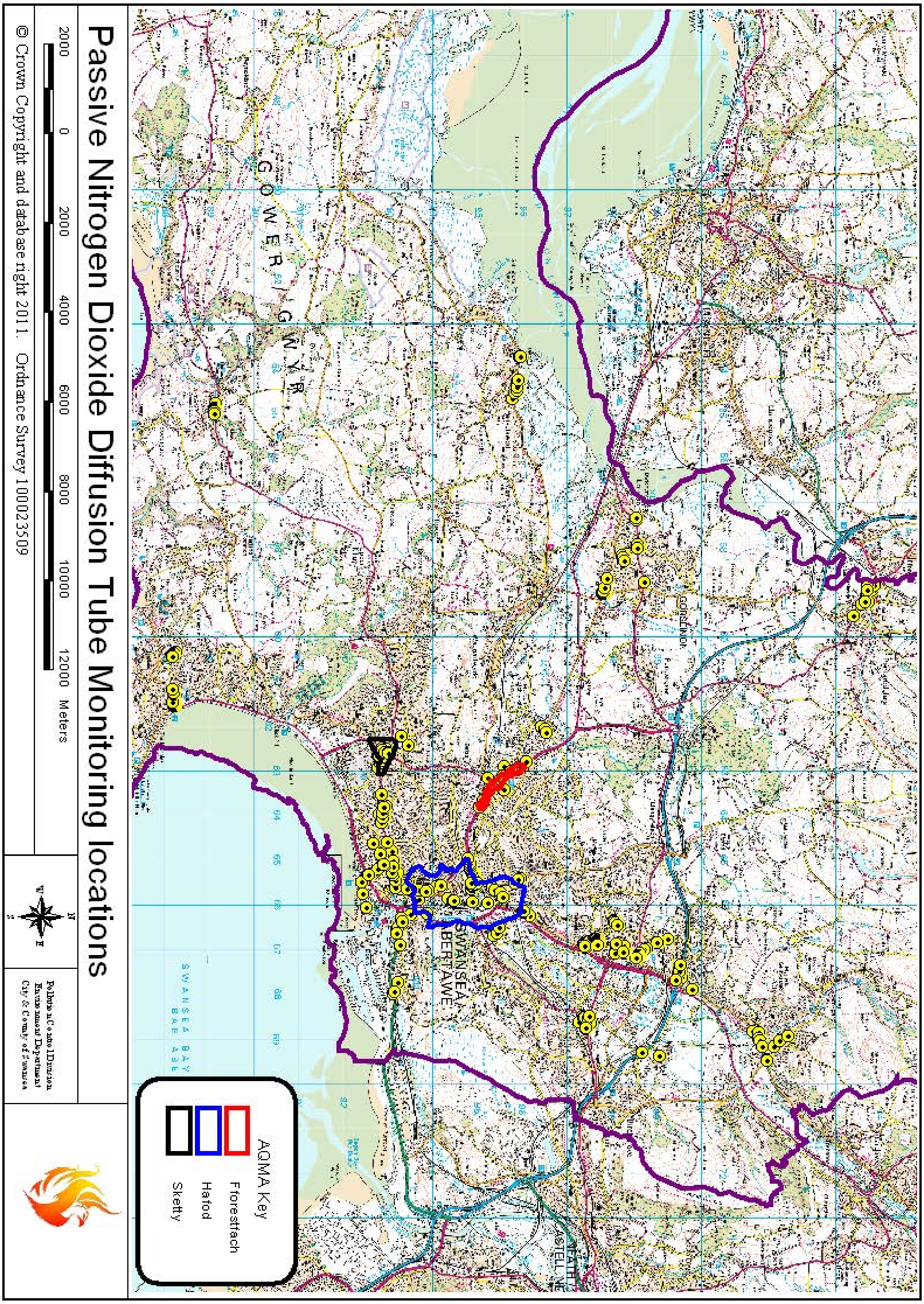
This contract laboratory has been operating for over 20 years and has extensive UKAS accreditation. In addition, all work is accredited to BS EN ISO 9001. Its predecessor the EMS Division, Harwell, carried out Swansea's original NO_2 mapping in 1985/86.

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 autoanalyser with ultraviolet detection. The analytical methods employed by Harwell Scientifics follow the procedures set out in the Harmonisation Practical Guidance.

Harwell Scientifics 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 Annexe 3. For the purpose of diffusion tube QA/QC in the context of Local Air Quality Management, NETCEN 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 Morriston 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 AEA Energy and Environment on behalf of DEFRA and the Devolved Administrations: NO_2 Diffusion Tubes for LAQM: Guidance note for Local Authorities[11].

The results of the 2010 tri-location studies are provided within ANNEXE 4. The NO_x chemiluminescent analyser data from the Morfa and Morriston Groundhog roadside stations, as well as the urban background site at Cwm Level Park have been rescaled and ratified by the QA/QC procedures undertaken by the authority and cross checked with the ratified datasets produced by AEA Energy and Environment as part of their contract with the Welsh Assembly Government to run the Welsh Air Quality Forum. Ratified data has also 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 2010 in Swansea is therefore 0.91 being the average of the 3 co-location studies undertaken within Swansea at the Swansea AURN, Morfa Groundhog and Cwm Level Park. The Morriston groundhog site result has been excluded as it is

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

unclear at present why the bias derived at the Morriston Groundhog site for both 2009 and 2010 differ so dramatically to the bias factor seen from the other roadside sites. The factor of 0.74 derived for 2010 at the Morriston site and similar results received for previous years would indicate some site specific issues possibly interfering with, or influencing the derived factor. Any such influences deserve investigation but this process is unlikely at present due to resourcing issues.

Full spreadsheets containing the automatic real-time data and the passive diffusion tube data used to derived the bias factors from all sites are shown within Annexe 4

The Swansea bias for 2010 (0.91) compares favourably to the overall mean of 0.85 from the national database results[12] using Harwell Scientifics from 19 studies during 2010. The range of the 19 studies during 2010 was between 0.68 (Hambleton DC) and 1.21 (Swale BC). The overall national bias mean using Harwell Scientifics during 2009 was 0.82 to further demonstrate the consistency with this laboratory. Mean bias results for Harwell Scientifics between 2001 to 2010 ranged from 0.78 (2001) to 0.88 (2004 and 2005) with the mean of all results between 2000-2010 being 0.83.

[12] http://laqm.defra.gov.uk/documents/Diffusion_Tube_Bias_Factors_v06_11.xls

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

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 specified[13]. 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.

Following rescaling works using the factors derived from the routine calibration of the API analyser, NO_2 is determined by NO_x - NO = NO_2. All existing stored NO_2 data is overwritten (within the working ASCII file only) with the rescaled derived NO_2 data.

All results are presented in $\mu g/m^3$ by multiplying the logged result in ppb by the conversion factor of 1.91[14] to produce results expressed in $\mu g/m^3$.

In the case of the Swansea AURN, the QA/QC procedures undertaken by NETCEN have resulted in ratified hourly data expressed in $\mu g/m^3$ 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. These data have then been imported into the OPSIS Enviman Reporter databases allowing analysis and graphical presentation. Sections 2.1.6 and section 2.1.7 refer to the data collection methodology for the Hafod

[13] LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-47
[14] *LAQM.TG(09) Appendix A1 - Data Processing- Box A1.5 page A1-36*

and St.Thomas DOAS systems. Annual means derived for 2010 are given below within table 4.

Site ID (see table2 above)	Location	Within AQMA	Data Capture 2010 %	Annual mean (ug/m^3)			
				2007	2008	2009	2010
1	Swansea AURN ** (12m)	Y	98.98%	**26.7** (31.0)	**25.6** (31.8)	**26.3** (33.2)	**27.8** (36.1)
2	Morfa Groundhog ** (34m)	Y	95.63%	**24.3** (36.1)	**23.2** (36.5)	**22.5** (36.38)	**22.3** (37.7)
3	Morriston Groundhog ** (22m)	N	95.70%	**27.6** (36.1)	**23.6** (29.0)	**22.3** (29.34)	**22.6** (30.5)
4	Cwm Level Park ** (100m)	Y	97.57%	**-**	**-**	**18.72**	**23.38**
5	Hafod DOAS	Y	87.35%	**52.19**	**58.64**	**53.44**	**58.60**
6	St.Thomas DOAS	N	98.47%	37	34.94	34.71	**45.88**

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 NO_2 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 page2-6. The supporting simple calculator Excel spreadsheet (Issue 4) has been downloaded from http://laqm.defra.gov.uk/documents/NO2withDistancefromRoadsCalculatorIssue4.xls

The resulting calculated NO_2 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 NO_2 concentrations were downloaded from http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html and overlain on a GIS background map within ArcView3.3. 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)			
		2007	2008	2009	2010
1	Swansea AURN)	16.9	16.9	15.9	16.3
2	Morfa Groundhog)	16.4	16.3	15.5	16.1
3	Morriston Groundhog	18.2	17.6	16.8	17.8

Table 5 NO_2 background concentrations

As the site at Cwm Level Park has an Urban Background classification, with the nearest receptor being 100m away, the annual mean is presented and 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 form the kerb.

From table 4 it can be seen that the Hafod DOAS continues to experience annual mean NO_2 concentrations above the objective level with the St Thomas DOAS now also exceeding the annual mean objective. Other sites have seen a marginal increase in annual mean concentrations. Interestingly for 2010, the Hafod DOAS has also exceeded the 1 hour objective on 20 occasions – the majority of these hourly exceedences occurred during November and December. Unfortunately, there are some data gaps during November and December so the situation maybe worse than indicated here.

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 and runs 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 NO_2 tube results within section 2.3 below). The bias corrected annual mean of $60.33 ug/m^3$ from this site also indicates exceedence of the annual mean objective and indicatively[15], also the hourly objective within this section of Neath Road.

Table 5 below indicates assessments from all stations in respect of the number of exceedences of the 1-hour NO_2 objective. Where data capture rates are below 90% the 99.8^{th} percentile is presented in brackets.

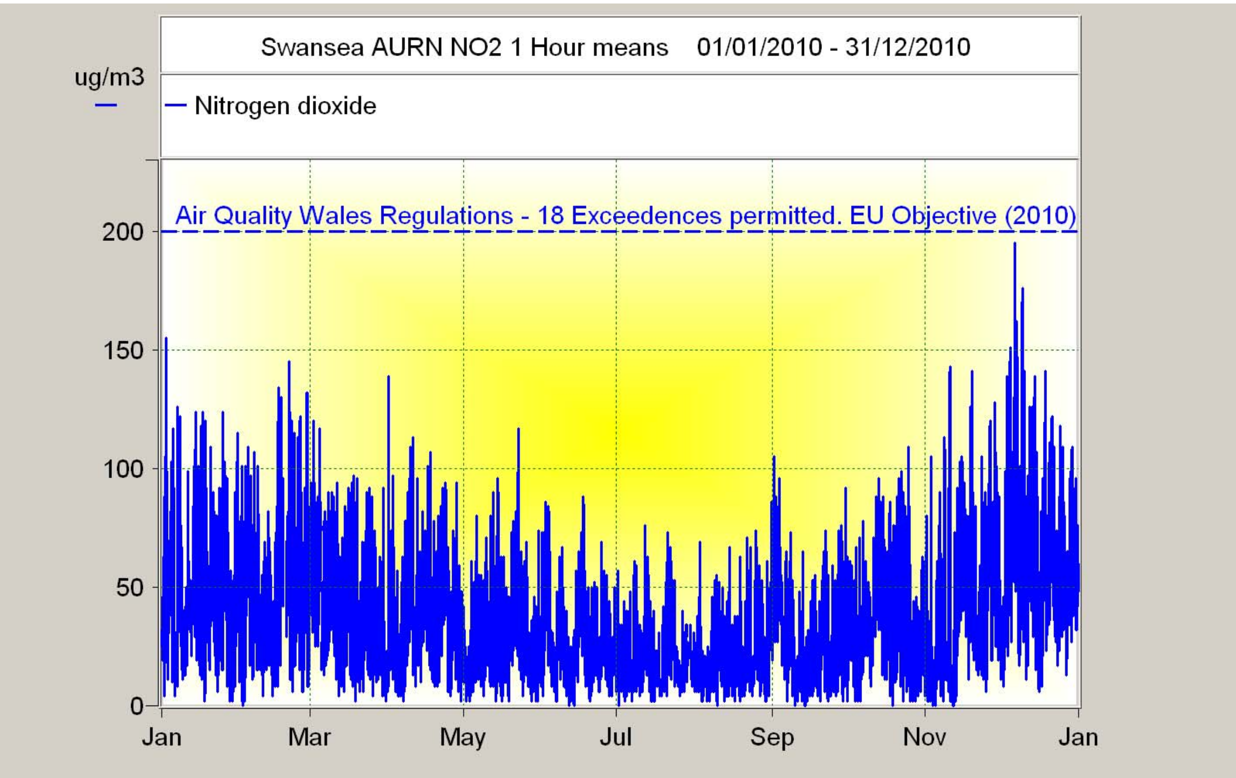
[15] http://www.airquality.co.uk/archive/reports/cat18/0806261511_TG_NO2relationship_report_draft1.pdf

Site ID (see table 4 above)	Location	Within AQMA	Data Capture 2010 %	Number of Exceedences of hourly mean (200 µg/m^3)			
				2007	2008	2009	2010
1	Swansea AURN	**Y**	98.98%	0	0	0	0
2	Morfa Groundhog	**Y**	95.63%	2	1	0 **(149.0)	1
3	Morriston Groundhog	**N**	95.70%	1	1 **(123.95)	0	0
4	Cwm Level Park	**Y**	97.57%	-	-	0 **(92.0)	0
5	Hafod DOAS	**Y**	87.35%	7	7 **(199.54)	11	20 **(203.13)
6	St.Thomas DOAS	**N**	98.47%	0	0	0	0

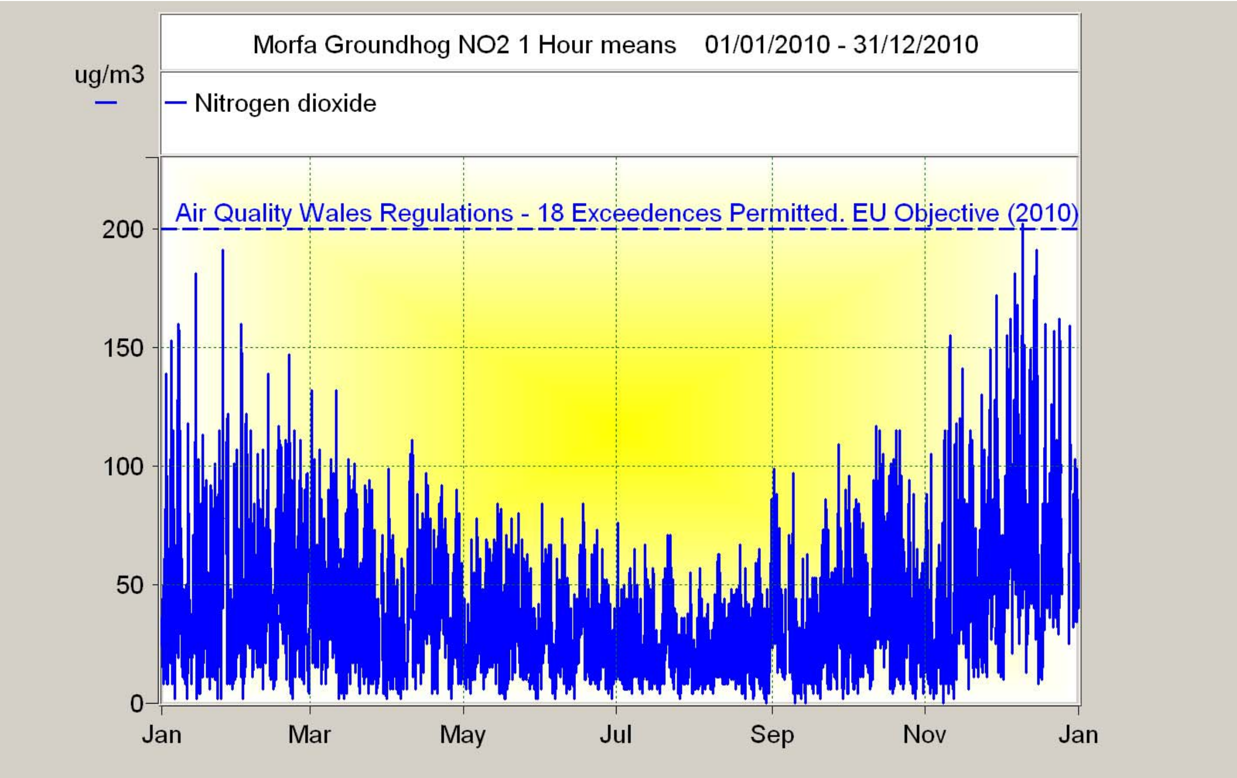
Table5 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective

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

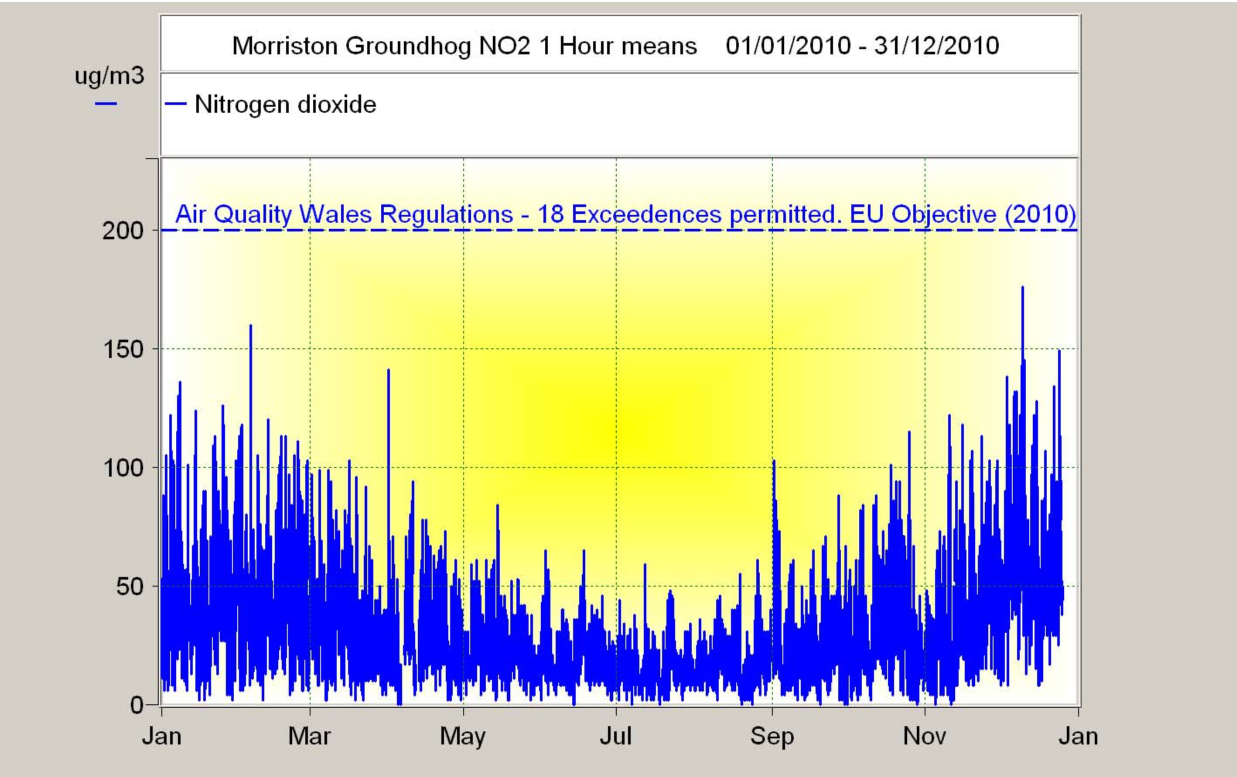
Graphs 1-6 below show the $NO_2$1 hour means for 2010 from the 6 automatic and continuous sites within Swansea.



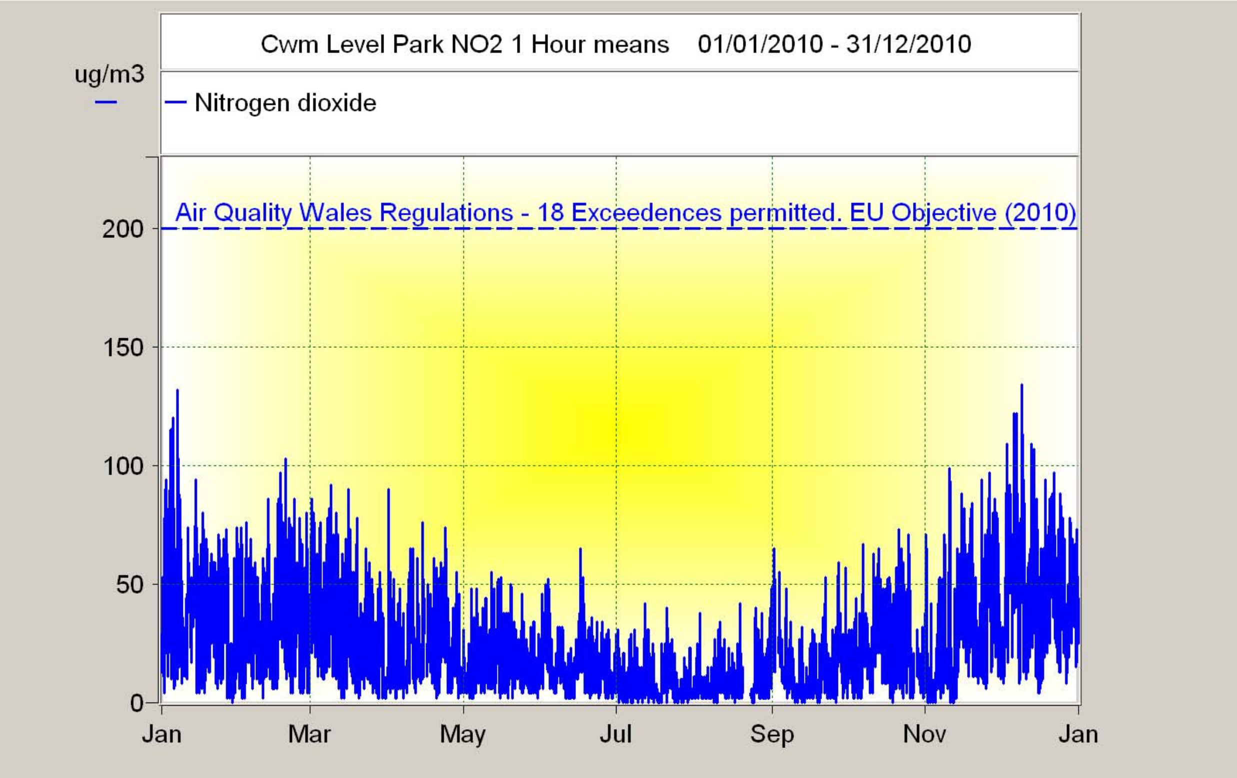
Graph 1 – NO_2 1-hour means Swansea AURN 2010



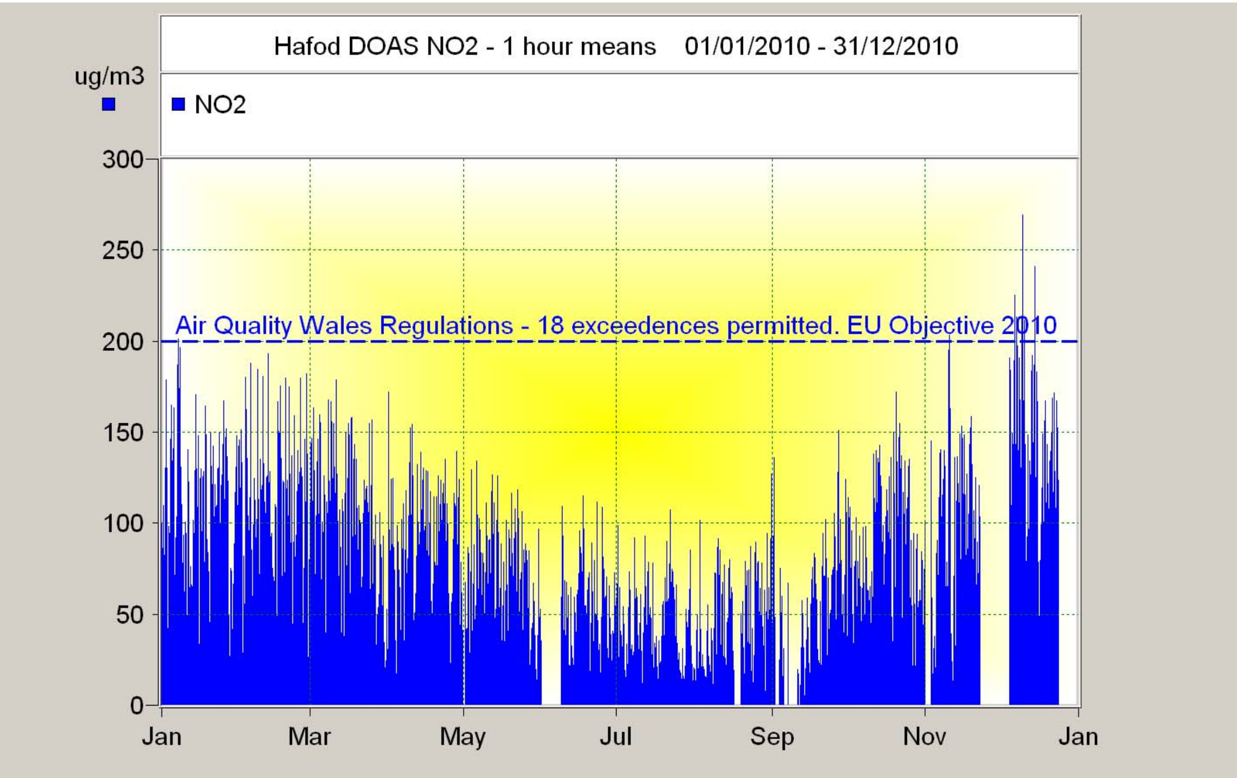
Graph 2 – NO_2 1-hour means Morfa Groundhog 2010



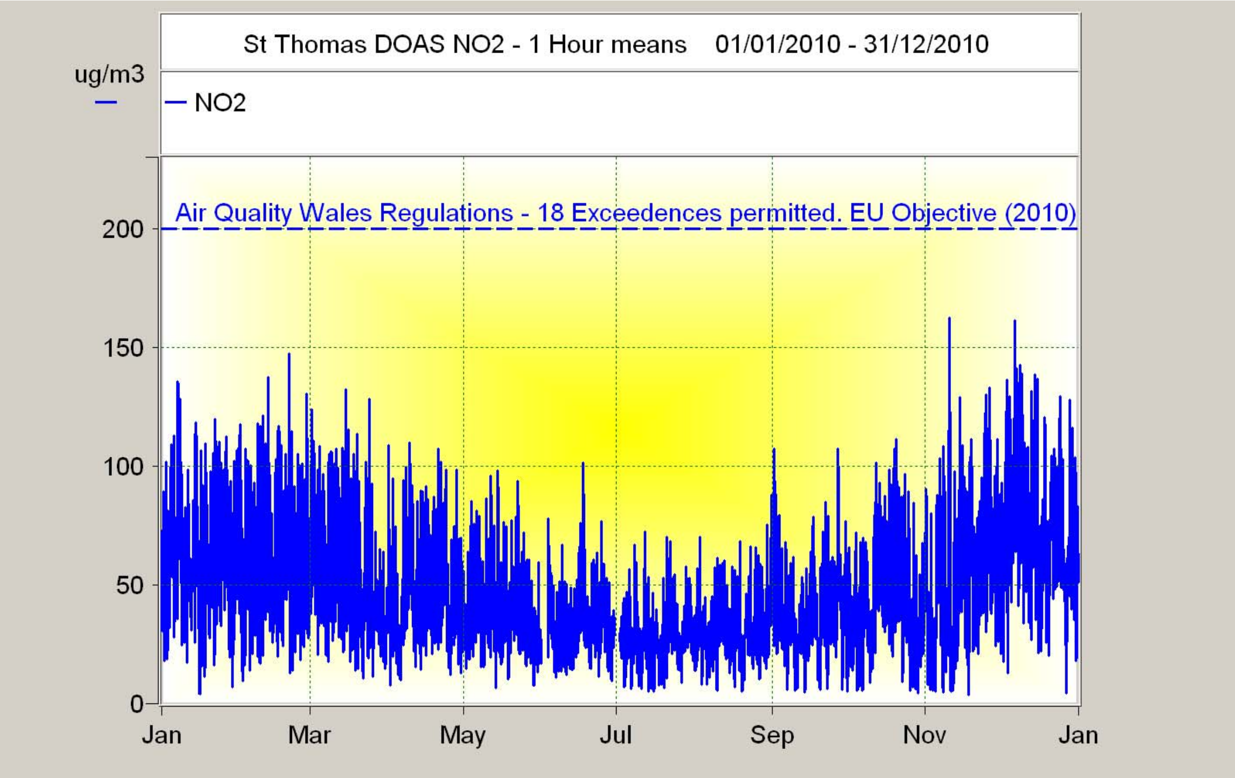
Graph 3 - NO_2 1-hour means Morfa Groundhog 2010



Graph 4 - *NO_2* 1-hour means Cwm Level Park 2010



Graph 5 - NO_2 1- hour means Hafod DOAS 2010

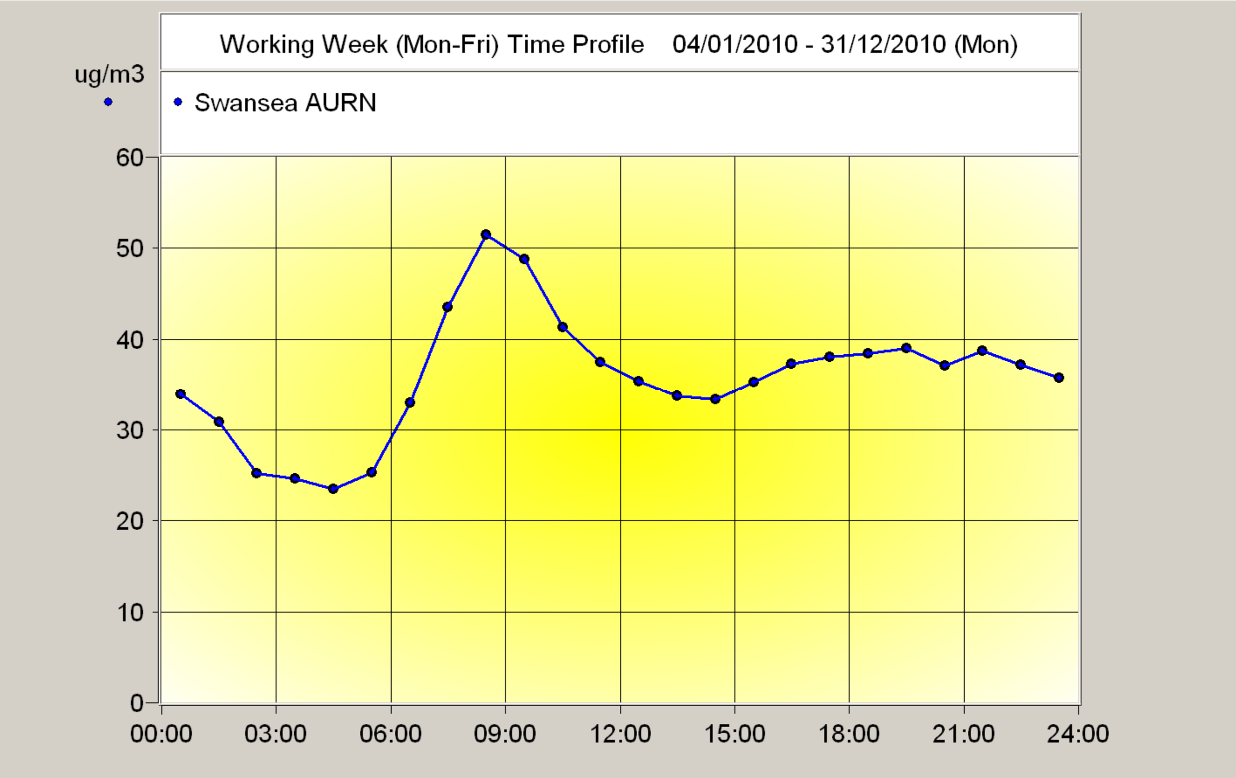


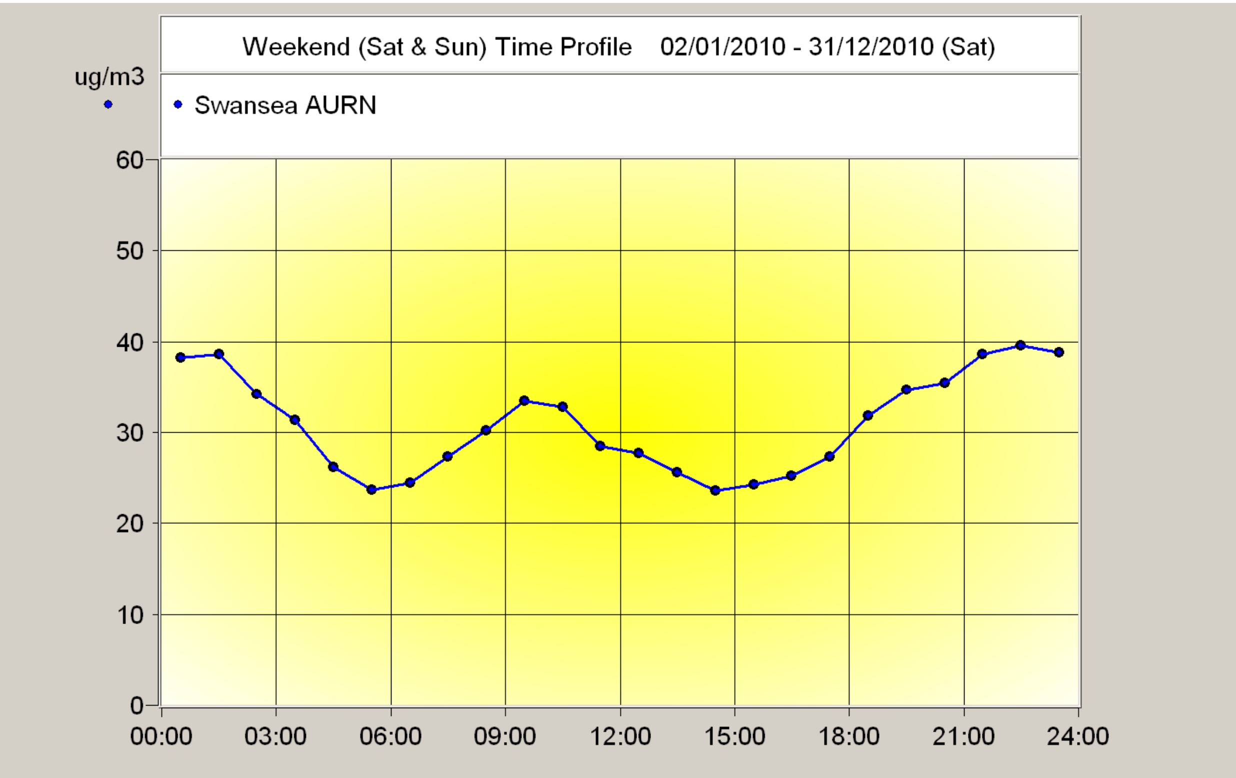
Graph 6 - NO_2 1- hour means St Thomas DOAS 2010

Graph 5 from the Hafod DOAS 1 hour means shows primarily one period during December 2010 where exceedences of the 1-hour objective were seen. This period saw winds primarily from the North-east but probably of more relevance, this period was characterised by, as would be expected periods of low wind speeds but in this instance combined with unusually (for Swansea) low temperatures. The mean air temperature for December was 1.61 degrees, with a minimum of -8.07 degrees being seen on the 25th December 2010. These conditions impacted on increased concentration which were evident at all sites during this period.

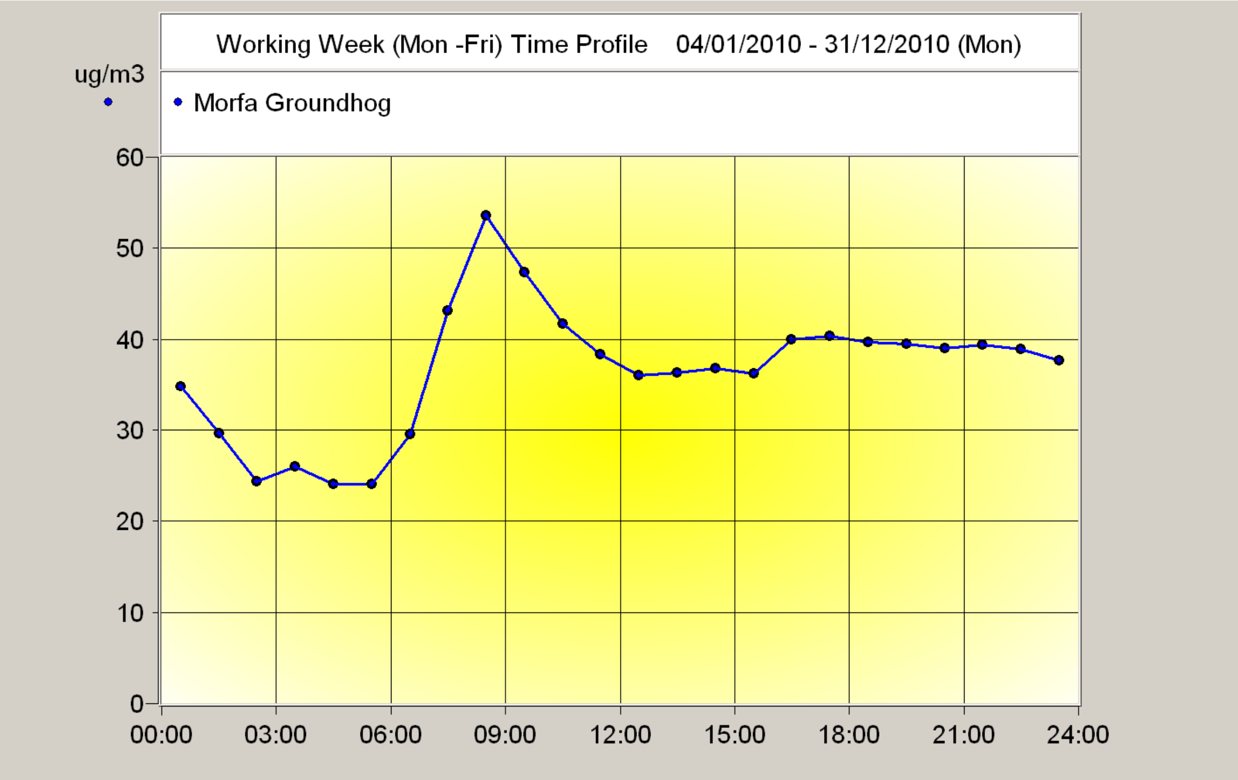
Diurnal NO_2 profiles for each site are provided below within diurnal plots 1-6. Again, as would be expected, the weekday peak concentrations are seen at each site during the am period with the pm period being much smoother. The am peak is thought likely to be influenced more by the prevailing meteorological 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.

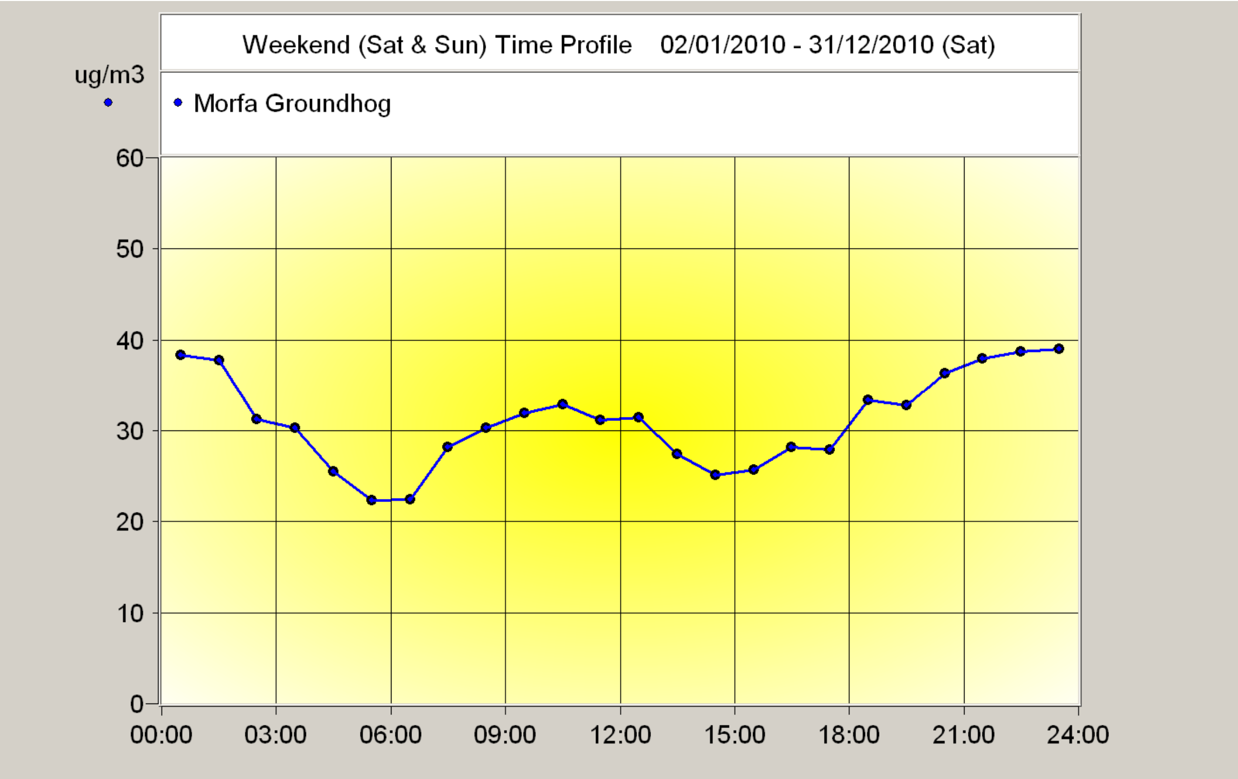
The weekday profiles raise the question whether the authority should, as part of its Hafod Air Quality Action Plan, concentrate efforts on reducing the NO_2 impact solely around the am peak traffic period of 7-10am. A view is being investigated as to what effect this may have on the overall NO_2 annual mean and 1 hour objectives and what practical traffic management measures can be introduced into the Nowcaster forecast system being developed for such situations to achieve widespread compliance with the objective.



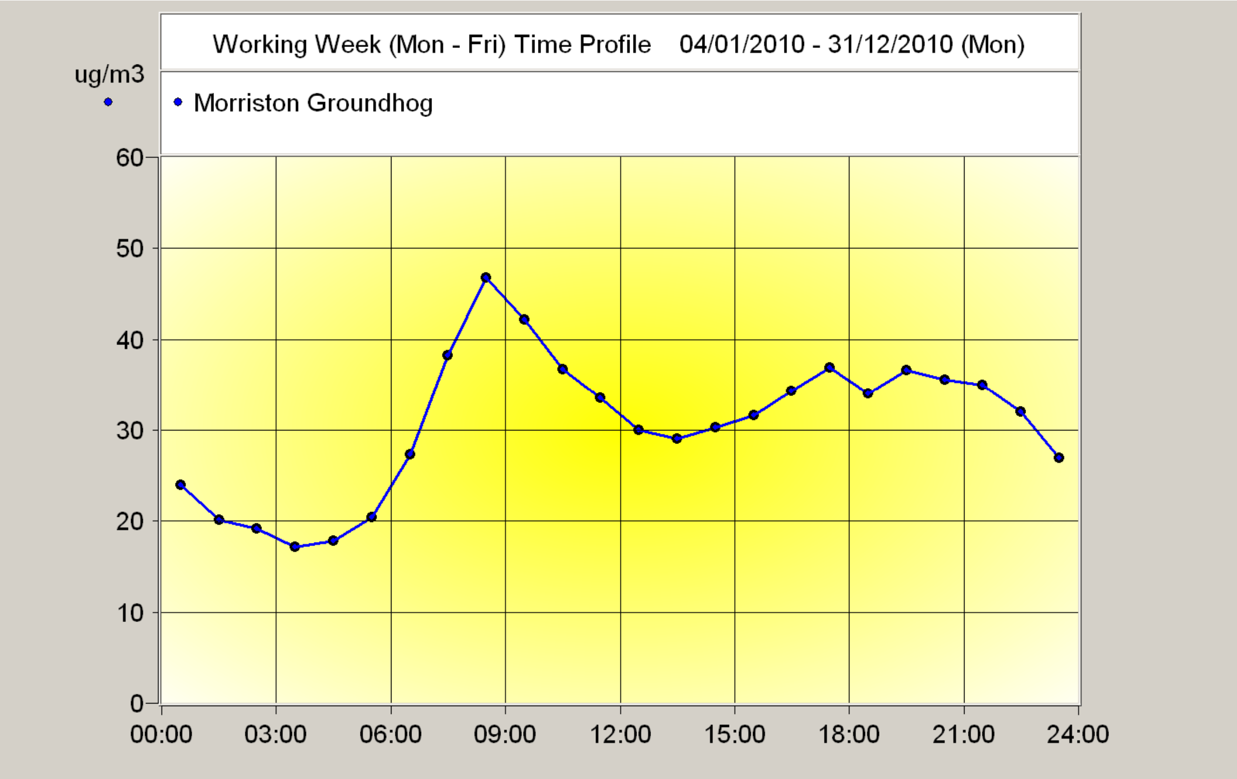


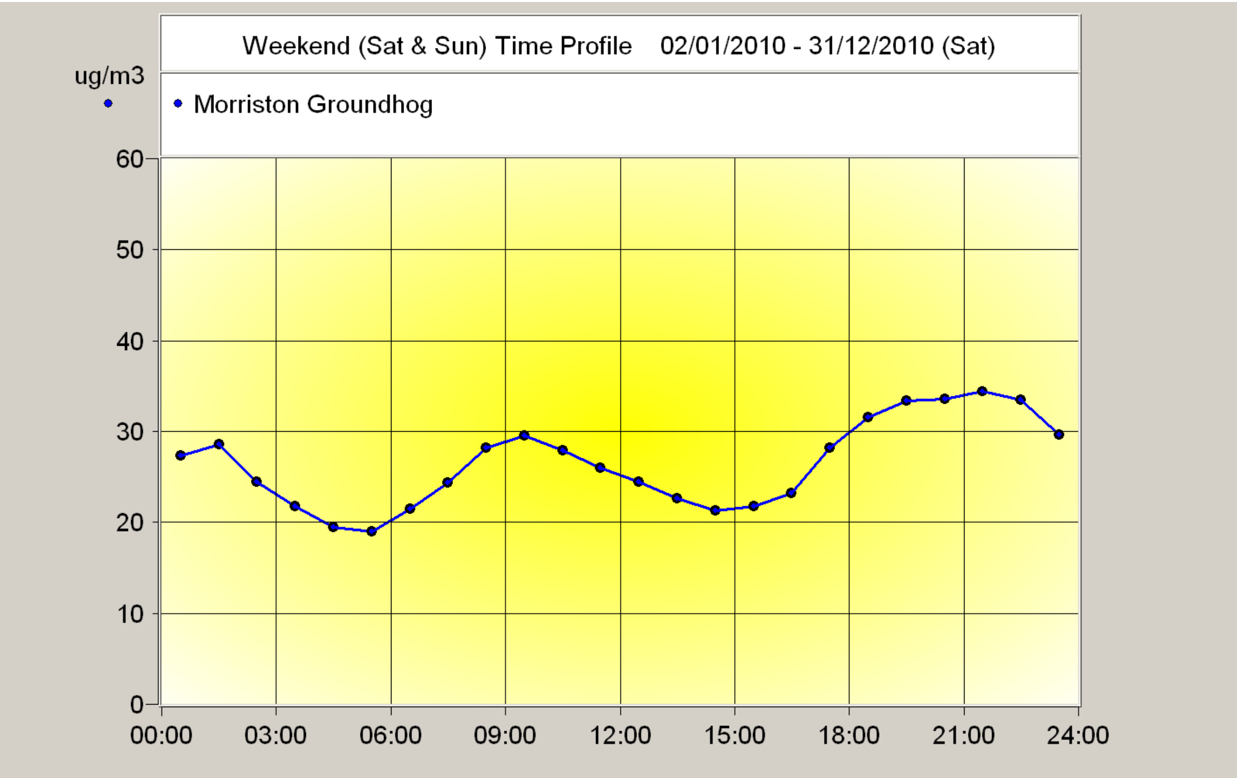
NO_2 Diurnal Profile 1 – Swansea AURN (top weekday profile, bottom weekend profile)



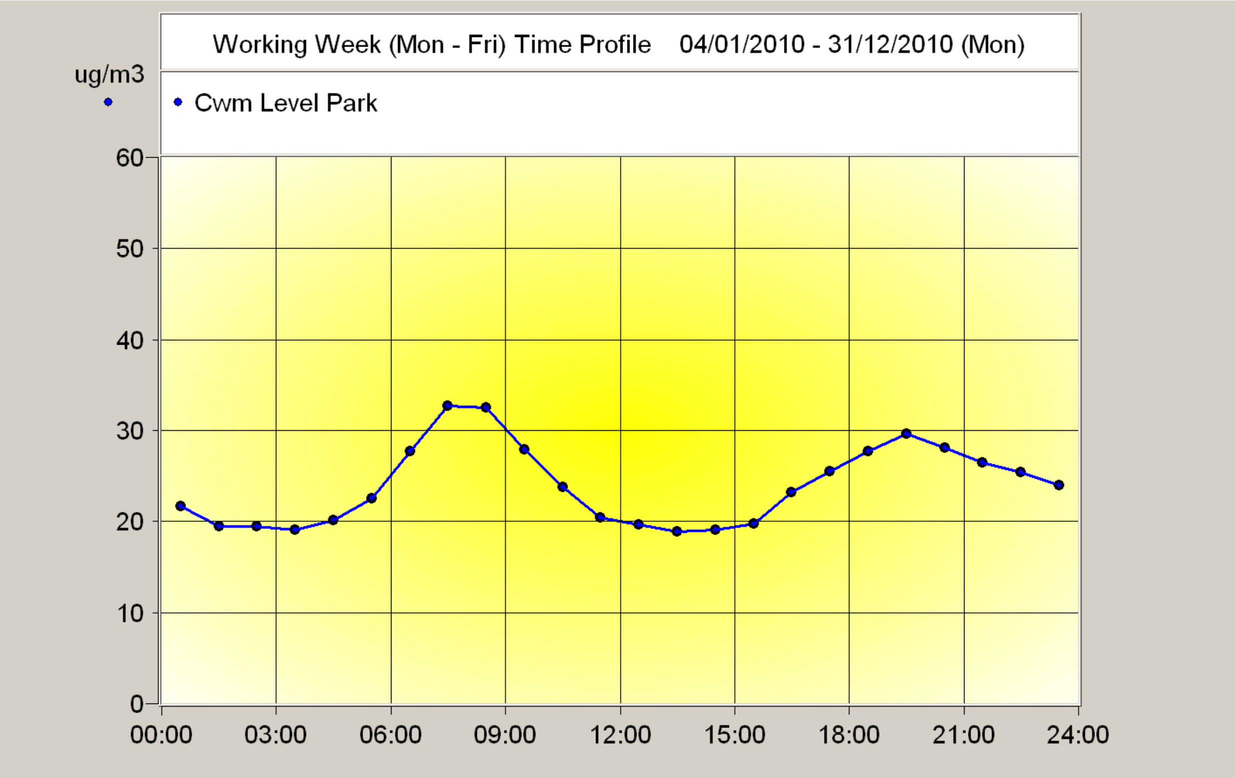


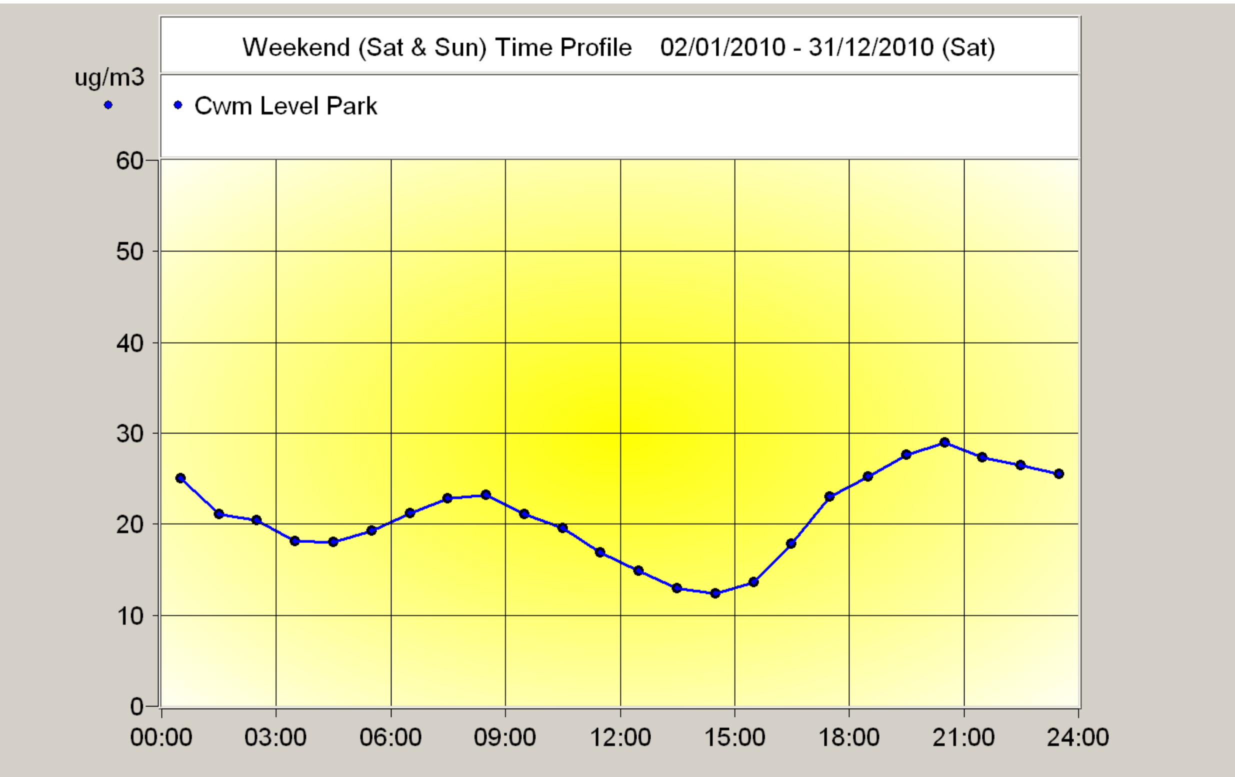
NO_2 Diurnal Profile 2 – Morfa Groundhog (top weekday profile, bottom weekend profile)



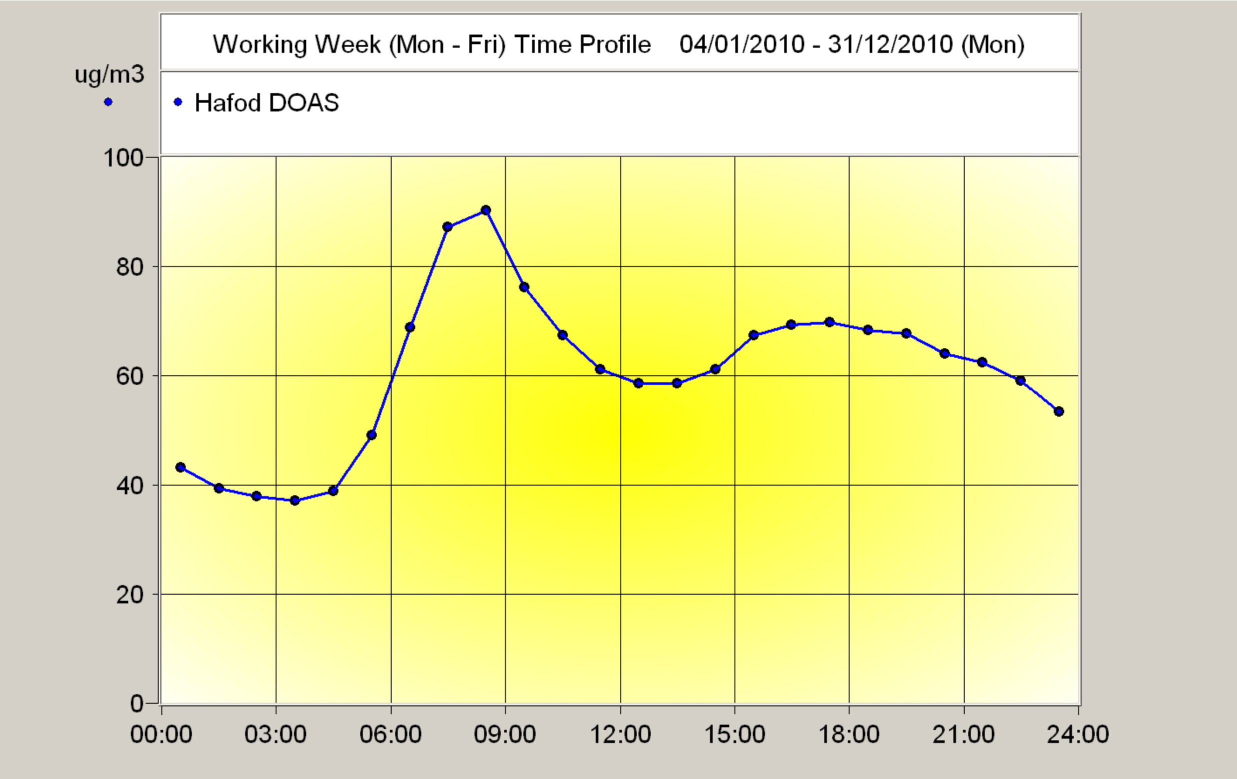


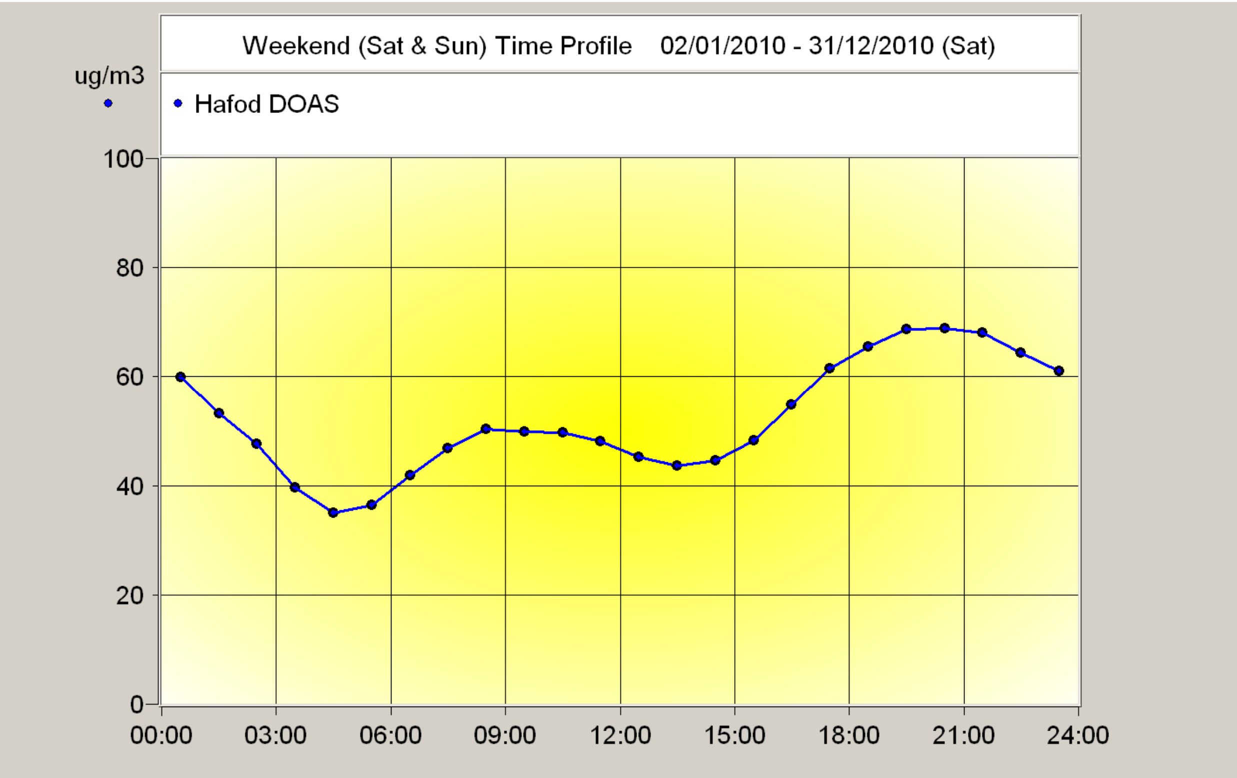
NO_2 Diurnal Profile 3 – Morriston Groundhog (top weekday profile, bottom weekend profile)



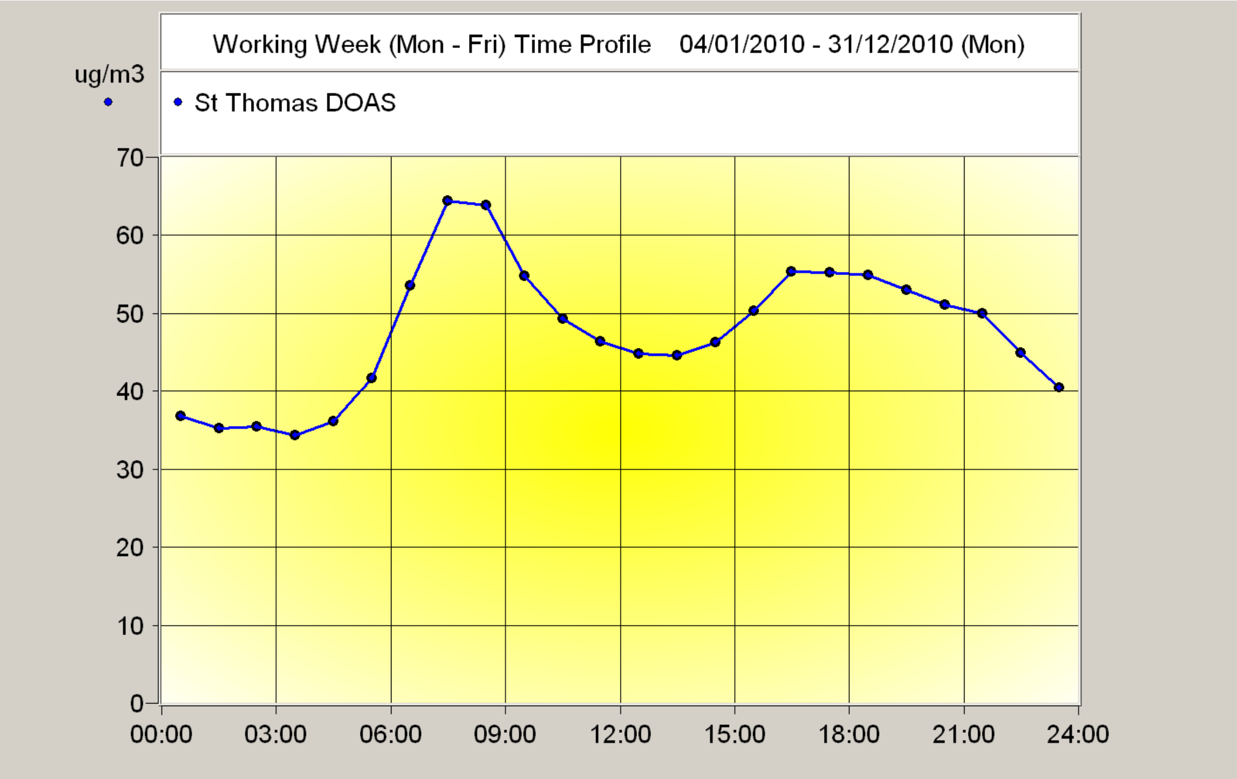


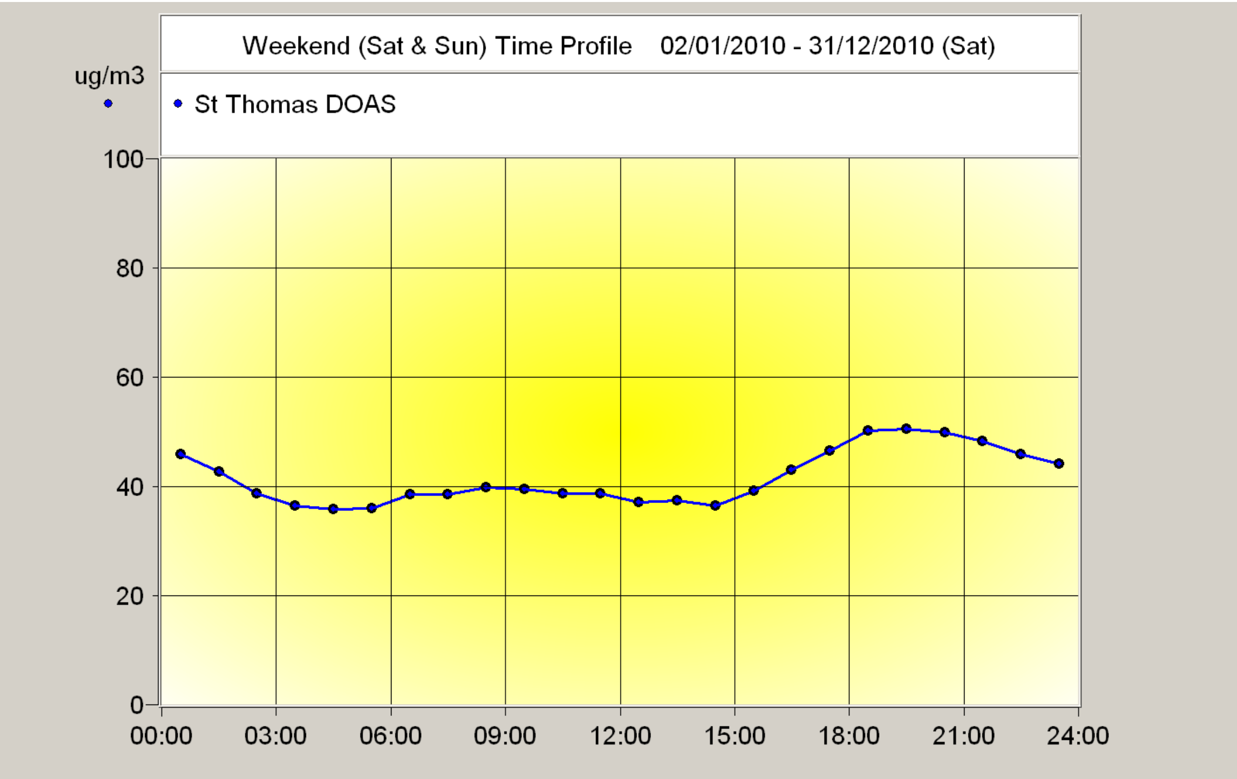
NO_2 Diurnal Profile 4 – Cwm level park (Urban background site) (top weekday profile, bottom weekend profile)





NO_2 Diurnal Profile 5 –Hafod DOAS (top weekday profile, bottom weekend profile)





NO_2 Diurnal Profile 6 – St Thomas DOAS (top weekday profile, bottom weekend profile)

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 has been updated 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

Table 6 indicates predicted concentrations in 2011 - 2016 at the 6 automatic sites 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 Projections (* at nearest receptor location)					
			2010	2011	2012	2013	2014	2015	2016
1	*Swansea AURN	Y	**27.8** (36.1)	26.2	24.6	23.0	21.4	19.7	18.6
2	*Morfa Groundhog	Y	**22.3** (37.7)	21.0	19.7	18.4	17.1	15.8	14.9
3	*Morriston Groundhog	N	**22.6** (30.5)	21.3	20.0	18.7	17.4	16.1	15.1
4	** Cwm Level Park (UB)	Y	**23.38**	22.0	20.7	19.3	18.0	16.6	15.7
5	Hafod DOAS	Y	**58.60**	**55.1**	**51.8**	**48.4**	**45.0**	**41.6**	39.2
6	St.Thomas DOAS	N	**45.88**	**43.2**	**40.5**	37.9	35.2	32.6	30.7

Table 6 – Predicted Future Years Roadside NO_2

*** Urban background site included for sake of completeness*

As can be seen within table 6 it is now predicted that the Hafod DOAS will not see compliance with the annual mean objective until 2016 (using 2009 data compliance was predicted in 2014 within the Progress Report 2010) with the St Thomas DOAS showing compliance during 2013 (using 2009 data compliance was predicted to be ongoing within the Progress Report 2010). 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 studies carried out at the three roadside chemiluminescent analysers[16]. 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 it 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 2010 was 291, exposed on a monthly basis**.** Sites 1 to 274 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. Data is presented for sites 275 - 291 as if it represented a full year of monitoring for 2010 but is presented for information purposes only.

