

Sounder City The Mayor's Ambient Noise Strategy



March 2004

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**Greater London Authority
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EvoBus Mercedes-Benz
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CITARO

FUEL CELL



foreword

Noise may not be top of everyone's priorities, but it is a big issue for many. That is clear from those who welcomed this first city-wide strategy when the draft was published for public consultation in March 2003. It focuses on getting more action going on 'ambient noise', mainly noise from transport and industry, but also looking to better housing and good building design.

My legal remit is ambient noise - mainly from transport. This strategy reflects that duty. However, I am in no doubt that neighbours from hell can leave people at their wits' end. Noise makers need to be aware that music systems or other equipment can be confiscated if they cause real nuisance to others.

In much of Europe, local police offer the first line of defence against excessively noisy neighbours. New Yorkers call NYPD. In London, the boroughs are responsible. Even so, more people call the police about noise than call their council Environmental Health Departments. In the long term, I would like to see properly resourced and responsive local policing being able to sort out most breakdowns in neighbourliness, with the noise specialists as back up. I have already expanded police numbers. More neighbourhood wardens and community support officers are coming through. Clearly there are going to be other pressing priorities for some time to come, but I will work for a future in which those responsible for these services can consider new options with potential benefits for all concerned.

Meanwhile, I invite London boroughs to reconsider the wide variations which exist in local noise services across the city. Some have good out of hours services, dealing with noisy parties and other nuisances. All boroughs need to achieve the standards of the best in this vital service to Londoners. Opportunities for shared services across borough boundaries need to be considered. I am keen to work with boroughs to get better funding for London's noise services, ring-fenced if necessary.

I also want to see better control of noise from roadworks and building works. Transport for London will play its part. This may not be defined as 'ambient noise', but all those responsible must pull together, so we can secure the benefits from growth, while keeping construction noise under control.

London is a noisy city. Its buzz is tangible. But everyone needs to rest and recover at some time. Noise can interfere with speech, learning and concentration, as well as leisure. Good modern city management needs to minimise noise for the wellbeing of all those who live, visit or work here.

London is leading the way for the UK with this first city-wide strategy for ambient noise. The Government has said it needs five years, noise mapping costing £13 million, and many other studies to prepare a national strategy.



The Greater London Authority Act required me to produce a strategy for probably the country's noisiest city, but with no new money and no new powers specifically to reduce noise. I am very aware of the costs of properly addressing noise - but also of the needs, and the benefits for Londoners' wellbeing. In our current system, only the Government can secure the changes required. It must speed up development of an effective national noise policy, including work on costing.

I am keen to do whatever I can, but no-one can pretend that it will be quick and easy to reduce noise in Europe's biggest city. London is ahead of national strategy, so there are many issues on which I must urge Government to act. Many practical actions will be pursued at city level, but we will still need further reductions at source, including quieter road vehicles, railways and aircraft. International agreement and action is vital, particularly for a world city. London can demonstrate practical action. Progress on noise demands partnership, with the Government, the London boroughs, and others.

I want to play my part, especially through Transport for London, and with the London Development Agency. A major early priority is making up the backlog of street re-surfacing. But we must have sufficient transport funding.

We will build noise management into as much of our transport and other work as we can. 'Streets for People' policies can help reduce noise in local areas. Local highway authorities need to consider alternatives to the 'road hump'. Fuel cell buses are being trialled. We also plan to trial hybrid-electric buses. If we can find suitable locations and funds, I would like to get some noise barriers in London which also generate solar electricity, so that we can increase renewable energy at the same time as reducing noise.

I was glad to support action in the European Court of Human Rights on night aircraft noise, though, like many Londoners, I was very disappointed that the Court went back on its earlier decision which had found for the residents. Trafalgar Square remodelling has, however, been a great success, with people remarking how they can hear the fountains from the gallery steps for the first time. Open spaces and watersides need special attention. Good planning and design of buildings can stop road and railway noise spreading. With good design, new development can create new quiet spaces.

I extend my thanks to all who gave views and advice, especially Victor Anderson, my Environment Adviser. I am glad to have received constructive input from the London Assembly and from many others during public consultation. Noise policy is becoming more positive. It is an exciting and creative time for those concerned with the sounds of the city.

Parliament gave London a pioneering role. London carries an extra noise burden as gateway to the UK. Action here can help in national policy development. Government must recognise this by supporting exemplary projects, and setting up funds for on going noise reduction.



Ken Livingstone
Mayor of London

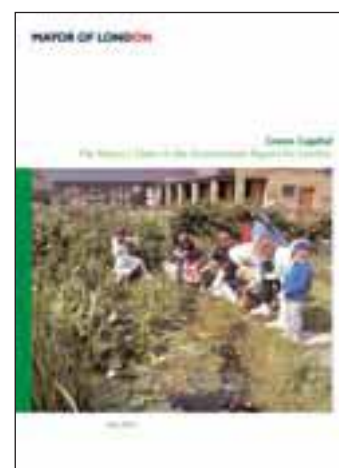
preface the Mayor's Environmental Strategies

This Strategy is one of a series dealing with environmental issues in London. The Mayor is required to produce four environmental strategies addressing Air Quality, Ambient Noise, Biodiversity and Municipal Waste Management. He has also decided to produce an Energy Strategy for London. The main elements of each environmental strategy are reflected in the overall London Plan and where appropriate in the Transport and Economic Development Strategies. Together these strategies provide the basis for improving London's environment. They also provide an integrated framework for sustainable development.

Whilst improvement of London's immediate environment, by reducing pollution and improving the quality of life for Londoners, is the main purpose of the environmental strategies, this is not the sole objective. The strategies also need to take account of London's wider impacts on the global environment and identify action to reduce damaging or unsustainable processes. To do this we need to understand the way that London functions in terms of its daily processes and be aware of its wider ecological footprint, recognising that this extends to virtually all parts of the globe.

A detailed analysis of London's ecological footprint, published in 2002, quantified the energy and materials used or wasted by current practices. This was summarised in the *Mayor's State of the Environment Report for London* published in May 2003. It demonstrates unsustainable levels of resource use resulting from a fundamental difference between the way a city works and the processes of the natural world. Whilst natural ecosystems have a series of inbuilt circular processes, preventing most wastage, the metabolism of a modern city is almost entirely a one-way process. This is particularly true of affluent cities in developed countries, where vast quantities of material are imported daily for human use and waste products are discharged as unwanted residues. London is no exception. Examining individual elements of London's functional metabolism, such as waste or energy will help to identify action we can take to improve our environmental performance and reduce damaging impacts elsewhere. This is crucial if we are to be successful in combating climate change and reducing London's global impacts on biodiversity and natural resources.

The Mayor's draft London Plan makes it clear that to become an exemplary, sustainable world city, London must use natural resources more efficiently, increase its reuse of resources and reduce levels of waste and environmental degradation. As London grows, these objectives will become ever more important. The shift towards a compact city, which is inherent in the London Plan, will contribute towards these objectives. It



will enable more efficient use of resources such as land and energy and will also enable the 'proximity principle' to be applied to promote greater self-sufficiency.

Implementing the Mayor's environmental policies will enable London to draw on the resources it needs to live, breathe and develop as a growing world city. It must aim to become a more sustainable and self-sufficient city, healthier to live in and more efficient in its use of resources. It should also be a better neighbour to its surrounding regions by consuming more of its own waste and producing less pollution.

How we use energy is fundamental to long-term sustainability. If London is to make a significant contribution to the reduction of greenhouse gas emissions we need to restrain our use of fossil fuels, encourage greater energy efficiency, and promote renewable energy. Implementation of the Mayor's Energy Strategy will help to mitigate climate change by reducing carbon dioxide emissions. The energy strategy has wide implications, promoting new kinds of fuel for transport and encouraging high performance buildings with less demand for energy. It promotes good practice in new developments and supports examples such as the Beddington Zero Energy Development. Although one of the principal objectives of the strategy is to reduce our dependence on fossil fuels, it also addresses the vital social issue of energy poverty.

Waste is another area where we need to significantly improve our efficiency. It is not simply a matter of improving levels of recycling, which is how the problem is often perceived. If London is to become sustainable, a more fundamental long-term change is required to establish a secondary materials economy. We need to develop a new business culture, where components of the waste stream are automatically considered as potential products for new industries. The policies contained in the Mayor's Waste Strategy set the framework for such a change. Substantial progress has already been made through the London Remade Programme, funded by the London Development Agency, and this approach is now being promoted as a component of economic development. The Mayor's Green Procurement Code is another key initiative which provides the necessary link between environmental improvement and business performance.

Clearly one of London's main environmental problems is air quality. Although we no longer see the smogs of the 1950s, London's atmosphere still poses major problems, in terms of health and environmental quality. The main problems are emissions from road traffic in the form of nitrogen oxides and air-borne particles. London currently fails to meet EU and



national targets for air quality because of the size of the conurbation and because of the density of road traffic. The Mayor's Air Quality Strategy makes proposals for meeting the legal targets, and for longer term solutions to introduce cleaner vehicle technologies.

Conservation of biodiversity is addressed in detail in the Mayor's Biodiversity Strategy and in the London Plan. The sub-title *Connecting with London's Nature* emphasises the social context, since one of the main objectives of the strategy is to ensure the conservation of London's natural heritage for people to enjoy. The Mayor has adopted the well-established procedures for identification of important habitats in London as the basis for his Biodiversity Strategy, which was published in 2002. At present, London is the only part of Britain where there is a statutory requirement for a biodiversity strategy as part of regional planning and it may provide a useful model for other towns and cities in the UK. The strategy also has an international dimension by making proposals to clamp down on the illegal international trade in endangered species for which London's airports are one of the main points of entry to Europe.



Strategic policies to deal with noise have until recently been far less advanced than other areas of environmental concern. However, the requirement for the Mayor to produce the UK's first citywide strategy for tackling environmental noise has resulted in much progress over the past three years. This strategy sets out the main steps that need to be taken, including quieter road surfaces, smoother traffic flow, rail infrastructure improvements, aircraft noise measures, and improved design for new developments.



The overall effect of the Mayor's five environmental strategies over the next twenty years will be to make significant improvements in our own local environment as well as reducing London's wider global impacts. The strategies provide many of the essential ingredients to make London a truly sustainable world city.

A handwritten signature in black ink that reads 'David Goode'.

David Goode

Head of Environment



executive summary

- 1 All of us have been affected at some time, in some way, by noise. We may have had to shout over the roar of traffic at the roadside. We may have been kept awake at night by the noise of a busy restaurant or bar.
- 2 Noise - unwanted sound - has been called the 'forgotten pollutant', the 'Cinderella' of the environment. Most of us probably blot it out most of the time. So we may not think to mention it when we are asked what needs to be done to improve our environment.
- 3 However, recognition of its importance is growing. In a modern city, noise is increasingly seen as a key quality of life issue. Our 'soundscape' needs as much care as townscape or landscape. The Mayor has a duty to consider the health and wellbeing of Londoners, and to produce a strategy for London on 'ambient noise' - long term predictable noise, mainly from transport and industry. This strategy focuses on reducing noise through better management of transport systems, better town planning and better design of buildings. It means minimising noise on roads and railways. It means being more careful where noisy activities are sited. It means protecting housing, schools, waterways and open spaces - places which should be peaceful havens.
- 4 Local 'nuisance noise' - from noisy neighbours, pubs or clubs, roadworks or a construction site - is dealt with by local boroughs. People can phone for help or advice if they are suffering a nuisance. Boroughs and the Environment Agency deal with industrial noise. The Health and Safety Executive works to protect people's hearing in places like noisy factories. The Mayor's strategy complements this work, while pushing for new projects to show that real change can be achieved. Improving soundscapes across a big and busy city will require new partnerships and fresh approaches.
- 5 This is the first city-wide noise strategy of its kind in the UK. Very little consistent London-wide information is currently available. Evidence needs to be improved before clear priorities for cost-effective action can be properly set. First results from computerised road traffic noise mapping are becoming available, as part of the Government's work on a National Ambient Noise Strategy, and the Mayor is supporting a London Noise Survey. The Mayor's strategy identifies practical actions and ways forward in the interim, especially in transport and through the planning system. The Mayor has not so far been given new powers or money specifically to control noise. He will work through Transport for London and with others, integrating noise with other Mayoral policies as far as possible. Government support will be needed to establish London Funds for pilot

exemplar projects, improvements to poorly insulated London housing, and other measures.

The issues

- 6 Noise can disrupt communication and other activities and increase stress. One person's music can be another person's intense irritation. One person's business may disturb another's concentration or sleep. This should not be seen, however, as just a negative strategy. Sound is an important part of communication, culture and many other aspects of everyday life. Many parts of the city have their own distinctive soundscapes. Minimising noise problems is a social balancing act.
- 7 Noise levels are often higher where transport and buildings are concentrated. However, quiet areas screened from road and rail traffic can still be found in high density areas, while more detached and semi-detached suburban development could allow noise to spread, eroding remaining tranquillity. Old-style planning policies which relied only on spatially segregating people and transport would not help London to gain the benefits of a compact city. Making cities attractive means that, over time, more people can gain access to more facilities while generating less noise - a virtuous circle.
- 8 Busy roads, major rail corridors, and aircraft are the main sources of ambient noise in London. In the London Household Survey 2002, 13% rated noise from road traffic where they lived a 'serious problem', compared with aircraft 6%, roadworks/construction/demolition 4%, noisy neighbours 4%, trains/tubes 2%, industrial/commercial premises 2%, and pubs/clubs/entertainment 2%. Larger percentages experienced at least some level of problem.
- 9 The ways in which different noises are created and heard are complex. It is rarely a case of just fitting a better silencer. Cars and other road vehicles can be measured as quieter in terms of the official noise test applied to new vehicle designs. However, traffic noise on typical urban roads does not generally appear to have fallen. New buses should be quieter, but driving on uneven roads overdue for spending on maintenance can lead to unnecessary noise. New trains should be quieter, but poor track quality can mean needless noise. Aircraft have been becoming quieter, weight for weight, but numbers have been increasing. People may notice bigger aircraft more, as they manoeuvre to join busy airport approach paths. The tranquillity of many open spaces has been eroded. On parts of the Thames, traditional sounds of working vessels have been replaced by those of tourist and party boats. More riverside housing means more people near working wharves and boatyards. Some

areas are less affected than they once were by noise from traditional industries, but more ventilation and air-conditioning plant can mean more annoying noise and vibration, particularly in central areas. Parts of London are becoming more of a '24 hour city' in response to global economic and lifestyle trends. More late night eating, drinking, clubbing and other entertainment, and more flexible patterns of living and working, tend to mean more noise in hitherto quieter periods of the day and week.

- 10 Locating more development on brownfield land at higher densities, especially around transport interchanges, will produce a more sustainable city. New development and building conversions can be designed to enhance local sound environments. Visual design quality in London has risen. Similar attention needs to be given to achieving good acoustic design.

Practical action on noise

- 11 The aim of the Mayor's ambient noise strategy is a practical one - **to minimise the adverse impacts of noise on people living and working in, and visiting London using the best available practices and technology within a sustainable development framework.**

New approaches

- 12 The challenge is to seek further noise reductions at source, while using development layout, building design, traffic management and other means to minimise noise exposure, and achieve progressively better soundscapes. There is no one approach that will address all the issues. So far, most effort has been devoted to attacking some kinds of noise at source. Efforts here need to be redoubled. However, tackling one noise on its own may not always solve the problem. For example, reducing a continuous background noise could enable a second, perhaps equally annoying, noise to be heard. So, co-ordination will be needed. Resolving tensions between different needs will require sensitive responses which will vary by time and place. Some sources and solutions could benefit from a strategic approach. Others can be managed locally. London contains areas of widely differing character. Soundscapes can vary widely over small distances, as well as across the city. Noise levels vary widely between day and night, and across the week, often with different issues at weekends.
- 13 Noise sources are increasingly controlled by international standards. This applies to aircraft, road vehicles and many types of equipment. The need to reach agreement can constrain how far and fast noise is reduced at source. Guideline values produced for the World Health Organization incorporate thresholds using the lowest noise level considered to affect

health and wellbeing. Very high levels of noise can damage hearing. However, the levels of ambient or environmental noise experienced by city residents, even close to busy roads or airports, are well below these levels. Wellbeing may be affected by sleep disturbance, stress, and in other indirect ways. However, evidence for the indirect health effects of noise is less conclusive than, for example, air pollutants such as fine particles. Noise can also contribute to inequalities in health. For example, many believe that higher levels of traffic noise are more likely to be experienced by socially deprived groups in areas more affected by busy roads.



- 14 A diverse range of guideline values, and legal and administrative processes are currently used in the UK for different aspects of noise. For example, regulations specify noise levels above which, in certain circumstances, offers should be made of home insulation against noise from new transport schemes. National planning policy guidance on noise sets out issues local planning authorities must take into account in considering noise sensitive developments, and activities likely to generate noise. The Government's Air Transport White Paper, December 2003, sets out new noise mitigation and compensation criteria which it expects airports to apply.
- 15 The European Environmental Noise Directive of 2002 is helping to change the profile of noise, and the UK Government has set out steps aimed at agreeing national policies by 2007. These include mapping the main areas and sources of noise, work to establish adverse effects, techniques to improve or preserve conditions, economic analysis and prioritising actions. This is a long process. The Mayor wishes to contribute constructively to it, as far as resources allow. The immediate priority of this London Ambient Noise Strategy is to use opportunities to take practical action where there is scope, and resources can be found. However, no-one should pretend that it will be quick and easy to reduce noise levels significantly across a big and busy city. London does not yet have a proper estimate of the numbers of people exposed to different levels of ambient noise or of the costs of reducing noise to levels which would solve the problems people experience. It is not realistic to set timescales for achieving target reductions, until the necessary facts, budgets, incentives and legal powers are available. The Mayor will pursue these.

Using the Mayor's transport powers

- 16 Many aspects of the Mayor's Transport Strategy will lead to a quieter London. If more people walk, cycle or use a modernised, well-maintained, well-run public transport system, noise will be lower than if public transport decays while driving becomes more aggressive.

Action on London's roads

- 17 Transport for London is responsible, on behalf of the Mayor, for the management of 580 kilometres of London's roads. A key issue is the backlog of basic street maintenance caused by decades of under-investment. Many different utility companies dig them up. Too many London streets are cracked and bumpy, generating needless noise. Traditional materials need to be progressively replaced with new quieter surfaces. Utility company works need to be better managed. Less traffic congestion and encouraging the use of quieter vehicles will help. Aggressive stop-start driving can be reduced. Roadspace can be reallocated. Vehicle flows can be smoothed by fine-tuning highway design and traffic signals. Lack of space, frequent junctions and the need for maintaining 'eyes on the street' to minimise vandalism and crime, limit opportunities for noise barriers in London. However, opportunities, such as for combining barriers with generation of solar electricity using photovoltaics, will be investigated.
- 18 A Traffic Noise Action Programme will be prepared for the Transport for London Road Network. Priorities for noise will be integrated with action on road safety, air quality, bus priority, cycling, walking and other improvements. Noise will be an integral part of day-to-day management decisions as well as larger scheme assessment. The Mayor's guidance to London boroughs will promote 'Streets for People', Home Zones, and other traffic calming and street environmental improvement schemes. Access needs to be promoted within people's immediate neighbourhoods to quiet publicly accessible outdoor spaces. Poorer residents of London, concentrated in inner and central areas, are more likely to live in poorly insulated buildings affected by traffic noise. Action to reduce noise needs, wherever possible, to be integrated with action on fuel poverty.
- 19 Buses will benefit from better street surfaces. Transport for London is introducing newer buses, which are typically quieter. Transport for London is also trialling quiet fuel cell buses, and will investigate other quiet technologies. Quieter and smoother driving, and other operational improvements will help to minimise noise. The Mayor's Central London Congestion Charge provides an incentive for certain alternative fuel vehicles which are often quieter. New heavy goods vehicles can be quieter, for example those using some alternative fuels. Quieter driving and operations need to be promoted.
- 20 Improved noise reducing surfaces, less congested stop-start driving with better traffic management, quieter tyres, hybrid-electric, fuel cells and other alternative fuels, with 'Streets for People' redesign in housing areas,





could cumulatively reduce traffic noise over the next few years - and encourage more people to walk and cycle.

Opportunities on London's Railways

- 21 A world class rail network for London is part of the Mayor's vision for the city's transport. A vital part of that world class quality will be rail systems which are efficient, well-maintained and operated, and do not produce needless noise. Rail transport needs to be able to expand if it is to contribute to reducing road traffic congestion and pollution. Investment in the rail system provides the opportunity to minimise noise in many different aspects of railway design, maintenance and operation.
- 22 Factors influencing railway noise include the design, quality and maintenance of track and rolling stock, noise screening and railway structures. Integrated management of the wheel-rail interface is critical to minimising railway noise. The Mayor and Transport for London seek to work with Government and the rail industry to secure improvements. Cross-European harmonisation of railway standards is taking place. Noise control needs to become integral to railway management and contracts. This is likely to include more direct measurement and monitoring of track condition.
- 23 The Transport Strategy seeks to overcome the backlog of investment on the underground rail network, to upgrade the infrastructure. One of the legacies of historic under-resourcing of the underground system is poor track quality on many parts of the network. As far as inherited Public Private Partnership arrangements allow, the Mayor will expect Transport for London to develop plans to minimise noise and vibration through improvements in design and maintenance, addressing groundborne vibration from underground lines, noise levels on the surface, and in-train noise for passengers.
- 24 The Mayor's Transport Strategy seeks a progressive shift of freight from road to more sustainable modes such as rail, where this is economical and practicable. Noise minimisation will be an important component of the work of a London Sustainable Distribution Partnership and Freight Quality Partnerships in promoting efficient and environmentally responsible freight management.

Seeking quieter skies

- 25 Aviation growth presents some of the starkest tensions between environment and economy. Solutions are not easily found. As a world city, London has been becoming more socially and economically dependent on air transport. Londoners as well as visitors are travelling more internationally. Concern has been expressed across Europe that the air transport industry is



growing faster than technological and operational advances to reduce the environmental impacts at source. The UK Government is responsible for national aviation policy, and for key regulatory decisions relevant to noise from aircraft using Heathrow along with Gatwick and Stansted Airports. Following public consultation on options for increased runway capacity, the Government published its Air Transport White Paper in December 2003, addressing potential demand over the coming 30 years. This proposed a new runway at Stansted, followed by an extra runway at Heathrow if stringent environmental limits could be met. The Mayor is minded to oppose creation of an additional runway at Heathrow on grounds of its likely overall environmental impact on Londoners. The decision will be the Government's, but the Mayor believes it is essential that the runway does not go ahead unless all the environmental problems can be overcome. The Mayor would also be very concerned if the respite provided by alternating the use of the two existing runways were lost.

- 26 Factors governing the impact of aircraft noise on people include quieter aircraft engines and airframes, noise abatement operational procedures, such as Continuous Descent Approach, operating restrictions on the use of airports, and land use planning and building design in the areas around them. The Mayor supports the 'polluter pays' principle. Aviation should pay for its environmental costs, including noise. This should be through a levy linked to mitigation and compensation. Demand for aviation should not be artificially inflated as a result of unfair taxation. Reform must, however, be internationally consistent, as a minimum at the European scale, or Londoners could be unfairly penalised.
- 27 The 2001 decision through the International Civil Aviation Organisation on a new 'Chapter 4' aircraft noise standard did not secure the degree of improvement many had pressed for. The Mayor supports the more rapid development of quieter aircraft, particularly those which are quieter on landing, where fewer improvements have been secured than at take off. Meanwhile, landing fees and other incentives should be used to secure replacement of noisier aircraft with quieter. Heathrow, one of the world's busiest airports, has major impacts on London. The effects of other airports, such as London City Airport, Biggin Hill, and Northolt, are more local.
- 28 The Mayor shares with many residents the considerable concern about night flights and supports the view that night flights should be banned. He supported and funded, along with local authorities and community organisations, a case taken on behalf of residents affected by night noise to the European Court of Human Rights. The Court found against the UK Government. The Government appealed in December 2001, and the second finding of the European Court, issued in July 2003, effectively



overturned the key part of its earlier ruling. Consultation is expected during 2004/05 on a new night noise regime.

- 29 The Government has introduced a new system of rotation of night movements at Heathrow. This should offer some relief to London residents, compared with the previous 'westerly preference', under which early morning landings came in over the city unless wind and weather dictated otherwise. The impact of these changes should be monitored. The Mayor's view is that, as long as night landings continue, planes should not come in over London, unless wind and weather make this unavoidable. This would reduce noise for as many people as possible. It is also important that the 'shoulder periods' between the day and night are properly defined. The current noise index has been criticised for giving insufficient weight to the growth in aircraft numbers. The Mayor has accepted the need for it to be reassessed. Aircraft noise needs to be assessed in ways which have public confidence, and people need more easily understood information. Studies should not, however, delay action where the need for it is clear.
- 30 Helicopter noise can be particularly intrusive and annoying, but the Mayor does not have any control over movements. Single engined helicopters are required to follow certain routes in the London Control Zone, which includes a section of the Thames through central London. However, as long as helicopters obey the Rules of the Air, and follow the instructions of air traffic controllers, their movements are not generally further restricted. Much helicopter activity over London is associated with security, and emergency response, both police and medical. In emergency, helicopters may fly lower than rules would otherwise require. If any proposals for heliports were made, for example, in relation to London's world city role, the specific noise impacts would need to be fully and carefully assessed.

Issues on London's rivers and canals

- 31 Moving freight by water can save many road journeys. The impact of noise on London's 'Blue Ribbon Network' needs to be minimised, through good planning, design and operations. Widely varying character includes contrasting soundscapes. Noise management criteria need to differ for different water spaces. Principles include making more use of rivers and canals, while ensuring that they are a healthy and a calm series of places. Local planning authorities should also ensure that any new sensitive uses near operating wharves and boatyards are so designed as to protect users adequately from such noise as is inseparable from a working waterway.
- 32 London River Services, part of Transport for London, operates some, but not all, of London's piers. It licenses a range of scheduled and chartered



riverboat services from these piers. Operators of party boats using them are required to fit devices to amplification equipment to enable noise to be controlled by the operator of the vessel. However, party boats also operate from other piers. Complaints about moving late night noise sources on a river are more difficult to deal with than similar complaints about a nearby pub. The Licensing Act 2003 rectified the anomaly whereby alcohol sales and public entertainment on party boats did not require a licence. The Government needs to ensure that measures implementing the Act provide an effective framework for river noise management.

Industrial noise

- 33 Arrangements for the control of industrial noise include a new system of 'Integrated Pollution Prevention and Control'. The Environment Agency regulates some industries, in liaison with boroughs, which are responsible for the rest. Industrial noise issues are mainly local, but the Mayor will work in partnership with local authorities and the Environment Agency where necessary. Noise minimisation will need to be promoted through provision of new and better waste management facilities, to deal with the extensive changes implied by higher rates of materials recycling. If resources can be secured, the Mayor will investigate recycling of waste materials into products which contribute to noise reduction, such as building insulation materials. The London Development Agency will consider following up its green economy audit with work on the economic development potential of specific sectors, including the sound insulation and noise control business.

Building a sustainable city

- 34 Good town planning and urban design can help secure the sustainability benefits of more compact city development while minimising exposure and improving soundscapes. The London Plan aims to minimise the adverse impacts of noise on, from, within, or in the vicinity of development proposals. More sustainable ways of building will be promoted. The Mayor seeks exemplary standards of acoustic design, including better sound insulation for new and existing homes.
- 35 Mixing of land uses can reduce the need to travel, and retail, offices and other uses can screen housing. Special care is needed with uses active late at night or early in the morning. However, urban vitality can be achieved with different degrees and types of mix. In many cases, vibrant frontages can be reconciled with quiet back courts, particularly if they can be freed of cars and noisy ventilation plant. The Mayor will expect boroughs in their development plans to indicate how potential conflicts between uses such as late night entertainment and housing will be resolved. Some areas could benefit from designation of Entertainment Management Zones -



areas in which planning, licensing, policing, transport and street management can be better co-ordinated.

- 36 Design needs to give a higher priority to all aspects of sound, not just the most annoying noises. Better soundscapes will be sought in public space projects. Passive ventilation and cooling of buildings can avoid annoying fan and other plant noise. Building over suitable railways, roads, superstore car parks and other facilities, could provide valuable space for recreation, housing, commercial and other purposes, as well as shielding people in the surrounding areas from noise - subject, of course to local amenity, cost and many practical considerations.
- 37 London's open spaces and green networks can provide 'reservoirs of tranquillity' in a compact and intensive city. The Mayor will promote positive management of open space soundscapes. Tensions between quiet and noisy recreation need to be managed, and 'access to quiet' considered. Places which provide havens of tranquillity from the city's bustle need special attention. So do those which have unusual or interesting sounds which add to London's diversity. Maximising the area of 'soft ground' and dense vegetation, where public safety allows, can help minimise noise in compact urban environments.



Joined-up noise management

- 38 Partnership working will be vital to improving London's soundscapes. Action on ambient noise needs to be integrated with that on other noise issues, and with other policy areas. It is important that noise policy does not aim just at long term 'averaged noise'. Computerised noise mapping only captures some of the noise problems people experience. Qualitative issues need to be addressed. It is important that local ownership and access are secured, that mapping can be used for practical planning and other purposes by boroughs and others, and that funding for action is secured. Data assembled for noise mapping can also help in better management of daylighting, sunlighting, and warmth and energy from the sun.
- 39 The Mayor wishes to promote exemplar monitored noise reduction projects in each part of London. A London Ambient Noise Fund needs to be established, recognising the special burden London carries through being the gateway to the UK. Social and economic inequalities between different groups of people, and past under-funding should be recognised in future resource allocation. 'Polluter pays' levies should feed through to noise mitigation and compensation.
- 40 However, this should not be seen as a 'killjoy' strategy. The aim should be positive management of sound quality - treating the 'soundscape' with

the same care as a much-loved landscape. Big cities have buzz, but they also need balance.

The following key issues and initial priorities have been identified:

Three key issues

- Securing good, noise reducing surfaces on Transport for London's roads.
- Securing a night aircraft ban across London.
- Reducing noise through better planning and design of new housing.

Other initial priorities are -

- Extending good, noise reducing surfaces across all roads where they would be effective, along with less disruptive and better reinstated streetworks.
- Encouraging quieter vehicles.
- Building in noise reduction in day-to-day traffic management - to maximise gains from reducing stop-start driving as congestion falls, smoothing traffic flow, allocating street space better, and other transport measures.
- Improving noise environments through 'Streets for People', in Home Zones, in town centres, and in exemplar Public Space projects.
- Developing a Traffic Noise Action Programme for the 580 kilometres of roads which Transport for London manages, including targeted traffic noise reduction projects.
- Trialling fuel cell buses, seeking to trial hybrid-electric buses, and seeking smoother and quieter driving, including through driver training.
- Establishing a London Ambient Noise Fund for exemplar noise reduction projects, and a London Domestic Noise Fund to improve internal and external noise, especially in poorly converted flats.
- Seeking improved railway track quality and maintenance on National Rail and Underground as far as organisation and funding allow.
- Securing support for exemplar noise barrier-integrated photovoltaic power generation along suitable roads and railways, and noise screening from safety and security fencing.
- Promoting development alongside or over suitable roads and railways, protecting wider areas from noise.
- Ensuring that 'polluter pays' levies compensate those affected by aircraft noise and other effects, such as through Aviation Environment Funds for each airport.
- Reducing noise through better planning and design, where London's growth in people and jobs presents challenges, but redevelopment and refurbishment also offer opportunities - high density, mixed-use development can create quiet outdoor spaces away from traffic.
- Examining the scope for a Mayor's Sound Award, and promoting exemplar City Soundscape projects.



1 introduction

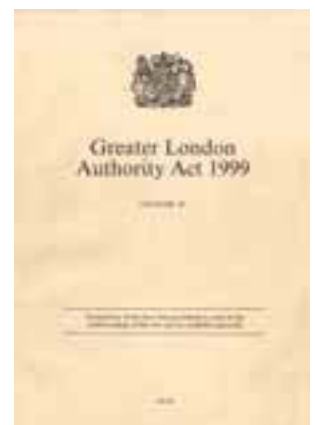
- 1.1 Noise - unwanted sound - has been referred to as the 'Cinderella pollutant'. However, recognition of its importance is growing. To many, noise is an inescapable fact of city life, which they push to the back of their minds. To others, noise becomes distressing. Either way, it is a quality of life issue. As more people want to live, work and do more things in London, it becomes even more important that noise is properly managed. However, no-one should pretend that it will be easy to reduce noise across the country's biggest and busiest city.
- 1.2 This should not be seen as a 'killjoy' strategy. Sound plays many positive roles in the lives of people, and of the city. Sound environments may contain features of special interest, which contribute to London's richness and diversity. Big cities have buzz - but this needs to be balanced by identifying and taking opportunities to secure improvements in ways which respect the many different needs of Londoners.

Box 1: Strategy approach

The Greater London Authority Act 1999 gave the Mayor a duty to prepare a '**London Ambient Noise Strategy**' (see box 2 for definitions). European noise policy has been seeking to raise the profile of what is often termed '**environmental noise**' - mostly the **long term, outdoor, on-going sources like transport and industry**. The Mayor's Strategy complements existing borough work on **neighbour noise, construction sites and other local nuisances**. This Strategy's required focus on 'environmental noise' does not mean that nuisance noise is considered less important - many staff in boroughs across London are already working on those issues. The Mayor aims to work in partnership with boroughs, the Environment Agency and others in developing fresh approaches to integrated noise management.

The Greater London Authority Act gave the Mayor no new powers or funds specifically for noise management. This Strategy thus focuses on identifying practical actions and specific areas where it is believed that useful progress can be made. Earlier drafts were the subject of consultation with the London Assembly, boroughs, other stakeholders and the public. Many valuable inputs were received and reflected in reviewing the Strategy. A separate report on public consultation is available.¹

The European Environmental Noise Directive (2002/49/EC, published 18 July 2002) will require noise mapping and preparation of action plans. By contrast with air quality, European or UK 'limits' or 'targets' have not yet been agreed. These would need to be based on detailed understanding of the distribution of noise exposure, effects on people, and the costs of reducing it - and then linked to powers and resources. Less information is



available about noise, both nationally and in London, than about many other pollutants, although there is evidence (see Chapter 2) to support a focus on traffic noise. The Mayor aims to work with the Government, the boroughs and others to define priorities and establish the case for resources where they are most needed.

- 1.3 Noise can annoy, disrupt communication, and disturb sleep. There is uncertainty over many of the possible health effects. Individual sensitivity, in terms of annoyance, appears to vary widely. One person's music can be another person's intense irritation. One person's business may disturb another's concentration or sleep. For those who are badly disturbed by noise, particularly in their homes, it can become an inescapable presence in their private lives. Annoyance is not just related to loudness. Repeating a noise can evoke a similar reaction to an originally noisy or unpleasant event, even if the subsequent noise is not so loud. However, sound is also an important part of communication, culture and many other aspects of everyday life. Many parts of the city have their own distinctive soundscapes (see glossary). Minimising noise problems is a social balancing act.

Box 2: Definitions

Ambient noise:

As defined in the Greater London Authority Act 1999, '**ambient noise**' covers noise and vibration from transport (including **road traffic, rail traffic, aircraft and water transport**) and fixed **industrial sources**. Transport and industry are the main long term, systematically predictable sources of what is also termed '**environmental noise**'.

Neighbour or neighbourhood noise:

A Government consultation paper 'Towards a National Ambient Noise Strategy', DEFRA, November 2001 referred to 'neighbour noise' or '**neighbourhood noise**' as '**noise from household appliances, TV, music systems, noisy pets, DIY activities, construction sites, intruder alarms, parties or similar gatherings**'. Borough Environmental Health Departments respond to residents affected by 'noisy neighbours' and other local nuisances. Noise from recreation, sport, festivals and other events is typically managed on a locally-specific basis.

More powers are becoming available to local authorities and the police to deal with many types of anti-social behaviour. Noise at work is governed by Health and Safety legislation.

Box 3: Key responsibilities

The **Government** is responsible for aviation policy, and regulating Heathrow Airport. The **Highways Agency** manages motorways in London. **Transport for London** manages 580 kilometres of streets, and **London boroughs** most of the rest. The **Environment Agency**, working with boroughs, has responsibilities under 'Integrated Pollution Prevention and Control' for regulating certain industries. **Boroughs** are responsible for local planning, licensing and 'statutory nuisance' functions related to noise.

- 1.4 Borough Environmental Health Officers are typically hard-pressed responding to neighbour noise problems, local licensing and development applications. Improving soundscape management will require the efforts, not only of acousticians and other noise specialists, but of town planners, architects and urban designers, traffic engineers, housing, parks and public space managers, and many others. Some London boroughs have been developing more proactive action. Experience elsewhere in Europe suggests that more resources will be needed if aspirations towards better noise management are to be realised.²
- 1.5 The European Commission green paper, 'Future noise policy'³, stated that 'Environmental noise, caused by traffic, industrial and recreational activities is one of the main local environmental problems in Europe.' It sought a Directive addressing assessment of noise exposure and exchange of information. In a second stage, target values could be set. The European Environmental Noise Directive⁴ (END) was adopted in June 2002. Its requirements include mapping of environmental noise and the preparation of action plans.
- 1.6 The Greater London Authority Act requires the Mayor's Strategies to have regard to the principal purposes of the new authority, which are to promote London's economic and social development, and environmental improvement. The Strategies must also have regard to health, equality of opportunity and sustainable development. They must be consistent with each other, with national policies, and must take account of resources available for implementation. The Strategies must take account of the desirability of promoting and encouraging the use of the River Thames. In producing the Strategies, the Mayor must have regard to any guidance issued by the Government, such as Planning Policy Guidance Note 24⁵ on noise in the town and country planning process. The UK national policy context is evolving (see box 4).

Box 4: National ambient noise strategy process

The Government announced in 2000 that it intended to consult on a National Ambient Noise Strategy. A consultation paper '**Towards a National Ambient Noise Strategy**' issued on 20 December 2001 proposed a three phase approach.

In **Phase 1, over the 2002-2005** period, the Government aims to establish:

- 'the number of people affected by different levels of noise, the source of that noise (i.e. road, rail, airports and industry) and the location of the people affected;
- the adverse effects of ambient noise, particularly regarding people's quality of life. Special consideration will also be needed in regard to tranquillity.
- the techniques available to take action to improve the situation where it is bad or to preserve it where it is good; and
- the methodology to be used to undertake economic analysis.'

In **Phase 2, 2004-2006**, the Government aims to evaluate and prioritise options for action identified in phase 1 in terms of costs and benefits, and relationships with priorities for other environmental, economic and social issues.

In **Phase 3, 2007**, 'the Government would need to agree on the necessary policies to move towards the desired outcome, i.e. the completion of the National Ambient Noise Strategy'.

- 1.7 This is a long process. It implies that issues of cost-effectiveness and overall priorities will not be resolved before 2007. The Mayor wishes to contribute constructively to it, as far as scarce resources now available allow. In the meantime, the priority of this London Ambient Noise Strategy is to identify specific issues where action by Government and others is needed to get the context right, as well as practical actions that can be taken in London if resources can be found.
- 1.8 Achieving major improvements in the complex sound environments of major cities will be costly. The way people respond to sound creates some distinct challenges. One sound can mask another, meaning that if one noise problem is solved, people may become more aware of the next. This increases the importance of integrated action. The London Ambient Noise Strategy is the first of its kind. Because it has been produced in advance of the large programme of noise policy development work set out by the Government, it needs to be regarded as an interim step.

References and notes

- 1 From the Public Liaison Unit, Greater London Authority, City Hall, SE1 2AA. See also <http://www.london.gov.uk>
- 2 Hepworth P, Rasmussen S. 'Noise Strategy - European Experience' Institute of Acoustics Proceedings Volume 23(5), 2001, pp 27-31
- 3 European Commission Green Paper COM(96)540, published in 1996
- 4 European Commission Directive 2002/49/EC 'relating to the assessment and management of environmental Noise.' Adopted 25 June 2002, published in the Official Journal on 18 July 2002.
- 5 Department of the Environment, Planning Policy Guidance Note 24, 1994, under review.



2 challenges, effects and information

The context

- 2.1 A guiding tenet of all the Mayor's Strategies is promoting sustainable economic growth in London - seen as essential in maintaining the world city status on which its prosperity, and that of the UK, depends. Major investment is needed to renew London's infrastructure. This offers opportunities to improve sound environments through better design, maintenance and operation, to counter the pressures which growth can present in cities. Improving environmental quality for those who live and work in London, or visit it, is vital to a sustainable world city.

Box 5: A growing city

London's population has been growing steadily since 1989. From a low of 6.8 million in 1983, the population in 2003 is estimated at more than 7.3 million.¹ It is expected to grow by approximately 800,000 people to reach 8.1 million by 2016. London's population includes more young people, many more in the black and minority ethnic communities, and more young newcomers from across Europe. Overall wealth has increased, but so has the disparity between rich and poor. The number of jobs in London is projected to grow by over 600,000 by 2016.²



- 2.2 Rising population, growing economy and increased tourism have been leading to growth in travel in London. Without the changes in transport provision in the Mayor's Transport Strategy, modelling commissioned by Transport for London suggests vehicle traffic would grow by 7.5% in Outer London, 4.5% in Inner London, and remain broadly unchanged in Central London over the 2001 to 2011 period (but see box 7 below).

Box 6: People and housing

A significant amount of new development is needed in London to accommodate expected population growth. Assuming constant household size, the number of households could increase by 336,000, from 3.1 million households in 2001 to around 3.4 million in 2016. As well as this growth in household numbers, a further 11,200 new homes a year will be needed to meet London's existing shortage of housing. The Mayor is thus seeking to increase London's housing output to 30,000 homes a year from all sources.³

- 2.3 Several factors could increase noise exposure - increasing residential population, with more single people or smaller households, more workers and visitors, a relatively young, mobile population, and higher densities. However, a higher rate of building offers opportunities to use the best modern design solutions, in new housing and mixed-use developments and in transport systems. In the longer term, more people will be able to walk to jobs, shops and other local facilities. Climate change could

increase exposure to outdoor noise, although there is a range of potential effects and adaptations.⁴

Box 7: Transport

The Mayor's Transport Strategy aims to accommodate the bulk of increased demand for travel on greatly expanded and improved public transport. Taking account of the demographic and employment assumptions set out in the Transport Strategy, and assuming availability of funding for the full programme of proposed transport improvements, the following broad changes in weekday travel patterns are expected between 2001 and 2011:

- forty per cent more bus passengers across London, alongside a similar increase in bus capacity;
- fifteen per cent increase in peak capacity on the existing Underground network;
- nine per cent more morning peak passengers on National Rail Services in London (excluding Crossrail and Thameslink), alongside an increase in capacity of 12 per cent;
- reduction of 15 per cent in Central London traffic, reducing growth from 4.5 per cent to zero in Inner London, and reducing the rate of traffic growth in Outer London to no more than five per cent - with greater traffic reductions in sensitive locations.

As a major world city London requires high quality international links. The range of international connections from London's airports, and now the Channel Tunnel Rail Link, makes London an attractive place in which to invest. The Mayor's Transport Strategy recognises that London's international transport links should be improved and expanded, but that this should be achieved in an environmentally sustainable fashion. Pollution, including noise, caused by air travel and road transport to and around Heathrow is a major concern.

Adverse impacts of noise

2.4 Sound can be generated by many different sources, and much of it plays an important positive role in people's lives - including communication, cues about the environments in which people live, and culture. However, it can also have negative effects. Noise can have many different effects on people, as described in Guidelines produced for the World Health Organisation.⁵ The evidence base is more diverse than for many other environmental issues.

2.5 The Government has stated that it will continue to support research in this area. Work is also proceeding internationally, through European



Union working groups and other networks. High quality noise research can be complex and expensive. The Mayor wishes to encourage work on the mix of noise issues which affect major cities like London. Full regard needs to be paid to equalities issues, notably impacts on those who may be more vulnerable, whether socially, in terms of health, disability or otherwise, although almost everyone can benefit from a more inclusive, less noisy environment.

Box 8: Adverse effects of ambient noise

A Government-commissioned review of the adverse effects of ambient noise⁶ concluded: 'The literature confirms that there are a number of potential effects of noise on health, although the evidence in support of actual health effects other than those based on reported bother or annoyance and on some indicators of sleep disturbance is quite weak. Although the scientific evidence suggests thresholds below which it is unlikely that there is an impact on health, we cannot interpret these as definitive at this time. Existing standards and regulations usually take the results of primary research into account to some extent, but social, political and historic factors are at least as important.'

A summary review of the evidence on health effects of noise for this strategy⁷ concluded that: 'Environmental noise has been shown to have effects on annoyance, children's learning, sleep and cardiovascular health. Noise exposure in London is likely to have similar effects on the health of people living in London. The effects of noise on health operate through a number of different pathways including direct effects, interference with cognitive processes and through reaction to interference in daily activities and communication. Children, people with existing physical and mental illness and the elderly are most susceptible to noise effects on the basis of the limited current evidence.' The cardiovascular effect was small, and noise was not considered likely to be a major risk factor for heart disease.

Annoyance

- 2.6 Noise can be defined as sound which people find annoying (see Appendix A2). Annoyance, bother or irritation associated with noise affects the largest number of people. It is generally assessed by structured field surveys.⁸ At most of the ambient noise levels commonly encountered, studies show a wide range of individual responses. Context is very important. How people react to a sound appears to depend not just on how loud it is, but what it means to the hearer, including how justified they think the intrusion is. Noise has meaning. It is not just pressure fluctuation.

Sleep disturbance

- 2.7 A good night's sleep is acknowledged as important to wellbeing. Losing sleep can be one of the strongest reasons people give for objecting to noise. Sleep research is, however, a complex and challenging field. It can be very hard to prove that a particular noise woke someone up. People typically wake up for many reasons, as well as the outdoor noise source which is being studied.
- 2.8 The main issues are difficulty getting to sleep, being awoken too soon, getting back to sleep once awoken, and changes in 'sleep stages' - the type of sleep experienced. People may report after-effects from disturbed sleep, including reduced sleep quality, increased tiredness, depressed mood, and decreased performance, or lack of concentration. Researchers have also studied physiological effects understood as induced by noise during sleep.⁹ These include increased blood pressure, increased heart rate, increased finger pulse, vasoconstriction, changes in respiration, cardiac arrhythmia and increased body movements.

