PROOF OF EVIDENCE

on

AIR QUALITY

I/AQ-01

Mr Jonathan Brooks

On Behalf of It's Our City

Planning Inquiry APP/A2335/V/09/2095002

Canal Corridor North Site, Lancaster

Contact: jonb@itsourcity.org.uk

Contents

Air Quality Proof Of Evidence
On behalf of It's Our City

Jonathan Brooks

1. Introduction

1.1 My name is Jonathan Brooks. I hold a BSc (Hons) in Computer Science. I was a Marine Systems Engineer by profession till 2003. Though I am not an air quality expert, my knowledge of computer modelling, programming and mathematics gives me some ability to comment on Waterman's Air Quality Assessment for the applicant Centros.

1.2 In my evidence I will show

- How the pollutant predictions from the atmospheric dispersion modelling program used in the applicant's Air Quality Assessment are unreliable due to the use of in some cases incorrect data and in other cases inappropriate data input to the model based on unsupported assumptions.
- How omissions in the assessment ignore good practice and fail to follow advice and guidelines established by LAQM technical guidance [CD84 + CD85].
- That the current AQMA is at risk of extension.
- That the Lancaster Air Quality Action Plan [CD82] is undermined by the plans
- How, since 2007, air quality actions at a local level in regard to the Lancaster AQMA have been influenced by Faber Maunsell and why this is inappropriate
- That national, regional and local policy regarding the planning system and air quality are not being followed.

2. Existing Lancaster Air Quality Issues

2.1 - The gyratory system

Since the AQMA was declared in 2004 covering the gyratory system in Lancaster there have been significant exceedences of the 2005 Annual Mean Objective for NO2 around the entire system [CD79 - 2006 Further Assessment section 2.2 page 8]. A conclusion of the report [CD79] on page 27 says:

"At the various monitoring locations within the AQMA where NO2 concentrations >40µg/m3 are being measured, estimates suggest that local emissions of nitrogen oxides (primarily from local roads) would need to be reduced by between 60 and 90% in order to meet the AQ objectives;"

The report [CD79 - 2006 Further Assessment Executive summary] also says:

"Despite Heavy Duty Vehicles only contributing to around 5-7% of vehicle flows, their large size and respectively greater emissions mean that this relatively small number of vehicles contributes over half of the nitrogen oxide emissions across the gyratory system."

The 2008 Air Quality Progress Report [CD81] section 2.2.2 page 8 says

"A number of sites showed reductions in annual mean concentrations between 2006 and 2007. Allowing for the influences of abnormally wet weather in 2007, however, none of these results were identified as evidence of significantly reduced pollutant emissions.

The same section says:

"The sites previously identified as exceeding the annual mean NO2 objective continued to record exceedences"

Table 5 [CD81 page 41] shows that diffusion measurements to date have consistently exceeded the statutory NO2 Annual Mean Objective for 2005 since 2003 when many of the monitors were first established.

2.2 - Opinion of Lancashire County Council

In their consultation response of 15th September 2008, Lancashire County Council commented on this development [I/AQ-06].

On page 2 regarding impact on the local network they say:

"However the network benefits provided by the Canal Corridor development are masked by the impacts of committed developments and do not negate against all sources of local congestion"

On page 2 regarding the impacts on the wider city network they say:

"The inclusion of the Canal Corridor development and committed developments will result in congestion levels increasing significantly at a number of locations within the City Centre, such as the northbound gyratory approach arms and surrounding area during the peak periods. Consequently queuing will impact on other corridors and junctions. The primary source of this additional congestion is from committed developments. The increased level of congestion with the Canal Corridor development, and that committed with all measures implemented (to the satisfaction of the Highway Authority), should not be at a level that compromises network safety but overall queue lengths and journey times during weekday and weekend peaks will increase. Journey reliability consequently will reduce when compared to that currently experienced."

On page 5, regarding Access and off-site highway works they say:

"It must be noted that vehicle movements in the area will increase, but with the implemented s278 measures traffic will be better managed thus minimising overall congestion growth (not reducing congestion) and facilities for pedestrians and cyclists will be provided. It must be recognised that this development with committed will have a negative impact on the overall network when compared to current levels observed, with queuing and congestion increasing and journey reliability reducing."

On page 8, they say:

"With a full package of s278 and s106 (yet to be agreed) it would be difficult to significantly improve the network further in the area the development impacts on."

The overall impression given is that this development, with an extra 750 short stay parking spaces above the existing 61 short stay spaces currently on the site, will constitute a significant impediment to effectively addressing Lancaster's existing air quality problems.

3. Shortcomings of the Waterman Air Quality Assessment

3.1 Inadequate Verification of the Atmospheric Dispersion Model

3.1.1 - Failure to Check Input Data

Section 13.31 (Verification) of chapter 13 of the ES [CD21] says:

"Model verification is the process of comparing monitored and modelled pollutant concentrations in order to give confidence in the accuracy of the modelling results. The model has been verified by comparing modelled annual mean NO2 values for 2006 with the actual monitored values from the NO2 diffusion tube monitoring undertaken in Lancaster. Model adjustment was then undertaken."

It is crucial that data used in verification of the model is as accurate as it can be since it is widely accepted that there are uncertainties associated with measured values from NO2 diffusion tubes.

The Technical Guidance LAQM TG(03) [CD84] - 3.54 says:

"Model *verification* refers to checks that are carried out on model performance at a local level. This basically involves the comparison of predicted versus measured concentrations. Where there is a disparity between the predicted and measured concentrations, the first step should always be to check the input data and model parameters in order to minimise the errors. If required, the second step will be to determine an appropriate bias correction that can be applied. For the review and

assessment of fugitive or road traffic sources it is **essential** that model verification is carried out."

The Technical Guidance LAQM TG(03) [CD84] - Appendix 3 (A3.164) says:

"Model verification may or may not result in an adjustment of modelled results depending on the outcomes and/or the source types being considered. If modelled results are adjusted the factors or amount of adjustment should be referred to as model adjustment. This corrects for systematic error. The full details of how the model verification and calibration is undertaken should always be provided. However, adjustment of the modelling results should only be carried out once other uncertainties have been minimised."

The Waterman assessment gives no indication that the input data was checked, therefore uncertainties have not been minimized because adjustment was performed without checking of the input data. The measured NO2 input data used is demonstrably incorrect and does not concur with Lancaster Council's own data as demonstrated below in 3.1.2.

