

Addendum to Wrexham County Borough Council's Update and Screening Assessment.

Summary: Section 5.5 of Wrexham County Borough Council's Update and Screening Assessment (USA) stated that "Further PM₁₀ monitoring in Chirk is expected to conclude that the PM₁₀ objective will not be breached".

This addendum to the USA provides additional monitoring results for Chirk and provides further information to support the conclusion in the USA report that "no Air Quality Management Area (AQMA) needs to be declared for Chirk".

Section 1 discusses the PM₁₀ results received at Chirk and compares them to the AURN (Automatic Urban and Rural Network) site at Wrexham. Section 2 will examine the siting at one of the Chirk locations in more detail by considering the influence of wind direction.

SECTION 1

The Public Protection Department of Wrexham County Borough Council (WCBC) has used a PARTISOL PLUS 2025 gravimetric analyser for the purposes of monitoring the PM₁₀ levels in Chirk. PM₁₀ is an abbreviation for Particulate Matter of 10µm (micrometers) or less. Since late 2002 monitoring in Chirk has been undertaken at two locations:

The location of the two PM₁₀ monitoring sites in Chirk is shown in Appendix 1 and Table 1, below. Appendix 1 defines the coal burning areas in Chirk in relation to these two monitoring sites.

Table 1

Locations of PM₁₀ monitoring equipment in Chirk

Location of PM ₁₀ Monitoring Equipment				
Start Date	Finish Date	X co-ord	Y co-ord	Location
26.11.02	15.05.03	329290	337970	Bron-Y-Waun
16.05.03	on-going	329040	338270	Chirk Court

With reference to Appendix 1, it can be seen the Bron-Y-Waun location represents approximately the middle of the larger coal-burning area of Chirk. Chirk Court's location is between the residential area and a large particleboard / chipboard plant with a formaldehyde plant. The Chirk Court monitoring is currently ongoing, though data gathered until the 26th April 2004 has been used for this report.

These locations were chosen to monitor particulate levels from the coal-burning area and to take account of the local geography which influences wind patterns in the valley. Chirk is protected on the west by a mountainous area which results in a predominately north easterly wind, which sweeps up through Chirk from the south west. Other considerations with regard to the siting included accessibility and security of the equipment. The Chirk Court location was also chosen to evaluate the particulate emissions from the chipboard plant and verify work that was carried out for WCBC's Stage 3 report. The Chirk Court location is discussed further in Section 2.

An experienced member of staff undertook all of the filter handling and weighing. The pre and post conditioning and the weighing of filters were undertaken at the Trading Standards Laboratory, Ruthin Road, Wrexham. The laboratory is NAMAS accredited.

This represents seventeen months of data, which is graphically displayed in figures 1 and 2 by monitoring site.

Figure 1: PM₁₀ monitoring data for the Bron-Y-Waun monitoring site.

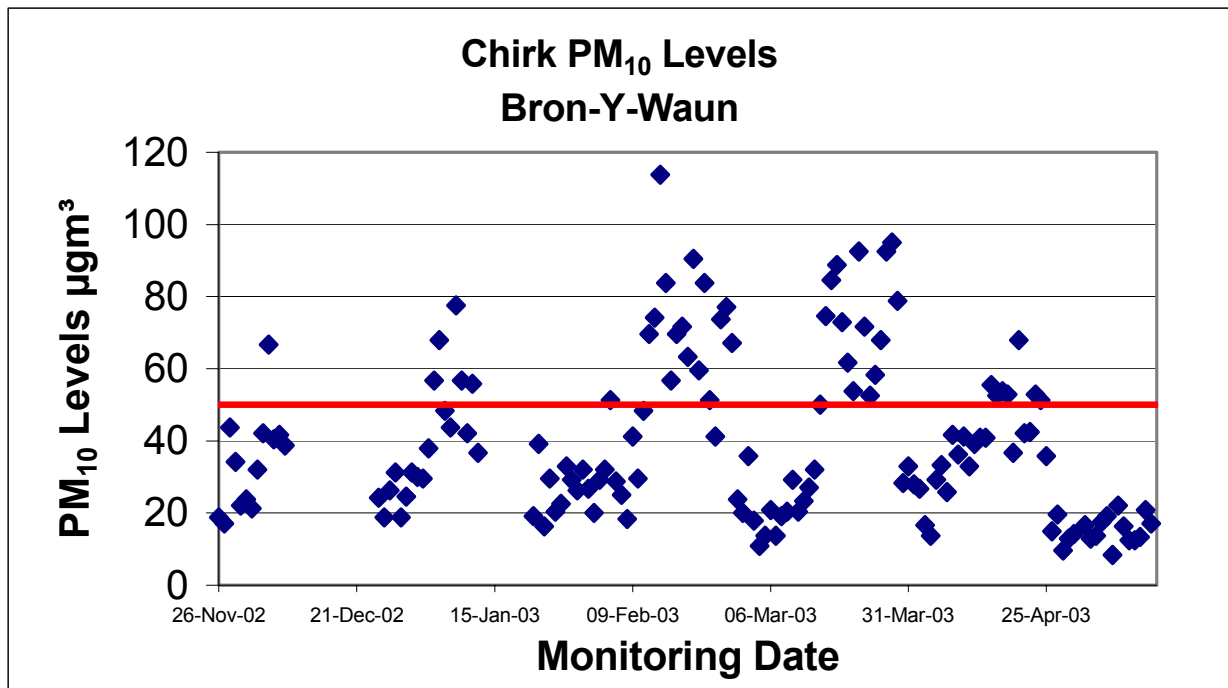
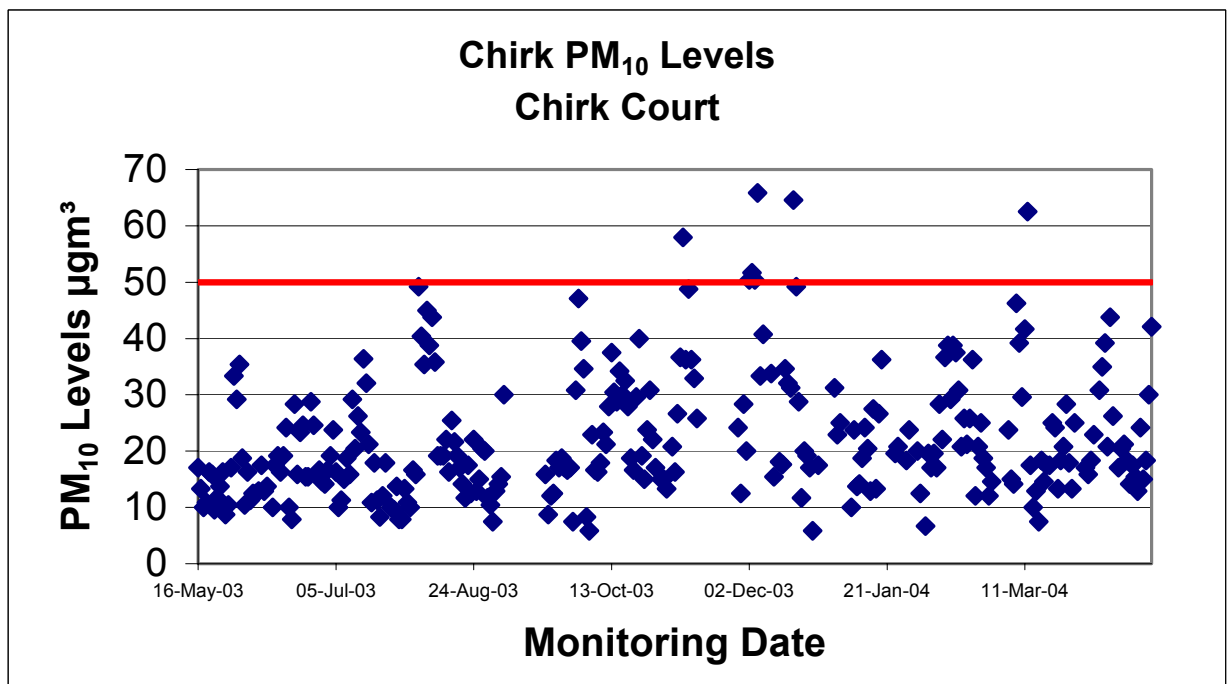


Figure 2: PM₁₀ monitoring data for the Chirk Court monitoring site



The Red line indicates levels of PM₁₀ (50 µg/m³) that may be exceeded a maximum of thirty-five times per year as stipulated in the Air Quality (Wales) Regulations 2000 as set by the Department of the Environment, Food and Rural Affairs (DEFRA) and Welsh Assembly Government. The overall annual level of PM₁₀ must not exceed an average of 40µg/m³ (Table 2):

Table 2
PM₁₀ Air Quality Standards

Air Quality Standards for PM ₁₀		
Pollutant	Standard	Measured as
PM ₁₀	50 micrograms per cubic metre (50 µg/m ³). Not to be exceeded more than 35 times a year.	24 hour mean
	40 µg/m ³	Annual mean

However, these results cannot be considered in isolation and have, therefore been compared to the background PM₁₀ levels in Wrexham. For the purposes of this study the AURN continuous monitoring unit located near Wrexham town was used to provide the background PM₁₀ level (see table 3 and/or http://www.wrexham.gov.uk/english/environment/air_quality/measured.htm for further information on the continuous monitoring unit)

Table 3
Victoria Road AURN Site

Location of Continuous Monitoring Unit		
Location	X co-ord	Y co-ord
Victoria road (Wrexham)	332861	349913

The AURN site is located at the side of a small, infrequently used, car park. It is approximately five meters from the roadside on a road that is considered to have a reasonable volume of traffic flow. The AURN site is also situated in a smoke control area and hence will not be exposed to emissions from coal burning or the burning of waste from the allotments situated to the west of the site. There is also no significant industry near the site. Therefore, it is ideally placed to provide a background PM₁₀ level for the County Borough.