Other adverse effects

- 2.9 Other adverse effects of noise include:
- **Hearing impairment** - Workers in certain industries have, if hearing protection or other measures have not been used, been at risk of hearing loss. There is increasing concern about noise exposure in nightclubs, and other leisure venues, including pubs and restaurants. Some sufferers from tinnitus report their condition being brought on by one loud exposure. Environmental noise levels near busy roads, railways and airports are not considered to pose a risk of hearing impairment to local residents.
 - **Interference with speech and other communication** - Noise can mask voices, radio/TV or other sounds, including music, which people want to hear. The extent of interference depends not only on the volume of the interfering noise, but whether it is similar in pitch or frequency to the sound people want to hear. Other factors include how distracting the interference is to the listener, and how good their own hearing is. Noisy environments can make communication harder for people with hearing impairments. It can become harder for people with visual impairments to sense where they are. Noise can cause people to keep windows closed when they would rather have them open.
 - **Cardiovascular and other physiological issues** - some studies have identified associations at noise levels higher than normally associated with ambient noise, and for very long term exposure. The evidence is not strong, but it is important that research in this area continues.

- **Mental health** - ambient noise is not thought to be a primary cause, though it is possible that it may be an accelerating or intensifying factor. Further research could help to identify if particular groups are more at risk.
- **Work performance** - evidence suggests background noise can increase performance in routine work, but impair performance in tasks requiring use of longer term memory and concentration. Background levels in many modern offices, for example, tend to be higher than in the past. Improving conditions for workers needs to address internal noise sources as well as ambient noise.
- **Learning** - there has been concern that on-going exposure to ambient noise during childhood can impair reading and language acquisition, reduce motivation, and particularly affect more complex tasks. Studies include Evans et al, 1995¹⁰ and 1998¹¹, Haines et al, 2001¹², and Shield B and Dockrell J, 2002.¹³ Studies are continuing. A current international study includes schools in West London.¹⁴ Many schools are affected not only by ambient noise from roads, railways and aircraft, but by high levels of noise interference between one learning activity and others.
- **Social behaviour** - Studies^{5,15} suggest that noise can encourage people to become more withdrawn, and less helpful to neighbours. It is unlikely that noise itself causes actual aggression, but noisy environments can make people feel less safe, or may actually be less safe if, for example, people are less able to hear a potential attacker approaching.
- **Erosion of tranquillity** - Government consultation on national ambient noise strategy focused on rural tranquillity, such as highlighted by the Council for the Protection of Rural England.¹⁶ Within London, concern has been expressed at the erosion of tranquillity in many of London's open spaces.¹⁷ Even within busy, high density areas, havens of tranquillity can often be found in courtyards and other enclosed spaces, as well as in formal public open space. It is difficult to put a value on the importance of such spaces for respite and recuperation in busy urban areas.

Changes in noise

2.10 Acknowledging the shortcomings in data available, analysis¹⁸ suggested that noise environments across Europe were likely, without ambitious noise abatement policies, to remain unsatisfactory or even deteriorate. This would be due to:

- Increases in the number and power of noise sources, and the increasing use made of them (especially in transport);
- Geographical dispersion of noise sources, including urban development, new transport facilities, spread of leisure and tourist activity;

- Spread of noise over time, especially early in the morning, in the evenings, at night and at weekends.

- 2.11 European environmental noise policy has so far focused on reducing noise at source, fixing maximum sound levels for road vehicles, aircraft and other machines, linked to certification procedures to ensure that new vehicles and equipment comply with noise limits laid down in directives at the time of manufacture.¹⁹
- 2.12 However, reductions in certified road vehicle noise do not appear to have reduced general noise levels across urban areas (see paragraph 4A.8 on issues related to certification testing). European standards have been lacking for some sources such as railways. There has been concern that a reactive policy towards individual noise sources has led to the phenomenon of 'creeping ambient' (see glossary). A new noise source, or an increase in the noise intensity of an existing activity, might not make a readily perceptible contribution to noise levels in areas which are already, at least to some extent, 'noisy' - where one noise would tend to be masked by another. However, an accumulation of such additional noise may, over time, lead to a deterioration.

Information on noise in London

- 2.13 Consistent and representative London-wide data on noise exposure is not yet available. The Government's proposals as part of National Ambient Noise Strategy will provide a measure of population exposure to long term 'averaged' noise from roads, railways, aircraft and industry. This has its limitations - the wrong sort of traffic hump, or badly-reinstated roadworks can be as annoying as the overall level of 'averaged' noise. Attitude surveys and noise measurement within a sample of areas can help build a fuller picture.
- 2.14 Attitude surveys have commonly found that, in response to general questions about priorities or concerns, noise tends to be mentioned spontaneously by relatively few people, compared with issues like crime. This is reflected in MORI polling of Londoners for the GLA (see Box 9). However, when specifically asked about noise, higher proportions typically report annoyance.

Box 9: Annual Greater London Authority Surveys

In an interview survey of a sample of residents across Greater London carried out in late 2003, people were asked 'Thinking about the quality of the environment in London, how much of a problem, if at all, do you consider noise to be?' 46 per cent considered noise to be a problem (13 per cent major problem, 33 per cent lower level of problem). 24 per cent included noise in their two or three top priorities for improving the quality of the environment in London.

In an earlier interview survey in 2001, those who said they were likely to move away from London in the next two years were asked why. In unprompted replies, 10 per cent cited noise, compared with 14 per cent crime, 13 per cent affordable home, and 11 per cent better area.

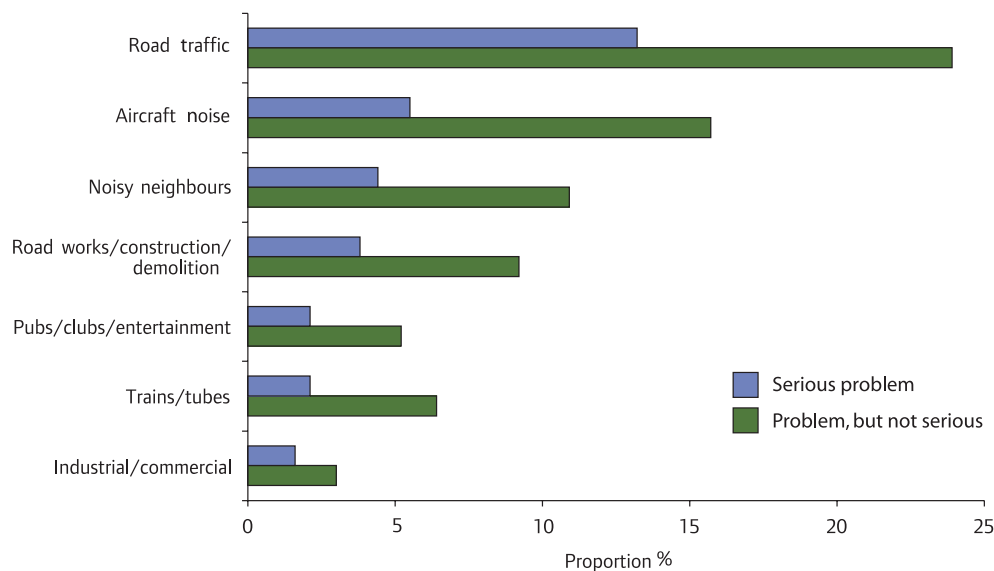
'Annual London Survey 2003' MORI for Greater London Authority, October-December 2003, published January 2004.

'Annual London Survey 2001' MORI for Greater London Authority, October-December 2001, published January 2002.

http://www.london.gov.uk/mayor/annual_survey/index.jsp

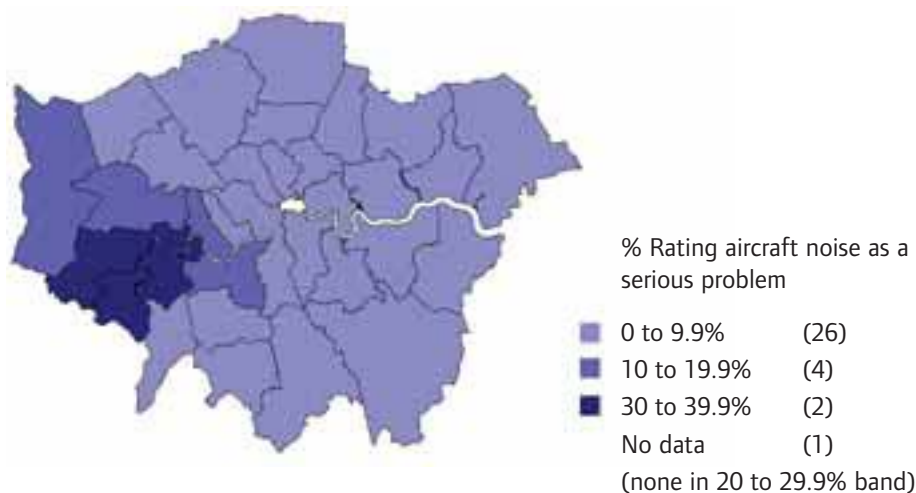
- 2.15 In the 2002 GLA London Household Survey, over 8,000 London householders were questioned on a range of issues. Respondents were asked how they would rate various types of noise where they lived, in terms of 'serious problem', 'problem but not serious' or 'not a problem.' The survey indicated that 13 per cent rated noise from road traffic where they lived a 'serious problem', compared with aircraft 6 per cent, roadworks/construction/demolition 4 per cent, noisy neighbours 4 per cent, trains/tubes 2 per cent, industrial/commercial premises 2 per cent, and pubs/clubs/entertainment 2 per cent. These percentages may seem low, but translate to large numbers of Londoners. Larger percentages said noise was a 'problem but not serious' (see Figure 1).²⁰ Figure 2 shows differences between boroughs in the proportions of respondents considering aircraft noise to be a serious problem where they lived.

Figure 1 Respondents to GLA London Household Survey 2002 reporting noise sources as a problem



source: Greater London Authority 2002 London Household Survey

Figure 2 Proportions of respondents to GLA London Household Survey 2002 rating aircraft noise as a serious problem



source: Greater London Authority 2002 London Household Survey

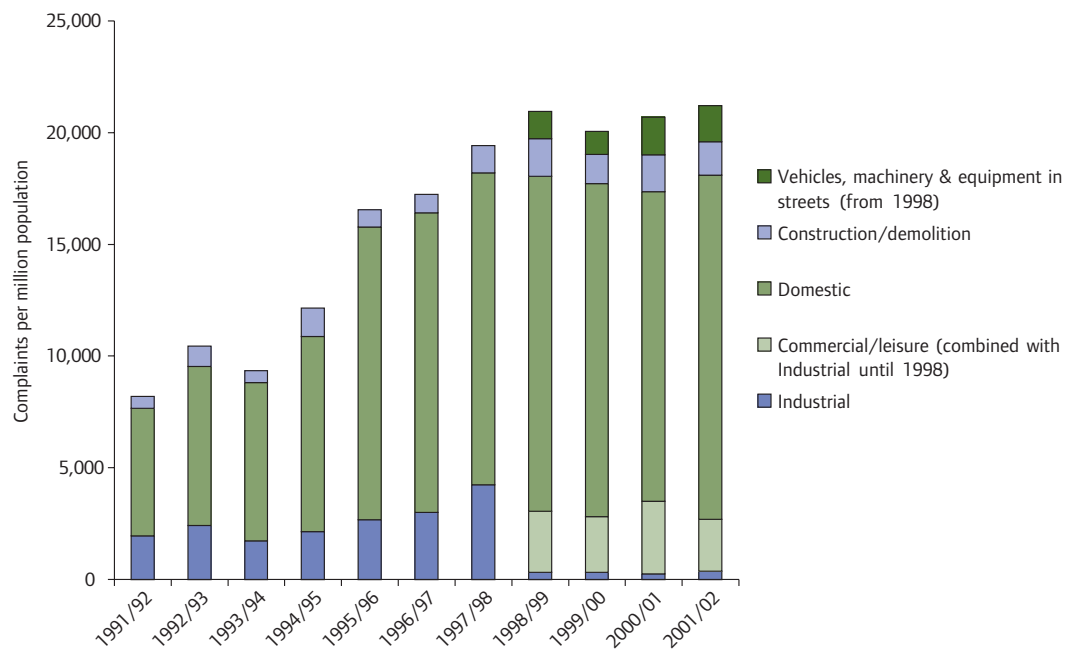
2.16 Information on noise problems experienced by housing occupants was gathered during the 2001 English House Condition Survey (EHCS). This suggested that 1.6 million households in London (54 per cent of all

households) had experienced problems with noise during the preceding year. Respondents to the EHCS who said they had problems with noise were then asked to identify the source of the noise. Sixty-nine per cent (1.1 million) of all London households having a problem with noise said that it originated from sources such as transport and industry. The remaining 31 per cent (489,000) said that the noise was due to neighbours (either immediate neighbours, other neighbours or noise from common areas).

- 2.17 It appears that dwelling age had some effect on the percentage of households reporting problems, but not in a distinct linear fashion. Respondents living in dwellings built between 1990 and 2001 reported the highest incidence of noise problems (62 per cent) followed by those living in dwellings built between 1900 and 1919 (60.5 per cent). Dwellings with the lowest reported incidence of noise problems were built between 1919 and 1964. When noise from immediate neighbours or common areas is considered, respondents living in dwellings built between 1990 and 2001 reported the highest incidence of problems (16 per cent), followed by those living in dwellings built between 1981 and 1990 (11 per cent).
- 2.18 Of the 223,000 households believing that the noise was due to immediate neighbours or noise from common areas, 72 per cent (160,000) said that the noise was either wholly or partially the fault of the neighbours in question, and not solely a consequence of a flaw in the design of the building.
- 2.19 In summary, the 2001 EHCS survey indicated that:
- 1.1 million households (37 per cent of all London households) were bothered by noise from transport and industry²¹;
 - 489,000 households (16 per cent of all London households) were bothered by noisy neighbours (immediate neighbours, other neighbours, noise from common areas, or a combination);
 - 104,000 households (3.5 per cent of all London households) were bothered by noise from immediate neighbours or noise from common areas and attributed it solely to the behaviour of the neighbours;
 - 117,000 households (4 per cent of all London households) were bothered by noise from immediate neighbours or noise from common areas and attributed this solely to the poor design of the building or a combination of the poor design of the building and behaviour of the neighbours.
- 2.20 The Chartered Institute of Environmental Health collects information annually on complaints to local authority environmental health/noise enforcement

departments. Recent complaints statistics are shown in Figure 3. There are several reasons why such service-related data cannot be regarded as a simple reflection of noise itself (see notes to Figure 3). About 70 per cent of all complaints are about domestic noise. The overall number of complaints appears to have levelled off. Complaints about construction/demolition noise appear to have become a larger proportion in London in recent years.

Figure 3 Complaints about noise received by London Environmental Health Officers



source: Compiled from data obtained by the Chartered Institute of Environmental Health.^{22 23}

London boroughs sampled in National Noise Attitude Survey 1999



source: BRE Review of London related data from the 2000 National Noise Attitude Survey

2.21 During 1999/2000, a National Noise Attitude Survey, carried out by the Building Research Establishment (BRE) for the then Department of the Environment, Transport and the Regions, included a sample of 350 home interviews in Greater London. The survey was designed as a national one, and cannot be taken as fully representative of London. The areas picked up in sampling were in parts of North and South Outer London (see map in margin). If the survey had been designed specifically to be analysed at the Greater London level, a different sampling strategy would have been used, with a better geographical spread of interviews over the whole city.

Box 10: NSCA National Noise Survey 2002

Aiming to overcome differences in the way complaints data are collected, the NSCA (National Society for Clean Air and Environmental Protection) surveys Chief Environmental Health Officers. They are asked what they consider to be the major sources of complaint about noise nuisance in their authority's areas. In 2002, 17 London boroughs (51 per cent) responded.

(Box 10 continued)

Major sources of complaint about neighbour noise

The NSCA 2002 survey showed that 'amplified music' was the main source of 'neighbour noise' complaint in London, as it was in England as a whole. Intruder alarms, voices and TV were the second most important sources of complaint for four boroughs each out of a total of 17 (24 per cent), followed by children in three boroughs.

Major sources of complaint about ambient noise

The NSCA survey uses a different definition of 'ambient noise' from that used by the Government. The NSCA's definition includes not just traffic and industry, but pubs/clubs, construction sites, outdoor events, car alarms and car stereos. 'Pubs/clubs' were the main source of complaint in 2002 for ten out of 17 responding boroughs in London (59 per cent) compared with 54 per cent in England. 'Construction sites' and 'industry' were the main source of complaint for three out of 17 London boroughs (18 per cent) for both sources, compared with 13 per cent for 'construction sites' and 20 per cent for industry in England.

Changes in levels of complaints over the previous year

Local officers were asked to indicate changes in levels of complaints over the previous year. Of 17 London boroughs, seven (41 per cent) reported that complaints about TVs had increased, seven that complaints about DIY had increased and seven that complaints about intruder alarms had increased. This compares with respective reports of 18 per cent, 19 per cent and 25 per cent in England as a whole. In England, the biggest increase in complaints was about dogs at 45 per cent.

In terms of complaints by time of day, six out of 17 (35 per cent) London boroughs reported an increase in night-time noise complaints, similar to the percentage for England. Six out of 17 (35 per cent) of London boroughs reported an increase in daytime complaints, compared with 28 per cent in England.

Sound insulation

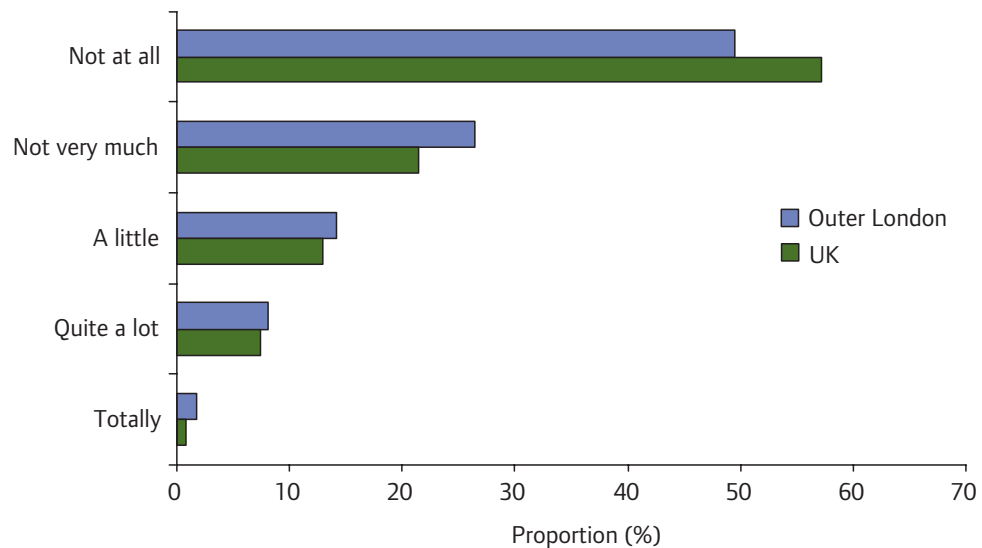
In 2002, 94 per cent of responding London borough officers thought work needed to be done to improve the sound insulation performance of existing housing (90 per cent in England).

Traffic and aviation noise

Thirty-five per cent of responding London borough officers considered traffic noise to be a problem (33 per cent in England). Forty-one per cent of London officers considered aviation noise to be a problem, compared with 30 per cent in England.

2.22 Of these (Outer) London respondents, ten per cent reported that noise, thinking about all types and sources, spoils their home life 'quite a lot' or 'totally' (see Figure 4). Twenty-one per cent of the Outer London respondents reported noise as one of the top five environmental problems, from a list of 12 such problems affecting them personally. The most commonly selected environmental problems from the list were 'litter and rubbish', 'traffic exhaust fumes and urban smog', and 'fouling by dogs'.

Figure 4 Extent to which noise spoils home life



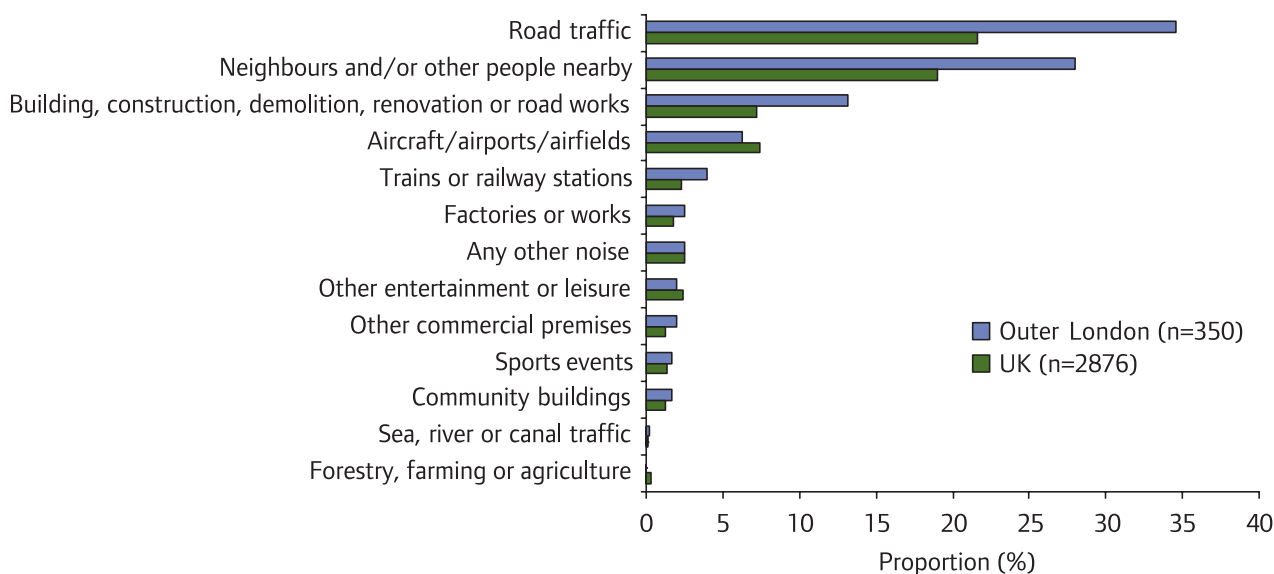
source: BRE Review of London related data from the 2000 National Noise Attitude Survey²⁴

2.23 Respondents were asked: 'When you are at home, do you, personally, hear any of the following noises?' The most commonly reported noise was 'road traffic' followed by 'neighbours and/or other people nearby', 'aircraft/airports/airfields', and 'building, construction, demolition, renovation or road works'. Road traffic was reported by 93 per cent of these Outer London respondents, compared with 83 per cent over the UK as a whole.

2.24 Thirty-five per cent of these Outer London respondents reported being 'moderately', 'very', or 'extremely' bothered, annoyed or disturbed by road traffic noise, compared with 22 per cent over the UK as a whole (see Figure 5). Neighbours and/or other people nearby comprised the next most important source at 28 per cent, compared with 19 per cent nationally. This figure incorporates neighbours both inside and outside their homes. Looking just at neighbours inside their homes, 15 per cent reported being 'moderately', 'very', or 'extremely' bothered, annoyed or disturbed, compared with 9 per cent nationally. Building, construction, demolition, renovation or road works were also more significant sources in London than nationally.

2.25 When looking at different levels of adverse reaction to the categories of environmental noise, road traffic noise remains the most reported. Fifty-nine per cent of London respondents reported being bothered, annoyed or disturbed to at least some extent by road traffic noise, compared with 40 per cent over the UK as a whole. Fifty-one per cent of London respondents reported this reaction to neighbours and/or other people nearby, compared with 37 per cent nationally. Looking just at those 'very' or 'extremely' bothered, annoyed or disturbed, 14 per cent of Londoners reported this reaction to road traffic noise, compared with eight per cent nationally.

Figure 5 Proportions reporting being 'moderately', 'very' or 'extremely' bothered, annoyed or disturbed by various categories of environmental noise

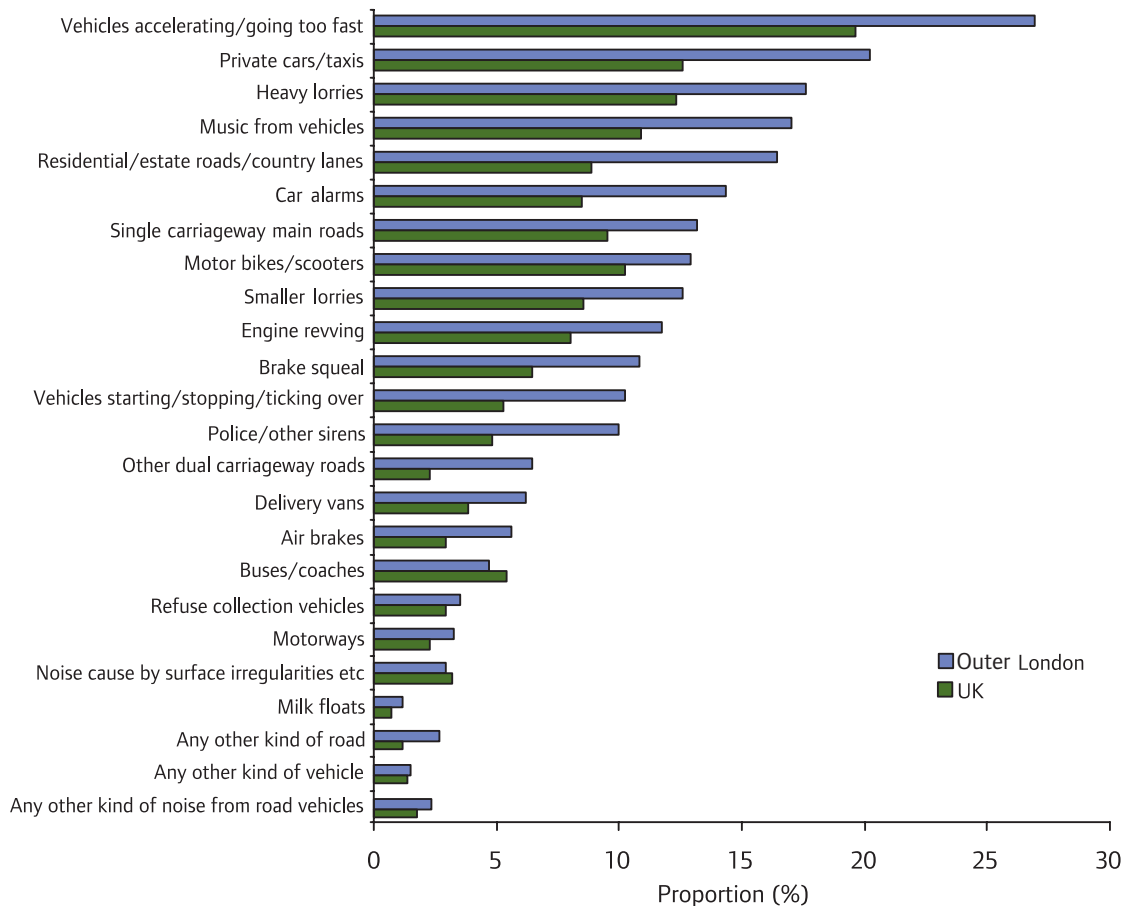


source: BRE Review of London related data from the 2000 National Noise Attitude Survey

2.26 The specific road traffic noise sources causing the most respondents to report being 'moderately', 'very' or 'extremely' bothered, annoyed or disturbed were 'vehicles accelerating/going too fast', 'private cars/taxis', 'heavy lorries' and 'music from vehicles' (see Figure 6). However, the wide variety of specific road traffic noise sources which cause bother or annoyance should be noted. Noise reduction strategies which focused only on overall 'averaged' ambient noise might not affect many of the 'noise events' - or, at least, not in the same proportion. Also, the extent to which some specific noise sources are separately identifiable to people may vary by type of road and area. In particular, 'noise caused by surface irregularities' may be more likely to be identified as such on a lightly-

trafficked road with one defect, than on a busy road with many vehicles and many irregularities.

Figure 6 Proportions reporting being 'moderately', 'very' or 'extremely' bothered, annoyed or disturbed by specific road traffic noise sources



source: BRE Review of London related data from the 2000 National Noise Attitude Survey

2.27 Respondents were asked whether road traffic noise bothered, annoyed or disturbed them during the week (Monday to Friday) and during the weekend (Saturday and Sunday), at particular times (day 0700-1900, evening 1900-2300, night 2300-0700). Respondents in London were more affected than in the UK as a whole (see Table 1).

Table 1 Proportions reporting being particularly bothered, annoyed or disturbed by road traffic noise at different times

Time		Proportion particularly bothered, annoyed or disturbed (%)	
		Outer London (n=341)	UK (n=2849)
Weekdays	Day	24	17
	Evening	25	16
	Night	21	14
Weekend	Day	22	15
	Evening	23	15
	Night	21	13

source: BRE Review of London related data from the 2000 National Noise Attitude Survey

2.28 Some 22 per cent of London respondents (compared with 18 per cent nationally) reported having taken action to try to reduce the amount of road traffic noise heard (see Table 2). Of the actions taken, the most common was to install double glazing, being 28 per cent of all actions, both in London and nationally. People also reported that they were more likely to complain to the police than to their local Environmental Health Department.

Table 2 Comparison of types of action taken by survey respondents as a result of road traffic noise

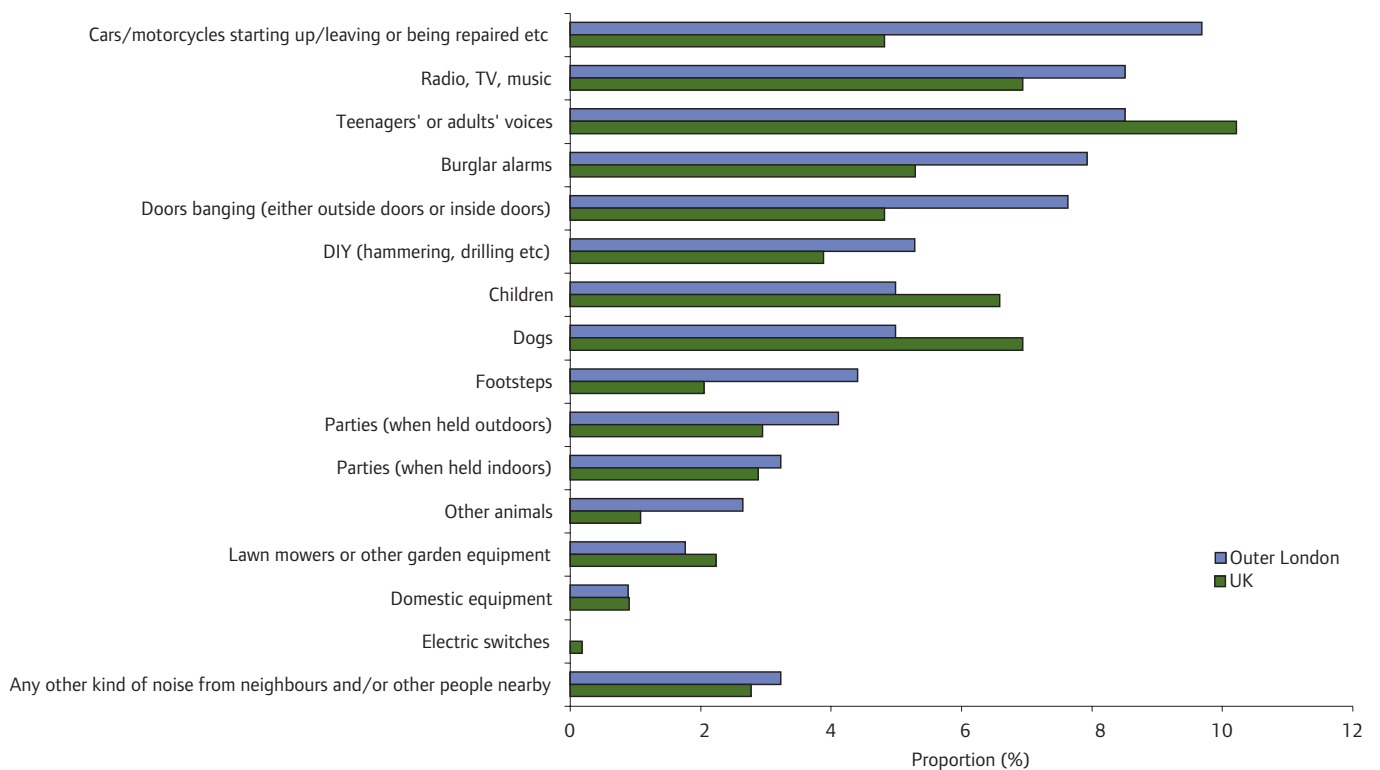
Action	% London	% UK
Installed double glazing	28	28
Complained to Housing or other council department (other than Environmental Health)/Housing Association/Other landlord	14	12
Complained to the person /people/organisation making the noise	11	14
Complained to the police	11	11
Started/signed/joined a campaign or petition	11	8
Complained to an MP or Councillor	8	8
Complained to the Council Environmental Health Department	7	5
Did something else	4	6
Did something to help you sleep (eg earplugs, sleeping pills)	3	2
Complained to a government department	2	2
Did something else to keep the noise out	1	1
Talked to the Citizens Advice Bureau	less than 1%	1
Took legal advice/action	less than 1%	less than 1%
Asked someone else to do one of the above	less than 1%	3

source: BRE Review of London related data from the 2000 National Noise Attitude Survey

2.29 In London, 29 per cent reported that road traffic noise interfered with having windows or doors open, compared with 19 per cent nationally. Twenty-five per cent of London respondents reported interference with sleeping, and 23 per cent with resting. Reported interference with activities was generally higher in London than nationally.

2.30 People were asked specifically about noise from neighbours and/or other people nearby. Ten per cent of London respondents said they were moderately, very or extremely bothered, annoyed or disturbed by neighbours' vehicles starting up, leaving, being repaired, etc. Nine per cent expressed this view about radio, TV or music, and nine per cent about teenagers' or adults' voices (see Figure 7).

Figure 7 Proportions of respondents 'moderately', 'very' or 'extremely' bothered, annoyed or disturbed by specific sources of noise from neighbours



source: BRE Review of London related data from the 2000 National Noise Attitude Survey

2.31 The most commonly reported forms of interference from neighbours and/or other people nearby were with sleeping (22 per cent in London, 18 per cent nationally) and resting (19 per cent in London, 16 per cent nationally).

2.32 London figures have been analysed from National Noise Incidence Surveys of noise levels outside dwellings in 1990 and 2000, carried out by

the Building Research Establishment (BRE) for the Government. The survey was designed on a national basis, and sampling cannot be taken as representative of all areas of London (see map in margin). In both 1990 and 2000, noise measurements were taken at some 140 sites in North and South Outer London for a full 24 hours on a weekday. Illustrative 24 hour time histories are shown in Figures 8 to 11 (see Appendix A2 for an explanation of the noise indices used, which show, separately, overall 'averaged' noise, and 'background' noise).

London boroughs in which noise measured in 1990 and 2000

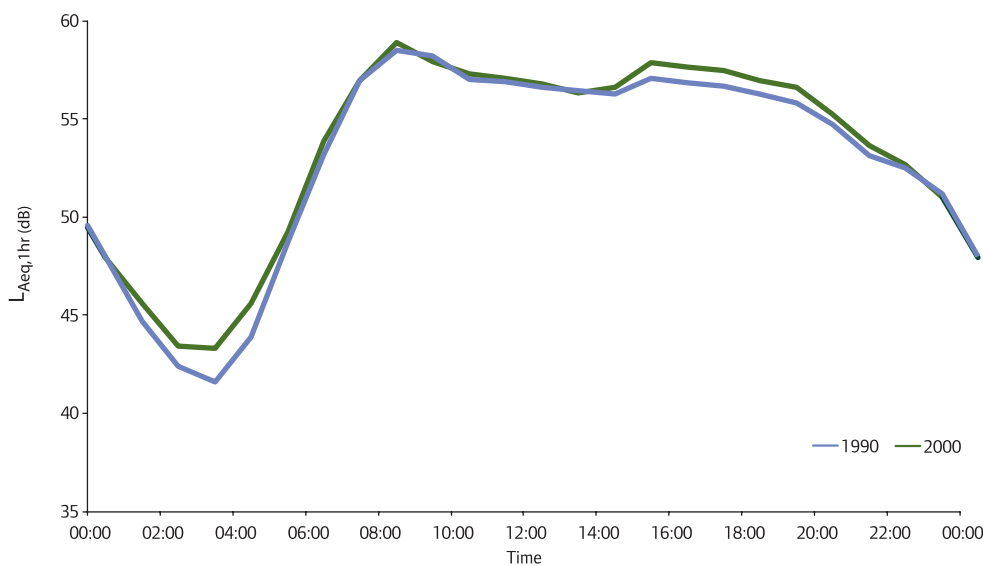


- Boroughs measured in 1990 and 2000
- 1990 only
- 2000 only

source: BRE Review of London related data from the 1990 and 2000 NNIS

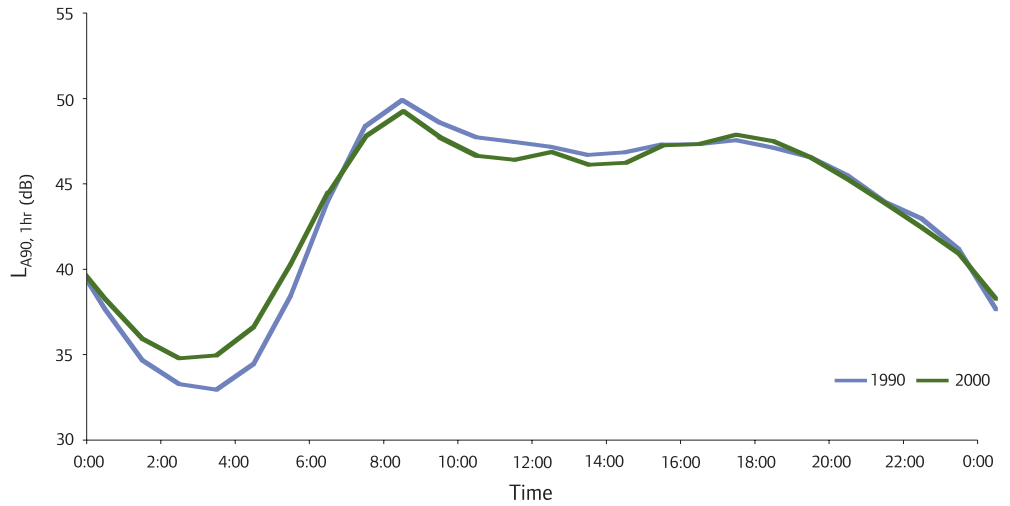
2.33 While the results must be treated with some caution statistically, they show that Outer London was noisier than England and Wales, and appeared to be getting noisier. There had been a slight increase in the average noise level throughout the night. The quietest part of the night, relatively speaking, started later in London and was shorter than in England and Wales. There appeared to be more noise in the lower frequencies in London than outside, and there were fewer quiet sites in London. It appears that the quietest sites in London generally experience a higher noise level than the quietest sites in England and Wales. Sites with the highest noise level within the surveyed parts of London are generally experiencing a similar level to those with the highest levels nationally.

Figure 8 24 hour time history of 'averaged' noise, Outer London, 1990 and 2000



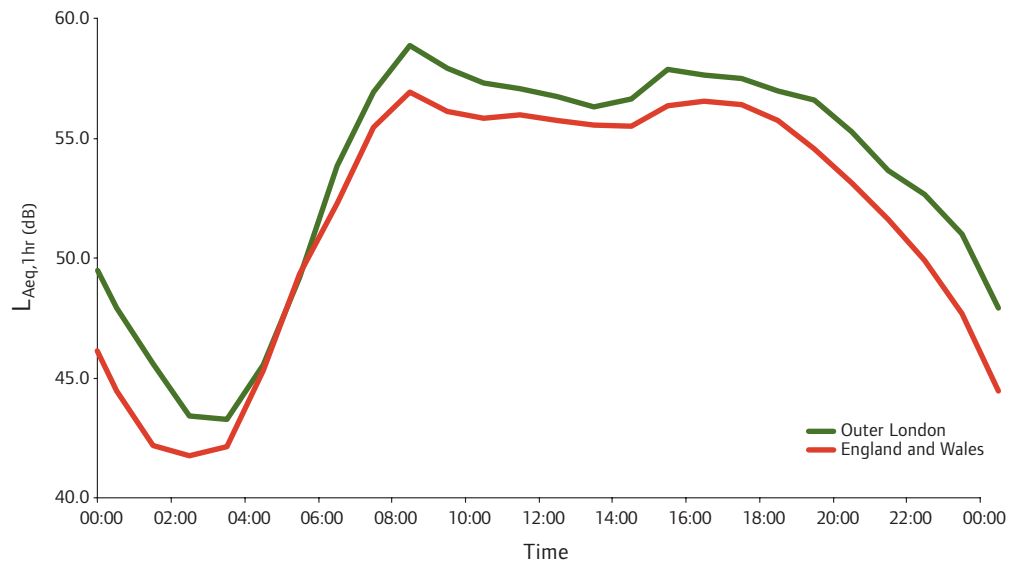
source: BRE review of London related data from the 1990 and 2000 NNIS

Figure 9 24 hour time history, background noise, Outer London, 1990 and 2000



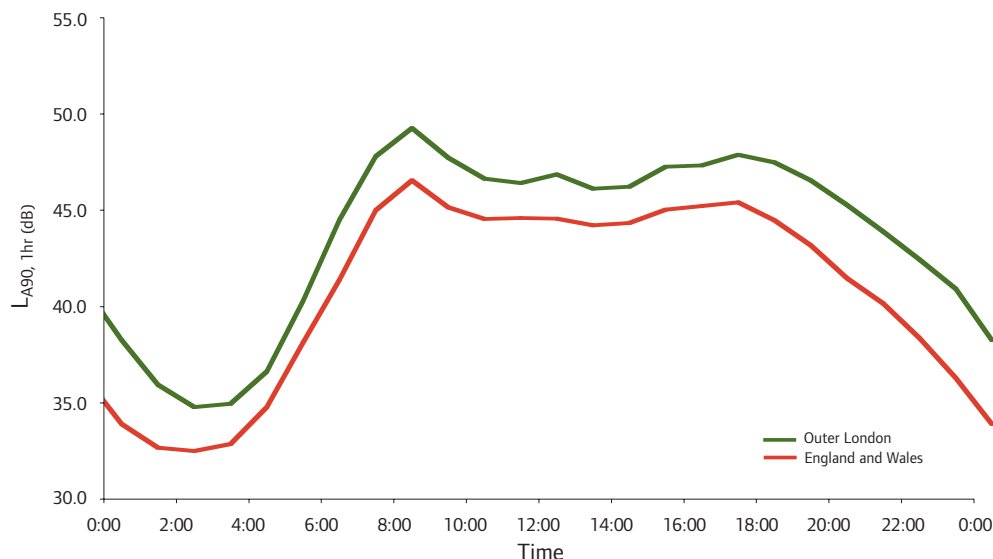
source: BRE review of London related data from the 1990 and 2000 National Noise Incidence studies

Figure 10 24 hour time history of 'averaged' noise, Outer London compared with England and Wales, 2000



source: BRE review of London related data from the 2000 NNIS

Figure 11 24 hour time history of background noise, Outer London compared with England and Wales, 2000



source: BRE review of London related data from the 2000 NNIS

Box 11: Estimated exposure in England and Wales to specified noise levels

- The World Health Organisation⁵ recommends that ‘to protect the majority of people from being seriously annoyed during the day-time, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady continuous noise’... ‘At night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax} so that people may sleep with bedroom windows open.’
- Assuming a 0700-2300 daytime, 55 per cent of the population of England and Wales were exposed to levels exceeding the 55 dB L_{Aeq} guideline in 2000, compared with 60 per cent in 1990.
- Assuming a 2300-0700 night, 68 per cent of the population of England and Wales were exposed to levels exceeding the 45 dB L_{Aeq} guideline in 2000, compared with 66 per cent in 1990, though this increase is not statistically significant.
- In both 1990 and 2000, eight per cent of the population of England and Wales were estimated to be exposed to a façade level of over 68 dB $L_{A10, 18\ hour}$ - the level at which offers of sound insulation would be made under the Noise Insulation Regulations if dwellings were affected by noise increases from a new road.

2.34 A London Noise Survey is being arranged, extending measurement to other parts of London. Participation of London boroughs and other stakeholders is being sought. Such wider coverage is necessary to yield more

representative figures. For example, areas most affected by aircraft noise were not captured in the national sampling frame. Differences between inner and outer London are likely. The London sample is not large enough to estimate population exposure reliably at different levels. The National Noise Incidence Surveys 1990 and 2000, however, do allow such estimates to be made for homes in England and Wales (see box 11).

Box 12: Qualitative description

- Ambient noise levels in a big city tend to be higher where transport facilities are concentrated. However, quiet areas screened from road and rail traffic can still be found in areas of high population density.
- Busy roads, major rail corridors, and aircraft are the main sources of ambient noise in London. New vehicles have been becoming quieter, but traffic has been growing, except in parts of London where the street network has already reached saturation. New buses should be quieter, but driving on uneven roads overdue for spending on maintenance can lead to unnecessary noise. New trains should be generally quieter, but track condition also needs to be managed. Aircraft have been becoming quieter, weight for weight, but their numbers have been increasing. People may notice bigger aircraft more, along with manoeuvring to join busy airport approach paths. London's network of parks and green spaces can provide relief from urban noise, but the tranquillity of many open spaces may have been eroded.
- On parts of the Thames, traditional sounds of working vessels have been replaced by leisure uses, including party boats, and the growth of riverside housing means more people near working wharves, and boatyards. Some areas are less affected by noise from traditional industries, but more ventilation and air-conditioning plant can mean more sources of annoying tonal noise and vibration, particularly in central areas.
- Parts of London are becoming more of a '24 hour city' in response to global economic and lifestyle trends. More late night eating, drinking, clubbing and other entertainment, and more flexible patterns of living and working generally, tend to mean more noise in hitherto quieter periods of the day and week.