3.1.2 - Input of Incorrect Data for Verification of the Model in ADMS-Roads

In the Waterman Assessment Appendix [CD22] 3.6 it states that Table 2 provides details of the diffusion tube monitoring sites within Lancaster City Centre and annual mean NO2 concentrations for 2003 to 2007. The note below the table says that this is the bias adjusted data supplied by LCC.

The values given in Table 2 [CD22] for the years 2003 to 2007 correspond to the Council's own records, except for 2006 which is the baseline year used to verify the model. The values for 2006 are almost completely at variance with the values published by Lancaster Council in Appendix 3 Table 5 of the 2008 Air Quality Progress Report [CD81].

Of the two values for 2006 that do correspond to the Council records, these locations have not been used for the model verification. i.e. the Water St co-located monitors (C, D and E) and Morecambe Rd High School (A).

Two of the values have been overstated in section 3.6 Table 2 for 2006 [CD22]. Owen Rd (5) is given as 55 when it should be 34 and Damside St (T) is given as 43 when it should be 35.

However, the rest of the values given in Table 2 for 2006 are under-stated by amounts varying between 3 uG/m3 and 29 uG/m3.

It is plain to see that this erroneous data has been used in the model verification by reference to the 2006 values given in section 3.6 Table 2 together with Figures 15 and 18. Note that section 5.9 Table 10 [CD22] lists the diffusion tube locations used to verify the model.

Fig 15 shows plotted values of measured NO2 against adjusted modelled NO2 for the five canyon locations used to verify the model. The measured NO2 concentration values read from the vertical y axis of the graph correspond to the incorrect 2006 values given in Table 2 section 3.6 [CD22]. These points from the left of the graph are Stonewell (K), Market St/China St (M), North Rd (J), 46 King St (L), and Great John St (1).

Fig 18 shows plotted values of measured NO2 against adjusted modelled NO2 for the five non canyon locations used to verify the model. The measured NO2 concentration values read from the y axis of the graph correspond to the incorrect 2006 values given in Table 2 section 3.6 [CD22]. These points from the left of the graph are Damside St (T), Caton Rd (G), Owen Rd (5), 93 King St (Q), and Parliament St (I).

Table 1 below shows the putative measured NO2 values used by Waterman to verify the model compared to the actual measured values published by Lancaster Council together with the error between them.

Table 1 – Comparison of Waterman and Council Annual Mean NO2 values used to verify model in uG/m3.

	Waterman Value	**Council Value**	**Waterman Error**
North Rd (J),	35	64	-29
Stonewell (K),	36	43	-7
46 King St (L),	37	57	-20
Market St/China St (M)	38	41	-3
Great John St (1).	52	67	-15
Owen Rd (5),	55	34	+21
Damside St (T),	43	35	+8
93 King St (Q),	41	45	-4
Caton Rd (G)	32	36	-4
Parliament St (I).	34	43	-9

This shows that incorrect NO2 data has been used to verify the atmospheric dispersion model and therefore NO2 levels predicted by the model for all scenarios are unreliable.

Following adjustment, the model predicts values for the existing 2006 baseline scenario. In Table 2 below, the predicted NO2 figures for the 2006 existing scenario (taken from Table 11 Dispersion Modelling Results [CD22]) and the measured values taken from Lancaster Council's published NO2 monitoring figures for 2006 are compared. Table 2 below only includes 8 of the 14 monitors listed in Table 2 section 3.6 [CD22] because there are no predicted values for the other six diffusion tube locations. There are also no predictions for three of the diffusion tubes used to verify the model. i.e. 93 King St (L), Market St/China St (M) and Damside Street (T).

Table 2 – Comparison of Predicted and Council Annual Mean NO2 values in uG/m3.

Location	Waterman Receptor ID	2006 Baseline Predicted NO2 Annual Mean	Council Monitor ID	Council Measured & Bias Corrected NO2 Annual Mean 2006
Great John St	19	41.7	LC1	67
Owen Rd	28	47.9	LC5	34
Parliament St	8	37.8	I	43
39 North Rd	9	37.3	J	64
Stonewell	16	34.9	K	43
46 King St	2	41.3	L	57
11 Cable St	32	58.1	N	42
95 Bulk Rd / Caton Rd	29	44.1	G	36

The process of checking for errors in the input data and subsequent model adjustment in the model verification process exists so as to minimize as far as possible systematic errors in the model and give more accurate predictions. The NO2 values in each row of the table above should ideally be roughly equal to indicate that the model verification was successful. What is striking about the results here is the wide differences between the 2006 baseline predicted values and Lancaster Council's bias corrected measured values despite the model adjustment.

Table 3 – Errors between council measured NO2 values and pre and post verification model results in uG/m3 (- denotes under prediction and + denotes over prediction)

Location	Pre-verification Errors	Post-verification Errors
Great John St	-15	-25.3
Owen Rd	+21	+13.9
Parliament St	-9	-5.2
North Rd	-29	-26.7
Stonewell	-7	-8.1
46 King St	-20	-15.7
11 Cable St	-3	+16.1
Caton Rd/95 Bulk Rd	-4	+8.1

The ES Appendix E - 5.4 [CD22] says:

"… precise agreement with monitoring data (or other modelling studies) is unlikely, although broad agreement is expected if the model is working correctly."

However, Table 3 above shows that there are still significant prediction errors and in some cases greater errors than before. The large post verification errors still present in the predicted values for the 2006 baseline can in no way be said to be in broad agreement with the Lancaster Council measured values for 2006.

The ES Appendix E - 5.21 [CD22] says:

"Systematic under or over prediction has been taken into account through the model verification/adjustment process described above."

The errors shown in Table 3 above show that systematic under and over prediction is still present following verification therefore the model is not working correctly.

Further evidence of the use of incorrect data is suggested by section 5.9 Table 10 [CD22] that shows Model verification results for Annual Mean Roadside NOx and has a column headed Measured Annual Mean. Diffusion tubes do not give an estimate of NOx but NO2 only, so the Measured Annual Mean NOx figure given is a misnomer. The NOx values given in the Measured Annual Mean column of Table 10 are reflected in Figures 14 and 17 on the following pages.

A simple visual comparison of the distribution of plotted points in Figure 14 representing the canyon NOx values in Table 10 [CD22] with the plotted points in Figure 15 (representing the incorrect 2006 NO2 data from Table 2 section 3.6 [CD22]) shows an identical pattern. The same comparison applies to Figure 17 and 18 for the non-canyon monitoring sites, though the stretched y axis in Figure 17 makes this less obvious..