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/m^3) are highlighted in bold blue. **Table 7 indicates the bias corrected annual means including any correction necessary for distance to nearest receptor from the 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.

[16] http://www.uwe.ac.uk/aqm/review/manswers.html#ROAD11 Nitrogen Dioxide -Question 8

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2010 %	Annual Mean concentrations 2010 (ug/m3) Adjusted for tube bias and distance to receptor
1	262046	196420		100.00	30.83
2	262095	196500		100.00	20.08
3	262161	196513		100.00	23.95
4	262497	192857	Y	100.00	35.07
5	262548	192943	Y	100.00	**42.06**
6	262612	192995	Y	100.00	34.62
7	262691	192852	Y	100.00	**58.76**
8	262990	195820	Y	91.67	**46.81**
9	263190	195205		100.00	31.41
10	263219	195513	Y	100.00	29.98
11	263344	195474	Y	100.00	**43.92**
12	263680	195103	Y	100.00	**48.15**
13	264830	193066		100.00	32.83
14	265285	192696		100.00	32.66
15	265334	192608		100.00	32.76
16	265339	192534		100.00	**38.61**
17	265496	192408		100.00	30.40
18	265526	195807	Y	100.00	**51.23**
19	265597	194061	Y	83.33	**52.20**
20	265594	194175	Y	100.00	**45.51**
21	265634	195316	Y	100.00	33.65
22	265682	195374	Y	91.67	**37.93**
23	265728	195494	Y	100.00	36.53
24	265760	192420		100.00	27.50
25	265845	195547	Y	100.00	31.43
26	265876	194318	Y	83.33	**45.81**
27	265922	194428	Y	91.67	**45.39**
28	265949	194891	Y	100.00	33.48
29	265973	195222	Y	91.67	**53.38**
30	266080	192516		100.00	25.92
31	266153	196003		100.00	**37.79**
32	266209	193867		100.00	**38.82**
33	266236	193488		100.00	**38.09**
34	266272	196168		100.00	**39.60**
35	266314	193298		100.00	**40.67**
36	266455	193300		100.00	34.42
37	266515	193213		91.67	28.33
38	266662	193181		100.00	**39.05**
39	266905	193271		100.00	28.35
40	266951	198278		100.00	31.80
41	266953	198085		100.00	**41.38**
42	267084	198274		83.33	**38.59**
43	267093	198063		100.00	**42.60**
44	267639	199543		100.00	28.37
45	267661	199451		100.00	**43.87**
46	267752	193218		100.00	17.71
47	267908	199773		100.00	26.83
48	268011	193101		91.67	27.08
49	268501	197329		100.00	32.35
50	268530	197419		100.00	**41.14**
51	268593	197434		100.00	34.19

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2010 %	Annual Mean concentrations 2010 (ug/m3) Adjusted for tube bias and distance to receptor
52	268643	197245		100.00	24.42
53	268652	197508		100.00	25.93
54	268693	197416		100.00	33.14
55	268789	197420		91.67	36.93
^56 *	269306	198661		91.67	22.4
57	269395	199042		100.00	15.73
^58	264052	192884		100.00	**41.7**
59	265918	194463	Y	91.67	**60.33**
60	265036	192931		100.00	**42.75**
61	264959	192878		100.00	**40.21**
62	266698	195335		91.67	26.83
^63	262675	192775	Y	83.33	25.9
^64	262719	192840	Y	91.67	**44.9**
65	262735	192855	Y	91.67	29.59
66	262802	192829	Y	100.00	36.04
^67	265903	193683	Y	100.00	**46.3**
68	265573	193432		100.00	**41.51**
^69	265543	193450		100.00	**50.9**
^70	266649	195435		100.00	25.7
^71 **	266514	195485		100.00	20.9
72	264091	192900		83.33	31.40
73	264138	192868		100.00	35.36
74	264163	192853		91.67	32.85
75	264072	192869		91.67	**45.19**
76	263968	192880		91.67	31.70
77	263856	192931		91.67	26.89
78	263819	192948		91.67	33.17
79	263842	192896		100.00	**37.13**
80	263558	192833		100.00	26.53
81	262940	192775	Y	91.67	27.79
82	262851	192805	Y	100.00	28.32
83	262785	192838	Y	100.00	35.51
84	262714	192839	Y	100.00	**39.42**
85	262702	192847	Y	100.00	**41.89**
86	262704	192865	Y	100.00	33.25
87	262697	192798	Y	100.00	23.93
88	262605	192916	Y	100.00	**38.27**
89	262587	192956	Y	100.00	25.99
90	262631	192996	Y	100.00	**37.93**
91	262534	192950	Y	83.33	**37.50**
^92	262545	192869	Y	100.00	33.7
93	263406	195534		100.00	33.38
94	263444	195572		91.67	30.34
95	262815	196090		91.67	34.29
96	262922	195950		100.00	31.05
97	262946	195902	Y	100.00	**39.95**
98	263142	195548	Y	91.67	**41.01**
99	263387	195332	Y	100.00	**37.64**
100	263470	195250	Y	100.00	31.78
101	263843	195047	Y	100.00	30.97
102	266379	193307		100.00	33.13

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2010 %	Annual Mean concentrations 2010 (ug/m3) Adjusted for tube bias and distance to receptor
103	268526	197359		91.67	35.11
104	268538	197389		100.00	31.70
105	268562	197472		100.00	30.33
106	268496	197476		100.00	34.66
107	268765	197420		100.00	36.16
108	267608	199461		100.00	35.76
109	267510	199487		100.00	32.44
110	267369	199521		100.00	30.46
111	267705	199426		100.00	34.62
^112	264868	192814		91.67	30.3
113	264654	192662		100.00	36.16
114	264622	192971		75.00	33.92
115	265031	193097		100.00	**45.67**
116	265192	193138		100.00	**48.73**
117	265288	193211		100.00	**47.27**
⊗118	265483	193385		100.00	**38.58**
119	265522	193390		100.00	**40.81**
⊗120	265570	193366		100.00	**57.75**
121	265706	193662	Y	100.00	**52.33**
122	265694	193505		83.33	**47.39**
123	265655	193423		100.00	**51.80**
⊗124	265651	193253		91.67	**51.72**
⊗125	265641	193162		91.67	**50.5**
⊗126	265475	193144		100.00	**62.03**
⊗127	265348	193110		100.00	**61.83**
⊗128	265297	193085		100.00	**51.71**
⊗129	265153	193098		91.67	**40.51**
⊗130	265139	192912		100.00	**43.92**
⊗131	265137	192846		100.00	**50.19**
132	265229	192753		100.00	**39.43**
133	265350	192566		100.00	33.15
⊗134	265113	192903		100.00	**47.74**
^135	262605	192916	Y	100.00	35.60
^136	262612	192995	Y	100.00	33.32
^137	262631	192996	Y	100.00	**37.13**
138	266779	199246		100.00	26.22
139	266867	199030		100.00	31.87
140	266863	199009		100.00	**39.36**
141	266979	198772		91.67	30.00
142	267017	198710		100.00	33.45
143	267089	198608		83.33	**37.32**
144	267141	198591		100.00	30.26
145	267139	198578		100.00	33.83
146	267156	198571		91.67	35.76
147	267165	198580		100.00	32.97
148	267170	198564		100.00	33.86
149	267204	198561		100.00	31.17
150	267205	198545		100.00	31.42
151	267192	198518		100.00	30.92
152	267081	198268		100.00	29.60
153	268845	201137		100.00	28.20

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2010 %	Annual Mean concentrations 2010 (ug/m3) Adjusted for tube bias and distance to receptor
154	268870	201267		100.00	27.98
155	269009	201280		83.33	30.76
156	269059	201296		100.00	31.79
157	269173	201355		100.00	28.79
158	269480	201441		100.00	30.89
159	269171	201620		100.00	31.63
160	269049	201744		100.00	34.94
161	268938	201929		100.00	19.77
162	259553	203379		100.00	31.59
163	259287	203556		100.00	27.11
164	259195	203667		100.00	31.90
165	259149	203675		100.00	24.52
166	259148	203690		91.67	28.89
167	259126	203700		100.00	25.73
168	259115	203705		91.67	23.26
169	259013	203747		100.00	24.97
170	258971	203797		100.00	19.95
171	258917	203826		100.00	28.08
172	258887	203859		100.00	26.00
173	259250	203708		100.00	20.96
174	259253	203660		100.00	19.60
175	259251	203638		100.00	18.05
176	258872	203691		100.00	15.00
177	258896	203697		100.00	14.87
178	258986	203684		100.00	14.94
179	259059	197831		100.00	29.13
180	259064	197781		100.00	32.43
181	259010	197817		100.00	27.49
182	259050	197790		100.00	30.96
183	259036	197795		83.33	34.37
184	259014	197797		100.00	28.82
185	258919	197820		100.00	26.46
186	258711	197868		100.00	23.64
187	258206	198239		100.00	18.28
188	258197	198219		100.00	17.15
189	258270	198257		91.67	16.79
190	258260	198237		100.00	17.17
191	258338	198270		100.00	17.45
192	257422	198542		100.00	16.02
193	257371	198522		100.00	21.34
194	257958	198581		100.00	19.41
195	257972	198563		100.00	26.32
196	258046	198558		100.00	22.61
197	258797	198701		100.00	**38.71**
198	258811	198701		100.00	**38.49**
199	254703	195764		91.67	34.16
200	254582	195821		100.00	27.71
201	254522	195859		100.00	30.47
202	254437	195879		100.00	23.13
203	254294	195885		100.00	25.57
204	253777	195926		100.00	18.53
205	253758	195939		100.00	22.91

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2010 %	Annual Mean concentrations 2010 (ug/m3) Adjusted for tube bias and distance to receptor
206	261565	188211		100.00	**51.37**
207	261561	188222		100.00	**45.70**
208	261541	188215		100.00	**46.18**
209	261534	188198		100.00	**46.87**
210	261516	188207		100.00	**43.61**
211	261501	188188		100.00	**39.49**
212	261486	188200		91.67	27.40
213	261490	188186		100.00	**40.24**
214	261315	188193		100.00	30.17
215	261299	188191		100.00	28.61
216	261276	188190		100.00	30.74
217	260357	188240		100.00	20.60
218	260384	188206		100.00	29.64
219	260419	188172		100.00	24.64
220	261194	188163		100.00	22.70
221	260454	188171		100.00	21.22
222	260469	188182		100.00	24.74
223	266899	197354		91.67	25.61
224	266881	197389		100.00	26.85
225	266861	197432		100.00	27.53
226	266829	197472		100.00	27.33
227	266836	197484		100.00	25.70
228	266779	197578		91.67	24.43
229	266772	197621		100.00	22.56
230	266777	197651		100.00	26.39
231	268802	197666		100.00	23.96
232	266825	197654		100.00	27.63
233	266823	197668		100.00	26.07
234	266858	197671		100.00	24.15
235	266874	197657		100.00	26.97
236	266886	197658		100.00	29.39
237	266885	197676		100.00	25.90
238	266902	197660		100.00	36.38
239	266181	196022		100.00	**37.70**
240	266169	195995		100.00	**40.14**
241	266159	196013		100.00	36.92
242	265655	193423		100.00	**45.21**
243	265474	194949		100.00	**41.64**
244	265466	194930	Y	100.00	**47.92**
245	265448	194922	Y	100.00	**49.14**
246	265425	194927		100.00	33.12
247	265394	194899	Y	83.33	**39.76**
248	265342	194894		100.00	31.71
249	265326	194871	Y	83.33	**40.58**
250	265274	194867		100.00	32.99
251	265263	194845	Y	100.00	**38.17**
252	265226	194830	Y	100.00	33.69
253	265194	194833		100.00	29.98
254	265142	194816		100.00	30.41
255	265098	194825		100.00	29.09
256	264995	194777		100.00	**45.60**
257	254817	189135		100.00	21.32

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Data Capture 2010 %	Annual Mean concentrations 2010 (ug/m3) Adjusted for tube bias and distance to receptor
258	254906	189110		100.00	31.14
259	254949	189113		100.00	20.10
260	254970	189116		100.00	19.06
261	254991	189115		75.00	22.75
262	255056	189118		100.00	12.93
263	262444	193447		100.00	20.38
264	262251	193293		100.00	18.44
265	266375	198023		100.00	33.26
266	266380	198043		100.00	23.98
267	266382	198028		100.00	32.14
268	266419	198053		100.00	31.05
269	266458	198111		100.00	27.34
270	266896	198084		100.00	27.21
271	266879	198078		83.33	35.52
272	266888	198074		91.67	36.22
273	267060	198234		100.00	31.92
274	269487	201451		100.00	25.97
^275	265658	194856	Y	41.67	24.0
276	265610	194871	Y	50.00	**37.77**
277	265596	194875	Y	41.67	**40.91**
278	265573	194882	Y	50.00	**40.18**
279	265555	194926	Y	50.00	**56.48**
^280	265542	194980	Y	50.00	**45.1**
^281	265542	194872	Y	50.00	**39.6**
^282	265540	194840	Y	41.67	33.9
283	265436	195937		50.00	34.58
284	265452	195899		50.00	**37.81**
285	266955	197415		50.00	**40.83**
286	266938	197377		50.00	**37.84**
287	265715	193902	Y	41.67	**38.57**
288	265698	193878	Y	50.00	**37.07**
289	265702	193842	Y	50.00	**41.83**
290	263014	195737	Y	50.00	34.61
291	267952	193121		33.33	**48.98**

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 NO_2 objective. Site 125 now corrected to relevant exposure to flats development above commercial premises.
^ See table 8 below for Correction of NO_2 for distance from road
Sites 275 - 291 presented for information purposes only

The distance to the nearest receptor location is given in brackets after the site name in table 3. The NO_2 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/documents/NO2withDistancefromRoadsCalculatorIssue4.xls

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 NO_2 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 NO_2 concentrations were downloaded from http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html and overlain on a GIS background map within ArcView 3.3. 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 Concentration ug/m^3	Measured 2010 Annual Mean ug/m^3 Corrected for bias	Predicted Annual Mean at Receptor ug/m^3
56	2	*166	17.62	39.12	22.4
58	4	8	14.93	48.12	**41.7**
63	2	6	11.27	30.92	25.9
64	1	3	11.27	54.43	**44.9**
67	2	5	17.75	54.10	**46.3**
69	2	4	17.75	57.38	**50.9**
70	2	7	16.18	29.69	25.7
71	2	*138	16.18	35.29	20.9
92	1	3	11.27	40.05	33.7
112	1	6	14.93	39.01	30.3
125	1	5	17.75	66.26	**50.5**
275	1	3	16.32	26.23	24.0
280	1	2	16.32	49.78	45.1
281	1	3	16.32	46.23	**39.6**
282	1	3	16.32	38.93	33.9

Table 8 – Correction of NO_2 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 NO_2 1-hour objective. As discussed later, Swansea city centre has seen significant change in the road network to accommodate the Metro Service. It is thought reasonable to access 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 results[17] to assess compliance with the 1 hour objective for NO_2 it is clear from the above results that it is likely that the 1 hour objective has been exceeded at sites 59, 125, 126 and 127 whilst

[17] http://www.airquality.co.uk/archive/reports/cat18/0806261511_TG_NO2relationship_report_draft1.pdf

the vast majority of the other sites do not exhibit this tendency as all annual means (those with a full year of monitoring data) are below 60ug/m^3.

Site 59 (annual bias corrected mean of 60.33 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 annual mean returned from the real-time DOAS is 58.6ug/m^3 and with 20 exceedences of the hourly exceedences also being seen within the 250m open path measurement length it is highly likely, given all of the evidence, that exceedences of the1-hour objective will have also occurred at this passive diffusion tube site.

Site 121 is located within the existing AQMA on High Street. 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

Photo 3 – Northern section of High Street showing passive diffusion tube site 121 and surrounding locale

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 6.5% of the flow during 2010. (NB. site affected by road closures during

2010 due to gas main replacement works) If the total LDV composition is taken into consideration, the figure rises to 12.6%. Full details on all GPRS ATC's operated by the authority can be found below within section 3.4. 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 have impacted upon NO_2 concentrations seen in the area. The authority were actively considering relocating a continuous chemiluminescent analyser into this section of High street (see photo 4) as concerns now exist for sections of High Street that fall outside of the existing AQMA exceeding the NO_2 annual mean objective with the distinct possibility of the 1-hour objective also being exceeded. Discussions have commenced with the Housing Association that manage a sheltered youth residence which forms the frontage to passive diffusion tube site 123 on High Street. The intention was to locate a continuous NOx chemiluminescent analyser to the frontage of the property at pavement level. Agreement had been reached to acquire electrical and telemetry feeds from within the premises but due to the budget restraints currently being imposed, there is no budget to purchase either the required enclosure or Teledyne NOx analyser.

Photo 4 – 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 development along the lower section of High Street. One such scheme within the middle section of High Street can be see in photo 4 opposite passive diffusion tube site 123 - the Urban Village development has commenced along High Street during early 2011 and is a mix of commercial and residential dwellings. Passive diffusion tube site123 is opposite the development and is exhibiting a bias corrected annual mean of 51.8ug/m^3. Further details of this scheme can be found in section 5.2.10 but recent alterations to the approved scheme 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.

Site 125 is located in the section of Castle Street that leads into the lower section of High Street. The authority is aware of preliminary proposals for redevelopment of old commercial premises at several locations in this vicinity. One such development has commenced at the junction of High Street/Castle Street and College Street to convert and extend a former nightclub into residential accommodation / flats.

Photo 5 - 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 2010 of 50.5ug/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. For 2010, the distance to receptor correction has been taken to be at the residential development under construction. 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.

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. These sites were identified during the USA 2009 as Newton Road, at this location forms a narrow, congested street (mainly in summertime due toindiscriminate parking etc) with an AADT flow greater than 5000 vehicles.

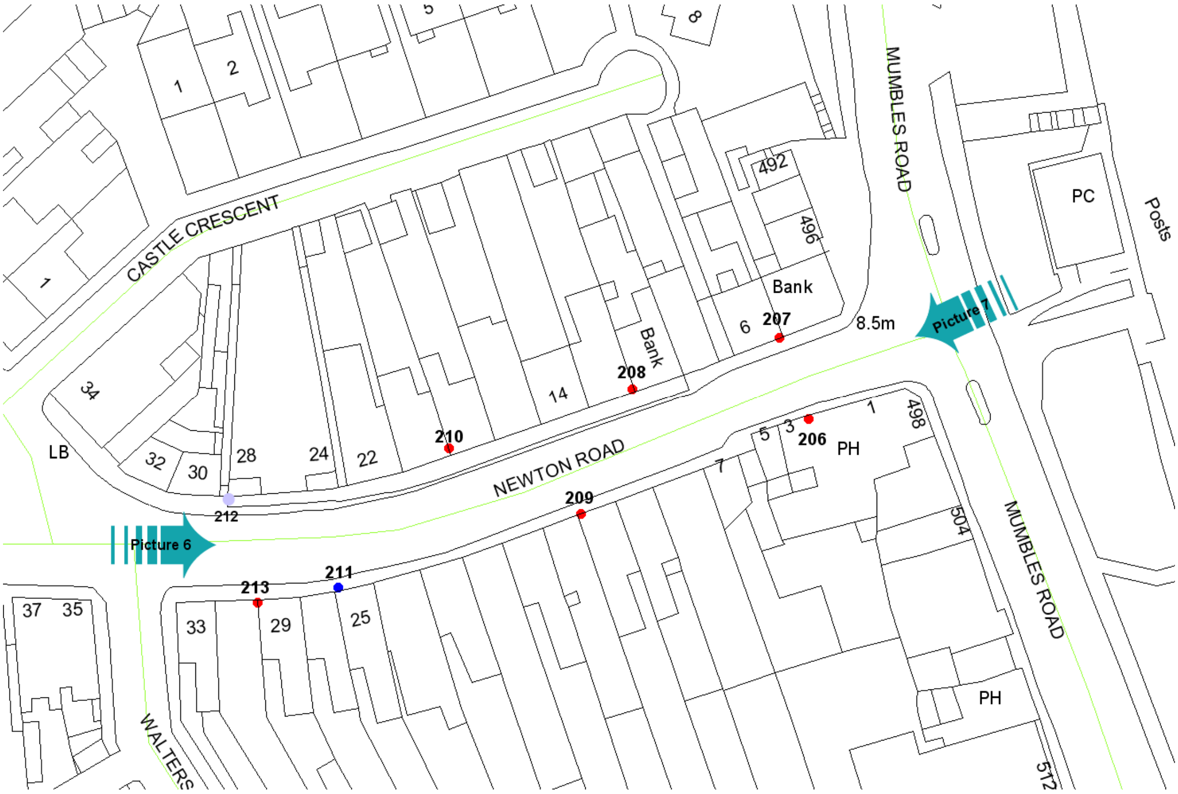
Photo 6 – View looking south down Newton Road towards junction with A483 Mumbles Road and Swansea Bay

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.

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

Photo 7 – View looking north up Newton Road

the passive diffusion tubes may be hindered under these circumstances with the returned annual means at sites 207, 208 and 210 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 7) do not suffer from a similar situation, with sites 206, 209 and 213 exceeding the annual mean objective. Site 211 is within 0.55ug/m^3 of exceeding the annual mean objective so in practical terms it can also be taken to exhibit probable exceedence of the annual mean objective. Site 212 returns an annual mean of 27.4 ug/m^3. Plan 1 below indicates the monitoring undertaken and locations.



Plan 1 – Newton Road Passive diffusion Tube Monitoring Sites

Table 9 details the annual NO_2 bias corrected annual means for sites 1-274 during the period 2005-2010. Whilst there was evidence of a slight overall downward trend with annual mean concentrations between 2005 and 2009, the vast majority of sites have bucked this trend during 2010 and have shown an increase in concentrations – in some cases the increase has been marked. This increase may be attributable to the atypical start to the winter months with cold calm conditions prevailing for long periods. This period can be clearly seen with the hourly exceedences returned by the Hafod DOAS along Neath Road, Hafod during November/December 2010.

Whilst the vast majority of sites have seen an overall increase in annual mean concentrations, two sites reported here have returned what may be seen as surprising decreases given results from previous years. These two sites have been discussed above. Site 121 and sites 125 both along Castle Street/High Street in the city centre and subject to relatively high bus/L/M/HGV flows have returned annual mean concentrations during 2009 of 61.19ug/m^3 and 59.48ug/m^3 respectively, whilst during 2010, returned lower annual means of 52.33 ug/m^3 and 50.5 ug/m^3 respectively. Site 125 can be explained by the change in distance to receptor calculation performed for 2010 which now corrects to residential dwellings under construction within the former nightclub behind the site, but no explanation is at hand for site 121.

A map of those sites failing the annual mean objective and those with the potential to fail the annual mean objective from the 2010 data is given below as map 11.

As numerous sites have continued to exhibit annual mean concentrations below 30ug/m3 for several years, a decision has been 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.

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations (µg/m³) Adjusted for bias					
				2005	2006	2007	2008	2009	2010
1	262046	196420		29.0	25.7	26.7	24.2	25.42	30.83
2	262095	196500		24.8	17.6	18.1	16.3	17.73	20.08
3	262161	196513		29.9	21.3	22.2	20.1	22.79	23.95
4	262497	192857	Y	**39.2**	33.7	33.9	30.8	33.25	35.07
5	262548	192943	Y	**43.5**	34.0	35.1	32.2	34.22	**42.06**
6	262612	192995	Y	35.3	31.9	32.0	29.8	28.71	34.62
7	262691	192852	Y	**56.1**	**51.1**	**50.0**	**48.5**	**53.02**	**58.76**
8	262990	195820	Y	**47.9**	**42.2**	**46.0**	**42.4**	**44.59**	**46.81**
9	263190	195205		**37.6**	29.9	30.3	28.6	29.00	31.41
10	263219	195513	Y	33.3	25.6	24.8	24.2	26.03	29.98
11	263344	195474	Y	**45.2**	**40.8**	**39.1**	**37.8**	**37.08**	**43.92**
12	263680	195103	Y	**49.7**	**41.8**	**42.3**	**40.7**	**43.92**	**48.15**
13	264830	193066		34.7	29.8	30.8	28.9	29.90	32.83
14	265285	192696		34.5	25.2	30.0	25.2	25.23	32.66
15	265334	192608		36.6	25.7	27.7	26.1	25.73	32.76
16	265339	192534		36.9	30.8	34.5	30.7	30.73	**38.61**
17	265496	192408		28.1	22.4	26.0	22.8	21.22	30.40
18	265526	195807	Y	**52.4**	**43.1**	**46.4**	**44.9**	**47.87**	**51.23**
19	265597	194061	Y	**56.1**	**44.9**	**48.2**	**42.6**	**44.92**	**52.20**
20	265594	194175	Y	**52.0**	**40.7**	**40.7**	**39.9**	**42.42**	**45.51**
21	265634	195316	Y	**38.3**	32.4	32.8	31.7	32.04	33.65
22	265682	195374	Y	**44.3**	36.6	36.6	35.7	34.57	**37.93**
23	265728	195494	Y	**40.1**	32.6	36.0	34.1	33.57	36.53
24	265760	192420		28.3	21.7	23.6	20.6	19.65	27.50
25	265845	195547	Y	**37.1**	29.6	28.9	27.7	29.82	31.43
26	265876	194318	Y	**42.4**	**43.7**	**42.1**	**41.7**	**40.20**	**45.81**
27	265922	194428	Y	**55.4**	**43.5**	**41.3**	**37.8**	**43.14**	**45.39**
28	265949	194891	Y	**39.9**	28.5	31.6	29.4	30.18	33.48
29	265973	195222	Y	**70.9**	**58.4**	**58.4**	**56.3**	**52.00**	**53.38**
30	266080	192516		31.4	22.3	24.6	20.1	21.35	25.92
31	266153	196003		**40.0**	33.9	33.4	32.4	32.39	**37.79**
32	266209	193867		**39.1**	32.6	34.0	31.3	32.11	**38.82**
33	266236	193488		**42.8**	32.4	32.7	31.0	30.86	**38.09**
34	266272	196168		**38.7**	35.1	36.1	32.7	31.18	**39.60**
35	266314	193298		**49.3**	**39.0**	**38.6**	35.9	36.23	**40.67**
36	266455	193300		**42.7**	33.0	34.0	31.0	30.03	34.42
37	266515	193213		35.7	26.1	26.5	24.2	23.88	28.33
38	266662	193181		**42.2**	33.7	35.5	33.1	35.34	**39.05**
39	266905	193271		**38.5**	27.4	26.7	25.2	25.70	28.35
40	266951	198278		34.8	28.1	29.7	28.2	28.71	31.80
41	266953	198085		**47.3**	**39.7**	33.4	**37.3**	**41.59**	**41.38**
42	267084	198274		34.1	28.4	31.3	34.8	**43.17**	**38.59**
43	267093	198063		**40.4**	35.8	35.1	34.4	36.19	**42.60**
44	267639	199543		32.8	29.9	28.3	29.0	29.71	28.37
45	267661	199451		**42.9**	34.6	**39.4**	35.5	**37.79**	**43.87**
46	267752	193218		23.1	17.0	16.7	16.0	15.91	17.71
47	267908	199773		26.9	24.4	24.1	23.9	25.19	26.83
48	268011	193101		31.3	24.8	24.3	25.2	23.88	27.08
49	268501	197329		32.8	28.7	29.9	29.6	29.43	32.35
50	268530	197419		**48.4**	**39.4**	**39.7**	35.3	**37.99**	**41.14**
51	268593	197434		36.9	32.3	30.7	32.2	30.98	34.19

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations (µg/m³) Adjusted for bias					
				2005	2006	2007	2008	2009	2010
52	268643	197245		26.0	27.3	20.9	22.5	24.20	24.42
53	268652	197508		30.0	23.7	23.4	22.9	23.67	25.93
54	268693	197416		**40.1**	**38.6**	34.3	34.6	35.44	33.14
55	268789	197420		**39.9**	**37.1**	36.2	35.3	33.50	36.93
56	269306	198661		**42.4**	**39.4**	**39.1**	**23**	22.80	22.4
57	269395	199042		21.3	16.3	15.9	15.4	15.51	15.73
58	264052	192884		**52.0**	**41.3**	**41.7**	**33.6**	34.90	**41.7**
59	265918	194463	Y	**69.0**	**56.8**	**60.5**	**53.9**	**49.76**	**60.33**
60	265036	192931		-	**37.4**	**38.7**	**37.1**	35.30	**42.75**
61	264959	192878		-	**38.3**	**38.2**	**38.0**	**38.24**	**40.21**
62	266698	195335		-	-	**38.4**	29.0	17.82	26.83
63	262675	192775	Y	-	-	35.4	**21.6**	22.00	25.9
64	262719	192840	Y	-	-	**65.1**	**42.4**	**40.10**	**44.9**
65	262735	192855	Y	-	-	**37.1**	27.0	26.47	29.59
66	262802	192829	Y	-	-	**44.3**	32.8	30.98	36.04
67	265903	193683	Y	-	-	**69.3**	**38.2**	**39.80**	**46.3**
68	265573	193432		-	-	**42.0**	34.4	34.64	**41.51**
69	265543	193450		-	-	**60.8**	**42.1**	**43.60**	**50.9**
70	266649	195435		-	-	**38.1**	23.3	22.90	25.7
71	266514	195485		-	-	**41.8**	19.9	19.80	20.9
72	264091	192900		-	-	-	25.1	23.86	31.40
73	264138	192868		-	-	-	34.0	34.62	35.36
74	264163	192853		-	-	-	28.9	28.76	32.85
75	264072	192869		-	-	-	35.1	**42.09**	**45.19**
76	263968	192880		-	-	-	26.1	26.30	31.70
77	263856	192931		-	-	-	22.8	23.14	26.89
78	263819	192948		-	-	-	27.5	27.83	33.17
79	263842	192896		-	-	-	33.0	33.95	**37.13**
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
83	262785	192838	Y	-	-	-	29.8	28.60	35.51
84	262714	192839	Y	-	-	-	**37.3**	**37.57**	**39.42**
85	262702	192847	Y	-	-	-	**38.6**	**39.58**	**41.89**
86	262704	192865	Y	-	-	-	30.8	28.90	33.25
87	262697	192798	Y	-	-	-	21.3	21.16	23.93
88	262605	192916	Y	-	-	-	**37.3**	35.21	**38.27**
89	262587	192956	Y	-	-	-	22.4	24.17	25.99
90	262631	192996	Y	-	-	-	34.2	35.74	**37.93**
91	262534	192950	Y	-	-	-	31.7	30.62	**37.50**
92	262545	192869	Y	-	-	-	32.0	34.62	33.7
93	263406	195534		-	-	-	29.9	30.94	33.38
94	263444	195572		-	-	-	29.6	31.05	30.34
95	262815	196090		-	-	-	29.1	28.88	34.29
96	262922	195950		-	-	-	27.9	28.99	31.05
97	262946	195902	Y	-	-	-	36.6	33.84	**39.95**
98	263142	195548	Y	-	-	-	**40.5**	**40.62**	**41.01**
99	263387	195332	Y	-	-	-	32.5	29.16	**37.64**
100	263470	195250	Y	-	-	-	28.7	28.13	31.78
101	263843	195047	Y	-	-	-	29.8	28.27	30.97
102	266379	193307		-	-	-	29.4	29.99	33.13

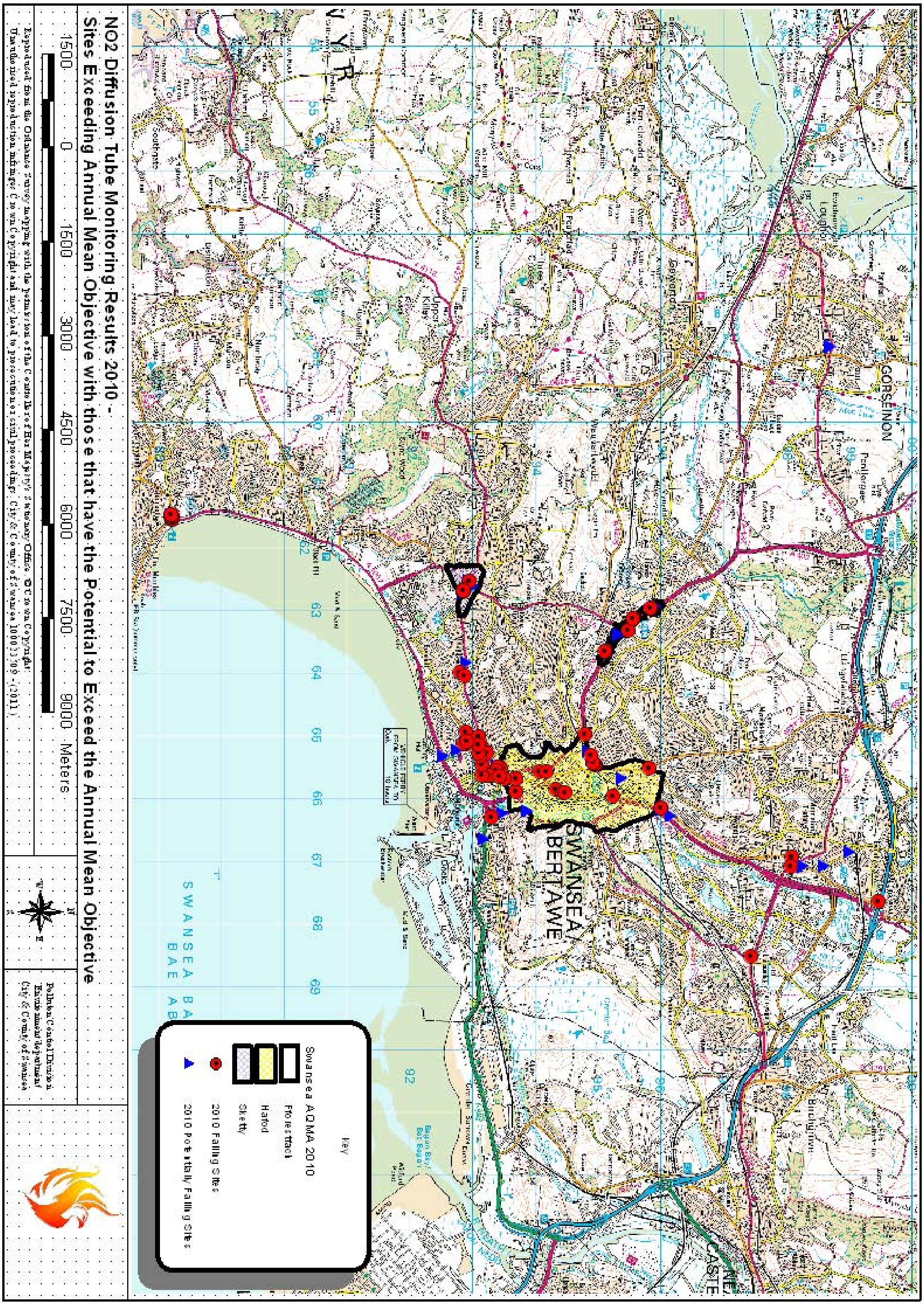
Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations (μg/m^3) Adjusted for bias					
				2005	2006	2007	2008	2009	2010
103	268526	197359		-	-	-	33.4	31.06	35.11
104	268538	197389		-	-	-	29.4	28.41	31.70
105	268562	197472		-	-	-	32.3	30.11	30.33
106	268496	197476		-	-	-	33.8	33.64	34.66
107	268765	197420		-	-	-	35.0	34.27	36.16
108	267608	199461		-	-	-	31.4	30.10	35.76
109	267510	199487		-	-	-	28.1	27.06	32.44
110	267369	199521		-	-	-	27.7	26.18	30.46
111	267705	199426		-	-	-	32.9	30.63	34.62
112	264868	192814		-	-	-	26.0	26.20	30.3
113	264654	192662		-	-	-	21.8	28.76	36.16
114	264622	192971		-	-	-	32.5	33.19	33.92
115	265031	193097		-	-	-	**38.8**	**40.48**	**45.67**
116	265192	193138		-	-	-	**41.5**	**42.87**	**48.73**
117	265288	193211		-	-	-	**39.4**	**38.32**	**47.27**
118	265483	193385		-	-	-	29.3	32.02	**38.58**
119	265522	193390		-	-	-	32.2	35.43	**40.81**
120	265570	193366		-	-	-	**46.5**	**44.16**	**57.75**
121	265706	193662	Y	-	-	-	**79.3**	**61.19**	**52.33**
122	265694	193505		-	-	-	**39.5**	**37.21**	**47.39**
123	265655	193423		-	-	-	**54.4**	**51.27**	**51.80**
124	265651	193253		-	-	-	**44.1**	**46.68**	**51.72**
125	265641	193162		-	-	-	**51.4**	**59.48**	**50.5**
126	265475	193144		-	-	-	**38.9**	**48.41**	**62.03**
127	265348	193110		-	-	-	**40.9**	**37.71**	**61.83**
128	265297	193085		-	-	-	**41.1**	**42.82**	**51.71**
129	265153	193098		-	-	-	36.1	35.34	**40.51**
130	265139	192912		-	-	-	**53.5**	**42.92**	**43.92**
131	265137	192846		-	-	-	**58.3**	**46.69**	**50.19**
132	265229	192753		-	-	-	32.7	32.39	**39.43**
133	265350	192566		-	-	-	26.8	27.05	33.15
134	265113	192903		-	-	-	**50.5**	**45.02**	**47.74**
135	262605	192916	Y	-	-	-	-	-	35.60
136	262612	192995	Y	-	-	-	-	-	33.32
137	262631	192996	Y	-	-	-	-	-	**37.13**
138	266779	199246		-	-	-	-	-	26.22
139	266867	199030		-	-	-	-	-	31.87
140	266863	199009		-	-	-	-	-	**39.36**
141	266979	198772		-	-	-	-	-	30.00
142	267017	198710		-	-	-	-	-	33.45
143	267089	198608		-	-	-	-	-	**37.32**
144	267141	198591		-	-	-	-	-	30.26
145	267139	198578		-	-	-	-	-	33.83
146	267156	198571		-	-	-	-	-	35.76
147	267165	198580		-	-	-	-	-	32.97
148	267170	198564		-	-	-	-	-	33.86
149	267204	198561		-	-	-	-	-	31.17
150	267205	198545		-	-	-	-	-	31.42
151	267192	198518		-	-	-	-	-	30.92
152	267081	198268		-	-	-	-	-	29.60
153	268845	201137		-	-	-	-	-	28.20

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations ($\mu g/m^3$) Adjusted for bias					
				2005	2006	2007	2008	2009	2010
154	268870	201267		-	-	-	-	-	27.98
155	269009	201280		-	-	-	-	-	30.76
156	269059	201296		-	-	-	-	-	31.79
157	269173	201355		-	-	-	-	-	28.79
158	269480	201441		-	-	-	-	-	30.89
159	269171	201620		-	-	-	-	-	31.63
160	269049	201744		-	-	-	-	-	34.94
161	268938	201929		-	-	-	-	-	19.77
162	259553	203379		-	-	-	-	-	31.59
163	259287	203556		-	-	-	-	-	27.11
164	259195	203667		-	-	-	-	-	31.90
165	259149	203675		-	-	-	-	-	24.52
166	259148	203690		-	-	-	-	-	28.89
167	259126	203700		-	-	-	-	-	25.73
168	259115	203705		-	-	-	-	-	23.26
169	259013	203747		-	-	-	-	-	24.97
170	258971	203797		-	-	-	-	-	19.95
171	258917	203826		-	-	-	-	-	28.08
172	258887	203859		-	-	-	-	-	26.00
173	259250	203708		-	-	-	-	-	20.96
174	259253	203660		-	-	-	-	-	19.60
175	259251	203638		-	-	-	-	-	18.05
176	258872	203691		-	-	-	-	-	15.00
177	258896	203697		-	-	-	-	-	14.87
178	258986	203684		-	-	-	-	-	14.94
179	259059	197831		-	-	-	-	-	29.13
180	259064	197781		-	-	-	-	-	32.43
181	259010	197817		-	-	-	-	-	27.49
182	259050	197790		-	-	-	-	-	30.96
183	259036	197795		-	-	-	-	-	34.37
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**
198	258811	198701		-	-	-	-	-	**38.49**
199	254703	195764		-	-	-	-	-	34.16
200	254582	195821		-	-	-	-	-	27.71
201	254522	195859		-	-	-	-	-	30.47
202	254437	195879		-	-	-	-	-	23.13
203	254294	195885		-	-	-	-	-	25.57
204	253777	195926		-	-	-	-	-	18.53

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations ($\mu g/m^3$) Adjusted for bias					
				2005	2006	2007	2008	2009	2010
205	253758	195939		-	-	-	-	-	22.91
206	261565	188211		-	-	-	-	-	**51.37**
207	261561	188222		-	-	-	-	-	**45.70**
208	261541	188215		-	-	-	-	-	**46.18**
209	261534	188198		-	-	-	-	-	**46.87**
210	261516	188207		-	-	-	-	-	**43.61**
211	261501	188188		-	-	-	-	-	**39.49**
212	261486	188200		-	-	-	-	-	27.40
213	261490	188186		-	-	-	-	-	**40.24**
214	261315	188193		-	-	-	-	-	30.17
215	261299	188191		-	-	-	-	-	28.61
216	261276	188190		-	-	-	-	-	30.74
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
239	266181	196022		-	-	-	-	-	**37.70**
240	266169	195995		-	-	-	-	-	**40.14**
241	266159	196013		-	-	-	-	-	36.92
242	265655	193423		-	-	-	-	-	**45.21**
243	265474	194949		-	-	-	-	-	**41.64**
244	265466	194930	Y	-	-	-	-	-	**47.92**
245	265448	194922	Y	-	-	-	-	-	**49.14**
246	265425	194927		-	-	-	-	-	33.12
247	265394	194899	Y	-	-	-	-	-	**39.76**
248	265342	194894		-	-	-	-	-	31.71
249	265326	194871	Y	-	-	-	-	-	**40.58**
250	265274	194867		-	-	-	-	-	32.99
251	265263	194845	Y	-	-	-	-	-	**38.17**
252	265226	194830	Y	-	-	-	-	-	33.69
253	265194	194833		-	-	-	-	-	29.98
254	265142	194816		-	-	-	-	-	30.41
255	265098	194825		-	-	-	-	-	29.09

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean concentrations ($\mu g/m^3$) Adjusted for bias					
				2005	2006	2007	2008	2009	2010
256	264995	194777		-	-	-	-	-	**45.60**
257	254817	189135		-	-	-	-	-	21.32
258	254906	189110		-	-	-	-	-	31.14
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
266	266380	198043		-	-	-	-	-	23.98
267	266382	198028		-	-	-	-	-	32.14
268	266419	198053		-	-	-	-	-	31.05
269	266458	198111		-	-	-	-	-	27.34
270	266896	198084		-	-	-	-	-	27.21
271	266879	198078		-	-	-	-	-	35.52
272	266888	198074		-	-	-	-	-	36.22
273	267060	198234		-	-	-	-	-	31.92
274	269487	201451		-	-	-	-	-	25.97

Table 9 – NO_2 Annual Mean concentrations 2005- 2010



Map 11- Passive NO_2 Monitoring locations failing or having potential to fail annual mean objective

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 has been updated during January 2010 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

Table 10 indicates predicted concentrations during 2012 - 2020 at all of the passive NO_2 diffusion tube sites within Swansea. Where applicable, the correction derived for distance from the roadside measurement location to the nearest receptor location is used as outlined within table 8 above to calculate the future year projections.

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean Adjusted for bias (µg/m^3) and distance to receptor	Future Years Projections					
				2010	2012	2013	2014	2015	2017	2020
1	262046	196420		30.83	27.24	25.46	23.68	21.90	19.38	15.56
2	262095	196500		20.08	17.74	16.58	15.42	14.26	12.62	10.14
3	262161	196513		23.95	21.16	19.78	18.39	17.01	15.06	12.09
4	262497	192857	Y	35.07	30.98	28.96	26.93	24.91	22.05	17.70
5	262548	192943	Y	**42.06**	**37.16**	34.73	32.30	29.88	26.44	21.23
6	262612	192995	Y	34.62	30.58	28.59	26.59	24.59	21.76	17.48
7	262691	192852	Y	**58.76**	**51.91**	**48.52**	**45.13**	**41.74**	36.94	29.66
8	262990	195820	Y	**46.81**	**41.35**	**38.65**	35.95	33.25	29.43	23.63
9	263190	195205		31.41	27.75	25.94	24.12	22.31	19.74	15.86
10	263219	195513	Y	29.98	26.48	24.76	23.03	21.30	18.85	15.13
11	263344	195474	Y	**43.92**	**38.80**	36.27	33.73	31.20	27.61	22.17
12	263680	195103	Y	**48.15**	**42.54**	**39.76**	36.98	34.20	30.27	24.31
13	264830	193066		32.83	29.00	27.11	25.21	23.32	20.64	16.57
14	265285	192696		32.66	28.85	26.97	25.08	23.20	20.53	16.49
15	265334	192608		32.76	28.94	27.05	25.16	23.27	20.59	16.54
16	265339	192534		**38.61**	34.11	31.88	29.65	27.43	24.27	19.49
17	265496	192408		30.40	26.86	25.10	23.35	21.59	19.11	15.35
18	265526	195807	Y	**51.23**	**45.26**	**42.30**	**39.35**	36.39	32.20	25.86
19	265597	194061	Y	**52.20**	**46.11**	**43.10**	**40.09**	**37.08**	32.81	26.35
20	265594	194175	Y	**45.51**	**40.20**	**37.58**	34.95	32.33	28.61	22.97
21	265634	195316	Y	33.65	29.73	27.79	25.84	23.90	21.15	16.99
22	265682	195374	Y	**37.93**	33.51	31.32	29.13	26.94	23.84	19.15
23	265728	195494	Y	36.53	32.27	30.16	28.06	25.95	22.96	18.44
24	265760	192420		27.50	24.29	22.71	21.12	19.53	17.29	13.88
25	265845	195547	Y	31.43	27.77	25.95	24.14	22.33	19.76	15.87
26	265876	194318	Y	**45.81**	**40.47**	**37.83**	35.18	32.54	28.80	23.13
27	265922	194428	Y	**45.39**	**40.10**	**37.48**	34.86	32.24	28.53	22.91
28	265949	194891	Y	33.48	29.58	27.65	25.71	23.78	21.05	16.90
29	265973	195222	Y	**53.38**	**47.16**	**44.08**	**41.00**	**37.92**	33.55	26.95
30	266080	192516		25.92	22.90	21.40	19.91	18.41	16.29	13.08
31	266153	196003		**37.79**	33.38	31.20	29.02	26.84	23.76	19.08
32	266209	193867		**38.82**	34.29	32.05	29.81	27.58	24.40	19.60

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean Adjusted for bias (µg/m3) and distance to receptor	Future Years Projections					
				2010	2012	2013	2014	2015	2017	2020
33	266236	193488		**38.09**	33.65	31.45	29.25	27.06	23.94	19.23
34	266272	196168		**39.60**	34.98	32.70	30.41	28.13	24.89	19.99
35	266314	193298		**40.67**	35.93	33.58	31.24	28.89	25.57	20.53
36	266455	193300		34.42	30.41	28.42	26.44	24.45	21.64	17.38
37	266515	193213		28.33	25.03	23.39	21.76	20.12	17.81	14.30
38	266662	193181		**39.05**	34.50	32.24	29.99	27.74	24.55	19.71
39	266905	193271		28.35	25.04	23.41	21.77	20.14	17.82	14.31
40	266951	198278		31.80	28.09	26.26	24.42	22.59	19.99	16.05
41	266953	198085		**41.38**	36.56	34.17	31.78	29.39	26.01	20.89
42	267084	198274		**38.59**	34.09	31.86	29.64	27.41	24.26	19.48
43	267093	198063		**42.60**	**37.63**	35.18	32.72	30.26	26.78	21.50
44	267639	199543		28.37	25.06	23.43	21.79	20.15	17.83	14.32
45	267661	199451		**43.87**	**38.76**	36.22	33.69	31.16	27.58	22.15
46	267752	193218		17.71	15.65	14.62	13.60	12.58	11.13	8.94
47	267908	199773		26.83	23.70	22.15	20.61	19.06	16.87	13.54
48	268011	193101		27.08	23.92	22.36	20.80	19.24	17.02	13.67
49	268501	197329		32.35	28.58	26.71	24.85	22.98	20.34	16.33
50	268530	197419		**41.14**	36.34	33.97	31.60	29.22	25.86	20.77
51	268593	197434		34.19	30.20	28.23	26.26	24.29	21.49	17.26
52	268643	197245		24.42	21.57	20.16	18.76	17.35	15.35	12.33
53	268652	197508		25.93	22.91	21.41	19.91	18.42	16.30	13.09
54	268693	197416		33.14	29.28	27.36	25.45	23.54	20.83	16.73
55	268789	197420		36.93	32.62	30.49	28.36	26.23	23.21	18.64
56	269306	198661		22.4	19.79	18.50	17.20	15.91	14.08	11.31
57	269395	199042		15.73	13.90	12.99	12.08	11.17	9.89	7.94
58	264052	192884		**41.7**	36.84	34.43	32.03	29.62	26.21	21.05
59	265918	194463	Y	**60.33**	**53.30**	**49.82**	**46.34**	**42.85**	**37.92**	30.46
60	265036	192931		**42.75**	**37.77**	35.30	32.83	30.37	26.87	21.58
61	264959	192878		**40.21**	35.52	33.20	30.88	28.56	25.28	20.30
62	266698	195335		26.83	23.70	22.15	20.61	19.06	16.87	13.54
63	262675	192775	Y	25.9	22.88	21.39	19.89	18.40	16.28	13.07
64	262719	192840	Y	**44.9**	**39.67**	**37.07**	34.48	31.89	28.22	22.67
65	262735	192855	Y	29.59	26.14	24.43	22.73	21.02	18.60	14.94
66	262802	192829	Y	36.04	31.84	29.76	27.68	25.60	22.65	18.19
67	265903	193683	Y	**46.3**	**40.90**	**38.23**	35.56	32.89	29.10	23.37
68	265573	193432		**41.51**	36.67	34.28	31.88	29.49	26.09	20.95
69	265543	193450		**50.9**	**44.97**	**42.03**	**39.09**	36.16	32.00	25.69
70	266649	195435		25.7	22.70	21.22	19.74	18.26	16.16	12.97
71	266514	195485		20.9	18.46	17.26	16.05	14.85	13.14	10.55
72	264091	192900		31.40	27.74	25.93	24.12	22.30	19.74	15.85
73	264138	192868		35.36	31.24	29.20	27.16	25.12	22.23	17.85
74	264163	192853		32.85	29.02	27.12	25.23	23.33	20.65	16.58
75	264072	192869		**45.19**	**39.92**	**37.31**	34.71	32.10	28.41	22.81
76	263968	192880		31.70	28.00	26.18	24.35	22.52	19.93	16.00
77	263856	192931		26.89	23.75	22.20	20.65	19.10	16.90	13.57
78	263819	192948		33.17	29.30	27.39	25.48	23.56	20.85	16.74
79	263842	192896		**37.13**	32.80	30.66	28.52	26.37	23.34	18.74
80	263558	192833		26.53	23.44	21.91	20.38	18.85	16.68	13.39
81	262940	192775	Y	27.79	24.55	22.95	21.34	19.74	17.47	14.03
82	262851	192805	Y	28.32	25.02	23.38	21.75	20.12	17.80	14.30
83	262785	192838	Y	35.51	31.37	29.32	27.27	25.22	22.32	17.93
84	262714	192839	Y	**39.42**	34.82	32.55	30.28	28.00	24.78	19.90

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean Adjusted for bias (µg/m³) and distance to receptor	Future Years Projections					
				2010	2012	2013	2014	2015	2017	2020
85	262702	192847	Y	**41.89**	**37.01**	34.59	32.17	29.76	26.33	21.15
86	262704	192865	Y	33.25	29.37	27.46	25.54	23.62	20.90	16.78
87	262697	192798	Y	23.93	21.14	19.76	18.38	17.00	15.04	12.08
88	262605	192916	Y	**38.27**	33.81	31.60	29.39	27.18	24.06	19.32
89	262587	192956	Y	25.99	22.96	21.46	19.96	18.46	16.34	13.12
90	262631	192996	Y	**37.93**	33.51	31.32	29.13	26.94	23.84	19.15
91	262534	192950	Y	**37.50**	33.13	30.96	28.80	26.64	23.57	18.93
92	262545	192869	Y	33.7	29.77	27.83	25.88	23.94	21.18	17.01
93	263406	195534		33.38	29.49	27.56	25.64	23.71	20.98	16.85
94	263444	195572		30.34	26.80	25.05	23.30	21.55	19.07	15.32
95	262815	196090		34.29	30.29	28.31	26.34	24.36	21.55	17.31
96	262922	195950		31.05	27.43	25.64	23.85	22.06	19.52	15.67
97	262946	195902	Y	**39.95**	35.29	32.99	30.68	28.38	25.11	20.17
98	263142	195548	Y	**41.01**	36.23	33.86	31.50	29.13	25.78	20.70
99	263387	195332	Y	**37.64**	33.25	31.08	28.91	26.74	23.66	19.00
100	263470	195250	Y	31.78	28.07	26.24	24.41	22.57	19.98	16.04
101	263843	195047	Y	30.97	27.36	25.57	23.79	22.00	19.47	15.63
102	266379	193307		33.13	29.27	27.36	25.44	23.53	20.83	16.72
103	268526	197359		35.11	31.02	28.99	26.97	24.94	22.07	17.72
104	268538	197389		31.70	28.00	26.18	24.35	22.52	19.93	16.00
105	268562	197472		30.33	26.79	25.04	23.29	21.54	19.07	15.31
106	268496	197476		34.66	30.62	28.62	26.62	24.62	21.79	17.50
107	268765	197420		36.16	31.94	29.86	27.77	25.69	22.73	18.25
108	267608	199461		35.76	31.59	29.53	27.46	25.40	22.48	18.05
109	267510	199487		32.44	28.66	26.79	24.91	23.04	20.39	16.38
110	267369	199521		30.46	26.91	25.15	23.39	21.64	19.15	15.38
111	267705	199426		34.62	30.58	28.59	26.59	24.59	21.76	17.48
112	264868	192814		30.3	26.77	25.02	23.27	21.52	19.05	15.30
113	264654	192662		36.16	31.94	29.86	27.77	25.69	22.73	18.25
114	264622	192971		33.92	29.97	28.01	26.05	24.09	21.32	17.12
115	265031	193097		**45.67**	**40.35**	**37.71**	35.08	32.44	28.71	23.05
116	265192	193138		**48.73**	**43.05**	**40.24**	**37.43**	34.61	30.63	24.60
117	265288	193211		**47.27**	**41.76**	**39.03**	36.30	33.58	29.71	23.86
118	265483	193385		**38.58**	34.08	31.86	29.63	27.40	24.25	19.48
119	265522	193390		**40.81**	36.05	33.70	31.34	28.99	25.65	20.60
120	265570	193366		**57.75**	**51.02**	**47.69**	**44.35**	**41.02**	36.30	29.15
121	265706	193662	Y	**52.33**	**46.23**	**43.21**	**40.19**	**37.17**	32.89	26.42
122	265694	193505		**47.39**	**41.86**	**39.13**	36.40	33.66	29.79	23.92
123	265655	193423		**51.80**	**45.76**	**42.77**	**39.78**	36.80	32.56	26.15
124	265651	193253		**51.72**	**45.69**	**42.71**	**39.72**	36.74	32.51	26.11
125	265641	193162		**50.5**	**44.61**	**41.70**	**38.79**	35.87	31.74	25.49
126	265475	193144		**62.03**	**54.80**	**51.22**	**47.64**	**44.06**	**38.99**	31.31
127	265348	193110		**61.83**	**54.62**	**51.05**	**47.49**	**43.92**	**38.87**	31.21
128	265297	193085		**51.71**	**45.68**	**42.70**	**39.71**	36.73	32.51	26.10
129	265153	193098		**40.51**	35.79	33.45	31.11	28.78	25.46	20.45
130	265139	192912		**43.92**	**38.80**	36.27	33.73	31.20	27.61	22.17
131	265137	192846		**50.19**	**44.34**	**41.44**	**38.55**	35.65	31.55	25.34
132	265229	192753		**39.43**	34.83	32.56	30.28	28.01	24.79	19.90
133	265350	192566		33.15	29.29	27.37	25.46	23.55	20.84	16.73
134	265113	192903		**47.74**	**42.17**	**39.42**	36.67	33.91	30.01	24.10
135	262605	192916	Y	35.60	31.45	29.40	27.34	25.29	22.38	17.97
136	262612	192995	Y	33.32	29.44	27.51	25.59	23.67	20.95	16.82

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean Adjusted for bias (µg/m3) and distance to receptor	Future Years Projections					
				2010	2012	2013	2014	2015	2017	2020
137	262631	192996	Y	**37.13**	32.80	30.66	28.52	26.37	23.34	18.74
138	266779	199246		26.22	23.16	21.65	20.14	18.63	16.48	13.24
139	266867	199030		31.87	28.15	26.32	24.48	22.64	20.03	16.09
140	266863	199009		**39.36**	34.77	32.50	30.23	27.96	24.74	19.87
141	266979	198772		30.00	26.50	24.77	23.04	21.31	18.86	15.14
142	267017	198710		33.45	29.55	27.62	25.69	23.76	21.03	16.89
143	267089	198608		**37.32**	32.97	30.82	28.66	26.51	23.46	18.84
144	267141	198591		30.26	26.73	24.99	23.24	21.49	19.02	15.28
145	267139	198578		33.83	29.89	27.93	25.98	24.03	21.27	17.08
146	267156	198571		35.76	31.59	29.53	27.46	25.40	22.48	18.05
147	267165	198580		32.97	29.13	27.22	25.32	23.42	20.73	16.64
148	267170	198564		33.86	29.91	27.96	26.01	24.05	21.28	17.09
149	267204	198561		31.17	27.54	25.74	23.94	22.14	19.59	15.73
150	267205	198545		31.42	27.76	25.94	24.13	22.32	19.75	15.86
151	267192	198518		30.92	27.32	25.53	23.75	21.96	19.44	15.61
152	267081	198268		29.60	26.15	24.44	22.73	21.03	18.61	14.94
153	268845	201137		28.20	24.91	23.29	21.66	20.03	17.73	14.24
154	268870	201267		27.98	24.72	23.10	21.49	19.88	17.59	14.12
155	269009	201280		30.76	27.17	25.40	23.62	21.85	19.34	15.53
156	269059	201296		31.79	28.08	26.25	24.42	22.58	19.98	16.05
157	269173	201355		28.79	25.43	23.77	22.11	20.45	18.10	14.53
158	269480	201441		30.89	27.29	25.51	23.72	21.94	19.42	15.59
159	269171	201620		31.63	27.94	26.12	24.29	22.47	19.88	15.97
160	269049	201744		34.94	30.87	28.85	26.83	24.82	21.96	17.64
161	268938	201929		19.77	17.47	16.32	15.18	14.04	12.43	9.98
162	259553	203379		31.59	27.91	26.08	24.26	22.44	19.86	15.95
163	259287	203556		27.11	23.95	22.39	20.82	19.26	17.04	13.69
164	259195	203667		31.90	28.18	26.34	24.50	22.66	20.05	16.10
165	259149	203675		24.52	21.66	20.25	18.83	17.42	15.41	12.38
166	259148	203690		28.89	25.52	23.86	22.19	20.52	18.16	14.58
167	259126	203700		25.73	22.73	21.25	19.76	18.28	16.17	12.99
168	259115	203705		23.26	20.55	19.21	17.86	16.52	14.62	11.74
169	259013	203747		24.97	22.06	20.62	19.18	17.74	15.70	12.61
170	258971	203797		19.95	17.62	16.47	15.32	14.17	12.54	10.07
171	258917	203826		28.08	24.81	23.19	21.57	19.95	17.65	14.18
172	258887	203859		26.00	22.97	21.47	19.97	18.47	16.34	13.13
173	259250	203708		20.96	18.52	17.31	16.10	14.89	13.18	10.58
174	259253	203660		19.60	17.31	16.18	15.05	13.92	12.32	9.89
175	259251	203638		18.05	15.95	14.90	13.86	12.82	11.35	9.11
176	258872	203691		15.00	13.25	12.39	11.52	10.66	9.43	7.57
177	258896	203697		14.87	13.14	12.28	11.42	10.56	9.35	7.51
178	258986	203684		14.94	13.20	12.34	11.47	10.61	9.39	7.54
179	259059	197831		29.13	25.73	24.05	22.37	20.69	18.31	14.71
180	259064	197781		32.43	28.65	26.78	24.91	23.04	20.39	16.37
181	259010	197817		27.49	24.29	22.70	21.11	19.53	17.28	13.88
182	259050	197790		30.96	27.35	25.56	23.78	21.99	19.46	15.63
183	259036	197795		34.37	30.36	28.38	26.40	24.41	21.61	17.35
184	259014	197797		28.82	25.46	23.80	22.13	20.47	18.12	14.55
185	258919	197820		26.46	23.38	21.85	20.32	18.80	16.63	13.36
186	258711	197868		23.64	20.88	19.52	18.16	16.79	14.86	11.93
187	258206	198239		18.28	16.15	15.09	14.04	12.98	11.49	9.23
188	258197	198219		17.15	15.15	14.16	13.17	12.18	10.78	8.66

