

Avenue Remediation Project

Air Quality and Odour Monitoring Programme

Summary of Results: December 2009

1. Overview

1.1 Summary of Monthly Air Quality Monitoring Results

Table 1 provides an overview of the air quality measurement data for December 2009 (6 December to 4th January¹) 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	18.32 – 27.89	Low
Fine Particulate Matter (PM ₁₀)	Monthly Mean	40 µg m ⁻³	7.13 – 15.64	Low
Fine Particulate Matter (PM ₁₀)	24-hr Mean	50 µg m ⁻³	0.10 – 26.70	Low
Fine Particulate Matter (PM _{2.5})	Monthly Mean	25 µg m ⁻³	4.04 – 4.93	Low
Sulphur Dioxide (SO ₂)	2-week Mean	125 µg m ⁻³	22.32 max	Low
Metals - Lead	Monthly Mean	0.25 µg m ⁻³	0.04 max	Low
Cyanide	2-week Mean	50 µg m ⁻³	0.02 max	Low
PAHs - Coal Tar Pitch Volatiles	2-week Mean	0.48 µg m ⁻³	0.00110 max	Low
PAHs - Naphthalene	2-week Mean	126 µg m ⁻³	<0.2 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	4.8	Low
Dust Deposition - Directional Gauge	Monthly Mean	200 mg m ⁻² day ⁻¹	28 – 73	Low
Odours	n/a	n/a	Low-Med	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.

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

In summary:

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

In terms of the monitoring results, there were no exceedences of the target levels of pollutants during the month. Levels of most pollutants were either the same or lower than those measured during the previous month. The maximum measured 24 hour average concentration of PM₁₀ was considerably lower than November when higher than normal concentrations were possibly due to the activities surrounding Bonfire Night.

1.2 Work Activity

The site remediation operations (known as Stage 3 of the Avenue project) officially commenced on 9 September 2009. Although, there was only limited operational activity during the month, some site-based works, with the potential to affect air quality have taken place. The earthworks included the following activities:

- Week 49 (30 November – 6 December)
 - Excavation of material from coke oven basements in Zone 4;
 - Borrow-pit excavation in Zone 2;
 - Stockpile crushing in Zone 5; and
 - Waste-tip treatment pad works in Zone 3a (High Level Stocking Area).
- Week 50 (7 December – 13 December):
 - Stockpile crushing in Zone 5;
 - Borrow-pit excavation in Zone 2;
 - Waste-tip treatment pad works in Zone 3a (High Level Stocking Area);
 - Holding Pond 1 outlet construction in Zone 2; and
 - Installation of trial water treatment plant.
- Week 51 (14 December – 20 December):
 - Stockpile crushing in Zone 5;
 - Waste-tip treatment pad works in Zone 3a (High Level Stocking Area); and
 - Emptying of Romney Shed drums in zone 3; and
 - Installation and operation of trial water treatment plant.
- Week 52 (21 December – 27 December):
 - Site closed over Christmas break.
- Week 53 (28 December – 3 January 2010):
 - Site closed over Christmas break.

1.3 Alterations, Downtime and Technical Difficulties

A summary of alternations 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
<i>Alternations to Monitoring Programme:</i>		
None	n/a	n/a
<i>Downtime and Technical Difficulties:</i>		
Site 7	3 rd December to 16 th December	The laboratory failed to split the 47mm filter prior to digestion which resulted in the loss of results for gravimetric PM ₁₀ , PAH and Phenols for period 1.
Site B and C	3 rd December to 16 th December	The power supply to sites B and C was interrupted on three occasions during December period 1. The power junction compound security was improved and the power supply was then stable during December period 2. Some data from the APM950s was lost as a result of the power loss.

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. The highest average concentration of 15.6 µg m⁻³ at Site 7 (Nursery at Stretton), which is located ~6 km to the south of the site, is less than 50% of the 40 µg m⁻³ annual mean air quality objective; concentrations at this location are significantly influenced by road traffic on the A61. The second highest monthly average of 9.5 µg m⁻³ was recorded at Site 4 (Village Hall, Hasland), which is ~1 km to the north-east of the site, whilst the stations within and close to the Avenue recorded levels in the 7.1-9.3 µg m⁻³ range.

