

Nowcasting in Swansea

Air Quality driving congestion control or
A Public Health intervention

Huw Morgan and Phil Govier -
City & County of Swansea.

Hakan Tornevik, OPSIS



Health evidence on air quality

- Even stronger – see latest COMEAP report especially for $PM_{2.5}$
- Mortality, cardio-pulmonary, lung cancer
- Causal link for mix with $PM_{2.5}$
- SO_2 NO_2 O_3 still important



Health evidence

- Loss of > 8 months life expectancy
- Underestimate – add morbidity
- US study on teenage lung development
- Is there an O₃ threshold?
- Metals & nanoparticles
- Hong Kong study SO₂ effect



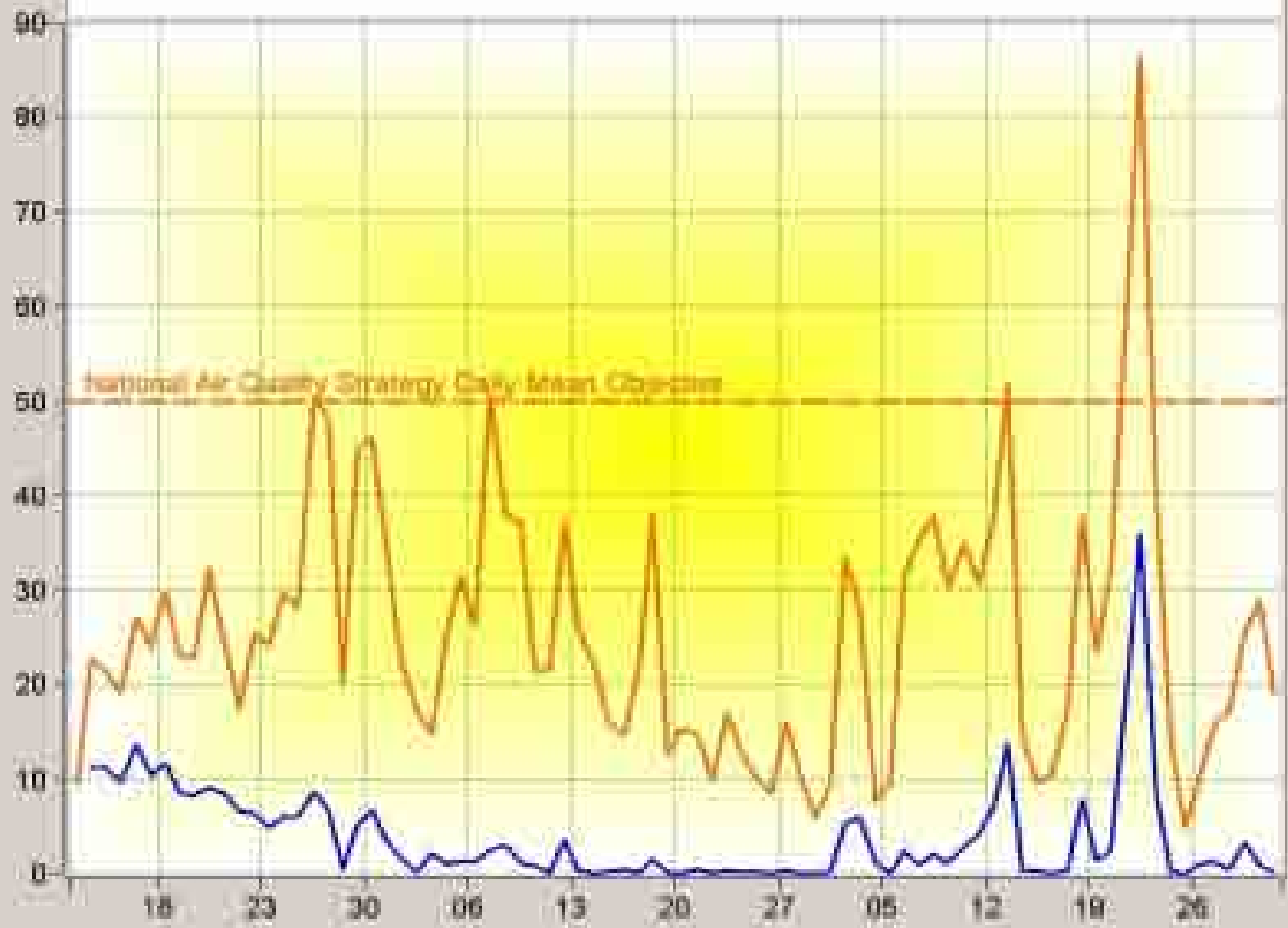
PM10 - Nursing Home (24 Hour Means) 10/01/2000 - 31/03/2000

ug/m3

ug/m3

PM10 Garden Nursing Home

PM10 Internal Nursing Home



The Air Quality Strategy

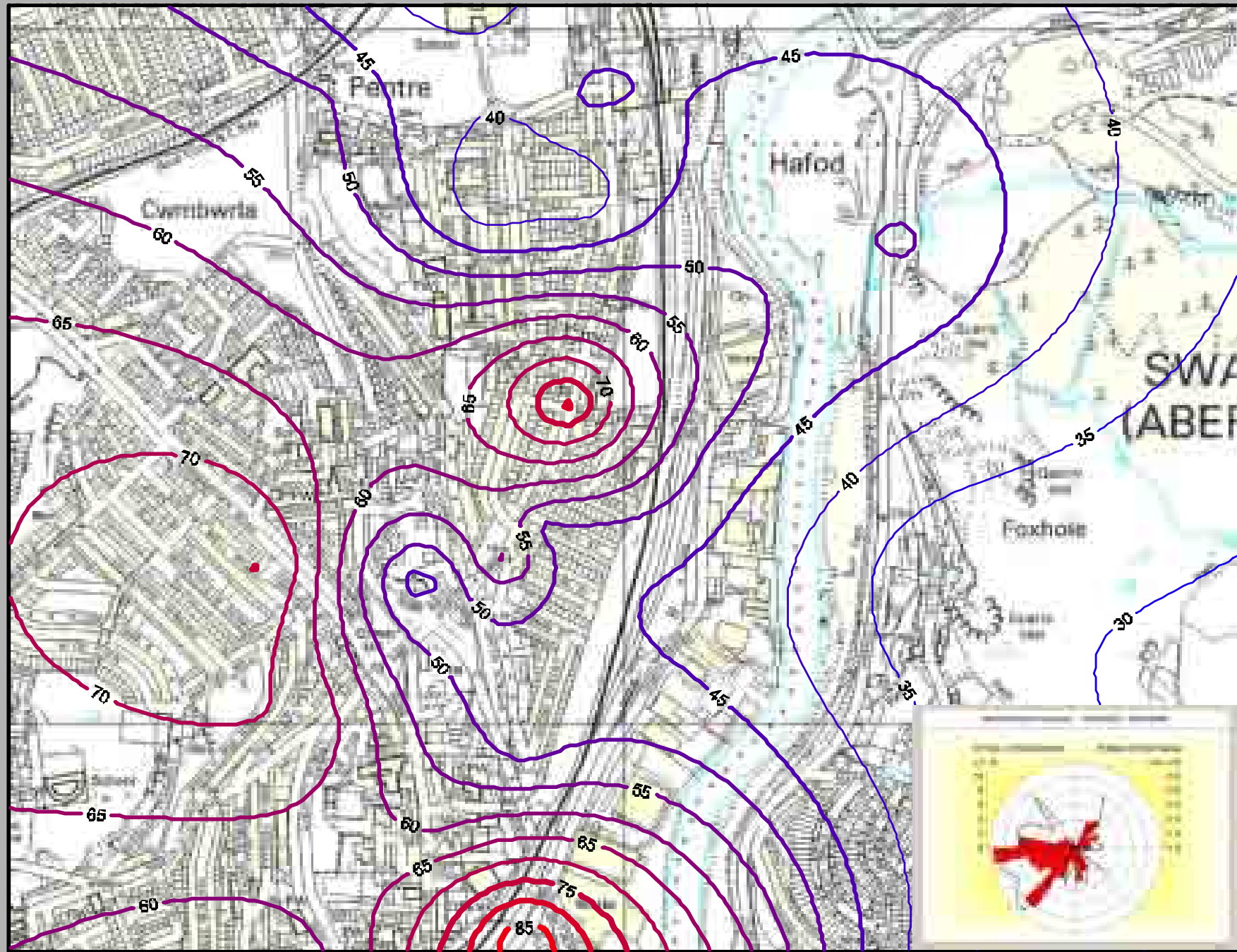
for England, Scotland,
Wales and Northern Ireland