- 2.35 In many parts of central and inner London, the road network has effectively reached saturation. With congestion, traffic speeds have fallen for much of the day. The Transport for London Road Network carries some of the highest flows, but many borough roads will be almost as noisy. Road traffic noise issues are considered in detail in Chapter 4A.
- 2.36 Decades of under-investment in Britain's railways suggest that levels of noise and vibration may be higher in some situations than would be

modelled using standard data for good track. Some measurement and mapping has been carried out, but there has been no systematic assessment of railway noise impact in terms of population exposure. Railway noise issues are considered in Chapter 4B.

- 2.37 In the ten years up to 2001, the area and population contained within long term 'averaged' aircraft noise contours published by the Government has fallen, while the number of air transport movements at Heathrow Airport has increased from 374,000 to 460,000 per year. 'Noise and number' issues and wider effects are considered in Chapter 4C.

References and notes

- 1 London Plan, GLA, February 2004, paragraph 1.34.
- 2 London Plan, GLA, February 2004, paragraph 1.42.
- 3 London Plan, GLA, February 2004, paragraphs 3.7 and 8.
- 4 Greater London Authority. 'London's warming: the impacts of climate change on London' Summary report, GLA, October 2002.
- 5 Berglund B, Lindvall T, Schwela D H (editors). 'Guidelines for Community Noise' World Health Organisation, Geneva, 2000 www.who.int.
- 6 Porter N D, Flindell I H, Berry B F. 'Health effect based noise assessment methods: a review and feasibility study' National Physical Laboratory Report CMAM 16. DETR, September 1998
- 7 Stansfeld S, Haines M, Curtis, S, Brentnall, S, Brown B. 'Rapid Review on Noise and Health for London' Report to inform preparation of Mayor's Ambient Noise Strategy, April 2001
- 8 for example, see Miedema H M E, and Vos H. 'Exposure-response relations for transportation noise' Journal of the Acoustical Society of America, Vol 104 (6), December 1998, pp 3432-3444
- 9 for example, see Berglund et al. 'Guidelines for Community Noise' World Health Organisation, 2000.
- 10 Evans G, Hygge S, and Bullinger M. 'Chronic noise and psychological stress' Psychological Science, Vol 6(6), 1995, pp 333-338.

- 11 Evans G, Bullinger M, and Hygge S. 'Chronic noise exposure and psychological response: A prospective study of children living under environmental stress' *Psychological Science*, Vol 9, 1998, pp 75-77.
- 12 Haines M, Stansfeld S, Job R, Berglund B, Head J. 'Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children' *Psychological Medicine*, 31, 2001, pp 265-277
- 13 Shield B and Dockrell J, 2002, 'The effects of noise on the attainments and cognitive performance of primary school children' Department of Health, 2002
- 14 www.ranchproject.org; e.g. Stansfeld S, et al. 'Aircraft and road traffic noise and children's cognition and health: Preliminary results on dose-response relationships from the RANCH study' Proceedings of the 8th International Congress on Noise as a Public Health Problem, IC BEN, Rotterdam, 29 June - 3 July 2003.
- 15 Berglund B, Lindvall T (editors). 'Community Noise' Document prepared for World Health Organisation. Archives of Centre for Sensory Research, 2, 1995, pp 1-195, <http://www.who.int/peh/>.
- 16 Council for the Protection of Rural England's Tranquil Areas maps, CPRE and Countryside Commission, 1995
- 17 HACAN ClearSkies. 'London's Blighted Parks' London, October 2000
- 18 Lambert J, Vallet M. 'Study related to the preparation of a communication on a future EC Noise Policy, Final Report' LEN Report No.9420, December 1994
- 19 European Commission. 'Future noise policy', European Commission Green Paper COM (96) 540, published in 1996.
- 20 Some complex changes to population estimates in London have delayed finalisation of the London Household Survey. However, it is not likely that these changes will have a significant effect on the percentages shown in figures 1 and 2.
- 21 The full list of such sources is road traffic, trains, aircraft, car or burglar alarms, factories and workshops, and building sites. The statistics do not allow subdivision into each source.

- 22 Data is based on responses from local authorities, and is dependent on numbers of authorities responding. Response rates vary from year to year, and different boroughs, experiencing different patterns of complaint, may respond in different years. This should not be interpreted as a strict time series when assessing trends.
- 23 Data on complaints or service requests to Borough Environmental Health Departments need to be interpreted with care. The number of complaints is not the same as the number of events which might theoretically give rise to a complaint. If the quality of the service on offer increases, the number of complaints can increase rather than decrease. If people receive rapid responses to complaints about one type of noise, more service requests may be received and handled on that subject than on others. People may complain less about some sources of noise if it appears that the local authority noise service can do little about them. Some people in some areas may be more likely to register a complaint than others. Differences in the way authorities collect data on complaints make comparisons difficult. Data definitions and collection methods may be revised, see 'Noise Management Guide' - Guidance on the Creation and Maintenance of Effective Noise Management Policies and Practice for Local Authorities and their Officers - Consultation Draft, Temple Environmental Consultants Ltd on behalf of Defra and CIEH. June 2003, referring to work by Faber Maunsell for Defra and CIEH. See <http://www.cieh.org/research/environment/noisemanagementguide.htm>
- 24 It should be noted that these surveys were designed to produce a national picture of noise exposure and of attitudes to noise. The clustered design of the samples means that there are large portions of Greater London where no interviews or measurements took place. Whilst the national sampling strategy has produced good estimates of population exposure and attitudes over the whole country, the sample design will result in higher uncertainties in Greater London than might otherwise be expected.



3 vision and linkages

Improving London's soundscapes will make it a more sustainable city, one that is a more attractive place in which to live, work and invest. The goal is a London where 'big city buzz' does not mean that people are deprived of rest, or denied freedom from unwanted distraction, and where havens of tranquillity may be found.

Context - the Mayor's wider vision is to develop London as an exemplary sustainable world city, based on the three interwoven themes of strong diverse long term economic growth, social inclusivity to give all Londoners the opportunity to share in London's future success, and fundamental improvements in environment and use of resources.

- 3.1 Fulfilling this vision requires concerted action which addresses the wide range of economic, social and environmental needs and priorities of Londoners. Economic efficiency must be improved and its benefits shared so as to increase social cohesion and environmental quality, and raise the overall quality of life.

A vision for the Mayor's Ambient Noise Strategy

- 3.2 The overall vision for the Mayor's Ambient Noise Strategy is **to minimise the adverse impacts of noise on people living and working in, and visiting London using the best available practices and technology within a sustainable development framework.**

Objectives of the Mayor's Ambient Noise Strategy

- 3.3 The objectives of the Mayor's Ambient Noise Strategy set out how the Strategy aims to work towards achieving the Mayor's vision. They are expressed qualitatively, and should be seen as interim, pending development of a new national and European framework for noise management. Objectives are not absolute and need to be weighed one against another, and in relation to those in the Mayor's other Strategies, including economic development and social inclusion objectives; for example, achieving long term infrastructure improvements can entail short term disruption. The objectives are:

- 1 To minimise the adverse impacts of road traffic noise;**
- 2 To encourage preferential use of vehicles which are quieter in their operating conditions;**
- 3 To minimise the adverse impacts of noise from freight and servicing;**

- 4 To promote effective noise management on rail networks in London;**
- 5 To minimise the adverse impacts of aircraft noise in London, especially at night;**
- 6 To minimise the adverse impacts of noise on or around London's rivers and canals, while retaining working wharves and boatyards, and enhancing water space tranquillity and soundscape quality;**
- 7 To minimise the adverse impacts of industrial noise, recognising the use of best practicable means/best available techniques, and the need to retain a diverse and sustainable economy;**
- 8 To improve noise environments in London's neighbourhoods, especially for housing, schools, hospitals and other noise-sensitive uses;**
- 9 To protect and enhance the tranquillity and soundscape quality of London's open spaces, green networks and public realm.**

Guidelines, limit values and targets

- 3.4 The way in which noise is managed in different countries varies widely. Many standards, regulations, guideline values, and legal and administrative processes are currently in use in the UK, addressing different aspects of noise in different ways (see Appendix A5). Processes of international harmonisation, particularly within the European Union, are likely to involve changes to UK practice, as may the process set out for a National Ambient Noise Strategy.
- 3.5 Noise policy has tended to focus on limits applied to sources, and guidelines for noise-sensitive receptors. Greater emphasis is being placed on maintaining and enhancing 'tranquillity'. Tranquillity is likely to need to be defined in relative rather than absolute terms. For example, a suburb of a large city might be considered quiet by city dwellers, while the same ambient level in a remote rural area might be considered noisy in local terms. Noise control has generally recognised that the acceptability of noise depends very much on context. A given physical level of road, rail, aircraft or industrial noise is not a complete predictor of human response, with wide variation in attitudes.
- 3.6 Requirements of the European Environmental Noise Directive¹ include member states reporting to the Commission on 'limit values'. There is

some debate on what constitutes a limit value, or what the consequences of exceeding it might be. The Government has not yet indicated what limit values would be reported for the UK. It will be important for noise management to consider, not just benchmarks or absolute levels, but the nature of the change expected from a proposed action (see Appendix A2, Assessing Changes). The particular qualities of local soundscape context are also likely to influence people's perceptions.

- 3.7 The NSCA's National Noise Committee has stated²: 'A noise strategy cannot be built on the development of absolute standards or objectives as this would ignore some of the quintessential aspects of noise as a pollutant. The variation in the subjective reactions to noise, the difficulty in quantifying quality of life and the valuing of amenity and its loss all act against the setting of blanket standards. Simple application everywhere of health-based thresholds, as has been done for air quality, will not suffice, because of the need to cope with annoyance and quality of life considerations.'

Box 13: Planning Policy Guidance

Planning Policy Guidance Notes on a range of issues set out Government policies which local authorities must take into account in preparing development plans, and which may be material to decisions on planning applications and appeals. Planning Policy Guidance Note 24 (PPG24) 'Planning and Noise', DoE, 1994, gives guidance to local authorities in England on the use of their planning powers to minimise the adverse impact of noise, including through defining Noise Exposure Categories (see Appendix A5).

The Government announced, in its plans for reform of the planning system,³ that it intended to review existing national policy guidance over the next three years. This included replacing existing planning policy guidance notes (PPGs) with national planning policy statements (PPSs), aimed at being more concise, clearer and better focused on implementation of policy objectives.

- 3.8 Guidelines produced under the auspices of the World Health Organisation⁴ give a context for moving towards the Mayor's vision. The Guidelines can be seen as aspirational targets based on the precautionary principle. However, any large city with a long history is likely to have many situations exceeding the WHO guideline values. London does not yet have accurate estimates of the numbers of people exposed to different levels of ambient noise, identifying the sources responsible, and the costs of reducing noise to particular levels, or by particular amounts, in differing soundscape contexts. Section 41(5)(c) of the GLA Act requires the Mayor to have regard to the resources available for implementation of

the Strategy. Until such information is available, and the necessary budgets and legislative powers can be defined, it is not possible to set overall timescales for achieving particular targets. Preparation of a National Ambient Noise Strategy will need to address these issues. It would be wrong to pre-empt it.⁵

Linkages and cross-cutting themes

- 3.9 In preparing or revising the London Ambient Noise Strategy, the Mayor must have regard to the principle purposes of the Authority, the effect it will have on the health of the people of London, and the achievement of sustainable development in the United Kingdom. The principal purposes of the Authority are to promote economic development and wealth creation; promote social development; and promote the improvement of the environment in Greater London. In preparation of the Strategy, due regard must be paid to the principle that there should be equality of opportunity for all people.

Equalities

- 3.10 Depending on income, gender, age, ethnicity and disability, different groups tend to occupy and use spaces in different ways, and be exposed to different levels and types of noise. This can contribute to inequalities in health. For example, older people, those who are unemployed, disabled or long-term sick and those (usually women) caring for young children may spend longer at home than most of those in paid work. Housing occupied by lower income groups may be more likely to be exposed to high external noise levels, and to have poorer internal noise insulation. Older parts of London tend to have a higher density of roads and railways. Lower income Londoners, including certain black and minority ethnic communities, tend to be more highly concentrated in many of London's older districts. Many main roads are lined by older buildings and blocks of flats. Many of these may be occupied by groups more prone to social exclusion, while higher value houses may be set back in larger gardens. Many noisier economic activities were traditionally located in more deprived areas.
- 3.11 However, there are also parts of the city, such as inner west London, with high residential and traffic densities, where all social groups may be exposed to high noise levels. The location of Heathrow on the generally wealthier western side of London cuts across the capital's historic pattern of disadvantage. Aircraft noise affects areas such as Richmond, where incomes tend to be higher, as well as Hounslow, where groups with lower incomes and significant minority ethnic representation may be found.
- 3.12 A more affluent long term resident may be more familiar with local administrative systems, and be more likely to register a noise or other

complaint than, for example, those with low incomes and living in less stable housing conditions, even if the adverse effects experienced by the latter are the same, or worse. Language can be a barrier to people who cannot get information on how to complain in their first language. Policy should ensure that the needs and priorities of different groups are identified and addressed in appropriate ways. A proactive approach to noise management may be more likely to avoid bias than a reactive approach relying on complaints.

Disability

3.13 The London Plan seeks to ensure disabled people can experience a better quality of life through policies including improved transport facilities, accessible housing and a more accessible urban environment. The Labour Force Survey for 2001 indicated that some 17.2 per cent (835,000) of London's population of (traditional) working age had a long term disability, compared with 19.3 per cent for Great Britain as a whole.⁶ However, definitions of disability vary between surveys. For example, the London Household Survey⁷ estimated that 10 percent of Londoners had a limiting long-term illness, health problem or disability which limited their daily activities or the work they could do. The Royal National Institute for Deaf People (RNID) has estimated that 8.5 million people in Britain, one in seven, have some form of hearing impairment.⁸



3.14 Design of streets and buildings can unintentionally exclude those with hearing or sight impairment. Many of London's public, leisure, entertainment and tourist facilities lack induction loops or good signage. Where loops are provided, staff need to be aware of their presence and trained in their use. Design of vehicles and other parts of the transport system has been improving, but there is still a long way to go, especially in terms of management and operation. Very noisy environments can create difficulties for people with any form of hearing impairment, particularly in terms of being able to hear speech, announcements or warning signals. People with visual impairment need acoustic environments which provide appropriate cues, for example, to enable people to locate themselves within a space, and which do not mask communication.

London's Older People

3.15 Twelve per cent of London's population is aged 65 or over, with three per cent of the total population is over 80.⁹ Older people are more likely to live in poorly insulated housing, and to spend more of their time there, and thus be more affected by local environmental noise. Older people and those with certain health problems, may be more adversely affected by some forms of noise, including unexpected or sudden sounds. As people

age, hearing tends to become less acute for high-pitched sounds. Sensitivity to low frequency noise may increase.

London's Children and Young People

3.16 In 2001, almost one in four Londoners was under the age of 18¹⁰ and 36 per cent of those under twenty were from black and minority ethnic groups. Over 300 different languages are spoken in London schools, with about 40 languages spoken by communities of 1,000 people or more. The child poverty rate in inner London is 48 per cent, compared with 26 per cent in outer London and 30 per cent nationally (after housing costs).¹¹ Many of London's children are likely to live in overcrowded and poorly insulated housing which does not help with study, rest, or play which does not disturb others. Many lack attractive or safe outdoor environments where they can play without being the subject of complaints, including about noise.¹²



3.17 Very high levels, such as in noisy workplaces, may affect foetal development. Noise may interfere with speech communication, including in terms of language acquisition and communication. Very high levels of noise may affect the speed or quality of communication between teachers and children. Many schools have poor internal acoustics, so that activities interfere with each other. Studies have been taking place in schools around Heathrow Airport, and elsewhere in London^{13, 14, 15} (see also paragraphs 2.9 and 4F.14-17).

3.18 Use of headphones at high volumes by young people, and extended exposure to very loud noise in pubs, clubs and other entertainment venues may cause permanent hearing damage.¹⁶

Women in London

3.19 The lower disposable incomes of many women mean they are likely to have less effective choice in where they live, and thus be more likely to live in poorer, noisier areas. Caring responsibilities and part-time work may mean that women are at home for longer, or during noisier parts of the day, than many men. Noise in the neighbourhood may add to women's concerns about their safety. The British Crime Survey indicates that women tend to be more worried about going out alone, particularly at night. Older women are much more likely to be living alone. Studies have indicated that women may be more sensitive to noise than men.¹⁷

London's Black and Ethnic Minority Groups

3.20 According to the National Census 2001, nearly 29% of Londoners were from Black and Minority Ethnic groups (not including minority white groups such as Irish, Turkish or Greek). There is much variation within and

between groups, but overall, such groups are probably more likely to live in noisy environments, because of their lower incomes and therefore lack of choice about where they live. The unemployment rate in London in 2001 was over 20% for Bangladeshis, over 17% for the population categorized in the 'Other Black' group, 16% for Black Africans, over 12% for Black Caribbeans and 12% for Pakistanis. The rate for Indians was under 6%, not much higher than the White British population (5%). Some of the more highly noise exposed areas east of Heathrow Airport contain high proportions of ethnic minority residents.¹⁵ Black and ethnic minority households have tended to be more concentrated in inner city areas and poorer housing, where noise levels are likely to be higher. Some minority ethnic communities may be less likely to make complaints about noise, because of loss of confidence in administrative systems, lack of familiarity with them, fear of racial harassment or attacks from noise makers, or a lack of information in their first language.



Refugees and Asylum Seekers

- 3.21 Refugees and asylum seekers can be especially insecure, vulnerable and socially excluded. They may be less aware of their rights, and particularly affected by language barriers. Overcrowded and noisy conditions can present additional pressures to people who may already have to cope with considerable pressures. Noisy environments could hinder language acquisition.

Faith Communities

- 3.22 High sound levels from places of worship and other spaces used by faith communities can be the subject of complaints to borough Environmental Health departments (e.g. bell ringing). Activities of faith groups can also be affected by noise from others. Information on complaints may not represent issues with full equality, and issues can require particularly sensitive handling at the local level.

London's Travellers and Gypsies

- 3.23 London continues to attract demand for gypsy and traveller sites, in inner as well as outer London. Available figures suggest that the number of authorised sites, both council and private, has decreased in most boroughs since January 1999.¹⁸ Many sites in London are overcrowded, and probably noisy, although systematic information is not available. Noise-sensitivity needs to be considered alongside noise generation issues.



Health

- 3.24 The constitution of the World Health Organisation defines health as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity.' Guideline values produced for the

World Health Organization⁴ are widely used in noise policy. These incorporate, for various situations, threshold noise levels below which adverse health effect would not be expected. Health in this context includes wellbeing. Potential adverse effects have already been referred to (see Chapter 2).

- 3.25 Health may be affected by sleep disturbance, stress, and in other indirect ways. However, there is less conclusive evidence for these indirect health effects of noise than, for example, in the case of air pollutants such as fine particles. This is not to discount the potential for such effects, or to argue against a precautionary approach. However, it is necessary to acknowledge that it is particularly difficult to set health-related thresholds for noise below the level of clinical damage.
- 3.26 Public health policies are generally derived from observations of effects on 'average' populations. Participants in studies, typically adults from the general population, may have been selected because of their easy availability. Vulnerable groups can be under-represented, including the very old or young, people with particular illnesses, disabled people, people with learning difficulties, or mental health service users. Many such groups may be more affected by noise than an 'average' population. The impact of higher density living on noise and health needs to be considered.

Sustainable Development

- 3.27 Sustainable development may be defined as: 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' The UK Government's sustainable development strategy¹⁹ saw a need to meet four objectives at the same time - social progress which meets the needs of everyone; effective protection of the environment; prudent use of natural resources; and maintenance of high and stable levels of economic growth and employment. The Mayor's duty is to have regard to 'the achievement of sustainable development in the United Kingdom.'²⁰ In improving noise environments in London, the Mayor cannot be indifferent to implications for the rest of the country. The Mayor set up a London Sustainable Development Commission in May 2002 to advise him on sustainability issues. In June 2003, the Mayor launched the Commission's London Sustainable Development Framework. The Framework provides the Commission's vision for a sustainable London and sets out thirteen high level objectives for delivering this vision. It provides the context for the development of strategic policy in London enabling planning, transport, social inclusion, economic development and environmental policies all to move in the right direction towards a more sustainable future. In June 2003, the Commission undertook a sustainability appraisal of the Draft London Ambient Noise Strategy, using the London

Framework, and the appraisal findings have been taken fully into account in reviewing the Strategy.

- 3.28 The NSCA's National Noise Committee has stated: 'While noise is transitory in nature, the effects it has over human health, and the quality of life and urban environments, are cumulative and so it comes under the umbrella of sustainable development.'²¹ The creation of infrastructure has implications for the future pattern of development and activities, and noise is a factor in their evolution. If cities become too noisy, their long term vitality may be reduced - lower quality of life in urban and especially inner city areas, may encourage dispersion and decentralisation of population and activities, and less sustainable patterns of future development. Higher densities create challenges, but also opportunities - for example, more people can gain access to what they need with less overall transport. Warmer temperatures with climate change are likely to encourage people to have windows open more and to use outdoor spaces more, increasing the need for effective urban noise management. The Mayor has been working with partners to produce Supplementary Planning Guidance on Sustainable Design and Construction.
- 3.29 It is easy to create silence by merely banning certain activities. It is much harder to maintain a city's vibrancy, while giving people more real choice over the sounds to which they are exposed. Industrial society increases our potential to generate noise. However, it also creates opportunities to develop and apply better technologies, to generate wealth to afford them, and to share information.

Linkages with the Mayor's other strategies

- 3.30 The Greater London Authority Act requires the Mayor to prepare eight strategies covering transport, economic development, spatial development, air quality, biodiversity, municipal waste management, culture, and ambient noise. In addition, an energy strategy has been produced. The Mayor's Tourism Action Plan encourages visitors to explore areas of the city outside the central area, while seeking to improve the public realm and visitor experiences, and avoid overloading²². A strategy on domestic violence has been published. A London Agenda for Action on Alcohol includes objectives and priorities to reduce alcohol-related harm. A Childcare Strategy and a Children and Young People's Strategy have been produced. A strategy to tackle anti-social behaviour in London is to be prepared, with partners. A State of the Environment Report for London, published in May 2003²³, includes information on noise.
- 3.31 Many policies designed to improve London's soundscapes will have positive effects on other strategic objectives, and vice versa. For example,

reducing traffic and improving public transport should reduce noise. The Mayor's other Strategies provide opportunities to take action, and to promote measures to reduce ambient noise in London. The following sections assess their impact on noise.

Transport Strategy



- 3.32 Links between the Mayor's Ambient Noise and Transport Strategies are extensive. The state of transport in London, with economic growth but continued under-investment, hinders business efficiency and quality of life. Resolving this is the Mayor's highest priority. The only viable approach, from both a financial and an environmental point of view, is for public transport to serve the vast majority of passenger traffic in Central London and for the majority of additional transport capacity to be accommodated through public transport. The Mayor's Transport Strategy, published in July 2001, seeks to address the needs of London as a world city, requiring excellent internal and international transport facilities, whilst minimising environmental impact on residents. However, many key decisions on international transport and related environmental issues are matters for central government.
- 3.33 Road traffic is the most widespread source of ambient noise in London. Many aspects of the Mayor's Transport Strategy will lead to a quieter London. If more people walk, cycle or use a modernised, well-maintained, well-run public transport system, noise environments should improve. The Mayor's Transport Strategy will have many different implications for ambient noise. It will be important to maximise the potential noise benefits from improved and more efficient systems, and minimise adverse impacts. Detailed policies and proposals are set out in Chapters 4A-D of this Strategy.
- 3.34 The Mayor's Transport Strategy (Policy 3.10) states that, where possible, Transport for London will lead by example by adopting and promoting cost-effective environmental good practice, particularly where this will contribute to minimising the noise impacts of transport. The Strategy envisages (paragraph 3.75, and proposal 3.4) that, with additional resources for integrated transport investment becoming available over time, it will be possible to place greater focus on targeting noise reduction in the design and maintenance of transport infrastructure and vehicles.

Box 14: Transport Strategy assessment by MVA for TfL - summary

- Modelling of basic noise levels, using methodology in 'Calculation of Road Traffic Noise' (CRTN) Department of Transport, 1988, indicated that many roads on the network, such as motorways and major roads, particularly those carrying a significant amount of commuter traffic such as the North Circular and the A40, and some central area roads such as Oxford Street, had noise levels of over 76 dB for 2001.
- The 2001 base case was projected to 2011 without measures in the Mayor's Transport Strategy. Traffic noise would increase on all the modelled roads. The smallest increases would be concentrated in central London, where a 15 per cent increase in bus flow would be partially offset by a 1.6 per cent decrease in car flow. Oxford Street, where traffic is predominantly buses, would have the largest increase in noise levels in central London - but this assumes no reduction in the noise of buses.
- The 2001 base case was projected to 2011 with measures in the Mayor's Transport Strategy. Traffic noise would decrease on several routes in central London. This would be as a result of Congestion Charging and a consequential decrease in car flow in central London. The highest projected increases in noise levels (up to 1.6 dB) would be on roads with high bus flows, associated with an overall increase of 40 per cent in buses, on some links in central London, in town centres and on other major bus routes. However, this calculation included buses in the heavy vehicle category of 'Calculation of Road Traffic Noise'. In practice, improvements in technologies are likely to reduce bus noise levels by 2011. Quiet fuel cell buses are being trialled in London. Benefits from quieter buses would be greatest in central London, where buses comprise a large proportion of all vehicles. Laying quiet road surfaces was assessed to give noticeable improvements on busy roads (those carrying over 25,000 vehicles per day).
- Modelling of railway noise levels, using methodology in 'Calculation of Railway Noise' (CRN) Department of Transport, 1995, showed the busiest national rail routes into and out of London as the noisiest, while those with higher speeds were also relatively noisy. Modelled change between 2001 and 2011 without measures in the Mayor's Transport Strategy would, for the most part, be less than 2 dB, with the exception of the Channel Tunnel Rail Link, which, however, would be in tunnel on its approach to London to avoid noise and other impacts. Increased services with the Mayor's Transport Strategy lead to a projected increase of over 2dB on a number of routes, particularly from the major stations north of the Thames. Services on the West London Line, East London Line, and the Gospel Oak-Barking Line also show increases, as does Crossrail (although this is in tunnel through the central area). For the network as a whole, however, the increase in noise levels is generally

below 2 dB. There would also be decreases in 'averaged' noise, such as where improvements in rolling stock are achieved.

- Noise levels on the London Underground were calculated as for national rail. Most of the underground network has lower modelled noise levels than on national rail, and much of it is, of course, underground. Tube trains generally operate at lower speeds with frequent stops. The Metropolitan Line north-west of Finchley Road is an exception. There would be negligible change in noise levels between 2001 and 2011 in the base case. With the Mayor's Transport Strategy, the largest increases were modelled on the Jubilee, Northern (Edgware branch and southern section), Victoria, Central, and Hammersmith & City lines, and the Docklands Light Railway, reflecting the increase in services. Decreases along the Metropolitan Line reflect a decrease in services as they switch to Crossrail.
- Overall, CRN modelling suggested that capacity increases in the Mayor's Transport Strategy would have a small effect on overall 'averaged' noise levels across London. Few assumptions were made about improvements in infrastructure. For example, new trains could be quieter than assumed in modelling.

Economic Development Strategy



- 3.35 Wealth creation in a modern world city offers opportunities for the development and application of cleaner and quieter technologies. The London Development Agency was established under the Greater London Authority Act 1999 to take forward economic development and regeneration in the Capital, and to deliver Economic Development Strategy for London. The Agency's responsibilities include funding regeneration and development projects, promoting competitiveness and business efficiency, skills, inward investment and sustainable development.
- 3.36 The Mayor has expressed his commitment to creating green jobs in London. The greatest initial scope is in waste recycling and reprocessing activities. As a first stage in developing a strategy for support of the Environmental Goods and Services sector in London, of which sound insulation and noise control is one element, the LDA has carried out an audit of the sector and assessed opportunities for its growth. The next stage is to identify priorities for future work. One early priority is to consider in more detail the potential LDA role in developing skills and capacity in the sustainable design and construction sector.
- 3.37 The LDA will seek to minimise noise, alongside other sustainable development objectives, in the projects and programmes in which it is involved. To that end, the LDA is working with the Mayor in developing the London Hydrogen Partnership.

Box 15: Economic Development Strategy

London's first Economic Development Strategy, published by LDA in July 2001, set out a shared agenda focusing the contribution of the London Development Agency in terms of economic growth, knowledge and learning, diversity, inclusion and renewal, and sustainable development. The Strategy recognised (page 81) that: 'Best contemporary noise management and design will be important if economic activities, housing and other uses are to mix sustainably.' It stated that the development of the environmental sector is integral to the delivery of sustainable economic growth, and that London needs to create and seize opportunities to encourage the development of a thriving environmental business sector. In addition to promoting development of this sector, the Strategy recognises the need for adoption of environmentally friendly business practices across all sectors. The Strategy stated (Action 4.3.5, page 83) that the London Development Agency 'will promote green business management practices including those relating to open spaces, waste reduction and reclamation, energy efficiency, air quality and noise pollution and control.' It added that 'The LDA will initiate demonstration projects with business organisations to raise business awareness of green management practices including waste management, energy efficiency and noise and pollution control.' A new Strategy for London businesses is being developed, and will be finalised in Autumn 2004.

Spatial development - the new London Plan

3.38 The London Plan (Spatial Development Strategy) sets out an integrated social, economic and environmental framework for future development, looking ahead over a 15-20 year period, reviewed as necessary. It aims to integrate the physical and geographic aspects of the Mayor's other Strategies. The London Plan provides a strategic planning framework for delivering some of the policies which other Strategies contain. Policy 4A.14 of the London Plan contains the statutory 'headline' expression of planning policy on noise reduction. Detailed policies in the London Ambient Noise Strategy offer consistent expansion, clarification and illustration, which the Mayor urges boroughs to consider adopting, reflecting or developing in pursuit of the overall vision for London. The Mayor is also responsible for reviewing London boroughs' Unitary Development Plans. These need to demonstrate general conformity with the London Plan. London Plan Supplementary Planning Guidance and Best Practice Guidance provide further guidance to boroughs on how local planning can contribute to London-wide needs, including carrying through the Mayor's other strategies. Under the Town and Country Planning (Mayor of London) Order 2000, certain categories of planning application must be referred to the Mayor.



Box 16: Some key spatial elements

- The London Plan expects higher density development to meet growing demand for homes and jobs. Densities are expected to rise in areas of greatest demand, where capacity exists and where there are no significant constraints.
- The most extensive areas of development capacity identified in the London Plan fall within four broad corridors running east, west, north and south through and out of London. Development opportunities in these regional corridors, where the London Plan stresses the importance of mixed-use, relate closely, in many cases, to transport facilities.
- The spatial geography of noise in London is diverse. Where more development is expected, as in the regeneration corridors of the Lee Valley and Thames Gateway, and around major new interchanges, well-designed development offers major opportunities to improve soundscapes.
- The London Plan proposes a Blue Ribbon Network in which public access to and more use of the Thames and other waterways is encouraged, and in which water space is planned from the water outwards. Enhancing soundscapes in sensitive locations need not stifle working waterways or rivers.
- The London Plan states that the boroughs should in their UDPs include policies to minimise the adverse impacts of noise, in terms of the location, design and operation of development, and should promote sustainable design and construction. They should also, where necessary, include measures to contain noise from late night drinking and entertainment and other 24 hour activities, and, where appropriate, promote well-managed designated locations.

Air Quality Strategy

- 3.39 There are strong links between noise and air quality, with obvious overlaps in objectives and policies. Both noise and air pollutants come mainly from the same sources. Reducing traffic volumes, encouraging smoother traffic flows, and using vehicles running on alternative fuels such as compressed natural gas or hydrogen, which are often cleaner and quieter, can both reduce noise and improve air quality. However, there are some tensions.²⁴ For example, the optimum traffic speeds for minimising air pollutant emissions are not the same as those for minimising traffic noise. Continuous building frontages can screen noise, but narrow, high-sided 'urban street canyons' (see glossary) can hinder dispersion of polluted air. Such tensions will need to be resolved at action plan and operational levels, and other factors, such as safety or feasibility, will also influence decisions.



- 3.40 Policy on air quality has moved much further and faster than noise policy over the last ten years. Tough European Union and UK national targets have been adopted for air quality. Very large reductions in vehicle air pollutant emissions have been achieved by progressively tighter 'Euro' standards. Substantial resources have been devoted to measuring and modelling local air quality by London boroughs. Reviews and Assessments of air quality by boroughs have been followed by declarations of Air Quality Management Areas across London, and action plans are now being drawn up.
- 3.41 Policy on ambient noise will not necessarily develop as an exact parallel. The physics of noise is very different from that of the pollutants covered by the Air Quality Strategy. Most noise is much more local in its effects. However, policy and implementation in the areas of air quality and ambient noise will need to work closely together. The Mayor's Air Quality Strategy sets out a programme of action in London. A Low Emission Zone Feasibility Study has been published.²⁵ This provides information to help the Mayor, in conjunction with the Association of London Government, London boroughs and the Government, determine whether Low Emission Zones, excluding the most polluting vehicles from certain areas, could contribute towards meeting air quality targets. A Low Emission Zone would be likely to have a modest effect on noise, reducing the level of some noise events.

Biodiversity Strategy

- 3.42 The Mayor's Biodiversity Strategy aims to ensure that all Londoners have ready access to wildlife and natural green spaces; to conserve London's plants and animals and their habitats; to ensure that the benefits that natural green spaces can bring to London's infrastructure and economy are fully realised; and to recognise that biodiversity conservation is an essential element of sustainable development.
- 3.43 Open spaces, watercourses and other natural features create some of London's most distinctive soundscapes. Better noise management could enable more people to enjoy more diverse aspects of the sound world. In particular, birds are often identified by sound. There is some evidence that continuous high noise levels, notably from busy roads, can have adverse effects on populations of breeding birds. Further evidence of adverse effects on animals comes from indications that different farm animal species react differently to constant or sudden loud noise.²⁶ Noisy development needs to be considered in relation to the welfare of animals. Tranquillity within open spaces is important to many people for their appreciation of the natural and semi-natural world. Ambient noise can affect people's enjoyment of wildlife, such as under aircraft flightpaths.



Conversely, people can be disturbed by noise from wildlife, such as by early morning birdsong.

- 3.44 The barrier effect of deciduous trees on noise levels is modest. A dense belt of evergreen trees or large shrubs may have a greater impact. Trees and other vegetation can, however, have a greater effect on subjective perceptions. Street trees can make a busy thoroughfare feel more liveable. Noise barriers, such as timber fencing, may be designed in conjunction with planting to enhance local biodiversity. 'Living barriers' can be formed largely from plants in a growing medium. 'Soft ground', including grassland and cultivated gardens, absorbs sound. Overall, conserving and enhancing London's biodiversity would have a positive impact on city soundscapes.

Municipal Waste Management Strategy

- 3.45 The collection, transfer, treatment and disposal and/or recycling of waste can generate noise. The amount of municipal waste produced in London has increased. 2.75 million tonnes of municipal waste were transported out of London for disposal in 2001/02. Approximately 27 per cent of this waste was transported by barge on the Thames, 27 per cent by rail and the remainder by road. The Mayor's Municipal Waste Management Strategy aims to reduce the production of municipal waste, and increase the proportion that is reused and recycled. Many local authorities have been adopting cleaner vehicles, which are typically also quieter. In some areas, small electric carts are being used to collect in confined situations. The Mayor will encourage the use of less polluting vehicles, along with aiming to deal with waste as close as possible to its place of production. There is a risk of more noise from more materials handling associated with some forms of recycling. However, it is believed that this can be managed acceptably. Transfer sites, processing facilities or recycling plant are assessed at planning and licensing stage. Measures to minimise the noise impact of vehicles and collection methods, and of waste management more widely, are included in Chapters 4A and 4E below.



Culture Strategy

- 3.46 The Mayor's Cultural Strategy is underpinned by the principle that all of London's cultures play an invaluable and integral part in the capital's make-up and prosperity. It demonstrates how and where culture can make a difference to the lives of Londoners and how important it is to the success of London as a world city. It addresses policies relating to the arts, tourism and sport, including ancient monuments, buildings of historical or architectural interest, museums and galleries, library services, broadcasting and film production, parks and open spaces, design, fashion and other creative industries.



- 3.47 City soundscapes are part of city culture. Enjoyment of historic open spaces and buildings can be affected by noise. Cultural events, including music, singing, and fireworks, can give joy to participants, though sometimes annoy others. A voluntary ban on the sale of the noisiest 'air bombs' to the public has been introduced, and the new Fireworks Act 2003, enables the Government to introduce additional regulations, expected during 2004.²⁷ Most people will understand the positive role that occasional outdoor events play in the lives of cities. New street festivities or outdoor events can be better accepted when accompanied by measures to build local understanding and, ideally, participation. Some sound levels experienced in city festivities across the world risk physical hearing damage, such as through highly percussive or impulsive sounds. During consultation in preparation of the Cultural Strategy, some concern was expressed at the impact of public entertainment licensing on emerging artistic enterprises, particularly in small or low cost venues. Research was suggested to establish the extent of the problem and identify solutions. National licensing reform provides an opportunity to consider new options, in particular to ensure that the cost of licences fairly reflects public costs and does not discourage diversity and innovation in cultural provision. Relevant issues, including the evening economy, town centres, outdoor activities and leisure venues are considered in Chapters 4F and 5 below, and in the London Plan.
- 3.48 While outdoor events may pose their own problems for noise control, the converse may also be true. High ambient noise levels may interfere with outdoor cultural activities and may even affect enclosed venues. Even where an indoor event itself is not affected by external noise, high ambient noise levels in the street may be off-putting to those wishing to attend. More broadly, improving environmental sound quality has key links with culture, including in education, music, sound art, museums and exhibitions, interdisciplinary work on soundscapes, soundmarks and soundwalks (see glossary), and community engagement.²⁸

Energy Strategy

- 3.49 The Mayor's Energy Strategy seeks to reduce London's contribution to climate change through increases in energy efficiency and the proportion of renewable energy, such as solar. It also seeks to eradicate fuel poverty, so that Londoners can adequately heat their homes at an affordable cost, and to secure jobs and economic development from improvements in energy supply and use. A London Energy Partnership will help implement this work across the capital.
- 3.50 The London Climate Change Partnership has commissioned a study of the possible implications for London of future climate change.²⁹ Issues include



changes in rainfall, flooding and storm incidence. High summer temperatures are likely to become more frequent, particularly at night in central London. People are likely to want to have windows open more often, and may spend more time out of doors. If passive alternatives are not successfully promoted, more people could want to use mechanical cooling, with its potential for noise.



Box 17: Relationships between energy use and noise

- The amounts of energy used in generating sound are minute in relation to the primary purposes of most equipment - typically one millionth of the energy used in a machine³⁰. There is no meaningful correlation between energy use and noise generation, still less impact on people.
- Noise reduction measures can have energy costs. Encapsulating a diesel engine can add to the weight of a vehicle. Better sound insulation of buildings can mean more energy used to produce glass and other materials, and additional building mass. Sealing pubs, clubs and other buildings to contain internally generated noise can increase energy consumption for ventilation and cooling if conventional systems are used.
- However, if more people walk, cycle or use modern, well-designed and maintained public transport systems, both energy use and noise levels will be lower than if roads become more congested and driving more aggressive. District heating and cooling networks, photovoltaics, passive solar gain and passive ventilation systems, and borehole cooling can both avoid or reduce noise generation, and reduce energy use and greenhouse gas emissions. Fuel cells should both save energy and reduce noise.
- Increases in local heat and power generation will require good plant design and management to minimise ambient noise in their locality. Scope for wind energy in London is limited. Modern wind turbines can be very much quieter than early wind farms in tranquil areas. A noise assessment will be expected as part of Environmental Impact Assessment for wind energy schemes in London.
- To maximise passive solar gain, housing should face roughly south, and not be overshadowed. This may place constraints on the location and orientation of buildings and barriers to screen noise.
- Much of London's building stock is poorly insulated, in terms both of energy and sound. Draught proofing and loft insulation would in general terms reduce exposure to external noise. However, many technical requirements for improving the sound insulation of buildings differ from those for saving energy. Nevertheless, action can and should be integrated.

References and notes

- 1 European Commission Directive 2002/49/EC 'relating to the assessment and management of environmental noise'. Adopted 25 June 2002, published in the Official Journal on 18 July 2002.
- 2 National Noise Committee. 'Towards a Noise Strategy for the UK' Clean air, vol 30 no 3, NSCA, May/June 2000
- 3 'Sustainable Communities - Delivering through Planning' Office of the Deputy Prime Minister, 18 July 2002
- 4 Berglund B et al (eds). 'Guidelines for Community Noise', World Health Organisation, Geneva 2000
- 5 During consultation on this Strategy, a number of respondents expressed a wish for targets. Different authorities have adopted a variety of values in response to differing local circumstances. It was not considered an effective use of resources to promulgate new values in this Strategy, only for boroughs to, potentially, face further change in the near future in the context of national strategy. This Strategy aims to work with boroughs and Government to build agreement as far as possible on values, while achieving practical improvements on the ground (e.g. Proposals 16-21 and Policies 90-94).
- 6 Extract from Autumn 2001 Labour Force Survey. Office of National Statistics www.ons.gov.uk
- 7 London Household Survey, Greater London Authority 2002
- 8 <http://www.rnid.org.uk> for more details
- 9 'London's Population Projections', Greater London Authority, 2000. Available from <http://www.london.gov.uk/approot/gla/publications/planning.jsp>
- 10 Theme Table on 'All People' - England and Wales, 2001 Census, Office of National Statistics, 2003
- 11 The Mayor's Children and Young People's Strategy, GLA, January 2004, page 90.
- 12 'Grumpy Grown-Ups Stop Outdoor Play' Spaces & Places: 005, October 2003. See also Playday Survey, 6 August 2003, <http://www.the-childrens-society.org.uk/newindex.html>

- 13 Haines M, Stansfeld S, Job R, Berglund B, Head J, 'Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children' *Psychological Medicine*, 31, 2001, pp 265-277
- 14 Shield B and Dockrell J, 2002, 'The effects of noise on the attainments and cognitive performance of primary school children' Department of Health, 2002
- 15 Stansfeld S, Haines M, Brown B. 'Noise and health in the urban environment' *Reviews on Environmental Health*, Vol 15, No 1-2, 2000, pp 43-82.
- 16 Maassen M et al. 'Ear damage caused by leisure noise' *Noise & Health*, Vol 4;13, 2002, pp 1-16
- 17 Vallet M. 'Effects of noise on health' in Garcia A (ed). 'Environmental Urban Noise' WITPress, 2001.
- 18 'Gypsy Sites provided by Local Authorities in England as at 2 January 2001' Department for Transport, Local Government and the Regions, 2001
- 19 DETR 'A Better Quality of Life: A strategy for sustainable development for the United Kingdom' Cm4345. The Stationery Office, 1999
- 20 Greater London Authority Act 1999, sections 30 and 41.
- 21 National Noise Committee. 'Towards a Noise Strategy for the UK' *Clean air*, vol 30 no 3, NSCA, May/June 2000
- 22 'Visit London: the Mayor's Plan for Tourism in London' London Development Agency/Greater London Authority, Sept 2002. See <http://www.london.gov.uk/gla/publications/economy.jsp>
- 23 'Green Capital, the Mayor's State of the Environment Report for London' May 2003 http://www.london.gov.uk/gla/publications/environment/green_capital.pdf
- 24 W S Atkins 'Determination of the Potential Synergies and Conflicts between Noise and Air Quality Action Plans' DETR, March 2001
- 25 AEA Technology Environment and others. 'The London Low Emission Zone Feasibility Study: Phase 2 Report' AEAT, Culham, 2003.

- 26 MPG11: 'The Control of Noise at Surface Mineral Workings' The Stationery Office, 1993
- 27 Department of Trade and Industry press release P/2003/477, 18 September 2003, <http://www.gnn.gov.uk/gnn/national.nsf>
- 28 See, for instance, UK and Ireland Soundscape Community <http://www.jiscmail.ac.uk/lists/SOUNDSCAPEUK.html>; World Forum for Acoustic Ecology <http://interact.uoregon.edu/MediaLit/WFAE/home/index.html>; National Sound Archive <http://www.bl.uk/collections/sound-archive/nsa.html>; Sonic Arts Network <http://www.sonicartsnetwork.org>; London Musician's Collective <http://www.l-m-c.org.uk/>.
- 29 London Climate Change Partnership. 'A Climate Change Impacts in London Evaluation Study' Entec UK Limited, October 2002. 'London's warming' Summary Report, Greater London Authority, October 2002.
- 30 Kihlman T. 'Noise Abatement and Improvement: The Systematic Approach' Noise News International, June 2001, pp 97-101



4 policies and proposals

- 4.1 Chapters 4A to 4E below consider noise measures in relation to the main 'ambient' sources highlighted in the Greater London Authority Act 1999 – road traffic, railways, aircraft, water transport, and industry. Chapter 4F on spatial planning and urban design focuses on how London's needs for more development can be met sustainably. Chapter 5 on integrated noise management includes other key noise issues not covered by the GLA Act definition of 'ambient noise' but which need to be considered in a coherent approach.
- 4.2 This structure serves to identify responsibilities and actions. However, **action on noise needs to take full account of situations where people may be exposed to noise from more than one source**. This includes noise from different transport modes and inter-relationships between ambient and non-ambient noise. In practice, the noise reduction achieved by a measure can depend on what other noise sources are present. For example, reducing traffic noise in one location could allow an annoying hum from a ventilation unit, previously at least partially masked, to be heard. In another location, the same reduction could result in pleasant quiet. Effectiveness also depends on the sequence in which measures are introduced. These are important issues for future action plans, especially where different agencies are responsible for different sources. This derives from the **non-linear nature of noise and how different sources combine** (see Appendix A2). This distinguishes noise from many other pollutants. It will make assessing and prioritising packages of measures more complex. Further research is needed on this as national and European noise policy develops.
- 4.3 Resolving tensions between the many different needs and aspirations of people across the city will require a range of responses which will vary by time and place. London contains areas of widely differing built form and land use mix. Noise levels can vary significantly over small distances, as well as across the city. Noise levels also vary greatly over the day, evening and night, with different components on different days of the week, especially at weekends. Night-time noise needs to become a focus for ambient noise policy, including improving information and understanding of effects.