These NOx values can only have been derived in some way from diffusion tubes or else from the automated monitoring site at Water St. However, section 5.7 [CD22] says:

"Therefore, the results from the monitoring sites close to the bus station were excluded from the model verification (i.e. the Water Street continuous monitor and the Water Street and Cable Street diffusion tube monitors)"

This suggests that the NOx values were derived from the diffusion tube NO2 measurements at the sites listed in section 5.9 Table 10 [CD22] using the 2006 values given in Table 2 section 3.6 [CD22]. Since, as explained above the NO2 values used in Table 2 section 3.6 [CD22] are not Lancaster Council's figures both the NO2 and NOx values used in model verification are incorrect.

The ES Appendix E - 5.19 [CD22] says:

"Due to the fact that the Water Street continuous monitor was excluded from the model verification process, as described above, there was no PM10 monitoring data to compare the model output to. Therefore, the roadside modelled NOx adjustment factors as detailed above, were applied to the roadside modelled annual mean PM10 concentrations before relevant background concentrations were added. This was agreed with the air quality advisors to LCC"

Because the PM10 predictions have relied on the same NOx adjustment factors which are based on erroneous data, the PM10 predictions are also unreliable.

3.1.3 - Exclusion of Relevant Data

The ES Appendix E 5.7 [CD22] excludes the results from the monitoring sites close to the bus station from the model verification on the grounds of a lack of accurate bus movement data. This is manifestly untrue since bus timetables are available in hard copy at the station itself and in electronic form from the Stagecoach website.

In the 2006 Further Assessment on Air Quality page 30/31 [CD79] Lancashire County Council comments on the Stage 3 Review and Assessment as follows:

"5) In the reference calculation for model bias the traffic contribution at the Water Street site is probably vastly underestimated due to slow moving traffic on the A6 and proximity of the Sainsbury's entry and car parking. We do not believe that data from the Water Street site has been used in an appropriate manner and hence the calculations, which indicate that the model vastly underestimates, are fundamentally flawed."

Lancaster Council responds to this by saying:

"In this study, the modelling has been verified and adjusted according to 12 monitoring sites (predominantly bias corrected diffusion tubes). Model error has been calculated for each monitoring location across the whole study area. Where special conditions apply (such as Sainsbury's (and other) car parks, the bus station and other bus stops) that have not been able to be modelled due to lack of suitable data, these have been taken into account in the model verification and adjustment"

Waterman claims (ES [CD22] Appendix E 5.5) that the verification of their model is consistent with the 2006 Further Assessment [CD79], but there are a number of inconsistencies. In the context of model verification, ES [CD22] Appendix E 5.7 says:

"The ADMS-Roads model was run to predict annual mean NOx concentrations at ten of the NO2 diffusion tube monitoring locations in Lancaster City Centre."

In fact Lancaster Council used 12 monitoring sites and not 10 to verify their model.

The Waterman Assessment [CD21 Chapter 13 and CD22 Appendix E] excludes the Cable St (N) monitoring site close to the bus station from the model verification on the grounds of a lack of accurate bus movement data. Cable St (N) has consistently exceeded the 2005 Air Quality Objective Annual Mean since it was established in 2003 ([CD81] Table 5 Air Quality Progress report 2008 page 41) and the Council included this in their model verification in the 2006 Further Assessment [CD79].

Another diffusion monitoring site left out of model verification is High School, Morecambe Rd (A) which has also consistently exceeded the 2005 Air Quality Objective Annual Mean since 2003. No justification is given for omitting this site and though it is not a roadside/residential site it still qualifies as a 'relevant location' for assessment of the NO2 annual mean as LAQM.TG(03) [CD84] section 1.20 page 1-10 makes clear in Box

1.4. This says that Annual Mean objectives should apply at "All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc." The High School site is not used either in model verification or in the 2006 baseline predictions and its inclusion in Table 2 [CD22 Appendix E] of the Waterman Assessment is misleading.

The 2006 Further Assessment [CD79] Figure 8 on page 17 shows features that may lead to additional/unmodelled road transport related NOx emissions which are not included in the modelling undertaken for the further assessment. These include the bus station, bus stops and car parks. The special conditions mentioned in Lancaster Council's response above concerning unmodelled road transport related NOx emissions have not been addressed in the Waterman Assessment [CD21 Chapter 13 and CD22 Appendix E]]. There is no description of how any special conditions such as the other car parks in the city and bus stops that were not modelled due to lack of suitable data have been taken into account in the model verification and adjustment.

3.2 - Use of Inappropriate Meteorological Data in ADMS-Roads

The Waterman Assessment [CD22 Appendix E] section 4.32 says that the meteorological data input into the model was obtained from the Blackpool Airport Meteorological Station and justifies this by saying that this is the nearest meteorological station with a coastal influence similar to Lancaster which has the required meteorological information. In fact, Blackpool airport is situated at an exposed coastal location where wind speeds are consistently higher than Lancaster and this is confirmed by close inspection of the UK Climate Impacts Programme windspeed map for the UK [I/AQ-02]. A hard copy of this pdf file has been supplied but it is more helpful to view it on a computer screen to enable zooming in and differentiation of the colors that denote different wind speeds.

The 2006 Further Assessment of Local Air Quality [CD79] says on page 32:

"Lancaster is not directly coastal, but lies approximately 7.5km inland at the end of the Lune Estuary behind the relatively sheltered Morecambe Bay. This means that Preston, approximately 15km from the mouth of the Ribble Estuary is likely to be a reasonably good proxy for conditions in Lancaster compared to the available alternatives."

In Appendix 2 of the 2006 Further Assessment [CD79] page 30 comment number 4, Lancashire County Council comments:

"Lancaster is more coastal than Manchester, but should not be considered a coastal site, as would Blackpool."

This shows that in the opinion of the city and county councils, use of meteorological data from Blackpool is not appropriate for modelling air quality in Lancaster.

Section 3.6 of the 2006 Further Assessment [CD79], says that the city council used temperature, wind speed and wind direction from the Preston weather station, 20 miles

from the modelling locations and cloud cover from Manchester saying that "although it is accepted that this is not an ideal method, cloud cover is usually one of the most regionally consistent of the variables."

