

Avenue Remediation Project

Air Quality and Odour Monitoring Programme

Summary of Results: May 2010

1. Overview

1.1 Summary of Monthly Air Quality Monitoring Results

Table 1 provides an overview of the air quality measurement data for May 2010 (5th May to 31st May¹) and the evaluation of significance of the measured values in the context of target levels for each pollutant. Further details concerning the measured levels of each of the pollutants are reported in subsequent sections of this summary report.

Table 1 – Summary of Air Quality Monitoring Results Compared to Air Quality Objectives and Guideline Values for Key Pollutants

Pollutant	Averaging Period	The Avenue Target Value	The Avenue Measured Values	Evaluation (Low, Med, High)
Nitrogen Dioxide (NO ₂)	Monthly Mean	40 µg m ⁻³	11.92 – 20.02	Low
Fine Particulate Matter (PM ₁₀)	Monthly Mean	40 µg m ⁻³	9.65 – 16.61	Low
Fine Particulate Matter (PM ₁₀)	24-hr Mean	50 µg m ⁻³	4.01 – 31.56	Low
Fine Particulate Matter (PM _{2.5})	Monthly Mean	25 µg m ⁻³	4.52 – 5.68	Low
Metals - Lead	Monthly Mean	0.25 µg m ⁻³	0.02	Low
Cyanide	2-week Mean	50 µg m ⁻³	0.03 max	Low
PAHs - Coal Tar Pitch Volatiles	2-week Mean	0.48 µg m ⁻³	0.05 max	Low
PAHs - Naphthalene	2-week Mean	126 µg m ⁻³	0.00015 max	Low
Phenols – Phenol	2-week Mean	48 µg m ⁻³	< 0.2	Low
Phenols – Cresols	2-week Mean	220 µg m ⁻³	< 0.2	Low
VOCs - Benzene	2-week Mean	5 µg m ⁻³	< 2	Low
Dust Deposition - Directional Gauge (off-site monitoring)	Monthly Mean	200 mg m ⁻² day ⁻¹	82 – 144	Low
Dust Deposition - Directional Gauge (on-site monitoring)	Monthly Mean	200 mg m ⁻² day ⁻¹	123 - 256	Medium**
Dust Soiling – Sticky Pad	% EAC*	5 % EAC	8.3 max	Medium**
Odours	n/a	n/a	Low-Medium	Low

Notes:

Where the averaging period of the target value is for a 2-week mean, the measured value presented in the table is the maximum value measured during the month.

* %EAC refers to percentage area covered per day.

¹ Monitoring reporting periods are 4 or 5 weeks in duration and may not correspond directly to a calendar month.

** Locations where dust levels are recorded as 'medium' are within the site boundary and are primarily situated to monitor on-site levels. The nearest receptor properties are some 500m away and are unlikely to be affected by elevated levels of dust.

In summary:

There were no air quality related complaints recorded during the month of May.

There were two exceedances of on-site targets in May and these involved the level of dust deposition at Site B on the north-east boundary of the Avenue site and the levels of dust soiling at Site 8 located on the western boundary. The sticky pad located at Site 5, adjacent to the fixed monitoring station at Site B, showed higher levels of dust soiling in May when compared to the majority of other sites, but these levels did not lead to an exceedance of the target level. The higher levels of deposited dust at Site B are likely to be due to proximity of this location to vehicular activities, haul route construction and dry surfaces (within 10 metres of the monitor). The elevated level at the sticky pad at location 8 was most likely to be due to very localised emissions of dust from the car parking area immediately upwind of the monitoring location.

Although there were elevated dust levels at Site B and at sticky pad Site 5 due to activities in close proximity, no visual off-site nuisance was evident, recorded or reported. Both monitors are within the site boundary and are primarily situated to monitor on-site levels. The nearest receptor properties are some 500 m away. Additionally no impact was observed upon the river.

Concentrations of particulate matter (PM₁₀) were generally lower than measurements in April 2010, with the maximum measured 24-hour average concentration of 31.6 µg m⁻³ recorded at Site 2 (Hunloke Park School). At the time of this peak in concentrations, the measured values at all other sites were generally lower than at other points during the month and the Avenue was downwind, which suggests that a source of particles close to the monitoring station at the school was in part responsible. The variability in concentrations of PM₁₀ at Site B across the month, combined with an analysis of wind directions, suggests that the remediation works at the Avenue are leading to slightly higher concentrations at this site; these observations are consistent with those for deposited dust and dust soiling. The magnitudes of the measured concentrations at all sites are comfortably within the target value of 50 µg m⁻³ and the remediation works are not having a significant effect on ambient concentrations of particulate matter.

Concentrations of PM_{2.5} were of a similar magnitude to those measured in previous months; the monthly averages were below 6 µg m⁻³ and were therefore comfortably below the annual mean air quality objective of 25 µg m⁻³. When the wind was from easterly sectors, Site B was upwind of the Avenue and monitored concentrations were marginally lower than the times when the wind was blowing from westerly sectors across the Avenue site towards the monitoring station.