Box 18: Policies and Proposals

In the following chapters:

- a **policy** is a statement of the Mayor's position on an issue, or a general course of action, not limited as to time.
- a **proposal** is a more specific statement of action or intent, where possible with a timescale for delivery.

The Implementation Framework in Appendix A1 sets out key responsibilities against each proposal.



Principal mechanisms for delivering noise reduction

4.4 Effective noise reduction needs active co-operation between central, regional and local government, and between different specialist agencies, as well as business and communities, within a supportive international framework, particularly where issues of technology development and competitiveness are involved. Action is needed at many levels:

- **Strategy** - agreeing future directions, indicating choices and use of resources;
- **Regulation** - not just emission limits for vehicle and equipment, but traffic management, environmental health, town planning and other regulation;
- **Enforcement** - where competing demands on scarce resources are especially acute in London;
- **Incentives** - both economic and non-economic; and
- **Investment** - getting the most from existing spending (e.g. on infrastructure, equipment and staff) and making the case for London's special needs.

4.5 It is important that the national noise strategy process includes detailed study of the relative cost-effectiveness of different measures in different contexts. The evidence base needs to be improved to enable priorities to be established on a clear foundation. The Mayor is keen to contribute to the Government's process of preparing a national ambient noise strategy. Trials should cover the range of measures referred to in this strategy, and results should be widely shared. Trials should aim to identify the typical costs and implications of attaining standard and guideline levels¹, and of increments of improvement which are themselves worthwhile.

4.6 The Mayor, Transport for London and, to a lesser extent, the other functional bodies (see glossary) have scope for practical action. However, available resources are very limited in relation to competing needs. **New or modified instruments, and more staff and investment will be**

needed to achieve significant citywide noise reductions. Over the Government's proposed timescale towards national strategy, monitored noise reduction measures in London could provide valuable evidence of practical effectiveness.

policy 1 The Mayor will urge the Government to fund trial noise reduction measures in London, with monitoring of effectiveness, recognising the contribution this could make to development of national ambient noise strategy.

Procurement

4.7 The Mayor is responsible for appointing members to, and setting budgets for, four new organisations, the 'functional bodies' (see glossary):

- The London Development Agency (LDA)
- Transport for London (TfL)
- London Fire and Emergency Planning Authority (LFEPA)
- Metropolitan Police Authority (MPA), which in turn has responsibilities regarding the Metropolitan Police Service (MPS).

4.8 The 'GLA group', which includes the core Greater London Authority working directly to the Mayor and London Assembly, as well as the functional bodies, can contribute to ambient noise management and other sustainability issues via contract awarding procedures. Including sustainability considerations, where relevant to the services or goods being purchased, as an element in the tender assessment process, is a way in which the GLA can lead by example. The different parts of the GLA group have already been developing environmental management practices relevant to their own activities (see, for example, paragraphs 5A.11-75 of the Mayor's Air Quality Strategy). Issues for noise include standards to be achieved, methods to be employed, types of quieter plant, machinery and practices, and definition of output measures which can form part of a tender specification.

policy 2 The Mayor will work with the GLA group to prepare complementary green procurement policies, including with respect to noise where relevant, and to promote best practice.

proposal 1 The Mayor will use sustainability considerations, including with respect to noise, where they are relevant to the performance of the service being tendered, as one way of evaluating tenders for future contracts, and to promote best practice.

An indicative noise management hierarchy

- 4.9 Noise management has traditionally been seen in terms of a threefold 'source-pathway-receptor' hierarchy:
- **Minimising noise generation at source** - e.g. using electric/fuel cell rather than diesel vehicles;
 - **Limiting the propagation or transmission of noise** - on the 'pathway', e.g. erecting a barrier alongside a busy road; or
 - **Protecting the receptor** - e.g. adding secondary glazing to rooms overlooking a busy road.
- 4.10 The cost-effectiveness of many noise abatement measures is, however, likely to vary depending on the local context (e.g. source features, propagation pathway, and receptor characteristics, such as number of persons per unit length of road noise source). It is not considered appropriate to enshrine a rigid 'hierarchy' in strategic policy. This could become mechanistic, and inhibit the taking of opportunities as they arise. It is important not to inhibit new solutions, especially where these may be multi-purpose. Nevertheless, it is generally sensible for examination of policy options to 'work out' from source. Also, **it is vital that attention is not distracted from the need for continued reductions at source**. Assessing the cost-effectiveness and practicability of noise management at source, pathway or receptor, or in combination, should take full account of a sustainable future in which more people, jobs and other activity are concentrated in London and other compact urban centres rather than dispersed - this is likely to favour source control.
- 4.11 In each of the following chapters, policies and proposals concerning noise abatement measures are generally set out in 'source-pathway-receptor' sequence. No one simple rank order of relative effectiveness of measures is likely to apply universally across the many different situations encountered in London. Also, measures are likely to need to be combined (with the proviso that some combinations would not be acoustically effective). A 'source-pathway-receptor' sequence accords with the widely-accepted 'polluter pays' principle, in first considering the responsibility of the noise-maker.

Reference

- 1 In particular, Community Noise Guidelines, World Health Organisation 2000; BS 8233; and such 'limit values' as the Government may report in response to Directive 2002/49/EC.

4A road traffic noise

4A.1 The Mayor's Transport Strategy states that: 'London's streets should be managed to assist the movement of people, goods and services - safely, expeditiously, reliably, securely and with minimum negative environmental impact; to ensure reasonable access to property, and to recognise their use as social spaces' (Policy 4G.1). Key priorities for the development of London's streets include reducing the level and impact of traffic in Central London, in the town centres of inner and outer London, and in residential areas. The Transport Strategy seeks to improve the attractiveness and amenity of London's streets, particularly in town centres and residential areas.



4A.2 Road traffic noise is the most widespread source of noise and related annoyance in London (see Chapter 2). Higher speed, higher volume roads generate the highest noise levels, which spread farthest. For example, noise from the M25 affects many parts of London's Green Belt. Lower speeds in much of urban and suburban London mean noise from gear changing, stopping and starting on congested streets. Congestion may hold down speeds during the day-time, especially in central and inner London. However, vehicles often move faster at night. Traffic has tended to grow at those times which used to be less busy. Limited evidence suggests a smaller difference in noise between day and night in London than nationally.

4A.3 Different dimensions of road traffic noise need to be considered, including:

- the continuous drone of free-flowing heavy traffic, and the average or background traffic noise to which people are exposed, often over longer time periods;¹
- congested stop-start traffic, where vehicle accelerations may be more important, and individual noise events, such as from a heavy vehicle bumping over an uneven surface.²

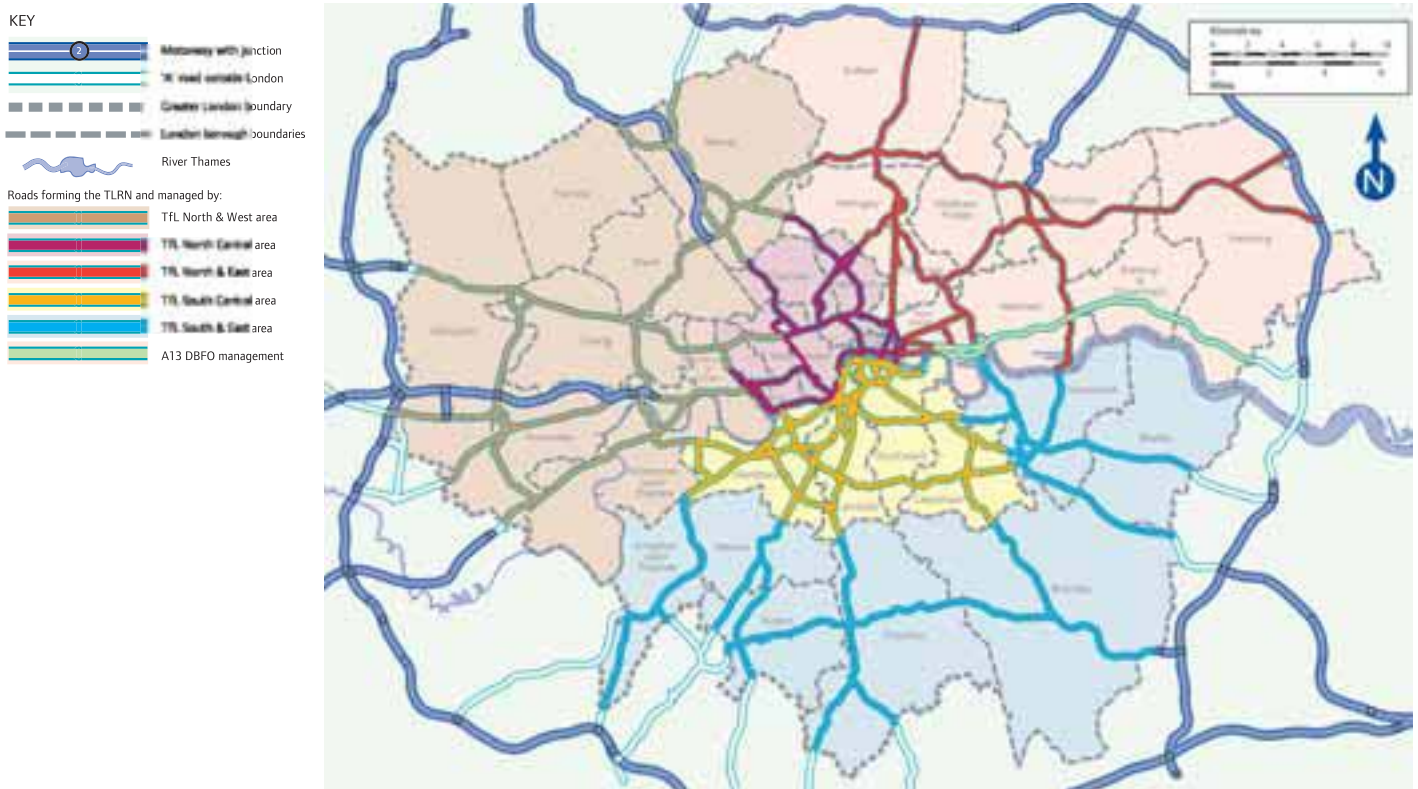
4A.4 Conventional noise mapping, such as proposed in the consultation on the national strategy³ is aimed at modelling the first type of traffic noise. However, other more variable types of noise can cause much annoyance, although these types of noise map may not show them. Noise policy needs to address all the types of noise which can affect people, across all streets and spaces, as well as the bigger roads. Actions related to different types of noise can be very different, although many policies can affect more than one kind of noise. Action plans and programmes need to distinguish, as far as possible, which types of noise are being targeted, and how effectiveness is to be assessed.



Managing London's streets

- 4A.5 Most streets in Greater London have frontage development. Most streets are used by walkers and cyclists as well as motorised vehicles. Many demands compete, including **distribution** - transport of people, goods and services; **access and servicing** - including parking and loading; and **amenity** - the use of streets as social spaces. Traffic noise can interfere with conversation in the street, and the enjoyment of gardens or balconies. Many of London's streets and buildings were not designed with modern traffic noise in mind. The Mayor's Transport Strategy sets priorities for competing users, with a presumption in favour of distribution functions on main roads, and in favour of access and amenity on other roads.

Figure 12 Transport for London Road Network



source: Transport for London⁴

- 4A.6 Although Motorways and the Transport for London Road Network (see Figure 12 and box 19) carry much of London's traffic, there are many other busy roads where noise levels are not much lower, and where more properties may be close to the road. These other busy roads cover many more kilometres. Partnership working will be needed between the authorities responsible for different streets to establish noise levels and priorities, analyse problems, and secure the optimum mix of actions.

Box 19: London's road hierarchy

This comprises:

- Parts of the M1, M4, M11 and M25 Motorways within Greater London, managed by the Highways Agency, reporting to the Secretary of State for Transport;
- Transport for London Road Network (TLRN) managed by Transport for London, some 580 kilometres in total, less than 5% of London's total street network by length, but carrying over a quarter of the capital's vehicular traffic;
- About 1,200 kilometres of streets classified as 'principal roads' and designated as 'A' roads, managed by the boroughs, and carrying a further 30% or so of London's vehicular traffic, and much of London's high volume bus and pedestrian movements - where the competing demands of distribution, access to property and amenity are often at their most acute;
- The remaining public roads and streets, just under 12,000 kilometres in length, are also managed by the boroughs. Boroughs are also responsible for London's footpaths, off-road cycleways, and bridleways, which are predominantly used for recreational purposes.

The Mayor's Transport Strategy (Policy 4G.2) seeks to balance the use of street space between the many competing demands. It makes a presumption in favour of distribution on the TLRN and most other A-roads. On other roads, it makes a presumption in favour of access and amenity, particularly for residents, buses, pedestrians and cyclists, and where necessary, business access.

Box 20: Consultation by Transport for London

Transport for London has developed a Consultation Toolkit for all its operations, from major transportation proposals to bus route changes. Street management works, for example, involve close liaison with the London boroughs. TfL consultation with the local community depends upon the nature and size of the works. For example, public exhibitions and meetings are held for the larger improvement schemes and for smaller schemes, information is given in the form of leaflets with contact details for people to obtain further information. TfL London Buses is statutorily required to consult with the police, the boroughs and the London Transport Users' Committee on all service proposals involving new routes and changes to existing routes. London Buses also consults local residents, where considered appropriate or where the borough specifically requests it. Mobility Forums need to be consulted wherever necessary. Consultees have the opportunity to express views on noise, alongside other concerns.

policy 3 The Mayor will seek a partnership approach with the Government, the Highways Agency, Transport for London, and the London boroughs to better understand traffic noise exposure, and to integrate noise management in day-to-day operations, wherever cost-effective and compatible with safety and other needs.

4A.7 The following sections set out policies and proposals for how traffic noise on London's streets may be minimised - generally following the 'source-pathway-receptor' sequence. Relative importance, whether in terms of ease of implementation, responsibility or cost-effectiveness, will vary widely according to local circumstances. Measures are considered under the following headings:

- Quieter vehicles
- Traffic reduction, street space allocation and routeing
- Quieter, smoother and safer driving
- Better streetworks and street maintenance
- Noise-reducing road surfaces
- Tree planting, noise barriers, landform and highway structures
- Spatial planning and urban design
- Building insulation
- Neighbourhoods, town centres, public spaces, walking and cycling.

Quieter vehicles

4A.8 The noise emitted by individual new road vehicles, as measured in the standard 'drive by' test, has become much lower over recent decades, as indicated in Table 3. Although these levels have fallen substantially, real world traffic noise levels do not appear to have fallen. This does not appear to be solely due to traffic growth. It is now generally accepted that the test is less representative of modern congested urban conditions.⁵ Congestion has increased, with more accelerations and decelerations. Interaction between tyres and the road surface is now a key area for reducing noise from road vehicles above all but the lowest speeds. There is relatively little to be gained from exhaust silencing or other engine noise related measures in many free-flowing traffic conditions.

Table 3 'Type approval' noise emission limits for cars, buses and heavy lorries

Vehicle category	1972	1982	1988/90	1995/96
Levels in 'drive-by' test, dB(A) ⁶				
Passenger car	82	80	77	74
Urban bus	89	82	80	78
Heavy lorry	91	88	84	80

source: European Directives⁷

4A.9 Ideally, tyres and road surfaces should be designed together. In practice the wide range of tyres, road surfaces and operating conditions makes this difficult. A European Directive on tyre noise was delayed by concern over the parallel need to retain safe grip in all conditions. It was approved in August 2001 (2001/43/EC). The use of a test surface specifically designed for lowering the noise of tyres during the vehicle noise test, means that the results are less representative of those on road surfaces commonly used in the UK. Within three years of the directive coming into force, the European Commission is required to report to the European Parliament on whether and to what extent technical progress would allow the setting of more stringent levels without compromising safety.



4A.10 Heavier and more powerful cars tend to have tyres that are wider and therefore noisier. Smaller, lighter vehicles can use narrower profile tyres, which would be quieter. Quieter-engined vehicles would be particularly effective in reducing noise where speeds are relatively low, as in much of London, including traffic calmed areas. Likely moves towards hybrid electric/fuel cell vehicles will, in the mid- to longer term, make reducing tyre noise even more important. The way sound energy combines means that a large proportion of the vehicles on a busy street have to be replaced with quieter ones before overall ambient noise falls noticeably. However, quieter vehicles would have more immediate benefits on local streets and at night. Relevant organisations including boroughs, health and care organisations, and delivery and servicing firms, should take a lead in using quieter vehicles, particularly in noise-sensitive situations. The Energy Saving Trust (www.est.co.uk) has supported market development of clean fuel vehicles. Similar support for quieter vehicles needs to be co-ordinated to avoid inconsistent or conflicting messages.



Box 21: Cleaner and quieter vehicles

Many cleaner vehicles, promoted through the Mayor's Air Quality Strategy, will also be quieter. Conversions from diesel to liquid petroleum gas (LPG) or compressed natural gas (CNG) can offer significant reductions, especially for large diesel engines – perhaps 6 dB – though this is not always the case. An 'Environmentally Enhanced Vehicle' (EEV) category has been suggested, with cleaner and quieter engines, control of body rattle and other incidental noise. Fuel cell vehicles would be very much quieter. Subject to positive results from trials and availability of resources, the Mayor wishes to encourage fuel cell vehicles in London. During the transition to fuel cells, hybrid-electric drive is likely to become more common (see glossary). Battery electric vehicles can, of course, be very quiet.

- 4A.11 The Mayor is working with boroughs through a London Clean Fuel Working Group to promote improvements to the support infrastructure for alternatively-fuelled vehicles. In pursuit of the Mayor's Air Quality Strategy, a Low Emission Zone Feasibility Study has been carried out, with partners (see glossary and paragraph 3.41). Many parts of London where air quality needs improving also experience high levels of traffic noise. The Congestion Charge (see paragraphs 4A.42-44) provides an incentive for electric vehicles and certain other vehicles propelled by alternative fuels. Many of these are also quieter. The Mayor, with others including the London Development Agency, is promoting a London Hydrogen Partnership to encourage fuel cell and related activities. Safety issues will need to be considered in the design and operation of ultra-quiet vehicles. Less noise from motorised vehicles can make walking and cycling more attractive – a virtuous circle of noise reduction.



- policy 4 The Mayor will seek Government action, with European partners where necessary, to secure vehicle noise certification standards and testing which reflect noise emissions in the conditions in which vehicles are typically used, having regard to urban driving patterns, and changing technologies. Effective measures to secure the development and use of quieter tyres should be vigorously pursued.
- policy 5 The Mayor will urge the Government and the motor industry to support development of markets for vehicles which are quieter in operating conditions, alongside other objectives, including consideration of differential taxation based on vehicle noise levels.
- proposal 2 The Mayor, with Transport for London will, and London boroughs and other organisations should, promote development and adoption of vehicles which are quieter in operating conditions, wherever practicable and cost-effective. This includes the work of the London Hydrogen

Partnership. As part of its involvement in this partnership, the London Development Agency will examine the economic development and job creation opportunities, such as for the attraction, development and growth of relevant manufacturing and support industries.

Vehicle noise enforcement

- 4A.12 Legal action can be taken against a vehicle producing excessive noise. Vehicles must, by law, be fitted with effective exhaust silencers. Regulations require road users not to make excessive noise, and not to run the engine unnecessarily while stationary. Such problems may not affect long term ambient noise levels, but they can startle or annoy, particularly in the evening or night.
- 4A.13 The annual MoT test and roadworthiness inspections include an assessment of the integrity of exhaust systems. Unlicensed vehicles which have not been MoT tested are more likely to have faults which increase noise. The Mayor seeks to improve vehicle registration rates and enforcement. More vehicles going through MoT testing will help to reduce noise as well as improve safety. An Enforcement Task Force has been established by Transport for London to pursue initiatives in partnership with the police, the boroughs, the Association of London Government, the Driver and Vehicle Licensing Agency and others (Transport Strategy Proposal 4G.2). A European Commission Green Paper COM (96) 540 proposed consideration of in-service noise testing for road vehicles. The UK Government is undertaking research concerning the potential for cost-effective in-service noise testing.
- 4A.14 The Mayor's Air Quality Strategy includes support for a better vehicle maintenance campaign, and action on vehicle emissions testing by boroughs and others. Better engine tuning and other vehicle maintenance should help to reduce noise. The Road Traffic (Vehicle Emissions)(Fixed Penalty) Regulations, which came into operation in May 2002, allow local authorities to legally test vehicle emissions at the roadside and require drivers to switch off their engines when parked at the side of the road.



Box 22: Vehicle noise enforcement by the Police

Limited resources mean that non-life threatening construction and use offences are low on Metropolitan Police Service (MPS) priorities for enforcement work. Many infringements are dealt with by verbal warning or advice, or under the Vehicle Defect Rectification Scheme (VDRS). VDRS requires approved repairs to be made as an alternative to prosecution. VDRS cases are resolved locally within Criminal Justice Units.

The Central Document Offences Unit of the MPS recorded the following in respect of the issue of non-endorable fixed penalty tickets, for the period 1 November 1999 to 30 June 2001:

Offence	Number of tickets issued
No silencer	21
Failing to maintain silencer	32
Not stopping engine when stationary	5
Sounding horn at night	6
Sounding horn when stationary	18
Causing unnecessary noise	35

Box 23: Other vehicle noise enforcement

The Vehicle Inspectorate has a duty to investigate defective vehicles. Activities have been focused on goods vehicles, where the risks associated with most defects are greater than from a car. In respect of silencers which are not of the approved type, the Vehicle Inspectorate recommends the issue of a 'defect notice'. This is similar to the VDRS scheme (see above). It requires the owner to replace the defective part.

A London-wide vehicle testing programme across London boroughs through the Association of London Government has been carried out. Improving air quality was a primary aim, but encouraging better vehicle maintenance can also reduce noise.

policy 6 The Mayor supports research into the potential for cost-effective in-service vehicle noise testing, and, if results so indicate, would wish to see trials in London, including at night.

proposal 3 Cost-effective opportunities to achieve lower in-service vehicle noise levels will be further pursued in conjunction with work related to the Mayor's Air Quality Strategy, including supporting a vehicle maintenance campaign and action on vehicle emissions testing.

Traffic reduction, street space allocation and routeing

4A.15 Where traffic can be much reduced, or removed from part of an area, as in Trafalgar Square, noise benefits will be significant. 'Streets for People' policies for appropriate residential areas are relevant (see glossary). The Mayor's goal (Transport Strategy, paragraphs 4G.66-68) is, subject to monitoring and review, to provide increasingly attractive alternatives to use of the private car and to achieve a 15% reduction in weekday traffic levels in central London, and zero traffic growth across the rest of inner London, over the 2001-11 period - in the context of growth of population and

jobs. With the Mayor's policies to improve public transport, walking and cycling, the net effect in outer London is likely to be to reduce the growth in traffic by a third over this period. Where appropriate, boroughs are encouraged to introduce local measures to reduce this growth further. In outer London town centres, potential is seen to achieve zero growth, particularly where through traffic can be removed. However, due to the non-linear nature of noise (see Appendix A2), traffic reduction is less effective at reducing noise on all but the least busy roads than it is, say, for improving air quality. The Mayor's Transport Strategy (e.g. Proposal 4P.4) and Air Quality Strategy (e.g. Policy 4) also promote travel plans and travel awareness campaigns to promote sustainable alternatives. The London Plan (e.g. Policies 3C.1 and 2) seeks to locate high trip generating development where public transport accessibility and capacity are high, so encouraging a shift towards public transport.

Figure 13 Noise emitted from London road traffic modelling network in 2001



source: MVA modelling for Transport for London

note: This diagram shows the "basic noise level", 10 metres from the edge of the carriageway and assuming no obstructions, for road links for which consistent traffic data was available, modelled according to the method set out in 'Calculation of Road Traffic Noise' Department of Transport, 1988. It is an approximate representation of the relative noisiness of roads as sources, but does not indicate actual noise levels around roads, which will depend on screening and other factors. For a typical noise map illustrating how noise propagates, see Figure 14 below. For an explanation of the noise descriptor used, see Appendix A2.



4A.16 Nearside cycle lanes can move accelerating vehicles further away from walkers and buildings. Bus lanes and other priorities enable buses to run more smoothly, with fewer accelerations. Within a street, some landscaped areas (paragraph 4G.16 of the Mayor's Transport Strategy), including vegetation and soft ground where possible, can provide at least qualitatively better conditions than where every surface is hard and acoustically reflective. Concentrating traffic on main roads, rather than dispersing it across many residential streets can, in principle, reduce overall noise disturbance. However, in practice, there are limits to what is feasible in an already developed urban area. Equalities issues can be exacerbated if socially excluded groups are concentrated on the most heavily-trafficked roads. Noise benefits can be gained from re-routeing heavy vehicles, but again, this can pose difficult choices. In theory, managing traffic to minimise noise can sometimes conflict with air quality objectives. In practice, it is rarely a simple choice, with many other factors, especially safety, in the balance. Safer Routes to Schools, Home Zones, and other traffic calming measures, are considered in paragraphs 4A.36 to 41 below.

policy 7 Transport for London will, and London boroughs and other organisations should, where practicable and cost-effective and having regard to other needs including increased public transport, develop and implement street space allocation, routeing, and related measures which contribute to reducing noise.

Quieter, smoother and safer driving

4A.17 Reducing higher traffic speeds generally gives worthwhile noise reductions, as well as improving safety. At lower speeds, below about 20 miles per hour (30 kilometres per hour) the situation is more complex, and not easily predictable with commonly available data or models. The number of accelerations becomes important, especially if traffic contains many heavy vehicles. Conditions for frustrated stop-start driving need to be avoided. The Mayor's Transport Strategy seeks improved management of the road network to help reduce traffic congestion and delays. Measures include tackling infringement of parking and loading restrictions. This should help to reduce noise from stop-start driving. Where significant reductions in traffic volume occur, specific measures may be needed to discourage large increases in speeds which could otherwise reduce safety.⁸ Noise can in certain circumstances be reduced as a result of optimising traffic signals, in particular to minimise the number of stops and starts.

4A.18 Overall journey speeds in London have been falling due to congestion, which in many areas now lasts for much of the day. It is, however, not

sufficient just to consider speeds during day-time hours. Where congestion is lower in the evening and at night, vehicle speeds may rise, reducing the noise benefits otherwise obtainable from lighter traffic. On the M25, variable speed limits have been introduced, responding to traffic volume and weather conditions. Variable message signing could be used to warn individual drivers that they were exceeding speed limits. Feedback might be given during the evening or night when there is less traffic, but where adherence to speed limits could have noise as well as safety benefits. Public opinion is a critical issue in achieving safer speeds. UK transport policy has focused on speed limits for safety reasons. However, in practice, noise and safety objectives often overlap.



- 4A.19 Effective traffic management on London's strategic roads will help reduce noise from congested stop-start driving. Dealing with congestion bottlenecks can enable traffic and noise to be reduced in adjacent housing areas and other noise-sensitive locations. As congestion is reduced, journey times are expected to improve. This should generally be as a result of reducing the time spent accelerating, braking, or idling, rather than increasing peak vehicle speeds while moving. If higher speeds with adverse safety or noise implications arise, these will need to be assessed, and managed. Intelligent Transport Systems, including sophisticated area-wide traffic signal control systems, variable message signs, bus priority at signals and parking guidance can contribute to smoothing traffic flow, encouraging the use of sustainable modes, and minimising noise.

Box 24: Quieter driving, car stereos and car alarms

Driver training could provide more information on noise reduction benefits of more relaxed driving. One study in which an urban route was driven in a passive rather than aggressive style found reductions of 5 dB(A) in average noise levels, and fuel savings of between 19 and 32%, with journey times less than 5% longer.⁹ Fleet management systems and fleet driver training offer opportunities to achieve quieter driving. Vehicle location, management and communications technologies could potentially provide much of the necessary information and monitoring, if this can be done in acceptable ways that do not infringe on privacy. Action Energy, formerly the Energy Efficiency Best Practice Programme¹⁰ and the Motorvate scheme¹¹ provide assistance to operators. Enforcement cameras can contribute.

Excessive noise from in-car entertainment systems - 'boom boxes' - can be highly disturbing, particularly at night, as can the unnecessary use of horns. Successful enforcement actions have been taken. Avoiding unnecessary and excessive noise needs to be seen as a basic part of considerate and safe driving.

Car alarms can be an acute source of annoyance, particularly when falsely activated at night. Improved design and installation should aim to reduce the number of false alarms. Legislating or providing incentives for the use of 'silent alarms', which alert only the owner or a designated person, would be a better long term solution.

policy 8 The Mayor will urge the Government to promote and support technological research, and to consider further campaigning, driver training and testing measures, to encourage quieter, smoother and more considerate driving, in association with road safety, air quality and energy saving objectives.

- proposal 4 Transport for London will, and London boroughs should, where practicable and cost-effective:
- progressively seek to reduce noise through measures to smooth traffic flow, having regard to public transport and other needs, and in conjunction with work related to road safety; and
 - with the Mayor, similarly consider measures to promote quieter, smoother and more considerate driving, in association with road safety, air quality, and energy saving objectives.

Better streetworks and street maintenance

4A.20 Needless noise is caused by local carriageway defects and 'patching' necessary to maintain a safe condition pending resurfacing. Better maintenance could reduce this. Digging up of streets also annoys people. Construction noise is excluded from the definition of 'ambient noise' in the Greater London Authority Act 1999, and would not be reflected in noise mapping under Environmental Noise Directive 2002/49/EC. Better practice needs, however, to be vigorously pursued.



4A.21 Uneven and pot-holed surfaces are not just due to wear and tear. The presence of poorly maintained utility equipment, such as access covers, and poor quality trench reinstatements are also contributory factors. Large numbers of utility companies are now licensed to dig up London's streets for communications cables, as well as for gas, electricity, water and sewerage. This can increase noise in a number of ways - directly from construction work and plant; during work through traffic disruption which can increase the amount of stop/start driving; after the work, as a result of poor street surface reinstatement or rocking access covers; and over time as multiple breaking open and patching leaves a street with a poor running surface and performance. Deformation can also prevent surface water draining properly, increasing noise levels during rainy weather, and causing premature failure of the road surface, leading to a noisier ride. The New Roads and Street Works Act 1991 requires utilities (such as gas, electricity,

cable and other companies) to comply with a prescribed specification when reinstating a street after works. However, rigorous inspection regimes need to be adopted to secure high quality work by utility companies or their contractors. Proposal 4G.24 of the Mayor's Transport Strategy proposed investigation of a 'lane rental' system that highway authorities could use to give a financial incentive to utilities for the rapid completion of streetworks. This will need to balance faster working against a reduction in the length of time noise may be caused, along with other factors including equipment and methods promoted. Lane rental could also encourage the use of trenchless insertion and other quieter, less disruptive techniques. The concept of introducing ducting for future service expansion when roads are being dug up, as has been carried out in the City of London, can help to avoid disruption in the future.

Box 25: Transport for London Roadworks

Transport for London is aware of the annoyance caused by noise from roadworks, particularly at night. It examines any need for working outside normal daytime hours very carefully. Difficult balances have to be taken into account when planning roadworks. Transport for London needs to carry out higher levels of maintenance due to under-investment in the past, but does not wish unduly to disrupt the travelling public, including bus users. It is therefore sometimes necessary to work at night to avoid these problems, although each case is considered on its merits.

Transport for London do not, however, wish to disturb residents. Practice is to discuss the proposed works with local authorities well in advance to agree working methods and times. These are incorporated in tenders or work instructions issued to contractors. Transport for London liaises with borough Environmental Health Officers to ensure that work is carried out as smoothly as possible. Transport for London also advise local people in advance, usually by leaflet, about larger maintenance schemes.

In the case of night working, it is Transport for London's usual practice to complete the noisier planing works (removal of old surface) between 8 pm and 11.30-12 pm, and to resurface, which is less noisy, after that. If Transport for London stopped work earlier, the total working period would need to be longer. The attempt is to achieve a balance between competing needs. This includes balancing the noise that local people are subject to when roadworks take place, and the benefits from better road surfaces which cause less noise in the long term. Consultation with borough Environmental Health Officers should always take place. Considerate Contractor/Considerate Roadworks schemes can also help by encouraging good practice and better ways of undertaking works on the highway. 'Ownership' of the works and any associated noise, together



with a telephone number to contact, is an effective way of ensuring that contractors do consider seriously the amount of noise (and dust, etc) they cause, and actively look for ways to achieve reductions.

4A.22 A serious backlog of street maintenance work in London has built up following years of under-funding. A survey by the London Borough of Hammersmith and Fulham for the Government Office for London (paragraph 4G.123 of the Mayor's Transport Strategy) suggested that £100 million was needed to bring London's principal roads up to standard. There are real noise benefits to be had in London from making up this past under-investment in maintenance. Restoring smoother running surfaces throughout the city would not show up in the 'standard' UK noise model¹², but annoying noise peaks, and the risk of groundborne vibration, could be reduced.

4A.23 The effectiveness of more sophisticated noise mitigation measures would be undermined if the basic road surfaces remain in the state many of them are in. The immediate priority is to ensure that roads do not break up and cause safety problems. However, improving surface quality on streets with high numbers of heavy vehicles or carrying larger volumes of traffic at night, is particularly important for noise. Planned, preventative maintenance, avoiding the need for disruptive reconstruction, can deliver noise and vibration benefits. The Mayor's Transport Strategy calls for development of a long term approach to the funding and management of all aspects of street maintenance and the reduction of noise will form part of this approach.

- proposal 5 Transport for London will continue to work, with the London boroughs and others where appropriate, to improve noise management of streetworks and to make good the backlog of street maintenance, which will itself contribute to reducing noise. This includes:
- Balancing the competing needs of residents, road users and others, having regard to the merits of each case;
 - Where possible, prioritising maintenance backlog reduction in streets where heavy vehicles are concentrated and streets with higher night flows; and
 - Taking account, in any 'lane rental' scheme encouraging rapid completion of streetworks, of the potential for adverse noise impact and providing appropriate mitigation, for example if there is night-time working.

Noise reducing road surfaces

4A.24 Following reductions in engine and other noise, noise produced by the interaction of tyres with the road surface has become relatively more significant.¹³ The logical technological priority for reducing noise from cars

is now quieter tyre-road combinations. Tyre-road noise is typically dominant at speeds above 60 kilometres per hour (40 miles per hour), but is becoming more significant at lower speeds, down to 50 kph (30 mph) or even lower. Tyres on many cars have become wider as they have become heavier. Porous asphalt is especially well-suited to reducing noise on faster roads, especially motorways. Other noise-reducing surfaces may be more suitable for highly urban situations. Some of the new 'thin' surfacings may reduce noise even at lower speeds. Stone mastic asphalt (SMA) is a particularly versatile material. Many such surfacings require less planing back and fewer other operations during resurfacing. They use less material and avoid use of some of the noisier construction plant. This is a particular benefit for sensitive times and locations.

4A.25 In deciding whether to use a noise-reducing surface, and which material to specify, changing traffic speed through the day needs to be taken into account. The choice of surface should take account of real vehicle speeds at night, in the evenings, and possibly at weekends, not just in congested weekday conditions. In assessing the noise benefits of different surfaces, account should be taken of changes in sound quality as well as in overall sound energy. Some surfaces reduce some sound frequencies (see Appendix A2 for explanation of acoustic terms) more than others, such that the sound quality becomes less annoying. A surface may give greater reductions when new than after several years of use. The life cycle performance of noise-reducing surfaces needs to be taken into account. Choice of materials for and design of footways, traffic islands and other spaces in addition to the vehicular carriageway needs to have regard to noise. For example, a smoothly-surfaced route should, if possible, be provided for trolleys where early or late loading and unloading takes place in mixed use areas.

proposal 6 Transport for London will, and London boroughs and others should, use noise-reducing surfaces, where practicable and cost-effective, and where they do not compromise safety, particularly skidding resistance, and other criteria. This includes:

- Where possible, prioritising higher speed roads and roads with significant night traffic flows and speeds; and
- Assessing how the life cycle acoustic performance of noise-reducing surfaces may best be monitored and findings shared.

Tree planting, noise barriers, landform and highway structures

4A.26 Reducing noise at source will generally be the first priority, especially in cities. Some form of screening is often seen as the next line of defence - such as noise barriers, mounding or other changes to landform alongside the road. Tree planting needs to be dense, and extend over a belt of



perhaps 10 metres to have any real effect. Issues of space and personal safety need to be considered. However, narrower belts of dense vegetation - or even just street tree planting - can subjectively improve people's perceptions. Trees and other vegetation can make other forms of noise screening more visually acceptable. The amenity, cooling and other benefits to be gained from tree planting reinforce their role.

- 4A.27 Noise barriers need to be as close as possible to the source, or to the receptor. Roadside barriers need to be continuous over long distances to be effective. Lack of space and frequent junctions make effective barriers impractical on most London roads. Badly-designed barriers can sever communities, attract graffiti, block views, and make people feel less safe. In London, many properties would be too close to the street, or too high, to be effectively screened. However, even if barriers would not reduce noise sufficiently at windows of noise sensitive properties, there might still be some benefits for gardens and other open areas. Theoretical performance may not be achieved in urban areas with multiple noise reflections among buildings. There is at present no specific funding for developing noise barriers. Support from adjacent development could be an option.
- 4A.28 Low barriers can, however, be effective on elevated roads and flyovers. One type of safety parapet which screens noise may not cost more than another which does not. Sound absorbing surfaces on highway structures, such as vertical cutting walls, within tunnel mouths, or on supporting surfaces of elevated structures could reduce noise, and may be more cost-effective during refurbishment.
- 4A.29 In other European countries, more ambitious noise barriers have been installed. Many different materials and imaginative designs have been used. To be effective, urban noise barriers often need to be taller than a typical wooden fence or garden wall. Their length means they become dominant features in the urban landscape. Continental practice demonstrates that successful environments can be achieved where skilled designers make strong urban design statements. By contrast, an apologetic 'keeping in keeping' approach can make urban surroundings cumulatively less interesting. Attractive solutions can, however, be expensive, particularly those that involve cantilevering a barrier partially over the road. Combining noise barriers with generation of electricity using photovoltaics (see glossary) may be feasible.¹⁴ Their performance can deteriorate if they are not well-maintained, and they should meet relevant guidance and standards.¹⁵ The screening performance of noise barriers can fall considerably after installation. The quality of the original construction is at least as important as age. Regular checks need to be considered.



4A.30 Noise mapping provides opportunities to examine how noise propagation from roads may be modified. The effectiveness of noise barriers or making cutting walls and other surfaces sound absorbing can be assessed. Costs and benefits need to be assessed in relation to other mitigation options, including building insulation, taking account of noise benefits for gardens, open spaces and pedestrian areas.

policy 9 As resources allow, Transport for London will, and London boroughs and others should, investigate the potential benefits of noise barriers, other noise screening and acoustic modifications to highway structures, where source-related measures would not be effective. Account must be taken of pedestrian severance and security, vandalism, visual amenity, historic building and conservation issues, sight-lines and other road safety issues.

Spatial planning and urban design

4A.31 Design innovation to achieve high quality self-protecting forms of development will need to be encouraged in both redevelopment and refurbishment alongside busier roads. Suitably self-protecting development with continuous or near-continuous façades, and linking development between existing detached properties, can reduce the propagation of noise, although reverberation, particularly within narrower 'street canyons' should also be considered. Development which provides occupants with a 'quiet side' away from the road is generally to be preferred to development at right angles to the road, where both sides of the building would be equally noisy. Self-protecting development should, however, still provide for 'eyes on the street' - so that activity on the street can be seen by adjacent occupiers, to help discourage crime and vandalism. Good design can enhance opportunities for development of roadside land, or conversion of buildings to noise-sensitive uses. Developers and local planning authorities will in many cases have a mutual interest in achieving noise-related improvements.

4A.32 Given the demands for housing, economic and other development in London, it will rarely be possible to rely on distance alone to protect sensitive uses from road traffic noise. One advantage of mixed-use schemes is that they offer opportunities for the more noise-sensitive uses to be screened by other activities. Development over suitable roads, especially in cutting, could provide space for London's development needs, while providing noise protection to the surrounding area. It is recognised that the number of suitable locations is limited, and issues such as fire safety, control of air pollution, biodiversity, visual amenity and maintenance need to be considered. Design must be to the highest standards and proposals must be socially and environmentally acceptable in other respects. Planning Policy Guidance Note 24 'Planning and Noise',



Department of the Environment, 1994 provides a framework. Chapter 4F (particularly paragraphs 4F.23 -27 on 'sound-conscious urban design') considers planning and design in more detail.

- policy 10 The Mayor will urge boroughs to consider including, in their Unitary Development Plans or other mechanisms, proposals to enhance the noise screening provided by roadside development, having regard to benefits for the wider area. Noise reduction in the wider neighbourhood should be taken into account by local planning authorities in assessing design in applications for development alongside or over roads. Decked or bridging development is most likely to be acceptable where roads are below adjacent ground levels.
- proposal 7 Transport for London will, and boroughs should, work with stakeholders and developers of roadside land and buildings, to take opportunities to minimise noise. Elements include:
- Considering seeking developer contributions to the cost of noise reduction measures, notably where this would enable more intensive development;
 - Taking account of noise in design of roadside development, such as potential for noise screening; and
 - Assessing whether there are practical opportunities for development over suitable roads, taking account of potential safety, maintenance, air pollution, visual amenity and other issues.

Building insulation

- 4A.33 If reducing noise at source is the first priority, and screening the second, building insulation has generally been seen as the measure 'of last resort' - to be considered only where other action cannot be effective. Building insulation does not, of course, protect gardens and other external spaces from noise. Many people want to be able to open windows without being disturbed. However, where it is not possible, for whatever reason, to reduce external noise sufficiently, good building insulation can provide high levels of protection.
- 4A.34 The Noise Insulation Regulations, made under the Land Compensation Act 1973, are based on the principle that noise from existing roads is already known, and reflected in property values. New roads may not have been expected by existing property owners, who may be eligible for compensation (see Appendix A7). Current legislation does not provide for offers of building insulation where traffic increases on an existing road, as opposed to a new or widened road, or simply where existing noise exposure is considered too high, and other measures would not deliver sufficient noise reduction. The preparation of a National Ambient Noise

Strategy provides the Government with the information and the opportunity for a review. Issues include whether the historic 'noise threshold' and package of measures in the Noise Insulation Regulations are still relevant. A more flexible hierarchy of measures might be appropriate (see Appendix A7), subject to administrative cost and complexity. New primary legislation could be required.

- 4A.35 The thermal insulation benefits obtainable from secondary glazing, or replacement double glazing, should be taken into account, and linkages made, as far as possible, with fuel poverty work. The insulation package specified in the existing Noise Insulation Regulations provides only for sound insulation to habitable rooms (bedrooms, living rooms, and kitchens also used for dining). This does not reflect modern 'whole house living' lifestyles. The Building Regulations do provide for whole house insulation. Any new Noise Insulation Regulations should consider specifications closer to those in the Building Regulations which are then in force, including taking account of other noise sources where necessary.



- policy 11 The Mayor will urge the Government to use the National Ambient Noise Strategy process to review relevant provisions of the Land Compensation Act 1973 and Noise Insulation Regulations 1975 (amended 1988), making appropriate financial grant provision to accompany any change. Consideration should be given to a flexible hierarchy of measures for cost-effective protection of a wider range of properties. Work should, wherever possible, be integrated across different noise sources, and with fuel poverty and climate change-related measures.

Neighbourhoods, town centres, public spaces, walking and cycling

- 4A.36 The Mayor's policies for sustainable urban development with more intense patterns of activity will in the longer term reduce the need to travel by motorised means to gain access to facilities. In the short term, better integration of the planning and management of streets and neighbourhoods can reduce the impacts of traffic noise. Too many Londoners suffer from the adverse effects of traffic noise, as well as other forms of intrusion. The Mayor's Transport Strategy seeks to improve the attractiveness of London's streets through 'Streets-for-People', '100 Public Spaces for London' and other measures. Home Zones (see glossary) and Clear Zones can also achieve noise benefits.



- 4A.37 Better design and management can enhance the valuable amenity role of streets as social spaces for neighbour interaction. The Mayor's Transport Strategy sees 20 miles per hour as a desirable maximum traffic speed in some appropriate local areas, particularly to improve safety. Traffic calming has reduced accidents, but the wrong sort of road hump can increase



noise. Design and spacing can be optimised.¹⁶ Heavy vehicles, especially unladen lorries with older suspension systems, can generate annoying noise, particularly over flat-topped humps. Traffic 'cushions' in theory allow heavy vehicles, including buses, to avoid the hump, while still reducing car speeds. In practice, kerbside car parking and manoeuvring problems can prevent buses and other heavy vehicles from avoiding the cushion. Humps and cushions need to be designed to avoid ground-borne vibration.¹⁷ Schemes need to be assessed not just in terms of long term 'averaged' noise, but potentially annoying noise peaks. Chicanes, narrowing of vehicle lanes, and other 'gateway' design features can signal that a street is not just for traffic. Newer technologies can provide driver feedback and aid enforcement. Cameras could help enforcement in shopping centres. Transport for London and the boroughs will need to continue to innovate.