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean Adjusted for bias (µg/m³) and distance to receptor	Future Years Projections					
				2010	2012	2013	2014	2015	2017	2020
189	258270	198257		16.79	14.83	13.86	12.90	11.93	10.55	8.48
190	258260	198237		17.17	15.17	14.18	13.19	12.20	10.79	8.67
191	258338	198270		17.45	15.42	14.41	13.40	12.40	10.97	8.81
192	257422	198542		16.02	14.15	13.23	12.30	11.38	10.07	8.09
193	257371	198522		21.34	18.85	17.62	16.39	15.16	13.41	10.77
194	257958	198581		19.41	17.15	16.03	14.91	13.79	12.20	9.80
195	257972	198563		26.32	23.25	21.73	20.21	18.70	16.54	13.29
196	258046	198558		22.61	19.97	18.67	17.37	16.06	14.21	11.41
197	258797	198701		**38.71**	34.20	31.96	29.73	27.50	24.33	19.54
198	258811	198701		**38.49**	34.00	31.78	29.56	27.34	24.20	19.43
199	254703	195764		34.16	30.18	28.21	26.24	24.27	21.47	17.24
200	254582	195821		27.71	24.48	22.88	21.28	19.68	17.42	13.99
201	254522	195859		30.47	26.92	25.16	23.40	21.64	19.15	15.38
202	254437	195879		23.13	20.43	19.10	17.76	16.43	14.54	11.68
203	254294	195885		25.57	22.59	21.11	19.64	18.16	16.07	12.91
204	253777	195926		18.53	16.37	15.30	14.23	13.16	11.65	9.35
205	253758	195939		22.91	20.24	18.92	17.60	16.27	14.40	11.57
206	261565	188211		**51.37**	**45.38**	**42.42**	**39.45**	36.49	32.29	25.93
207	261561	188222		**45.70**	**40.37**	**37.74**	35.10	32.46	28.73	23.07
208	261541	188215		**46.18**	**40.80**	**38.13**	35.47	32.80	29.03	23.31
209	261534	188198		**46.87**	**41.41**	**38.70**	36.00	33.29	29.46	23.66
210	261516	188207		**43.61**	**38.53**	36.01	33.49	30.98	27.41	22.01
211	261501	188188		**39.49**	34.89	32.61	30.33	28.05	24.82	19.93
212	261486	188200		27.40	24.21	22.62	21.04	19.46	17.22	13.83
213	261490	188186		**40.24**	35.55	33.23	30.91	28.58	25.30	20.31
214	261315	188193		30.17	26.65	24.91	23.17	21.43	18.97	15.23
215	261299	188191		28.61	25.27	23.62	21.97	20.32	17.98	14.44
216	261276	188190		30.74	27.16	25.38	23.61	21.84	19.32	15.52
217	260357	188240		20.60	18.20	17.01	15.82	14.63	12.95	10.40
218	260384	188206		29.64	26.18	24.47	22.76	21.05	18.63	14.96
219	260419	188172		24.64	21.77	20.35	18.92	17.50	15.49	12.44
220	261194	188163		22.70	20.05	18.74	17.43	16.12	14.27	11.46
221	260454	188171		21.22	18.75	17.52	16.30	15.07	13.34	10.71
222	260469	188182		24.74	21.86	20.43	19.00	17.57	15.55	12.49
223	266899	197354		25.61	22.62	21.15	19.67	18.19	16.10	12.93
224	266881	197389		26.85	23.72	22.17	20.62	19.07	16.88	13.55
225	266861	197432		27.53	24.32	22.73	21.14	19.56	17.31	13.90
226	266829	197472		27.33	24.14	22.57	20.99	19.41	17.18	13.80
227	266836	197484		25.70	22.70	21.22	19.74	18.26	16.16	12.97
228	266779	197578		24.43	21.58	20.17	18.76	17.35	15.36	12.33
229	266772	197621		22.56	19.93	18.63	17.33	16.03	14.18	11.39
230	266777	197651		26.39	23.31	21.79	20.27	18.75	16.59	13.32
231	268802	197666		23.96	21.17	19.78	18.40	17.02	15.06	12.10
232	266825	197654		27.63	24.41	22.81	21.22	19.63	17.37	13.95
233	266823	197668		26.07	23.03	21.53	20.02	18.52	16.39	13.16
234	266858	197671		24.15	21.33	19.94	18.55	17.15	15.18	12.19
235	266874	197657		26.97	23.83	22.27	20.71	19.16	16.95	13.61
236	266886	197658		29.39	25.96	24.27	22.57	20.88	18.47	14.84
237	266885	197676		25.90	22.88	21.39	19.89	18.40	16.28	13.07
238	266902	197660		36.38	32.14	30.04	27.94	25.84	22.87	18.36
239	266181	196022		**37.70**	33.30	31.13	28.95	26.78	23.70	19.03
240	266169	195995		**40.14**	35.46	33.14	30.83	28.51	25.23	20.26

Site ID	X Coordinate	Y Coordinate	Within AQMA ?	Annual mean Adjusted for bias (µg/m^3) and distance to receptor	Future Years Projections					
				2010	2012	2013	2014	2015	2017	2020
241	266159	196013		36.92	32.62	30.49	28.36	26.23	23.21	18.64
242	265655	193423		**45.21**	**39.94**	**37.33**	34.72	32.11	28.42	22.82
243	265474	194949		**41.64**	36.79	34.38	31.98	29.58	26.18	21.02
244	265466	194930	Y	**47.92**	**42.33**	**39.57**	36.80	34.04	30.12	24.19
245	265448	194922	Y	**49.14**	**43.41**	**40.58**	**37.74**	34.91	30.89	24.81
246	265425	194927		33.12	29.26	27.35	25.44	23.53	20.82	16.72
247	265394	194899	Y	**39.76**	35.12	32.83	30.54	28.24	24.99	20.07
248	265342	194894		31.71	28.01	26.18	24.35	22.52	19.93	16.01
249	265326	194871	Y	**40.58**	35.85	33.51	31.17	28.83	25.51	20.49
250	265274	194867		32.99	29.14	27.24	25.34	23.43	20.74	16.65
251	265263	194845	Y	**38.17**	33.72	31.52	29.32	27.11	23.99	19.27
252	265226	194830	Y	33.69	29.76	27.82	25.87	23.93	21.18	17.01
253	265194	194833		29.98	26.48	24.76	23.03	21.30	18.85	15.13
254	265142	194816		30.41	26.86	25.11	23.36	21.60	19.12	15.35
255	265098	194825		29.09	25.70	24.02	22.34	20.66	18.29	14.68
256	264995	194777		**45.60**	**40.28**	**37.65**	35.02	32.39	28.66	23.02
257	254817	189135		21.32	18.83	17.60	16.37	15.14	13.40	10.76
258	254906	189110		31.14	27.51	25.71	23.92	22.12	19.57	15.72
259	254949	189113		20.10	17.76	16.60	15.44	14.28	12.63	10.15
260	254970	189116		19.06	16.84	15.74	14.64	13.54	11.98	9.62
261	254991	189115		22.75	20.10	18.79	17.47	16.16	14.30	11.48
262	255056	189118		12.93	11.42	10.68	9.93	9.18	8.13	6.53
263	262444	193447		20.38	18.00	16.83	15.65	14.48	12.81	10.29
264	262251	193293		18.44	16.29	15.23	14.16	13.10	11.59	9.31
265	266375	198023		33.26	29.38	27.46	25.54	23.63	20.91	16.79
266	266380	198043		23.98	21.18	19.80	18.42	17.03	15.07	12.11
267	266382	198028		32.14	28.39	26.54	24.68	22.83	20.20	16.22
268	266419	198053		31.05	27.43	25.64	23.85	22.06	19.52	15.67
269	266458	198111		27.34	24.15	22.58	21.00	19.42	17.19	13.80
270	266896	198084		27.21	24.04	22.47	20.90	19.33	17.10	13.74
271	266879	198078		35.52	31.38	29.33	27.28	25.23	22.33	17.93
272	266888	198074		36.22	32.00	29.91	27.82	25.73	22.77	18.28
273	267060	198234		31.92	28.20	26.36	24.52	22.67	20.07	16.11
274	269487	201451		25.97	22.94	21.44	19.95	18.45	16.32	13.11

Table 10 – NO_2 Future year's annual mean projections from 2010 data

Table 10 above would appear to indicate that the revised adjustment factors produce a much improving situation in 2015 with only 5 sites predicted to exceed the annual mean objective. However, what is not known is the continued impact of the newer EURO category diesel vehicles and how the adjustment factors within TG(09) account for the additional primary NO_2 emitted by these vehicles as their impact and numbers within the fleet increases. A query had been previously raised with the LAQM Review and Assessment Helpdesk in 2009 (for the USA 2009) to address this question. An answer was received which stated "AEA Technology, who are responsible for producing these factors, have confirmed that the impacts of Euro standards are included in the projections up to Euro 6 for LDVs and Euro Vi for HDVs and that the impact of expected changes in primary NO_2 emission fractions is also included ”.

Given the above, it is reasonable to assume that exceedences of the annual mean objective will continue to be seen during 2011-2015. It is further predicted that widespread compliance with the objective may not be seen within Swansea until 2017. Even then, three sites still indicate marginal compliance (within range 37-39.99ug/m^3) of the annual mean objective. However, previous LAQM experience has shown that future year projections have not always materialised due to unforeseen circumstances, so the projections obtained by using the method within LAQM.TG(09) should still be treated with caution.

2.2.4 Particulate Matter PM_{10}

Thermo PM_{10} FDMS system are installed at all 3 sites (Swansea AURN, Morfa and Morriston Groundhogs), providing equivalency with the EU reference gravimetric method[18].

Brief operational issues that have been identified are outlined here for information as the operation of the FDMS units differs substantially from that of the R&P Teom units.

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C[19]. 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 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 PM_{10} 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.

Data collected from the FDMS units has an integration period of 1-hour. Hourly ratified Particulate Matter PM_{10} data for 2010 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 Morfa and Morriston Groundhog sites. 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

[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
[18] UK Equivalence Program for Monitoring of Particulate Matter dated 5th June 2006 section 5.5.2

part of the service and maintenance contract with Enviro Technology Services Plc, each dryer unit is replaced annually.

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[20]

The datasets collected from the FDMS systems are not directly comparable to the historical R&P PM_{10}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 correction factors. TEOM PM_{10} data for 2006 has not therefore been included within table 11. These TEOM PM_{10} data have 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 PM_{10}TEOM datasets at the Morfa and Morriston stations within this report. The dates that the PM_{10} FDMS systems were installed at each site are given below table 11 for information. Due to the limited available FDMS PM_{10} datasets for 2006 (which were also further compromised due to initial setup problems with the FDMS chiller units) no PM_{10} FDMS data has been presented for 2006

Site ID (see table 4 above)	Location	Within AQMA	Data Capture 2007 %	Data Capture 2008 %	Data Capture 2009 %	Data Capture 2010 %	Annual mean concentrations (µg/m³)			
							2007	2008	2009	2010
1 *	Swansea AURN	Y	**82.2**	98.4	97.53	98.63	18.29	17.49	17.19	15.79
2 **	Morfa Groundhog	Y	**86.8**	**50.0**	**54.25**	**65.48**	27	29.34	30.41	20.06
3 ***	Morriston Groundhog	N	**79.5**	**60.1**	90.68	**78.36**	21.56	23.46	22.53	18.67

Table 11 Results of PM_{10} Automatic Monitoring: Comparison with Annual Mean Objective
* FDMS unit installed 26th September 2006
** FDMS unit installed 28th November 2006
*** FDMS unit installed 27th October 2006

[20] *LAQM.TG(09) Annexe 1- Monitoring A1.216 page A1-48*

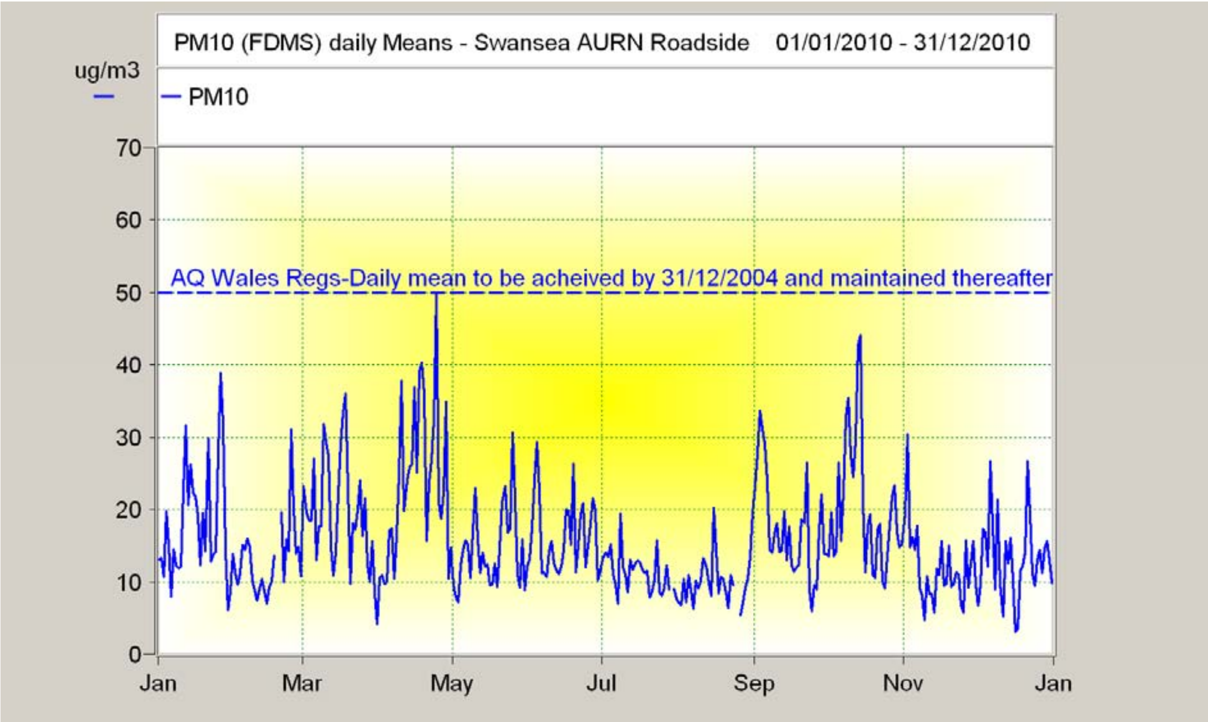
Site ID	Location	Within AQMA	Data Capture 2007 %	Data Capture 2008 %	Data Capture 2009 %	Data Capture 2010 %	Number of Exceedences of 24-hour mean (50 µg/m³)			
							2007	2008	2009	2010
1	Swansea AURN	Y	**82.2**	98.4	97.53	98.63	7 **(32.53)**	6	4	0
2	Morfa Groundhog	Y	**86.8**	**50.0**	**54.25**	**65.48**	22 **(45.6)**	15 (45.79)	14 (45.11)	1 **(30.5)**
3	Morriston Groundhog	N	**79.5**	**60.1**	90.68	**78.36**	8 **(33.1)**	11 **(37.21)**	6	1 **(29.6)**

Table 12 Results of PM_{10} Automatic Monitoring: Comparison with 24-hour Mean Objective

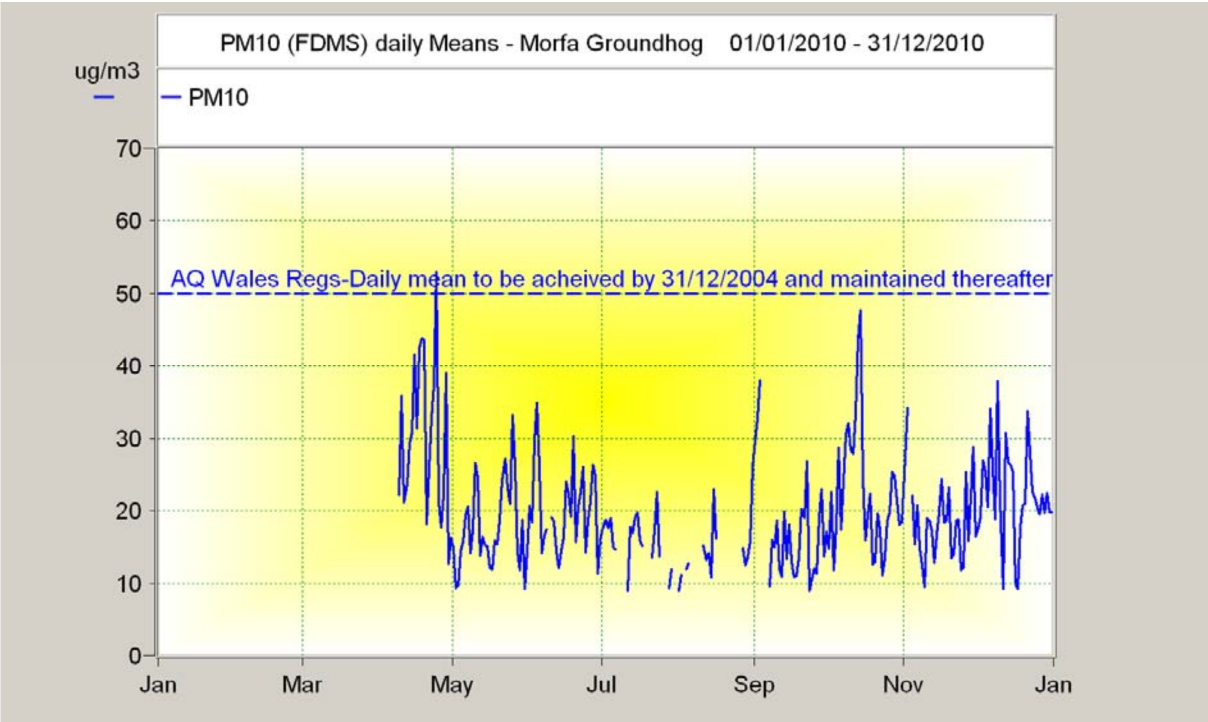
The 90th percentile's of the daily means of measurements made during 2007 -2010 are presented in bold within brackets in table 12 where appropriate, as the data capture rates in the majority of instances fall below the required 90%[21] - especially at the problematic FDMS installations at the Morfa and Morriston Groundhog sites. There have been numerous problems since the installation of the Thermo Inc FDMS PM_{10} analysers at all 3 sites during late 2006, resulting in significant periods of data loss**.** These issues have been 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 remain with the operation of the FDMS units within the Swansea Network as can be seem 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 PM_{10} stations within Swansea and therefore the calculated mass concentration being seen was consistently on average 20ug/m^3 above that seen at either the Swansea AURN or Morriston 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 has led to data being rejected from the 11th August 2009 to 7th April 2010. Problems have continued with the reliability of the FDMS throughout 2011 with

[21] LAQM TG(09) Annexe A1 – A1.157 page A1-34

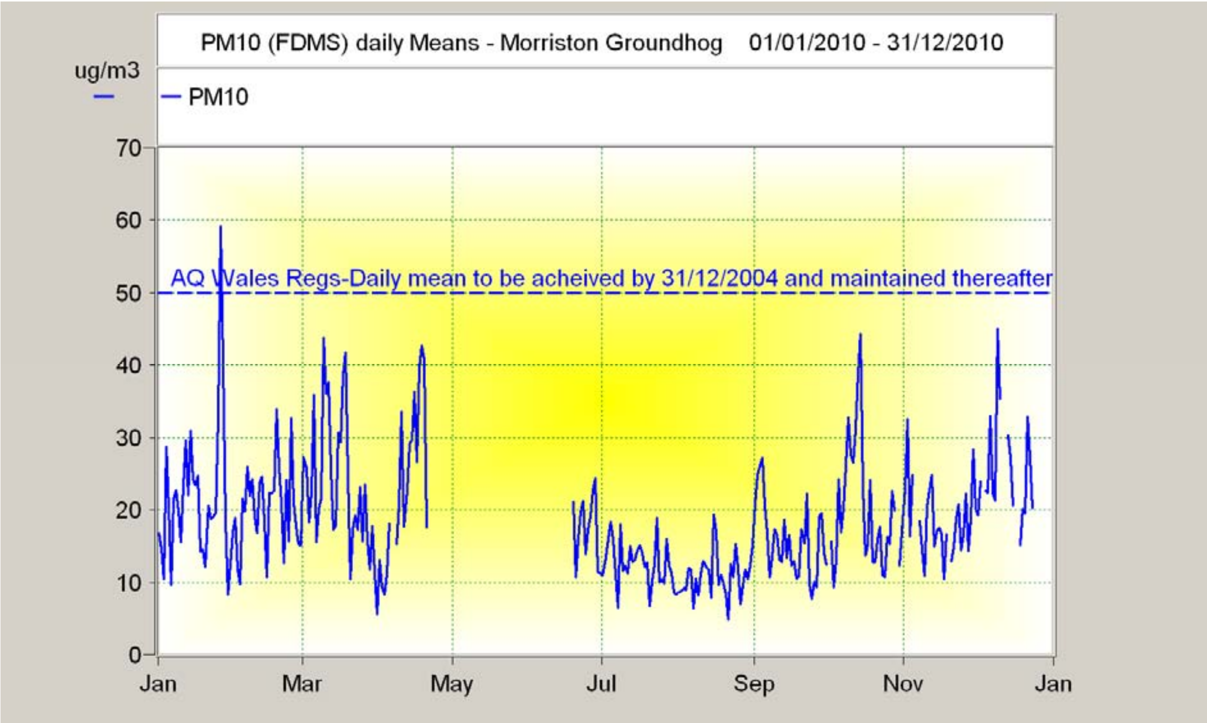
yet more data being rejected resulting in significant data loss – during 2011 the Swansea AURN units (both $PM_{2.5}$ and PM_{10}) have seen significant data loss. Graphs 7-9 of the monitoring undertaken during 2010 are detailed below with scatter plot 1 summarising the period of measurement.



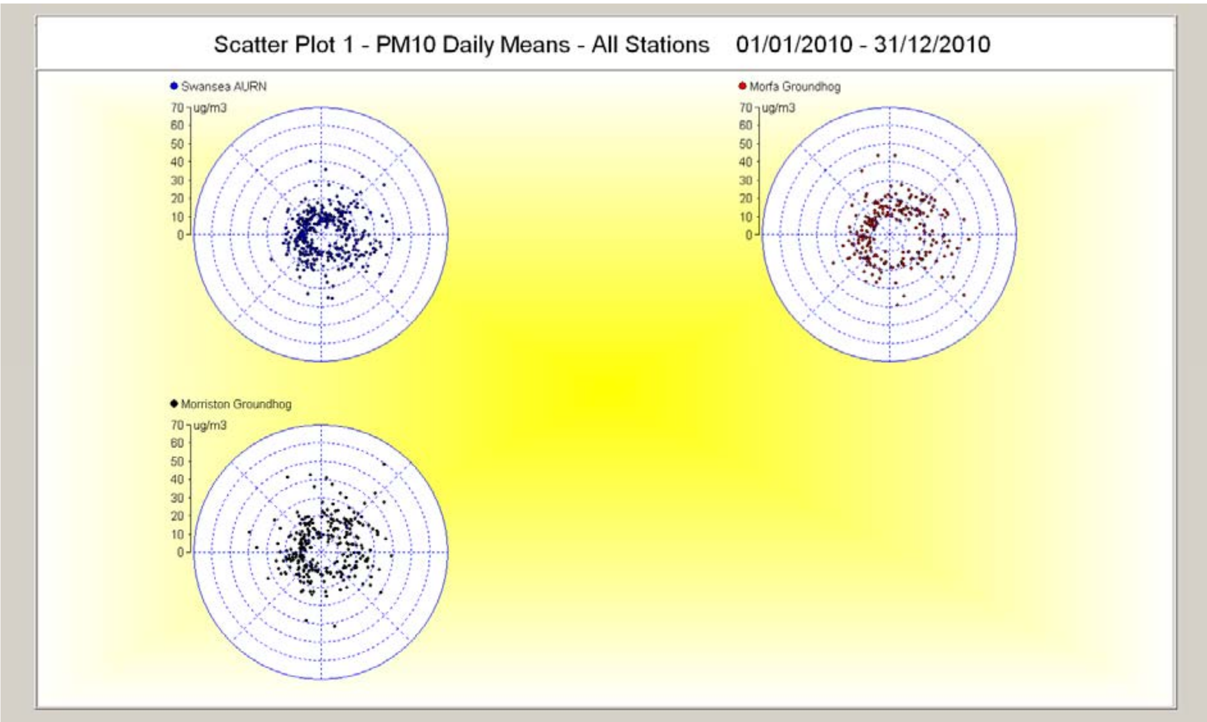
Graph 7 – Swansea AURN 24-hour FDMS PM_{10} concentrations 2010



Graph 8 – Morfa Groundhog 24-hour FDMS PM_{10} concentrations 2010



Graph 9 - Moriston Groundhog 24-hour FDMS PM_{10} concentrations 2010

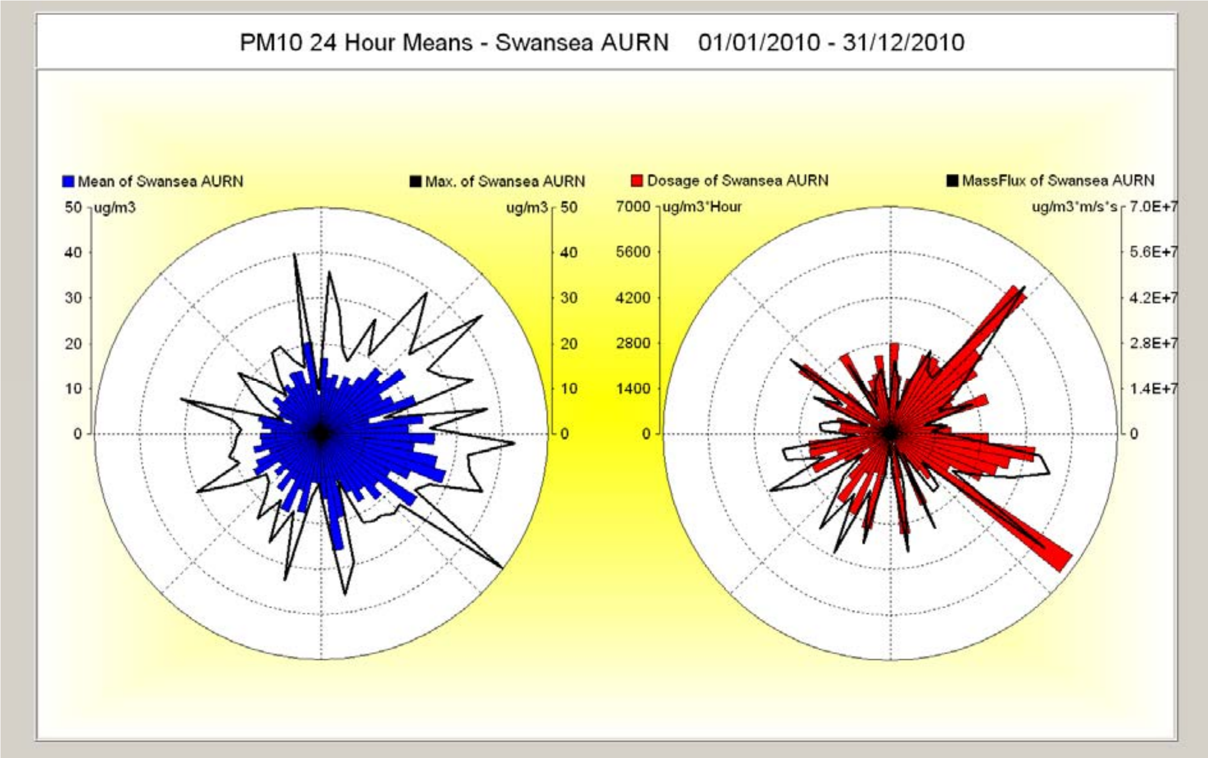


Scatter Plot 1 – PM10 daily Means – All Stations 2010

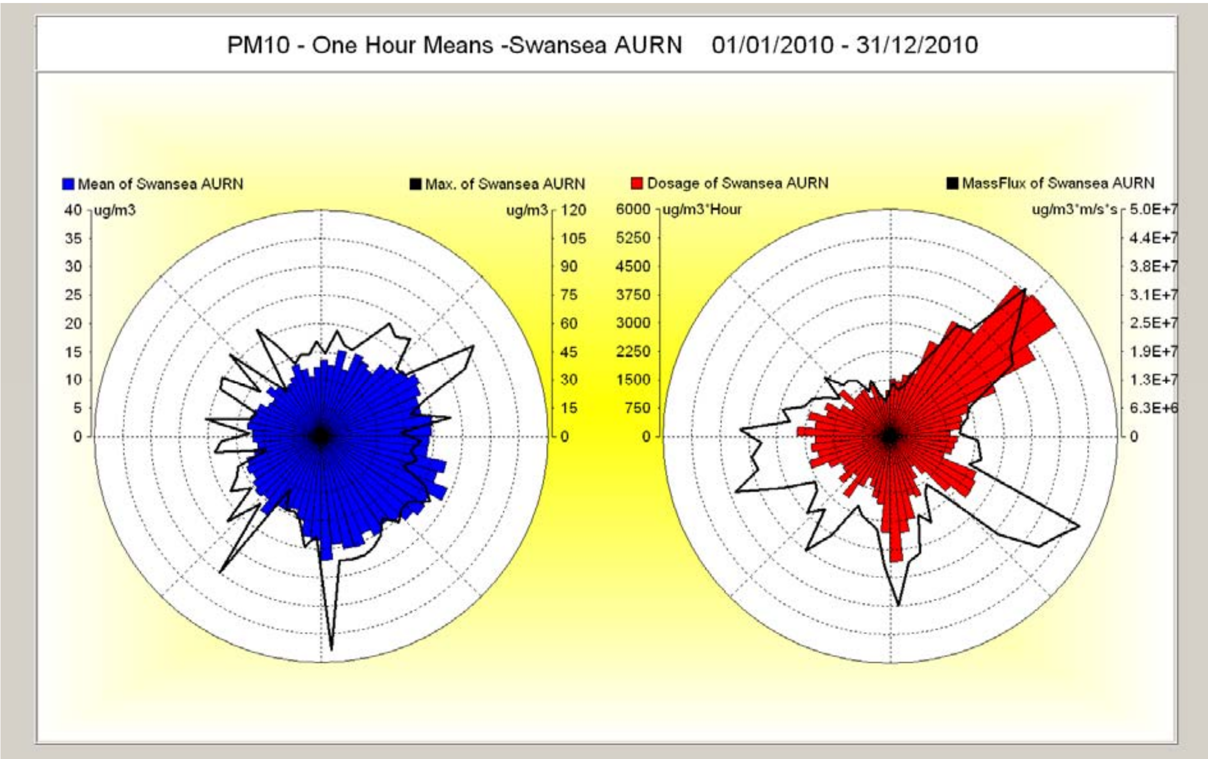
In previous years, there has been a noticeable trend for any elevated concentrations to emanate from a south-easterly direction. However, during 2010 no such trend is easily evident within the daily means scatter with the scatter suggesting the probability of local sources dominating.

Breuer Plot 1 below reinforces the view that the primary source of daily PM_{10} mean concentrations at the Swansea AURN are from “locally” derived sources. However, from the maximum concentration there is a suggestion of a slight influence from the south-east. This view is reinforced by the dosage and max flux within Bruer Plot 1 with interestingly a firm indication from the dosage and max flux of an influence from the north-east. Dosage is taken to be the accumulated time multiplied with the average value of PM_{10}. 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 [PM_{10}] are not used to calculate the result). The result is presented in the multiplied units of the wind speed and the parameter (PM_{10}). 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.

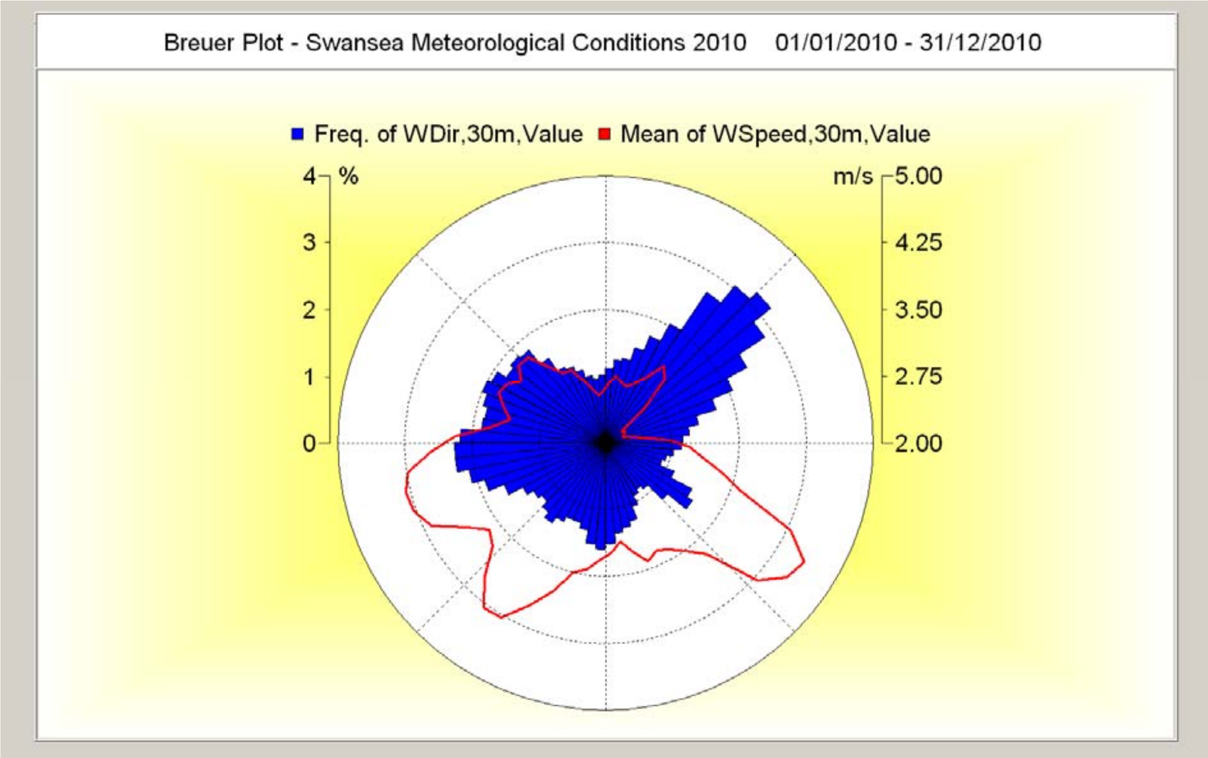
If the same analysis is undertaken but this time using the 1-hour means, (as shown within Breuer Plot 2 below) the influence, as shown by the dosage and mass flux, of sources from the north-east becomes even more evident and dominant. No major industrial sources are know in the north-east sector as this area is primarily urban housing with the Swansea Enterprise Zone being located at Morriston with the M4 motorway further north up the lower Swansea Valley, extending to Clydach and Pontardawe further up the Swansea Valley. To try and explain the north-east influence seen during 2010 the meteorological conditions were examined. Breuer Plot 3 indicates conditions seen at the 30m Meteorological Mast at Cwm Level Park. This site is within the lower Swansea Valley and is highly representative of conditions throughout Swansea.



Breuer Plot 1 – Daily Means – Swansea AURN

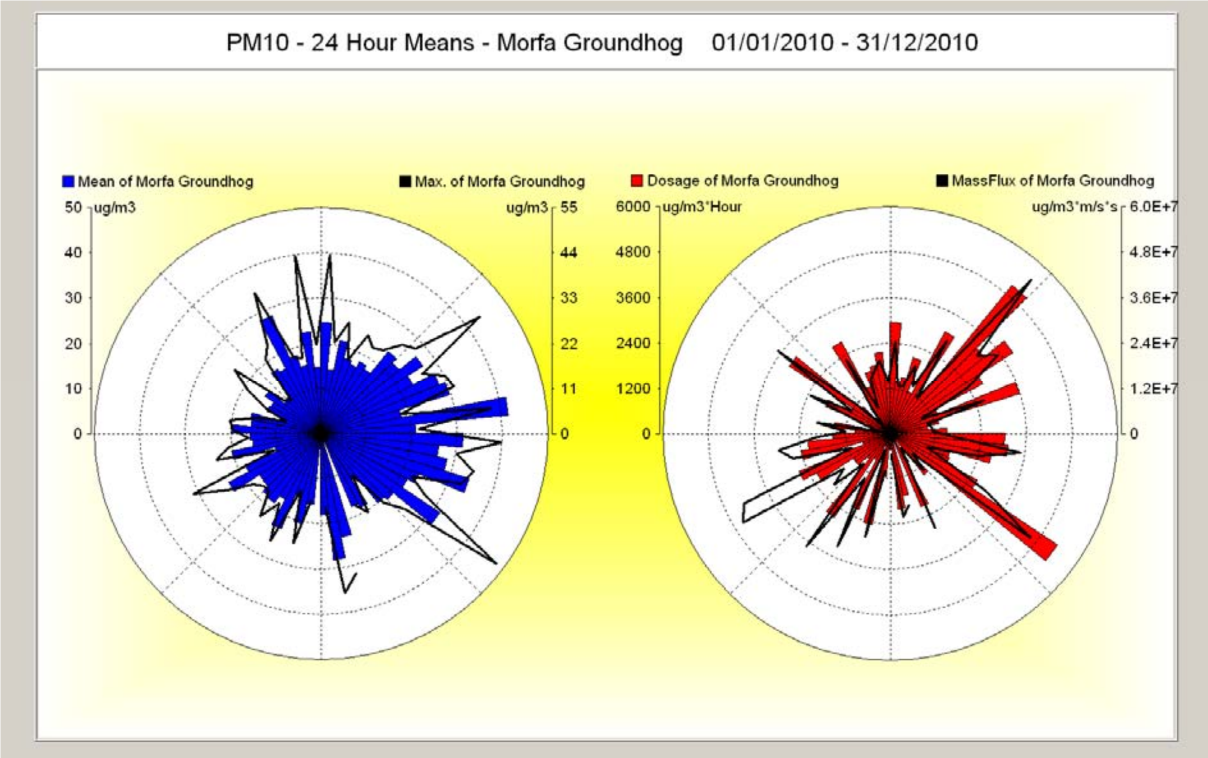


Breuer Plot 2 – Hourly Means – Swansea AURN

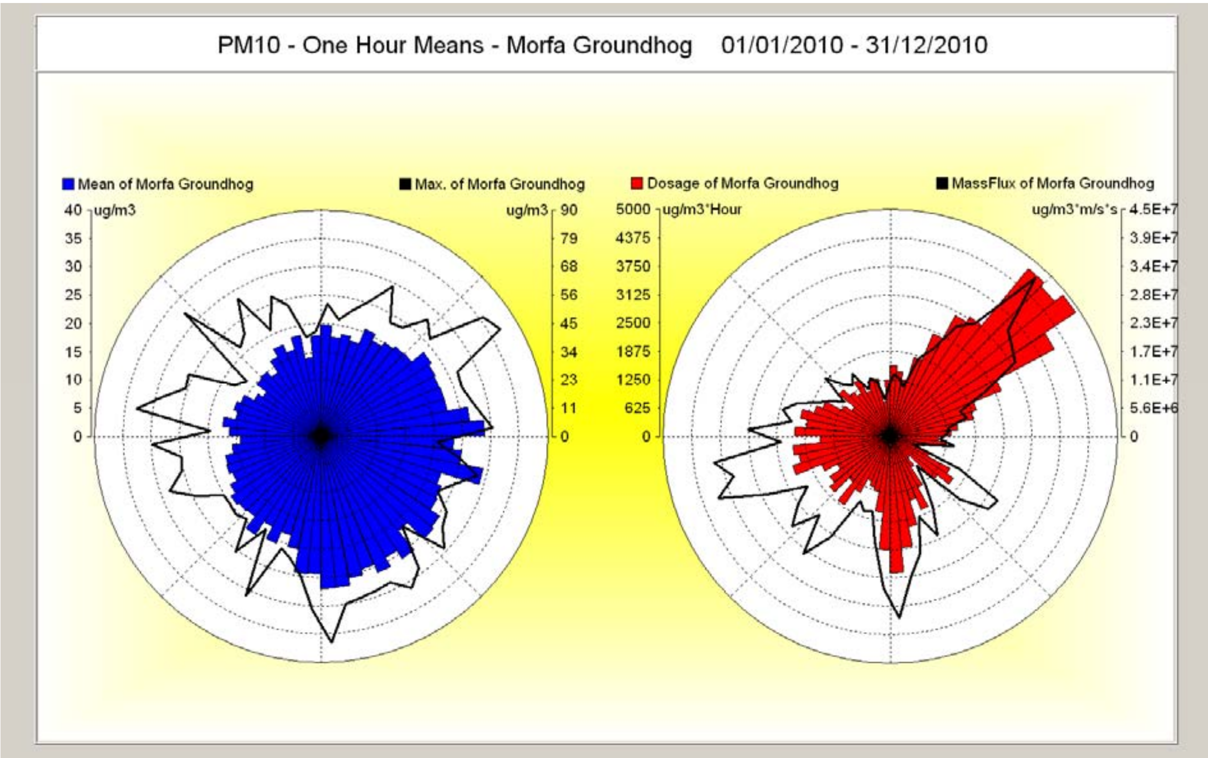


Breuer Plot 3 – Swansea Meteorological Conditions 2010

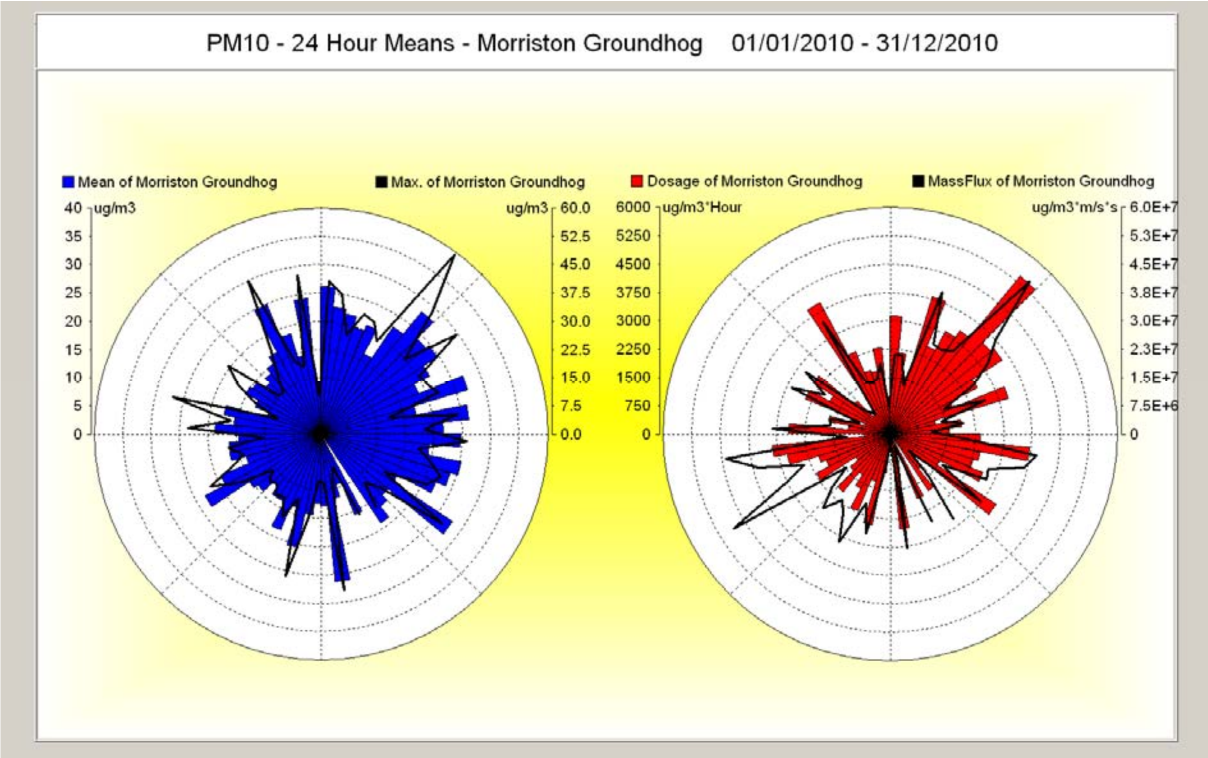
From Breuer Plot 3 it is evident that atypical meteorological conditions were seen within Swansea during 2010. These conditions are typified during late 2010 with cold calm stable conditions that are thought to have influenced NO_2 concentrations within the lower valley area – the most notable being the Hafod DOAS. These atypical conditions have also been noticed within the UK Heavy Metals Network results for 2010 with increased concentrations seen to the south-west monitoring sites with the wind direction following the alignment of the Swansea Valley.



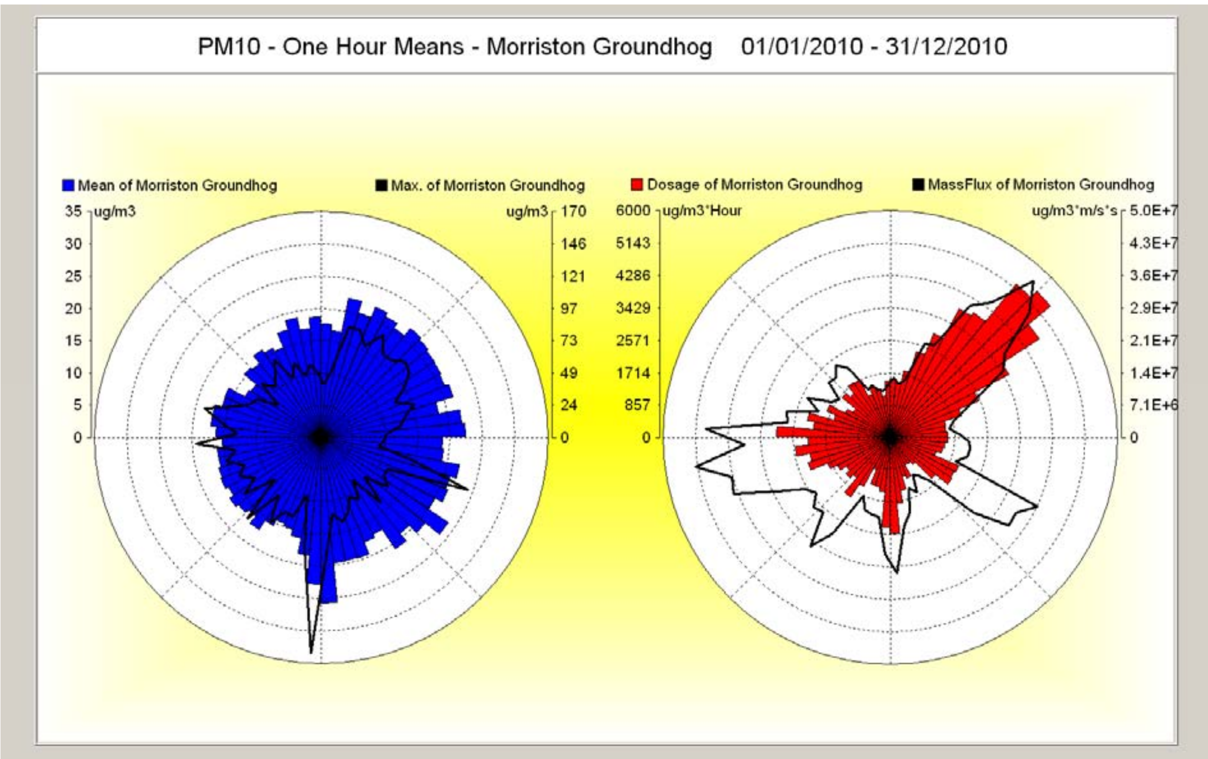
Breuer Plot 4 – Daily Means – Morfa Groundhog



Breuer Plot 5 – Hourly Means – Morfa Groundhog



Breuer Plot 6 – Daily Means – Morriston Groundhog



Breuer Plot 7 - Hourly Means – Morriston Groundhog

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 localised and directionally apportioned PM_{10} seen within Swansea since measurement of PM_{10} commenced during the late 1990's. However, due to the atypical meteorological conditions seen during 2010 the influence from source is not apparent.

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/m^3**.

LAQM.TG(09) provides a method to project measured annual mean roadside PM_{10} concentrations to future years[22]. 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:

Steps 1-4	Measured 2010 Conc.	2010 Background Conc.	2010 Local Road Contribution	Road Cont 2015	Road Cont 2020
Swansea AURN	15.79	14	**1.79**	0.641956	0.541137
Morfa	20.06	13	**7.06**	0.564704	0.473535
Morriston	18.67	14	**4.67**	0.616849	0.512956

Step 5	Year Adj. Factor 2015	Year Adj. Factor 2020
Swansea AURN	0.801676393	0.67577335
Morfa	0.688686931	0.57750143
Morriston	0.494555352	0.4112597

[22] LAQM.TG(09) box 2.2 page 2-5

Step 6	Year Adj. Factor 2015	Year Adj. Factor 2020
Swansea AURN	1.435000743	1.209634301
Morfa	4.862129731	4.077160074
Morriston	2.309573496	1.920582804

Site ID	**Location**	**Within AQMA?**	**Measured Annual mean 2010**	**Future Years Projections**	
				2015	**2020**
1	Swansea AURN	Y	15.79	15.20	14.57
2	*Morfa Groundhog	Y	20.06	18.39	17.19
3	**Morriston Groundhog	N	18.67	16.13	15.30

Table 13 PM_{10} Annual Mean projections
**Data capture for 2010 65.48%*
*** Data capture for 2010 78.36%*

From table 13 it can be seen that from the 2010 annual mean concentrations seen at the various sites that come 2015 or 2020 there is remarkable projected harmony between the projected PM_{10} concentrations at all three sites. It should be noted that these projections are higher than has been projected within previous reports. It should also be noted that these projections are based (for Morfa and Morriston Groundhogs) on data capture rates below the required 90%. Projections for both 2015 and 2020 are for PM_{10} concentrations to remain considerably below the annual mean objective.

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 (NO_2) 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 NO_2 pattern highlighted above within section 2.2, seemingly confirming the likelihood that traffic is the dominant source for these two pollutants**.

2.2.5 Sulphur Dioxide

There have been major alterations to the authority's network of SO_2 analysers during 2010. Due to budget restrictions and the knowledge that SO_2 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 SO_2 analysers at the Swansea AURN, Morfa and Morriston Groundhog stations.

SO_2 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 SO_2 seen within Swansea since measurement of SO_2 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 specified[23]. 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 present[24]

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%[25]

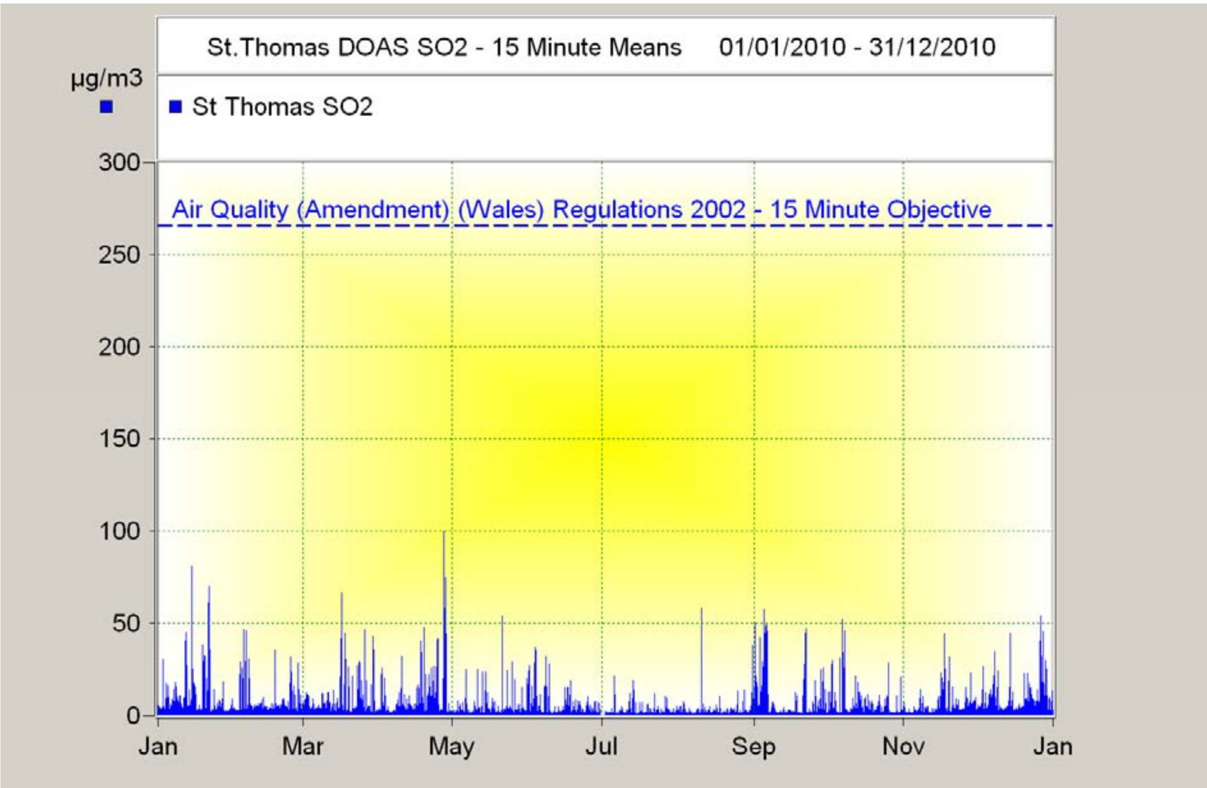
Graphs 10 -12 are presented below, representing time series measurements made during 2010 with the accompanying Breuer plot 8 providing an insight into the more likely source direction.

[23] LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-47
[24] LAQM.TG(09) Appendix A1 - Reporting of Monitoring data – Calculation of Exceedence Statistics A1.216 page A1-48
[25] LAQM TG(09) Annexe A1 – A1.157 page A1-34

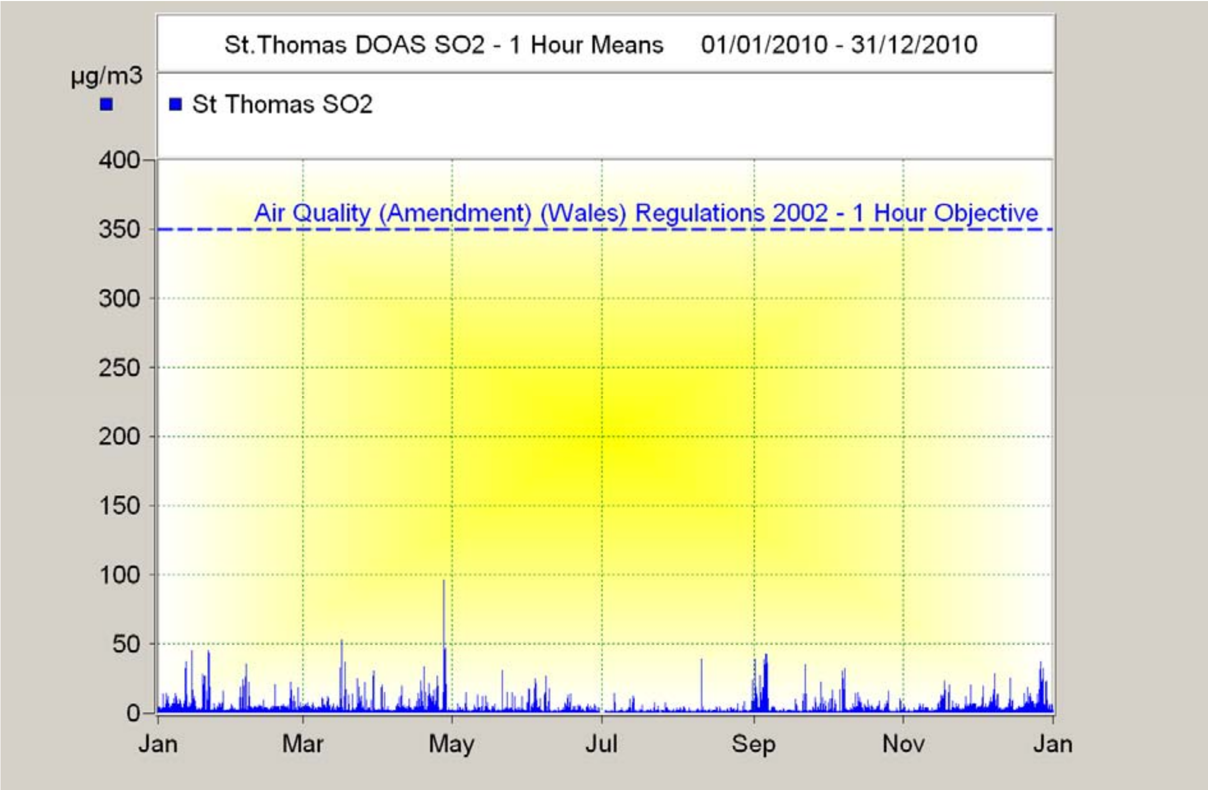
St.Thomas DOAS 2010	Max 15-Min Mean µg/m³ (266µg/m³)	Max 1-hour Mean µg/m³ (350µg/m³)	Max 24-Hour Mean µg/m³ (125µg/m³)
Data Capture	96.93 %	98.38%	99.18%
Value	96.27	96.53	23.93
Exceedences	0	0	0
Date of Max	27th April 2010	27th April 2010	5th September 2010
Time of Max	10:30	10:00	-
2010 Percentiles	15 Minute	1 Hour	24-Hour
99.9th Percentile	N/A	-	-
99.7th Percentile	-	N/A	-
99th Percentile	-	-	N/A

Table 14 – SO_2 Concentrations 2010 St.Thomas DOAS

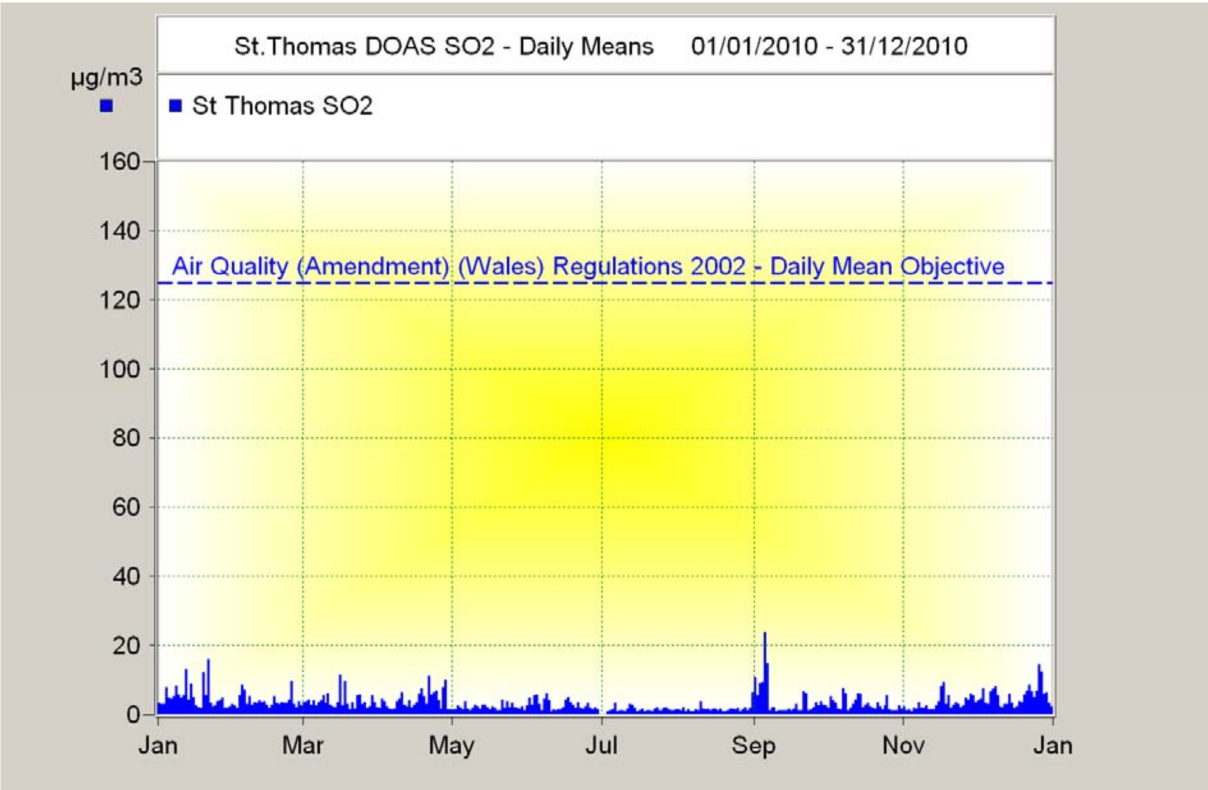
From table 14 above, it can be seen that **all objectives, at all averaging periods, have seen compliance during 2010 at the St.Thomas DOAS.** Historical real-time data analysis (back to 2001 in some cases) has been reported within previous Progress Reports undertaken by the authority. It is evident given all of the above, that monitored levels of sulphur dioxide continue to decline and there has not been an issue with compliance of any of the objectives since real-time continuous monitoring commenced in Swansea. This reinforces the decision that to cease SO_2 monitoring at all but the St.Thomas DOAS site was justifiable.