Concentrations of nitrogen dioxide (NO₂) were between approximately 12 and 20 µg m⁻³ and were therefore typically less than 50% of the 40 µg m⁻³ annual mean air quality objective. Concentrations of cyanide, metals, VOCs and PAHs were comfortably within their respective target levels.

There were no odour complaints in May and at all locations where the sensory field odour surveys were conducted, the maximum odour annoyance impact was 'low-medium'. No odour diarists reported odours that were likely to be linked to the Avenue. During May, the effects of odour were not considered significant.

1.2 Work Activity

The site remediation operations are now well established and some site-based works with the potential to adversely affect air quality have taken place during May 2010. The earthworks included the following activities:

Zone 1: River Flood Plain

- Construction of the sheet pile wall / coffer continued with works centring around the welding of struts; and
- The continued construction of the temporary bridge over the river and the concrete haul road up to the bridge.

Zone 2: Low Level Stocking Area (western boundary, adjacent to A61)

- The filling of the borrow-pit in the southern part of Zone 2 with material excavated from Zone 4 (former plant area).

Zone 3: High Level Stocking Area and Waste Tip

- The temporary stockpiling of small volumes of contaminated material from Zone 4 requiring further treatment in advance of the availability of the treatment processes;

- Red shale has been excavated from the northern part of the High Level Stocking Area for use as fill in the development area in Zone 4.

Zone 4: Former Plant Area

- Works associated with the gas supply line had been undertaken;
- Construction of the Thermal Treatment Plant continued;
- Excavations and concrete breakout works continued to the south of the site water treatment plant where the proposed new water treatment plant is to be constructed;
- Further investigation of the Coke Oven basement structures had been undertaken;
- Breakout of structures north of the Coke Oven basements associated with old cooling tower and pumping sumps had been undertaken. Rubble from sumps was excavated and refilling activities were undertaken; and
- Demolition of the large green storage tanks (hydraulic steel cutting) continued and these were removed from site.

Zone 5: Eastern Area

- Works associated with site surface drainage redirection and works involving the positioning of the holding pond (HP11) associated with the bioremediation area continued; and
- Preparation of the concrete hardstanding area for bioremediation continued.

1.3 Alterations, Downtime and Technical Difficulties

A summary of alterations to the monitoring programme, alongside downtime and technical issues during the month are summarised in Table 2.

Table 2 – Summary of Alternations, Downtime and Technical Difficulties

Location	Dates	Technical Issue
Alternations to Monitoring Programme:		
Site 8 (Sticky Pad)	May onwards	The sticky pad at this location has been measuring elevated levels of dust soiling. However, the location of the pad is on the western edge of the car parking area and dust is generated by turning vehicles. The pad location has been moved (02/07/10) to the east and is now located on the opposite side of the car park so that measured dust levels would be more representative of the site works and not activity in the car park.
Sites 1, 7 and C	May onwards	Sites decommissioned in line with the Air Quality Management Plan. No results presented.
All Sites	May onwards	SO ₂ monitoring ceased, in line with the Air Quality Management Plan.
Downtime and Technical Difficulties:		
Site 6	22 nd - 31 st May	There was a loss of power to the monitoring station resulting in data loss. The electricity supply cable was replaced and power restored.

2. Detailed Air Quality Monitoring Results

2.1 Routine Air Quality Monitoring

This section provides an overview of the measurement data for the fixed monitoring sites.

2.1.1 PM₁₀ Concentrations

Table 3 presents monthly average concentrations of PM₁₀ at the fixed monitoring sites. Concentrations of PM₁₀ within and close to the Avenue recorded levels in the range of 9.6–17.2 µg m⁻³. The highest average concentration of 17.2 µg m⁻³ at Site B (Avenue NE) and Site 6 (BT Offices) is less than 50% of the 40 µg m⁻³ annual mean air quality objective. As there are only slight variations in monitored concentrations at sites bordering the Avenue, it could be concluded that the Avenue is having no discernible effect on concentrations of particulate matter.

Table 3 – Monthly Average Concentrations of PM₁₀ Particulate Matter (µg m⁻³)

Monitoring Site	PM ₁₀ Monthly Average Concentration (µg m ⁻³)
Site A: Avenue (NW)	13.6
Site B: Avenue (NE)	17.2
Site D: Avenue (SW)	9.6
Site 2: Hunloke Primary School	16.0
Site 4: Village Hall, Hasland	12.7
Site 5: Avenue Farm	13.6
Site 6: BT Offices (Pioneer House) Mill Lane	17.2

Figure 1 presents 24-hour average concentrations of PM₁₀ at the fixed continuous monitoring sites.

Compared to some previous months, there has been less variation in the measured concentrations of PM₁₀ during May.