- 4A.38 In some cases, existing traffic calming schemes may need to be reviewed. Safer Routes to School measures often accompany introduction of local 20 mph zones. They can form an integral part of school travel plans. Measures to improve pedestrian and cycle routes and provide safer crossings can help to reduce the 'school run' which otherwise adds to traffic congestion and noise. School travel plans could include noise action messages. Controlled Parking Zones (see glossary) can reduce disturbance to residents, especially when controls extend into the evening. Conditions attached to planning permissions can control delivery hours to premises in noise-sensitive locations.

Box 26: Streets for People

The Mayor's Transport Strategy (Proposal 4G.10) encourages boroughs to 'design and manage appropriate local streets as 'Streets-for-People' areas, emphasising their function as social spaces.' It proposes to give priority initially to areas of high deprivation, regeneration areas, and in particular, areas of high density neighbourhood renewal. Many of these will be areas of high ambient noise, where a comprehensive approach to urban noise management could secure improvements.

100 Public Spaces

The Mayor's '100 Public Spaces for London' aims to show how existing and new public spaces can improve quality of life, community vitality and Londonwide livability – see concluding part of Chapter 4F.



Box 27: Town centres

Many town centres suffer from high levels of traffic noise. The Mayor's Transport Strategy sees reducing through traffic as a priority, along with improving conditions for pedestrians, cyclists and public transport. The London Plan sees areas of high public transport, walking and cycling accessibility as appropriate places for higher densities, including housing, especially for smaller households. Minimising town centre noise can assist realisation of the potential benefits of compact and accessible mixed development.

- 4A.39 People's activity patterns are becoming more dispersed over the day, evening, night and week, although by no means all parts of London are affected equally. Internet- and tele-shopping offer the potential for more home deliveries, by motorcycles, as well as vans. More attention will need to be given in neighbourhoods to evening and night noise. Reductions in traffic noise may need to be accompanied by measures to protect residents and workers from other noises which may then become more audible, such as inappropriate busking. The Mayor's Transport Strategy (Policy 4G.3) seeks to improve personal security, reduce crime and the fear of crime on London's streets, working with the London boroughs and the police, pursuing objectives of the Crime and Disorder Act 1998. The benefits of further neighbourhood wardens and similar schemes will need to be considered.
- 4A.40 Creating more attractive footways, pedestrian areas and walking routes will help to make London a connected, safe, convenient and attractive walking-friendly city. Less noise can contribute to building convivial and supportive neighbourhoods. A busy street can feel safer than a deserted one, but too much noise can mask the sound of other people approaching. People with a hearing or sight impairment may benefit particularly from quieter streets. Walking routes can have their own unique soundscapes which should be protected or enhanced. Distinctive soundscape features, such as bells, trees, water, ground surfaces which reveal footfall, and reverberant structures or enclosures, should be identified. Positive features should be enhanced, and negative features mitigated, having regard to user needs and preferences. 'Hearing-conscious design' should consider the heights of walking and sitting areas relative to noise sources, including any 'noise shadow' below traffic level. More information is needed on outdoor personal noise exposure, and people's needs and preferences, as they move through the city.
- 4A.41 The Mayor's Transport Strategy aims to make conditions for cyclists safer, more convenient and more pleasant. Using cycles rather than cars will contribute to reducing traffic noise. Cyclists themselves would benefit



from less traffic noise. Achieving direct routes away from busy traffic has been difficult in London. Kerbside cycle paths help to separate pedestrians from traffic.

proposal 8 Transport for London will, and boroughs should, wherever practicable and cost-effective and having regard to other needs including increased public transport and road safety, take opportunities to improve noise environments from:

- Optimising traffic calming measures, such as reviewing design and location of traffic humps;
- Design and management of Streets-for-People areas (Proposal 4G.10 of Transport Strategy), including considering public access to quiet outside space, and extending Controlled Parking Zones; and
- Improving conditions for walkers and cyclists across the city.



Central London Congestion Charging

4A.42 Following extensive consultation, the Mayor announced on 26 February 2002 his decision to proceed with Central London Congestion Charging. This involves a £5 charge to drive or park within the Congestion Charging Zone on weekdays between 0700 and 1830 hours. It was introduced in February 2003. Environmental effects, including noise, are being monitored alongside transport, economic and other issues.

4A.43 Central London Congestion Charging was not expected in itself to have significant environmental effects, either positive or negative, inside or outside the charging zone. It should increase the scope for noise reductions in some areas while not having significant disbenefits elsewhere. The World Squares for All project, which includes pedestrianising the north side of Trafalgar Square, gives a marked improvement in the soundscape of one of London's most prominent public spaces. Reductions in traffic levels in central London could offer opportunities for other initiatives which could support Ambient Noise Strategy. In terms of the direct effects of Congestion Charging in general, however, changes in noise are likely to be small, both within the charging zone, and near its boundary, taking account of traffic management measures introduced either beforehand or based on experience following implementation.

4A.44 Monitoring of Congestion Charging indicates that it has contributed to traffic conditions being more free flowing. A survey of about 8,000 people 'on street' at shopping and tourist locations and other public spaces in and immediately around the charging zone suggests an overall popular perception that the noise environment has improved.¹⁸ Additional bus priority measures complement the Congestion Charge. These will improve bus operation and smoother bus driving will be possible. This will assist in

making future bus operations quieter, although the overall effect is not likely to be significant. Reduced congestion should mean less of the types of noise which can cause annoyance, such as idling engines, and frustrated stop-start driving. The potential for encouraging some road users to travel earlier or later to avoid the charge is not expected to be significant.

policy 12 The Mayor will encourage exploration of public realm improvements in Central London, developed in full consultation with affected parties, having regard to potential noise benefits and other issues.

proposal 9 Transport for London will continue to carry out extensive monitoring of the impacts of Central London Congestion Charging, including traffic impacts outside the charging zone.

Road freight

4A.45 Lorries have become quieter, and can become quieter still with wider application of newer technologies. The standard 'drive-by' noise level limit for a heavy goods vehicle has been reduced, progressively from 91 to 80 dB(A) over the last 25 years. However, the current ISO 362 drive-by test for certifying exterior noise for the purposes of European Directive 1992/97/EC is particularly inappropriate for commercial vehicles. Alternatives include lower speed, part-laden acceleration, 'cruise-by' and stationary tests. A stationary noise test could be combined with controlling noise from other components such as vehicle bodies.¹⁹ This could assist users and authorities to specify 'Environmentally Enhanced Vehicles' (see glossary). Older lorries can still be among the noisiest vehicles on the road. They can generate high noise levels when driven harshly or under full load. Low frequency noise from large engines can be an issue. The proportion of heavy vehicles in the traffic flow has implications for sorts of measures which can best reduce noise on a particular street. Minimising stop-start conditions is especially important for reducing noise from many heavy vehicles. On the other hand, many heavy goods vehicle fleets are renewed more frequently than light vans, which have been growing in number in London.



4A.46 A London Sustainable Distribution Partnership (LSDP), proposed in the Mayor's Transport Strategy, was launched in February 2002. It brings together the London Boroughs, business and the freight industry to develop an effective strategy for the distribution of goods and servicing in London. The Mayor's Transport Strategy identified three main work areas - road based distribution and delivery issues; rail freight development; and use of London's waterways. The Transport Strategy also proposed that Transport for London will encourage early development of Freight Quality Partnerships (FQPs), particularly at the sub-regional level, to complement

borough-led initiatives at a more local scale. Such partnerships involve dialogue between local authorities, the business community, residents, environmental groups and industry. A freight issues group, held during consultation on the draft Transport Strategy stated that the LSDP and FQPs should consider allocation of road space; loading and unloading provision; servicing; London Lorry Ban; overnight parking; new means of delivery; information technology; road freight and the environment; and rail, water-borne and air freight.

- 4A.47 The noise implications of many of these issues are considered elsewhere in this strategy (e.g. paragraphs 4E.18-21 and Policies 64 and 65). All of them have potential noise implications which the LSDP and FQPs will need to assess in detail. In some outer London locations there may be insufficient justification for a bus lane, but a priority lane shared with heavy goods vehicles could potentially enable both to be driven more smoothly and generate less noise. However, practical issues include maintaining clarity in lane status. Transport for London and the boroughs are examining a number of pilot measures. The noise impacts would need to be assessed on a case-by-case basis. Reducing the amount of empty or partially-empty running would have a more than proportionate effect on reducing noise, since heavy vehicles can generate more noise when empty or lightly laden than when carrying their design load, especially from suspension systems and body rattle on uneven road surfaces.
- 4A.48 Driver training in quiet, smooth and safe driving is already promoted by some fleet operators, vehicle/engine manufacturers, and in guidance related to the London Night and Weekend Lorry Control Scheme. Measures to improve driving include bonus schemes for accident-free performance and fuel saving, and staff consultation and suggestion schemes, building a constructive approach and sharing the benefits from tachograph analysis and other monitoring. Noise from loading and unloading - such as from roller shutters, tailgates, trolleys and reversing signals, as well as voices and music from cabs - can create annoyance, particularly during times of the day when background noise levels are lower. Modern broadband reversing signals can replace the highly intrusive 'beep' of traditional alarms.²⁰ Crossover, footway and other servicing surfaces, trolleys and other equipment should be designed to minimising noise. Quiet roller shutters can be specified.

Box 28: Home deliveries, e-shopping, and new forms of working

Home delivery services, where available and affordable, can be of great value to those who may be housebound, or unable to carry shopping. A proliferation of home delivery services could, however, increase congestion and noise. More delivery vehicles, large as well as small, could seek to penetrate quiet residential streets in hitherto quieter periods of the day. Some delivery to intermediate points such as 'electronic corner shops', workplaces, or points on the public transport system, rather than just the home, could help to reduce the overall noise impact. It is not yet clear how far new forms of working, at home, at non-traditional places, or on the move, could reduce noise overall. For instance, regular homeworkers may be more likely to relocate to areas which involve longer trips on the fewer occasions when travel is required. Noise needs to be considered alongside the other implications of new patterns of living.

policy 13 The Mayor and Transport for London will work with the London boroughs, business and the freight, distribution and servicing industries, and others where relevant, to ensure the needs of business and Londoners for the movement of goods (including waste) and services are met, whilst minimising congestion and environmental impacts in accordance with the objectives of the Mayor's Transport, Air Quality, Municipal Waste Management and Ambient Noise Strategies.

proposal 10 Transport for London will continue its active membership of, and continue to work with, the London Sustainable Distribution Partnership (LSDP) to assist in developing and implementing effective improvements. Elements to be considered alongside other objectives include:

- Encouraging accelerated take-up of cleaner and quieter vehicles;
- Promoting better vehicle maintenance and smoother driving.

The London Lorry Ban

4A.49 The London Night and Weekend Lorry Control Scheme, often referred to as the 'London Lorry Ban', was introduced, following an independent inquiry chaired by Derek Wood QC. It was implemented from 1986 under the Greater London (Restriction of Goods Vehicles) Traffic Order, 1986. The scheme is now administered by the Association of London Government on behalf of the London boroughs. Its objectives were to ensure that environmental benefits to London residents, particularly in relation to noise, were realised following the opening of the M25 by removing through-London freight trips and minimising use of unsuitable roads. It places restrictions on the use of heavy commercial vehicles (over 18 tonnes maximum gross weight) during the night (defined as 9 pm to 7 am) and additionally during the weekend (from 1 pm on Saturday through until Monday at 7 am). It does not deny night or weekend deliveries to



those who need to make them, but seeks to ensure that associated impacts are minimised.

Box 29: London Lorry Ban

The Mayor's Transport Strategy (paragraph 4K.15) considered two perspectives from which there was a case for reviewing the London Lorry Ban:

- Operation and administration needed re-examining in the context of the exempt network, (including the interface with the Transport for London Road Network), the proposed introduction of a Central London Congestion Charge, and the possible introduction of one or more Low Emissions Zones (see paragraph 3.41 above).
- Environmental criteria needed looking at, given improvements in environmental performance since the scheme was introduced.

4A.50 Review of the London Lorry Ban, proposed in the Mayor's Transport Strategy, has been taking place in partnership with the Association of London Government and London boroughs. It includes assessment of noise implications. New heavy goods vehicles have become quieter in terms of the 'drive by' type approval test, although this does not mean that overall noise in use has necessarily fallen by a similar amount. Average noise levels and the number of lorry movements can both be sensitive issues for residents. Road surface condition in particular needs to be addressed to avoid annoying noise and vibration events. A gas spark ignition engine can be much quieter than a conventional diesel compression ignition engine. Vehicles can also be further quietened. Ancillary equipment and many detailed noise issues need to be addressed. Good environmental performance implies an attention to noise at all stages of a trip, especially loading and unloading - where it is typically local planning conditions which prohibit or restrict night-time deliveries, rather than the 'Lorry Ban'. New forms of enforcement could be considered. For example, in-service night noise testing could play a role, including provisional identification of vehicles on the road for subsequent detailed noise testing. Demands for night movement must be balanced with residents' concerns.

proposal 11 The review by the Association of London Government, boroughs and Transport for London of aspects of the London Lorry Ban (as proposed in the Mayor's Transport Strategy, Proposal 4K.3) will include and take account of noise assessment, having full regard to potential effects on residents along with wider strategic transport and environmental concerns.

Waste vehicles

4A.51 Changes in waste management sought in the Mayor's Municipal Waste Management Strategy offer opportunities to improve the handling of waste.²¹ Traditionally, waste collection vehicles have generated annoying levels and types of noise, at sensitive times of the day. Collection rounds involve stop-start driving, and bulky collection vehicles often need to manoeuvre in cramped areas close to noise-sensitive activities. High noise levels can be generated during on-board waste compaction and other procedures.



4A.52 A stationary noise test - with the vehicle laden and compacting - would be more representative than the current unladen 'drive-by' test. Traffic congestion influences the timing of many collection rounds. In future, reduced congestion could allow a higher priority to be given to local noise-sensitivity. Sufficient flexibility should, as far as possible, be built into contracts to allow for such changes, without disproportionate costs. Stop-start operations may make electric or hybrid vehicles more attractive. Noise needs to be assessed when vehicles are chosen. Many of the issues in the sections on Road Freight and London Lorry Ban, above, also need to be considered by those commissioning, managing or regulating waste industry transport. Vehicle body design and maintenance best practice can contribute to reducing noise.¹⁹ Changes to waste collection regimes could allow quieter vehicles to be used. More far-reaching moves to recycling/composting collections could permit different, quieter types of vehicles to be introduced. Site licensing of waste management facilities is covered in Chapter 4E (paragraphs 4E.8 and 9, and Policy 63).

policy 14 As set out in the Mayor's Municipal Waste Management Strategy, waste authorities will be encouraged to minimise the noise impact of waste transportation, especially in respect of night time or early morning collections, by appropriate vehicle specifications, routeing and operating practices. This will, as far as possible, be integrated with work to promote cleaner vehicles, pursuant to the Mayor's Air Quality Strategy.

Bus services

4A.53 Nearly all local scheduled bus services in London are provided by private companies under contract to Transport for London. The structure of the network, including routes, service frequency, fares and types of buses, is determined by the Mayor and Transport for London. There are over 6,000 buses, on over 700 different routes. The Mayor's Transport Strategy seeks a greater role for buses in meeting Londoners' needs, with a programme to increase bus services by 40% by 2011. The Transport Strategy proposes more bus priority measures to protect services from traffic congestion.



Such improvements will allow buses to run more smoothly with less 'stop-start' noise. Transport for London will continue to improve bus journey times and reliability through major bus priority programmes of works and enforcement. TfL London Buses is also encouraging better driving through sponsoring a BTEC training scheme for drivers. This will, among other things, encourage smoother, quieter driving.



Box 30: Buses and traffic noise

Bus noise should not be looked at in isolation. Using buses for journeys which would have taken place using many individual cars or other motorised vehicles, and using them as part of a network which also encourages walking and cycling, can contribute to an improved noise environment overall. Changes in noise as a result of increased bus services, but fewer cars, will vary between different links in the road system. The changes depend on a range of factors, some of which can be more readily predicted than others. The mix of buses, cars and other vehicles will vary substantially between different streets, as will the speeds of vehicles. The introduction of newer buses should mean a quieter fleet overall, due, for example, to newer engine technology. See also box 31 on trialling new fuel cell buses.

- 4A.54 Modern buses have been becoming generally quieter. With many of London's streets in poor condition after decades of under-investment, buses jolting over uneven road surfaces can generate more noise than they should. However, since most modern buses use air suspension systems, they are less likely to generate the types of body noise associated with commercial vehicles with loose body fittings, or non-isolated steel suspension systems. Traffic congestion disrupts schedules and increases the pressure to drive faster when traffic is clear. The bus priority measures which the Mayor is pursuing to protect buses from congestion, will enable smoother, quieter bus driving. As London's bus fleets are further modernised, and as conditions for bus driving improve, with more bus priority, less congestion, properly maintained streets and adequately paid, motivated and trained staff, conditions should improve.



- 4A.55 A high priority has been given over recent years to how London buses can contribute to better air quality. Many of these measures also reduce noise. Bus engines which use gas can be substantially quieter than traditional diesels. TfL London Buses currently operates three liquid petroleum gas-powered buses, though fuel and capital costs have not incentivised take-up. Alternative fuels are being actively reviewed. A London Bus Testing Cycle, developed for air quality testing purposes in conjunction with Millbrook Proving Ground, indicates buses are idling for 31.5% of the time, and decelerating for 27.5%. This could make some form of hybrid

electric drive potentially attractive for noise, provided cost and other feasibility issues allow.

Box 31: Fuel cell buses

TfL London Buses is taking part in a European trial of hydrogen fuel cell buses in partnership with Daimler Chrysler, BP, the Government, Energy Saving Trust and FirstGroup plc. This includes testing three Daimler Chrysler fuel cell buses on London streets for two years from December 2003. Carrying up to 70 passengers, they will have an operating range of 200 to 250 kilometres fuelled on compressed hydrogen. Fuel cell buses promise to be significantly quieter than any conventional vehicle.

Hybrid electric buses and other technologies

In September 2004, Transport for London plan to trial 12 hybrid-electric buses on route 360, Elephant & Castle to Kensington. In addition to reducing carbon dioxide emissions by 30%, these vehicles promise considerable noise reduction. The potential of other technologies will be kept under review.



- 4A.56 Assessing, specifying and monitoring bus noise in London's actual operating conditions is not straightforward. Modern buses have been required to become quieter, in terms of the standard 'drive-by test', when vehicles are given type approval. In-service noise testing would require space and other conditions for reliable measurement, which is difficult to find in London. Indicative in-service measurement 'on route' could enable potentially offending vehicles to be identified for more accurate measurement elsewhere, or for mechanical checking. Good vehicle maintenance is important in reducing noise, such as from brakes. Light transit schemes (see para 4B.38 below) are being considered in pursuit of the Mayor's Transport Strategy. Options include buses and trams. Schemes would be likely to operate under more controlled conditions and be quieter than conventional routes.
- 4A.57 The Mayor's Transport Strategy proposes to improve the night bus network to meet growing demand. Not to meet demand would not necessarily mean that people would not travel. Many would do so by other motorised means. The bus fleet in general is a modern one, with 80% of vehicles dating from after 1996. Traffic management with fewer competing vehicle movements can offer smoother conditions for buses at night.
- 4A.58 Modern buses are typically quieter for passengers than those they replace. However, bus passenger attitudes and aspirations for comfortable noise environments need to be considered, as resources and priorities permit, as part of overall service quality, including the soundscape experienced while



waiting. Conditions for passengers with a hearing impairment or other disability need to be considered, e.g. in relation to any audible signals. The location of bus stands is becoming a sensitive environmental issue. More space and new sites are needed for an expanding network. London Buses and boroughs need to work together to find facilities which meet the needs of an effective network, and address local environmental sensitivities. Consultation on bus issues is covered in Box 20 above, following paragraph 4A.6. The potential impact of noise is considered in the design and construction of bus stations and other facilities. Most bus garages are operated and maintained by the bus operators, and vary widely in type and design. Issues of screening, enclosure and operation are best decided in relation to specific local contexts. At relevant termini and garages, notices are posted to remind drivers that engines should not be kept idling while stationary, and action is taken by inspectors if it occurs.

- policy 15 Within the context of ensuring efficient operation of the road network and in particular of buses, Transport for London will consider practicable and cost-effective measures to secure quieter road traffic operation, particularly at night.
- policy 16 Transport for London will require operators and designers of existing and proposed bus garages, termini and other bus-related facilities to reduce noise to a cost-effective and practicable minimum, with particular emphasis on night-time noise.
- proposal 12 Transport for London will work to secure practicable and cost-effective noise control and management on London's bus network. Potential elements include:
- Working with bus operators and suppliers as bus fleets are replaced, to secure use of quieter vehicles;
 - Assessing the need for and potential of in-service testing;
 - In association with work on reducing bus air pollutant emissions, reviewing the opportunities which alternative fuels and other technologies offer for quieter bus running, including trials of zero emission buses operating on fuel cells, and exploring the potential of technologies such as hybrid diesel-electric and gas-electric drive;
 - Working with bus companies to secure smoother and quieter driving, 'no idling' and other good practices at bus stands, including through driver training; and
 - As resources and priorities allow, assessing passenger attitudes towards noise and sound quality on the bus network, alongside other quality of service issues, having particular regard to the needs of hearing and sight-impaired people.

Coaches, tourist buses, and other bus services

4A.59 The Mayor's Transport Strategy acknowledges that coaches provide cost-effective transport for long distance travellers, commuters and tourist and leisure services. Inconsiderate use can cause disturbance, particularly if unsuitable streets are used, early in the morning or late in the evening or night. Some coaches, particularly tourist and leisure services, can be older and noisier than current vehicles. A number of London companies have been awarded a 'CoachMarque' certificate, under a scheme devised by the Confederation of Passenger Transport. This includes a requirement for at least 75% of a coach company fleet to be under 10 years old. Annoyance can be caused if engines are kept idling while coaches are parked. A London Coach Forum of interested parties has been set up by Transport for London including representatives from TfL, London boroughs and coach companies. It will discuss arrangements for coach parking and drop off points, driver facilities and terminals. Co-ordinated action is needed between these groups to ensure that improvements such as better parking and stopping unnecessary idling happen. Best practice can be harder to extend to overseas operators.



4A.60 Longer distance express and regional coach services are focused on Victoria Coach Station and Heathrow Airport. Noise management at Victoria Coach Station (VCS) includes controlling noise from staff, operators, contractors and tenants outside the premises, not allowing coach engines to run unnecessarily, only making essential public address announcements, and containing these within the enclosed terminals except in emergency. Coach routes in the Victoria area have been agreed with the police and the City of Westminster to minimise local impact. These routes are more restrictive than the Traffic Orders in force, and are imposed on coach operators using VCS through Conditions of Use. Other coaches not using VCS stop at other locations in the Victoria area.



4A.61 Transport for London is responsible for the issue of London Service Permits for bus services within London which are not part of the London bus network. These include some commuter services, and sight-seeing tours. Guidance issued by the Mayor under Section 185 of the Greater London Authority Act 1999 focuses on the need to reduce air pollution. Associated vehicle modernisation is expected also to reduce noise.

proposal 13 Transport for London will seek to address relevant noise issues through the London Coach Forum's work to review arrangements for coach parking, facilities and terminals, building on the work of interested parties, including the coach industry, London boroughs and the police.



Taxis and private hire vehicles

4A.62 The Mayor's Transport Strategy recognises that licensed taxis ('black cabs') and private hire vehicles ('minicabs') make an important contribution to overall transport needs in London, especially providing door to door services late at night. Some 21,500 licensed taxis operate in London, mostly in Central London and around Heathrow Airport. Over 24,000 taxi drivers are licensed. They undertake about 85 million taxi trips a year. In Greater London taxis account for some 2% of all kilometres travelled by road vehicles. In Central London they account for 14% of kilometres driven. Licensed taxis and their drivers are regulated for quality by the Public Carriage Office, now part of Transport for London. The usual maximum operating life of a taxi is 15 years. Over the last decade, the average number of new licensed taxis entering the fleet is around 1,000 per year. As of July 2003, only 0.8% of the taxi fleet (165 taxis) were over 15 years old.

4A.63 The recognisable rattle of older diesel-engined taxis has been one of the distinctive sounds of London. Older diesel taxis can be noticeable in quieter streets, particularly outside busy periods. However, newer taxis are becoming quieter, and older taxis are being replaced. Gas engines are often quieter than diesel. The Mayor's Air Quality Strategy (Proposal 18) seeks to ensure that taxis with older (and noisier) engines will be either replaced by modern vehicles or modernised with quieter engines. It states (Air Quality Strategy, paragraph 4D.39) that Transport for London will work with the taxi trade to increase the number and improve the quality of taxi ranks. Location and design need to take account of the need to minimise local noise impact. Transport for London intends to implement a taxi emissions reduction strategy, which, with changes in engine technology used by taxi manufacturers, will help to reduce noise.



4A.64 It is estimated that there are between 35,000 and 40,000 minicab drivers operating in London, mostly outside the centre, undertaking some 70 million trips a year. Private hire operator, driver and vehicle licensing is being introduced, under the Private Hire Vehicles (London) Act 1998. The sector has hitherto been unlicensed in London. Licensing is proceeding - first operators, then drivers and vehicles. Whilst the primary concern is safety, this should also reduce some of the local noise problems associated with 'touting' around venues, alongside other public order and safety issues. Licensing should also encourage better maintenance of vehicles, with some benefit for noise.

4A.65 Transport for London seeks to build consensus on major issues facing both taxis and minicabs. Account should be taken, as far as possible, of noise from customers waiting and disembarking, as well as from vehicles. TfL also

proposes a review of taxi ranks and stopping arrangements. Minicab offices can generate noise, particularly late at night. Their suitability in terms of local land use and amenity is primarily a matter for borough development planning and related enforcement. In the future, quiet hybrid-electric drive and fuel cells may well become particularly appropriate technologies for high mileage vehicles such as taxis and minicabs.

proposal 14 Transport for London will, as part of wider taxi and private hire vehicle initiatives in the Mayor's Transport Strategy, consider practicable and cost-effective ways to minimise adverse noise impacts, especially at night, in order to ensure that taxis and private hire vehicles can maximise their contribution to accessibility and environmental improvement in London.

Fleets and facilities of GLA and functional bodies and other emergency services

4A.66 The Greater London Authority's procurement policies seek to minimise vehicle use and noise alongside other environmental objectives. Where practicable, tenders place a requirement on contractors to state relevant policies. Relevant GLA 'functional bodies' - Transport for London, London Fire and Emergency Planning Authority, and the Metropolitan Police Authority (the London Development Agency does not have a vehicle fleet) - also take noise into account, although, of course, the safe and effective operation of the police, fire and ambulance services requires the generation of sound. It is recognised that emergency sirens can create repeated disturbance, including at sensitive times and places. However, trained, responsible personnel in the emergency services must retain operational discretion as to when and where sirens are used. For example, it is not only necessary to alert other road users to fire service vehicles on the way to an incident, but to alert building users and passers-by to the possibility of fire having broken out in premises.



Box 32: London Fire and Emergency Planning Authority, Fire Brigade

The Brigade is replacing many fire appliances. Within the first 5 years of new contractual arrangements, by April 2006, 104 new pumping appliances, 61% of frontline fleet, will be replaced. New units are quieter when running at an incident to supply water, power and air. Support vehicles, such as vans and light commercial lorries, are being replaced. Those replaced so far use the latest technology to aid efficient diesel fuel injection, which will lead to quieter engine operation. All future vehicle replacements will include reduction of operating noise as an item in the design requirement specification. All 120 old-style 'rapid intervention sets', using noisy 2-stroke engines, have been replaced with new units using 4-stroke 'whisper' engines. A fleet of 45 new light portable pumps

has also been introduced, using quieter modern technology. Varying the warning siren sounds (wail, yelp and two tone) improves response. Also, a closely following appliance needs to be distinguished by other road users from the first. Trials with directional sirens in other brigade areas have not so far shown clear benefits, but options will be kept under review. Those responsible for fire safety management in buildings must ensure that fire alarm systems are properly installed, tested and maintained, and are recommended to use a fire alarm company certificated by the Loss Prevention Certification Board. The brigade has a key objective to reduce the number of non-domestic false alarm calls and hoax calls. It also seeks to address the noise exposure of brigade personnel, and to design-out possible conflicts between noise insulation and fire and emergency requirements in the advice given on buildings generally.



Box 33: Metropolitan Police Authority, Metropolitan Police Service

Frontline liveried response vehicles are replaced after 30 months, using latest available technology. Liquid petroleum gas and electric vehicles have been trialled for use where operational requirements permit. Police warning sirens need to use a readily recognisable range of sounds, at volumes which can be readily heard by drivers within well-insulated vehicles which may have closed windows and in-car amplified sound. Noise from specialist vehicles and equipment, such as boats and generators is taken into account in terms of overall fitness for purpose.

policy 17 The Mayor will urge the GLA group ('functional bodies') and other emergency services to, wherever practicable and cost-effective in relation to operational needs, use vehicles and equipment which demonstrate good practice in quiet and considerate design and operation.



4A.67 **Motorcycles, mopeds and scooters** The Mayor's Transport Strategy recognises that motorcycles, mopeds and scooters may offer advantages over cars by using less fuel, and taking up less space. However, there are road safety and environmental concerns surrounding motorcycles. They are often perceived as noisier, and their sounds tend to be distinctive even when not necessarily very loud. When the correct silencing equipment is not fitted, or is removed or tampered with, or when machines are poorly maintained, or ridden at excessive speeds, motorcycles can create annoyance out of proportion to their numbers. One noisy machine can influence perceptions of the rest. Motorcycles may produce less tyre noise, and need to stop and start less often in congested conditions than other vehicles. However, they can be more noticeable if they are accelerating or travelling faster, while other vehicles are queued. If motorcycles were quieter, but still driven at higher speeds, other road users could be caught unprepared. A London

Motorcycle Working Group is convened by Transport for London. This includes user groups, the police and the boroughs. The main aims of the Group are to promote a reduction in casualties, improve facilities for motorcycles, and reduce environmental harm.

Box 34: Motorcycle noise levels

Modern motorcycles, as type approved, and when used responsibly, have become much quieter than in the past. Standard noise test limits have been significantly reduced since the 1970s. From June 1999, noise limits for new motorcycles approved to EU Directive 97/24/EC, Chapter 9, are:

- Mopeds - 71 dB(A);
- Up to and including 80 cc engine size - 75 dB(A);
- Between 80 and 175 cc - 77 dB(A);
- Above 175 cc - 80 dB(A).

Limits for motorcycles first used from April 1991 were 2 dB(A) higher than the above figures.

It is an offence to sell replacement motorcycle silencers which do not carry prescribed approval markings.²² Periodic roadworthiness testing of motorcycles includes a check that they are fitted with correctly marked approved silencer systems.

Noise levels inside motorcycle helmets can be a 'healthy hearing' issue for those, such as despatch riders, who spend long periods on their machines at higher speeds. This may affect their perception of the noise they make. Hearing protection measures integrated with helmet design are increasingly available.

proposal 15 Transport for London through the London Motorcycle Working Group will, as funding allows, explore ways in which motorcyclists, moped and scooter users can be encouraged to maintain the noise specification of their machines as type approved; to drive more quietly and smoothly, as well as more safely; and to consider the benefits of hearing protection while riding, subject to road safety. The need for public communication and consistent and firm enforcement should be kept under review.

Assessing and prioritising action

4A.68 The suitability and effectiveness of the above measures will vary according to particular local circumstances. The noise reduction achieved by a single measure may be modest. Measures are likely to need to be combined to affect popular perception, although it would not be acoustically effective to combine certain measures. The effectiveness of

an individual noise reduction will often depend on what other noise sources are present, and how they inter-relate. This implies the need for assembling bundles of noise reduction measures which can preferably be implemented together, or at least in planned sequence. Action needs to be integrated on a local area basis, taking account of other 'secondary' sources of annoyance, wherever possible.

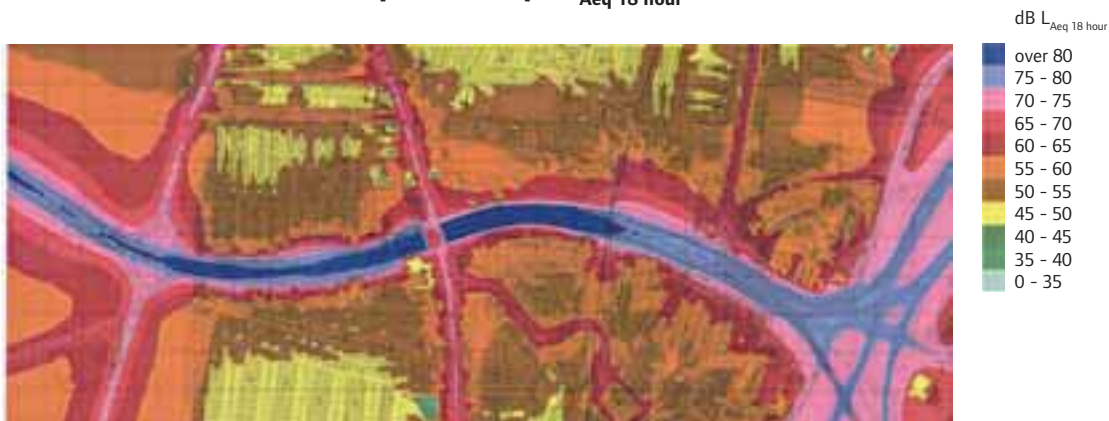
- 4A.69 Works to reduce noise cannot be considered in isolation from measures to manage the street network for other purposes. Priorities for reducing noise need to be developed alongside those for speed, road safety, air quality, energy use, bus priority, provision for cyclists and walkers, severance, and other issues. The inter-relationships need to be assessed, including effects on perceptions as well as physical noise levels. Working with those affected is likely to contribute to increasing satisfaction.
- 4A.70 A multi-criteria approach is therefore needed, assessing the effectiveness and suitability of all potential methods of noise-reduction in the particular circumstances of each section of road in its environment, to achieve the best combination of outcomes with the resources that can be secured. Routine 'Sound Audit' of changes is needed (see glossary). This should take account of sound quality and wider soundscape issues, as well as road traffic noise, narrowly defined. It will ensure that opportunities are not lost to fine tune, for noise minimisation, schemes originated for other reasons, such as safety. Assessment methods have historically been developed primarily for larger inter-urban road schemes. Assessment methods need to be able to deal with urban-scale and finer-resolution projects and programmes. Resources devoted to audit or assessment should, of course, be proportionate to the scale of benefits achievable.

Box 35: Transport for London - Business Plan

Transport for London's Business Plan for the period 2004/5 to 2009/10 includes key environmental measures being taken by TfL to mitigate negative impacts of the transport network and to promote sustainable transport. Relevant work is part of other Business Plan headings, rather than comprising a separately identified environmental budget. TfL works on noise reduction through a number of projects, for example, using low noise surfacing when resurfacing as part of the maintenance programme, in the bus vehicle replacement programme, etc. TfL Surface Transport intends to develop its business planning process to enable clearer identification of how projects support social inclusion, and the Mayor's Transport and other strategies, including the London Ambient Noise Strategy. TfL's project appraisal for large projects considers noise alongside other environmental issues.

- 4A.71 Transport for London has examined options for noise mapping of the Transport for London Road Network (see pilot map Figure 14 below). The Government has commissioned road traffic noise mapping of London as part of work on national ambient noise strategy.³ Constructive participation by Transport for London in national work will help to ensure that it is as useful as possible for London-level and borough purposes. Noise mapping should be used as a tool, not just for assessing population exposure to noise, but also, as far as possible, for testing the effectiveness of potential mitigation measures. Available noise mapping models do not contain parameters representing every possible way of reducing noise, so standardised or measurement-related adjustments may be needed.

Figure 14 Pilot road traffic noise exposure map ($L_{Aeq\ 18\ hour}$)



source: WS Atkins 2001: Noise mapping in London - Options for progress

- 4A.72 Many measures which would reduce the types of noise which annoy people would not be reflected in 'averaged' ambient noise mapping. Such a map is only one part of the process of understanding urban traffic noise, and improving people's conditions (see Chapter 5). Physical measurement of noise in sample areas can identify changing noise profiles over the day, evening and night, and at weekends, particularly where the contribution of different sources changes. A noise monitoring network, including a sample of sites at which periodic measurements are made over a period of years, would provide comparisons with noise mapping, and improve understanding of changes in noise over the day and week.



- 4A.73 Transport for London, and other highway authorities in London, should seek to record where substantive noise-reducing measures have been taken, their cost, and, where appropriate, information on effectiveness. Analysis on a case study basis should be carried out to help adjust and improve performance. The Government should fund monitored trials of the effectiveness of targeted noise reduction projects and programmes in

London as part of development of national strategy. Surveys of Londoners' attitudes to different types of traffic noise and noise changes would help to focus scarce resources on those aspects of noise which most concern people. Differential impacts on, or attitudes of, different groups of Londoners need to be identified wherever practicable.



4A.74 Proposal 3.4 of the Mayor's Transport Strategy states that Transport for London will contribute to reducing traffic noise by 'working with the London boroughs and local communities living adjacent to the Transport for London Road Network (TLRN) to develop a programme to reduce traffic noise in the worst affected areas'. It is anticipated that criteria will be developed for this in conjunction with Government preparation of National Ambient Noise Strategy, and work on implementing the European Environmental Noise Directive. Transport for London will discuss with the Government how such a programme for the TLRN could contribute to development of National Ambient Noise Strategy and what additional funding might be secured for practical improvements. Noise will be included in Transport for London's guidance on Borough Spending Plans.

policy 18 The Mayor will urge the Government to fund monitored trials of the effectiveness of targeted road traffic noise reduction projects and initiatives in London that take into account the needs of different road users, recognising the role that pilot projects in the UK's largest concentration of population exposure to traffic noise could play in demonstrating a commitment to action-oriented policy development. Priorities are likely to include measures addressing sensitive night-time and weekend periods.

proposal 16 Following work by Government on road traffic noise mapping of London, expected to be completed by 2004, Transport for London will prepare a Traffic Noise Action Programme for the Transport for London Road Network, and seek resources for practical noise reduction projects contributing to development of National Ambient Noise Strategy.

proposal 17 Transport for London will provide guidance on the framework within which financial assistance may be given, under section 159 of the Greater London Authority Act 1999, to London boroughs or others, for measures which contribute to reducing or minimising noise. This will normally be through the Borough Spending Plan process.

proposal 18 Transport for London will, and the London boroughs should, apply Sound Audit or other appropriate assessment to ensure that noise and vibration impacts of highway schemes, traffic control and management, and other transport projects and programmes are identified and reduced to a

practical, cost-effective minimum, taking account of other needs. This includes identifying soundscape improvement opportunities.

proposal 19 Transport for London will work with the Government, its consultants, London boroughs and other stakeholders to ensure that noise mapping not only meets national and European Environmental Noise Directive requirements for quantifying population exposure, but enables a full range of potential measures to reduce noise to be assessed realistically and conveyed comprehensibly to stakeholders.

proposal 20 Transport for London will establish a noise monitoring network, at which periodic noise measurements are made, including frequency spectra, and time histories over the day and, where possible, week.

proposal 21 Transport for London will, and other highway authorities in London should, as resources become available:

- Record where substantive noise-reducing measures have been taken, their cost, and, where appropriate, information on effectiveness, to adjust and improve performance, and to identify where new instruments, technologies or other resources are required;
- Carry out before and after surveys of selected measures involving changes in noise, including, where necessary, noise level measurement and attitude surveys of people affected, to support improvements in programme effectiveness;
- Carry out, or participate with others in, periodic noise measurement and attitude surveys in London to assess priorities for noise reduction;
- As far as possible, identify and address the equalities implications of differences in noise exposure.

References and notes

- 1 Often measured using the equivalent continuous sound level, L_{eq} , see Appendices A2 and A8.
- 2 Often measured using the maximum sound pressure level level, L_{max} , see Appendix A8.
- 3 DEFRA. 'Towards a National Ambient Noise Strategy' Consultation paper, DEFRA, November 2001.
- 4 Available from <http://www.transportforlondon.gov.uk/>
- 5 Sandberg U. 'Noise Emissions of Road Vehicles: Effect of Regulations' Final Report 01-1, I-INCE Working Party on Noise Emissions of Road Vehicles (WP-NERV), International Institute of Noise Control Engineering, July 2001.
- 6 Note: The noise levels quoted above are for individual vehicles as 'type approved' in terms of the international standard 'drive by' test (ISO 362). In this test, unladen vehicles approach a test area at a speed of not more than 50 kilometres per hour (30 miles per hour) and then accelerate at maximum throttle over a measured distance. This exaggerates noise emission from certain components, and may encourage vehicle makers to use technologies which are less relevant to minimising noise in modern urban traffic conditions. A stationary noise test (ISO 5130) is used in some countries. Alternatives include a 2-stage test, with both acceleration and cruise-by components.
- 7 New vehicles are subject to exterior noise certification according to European Directive 1992/97/EC, which is implemented in the UK through the Road Vehicle Construction and Use Regulations 1986, as amended. The latest standards came into effect in 1996.
- 8 Abbott PG, Phillips SM, Nelson PM. 'Vehicle Operation and Road Traffic Noise Reduction' Institute of Acoustics Proceedings, Volume 23(5), 2001, pp 53-60
- 9 Kemper GD. 'Noise emissions from road vehicles and provisions for noise reductions' Proceedings of Inter-Noise 85 conference, Munich, 1985
- 10 www.actionenergy.gov.uk; www.energy-efficiency.gov.uk/transport
- 11 www.greenerfleet.org.uk

- 12 Department of Transport. 'Calculation of Road Traffic Noise' The Stationery Office, 1988.
- 13 Nelson PM, Phillips SM. 'Quieter Road Surfaces' TRL Annual Review, Transport Research Laboratory, 1997
- 14 McCubbin I. 'Development of a Renewable Energy Assessment and Targets for London' Report to Government Office for London and the Greater London Authority by the Energy Technology Support Unit, AEAT, December 2001
- 15 HA65/94 Design guide for Environmental Barriers; HA 66/95 Environmental Barriers, technical requirements; BS EN 1793 part 1 - Sound absorption and stability; BS EN 1793 part 2 - Airborne sound insulation and safety. See also Appendix A5.
- 16 DETR 'Traffic calming bibliography' Traffic advisory leaflet 5/01, 2001
- 17 Watts GR, Harris GJ, Layfield RE. 'Traffic calming: Vehicle generated ground-borne vibration alongside speed control cushions and road humps' TRL Report 235, Transport Research Laboratory, Crowthorne, 1997
- 18 Transport for London 'Congestion Charging: Update on scheme impacts and operations' TfL, February 2004. See http://www.tfl.gov.uk/tfl/cc_london/cc_monitoring.shtml
- 19 DETR 2000. 'Control of Body Noise from Commercial Vehicles - Guide to best practice' DETR, 2000; <http://www.roads.dft.gov.uk/vehicle/environment/bodynoise/index.htm>
- 20 See, for example, <http://www.bbs-tech.com>
- 21 'Rethinking Rubbish in London: The Mayor's Municipal Waste Management Strategy' Greater London Authority, September 2003, Chapter 45.
- 22 Motor Cycle Noise Act 1987. Motor Cycle Silencer and Exhaust Systems Regulations 1995.



4B railway noise

4B.1 The Mayor's Transport Strategy seeks a consensus around creating a world class transport system for London. That includes rail systems which are efficient, well-maintained and operated, and do not produce needless noise or vibration. New rail and tramway systems can be designed to be quieter. The huge backlog of under-investment in Britain's railways means that many are likely to be noisier than they need to be, although information is limited. Enhanced surface and underground railway services are needed if London's road traffic congestion and pollution problems are to be reduced. Many trains in London run close to noise-sensitive uses. This makes it particularly important that the incentives and resources are provided to secure good practice. Investment in London's railways provides the opportunity to minimise noise and vibration in railway design, maintenance and operation, alongside improving service quality and reliability for users.



Figure 15: London's existing National Rail and Underground networks



source: GLA and Transport for London 2003

4B.2 Wayside noise is affected by the speed and length of individual trains, as well as their number, track quality and other factors, notably brake type (disc or tread). Trains crossing bridges or viaducts can give rise to additional sound. Heavy freight trains, and trains running underground, can give rise to groundborne vibration, and low frequency noise. Groundborne vibration is very rarely a risk to building structures, but can cause anxiety as well as annoyance. Groundborne vibration can be re-radiated as a low 'rumble' in buildings, without people feeling vibration. Airborne low frequency sound can rattle windows or other objects, giving people an impression of structural vibration, without perceptible structural vibration actually occurring.

4B.3 Railway operators in different countries have historically agreed with manufacturers their own noise-related specifications for new locomotives

and rolling stock. However, there are now a number of developments on railway noise within the European Union. A European Commission Working Group on Railway Noise is drafting a European Commission strategy on railway noise in connection with European Directive 2002/49/EC, relating to the assessment and management of environmental noise. The European Association for Railway Interoperability (AEIF) has produced 'Technical Specifications for Interoperability' (TSIs) for the implementation of Directive 96/48/EC on the interoperability of the trans-European high speed rail system. TSI 96/48-ST 05 specifies noise levels. For the UK, Directive 96/48/EC applies to new-build and major upgrades to the East Coast Main Line, the West Coast Main Line, Great Western and the Channel Tunnel Rail Link. AEIF is currently producing TSIs in connection with Directive 01/16/EC which relates to the conventional rail network (including freight). In the UK this will affect about half the national network. Proposals for Directives on noise and vibration and safety are anticipated. In the UK, track quality-related contract specifications for asset maintenance or renewals have not generally included specific noise requirements. The EC 5th Framework project, 'STAIRRS', has developed a classification system for defining different vehicle and track designs, with reference to the revised version of ISO 3095 drawn up by committee CEN/TC 256. The EU funded project CONVURT (Control of Noise and Vibration in Underground Railway Transport) has been led by London Underground.