If a combination of data from different sources is considered acceptable for modelling, then it should be considered why data from the Meteorological Office Station Number 7236 at Hazelrigg has not been used since this station is only 3 miles from Lancaster and daily measurements of temperature, wind speed and direction, and cloud cover data are taken.

The higher wind speeds used by the Waterman assessment which are based on the Blackpool airport wind rose can therefore be expected to contribute to additional underestimation of both nitrogen dioxide (NO2) and particulate matter (PM10) predicted by ADMS-Roads.

Section 4.32 of the Waterman Assessment [CD22 Appendix E] also says that use of the Blackpool data is consistent with the meteorological site used within the Wind Microclimate Desk Study undertaken for the Development. This indicates that the conclusions of the Wind Microclimate Desk Study may also be open to criticism on the same grounds.

With regard to consistency with the 2006 Further Assessment claimed by Waterman in the verification of their model, the use of the Blackpool data is also inconsistent. In section 5.5 of their assessment, Waterman say:

"As noted above the meteorological data used in the modelling study was 2006, so that all input elements were consistent."

The only consistency in this case is that of the year 2006 and it is misleading to suggest consistency when the meteorological data used by the Waterman Assessment [CD21 and CD22] is from a different location to those used by Lancaster Council and both the county and city councils have given reasons why data from Blackpool would not be appropriate for Lancaster.

3.3 - Lack of pollutant predictions for construction phase

There are no pollutant predictions for the demolition and construction phase in the Waterman Assessment [CD21 Appendix E]. Section 13.38 [CD21] says that a qualitative approach has been employed to predict potential impacts from the anticipated works, on the grounds that "the amount of dust cannot be easily quantified in the demolition and construction phase". This justification for using a qualitative assessment does not mention traffic related pollutants NO2 and PM10.

The Environmental Statement [CD21 Chap 12] sections 12.73 and 12.74 show that construction traffic has been estimated at between 60 and 120 vehicles a day, mostly HGV's. The Environmental Statement [CD21 Chap 13] 13.56 says

"However, given the type of vehicles involved with the demolition and construction works it is considered that construction traffic movements will be likely to be at worst **minor adverse** in the context of local background concentrations and existing adjacent road traffic emissions (refer to Chapter 12: Transport)."

This conclusion is not supported by the facts. Chapter 6 page 23 of the 2006 Further Assessment [CD79] says:

"What does stand out clearly from the model results is that although the modelled HDV components were only between 5 and 7% of total traffic flows, the resultant emissions comprise the most significant part of the pollution load, between 50 and 72% of NOx emissions from the road links modelled."

The top left graph of Figure 15 of the 2006 Further Assessment [CD79] page 25 shows that the NOx emission rates of HDV's rise markedly when vehicles are slow moving or idling at a standstill, which would be the prevailing situation on a building site with vehicles entering, leaving and waiting.

Reference 10 at the bottom of page A1-34 of Technical Guidance LAQM. TG(03) [CD84] talks about major construction works and says that certain construction activities can cause breaches of the 24-hour mean PM10 short-term objective. It cites the example of a retail development that in 1994 caused 105 exceedences of the 24 hour limit value (50 μg/m3) for the protection of human health measured by the Cardiff AURN station which was within about 10m of the construction works. Section 5.92 of the most recent version of the technical guidance LAQM. TG(09) [CD85] says "recent studies have identified substantial increases in annual mean PM10 concentrations, up to 30 μg/m3, alongside public roads up to 50 m from the entrances to waste management sites and construction sites".

There are a significant number of residential properties adjoining the eastern and northern edges of the site as well as hundreds of school children that transit this area twice a day to and from a number of schools. This clearly highlights the need for a quantitative assessment of PM10 and NOx/NO2 which is not provided by the Waterman Assessment.

4. Risk of Extension of AQMA

In the executive summary of the 2006 Further Assessment [CD79], when referring to exceedences of the Annual Mean objective for N02, it was stated that a finding of the Assessment was:

- These exceedences are occurring entirely within the current AQMA and there is no need to extend the current boundaries. However, model results suggest that objective concentrations may be being exceeded in St Leonard's Gate. There are currently no residential properties along this street and therefore there is no current requirement to declare an AQMA but on the basis of current information the AQMA may need to be extended if any residential property is likely to be developed in this area. In the mean time it is recommended that a diffusion tube is located in this area to provide additional information to compare with the model;

2006 Further Assessment [CD79] page 20 clarifies this by saying "..., if any residential properties were likely to be developed in this area it would be necessary to extend the AQMA boundary to encompass them:

Since the 2006 report, the situation has changed in that outline planning permission has been granted for the building of up to 68 residential units on St Leonard's Gate. This application (08/00864/OUT) which was not referred to GONW by Lancaster Council with the applications currently under consideration, forms part of the applicants overall master plan, and is located at the north end of the site at the corner of St Leonard's Gate and Alfred St.

In Feb 2008, a new diffusion tube (identified as LC6 or just 6) was established on St Leonard's Gate at the junction with Alfred St outside the sheltered housing complex St Leonard's Court and next to the residential development mentioned above. The location is shown in the 2008 Air Quality Progress Report [CD81] Figure 6 page 24. The new tube recorded an annual average concentration of 33.5 uG/m3 in 2008 [I/AQ-03] that is virtually identical to the same reading for Owen Road in 2006 that was referred to in the 2007 Lancaster Air Quality Action Plan [CD82] as quoted below.

The Action Plan [CD82] 3.1.2 referring to summaries of the findings of the Stage 4 review and assessment (i.e. the 2006 Further Assessment) says concerning the AQMA:

- There is also no evidence to suggest that the boundaries could/should be reduced. Although there has been some discussion of removing some or all of the North West loop of the Gyratory system from the Air Quality Management Area the modelling still suggests that there is some risk of objective exceedences occurring along the north edge of Owen Road. It would seem sensible to keep the AQMA based on the entire gyratory system as a cohesive road network, particularly with the school sited between Morecambe Road and Greyhound Bridge Road as children are particularly susceptible to air pollution.

If the reading at Owen Road was sufficient to justify a rejection of the suggestion to remove the North West loop of the Gyratory system from the Air Quality Management Area, then it follows that the same reading for St Leonard's Gate implies similar considerations in relation to the AQMA in that vicinity, which conversely would involve an extension of the existing AQMA.