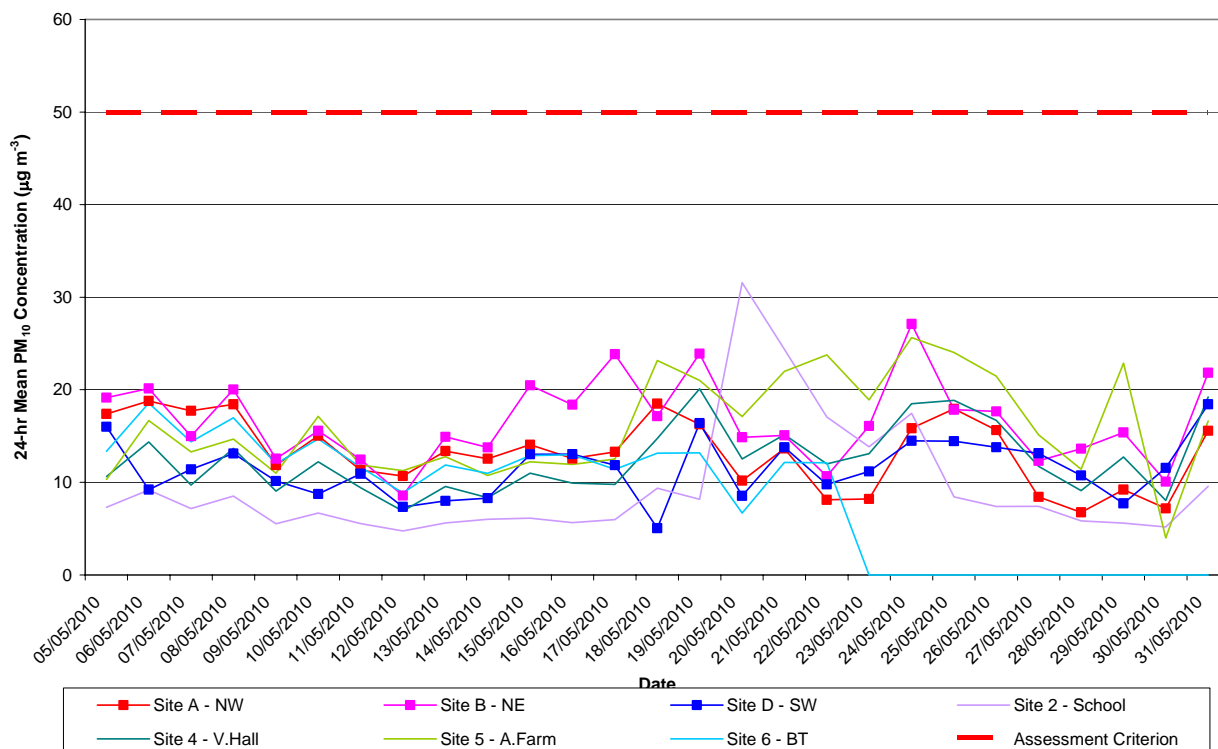
The maximum measured 24-hour average concentration of 31.6 µg m⁻³ was recorded at Site 2 (Hunloke Primary School) on 20th May. At the time of this peak in concentrations, the measured values at all other sites were generally lower than at other points during the month, which suggests that a source of particles close to the monitoring station at the school was in part responsible. The wind direction at the time of the peak concentration supports this conclusion, as the monitoring station was upwind of the Avenue. With the exception of elevated concentrations at Site 2 from 19th–25th May, the monitored concentrations at Site 2 were the lowest of all the sites.

The graph shows that that measured concentrations across the month were similar at each of the sites, although there was more variability in 24-hour average concentrations at Site B which would suggest a contribution from the Avenue. Given the proximity of Site B to the Avenue, its general downwind location and its proximity to works taking place to the north-east of the Avenue site, these observations are not unexpected. On the 24th May the wind was at times blowing from the north-west and the monitoring station was therefore downwind of the remediation works. Similar observations are made with respect to Site 5 (Avenue Farm), although it is known that activities taking place at the farm, in close proximity to the monitoring station, can affect the level of monitored concentrations.

The magnitudes of the measured concentrations at all sites are comfortably within the target value of 50 µg m⁻³. Furthermore, as concentrations at each location are similar, and trends in increasing and decreasing concentrations are generally observed simultaneously at both upwind and downwind sites, it would seem that the remediation works are not having a significant effect on ambient concentrations of particulate matter.

The zero concentrations in PM₁₀ at Site 6 from 23rd May are the result of a loss of power to this monitor.

Figure 1 – 24-hour Average Concentrations of PM₁₀ Particulate Matter (µg m⁻³)



2.1.2 PM_{2.5} Concentrations

Table 4 presents monthly average concentrations of PM_{2.5} at the two fixed monitoring sites.