Issues in controlling railway noise

4B.4 Key issues involved in railway noise management include:

- Track type and quality - including wheel-rail rolling contact
- Quieter rolling stock and operation
- Railway structures and noise barriers
- Spatial planning and urban design
- Building insulation.

It will generally be less costly and more effective for noise and vibration control measures to be incorporated from a very early stage in programmes and projects rather than added as remedial actions. In view of the number of organisations involved in providing services and infrastructure on the national rail network, references in this chapter are generally to the Strategic Rail Authority and 'the rail industry' rather than specific organisations within it.

Track type and quality - including wheel-rail rolling contact

4B.5 Optimising the design and management of the wheel-rail interface is widely seen as the first priority technically in minimising railway noise.



Lack of resources and divisions of responsibility have made it hard to achieve in the UK. Changes in the national railway industry provide a chance for reappraisal.

4B.6 Noise generated from rolling contact between wheel and rail is the dominant source for electric trains, and in many situations, particularly at higher speeds, for diesel trains. Noise generation depends not just on speed, but on the condition, particularly smoothness, of the wheel and railhead surfaces. Wheels with cast-iron tread brakes are typically 8 dB(A) noisier in rolling than disc-braked wheels. Corrugations, with a pitch typically between 30mm and 80mm (but considerably longer on London Underground), can form along the running surface of the rail. These can be removed by railhead grinding, provided the corrugation is not too deep. Rail corrugation can increase nearby noise by 10 to 20 dB(A) - subjectively twice or four times as loud. This is larger than noise reductions typically achievable by noise barriers. The prediction method used in the UK for assessing new or additional railways¹, assumes track in good condition. Across a sample of the UK rail network, actual noise levels may be averagely 5 dB(A) higher, but in some locations up to 20 dB(A) higher. Noise levels typically change over track maintenance and replacement cycles.

4B.7 On the national rail system, rail regrinding has usually been done only for safety reasons, rather than noise. The benefits of appropriate types of rail grinding for noise control are increasingly recognised. Additional grinders have been, or will soon be, bought into use. By 2006, a full preventative regime for gauge corner cracking will be introduced, which could give significant benefits for environmental noise. Automated systems for identifying railhead condition, wheel flats, and other problems, are increasingly available. Systems have been installed at a number of locations which identify trains that could damage the infrastructure by causing excessive forces (for example, due to wheel flats or out-of-round wheels). Such trains, which would also be noisy, could be withdrawn from service until the problem is rectified. Some sections of track prove susceptible to more rapid corrugation re-growth than others. This is for complex reasons, many of them locally specific and not currently predictable. It may not be cost-effective to require grinding to a set standard everywhere. On London Underground, rail grinding is already carried out for acoustic reasons and different standards may be needed depending on the sensitivity of the site. Further research is needed to establish cost-effective monitoring and maintenance regimes in different situations. New contracts, franchises and other arrangements should not be so structured as to make improved noise management artificially difficult or expensive.



4B.8 Some fundamental design issues can be particularly intractable. High levels of tonal noise (see glossary) can occur on tight radius curves. The piercing sound can be highly intrusive and wheels can be damaged, generating more noise. Ways of reducing 'wheel squeal' include railhead or wheel lubrication, water sprays, and special coatings to rail running surfaces. Resilient wheels, such as used on many modern tram systems, are primarily effective in reducing squeal rather than normal rolling noise.

4B.9 Continuously welded rail is quieter than traditional jointed track. On national rail, much jointed track has already been replaced with continuously welded rail, giving noise benefits of perhaps 2 dB L_{Aeq} . Long welded rail (maximum 700 metres, as opposed to continuous welded) has been used on parts of the Underground. Quieter rail types are under development, including tuned damping (see glossary) of the rail to reduce noise radiation. Rail fastenings and mounting systems include proprietary systems designed to offer groundborne noise or vibration reductions. Maintaining good track quality includes ensuring railway sleepers are firmly bedded in the ballast. The open structure of coarse aggregate ballast gives noise absorption (of perhaps 2 dB) compared with slab track, in which rails are attached to a solid concrete slab. Under-ballast mats - a resilient mat placed below ballast - can reduce groundborne noise and vibration as can floating slab track, although cost effectiveness needs to be considered. Space constraints may also preclude use of floating slab track.

4B.10 The mechanisms by which noise and vibration propagate from underground sections of track to buildings are complex. They include the type of tunnel, type of property, distance, ground conditions (including groundwater), and type of rail fixing. Reducing vibration at the wheel-rail interface is a typical first area for optimisation.

policy 19 The Mayor will urge the Government to allocate clear responsibilities, and to consider suitable funding mechanisms, for the rail industry to develop cost-effective quieter railway track technologies and management systems. Research to establish the parameters for cost-effective good practice should be carried out urgently, taking account of any guidance provided by the European Commission-funded 'STAIRRS' project.

Quieter rolling stock and operation

4B.11 New railway rolling stock, particularly that used in moderate speed suburban operations, is generally quieter. The replacement of tread-braked rail vehicles with modern stock using disc brakes has typically reduced noise. Traditional iron block tread brakes, still fitted to many vehicles, cause roughening of the wheel treads. Other composite brake



block materials can be used to reduce this problem. Electric traction motors on suburban passenger trains produce relatively little noise. Intermittent operation of braking system compressors, ventilation or cooling fans and electrical control systems can generate noise. At low speed, a diesel locomotive on power tends to dominate overall train noise, especially with modern disc-braked rolling stock. Low frequency noise from diesels can be intrusive. Newer diesels are quieter. Electric locomotives are also relatively quiet. However, on Eurostar trains and other high speed locomotives such as the Class 91, powerful fans required to cool electrical equipment can dominate train noise at lower speeds. Much of the UK's freight rolling stock, including locomotives, has been modernised. Groundborne and structure borne noise and vibration from very heavy freight trains can be difficult to control. 'Low track force' bogies can reduce vibration, as well as track wear and tear.



4B.12 Shields on the vehicle and low noise barriers close to the track have been investigated in research projects by British Rail Research and, more recently, by the European Rail Research Institute (ERRI)². Resilient wheels and simple vehicle skirts are common on modern tram systems. Automated braking systems, such as used on Croydon Tramlink, can avoid wheel slide on compacted leaf material, and the formation of wheel flats.

4B.13 Variable track access charges to encourage train operators to invest in quieter vehicles, or to specify technologies which reduce noise as well as wear and tear on track, were suggested in the European Commission Green Paper 'Future Noise Policy', 1996. Excessive complexity and high transaction costs clearly need to be avoided. Variable charges have not been introduced so far in the UK. Integrated engineering-based management is likely to be preferable. Automated and remote sensing technologies, such as Auto Video Inspection (AVI) can be used to improve asset condition monitoring and implement comprehensive planned preventative maintenance programmes.



4B.14 Railway speeds are, as a principle, tightly controlled for operational reasons, including safety and capacity. Overall improvements in railway reliability should avoid pressure for higher speeds to catch up on late running. Train speed would need to be reduced by 30% to reduce noise by 3 dB L_{eq} , and by 50% to reduce noise by 6 dB. Reducing speeds generally by such amounts would have serious implications for users of railway services, and overall network capability, given that journey speed is a key attraction of railways compared with other often noisier modes of travel. However, the option to restrict speed at night in a limited number of locations, where no other options exist, should be available. Ideally, heavy freight trains should use routes by-passing residential areas,

especially at night. Otherwise, acceleration and deceleration rates should be minimised. Heavy diesel engines should not be kept idling, emitting low frequency noise which people can find particularly annoying. Network Rail has an agreement with the largest rail freight operating company, EWS, that signallers will inform drivers if they will be waiting for more than 15 minutes, so that the driver can shut down the locomotive. The signaller informs the driver 5 minutes before a green signal. A similar approach is sought in stations, but powers are not available to enforce the practice in either case. Railway horns and other warning devices can disturb or startle waiting passengers and those living close to railways. Alternative ways of achieving safety objectives should be periodically reviewed by the railway industry. Where audible signals are unavoidable, ways of reducing adverse impacts, such as using broadband sound, or otherwise improving sound quality, should be considered.

- policy 20 The Mayor will urge the Strategic Rail Authority and the rail industry to promote the cost-effective development and adoption of quieter railway vehicle technologies and management systems. Railway operating practices which minimise noise, particularly at night, should be promoted and 'no idling' policies observed.

Railway structures and noise barriers



- 4B.15 Vibration of steel bridges and other structures can radiate noise. This can be complex and expensive to reduce, but options should be examined when structures, particularly long spans, are being refurbished or replaced. Many bridges and viaducts incorporate a parapet which may act as a noise barrier, screening wheel-rail noise for buildings of moderate height. Noise barriers can be structurally difficult to achieve on viaducts at low cost. Parapets can also re-radiate sound resulting from vibration in the bridge structure, negating the shielding effect of the parapet. It may require comprehensive isolation of the track from the viaduct to avoid this, although this could only be done as a part of a major track replacement programme. Options to improve parapet screening could be most cost-effective where replacement, or other major works occur.



- 4B.16 Railway cuttings can screen noise, although they are less effective for low frequency noise. Noise from cuttings can be reduced by using absorptive surfaces on vertical retaining walls, and inside the mouths of tunnels, where clearances allow. In 'natural' cuttings, sloping rough ground can attenuate sound. Dense vegetation may assist if the width is several metres. Barriers close to tracks are most effective, but are subject to safety and other operational constraints. Well-placed, well-designed barriers can reduce rolling noise by over 10 dB. They are less effective against diesel locomotives on power, where the main source of the noise

is higher. Ideally, vehicle skirts and low, close barriers should be designed together, though this is difficult on existing or multi-user railways. Railway barriers need to have absorptive inner surfaces or have surfaces at an angle to the vertical in order to avoid multiple reflection of sound between the barrier and the side of the train.

Box 36: Solar power from noise barriers

A recent study of renewable energy potential in London³ drew attention to the potential for generating electricity from photovoltaics (PV) integrated into noise barriers along suitable railway lines in London, as well as major roads (see paragraph 4A.29).



- 4B.17 Railway noise barrier installation has been difficult to achieve in the UK. However, they have been introduced in some London Boroughs, Kent and Surrey to reduce noise from intensified freight traffic as a result of the opening of the Channel Tunnel. They have also been used on the Docklands Light Railway and the Channel Tunnel Rail Link. Such barriers need to be designed to appropriate standards⁴ and well maintained. Very high costs have typically been quoted for any works on railway operational land. The need to improve railway security against trespass and vandalism may provide opportunities, such as screening at ventilation ducts for underground sections. Purpose-designed combined noise barriers and secure boundary fences may be cost-effective.

- policy 21 The Mayor will urge the Strategic Rail Authority and the rail industry, and will expect Transport for London, taking particular account of vandalism, visual amenity, historic building and conservation issues to:
- Examine the scope for promoting the safe and cost-effective use of railway noise barriers, where source-related measures would not be effective;
 - Consider securing noise benefits from routine renewal or improvement of boundary walls/security fencing, including at ventilation ducts, and in refurbishment of structures, notably bridges;
 - Investigate the potential for noise barrier-integrated photovoltaic power generation along suitable railway lines.

Spatial planning and urban design

- 4B.18 The need for more housing and other space in London provides opportunities to improve soundscapes by well-designed development alongside, and in some cases over, railways. Adequate isolation of such new buildings from railway generated noise and vibration needs, of course, to be achieved. Suitably self-protecting continuous or near-continuous development alongside railways can screen amenity spaces and buildings further from the railway and non noise-sensitive buildings



may be particularly appropriate in such locations. Mono-pitch roofs can enhance the barrier effect of garage blocks, workshops and other low-rise buildings. Development which provides occupants with a 'quiet side' away from a busier railway is generally to be preferred to development at right angles to the tracks, where both sides of the building would be equally noisy. Self-protecting development should, however, still maintain visibility by adjacent occupiers, to help discourage crime and vandalism. Sound absorbing finishes should be considered for larger and longer lineside buildings to reduce reflection back towards any noise-sensitive buildings or open spaces on the opposite side of the railway. Noise mapping provides opportunities to demonstrate screening benefits to existing residents. Planning Policy Guidance Note 24 'Planning and Noise', Department of the Environment, 1994 provides a framework, and chapter 4F below considers planning and design in more detail. Noise will be considered alongside other issues in Supplementary Planning Guidance on Sustainable Design and Construction, prepared in association with the London Plan.

4B.19 The Mayor's Transport Strategy recognises that car parking at stations may have a role in making rail an attractive option (Policy 4E.3). Car parking structures could provide opportunities to improve screening of railway noise from local neighbourhoods. Development over railway stations, tracks or depots provides opportunities to reduce noise in surrounding areas, as well as contributing to London's needs for more housing, commercial and amenity space. Such development could improve local public transport interchange, and contribute to local urban renaissance. Bridging and enclosing development will need good urban design, and structure-borne vibration will, of course, need to be addressed, along with construction disturbance, safety, daylighting/sunlighting, maintenance, visual design, historic building and conservation issues, and environmental issues. Lineside biodiversity should be respected (see the Mayor's Biodiversity Strategy regarding rail-side Sites of Importance for Nature Conservation).

policy 22 The Mayor will urge the Strategic Rail Authority and the rail industry, and will expect Transport for London, in partnership with local planning authorities and other stakeholders, and taking particular account of biodiversity, visual design, listed building and conservation area issues, to:

- Examine the cost-effective scope for promoting development over suitable railway stations or tracks, especially those in cutting, taking account of potential net noise benefits; and
- Seek design of new development near railways which screens or otherwise minimises noise.

policy 23 The Mayor will urge boroughs to consider including, in their Unitary Development Plans, proposals to enhance the noise screening provided by development alongside railways, having regard to benefits for the wider area. Noise reduction in the wider neighbourhood should be taken into account as a benefit by local planning authorities in assessing design in applications for development alongside or over suitable railways. Decked or bridging development is most likely to be acceptable where railways are below adjacent ground levels.

Building insulation

4B.20 Current Noise Insulation Regulations for railways are based on the principle that noise from existing facilities is already known to local residents, and reflected in property values. New railways may not have been expected by existing property owners, who may be eligible for compensation (see Appendix A7). As with roads, the regulations do not apply where the use of existing lines is intensified. However, investment in better track and trains should mean that, in many cases, the noise generated by each train will be lower. The preparation of a National Ambient Noise Strategy⁵ provides the Government with the information and the opportunity for a review. Issues include whether the historic 'noise threshold' and package of measures in the Noise Insulation Regulations are still relevant. A more flexible hierarchy of measures might be appropriate, (see Appendix A7), although administrative costs need consideration.

4B.21 The thermal insulation benefits obtainable from secondary glazing, or replacement double glazing, should be taken into account, and linkages made, as far as possible, with fuel poverty work. As with roads, the insulation package specified in the railway noise regulations provides only for sound insulation to habitable rooms (bedrooms, living rooms, and kitchens also used for dining). This does not reflect modern 'whole house living' lifestyles. Any new regulations should consider insulation specifications closer to those in the Building Regulations which are then in force, including taking account of other noise sources where necessary (see Appendix A7).

policy 24 The Mayor will urge the Government to use the National Ambient Noise Strategy process to review relevant provisions of the Land Compensation Act 1973 and Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 (amended 1998), making appropriate financial grant provision to accompany any change. Consideration should be given to a flexible hierarchy of measures for cost-effective protection of a wider range of properties. Work should, wherever possible, be integrated across different noise sources, and with fuel poverty and climate change-related measures.



London Underground

- 4B.22 The London Underground provides for some three million passenger trips each weekday, including the journey to work trips of 35% of those working in central London. However, many parts of the basic infrastructure are in a poor state of repair after decades of inadequate investment. London Underground has estimated that 60% of delays (in terms of total passenger minutes lost in delays of two minutes or over) are caused by infrastructure and rolling stock failures.

Box 37: Investment in the Underground

The Mayor's Transport Strategy seeks to overcome the backlog of investment on the London Underground rail network, so that the service provided to passengers is consistently reliable, comfortable, easy to use, safe and secure. It also seeks to increase capacity by bringing the system into a state of good repair.

Considerable resources were devoted by Government to preparation of Public Private Partnership (PPP) contracts. However, full engineering assessment and quantification of the capital investment needed to restore the system to good repair were not carried out. London Underground Ltd was merged with Transport for London on 15 July 2003, after the signing of PPP contracts, which will govern maintenance and asset renewal by private companies, Metronet and Tube Lines.

Concerns remain, both over the complex financial and operational structure inherent in PPP arrangements, and at the limited level of investment, relative to need, available from Government grant and fare revenue.

- 4B.23 One of the legacies of historic under-resourcing is poor track quality in many parts of the Underground. The Mayor's Transport Strategy proposed (Proposal 4C.3) that Transport for London would conduct a proper engineering assessment to determine the cost and the time required to address the deficiencies of the existing Underground infrastructure, and to identify immediate and long term priorities. Noise and vibration could have been straightforwardly integrated in enhanced asset condition monitoring, and in planned, preventative maintenance programmes. Complex Public Private Partnership (PPP) arrangements were, however, imposed (see Box 37).



- 4B.24 Many asset renewals should provide opportunities for improvements in noise and vibration. However, arrangements already agreed between London Underground Ltd and PPP partners or suppliers are likely to constrain Transport for London's ability to introduce new noise and vibration requirements. Changes which require Engineering or other

Standards related to PPP to be altered could have significant cost implications. Transport for London will need to develop its 'client side' capabilities in noise and vibration in order to quantify the benefits of noise control in 'business case' terms, and to negotiate and secure cost-effective measures through the complexities of inherited PPP arrangements. Exemplary noise and vibration management could require additional resources. This may need to be the subject of specific negotiation with Government, related to development of relevant national noise and rail policies and statutory requirements.



4B.25 Having regard to the needs of London's night time economy and cultural and entertainment sectors, the Mayor's Transport Strategy (paragraph 4C.7) calls for exploration of the costs and benefits of extending the operating hours of the Underground, particularly at weekends, taking account of the requirements of night time maintenance. Wherever possible, infrastructure, including ancillary plant and equipment, such as ventilation ducts, needs to be brought up to best modern practice before significant extensions in operations. Improved understanding of the costs and benefits of reducing noise and vibration, in the context of evolving funding arrangements, is needed for priority setting. The work proposed in consultation on a National Ambient Noise Strategy⁵ will be useful. It is important that conditions are improved cost-effectively, to maintain fair treatment of rail in relation to other transport modes.

policy 25 The Mayor will expect Transport for London to develop cost-effective plans, as far as Public Private Partnership and resource constraints allow, to minimise noise and vibration through improvements in the design, operation, monitoring and maintenance of transport infrastructure, while seeking improved London Underground services in pursuit of London's transport, regeneration and sustainable development needs.

policy 26 The Mayor will expect Transport for London to develop its technical monitoring, assessment, specifying and commissioning capabilities in noise and vibration related to securing cost-effective improvements in performance through Public Private Partnership and other contract arrangements. This includes developing methods of quantifying the benefits of noise and vibration reduction, and taking account of resident and other complaints in assessing the need for remedial treatment.

policy 27 The Mayor will expect Transport for London to assess, on a scheme-by-scheme basis, the implications of service improvements which could have significant impacts on noise and vibration, and incorporate cost-effective mitigation measures where appropriate.



National Rail

- 4B.26 The National Rail Network is a vital component in London's local public transport system, as well as in the city's role as national and international gateway. The Mayor's Transport Strategy seeks the integration of London's historic legacy of overground railways into a system to facilitate not only commuting and reduction in passenger overcrowding, but wider travel needs through development of services into an overground London Metro. Over time, this will include development of orbital rail services in inner London, and increased late night and weekend services. Mechanisms have been established to provide co-ordination between the Mayor, the Government, Transport for London, and the Strategic Rail Authority (SRA) in delivering shared objectives for National Rail in London.
- 4B.27 National Rail has suffered from under-investment for many years, and much infrastructure is in a poor state of repair. Massive investment is needed to upgrade it and to increase capacity. Securing public acceptance of expansion requires National Rail to set standards for construction and maintenance plant and equipment to minimise noise disturbance during upgrading work. Similarly, to secure public acceptance for increased capacity requires the relevant railway organisations to play a positive role in setting product acceptance criteria for new plant and equipment (both trackside and train mounted), and agreeing common approaches to assessment, monitoring, managing and resolving of operational noise and vibration issues. Improvements in track quality and maintenance, with new, quieter rolling stock, operated reliably and consistently, should make it possible to provide more train services on many lines without significant adverse effects. The implications of service improvements which could have significant impacts on noise or vibration will need to be assessed on a scheme-by-scheme basis.
- 4B.28 Integrated design and management of the wheel-rail interface is critical to railway noise and vibration minimisation. The heightened attention to asset management following the Hatfield rail disaster presents the opportunity to put in place modern engineering management to deliver safety, efficiency and environmental benefits. Asset condition monitoring systems provide a basis for planned preventative maintenance programmes. They can incorporate data relevant to noise management and give a tool for improving the railway's relationships with its neighbours, including prompt and informed response to complaints. Such improvements are essential if London is to achieve a modern and expanding railway which maximises its contribution to sustainable development.
- 4B.29 Negotiation of franchises, and other arrangements on National Rail should build in sufficient flexibility to allow for responsive noise

management, without prohibitive penalties, as unforeseen noise or vibration problems emerge, as changing technologies become available, or where emerging problems can be addressed through modest operating changes. As with the Underground, improved understanding of the costs and benefits is needed for priority setting. It is important to maintain fair treatment of rail in relation to other transport modes, and fair treatment for London in relation to other areas. Clear allocation of responsibilities is particularly important on a multi-user railway system.

- policy 28 The Mayor will expect the Strategic Rail Authority and the rail industry to develop cost-effective plans to minimise noise and vibration through improvements in the design, operation, monitoring and maintenance of transport infrastructure, while seeking improved National Rail services in pursuit of London's transport, regeneration and sustainable development needs.
- policy 29 The Mayor will expect the Government, Strategic Rail Authority and the rail industry to ensure that network licences incorporate actively enforced arrangements for management and monitoring which enable noise to be minimised through best engineering practice, particularly related to track condition, in pursuit of the Secretary of State's Directions and Guidance to the SRA in respect of sustainable development and effects on the environment. Elements include:
- Making available information from asset registers or databases, and maintaining good asset condition monitoring systems.
 - Ensuring that franchises, contracts, and other arrangements on National Rail make provision, without disproportionate penalties, for flexible operational, engineering and other responses to noise and vibration issues as these are identified.
- policy 30 The Mayor will expect the Strategic Rail Authority and the rail industry to assess, on a scheme-by-scheme basis, the implications of service improvements which could have significant impacts on noise and vibration, and incorporate cost-effective measures to mitigate such impacts.

Construction and maintenance works

- 4B.30 Noise from construction and maintenance works is excluded from the definition of 'ambient noise' in the GLA Act 1999. London boroughs remain responsible under the Control of Pollution Act (CoPA), 1974, for agreeing appropriate measures to protect noise-sensitive occupants in the vicinity of relevant construction works. Night maintenance as well as construction work can be particularly necessary on railways because of pressure on capacity during the day. Bringing London's rail facilities up to necessary standards, and expanding capacity, will, however, have



environmental benefits. It is nevertheless important that the best available techniques and operating practices are employed to minimise the risks of disturbance. Construction noise issues should be addressed at programme and project planning stage, and measures agreed with local authorities and others. Local authorities and scheme promoters are increasingly seeking to harmonise Codes of Construction Practice. Responsible authorities and contractors should apply good practice. This implies prior discussions with the local authority and, in most cases, application for prior consent under Section 61 of CoPA. It implies adherence to BS 5228, some sections of which are Codes of Practice under CoPA. Good practice in implementing major construction and maintenance works with significant noise implications is likely to include advance letters to neighbouring occupants, 24 hour helplines where necessary, rapid response to complaints, and regular publication of information on the types of complaints.

- policy 31 The Mayor will urge the Strategic Rail Authority and the rail industry, and will expect Transport for London, to secure good practice in minimising noise and vibration where railway construction and maintenance are carried out.

Noise mapping of railways in London

- 4B.31 The UK Government published its consultation paper on a National Ambient Noise Strategy in December 2001, which included mapping the main sources and areas of noise by 2004. It is important that noise mapping should be used not just to quantify noise exposure in general terms, but to play a part in optimising some of the key actions affecting noise generation. Local authorities have typically found it difficult to obtain accurate information of the type required for noise mapping from the railway industry. Giving specific parts of the railway industry responsibility for producing source noise mapping to defined protocols, and making this available to local authorities and others, is likely to be more cost-effective than many local authorities mapping 'their' parts of a much wider network. It should also assist the railway industry in moving towards integrating noise management in system management. A specific concern over the current UK railway noise prediction model is that it does not cover the effects of railhead roughness, including corrugation. This has been recognised by Government and rail industry advisors. Research is being carried out to enable such effects to be included in modelling for mapping purposes.

- policy 32 The Mayor will urge the Strategic Rail Authority and the rail industry, and will expect Transport for London, to work with the Government, its consultants, London boroughs and other stakeholders to ensure that

Government-funded noise mapping both meets national and European Environmental Noise Directive requirements for quantifying population exposure, and provides, as far as possible, a practical tool to assist in improving noise and vibration management of railway networks.

Passenger stations and interchanges

4B.32 The Mayor's Transport Strategy seeks to improve passenger waiting and interchanging environments. A high quality passenger environment needs to include comfortable soundscapes in which speech is intelligible, and warning and other signals are not only audible, but also consider sound quality. Train wheel squeal can be an issue on stations with tight curves, particularly in the Underground. High levels of noise from fast through trains can be an issue on National Rail. Particular account needs to be taken of the needs of the hard of hearing and partially-sighted people.



4B.33 Noise at stations can also cause irritation to local occupiers, including poorly designed or operated public address systems. Modern public address systems can employ directional and/or distributed speakers to focus sound. Staff training in the use of public address systems can help to maintain speech clarity at lower sound levels. Station structures, including canopies and boundary walls and fences, should where possible be designed to screen adjoining uses from noise, and to reduce disturbance from passengers leaving stations late at night. 'Adaptive Noise Sensitive Systems' can be used to raise and lower the sound output of public address systems and other signals in response to the prevailing background noise level and, in some situations, to turn off speakers when there is no-one adjacent to hear announcements. Restrictions on public address system use may still be necessary at sensitive times, with measures to improve availability and accessibility of other forms of information. Full account must, of course, be taken of the safety need for announcements and other audible warnings, as well as of the wider needs of disabled people.



policy 33 The Mayor will urge the rail industry and other stakeholders, and will expect Transport for London, to minimise the impact of noise at and near stations, interchanges and other rail facilities, as far as safe and practicable, having particular regard to the needs of disabled people. This includes measures related to announcements.

Train noise for passengers

4B.34 Noise can interfere with communication between the train operator and passengers, and can disrupt passenger conversation, concentration and comfort. Sound quality should be considered in passenger satisfaction surveys alongside issues such as ride quality. Passenger noise levels,



attainable with and without opening of carriage end-windows and other ventilation flaps or grilles, should be taken into account when commissioning new rolling stock or undertaking major refurbishment. Sound levels inside rail vehicles can be required to not exceed specified maximum permitted levels, measured in accordance with the requirements of ISO 3381. Cost can vary very widely depending on the nature of the railway vehicle and its operating environment, and decisions will need to be made on a project basis. Audible warning signals are required by the Rail Vehicle Accessibility Regulations. They are required for safety reasons and can be particularly important for disabled people. In some situations, adaptive systems (see previous paragraph) can reduce annoyance (e.g. automatic train door warning alarms).

- policy 34 The Mayor will urge the Strategic Rail Authority, the rail industry and other stakeholders, and will expect Transport for London, when assessing issues of service quality, to give consideration to monitoring noise levels experienced by passengers and/or public attitudes to interior noise.

Rail freight



- 4B.35 The Mayor's Transport Strategy and London Plan support the transfer of freight from road to rail, where this is practical and in keeping with other objectives. More rail freight can contribute to environmental improvement on London's streets by reducing the number of heavy lorries. This needs to be balanced against localised environmental disbenefits. Freight trains are typically much heavier than passenger trains, and can create more low frequency noise and vibration. Local effects vary. The noise and vibration implications of major schemes to achieve modal transfer will need to be assessed on a scheme-by-scheme basis. Assessment should include short term measurements (such as hourly values) and/or the number and level of individual noise events at night as well as long period 'averaged' noise, and should take account of low frequency noise and vibration.
- 4B.36 Competition with passenger services for the limited amount of rail capacity nationally and within London increases the pressure for rail freight movements to take place at night, when background noise levels are lower. London's rail network is often used for freight which does not have an origin or destination in London, and could be diverted round the city. This would help to minimise noise and vibration in London's dense residential areas and release scarce rail capacity for freight with an origin or destination in London as well as passenger services. Multi-modal freight terminal proposals and expansion of existing terminals will require careful assessment of layout and screening, the routes used for access by road vehicles, the types of road vehicles used, hours of operation and

other issues. Transport for London works with stakeholders through the London Sustainable Distribution Partnership to address rail freight issues.

- policy 35 The Mayor will urge the Strategic Rail Authority and the rail industry to ensure that schemes and facilities that transfer freight to rail are developed and implemented in a co-ordinated way which limits local noise and vibration impacts to a practical minimum, taking into account that much rail freight currently moves during the night. Noise and vibration-minimising freight routeing and infrastructure initiatives should be promoted.

New schemes and assessment

- 4B.37 The Mayor supports early improvement of London's rail links to the continental European high speed rail network. Dealing properly with the particular effects of high speed rail is one reason for the high construction cost of Phase Two of the Channel Tunnel Rail Link, from Southfleet in north-west Kent, into St Pancras, via a new Stratford International Station. Much of this will be in tunnel or will include measures to deal with noise and vibration.
- 4B.38 The Mayor's Transport Strategy promotes a number of new schemes to increase public transport capacity, including extending the East London line northwards and southwards, increasing Docklands Light Railway capacity, a new east-west Crossrail linking Stratford, the Isle of Dogs, the City and Paddington, new Thames Gateway River Crossings, and in the longer term, an additional Crossrail linking South west London and Hackney. The Transport Strategy (Policy 4L.6) also encourages the development of high levels of public transport access to London's Airports, at Heathrow, Gatwick, Stansted, Luton and London City. This will help to minimise road traffic congestion and traffic noise. The noise and vibration implications of projects will need to be assessed as the schemes are prepared and consulted upon. As well as promoting conventional rail schemes, the Transport Strategy aims to bring forward new forms of light transit, such as trams and light rail.



Box 38: Assessment

The White Paper on Integrated Transport⁶ set a policy framework for assessment. Schemes are to be assessed against five criteria: environment, safety, economy, accessibility and integration. The document 'Planning Criteria: A Guide to the Appraisal of Support for Passenger Rail Services',⁷ reflects this policy approach. Guidance has also been produced for the study of options incorporating more than one mode of transport.⁸ For major projects, the Strategic Rail Authority has indicated that it expects the scheme's proposer to conduct a full environmental impact assessment,

which would include noise issues. For other projects, the level of detail would depend on the size of the scheme and level of impact. Small scheme should still have regard to possibilities to incorporate cost-effective measures to minimise noise and vibration.

- 4B.39 Methods of scheme assessment will need to evolve, reflecting changes at the European level, and UK national policy towards ambient noise, and responding to improvements in the available technologies. Understandable information needs to be conveyed to the public. Ambient noise mapping will be useful, but other information may also be required. Noise needs to be part of multi-criteria assessment which is, where necessary, multi-modal.

- policy 36 The Mayor will urge proposers of major rail schemes and light transit projects to minimise any adverse impacts of noise and vibration, using the best available cost-effective technologies. The noise and vibration impacts of schemes should be assessed along with other criteria, and understandable information conveyed in public consultation as proposals are brought forward.

References and notes

- 1 'Calculation of Rail Noise' Department of Transport, 1995
- 2 'Silent Freight' and 'Silent Track' - Jones RRK. 'Railway noise control using combined vehicle and track treatments' World Congress on Railway Research, Paris, November 1994

Hemsworth B and Jones RRK. 'Silent Freight Project - Final Report' European Rail Research Institute, 2000

Hemsworth B. 'Silent Track Project - Final Report' European Rail Research Institute, 2000
- 3 ETSU 'Development of a Renewable Energy Assessment and Targets for London' Report to Government Office for London and the Greater London Authority by the Energy Technology Support Unit, 2001
- 4 HA65/94 Design guide for Environmental Barriers; HA 66/95 Environmental Barriers, technical requirements; BS EN 1793 part 1 - Sound absorption and stability; BS EN 1793 part 2 - Airborne sound insulation and safety. See also Appendix A5
- 5 DEFRA. 'Towards a National Ambient Noise Strategy' Consultation paper, DEFRA, November 2001
- 6 'A New Deal for Transport: Better for Everyone' DETR, 1998
- 7 published by the Office of Passenger Rail Franchising (OPRAF), 1999
- 8 'Guidance on the Methodology for Multi-Modal Studies, Volumes 1 and 2' DETR, March 2000



HSBC

Lufthansa

MALEV Hungary

EC-EYB

EC-EYB

MD-87

4C aircraft noise

- 4C.1 London's central importance to the UK economy and status as a key world city rests, in part, on its role as an 'international gateway'. London's airports provide international access to the UK and the rest of Europe for business, investors, and tourists. Continuing improvements in the international services that London provides and better access to them are essential if London is to retain and enhance its international competitiveness. These issues are considered in the Mayor's Transport Strategy, London's Economic Development Strategy, and the London Plan.
- 4C.2 Aircraft noise is a particularly difficult issue for London, given the location of one of the world's busiest airports, and a key UK global gateway, on its western edge. With the prevailing wind direction from the west, this means that most aircraft descending to land at Heathrow Airport approach over the city. Aircraft using other airports, including outside the city, also pass over London. Many Londoners are concerned about aircraft noise.
- 4C.3 Aviation presents some of the starkest tensions between environment and economy. Solutions are not easily found. As an increasingly diverse and globalised world city, London has been becoming more socially and economically dependent on air transport. Londoners as well as visitors are travelling more internationally. Of a UK total of 189 million air passengers in 2002,¹ 117 million used the London area airports (Heathrow, Gatwick, Stansted, Luton and London City). Heathrow Airport is the largest airport in the country, handling some 63 million passengers in 2002, along with 1.2 million tonnes of freight, most of it carried in the holds of passenger aircraft. The Government has forecast² substantial continued growth in demand, nationally and in the South East.
- 4C.4 Following a series of regional studies, including a South East and East of England Regional Air Services Study³ (see paragraphs 4C.56-7), the Government published, in December 2003, a national Air Transport White Paper providing a framework for the next 30 years.⁴ Following a Public Inquiry, the Secretary of State had approved, in November 2002, a proposal for a fifth terminal at Heathrow allowing it to grow to accommodate 90-95 million passengers per year or possibly more. The Inquiry Inspector's report raised a number of issues likely to remain important to future policy.⁵ The Secretary of State's decision imposed a limit of 480,000 flights per year, compared with 460,000 in 2000; and the area contained within the Government's 'official' 57 dB $L_{Aeq 16 \text{ hour}}$ contour was not to exceed 145 square kilometres as from 2016.⁶ The Air Transport White Paper sets out Government support for further development of Heathrow, including a new runway and additional terminal capacity, to be delivered within the 2015-2020 period, if stringent environmental limits can be met. The Government White Paper proposes that further



development could only be considered on the basis that it resulted in no net increase in the total area of the 57 dB $L_{Aeq, 16 \text{ hour}}$ contour compared with summer 2002, an area of 127 square kilometres. Any extra runway or terminal would require further planning permission.

- 4C.5 The UK Government is responsible not just for overall aviation policy as set out in the White Paper and other instruments, but for key regulatory decisions relevant to noise for airports designated under the Civil Aviation Act 1982 - Heathrow in London, and Gatwick and Stansted outside. London City Airport is regulated through planning legislation, including a planning agreement between the operator and the London Borough of Newham. The London Borough of Bromley is both local planning authority and landowner at Biggin Hill. The Mayor's powers relate mainly to strategic development control⁷ of any new airport facilities within the GLA area, and securing more sustainable surface access. Many other bodies are involved in managing noise, including international organisations, aircraft engine and airframe manufacturers, air traffic control, airport operators, airlines and pilots. The Ministry of Defence has overall policy responsibility for Northolt.

Box 39: Consultation related to air navigation and noise

Section 371 of the GLA Act 1999 requires any provider of air navigation services to consult the Mayor on specified alterations or additions to routes or procedures which would have a significant adverse impact on noise. The Director of Airspace Policy at the Civil Aviation Authority is the regulatory authority responsible for overseeing the technical design of airways, holding arrangements and related frameworks. National Air Traffic Services (NATS) is responsible for any proposals to change such arrangements, in consultation with other interested parties, and for day-to-day air traffic control. Controllers have tactical discretion as to how aircraft are routed within the overall framework. Changes in airspace structure with significant noise effects are infrequent. For example, the Noise Preferential Routes used on departure at Heathrow (see below) have been in use for many years. Any proposal for change would be required to be the subject of wide consultation. Policy 50 below calls for review of airspace design and management to reduce noise impacts. See also box 47.



- 4C.6 The Mayor's Transport Strategy recognises that provision of adequate airport capacity to meet London's needs, as a world city and the international gateway to the UK, is important. However, London's environment also needs to be protected (Transport Strategy, Policy 4L.1). Noise is, of course, one of the key environmental issues for air transport, along with air quality, and, increasingly, greenhouse gas emissions. The

Mayor has stated that he supports ending the exemption of aviation fuel from taxation to help reduce unnecessary air journeys (Transport Strategy, paragraph 4L.12). However, reduction in general demand for air travel would not automatically be expressed in equivalent reductions in demand at a particular airport that was more popular and accessible to travellers than other airports; general and location-specific noise management would still be needed.

4C.7 Air pollution modelling reported in the Mayor's Air Quality Strategy, and in Government and Hillingdon Council work, has identified areas of concern along the major roads and in specific 'hot spots'. West London, around Heathrow Airport, was one of the main areas of projected exceedence of the annual average nitrogen dioxide objective, predominantly due to directly and indirectly airport-related activities and the high level of vehicle use along the M4 corridor. The Air Transport White Paper recognises that further expansion at Heathrow could only take place if the Government could be confident that the European Union air quality limit values applying from 2010 could be met. The London Plan recognises that airports outside Greater London have major implications for development, regeneration and surface access, as well as for the environment.

policy 37 The Mayor will urge the Government (which has the key decision-making powers at Heathrow), the aviation industry, local authorities and other stakeholders to minimise the impact of aviation noise on London, within the context of meeting London's needs as a world city. The Government is urged to work vigorously to reduce noise associated with aviation, including through international agreements, national and airport-related regulation and economic measures.

Issues in controlling aircraft and airport-related noise

4C.8 Issues involved in aircraft and airport-related noise management include:

- Quieter aircraft and aircraft numbers;
- Noise abatement operational procedures;
- Operating restrictions, including restrictions on night flights;
- Ground noise and surface access;
- Spatial planning and building insulation.

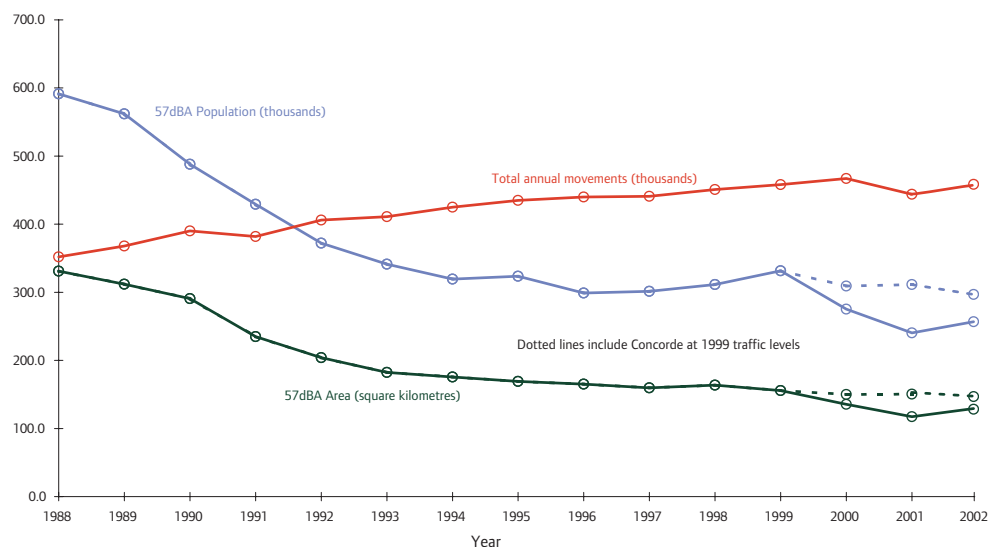
Quieter aircraft and aircraft numbers

4C.9 Aircraft have, weight for weight, been becoming quieter. However, their numbers have been growing, not just at Heathrow, but at other airports in and around London. Residents' groups and others have been concerned at the growth in the number of planes over London as global aviation has expanded. The increasing size of aircraft is likely to make



them more noticeable on flightpaths. The number of people and the area bounded by the Government's 'official' 57 dB $L_{Aeq, 16 \text{ hour}}$ noise contour has fallen (see Figure 16). The contour relates to average daily aircraft movements between mid June and mid September during 16 hour period from 0700–2300 hours. The index used in the contour incorporates an 'energy averaging' of sound. Many people, including the Heathrow fifth terminal Inquiry Inspector, believe the index to give insufficient weight to the increasing number of movements (see box 40 and paragraphs 4C.41–2). The criticism is that energy averaging over 16 hours does not reflect people's experience of specific noise events.

Figure 16 Heathrow aircraft movements, population and area within 57 dB $L_{Aeq, 16 \text{ hour}}$ 'actual modal split' contour



source: Department for Transport - Noise Exposure Contours for Heathrow Airport 2002⁸

Box 40: Aircraft noise contours and indices

The 57 dB $L_{Aeq, 16 \text{ hour}}$ noise contour has been used by the Government as an indicator of the 'onset of significant community disturbance'⁹. The Government publishes noise contours, at 3 dB intervals between 57 and 72 L_{Aeq} for Heathrow, Gatwick and Stansted. The contours are based on aircraft movements over the 3 month period 16 June to 15 September. Many other airports publish similar information. The use of such contours as an aggregate measure to represent a complex mix of events for planning and other purposes should not be taken as implying that no-one outside, for example, the 57 L_{Aeq} contour is affected. Planning Policy Guidance Note 24¹⁰ recognised that: 'Beyond the extremities of the published contours, noise will still be audible near the arrival and departure routes.'

There is a wide variation in individual response to aircraft noise. The noise index on which the 57 L_{Aeq} contour is based was derived at a time when the number of aircraft movements was much lower than today¹¹. A three year study was announced by the Aviation Minister on 8 May 2001¹². The study is expected to cover the relationship between noise levels and annoyance, attitudes to sleep disturbance at night, and values placed on lower noise levels relative to other environmental factors. It is important that research encompasses the difficulties people have getting to sleep or getting back to sleep once woken, as well as actually being woken once asleep. It is unlikely that a single noise index will be suitable for all policy purposes.

Requirements of the Environmental Noise Directive 2002/49/EC include use of the L_{den} and L_{night} indicators (see glossary) averaged over the whole year. Other indices may be used on a supplementary basis. Night noise contours have not previously been produced as a standard practice for Heathrow. L_{night} contours are likely to provide useful addition information. Other information, such as number of events along the glidepaths, at different times, is also likely to be needed (see 'Public information and communication' below). Changes in the way noise is quantified do not, of course, reduce it. However, ensuring that any noise index reflects adverse effects on people as accurately as possible must be an essential part of good decision making.

- 4C.10 Noise from jet aircraft engines was significantly reduced with the introduction of high-bypass turbofan designs. The need for noise reduction around airports is expected to influence aircraft design further, although there can be tensions with other environmental objectives, such as minimising fuel use. Civil aircraft are required to hold a noise certificate containing noise values related to certain test conditions. Noise standards for aircraft are agreed internationally through the International Civil Aviation Organisation (ICAO).¹³ Some older low by-pass engined aircraft, fitted with 'hushkits' to enable them to meet 'Chapter 3' standards (see glossary) remain, but are a small minority of the fleet.¹⁴ At Heathrow, nearly all movements are by Chapter 3 aircraft.
- 4C.11 After the 2002 Chapter 2 phase-out, there is no immediate prospect of a technological advance giving a similar reduction to that achieved through introduction of high by-pass engines.¹⁵ The 2001 ICAO decision on a new Chapter 4 aircraft noise standard did not secure the degree of improvement many had pressed for. European negotiators seeking quieter aircraft at ICAO were outvoted by those from other parts of the world whose priority was cheaper aircraft. The ICAO decision effectively pushes the onus onto regulators, airport operators and land use planners in countries where noise sensitive airports are located.

- 4C.12 A Government-commissioned study of aviation technology futures¹⁶ made it clear that significant further progress on noise reduction would only be implemented if regulatory agencies created the right framework. The life of an airframe may be forty years, compared with around ten for a road vehicle, so the impact of quieter new aircraft on overall noise levels will be slow unless instruments, such as higher landing charges at more noise-sensitive airports, higher fuel prices, incentives for scrapping, or other measures are used to encourage removal of those aircraft which are more polluting and/or less fuel efficient.
- 4C.13 Reductions in aircraft noise at take-off, dominated by engine noise, have been more significant than when landing. Noise from aerodynamic sources, from the airframe, such as control surfaces, and undercarriage, has been becoming more significant. Landing noise is more complex to control. With construction of Heathrow Terminal 5, increases in the proportion of larger aircraft can be expected. Increases in perceived noise under the final approach glidepaths east of Heathrow Airport are likely. Airlines can be encouraged to use quieter aircraft through landing fees. At Heathrow, differential landing charges are applied. In 2000/2001, Chapter 2 aircraft (see glossary) were required to pay double the landing fee, compared with Chapter 3. The noisiest Chapter 3 aircraft paid 10% more, and the quietest 10% less. A supplementary noise quota system is operated at night to encourage the use of quieter aircraft.
- policy 38 The Mayor will urge the Government, European Union, and the aviation industry to negotiate vigorously for and support economically the more rapid development of quieter aircraft, particularly those which are quieter on landing, and the rapid replacement of existing noisier aircraft by the quietest available aircraft, including measures to secure removal of the noisiest aircraft at specific airports where necessary, recognising that sustained improvements in overall environmental performance are required, having regard to any tensions with air quality or other environmental objectives.
- policy 39 The Mayor will urge Government to create and maintain a supportive regulatory environment for, and airport operators to use, all available incentives, including further consideration of differential landing charges, to encourage the development and deployment of the quietest available aircraft. This includes:
- distinguishing between aircraft of different noise levels within existing or future 'Chapter' categories; and
 - examining the merits, particularly at Heathrow, of weighting charges according to the landing element of the certification test.