The following bar charts show the overall levels of PM₁₀ recorded in Chirk. In addition they show the contribution from the background levels in Wrexham (figures 3 to 8). The blue colour shows the PM₁₀ level at Wrexham and the red colour shows the difference between Chirk's PM₁₀ level and Wrexham's. Hence where the red column is above the blue column the PM₁₀ levels at Chirk are higher than at Wrexham and where the red column is below the blue column (i.e. a negative value) the PM₁₀ levels at Wrexham were higher on that day.

Figure 3: Overall PM₁₀ for 2002

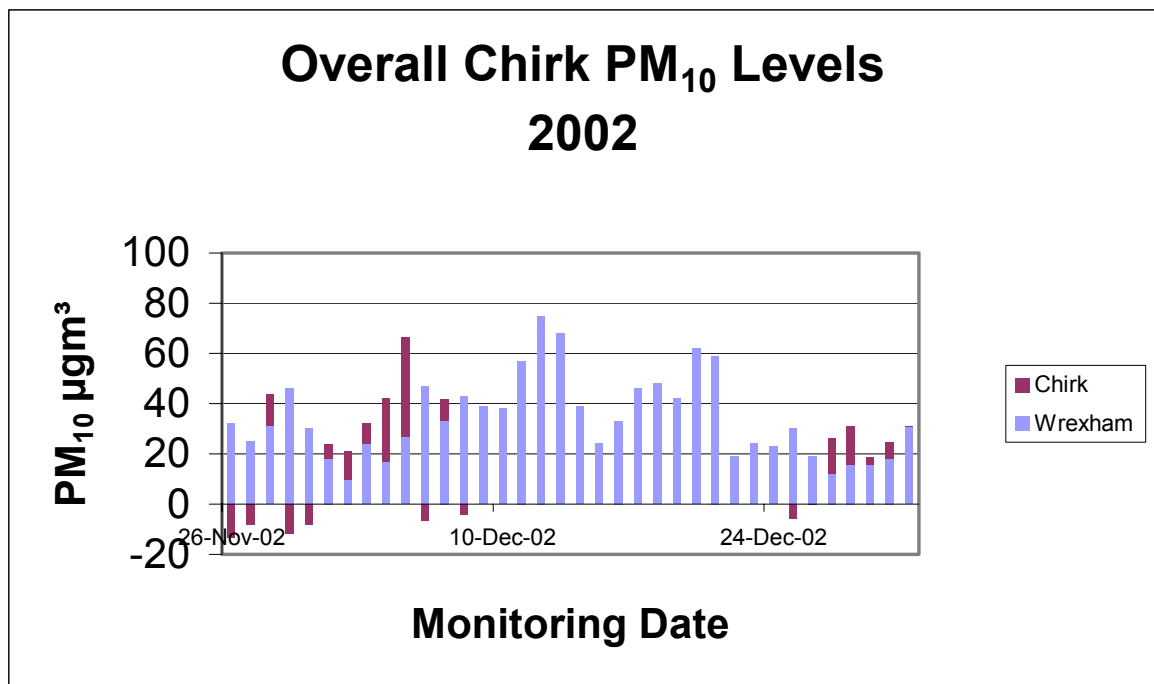


Figure 4: Overall PM₁₀ for quarter 1 2003

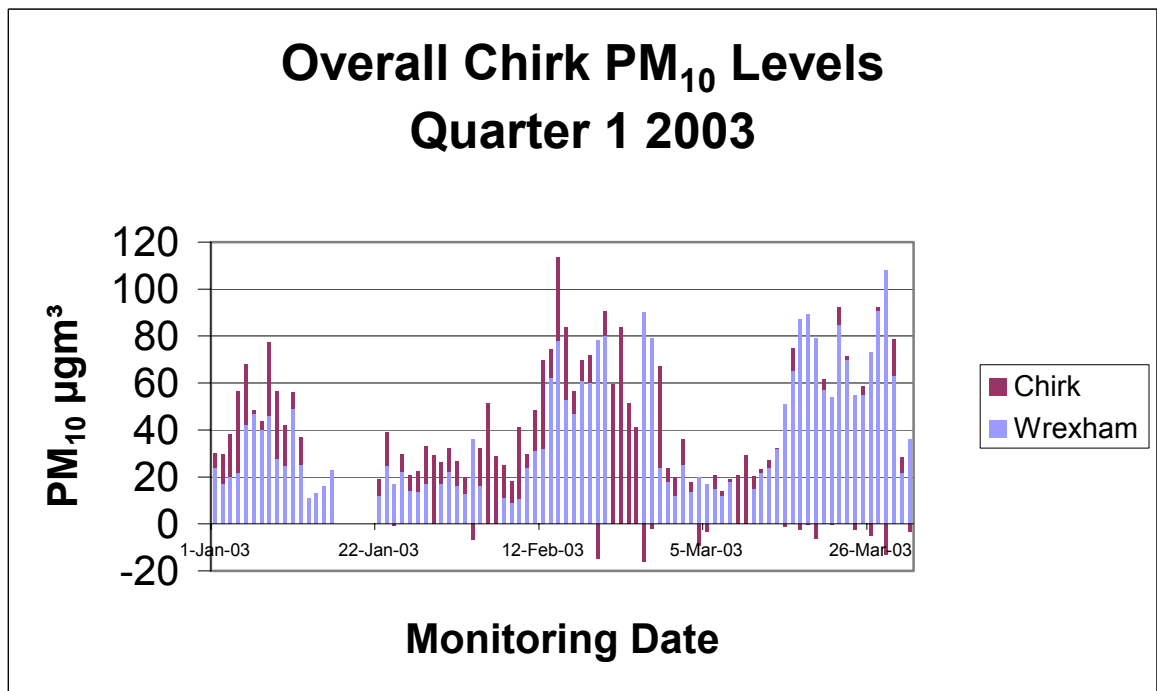


Figure 5: Overall PM₁₀ for quarter 2 2003

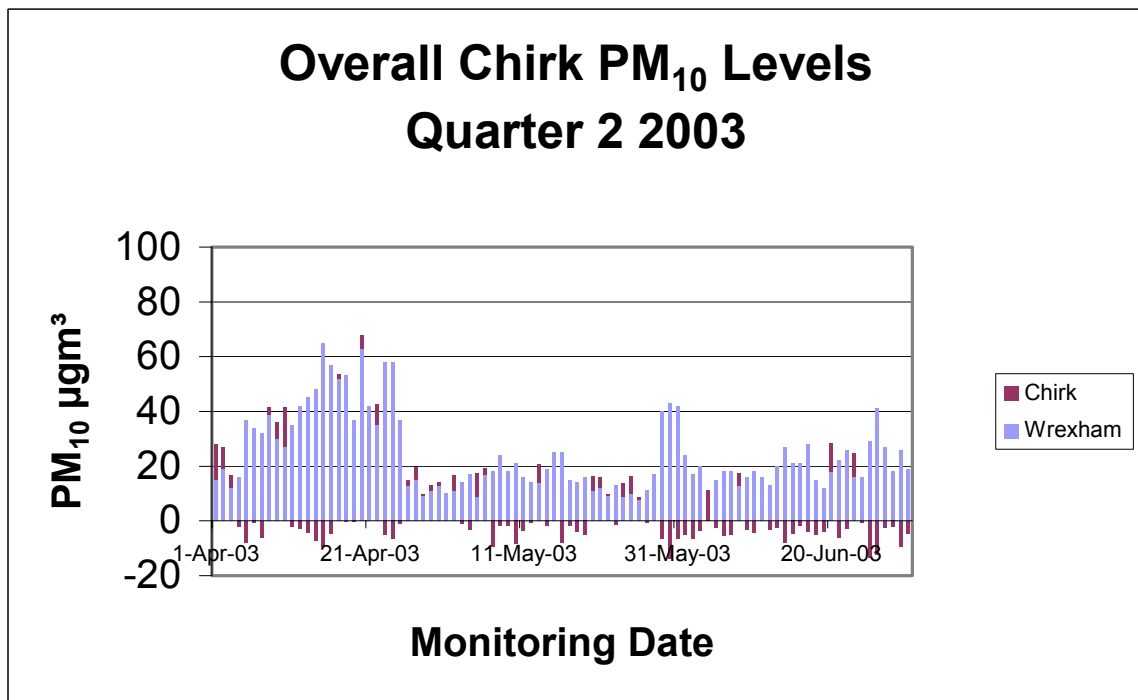


Figure 6: Overall PM₁₀ for quarter 3 2003

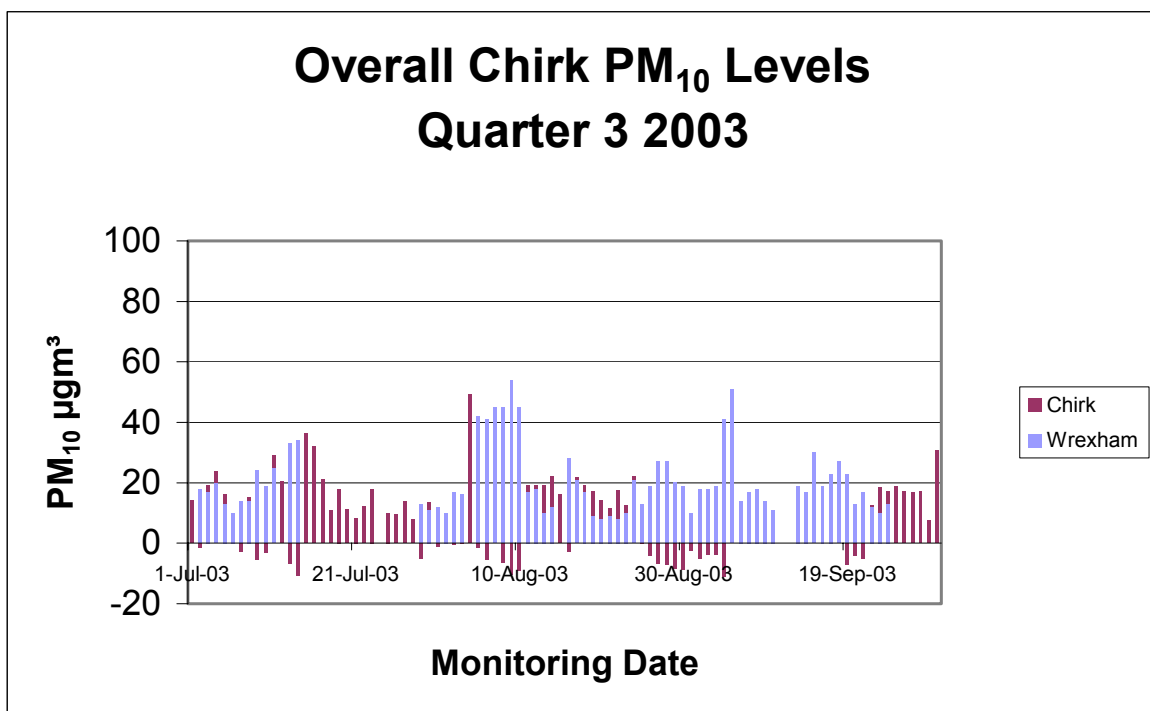


Figure 7: Overall PM₁₀ for quarter 4 2003

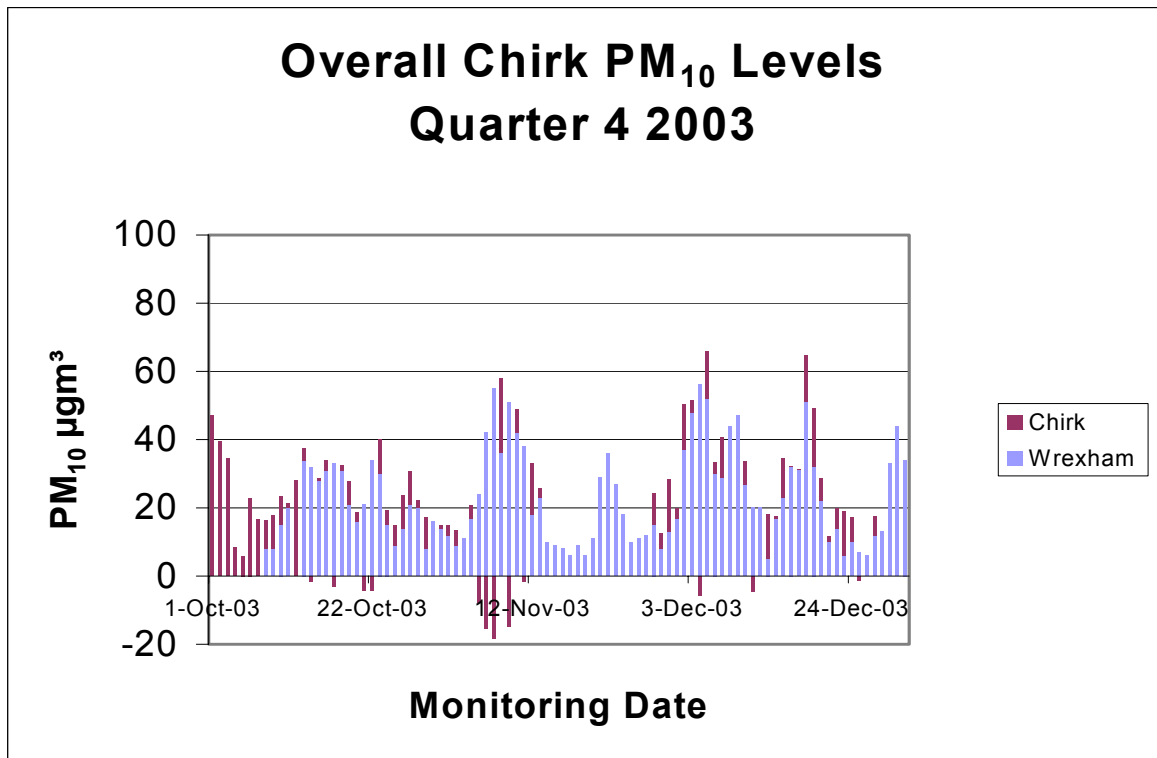
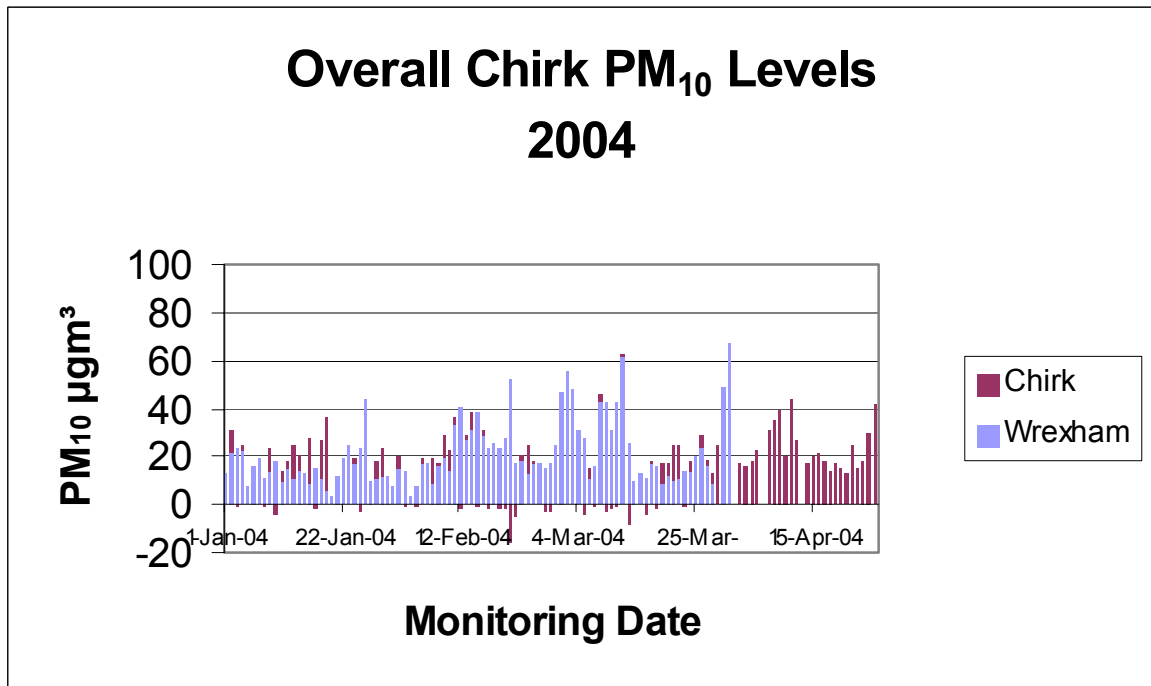


Figure 8: Overall PM₁₀ for 2004



The charts demonstrate that the bulk of the PM₁₀ levels recorded in Chirk can be attributed to the background levels in the County Borough.

