Clean Air IN LONDON

Mayor Johnson
Chairman
Transport for London
Windsor House
42-50 Victoria Street
London SW1H OTL

18 December 2011

Dear Mayor Johnson

Environmental information request reveals high levels of 'tube dust' in London

Concentrations of airborne particles in the London Underground (tube dust) are much higher than those measured in Barcelona, Milan, Paris, Rome, Stockholm or San Francisco

Government has not changed guidelines for occupational exposure to 'dust' since 1998 despite significant recent statements from leading experts including the Trades Union Congress

'Clean Air in London' urges the Mayor to follow the 'precautionary principle' on 'tube dust' and: protect employees (and others) from possible health risks; ask the Government to consult the Committee on the Medical Effects of Air Pollutants and seek updated advice from the Health and Safety Executive on the issue; and ask Transport for London to reduce it

I am writing on behalf of Clean Air in London (CAL) to bring to your attention recent advice from leading experts including the Trades Union Congress (TUC) that limits for occupational exposure to 'respirable dust' should be reduced by 75% and urge you to follow the 'precautionary principle' with respect to the London Underground (tube). Please also consider again the possibility of health risks for vulnerable passengers and the practicality of measures to reduce 'tube dust'.

Introduction

Transport for London (TfL) responded on 29 November to a request from CAL submitted under the Environmental Information Regulations. CAL had asked:

> *"to know for all places measured, estimated and/or modelled in/for the London Underground relating to the 2009/10 and/or 2010/2011 data and/or otherwise since 1 January 2009: particle [mass] concentrations; particle sizes; particle numbers; particle density; particle composition; and/or particle 'activity' or toxicity. [CAL] would also like to know whether the air throughout publicly accessible spaces in the London Underground is filtered and/or ventilated and if so how, when and to what standard (e.g. European guideline EN 13779). If possible [CAL] would like the information organized by tube line. [CAL] would like to know as much as possible about the particles in air within the London Underground system."*

See also the Communication from the European Commission on the 'precautionary principle' in 2000.

http://ec.europa.eu/dgs/health_consumer/library/pub/pub07_en.pdf

Clean Air IN LONDON

Summary

Note: 1,000 micrograms per cubic metre (μg/m^3) = 1 milligram per cubic metre (mg/m^3)

Clean Air in London (CAL) has investigated 'tunnel dust' in the London Underground (tube dust).

The Health and Safety Executive (HSE) set guidelines for occupational exposure to 'general dust' with specific limits for 'inhalable dust' and 'respirable dust' in 1998. 'Inhalable dust' approximates to the fraction of airborne material that enters the nose and mouth during breathing and is therefore available for deposition in the respiratory tract. 'Respirable dust' approximates to the fraction that penetrates to the gas exchange region of the lung ($PM_{3.5}$). The HSE guidelines for 'inhalable dust' and 'respirable dust' are 10 and 4 milligram per cubic metre (mg/m^3) respectively for an 8-hour time weighted average (TWA). However, as early as 1984, the HSE said "All dusts should be controlled to the lowest levels that are reasonably practicable".

Transport for London (TfL) and you appear to base your approach on HSE guidelines and the 'authoritative report' undertaken by the Institute of Occupational Medicine (IOM) in 2003 titled 'Assessment of health effects of long-term occupational exposure to tunnel dust in the London Underground'.

The main results from the IOM report were:

- average $PM_{2.5}$ concentrations in stations on platforms ranged from 270-480 μg/m^3 with about 80% of particles having a measured diameter less than 1 micron (μm);
- above ground, there were high particle number counts and low mass concentrations with the opposite pattern underground;
- average levels of $PM_{2.5}$ in Train Drivers' cabs ranged from 130 to 200 μg/m^3;
- some 90% of the dust in the $PM_{2.5}$ was analysed as iron [oxide]. There were trace amounts of chromium (0.1-0.2 %), manganese (0.6-1%) and copper (0.1-0.5%) and larger amounts of quartz (1-2%); and
- personal exposures of London Underground workers and commuters were estimated at 67 μg/m^3 (i.e. eight hours) and 17 μg/m^3 (i.e. two hours spent in trains or on station platforms) per day respectively.

According to the Scotland and Northern Ireland Forum for Environmental Research, the population-weighted annual mean $PM_{2.5}$ concentration in ambient air in inner London in 2010 was 14.1 μg/m^3.