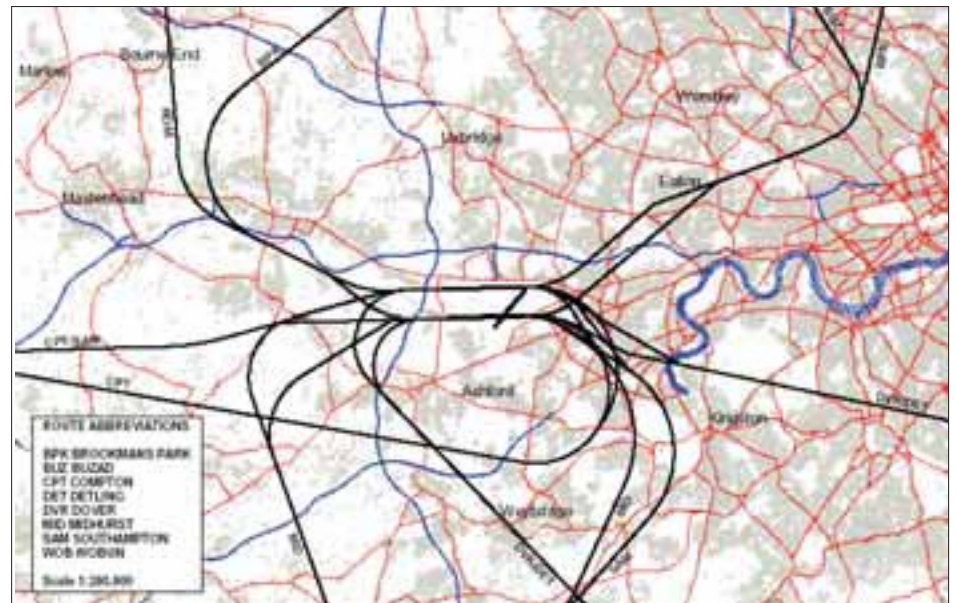
policy 40 The Mayor supports review of the aircraft noise index currently used at Heathrow and other airports in the UK. The index should be reviewed, normally at five-yearly intervals or as appropriate in the light of developing scientific understanding. Research should encompass issues related to getting to sleep and getting back to sleep once woken, as well as being woken once asleep.

Noise abatement operational procedures

- 4C.14 Operational procedures applied at Heathrow and other designated airports to abate noise include maximum permitted noise levels for departure; noise preferential routes for departure; minimum altitudes for joining the final approach glidepath (Instrument Landing System, ILS); low power/low drag procedures, and continuous descent approach.
- 4C.15 Take-off noise has traditionally been seen as of greater concern than landing noise. Take-off has been where the main improvements in aircraft technology, principally from reducing engine noise, have been made. The 'noise footprint' at take-off has been significantly reduced, as modern aircraft are able to climb much more steeply. At Heathrow, complaints about departure noise have fallen considerably.
- 4C.16 At Heathrow, noise monitoring and noise limits for departing aircraft have been in place since 1959. The airport operator undertakes monitoring for noise infringements at take off. Airlines are surcharged, and the income distributed by a Noise Fund Panel to community projects. Infringements have tended to be by older aircraft. New lower departure noise limits were introduced by the Government in December 2000, enforced from February and March 2001. The departure noise limits (L_{Amax} see glossary) are: daytime 94 dB(A); night 87 dB(A); and 89 dB(A) for the 'shoulder periods' between day and night (2300–2330 and 0600–0700 hours).



Figure 17 Map of Heathrow standard instrument departure routes¹⁷



source: Department for Transport - Noise Exposure Contours for Heathrow Airport 2002⁸

4C.17 Noise and track keeping systems (see glossary) are used to monitor the adherence of aircraft to designated departure routes. Feedback from monitoring enables pilots to improve their performance. For 2003, 2004 and 2005, the airport operator has a target of 95% of departures on track.¹⁸ Noise Preferential Routes used on take off towards the west (the predominant mode of operation) were designed, within constraints related to aircraft handling and navigation, to require flights to pass between the more densely built up areas. This is not possible for Noise Preferential Routes used when aircraft, for reasons of wind direction and strength, take off to the east, over built up areas. An alternative system for dispersal of aircraft departures on easterly operations at Heathrow could reduce the burden on the most-affected, but this would require detailed study.

4C.18 Most complaints about noise associated with Heathrow now concern aircraft coming in to land. At Heathrow aircraft continue to need to approach at a standard 3 degree glideslope. London City Airport, with specific obstacle clearance requirements, is exceptional in being limited to use by aircraft which can approach more steeply. Steeper approach reduces the area affected, but would be demanding for some aircraft types (some would require special certification), and steeper approach procedures are only permitted under international procedure design criteria (PANS-OPS) for the purpose of obstacle clearance. Aircraft are required to join the glide path (see glossary) at or above 2,500 feet in daytime, and 3,000 feet at night. When aircraft are approaching towards

the west (the predominant mode of operation at Heathrow) the glideslope may extend across London as far as Greenwich.

- 4C.19 Much of the noise produced during descent to landing is aerodynamic, including from flaps and undercarriage. An ANMAC study (see glossary) concluded that specific measured arrivals noise limits were not practicable. Regular monitoring and reporting of approach noise and close working between the airport operator, airlines and air traffic control are all necessary to achieve improvements. Continuous Descent Approach (CDA) is a noise abatement technique for arriving aircraft which avoids the higher noise levels generated when aircraft descend in steps (see glossary). At Heathrow, CDA achievement during the 2300 to 0600 period improved from 73% in the second quarter of 1999 to 88% in the third quarter of 2001. The airport operator has a target to increase this to 90% of arrivals by December 2004.¹⁸ A Code of Practice has been developed to reduce noise from each aircraft arrival.¹⁹ Low engine power settings during CDA reduce fuel use, and the aircraft is generally higher than in a stepped approach. Much of the noise is from the turbofan assembly and is tonal in quality. People tend to find tonal noise more annoying at a given level.
- 4C.20 Future changes to international air traffic management include integrated 'gate to gate' operational systems, and 'area navigation' procedures (RNAV, see glossary), with the prospect of adjustments to the present structure of departure routes. Reducing the need for entering one of the four 'holding stacks' around London, would not necessarily reduce the need for integrating different traffic streams for final approach. Airspace management is the responsibility of the Civil Aviation Authority/National Air Traffic Services. Air traffic controllers use a variety of rules, procedures and practices designed to ensure the safe and expeditious separation and sequencing of aircraft. The structure of controlled airspace over London has been built up over a long period. Any major redesign would have widespread 'knock on' implications. Aircraft positioning for approach to Heathrow are not necessarily required to enter a holding pattern, or be constrained to a particular standard arrival route. Aircraft may, depending on air traffic conditions, weather conditions and other factors, be directed and sequenced to final approach in a variety of ways.
- 4C.21 Aircraft manoeuvre over many parts of London, outside the most-affected areas in south-west London. Many of these are manoeuvring across south or north London to join the glideslope on their approach to Heathrow Airport. There are also increasing movements to and from other airports in and around London. It may not always be clear to people in Tower Hamlets or Greenwich, for example, whether the aircraft they see are using Heathrow, London City or other airports. Air traffic control



arrangements change only infrequently. This makes it even more important that as complete as possible an understanding of the noise and other environmental effects is established, so that no opportunity to improve the situation is missed.

4C.22 At Heathrow, the existing system of runway alternation (see glossary, also under 'Cranford Agreement') serves to provide predictable periods of relief for many Londoners when the airport is operating in a westerly direction. The Mayor recognises the value of this arrangement continuing. The Government's Air Transport White Paper seeks examination of the scope for greater utilisation of the two existing runways, stating that: 'For example, mixed mode operation in peak hours might be introduced, while retaining runway alternation for the rest of the time'²⁰. Any such proposals would need to be subject to detailed study and full public consultation. Westerly preference (see glossary) reduces the number of take-offs over the more densely populated London areas east of Heathrow. Take-offs have traditionally been more of a noise problem than landings. The balance of advantage may shift as aircraft technologies change. This aspect of current arrangements requires periodic review.

policy 41 The Mayor will urge the Government to pursue more vigorously noise abatement operational procedures, such as Continuous Descent Approach. The balance between easterly and westerly preference at Heathrow should be periodically reviewed, in relation to changes in population exposure to take-off and landing noise as relevant technologies change. The Mayor supports the principle of giving predictable periods of respite to residents through runway alternation at Heathrow; any modification would require stringent justification and full public consultation. Studies should be carried out, to identify how people across London are being, or may be, affected by aircraft noise, in varying air traffic conditions, and as the size and performance characteristics of aircraft change over time.

Operating restrictions, including restrictions on night flights

4C.23 London City Airport and Biggin Hill are closed at night. Northolt is not normally used at night. Aircraft movements at Heathrow between 2330 and 0600 hours are limited to 5,800 movements annually. This represents an average of 16 per night. There is a supplementary noise quota system to encourage use of quieter aircraft²¹. The majority of night aircraft movements are long haul landings in the early morning from about 4.30 am onwards. There is a target to achieve Continuous Descent Approach (see glossary) for 90% of arrivals in the 2300 to 0600 period by the end of 2004.

4C.24 The Mayor has indicated that he supports the view that night flights should be banned. The decision, however, rests with the Government. In

considering the case for a night ban, Government will need to assess evidence on the extent and nature of adverse effects on residents, as well as economic and other issues. Such evidence will need to be sufficiently detailed to enable conflicting demands to be properly assessed, in full public consultation. The Aviation Minister announced in December 2000 changes in the night-time use of Heathrow's runways. This was not a night ban, as many had called for, but a weekly rotation between westerly and easterly operations whenever weather conditions permitted. This was designed to roughly equalise directional operations. Full implementation of this new night rotation system was delayed by a phased programme of extensive refurbishment of Heathrow's two main runways. When the arrangements are uncomplicated by construction works, the effects on people under the rotating flightpaths should be assessed.

Box 41: Existing night flight restrictions at Heathrow

The Government has imposed various restrictions on night flights at Heathrow since 1962. There are no scheduled departures between 2330 and 0630 hours. Aircraft delayed, for example, by bad weather, sometimes leave after 2330, as may small aircraft, such as medical flights. The first arrival is scheduled around 0455, but can arrive earlier.

The most recent controls, introduced in 1999, impose the following restrictions:

- Limit to total flights each season between 2330 and 0600 hours (3250 summer, 2550 winter);
- Supplementary quota system to encourage use of quieter aircraft. Aircraft types are given a Quota Count (QC) value reflecting their certificated noise values for landing or take-off. A maximum QC number is also set for each season between 2330 and 0600 hours, the 'night quota period';
- Noisier aircraft (QC16 and QC8) cannot be scheduled to operate between 2300 and 0700, and cannot operate between 2330 and 0600 unless there are very exceptional circumstances.

In addition, there is a voluntary ban on the scheduled operation of QC4 aircraft, which are currently the noisiest category of aircraft permitted to operate during the night quota period. In January 2004, the Secretary of State announced that, following consultation²², the night restrictions regime would be extended on an interim basis until October 2005. Further consultation on arrangements beyond then is expected during 2004/05.

Full details are published in the CAA's Supplement to the UK Aeronautical Information Publication S15/2001.

- 4C.25 The Mayor's view is that the imbalance in the number of people under the westerly and easterly flightpaths approaching Heathrow is a strong factor supporting adoption of easterly preference (approaching from the west except when wind or other conditions dictate otherwise) for any night flights. There are many more people living beneath flightpaths to the east of the airport (in London) than to the west. If the night rotation scheme which the Government has chosen does not substantially allay public concern, the Government should consult on introduction of full easterly preference at night (i.e. affecting the fewest people).

Box 42: European Court of Human Rights - Night flights

The Mayor provided a first sum of £20,000 towards a case concerning night noise regulation at Heathrow, taken on behalf of affected residents (Hatton and others) to the European Court of Human Rights. The case was supported by a wide range of interests including community organisations and local authorities. The first finding of the European Court of Human Rights²³ was that the UK Government had violated Article 8 (right to respect for private and family life and home) in its decisions in 1993 on control of night flights at Heathrow Airport. It found that adequate and independent evidence on the economic case had not been produced, and also that insufficient account had been taken of getting to sleep, or getting back to sleep, as distinct from being woken once asleep. The UK Government announced on 19 December 2001 that it was appealing on grounds related to its legal scope for discretion. The European Court announced in April 2002 that it would allow the case to go forward to a Grand Chamber hearing. The Mayor provided a second sum of £20,000 towards the legal costs of the case on behalf of affected residents. The second finding of the Court, issued on 8 July 2003, effectively overturned its earlier Article 8 ruling.²⁴

- 4C.26 Some groups of people, notably older people and those with some types of illness, are more likely to wake at night, and to have more difficulty getting back to sleep, once woken²⁵. If sufficient reductions cannot be achieved at source consideration should be given to targeted measures (see *Spatial planning and building insulation* below).
- policy 42 The Mayor supports the view that night flights should be banned. In the short term, the night quota period at Heathrow should be extended to cover the whole period from 2300 to 0700 hours, and relevant controls and financial incentives used to minimise adverse impacts within component sub-periods.
- policy 43 The Mayor will urge the Government to assess the effects of weekly night rotation of runway preferential use at Heathrow, when the scheme has

been operating fully for an adequate period following runway refurbishment. If assessment so indicates, full easterly preference should be introduced for such landings, subject to consultation, and to no scheduling of departures during the relevant time of operation.

Ground noise and surface access

- 4C.27 As well as noise from aircraft taking off and landing, noise can be generated from use of reverse thrust to slow the aircraft on the runway during landing, as well as engine testing, taxiing, and the use of auxiliary power units, affecting local areas around airports. For example, the use of reverse thrust at sensitive times is required to be kept to a minimum at Heathrow. Control of ground noise is the responsibility of the airport operator. The use of auxiliary power units on aircraft has been restricted, following provision of fixed electrical ground power to most stands. A number of controls limit ground engine testing at night. Between 2300 and 0700, all high power runs must be carried out inside one of the ground run pens, where noise is attenuated by barriers. Noise barriers have been provided at other locations.
- 4C.28 Noise and other pollution from road traffic around airports is a growing issue. As passenger throughput at Heathrow has grown, road traffic and public transport use have also grown. The Mayor's Air Quality Strategy and the National Air Quality Strategy²⁶ recognise the significance of road traffic around Heathrow and the impact it has on local air quality. With the approval of Terminal Five, passenger numbers are expected to grow from 64 million in 2000 to between 80 and 100 million. About a third of passengers use public transport, with a BAA/Heathrow target of 40% by 2007, and 50% as a longer term vision.
- 4C.29 Through the Transport Strategy, the Mayor is proposing improved public transport to Heathrow, most importantly by building a new east-west rail link, Crossrail, to connect Heathrow with the City and East London. Transport for London will work with BAA/Heathrow and the Heathrow Area Transport Forum to seek the implementation of further measures to increase the use of sustainable travel in West London. The provision of sustainable public transport access for passengers and workers will continue to be an important factor influencing the Mayor's position on airport development.
- 4C.30 The Mayor made clear his view that in the event of Government giving approval to Heathrow Terminal Five, additional public transport facilities should be provided to support at least a 50% modal share for air passengers, and at least 25% by airport employees. The Government's approval has been made conditional on the Piccadilly Line and Heathrow



Express extensions to Terminal Five being completed. Future public transport links from the south remain to be resolved. It is important that Government ensures the provision of adequate funding for the implementation of public transport improvements vital to improving access, reducing traffic congestion and improving the overall environmental impact.

4C.31 The Mayor supports the improvement of public transport access to London City Airport. Extension of the Docklands Light Railway is in progress. Airport Travel Plans and other measures need to continue to be vigorously pursued by airport employers to reduce the impact of private road vehicles in pursuit of overall environmental improvement.

policy 44 The Mayor and Transport for London will work with BAA/Heathrow, London City Airport Ltd, the Government and other stakeholders to improve public transport to and around Heathrow and London City Airports. This will require additional funding from Government, or airport operators, for this purpose. The noise impact of additional transport facilities should be included appropriately in the assessment process as schemes are brought forward, and cost-effective noise mitigation measures incorporated where applicable.

Spatial planning and building insulation

4C.32 For environmental reasons, it is desirable to limit the numbers of people affected by the operation of airports. However, as they become larger employers, and generate wider economic activity, airports tend to attract more people to live in their vicinity, together with other urban activities. UK planning policy²⁷ seeks to restrict the amount and location of noise sensitive development, including housing, hospitals and schools, around airports. The Mayor will, in appropriate planning applications referred to him, seek specific evidence on the action to be taken to address noise (see paragraph 4F.5 and Policy 70).

4C.33 Relating development to aircraft routes presents choices. Should aircraft be contained to a small number of routes, to give developers and local communities a degree of certainty, and enable the numbers of buildings requiring insulation to be minimised? Or should aircraft movements be dispersed in order to give communities some periods of respite? PPG24 states that: 'Development plans should give developers and local communities a degree of certainty about the areas in which particular types of development will be acceptable and those in which special measures may be required in order to mitigate the impact of noise.'

Box 43: Guidance to Civil Aviation Authority

In January 2002, the Department for Transport, Local Government and the Regions issued 'Guidance to the Civil Aviation Authority on environmental objectives relating to the exercise of its air navigation functions'.²⁸

- Paragraph 32 stated that it had been the view of successive Governments that 'the balance of social and environmental advantage lies in concentrating aircraft taking off from airports along the least possible number of specified routes, consistent with airspace management considerations and the overriding need for safety.'
- Paragraph 34 qualified this, stating that 'there may be local circumstances where it is impossible to concentrate traffic over less populated areas and where the advantage lies in dispersing traffic to avoid the concentration of noise over noise sensitive areas.'
- Paragraph 35 stated that the Director of Airspace Policy should 'place a high value on the legacy of planning decisions and the location of noise-sensitive development, and generally should recognise the importance of the long term stability of the route structure in the vicinity of airports, since people need to know where significant aircraft noise will be experienced.'

4C.34 UK aviation and planning policy has tended to seek to provide predictability by, for example, designating Noise Preferential Routes for departure. At Heathrow, alternating the use of runways gives predictable periods of relief. Confining aircraft to certain routes enables those who are most concerned about noise, where they have real housing choice, to seek out quieter areas. In practice, air traffic control requirements, with existing technology, have tended to confine aircraft to certain routes, particularly on immediate take-off and on approach to landing. At Heathrow, the Noise Preferential Routes which are used on departures when the airport is on westerly operations (the predominant mode), were designed, as far as possible, to pass between the more densely built up areas. Limiting noise sensitive development under preferential departure routes west of the airport does not involve a great sacrifice of potential, since much of the land is designated Green Belt, in which development is normally precluded.

4C.35 However, precluding noise sensitive development along the long glideslopes on the approaches to the Heathrow Airport from the east would be an enormous constraint on London's development. Housing shortages, projected housing demand, and the wide variation in individual response, imply a more flexible approach, outside areas exposed to high levels of noise where new housing development needs to be avoided.²⁹ Future changes in aircraft fleet mix and technology may have implications

for areas along the landing glideslopes. For example, larger and heavier aircraft are likely to remain noisier than smaller. The decision through ICAO not to go for a tougher noise standard for new aircraft implies more reliance on land use planning around airports to limit exposure. Advances in aircraft technology do not appear likely, without further incentive, to deliver major reductions in landing noise over the period to 2016. Future advances in airspace management may enable improved track keeping, or other operational changes.

Box 44: Flightpath Development Issues

Issues include:

- Updating projections of noise impact, particularly in terms of latest available estimates of aircraft size and noise footprints, not just for existing noise contours, but in terms of number of events above defined noise levels on the glidepath and departure routes, taking account of any potential changes in airspace design and management;
- Examining the scope for transfer of development rights and other mechanisms to promote logistics, manufacturing and other less noise-sensitive development in the more affected areas under the glidepaths, while securing space for housing and schools in quieter areas;
- Preparing planning and urban design guidelines for minimising the impact of aircraft noise in external as well as internal environments. Issues include materials, building form and layout.

4C.36 The London Plan sets out a framework for addressing London's housing supply needs. The Mayor is committed to carrying out a new London Housing Capacity Study in 2004. The Air Transport White Paper leaves uncertainty regarding further growth of Heathrow, and, although road traffic noise mapping is well advanced, other parts of the national mapping programme are experiencing delays. When complete, noise maps should help in assessing the implications of road, rail and aircraft noise on a consistent basis, although they are likely to need to be supplemented by other information. Over the period to 2016 or 2021, it is possible that technological developments in non-aviation sources, such as quieter tyres and road surfaces, and rail engineering improvements, could reduce road and rail noise relative to that from aircraft noise. The implications of different noise sources for potential housing sites needs to be assessed, including, as far as available information allows, differences in likely rates of change, notably under aircraft flightpaths.

policy 45 The Mayor will work with boroughs to ensure that Government guidance is properly applied so that residential development provides suitable conditions for residents. London-wide Housing Capacity Studies should

seek, as far as practicable and appropriate, to take account of likely changes in the levels of road, rail and aircraft noise. Studies should assess how housing needs can best be met while minimising noise exposure.

Box 45: Planning Policy Guidance Note 24, and Building Bulletin 93: Schools

PPG24 regards $60 \text{ dB}_{\text{Leq}}$ as a desirable upper limit for major new noise-sensitive development exposed to aircraft noise. It states that 'When determining applications to replace schools and build new ones in such areas, local planning authorities should have regard to the likely pattern of aircraft movements at the aerodrome in question which could cause noise exposure during normal school hours/days to be significantly higher or lower than shown in average noise contours'. More recent guidance in the Department for Education and Skills (DfES) Building Bulletin 93³⁰ suggests that noise should be assessed by taking the highest L_{Aeq} values likely to occur in any 30 minute period during normal teaching hours and that, for aircraft flyovers, the highest 30 minute value of L_{A1} (the level exceeded for 1% of the 30 minute period) should also be considered for many types of teaching room. (See also Appendix A5, including review of planning policy guidance)

Box 46: Worst mode

Some have argued that 'worst mode contour' (see glossary) should be used for planning and development control purposes, rather than 'average mode'. Although easterly take-off may, in an average year at Heathrow, for example, occur only on one day in five, it may be argued that development should be planned and designed on the basis of aircraft noise contours for that 'worst mode' condition. In the case of schools to the east of Heathrow, for example, easterly operations may, in practice, predominate during a substantial period. This could mean that a period important for child learning could be subject to noise at a higher than 'average' level. This factor is implicitly recognised in Building Bulletin 93 (see box above), but there is no equivalent advice for other noise sensitive buildings. This issue needs to be considered in reviewing Planning Policy Guidance Note 24, and against the background of European moves towards annual noise values.

- 4C.37 The time period over which aircraft noise should be assessed is an issue of particular importance for schools (see boxes above). Schools can be affected not just by aircraft, road, railway or other external noise, but by high levels of 'cross-talk' between different activities within the school. Issues are considered in paragraphs 4F.14-17 in Chapter 4F. While comprehensive information is not available, it is likely that the acoustic environment in many school buildings in London is less than satisfactory

for teacher communication and pupil concentration. A study has recently been published concerning West London³¹, and further studies are being carried out.³² Acoustic improvements are taking place at number of schools around Heathrow, and the Government's Air Transport White Paper commends certain measures.³³

- policy 46 The Mayor urges the Government to produce guidance, such as through review of Planning Policy Guidance Note 24, on the use of 'worst mode' aircraft noise contours in assessing the need for building insulation or other mitigation for noise-sensitive uses, and to ensure the provision of necessary funding, in the context of the 'polluter pays' principle, where appropriate and cost-effective.
- 4C.38 Several Noise Insulation Schemes have been implemented at Heathrow, the most recent being a voluntary scheme offered by the airport operator for housing and schools. A scheme is also being implemented at London City Airport, where homes are eligible for sound insulation at lower levels than at any other airport in the UK. Funding has been through the 'polluter pays' principle. Offers of noise insulation, notably secondary acoustic glazing, have typically been made, mainly for living rooms and bedrooms. If residents wish to have new full replacement double glazed windows, they may pay the difference. The basic package offered has typically included a simple forced air ventilation system with baffles against noise penetration. Since noise insulation schemes were first implemented, popular expectations as to 'whole house living' raise the question as to whether restricting insulation to certain rooms should be reviewed. A more flexible hierarchy of measures might be appropriate, (see Appendix A7), although administrative costs need consideration. Although measures to insulate against noise are not the same as those to improve thermal insulation, many works designed for one also have benefits for the other. Hence, it is clearly desirable to seek to integrate measures which address fuel poverty, save energy, have climate change benefits, and reduce noise, taking account of other noise sources where necessary³⁴.
- policy 47 The Mayor will urge the Government to assess the particular noise characteristics associated with potential changes in aircraft fleet mix and technology, and produce updated projections of aircraft noise impact in areas affected by Heathrow Airport, with particular reference to the final approach glidepaths across London. Consideration should be given to a new Noise Insulation Scheme, incorporating a flexible hierarchy of measures for cost-effective protection of a wider range of properties. Work should, wherever possible, be integrated across different noise sources, and with fuel poverty and climate change-related measures.

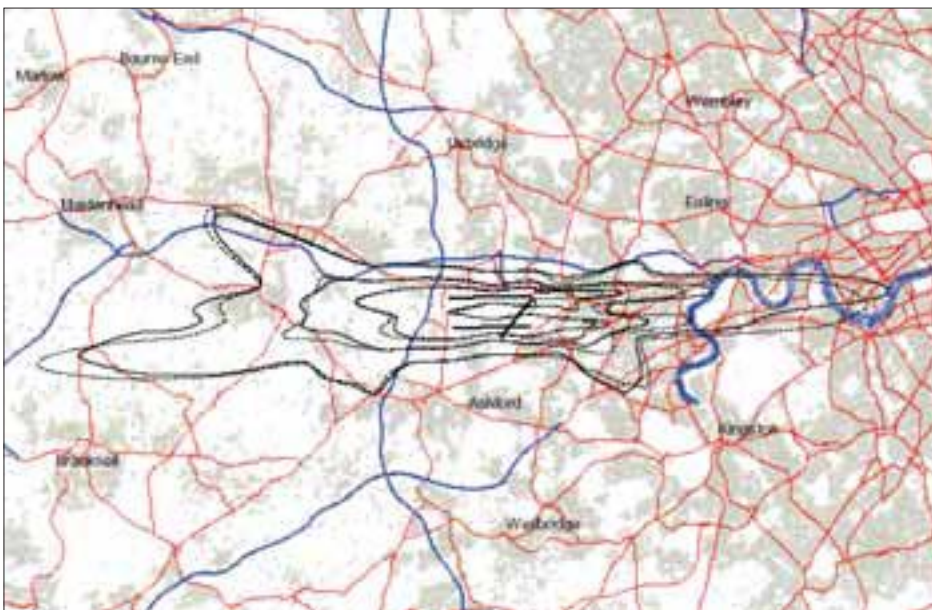
Public information and communication

- 4C.39 Consultative committees provide for communication and consultation between airports and affected communities. They provide regular opportunities for all parties to monitor and exchange information, and to review noise management alongside other issues, as circumstances change.

Box 47: Airport Consultative Committees

The Heathrow Airport Consultative Committee is a statutory body including representatives of local residents, local authorities for areas both inside and outside Greater London³⁵, specialist groups, environmental groups and industry bodies. The Heathrow Area Transport Forum plays an important role in relation to surface access. A Noise and Track Keeping Working Group studies noise reduction methods and monitors issues such as aircraft adherence to designated routes, night engine testing, and ground noise. Annual noise reports are published, beginning with 2000/2001, including data on air transport movements, passenger figures, contour areas and numbers of residents contained within them, CDA achievement, night quota use, track keeping and infringements. Other Airport Consultative Committees, such as at London City, perform a similar function.

Figure 18 Heathrow 57, 63 and 69 dB $L_{Aeq, 16 \text{ hour}}$ 'standard modal split' ('standardised mode')³⁶ noise contours 2001 (dotted) and 2002 (solid), both with Concorde movements at 1999 levels



source: Department for Transport - Noise Exposure Contours for Heathrow Airport 2002

- 4C.40 Airport operators are responsible for receiving and responding to noise complaints, where the issue involves a possible contravention of noise rules. Complaints about policy are responded to by Government. Airport

staff have immediate access to noise and track keeping data, which can identify specific noise events. Relevant data should be made readily available to those with a valid interest or concern, subject only to practical and security considerations. Some local authorities provide a service for local aircraft noise complaints, in addition to their general noise nuisance services. The patterns of complaints are regularly scrutinised through the airport consultative committees.

- 4C.41 One of the problems with the published $L_{Aeq\ 16\ hour}$ aircraft noise contours is that they are being used for purposes for which they are not suitable. They reduce a complex series of events to a single figure, which is useful for planning, summary trends and other purposes. However, despite published caveats, people can interpret the 57 contour as implying that people outside it should not notice aircraft at all. In fact, a proportion of people are annoyed at lower levels of aircraft noise. The contours only give a generalised long term indication of overall noise energy. Particularly when they are choosing where to live, people may want to know how many aircraft are likely to fly over, and at what times, including whether there are regular periods of respite. In the case of roads, railways and many other noise sources, the physical presence of infrastructure in the vicinity of a house may alert a buyer, while aircraft may not be using a relevant flightpath when buyers inspect. Better information on the probability of overflight could also be useful when people are visiting historic parks or gardens, nature reserves, or making other plans for open air activity.
- 4C.42 There are likely to be advantages in providing more information about aircraft noise in everyday language, such as where flightpaths normally are, and numbers of aircraft during particular times of the day. Radar plots can indicate where aircraft flightpaths are concentrated. However, they do not indicate how audible aircraft are likely to be in a given location. Also, the time of day in which people are most interested may vary depending on their activity patterns. The Australian Government has published papers assessing alternative forms of information.³⁷ The information people want may be simple, but analysing and presenting it in fully customised ways, such as through interactive websites may require considerable resources. What information people would find most useful, for what purposes, and through what delivery channels, needs to be examined.
- policy 48 The Mayor will urge the Government to examine how people use different types of aircraft noise information for different purposes, and how relevant data, such as on flightpaths, can be made readily available, subject to practical and security considerations. A study should assess what forms of communication would be more transparent and inclusive, and what arrangements for preparation, publication and independent

verification would best earn and maintain public confidence. The Government should consider what information on aircraft noise and flightpaths would be found most useful by those moving into an area.

Air freight

4C.43 Heathrow Airport is the largest air freight facility in the UK, handling some 56% of all UK air cargo in 2002.¹ The vast majority of air freight using Heathrow is carried in the holds of passenger aircraft. Freight-only aircraft are concentrated at Stansted. Luton is a centre for night courier operations. Air freight shipping and forwarding is a major activity in the Heathrow area, which assembles air freight consignments for other airports. The Mayor's Air Quality Strategy has highlighted air quality issues in the Heathrow area, and seeks to encourage lower emission vehicles. The use of the quietest available vehicles for inter-airport and other night movement of freight needs to be encouraged. The Heathrow Joint Distribution Centre for airport retailing has reduced the number of service delivery vehicles entering the airport. This is an important initiative with wider implications for demonstrating how load consolidation can reduce the environmental impact, including noise, of freight vehicles.



policy 49 The Mayor will urge the Government to work vigorously, including through international agreements, national and airport-related regulation and economic measures, to minimise the environmental impacts of air freight, including its overall implications for noise, and to promote effective and sustainable alternatives.

proposal 22 Transport for London will work with stakeholders to minimise the noise impacts of surface movements related to London area airports, including freight movements.

Other airports and airfields

4C.44 Noise associated with London City Airport is managed under the terms of a planning agreement between the operator and the London Borough of Newham. The Mayor will keep relevant issues under review, having regard to developments in Thames Gateway and the Lee Valley.

4C.45 Biggin Hill, in Bromley, is a general aviation airfield. It is used largely by executive and small commercial aircraft, and for recreational flying. Its use is controlled through an agreement with the London Borough of Bromley, which is both landowner and local planning authority. Biggin Hill accommodates a beacon which is used in one of the four 'holding stacks' associated with Heathrow. These stacks are part of a highly complex pattern of airspace management over South East England which has evolved over many decades. Subject to regulatory approval from the Civil

Aviation Authority, National Air Traffic Services Ltd is responsible for design of airspace management systems and procedures. Stack relocation would have many 'knock on' implications, though many consider that changes could reduce impacts on the more built-up areas.

4C.46 RAF Northolt, in north west London is used for military and VIP purposes. It is a 'core site' within the Ministry of Defence's future estates plan³⁸. Use of Northolt as a satellite or feeder airport for Heathrow has been considered and rejected³. Any increase in civil aviation use would require extensive consultation, and careful environmental assessment, particularly of the impact of any changes in take offs and landings over residential areas around the airport. Hillingdon Council has indicated it would strongly oppose any expansion of capacity for civil air traffic movements at Northolt above 7,000 annually.

4C.47 In terms of airfields in or close to London, Denham, Elstree, Kenley and Stapleford are used by light aircraft and gliders. The number of air movements is relatively small. Some operations at smaller airfields, such as repeated 'touch and go' (see glossary) during training, can have more potential for annoyance than 'average' noise levels might suggest. However, the issues are best dealt with by the local authorities concerned.

policy 50 The Mayor will urge the Government, the Civil Aviation Authority and airport operators, as technologies evolve and opportunities occur, to review the potential for airspace design and management to reduce the overall impact of aircraft noise on affected communities, with particular reference to the location of holding stacks, navigational aids, and aircraft routeing at relevant heights, relative to built-up areas. Significant changes in movement patterns within a framework of airspace infrastructure and rules should be subject to consultation, as well as changes in fixed infrastructure and rules themselves.

Helicopters

4C.48 Many people - workers and visitors, as well as residents - find helicopter noise especially annoying. Rotor blades generate particular kinds of noise, including at low frequencies. All new designs of helicopters to be flown in the UK have, since 1986, been required to meet noise certification standards, which are periodically improved. Some machines may, however, remain available for use for many years.

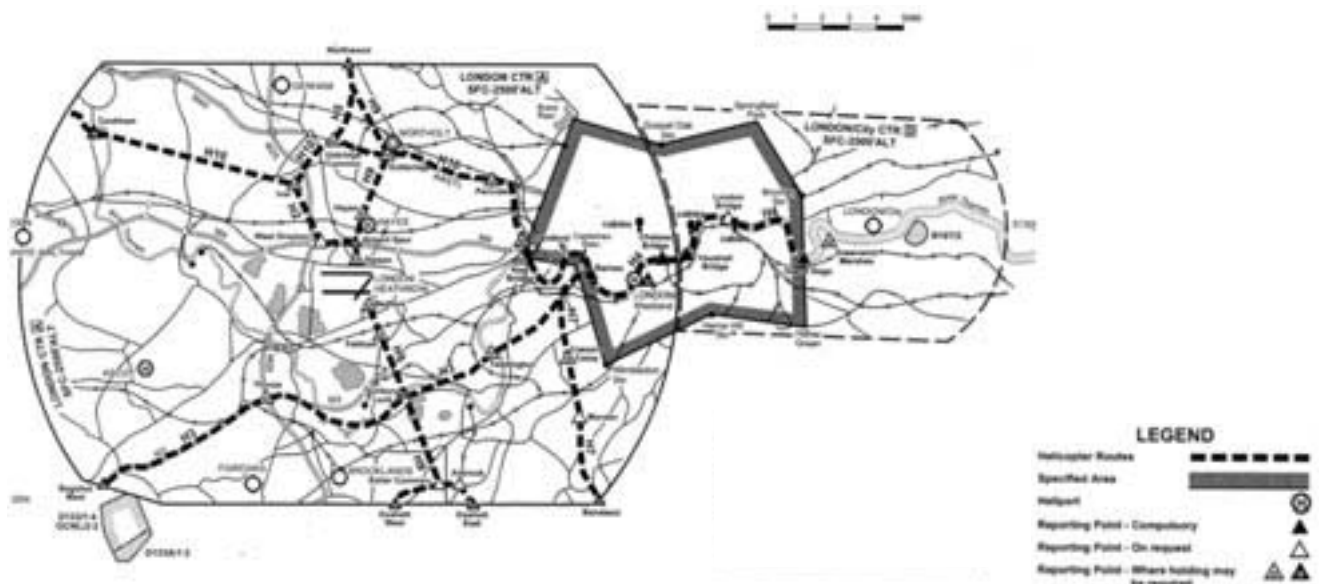
4C.49 Helicopters must obey Rules of the Air Regulations, and follow the instructions of air traffic controllers, but their movements are not generally further restricted. Single engined helicopters are required to follow certain routes in the London Control Zone, which includes a section



of the Thames through central London. Twin-engined machines have more freedom to take the most direct route. The limited number of routes available to single-engined machines can become heavily used during some periods. In certain areas, such as Greenwich, helicopters may be held for air traffic control reasons, which can create additional disturbance as machines circle.

4C.50 Existing helicopter routes have been designed taking account of flight safety and operational aspects of integration with other traffic flows. They tend to follow open spaces where available. This minimises the residential population overflow, though it reduces open space tranquillity. For example, the Barnes Wetlands wildfowl centre is located at a junction between helicopter routes. The corridors used are in practice some half a mile wide, which reduces the concentration of highest noise levels in many locations. Helicopters may not fly closer than 500 feet to any person, vessel, vehicle or structure, except when taking off or landing. The upper flying limits specified for helicopters are the highest practicable to avoid conflict with aircraft arrivals and departures. Flying heights are subject to weather and flight visibility requirements.

Figure 19 Helicopter routes across London



source: CAA - The UK CAA Aerodrome Charts manual (Extract from Airac 7 1999)

4C.51 People's attitudes to helicopter use are likely to be influenced by how essential they consider their use to be. It is not always clear to people on the ground whether a helicopter is being used for air ambulance, or other emergency services, for business, or for recreational purposes. Helicopters are secured for emergency services under a variety of

arrangements, and the use to which a helicopter is being put may not be obvious from its appearance.

- 4C.52 Police and other security operations can operate lower than other helicopters, and can depart from normal helicopter routes. This is likely to have accentuated public awareness of helicopter noise. Policy is, however, normally to fly as high as possible, subject to air traffic constraints. Air ambulance services operate from the Royal London Hospital at Whitechapel. Helicopter Emergency Medical Services (HEMS) have been expanding. Helicopter operation at night should normally be limited to emergency services.



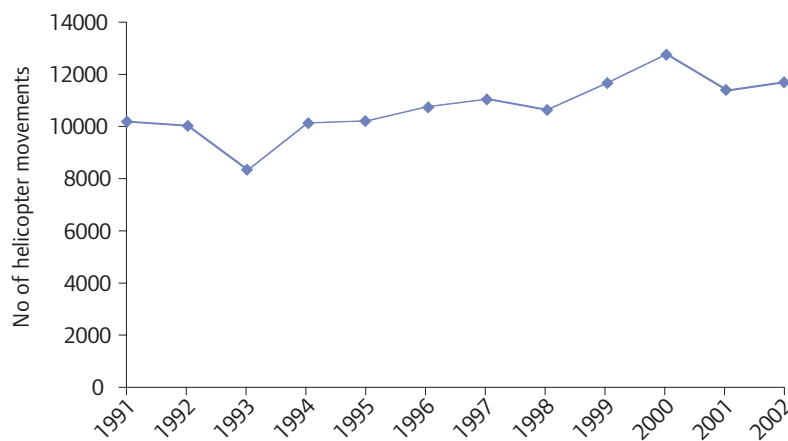
Box 48: Police helicopters

Police helicopter operations are governed by the provisions of a Police Air Operations Certificate, issued by the Civil Aviation Authority and held by the Metropolitan Police Commissioner. The Home Office act in an advisory role. The Metropolitan Police Service Air Support Unit operates three helicopters, carrying out operations including counter terrorist work, intelligence gathering, photographic, public order, crime prevention, missing person and suspect searches, vehicle pursuits and public safety tasks. When the current machines are replaced, noise will be one of the major factors taken into account in order to reduce impacts over London.

- 4C.53 The Mayor does not have any powers to control helicopter numbers, movements or routes. The use of helicopters may be influenced where planning permission for additional helicopter take-off and landing facilities is required. Under existing planning legislation, however, a site can be used for helicopter take offs and landings for up to 28 days a year without specific planning permission. It is difficult for local planning authorities to ensure that the 28 days are not exceeded. Helicopters can only operate from elevated sites with special permission from the Civil Aviation Authority. Emerging technologies may provide new opportunities for cost-effective monitoring and control.
- 4C.54 The London Heliport Study, published in 1995, concluded that there was demand for further heliport capacity east of the City, given that permitted unused capacity at Battersea Heliport was limited.

4C.55 Any additional heliport, including a floating heliport or a helipad on a building, would require planning permission. The noise impact of any new location on residents, workers and others would need to be fully and carefully assessed, not just in terms of immediate take off and landing flight paths, but the use of wider helicopter routes.³⁹ Implications for noise of changing helicopter use will need to be kept under review, together with other potential future developments such as airships and commercial tilt-rotor aircraft.

Figure 20 Aircraft movements at Battersea Heliport 1991-2002



source: CAA: UK Airport Statistics, 2002⁴⁰

policy 51 The Mayor will urge the Government, European Union, and the helicopter industry to progressively tighten noise emission standards, support the development of quieter helicopters, and ensure that noise impacts of related emerging aviation technologies are minimised.

policy 52 The Mayor will urge the Government and air traffic services to keep the noise implications of changing helicopter use under review, together with emerging opportunities for cost-effective monitoring and control, and to examine, in consultation with the Mayor, London boroughs and others, how relevant technologies could provide new ways of minimising noise impacts.

policy 53 The Mayor will expect any proposed heliport or similar facilities to be assessed in accordance with Planning Policy Guidance Note 24 or its replacement, and noise impacts minimised, including in terms of projected changes in intensity of use of helicopter routes across London. Working with boroughs in east London, the Mayor will consider the need for and practicality of identifying sites in east London for an additional heliport to support London's economy. Boroughs should, in general, resist proposals for private heliport facilities, with the exception of predominantly emergency use facilities.



Future spatial distribution of airport facilities

4C.56 As part of its preparation of a new national airports policy looking ahead 30 years, the Government set up a series of regional airport studies, including the South East and East of England Regional Air Services Study (SERAS)³. The Air Transport White Paper was published in December 2003⁴¹. The Government expressed support for the provision of two new runways in the region in the period to 2030. One would be provided as a second runway at Stansted, around 2011/2012. The other new runway would follow at Heathrow, in the 2015-2020 period, if stringent environmental limits could be met. An urgent programme of work and consultation was proposed 'to find solutions to the key environmental issues at Heathrow' and to consider how to 'make best use of the existing airport'⁴⁴. The White Paper sets out a strategic policy framework, but does not itself authorise any particular development. This would need to be the subject of a future planning application.

4C.57 The Mayor published his detailed views⁴³ in response to Government consultation on options for the region. London's international transport links for passengers and freight need to be provided for in ways which minimise noise exposure alongside other adverse environmental impacts. The Mayor recognises that further runway capacity in the south east will be required. In assessing any planning application, he will have regard to his statutory duties, including as regards 'the health of persons in Greater London' and 'the achievement of sustainable development in the United Kingdom.'⁴⁴ He will have full regard to economic and environmental factors, public transport access and regeneration benefits, and to the results of any investigations carried out by the London Assembly. The Mayor would be legally required to consider any planning application referred to him by a local planning authority⁴⁵ on its merits. Consideration of any planning application would include having regard to many factors extending beyond the scope of this London Ambient Noise Strategy, such as air quality, land take and housing demand. However, on the issue of noise, and on the basis of information currently available to him, the Mayor believes it unlikely that the provision of a further runway at Heathrow, catering for an increase of over a third in the number of flights, could be made acceptable to Londoners in noise terms.

policy 54 The Mayor will keep potential changes in the spatial distribution of London-related runway capacity and airport facilities under review, and will seek the fullest possible scrutiny of noise and other environmental impacts, as part of the consideration of implications for London. On the basis of information available to date, and taking a strategic view, he is minded to oppose creation of an additional runway at Heathrow on grounds of its likely overall environmental impact on Londoners.

policy 55 If aviation technologies and operational procedures prove unable to deliver sufficient improvements in noise and other environmental performance to match Londoners' legitimate expectations, and the needs of sustainable development, the Mayor considers that the Government should promote international action to manage aviation demand sustainably.

Applying the polluter pays principle

4C.58 The Air Transport White Paper⁴⁶ states that, over time, aviation should pay 'the external costs its activities impose on society at large - in other words, that the price of air travel reflects its environmental and social impacts'. The Mayor supports this principle, and urges the Government to bring forward concrete proposals to implement it. The Mayor believes funds raised should be ring-fenced for implementing measures to mitigate the environmental consequences associated with airports, including noise, and surface access.

4C.59 It is essential that funding, whether raised through Government or airport operators, is sufficient to address the full impacts on surface access and the environment. Monies raised should be distributed through Aviation Environment Funds. Their remit should be drawn sufficiently broadly to allow future support for projects and programmes related to noise mitigation and/or compensation, and other environmental action, including air quality and energy/carbon dioxide-related. For example, a programme of improvements to London's generally poorly insulated building stock, beyond those already carried out under existing airport home insulation schemes, could deliver noise, fuel poverty and greenhouse gas reduction benefits.