The Avenue site was closed over the Christmas period and although measured concentrations are dominated by ambient background levels of particulate matter, it is possible that some of the reduction was due to limited emissions from the Avenue. Furthermore, weather conditions, including heavy snow and frozen ground would have led to reduced pollutant concentrations.

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)	9.0
Site B: Avenue (NE)	7.1
Site C: Avenue (SE)	7.9
Site D: Avenue (SW)	8.7
Site 1: Press Lane Farm, Old Tupton	8.1
Site 2: Hunloke Primary School	7.7
Site 4: Village Hall, Hasland	9.5
Site 5: Avenue Farm	9.3
Site 6: BT Offices (Pioneer House) Mill Lane	9.1
Site 7: Nursery at Stretton*	15.6

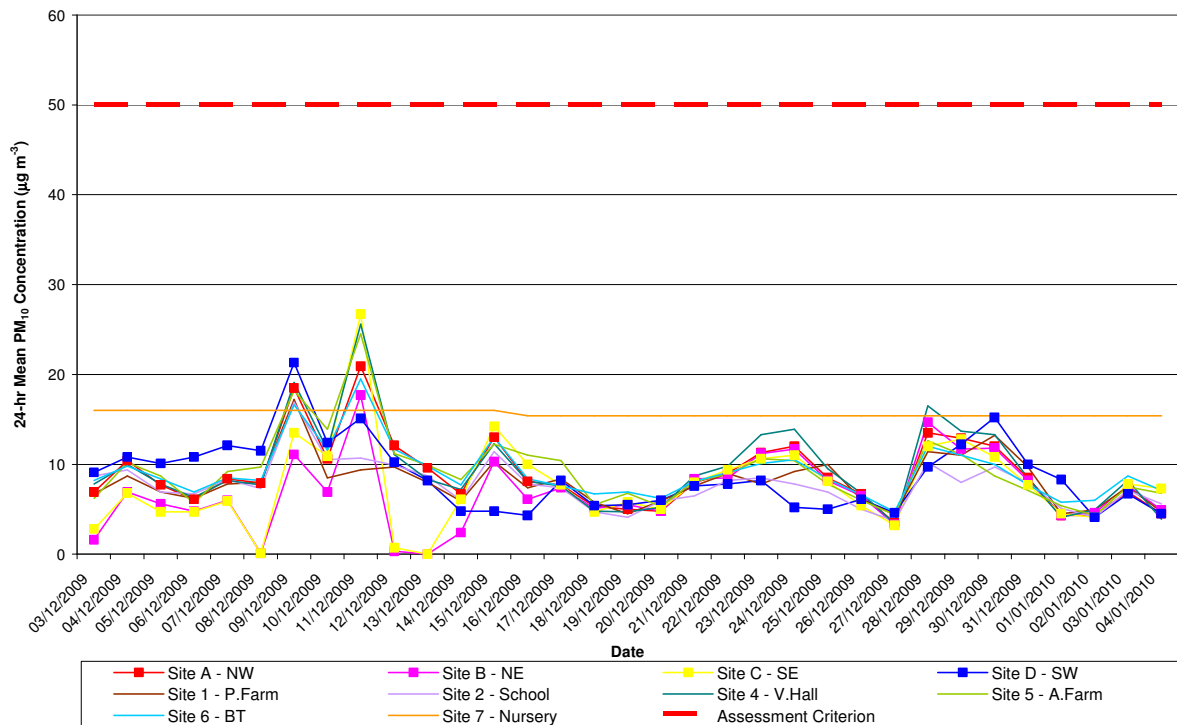
Notes:

* Concentration measured at Site 7 using Mini-Vol sampler. All other measurements using APM950 instrumentation

Figure 1 presents 24-hour average concentrations of PM₁₀ at the fixed monitoring sites; measured concentrations in the December monitoring period were generally lower than those measured during November. The maximum measured concentration of 26.7 µg m⁻³ was recorded at Site C (Avenue SE) on 11th December, which was also the date of the maximum measured concentration at Sites A, B, 4, 5 and 6. A review of the windspeed and direction from the on-site meteorological station shows that 11th December experienced light winds during 5 hours of the day with no measured windspeed for the remaining 19 hours. During the time period 12:00-13:00 when measured particulate concentrations were at the highest during the day at Site C, the wind was blowing from a north-easterly direction and Site C was upwind of the Avenue, thus indicating that the Avenue site would not have been the dust source leading to higher measured concentrations. Sites 4, 5 and 6 were also upwind of the Avenue site on 11th December and the same conclusions can also be drawn. Site A was the only site downwind of the Avenue on this date, but it is most likely that particulate matter originated to the NE of the Avenue site and was blown across the site to the monitoring station.