Currently, St Leonard's Gate is congested at morning and evening peak hours mainly due to car park traffic and vehicles seeking to avoid the gyratory system and HDV traffic is rare. During the rest of the day traffic is light. With the proposed development in place there will be LDV traffic throughout the day to and from an 810 space multi-storey car park that provides 750 short stay spaces above the existing 61 short stay spaces on the site as indicated in the Transport Assessment [CD17] Table 7.6 page 57. There will also be a large increase in HDV traffic on St Leonard's Gate servicing the retail development.

According to the Transport Assessment [CD17] 5.18 and 5.19, both these elements of traffic will be fed into the site along the new link road from Caton Road and when leaving the site, will be constrained to turn right, effectively doubling the traffic volume passing the new residential units and the sheltered housing complex at St Leonard's Court. The proposed 20 mph restriction from Caton Road along St Leonard's Gate to Stonewell is also likely to contribute to elevated NO2 levels but it will not deter rat-running [CD17 - Transport Assessment 6.74]. If the adjacent southbound gyratory system is congested enough to encourage drivers to try the new widened link road on St Leonard's Gate connecting with Stonewell further along the southbound gyratory system, they will not be deterred by a 20 mph speed limit and perhaps even encouraged by the widened road.

An additional consideration is the location of the new residential units that will be directly exposed to the pollution generated by the multi-storey car park right next door as well as the traffic along St Leonard's Gate.

The 33.5 uG/m3 NO2 Annual Mean reading of the diffusion tube located at St Leonard's Court is above the upper assessment threshold for NO2 (32 uG/m3) stated in Schedule 4 Part 1 of the Air Quality Standards Regulations 2007 [CD96]. From the extra burden of traffic that the development will generate and the uncertainty of the predictions from the modelling there is a clear risk of St Leonard's Gate forming part of an expanded AQMA.

Lancaster's 2007 Air Quality Progress Report [CD80] section 8 page 16 Conclusions says:

"It continues to be important that the council assesses and controls new developments that have the potential to worsen local air quality, to undermine local actions to achieve the air quality objectives, or to introduce new residents to 'exceedence' areas. Whilst recognising the need for local economic regeneration, the council will continue to be vigilant for such development proposals and will take a firm line on minimum acceptable requirements for development-led air quality assessments. At the same time, work will

begin on new air quality planning policies to be included in the Local Development framework."

The 2006 Further Assessment [CD79] notes concerns with respect to St Leonard's Gate, the AQMA and any possible future residential development in this area, but AQAP steering group meeting notes [I/AQ-04] and [I/AQ-05] show that this has not been considered. Notes from the first meeting in July 2007 up to 2008 show no mention of the car park associated with this major development despite its obvious implications for air quality. The issue of risk of extension of the AQMA has not been addressed by Waterman's assessment either. Lancaster Council has stated that a further meeting of the AQAP steering group was held on 29th November but that no record exists for this meeting.

The council has a statutory duty to improve air quality. The poor quality of record keeping on such an important public health matter appears negligent and does nothing to allay concerns about the air quality implications of this development.

5. Air Quality Action Plan (AQAP)

The executive summary of the Lancaster 2007 AQAP [CD82] implied that Lancaster Council Environmental Health Services was awaiting the results of a study from the Lancaster and Morecambe Vision Board to inform their air quality action planning and justifies addressing only interim air quality actions on this basis.

This Vision Board report was prepared by Faber Maunsell (now known as AECOM), a consultant that was simultaneously employed by developers Centros to work on their Environmental Assessment.

Faber Maunsell attended the two AQAP steering group meetings in July and August 2007 though there is no record of why they were present or what contribution they made to proceedings ([I/AQ-04] and [I/AQ-05]).

The 2007 AQAP [CD82] section 5.4 lists 19 options for actions to take forward for improving air quality within the Lancaster AQMA. Eleven of these are stated as originating from the Vision Board transport strategy workshop but not a single one offers the prospect of a concrete improvement. Most of them are simple re-iterations of various guidelines and advice for reviewing air quality management issues such as intentions to perform reviews, explore potentials, identify opportunities etc.

The Lancaster 2008 Air Quality Progress Report Conclusions page 22 says:

"During 2007 the Council has published its Further Assessment for Lancaster and an interim Air Quality Action Plan. Efforts focussed on Lancaster are being concentrated (1) to deliver on the actions contained in that Action Plan and (2) to prepare a longer-term

action plan once the work of the Lancaster & Morecambe Vision Board is published during 2008."

There would seem to be a clear conflict of interest involved for Faber Maunsell to influence and to continue to influence Lancaster Council's air quality action planning, given that they have a commercial interest in a development that will add an additional overall 500 parking spaces above existing provision in a location bordering an existing AQMA.

An AQAP and local policy should normally influence a developer's choice of options but in this case the roles are reversed and it is the inclusion of a multi-storey car park that is limiting options of the AQAP and influencing the development of local air quality policy. This compromises the Council's stated position in Lancaster's 2007 Air Quality Progress Report [CD80] section 8 page 16 Conclusions which says:

"It continues to be important that the council assesses and controls new developments that have the potential to worsen local air quality, to undermine local actions to achieve the air quality objectives, or to introduce new residents to 'exceedence' areas."

The 2007 AQAP [CD82] Table 9.7.5a on page 36 shows that a total of 0.9 uG/m3 reduction in NO2 is expected from implementation of the Heysham M6 Link, Cycling Demonstration Project, Personalised Travel Planning and Park and Ride. Without Park and Ride this reduction becomes 0.5 uG/m3. Both these figures are insignificant when the scale of exceedences of the 40 uG/m3 Annual Mean NO2 Objective in the Lancaster AQMA are considered [CD81 Table 5 on page 41].

The Cycling Demonstration Project will also be affected by the inclusion of the car park. The Lancashire Transport Plan Vol 1 [CD83] 4.2.17 page 116 says:

"The DfT Cycling Demonstration Project pilot will build upon the cycling infrastructure already in place in Lancaster to produce a sharp increase in the levels of cycling. Three of the four objectives are to:

- Produce growth in number of journeys made by bike
- Reduce congestion and journey time
- Support Air Quality Zone and Personalised Travel Planning"

Current levels of cycling across the gyratory system and AQMA are very low as shown in Figure 4 page 7 of the 2007 AQAP [CD82] and the increased congestion and pollution resulting from this development will not be conducive to a growth in the number of journeys made by bike within and adjoining the AQMA and is more likely to have the opposite effect, hampering efforts to promote Lancaster as cycling demonstration town.