Working Together for Cleaner Air

- Biggest driver for establishing air quality position in every LA



Pollution Control Division
 Nitrogen Dioxide Survey April 2001 - March 2002
 Hafod Area 13th - 20th February 2002 Week 46 - Isopleths given as ug/m³



Base Map Reproduced from the Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationary Office
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Isopleths given as ug/m³



Congested narrow streets



Neath Road, Hafod - on the valley floor



A "state of the art project" combining:

- ✓ Traffic monitoring
- ✓ Air quality monitoring
- ✓ Weather monitoring
- ✓ Emission mapping
- ✓ Internet & GPRS
- ✓ Variable Message Signs



The Nowcasting principles

We are setting up a combined monitoring and modelling system to diagnose the traffic situation, the weather situation as well as the air quality level in real time.

Using this information and extrapolating for the next few hours, we would like to advise the motorists to use alternative routes by informing them via radio, internet and traffic signs.

As a bonus effect we believe that the long term environmental awareness among the population will increase.



The new monitoring system

The following monitoring systems are being installed to support the Nowcaster concept...





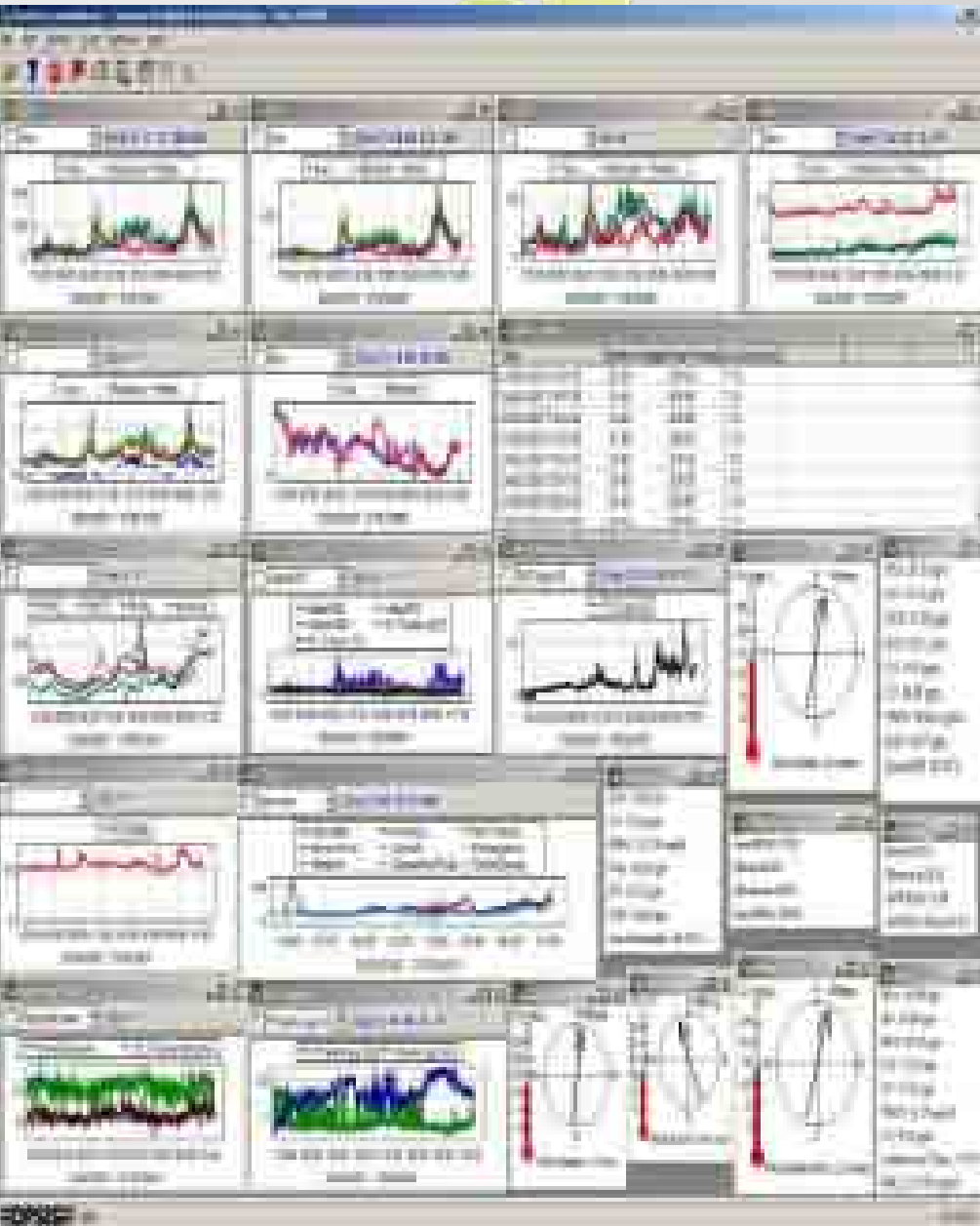
Swansea AURN Roadside



- New AURN Monitoring Station
- 2 FDMS units (1 PM10 and 1 PM2.5)
- NO_x, SO₂, CO, O₃
- Feeds into UK and Welsh AQ forum website
- More on local sites but check with LA



What happens to the data?

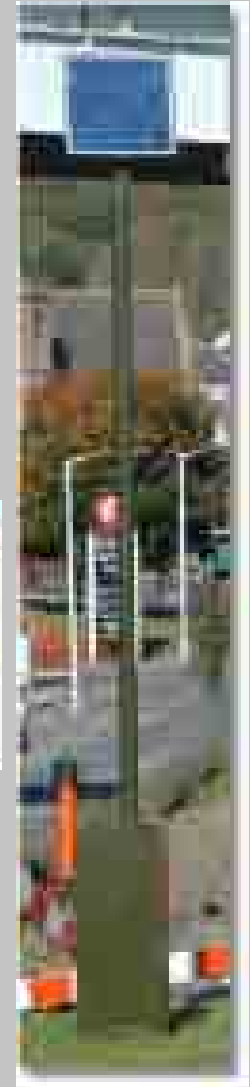


- Stations are polled every hour
- Data collected via Opsis Software
- Stored on server
- Can be viewed in Reporter package to perform Stats
- On screen for up-to-date display
- Uploaded to the Web