For the remainder of the sites (D, 1 and 2), the 9th December was the date with the highest measured concentrations. These results show that elevated concentrations of particulate matter were widespread and as such, the Avenue site was not likely to be the principal source of emissions. Furthermore, an evaluation of the meteorological data for 9th December indicates moderate winds blowing from the west / north-west, which would indicate that the air quality monitoring stations were upwind of the Avenue, thus the Avenue was not the source of particulate matter.

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



Notes:

* Concentration measured at Site 7 using Mini-Vol sampler. All other measurements using APM950 instrumentation

2.1.2 PM_{2.5} Concentrations

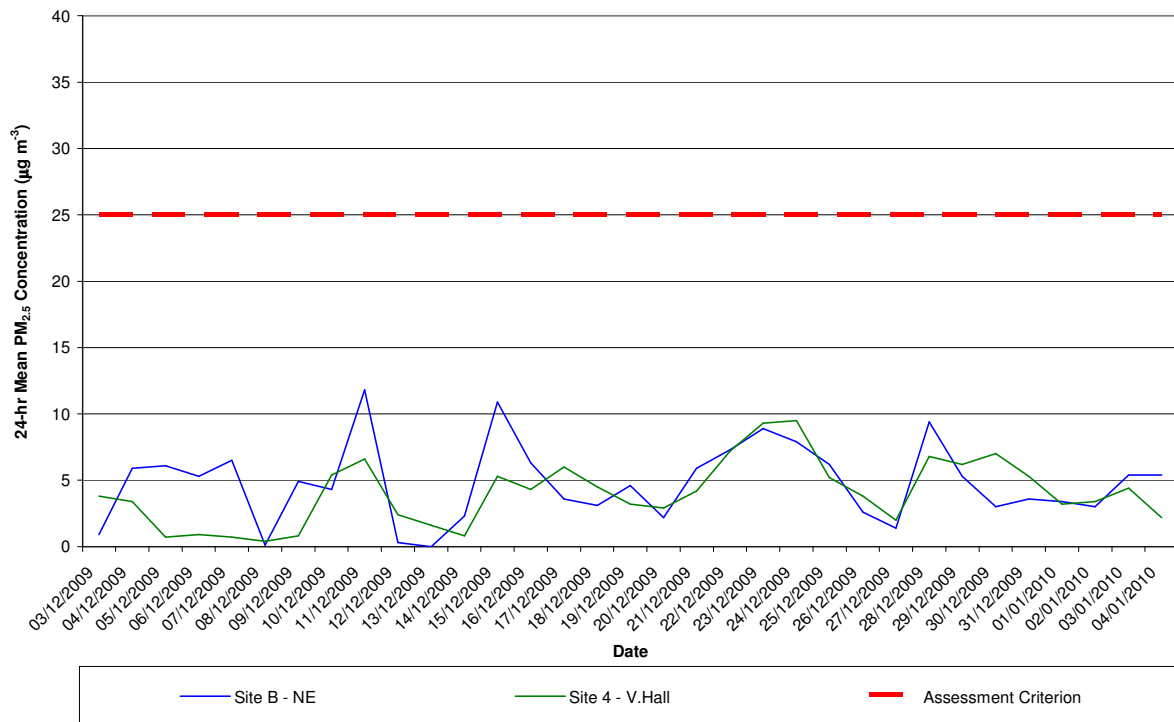
Table 4 presents monthly average concentrations of PM_{2.5} at the two fixed monitoring sites; as observed for PM₁₀, concentrations of PM_{2.5} are slightly lower in December than in November. The highest average concentration of 4.9 µg m⁻³ occurred at Site B (located on the north east boundary of the Avenue site), but this is 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)	4.9
Site 4 – Village Hall, Hasland	4.0

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. The figure shows the monitored concentrations at both locations being of a similar magnitude for the whole period, although there is more variability in the measured concentrations at Site B. There are two distinct periods where concentrations at Site B are more than double those at Site 4 which suggests that the emissions causing the higher concentrations are perhaps more local to the monitoring station. In any event, the 24 hour concentrations of PM_{2.5} at Site B and 4 do not exceed the assessment criterion during the period; the highest concentrations measured at Site B are less than 50% of the 25 µg m⁻³ annual mean national air quality objective.