The highest average concentration of 5.9 µg m⁻³ occurred at Site B located at the north-east boundary of the Avenue site, and this was 1.7 µg m⁻³ higher than the concentration measured in April. At Site 4, located in Hasland beyond the north-eastern boundary of the Avenue site, the monthly average concentration of PM_{2.5} decreased from 7.2 µg m⁻³ in April to 4.5 µg m⁻³ in May. From the relatively small changes in PM_{2.5} concentrations it is not possible to identify whether remediation activities have been partly responsible for these variations in measured values.

All measured concentrations are significantly less than the 25 µg m⁻³ annual mean national air quality objective.

Table 4 – Monthly Average Concentrations of PM_{2.5} Particulate Matter (µg m⁻³)

Monitoring Site	PM _{2.5} Monthly Average Concentration (µg m ⁻³)
Site B: Avenue (NE)	5.9
Site 4 – Village Hall, Hasland	4.5

Figure 2 presents 24-hour average concentrations of PM_{2.5} at the fixed monitoring sites, to provide an indication of the monthly variation in measured values.

In the context of the 25 µg m⁻³ annual mean air quality objective for PM_{2.5}, there is little variability in measured concentrations across the month, and until halfway through the month concentrations at both sites are similar and follow the same trend in terms of increasing and decreasing daily concentrations. This suggests that background levels of PM_{2.5} dominate.

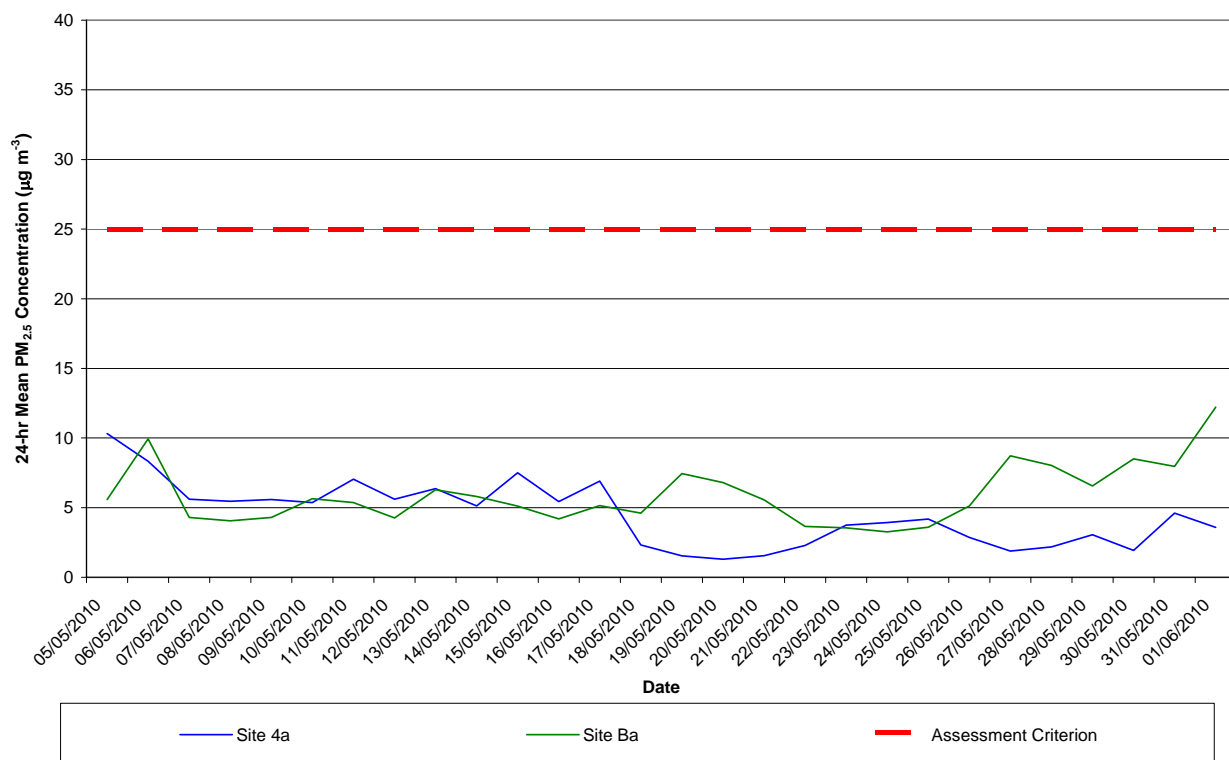
From 18th May, concentrations at Site 4 reduce for the remainder of the month, whereas concentrations at Site B increase, relative to those at Site 4, before both monitoring stations simultaneously measure approximately 3.5 µg m⁻³ between 23rd and 25th May; the concentrations at Site B then begin to rise once again whereas those at Site 4 reduce further.

Concentrations at Site B at the end of the month are higher than those at Site 4, which is the reverse of the trend that the graph indicates for the first half of the month.