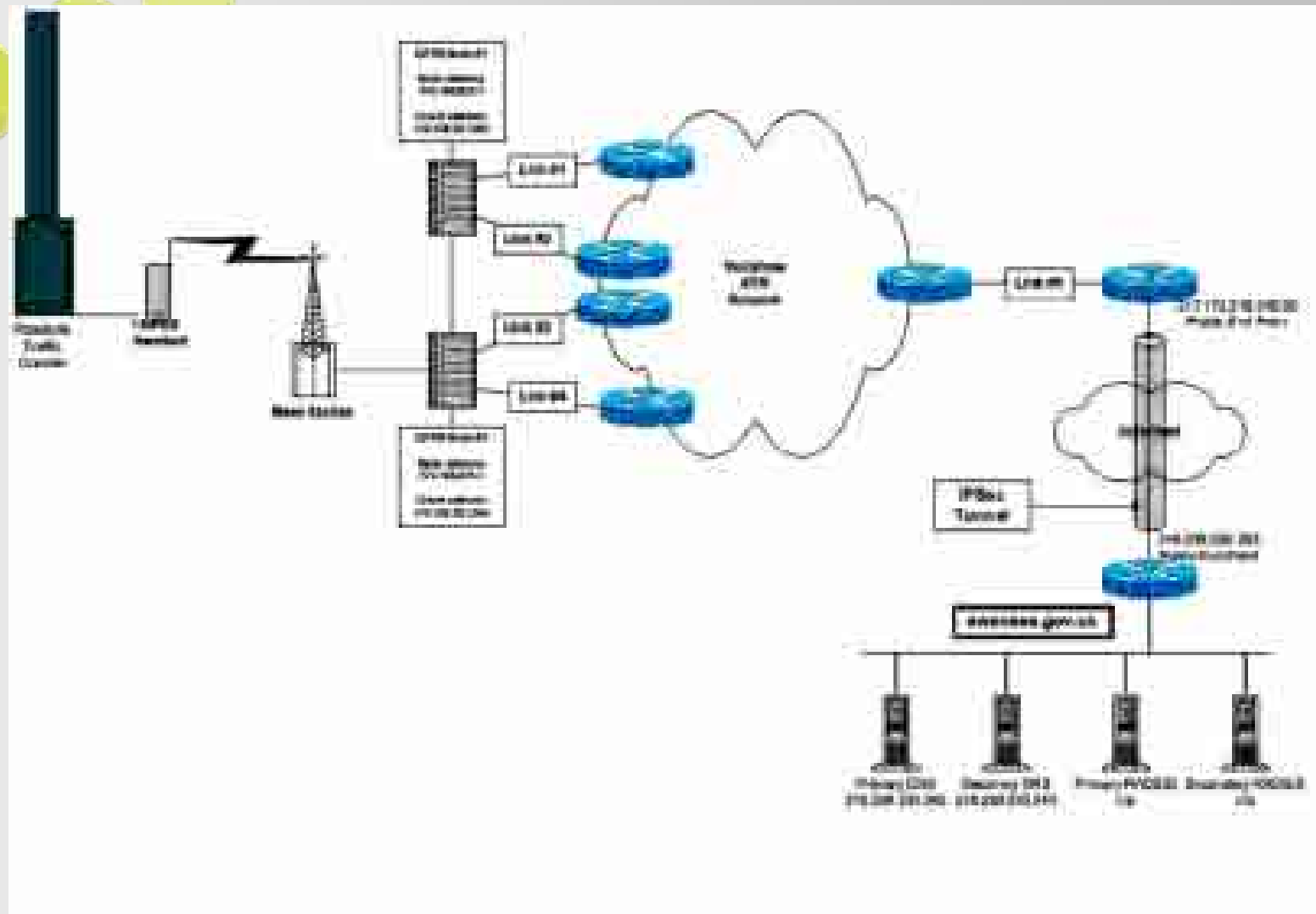
Traffic monitoring

42 traffic counters. Features:

- Monitoring 3-5 lanes at each site
- Individual vehicle identification
- 6 vehicle classes
- Speed detection
- Data transfer every 5 minutes
- Data transfer via GPRS
- No external power required (solar panels + battery)



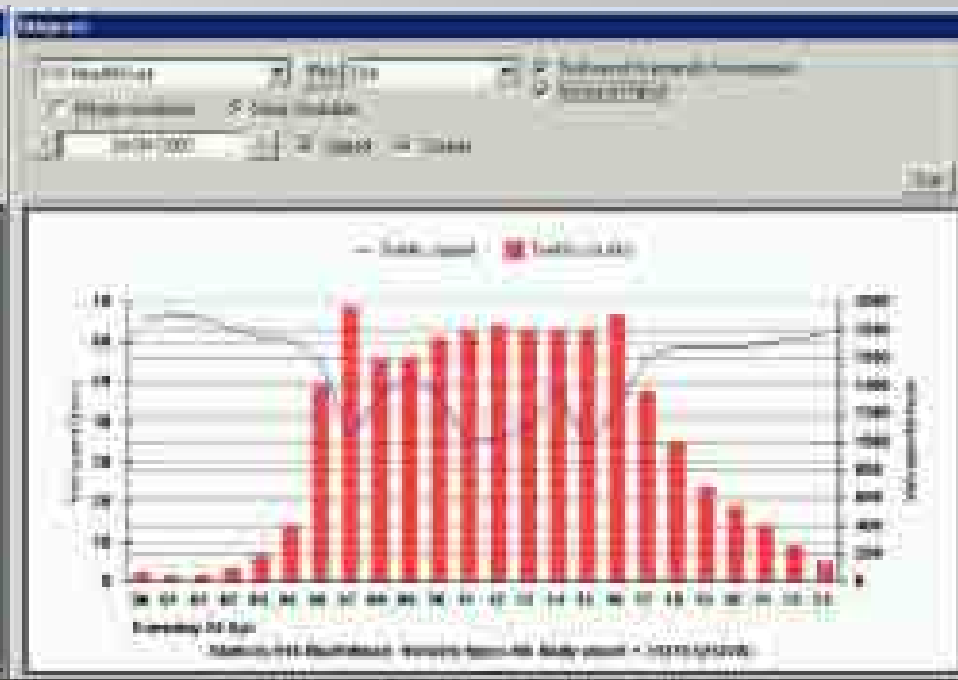
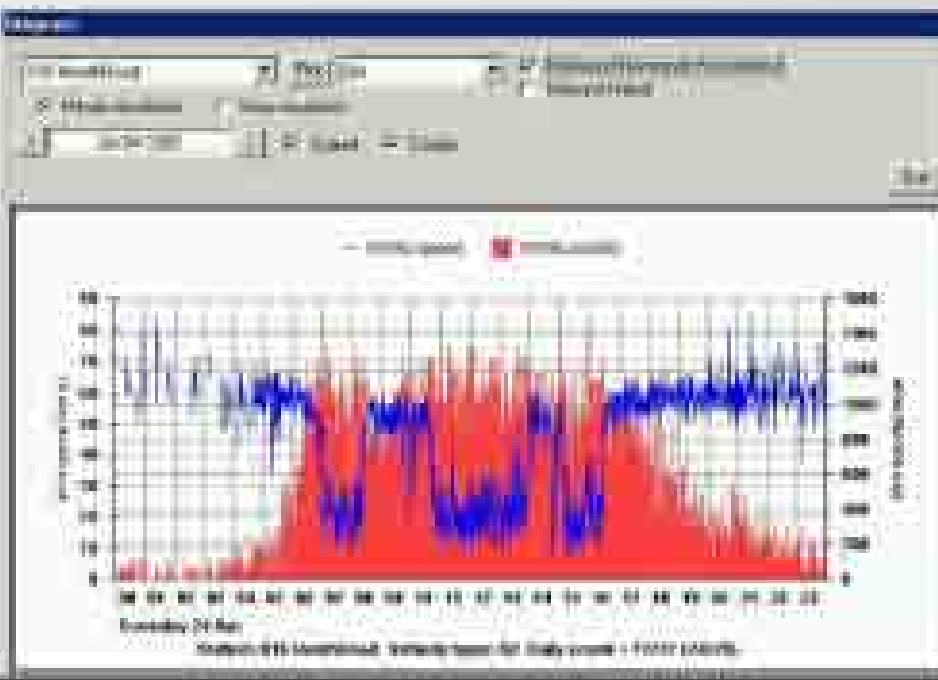
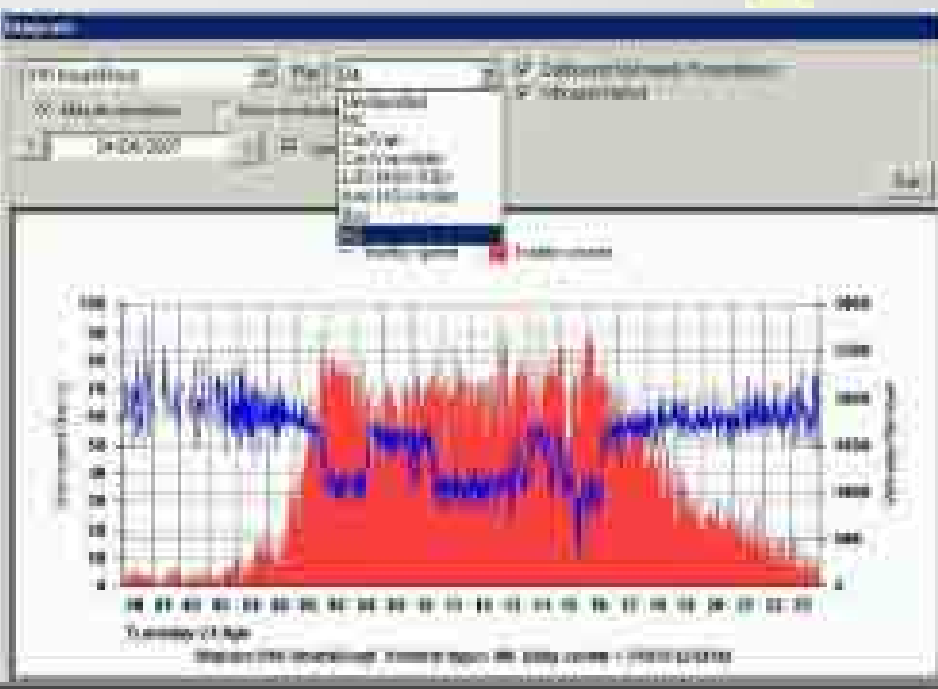
GPRS Data transmission route on Vodafone network