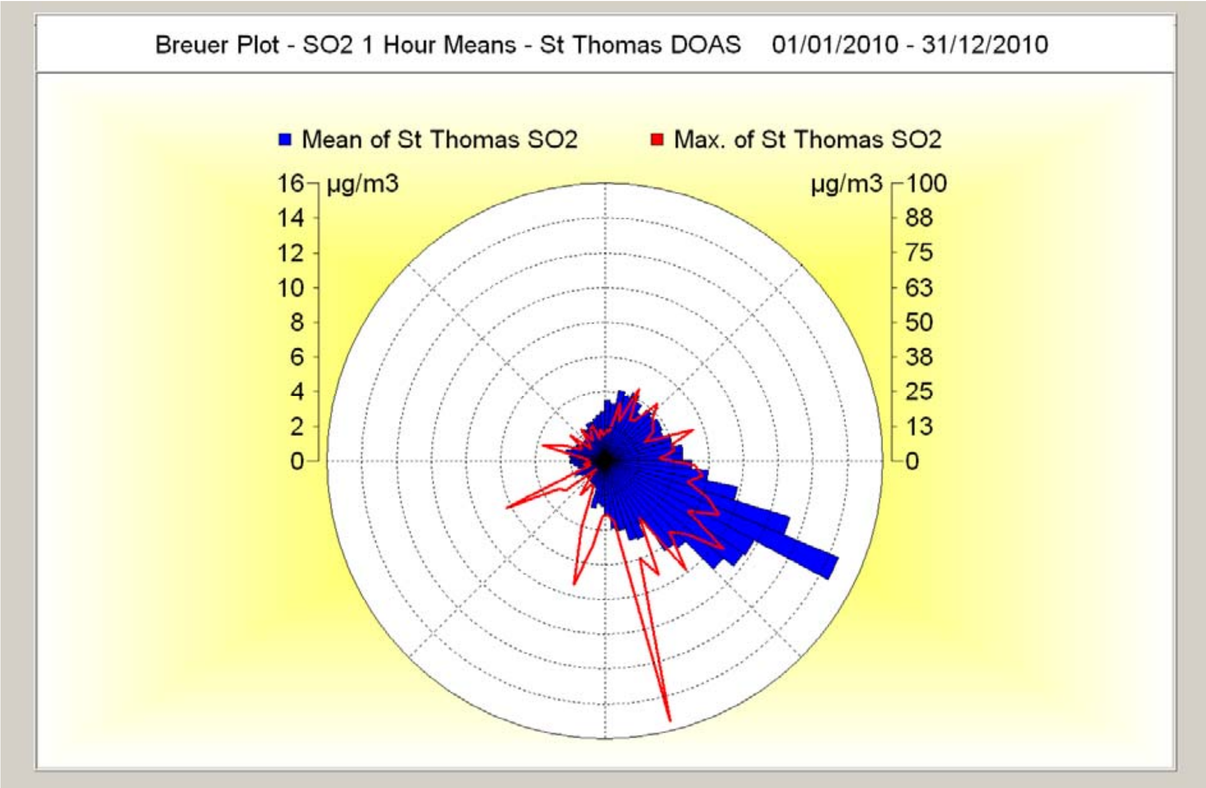
Graph 10 - SO_2 15-minute means St.Thomas DOAS 2010



Graph 11 - SO_2 1-hour means St.Thomas DOAS 2010



Graph 12 - SO_2 Daily means St.Thomas DOAS 2010



Breuer Plot 8 - 1 hour SO_2 concentrations St.Thomas DOAS 2010

From Breuer Plot 8 it is evident that whilst low SO_2 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 8 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 hourly concentrations seen. 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 hourly concentrations seen. 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 SO_2 seen within Swansea since measurement of SO_2 commenced during the late 1970's. From 2010 data this would seem to remain the case.

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 2008-2010 is provided below within table 15

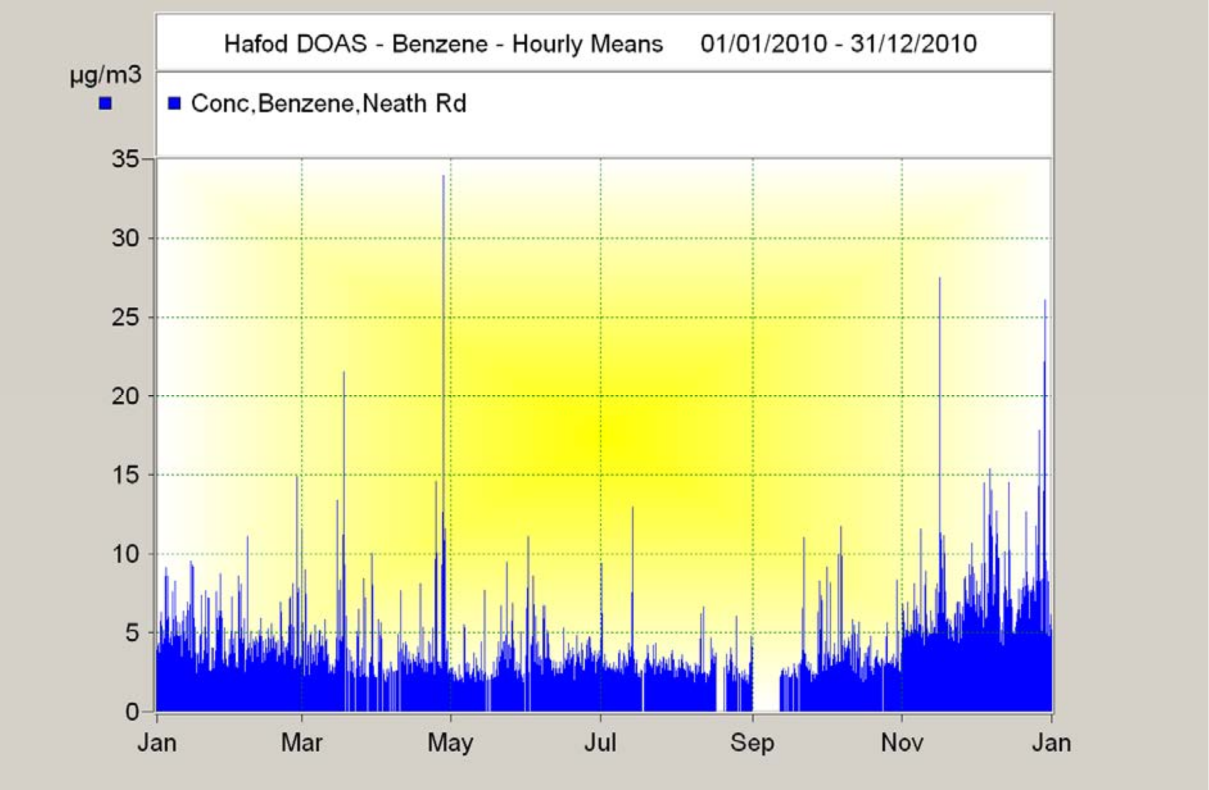
Site ID (see table 2 above)	Location	Within AQMA	Data Capture 2008 %	Data Capture 2009 %	Data Capture 2010 %	Annual mean concentrations (µg/m^3)		
						2008	2009	2010
5	Hafod DOAS	**Y**	**35%**	98%	**76.7%**	2.28	1.88	3.69
6	St.Thomas DOAS	**N**	96%	**88%**	**80%**	2.52	1.81	3.58

Table 15 Benzene annual means 2008-2010

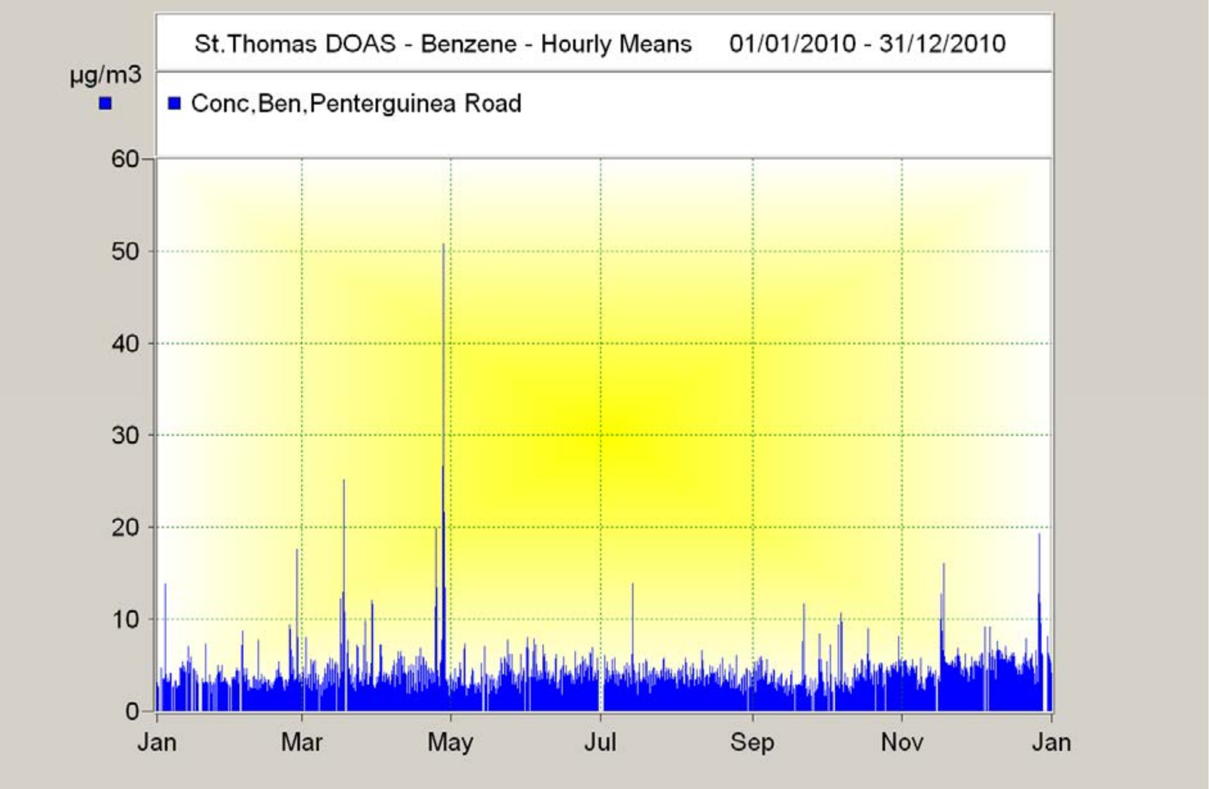
Significant data has been lost at these sites in previous years due to operational issues and also building renovation works in the case of the Hafod site. Analysis of the data for 2010 has produced data capture rates below the recommended 90% but this can be explained by the validation rules outlined within sections 2.1.6 – 2.1.7 together with some periods of measurement cycle 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 13 and 14 below illustrate some exceptionally high hourly "spikes" of benzene throughout the year for short periods of time at both sites, and importantly at the same time, indicating a likelihood of he same source.

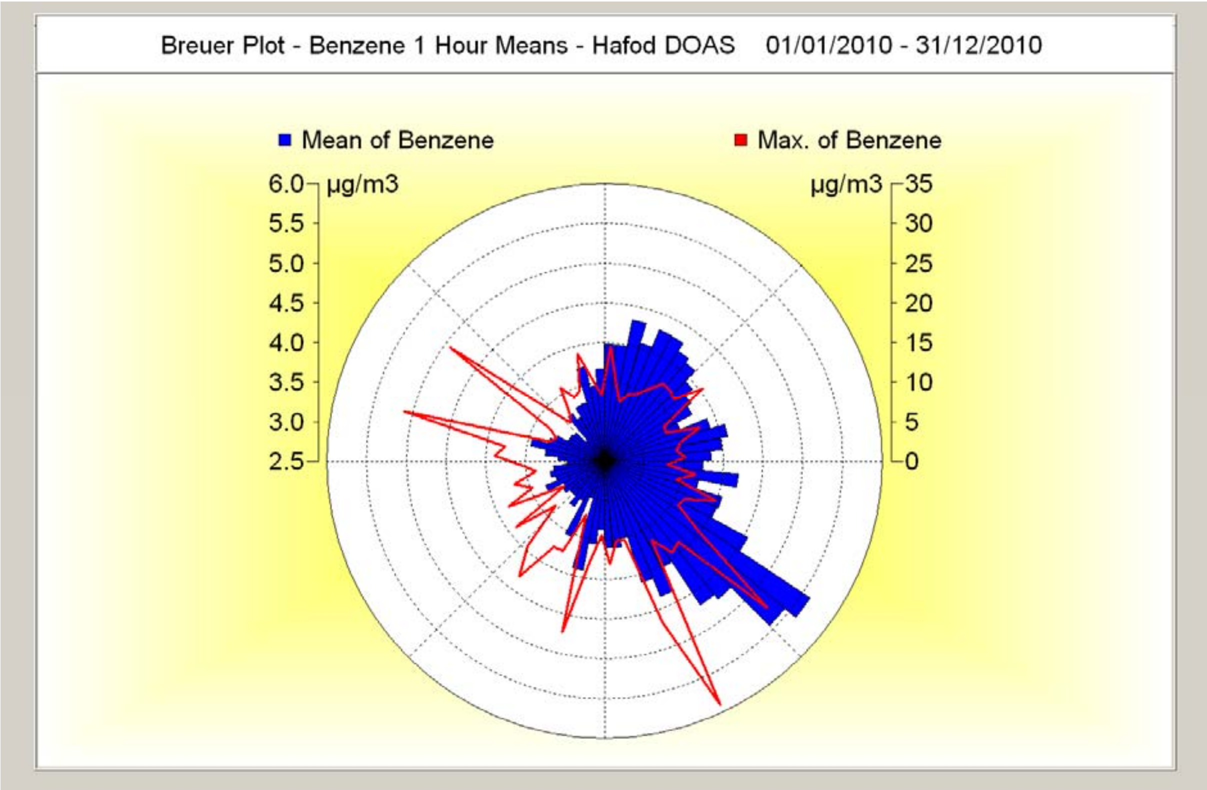
Both sites show a doubling of annual mean concentrations over those reported for 2009 but remain below the annual mean objective level of 5µg/m^3. It is evident from graphs 13 and 14 that along with other pollutants, the benzene concentrations recorded have been influenced by the atypical meteorological conditions experienced during 2010, particularly during the early winter months of late 2010. Interestingly, if charts 10 and 11 above for the St Thomas DOAS SO_2 (15 minute and hourly means) are examined, the maximum benzene spikes seen in late April within charts 13 and 14 below correlate to the SO_2 spikes. St Thomas Breuer plots 8 (SO_2) above and Breuer plot 10 (benzene) below are strikingly similar.



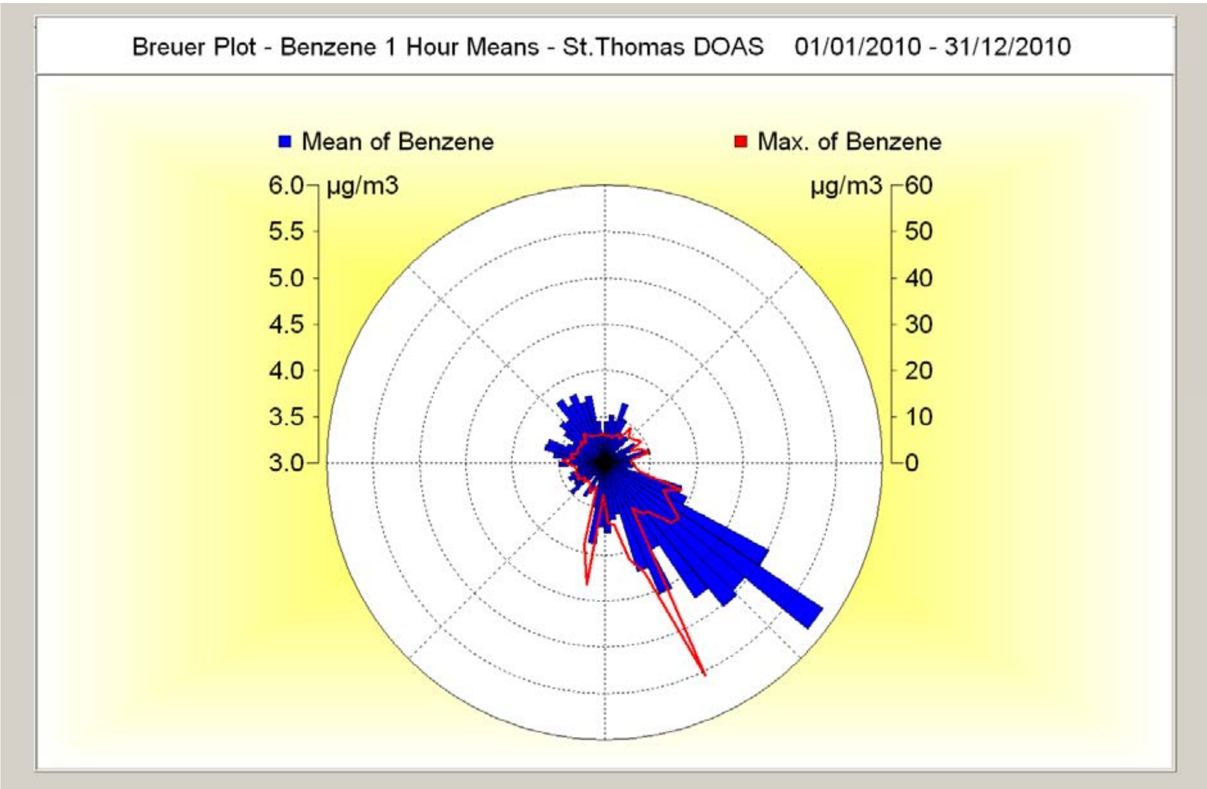
Graph 13 – Hourly benzene concentrations Hafod DOAS 2010



Graph 14 – Hourly benzene concentrations St.Thomas DOAS 2010



Breuer Plot 9 – Hafod DOAS Hourly Benzene concentrations



Breuer Plot 10 – St.Thomas DOAS Hourly Benzene concentrations

There are firm indications from Breuer Plots 9 and 10 above those sources to the south-east are impacting on measurements at both DOAS monitoring stations. This is clearer at the St Thomas DOAS as it is probably nearer the source(s) whilst Breuer plot 9 from the Hafod DOAS complicates the picture, indicating maximum concentrations being received from the north-west with increased mean concentrations also being received from the north-east.

From table 15 above it can be seen that no annual mean exceeds 5ug/m^3 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 the Morfa and Morriston Groundhog sites, resulting in no roadside carbon monoxide monitoring being undertaken within Swansea during 2010. 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 Morriston 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 PM_{10})

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).

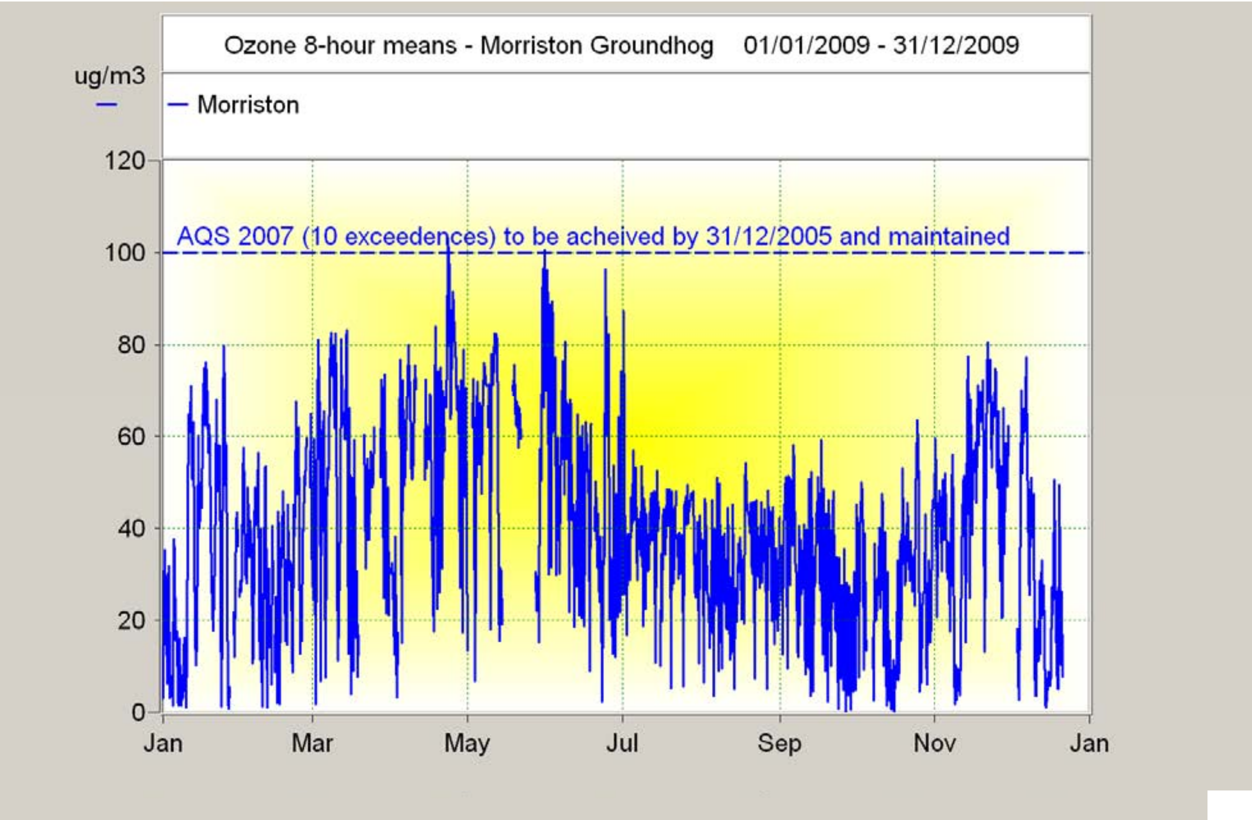
2.3.1 Ozone

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 2010. The objective for ozone is for the 8-hour means not to exceed 100µg/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 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.

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 specified[26]. 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 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 2010 along with previous years results. 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.

Morriston Groundhog



Graph 15- Morriston Groundhog Ozone 8-hour means 2010

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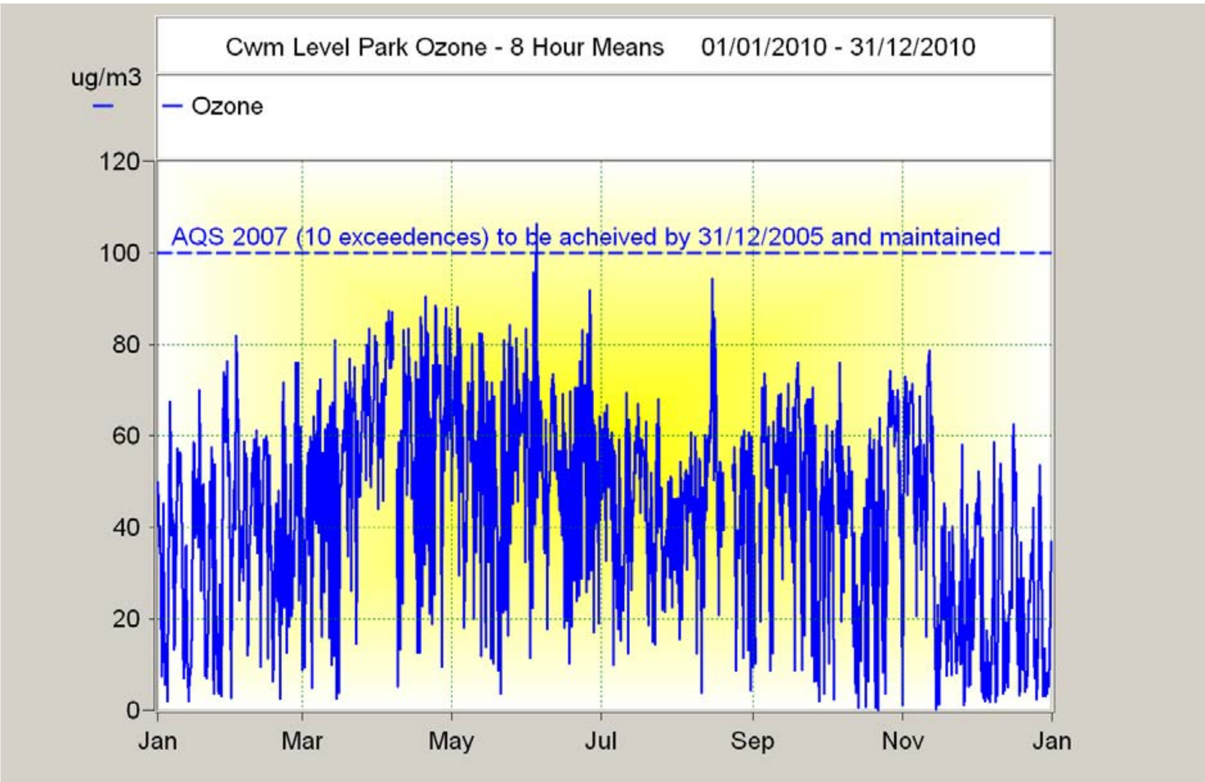
[26] LAQM.TG(09) Calculation of Exceedence Statistics A1.216 page A1-47

Morriston Groundhog	Max 8-hour Mean (µg/m^3)	Data capture	Exceedences of 8-hour objective 100µg/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

Table 16 - Morriston Groundhog Ozone 8-hour means 2002-2010

Previous reporting has commented on the effect that atypical meteorological conditions i.e. 2003 and 2006 have had on ozone concentrations. Given that 2010 is thought to be atypical also, with a high frequency of winds from the north-east, this “effect” is not apparent within the data for 2010.

Cwm Level Park

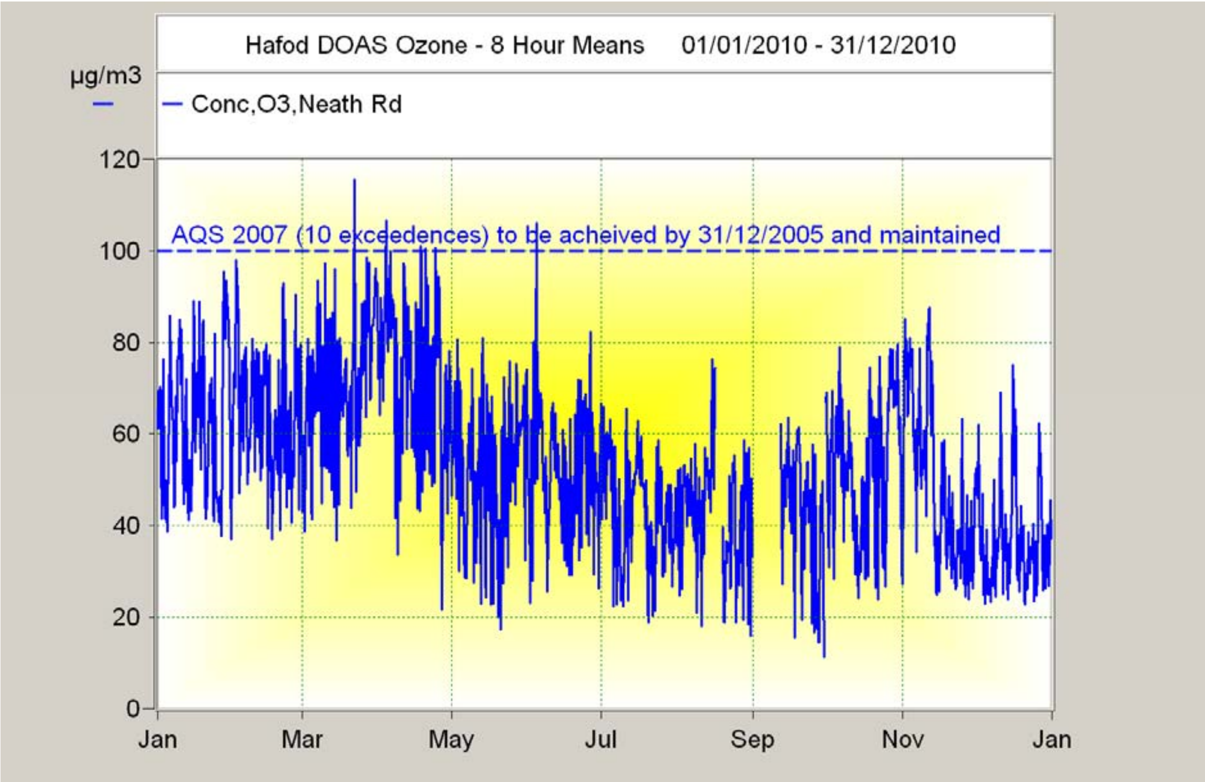


Graph 16 - Cwm Level Park Ozone 8-hour means 2010

Cwm Level Park	Max 8-hour Mean (µg/m^3)	Data capture	Exceedences of 8-hour objective 100µg/m^3 (10 permitted)
2009	100.75	92.6%	1
2010	106.5	98.26%	1

Table 17 – Cwm Level Park Ozone 8-hour means 2002-2010

Hafod DOAS

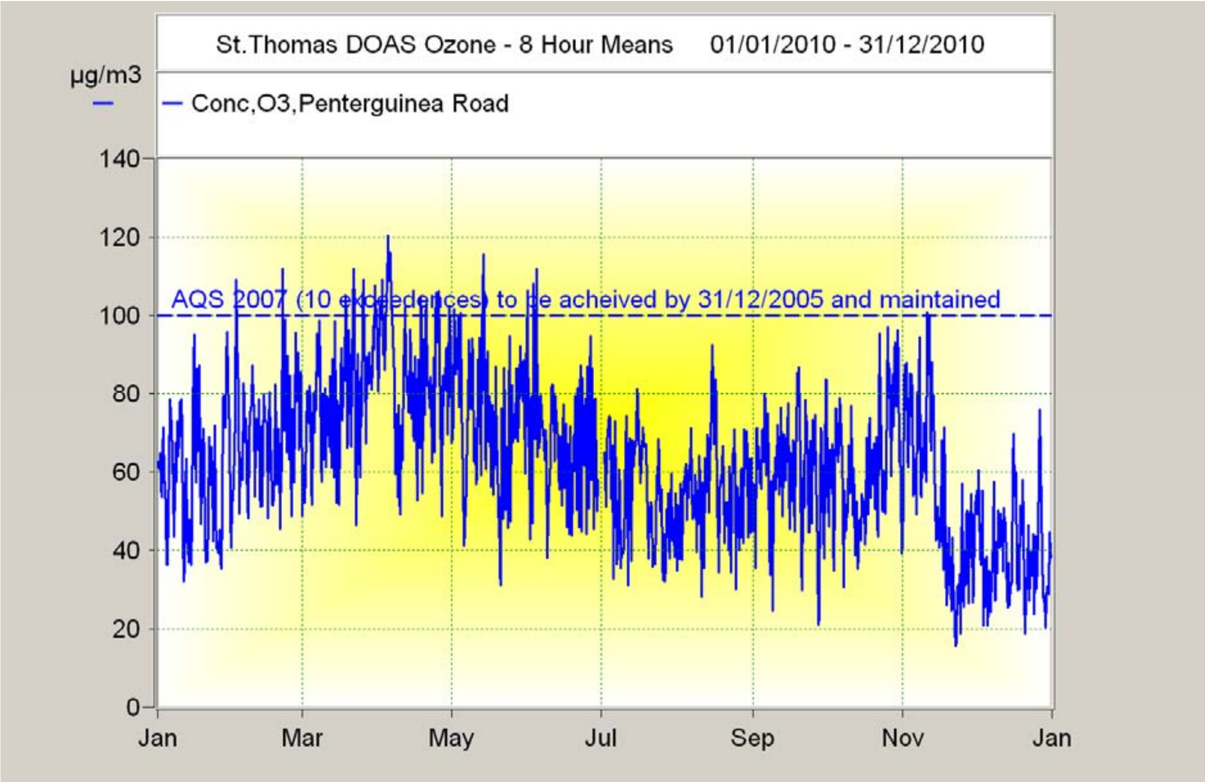


Graph 17 - Hafod DOAS Ozone 8-hour means 2010

Hafod DOAS	Max 8-hour Mean (µg/m^3)	Data capture	Exceedences of 8-hour objective 100µg/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

Table 18 - Hafod DOAS Ozone 8-hour means 2006 -2010

St.Thomas DOAS



Graph 18 – St.Thomas DOAS Ozone 8-hour means 2010

St Thomas DOAS	Max 8-hour Mean (µg/m^3)	Data capture	Exceedences of 8-hour objective 100µg/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

Table 19 - St.Thomas DOAS Ozone 8-hour means 2006 -2010

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 14784 and 20856 respectively during 2010, it's clear that considerable photochemistry is evident along Pentreguinea Road, St Thomas.

The Hafod DOAS is operating in what can loosely be considered to be a street canyon whilst the St Thomas site, despite an open aspect to one side of the roadway not hindering dispersion is showing exceedences during 2010 and previous years. Clearly, significant exceedences of the objective have been seen during 2006 – 2010 at the St.Thomas DOAS. The results from the open path measurements at Hafod and St.Thomas clearly differ 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 the R&P Teom units.

The FDMS units are required to operate within an ambient enclosure temperature range between 18-22°C[27]. 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 provides hourly integration data and has 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. However, the FDMS unit will not directly produce a $PM_{2.5}$ mass concentration. The $PM_{2.5}$ mass concentration is obtained via post processing of the volatile and non volatile mass parameters by creating a calculated channel the software package Opsis Enviman ComVisioner.

[27] UK Equivalence Program for Monitoring of Particulate Matter dated 5th June 2006 section 5.5.2

AEA Energy and Environment has produced a new LSO operating procedure for the FDMS units.

Data collected from the FDMS unit has 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 Opsis Enviman ComVisioner. 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[28]. 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 has been queried on many occasions as the $PM_{2.5}$ unit was reporting higher concentrations of $PM_{2.5}$ than the PM_{10} unit. Both FDMS units have been investigated for leaks, dryer issues, pump vacuum issues during 2010 but no $PM_{2.5}$ data has been rejected (as yet) by the network operators. The data for 2010 should beused and treated with caution at present. However, problems have continued with the reliability of the FDMS throughout early 2011 with data now likely to be rejected. It is now being proposed that both problematic Swansea units will be removed for extensive workshop investigation into their operation. It is hoped that these investigations will provided information of value that can be cascaded to the UK Networks sites where some FDMS installations are also proving to be problematic.

[28] LAQM.TG(09) Calculation of Exceedence Statistics A1.216 page A1-48

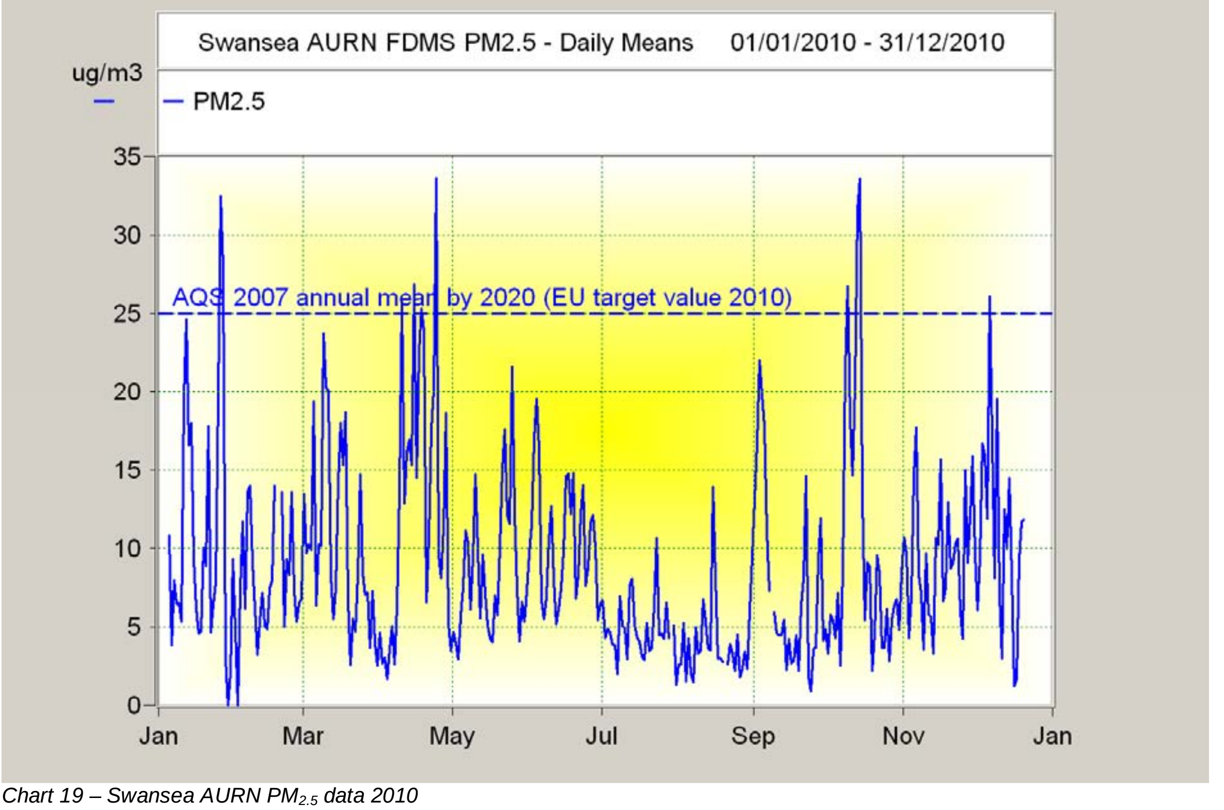


Chart 19 – Swansea AURN $PM_{2.5}$ data 2010

Swansea Roadside AURN $PM_{2.5}$ (FDMS)	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

Table 20 - Swansea AURN $PM_{2.5}$ data 2007 - 2010

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/m^3 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 Hafod Air Quality (NO_2) Management Area.

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 2007-2009 representing the last 3 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 22-25 below detail the monthly means during 2007-2010 for the **Glais Primary School ❷** 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 have been 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 have been seen at the Glais Primary School site during 2010 due to instrument faults.

Tables 26 - 29 detail the monthly means for the **Coed-Gwilym Cemetery site ❸** between 2007 and 2010. 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 26– 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 27– 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 28– 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 29– Heavy Metals monitoring 2010 Coed-Gwilym Cemetery

Tables 30-33 detail the monthly means for the **Morriston Groundhog ❺** site during 2007 -2010. All results are expressed in ng/m^{-3}

Morriston 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 30 – Heavy Metals monitoring 2007 Morriston 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 31– 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 32– Heavy Metals monitoring 2009 Morriston Groundhog

Morriston 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 33– Heavy Metals monitoring 2010 Moriston Groundhog

As mentioned above within section 2.1.10 above, monitoring at the site **YGG Gellionnen** ❹ (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 -2010 can be found below within tables 34 - 36.

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 34– 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 35– 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 36– Heavy Metals monitoring 2010 YGG Gellionnen

Table 37 presents the nickel annual means from all four monitoring sites for the years 2002-2010 where appropriate.

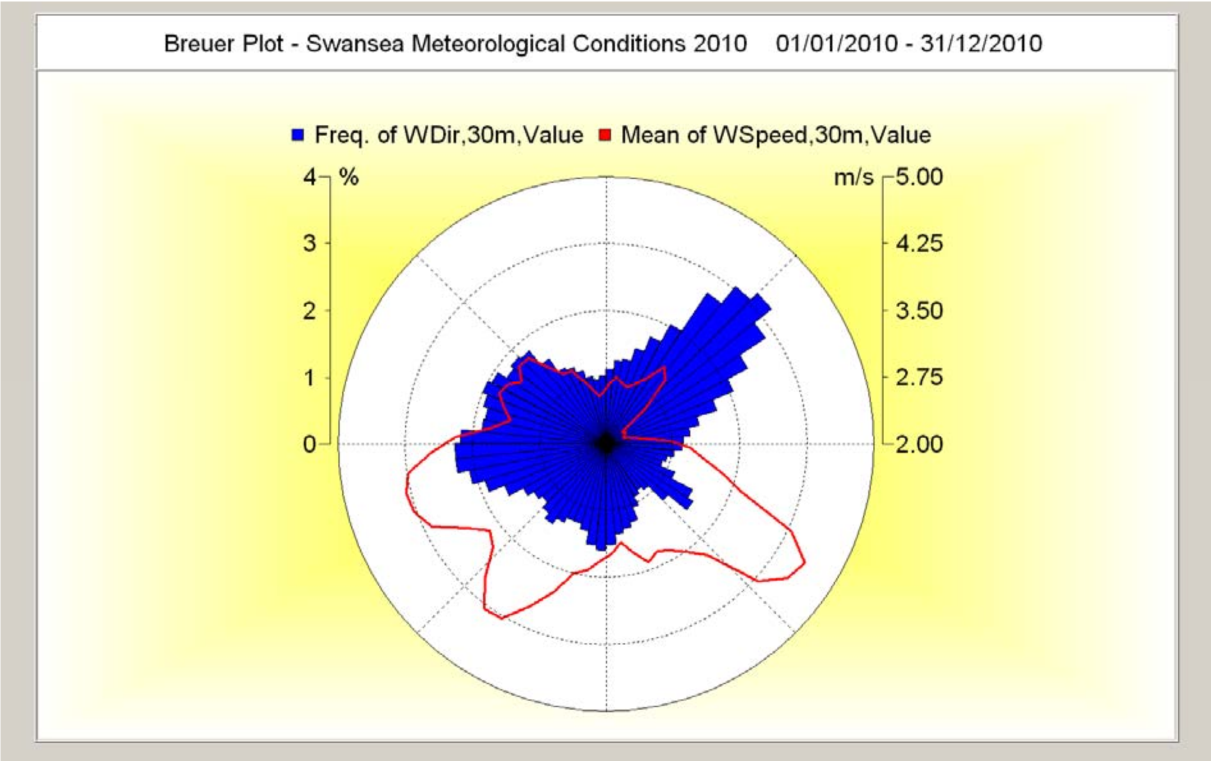
Year	Glais Primary School ❷	Coed-Gwilym Cemetery ❸	YGG Gellionnen ❹	Morriston Groundhog ❺
2002	**28.91**	-	-	-
2003	18.14	-	-	-
2004	**33.83**	-	-	-
2005	19.62	-	-	-
2006	**26.13**	-	-	-
2007	**28.04**	**37.31**	-	18.3
2008	10.34	19.61	10.99	7.6
2009	4.64	16.0	19.22	9.34
2010	7.0	10.48	15.0	15.28

Table 37 – Swansea Nickel Annual Means 2002 – 2010

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 INCO 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.

Interestingly, downwind of the release point in Clydach, concentrations during 2010 have increased from the previous two years whilst upwind of the release point in Clydach, concentrations at Coed-Gwilym cemetery have decreased. These atypical results can be attributed to the atypical meteorological conditions seen within Swansea during 2010.

Breuer Plot 11 below shows the meteorological conditions recorded during 2010 at Cwm Level Park in the lower Swansea Valley. Conditions seen here broadly represent the wider area and indicate a prevalence of north-easterly winds 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



Breuer Plot 11- Swansea Meteorological Conditions 2010

From the data available within tables 22-36, 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 22-36, it is clear that annual mean concentrations for lead at all monitoring locations fall well below the 0.25ug/m^3 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 incomplete for 2010 with results only being available up to September 2010. Results of all compounds measured from 2007 up to September 2010 can be found by following links at: http://www.airquality.co.uk/pah_data.php.

The latest 2010 data can be specifically viewed at http://uk-air.defra.gov.uk/data/pah/Compiled_Concentrations_PAH_Digitel_2010-Web_v1.xls - please select the Swansea Conc Data tab (the last one)

2.4 Summary of Compliance with AQS Objectives

The City & County of Swansea has measured concentrations of nitrogen dioxide during 2010 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 2009. 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 2009. This rational is also followed elsewhere within this Progress Report.

3.2 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,[29] 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 discounted[30] from further consideration.

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

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 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 38 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 LAQM [31] 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	Morriston / Cwmrhydyceirw
Cwmrhydyceirw Road	Cwmrhydyceirw
Alexandra Road	Gorseinon
Belgrave Road	Gorseinon
Courtney Street	Manselton
Clyndu Street	Morriston
Morfydd Street	Morriston
Parry Road	Morriston
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 38 – 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 of locations and

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

therefore due to financial restrictions it is planned to cease further monitoring at these locations. 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 is proposed before variation of the Swansea Air Quality Management area 2010 is considered to assess conditions at the residential properties at first floor level above the shop canopy.

3.3 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. 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 NO_2 tube survey work undertaken within the city centre during 2010, several locations are showing the potential to exceed the 1-hour mean objective. In particular, sites 126 and 127 along The Kingsway, Swansea indicate annual means exceeding 60ug/m^3 and therefore exceedences of the 1-hour NO_2 objected are likely[32]. These locations are either close to or adjacent to café environments situated on the pavement area alongside the roadway. Concerns also exist for sections of High Street that fall outside of the existing Hafod AQMA exceeding the NO_2 annual mean objective. These situations are described within section 2.3 above. Whilst these data are, below an annual mean of 60ug/m^3, there is published evidence[33] to support the possibility that exceedences of the 1-hour NO_2 objective may be seen with an annual mean below 60ug/m^3. Statistically the chances of this occurring are low (around 5% and mainly in the south-east of England if the data for 2007 is included) but the possibility remains given both the increased primary NO_2 now being seen from newer EURO diesel heavy vehicles and the knowledge that High Street witnesses an LDV composition in the traffic flow of over 14%.

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

[33] 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

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 NO_2 passive tube diffusion results. Further details of the development are described within section 5.2.10 below. 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.

3.4 Roads with a High Flow of Buses and/or HGV's.

The authority operate 44 GPRS traffic counters that have been configured to produce a vehicle classification split into the EUR 6 basic categories as detailed below within table 39. Their location can be seen within Annexe 6. These tend to be within the lower Swansea Valley area in and around the Hafod AQMA 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, expansion is unlikely.

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 39 – EUR6 Classification scheme

Data from the ATC network has been analysed for the years 2004 – 2010 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 40-37. Table 38 summarises the total HDV flows.

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

Table 40 – EUR6 Classification scheme 2004-2010 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.

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

Table 41 – EUR6 Classification scheme 2004-2010 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, 4, 11, 32 and Site 40 that see 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
Site 1	0.3	0.3	1.2	1.6	1.4	1	0.8
Site 2	0.2	0.2	0.2	0.2	0.3	0.3	0.4
Site 3	0.2	0.2	0.5	0.5	0.6	0.6	0.6
Site 4	0	0.3	0.5	0.7	0.7	0.7	0.7
Site 5	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
Site 7	0.5	0.4	0.6	0.8	1	0.7	1.4
Site 8	1.5	1.4	0	1.1	0	0.0	0
Site 9	0.5	0.3	0.4	0.4	0.4	0.4	0.4
Site 10	0.4	0.3	0.7	0.9	0.5	0.2	0.2
Site 11	0.8	0.8	2.7	2.9	3.4	2.9	2.9
Site 12	0.3	0.4	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
Site 14	1.5	1.3	2	2.2	1.9	1.3	1
Site 15	0.9	1	1.1	1.2	1.1	0.9	0.6
Site 16	0.7	0.2	0.3	0.3	0.4	0.3	0.2
Site 17	0.3	0.2	0.4	0.4	0.4	0.3	0.2
Site 18	1	1.6	2.1	2.1	1.7	1.3	1.3
Site 19	1.2	1.2	2.5	3.3	3.6	3.3	3.1
Site 20	1.1	1.1	1	0.9	0.9	0.9	0.9
Site 21	0.2	0.3	0.5	0.5	0.3	0.3	0.3
Site 22	3.6	3.2	6.7	8.4	8.7	7.4	6.5
Site 23	0.5	0.4	0.7	0.9	0.9	0.8	0.8
Site 24	-	0.6	0.7	0.7	0.7	0.8	0.8
Site 25	-	0.7	0.5	0.8	0.8	0.8	0.9
Site 26	0.5	0.4	0.4	0.5	0.5	0.4	0.5
Site 27	0.5	0.4	0.5	0.6	0.6	0.6	0.4
Site 28	0.4	0.4	0.5	0.5	0.5	0.4	0.4
Site 29	0	0.3	1.3	1.7	1.7	1.7	1.6
Site 30	-	0.8	0.8	0.8	0.8	0.8	0.6
Site 31	0.3	0.3	0.4	0.4	0.5	0.5	0.5
Site 32	-	1.3	1.3	1.4	1.4	1.2	1.2
Site 33	0.2	0.5	1.1	1.5	1.3	1.3	1.3
Site 34	-	1.5	1.5	1.7	1.7	1.6	0.9
Site 35	-	2	1.6	1.5	1.4	1.2	1
Site 36	-	-	-	-	-		
Site 37	-	0.9	0.8	0.7	0.8	0.8	0.7
Site 38	-	0.7	1.6	2.1	1.8	1.0	1.2
Site 39	-	0.2	0.4	0.7	0.8	0.8	0.9
Site 40	0	0.3	0.7	0.7	0.7	0.7	0.8
Site 41	-	0.2	0.2	0.2	0.2	0.3	0.4
Site 42	-	0.8	1	1.1	1.1	1.1	1
Site 43	-	0.4	0.4	0.4	0.4	0.4	0.4
Site 44	-	-	-	0.9	0.9	0.9	1.0

Table 42 – EUR6 Classification scheme 2004-2010 Class 6

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 site 19 Carmarthen Road which leads directly into High Street.

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

Table 43– HDV composition from EUR6 Classification scheme 2004-2010

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 43 it can be seen that only site 8 at Morfa Road 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 within the next 6-12 months as residential development at the former Unit Superheaters site (see section 5.2.4) has commenced during mid 2011. Morfa Road falls within the development proposals of The Tawe Riverside Development Corridor (see sec 5.2.1). These proposals include residential developments 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 until mid 2011 but it is inevitable that further works will commence in the coming years. It is open to debate at present as to how long the whole scheme will take 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

Site 22 High Street was approaching the 20% threshold in revious 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 40-43 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.

3.5 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 PM_{10} 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 PM_{10} analysers at these locations. Therefore, alternative real-time instruments have 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 are 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 Etype 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 ceased and alternatives are being sought subject to the financial restrictions being imposed upon the authority.

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 proposed 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 PM_{10} measurements are:

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 NO_2 monitoring around several of these junctions, reliable long term PM_{10} monitoring has not proved possible as described above.

3.6 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.

3.7 Roads with Significantly Changed Traffic Flows

Data is available from 2006-2010 and these data are presented below within tables

44 - 48 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 44 - 48 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.

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 44 – GPRS ATC Classification split 2006

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 45 – GPRS ATC Classification split 2007

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 46 – GPRS ATC Classification split 2008

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 47 – GPRS ATC Classification split 2009

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 48 – GPRS ATC Classification split 2010

To assess if the AADT has changed significantly over the period 2005-2010, data is presented below in table 49

Site	AADT 2005	AADT 2006	AADT 2007	AADT 2008	AADT 2009	AADT 2010	% Growth 2010 over 2007 Base year	% Growth 2010 over 2008 Base year	% Growth 2010 over 2009 Base year
Site 1	7248	12072	11976	10584	11808	**11856**	-1.00	**12.02**	**0.41**
Site 2	10608	14160	13824	14472	14448	**13536**	-2.08	-6.47	-6.31
Site 3	10368	13272	13272	12048	12888	**12792**	-3.62	**6.18**	-0.74
Site 4	8616	10392	10368	9936	9864	**10080**	-2.78	**1.45**	**2.19**
Site 5	5472	7728	7800	7656	7152	**7224**	-7.38	-5.64	**1.01**
Site 6	12552	14616	14952	15528	14232	**11544**	**-22.79**	**-25.66**	**-18.89**
Site 7	19536	21576	20424	20064	19248	**20832**	**2.00**	**3.83**	**8.23**
Site 8	1632	2568	2280	2616	2256	**2088**	-8.42	-20.18	-7.45
Site 9	9288	12984	13536	12864	12912	**12768**	-5.67	-0.75	-1.12
Site 10	18888	21672	21432	21312	21624	**20856**	-2.69	-2.14	-3.55
Site 11	2904	4368	4056	4176	4200	**4152**	**2.37**	-0.57	-1.14
Site 12	12864	19440	19896	19440	19776	**18720**	-5.91	-3.70	-5.34
Site 13	12720	13320	13080	12864	12792	**12096**	-7.52	-5.97	-5.44
Site 14	13344	15408	15072	16368	14952	**14640**	-2.87	-10.56	-2.09
Site 15	16392	22032	22368	22512	20544	**20784**	-7.08	-7.68	**1.17**
Site 16	21120	27120	27600	26976	25656	**25176**	-8.78	-6.67	-1.87
Site 17	22368	27336	27360	27048	26640	**28488**	**4.12**	**5.32**	**6.94**
Site 18	11784	15744	16200	15744	14760	**14784**	-8.74	-6.10	**0.16**
Site 19	18240	23232	22704	18216	21936	**20136**	-11.31	**10.54**	-8.21
Site 20	28392	32904	32976	31560	31680	**30840**	-6.48	-2.28	-2.65
Site 21	23808	30528	30984	30744	27768	**28968**	-6.51	-5.78	**4.32**
Site 22	8160	10752	10896	10728	10320	**5928**	**-45.59**	**-44.74**	**-42.56**
Site 23	19776	22656	22344	22200	22320	**21792**	-2.47	-1.84	-2.37
Site 24	-	9672	9696	9672	9600	**8880**	-8.42	-8.19	-7.50
Site 25	-	23160	12000	14352	14232	**13488**	**12.40**	-6.02	-5.23
Site 26	19248	22440	22584	22440	21768	**20976**	-7.12	-6.52	-3.64
Site 27	18720	17496	22320	19920	22464	**19344**	**-13.33**	**-2.89**	**-13.89**
Site 28	11160	13584	13656	13248	13608	**12456**	-8.79	-5.98	-8.47
Site 29	9240	11208	11328	11160	11280	**10488**	-7.42	-6.02	-7.02
Site 30	-	21480	22344	21936	22224	**14952**	**-33.08**	**-31.84**	**-32.72**
Site 31	13896	16416	16056	15360	15840	**15336**	-4.48	-0.16	-3.18
Site 32	-	16464	15984	15792	16152	**15456**	-3.30	-2.13	-4.31
Site 33	19752	21864	21312	21408	21528	**20280**	-4.84	-5.27	-5.80
Site 34	-	17088	15144	16824	16872	**15360**	**1.43**	-8.70	-8.96
Site 35	-	13656	12696	12288	12432	**12024**	-5.29	-2.15	-3.28
Site 36	-	-	-	-	-	**-**	-	-	-
Site 37	-	44088	47592	45960	47064	**45648**	-4.08	-0.68	-3.01
Site 38	-	8976	9240	9144	9144	**7776**	**-15.84**	**-14.96**	**-14.96**
Site 39	-	23664	23280	23208	22944	**22248**	-4.43	-4.14	-3.03
Site 40	7872	10248	10200	9936	9720	**8928**	-12.47	-10.14	-8.15
Site 41	-	30768	30720	29856	30336	**29136**	-5.16	-2.41	-3.96
Site 42	-	14592	14904	14976	14832	**14520**	-2.58	-3.04	-2.10
Site 43	-	31248	30648	29784	29232	**27264**	-11.04	-8.46	-6.73
Site 44	-	-	10944	13344	13272	**12456**	**13.82**	-6.65	-6.15

Table 49 AADT Percentage Growth 2005-2010

* 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. ** Site 27 was out of service for a several weeks during 2006 due to gas main replacement works- data capture affected

It should be noted that as mentioned above, sites 6, 22, 27, 30 and 38 suffered from significant downtime due to either resurfacing works destroying the loops or gas mains replacement works destroying the loops. These sites show a significant decrease in growth for 2010 and the indication should therefore be treated with extreme caution. For ease of reference, these sites are highlighted blue within table 49 above.

Notwithstanding the unavoidable loss of data at the above mentioned sites, the vast majority of sites actually show a decrease in growth over previous years. Only a handful of sites show a positive growth over the three year period with only two sites showing a year on year growth. These sites, sites 7 and 17 are interesting for different reasons. Site 7 is on the outskirts of the city centre and has probably been affected by the changes to the network infrastructure within the city centre whilst site 17 is outside the Liberty Stadium in Landore – home of Swansea City AFC and the Ospreys and close to the Morfa Retail Park.

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%. Clearly, this level of growth was seen between 2005 and 2006 at several sites but between 2007- 2010, 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

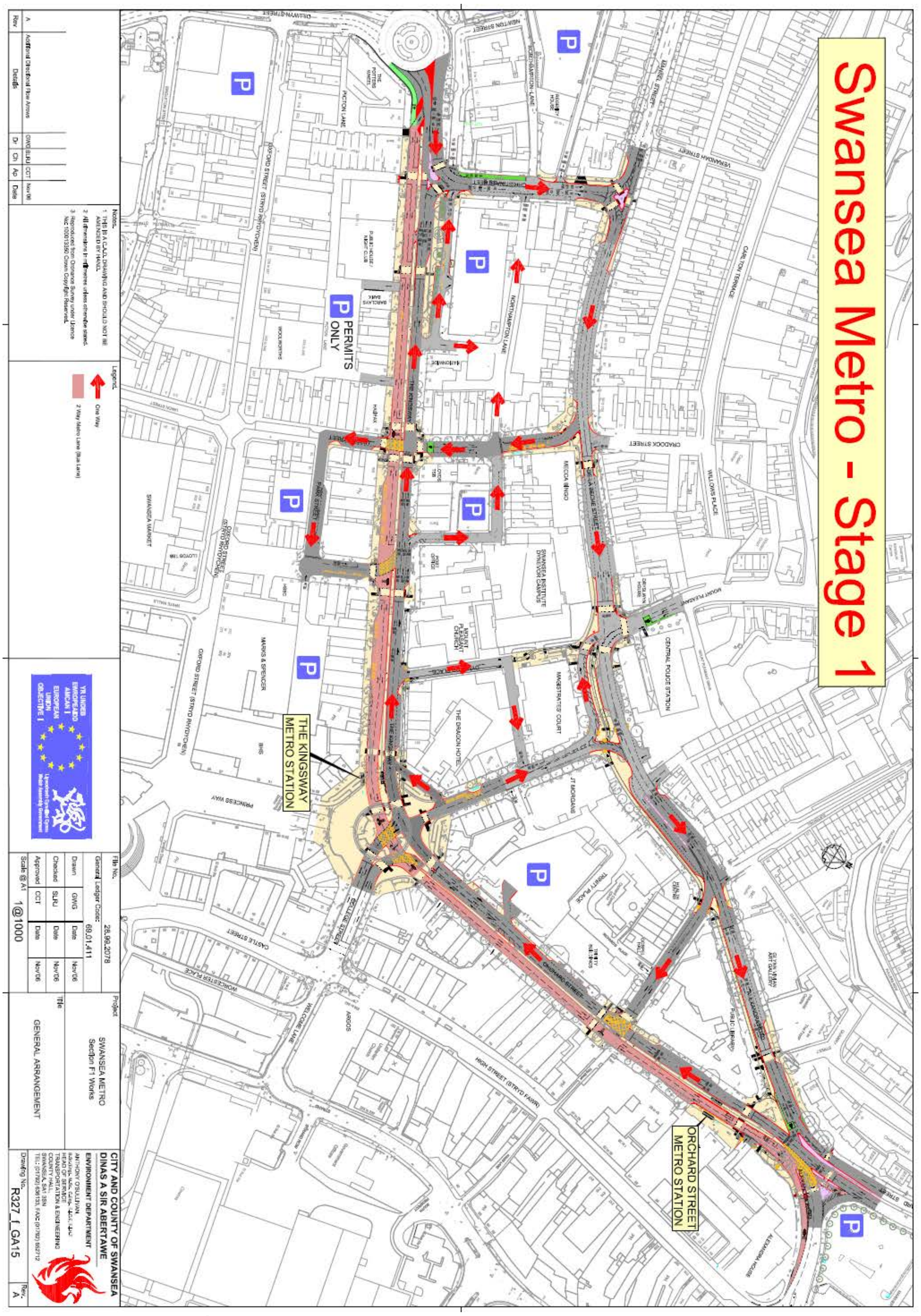
In order to enable the Swansea Metro to run, considerable works to the existing road network were required. Some of these works required at Cwm Level and Normandy Road roundabouts lie within the existing Hafod Air Quality Management Area. The road network surrounding these key roundabouts has been altered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

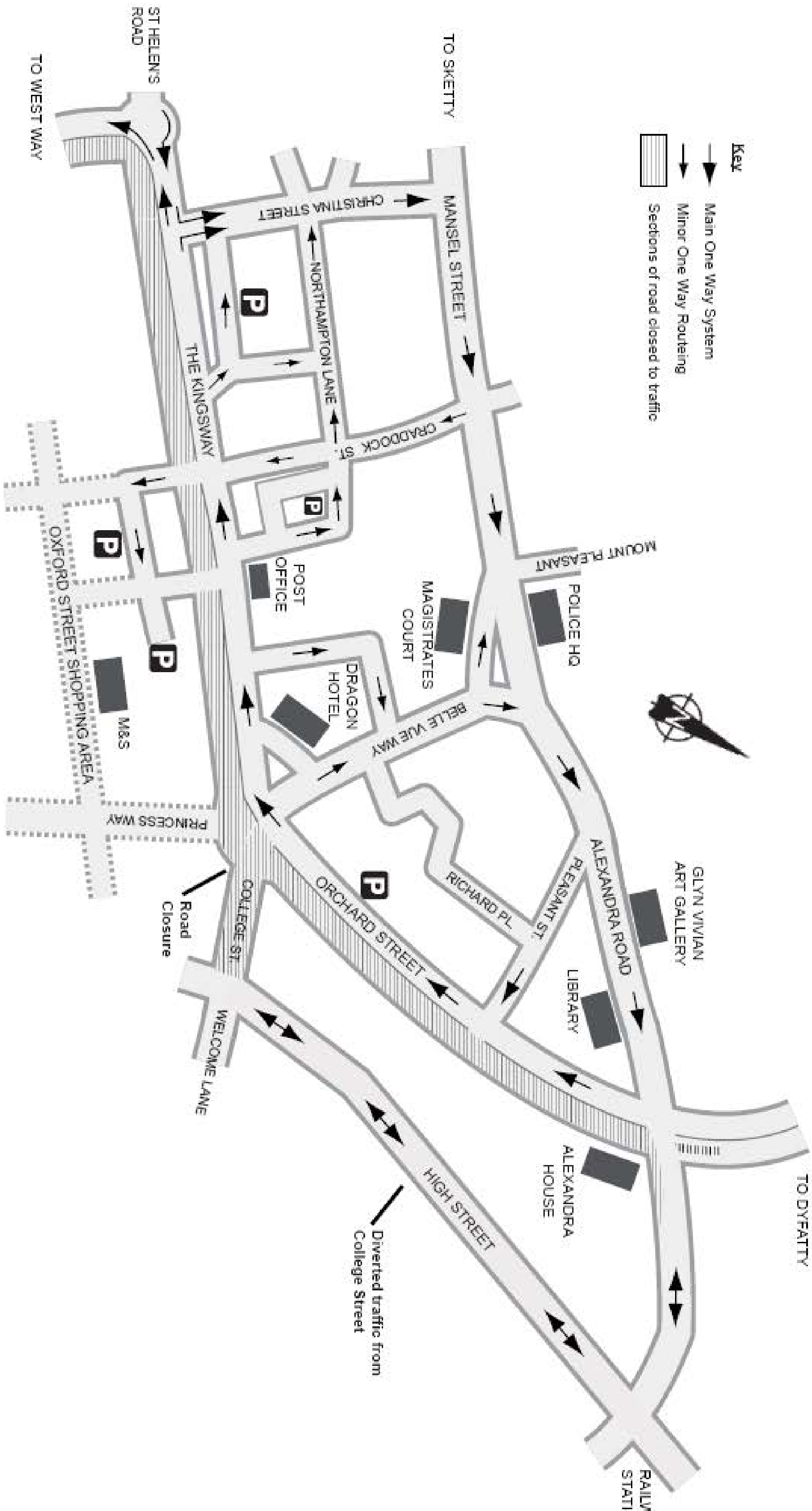
Phase 2 of the Metro scheme (see map 14) commenced during July 2007 to extend the provision from the Kingsway down along Westway, linking into the Quadrant Transport Interchange (see section 3.8 below) and to the new Civic Centre on Oystermouth Road. Phase 2 was completed during late 2008/early 2009.

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 place 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 NO_2 levels. This work is outlined within section 2.3 above.