Some of the difference in concentrations between those measured at Site 4 and Site B may be attributable to the Avenue (when Site B measures higher concentrations than Site 4). This conclusion is supported by the meteorological data which shows that the wind leading up to the evening of 24th May was broadly from a westerly direction, switching to winds from easterly sectors, before reverting back to predominantly westerly sectors from the evening of 27th May. At times when the wind was from easterly sectors, Site B was upwind of the Avenue and monitored concentrations were marginally lower than the times when the wind was blowing from westerly sectors across the Avenue site towards the monitoring station.

Concentrations across the month are significantly less than the annual mean national air quality objective of 25 $\mu\text{g m}^{-3}$.

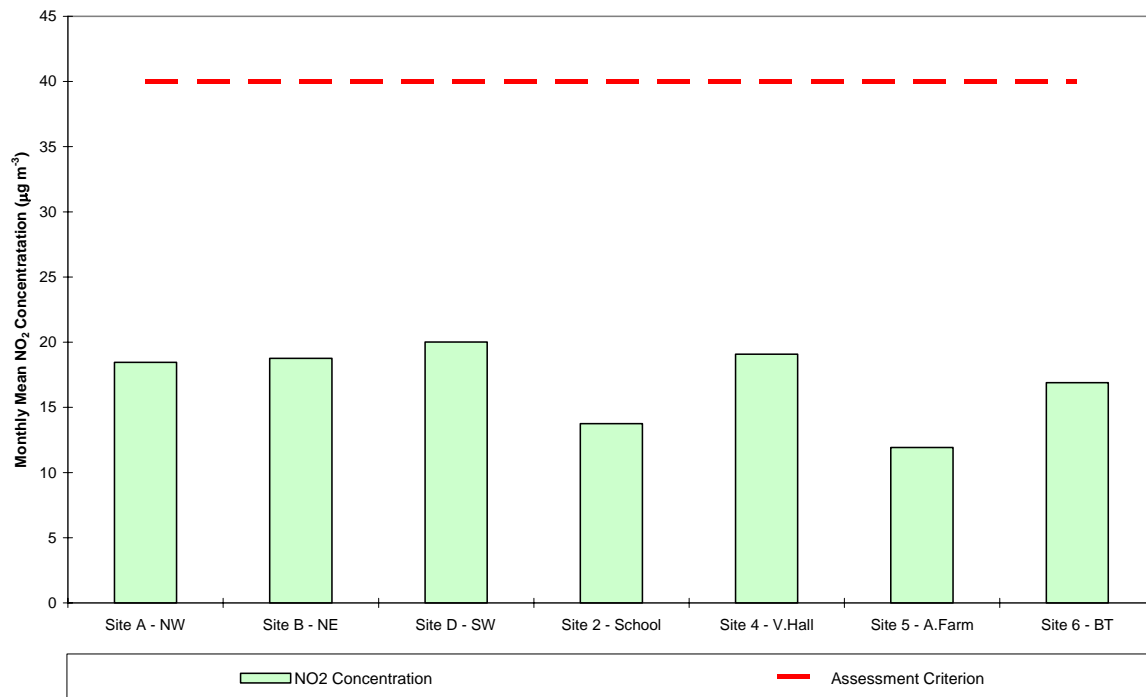
Figure 2 – 24-hour Average Concentrations of PM_{2.5} Particulate Matter ($\mu\text{g m}^{-3}$)



2.1.3 Nitrogen Dioxide Concentrations

Figure 3 presents monthly average concentrations of nitrogen dioxide across each of the fixed monitoring sites. At all locations, measured concentrations were below the 40 $\mu\text{g m}^{-3}$ annual mean air quality objective. The maximum measured monthly average concentration was 20.02 $\mu\text{g m}^{-3}$ at Site D (Avenue SW), although several of the other sites have monthly average concentrations approaching this maximum value including sites A, B and 4, with monthly average concentrations of 18.45 $\mu\text{g m}^{-3}$, 18.77 $\mu\text{g m}^{-3}$ and 19.08 $\mu\text{g m}^{-3}$ respectively).

Figure 3 – Monthly Average Concentrations of Nitrogen Dioxide ($\mu\text{g m}^{-3}$)