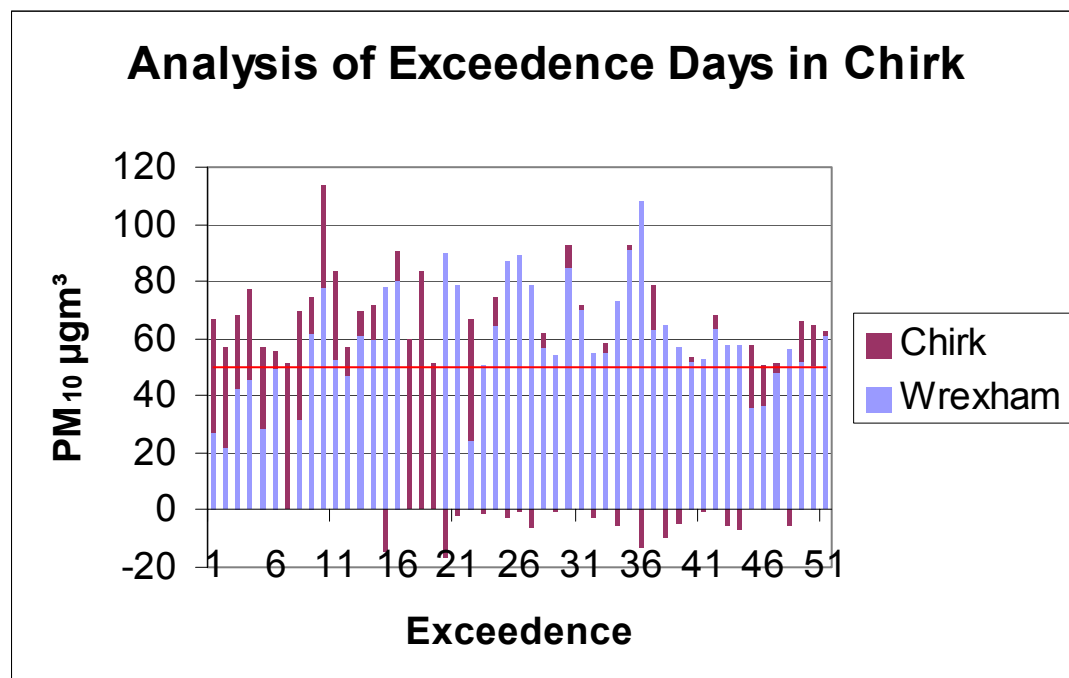
A statistical analysis of the results for each monitoring site is tabulated below (table 4).

Table 4:
Statistical analysis of PM₁₀ results for Chirk

Statistical Data for Chirk				
Site	Period in Situ	Criteria	Unit	Value
Bron-Y-Waun	26-Nov-02 – 14-May-03 (170 days)	Data Capture	%	81.3
		Number of Exceedences	-	44
		Average Value	µgm ³	39.7
Chirk Court	15-May-03 – Present (347 days)	Data Capture	%	85.8
		Number of Exceedences	-	7
		Average Value	µgm ³	22.0

In total this represents fifty-one exceedences of the daily 50µg/m³ limit over a seventeen-month period. See appendix 2 for a table of these exceedence days. If these specific days are compared to the background levels recorded for Wrexham the following bar chart can be generated (Figure 9):

Figure 9:
Comparison of specific exceedence days:



This chart more clearly demonstrates the relationship between the values recorded for Chirk and the general background levels in the County Borough. Again negative values shown for some Chirk readings, indicate times when the PM₁₀ levels in Chirk are lower than those recorded at the Wrexham AURN site.

Hence with the exception of sixteen of the values, the exceedences were caused by background PM₁₀ levels observed throughout the County Borough. i.e. the background level of PM₁₀ in the County Borough was higher than the 50µg/m³ limit. The graph also shows four readings were background data is unavailable and therefore, assuming worse case, these have been included in the sixteen exceedences highlighted above. It should also be emphasised that this is for a seventeen month period as opposed to the recommended twelve months.

The Air Quality (Wales) Regulations 2000 stipulates a running mean of 40µg/m³. In table 5, analysis of the Chirk data has been broken down into three sets of data, with some overlap. The first set is for the initial twelve months from site commissioning, the second set is for 2003 and the third set is for the final twelve months (assuming a finish date of 26-April-2004).

Table 5:
Annual mean PM₁₀ levels for Chirk

Annual Mean PM₁₀ Level			
Start Date	Finish Date	Data Capture %	Annual Mean µg/m³
26-Nov-02	25-Nov-03	84.4	29.4
01-Jan-03	31-Dec-03	86.0	29.4
27-April-03	26-April-04	82.2	21.7

The above table indicates that the Chirk will not breach the air quality standard for the annual mean.

Section 2

In order to confirm that the Chirk Court location was situated so as to give useful information (i.e. where it would be exposed to the highest amount of PM₁₀ that may be present) the wind data for the monitoring period May 5th 2003 to April 16th 2004, has been evaluated.

The following three charts (Figures 10 to 12) show the hourly wind direction plotted as a function of the PM₁₀ levels, i.e. the daily PM₁₀ levels recorded at both Chirk Court and the Wrexham AURN site were plotted against the average wind direction for each hour. For this purpose 0° is North and any wind direction quoted refers to the origin of the wind (i.e. the direction the wind is blowing from).

The trend line (yellow) has also been added to each chart. This is a line showing the average PM₁₀ level at that wind direction

Figure 10:
PM₁₀ levels vs wind direction for Chirk Court.

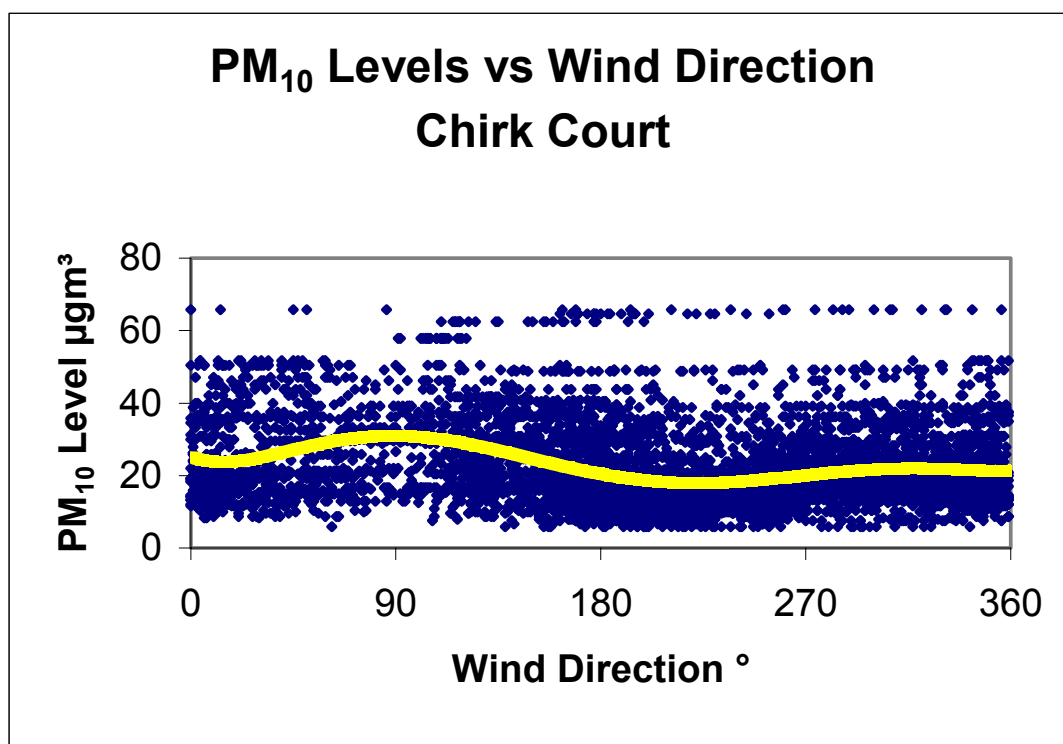


Figure 11:
PM₁₀ levels vs wind direction for Wrexham.