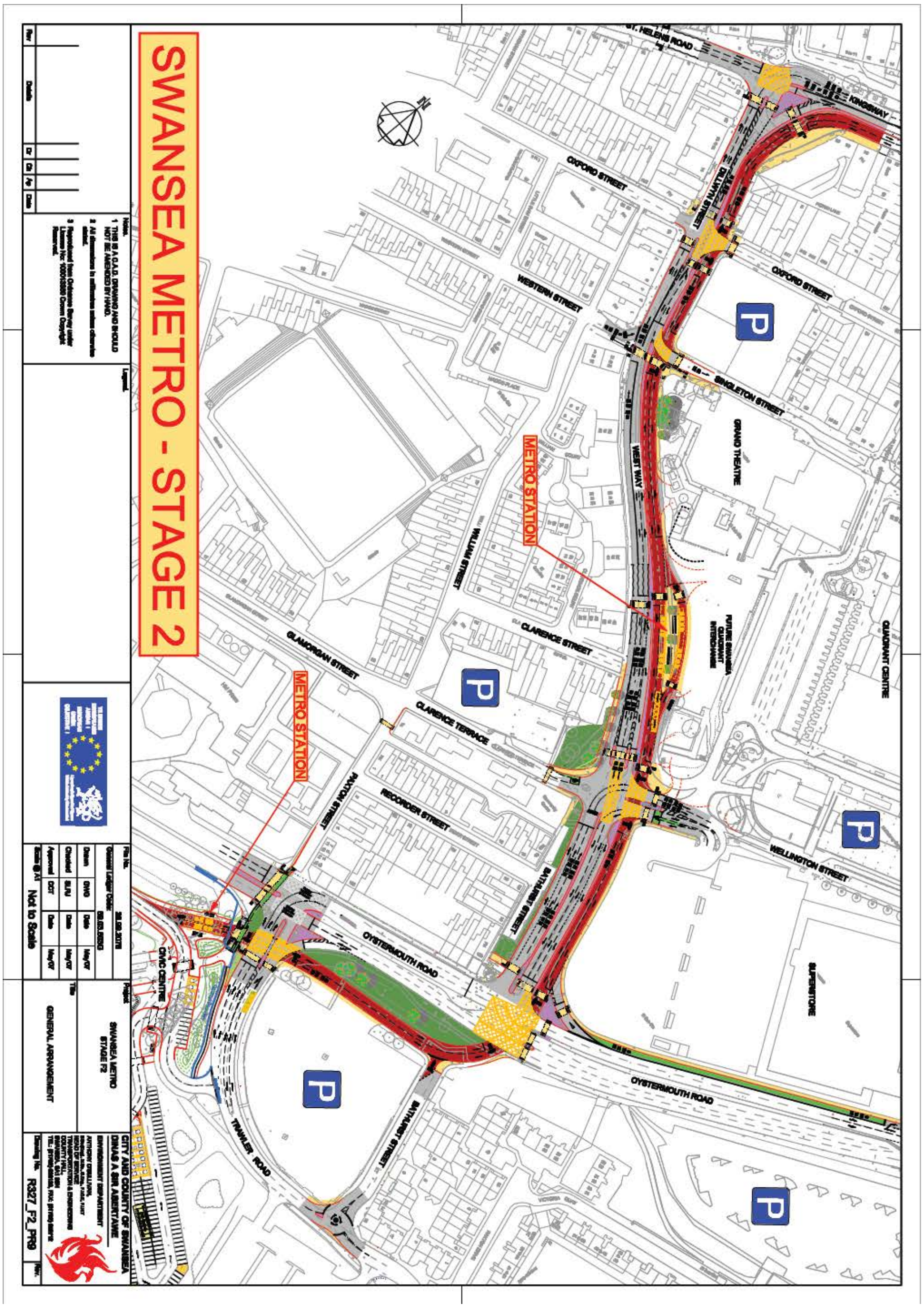
Installation of site 36 (Westway) has been awaiting the completion of the redevelopment of the Quadrant Interchange (Sec 3.8 below) as access and egress roadways from the new interchange will require consideration and monitoring. However, the same budgetary constraints now evident within the authority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

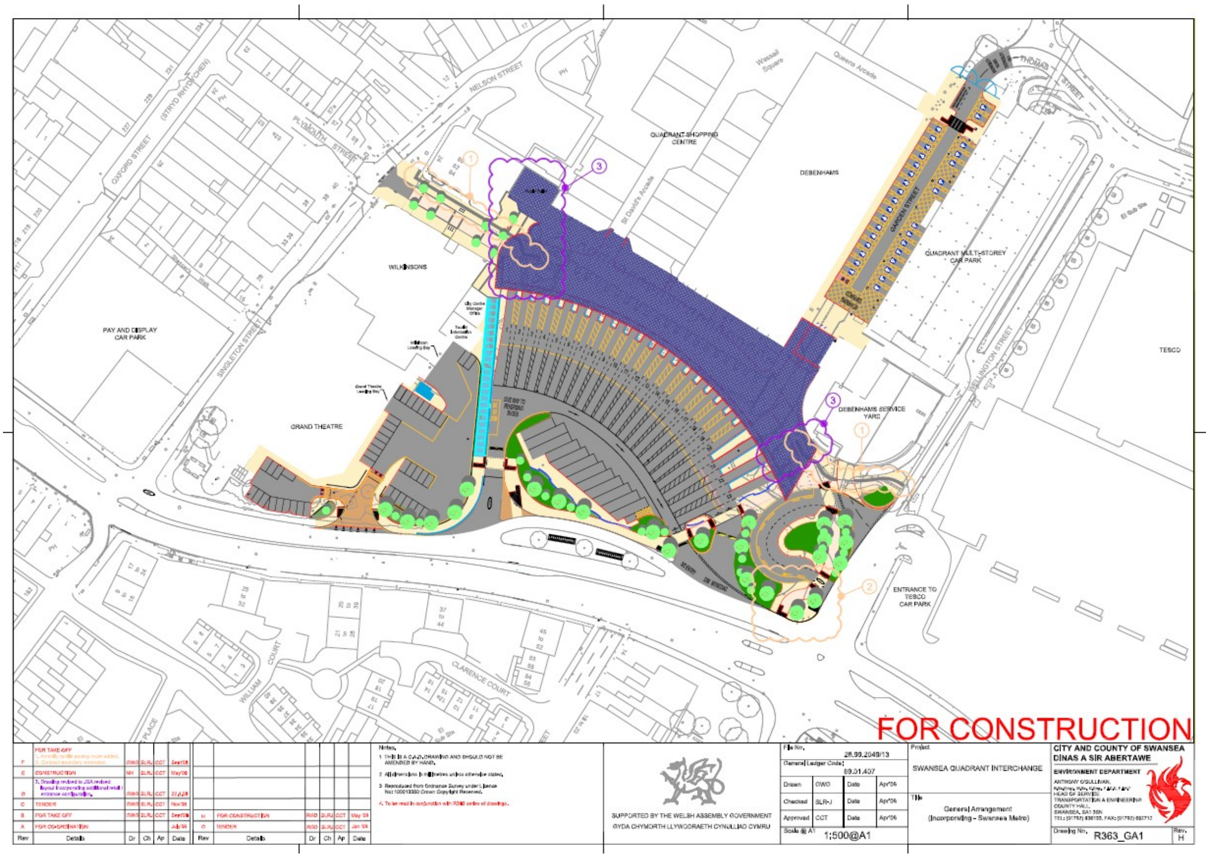
The City and County of Swansea confirms that there are no new/newly identified roads with significantly changed traffic flows.

3.8 Bus and Coach Stations

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 2-3*.* A plan of the development area is given below as map 15.

Sketch 1 Quadrant Transport Interchange off Westway, Swansea



Map 15 – *Quadrant Transport Interchange off Westway, Swansea*

Blocks of flats can be seen opposite the proposed 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 has 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 provided but provision of these may be some way off due to financial restrictions.

Sketch 2 Quadrant Transport Interchange

Sketch 3 Quadrant Transport Interchange

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

Movements of buses in and out of the interchange will be capable of being monitored when GPRS ATC site 36 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.

3.9 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 following key objectives will be pursued:

- Improve the environmental quality throughout the corridor both in terms of consistent tree planting, streetscape and building quality
- Create high quality pedestrian routes between the heart of the City and the maritime areas without compromising traffic flow
- Maintain the corridor's role as a major vehicular route into and through the City
- Incorporate sustainable transport measures
- Integrate and accommodate key development proposals into the schemes development
- Use buildings & spaces to introduce more life into street frontages

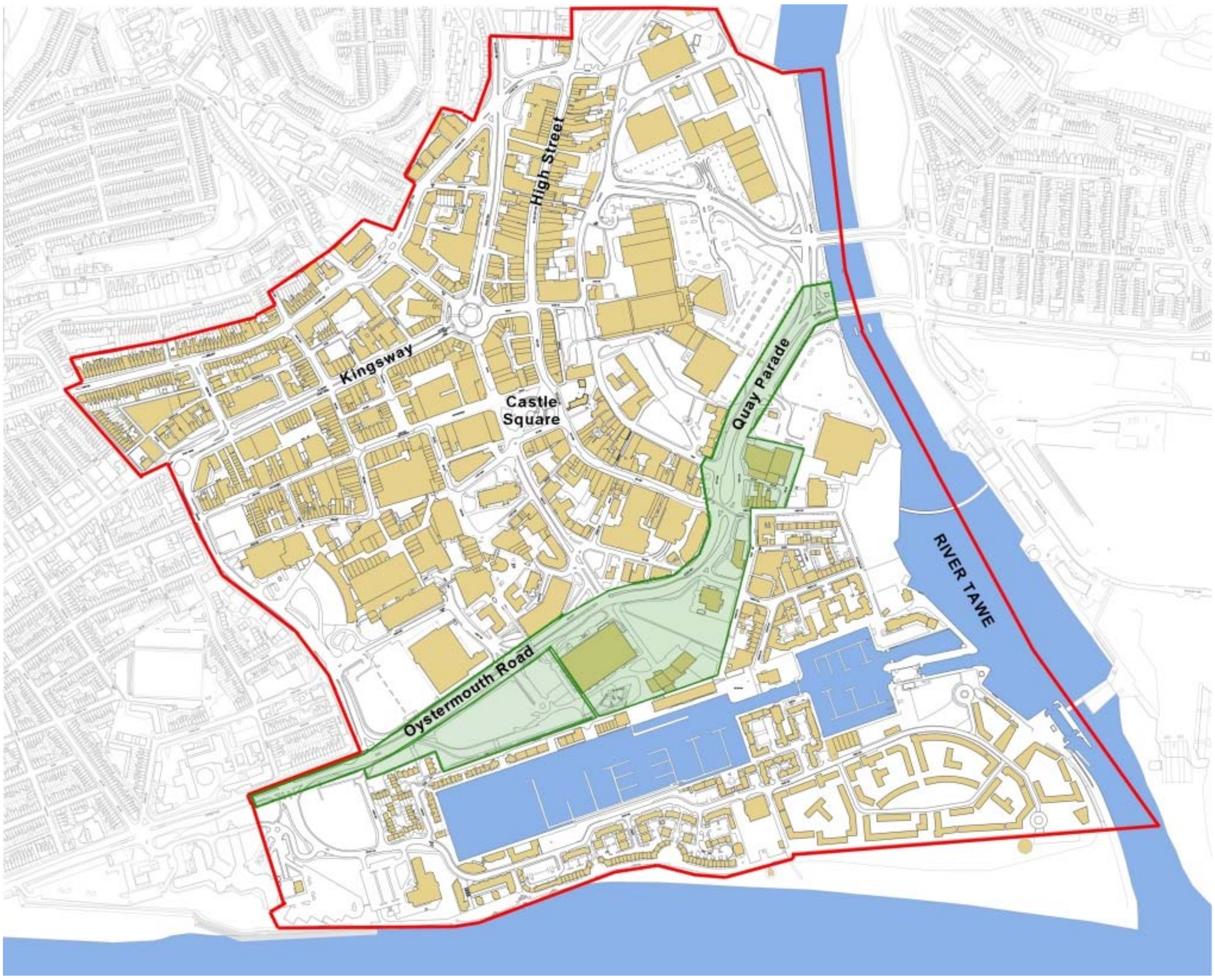
The following key principles are fundamental to the scheme:

- Optimising the use of the full width of the adopted highway in accordance with the Project's key objectives
- Rationalisation of numbers of roads accessing the Boulevard
- Contained within the adopted highway
- Improvements to traffic light sequencing to facilitate better traffic movement
- Clearly defined, safe, pedestrian crossings at:
    - Parc Tawe - Sainsbury's
    - Wind Street - Museum Green
    - Princess Way - NWM/LC
    - Westway - Paxton Street

- Wide continuous, tree lined central median and pavements

- Sustainable transport measures involving a combination of bus priority measures such as: bus lanes and bus gates
- Cyclists will be accommodated by means of links to and from the Boulevard
- Minimisation of clutter, rationalise and reduce highway signage
- Minimise future revenue commitments - on the basis of whole life costs the scheme must be revenue neutral

The Council has secured £38.5m from Convergence and other sources towards a package of works within the City Centre. £17.5m of this is identified to fund the delivery of Phases 1 and 2 of the "Boulevard" (Phase 1 - River Bridges to Strand; Phase 2 - Strand to Princess Way.) A funding strategy to secure match funding to achieve the full identified budget is currently being developed.



Swansea Boulevard project

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Sketch 4 Swansea Boulevard project

3.10 Other Transport Sources

3.10.1 Airports

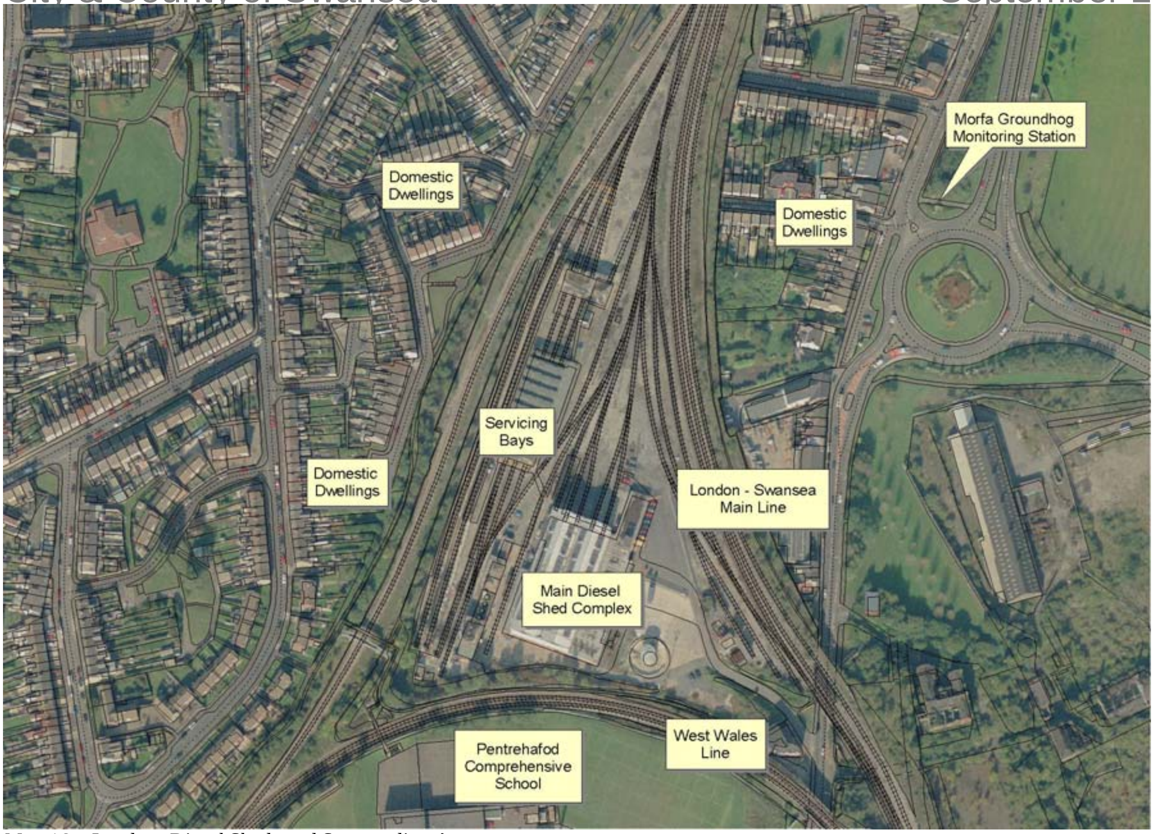
Swansea does have a small airport located at Fairwood Common, Upper Killay that has previously been used as a “regional airport”. However, guidance within LAQM.TG(09) box 5.4 Section B1 page 5-21 indicates that assessment for NO_2 will only be required should relevant exposure exist within 1000m of the 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

3.10.2 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

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 minutes[34]. 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.

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

An identical view has also been formed for the activities 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.

“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.

3.10.3 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 NO_2 concentration is above 25ug/m^3. In order to answer this question, use has been made of the 1k by 1k background maps from http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html. The text file for NO_2 background concentrations for 2010 has been imported into Arcview 3.3 GIS and examined. If the background NO_2 1k by 1k concentrations are indexed in descending order it can be seen that the maximum 1k by 1k grid square (266500 196500) for 2010 returns a value of 23.49ug/m^3. 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.

Local knowledge of the path of the Swansea to Paddington London railway line would also indicate that 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 NO_2 concentration is expected to exceed the threshold for assessment of 25 ug/m^3. 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 NO_2 at locations within 30m of the Swansea to Paddington London railway line.

3.10.4 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 2010 there were a total of 529 vessels visiting the port which equates to 1058 total shipping movements. 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.

3.11 Industrial Sources

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

There have been no new or proposed installations received by the City & County of Swansea.

In 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.[35] 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, PM_{10} and sulphur dioxide would be insignificant in respect of the Air Quality Objectives.

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.

[35] Source Neath Port Talbot Council

Map 17 Location of Prenergy site within Neath Port Talbot

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.

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

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.

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

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.

3.11.4 Major Fuel (Petrol) Storage Depots

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

3.11.5 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 5µg/m^3 objective at risk if the throughput exceeds 2000m^3 of petrol , especially if combined with higher levels from a nearby busy road[36]. 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 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 has been 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.

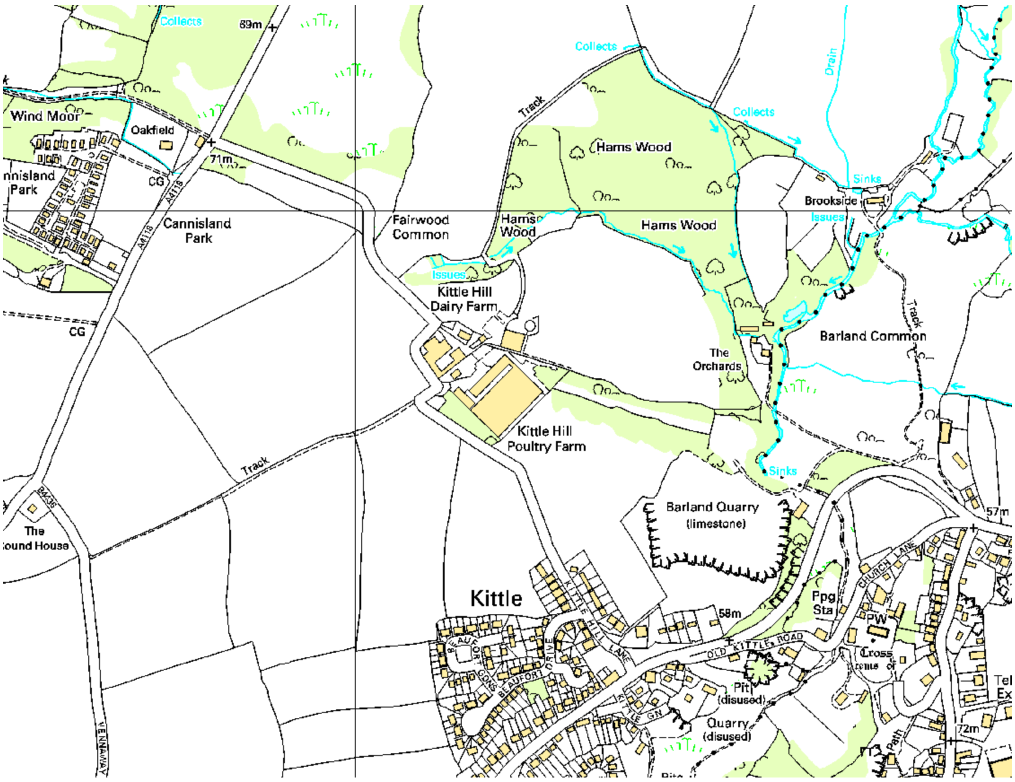
[36] LAQM.TG(09) Box 5.5 Section C3 petrol Stations page 5-40

These arrangements were negotiated with the relevant fuel companies many years ago, particularly to resolve late night noise nuisance complaints.

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

3.11.6 Poultry Farms

LAQM.TG(09) contains guidance on assessing potential exceedences of the PM_{10} 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.



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

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

Previously under the Environment Agency permit application granted during 2007 up to a total of 295,680 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 has indicated intent to grant a PPC permit to permit up to 400,000 birds to be housed. However, information to hand indicates that the operators only intend to bring in 388,080 birds at present. 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.

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 repeats this number of permitted birds at this establishment. 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.**

3.12 Commercial and Domestic Sources

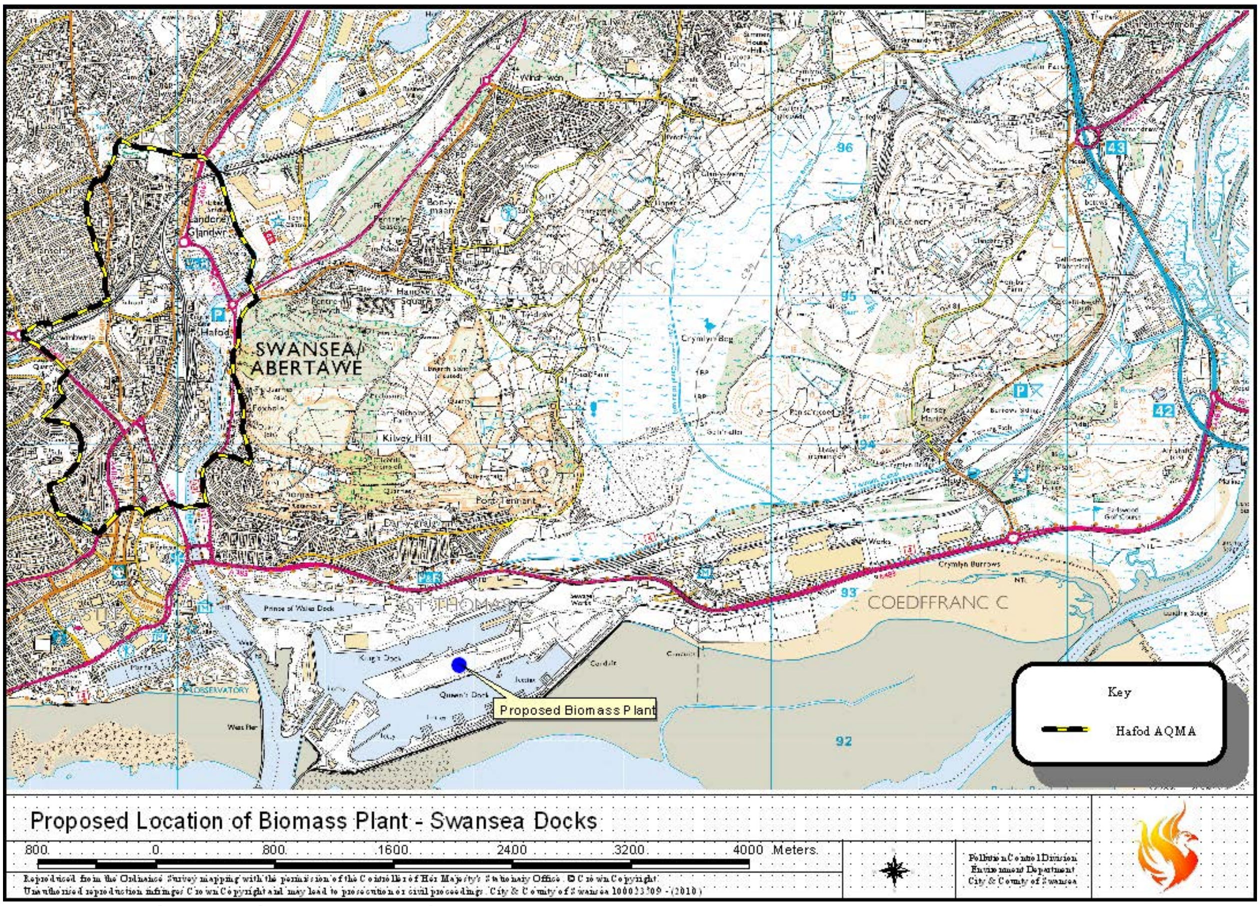
3.12.1 Biomass Combustion – Individual Installations – Ethnic Quisine

The authority was aware of one A2 process which was permitted during 2005-2006 at Ethnic Cuisine Ltd located on the Winch Wen Industrial Estate in Swansea. The biomass plant was used to treat waste food into bio-fuel, which was thermally treated in a bio-mass burner, with the heat generated being fed into a boiler to produce steam for use in the factory. The system was modular with the main components consisting of the bio-fuel converter, a bio-fuel silo, the bio-mass burner, a boiler to recover heat from the hot flue gases and a cyclone. However, the bio-mass installation suffered an explosion and was later determined to be dangerous due to design flaws and has not been put back into operation with litigation pending between the parties.

3.12.2 Proposed Biomass Plant – Swansea Docks

Details of the application are reproduced here from those previously reported to provide the latest updates following the applicants appeal against refusal of permission in April 2009.

Application (Reference 2007/2684) was submitted during late 2007 for the erection of a biomass fired combined heat and power plant with ancillary offices, workshops, heat rejection building, car parking, landscaping and infrastructure requirements on land within Swansea Docks (between the King's Dock and Queen's Dock). Timber would be shipped into Swansea docks from Canada (with some locally sourced) and the power/heat connections would be local. The proposed location is shown below within map 21.



Map 21 Proposed Biomass Plant – Swansea Docks

An Environmental Statement was published in November 2007 which included an assessment of the impact of the proposed biomass power station on air quality. Dispersion modeling was carried out based on a stack height of 60m to assess air quality impacts and deposition rates locally. It was concluded that all of the Air Quality strategy objectives would be met with the power station in operation at all locations assessed.

Critical loads are already being exceeded in Crymlyn Bog SAC for nitrogen deposition and acid deposition at Pant y Sais and part of Nant y Crimps SSSI. The increase in acid deposition due to the biomass power station would be less than 1% of the critical load at all sites except Pant y Sais where it was predicted to be 8%. Discussions between the applicants and the Countryside Council for Wales (CCW) took place during 2008 and a further air quality assessment was requested with stack heights of 70m and 80m. Following this assessment it was found that deposition rates would be reduced if a 70m stack was specified. The planning application was amended during June 2008 to include a 70m stack. Further negotiations and assessments have been undertaken resulting in delays within the planning process until the application was refused by this authority during April 2009.

The grounds for refusal were given as "*The proposed development by virtue of the nature of its use, location, scale and design, its adverse visual and landscape impacts, and the perception of reindustrialisation and risks to health exacerbated by the 70 metre tall chimney stack and smoke plume would have unacceptable social and economic impacts particularly on SA1 Swansea Waterfront, St Thomas and Swansea Point and prejudice the Councils adopted strategic vision to make Swansea a vibrant, attractive and distinctive 21st Century Waterfront City which capitalises on its waterfront location. As such the proposal fails to accord with or would unacceptably prejudice the delivery of the 2008 Swansea Unitary Development Plan (UDP) Goals 1 and 2 and their objectives: UDP strategic Policies SP1, SP3, SP4, SP5, SP6, SP7, SP8, SP9; UDP part 2 Policies EV1, EV2, EV40, EC1, EC2, EC15, EC16, HC1, AS12 and R11; the Swansea City Centre Strategic Framework and the Port Tawe and Swansea Dock Supplementary Planning Guidance".*

An appeal was lodged during November 2009 with the appeal process hearing commencing during May/June 2010 but was adjourned shortly afterwards until October 2010 with the authority notified of the appeal decision during December 2010.

The Inspectors decision was to dismiss the appeal with the following conclusions:

"Notwithstanding my favourable findings for the appellant on some of the matters before the Inquiry, including the second, third and fourth main issues, I consider that the harm to the character and appearance of the area represents a compelling objection to the proposal. The proposed development is contrary to the provisions of the development plan, and there are no other material considerations which are sufficient to outweigh the harm and policy conflict I have identified. The scheme would add to the mix of energy provision for Wales, but it would not do so whilst minimising the impact on the environment, and so the proposed development would be at odds with the aims of PPW. For the reasons given above and having regard to all other matters raised, I conclude that the appeal should be dismissed"

3.12.3 Biomass Combustion – Combined Impacts

Local knowledge of areas of Swansea with the highest densities of housing and those areas dominated by commercial activities/service sectors would point to no area of 500 by 500m having sufficient quantities of solid fuel burning appliances or bio-mass combustion to impact on PM_{10} concentrations. This view is supported by the virtual lack of nuisance complaints from both sectors. The authority has received individual nuisance complaints from individual instances of domestic wood burning stoves/appliances but these have been few and far between.

3.12.4 Domestic Solid-Fuel Burning

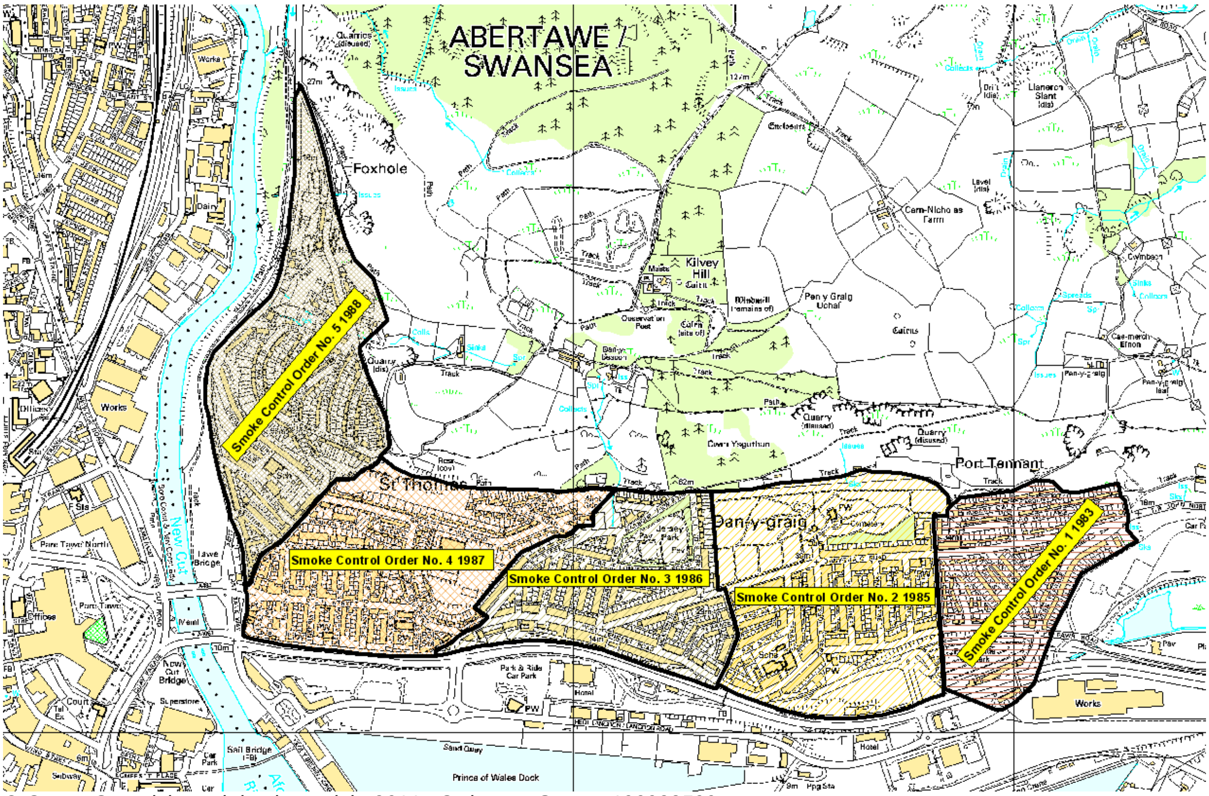
Swansea City Council, the predecessor to the City and County of Swansea, declared 5 Smoke Control Areas within the Port Tennant and St.Thomas areas between 1983 and 1988 – these Orders can be seen below within map 22.

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.

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 area[37]. 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 submitted. However, the approach within LAQM.TG(09) box 5.8 section D2 page 5-51 then presents a conflicting "Question" which asks "Does the

[37] LAQM.TG(09) box 5.8 section D2 page 5-51

density of coal burning premises exceed **100** per 500 by 500m area". This would appear to be an artefact from previous technical guidance.



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Map 22 – City & County of Swansea Smoke Control Orders 1-5

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 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.

3.13 New Developments with Fugitive or Uncontrolled Sources

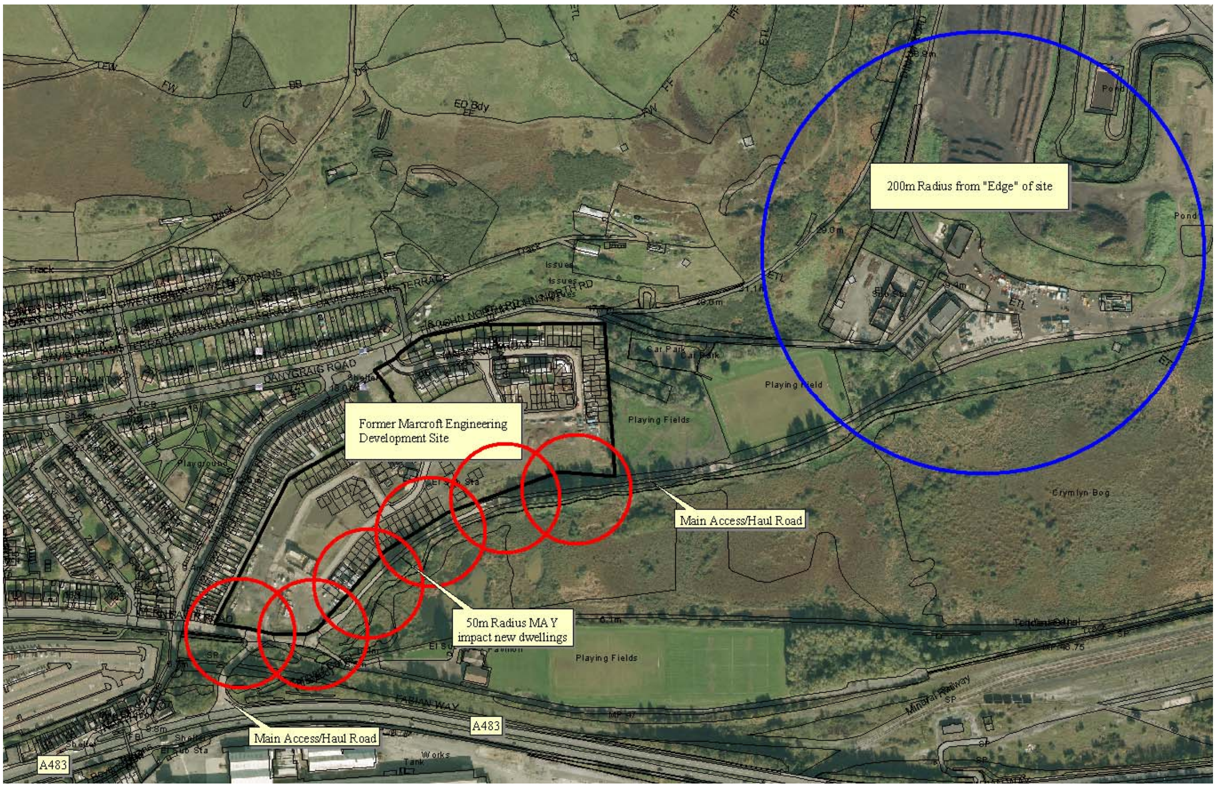
Guidance within LAQM.TG(09) box 5.10 Section E page 5-53 indicates an approach to adopt to assess fugitive sources of PM_{10} from a number of sources including quarrying, landfill sites, coal and material stockyards, or materials handling. Where dust is emitted, a proportion, (typically about 20%) will be present as PM_{10}. 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 PM_{10} annual mean background concentration taken from background maps is greater than or equal to 28μg/m^3, within 400m if the 2004 objective PM_{10} annual mean background concentration taken from background maps is greater than or equal to 26μg/m^3, and within 200m for any background

Based on the 1k by 1k grid squares background PM_{10} maps downloaded for 2010 from http://laqm.defra.gov.uk/maps/maps2008.html , and after indexing the field Total_PM_{10} it can be seen that the maximum 1k by 1k grid square (270500 197500) background concentration is 16.69 ug/m^3. Therefore, “near” is taken to be the latter distance i.e. 200m.

3.13.1 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 25ug/m^3 and there are visible deposits on the road. Map 23 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 is in the process of being developed for housing. As of June 2010, numerous new properties have been constructed, more than is reflected at present within the Ordnance Survey MasterMap data shown within map 23. These newly constructed properties are now within the 50m radius from the haul/ access road. Obviously, when the development is completed, dozens of new properties will fall within the 50m radius (red circles) from the access road. At present, as the background PM_{10}

concentrations do not exceed 26ug/m3 and there are no visible deposits on the road, these locations can be discounted.

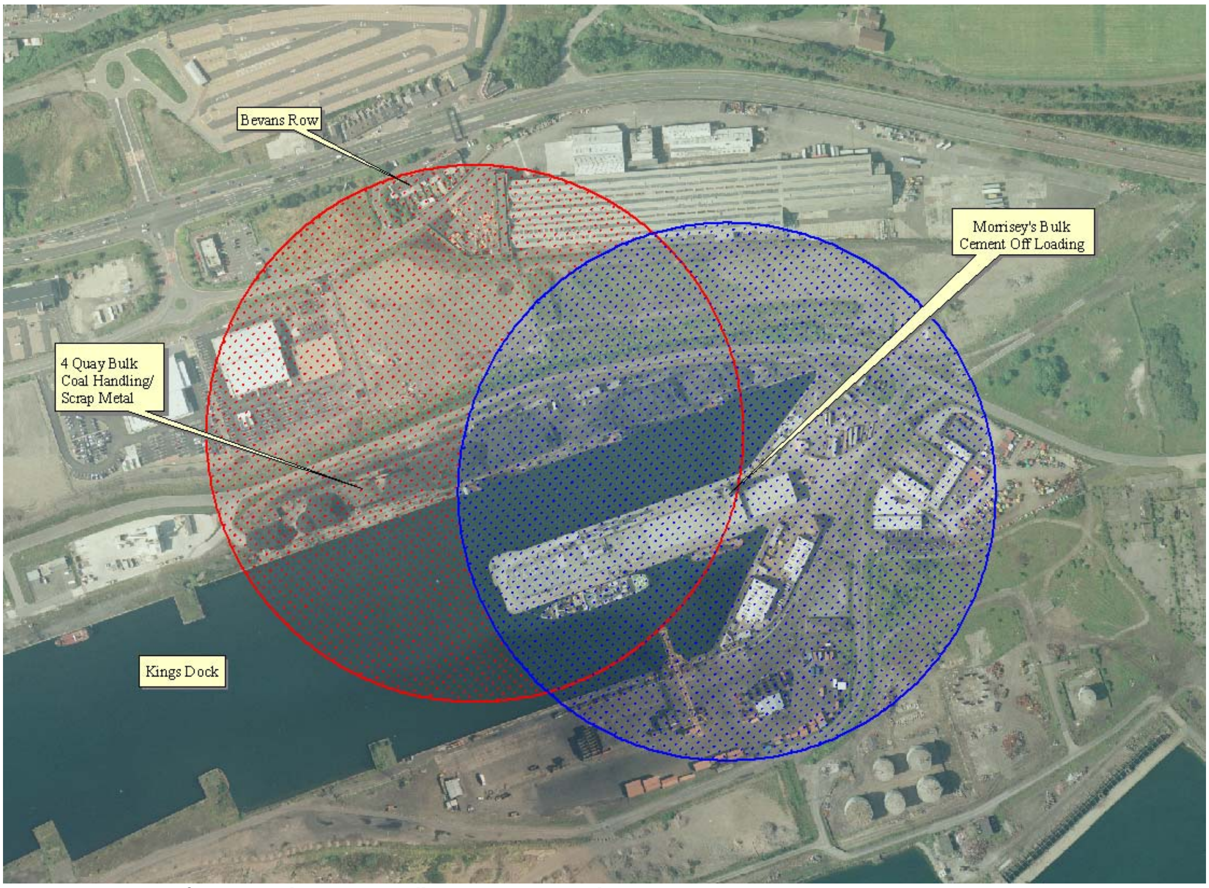


Map 23- Tir John Landfill Site, Port Tennant, Swansea

There are no receptor locations within 200m of the main landfill area (blue circle). The Environment Agency 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 LAWDAC subsequently won the appeal and the site is now once again fully operational.

3.13.2 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 Morrisey's Cement Bulk off loading facility both located around the Kings Dock. The Port Health Authority regulates both of these operations. Map 24 below identifies both these activities at Kings Dock. 4 Quay handles a bulk coal handling facility on the dock side. 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.

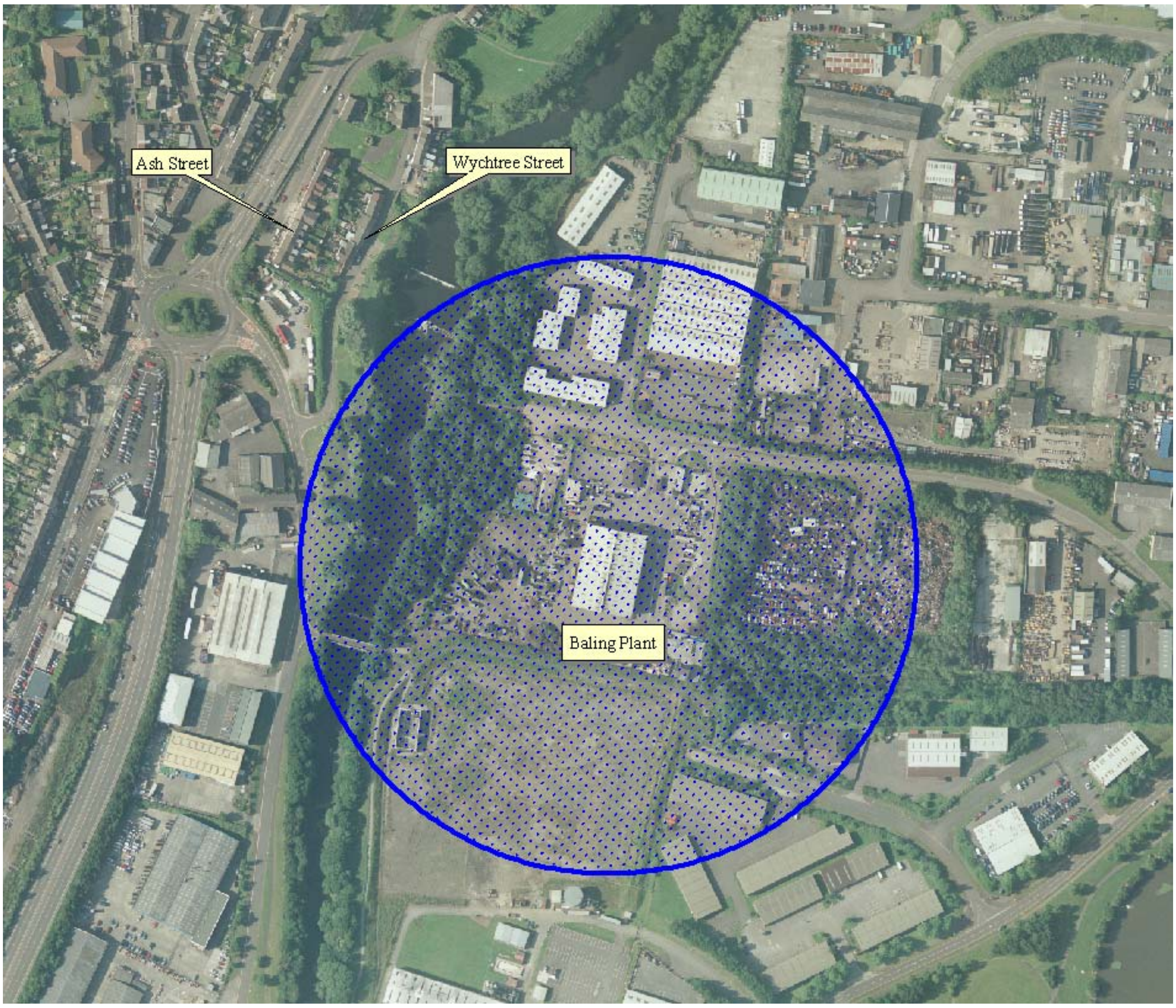


Map 24 – Location of 4 Quay and Morriseys Bulk Cement Kings Dock, Swansea

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).

3.13.3 Waste Management Facility – Baling Plant

The LAWDAC operate the Baling Plant off Ferryboat Close, Morriston Enterprise Park which 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 25 shows the proximity of the facility to the nearest receptor locations.



Map 25 – Baling Plant, off Ferryboat Close, Morriston Enterprise Park

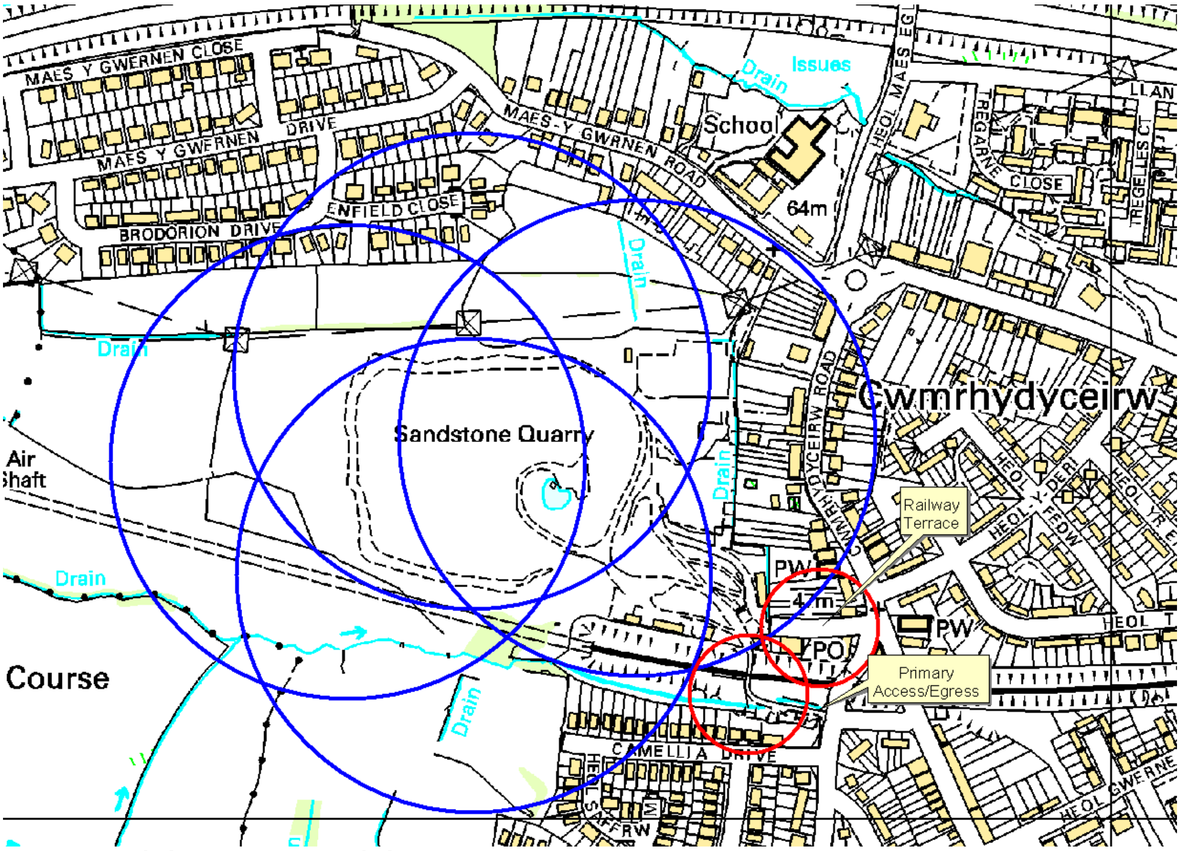
There have been numerous complaints of odour during 2010 resulting mainly from the composting activities at the facility, but no substantive dust complaints. In any case, with reference to LAQM.TG(09) box 5.10, there are no receptors within 200m of the centre of the facility (blue circle).

3.13.4 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 has now been issued for deposits of waste to recommence following extensive preparatory works. These preparatory works include 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 have the potential to emit substantial fugitive emissions as well as odour nuisance. Discussions have commenced with the operators to establish what monitoring and local liaison is required with local residents. Receptor locations are within 200m. Map 26 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, Cwmrhdyceirw 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, at this stage it is not envisaged that this route will 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 PM_{10} levels (against the 2004 objective) are below 25ug/m^3 they are not considered to be "near".[38]

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

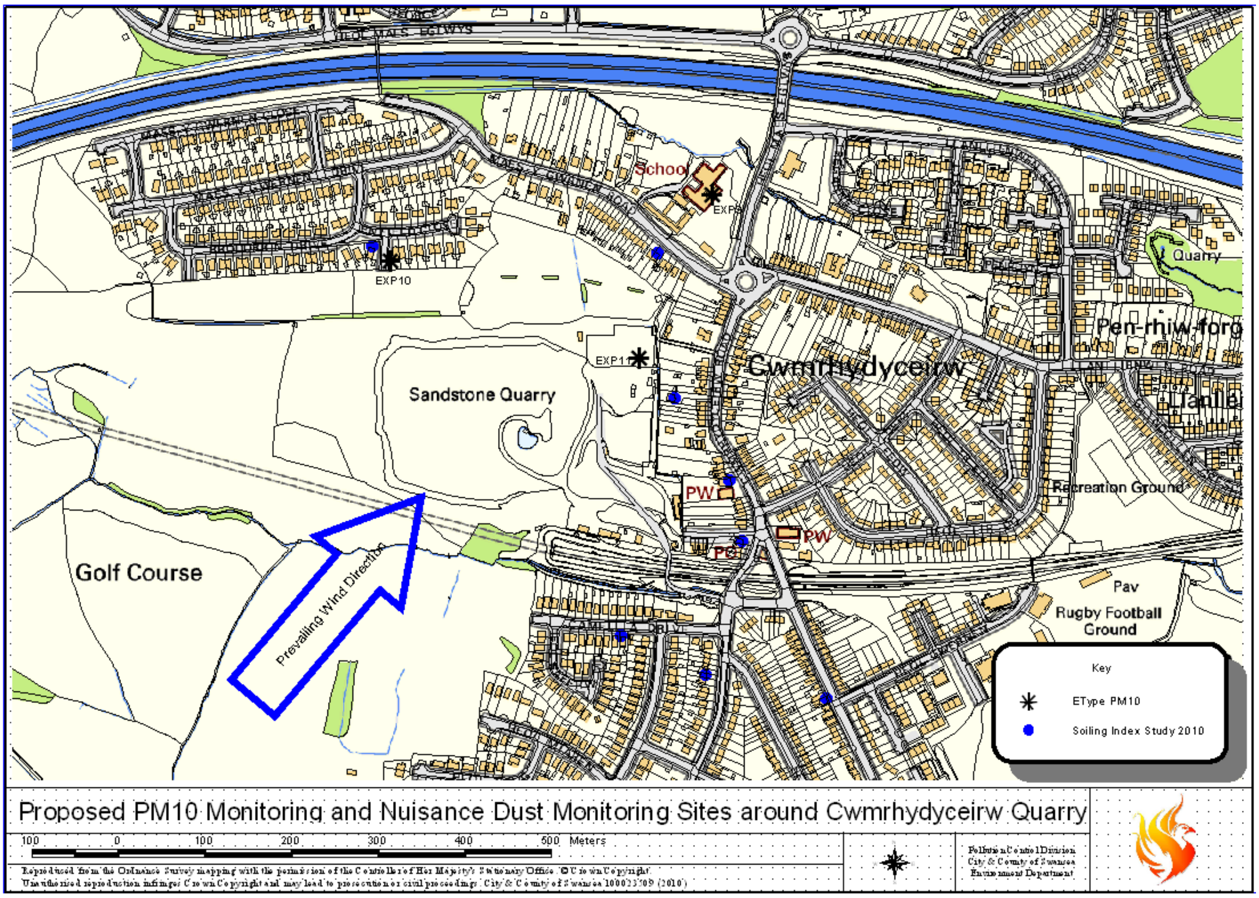


Map 26 – Cwmrhydyceirw Quarry, Cwmrhydyceirw

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. Any fugitive emissions during excavation and relining are likely to be of a transitional/temporary nature. However, preparatory works have now commenced during the early stages of 2010 with the sinking of extensive new monitoring boreholes around the site along with trial holes into the previously deposited material.

The authority have therefore commenced a monitoring program to assess nuisance dust in the immediate vicinity of the quarry as well as the installation of three real time Etype PM_{10} analysers upwind of the quarry to enable a preliminary screening of the operations to be made. Etype analysers have 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 is planned at a property at Enfield Close. It should be noted that the Etype analysers are not type approved, have not undertaken equivalency testing and are deployed for the sole purpose of undertaking a preliminary "screening assessment" as part of this authorities undertaking to local residents. These Etype analysers have proven problematic in use elsewhere within Swansea.

In addition to the real-time PM_{10} monitoring, the authority have also established eight "soiling index" dust sites to assess any dust of nuisance value generated by site activities, and offsite vehicular access/egress once preparatory works and landfill operations become established in the coming months. Map 27 below outlines the chosen locations



Map 27 PM_{10} and Soiling Index Dust Sites

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3.13.5 Operational Opencast Coal Mines or Quarries

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

The City & County of Swansea has identified the following new or previously unidentified local development which may impact on air quality in the Local Authority area.

Cwmrhydyceirw Quarry Landfill Site

These will be taken into consideration in the next Updating and Screening Assessment, scheduled for 2012.

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 reflects 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.

In 2008, air quality was one of five 'big issues' selected by SEF as part of a Better Swansea Partnership (community strategy) initiative to identify a limited number of 'shared priorities' across all public services in Swansea that are difficult to progress and require greater attention and wider collaboration. SEF committed itself to facilitating progress with this issue and reporting back on a regular basis to the Better Swansea Partnership. In early 2009, a task group was formed involving officers from various council departments and services. The group first met in March 2009 to share information on air quality issues, and to discuss existing projects that support air quality objectives, barriers to progress and potential opportunities and solutions. A further meeting of the task group was held in September 2009 and involved the drafting of an air quality improvement action plan. These 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 have been proposed to address these aims and updates on progress with these actions are discussed at air quality task group meetings.

In October 2009, representatives of the air quality task group met with representatives of Swansea University to discuss the potential for undergraduate and postgraduate research projects that would support the air quality improvement action plan. Though several ideas and opportunities were discussed, no further progress has been made on this to date.

In November 2009, SEF held a public seminar – *The Air that we Breathe* – which gave an opportunity to update SEF members and the general public on the current state of air quality in Swansea and on progress with the air quality improvement action plan.

During 2009, SEF provided three written updates to the Better Swansea Partnership on the air quality 'shared priority' and in January 2010, SEF and theauthorities air quality team gave a formal presentation to the Better Swansea Partnership.

In February 2011, the air quality task group met again and had a presentation from Prof. Ronan Lyons 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 introducing an LEZ scheme in Swansea.

The Swansea Environment Strategy and associated action plans and reviews can be accessed from the Swansea Environmental Forum website, at www.swanseaenvironmentalforum.net . Hard copies of both the full Environment Strategy and a summary version can be obtained from the Environment Centre.

5 Planning Applications

Prior to the economic downtown 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 been reported fully within the Updating and Screening Assessments submitted in April 2006 and May 2009, Progress Reports 2007, 2008 and 2009. 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. The intention here is to highlight significant new proposals/applications post 2009/10 that have either commenced works or are awaiting decisions within the planning process.

5.1 New Retail Developments

5.1.1 Asda Store, Gorseinon

The application site consisted of a vacant parcel of land (2.63 hectares / 6.5 aces) and incorporates the two existing residential properties of 12 and 13 Mill Street and forms part of the Melyn Mynach development site adjacent to the north-east of the Gorseinon District Shopping Centre and Somerfield retail store. The site was previously part of the Mountain Colliery and Gorseinon Tin Plate Works, which was reclaimed in the late 1970’s. The site is bounded by the residential development of Cae Glas and Cwrt Rhian to the north; Ty’r Felin doctors surgery and the residential properties in Cecil Road to the west; the Somerfield store to the south and Heol Mynydd to the east. An outline of the proposed site can be seen within map 28 below.

The application was refused during 2007 for the following reason **“**The application fails to adequately demonstrate the need for the size and type of store proposed at this location and that the development would not have an unacceptable adverse impact upon the Gorseinon Shopping Centre as a whole and the potential for enhanced shopping facilities within the broader catchment area.” As such, the development fails to accord with Structure Plan Policies S2 and S4, Southern Lliw Valley Local Plan Policies S1, S3 and S9, Draft Swansea Unitary Plan Policies SP6, EC4 and EC5 and the adopted Parc Melin Mynach Development Brief

The application was resubmitted during February 2009 and sought full planning permission for the development of a Class A1 retail store with a gross floor space of 5,375 sq m (57,858 sq ft) together with associated car parking (329 spaces) and service delivery area. The net sales area of the store will be 2705 sq m, of which it is proposed that up to 40% (1082 sq m) would be used for the sale of comparison goods and the remainder, convenience goods (1623 sq m). The proposal involved the demolition of the residential properties at 12 and 13 Mill Street. It was proposed to construct a new vehicular access incorporating a roundabout on Heol-y-Mynydd at the eastern end of the site which would also accommodate the separate service yard access. The existing vehicular connection to Cecil Road will remain open, however, following negotiations with the developer, in order to provide an enhanced pedestrian link into High Street it is was proposed to reduce the width of the carriageway adjacent to Mill Street, extend the width of the pavements and provide appropriate hard and soft landscaping. It is was also proposed to install a new mini-roundabout with its junction on High Street. It is indicated that the proposed store will not contain a post office, pharmacy or dry cleaners ‘*or other specialist operation which might lead to direct competition with the small specialist operators in Gorseinon town centre’.* The store will create 300 permanent jobs, 100 will be full time and 200 part time.

Map 28 – Asda Stores Development, Gorseinon

The planning application was accompanied by a Retail Assessment, Transport Assessment, Design and Access Statement, Noise Assessment Statement, Archaeological Impact Assessment, a Statement of Community Involvement, Bat Emergence Survey, Air Quality Assessment and Desk Study/ Geotechnical and Phase 2 Geo Environmental Investigation Reports.

The submitted Design Statement indicated that the revised proposal took into consideration the comments of the Planning Inspector in the previous appeal decision, in particular the site layout has been re-organised to address the proposed relationship between the store / servicing area and neighbouring residences. The store itself is rotated through 180 degrees so that the frontage of the store and its car park faces west (towards Cecil Road / Mill Street) rather than east (Heol-y-Mynydd) in the previous proposal. The Design Statement indicates *the revised arrangement will address the main concern of the Inspector on the previous scheme which was the poor relationship to the centre for car borne customers and its consequent effect on linkage. The revised scheme will promote the best physical and psychological connection to the centre. Furthermore by 'handing' the store the service yard will now be adjacent to Heol y*

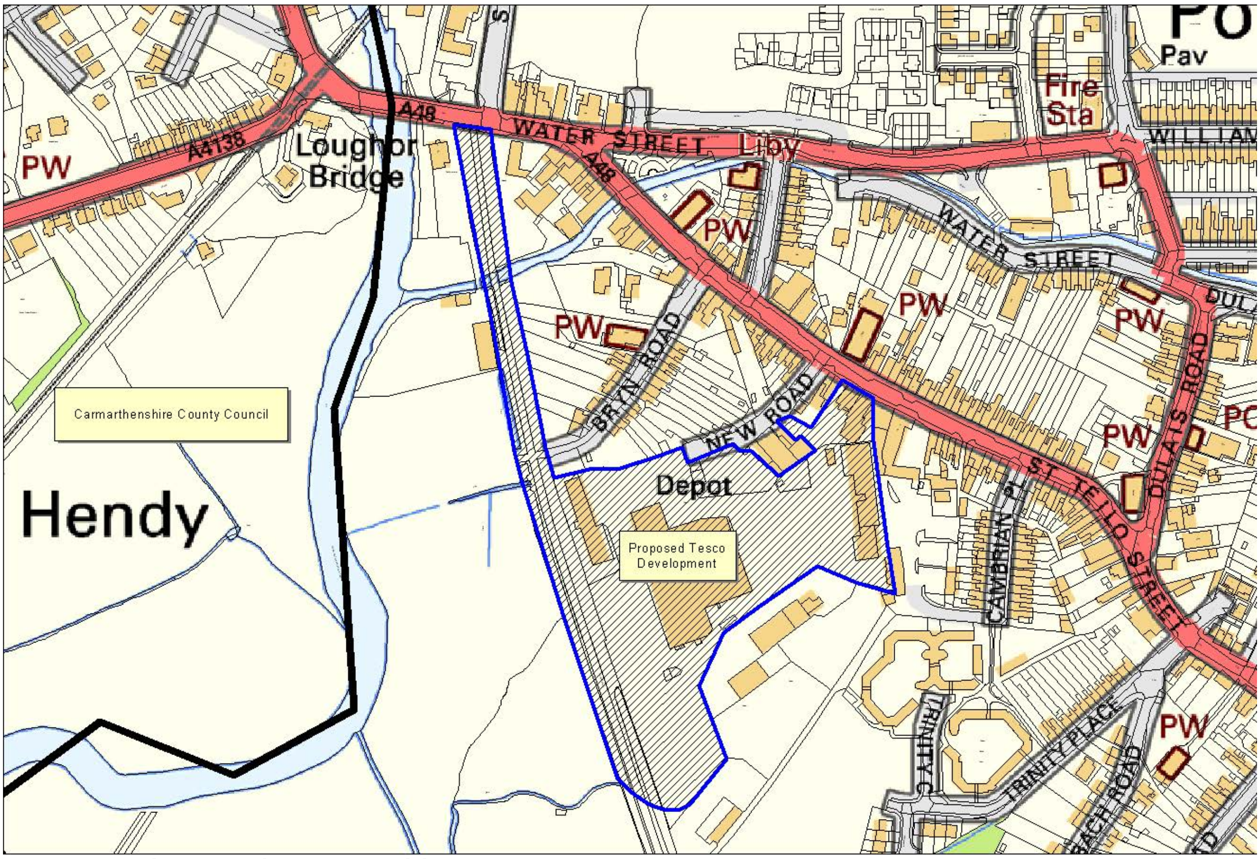
Mynydd and be materially further away from neighbouring houses. *A*dditionally, the proposal aims to improve pedestrian linkages and public realm improvements in order to provide enhanced connections to the town centre. These include the provision of a covered walkway from the store entrance through the store car park; a feature landscaped public realm area in the south west corner of the site; and as indicated above, reducing the width of the carriageway along Cecil Road to its access into the unnamed access road together with installing a raised table and extending the width of the pavements and extending the landscaped verge along Mill Street together with tree planting and other street furniture. It is also proposed to enhance the pedestrian crossing facilities on High Street. It is hoped that the provision of the enhanced pedestrian link between the store and the town centre will facilitate linked pedestrian trips between the two. The retail store's car park will provide additional short term public parking in close proximity to the town centre, and it was proposed that a car parking management plan be implemented in order to allow the use of the car park by all shoppers visiting the town.

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 m^2 of new commercial floor space. It was therefore considered that an Environmental Impact Assessment was not required.

The application was approved during August 2009 and works were completed during mid 2010. The store is now open and fully functional. No concerns have been raised regarding any increased traffic attracted to the area and accessing the store via Heol-y-Mynydd. However, it is planned to revisit NO_2 monitoring in the nearby High Street area as several dwelling now exist over ground floor commercial premises.

5.1.2 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.

The authority resolved to grant outline planning permission on 31 January 2008 subject to the completion of a Section 106 Planning Obligation, for the construction of retail food store (Class A1) with a gross floorspace of 2,750 sq.m (approx. 30,000 sq.ft.), with an additional retail (9,150 sq.ft.) / residential units (24) a pedestrian link to St. Teilo Street, and a new highway access from A48, together with associated car parking (Ref:2007/1440). The Section 106 Obligation was in respect of:

i) Construction of the access road to be of a standard capable of being utilised as a by-pass in order to open up the larger development site;
ii) Necessary off-site highway works as specified by the Highway Authority pursuant to condition 12 of the permission;
iii) Preparation of a Design and Development Masterplan in order to outline the comprehensive development of the larger development site to the south;
iv) A financial contribution towards achieving a pedestrian link from the retail store to St Teilo Street and public realm works towards environmental improvements to Pontarddulais town centre;
v) The proposed retail store should not include the following: a) cafeteria; b) pharmacy; c) opticians; d) post office; or e) dry cleaners;
vi) A car park management plan which would allow the use of the car park by the general public;
vii) The provision of facilities within the retail store for the disposal and recycling of excess packaging including plastic bags.

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 supporting Retail Assessment (RA) has been prepared by Planning Consultants, DPP, who were responsible for preparing the retail assessments considered by the authority in support of Tesco's earlier proposals for retail stores on the Clayton Works site (Ref: 2005/2590 & 2007/2462 – see previous Progress Report 2008 page 171). The RA has been prepared for a 4,169 sq. m (44,874 sq.ft) gross floorspace superstore, with a convenience goods sales area of 1,486 sq m (16,000 sq.ft.), a comparison goods sales of 836 sq m (9,000 sq. ft.), including health and beauty products, pet foods, clothing, DVD / CD's and small items of homeware, and a checkout area of 314 sq.m (3,382 sq.ft.). The store will not include a cafeteria, pharmacy, opticians, post office or dry cleaners.