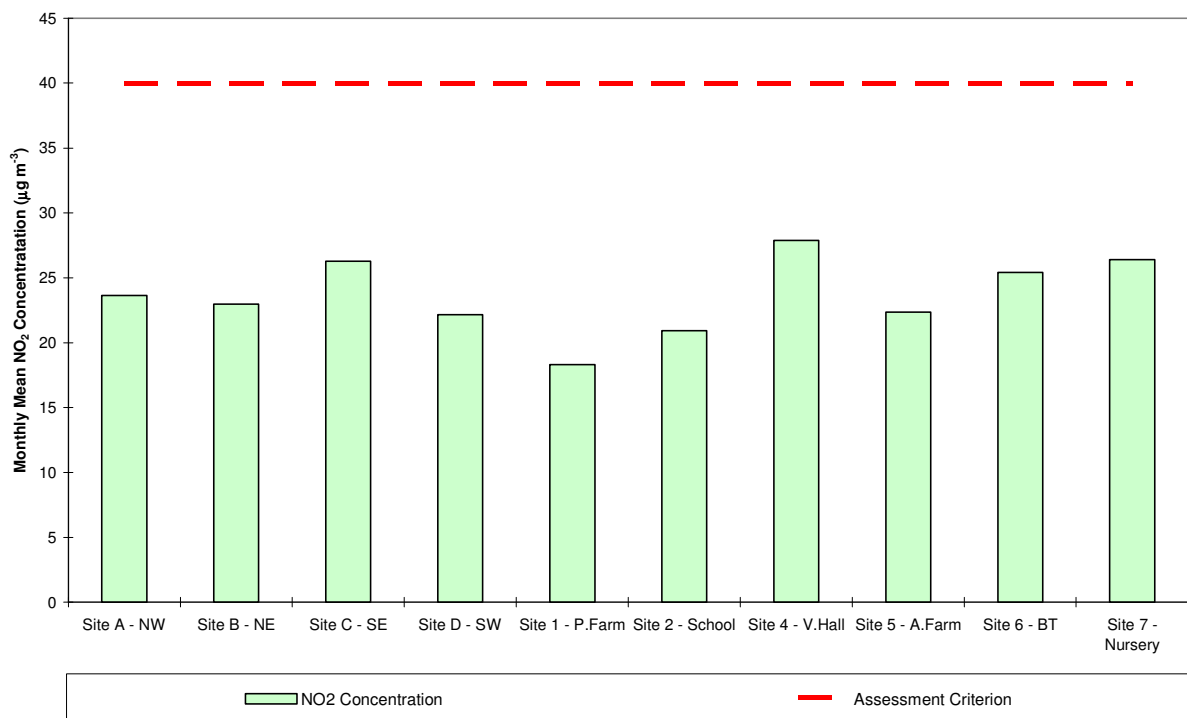
Figure 2 – 24-hour Average Concentrations of PM_{2.5} Particulate Matter ($\mu\text{g m}^{-3}$)



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 concentration was $27.89 \mu\text{g m}^{-3}$ at Site 4 (the Village Hall in Hasland), although levels of NO_2 at this location would be primarily affected by local emission sources unconnected to The Avenue.