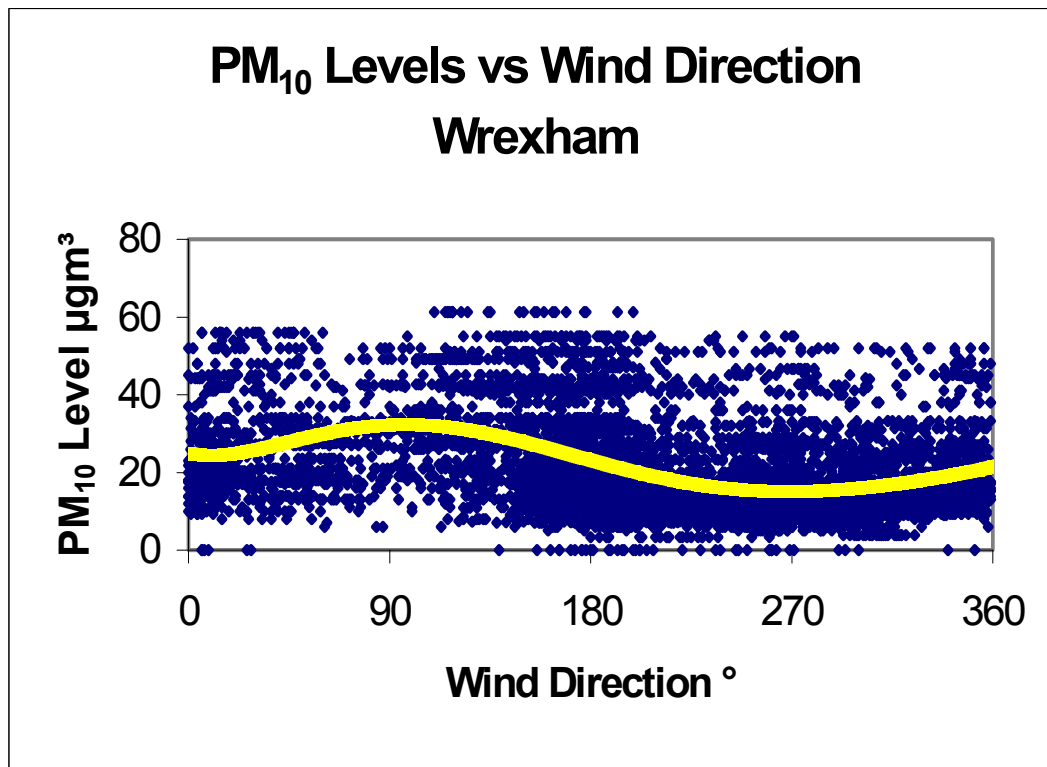
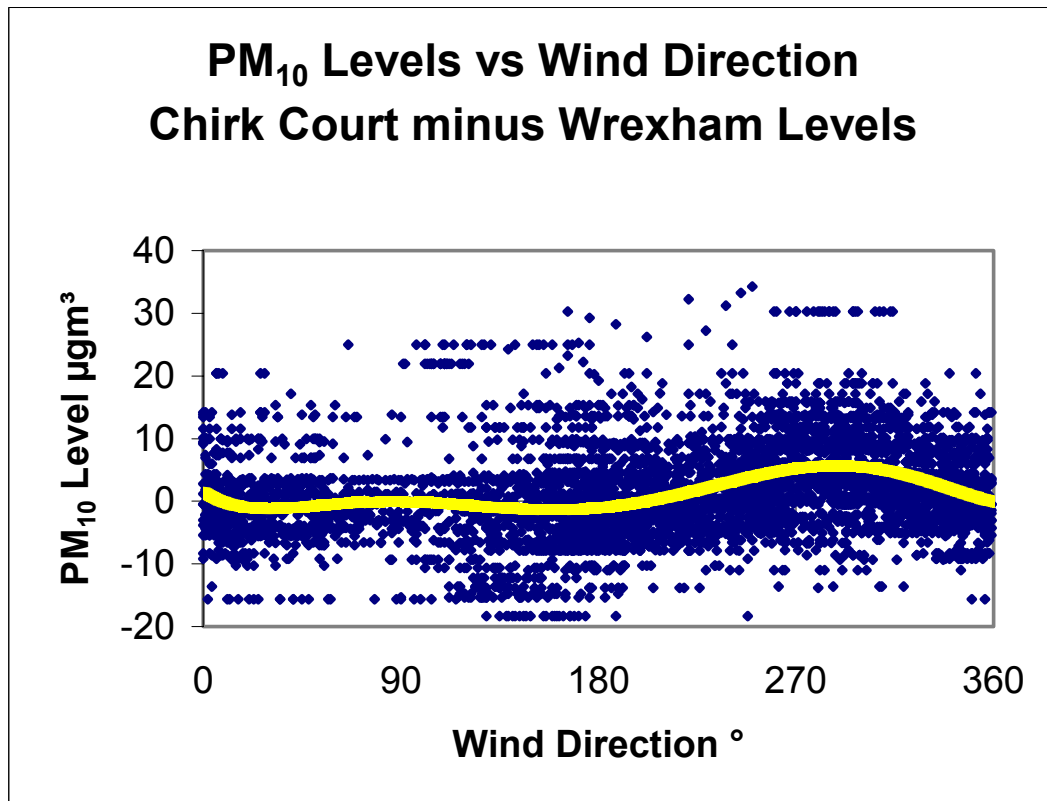


Figure 12:
PM₁₀ levels vs wind direction for Chirk Court after subtracting the Wrexham levels.



As can be seen from the above charts the greatest difference between the results for Wrexham and Chirk arises from westerly blowing winds (270°), which may be an influence from road traffic in Chirk. The monitoring site is situated next to (though not on) the main road through Chirk. This carries the significant number of lorries, which deliver to and collect from the chipboard plant (also situated to the west of the Chirk Court monitoring site). This chipboard plant is located at the centre of the village and dominates the valley, as it's the single biggest industrial site. Due to the nature of its business, a significant percentage of these lorries will be delivering and collecting wood products.

A closer examination of the PM₁₀ from a south-west to north-west range does show that higher levels of PM₁₀ come from a north-west-west to north-west direction in Chirk (see Figure 13) on this compass range. Wrexham experiences lower levels of PM₁₀ from this direction (see Figure 14), which can be seen on the difference plot for these two sites (see Figure 15).