Example of GPRS ATC data – 1 minute integration

This ATC is located on a “B road”- Neath Rd, Hafod – notice high daily flow and congestion during AM and PM periods

By selecting outbound lane the congestion can be seen at the 1 minute integration – not easily seen at 1 hr integration



Traffic monitoring

10 radar based traffic counters. Features:

- Operated on battery
- Individual vehicle identification
- 3-5 vehicle classes (length based identification)
- Speed detection
- Used for one week campaigns at each site
- Providing infill detail for traffic mapping of smaller roads



Air Quality street monitoring (DOAS)

Nowcasting in Swansea

Measuring:

- NO
- NO₂
- O₃
- Benzene

Resolution: 5 minutes

Data transfer via the Internet (Broadband)

Two roadside DOAS has been installed



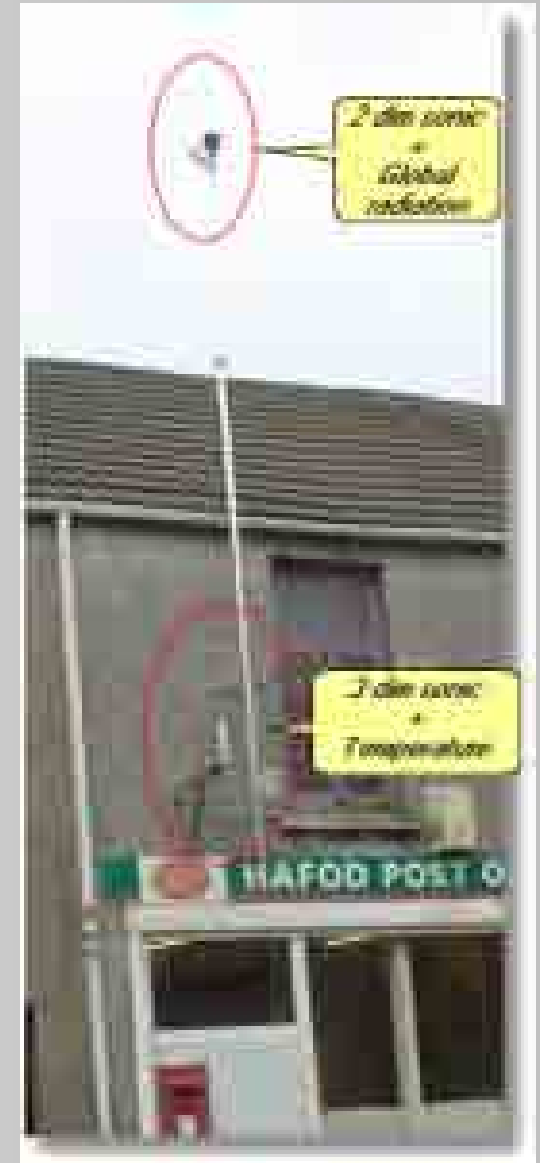
Weather monitoring in the street canyon

Detailed monitoring in the street + roof level