TfL paraphrased the IOM's conclusions in its reply to CAL dated 29 November 2011 as saying "this report concluded that dust on the tube is:

- Highly unlikely to cause serious damage to the health of London Underground workers;
- Highly unlikely to be damaging to the travelling public; and
- There is no need for more research at the moment but its conclusions should be kept under review."

Since 1998 and 2003, the health effects of exposure to air pollution have become much better understood. The IOM issued a statement on 5 May 2011 that:

1. *the current British limit values for respirable and inhalable dust (4 and 10 mg/m^3,*

respectively) are unsafe and it would be prudent to reduce exposures as far below these limits as is reasonably practicable.

2. *we suggest that, until safe limits are put in place, employers should aim to keep exposure to respirable dust below 1 mg/m^3 and inhalable dust below 5 mg/m^3."*

The Trades Union Congress (TUC) issued a media release on 1 September 2011 stating:

"Because of the serious health risks that exposure to dust can cause the TUC believes that unions and union health and safety representatives should try to ensure that employers follow a precautionary standard of 2.5 mg/m^3 for inhalable dust (as opposed to the current 10 mg/m^3 standard) and 1 mg/m^3 for respirable dust (as opposed to the current 4 mg/m^3 standard) for all general dust and dusts where there is not a lower [Workplace Exposure Limit]."

CAL submitted its request to TfL for environmental information about 'tube dust' after seeing your response to a Mayoral Question submitted by Mike Tuffrey AM (Liberal Democrat) in September 2011.

TfL's response included the latest report by 4-Rail Services Ltd dated 6 October 2011which appears to show that levels of 'respirable dust' at four stations equal or exceed the maximum levels proposed by the TUC and the authoritative IOM. They are:

Baker Street Station, Bakerloo line, southbound, platform 8:	1.23 mg/m^3
Baker Street Station, Bakerloo line, platform 9:	1.00 mg/m^3
Hampstead Station, Northern line, northbound, platform 1:	1.01 mg/m^3
Piccadilly Circus Station, Bakerloo line, southbound:	1.00 mg/m^3

The report also said that 'respirable dust' concentrations for Train Operators were all below 0.4 mg/m^3 and below 0.7 mg/m^3 for 'Station Staff'. Presumably cleaners and others, such as passengers, could be exposed regularly to the higher 'tube dust' levels on platforms.

It appears that concentrations of 'respirable dust' are highest on the older and/or deeper tube lines. You

stated as recently as 16 November 2011 in MQT 3330/2011 that:

"All readings are less than one third of the Health and Safety Executive limit for general dust, and exposure remains safe for both staff and customers."

On 16 November in MQT reply 3332/2011 you also said that:

"The air throughout publicly accessible spaces on the Underground is not filtered. Many of these spaces are open areas, so it would not be practicable to filter the air. The Underground is ventilated by 160 vents."

The former statement was unequivocal. However, when read in conjunction with your other recent MQT responses, it is not entirely clear whether you consider: levels and/or exposure to 'tube dust' do/does not need to be reduced; and/or they should be reduced but you consider it 'impracticable' to do so. Please clarify your meaning.

Given the recent statements from IOM, the TUC and other experts, please will you follow the 'precautionary principle' with respect to 'tube dust' and consider taking the 10 actions suggested by CAL at the end of this letter. These include seeking updated advice, protecting employees and perhaps amending advice to vulnerable members of the travelling public.

Selected health advice and standards

CAL includes below selected health advice and standards for occupational exposure limits.

1984

The HSE said "All dust should be controlled to the lowest levels that are reasonably practicable".

Source: EH 44, paragraph 19

1998

The HSE said "In the absence of a specific exposure limit for a particular dust, it is important to keep personal exposure levels below 10 milligrams per cubic metre (mg/m^3), 8-hour time weighted average, of 'total inhalable dust' and 4 mg/m^3, 8-hour TWA, of 'respirable dust'".

Source: EH 44 Third edition, paragraph 29

December 1998: COMEAP said "Members concluded that using published epidemiological studies to predict the effects of exposure to dust on the underground on health was unwise in that: the epidemiological studies quoted dealt with 24 hour average and not peak concentrations….".

Source: COMEAP Statement 'Dust on the London Underground'

http://comeap.org.uk/images/stories/Documents/Statements/Dust_on_the_London_Underground_Statement__Dec_98.pdf

2003

IOM said:

"It is always wise and prudent to keep the levels of any workplace or ambient dust as low as practicable."