Figure 13:
Analysis of westerly winds at Chirk

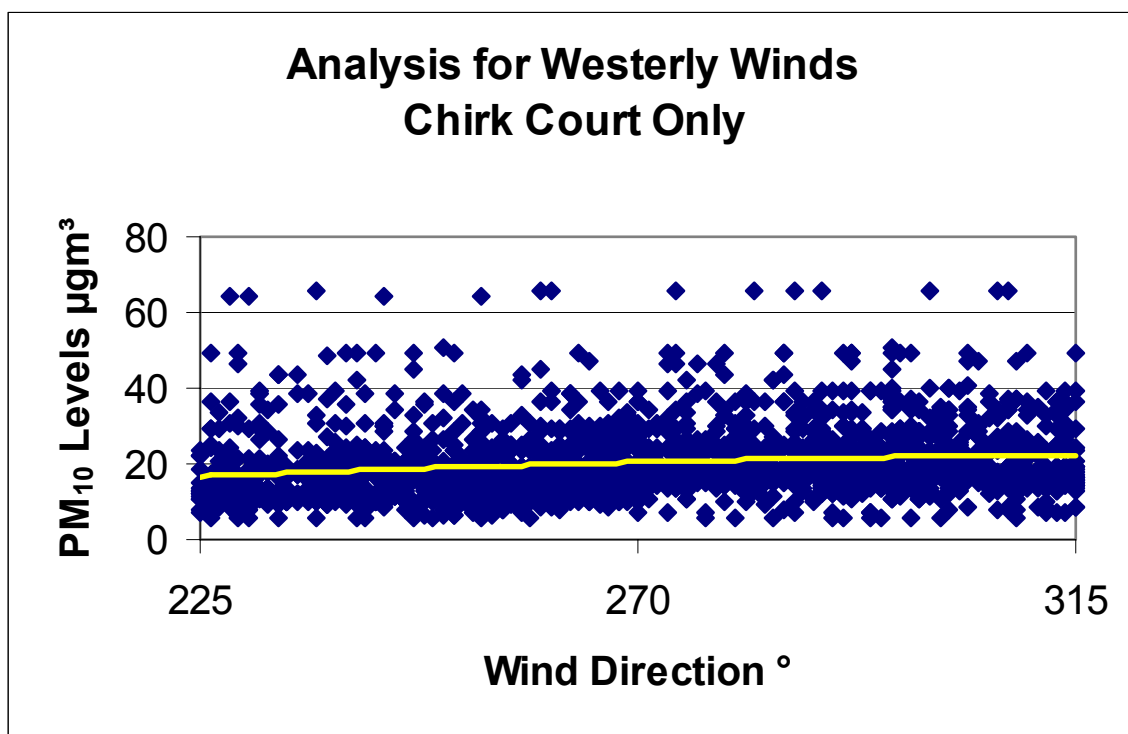


Figure 14:
Analysis of westerly winds at Wrexham

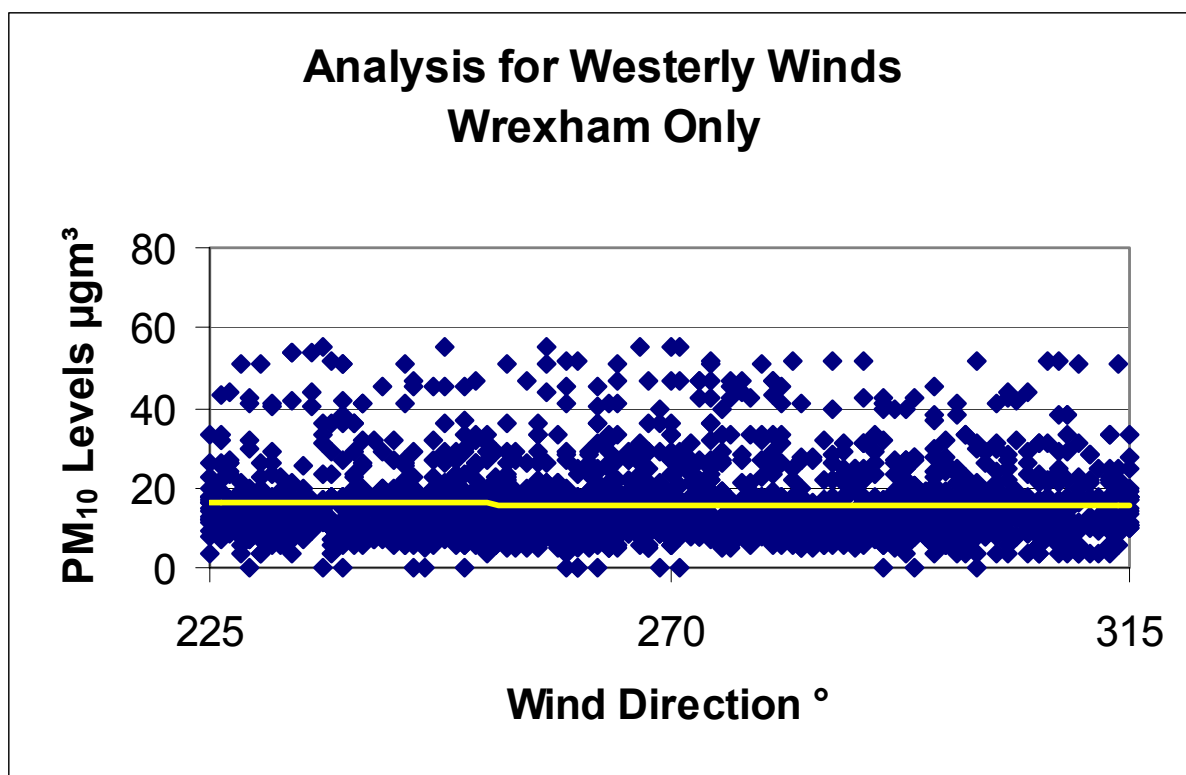
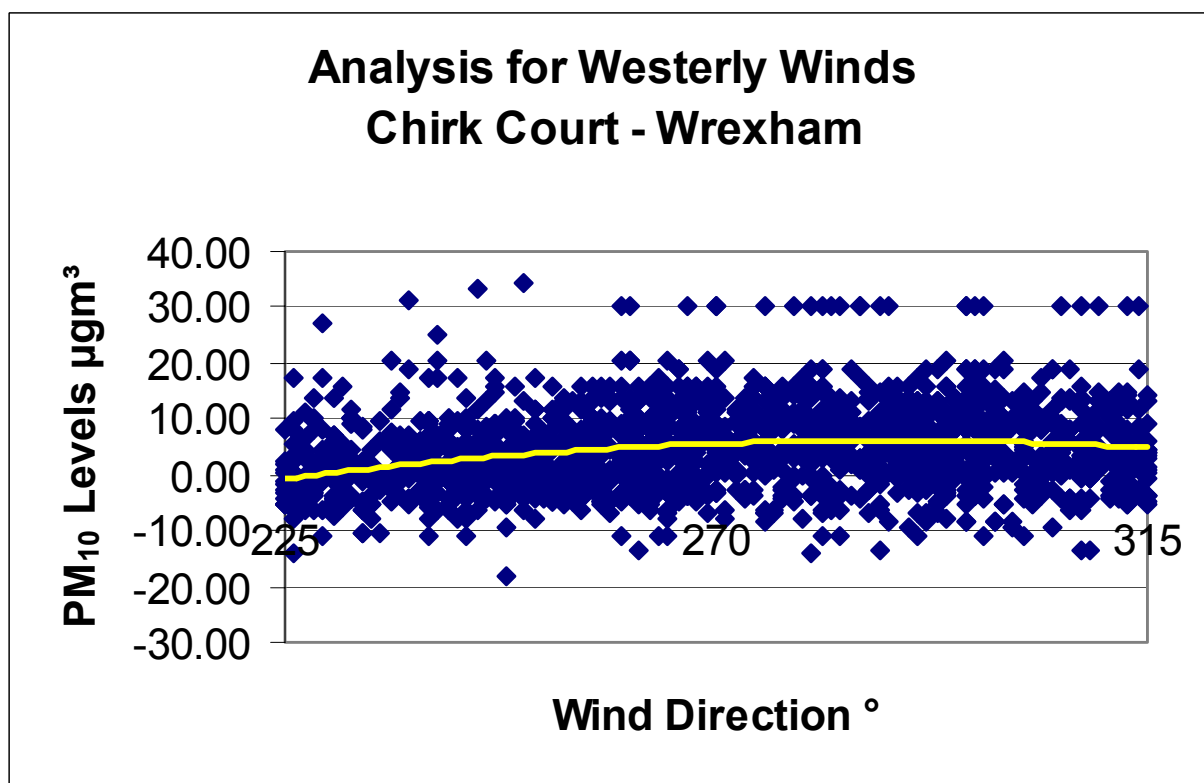


Figure 15:
Difference in westerly winds between Chirk and Wrexham



Analysis by season (Figures 16 and 17) show that during the spring & summer months the lowest levels (i.e. values) of PM_{10} are observed from the south. The autumn & winter months again show a gradual decrease through the south-west-north.

Figure 16:
Seasonal analysis of wind direction for the Spring and Summer at Chirk

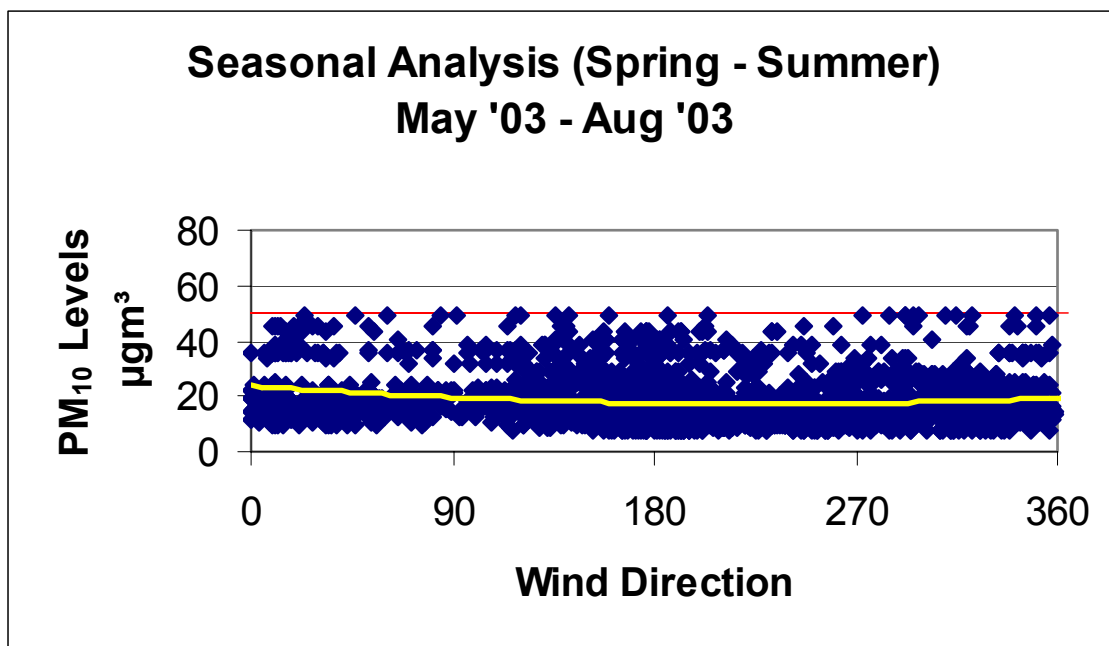
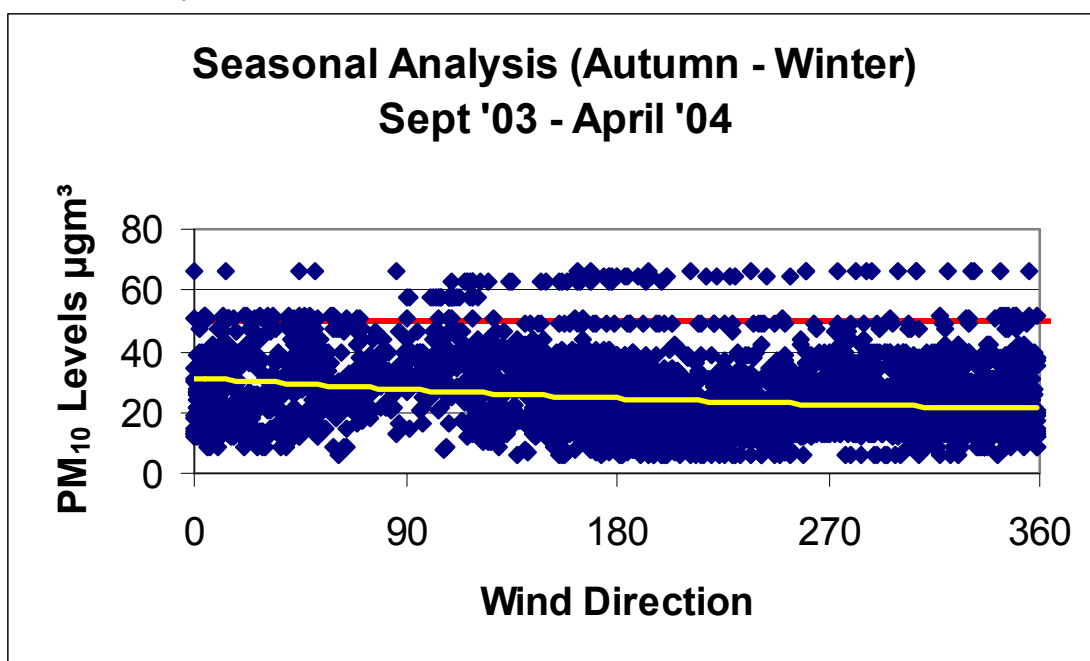


Figure 17:
Seasonal analysis of wind direction for the Autumn and Winter at Chirk



It is possible that these trend-lines may be distorted by a greater number of lower values originating from these directions. Hence a density plot was generated (Figures

18, 19 and 20) which shows that throughout the year the south still gives rise to the greatest amount of PM₁₀, with the west and north-west also giving rise to more PM₁₀ than the other compass directions (over the year).