Measuring: 3-d winds, temperature and global radiation

Resolution: 1 minute

Data transfer every 5 minutes

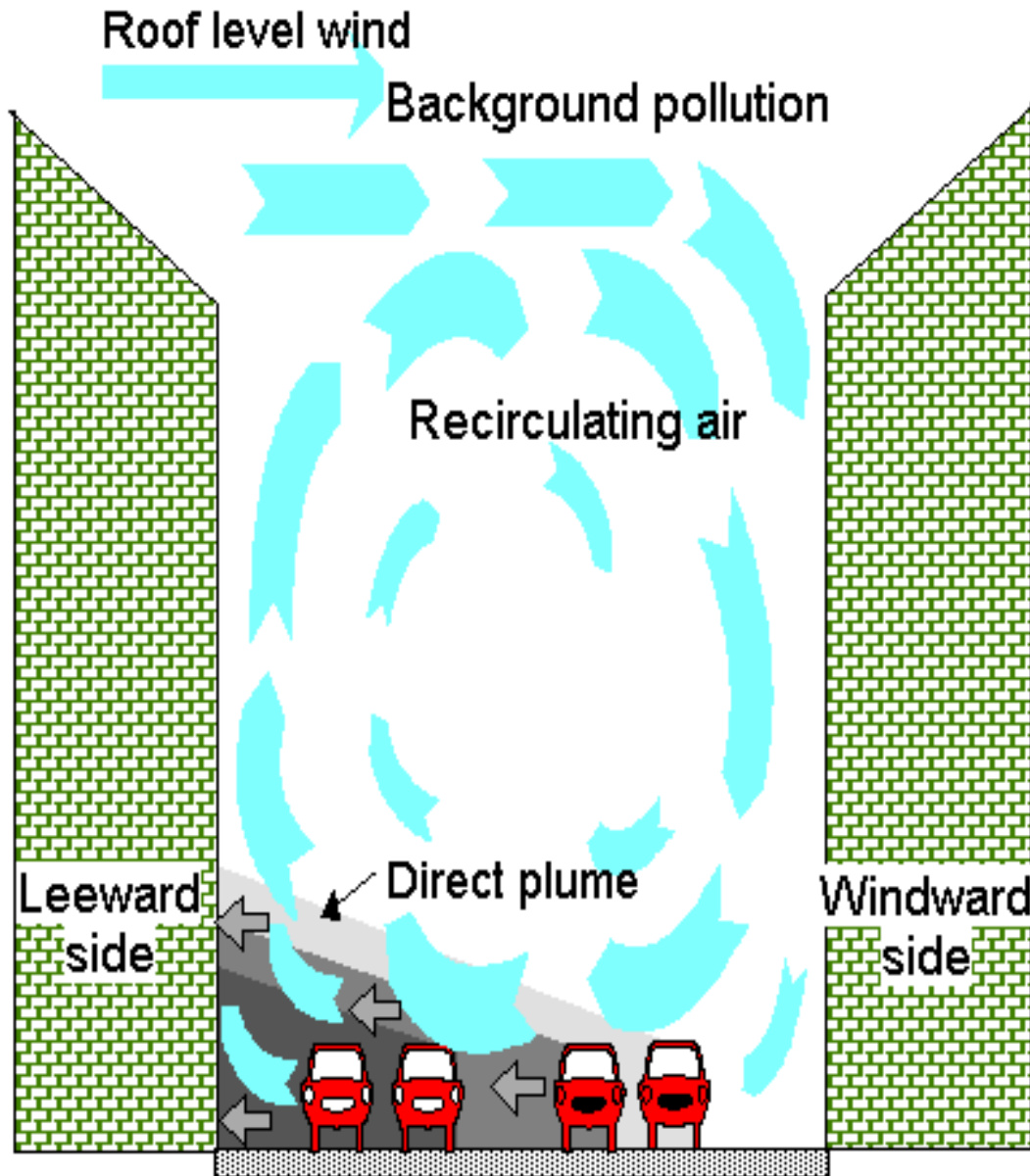


Street monitoring

The special monitoring at the Neath Road, Hafod will be used for:

- A detailed validation of emission/dispersion modelling
- Short time model updates
- Special studies of pollution in a street canyon
- Special studies of the wind/turbulence in a street canyon
- Testing new data transfer technique

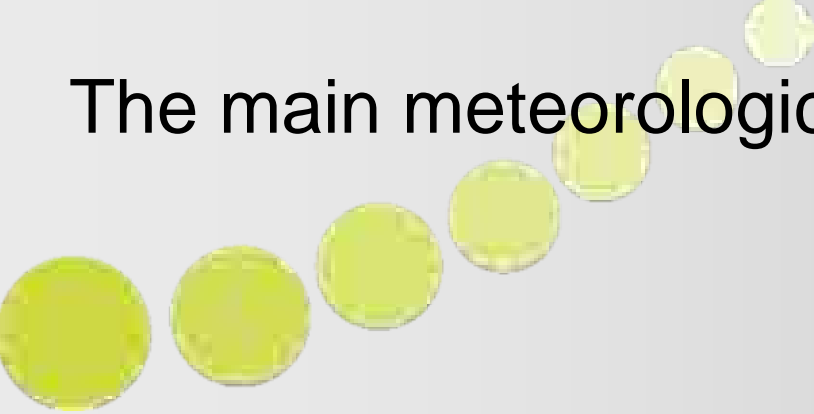




Resolution of 1 minute aids the definition of the vertices and mixing capacity of the street.

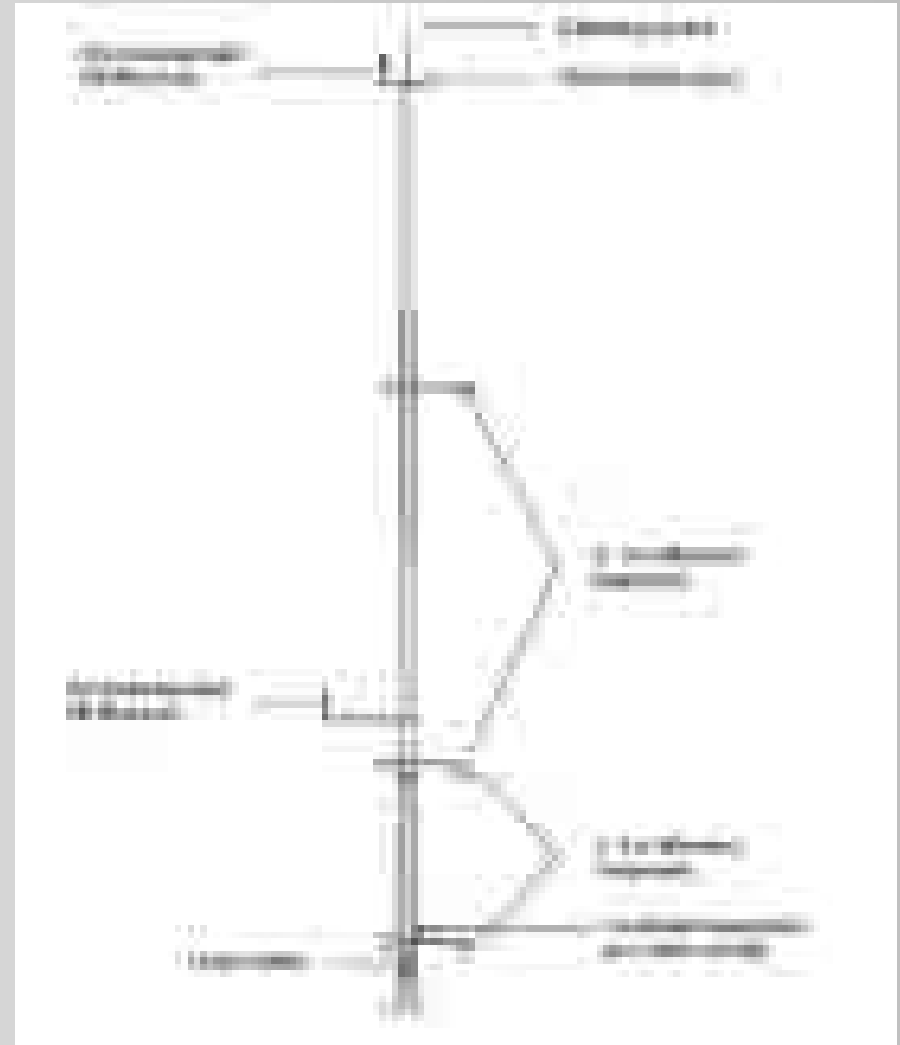
Helps to determine and evaluate the atmospheric chemistry responsible for the formation of NO_2 and ozone within the street.

The main meteorological mast



Weather mast 30 m

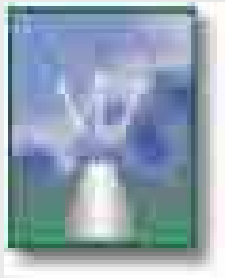
Measuring temperature
and wind profiles in the
lowest atmospheric layer
in the valley