Source: page ix of IOM report titled 'Assessment of health effects of long-term occupational exposure to tunnel dust in the London Underground'

"Estimate of personal exposures of LUL workers and commuters: This involves linking concentration data with the duration of time spent exposed. We focused on the mass concentration of PM rather than on particle number because the number counts were dominated by particles from above ground. Using, on a precautionary basis, the higher values of estimates from the present study, we have estimated that the likely maximum exposures of station staff and drivers are similar over a shift, at approximately 200 $\mu g/m^3$, based on an 8-hour average period. Averaged over 24 hours this would

correspond to 67 µg/m^3. The duration of exposure of commuters would be less than that of the staff. For someone who spent approximately 2 hours in trains or on station platforms per day, assuming that the average exposure level was similar to the drivers, say at most 200 µg/m^3, then their 24-hour average concentration would be increased by 17 µg/m^3."

Source: page v IOM report titled 'Assessment of health effects of long-term occupational exposure to tunnel dust in the London Underground'

The IOM report "concluded that dust on the Underground is:

- Highly unlikely to cause serious damage to the health of London Underground workers;
- Highly unlikely to be damaging to the travelling public; and
- There is no need for more research at the moment but its conclusions should be kept under review."

Source: IOM report titled 'Assessment of health effects of long-term occupational exposure to tunnel dust in the London Underground' as paraphrased by TfL on 29 November 2011.

http://www.iom-world.org/pubs/IOM_TM0302.pdf

16 July 2003 MQT 1272/2003: Air Pollution – London Underground. Reply to Jenny Jones AM

http://mqt.london.gov.uk/mqt/public/question.do?id=3307

2006

15 November 2006 MQT 2441/2006: Tunnel Dust. Reply to Mike Tuffrey AM

http://mqt.london.gov.uk/mqt/public/question.do?id=16362

2008

'Air Quality in Subway Platforms and Carriages of Six Major Cities' by G Invernizzi et al, 2008

http://journals.lww.com/epidem/Fulltext/2008/11001/Air_Quality_in_Subway_Platforms_and_Carriages_of.415.aspx?utm_source=twitterfeed&utm_medium=twitter#

Mean $PM_{2.5}$ levels (µg/m^3) on platforms were 111 in Barcelona, 162 in Milan, 214 in Rome, 62 in Paris, 82 in Stockholm and 55 in San Francisco. Inside carriages, the mean $PM_{2.5}$ (µg/m^3) was 64 in Barcelona, 186 in Milan, 179 in Rome, 75 in Paris, 16 in Stockholm and 16 in San Francisco.

2010

HSE Board: "Notes the action of the TUC representatives on [Advisory Committee on Toxic Substances] in recommending trade unions follow an interim level for the allowable levels of dusts not assigned a specific exposure limit, and the basis for HSE's view that this should not be supported."

Source: HSE Board minutes (15 December) Position paper

http://www.hse.gov.uk/aboutus/meetings/hseboard/2010/151210/pdecb1094.pdf

Minutes

http://www.hse.gov.uk/aboutus/meetings/hseboard/2010/151210/mdecb1012.pdf

2011

5 May 2011: 'The IOM's position on occupational exposure limits for dust'

> **"The Institute of Occupational Medicine (IOM) considers that the current British occupational exposure limits for airborne dust are unsafe and employers should attempt to reduce exposures to help prevent further cases of respiratory disease amongst their workers." CAL emphasis**

"The WATCH [Working Group on Action to Control Chemicals] scientific advisory committee of the Health and Safety Executive (HSE) has advised that in their opinion current occupational exposure limits for inhalable and respirable dust are not safe. The evidence they examined suggests exposure to any poorly soluble dust, even at low doses, will affect lung function in a roughly linear fashion, i.e. increasing exposure will result in increasing adverse health effects. It was not possible for WATCH to identify a lower threshold below which there would be no lung function decline. The literature reviewed by the committee only considered in detail kaolin, carbon black and coalmine dust but it appears that they felt that the results could probably be generalised to all other low toxicity dusts.

"This issue was also considered by the Advisory Committee on Toxic Substances (ACTS), who recommended an awareness raising campaign for those exposed to dusts to highlight possible risks to health. The trade union representatives on the committee dissented from this approach because they considered it was not sufficient and they have recommended that, as an interim measure, unions should follow a precautionary standard for inhalable dust and respirable dust.