Figure 18:
PM₁₀ Origin in relation to the Chirk Court monitoring site

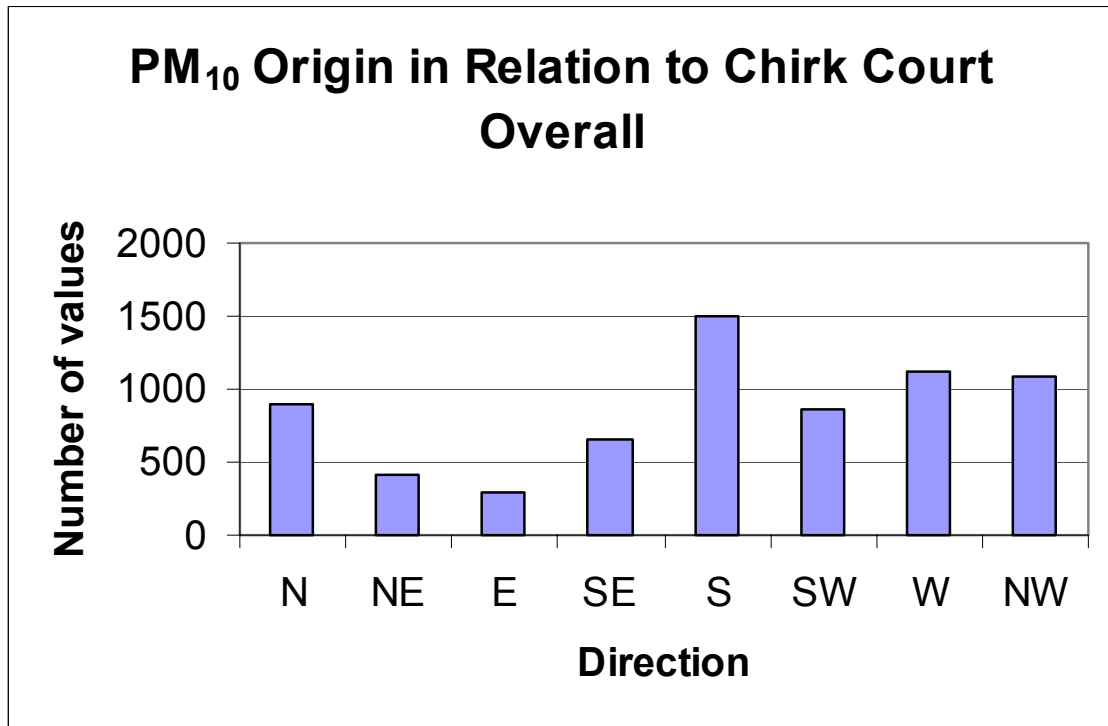


Figure 19:
PM₁₀ Origin in relation to the Chirk Court monitoring site for the Spring and Summer

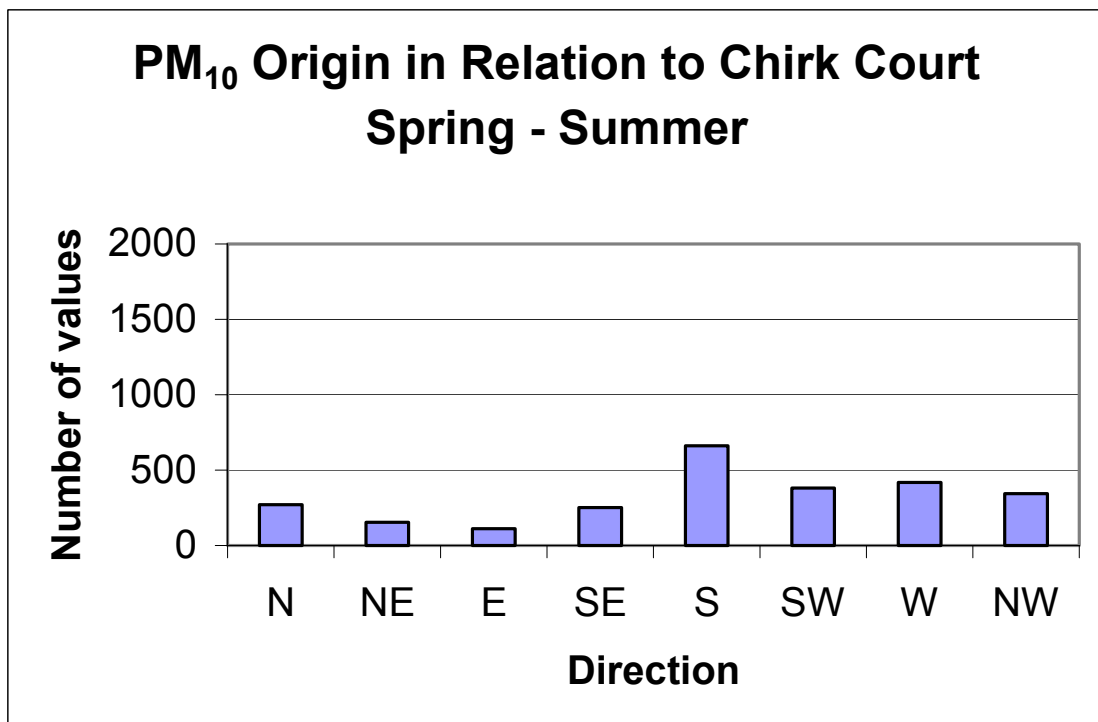
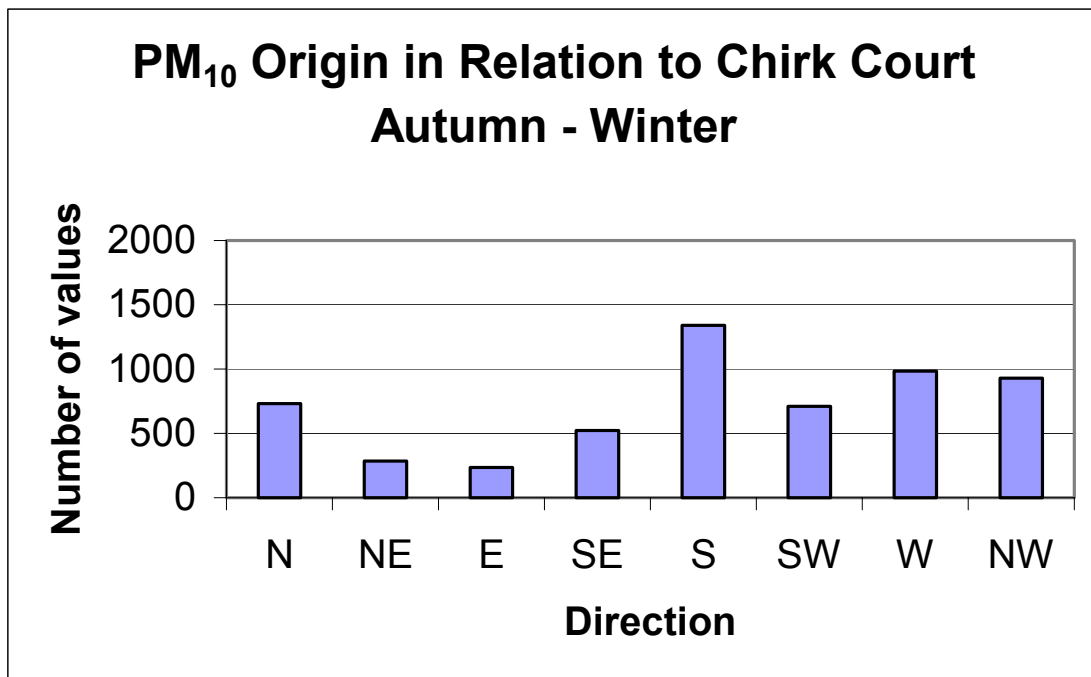


Figure 20:

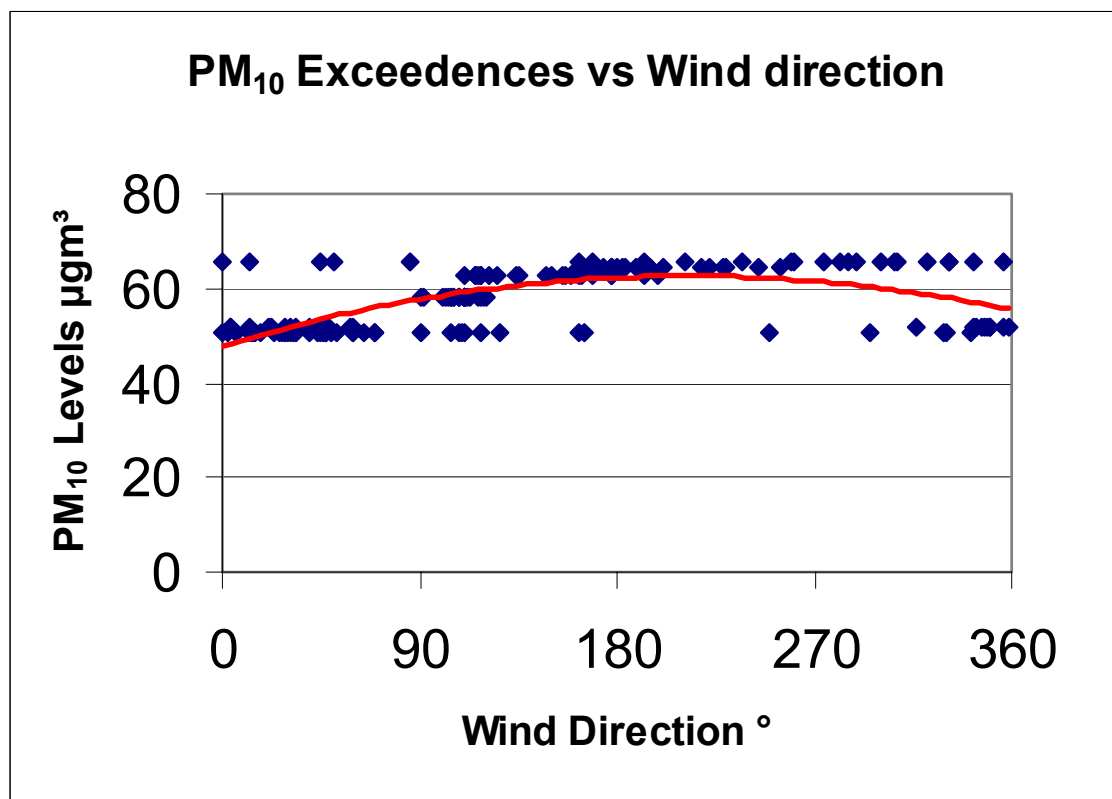
PM₁₀ Origin in relation to the Chirk Court monitoring site for the Autumn and Winter



Due to Chirk's topography it is subject to temperature inversions from early autumn onwards (September). This tends to cause poor dispersal of emissions from the chipboard plant and other point sources, which will no doubt also lead to poor dispersal from traffic and domestic sources. This poor dispersal can be clearly visible at times as an easily definable layer when viewed from above.