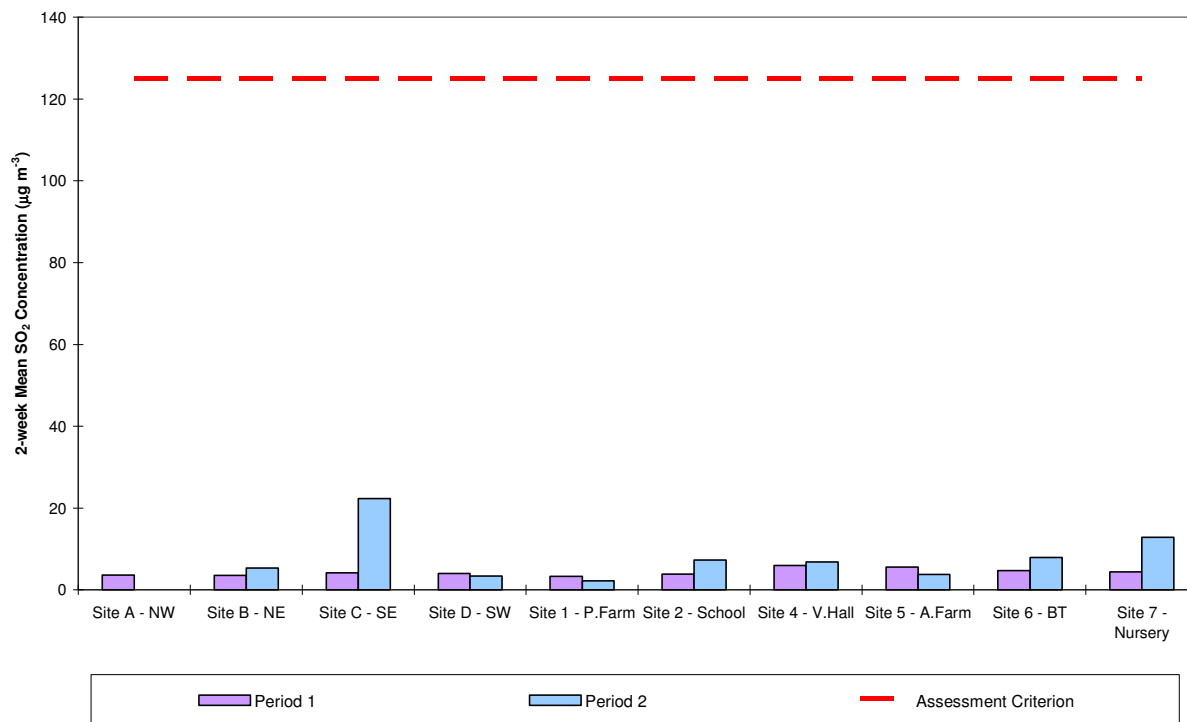
Figure 3 – Monthly Average Concentrations of Nitrogen Dioxide ($\mu\text{g m}^{-3}$)



2.1.4 Sulphur Dioxide Concentrations

Figure 4 presents 2-week average concentrations of sulphur dioxide across each of the fixed monitoring sites. At all locations, measured concentrations were significantly below the $125 \mu\text{g m}^{-3}$ target level. The maximum measured concentration was $22.32 \mu\text{g m}^{-3}$ and occurred at Site C (Avenue SE) during the second monitoring period. At Site A (Avenue NW) concentrations of SO_2 were below the limits of detection during the second period of monitoring.

Figure 4 – 2-week Average Concentrations of Sulphur Dioxide ($\mu\text{g m}^{-3}$)