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.

In order to better integrate the proposed store to the town centre, and to improve the existing town centre, the previous outline proposal on the site was granted subject to a Section 106 Obligation requiring the provision of a pedestrian link from the retail store to St Teilo Street and the provision of a financial contribution towards environmental improvements to Pontardulais town centre. In relation to previous applications on the Clayton Works site in Pontardulais, Tesco offered financial contributions of £70,000 and £250,000 respectively to fund a pedestrian link and town centre environmental improvements. These similar requirements were imposed under the outline application 2007/1440. As part of this application, the developers contend that as it is proposed to construct Phase 1 of the Pontardulais Relief Road (i.e. the proposed new access road), and also significant public realm enhancement through the creation of an area of public space adjacent to the store, then the contributions in addition to the public realm works are more than the £70,000 previously offered to provide the pedestrian link.

Furthermore, it is contended that the location of the store, integrated within the town centre, means that the prospect for linked trips is increased compared to the Clayton Works site (Ref: 2005/2590 & 2007/2462 – see previous Progress Report 2008 page 171) and as such, the economic spin-off benefits for the town centre will be greater than the previous Tesco applications. The developer therefore contends that the current application does not represent a more significant departure than the previous Tesco applications.

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 m^2 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 7 full compliance with the annual mean objective is currently being seen at all monitoring locations.

Development of the site commenced during late 2009 with the demolition of the old warehouses and other structures. However, construction of the access road did not commence until 2010, with construction of the store not commencing until mid 2010. It is intended to continue the NO_2 passive diffusion tube monitoring within the Pontardulais town centre area outlined above for a full calendar year post opening of the store, to enable an assessment of any impact resulting from the store to be made.

5.2 Mixed use Developments

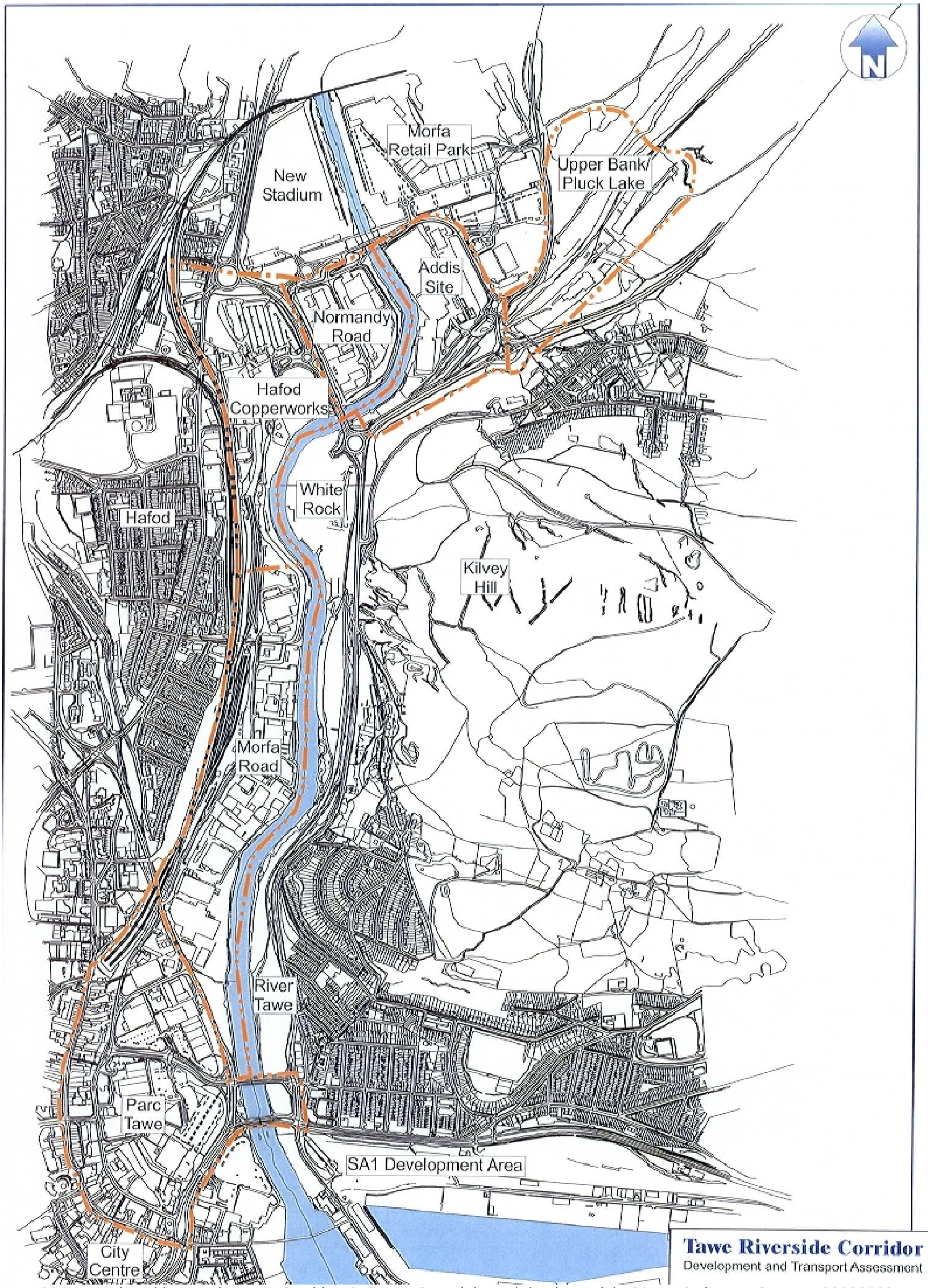
5.2.1 The Tawe Riverside Development Corridor

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 below[39]. 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.

[39] 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 2011. 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-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. 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.

5.2.2 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

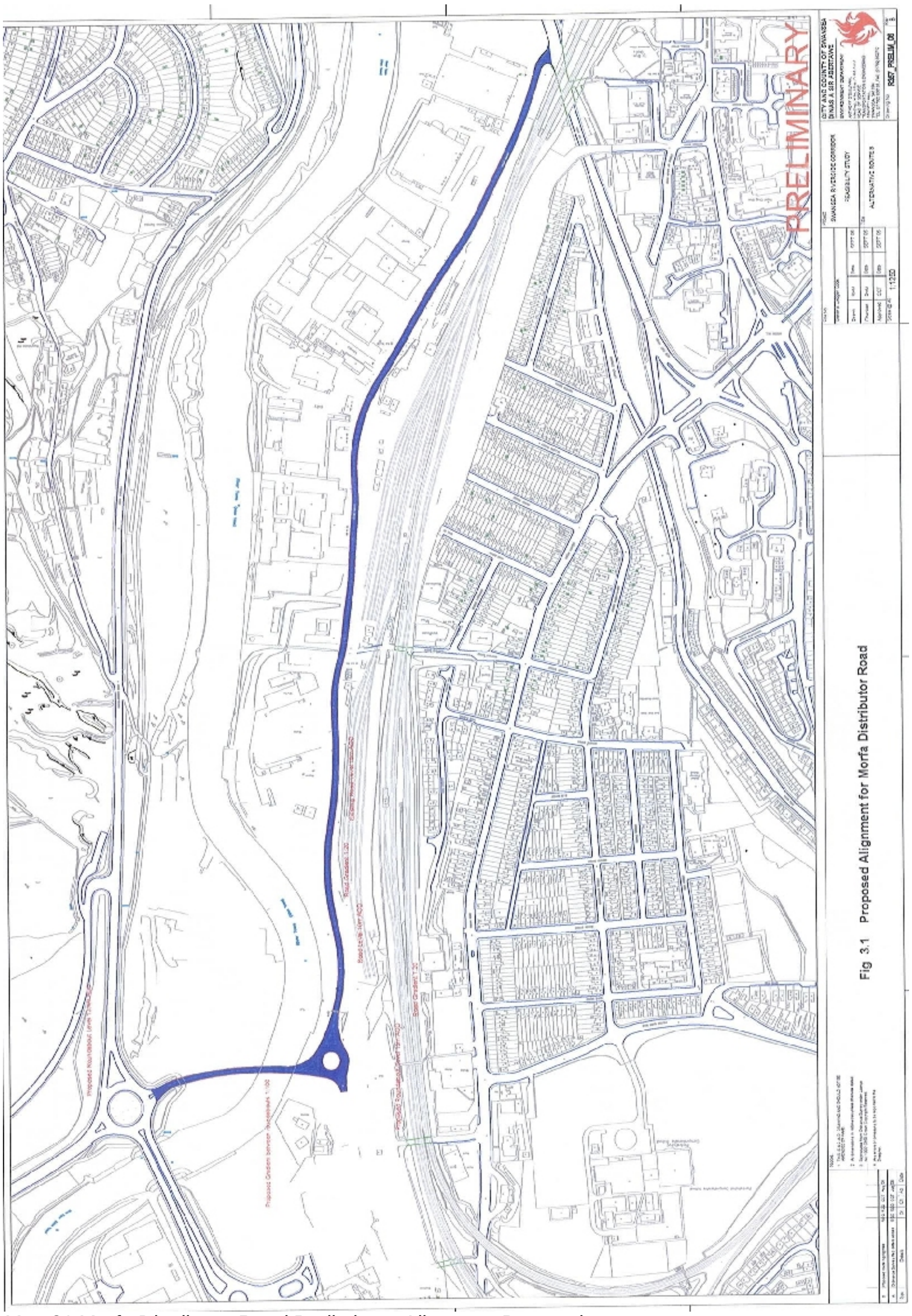
- The redevelopment of the Addis site for residential uses as the next stage in forming a truly mixed use and high quality part of the riverside – with leisure, retail, industrial and residential uses, whilst respecting the heritage importance of the site. Development of this site commenced during 2006 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. 2010 has seen works recommence at the site with several new blocks being erected.

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.

5.2.3 Morfa Distributor Road

The City and County of Swansea is proposing to introduce a new road from the



Map 31 Morfa Distributor Road Preliminary Alignment Proposals
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vicinity of the existing junction between the B4603 and A4067 (Hafod Site) to the Strand and New Cut Road (Morfa Road site). It is intended that the road would have a "distributor route" function aiming to serve development in the area. Map 31 below shows the Distributor Road preliminary proposals which have now been modified during 2007/2008. 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 as1992. 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.

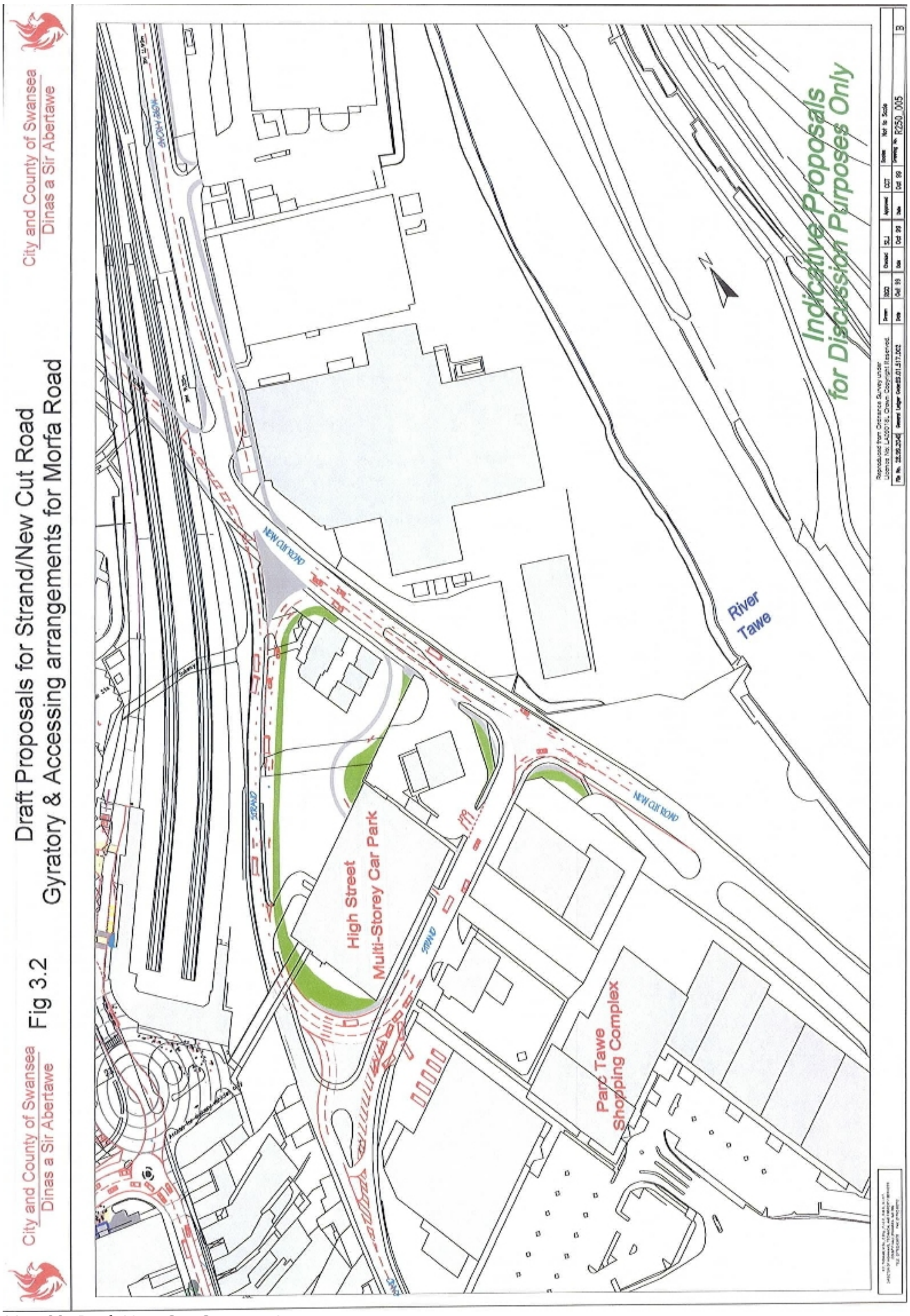
It is anticipated that any Distributor Road could accommodate bus services, subject to the provision of a new service along the route.

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 would involve the provision of a gyratory carriageway layout (as previously proposed in Transport Grant Applications). The draft gyratory layout is illustrated below in map 32.

In summary, it involves 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 is 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 is moving away for the gyratory concept as the modelling undertaken has proved conflicts with the existing/prposed Quay Parade bridges area/intersection. The latest proposals are to provide signal controlled junctions at the bottom of Morfa Road and The Strand – the final resolution to the issue may move through several other stages/proposals before a satisfactory alternative is determined. Updates will be provided within future reporting as to the direction of the likely design outcomes.



Map 32- Draft New Cut Gyratory Layout

5.2.4 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 33 below.

Map 33 - Morfa Road Area Master Plan

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 m^2 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 m^2 of industrial/ trading space);
  - Office development of the former dairy site, average of three storeys (1.55 ha, approximately 23,250 m^2 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 m^2/ 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 have commenced during late 2010 /early 2011 to the area formally occupied by Unit Superheaters. This site fronts new Cut Road and Morfa Road and is adjacent to the existing Council transport unit at Pipehouse Wharf.

5.2.5 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 34.

Map 34 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 ungalows

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

5.2.6 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 35.

Map 35 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;

5.2.7 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 under croft), 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.[40] The Master plan for the site produced for the application is included as map 36.

[40] Images courtesy of Hyder Consulting Final Report Tawe Riverside Corridor June 2006

Figure 1

Figure 2

Map 36 Addis Development Site

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 due to uncertainty within the housing sector as a result of the financial crisis. Further areas of the site have now being cleared during 2010 and construction of other dwellings within the overall scheme are well advanced.

5.2.8 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 37 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.

5.2.9 Proposed New Leisure Facility incorporating Snow Ski Facility, Water Park and Hotels.

The site extends to approx. 27 hectares in total and comprises of two main parcels sub-divided by Nantong Way with approx. 7 hectares located at the former dry ski slope site to the west of Nantong Way and approx. 20 hectares comprising Pluck Lake and the associated woodland area located to the east of Nantong Way. The majority of the proposals for the site east of Nantong Way are outlined above in 5.2.8 and can be seen within map 37. It is indicated that the submitted site area is indicative at this stage and may be refined prior to and if a submission for planning is made. The site is bounded to the north by the main Swansea / Paddington railway line and Llansamlet Industrial Estate, and the former dry ski slope is situated to the rear of the Morfa Retail Park, with the Swansea Vale Railway Line (Upper Bank) located to the south – east. An indicative map of the development (west of Nantong Way) is given below as map 38.

The proposal is to develop a comprehensive new leisure resort focussed around the existing redundant dry ski slope. The project would involve the following:

West of Nantong Way:

- the redevelopment of the existing ski-slope into an Indoor Snow Centre / Ski Facility
- Fitness / Health Facility
- Skateboard / BMX Park
- Bike Hire and Associated Bike Trails

East of Nantong Way:

- 120 bed Budget Hotel and associated Restaurant
- 3 / 4 Star 150 bed Family Hotel and Conference Centre
- 37 No. Lakeside Chalets
- Extension of Pluck Lake to be used for Rowing / Fishing / Boating Activities
- Boating and Fishing Club

Map 38 Indicative outline of proposed Ski Centre development site

It is indicated that the proposed development is intended to create a multi leisure attraction including the indoor real snow and ski facility, fitness / health club, skateboard / bike facility and boating / fishing activities, which will promote a sustainable tourism / leisure facility.

5.2.10 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 Assesment (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. It is now essentially a vacant development platform elevated above The Strand Level. It is screened from the road by timber hoardings and has a frontage of approximately 70m.

The area adjoining The Strand comprises a relatively shallow part of the site. It is currently vacant and until recently has been partly utilised for surface car parking. The rear of this part of the site is characterised by retaining walls and the remnants of buildings backing onto the High Street level, which have recently been revealed to a greater extent by the removal of vegetation in this area. The Strand frontage extends to approximately 120m.

The warehouse, which dates from the late 1860s, is the only building on the site, other than ‘Crumbs café’ that will not be 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).

In order to achieve the maximum level of sustainability of the various uses and to allow the applicant to promptly respond to the current and medium term economic climate, the application seeks approval for more than one use potential within the various spaces across the site.

Whilst the flexible use of space is proposed, the application seeks to fix the external appearance of each of the buildings, including the windows and doors. The scheme however has been designed in such a way that the various uses could be accommodated without any changes to the external elevations.

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.

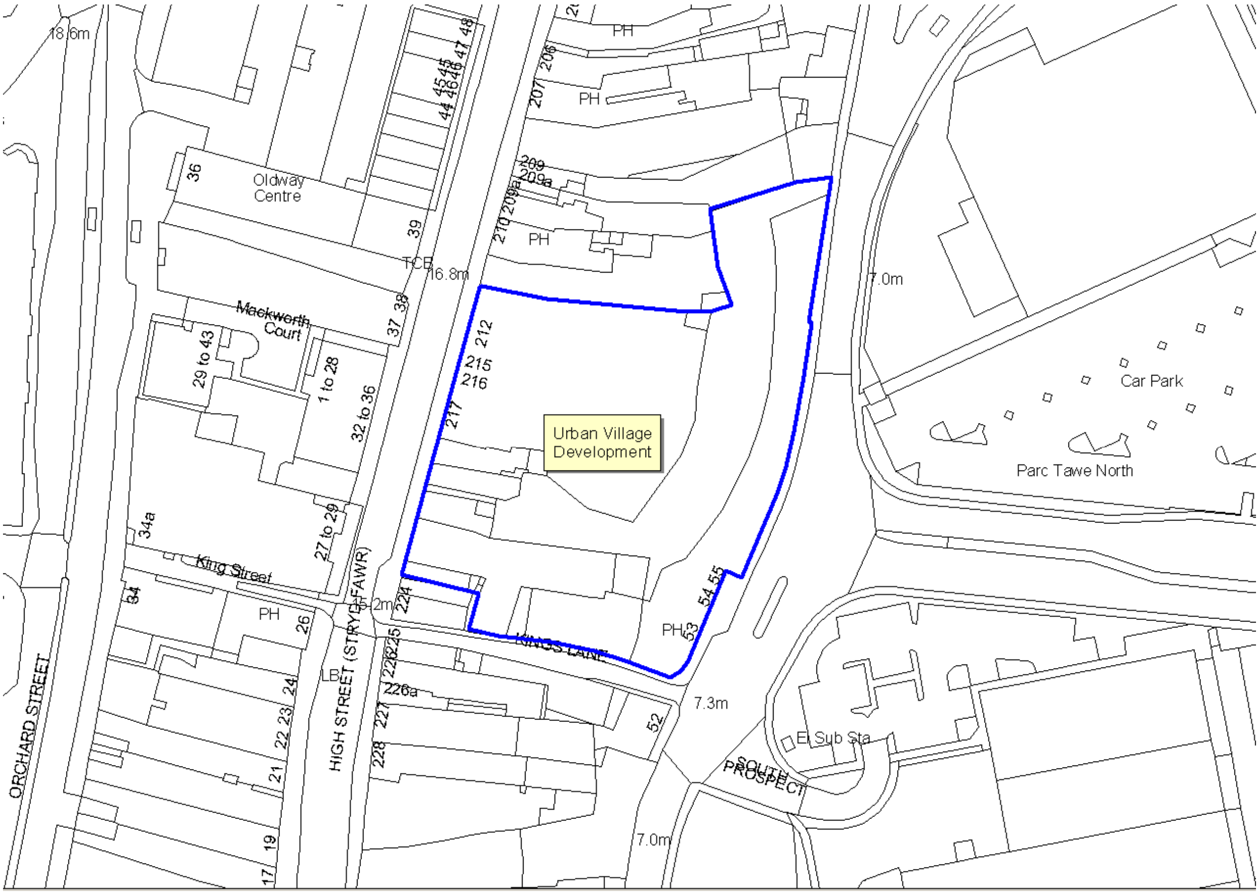
Within the creative cluster it is envisaged that a number of activities will be undertaken. The list below sets out the range of such activities:

- 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 39 below outlines the extent of the development.



Map 39 Urban Village Development, High Street

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 NO_2 annual mean objective. Section 2.3 outlines the recent NO_2 monitoring undertaken in the area surrounding the development

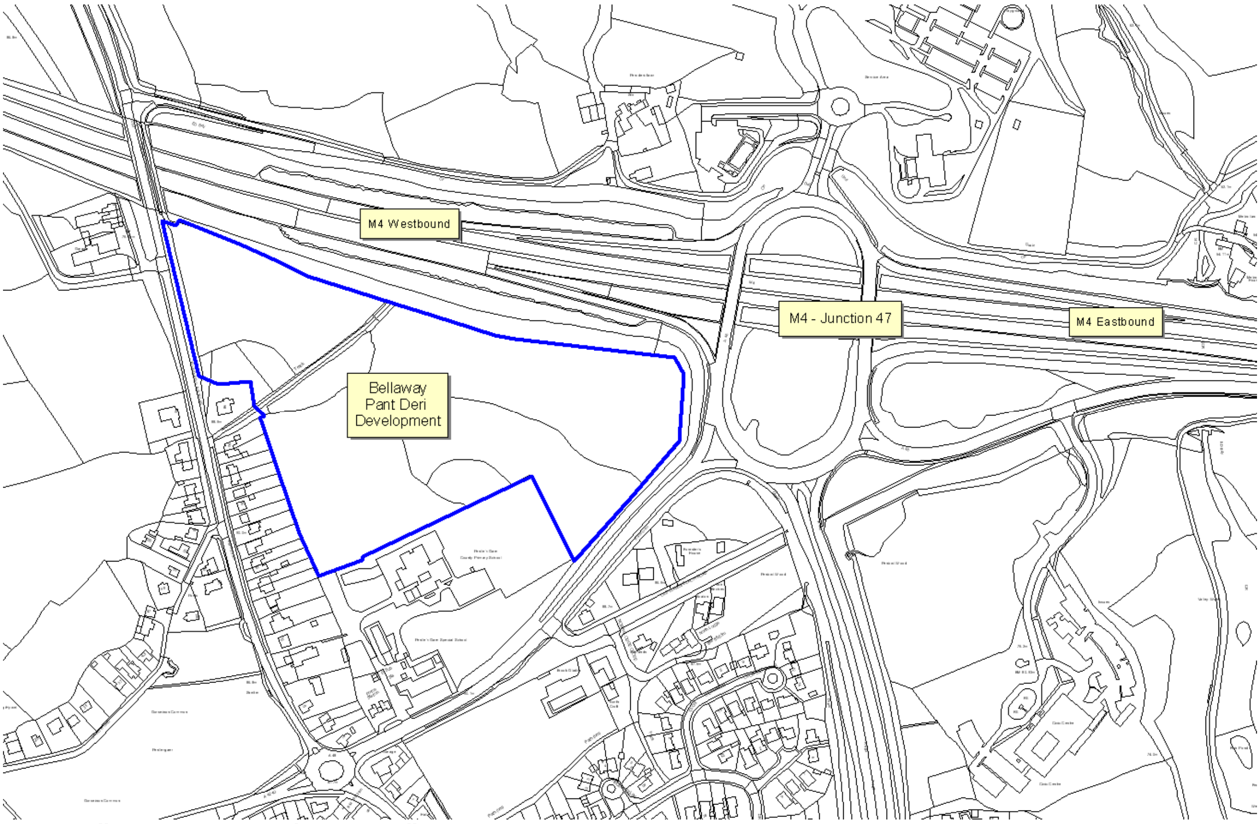
5.3 Housing Developments

5.3.1 Bellway, Pant Deri, Penllaergaer

Outline planning permission for the residential development of this site was granted on 27 June, 2006 following the completion of a Section 106 Agreement (Ref:2005/0599). Reserved matters approval for the detailed residential layout of 228 residential units, consisting of 192 dwellings and 36 residential apartments was approved November, 2006. The obligations within the Section 106 Agreement remain in place on the development.

The dwellings consist predominantly of two storey, two, three and four bedroomed dwellings within a layout consisting of detached, semi-detached and short - terraced properties with a proportion (6) of two and a half storey dwellings. The approved layout incorporates a three storey block of residential apartments adjacent to the area of public open space, however, this has now been omitted within the amended layout. The vehicular access would be obtained from Pontardulais Road with the construction of a new access road and mini-roundabout in accordance with the Outline Planning Permission.

The site lies just to the south of the M4, adjacent to junction 47. Map 40 below shows the site location. The northern part of the site is approximately 13m above the M4 carriageway itself and is bounded on this northern edge by deep foliage which it is proposed will remain to help form an acoustic barrier along with the provision of a physical 3m acoustic barrier.



Map 40 Bellaway Pant Deri Development, Penllaergaer

Works commenced during the early stages of May/June 2010 and remain at an early stage of development.

5.3.2 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 Tescos development outlined within section 5.1.2 above lies just to the south west. Cumulative impacts may be noted within the centre of Pontardulais which lies approx. 150 metres to the south west of these sites. Map 41 outlines the development site.

Map 41 Persimmon Homes Development, Pontardulais

Previous outline and reserved matters applications have been the subject of screening opinions under the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 to assess the requirement for an Environmental Impact Assessment (EIA) to accompany the applications. Whilst it was concluded that the potential impact from the development would be significant on the environment by way of its size and location, in terms of the nature of the development the proposal would remove an industrial use from the residential area. The site is not considered to be located within an environmentally sensitive area and the redevelopment proposal will not breach the threshold figure of 5 hectares or 1000 dwellings contained in Annex A of DETR Circular 02/99. Having regard to the nature and scale of the proposed development, the proposal is unlikely to raise any significant environmental issues of more than local importance and therefore an Environmental Impact Assessment was not required for the proposed development.

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.

The new development aims to create an attractive and interesting 'people friendly' environment where cars are not allowed to dominate the street scene, whilst integrating the layout with the surrounding area and community. The principles that drive the proposal are: -

- a comprehensive approach to both former industrial sites;
- a public open space within development linked to surrounding areas;
- the incorporation of a pedestrian/cycle movement framework within and linking beyond the development; and
- a landscape strategy that supports the concept and utilises existing natural features.

The layout is based upon a loose grid of streets that connect with the existing street pattern at two locations: to the north from High Street and to the south from Water Street, where vehicular accesses to the site are proposed. In addition to this there are pedestrian/cycle connections with Ty'n y Bonnau Road to the east and Water Street at the southwest corner of the site. There is an area of public open space at the heart of the development, which consists of a 40m x 32m 'village green' laid out in a formal rectangular pattern partially surrounded by trees, and overlooked on four sides by residential frontages. At the centre of the development the green provides an obvious focus for the development.

Vehicular access will be obtained from a new junction off Water Street and a further new access is proposed 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 will 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.

The application site is suitably located for access by all modes. There are bus stops within a short distance of the site to an adequate bus service and footways are present for pedestrian access. In addition to the vehicular accesses there are two pedestrian/cycle accesses shown, one to the east and one to the west, the vehicle accesses are to the north and south of the site.

Whilst the bus frequency in the locality is acceptable, improvements to facilities at and on the approach to the adjacent bus terminus are required. The improvements will become more crucial as a result of this proposal if the travel mode of future occupiers is to be influenced. This residential development will strengthen the need for improvements to be implemented before the development is fully occupied.

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.

Broadly speaking the proposed layout is a logical approach to the site which will help to create a sense of place and community. The network of alternative routes within the site and beyond for vehicles, cyclists and pedestrians will encourage walking and maximise pedestrian activity and community interaction on the street. The layout based on perimeter blocks ensures public fronts and private backs where streetscenes are mainly addressed by attractive active frontages. This is also inherently more secure as there are higher levels of natural surveillance and in most cases a clear definition between public and private ownership. The layout incorporates a combination of railings and dwarf wall/ railings for the front boundary treatments which will provide appropriate public/private definition by utilising an architectural device that is widely seen in the established parts of Pontardulais.

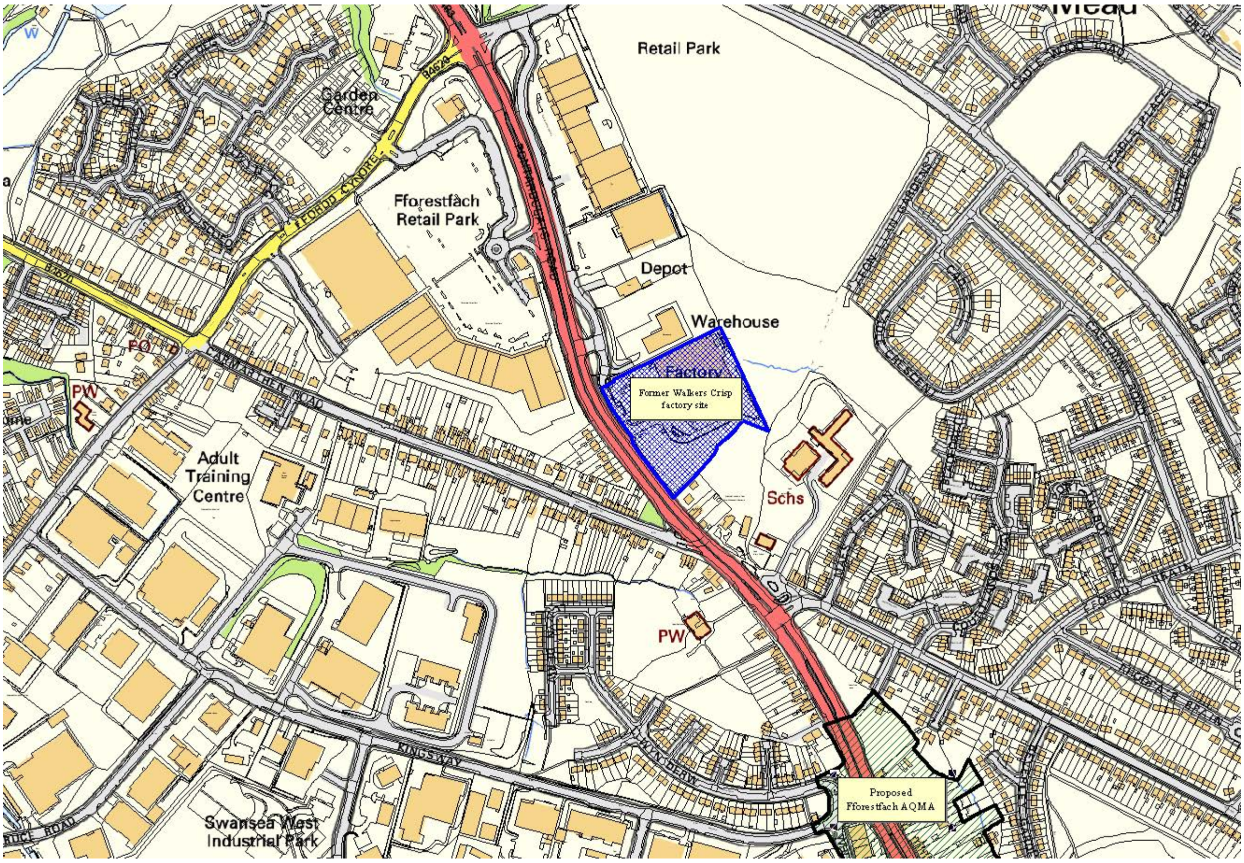
Approval has been given and demolition/construction works commenced late 2006. A limited number of the dwellings were first occupied during 2007. Development and occupation has continued apace with the development being nearing completion during early 2011.

5.3.3 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 42 below outlines the proposed development site.



Map 42 Proposed Development of former Walkers Crisp factory site

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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 there anti pollution legislative powers to monitor and enforce against discharges, noise, etc.

1.8.10 *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, WelTAG 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

What can we do now – **Projects**
Engagement - *workshops on programme*

↑

What principles guide progress – **Policies**
Engagement – *Internal working groups*

↑

How can we make progress - **Long Term Strategy**
Engagement – *workshops on option generation and LTS elements*

↑

Which are most important for the first five years – **Regional Priorities**
Engagement – *Workshop identification of priorities*

↑

What do we want improved access to facilitate in the region – **Vision and Objectives**
Engagement - *Workshops on problems and opportunities*

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	• Redoubling the line west of Swansea to secure improved services to West Wales including
	  ◦ 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	• 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	• 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	• 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	• 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:
	  ◦ A4138 - between M4 and Llanelli
	  ◦ A483 - Fabian Way corridor
		2

A 40 improvements	• 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	• Trunking of:
	  ◦ 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:
	  ◦ A40 Salutation Square to Withybush Roundabout
		4

Revenue Priorities

Description	Detail	Priority
Support for existing levels of service	• 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	• 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	• 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	• Revenue implications of capital projects like Park and Ride • Revenue impacts of improved parking enforcement	4

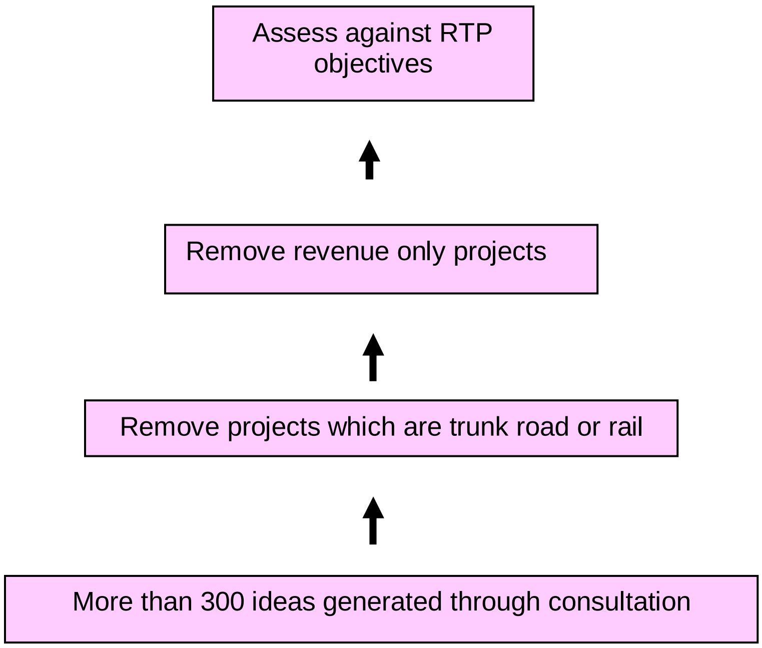
SWWITCH has also developed a series of component strategies providing a more comprehensive framework for the development and delivery of transport and access in the future. The component strategies relate to:

- 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

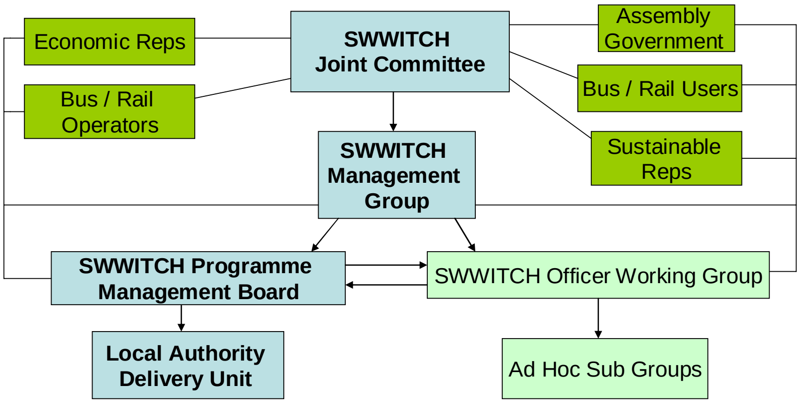
Delivery

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 Indictors 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.

WelTAG

SWWITCH has applied the principles of the Welsh Transport Planning and Appraisal Guidance (WelTAG) 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 – SWWITCH Monitoring Proposals

RTP Objective	Indicator	Data Source	Baseline
1	• Accessibility: maps/stats • Car access • public transport access • Key Connectivity analysis	• Accessibility planning software (Accession), Traveline database	• RTP appendix J and K
2	• 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	• Surveys • Surveys • Operators • Surveys, operator market research data • Cycle counters	• Some baseline survey data (2005)

3	• Journey time reliability
	  • buses
	  • cars
	  • HGVs
		• ITIS data	• To be established

4	• Passenger satisfaction about bus rail integration	• surveys	• To be established
5	• Number of AQMAs • Air pollution index	• Local authority air quality monitoring	• Established LA monitoring
6	• Proportion of transport schemes having an adverse impact on national and built environment	• Environmental Impact Assessments	• To be established
7	• Road casualty stats • KSIs • Child KSIs • Slight injuries per 100m vehicle kms • Public perception of personal safety related to transport use	• Local authority data	• 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).

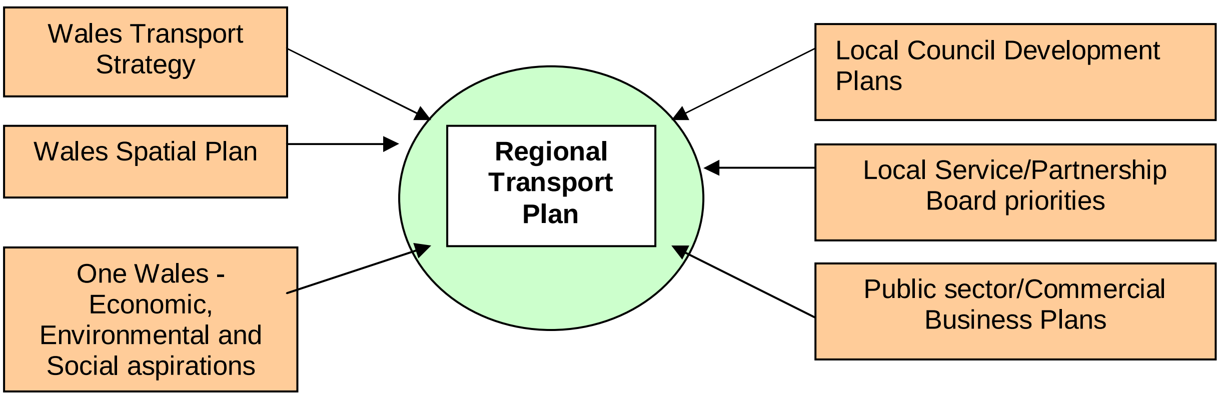
7.9 RTP Progress Report 2010/11

TRANSPORT POLICY AND PLANNING CONTEXT

7.9.1 Background

The Regional Transport Plan (RTP) for South West Wales[1] was prepared during a three year period up to 2009 with the extensive involvement of a large number of stakeholders. It was in line with guidance issued by the Welsh Assembly Government and was consistent with relevant national and local policies as shown in Figure One below.

Figure One – Link between RTP and National/Regional and Local policies



The RTP was approved by the Welsh Government in December 2009 and it now provides the strategic framework for transport policy and investment decisions in the region. Delivery of the RTP programme of projects began from April 2010 when Regional Transport Consortia capital grant funding commenced.

This first Annual Progress Report highlights changes that have occurred since the RTP was submitted and also reports on progress made during 2010/11 towards achieving the SWWITCH vision and objectives and delivering the RTP capital programme.

The RTP vision, objectives, strategy and policies are included as Appendix One to this document.

7.9.2 External Changes since RTP submission

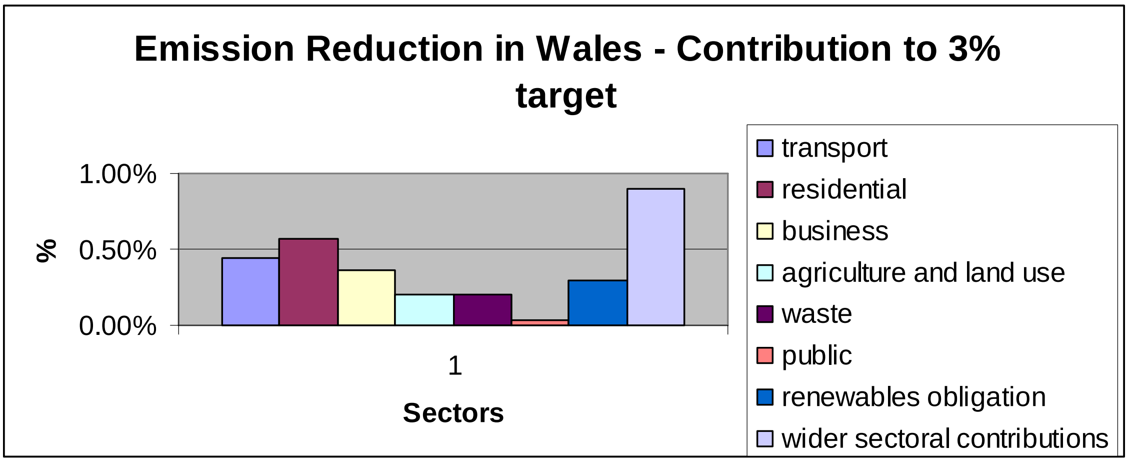
There have been a number of changes since the RTP was published. Those with the most significant impacts on the RTP are as follows:

- National Transport Plan[2] publication in 2010
- Climate Change Strategy[3] and Delivery Plan
- Equalities Act 2010

The National Transport Plan (NTP) builds on the Wales Transport Strategy objectives and strategic priorities and sets out “solutions to transport issues along the main movement corridors in Wales”. It is a delivery plan which is about more than just capital projects and includes public transport service enhancements and information, awareness raising and behavioural change measures.

The NTP was being developed at the same time as the RTP and there is a synergy between the two plans, with a consistent focus on meeting objectives through policy integration and scheme delivery.

The Climate Change Strategy (CCS) and Delivery Plan are confirmation of the Welsh Government commitments to tackling climate change by reducing greenhouse gas emissions (by 3% a year in areas which are devolved) and encouraging and supporting adaptation of services and facilities to meet changes that will arise. The CCS sets targeted reductions in emissions for six specific sectors, one of which is transport, as shown in the pie chart below.



The CCS confirms that transport is responsible for approximately one fifth of the emissions covered by the 3% target and sets out a series of interventions that will deliver the necessary reduction in emissions from transport. Many of these are also key interventions in the RTP, at policy or project level and SWWITCH has been an active player in the Climate Change Strategy sub groups, task and finish groups and the South West Wales Low Caron Task Force.

The synergies between the NTP and the CCS and the RTP are set out in Appendix Two.

The Equalities Act 2010 sets a clear duty on the public sector to:

- Advance equality of opportunity
- Eliminate discrimination (associated with groups identified as "protected")
- Foster good relations

A good method for determining what key issues are and potential solutions is an Equality Impact Assessment (EIA). This is a four stage process which involves:

- Gathering evidence from protected groups
- Indentifying potential impacts of policies or projects on those groups
- Developing appropriate responses and actions
- Recording the process and decisions

Many of the considerations and actions included with an EIA are already part of a professional approach to strategy development and delivery of transport projects. The EIA has the benefit of bringing these together in a simple and accessible format and providing a clear record of actions and decisions.

The RTP was submitted prior to the Equality Act and a post submission EIA was subsequently prepared utilising the records of extensive stakeholder consultation carried out during the RPT development period. The work is ongoing however and as RTP projects are delivered any impacts on protected groups will be considered thoroughly as part of an inclusive design process. The SWWITCH EIA is included as Appendix 3 in the submitted document (not within this update)

7.9.3 Economic Downturn

The RTP assumed a 2010/11 budget of £11m would be available to kick start the five year programme. However, the first year of the new RTP Grant system, at a time of global recession and significant reduction in public sector spending, meant a total of £4.909m was available to develop and deliver RPT projects in the region. This has meant that delivery has been slower than expected.

Similarly, Local Councils have seen budgets reduced and there have been staff losses (mostly through a process of natural wastage). This has also had an impact on the ability of SWWITCH to develop policies as much as was intended.

SWWITCH will continue to develop and evolve and support collaborative working across and beyond the region making the best use of resources, capacity and expertise.

A further impact of the financial situation on regional transport has been a retrenchment in the commercial bus service network, resulting in additional costs to Councils where replacement subsidised services have been provided, or, where that has not proved possible, a loss of amenity to residents, businesses and visitors in South West Wales. This has a negative impact on the aspirations of the RTP to encourage and support the use of more sustainable transport.

Conversely the economic situation combined with the rising costs of fuel has stabilised traffic growth and provided fertile ground for the encouragement and support of behavioural change measures including car sharing, walking and cycling and more strategic responses through Travel Plan and School Travel Plan development.

7.9.4 Changes to the RTP

Whilst the APR is not intended to change the direction and focus of the RTP it is an opportunity to highlight “internal” changes and to expand on the RTP where further clarity will be helpful. Key areas to note are:

- Current transport issues
- SWWITCH Programme Management Group

One point of clarity relates to the use of the term “access for all” which is used in the RTP key priorities and objectives. SWWITCH avoided reference to specific groups of users because it was genuinely intended to reflect regional intentions that all users of road and public transport networks (no matter what their needs) should have high quality access. Some concerns have been expressed by organisations representing Motorcyclists and Horse riders that the RTP should make reference (or more positive reference for motorcyclists) to the needs of their members.

SWWITCH is clear that Motorcyclists and Horse riders are an important part of the “transport mix” and that where appropriate policies or projects to improve access will also include consideration of the needs of their members. In particular that the approach to inclusive design is about more than just “protected groups” identified in Equality legislation and a genuine desire to produce the most balanced and appropriate solution to a wide range of needs.

7.9.5 Current transport issues

Traffic levels have generally remained static or shown a slight decrease since the submission of the RTP in line with the pattern across Wales as shown in Table One overleaf.

Table One – SWWITCH Traffic Levels 2007 – 2009

Billion vehicle kms travelled

Area	2007	2008	2009
Carmarthenshire	1.97	1.96	1.92
Neath Port Talbot	1.39	1.35	1.33
Pembrokeshire	1.09	1.11	1.10
Swansea	1.76	1.73	1.69
Wales	**28.41**	**28.35**	**27.95**

Despite static or lower traffic levels, transport related air quality is an increasing problem in the region, especially in Swansea. When the RTP was submitted the only transport related Air Quality Management Area (AQMA) in the region was in Hafod in the lower Swansea Valley. Since that time further declarations have been made in relation to Sketty and Fforestfach in Swansea and the Hafod area AQMA has been expanded to encompass a much wider area affected by poor air quality. Additionally Carmarthenshire are currently consulting on a potential AQMA for Llandeilo town.

7.9.6 The RTP programme pool

SWWITCH Programme Management Group (PMG) was established in April 2010 to oversee the delivery of RTP projects. Membership of the group, details of how it operates and the mandate, protocols and delegated power of the Group are included in Appendix Four.

Alongside managing the RTP programme in 2010/11, the PMG also reviewed and prioritised the RTP programme pool in the light of financial constraints and expected levels of capital grant over the lifetime of the plan. Details of the process and outcomes are shown in Appendix Five, but worthy of specific note here is:

- The RTP programme pool was reduced from 75 projects to 57 projects
- All projects were grouped into specific “mode type” groupings to maintain consistency with the way the 5 year programme was set out in the RTP
- All projects were prioritised within those groups to facilitate decision making on future funding bids

A number of new projects have subsequently been proposed for inclusion in the RTP programme pool. These reflect changing circumstances and demands, but are consistent with the RTP objectives and strategy. *The following projects were formally approved for admission to the programme pool by SWWITCH in September 2011:*

- *Fabian Way scheme - includes park and ride, bus priority measures, walking and cycling and bus interchanges*
- *Wind Street/Tir y Dail Lane junction, Ammanford*
- *Haverfordwest to Narberth shared use path*
- *Glasfryn Road Improvements*

These projects are in the process of being scored within the mode type.

7.9.7 Relationships with Local Council Strategic Planning

During the development of the RTP the input of Local Authority planning colleagues was very important, particularly as Councils were in the early stages of the Local Development Plan (LDP) process. The relationship and interaction between the strategic transport plan and those projects which develop from it and land use strategies and development proposals remains pivotal in securing sustainable and integrated access.

SWWITCH Councils are using the RTP vision, objectives and strategy as key building blocks in the LDP process and more detail is included in Appendix Six. Also included in the Appendix is an outline of major planning applications approved since the RTP submission which have significant transport implications.

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, which included carbon management issues. In the same year, council's Sustainable Development Unit was invited to join a European partnership project which aimed to develop guidelines on sustainable energy action plans for European Union communities. The project, called WISE Plans, enabled local officers to work with other communities across Europe on a shared methodology and also involved setting-up a local action board to prepare an action plan for Swansea. In 2008, Sustainable Energy Action Plan (SEAP) for Swansea was published.

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. The overarching vision in the SEAP was:

> *Swansea will strive towards carbon neutrality by embracing its responsibilities to climate change and will work to reduce its carbon dioxide emissions by 26-32% by 2020 and 60% by 2050, in line with national UK targets. We will work closely with the Welsh Assembly and Central Government and other agents for change to deliver the UK Climate Change Programme in Wales.*

The four strategic aims were:

- Reduce the use of energy by helping to change attitudes and behaviour, to encourage personal responsibility and action.
- Improve the energy efficiency of our buildings

- Develop Swansea’s use of low and no carbon heat and increase the amount of locally generated electricity from renewable sources
- Promote a reduction in car use and make low carbon road fuels more accessible and available

Also in 2008, both carbon management and climate change adaptation were chosen by SEF as two of the five ‘big issues’ selected as part of a Better Swansea Partnership (community strategy) initiative to identify a limited number of ‘shared priorities’ across all public services in Swansea. These ‘shared priorities’ involve issues that it is felt are difficult to progress without greater attention and wider collaboration. SEF agreed to facilitate progress with both these issues and report back regularly to the Better Swansea Partnership.

In March 2009, SEF collaborated with the council’s Sustainable Development Unit and South West Wales Environmental Research Forum (coordinated by Swansea University) to organise a well-attended climate change adaptation seminar. In October 2009, representatives of SEF and the local authority met with representatives of Swansea University to discuss the potential for undergraduate and postgraduate research projects that would support carbon management and climate change adaptation objectives. Though several ideas and opportunities were discussed, no further progress has been made on this to date.

A brief review of the SEAP was undertaken in early 2010. This showed that eight of the sixteen actions listed in the SEAP had already been completed. In a BEES meeting in March 2010, it was agreed that the SEAP required updating and that more focussed work was needed to progress the carbon management shared priority. A carbon management task group was formed and met on two occasions and developed proposals for a wider initiative which included auditing existing carbon management projects in Swansea, measuring Swansea’s carbon footprint, establishing a broad carbon management partnership, updating the action plan and appointing a carbon management champion or agency for Swansea. These proposals were presented to the SEF Executive Committee for consideration. SEF commissioned a consultant to develop the proposals into a more comprehensive project plan. The resultant Low Carbon Swansea Project aims to develop a coordinated, integrated and sustainable approach to reducing carbon emissions across all sectors in the City and County of Swansea area.

In January 2011, the Swansea Local Service Board (Better Swansea Partnership) agreed to adopt the Low Carbon Swansea Project as one of its top four priority projects. A project board has been established involving representatives of the local authority, the Carbon Trust, the Environment Agency and SEF. Funding has been secured from the Environment Agency and the LSB has supported a bid from SEF for match funding from the Welsh Assembly Government. This funding will be used to recruit a project manager / carbon champion to deliver and develop the initiative.

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 the autumn 2010 spending review.

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 4th 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 commenced	Quadrant Bus station redevelopment completed	Late 2010
6	Safe Routes to School	Reduce car usage around schoolsites				Numerous schemes implemented	none	Acheived

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	Feasibility Studies resulted in design of scheme to implement 48% greater capacity in AM peak and 9% improvement in PM peak	Scheme commenced July 2011	Xmas 2011
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 - 2012	Reduced Congestion/Modal shift/Improved air quality within areas	Considerable but certain items remain outstanding	Further enhancements commissioned to model interface and data dissemination	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 43 below shows the location on the A483 Carmarthen Road.

Map 43 Location of Fforestfach Park and Ride Site
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Patronage statistics for 2005-2010 show the continued popularity of the park and ride provisions provided by the authority but figures for 2010 show a drop in previous years usage.

Table 50 shows the total vehicles using the facilities at the 3 sites during 2005-2010.

Site	Total Spaces	2005	2006	2007	2008	2009	2010
Landore	550	122,105	138,692	137,825	133,025	137,232	123,094
Fabian Way	550	86,407	111,878	122,530	125,737	116,954	106,441
Fforestfach	449	-	4,982	43,880	64,134	66,581	67,241

Table 43 Park & Ride Vehicle Usage Figures 2005-2010

- 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.

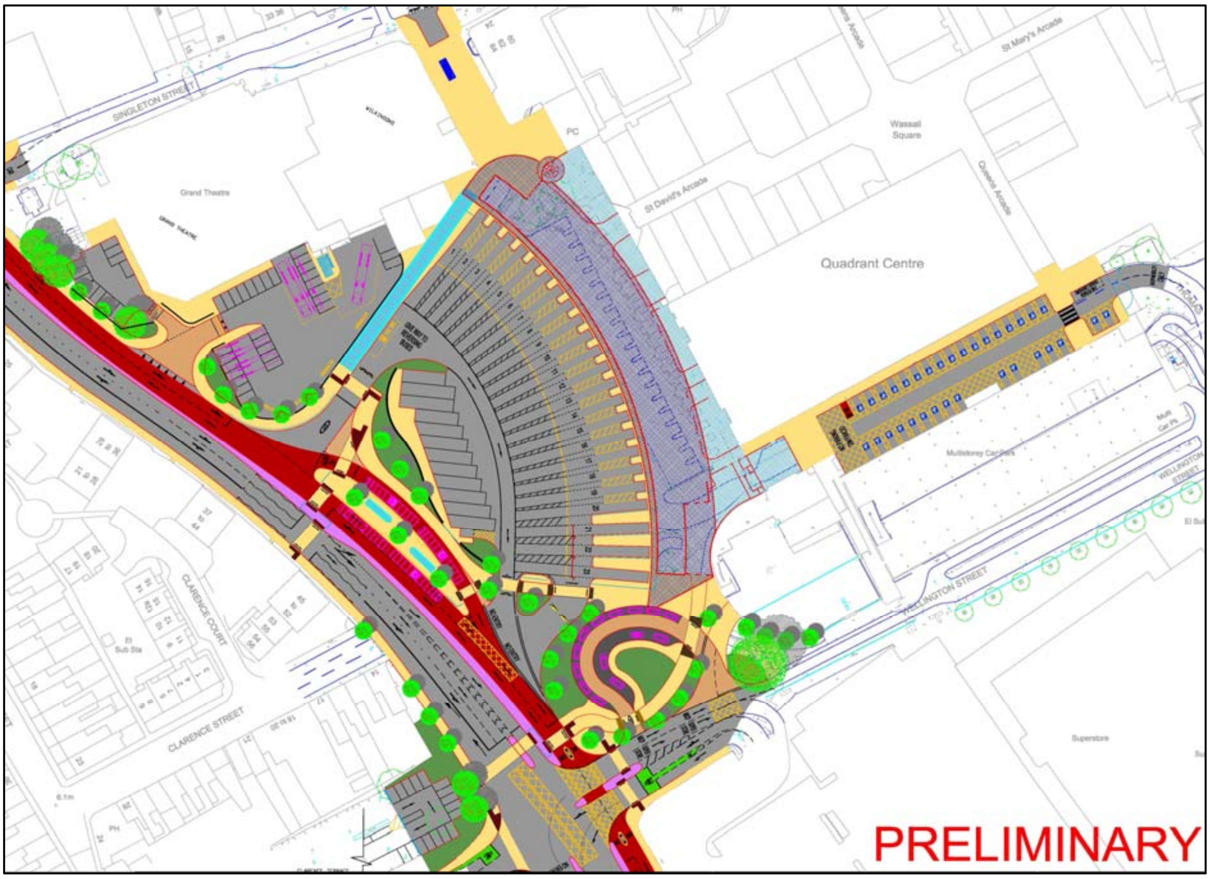
- **Action Point 5 - Enhancements of Bus and Rail Stations**

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 artists impressions of the façade given below.



Map 44 Transport Interchange off Westway, Swansea.

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 has until now been kept serviced and calibrated. 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.

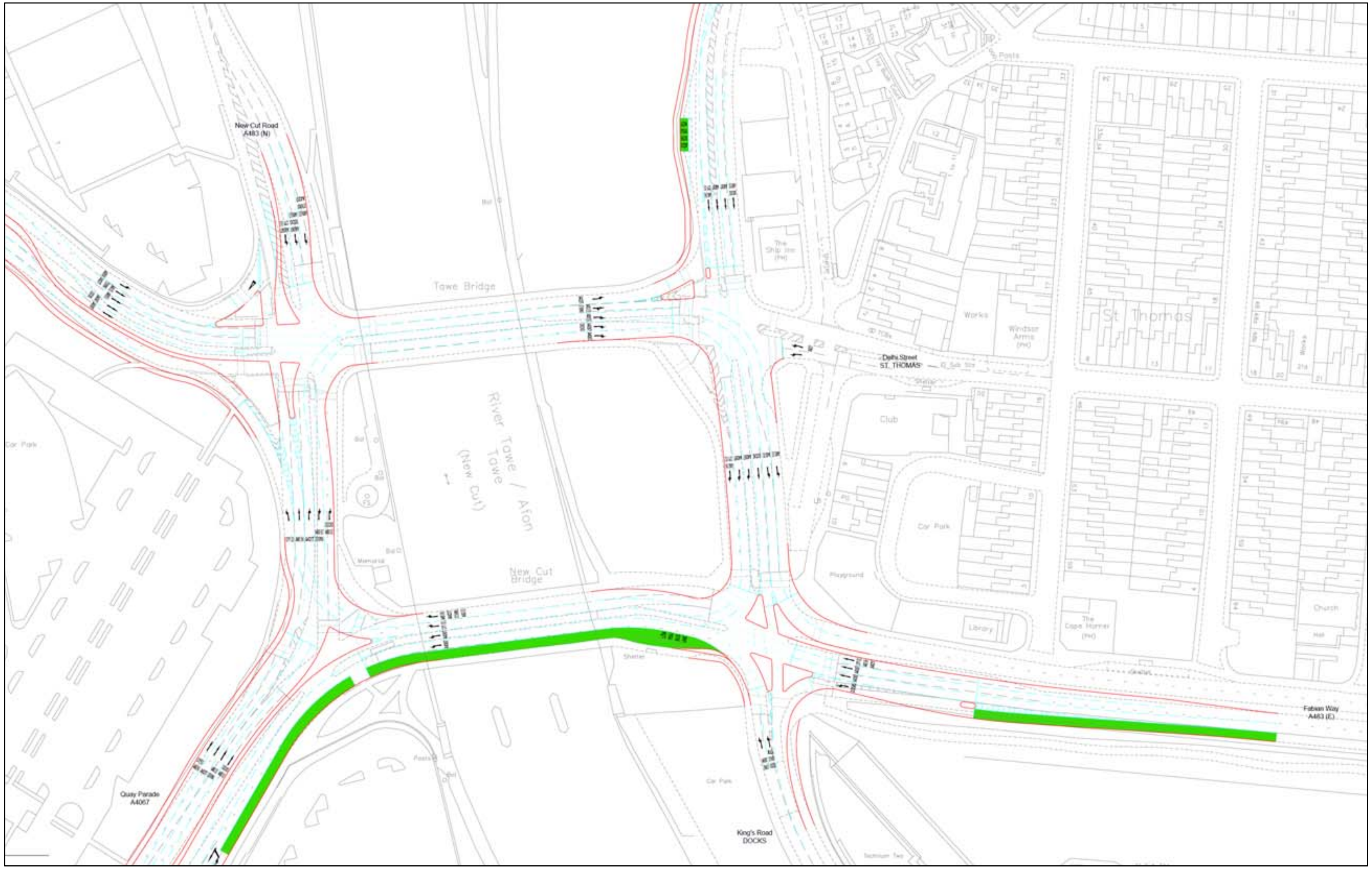
Option 3, the part gyratory, provides significant improvements in both the AM and PM peak hours.

TRANSYT Output for Tawe Bridges (AM Peak: 0800-0900; 2020+ Development)

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**	

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 Proposed layout

- 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, toluene and xylene 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

- 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.**

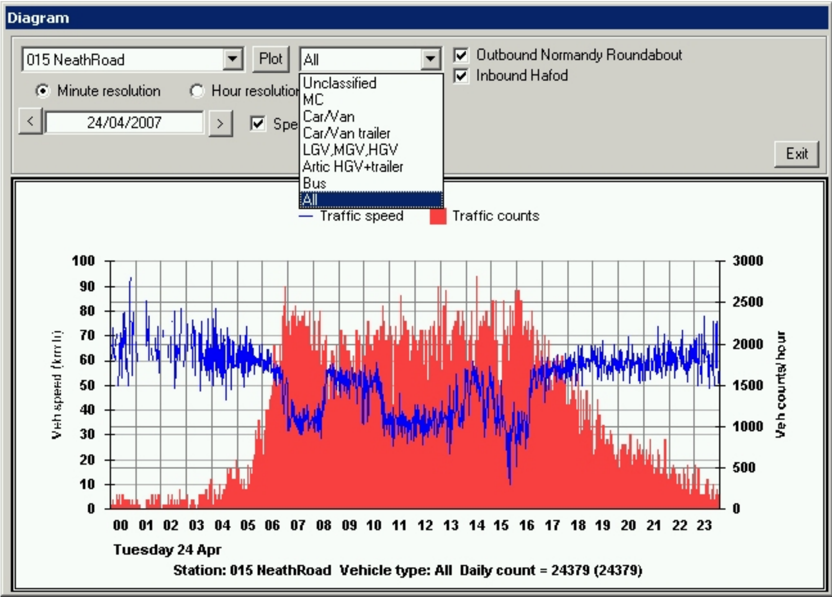
Considerable efforts are being made to ensure that all data feeds into the system under development operate reliably. The major data feeds are:

- Vehicle by Vehicle Traffic flow
- Ambient Air Quality Monitoring data
- Meteorological forecast

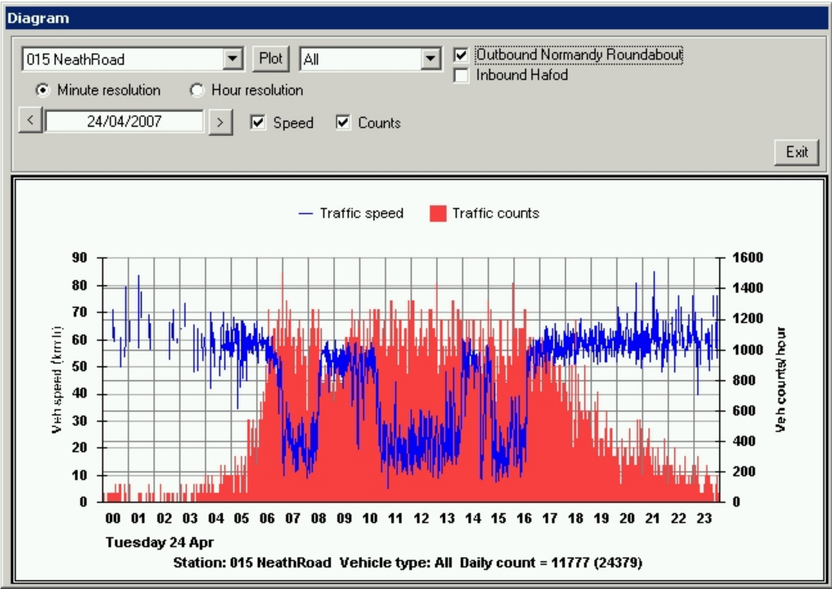
A total of 44 GPRS vehicle by vehicle (VbV) automatic traffic counters have been installed and commissioned and data quality is being assessed - see map 44 below for the location of the existing 44 GPRS traffic counters. Additional temporary surveys are underway within “local streets” for a period of 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.