2.1.4 Deposited Dust Levels

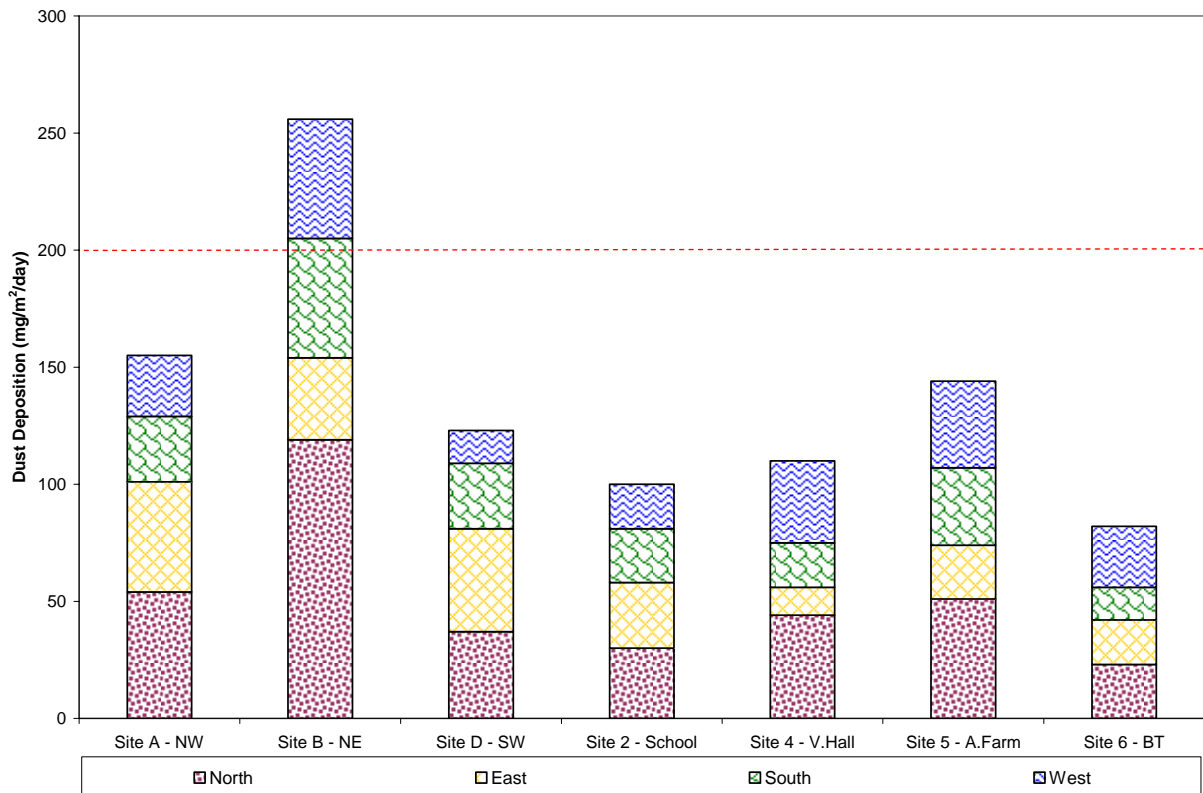
Figure 5 presents the monthly levels of deposited dust at each of the monitoring stations and the source direction.

The highest measured level of deposited dust of 256 mg/m²/day was recorded at Site B (Avenue NE) where the measured levels represent an exceedence of the target level. If these levels were measured at a sensitive receptor location, as opposed to an on-site monitoring station, the level of deposition would be likely to lead to complaints. Exceedences of this threshold were also measured at Site B in April.

At Site B, approximately a half of the deposited dust originated from the north and this pattern of dust deposition levels would suggest the Avenue site was a contributing element to these dust levels. The higher levels of deposited dust at Site B are likely to be due to proximity of this location to vehicular activities, haul route construction and dry surfaces (within 10 metres of the monitor). Mitigation measures employed onsite include; the use of a water bowser ,which is in continuous operation around the site during working hours; speed limits are observed onsite, trafficking on un-dampened roads is minimised; and daily checks for nuisance dust levels offsite are undertaken.

At Site A, the north and east sectors represent 2/3 of the total deposited dust in May and it would be reasonable to assume, based on the site's proximity to the remediation activities taking place at the Avenue, that the site was the predominant dust source. At Site D, marginally more dust came from the east, which is the direction of the Avenue, whereas at the offsite locations (2, 4, 5 and 6) the distribution of deposited dust at each of the compass points is more even, suggesting no dominant local source direction of dust.

Figure 5 – Measured Dust Deposition Levels (mg/m²/day)



2.1.5 Dust Soiling Levels

Measurements of dust soiling continue to be undertaken using sticky pads at 8 locations, over periods of approximately seven days, for comparison against target levels measured in units of effective area covered per day (% EAC).