The 2007 Air Quality Progress Report [CD80] chapter 4 says that during 2006 the council did not complete preparation of an Air Quality Action Plan for Lancaster, and none was in place.

The Core Strategy [CD62] section 6.23 says that a Lancaster City Centre Air Quality Zone is one of the key schemes for Lancaster District in the period up to 2011, the year before estimated completion of this development. Extra traffic to the car park and servicing areas of the development will undermine actions to establish an Air Quality Zone.

Overall, the inclusion of the multi-storey car park in this development poses real problems for implementation of an effective AQAP. If the multi-storey car park is permitted, there will be no real prospect of tackling poor air quality effectively for many years to come and the NO2 Annual Mean will continue to exceed the Objective Limit Value.

6. Policy

6.1 - LDLP Core Strategy Policy E2

Policy E2 [CD62] says that the Council will minimise the need to travel by car by, among other measures "Reducing local traffic impacts through the Lancaster Air Quality Management Plan".

The Transport Assessment [CD17] 4.11 says:

"The opportunity to provide a possible "park and ride" scheme has been discussed, although no "park and ride" sites have been formally identified. It was agreed that the provision of such a facility was not a prerequisite for the development on this Site, but that it should form part of the Council's overall strategy for the City Centre."

There is no further elaboration on a park and ride scheme or any good reasons given for one to be rejected.

Local Transport Plan [CD83] Vol 1 Introduction Table 1.2.1 says:

"Park and Ride helps to promote public transport and encourage car users to use public transport for a significant portion of their journey. It reduces the number of car journeys into urban centres, helping to reduce congestion and pollution levels."

Local Transport Plan [CD83] Vol 2 Table 9.4.1 (Measures to address transport-related Air Quality problems) on page 436 shows that the only three measures with a high impact on air quality are a park and ride, an air quality zone and a major highway scheme.

The AQAP [CD82] 9.7.5 recognises that the Heysham M6 Link scheme will not appreciably help air quality in the city centre. A park and ride scheme has been dismissed by the Transport Assessment [CD17] without explanation and the only mention of an air quality zone anywhere in the Centros plans concerns an objective of the Cycling

Demonstration Town Project in the Transport Assessment [CD17] 6.60 which quotes a non-existent paragraph for further information.

A park and ride scheme is a key proposal of the Lancaster Core Strategy [CD62] 9.27 page 113 and of Policy E2 (page 116) but the development plans fail to consider the multi-storey car park in the context of Lancaster Council's integrated management of parking and park and ride mentioned in 3.13 of the Core Strategy or how the increased traffic due to their car park will affect the Air Quality Management Area.

In opposition to Policy E2, the multi-storey option chosen by the developer does not minimise the need to travel by car or the environmental impacts of traffic and neither does it improve resident's quality of life.

6.2 - PPS 23 [CD58]

Appendix 1G of PPS 23 Annex 1 Section 1G.1 shows that air quality is a material planning consideration in this case. It says:

"The impact on ambient air quality is likely to be particularly important:

- where the development is proposed inside, or adjacent to, an air quality management area (AQMA) designated under Part IV of the Environment Act 1995;
- where the development could in itself result in the designation of an AQMA; and
- where to grant planning permission would conflict with, or render unworkable, elements of a LA's air quality action plan."

All three of these situations hold in relation to these development proposals. It is a fact that the development site is next to the Lancaster AQMA. As outlined in section 4 of this Proof, the altered traffic flows resulting from the development could result in the extension of the existing AQMA due to the planning permission already granted for residential units at the north end of the site, and as section 5 of this Proof shows, the inclusion of a multi-storey car park conflicts with the aims of the Action Plan and the statutory duty of Lancaster Council to improve air quality.

Annex 1 section 1.29 of PPS 23 [CD58] says:
"Section 54A of the Town and Country Planning Act 1990, requires that planning applications shall be determined in accordance with the development plan where it contains relevant policies, unless material considerations indicate otherwise."
and
"More weight will generally need to be given to air quality considerations, for example, where a development would have a significant impact on air quality inside, or adjacent to, an AQMA (see paragraph 1.11). But air quality considerations can also be important even where existing levels of air pollution are not sufficient to justify AQMA designation"

The insignificant effect of the development on pollution levels suggested by their 2012 predictions in Table 11 of Appendix E [CD22] cannot be considered reliable due to the concerns outlined in section 3 of this Proof. Therefore air quality impacts should be considered an important material consideration of these proposals and this inquiry.

6.3 - The Precautionary Principle

PPS 23 [CD58] states that the government is committed to using the 'Precautionary Principle' and Section 6 of PPS 23 says:

"The Interdepartmental Liaison Group on Risk Assessment (ILGRA), in its 2002 paper The Precautionary Principle: Policy and Application, made a number of important points including noting that the:
– precautionary principle should be invoked when:

- there is good reason to believe that harmful effects may occur to human, animal or plant health, or to the environment; and
- the level of scientific uncertainty about the consequences or likelihood of the risk is such that best available scientific advice cannot assess the risk with sufficient confidence to inform decision-making."

There is good reason to believe that harmful effects may occur to humans not only due to lack of confidence in the atmospheric dispersion model results as previously described, but also in the context of possible extension of the AQMA by virtue of the fact that permission has already been granted for a residential development application at the northern part of the site. Currently this stretch of road is only busy at peak hours but with an 800 space car park on St Leonard's Gate, the extra all day traffic accessing the car park could increase pollutant levels dramatically.

The use of incorrect and inappropriate data input to verify the atmospheric dispersion model mentioned elsewhere in this proof means that there cannot be sufficient confidence in the model predictions to inform decision-making. The Precautionary Principle should be applied since the additional traffic from the overall development comprising the applications which are the subject of this inquiry is likely to create a situation where the AQMA would need to be extended due to the residential application for which outline planning has already been granted and which can go ahead independently of the main application as has been stated by both the developer and Lancaster Council.

6.4 - Northwest RSS Policy DP 9 and DP7

RSS Policy DP 9 says that as an urgent regional priority, plans should contribute to the regional policy to reduce carbon dioxide emissions from all sources, including transport.

The development proposals include roughly 500 <u>additional</u> parking spaces in the city and 750 additional short stay spaces above existing short stay provision on the site.

The applicants Transport Assessment [CD17] 4.12 says:

"… the scheme does include the provision of an interceptor shoppers' "park and walk" car park on the Site, on the northern approach to the City, serving a similar function to a park and ride car park.