"At their December 2010 meeting the HSE Board considered these discussions and concluded that only limited benefits would accrue from reducing the exposure limits for airborne dust and that it would not therefore be seeking to do this in pursuit of a long-term reduction in respiratory disease."

And then:

"….studies demonstrated that surface area is a major determinant of the toxicity of inhaled chemically inert dusts, and suggest that if there is a threshold for adverse effects it may be lower than the current limit values."

And on page 2:

"IOM will adopt the following approach in advising its clients:

1. The current British limit values for respirable and inhalable dust (4 and 10 mg/m^3, respectively) are unsafe and it would be prudent to reduce exposures as far below these limits as is reasonably practicable.

2. We suggest that, until safe limits are put in place, employers should aim to keep **exposure to**

respirable dust below 1 mg/m^3 and inhalable dust below 5 mg/m^3." **CAL emphasis**

Source: 'The IOM's position on occupational exposure limits for dust'

http://www.iom-world.org/pubs/IOMs_position_on_OELs.pdf

1 September 2011: TUC media release: 'Dust level limits must be reduced to protect workplace health'

"Because of the serious health risks that exposure to dust can cause the TUC believes that unions and union health and safety representatives should try to ensure that employers follow a precautionary standard of 2.5 mg/m^3 for inhalable dust (as opposed to the current 10 mg/m^3 standard) and **1 mg/m^3 for respirable dust (as opposed to the current 4 mg/m^3 standard)** for all general dust and dusts where there is not a lower [Workplace Exposure Limits]." **CAL emphasis**

Source: Dust in the Workplace, Guidance for Health and Safety Representatives

http://www.tuc.org.uk/workplace/tuc-19972-f0.cfm

14 September 2011: MQT 2546/2011: Air quality on tube. Response to Mike Tuffrey AM "Written

answer received on 29 September 2011:

"As the figures below show**, the levels of tunnel dust remain stable compared with those last reported in the previous Mayor's answer to question 2441/2006. All readings are less than 1/3 of the Health and Safety Executive limit for general dust, and exposure remains safe for both staff and customers**.

"Year Dust level in milligrams per metre cubed (mg/m^3)

2004/5	0.753 to 1.447
2005/6	0.050 to 0.910
2006/7	0.130 to 1.440
2007/8	0.060 to 1.140
2009/10	0.030 to 1.270

"There is no measurement for the year 2008/9, as measurements are taken every 12-18 months. Dust levels vary by location which is why a range is given. The results for 2010/11 are expected in October.

"No further analysis has been carried out on potential health impacts since the **authoritative study** (Assessment of health effects of long-term occupational exposure to tunnel dust in the London Underground) produced by the Institute of Occupational Medicine (IOM) in 2003/4. This report concluded that tunnel dust was highly unlikely to be harmful to human health. London Underground focuses on minimising dust levels as far as reasonably practicable and, monitoring them annually, as recommended in the IOM report." **CAL emphasis**

http://mqt.london.gov.uk/mqt/public/question.do?id=37419

16 November 2011: MQT 3330/2011: Air quality on Tube (1). Response to Mike Tuffrey AM

"As the figures below show, the levels of tunnel dust remain stable compared with those last reported in my answer to question 2546/2011. All readings are less than one third of the Health and Safety Executive limit for general dust, and exposure remains safe for both staff and customers.

"Year Dust level in milligrams per metre cubed (mg/m^3)

2009/10 0.030 to 1.270
2010/11 0.030 to 1.230

"Dust levels vary by location which is why a range is given."

http://mqt.london.gov.uk/mqt/public/question.do?id=38485

16 November 2011 Air Quality on Tube (3): MQT 3332/2011. Response to Mike Tuffrey AM

"The air in publicly accessible spaces on the Underground is not filtered. Many of these spaces are open areas, so it would not be practicable to filter the air. The Underground is also ventilated by 160 vents."

http://mqt.london.gov.uk/mqt/public/question.do?id=38487

12/13 December 2011: Philip White, HSE Chief Inspector of Construction was reported as challenging industry on occupational health:

"Mr White was concerned that the unintended consequence of larger firms switching to workforce 'wellbeing' was less attention being paid to traditional health risks, such as hand arm vibration and **exposure to dust**." **CAL emphasis**

Source: Philip Poynter Construction Safety 13 December

http://www.ppconstructionsafety.com/newsdesk/2011/12/13/hse-chief-challenges-industry-on-occupational-health/

Action

CAL urges the Mayor to adopt the 'precautionary principle' and consider taking the following actions:

1. adopt throughout Transport for London's activities and with immediate effect the latest advice from the TUC and the authoritative IOM on occupational health limits for exposure to 'respirable dust' i.e. 1 mg/m^3;

2. ask the Government to consult the Committee on the Medical Effects of Air Pollutants on 'tube dust' and invite the Health and Safety Executive to update its advice on 'general dust' including
'respirable dust' and 'inhalable dust';

3. write to the Chair of the HSE Board inviting the HSE Board to update its advice on

occupational exposure to 'respirable dust' and 'inhalable dust' reconsidering the advice of ACTS and taking into account the most recent statements by IOM and the TUC;

4. ask Transport for London to reduce 'tube dust' at source and in the air. It is possible that large, self-standing air filters could reduce concentrations of dust and exposure to it in the most polluted parts of the 'tube' (i.e. without the need for ducting). In the interests of disclosure, CAL is sponsored by Camfil Farr, the world leader in the development and manufacture of air filters;

5. warn employees (and vulnerable people travelling on the London Underground) of the possible health risks from 'tube dust';

6. allow London Underground employees – who ask for them and whether tube drivers, platform staff, cleaners or others – to wear respiratory protection during their working day including in public places. Engage transparently with unions and others who are concerned about this issue;

7. make clear that customers who are concerned about the issue, such as vulnerable people, may choose to wear breathing protection on the tube if they wish to do so.

For example, a filter described by Pure Breathe claims to be able to remove, if properly maintained, 0.5 micron particles with 98% efficiency and be capable of removing particles as small as 0.05 microns. See: http://www.purebreathe.com/;

8. take rapid action to reduce on a long-term basis 'tube dust' before the Olympics to make this another legacy from the 'greenest Games ever';

9. facilitate independent monitoring, analysis and scrutiny of 'tube dust' for example by the highly regarded Environmental Research Group at King's College London; and

10. improve public understanding of 'tube dust' by publishing on the TfL website the IOM report in 2003/4 and the five 'annual' reports on the monitoring of 'tube 'dust'.

CAL appreciates it may be a challenging task to reduce levels of 'tube dust' and/or exposure to it. However, CAL considers there is an urgent need to reconsider standards and advice after recent statements by leading experts in the field of occupational health.

I look forward to hearing from you.

With best wishes.

Yours sincerely

Simon Birkett
Founder and Director

Clean Air in London

Cc:

Professor Frank Kelly, Chairman of COMEAP Judith Hackett CBE, Chair of the HSE Board
Isabel Dedring, Deputy Mayor, Transport
Peter Hendy, Chief Executive, Transport for London
James Cleverly AM, London Assembly Environment Committee
Darren Johnson AM, Deputy Chair, London Assembly Environment Committee
Murad Qureshi AM, Chair, London Assembly Environment Committee
Mike Tuffrey AM, London Assembly Environment Committee

APPENDIX

Other selected links (in alphabetical and date order)

Committee on the Medical Effects of Air Pollutants (COMEAP)

1. December 1998: Committee on the Medical Effects of Air Pollutants (COMEAP) Statement: 'Dust on the London Underground'

   http://comeap.org.uk/images/stories/Documents/Statements/Dust_on_the_London_Underground_ Statement _ Dec_98.pdf

2. April to June 2002: COMEAP statement on the report prepared by Dr Leslie Hawkins: 'Dust in the London underground, a review of the health implications of exposure to tunnel dust'

   http://comeap.org.uk/documents/statements/83-london-underground-tunnel-dust.html

3. 20 December 2010: COMEAP Secretariat – 'Previous UK estimates of the impact of long-term exposure to fine particles'

   http://comeap.org.uk/images/stories/Documents/Reports/supporting%20paper%20-%20comeap%20secretariat.pdf

Health and Safety Executive (HSE)

4. October 2007: Health and Safety Executive EH40/2005 Table 1: List of approved workplace exposure limits (consolidated with amendments)

http://hrmg.co.uk/doc/EH40_Workplace_Exposure_Limits.pdf

5. 7-8 November 2007: WATCH

   http://www.hse.gov.uk/aboutus/meetings/iacs/acts/watch/071107/minutes.pdf

6. 15 December 2010: Health and Safety Executive Board meeting

   Position paper

http://www.hse.gov.uk/aboutus/meetings/hseboard/2010/151210/pdecb1094.pdf

   Minutes http://www.hse.gov.uk/aboutus/meetings/hseboard/2010/151210/mdecb1012.pdf

Health Protection Agency (HPA)

7. April 2010: Health Protection Agency: 'Paper on the possible effects on health of exposure to

volcanic ash and associated gases'

Paragraph 16 on page 5:

"Given that all the information we have on the effects of exposure to low concentrations of particles comes from studies of ambient particles, it is difficult to assess the effects of exposure to ash except in comparison with the effects of ambient particles."