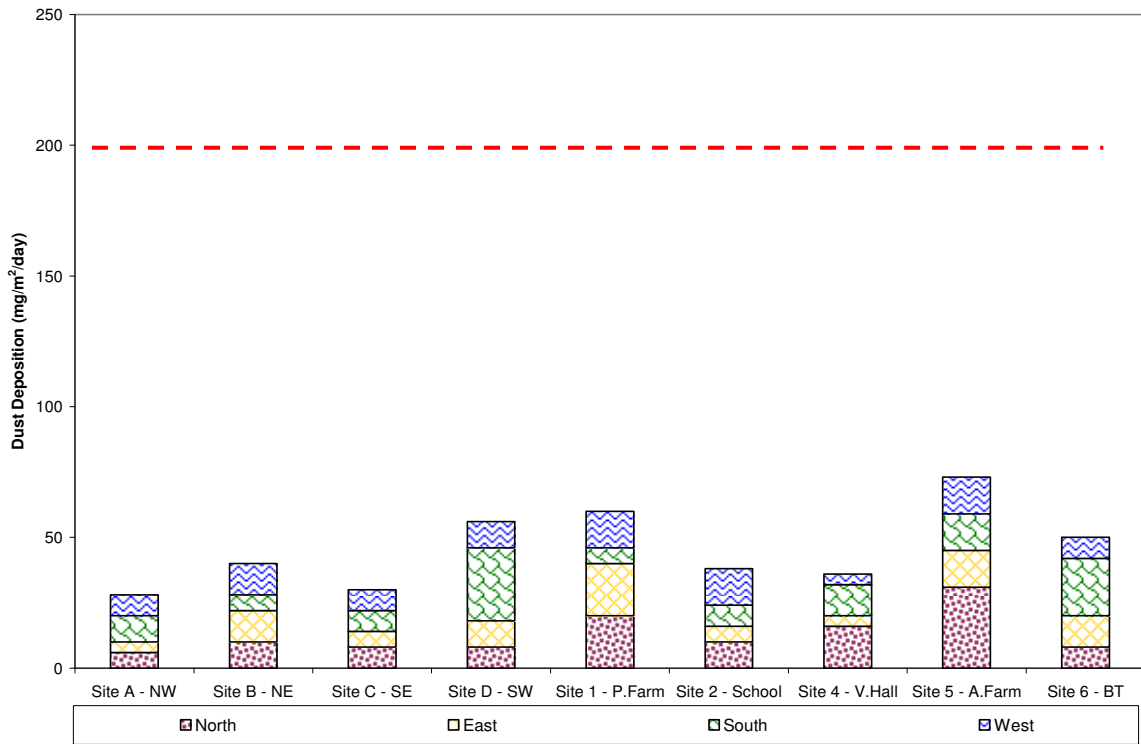


2.1.5 Deposited Dust Levels

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

The highest recorded levels of deposited dust of $73 \text{ mg/m}^2/\text{day}$ were recorded at Site 5 (Avenue Farm) and the measured levels do not represent an exceedence of the target level. At Site 5, approximately 40% of the deposited dust originated from the north, with the remainder from the east, south and west in equal proportions. The pattern of dust deposition levels would suggest the Avenue site was not the main contributing element to these dust levels and that other local sources of dust (e.g. farming activity) may be the dominant source of dust.