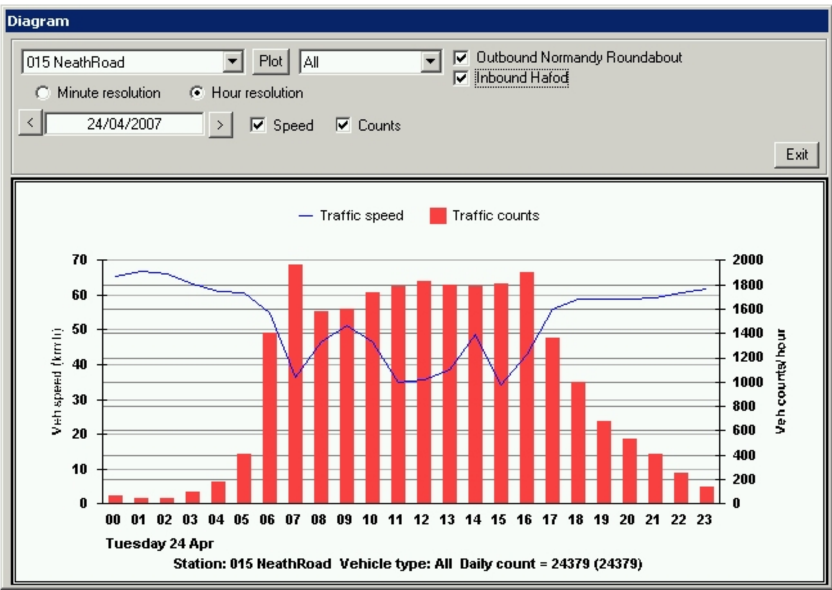
All vehicles are classified into the EUR6 classification scheme at point of detection as well as the speed of the vehicle. This information has again been provided for use within the modelling under development.



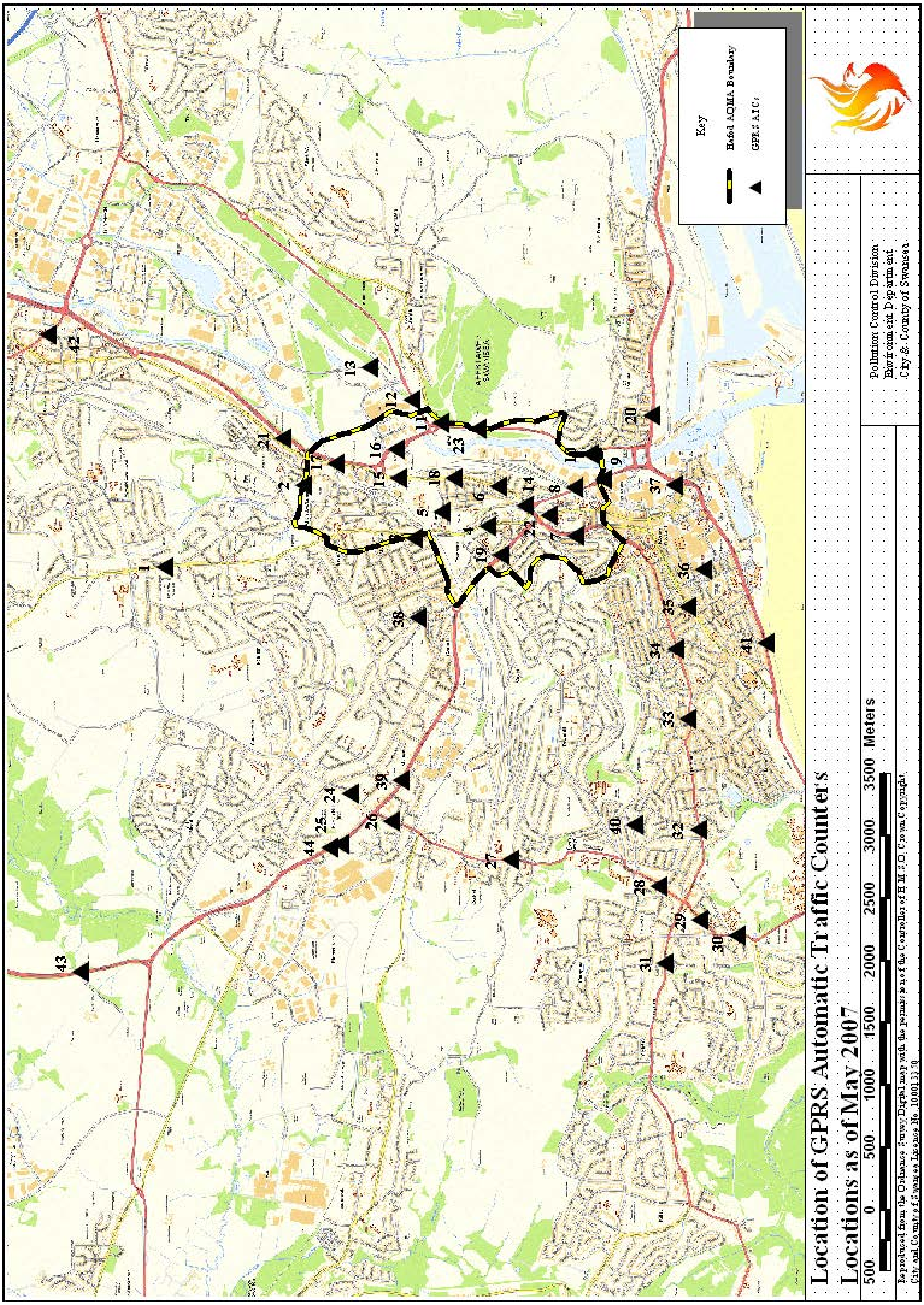
ATC 15 Neath Road is located opposite Morfa Terrace on the B4603. The AADT for 2006 is 20,544 with the AWDT being 21,864. 1 minute resolution traffic flow data enables detection of congestion in almost "real-time".



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

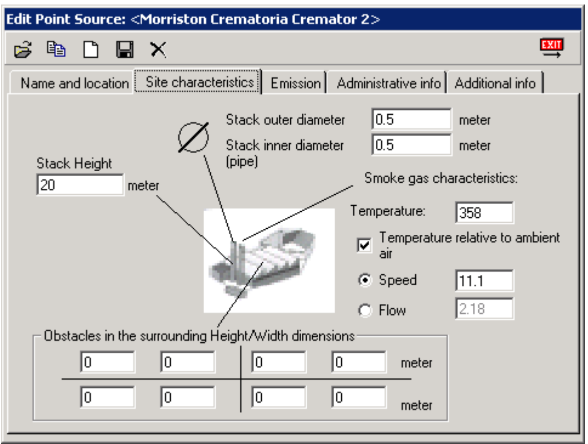


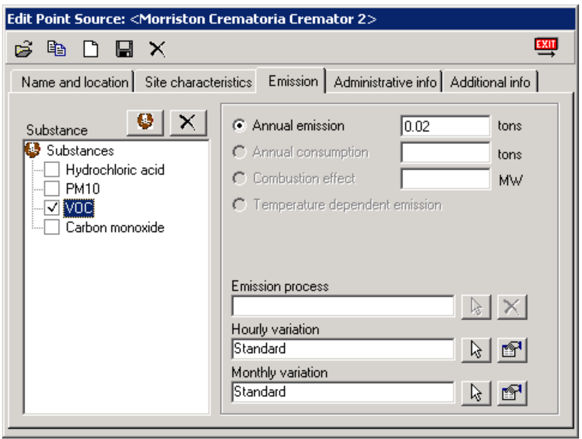
Map 46 - Location of GPRS Automatic Traffic Counters

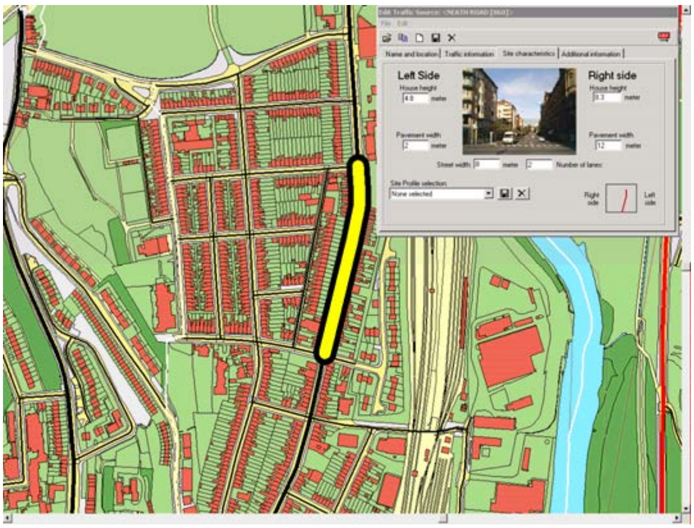
© Crown Copyright and database right 2011. Ordnance Survey 100023509

- 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.





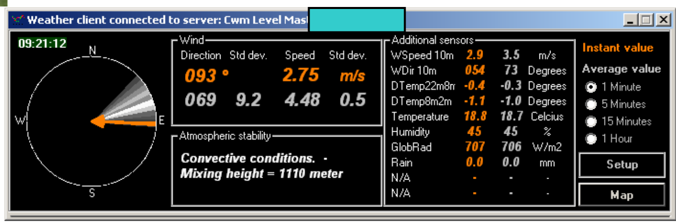


Every road **link** is in process of being classified and the details inputted into the EDB in order that the model understands the local geometry and conditions influencing dispersion in that road link.Width of road/pavement and building heights are being provided as parameters into the emissions database.

- 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.

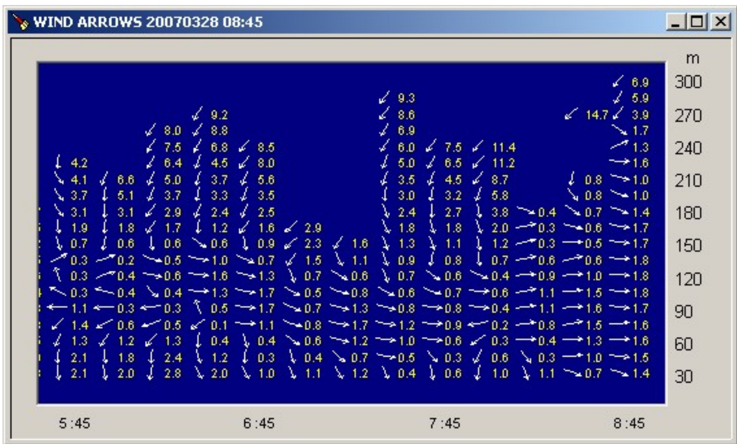
Meteorological parameters measured

- Wind Speed at 30m
- Wind Direction at 30m
- Global Radiation at 30m
- Wind Speed at 1Om
- 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.

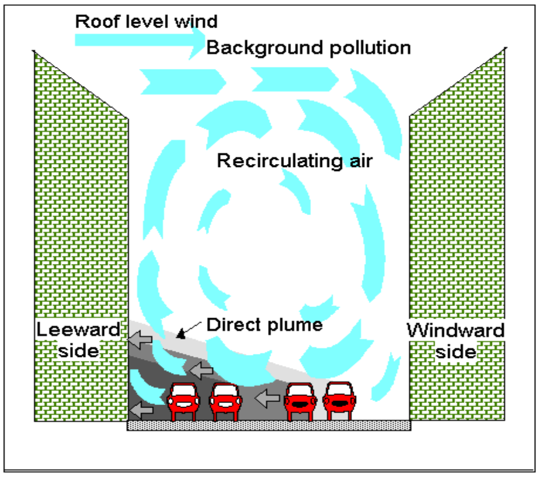
This equipment measures the wind speed and wind direction in 15m "layers" up to its maximum height range of 300m.

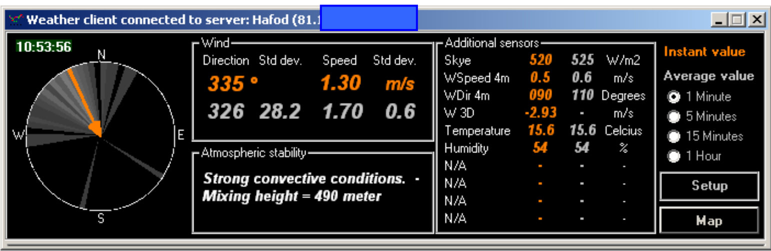


- Establishment of a street canyon meteorological station within Neath Road. This station has been fixed to the front elevation of the Hafod Post Office opposite the open path air quality measurements being undertaken by the Hafod DOAS. This station will supply the meteorological information to validate Nowcaster and other modelling output/predictions/forecasts.

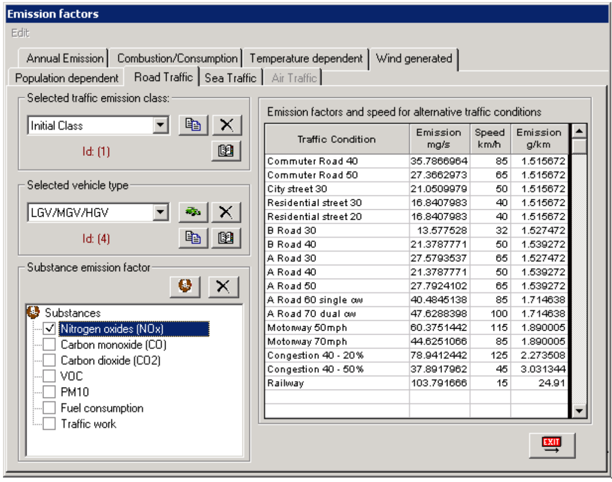
Meteorological parameters measured

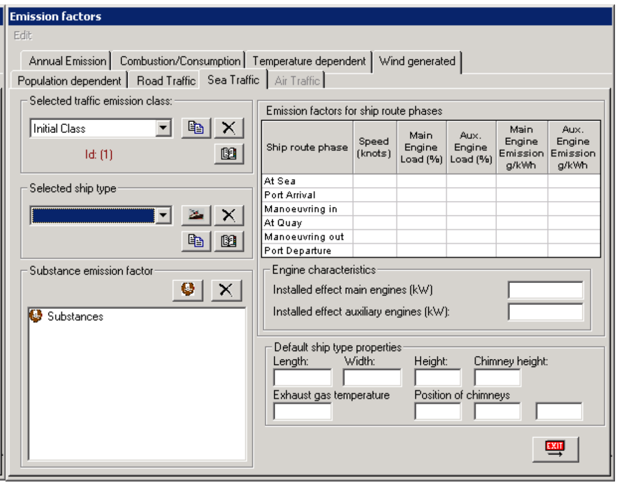
- Global Radiation
- Wind Speed 5m above roof ridge level
- Wind Direction 5m above roof ridge level
- Horizontal Wind Speed at first floor level
- Horizontal Wind Direction at first floor level
- Vertical Wind Speed at first floor level
- Air Temperature at first floor level
- Relative Humidity at first floor level



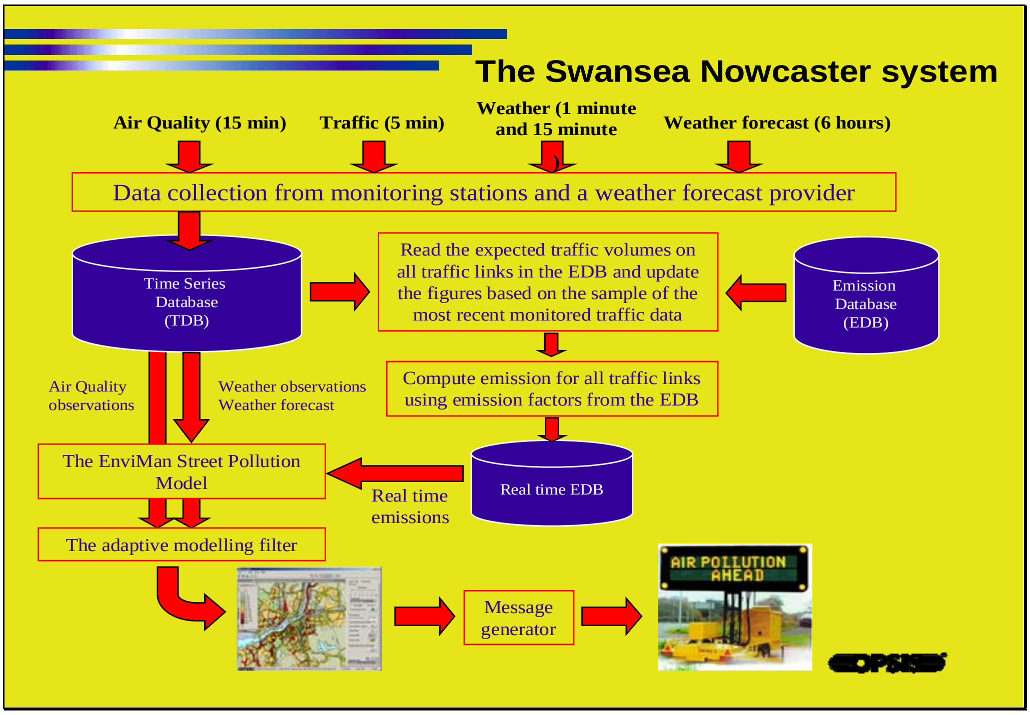


- Development of emission factors for all modes of transportation.





- 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 steams 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 for the first 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 potential of exceedence of both the annual mean and 1-hour objectives.

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 with indications from some other sites within the city centre area that exceedences of the 1-hour objective may potentially be occurring. Several sites within the Uplands area are indicating exceedence of the annual mean objective. This area is situated between the city centre and the Sketty area which forms part of the Swansea AQMA 2010. The failing sites within the Uplands area are on the main access road linking the city centre with the Sketty area. Several sites along Newton Road within the Mumbles area are indicating a breach of the annual mean objective. The situation along Newton Road is exacerbated by tourism traffic during the summer months and complicated by the canopy extending over the commercial and domestic dwellings on one side of the road. The situation along Newton Road is discussed and outlined within section 2.3, plan1 and photos 6 and 7. Additional monitoring will be undertaken at 1st floor level above the canopy at façade (or as close to as possible) of the flats above commercial premises. Two sites in Morriston are indicating failure of the annual mean objective (sites 41 and 43) along with one site at Nantyffin Road Llansamlet (site 50) and another in Ynystawe at a property (site 45) overlooking junction 45 of the M4. These sites are marginal failures in the range of 41-43ug/m^3.

Given the projected compliance with the NO_2 annual mean objective by 2012 at these sites within Morriston, Llansamlet and Ynystawe (see table 12), further monitoring will be undertaken during 2011 / 2012 within these areas.

In addition, some 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/m^3 range). These sites will continue to be monitored to establish trends.

Annual mean NO_2 projections made for 2012, 2013, 2015 and 2020 using 2010 data would appear to indicate that the revised adjustment factors produce a much improving situation in 2015 with all but 5 of the 274 sites indicating compliance with the annual mean objective. However, what is not known is the continued impact of the newer EURO category diesel vehicles as their impact and numbers within the fleet increases.

Given the above, it is reasonable to assume that whilst exceedences of the annual mean objective are predicted to remain during 2012-2015, it is further predicted that widespread compliance with the objective **<u>may</u>** be seen within Swansea during 2015. For this reason it is not proposed to vary the Swansea AQMA 2010 until further additional monitoring has been undertaken. However, previous LAQM experience has shown that future year projections have not always materialised due to unforeseen circumstances, so the projections obtained by using the method within LAQM.TG(09) should still be treated with caution. Additionally, the effect of the recession on fleet renewal rates is unknown.

Nitrogen Dioxide Real Time Continuous Automatic Monitoring Data

Compliance with both the annual mean and hourly objectives were seen at the Swansea AURN, Morfa Groundhog, Morriston Groundhog monitoring stations during 2010. However, real-time open path monitoring along Neath Road, Hafod (Hafod DOAS) continues to show exceedence of the annual mean objective with indications that the hourly objective may also be being breached with a 99.8th percentile of 203.13ug/m^3. An exceedence count of 20 was obtained but this was against a data capture rate of only 87.35%. During 2010, the annual mean objective was exceeded at the other open path monitoring location at the St.Thomas DOAS monitoring station.

Projections to 2016 indicate continued full compliance with both objectives at suitable receptor locations at the Swansea AURN, Morfa Groundhog, and Morriston Groundhog. Projected compliance with the annual mean objective is not seen until 2013 at the St.Thomas DOAS site and not until 2016 at the Hafod DOAS site.

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.

Particulate Matter PM_{10}

No exceedences of the annual mean objective were seen at any of the monitoring stations during 2010. 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/m^3.

Projections made to 2015 and 2020 show compliance with the annual mean objectives at all sites – indeed, there is remarkable harmony between the projected PM_{10} concentrations at all three sites in 2020.

Benzene

No exceedence of the objective has been observed within Swansea since monitoring commenced.

Ozone

Continued exceedences of the UK objective (not set in regulation) continue to be seen but ozone is considered as a national rather than local problem. 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 2010 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 exceedences 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.

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/m^3 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

The authority has highlighted new local developments that will require more detailed consideration in the next Updating and Screening Assessment. These include:

- **Narrow Congested Roads with Residential Properties Close to the Kerb**

The authority has during November 2009 started additional new NO_2 diffusion tube monitoring in numerous streets with an AADT >5000. As mentioned and detailed above, numerous sites have, during the first year of monitoring shown an exceedence of the annual mean objective. These sites will continue to be monitored and the authority's position reviewed should a further year of monitoring confirm the exceedences. This decision has been taken knowing the atypical meteorological conditions within Swansea during 2010 and the projected future year's annual means using the latest guidance.

- **Roads with High Flow of Buses and/or HGV's**

High Street in Swansea stretching from the Dyfatty junction down into the city centre has a high HDV composition. Several NO_2 tube monitoring locations along the length of High Street, some within the existing Hafod AQMA and some outside are exceeding the annual mean objective. One site within the AQMA close to High Street railway Station is now indicating that it has the potential to exceed the 1-hour objective.

The authority was actively considering the installation of a real-time chemiluminescent analyser into the High Street area to enable a full assessment. However, due to financial restriction within the authority this is now considered unlikely to happen.

- **Bus and Coach Stations - Quadrant Bus Interchange**

Redevelopment works were completed at the Quadrant Bus Interchange during late 2010. Receptor locations exist opposite the site in the form of several sheltered housing blocks of flats with relevant exposure within 20m of the curtilage of the existing site. 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. Assessment when works were complete was indicated as an outcome in the Progress Report 2010. However, due to the failure of the Etype PM_{10} analysers to provide reliable data capture and the lack of finances to provide an alternative PM_{10} measurement and traffic counts within Westway, this issue will be revisited at a future date.

- **Waste Management Facility – Cwmrhydyceirw Quarry**

The landfill site had been closed for several years but the new owners have obtained an Environment Agency permit to recommence landfill activities at the site. Preparatory engineering operations have commenced at this former mixed waste landfill site with numerous monitoring boreholes being sunk. Preparatory works will also include 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 have the potential to emit substantial fugitive emissions as well as odour nuisance. Discussions have commenced with the operators to establish what monitoring and local liaison is required with local residents. Receptor locations are within 200m.

It is not proposed to consider any further assessment at this stage as the timescale of operations (both remediation and active deposition) are not as yet fully known. Any fugitive emissions during excavation and relining are likely to be of a transitional/temporary nature. However, preparatory works have now commenced during the early stages of 2010 with the sinking of extensive new monitoring boreholes around the site along with trial holes into the previously deposited material.

The authority have therefore commenced a monitoring program to assess nuisance dust in the immediate vicinity of the quarry as well as the installation of three real time Etype PM_{10} analysers upwind of the quarry to enable a preliminary screening of the operations to be made. The first of the Etype analysers was deployed at Cwmrhydyceirw Primary School during June 2010. Another Etype has been located within the curtilage of the site behind properties along Cwmrhydyceirw Road at the site boundary and a third is planned at a property at Enfield Close. It should be noted that the Etype analysers are not type approved, have not undertaken equivilancy testing and are deployed for the sole purpose of undertaking a preliminary “screening assessment” as part of this authorities undertaking to local residents. It should also be noted that operation of other Etype PM_{10} anlaysers as mentioned above have proved problematic. It is highly likely that the authority will be financially unable to install Thermo FDMS units or any other compliant/equivalent gravimetric analysers in order to undertake any assessment.

In addition to the real-time PM_{10} monitoring, the authority have also established eight “soiling index” dust sites to assess any dust of nuisance value generated by site activities, and offsite vehicular access/egress once preparatory works and landfill operations become established in the coming months.

Updates on the engineering works progress and any monitoring results will be presented within future reporting.

10.3 Other Conclusions

The authority has been making progress with its Action Plan since 2004. Progress has been slow due to limitations in availability of funding. This situation is unlikely to change and it is expected to become even more difficult in the current financial climate to secure the required funding. With no funding being made available from the Welsh Assembly Government to directly assist local authorities with their local air quality management duties, there is little option available to the authority but to accept that development works with action point 10 of the Action Plan will cease. In addition, the spending review currently underway has cast doubt on the future of other major highway schemes. The strong feeling is that transport issues can expect a substantial budget cut and it seems unlikely that capital schemes will go ahead unless there is substantial match funding, which is impossible given the Council’s current financial position.

10.4 Proposed Actions

The authority is aware that additional areas are also exceeding the nitrogen dioxide annual mean objective within the Uplands, Mumbles, Morriston, Llansamlet and Ynystawe areas as well as sites within the city centre. Given the atypical meteorological conditions during 2010, coupled with the projected compliance with the NO_2 annual mean objective by 2015, further monitoring will be undertaken within these areas. These sites will therefore continue to be monitored and the authority's position reviewed should a further year of monitoring confirm the exceedences and the projected future years compliance be brought into doubt.

Due to financial restrictions the existing passive nitrogen dioxide tube survey (sites 1-274) has been revised. Measurements have now ceased at all sites that return a bias corrected annual mean below 30ug/m^3 except where the site is within, or close to an AQMA and may provide useful information in assessing trends and outcome measures of any action taken within the AQMA

On the 1st April 2010 the authority took the decision again due to budgetary restraints to cease real-time automatic measurements of sulphur dioxide, carbon monoxide and hydrogen sulphide at the Swansea AURN, Morfa Groundhog and Morriston Groundhog sites. The service and maintenance contracts have been amended to reflect these changes.

Additionally, due to the increasing financial pressures being faced by the authority, real-time automatic measurements at the Morfa Groundhog site has ceased during early 2011. Consideration is being given to the disposal of the real-time equipment.

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. Technical Guidance LAQM.TG(09)

ix. Air Quality (Wales) Regulations 2000, No. 1940 (Wales 138)

x. Air Quality (Amendment) (Wales) Regulations 2002, No 3182 (Wales 298)

xi. 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

xii. South West Wales Integrated Transport Consortium - **Regional** Transport Plan 2010-2015 and 2011 Progress Report update

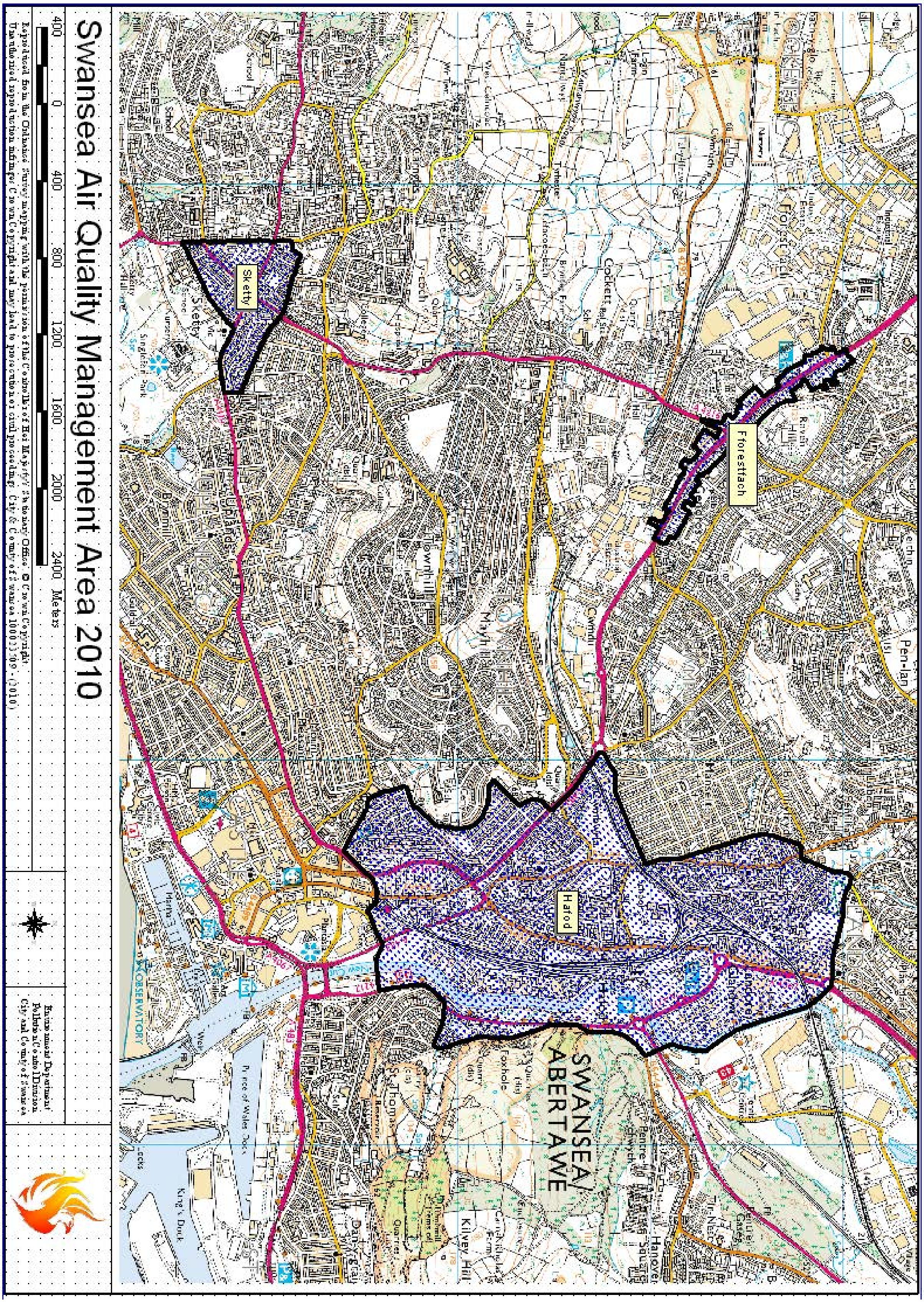
Appendix 1

Hafod AQMA


Hafod Air Quality Management Area
400 0 400 800 1200 Meters
Pollution Control Division.
Environment Department.
City & County of Swansea.
SWANSEA/ABERTAWE

Appendix 2

Swansea AQMA 2010


Swansea Air Quality Management Area 2010
400 0 400 800 1200 1600 2000 2400 Meters
Sketty
Fforestfach
Hafod
SWANSEA/ ABERTAWE

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) Sample A: Calculated Spiked Value	HSL Calculations (Pre-Sendout) Sample A: Measured Value	Harwell Analysis Tubes A: Result Tube 1	Result Tube 2	Average	Standard Deviation	RSD	Z-Score	HSL Calculations (Pre-Sendout) Sample B: Calculated Spiked Value	HSL Calculations (Pre-Sendout) Sample B: Measured Value	Harwell Analysis Tubes B: Result Tube 1	Result Tube 2	Average	Standard Deviation	RSD	Z-Score
2011	115	Sept-Dec																		
	114	Jul-Aug																		
	113	Apr-Jun			1.532	1.524	1.478	1.471	1.475	0.005	0.30%	-0.5	2.304	2.292	2.296	2.254	2.275	0.030	1.30%	-0.1
	112	Jan-Mar			2.10	2.07	2.103	1.090	2.097	0.010	0.50%	0	0.94	0.93	0.952	0.953	0.953	0.027	0.10%	0.2
2010	111	Sept-Dec			1.84	1.85	1.821	1.821	1.821	0.000	0	0.1	1.54	1.57	1.512	1.482	1.497	0.022	1.50%	-0.4
	110	Jul-Aug			0.99	1.00	0.972	0.987	0.980	0.011	1.1	0	2.37	2.47	2.367	2.394	2.381	0.020	0.80%	0.1
	109	Apr-Jun			1.03	1.06	1.053	1.053	1.053	0.000	0	0.3	1.27	1.27	1.265	1.268	1.267	0.003	0.20%	0
	108	Jan-Mar			1.92	1.91	1.921	1.896	1.910	0.018	0.9%	-0.1	1.47	1.47	1.409	1.422	1.420	0.009	0.6%	-0.5
2009	107	Oct-Dec			2.03	2.04	1.905	1.914	1.910	0.007	0.4%	-0.8	2.20	2.20	2.049	2.046	2.048	0.003	0.1%	-0.9
	106*	Jul-Sept			1.84	1.84	1.880	1.439	1.660	0.312	18.8%	-1.3	1.42	1.44	1.880	1.429	1.655	0.319	19.3%	2.1
	106*	Jul-Sept			1.84	1.84	1.880	1.880	1.880	0.000	0.0%		1.42	1.44	1.439	1.429	1.434	0.007	0.5%	
	105	Apr-Jun			1.68	1.69	1.795	1.784	1.790	0.008	0.4%	0.8	0.96	0.96	1.031	1.035	1.033	0.003	0.3%	0.9
	104	Jan-Feb			2.02	2.01	2.017	2.047	2.032	0.022	1.1%	0.0	1.22	1.19	1.269	1.230	1.252	0.024	1.9%	0.2
2008	103	Sept-Dec			1.22	1.22	1.242	1.234	1.238	0.006	0.5%	0.1	0.94	0.95	0.957	0.951	0.954	0.005	0.5%	0.1
	102	Jun-Aug			1.37	1.38	1.470	1.472	1.471	0.043	2.9%	0.5	2.28	2.30	2.435	2.386	2.411	0.035	1.5%	0.4
	101	Apr-Jun			0.92	0.94	0.974	0.991	0.983	0.013	1.3%	0.5	1.86	1.93	1.947	1.958	1.953	0.008	0.4%	0.4
	100	Jan-Mar			1.36	1.37	1.395	1.384	1.390	0.008	0.6%	0.2	1.47	1.45	1.511	1.516	1.514	0.004	0.3%	0.2
2007	99	Oct-Nov			2.15	2.16	2.242	2.235	2.239	0.005	0.2%	0.3	0.84	0.84	0.906	0.901	0.904	0.004	0.4%	0.6
	98	Jul-Sept			1.83	1.85	1.877	1.854	1.866	0.013	0.7%	0.2	1.19	1.20	1.229	1.223	1.226	0.005	0.4%	0.2
	97	Apr-Jun			0.89	0.87	0.920	0.918	0.919	0.002	0.2%	0.2	1.58	1.59	1.619	1.640	1.630	0.015	0.9%	0.2

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 Environment[41] 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

AEA Energy & Environment
From the AEA group

	Diffusion Tubes Measurements									Automatic Method		Data Quality Check	
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	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	12-Jan-10	04-Feb-10	58.00	57.20	52.30	56	3.1	6	7.7	47.88	99.4	Good	Good
2	04-Feb-10	04-Mar-10	52.60	51.70	47.50	51	2.7	5	6.8	48.66	95.5	Good	Good
3	04-Mar-10	01-Apr-10	52.30	50.70	50.10	51	1.1	2	2.8	39.7	99.7	Good	Good
4	01-Apr-10	28-Apr-10	39.50	42.10	41.20	41	1.3	3	3.3	37.83	99.5	Good	Good
5	28-Apr-10	02-Jun-10	31.40	26.80	23.00	27	4.2	16	10.4	27	99.76	Good	Good
6	02-Jun-10	30-Jun-10	27.60	27.20	26.50	27	0.6	2	1.4	26	99.7	Good	Good
7	30-Jun-10	04-Aug-10	24.10	23.80	25.20	24	0.7	3	1.8	20	96.42	Good	Good
8	04-Aug-10	01-Sep-10	24.00	22.60	22.90	23	0.7	3	1.8	20	99.85	Good	Good
9	01-Sep-10	29-Sep-10	34.80	33.50	33.80	34	0.7	2	1.7	28	99.85	Good	Good
10	29-Sep-10	03-Nov-10	36.40	35.90	34.80	36	0.8	2	2.0	34	99.76	Good	Good
11	03-Nov-10	01-Dec-10	51.40	50.70	51.70	51	0.5	1	1.3	44.86	99.85	Good	Good
12	01-Dec-10	05-Jan-11	66.30	69.70	69.30	68	1.9	3	4.6	60.33	99.64	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

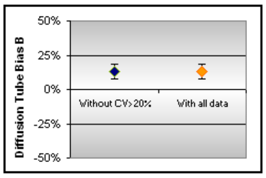
Site Name/ ID: Swansea AURN

Precision 12 out of 12 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.89 (0.85 - 0.93)
Bias B	13% (7% - 18%)
Diffusion Tubes Mean:	41 μgm^{-3}
Mean CV (**Precision**):	4
Automatic Mean:	36 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	36 (35 - 38) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.89 (0.85 - 0.93)
Bias B	13% (7% - 18%)
Diffusion Tubes Mean:	41 μgm^{-3}
Mean CV (**Precision**):	4
Automatic Mean:	36 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	36 (35 - 38) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Bias correction factor 1 – Swansea Roadside AURN 2010

The derived bias correction factor of 0.89 (0.85-0.93) has been determined with good tube precision as all diffusion tube data periods have a coefficient of variation below 20%. Accuracy (with 95% confidence interval) indicates a bias B factor of 13% (7% - 18%)

[41] http://www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

- ## Morfa Groundhog 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 Environment[42] 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

AEA Energy & Environment
From the AEA group

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	Automatic Method: Period Mean	Automatic Method: Data Capture (% DC)	Data Quality Check: Tubes Precision Check	Data Quality Check: Automatic Monitor Data
1	12/01/2010	04/02/2010	50.9	50.5	51.6	51	0.6	1	1.4	46.43	91.3	Good	Good
2	04/02/2010	04/03/2010		50.1	46.6	48	2.5	5	22.2	48.67	94.97	Good	Good
3	04/03/2010	01/04/2010	49.6	51.3	51.0	51	0.9	2	2.3	39.57	90.64	Good	Good
4	01/04/2010	28/04/2010	44.4	36.3	45.5	42	5.0	12	12.5	37.65	94.25	Good	Good
5	28/04/2010	02/06/2010	34.5	30.2	29.9	32	2.6	8	6.4	29.98	98.33	Good	Good
6	02/06/2010	30/06/2010	30.9	30.7	29.7	30	0.6	2	1.6	27.71	96.43	Good	Good
7	30/06/2010	04/08/2010	28.8	26.0	23.6	26	2.6	10	6.5	22.10	99.4	Good	Good
8	04/08/2010	01/09/2010	27.0	25.9	24.1	26	1.5	6	3.6	22.76	98.51	Good	Good
9	01/09/2010	29/09/2010	25.2	29.2	19.6	25	4.8	20	12.0	29.53	95.71	Poor Precision	Good
10	29/09/2010	03/11/2010	44.7	40.9	45.6	44	2.5	6	6.2	36.81	99.16	Good	Good
11	03/11/2010	01/12/2010	47.8	49.0	53.3	50	2.9	6	7.2	47.10	97.92	Good	Good
12	01/12/2010	05/01/2011		63.6	65.8	65	1.6	2	14.0	67.48	88.33	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

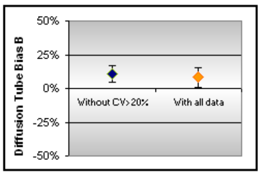
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Morfa Groundhog

Precision 11 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 11 periods of data	
Bias factor A	0.92 (0.87 - 0.97)
Bias B	9% (3% - 15%)
Diffusion Tubes Mean:	42 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	39 μgm^{-3}
Data Capture for periods used:	95%
Adjusted Tubes Mean:	39 (37 - 41) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.93 (0.87 - 1)
Bias B	7% (0% - 15%)
Diffusion Tubes Mean:	41 μgm^{-3}
Mean CV (Precision):	7
Automatic Mean:	38 μgm^{-3}
Data Capture for periods used:	95%
Adjusted Tubes Mean:	38 (35 - 41) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

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Bias correction factor 2 –Morfa Groundhog 2010

The derived bias correction factor of 0.93 (0.87 - 1) has been determined with good tube precision as all diffusion tube data periods have a coefficient of variation below 20%. Accuracy (with 95% confidence interval) indicates a bias B factor of 7% (0% - 15%)

[42] http://www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

- ## Morriston Groundhog 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 Environment[43] 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

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
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	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	12-Jan-10	04-Feb-10	55.60	56.10	57.00	56	0.7	1	1.8	44.97	99.64	Good	Good
2	04-Feb-10	04-Mar-10	50.20	62.10	48.30	54	7.5	14	18.6	40.97	98.67	Good	Good
3	04-Mar-10	01-Apr-10	45.60	45.70	49.00	47	1.9	4	4.8	32.07	98.51	Good	Good
4	01-Apr-10	28-Apr-10	35.60	34.30	39.60	37	2.8	8	6.9	27.97	87.94	Good	Good
5	28-Apr-10	02-Jun-10	25.80	31.80	34.00	31	4.2	14	10.5	22.36	99.04	Good	Good
6	02-Jun-10	30-Jun-10	21.90	25.30	27.20	25	2.7	11	6.7	18.56	96.3	Good	Good
7	30-Jun-10	04-Aug-10	18.10	22.90	24.90	22	3.5	16	8.7	14.71	98.34	Good	Good
8	04-Aug-10	01-Sep-10	23.70	24.20	28.90	26	2.9	11	7.1	17.49	94.21	Good	Good
9	01-Sep-10	29-Sep-10	31.60	33.30	34.40	33	1.4	4	3.5	23.95	99.7	Good	Good
10	29-Sep-10	03-Nov-10	39.00	40.60	41.20	40	1.1	3	2.8	28.82	97.38	Good	Good
11	03-Nov-10	01-Dec-10	49.30	48.70	52.60	50	2.1	4	5.2	39.52	98.81	Good	Good
12	01-Dec-10	05-Jan-11	76.60	63.90	69.30	70	6.4	9	15.8	58.91	74.29	Good	or Data Capture
13													
										Overall survey -->		Good precision	Good Overall DC

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

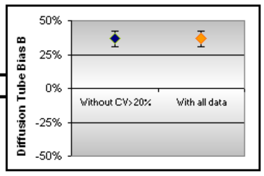
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Morriston Groundhog

Precision 12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)	
without periods with CV larger than 20%	
Bias calculated using 11 periods of data	
Bias factor A	0.74 (0.71 - 0.77)
Bias B	35% (29% - 40%)
Diffusion Tubes Mean:	38 μgm^{-3}
Mean CV (Precision):	8
Automatic Mean:	28 μgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	28 (27 - 29) μgm^{-3}

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 11 periods of data	
Bias factor A	0.74 (0.71 - 0.77)
Bias B	35% (29% - 40%)
Diffusion Tubes Mean:	38 μgm^{-3}
Mean CV (Precision):	8
Automatic Mean:	28 μgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	28 (27 - 29) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

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Bias correction factor3 – Morriston Groundhog2010

A bias correction factor of 0.74 (0.71-0.77) has been determined with good tube precision as all diffusion tube data periods have a coefficient of variation below 20%. Accuracy (with 95% confidence interval) indicates a bias B factor of 35% (29% - 40%).

[43] http://www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

- **Cwm Level Park (Urban Background Site)**

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 Environment[44] 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

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
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	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	12-Jan-10	04-Feb-10	36.80	37.30	38.80	38	1.0	3	2.6	33.46	99.28	Good	Good
2	04-Feb-10	04-Mar-10	32.50	33.50	32.30	33	0.6	2	1.6	33.08	99.56	Good	Good
3	04-Mar-10	01-Apr-10	30.10	31.10	30.80	31	0.5	2	1.3	27.29	97.34	Good	Good
4	01-Apr-10	28-Apr-10	24.00	22.10	23.70	23	1.0	4	2.5	23.6	92.53	Good	Good
5	28-Apr-10	02-Jun-10	16.30	17.30	15.50	16	0.9	6	2.2	15.62	99.64	Good	Good
6	02-Jun-10	30-Jun-10	13.40	14.00	12.40	13	0.8	6	2.0	14.61	99.26	Good	Good
7	30-Jun-10	04-Aug-10	9.20	10.90	12.40	11	1.6	15	4.0	8.08	99.68	Good	Good
8	04-Aug-10	01-Sep-10	12.10	12.60	12.60	12	0.3	2	0.7	9.66	87.67	Good	Good
9	01-Sep-10	29-Sep-10		18.40	18.30	18	0.1	0	0.6	13.10	95.57	Good	Good
10	29-Sep-10	03-Nov-10	29.90	25.20	23.10	26	3.5	13	8.6	21.15	96.89	Good	Good
11	03-Nov-10	01-Dec-10	31.50	31.50	32.90	32	0.8	3	2.0	30.88	99.85	Good	Good
12	01-Dec-10	05-Jan-11	47.30	45.10	45.10	46	1.3	3	3.2	45.20	99.76	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

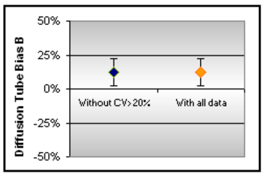
Site Name/ ID:	Cwm Level Park

Precision 12 out of 12 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.92 (0.84 - 1.01)
Bias B	9% (-1% - 19%)
Diffusion Tubes Mean:	25 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	23 μgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	23 (21 - 25) μgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.92 (0.84 - 1.01)
Bias B	9% (-1% - 19%)
Diffusion Tubes Mean:	25 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	23 μgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	23 (21 - 25) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

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Bias correction factor4 –Cwm Level Park 2010

A bias correction factor of 0.92 (0.84 -1.01) has been determined with good overall tube precision with 8 out of 9 data periods have a coefficient of variation below 20% . However one period exhibited poor tube precision with a coeficient of variation of 23 %. Accuracy (with 95% confidence interval) indicates a bias B factor of 9% (-1% - 19%)

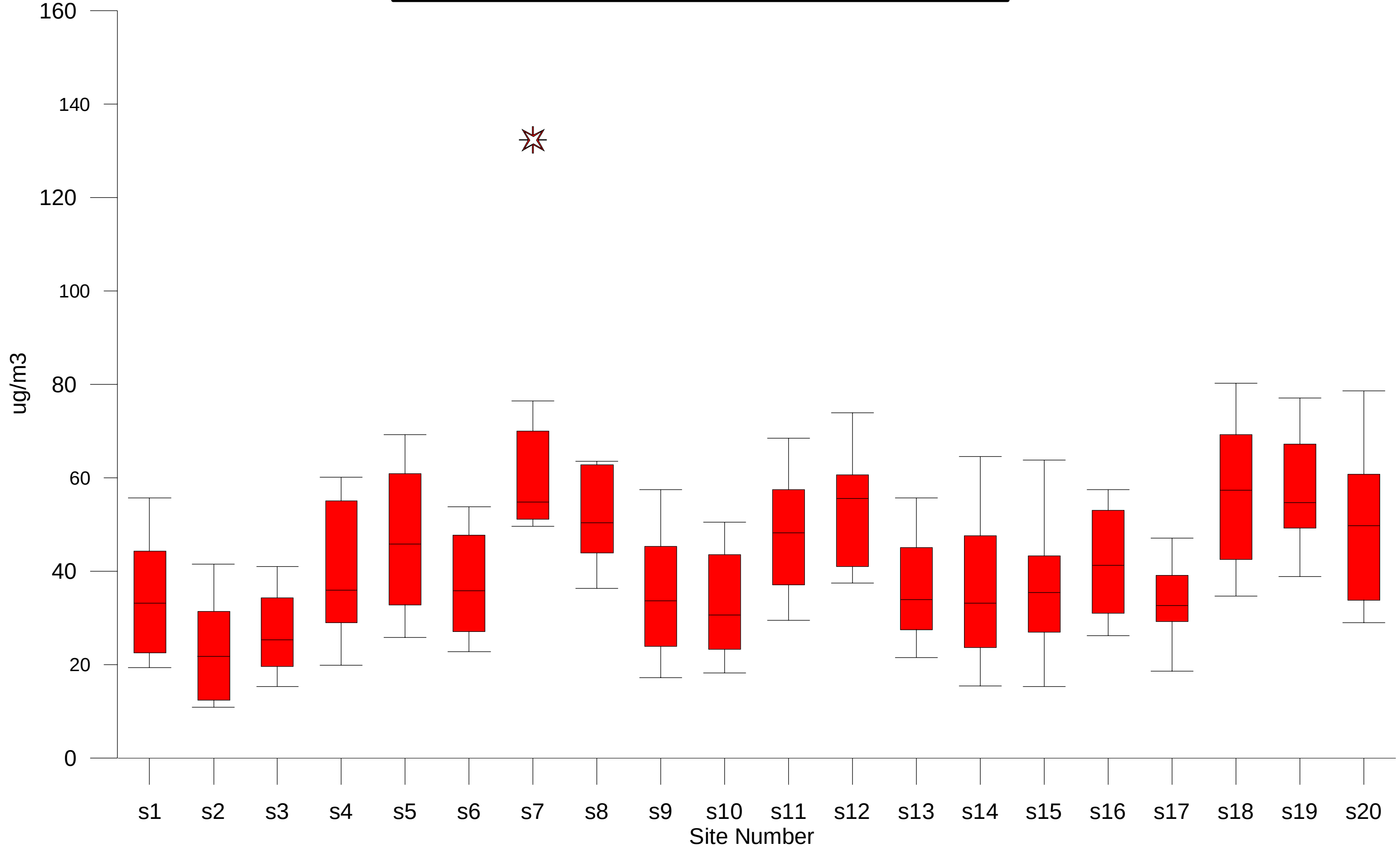
[44] http://www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

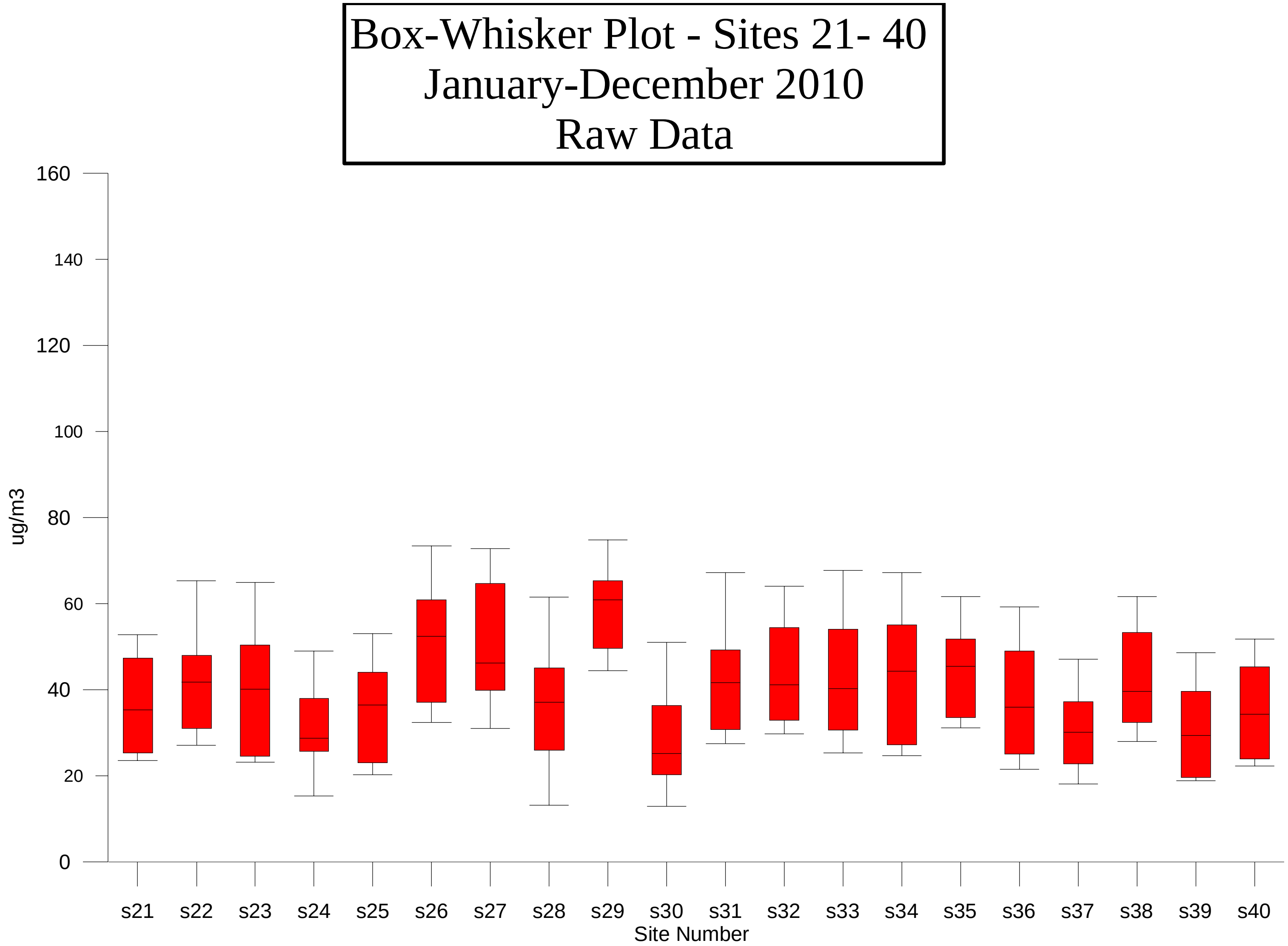
Appendix 5

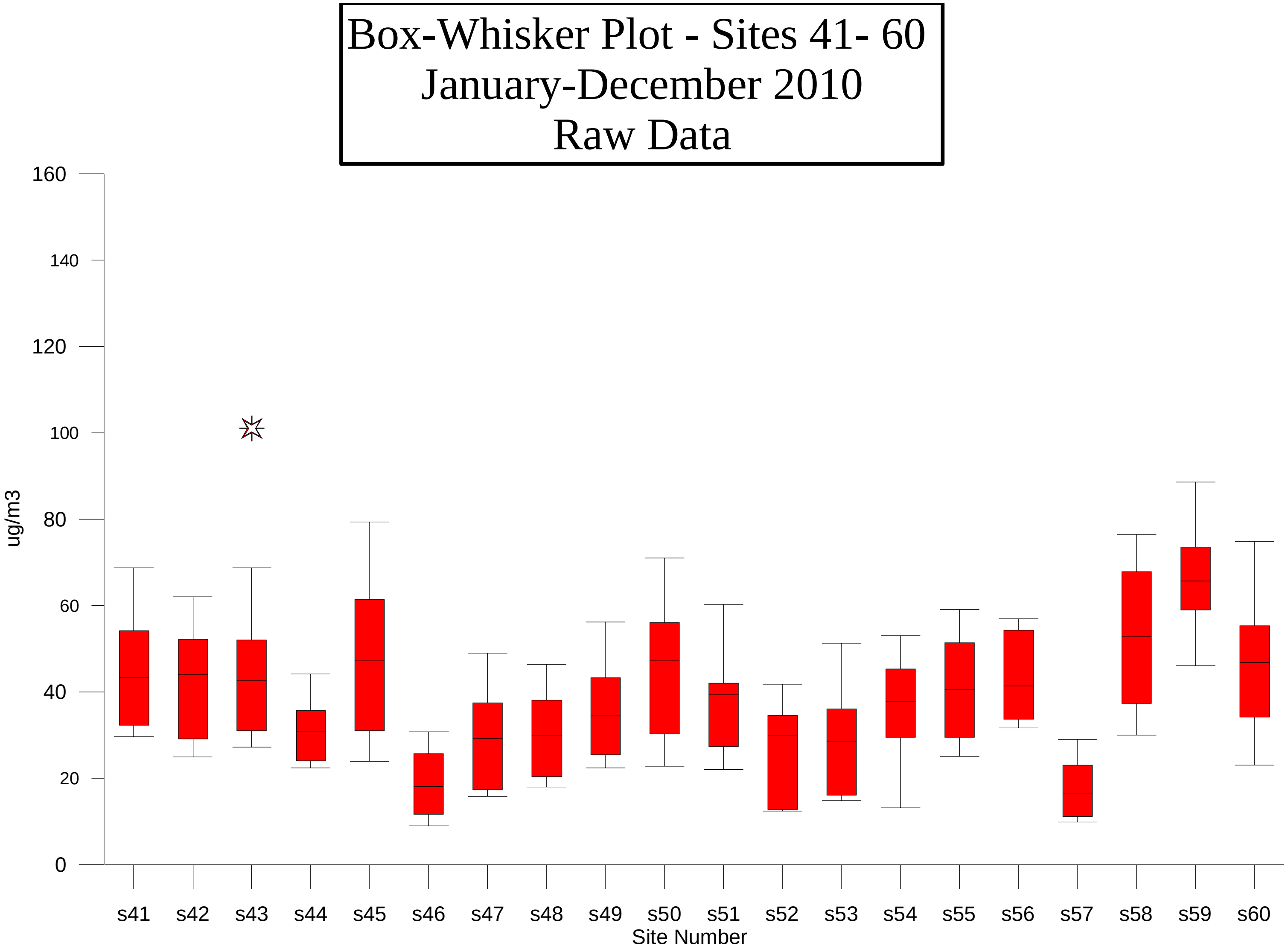
Nitrogen Dioxide Passive Diffusion Tube Data (uncorrected)

Box-Whisker Plots

Box-Whisker Plot - Sites 1-20
January-December 2010
Raw Data




Box-Whisker Plot - Sites 21- 40
January-December 2010
Raw Data
160
140
120
100
80
60
40
20
0
ug/m3
s21
s22
s23
s24
s25
s26
s27
s28
s29
s30
s31
s32
s33
s34
s35
s36
s37
s38
s39
s40
Site Number