To say that the car park is on the northern approach to the City in this context is highly misleading; it is nearly two miles from junction 34 on the M6 north of the city and within a couple of hundred yards of the heart of the city. It will also be within tens of yards of an existing residential area and right next to a new residential development which has already been given outline planning permission. It is also misleading to describe this car park as serving a similar function to a park and ride car park.

The Northwest RSS [CD61] gives a definition of park and ride in its glossary as "Long stay parking areas at the edge of built-up areas linked to the city or town centre by frequent bus or other public transport services."

.

The rationale for a park and ride scheme is given by an ambition/action in the Lancashire Transport Plan Vol 1 [CD83] Table 1.2.1 which states:

"Develop bus and rail based Park and Ride schemes close to major road corridors, railway stations and rapid transit corridors. Park and Ride helps to promote public transport and encourage car users to use public transport for a significant portion of their journey. It reduces the number of car journeys into urban centres, helping to reduce congestion and pollution levels. Potential Park and Ride sites will be identified through the Lancashire Local Transport Plan process."

The multi-storey car park conflicts with these objectives. It will not promote or encourage car users to use public transport. It will increase car journeys into the centre and it will increase congestion and pollution levels. It will also attract additional operational HDV traffic which does not currently exist on St Leonard's Gate to service the development. As mentioned in section 3.3 of this proof, HDV's make a disproportionate contribution to NO2 emissions on the gyratory system.

This development will increase transport related carbon dioxide emissions which undermines RSS Policy DP9.

RSS Policy DP7 also requires environmental quality (including air quality) to be protected and enhanced. This development will have the opposite effect.

7. Report on the Waterman Air Quality Assessment by Dr Sarah Massey

Dr Massey, who is employed by the Environment Agency and is based at Lancaster University's Environmental Science Department, prepared a short report on the Waterman Assessment that supports many of our criticisms. Dr Massey's employer would not permit her to appear on behalf of It's Our City at the inquiry so her report is included as Appendix 1 to this Proof and her observations are summarized here.

- Gaps in the data
- Exclusion of other relevant pollutants apart from NO2 and PM10
- Exclusion of continuous monitoring data from the Water St station
- Lack of range to possible future scenarios concerning road traffic, meteorological variability, climate change, background air quality and atmospheric chemistry
- Inadequate modelling coverage of affected areas
- No pollutant predictions for construction phase
- Predictions of pollutant levels at some locations without baseline data to extrapolate from
- Uncertainties attached to using diffusion tube data for assessing concentrations
- Lack of consideration of seasonal signal associated with NO2 concentrations.

Appendix 1 - Report on Waterman Air Quality Assessment by Dr Sarah Massey

Air Quality Report

1. Diffusion tubes can be used for an idea of spatial variation in NO_2 concentrations but using them for concentration levels is not advisable (see attached references and quotes). These have been seen to have huge uncertainties attached to them with > ±25% being reported. With this in mind, the majority of the sites will NOT be in compliance with the AQMS levels.
2. I find it strange that there are predicted levels of NO_2 and PM_{10} for receptor sites 33-39 with the development as there is no existing data for these to be extrapolated from and there are no levels stated for without the development.
3. The fact that the bus station is not included in the model data is unbelievable – I cannot believe that there is a lack of 'accurate bus movement data'. Are not bus timetables available both in paper form and on the Stagecoach website? Could these not be included and the National Express coaches, together with other touring coaches added to this? This is a MAJOR shortfall of the report as buses travel from Lancaster to the University alone every 10 minutes and would represent a major contribution to atmospheric pollutants – in particular polycyclic aromatic hydrocarbons such as Benzo[a]pyrene, which is a recognised carcinogen.
4. Why is there no mention of benzene, CO (carbon monoxide), NO_x (nitrous oxides are also proven harmful and can provide insight into the actual source of the NO_2), SO_2 (sulphur dioxide) or O_3 (ozone) being monitored in this report?
5. Why is the continuous monitoring station at Water Street not used in the validation of the model? The results from this monitoring station are the most reliable, providing continuous measurements. This could lead to serious underestimation of the concentrations which will be experienced in the future.
6. Why are there no predictions for DURING construction? There will, inevitably be far greater levels of all air pollutants, in particular NO_2, PM_{10}, SO_2 and CO during this period – considering the number of children who will be walking/cycling to school in this area, this is an important factor for their health.
7. Why are none of the monitoring sites set up along the canal? The dominating wind direction would suggest that this would be an area which would suffer major effects from this development. If the trees in this area are to be felled to make way for the development, this will also have implications for NO_2 concentrations as the presence of trees reduces NO_2 concentrations.
8. When was the analysis conducted? There is a seasonal signal with NO_2 concentrations associated with winter highs and summer lows, although wind speeds can also have a slight effect.
9. Photolysis is an important factor when it comes to NO_2 concentrations, whereby nitric oxide (NO) and atomic, or singlet oxygen (O) are formed when excited by light. From this ozone (O_3) is formed. There is a further reaction between ozone and NO to form NO_2 and oxygen, although this reaction is relatively unimportant, meaning that ozone is able to build up – this is an important pollutant when at

ground level and is capable of reacting with hydrocarbons (from fossil fuels) to form photochemical smog (although levels would have to be extremely high to do this. These reactions will effectively lower NO_2 concentrations, whilst maintaining high concentrations of NO_x and O_3 as well as the singlet oxygen (O). (I am attaching a diurnal (daily) cycle of these pollutants so you can see how they relate to NO_2 and see how important it is to monitor ALL pollutants involved.