Paragraph 17 on page 6:

"Perhaps more important than composition is the size distribution of the particles of the ash."

Paragraph 21 on page 7:

"It is suggested that 200 μg/m^3 (as PM_{10}, 1 hour average) is used as a trigger point to initiate examination of data from PM_{10} monitors. Such a concentration at a background site would clearly be more important than one recorded near a busy road. A second figure of 500 μg/m^3 (PM_{10}, 1 hour average) is suggested as a second trigger point that should initiate observation of current conditions: is there an ash fall?"

And later on page 7:

"These figures suggest that the values of 200 μg/m^3 and 500 μg/m^3 (PM_{10}, 1 hour average) might be acceptably precautionary."

http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1274089597960

Institute of Occupational Medicine (IOM)

8. 1995: 'Experimental studies on dust in the London Underground with special reference to the effects of iron on the toxicity of quartz'

   http://www.iom-world.org/pubs/IOM_TM9501.pdf

9. December 2003: 'Assessment of health effects of long-term occupational exposure to tunnel dust in the London Underground'

   http://www.iom-world.org/pubs/IOM_TM0302.pdf

10. 21 October 2004: 'The London Underground: dust and hazards to health' by A. Seaton et al

    http://oem.bmj.com/content/62/6/355.full.pdf

11. 2006: 'Trends in inhalation exposure – Mid 1980s till present'

    http://www.hse.gov.uk/research/rrpdf/rr460.pdf

12. 5 May 2011: 'The IOM's position on occupational exposure limits for dust'

http://www.iom-world.org/pubs/IOMs_position_on_OELs.pdf

Mayor's Question Time

13. Mayor's Question Time answers

    16 July 2003 MQT 1272/2003: Air Pollution – London Underground. Jenny Jones AM

    http://mqt.london.gov.uk/mqt/public/question.do?id=3307

    15 November 2006 MQT 2441/2006: Tunnel Dust. Mike Tuffrey AM

    http://mqt.london.gov.uk/mqt/public/question.do?id=16362

    14 September 2011MQT 2546/2011: Air quality on tube. Mike Tuffrey AM

    http://mqt.london.gov.uk/mqt/public/question.do?id=37419

    16 November 2011 MQT 3330/2011: Air quality on Tube (1). Mike Tuffrey AM

    http://mqt.london.gov.uk/mqt/public/question.do?id=38485

    Air Quality on Tube (2): MQT 3331/2011. Mike Tuffrey AM

    http://mqt.london.gov.uk/mqt/public/question.do?id=38486

    Air Quality on Tube (3): MQT 3332/2011. Mike Tuffrey AM

    http://mqt.london.gov.uk/mqt/public/question.do?id=38487

National Physical Laboratory (NPL)

14. August 2011: 'CPEA 28: Airborne Particulate Concentrations and Numbers in the United Kingdom (phase 2). Annual Report 2010'

    http://publications.npl.co.uk/npl_web/pdf/as65.pdf

Scotland and Northern Ireland Forum for Environmental Research (SNIFFER)

15. 20 December 2010: '$PM_{2.5}$ in the UK'

    http://www.sniffer.org.uk/Webcontrol/Secure/ClientSpecific/ResourceManagement/UploadedFile s/PM25%20Report%20Final%20(20Dec10).pdf

Trades Union Congress

16. 1 September 2011: TUC media release: 'Dust level limits must be reduced to protect workplace health'

http://www.tuc.org.uk/workplace/tuc-19972-f0.cfm

Other research

17. 'Air Quality in Subway Platforms and Carriages of Six Major Cities' by G Invernizzi et al, 2008

    http://journals.lww.com/epidem/Fulltext/2008/11001/Air_Quality_in_Subway_Platforms_and_Carriages_of.415.aspx?utm_source=twitterfeed&utm_medium=twitter#

18. 'Links between urban environment particulate matter and health – time series analysis of particle metrics' by R Atkinson et al

    http://www.environment-health.ac.uk/Staff/Publications/Atkinson.pdf