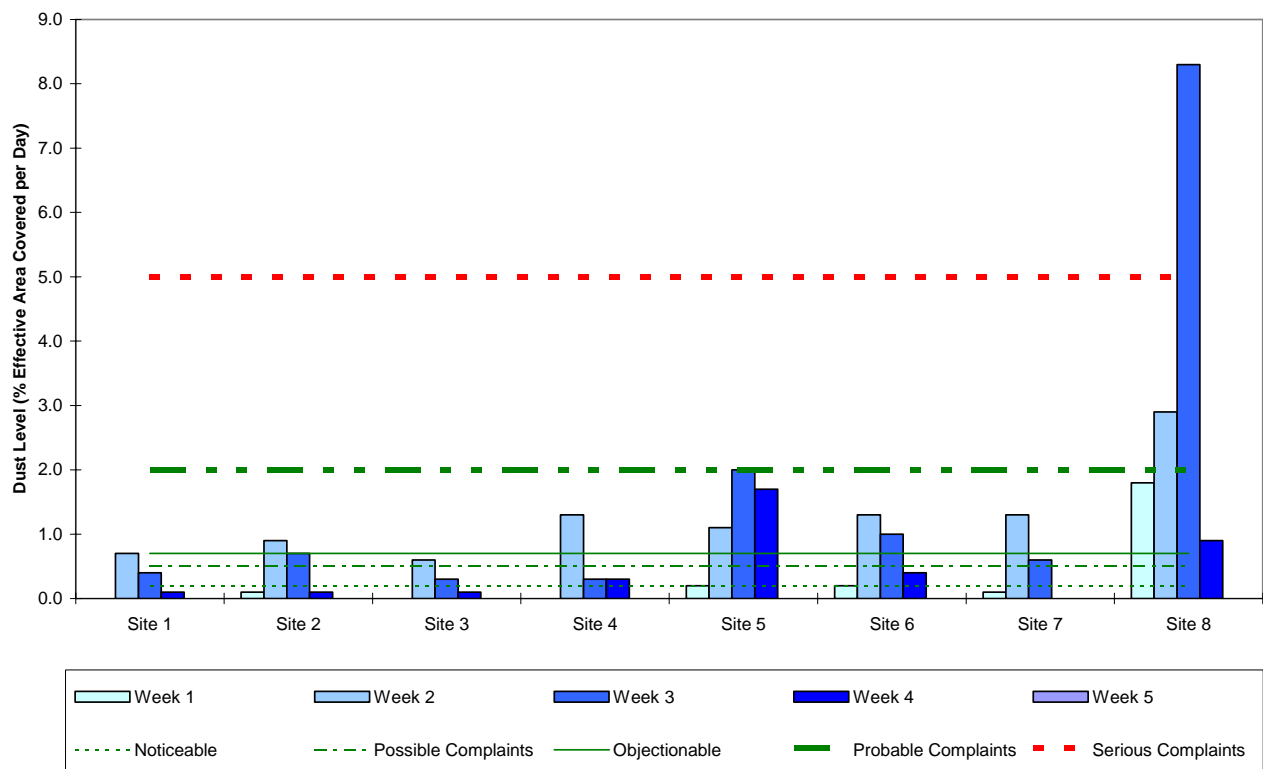
Figure 6 shows the maximum measured weekly levels of dust from the sticky pads at each of the 8 monitoring locations. The highest level of dust of 8.3 %EAC was measured in Week 4 at Site 8 (west boundary). This value was recorded for the eastern side of the sticky pad suggesting that the source of dust was from the east, and was therefore likely to originate from the Avenue site. The level of dust experienced at this location could result in complaints if this monitoring site was located at a receptor, rather than the edge of the Avenue site, within the site boundary. This sticky pad location is however immediately on the edge of the car park that lies between the main Avenue site and the monitoring location. Vehicles manoeuvring in the car park have been observed to cause surface dust to become airborne which then deposits on the sticky pad a few metres away. As the measured levels at the sticky pad do not represent the wider contribution from the remediation activities at the Avenue, and instead reflect very localised levels of dust soiling, the monitoring site has been moved approximately 20 m to the east and is now located between the main Avenue site and the car park.

The dust soiling levels at Site 5 coincide with the elevated deposited dust levels at Site B, as these sites are co-located. The road construction, local trafficking and dusty surfaces in the area are the likely sources of the dust. Both of these monitors are situated within the site boundary. There were no visual off-site impacts and there was no impact upon the river.

At all locations, with the exception of Site 8 in week 4 (as explained above), measured levels of dust were below the target level of 5% EAC and would therefore be unlikely to lead to complaints from receptors located further from the Avenue site.

The threshold values will be re-evaluated in the review of the site Air Quality Management Plan that is scheduled for July / August 2010.

Figure 6 – Maximum Weekly Measured Dust Levels using Sticky Pad Technique (%EAC/day)



2.1.6 Volatile Organic Compounds

The assessment criteria limits for benzene and toluene are $5 \mu\text{g m}^{-3}$ and 1.9 mg m^{-3} as a 2-week average, respectively.

The maximum measured concentration of benzene in period 1 was less than the limit of detection of $2.0 \mu\text{g m}^{-3}$ and in period 2 the maximum measured concentration was less than the limit of detection of $1.8 \mu\text{g m}^{-3}$. The assessment criterion for benzene has therefore been comfortably achieved at all monitoring stations.

The maximum measured concentrations of toluene in period 1 were 0.0064 mg m^{-3} and in period 2 the measured concentrations were 0.0059 mg m^{-3} . The assessment criterion for toluene has therefore been comfortably achieved at all monitoring stations.