A vertical remote wind sounder

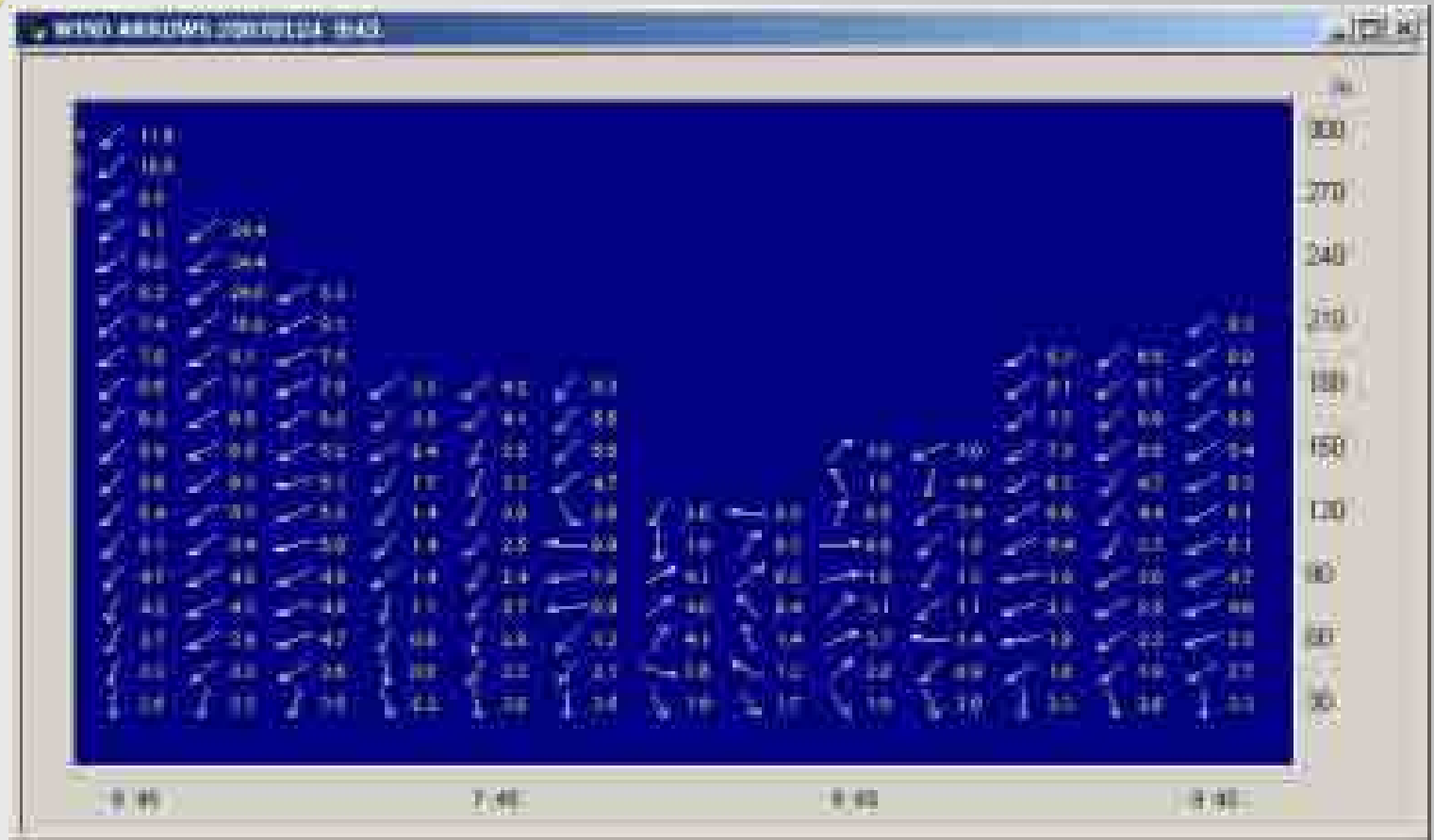
A SODAR has been installed to provide:

- Information about wind profiles up to 300m
- Increase the understanding of the complex wind variations due to topography and land/sea effects



Wind pattern

A height/time diagram of winds



Weather forecasts



- Four times a day, hourly weather forecasts (1-72 hours) are received from NERI - Denmark
- The weather forecasts will be used by the Nowcaster
- The weather forecasts are also presented for the general public on the Internet



The weather forecasts include the following parameters:

- Wind speed (10 m, 80 m and 800 m),
- Wind direction (10 m, 80m and 800m),
- Temperature (2 m, 80 m and 800 m),
- Mean sea level pressure,
- Precipitation (convective, stratisform and snow),
- Boundary layer height,
- Friction velocity, surface heat flux,
- Relative humidity,
- Cloud cover (low and high).



Swansea emission inventory

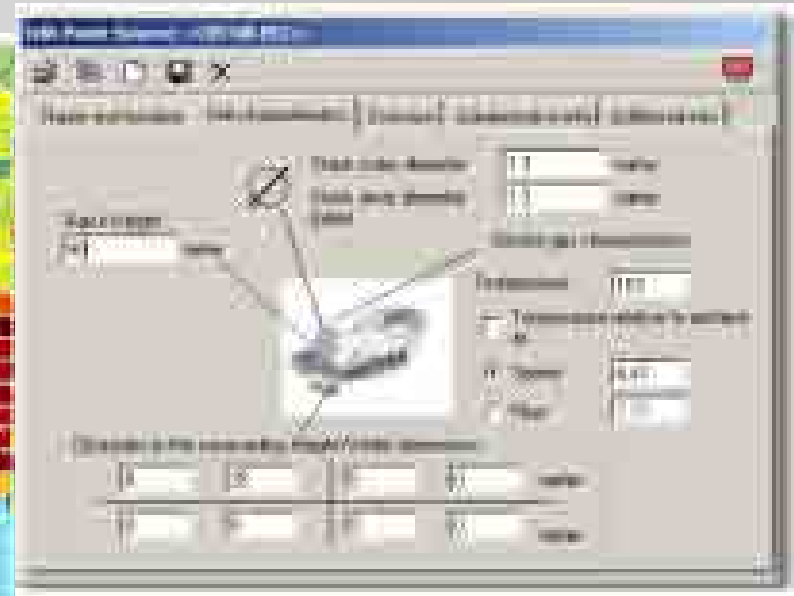
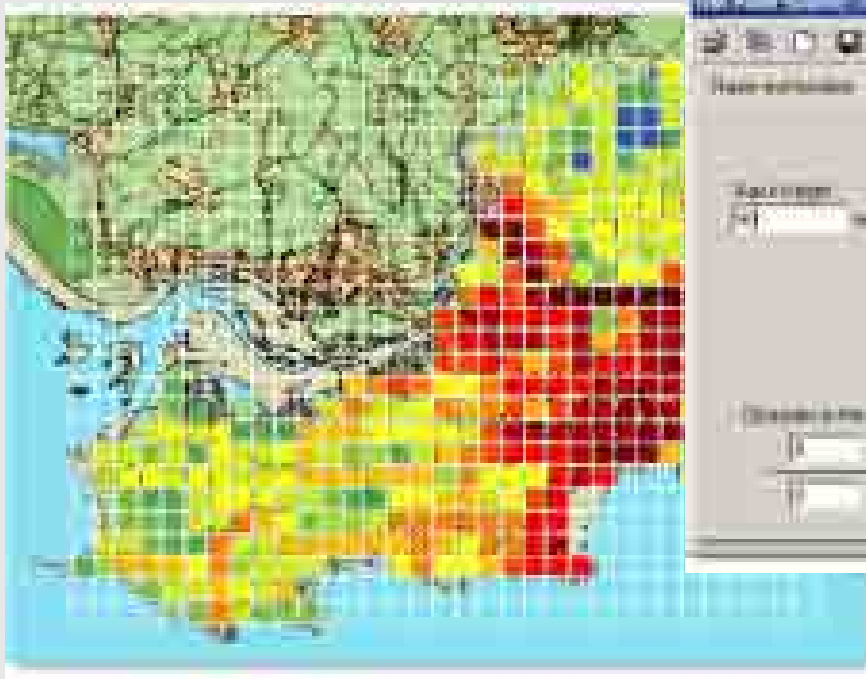
To provide the basic input for the modelling, a detailed dynamic emission database has been compiled including:

- Typical road traffic figures, vehicle composition and diurnal variation for the major roads in the city
- Industrial emissions
- Emissions from domestic heating, agricultural activities, waste disposal, shipping etc