Additionally an analysis of just exceedence values (i.e. a plot of only PM₁₀ values higher than 50 µgm³ - Figure 21) does show a majority of exceedences originate from the north-east-south directions, with the south showing the greatest density of the highest exceedences.

Figure 21:
Analysis of just exceedence days by wind direction



The above wind analysis charts confirm Chirk Court was ideally situated for this monitoring program, experiencing both the main coal burning regions PM₁₀ and the road and chipboard manufactures contribution.

CONCLUSION

Detailed analysis of the exceedences in Chirk have indicated that they occur over the winter months (see appendix 2 – Detailed analysis of exceedence days). Therefore, these exceedences can most likely be attributed to domestic coal burning. The monitoring has concluded that there is no specific contribution to the PM₁₀ levels from the chipboard plant, as had this been the case, a consistent level of PM₁₀ would have been recorded throughout the year.

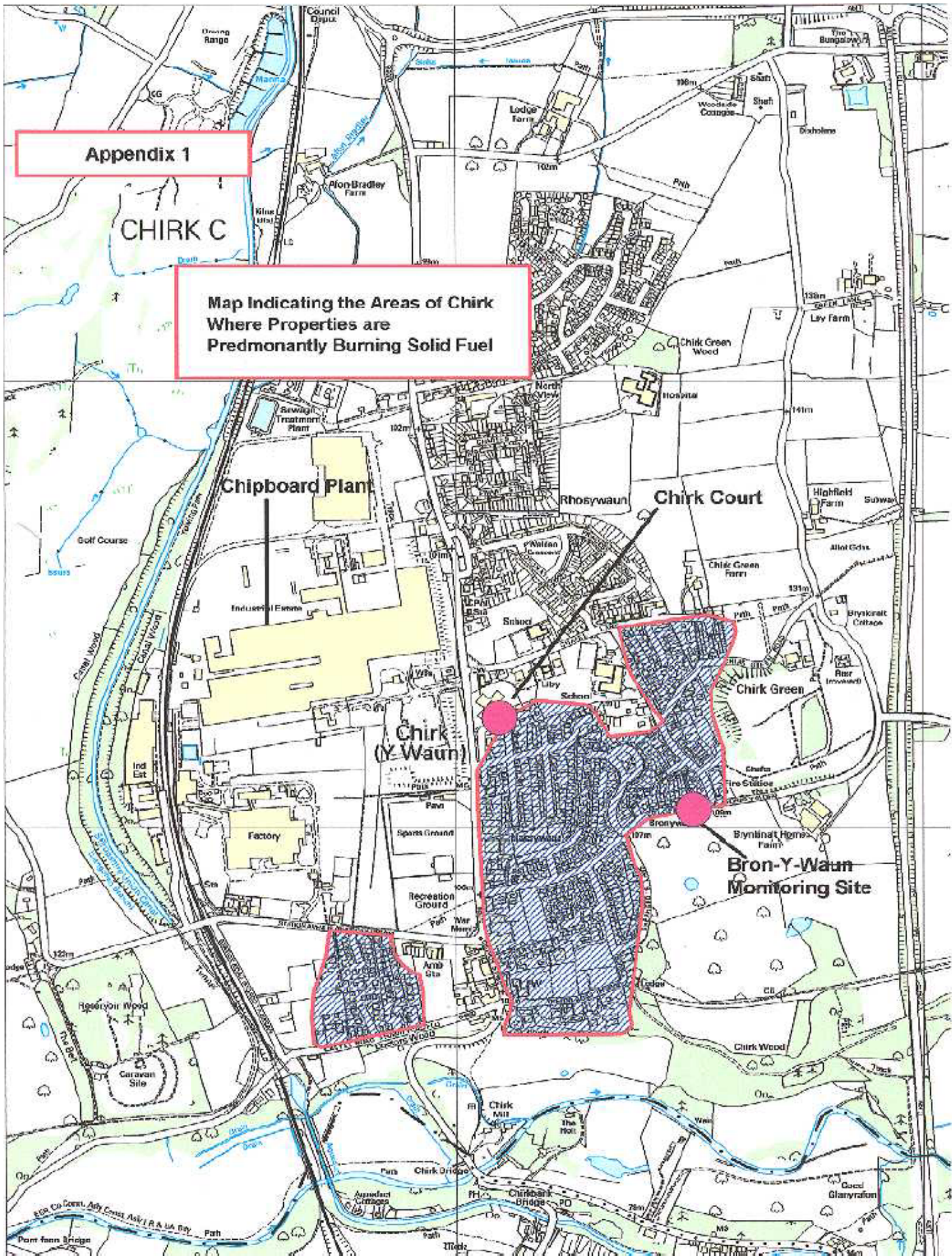
Detailed analysis of wind data has demonstrated that the Chirk Court location is ideally situated to catch the predominate southerly wind as it blows up through the main domestic coal burning area of Chirk. It has also demonstrated that whereas there is likely to be some contribution to Chirk's PM₁₀ level from the main road and associated number of HGV's that use it, this hasn't resulted in a breach of the PM₁₀ objectives as quoted in the Air Quality (Wales) 2000 regulations.

Hence it is the opinion of the Authority that it is not necessary to declare Chirk as an air quality management area.

Appendix 1

CHIRK C

Map Indicating the Areas of Chirk Where Properties are Predominantly Burning Solid Fuel



APPENDIX 2

Detailed Analysis of Exceedence Days				
Exceedence	Date	PM ₁₀ Levels		
		Chirk	Wrexham	Difference
1	05.Dec.02	66.67	27	39.67
2	04.Jan.03	56.67	22	34.67
3	05.Jan.03	67.92	42	25.92
4	08.Jan.03	77.5	46	31.5
5	09.Jan.03	56.67	28	28.67
6	11.Jan.03	55.83	49	6.83
7	05.Feb.03	51.25	-	51.25
8	12.Feb.03	69.58	32	37.58
9	13.Feb.03	74.17	62	12.17
10	14.Feb.03	113.75	78	35.75
11	15.Feb.03	83.75	53	30.75
12	16.Feb.03	56.67	47	9.67
13	17.Feb.03	69.58	61	8.58
14	18.Feb.03	71.67	60	11.67
15	19.Feb.03	63.33	78	-14.67
16	20.Feb.03	90.42	80	10.42
17	21.Feb.03	59.58	-	59.58
18	22.Feb.03	83.75	-	83.75
19	23.Feb.03	51.25	-	51.25
20	25.Feb.03	73.75	90	-16.25
21	26.Feb.03	77.08	79	-1.92
22	27.Feb.03	67.08	24	43.08
23	15.Mar.03	50	51	-1
24	16.Mar.03	74.58	65	9.58
25	17.Mar.03	84.58	87	-2.42
26	18.Mar.03	88.75	89	-0.25
27	19.Mar.03	72.92	79	-6.08
28	20.Mar.03	61.67	57	4.67
29	21.Mar.03	53.75	54	-0.25
30	22.Mar.03	92.5	85	7.5
31	23.Mar.03	71.67	70	1.67
32	24.Mar.03	52.5	55	-2.5
33	25.Mar.03	58.33	55	3.33
34	26.Mar.03	67.92	73	-5.08
35	27.Mar.03	92.5	91	1.5
36	28.Mar.03	95	108	-13
37	29.Mar.03	78.75	63	15.75
38	15.Apr.03	55.42	65	-9.58
39	16.Apr.03	52.5	57	-4.5
40	17.Apr.03	53.75	52	1.75
41	18.Apr.03	52.92	53	-0.08
42	20.Apr.03	67.92	63	4.92
43	23.Apr.03	52.92	58	-5.08
44	24.Apr.03	51.25	58	-6.75
45	08.Nov.03	57.92	36	21.92
46	02.Dec.03	50.42	37	13.42
47	03.Dec.03	51.67	48	3.67
48	04.Dec.03	50.42	56	-5.58
49	05.Dec.03	65.83	52	13.83
50	18.Dec.03	64.58	51	13.58
51	12.Mar.04	62.5	67	-4.5