Box-Whisker Plot - Sites 41- 60
January-December 2010
Raw Data
ug/m3
0
20
40
60
80
100
120
140
160
s41
s42
s43
s44
s45
s46
s47
s48
s49
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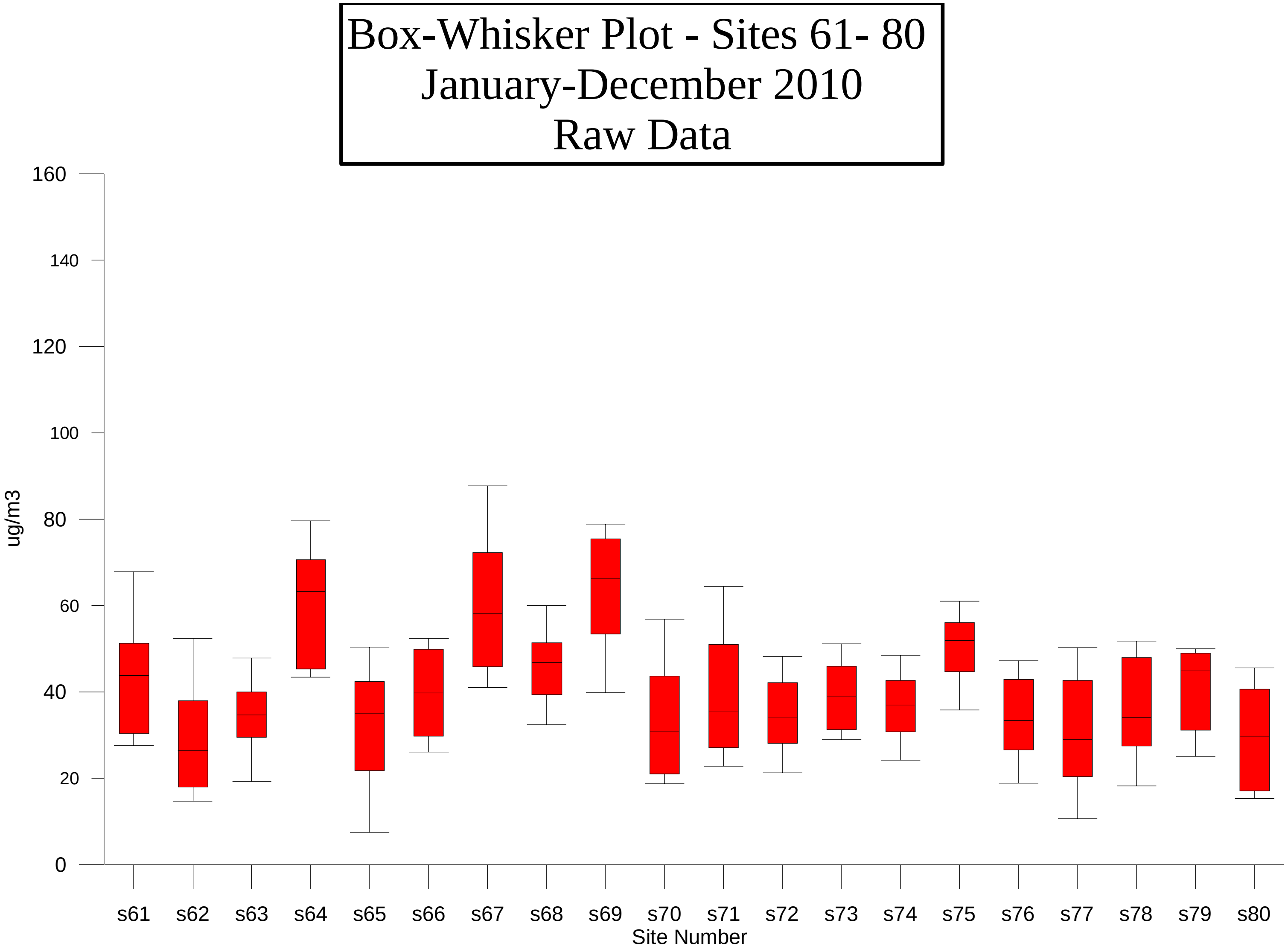
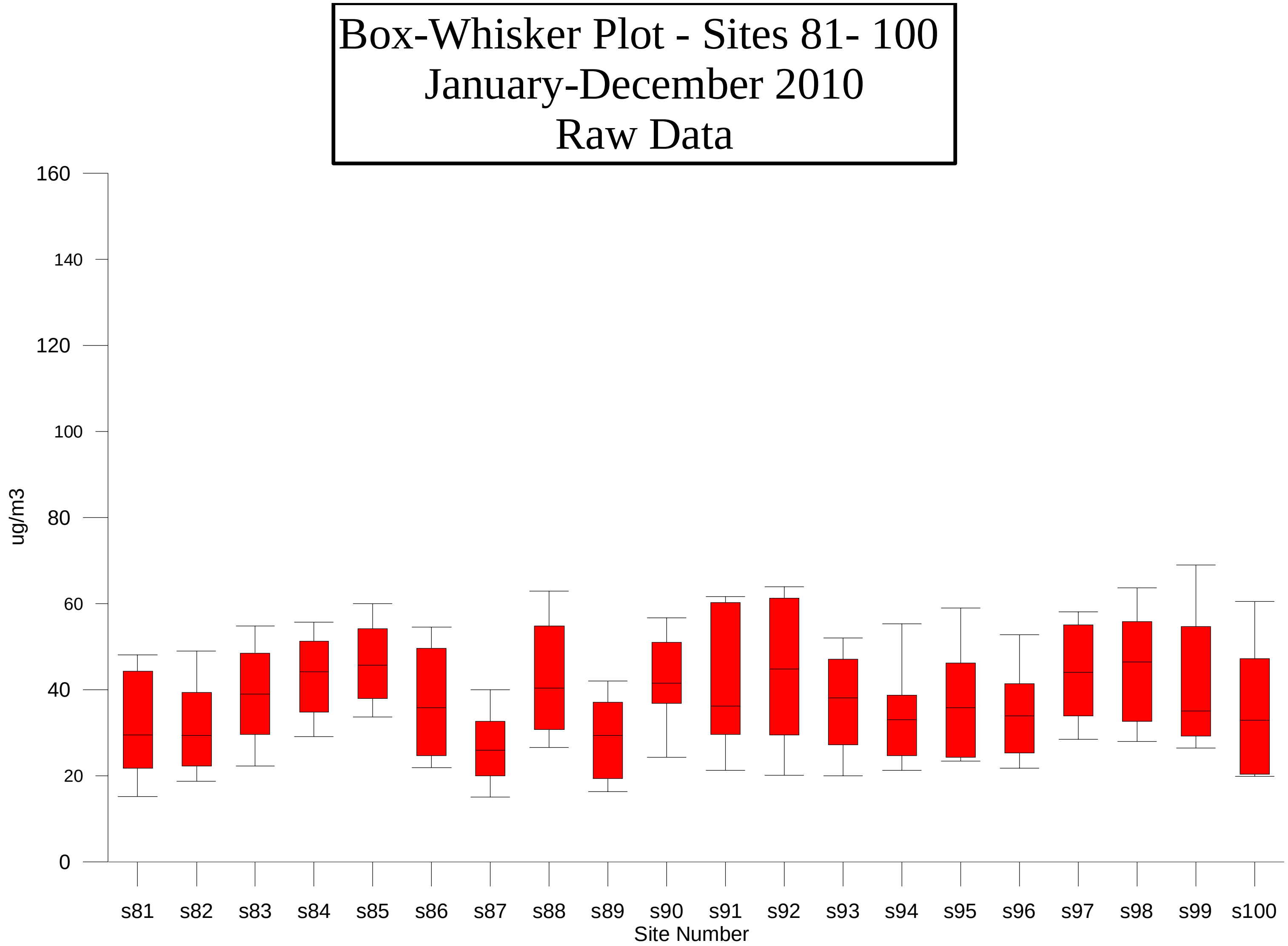
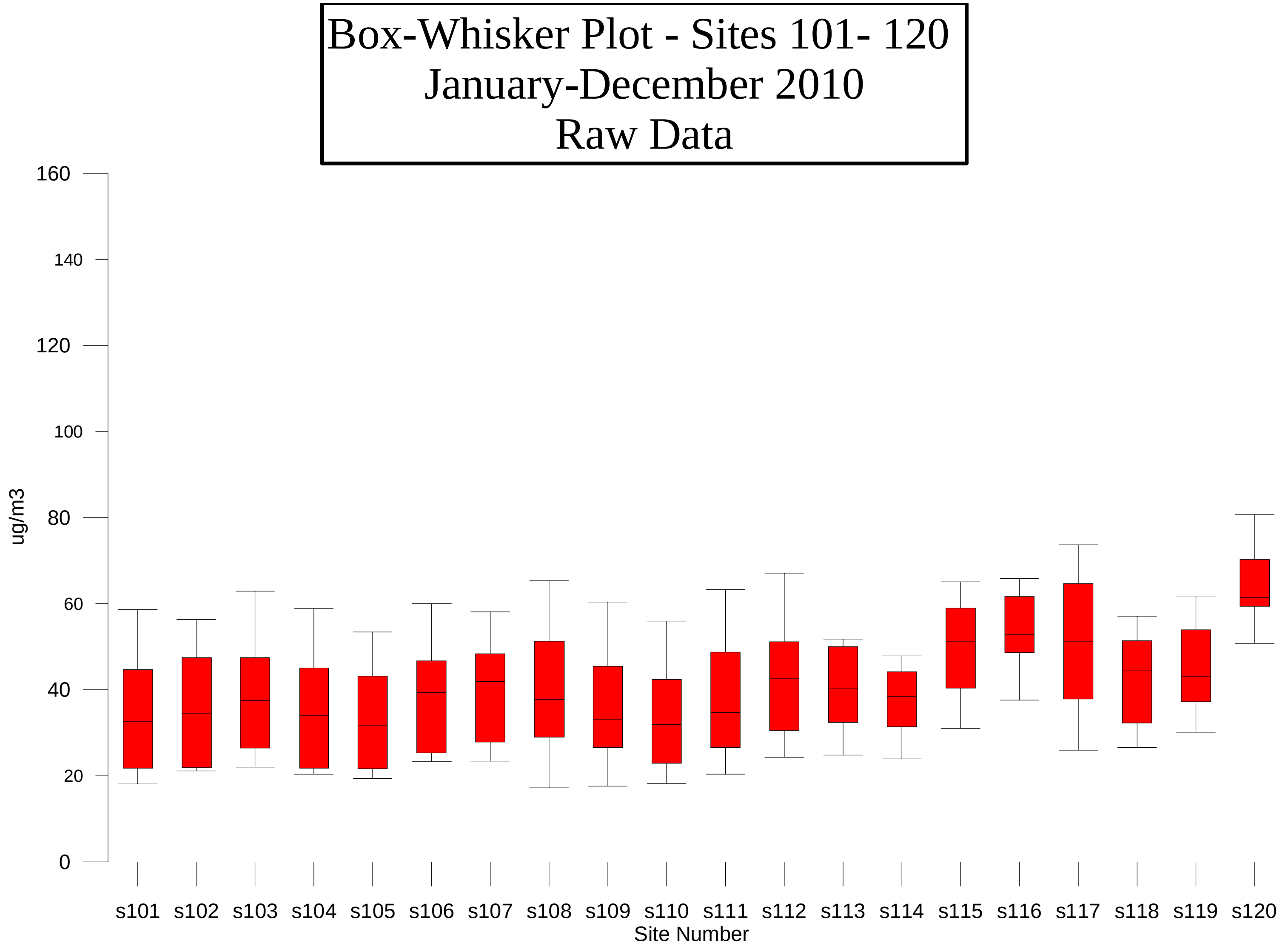
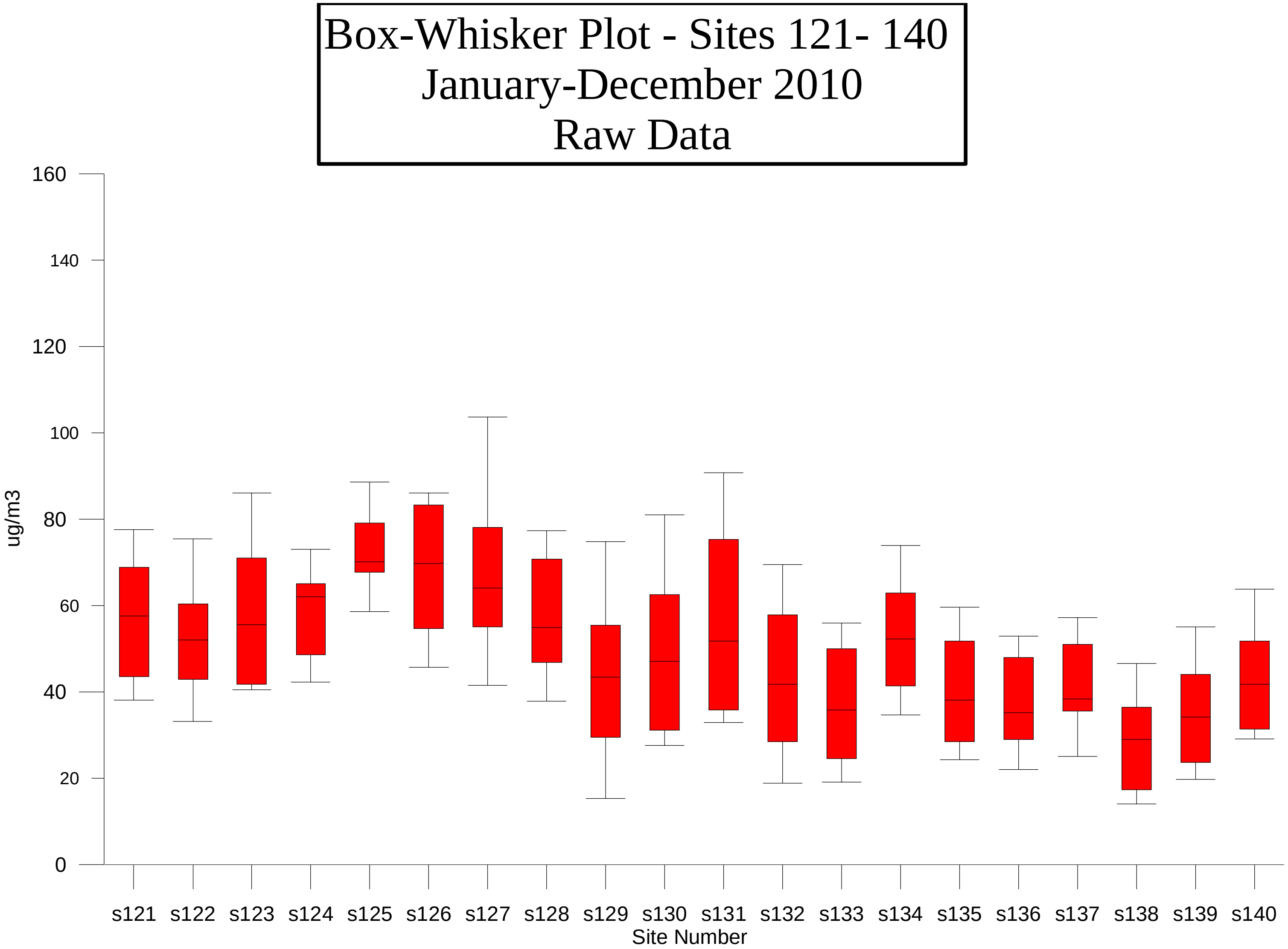
s57
s58
s59
s60
Site Number

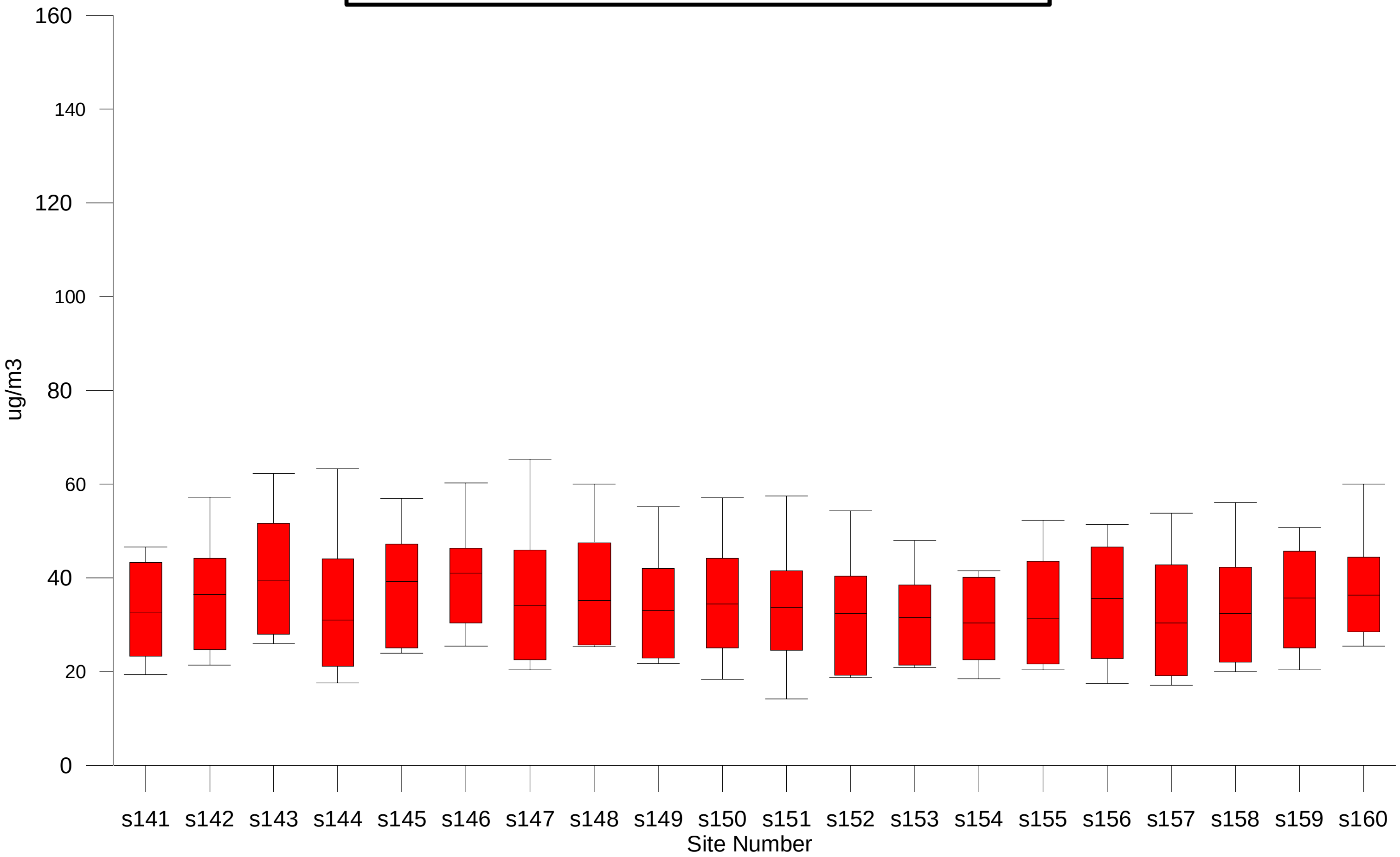

Box-Whisker Plot - Sites 61- 80
January-December 2010
Raw Data
160
140
120
100
80
60
40
20
0
ug/m3
s61 s62 s63 s64 s65 s66 s67 s68 s69 s70 s71 s72 s73 s74 s75 s76 s77 s78 s79 s80
Site Number

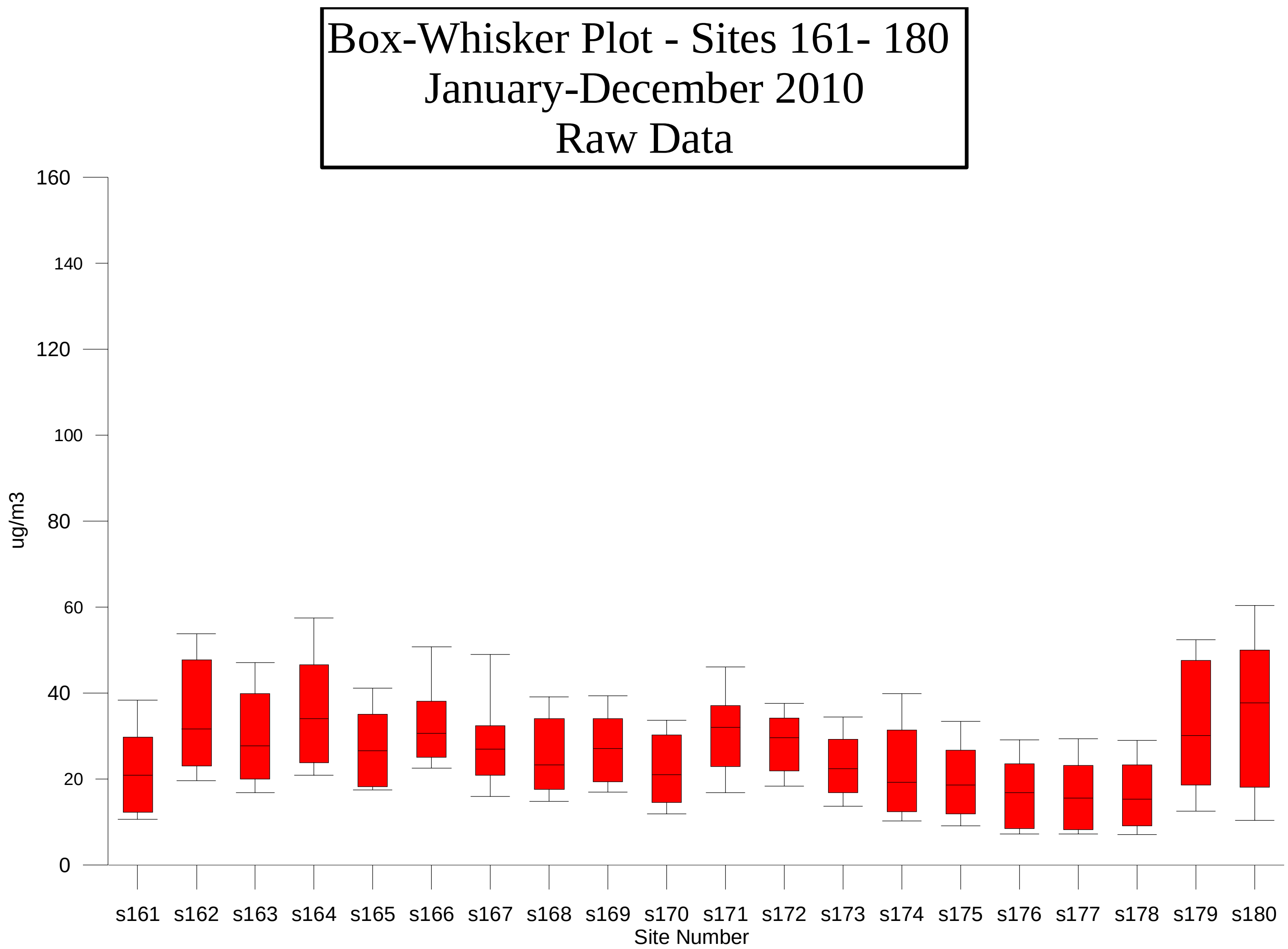

Box-Whisker Plot - Sites 81- 100
January-December 2010
Raw Data
160
140
120
100
80
60
40
20
0
ug/m3
s81
s82
s83
s84
s85
s86
s87
s88
s89
s90
s91
s92
s93
s94
s95
s96
s97
s98
s99
s100
Site Number

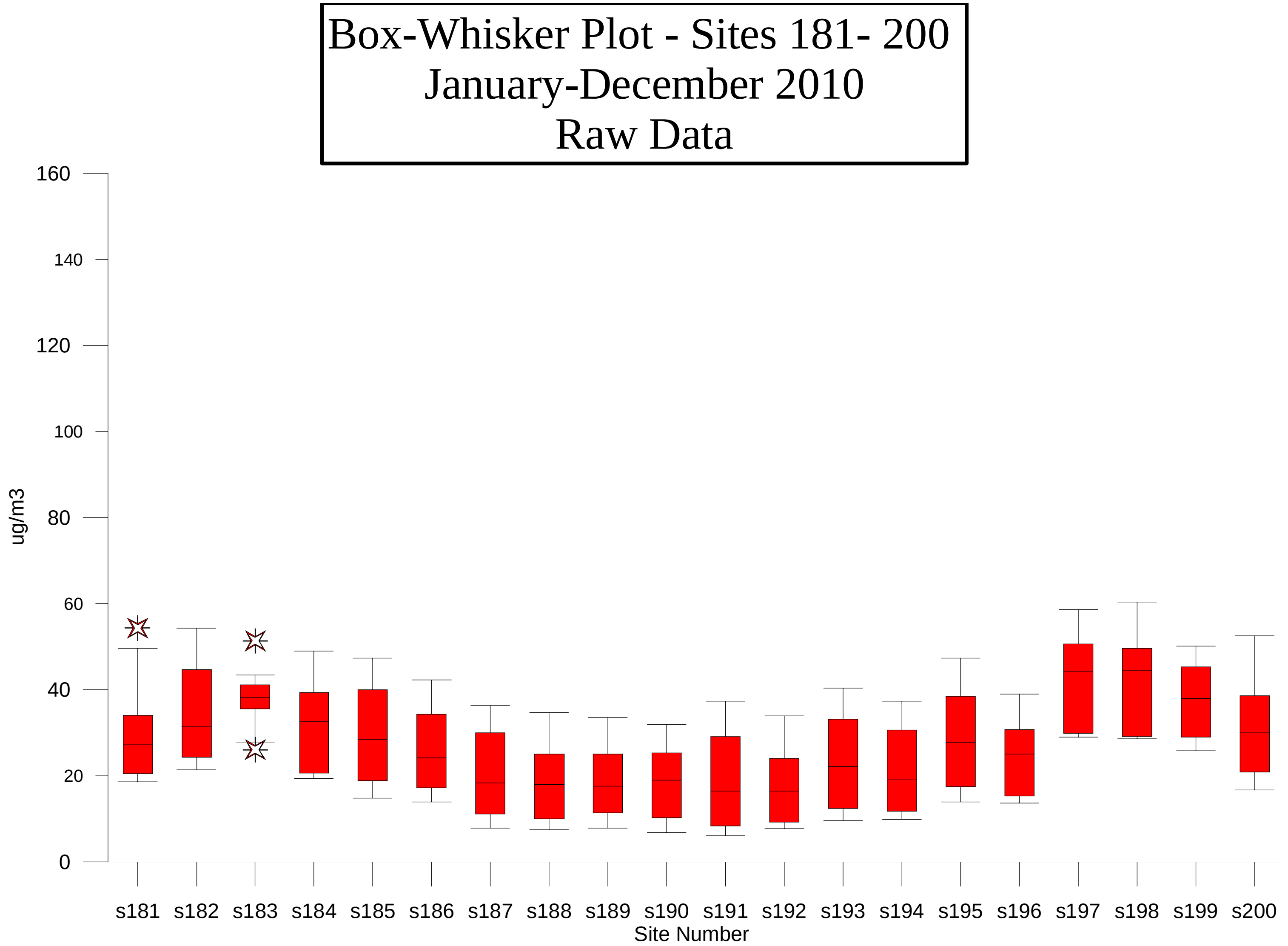

Box-Whisker Plot - Sites 101- 120
January-December 2010
Raw Data
160
140
120
100
80
60
40
20
0
ug/m3
s101
s102
s103
s104
s105
s106
s107
s108
s109
s110
s111
s112
s113
s114
s115
s116
s117
s118
s119
s120
Site Number

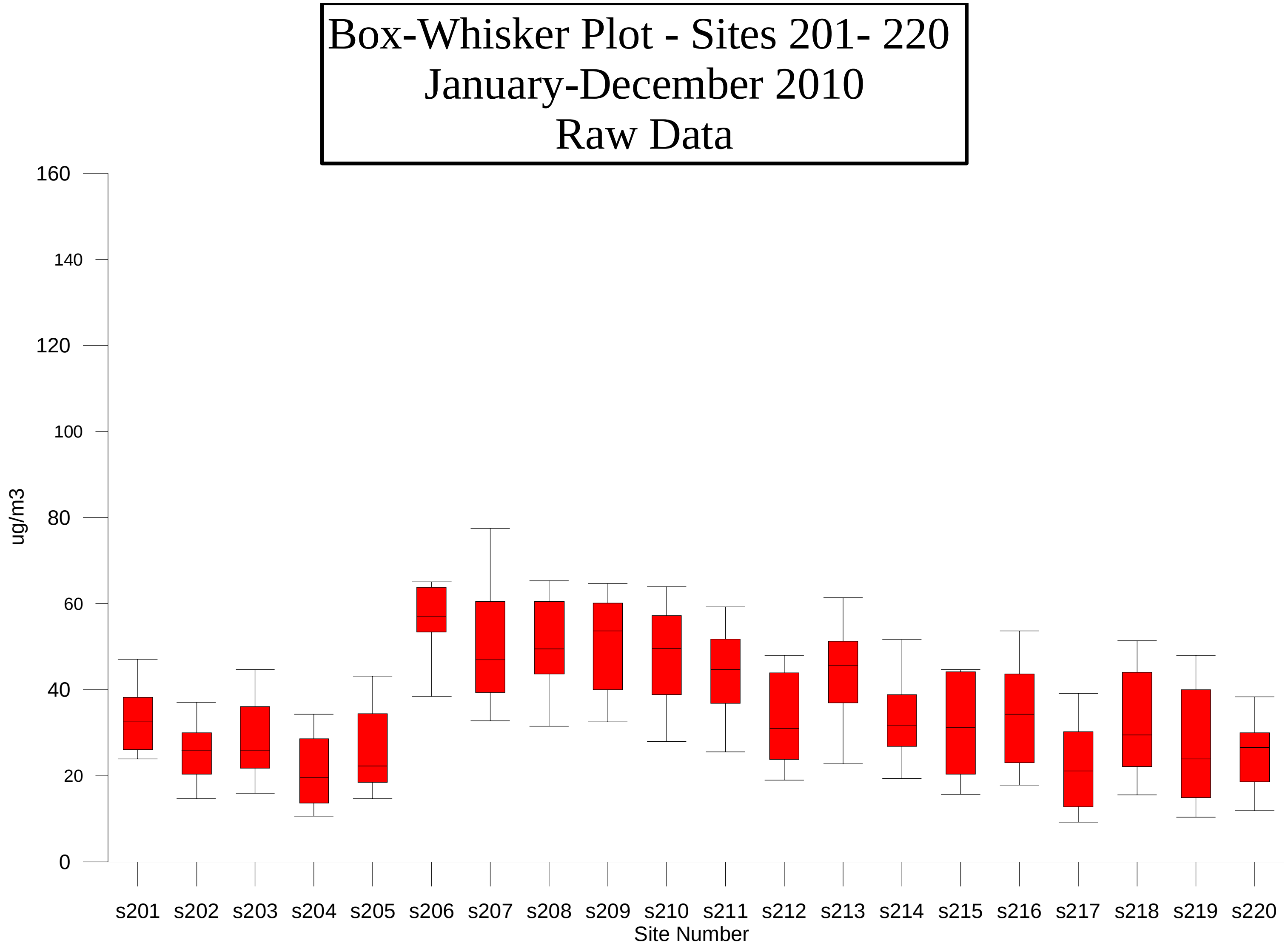

Box-Whisker Plot - Sites 121- 140
January-December 2010
Raw Data
160
140
120
100
80
60
40
20
0
ug/m3
s121 s122 s123 s124 s125 s126 s127 s128 s129 s130 s131 s132 s133 s134 s135 s136 s137 s138 s139 s140
Site Number

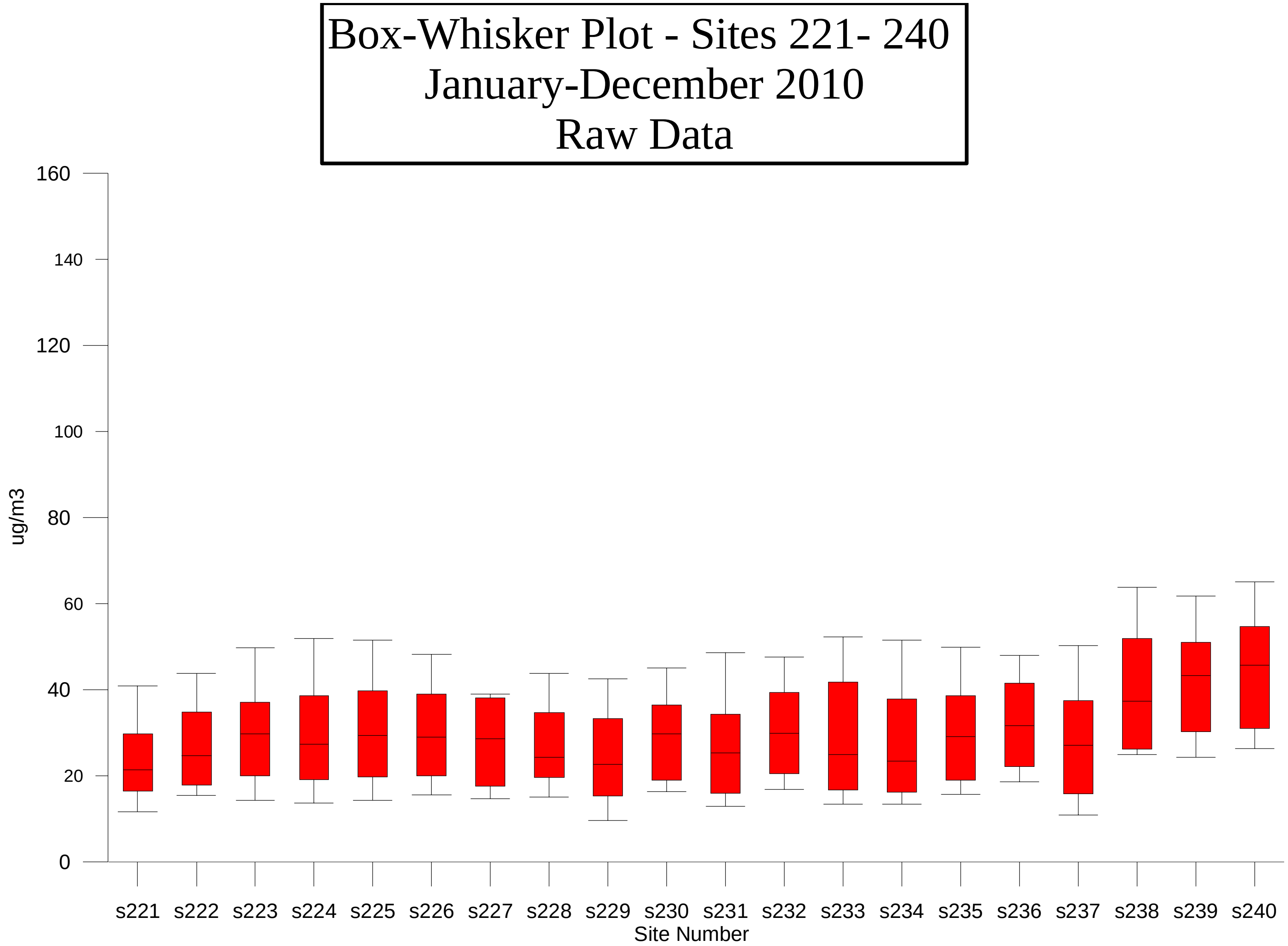
Box-Whisker Plot - Sites 141- 160
January-December 2010
Raw Data




Box-Whisker Plot - Sites 161- 180
January-December 2010
Raw Data
160
140
120
100
80
60
40
20
0
ug/m3
s161 s162 s163 s164 s165 s166 s167 s168 s169 s170 s171 s172 s173 s174 s175 s176 s177 s178 s179 s180
Site Number


Box-Whisker Plot - Sites 181- 200
January-December 2010
Raw Data
160
140
120
100
80
60
40
20
0
ug/m3
s181 s182 s183 s184 s185 s186 s187 s188 s189 s190 s191 s192 s193 s194 s195 s196 s197 s198 s199 s200
Site Number


Box-Whisker Plot - Sites 201- 220
January-December 2010
Raw Data
ug/m3
160
140
120
100
80
60
40
20
0
s201 s202 s203 s204 s205 s206 s207 s208 s209 s210 s211 s212 s213 s214 s215 s216 s217 s218 s219 s220
Site Number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120
100
80
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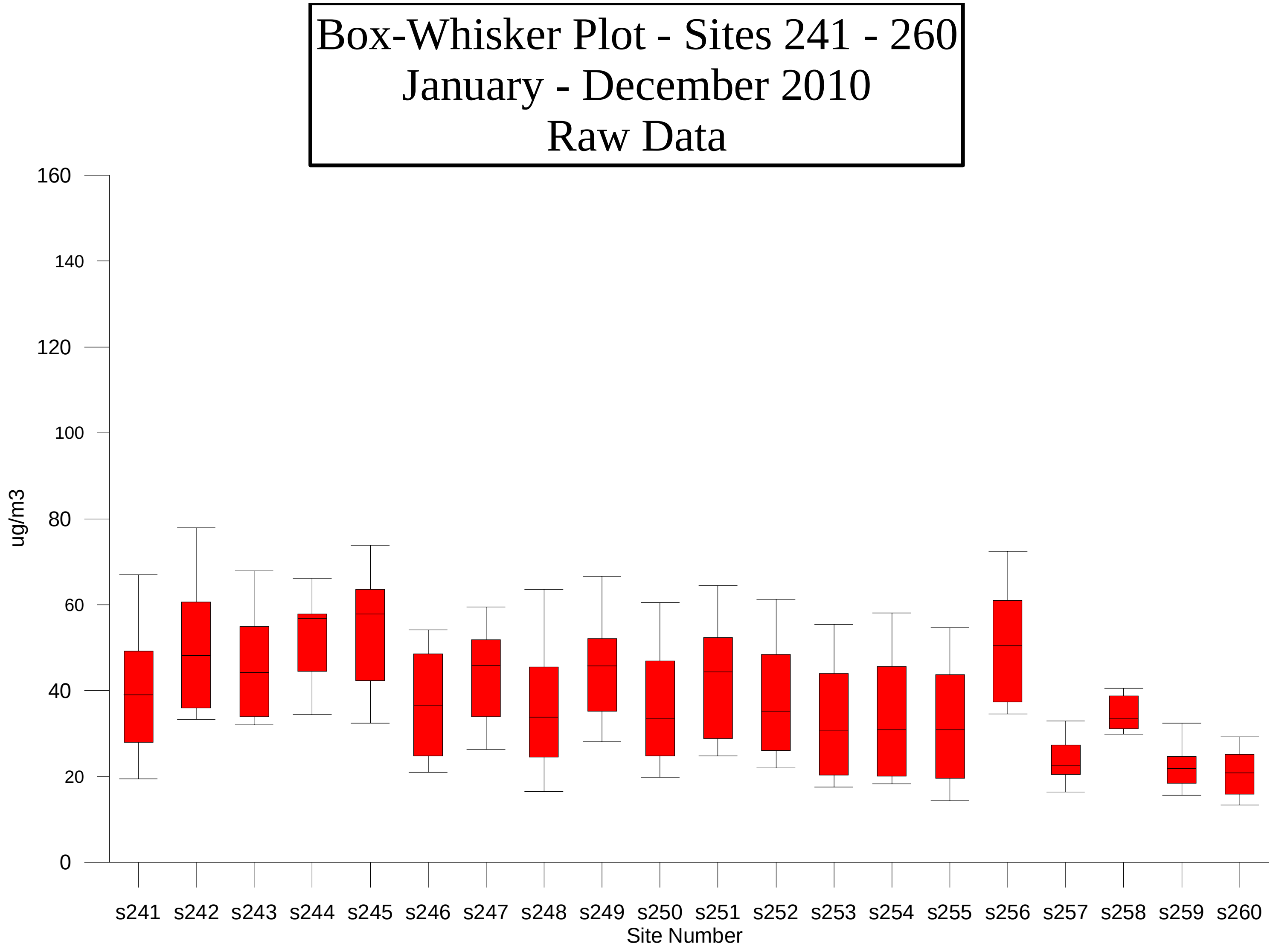
Box-Whisker Plot - Sites 241 - 260
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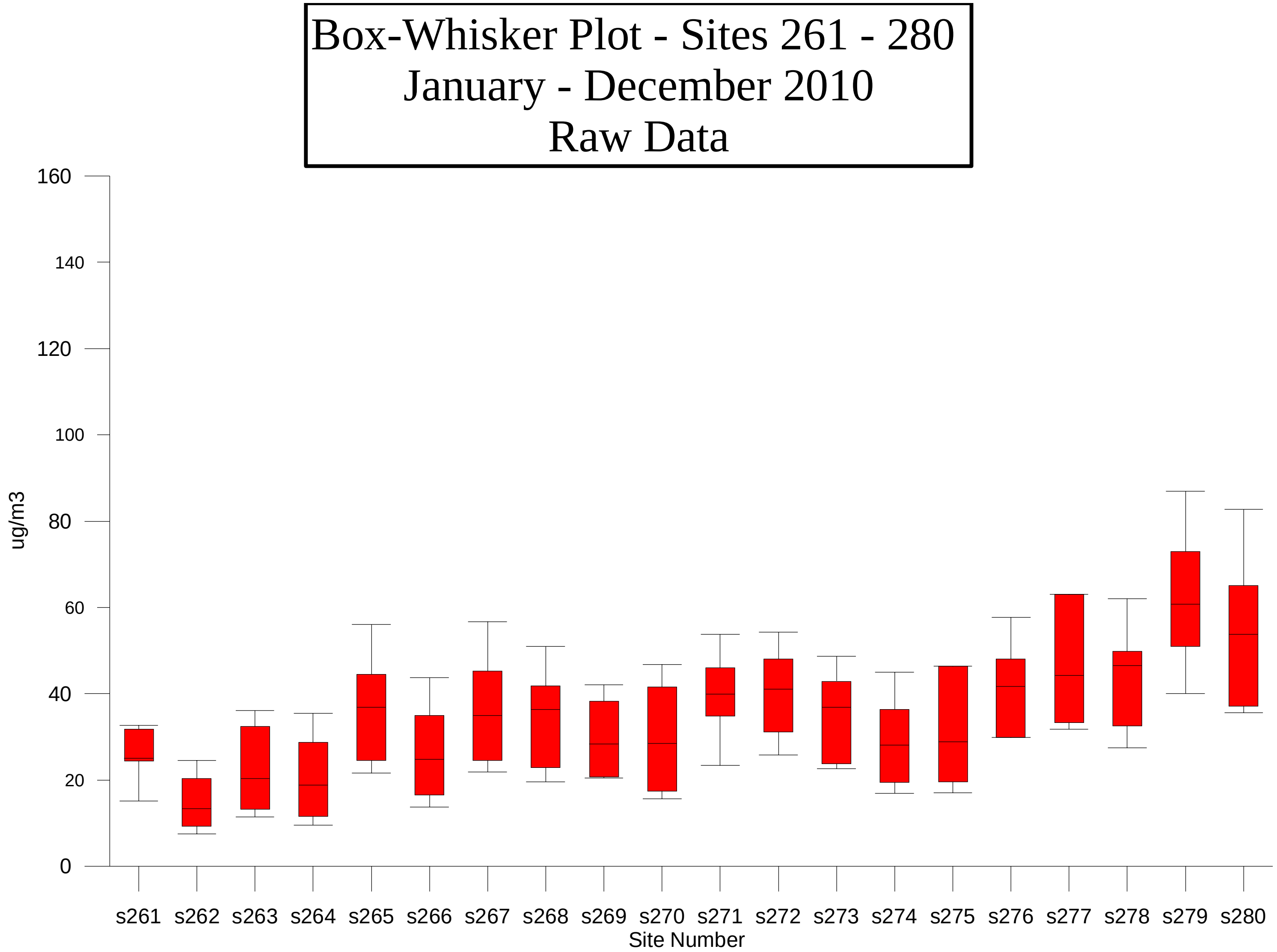
Site Number


Box-Whisker Plot - Sites 261 - 280
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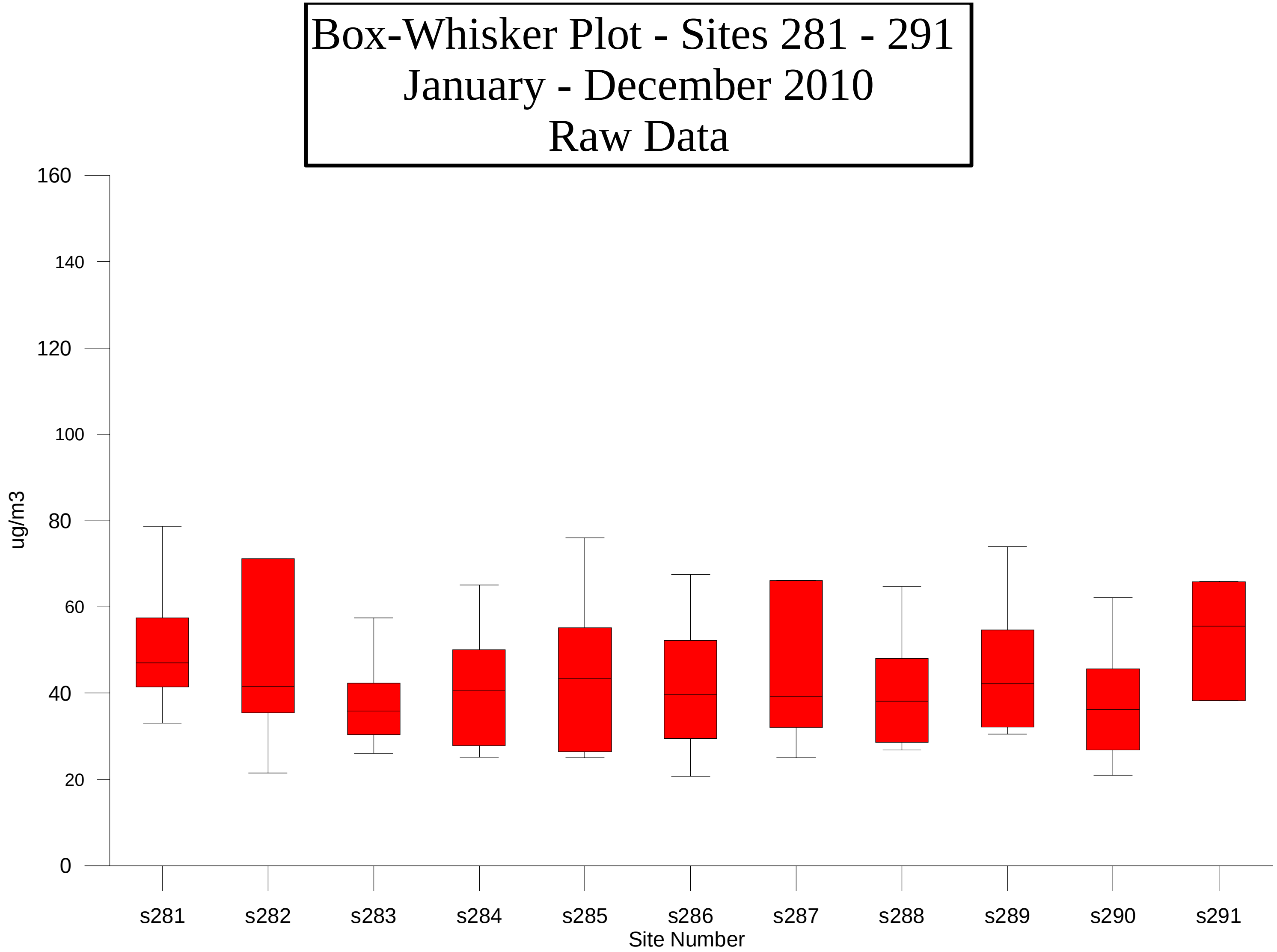
Site Number


Box-Whisker Plot - Sites 281 - 291
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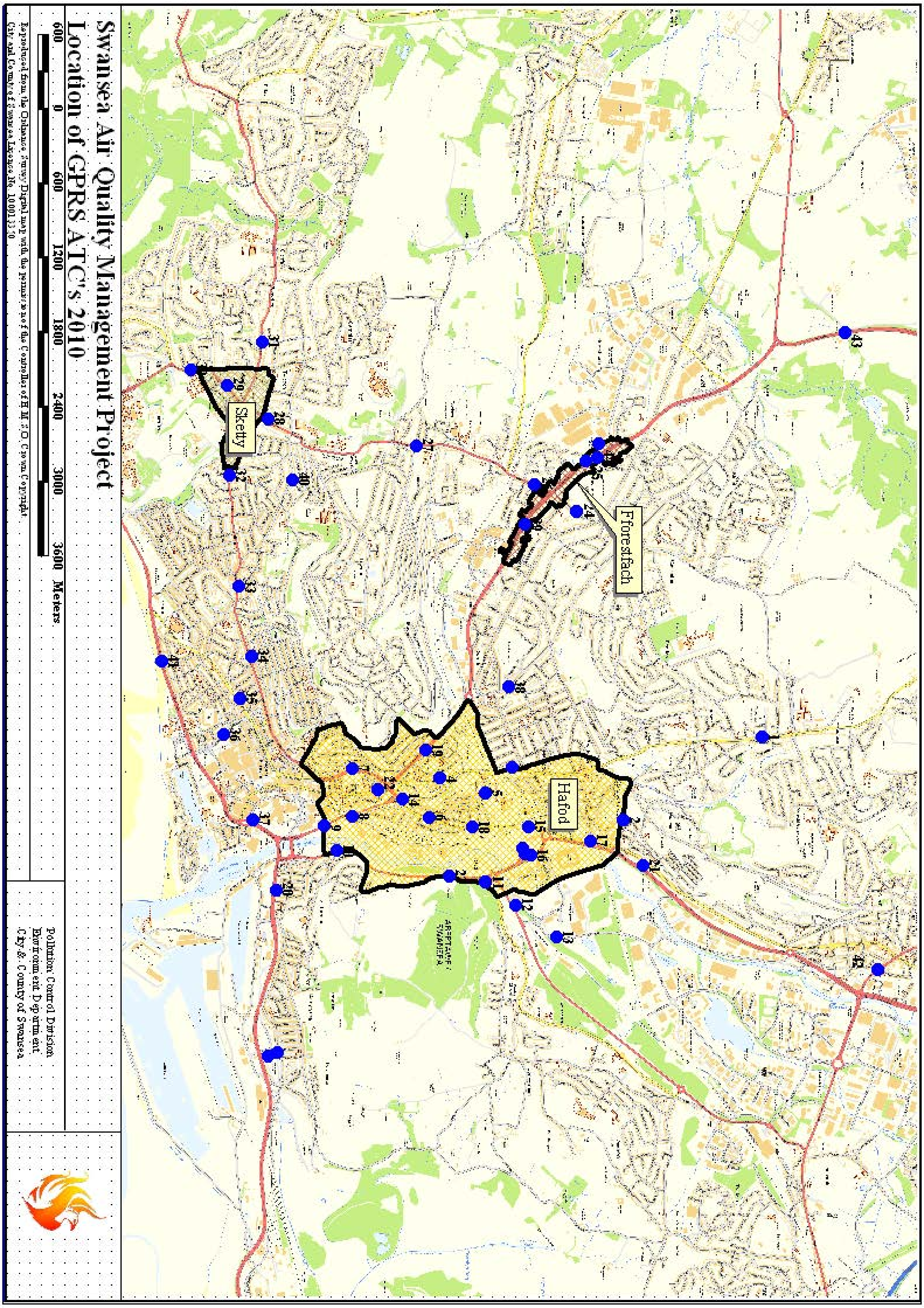
Site Number

Appendix 6

Automatic Traffic Counter Locations



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Appendix 7

AIRBORNE PARTICLES IN SWANSEA, UK: THEIR COLLECTION AND CHARACTERISATION

AIRBORNE PARTICLES IN SWANSEA, UK: THEIR COLLECTION AND CHARACTERISATION

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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; Mejìa 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- 2.39µm, 2.4µm- 10µm). 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 DekatiTM 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 (AralditeTM) 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- 2.39μm). When considering the coarse size fraction (2.4μm- 10μm), 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 (2.4μm- 10μm) 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- 2.39μm) and Coarse (2.4μm- 10μm) 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 (2.4μm - 10μm) 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 (Mejìa 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 (Mejìa 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 (Mejìa 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.

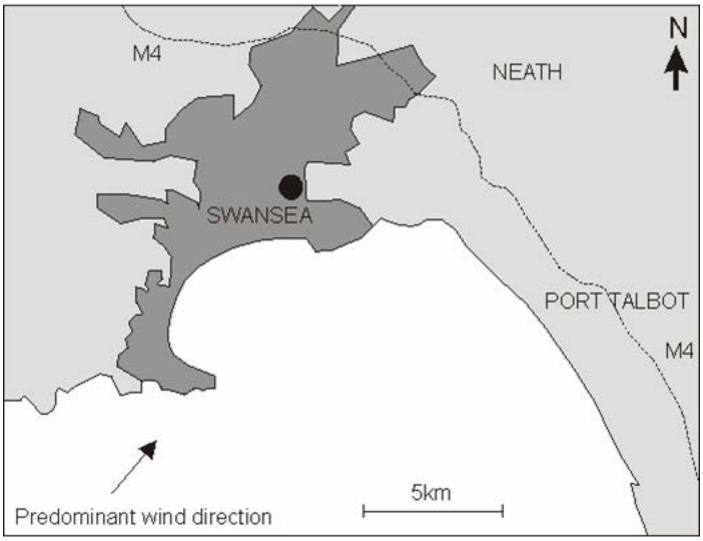
The elemental concentrations identified in this study (ICP-MS analysis; Figure 6) are much lower than in London 1950s particulate samples (Whittaker et al., 2004). Comparisons include 157ppm Fe concentration at Neath road and 19,294μg g-1 London 1955 sample, and 1.3ppm Mn concentration at Neath Road 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 at 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

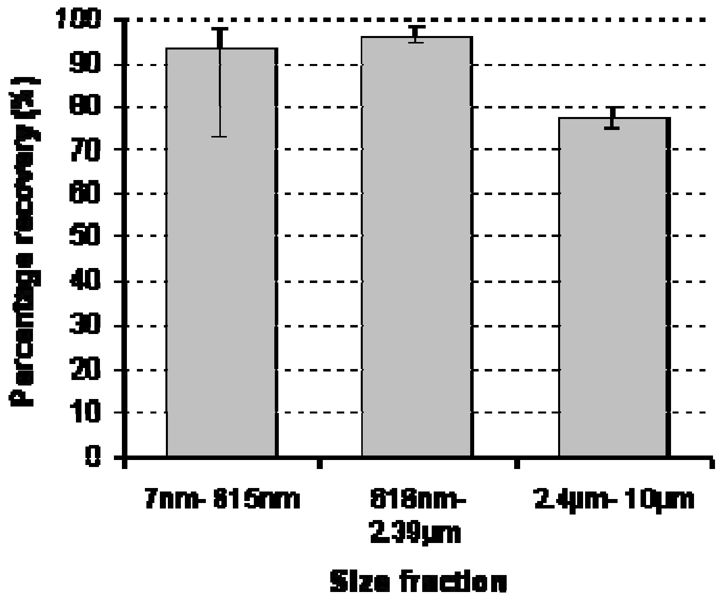


Figure 2. Particle mass extraction efficiency for the three analysed size fractions (30nm- 615nm, 616nm- 2.39µm, 2.4µm- 10µm). Error bars indicate the range of recovery efficiencies measure

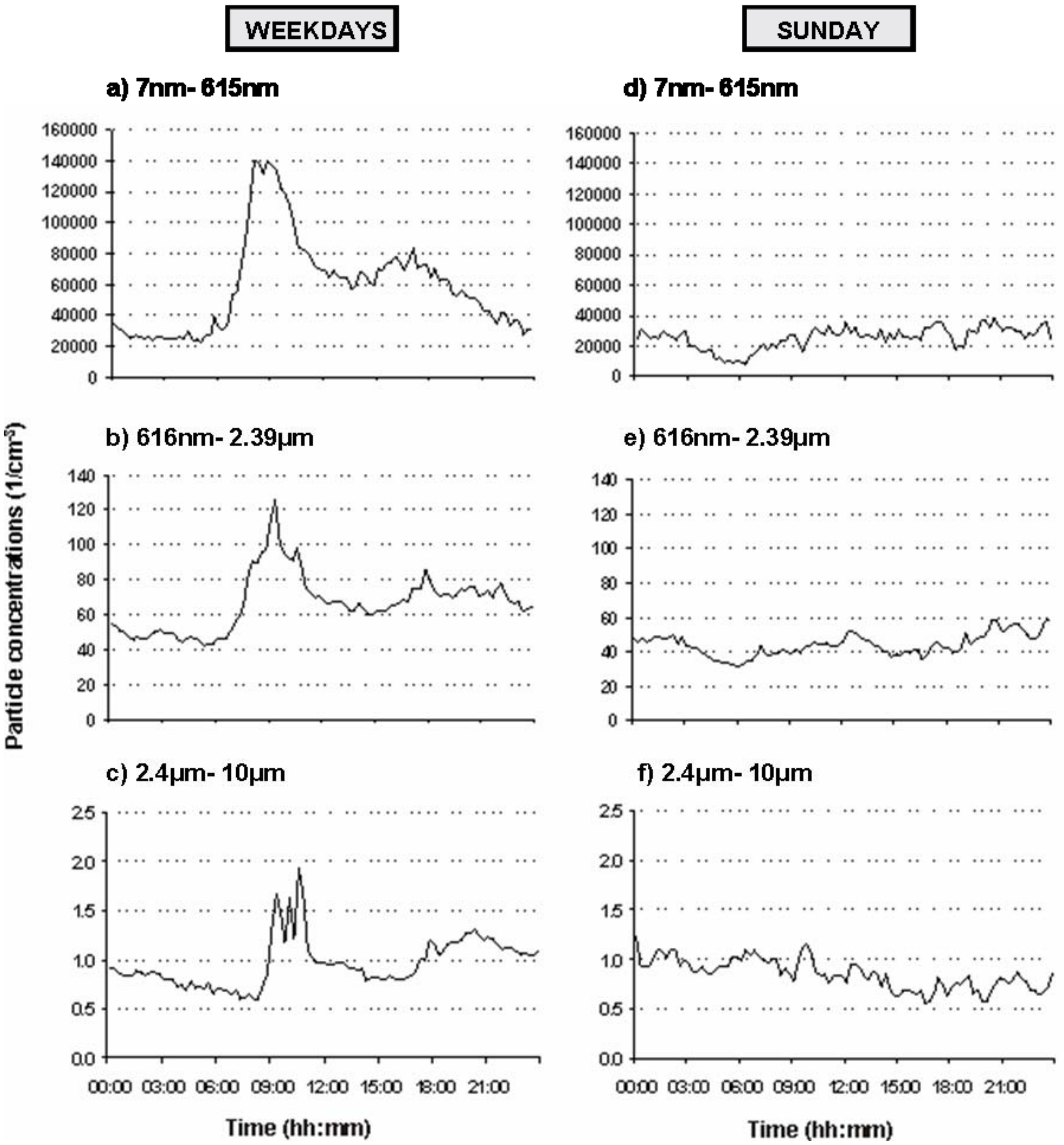


Figure 3. Average daily particle concentration profile in Neath Road traffic corridor for (1) weekdays and (2) Sundays in three size fractions (a) 7nm- 615nm, (b) 616nm- 2.39µm, (c) 2.4µm- 10µm

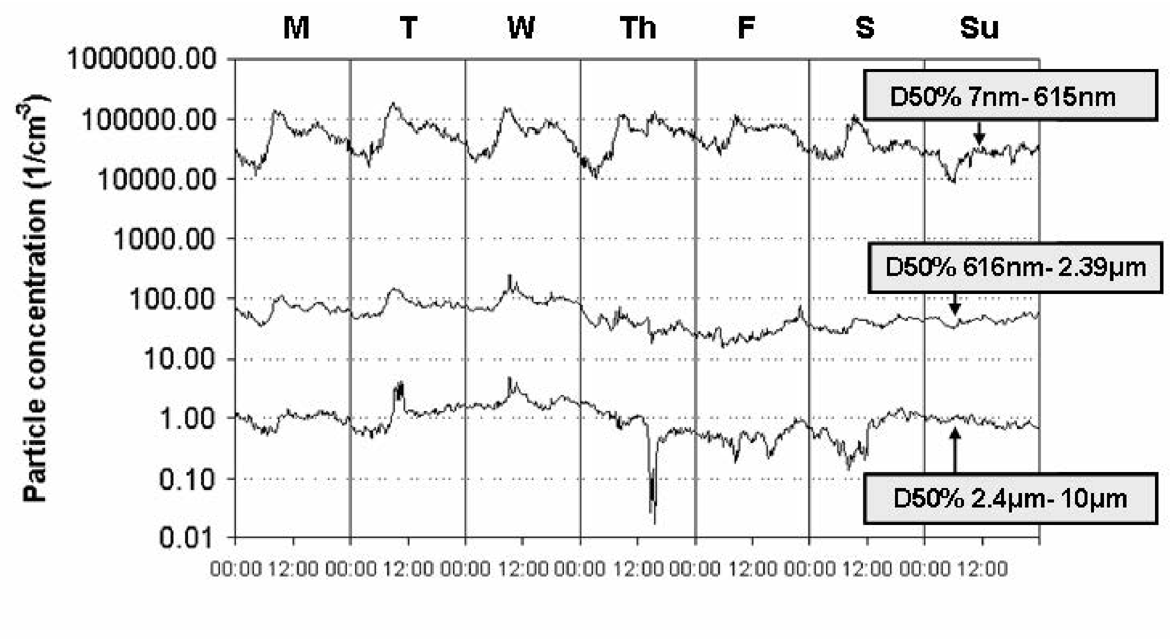


Figure 4. Average weekly particle concentration profile for Neath Road, Swansea

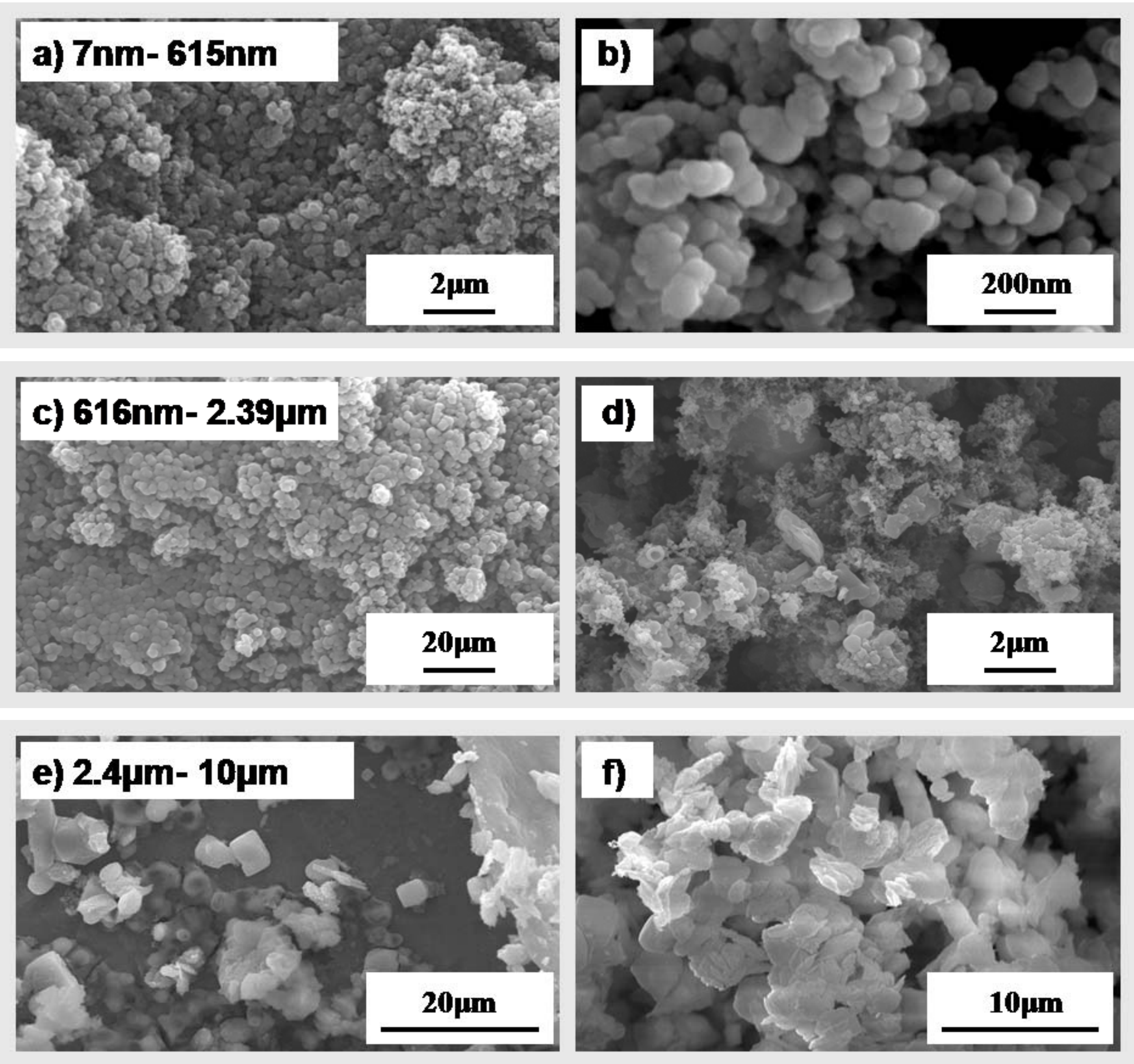


Figure 5. FE-SEM images of particles in the three measured size fractions collected in Neath Road, Swansea

(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

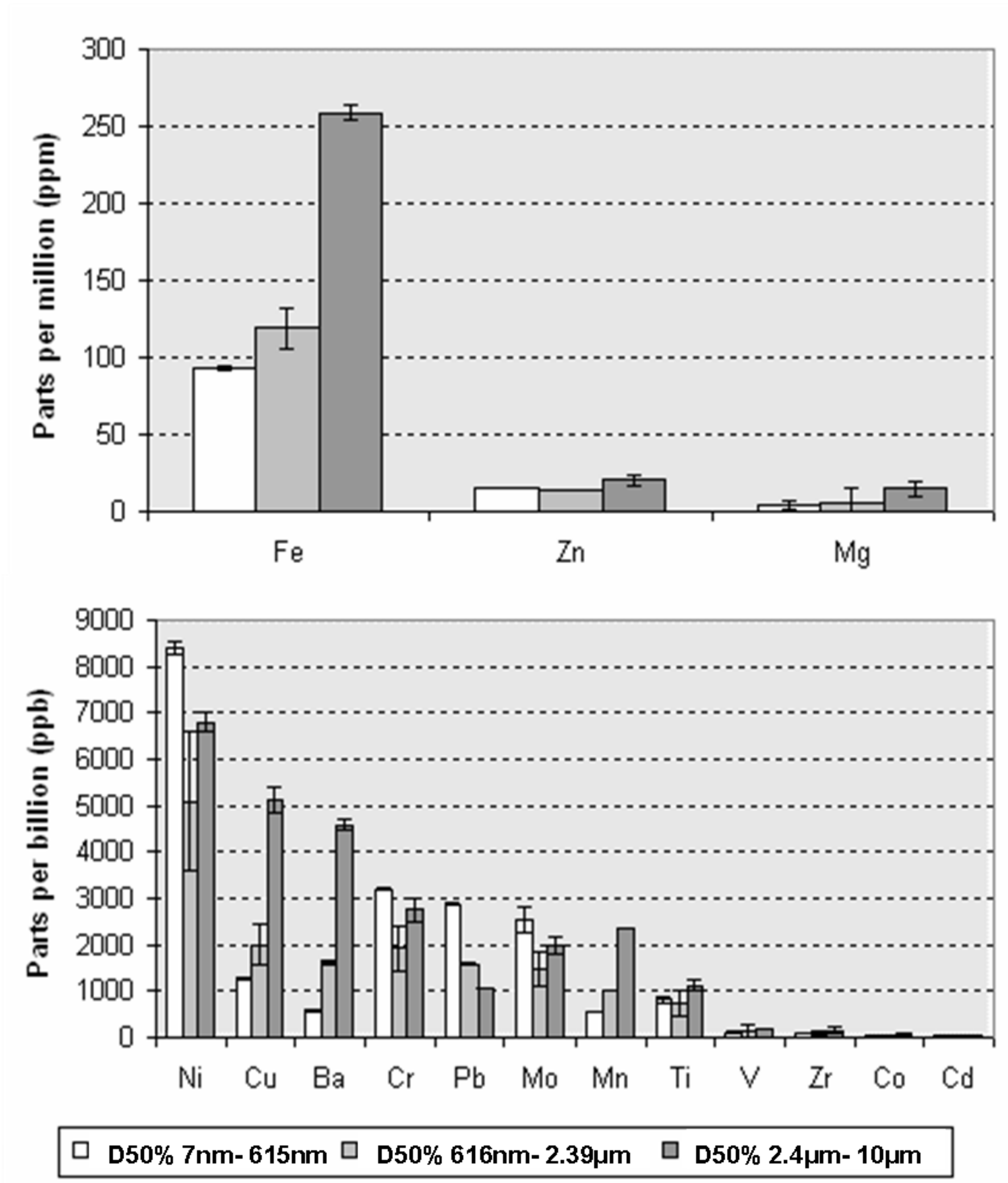


Figure 6. ICP-MS elemental analysis of the three analysed size fractions
Bars represent the three different analysed size fractions (white= D50% 30nm- 615nm; light grey= D50% 616nm- 2.39µm; dark grey= D50% 2.4µm- 10µm), top graph showing elements in parts per million (ppm) concentrations and bottom graph showing elements in parts per billion (ppb) concentrations. Error bars represent one standard deviation either side of the mean.

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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., Wåhlin, 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.

Mejìa, 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 PM2.5 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.