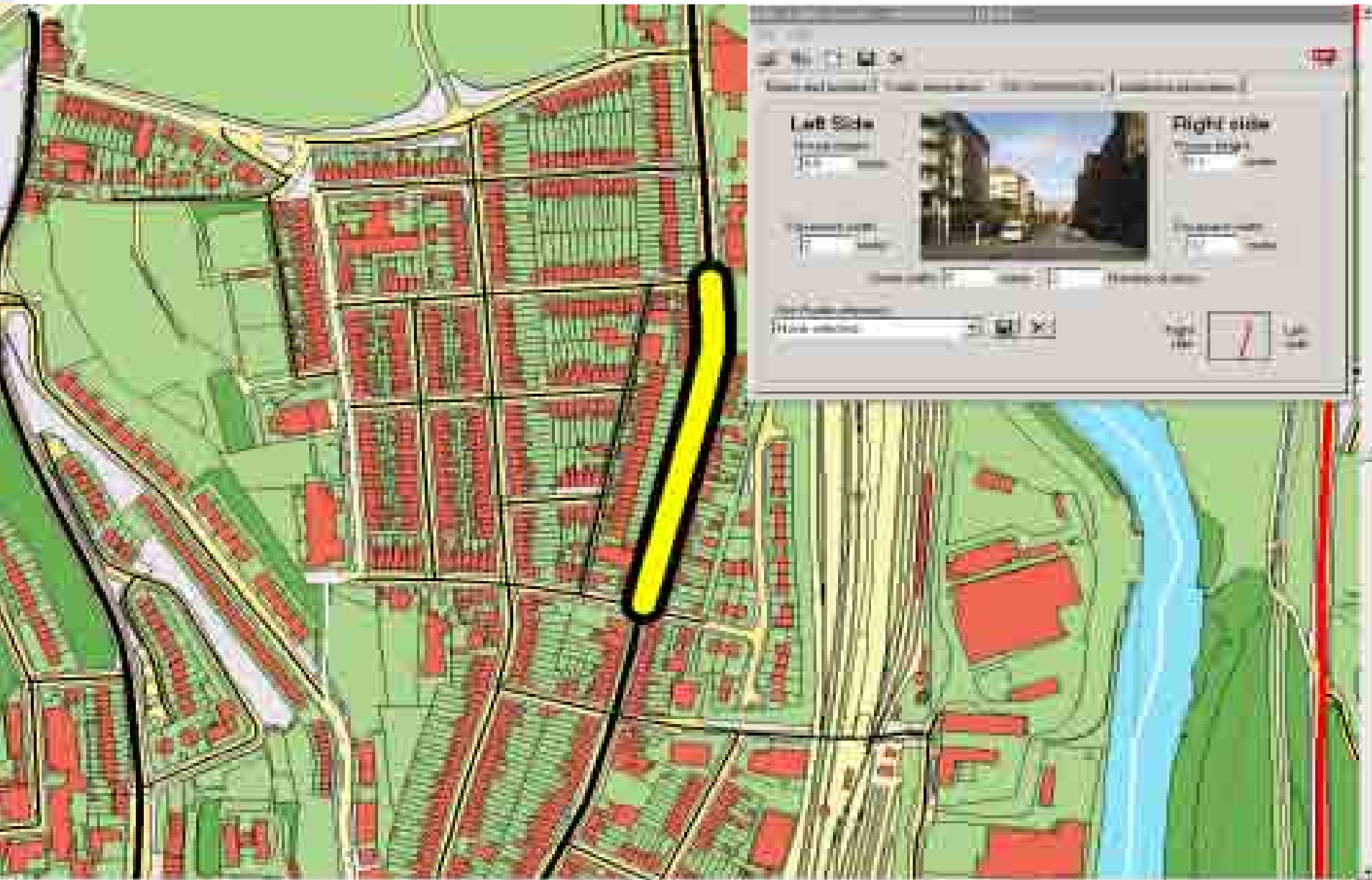


Swansea emission inventory

- Industrial sources included as point sources (stacks) and grid sources
- All other non-traffic activities included as grid 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 conditions influencing dispersion in that road link





Map Elements Panel

- Street Symbols
- Use of Right-of-Way Lines
- Placename Symbols
- Bridged Crossover Symbols
- Canals, Ditches, Irrigation Canals

Show only the selected map elements

Layers: [Layers] [Placenames] [Streets] [Water]

Street Symbols

Street Name: [Field]

Code: [Field] [Field]

Street Properties

Property	Setting
Color Name	000000 (Black)
Width	5000
Stroke Style	[Field]
Cap Style	[Field]
Join Style	[Field]
Layer Name	[Field]
Track Location	[Field]

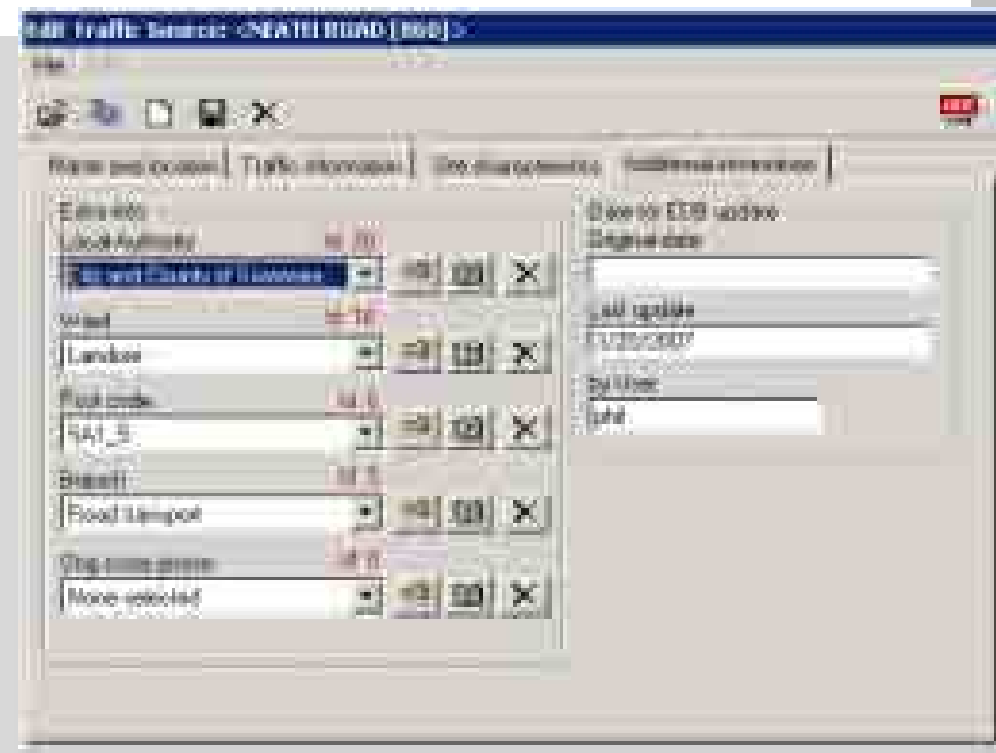
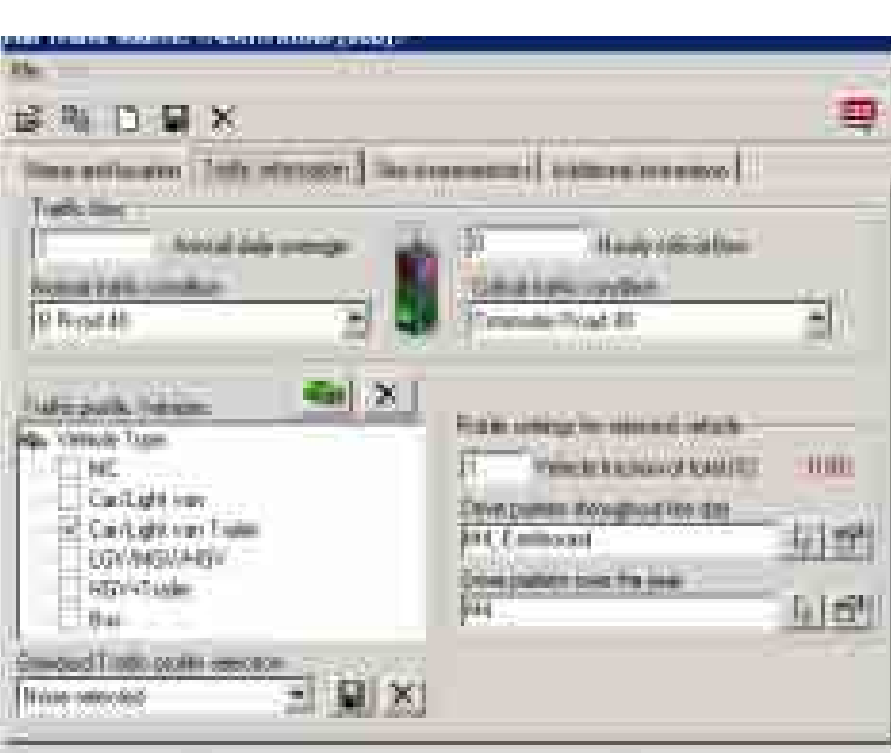
Buttons: [All Categories] [Home] [Refresh]

Nowcaster will use the geometry details together with the actual traffic flow data and all meteorological conditions to compute the predicted air quality within that road link.