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

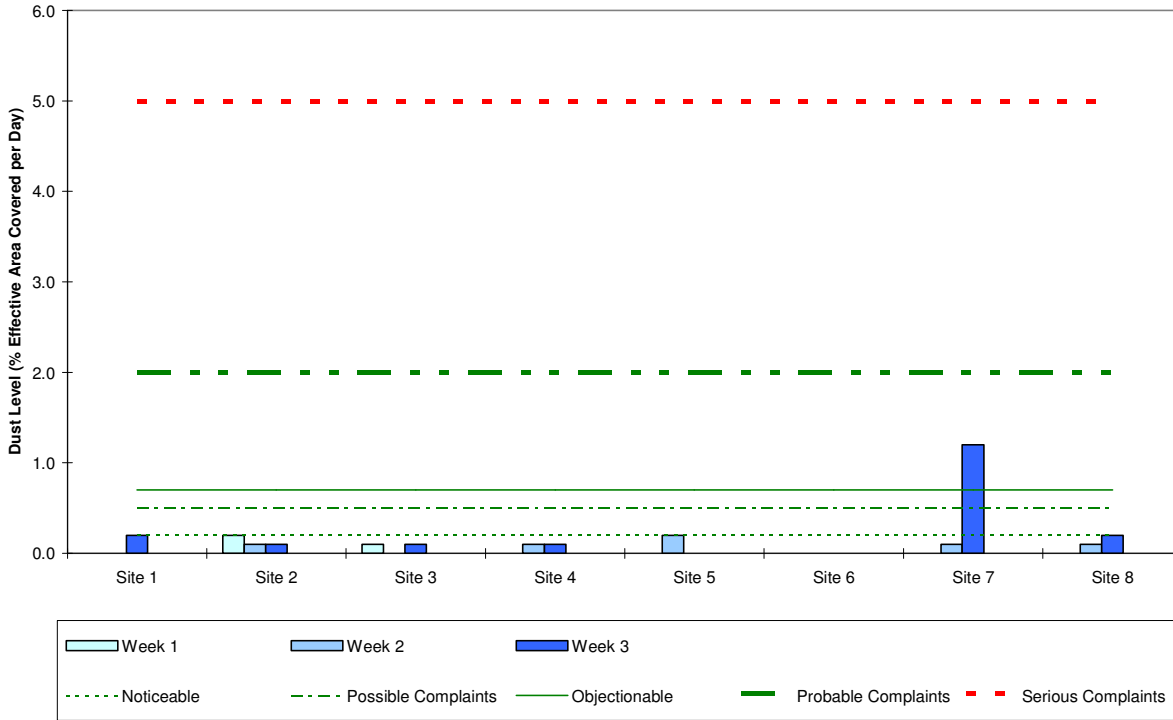


2.1.6 Dust Soiling Levels

Measurements of dust soiling continue to be undertaken using sticky pads at 8 locations over periods of seven days, for comparison against target levels measured in units of effective area covered per day (% EAC). Site 1 is the only boundary monitoring location (it is located north of the site entrance in Zone 2, as opposed to south of the main site entrance) that is not directly comparable with the external monitoring locations identified in the Air Quality Management Plan.

Figure 6 shows the maximum measured weekly levels of dust from the sticky pads at each of the 8 monitoring locations. The highest levels of dust were measured in Week 3 at Site 7 at the southern end of the site and were considerably higher than measurements at all other locations for each of the three monitoring periods during the month of December. The maximum dust level of 1.2% EAC measured at Site 7 occurred due to the stockpiling of material that was taking place in close proximity to the monitoring equipment. All of the other measured values were below 0.2% EAC and below the target level of 5% EAC that is considered the threshold likely to lead to complaints if measured at the location of a dust sensitive receptor.

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



2.1.7 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.

During the first and second 2-week monitoring periods all recorded levels of benzene were below the limit of detection of $2 \mu\text{g m}^{-3}$ in the first monitoring period (3rd to 16th December) and $1.3 \mu\text{g m}^{-3}$ in the second monitoring period (16th December to 4th January), except at Site 2 (Hunloke Primary School) in the second monitoring period where the concentration of benzene was $4.8 \mu\text{g m}^{-3}$. The assessment criterion for benzene has therefore been achieved at all monitoring stations and it is unlikely that the Avenue contributed significantly to the concentrations measured at Site 2 as monitoring sites closer to the Avenue site did not detect any increase in ambient concentrations of benzene.

The maximum measured concentration of toluene in period 1 (3rd to 16th December) was 0.025 mg m^{-3} and in period 2 (December to 4th January) the maximum measured concentration was 0.011 mg m^{-3} ; at most of the monitoring stations the levels of toluene were below limits of detection. The assessment criterion for toluene has therefore been comfortably achieved at all monitoring stations.

2.1.8 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 $0.04 \mu\text{g m}^{-3}$, recorded at Site 4 (the Village Hall in Hasland) during the first monitoring period, which is less than 20% of the objective concentration.

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

2.1.9 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. The maximum concentration of cyanide was $0.02 \mu\text{g m}^{-3}$.

2.1.10 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.

2.1.11 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 these criteria during the month. The highest measured concentration of total Coal Tar Pitch Volatiles was $0.18 \mu\text{g m}^{-3}$ and the highest measured concentration of naphthalene was $0.002 \mu\text{g m}^{-3}$.

2.1.12 Quality Control Samples

Media Blanks

The analysis of media blanks indicated no issues with the contamination of media used for the collection of samples.

Duplicates

Duplicate PM_{10} measurements at Site A correlated well with original data during the month. The monthly average concentration at Site A was $9.0 \mu\text{g m}^{-3}$ compared to $8.4 \mu\text{g m}^{-3}$ for the duplicate monitor.

Duplicate metals results taken at Site A correlated well during both monitoring periods. The most significant variation in measurements was for manganese, where concentrations in the first period were $0.007 \mu\text{g m}^{-3}$ and $0.004 \mu\text{g m}^{-3}$; in the second period concentrations were $0.002 \mu\text{g m}^{-3}$ and $0.005 \mu\text{g m}^{-3}$.