2.1.7 Metals

The only metal with an air quality objective is lead, with a concentration of $0.25 \mu\text{g m}^{-3}$ as an annual average. The maximum measured concentration of lead was $0.02 \mu\text{g m}^{-3}$ at four locations during the first monitoring period; Site A (north-west of the site), Site 4 (Village Hall), Site 5 (Avenue Farm) and Site 6 (BT Offices). During the second monitoring period the maximum measured concentration of lead was $0.01 \mu\text{g m}^{-3}$ at Site D (west of the site).

Concentrations of all metals were in most cases below limits of detection; where concentrations were above limits of detection the concentrations were below target levels.

2.1.8 Cyanide

There are no air quality objectives for cyanide. The assessment criterion for the Avenue is a maximum concentration of $50 \mu\text{g m}^{-3}$ as a 2-week average. At all locations concentrations of cyanide were below the limit of detection of $0.03 \mu\text{g m}^{-3}$.

2.1.9 Phenol(s)

The target levels for phenol and cresol at the Avenue are $48 \mu\text{g m}^{-3}$ and $220 \mu\text{g m}^{-3}$ as a 2-week average, respectively. The reporting of these compounds is subject to a lower detection limit of $0.2 \mu\text{g m}^{-3}$ and there were no measured concentrations above this level.

2.1.10 Poly-Aromatic Hydrocarbons

The target level of Coal Tar Pitch Volatiles at the Avenue is $0.48 \mu\text{g m}^{-3}$, whilst for naphthalene the level is $126 \mu\text{g m}^{-3}$. There were no exceedences of the target level for Coal Tar Pitch Volatiles during the month and no exceedences of the target level for naphthalene.

The highest measured concentration of total Coal Tar Pitch Volatiles was $0.05 \mu\text{g m}^{-3}$ at Site B (Avenue NE) during the second period of monitoring. The highest measured concentration of naphthalene was $0.00015 \mu\text{g m}^{-3}$ at Site 5 (Avenue Farm) in the second period of monitoring,

Given the location of Site B, it is likely the source of Poly-Aromatic Hydrocarbons was the Avenue site. The activities taking place near this monitoring location during May included the stockpiling, prior to treatment, of small quantities of contaminated material from Zone 4 in Zone 3 close to the monitoring location.

2.2 Targeted Air Quality Monitoring

2.2.1 Asbestos

Reassurance air testing for asbestos was carried out on 4th, 10th, 19th and 26th May. The monitoring was undertaken downwind and at the boundary of the following works:

- Zone 4: Downwind of earthworks, stockpiling and excavation works south of the Roman Baths (underground liquid holding tanks) (4th, 10th, 19th and 26th May); and
- Zone 2: Downwind of dozer and roller activity (19th and 26th May).

All measured concentrations of fibres were $< 0.01 \text{ f ml}^{-1}$ (fibres per milli-litre) and are therefore comfortably within the control limit.

2.3 Odour Monitoring

2.3.1 Odour Diaries

Odour diaries for May show that there were 4 Odour Days when odour intensity was rated greater than 4 when wind was blowing from the Avenue.

The odour day of the 7th May had odours that were described as Tar / Asphalt, with the odour intensity rated as 4; on 19th May odours were described as Smokey with an odour intensity of 4; on 21st May odours were described as Rotten / Decaying with an odour intensity of 5; on 25th May odours were described as Creosote with an odour intensity of 5.

The observation on 7th May was from a location within the boundary of the Avenue site and the odours with Tar / Asphalt characteristics were most likely to be from the remediation activities.

On the day when smokey odours were recorded (19th May), the wind direction was from the south-west which could result in odours from the site being transported to the location where the odour was recorded. However, there were no activities on site which could have generated smokey odours and the location where the odour was recorded was over 1km from the boundary of the Avenue site.

The odours described as rotten / decaying were observed when the wind was blowing from the south-west. The location of the odour diarist was to the west of the main site access in Wingerworth, and on the basis of the prevailing wind it would be possible for odours to migrate from areas within the south-western corner of the Avenue site. However, the characteristics of the odours are not those associated with the remediation works taking place at the Avenue and it's therefore more likely that another local source of odour was responsible.

At the time when creosote odours were recorded on 25th May, the wind was from the north-east and it would be possible for odours from the north-west of the Avenue site to migrate towards the location of the observation near to the school in Wingerworth. No explanation has been identified for these odours, but based on the distance of the observation from the boundary of the Avenue site and that odour diarists located further upwind and closer to the boundary of the Avenue did not observe similar odours, it is concluded as unlikely that the Avenue was the source of these odours.

2.3.2 Sensory Field Odour Surveys

Sensory field odour surveys were carried out on 5th, 14th, 20th and 26th May at each of the fixed monitoring stations. During each survey, the maximum odour annoyance impact level at the times when the wind was blowing from the Avenue was recorded. At all locations, the maximum odour annoyance impact was '*low-medium*' and, therefore, the effects of odour are not considered significant.

2.3.3 Odour Complaints

There have been no odour complaints during May 2010.