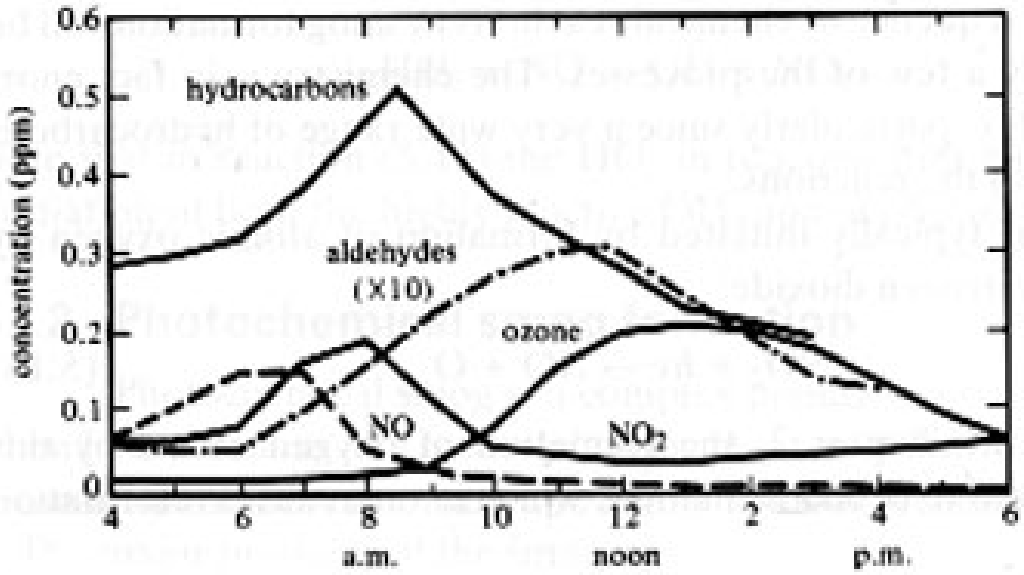
10. The levels which are cited as being the 'safe' levels are, in fact, not seen as such by regulatory bodies such as the Environment Agency. In fact, it is widely recognised that these 'safe' levels have been seen to have seriously detrimental effects for, in particular, children and those suffering from asthma (paper I gave you before). Exposure to NO_2 has also been linked to increased risk and occurrence of diabetes mellitus. (The relationship between diabetes mellitus and traffic related air pollution, Robert Brook *et al.*. *Journal of Occupational and Environmental Medicine,* 2008, Vol. 50, 32-38). It is the recommendation of the Environment Agency that these levels be regarded with extreme caution as children are prone to detrimental health effects at levels far lower. Being average values, this does not take into account the high values that can be found with certain wind directions.

In summary – although, on the face of it, this report is reasonably thorough, there are many gaps in the data, which are vital to understanding air quality. The conclusions are not backed up by the results – 85% (27/32) sites showing an increase in pollution concentrations is NOT acceptable by any means. How about the residential areas to the east of the site which will be affected, together with the many children who walk through this way on there way to and from school on a daily basis? Especially if mothers are pushing pushchairs with babies/toddlers – they will be exposed to unacceptable levels of pollutants. The lack of data on many air pollutants is astounding – how can air quality be assessed with any accuracy with such gaping holes in the analysis?

I therefore believe that this report and the evidence provided within it is NOT sufficiently robust to conclude that the development would not have a detrimental effect on air pollution levels in Lancaster, bearing in mind the uncertainties which should be addressed and the lack of inclusion of any pollutants other than NO_2 and PM_{10}. There is also a lack of range to possible future scenarios concerning road traffic, meteorological variability, climate change, background air quality and atmospheric chemistry. The likely increases in temperature will have major implications for air pollution concentrations – making them much higher due to photochemical reactions. Considering the uncertainties and importance of traffic emissions, there should be much more of a range of plausible future projections with which to test the reliability of the model outputs.

Dr. Sara Massey BSc. (Hons.) PhD.
sara.massey@environment-agency.gov.uk
Office number: 01524 594806
Mobile: 07809158082

Figure – Traffic Related Pollution



List of References

Underestimation of NO_2 from diffusion tubes – 30-50%

Gerboles, M. and Amantini, L. (1993). Validation of measurement by passive NO_2 passive sampler. A comparison with Chemiluminescent Monitor. Office of Publication of the European Commission, Luxembourg TNI/93/107.
(30%)

Kasper-Giebl, A. and Puxbaum, H. (1999). Technical note: deposition of particulate matter in diffusion tube samplers for the determination of NO_2 and SO_2. Atmospheric Environment 33, 1323-1326.
(50%)

Over estimation of ~ 30%.

Heal, M.R., O'Donoghue, M.A. and Cape, J.N. (1999). Overestimation of urban nitrogen dioxide by passive diffusion tubes: a comparative exposure and model study. Atmospheric Environment 33, 513-524.

Campbell, G.W., Stedman, J.R. and Stevenson, K. (1994). A survey of nitrogen dioxide in the United Kingdom using diffusion tubes. Atmospheric Environment 28, 477-486.

"Although the tubes are useful for assessing the spatial variation in NO_2 concentrations, it is necessary to know the limitations for their adequate use in air quality networks."

Plaisance, H., Piechocki-Minguy, A., Garcia-Fouque, S. and Galloo, J.C. (2004). Influence of meteorological factors of the NO_2 measurements by passive diffusion tube. Atmospheric Environment 38, 573-580.

Diffusion tubes can be used for 'indicative' results and 'spatial comparisons' although uncertainty attached to measurements even with extremely rigorous quality control measures are > 25%.

Stevenson, K., Bush, T. and Mooney, D. (2001). Five years of nitrogen dioxide measurement with diffusion tube samplers at over 1000 sites in the UK. Atmospheric Environment 35, 281-287.

Uncertainties are 24-38% for diffusion tube concentrations of NO_2.

Bush, T., Smith, S., Stevenson, K. and Moorcroft, S. (2001). Validation of nitrogen dioxide diffusion tube methodology in the UK. Atmospheric Environment 35, 289-296.

Appendix 2 - Additional References not in Inquiry Library Core Documents List:

[I/AQ-01] – This Proof
[I/AQ-02] - UK Climate Impacts Programme wind speed maps for the UK speed
http://www.ukcip.org.uk/images/stories/08_pdfs/Trends_windspeed_maps.pdf
[I/AQ-03] - Lancaster Air Quality Annual Report 2008
[I/AQ-04] - Notes of 6 July 07 AQAP steering group meeting
[I/AQ-05] - Notes of 3 Aug 07 AQAP steering group meeting
[I/AQ-06] – Extract from Core Doc CD72 - Letter from Lancashire County Council to Lancaster Council 16 Sept 08

Glossary

AQMA	– Air Quality Management Area
AQAP	– Air Quality Action Plan
AURN	– Automatic Urban and Rural Network
CO2	– Carbon Dioxide
ES	– Environmental Statement
HDV	– Heavy Duty Vehicle
HGV	– Heavy Goods Vehicle
NO2	– Nitrogen Dioxide
NOx	– Nitrous Oxides
PM10	– Particulate Matter
LAQM	– Local Air Quality Management
LDV	– Light Duty Vehicle
uG/m3	– Micrograms per cubic metre