Duplicate PAH results from Site 1 showed that the largest magnitude difference in measured concentrations was $0.021 \mu\text{g m}^{-3}$ for Phenanthrene, a 62% difference between the two measurements. For several of the PAHs, the difference in measurements was greater than 50%, but in the context of the measured concentrations and the assessment levels, these differences are not considered significant. The largest percentage difference was for Acenaphthylene during the first period of monitoring; the measurements were $0.0014 \mu\text{g m}^{-3}$ and $0.00041 \mu\text{g m}^{-3}$, a difference of 71%, but an absolute difference of only $0.0009 \mu\text{g m}^{-3}$.

Duplicate phenol samples were taken at Location 1. No results were reported above the limit of detection (LOD) of $0.2 \mu\text{g m}^{-3}$ during either of the two monitoring periods.

The duplicate SO_2 measurements during the second period of monitoring (date) could not be compared as one set of samples were below the limit of detection. In period 1 (3rd to 16th December) the measured concentrations were $3.58 \mu\text{g m}^{-3}$ and $4.12 \mu\text{g m}^{-3}$, a 15% difference in the measurements. It is therefore considered that the measurements are in good agreement.

For total VOC measurements, the measured concentrations from the duplicate diffusion tubes, is the same for both the first and second periods of monitoring as measurements were all below limits of detection.

The duplicate NO_2 measurements gave concentrations of $23.6 \mu\text{g m}^{-3}$ for the first diffusion tube, and $22.98 \mu\text{g m}^{-3}$ for the second tube. The diffusion tube measurements are therefore considered to be accurate.

2.2 Targeted Air Quality Monitoring

2.2.1 Asbestos

Reassurance air testing for asbestos was carried out during 11th December and 16th December on and around the boundary of the crusher area. All measured concentrations of fibres were $< 0.01 \text{ f ml}^{-1}$ (fibres per litre) and are therefore comfortably within the control limit of 0.1 f ml^{-1} .

2.3 Odour Monitoring

2.3.1 Odour Diaries

Background monitoring using odour diaries was suspended at the end of October 2008 following an 18 month period of monitoring; it was considered that a sufficient level of background data had been collected during this period. The odour diary programme recommenced in December 2009. Odour Diarists record information such as when odour was detectable, what the odour was like, whether the odour was continuous or sporadic and what wind speed and direction were at the time of the observation. The Odour Diarists log the odour description against one of 28 categories, such as 'smokey', and rate its intensity on a scale of 0-6, ranging from 'not perceptible' to 'extremely strong'; level 4 is rated as 'strong' and is the point at where it becomes easier to describe the odour's character.

Odour diaries for December show that there were 2 Odour Days when odour intensity during at least one point in the day was rated greater than 4 when the wind was blowing from the Avenue site. There were no days when odour intensity was rated greater than 5 or 6. During these odour episodes (10th December at 09:20 and 20th December at 04:50) the reported

odour descriptions were “*disinfectant*” and “*tar, asphalt, bitumen*”, respectively. There were two further recorded episodes on 20th December when the odour description was also “*tar, asphalt, bitumen*” but at these times there was no wind and therefore the direction of the source of odour could not be determined. It is likely that the Odour Diarist may have been reporting on Grassmoor related odours rather than those from the Avenue and this is currently under further investigation.

2.3.2 Sensory Field Odour Surveys

Sensory field odour surveys were carried out on 3, 10, 16, 24 and 30 December at each of the fixed monitoring stations. Firstly, the Odour Annoyance Potential of the odour is estimated from the frequency, intensity, duration and pleasantness of the odour during the survey. Then the Odour Annoyance Impact (rated as very low, low, medium, high or very high) is assessed from the Annoyance Potential of the odour and the odour sensitivity of the location.

During each survey, the maximum Odour Annoyance Impact level was ‘*Low-Medium*’ and, therefore, the effects of odour are not considered significant. Furthermore, odour descriptors used during the field odour surveys to characterise the odours did not suggest that odours were from the Avenue site and identified in several instances that agricultural activity was the cause of the observed unpleasant odours.

2.3.3 Odour Complaints

No odour-related complaints were received during the month.