Nowcaster will automatically have the latest data with updated annual daily average / diurnal flow pattern as links will be formed between the data collection software and the EDB

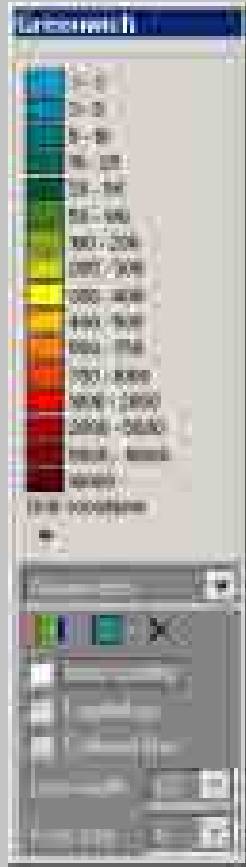
Traffic profiles can be set to further fine tune the traffic behaviour for that road link

When the EDB is complete we will be able to run additional reports on emissions for example from Wards or Post Code or even by local authority (all Welsh LA are already in the EDB for their grid data emissions) by specifying the search keys to use.



Example of Grid data Simulation – All CO₂ Emissions for Wales

Nowcasting in Swansea



The base modelling...

The basic emission database includes the bulk features of all emissions and can be used for dispersion modelling



The Nowcaster system

The Nowcaster system will:

- Utilise the basic emission database and update the traffic figures in near real time
- Use the monitoring data to improve the modelling
- Use the weather forecast in order to extrapolate conditions for the next few hours to come



The Swansea Nowcaster system

Nowcasting in Swansea

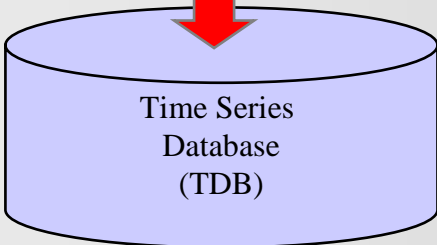
Air Quality (5 min)

Traffic (5 min)

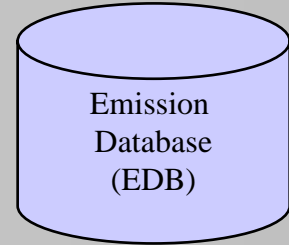
Weather (5 min)

Weather forecast (6 hours)

Data collection from monitoring stations and a weather forecast provider



Read the expected traffic volumes on all traffic links in the EDB and update the figures based on the sample of the most recent monitored traffic data

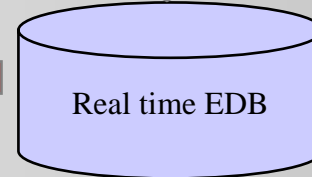


Compute emission for all traffic links using emission factors from the EDB

Air Quality observations

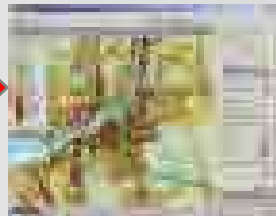
Weather observations
Weather forecast

The EnviMan Nested Grid and Street Pollution Model



Real time emissions

The adaptive modelling filter



Message generator



OPSIS





Chelmsford

(A 414)

Chipping Ongar A 128

Brentwood

Kelvedon Hatch A 128

Industrial Estates

Secret Nuclear Bunker

The users....



EnviMan System (2 computers located in a DMZ)

Internet

Local radio
stations or
direct to
public

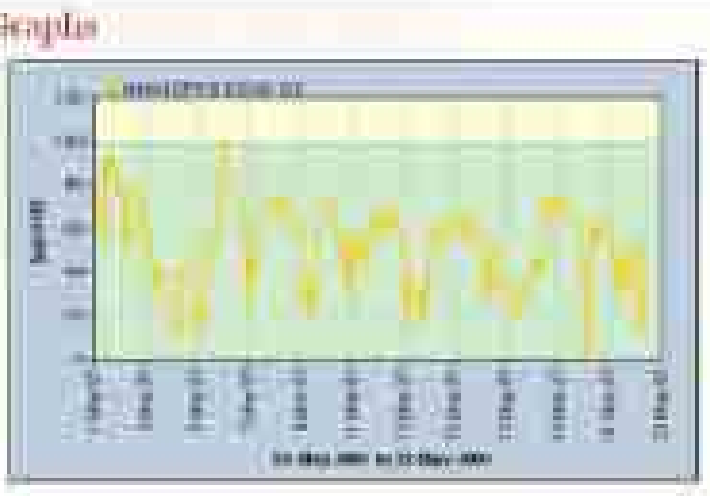
City Council:
Env. & Health

Highways
dept.

Public
Health /
clinicians



The charting default presentation is via the index banded system – note the different colours within the chart and the explanation below the chart. The chart can be saved / printed or downloaded



Index Legend:
 The colour banding of the graphs shows the level of the index:

- Green - Good
- Yellow - Moderate
- Red - High
- Dark Red - Very High

When there are 2 or 3 banded index averaged it will have an 'at' (average) label. It does not show when there are 4 or 5 banded index averaged (eg 2.5 or 3.5) (noted by point) & overall index average is shown in the bottom bar.



The system has also been developed to allow automatic email alerts to be sent when a pollutant of choice reach a user predefined level. Helpful for medical health professionals (eg PM₁₀ episodes) and the public who are known to be pre-disposed to suffer effects from elevated levels.

The screenshot displays a web interface for air quality monitoring. At the top, there is a navigation bar with links such as 'Home', 'About Us', 'Data and Reporting', and 'Help'. The main heading is 'Email alerts'. Below this, there are several sections:

- A text area for providing an email address.
- A section for selecting a pollutant and setting a threshold value.
- A 'Frequency' section with radio buttons for 'Daily' and 'Weekly'.
- A 'Send to' section with a dropdown menu.
- A 'Save' button.

 On the right side, there is a 'Current status' section with a table of pollutant levels. A small dialog box is open in the bottom-left corner, showing a 'Save email alert' form with a 'Save' button.

- Forecasting ahead allows for some of the traffic to be redirected away from “failing” areas.
- Planned to incorporate information on parking spaces in the city centre as well as the park and ride sites at Landore, Port Tennant and Fforestfach.
- This information should allow the motorist to make an informed decision regarding their final destination.
- Nowcaster forecast can expand to match the areas where new GPRS ATC’s are established and where PM10 or 2.5 failures are likely.
- Could trigger health response via targeted e mail?



Other information?

congestion/slow moving traffic ahead etc. as the system is able to detect the average speed of the traffic flow on any road link from the vehicle by vehicle GPRS speed data.

Information regarding weather conditions i.e. ice on road / roadwork's ahead / scheduled roadwork's next week/information can all be sent.

Climate change benefits - Structural - technical - political - media