4C.60 London accommodates over its built-up area the main landing approaches to the nation's main aviation gateway. This effectively makes a major contribution to tranquillity in urban and rural areas elsewhere in the UK. Recognition should be given to this in the distribution of existing and future resources for noise reduction.

policy 56 The Mayor supports the view that the aviation industry should pay for the external costs which it imposes on society, including those related to noise.

proposal 23 The Mayor encourages the Government to issue proposals for levies to mitigate the environmental impacts of aviation, which should be distributed through Aviation Environment Funds for each airport.

References and notes

- 1 CAA. UK Airport Statistics 2002 available from http://www.caa.co.uk/erg/erg_stats/.
- 2 DfT. Air traffic forecasts 2000 available from <http://www.aviation.dft.gov.uk/atfuk2000/index.htm>
- 3 DfT. 'The Future Development of Air Transport in the United Kingdom: South East' Second Edition, Department for Transport, February 2003. See <http://www.dft.gov.uk>
- 4 DfT. 'The Future of Air Transport' Cm 6046. Presented to Parliament by the Secretary of State for Transport, 16 December 2003.
- 5 Copies of the Inspector's Report on the Terminal 5 Inquiry are available on disk from the Government Office for London, Planning Division, Riverwalk House, 157-161 Millbank, London, SW1P 4RR.
- 6 This compares with an area of 145.2 square kilometres within the 'standardised mode' contour in 2002, assuming Concorde had operated at 1999 levels, or 126.6 square kilometres with the reduced level of Concorde operations which actually took place; see 'Noise Exposure Contours for Heathrow Airport 2002' available from the Department for Transport, http://www.dft.gov.uk/stellent/groups/dft_aviation/documents/page/dft_aviation_022743-03.hcsp#P239_11608
- 7 Although a planning application can be 'called in' by the Secretary of State.
- 8 Available from http://www.dft.gov.uk/stellent/groups/dft_aviation/documents/page/dft_aviation_022743.hcsp
- 9 Department for Environment, Food and Rural Affairs, 'Towards a National Ambient Noise Strategy' Consultation paper, November 2001
- 10 Department of the Environment, 'Planning and Noise' Planning Policy Guidance Note 24, HMSO, September 1994, where $57 \text{ dB}_{\text{Aeq}}$ is also the boundary between Noise Exposure Categories A and B, see Appendix A5.
- 11 Civil Aviation Authority. 'United Kingdom Aircraft Noise Index Study: Main Report' DR Report 8402, CAA January 1985
- 12 'Ainsworth unveils new study into aircraft noise' DETR News Release 269, 8 May 2001. Study proceeding as ANASE (Attitudes to Noise from Aviation Sources in England).

- 13 ICAO Resolution A33/7, 'A consolidated statement of continuing ICAO policy and practices relating to environmental protection' provides a framework within which action to reduce aircraft noise is considered.
- 14 Following Government consultation in 2002, the Aerodromes (Noise Restrictions)(Rules and Procedures) Regulations 2003 (SI No 1742) implement European Directive 2002/30/EC on rules and procedures for introducing noise-related operating restrictions at Community airports. Proposals for change would also need to have regard to ICAO Resolution A33/7.
- 15 Strategic research goals of the Advisory Council for Aviation Research in Europe include reducing perceived external noise levels by half by 2020, see Strategic Research Agenda, October 2002, <http://www.Acare4Europe.com/>
- 16 Arthur D Little Ltd (2000), 'Study into the Potential Impact of Changes in Technology on the Development of Air Transport in the UK' Report to DETR, November 2000
- 17 The initial part of Standard Instrument Departure Routes (SIDs) form the centre-line for Noise Preferential Routes used by departing aircraft, see glossary. Aircraft approach to land on a glideslope which is nominally a straight extension of the runway centre-line.
- 18 BAA/Heathrow, Noise Strategy 2000-2005. BAA Heathrow Planning & Environment Department, April 2001
- 19 'Noise from arriving aircraft: an industry code of practice' Department for Transport, Local Government and the Regions, with CAA, NATS, BAA, BA, Airtours International, September 2001, available from <http://www.aviation.dft.gov.uk/index.htm#env>
- 20 DfT. 'The Future of Air Transport' Cm 6046. Presented to Parliament by the Secretary of State for Transport, 16 December 2003, paragraph 11.66.
- 21 Paragraph 3.14 of the Air Transport White Paper (see note 20) indicated the Government's intention to amend section 78 of the Civil Aviation Act 1982 so that night restrictions 'could, subject to public consultation, be set on the basis of noise quotas alone, without a separate movements limit.' The White Paper states that this could provide 'a more effective incentive for airlines to acquire, use and develop quieter aircraft.' However, as set out in paragraph 4C.9 of this strategy, numbers of noise events can also be an issue which Government policy proposals would need to address.

- 22 For Government consultation on interim extension, 'Night Flying Restrictions at Heathrow, Gatwick and Stansted', Department for Transport, April 2003, see http://www.dft.gov.uk/stellent/groups/dft_aviation/documents/page/dft_aviation_022757-01.hcsp#P28_575
- 23 Application No. 36022/97: Hatton and others v the United Kingdom, judgement issued 2 October 2001
- 24 Application No. 36022/97: Hatton and others v the United Kingdom, judgement issued 8 July 2003
- 25 Vallet M. 'Effects of noise on health' in Garcia A. 'Environmental Urban Noise' WIT Press, Southampton, 2001
- 26 DETR 'Air Quality Strategy for England, Scotland, Wales and Northern Ireland' The Stationery Office, 2000
- 27 DETR, Planning Policy Guidance Note 24, 1994
- 28 Available on the Civil Aviation Authority website:
<http://www.caa.co.uk/docs/7/DfTEnvironmentalGuidance.pdf>
- 29 Paragraph 3.7 of the Government's Air Transport White Paper (see note 4) calls for a balanced approach to limiting and where possible reducing noise impacts. This includes 'using land-use planning and management measures at and around airports, including avoiding new housing development in areas exposed to high levels of noise.' Paragraphs 3.21 and 3.24 of the White Paper imply that 'high' means 69 dB L_{Aeq} or more.
- 30 Building Bulletin 93 'The Acoustic Design of Schools', DfES. (Section 1 came into force 1 July 2003).
- 31 <http://www.doh.gov.uk/hef/airpol/wlondonschools.htm>
- 32 <http://www.ranchproject.org>
- 33 See particularly, paragraph 3.23 of the December 2003 Air Transport White Paper (note 4).
- 34 Paragraphs 3.15 to 3.27 of the December 2003 Air Transport White Paper include some outline criteria for acoustic insulation schemes. No reason is given for specifying a 3 dB(A) increase criteria to trigger eligibility in respect of aircraft noise, when regulations for road and railway noise specify a 1 dB(A) increase (see Appendix A7).

- 35 The Mayor acting on behalf of the Greater London Authority is a statutory consultee under section 35 of the Civil Aviation Act 1982 as amended by section 372 of the Greater London Authority Act 1999.
- 36 See glossary, Appendix A8.
- 37 'Discussion Paper - Expanding Ways to Describe and Assess Aircraft Noise' Department of Transport and Regional Services, Australia, August 2002. See <http://www.dotars.gov.au/avnapt/sepb/discussion/5.htm>
- 38 Paragraph 11.102 of the December 2003 White Paper (see note 4).
- 39 Planning Policy Guidance Note 24: 'Planning and Noise' The Stationery Office, September 1994. See http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_606912.hcsp
- 40 available from http://www.caa.co.uk/erg/erg_stats/
- 41 See paragraph 4C.4 and note 4.
- 42 See paragraph 11.11 of White Paper (see note 4) which also states that land should be safeguarded for a second wide-spaced runway at Gatwick after 2019, if conditions related to Heathrow cannot be met.
- 43 The Mayor of London's response to the consultation document 'The Future Development of Air Transport in the United Kingdom: South East', Greater London Authority, June 2003. See http://www.london.gov.uk/gla/publications/planning.jsp#seras_response
- The London Assembly Transport Committee's response to the Government's aviation consultation 'Flying into the Future' GLA, July 2003 is also available, see <http://www.london.gov.uk/assembly/reports/transport.jsp>
- 44 Greater London Authority Act 1999, sections 30 and 41.
- 45 Town and Country Planning (Mayor of London) Order 2000. Statutory Instrument 2000 No.1493. The Stationery Office.
- 46 Paragraph 2.18 of White Paper (see note 4). Also, DETR, 'The Future of Aviation: The Government's Consultation Document on Air Transport Policy' December 2000, and 'Aviation and the Environment: Using Economic Instruments' HM Treasury and Department for Transport, March 2003.

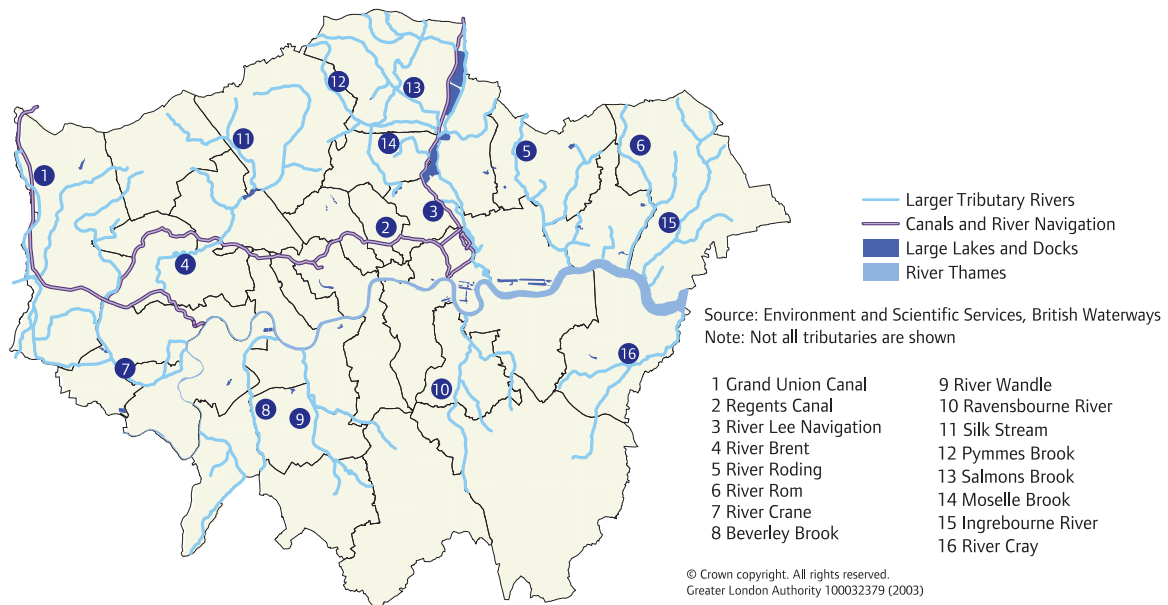


4D noise on rivers and canals

4D.1 The Mayor's London Plan seeks policy and action which takes account of the unique character of the 'Blue Ribbon Network' - the semi-natural and man-made system of rivers, canals and water spaces which plays such an essential role in sustaining London. Chapter 4C of the London Plan seeks to protect and enhance the Blue Ribbon Network, supporting a complex mix of demands. Principles include making more use of it, contributing to economic success, accessibility, inclusivity and safety while ensuring that it is both a healthy and a calm series of places.



Figure 21 The Blue Ribbon Network



4D.2 In relation to all his strategies, the Mayor has a duty under the Greater London Authority Act 1999 to have regard to 'the desirability of promoting and encouraging the use of the River Thames safely, in particular for the provision of passenger transport services and for the transportation of freight' (section 41(5)(d)). The Greater London Act 1999, in requiring preparation of a 'London Ambient Noise Strategy' states that 'ambient noise' includes 'noise related to... water transport' (section 370(3)(a)). This is taken here to refer to all of London's navigable waterways, including the River Thames, other river navigations, and canals. With river tributaries, lakes and docks, these are vital parts of London's structure, heritage, environment and urban quality. Their widely varying character includes contrasting soundscapes. Water is acoustically hard, and sound propagates readily over its surface. Higher wind speeds across open water can scatter sound, or carry it further downwind.

4D.3 It is important that the benefits for overall noise minimisation achievable by diverting movement from noisier modes are secured while respecting the varied soundscapes of London's navigable waterways, including in





terms of freight access to and from wharves. The Government announced in November 2000 that it would sponsor an inland waterways freight study group¹. National policy on inland waterways is set out in 'Waterways for Tomorrow'². The Mayor's Transport Strategy seeks examination of measures to make better use of the River Thames and other navigable waterways for freight as well as passengers.

policy 57 The Mayor will, and Boroughs, the Port of London Authority, British Waterways, the Environment Agency and others with responsibilities for London's Blue Ribbon Network should, seek to minimise the adverse impacts of noise on, from, within or in the vicinity of water spaces, while promoting sustainable uses, including for passenger services, freight, leisure, and as eco-systems.

4D.4 Issues involved in noise management on London's navigable waterways include powering of craft; tourist and party boats, piers and moorings; wharves, boatyards and waterside planning; and water and waterside tranquillity. The scale and nature of issues and solutions can vary widely, particularly between the Thames and other waterways. Competing objectives, such as leisure and recreation, heritage, freight transport, and regeneration, need to be balanced.

Powering of craft

4D.5 Many of the Port of London Authority's freight facilities are now outside the administrative boundary of London. However, the River Thames still has an important role in carrying freight to and from the city. Three million people travel on the Thames each year. The propulsion systems of modern passenger and leisure craft have generally become quieter. Large marine engines generate noise at low frequencies which can be difficult fully to contain. Modern hull designs are generally more efficient than in the past, offering less drag, and creating less wash. The four miles per hour speed limit on London's canals means wash is rarely an issue there. Electric charging points have been provided by British Waterways, the Environment Agency and others to encourage the use of electric boats. River craft may be early users of new, quiet technologies such as fuel cells. Small fast craft, such as jet skis, mini-hovercraft and leisure powerboats, can be disproportionately noisy. Noise management criteria will need to vary for different water spaces.



policy 58 The Mayor will encourage the development and use of quiet propulsion and power systems for vessels using London's rivers and canals. This will include promoting fuel cells for water craft through the London Hydrogen Partnership, and wider availability of electric boats and charging points.

Tourist and party boats, piers and moorings

- 4D.6 While noise from the engines of modern craft, or their passage through the water, has reduced, incidental or associated activities can cause annoyance. Public address systems, particularly loudspeaker commentaries to tourists on riverboats, can annoy Thames-side residents or workers, although investment in new vessels is helping to reduce this problem. Late night noise from 'party boats' - entertainment noise more often associated with pubs and clubs - can cause particular annoyance to those in riverside housing. Conflicts along the Thames could potentially increase.

Box 49: London River Services

London River Services, part of Transport for London, operates a number of piers. It licenses a range of scheduled and chartered riverboat services which use those piers. Operators of party boats are required to fit noise limiting devices to amplification equipment to enable noise to be controlled by the person in charge of the vessel, and to take other measures to control noise. Party boats, however, also operate from other privately owned piers.



London River
Services

- 4D.7 The Port of London Act 1968, section 162, gives the Port of London Authority power to make byelaws. The Port of London River Byelaws 1978 (as amended) include provisions against intoxication or causing unreasonable noise. The Maritime and Coastguard Agency requires the fitting of noise limiters for safe navigation purposes, notably to prevent interference with on-board communication. Ensuring that such equipment is maintained and operated in such a way as to control noise nuisance, such as from an on-board disco, can be problematic. The London Port Health Authority undertakes launch-based patrols, and works jointly with riparian local authorities, the Port of London Authority and the Metropolitan Police to deal with noise from party boats. The London Port Health Authority has general powers under the Environmental Protection Act 1990 to take action against excessive noise on the river on grounds of nuisance. However, it is much more difficult to establish a specific case of noise nuisance related to a boat moving on the river than a public house.
- 4D.8 The Licensing Act 2003 rectifies the anomaly whereby alcohol sales and public entertainment on moving vessels were not licensed like land-based activities. The Act will require craft to be treated for licensing purposes as if they were premises situated in the place where they are usually moored or berthed. It is important that regulations and guidance implementing the Licensing Act 2003 fully address the specific issues associated with managing noise and other issues on riverboats which operate along the Thames. It is likely to be more efficient and cost-effective for Thames riverboat licensing and enforcement to be carried out by a single body



with specialist resources, such as the London Port Health Authority, than by each London borough with a relevant mooring or berth. Co-ordination will be needed, for example, related to noise from people leaving piers late at night. It is vital that licensing fees cover not just the issue of a license, but the costs of enforcement³, and any other public services which may be required.

4D.9 Craft on London's canals serve far fewer people, and in typically more low key ways, than do Thames riverboats. Passenger and other services operate on the Regent's Canal. British Waterways continues to review the potential for increasing the numbers travelling on other waterways, through a range of initiatives, and incorporates noise where necessary in its management of competing needs. It regulates canal operators through licensing and operating agreements, which include operating times and boarding arrangements.

policy 59 The Mayor will urge the Government, in regulations and guidance in respect of vessels defined in section 189(1) of the Licensing Act 2003, to ensure that resources for enforcement and other services are adequate, having regard to the particular issues of night noise associated with Thames 'party boats'. Partnership working between the London Port Health Authority, the London boroughs and others with relevant responsibilities, should seek a clear and effective framework for river noise management.

Wharves, boatyards and waterside planning

4D.10 In mid 2001, some 40 of the 55 wharves in the Port of London, within the GLA boundary, were operational. Much of the material handled is bulk. Aggregates, steel, cereals and municipal wastes are important (see paragraph 4E.23 on special issues related to aggregates). Strategic and local planning policies have sought to offer protection to river freight handling facilities. Regional guidance⁴ stated that 'the movement of goods by water rather than road can help relieve traffic congestion and air and noise pollution, and is consistent with the principle of sustainable development.' In parallel with guidance, the Government issued directions introducing a system of wharf safeguarding, to ensure that water freight facilities could not easily be lost to other forms of development. This power has been transferred to the Mayor.

4D.11 The Mayor, in consultation with the Port of London Authority and the riparian local authorities, reviewed 29 currently safeguarded upstream wharves, and 42 proposed sites downstream of the Thames Barrier, in the context of the London Plan, new trade forecasts to 2015, associated port capacity requirements and general cargo-handling trends.⁵ The Mayor seeks protection and use of relevant wharves for sustainable distribution.



A review of the provision of boatyard facilities in London will also be carried out. The London Plan recognises that opportunities for new freight facilities on London's canals will be limited, but should be encouraged where they occur.



- 4D.12 Operational wharves and boatyards are vital to the future of working waterways. Water transport is in principle a highly 'noise efficient' mode. However, noise cannot be eliminated entirely from the operation of working waterways. Codes of practice can and should be followed to minimise noise from operations at wharves and boatyards. Unnecessary industrial noise, particularly that which has a tonal quality, low frequency noise, and annoying impulsive noise, should be minimised at source. However, hours of operation may need to relate to the tidal cycle, rather than a regular working day. The role of the Thames as a working river can be threatened, not just by direct replacement of wharves and boatyards by other uses, but by the change of use of buildings and land next to them to noise-sensitive uses. The use of nuisance legislation by occupants of new housing can result in the continued viability of operations being undermined, despite benefits for sustainable development. Local planning authorities should ensure that any new noise-sensitive uses near safeguarded as well as operating wharves and boatyards are so designed as to protect users adequately from noise inseparable from a working waterway. Local planning authorities should consult the London Port Health Authority on relevant planning applications. Policy 4C.15 of the London Plan states that development next to or opposite safeguarded wharves should be designed to minimise the potential for conflicts of use and disturbance.

- policy 60 The Mayor will urge boroughs, the Port of London Authority, British Waterways and other relevant agencies, as far as reasonably practicable and cost-effective in the context of a working river, to avoid, contain or minimise noise from or associated with the water space, recognising that some sounds can make positive contributions to water space character. Boroughs should pay particular regard to the viability of established waterside infrastructure, canal sites identified by British Waterways as having future potential, safeguarded wharves and boatyards when giving permission for noise-sensitive uses next to, nearby, or opposite. Planning briefs, conditions, agreements or other mechanisms should be used to protect incomers, including through contributions to noise reduction at source.

Water and waterside soundscape quality

- 4D.13 Many parts of London's rivers, canals, lakes and reservoirs are among its most valued sources of tranquillity, though busy and vibrant sections may also be valued for their particular character. Their importance for wildlife,





recognised in the Mayor's Biodiversity Strategy, is reflected in the counterpoint to urban noise offered by natural sounds. Sensitive soundscape management can help people experience being on the edge of the wild in the heart of the urban. Diversity and distinctiveness can also include local human-made 'soundmarks', such as weirs or other active water. Canal towpaths and routes along London's rivers are used extensively as walking and cycling routes. They are key leisure, sport and recreation resources for Londoners and visitors, and can be further explored in terms of their changing sound environments (see glossary under 'soundscape'). The Thames Path from the source to the Thames Barrier provides many places for tranquil enjoyment, including where people can gain access to the foreshore. Watersides are typically places where people have a reasonable expectation of relative quiet. Craft on residential moorings may provide their occupants with less physical protection from road, rail, helicopter or other aircraft noise than do conventional dwellings.

- 4D.14 It is important that future planning, design and operation on and around London's water spaces protect tranquillity as far as possible. Many London water spaces may not be especially quiet in absolute terms, compared with those outside the city. However, their relative tranquillity may be no less valued by people. British Waterways often requests that a noise assessment is conducted to establish existing noise levels along the towing path, and to predict the noise effect of proposed development on the waterway environment.⁶ Noise mapping can provide a useful framework. However, it is also important, particularly in the water space context, to consider features of positive soundscape interest or identity.⁷ Qualitative analysis can provide opportunities for popular engagement. 'Areas of Relative Tranquillity or Special Soundscape Interest' are not, at this stage, included in the London Plan, but exploration of the potential role of such a designation is encouraged (see also paragraph 4F.29 and Policy 78 below).
- 4D.15 Given the London Plan's encouragement to more sport and leisure use of London's Blue Ribbon Network, as well as freight and passenger transport, tensions between demands for active and tranquil uses need to be addressed in design and management. The level of noise and its local impact need to be assessed to determine whether a noise management plan is appropriate. Soundscape management, by space and time, could be among the issues considered in Thames Policy Area appraisals (as proposed in the London Plan, Policy 4C.26), and in management plans of river and canal authorities.

- policy 61 The Mayor will urge boroughs, the Port of London Authority, British Waterways, the Environment Agency and others with responsibilities for London's Blue Ribbon Network to consider the need for frameworks for managing water soundscapes. Elements include noise mapping, measurement and attitude surveys, access to quiet, and, having full regard to the needs of a working river or waterway, exploring designation of Areas of Relative Tranquillity or Special Soundscape Interest.
- policy 62 The Mayor will urge boroughs in their Unitary Development Plans, and the Port of London Authority, British Waterways, the Environment Agency and other agencies through their plans and management regimes, to include measures to protect and enhance soundscapes on or adjoining appropriate water spaces. This includes screening by buildings and development over noise sources, design of bridge parapets and other features, to reduce noise on and in the vicinity of appropriate water space.

References and notes

- 1 'Modern Ports: A UK Policy' DETR, 2000. See <http://www.shipping.dft.gov.uk/index.htm>
- 2 'Waterways for Tomorrow' DETR, June 2000. See <http://www.defra.gov.uk/environment/bw/tomorrow/index.htm>
- 3 An effective enforcement framework is likely to require the establishment, in agreement with riparian local authorities and others, of river noise guidelines, covering, for example, noise limiter settings and other criteria.
- 4 'Strategic Planning Guidance for the River Thames', RPG3B/9B, Department of the Environment, February 1997
- 5 'Safeguarded Wharves on the River Thames' Consultation Draft, Greater London Authority, April 2003.
- 6 In consultation on this strategy, British Waterways identified busy road and railway bridge crossings as the most significant source of noise on its waterways in London (13 June 2003). Transparent materials can, in principle, reduce traffic impacts while retaining an open visual aspect.
- 7 For example, locks and weirs on the canals. In some contexts, reverberant under-bridge spaces can be features of interest (though see also previous note).

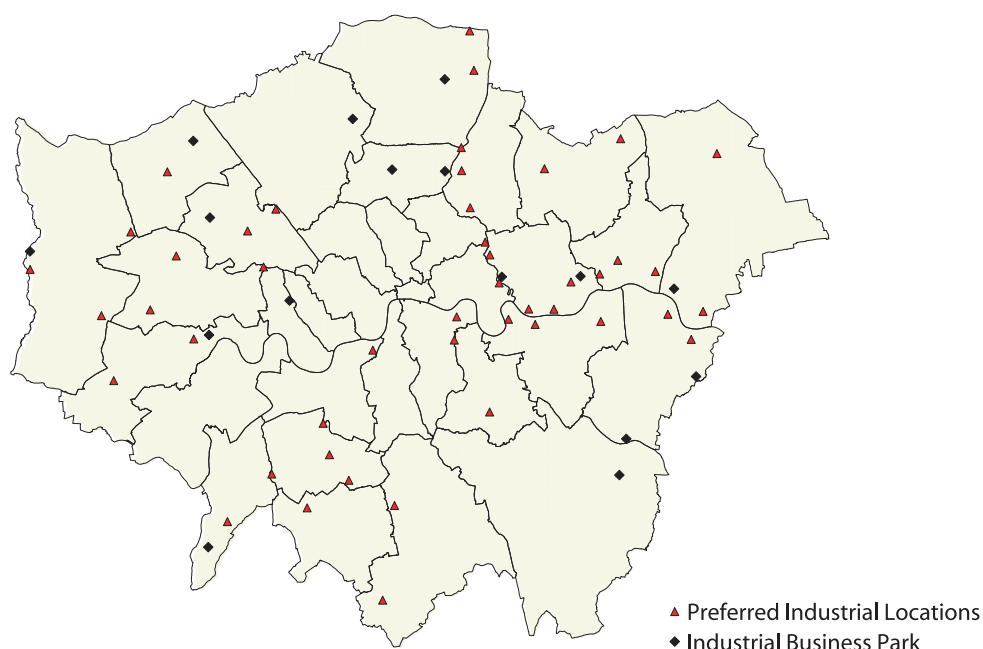




4E industrial noise

- 4E.1 Manufacturing output per head is higher in London than in the UK. Many older and noisier industrial activities have left the city, closed, or been replaced with modern, higher productivity processes. Estimates for the London Plan¹ were that some 322,250 people, or 7.2% of the total, were employed in manufacturing in 2001. This was projected to fall to 240,000, or 4.7% of the jobs total, over the plan period to 2016.
- 4E.2 It was estimated that in 1998, London had some 6,900 hectares of industrial land.² 14% was vacant, together with 1.8 million square metres of vacant industrial floorspace. The interface between remaining industry and new noise-sensitive uses will need to be given careful attention wherever selective release of industrial land occurs.³ Existing and prospective noise from transport also needs to be considered, to ensure that it is, as far as possible, the quieter sites that are released for noise-sensitive uses (see particularly paragraphs 4C.32-36 and Policy 45). Since 1994, policy has been guided by a Strategic Employment Locations framework. This takes account of industry's needs in terms of clustering, capacity, environment, accessibility and cost through two basic types of location: Preferred Industrial Locations (PILs) - lower cost, often space extensive premises where environment is not a major constraint; and Industrial Business Parks (IBPs) - higher quality, usually more expensive, and sometimes higher density. It is important to London's future noise environment that space for potentially noisy activities remains available in PILs. Noise-sensitivity needs to be a key part of deciding where wholesale distribution and servicing-related uses are located, having special regard to any night loading and unloading.

Figure 22 Strategic Employment Locations





- 4E.3 Published data⁴ indicates some 740 sites involved in managing waste within London. There will be a need to identify and safeguard land and premises in appropriate locations for new environmental industries and activities connected with recycling and reprocessing of materials. Preferred Industrial Locations are likely to be particularly suited to many handling and processing activities from the viewpoint of minimising potential noise impact. London's first Economic Development Strategy, published in July 2001, set out a shared agenda which included ensuring that London continues to support a broad range of economic activity. New and renewable sources of energy and materials recycling were seen as making growing contributions. The London Development Agency has recently completed an audit of the environmental goods and services sector.
- 4E.4 The EU Directive on the Assessment and Management of Environmental Noise⁵ (END) requires mapping of noise from major industry 'such as' those defined in Annex 1 to the Directive on Integrated Pollution Prevention and Control⁶ within agglomerations including London. Under the Greater London Authority Act 1999, section 370 (3) and (4), 'ambient noise' can include any fixed industrial source.

Integrated Pollution Prevention and Control, and Waste Management

- 4E.5 Ambient noise from industrial development has been controlled largely by boroughs through the town and country planning system, and their environmental health functions - including action against noise disturbance from existing industrial activities under Part III of the Environmental Protection Act 1990. A new system of Integrated Pollution Prevention and Control (IPPC) is being introduced for certain industrial activities to comply with European Commission Directive 1996/61. IPPC is an integrated approach controlling emissions to air, water and land, alongside noise and energy consumption, through enforcement of permit conditions based on the use of 'Best Available Techniques'⁷ (BAT - see glossary). The system of control entails site specific permits laying down emission limit values and/or equivalent technical measures. Permits may contain suitable release monitoring requirements and an obligation to supply the competent authority with data required for checking compliance. IPPC will be applied progressively over the period to 2007. The Environment Agency is the regulator of larger, potentially more polluting industries (Part A1 installations). Other industries - the majority in London - continue to be regulated by local authorities. The London Port Health Authority has the same powers as a local authority in relation to industrial noise on and around the river, and should be consulted by riparian authorities.



- 4E.6 Local Authorities are consulted on all IPPC permit applications, and the Environment Agency attaches particular weight to their response when determining BAT for noise at a given installation. According to the Government's 'Practical Guide' on IPPC,⁸ "The Agency shall justify the occasions when it does not follow any Local Authority noise proposals". The emphasis is on control of noise at source and a risk-based approach to the regulation of noise under IPPC is outlined in the Agency guidance. Where noise is not a problem and good practice is being observed, it is unlikely that permits will include any specific conditions relating to noise other than a general requirement to use BAT. However where noise is likely to be a problem, the permit conditions are likely to be influenced by relevant planning conditions and previous enforcement history. An operator may be required to prepare a noise management plan where the degree of noise risk justifies its use. Any monitoring required will be expected to be carried out according to relevant British Standards or other guidance. Permitted noise levels will depend on local circumstances. In theory, different environmental objectives may be traded off against each other to achieve best overall environmental protection. In practice, this is not expected to result in any reduction in standards as regards noise.
- 4E.7 The Mayor's Municipal Waste Management Strategy and Green Procurement Code envisage large increases in waste recycling. Major changes to London's materials economy are implied, with a growth in local and regional 'remanufacturing' from materials which would previously have been exported as waste. Planning Policy Guidance Note 10,⁹ includes advice on how the land-use planning system can contribute to sustainable waste management by providing the required facilities. The image and public acceptability of many parts of the waste management industry need to be improved. Noise from waste vehicles is considered in Chapter 4A (paragraphs 4A.51 and 52, and Policy 14).
- 4E.8 The Waste Management Licensing Regulations 1994 require the avoidance of nuisance through noise arising from the recovery or disposal of waste. This requirement applies to activities subject to the waste management licensing system, and those processes dealing with waste which fall under IPPC. The Environment Agency works closely with boroughs at early stages in the licensing and planning processes to ensure that responsibilities for dealing with noise from waste sites are clear. The Agency's 'Guidance for the Regulation of Noise at Waste Management Facilities', version 3 was published by the Environment Agency in July 2002. It proposes that its inspectors will consider the impact of noise on the surrounding environment as part of routine site inspections, and that the Agency should set conditions in waste management licenses to include, where appropriate, conditions to control noise.



4E.9 The Environment Agency views conditions in the waste management site licence as complementing the planning requirements, allowing for a more flexible approach to the regulation of day-to-day activities on the site. If relevant objectives are not met within the framework of planning permission, the Environment Agency is obliged to set conditions under section 35(3) of the Environmental Protection Act 1990, included in the waste licence. Licence conditions do not prevent statutory noise nuisance proceedings being taken.

4E.10 High levels of building activity are expected to meet demands for more housing and workplaces in London. More stringent Building Regulation requirements for sound transmission could increase building materials use. Considerable efforts have been made in the building industry over recent years to minimise materials use and increase recycling. Improved building insulation is a potential market for recycling of materials from within the building sector and from outside.

policy 63 The Mayor will, where appropriate and practicable, participate in initiatives to minimise the adverse impacts of industrial noise, such as through promoting good practice in building design. This would include initiatives related to Integrated Pollution Prevention and Control industrial sites, and waste management facilities, in conjunction with the Environment Agency, local planning authorities and others.

proposal 24 Subject to resources being secured, the Mayor will investigate the scope for promoting recycling of waste materials into products which contribute to noise reduction, such as noise insulation materials for buildings.

Issues in controlling industrial noise

4E.11 Industrial noise control has had two main goals - avoiding exceeding desirable absolute noise levels, such as set out in guidelines produced for the World Health Organisation, PPG24 and BS 8233; and avoiding noise which is considered likely to give cause for complaint, as set out in BS 4142. However, there is also the question of preventing a gradual upward creep in background noise levels (see 'creeping ambient' in glossary). Avoiding creep could require new sources to be 10 dB below the background L_{90} (see Appendix A2 for terms) though judgement needs to be exercised in relation to local circumstances. Sustainable development requires a pragmatic approach taking account of all of these in the local context. Under IPPC the operator must apply 'Best Available Techniques' (BAT - see glossary) which aim to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary, in relation to Part A1 installations regulated by the Environment Agency.

4E.12 Industrial noise should be primarily controlled at source, through plant design, installation, operation, and maintenance. Good operator training is important. Sources of industrial noise are many and highly varied. Industrial noise can be challenging to predict at the planning stage. Diagnosing the source of annoyance, and designing appropriate solutions can also be difficult. Industrial noise and vibration control is a highly specialised field. Control technologies are often specific to the particular industry. Impulsivity, intermittency and tonality can be particularly disturbing features of industrial noise. Low frequency noise can be especially problematic. Planning Policy Guidance Note 'Planning and Noise', PPG24 states that the character of the noise should be taken into account as well as its level, and that 'sudden impulses, irregular noise or noise which contains a distinguishable continuous tone' will require special consideration. BS 4142 applies a weighting to the measured or calculated noise level to allow for such characteristics.



4E.13 Issues involved in noise management in industrial development include quieter processes and equipment; plant insulation and absorption, enclosure and screening; ventilation and process extracts; hours of operation; and spatial planning and building insulation. Noise sources requiring similar measures may also be found in commercial and other premises (e.g. air conditioning plant, chillers and extract ventilation plant) - see also Chapter 4F, especially Box 55 and Policy 77.

Quieter processes and equipment

4E.14 Noise is produced in many different ways, such as from vibrating surfaces; reverberation or aerodynamic processes, such as from a fan, jet or pump; and impact, which may include first impact and subsequent resonance. Generally, as a first priority, all reasonably practicable steps need to be taken to secure use of the quietest processes and specification of the quietest plant and methods of working, with the aim of designing out noise and vibration at source. European Union Directives increasingly control industrial noise at source, through specifying limits for noise produced by many types of machinery. Noise is particularly difficult to control from open activities, such as scrap metal handling, and sites used for temporary purposes.

Plant enclosure and screening

4E.15 Generation of noise and vibration cannot always be avoided with available manufacturing technologies. Transmission of noise and vibration can, however, be controlled. Issues include siting noisy equipment as far as possible from noise-sensitive areas; orienting any plant with strong sound directivity away from noise-sensitive areas; isolation and containment, e.g. using resilient mountings, insulating ductwork, lagging pipework and using acoustic claddings and linings; insulating buildings which house

machinery; acoustic screening by buildings on the site, including locating vents in the most screened positions; installing noise barriers, such as 3-sided pens for electrical transformers; and using landscaped earth bunds where space is available.

Ventilation and process extracts

- 4E.16 Acoustic enclosure of machinery may give rise to additional requirements for cooling and ventilation. Silencers to inlets and outlets, e.g. to attenuate ventilation fan noise, will frequently be required. Ductwork and pipework can generate as well as transmit noise. 'Anti-noise' (see glossary) can be particularly effective when used to cancel noise of a simple and consistent frequency, such as in fan assemblies.

Operation and management

- 4E.17 Good operating and management practices are essential, backed up where necessary with an environmental management system. Regular and effective maintenance can be cost-effective, e.g. avoiding friction wear in conveyor rollers, trolleys and other machinery, and improving balancing to reduce vibration in rotating parts. Regular vibration monitoring of rotating machinery can detect deterioration of bearings, enabling replacement before damaging failure occurs, saving money as well as reducing noise and vibration. Conditions on hours of operation may apply to the whole plant or parts, loading and unloading, or other specified operations. Machinery in intermittent use should, wherever possible, be shut down between work periods. Types of activities may be restricted. Staff training should include use and maintenance of plant, and positioning of mobile equipment.

Spatial planning and building design

- 4E.18 Numerical noise limits may be set at the site boundary or at the nearest noise sensitive location. Guidance is given in BS 4142 1997 for rating industrial noise, and, for mineral workings, in MPG 11: The Control of Noise at Surface Mineral Workings¹⁰ (currently under review¹¹). Recommended noise levels in workshops, offices and other potentially affected uses, are given in BS 8233: 1999 'Sound Insulation and Noise Reduction for Buildings'. BS 4142 is the subject of review.
- 4E.19 Finer-grained land use mixing increases the importance of controlling noise at source. Site entrances and building openings need to be sited away from sensitive receptors, and screened by intervening buildings, structures, or noise barriers. Low frequency noise can travel considerable distances, especially from high level air handling plant. Temperature inversion at night can assist sound propagation. Hums and unusual sounds on the borders of the audible, can arise from gas, electricity, water and other utility plant as well as from industry. Specialist acoustic trouble-

shooting is often necessary. Many of the issues considered in Chapter 4F, notably paragraphs 4F.23 onwards, apply in industrial areas, including the use of acoustically soft surfaces.

Box 50: Guidance on noise from industry

Planning Policy Guidance Note 4: 'Industrial and Commercial Development and Small Firms' DTLR, November 1992 states that, in the context of mixed use, many businesses can be carried on in residential areas without causing unacceptable disturbance through increased traffic, noise, other adverse effects. Scale of the development, nature of use and location remain important. Planning permission should normally be granted unless there are specific and significant objections.

4E.20 Established industrial uses are not immune from action on statutory nuisance grounds. Local authorities may issue Abatement Notices in respect of nuisance under the Environmental Protection Act, 1990, except for Part A installations where the noise or vibration emissions have been regulated by a Pollution Prevention and Control (PPC) permit, in which case the prior consent of the Secretary of State would be needed. New occupants can bring private actions, following a move into new housing built near existing industry. The continued viability of established, otherwise desirable industrial activities can thus be threatened, although the legal defence is available to the operator that Best Practicable Means have been employed to limit impact (see glossary). This issue is particularly likely to arise where only parts of industrial areas are released for housing. Opportunities should not be lost to achieve noise control at the planning stage of the new development. For example, the housing developer may agree to pay for source noise measures, barrier walls, or other works. It is important that noise surveys are adequately scoped and sufficiently extensive.

4E.21 Regulation of industrial noise is largely a matter for the Environment Agency and the boroughs. The Mayor will work in partnership with local authorities and the Environment Agency where necessary. In particular, the Mayor will consider how noise reduction might be more effectively promoted at the London level, as part of more sustainable design and construction. Quieter ventilation and cooling technologies include using ground water from boreholes for cooling, district cooling networks, passive systems, and better design, installation and maintenance of conventional systems.



policy 64 The Mayor will urge boroughs, together with the Environment Agency where it has responsibility for noise control under Integrated Pollution Prevention and Control, to avoid, contain or minimise noise from industrial activity. Particular regard should be paid to the viability of established industrial and distribution uses when giving permission for

noise-sensitive uses nearby. Planning briefs, conditions, agreements or other mechanisms should be used to protect incomers, including through contributions to noise reduction at source.

- policy 65 The Mayor will encourage the London Development Agency to identify, through existing manufacturing networks, any shared problems related to noise and vibration, and, where relevant, bring forward proposals through the Production Industries Commission to promote good practice in noise management.

Economic development potential

- 4E.22 The noise and vibration control sector is relatively small, compared with those dealing with air pollution, water treatment and solid wastes. A national survey of environmental protection expenditure, involving 7,400 companies in extraction, manufacturing, energy and water supply industries, was carried out in 2001.¹² This indicated capital expenditure on noise and vibration control of £98 million in 2001, or 9% of the environmental protection total. Operating expenditure on noise in the same year amounted to £22 million, or 1% of the total. The London Development Agency has conducted an audit of the environmental business sector, in the context of promoting green jobs. This included business support infrastructure and relevant university research centres. The aim was to identify key issues for the sector as a whole. The study will inform future LDA priorities in developing the sector. For instance, a future study of the economic development potential of businesses engaged in sound insulation and noise control could identify capacity, areas of innovation, supply chains, factors governing demand, and economic growth and employment potential. The London Hydrogen Partnership will be examining pathways to fuel cells, which offer scope for noise reduction in many applications.

- policy 66 The Mayor will encourage the London Development Agency, as resources allow, to examine the economic development potential of businesses engaged in sound insulation and noise control, with an initial focus on sustainable design and construction, and including potential employment in deprived areas.

Aggregates

- 4E.23 Advice on minimising noise from aggregates operations is contained in MPG 11: The Control of Noise at Surface Mineral Workings.¹³ Safeguarding river wharves¹⁴ and retaining well-sited railheads are particularly important for the sustainable transport of aggregates, which will be needed to support London's development. Operational noise should be minimised, but cannot be entirely eliminated. Established use does not provide protection against action under nuisance legislation. The



continuation of facilities can be put at risk if residential development is permitted nearby without sufficient noise protection.

- policy 67 The Mayor will urge boroughs to continue working to avoid, contain or minimise noise from aggregates handling activity, in liaison with the Environment Agency where it has relevant regulatory responsibility. Particular regard should be paid to the viability of established aggregates uses when giving permission for noise-sensitive uses nearby. Planning briefs, conditions, agreements or other mechanisms should be used to protect incomers, including through contributions to noise reduction at source.

Transport routeing and access

- 4E.24 Local street redesign, traffic management, and area improvement can play important roles in protecting noise-sensitive uses. Routeing and local access require special attention where loading and unloading may occur at night. This includes industrial, distribution, waste management, and aggregates activity. Wider road, rail and air freight transport noise issues are considered in Chapters 4A, 4B, and 4C respectively.

- policy 68 The Mayor will urge boroughs, in their Unitary Development Plans and other policies, such as on economic development, and in their transport spending programmes, to consider measures that will minimise the potential adverse impacts of industrial, distribution, waste management and aggregates sites on nearby noise-sensitive uses, such as through street improvement schemes. Transport for London will include consideration of noise issues in allocation of transport funding to boroughs.

References and notes

- 1 Volterra Consultants, Table 2b, in 'Planning for London's Growth', GLA, March 2002
- 2 LPAC, 2000
- 3 'Industrial Capacity' London Plan Draft Supplementary Planning Guidance, Greater London Authority, September 2003.
- 4 Enviro, 'Technical Assessment for Waste Management in London', Enviro, 2003, ISBN 1 85261 490 0
- 5 European Commission Directive 2002/49/EC 'relating to the assessment and management of environmental Noise.' 25 June 2002
- 6 Annex 1 to Commission Directive 1996/61/EC of 24 September 1996 concerning integrated pollution prevention and control; OJ L 257, 10 October 1996, p.26.

- 7 In determining BAT across an installation, noise has to be considered and balanced within the wider context of other releases to different media and taking issues such as energy and raw materials into account. Noise cannot therefore be considered in isolation from other impacts on the environment. For noise there are 3 key criteria that influence the determination of permit applications and BAT:
- underpinning of good practice
 - noise levels should not be loud enough to give reasonable cause for annoyance to persons in the vicinity
 - prevention of creeping ambient (often referred to as creeping background).

The concept of reasonable cause for annoyance depends on many factors, including not just the noise level, but also the type and nature of the noise, the nature of the receiving environment, time of day or night etc. The Environment Agency Horizontal Noise Guidance H3 provides advice on the determination of BAT for noise and vibration

- 8 Department for Environment, Food and Rural Affairs. 'Integrated Pollution Prevention and Control: A Practical Guide - Edition 2' paragraph 6.9. DEFRA, June 2002
- 9 Department for Transport, Local Government and the Regions. PPG10 'Planning and Waste Management' DTLR, September 1999.
- 10 Available from the Stationary Office, published April 1993
- 11 'Draft Minerals Policy Statement 2: Controlling and mitigating the environmental effects of mineral extraction in England: Annex 2. Noise', February 2003 http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_609221.pdf
- 12 DEFRA, Environmental Protection Expenditure by Industry: 2001 UK Survey. URS Corporation Ltd for DEFRA, June 2003. See <http://www.defra.gov.uk/environment/statistics/envsurvey/expn2001/index.htm>
- 13 Available from the Stationary Office, published April 1993, currently under review.
- 14 'Safeguarded Wharves on the River Thames' Greater London Authority, April 2003. The London Port Health Authority has relevant powers, see paragraph 4E.5. See also paragraphs 4D.10-12 on wharf issues.

4F spatial planning, urban design and open spaces

4F.1 This chapter reviews some of the main noise and soundscape issues involved in achieving a sustainable urban renaissance, particularly through the planning system, and in promoting tranquillity in appropriate open spaces. Policies relevant to Unitary Development Plans and control of development are also considered in the 'spatial planning and design' sections of Chapters 4A to E. Those sections, together with this chapter, should be read in conjunction with the London Plan¹ and, particularly in terms of the way natural sounds can provide relief in many different city situations, the Mayor's Biodiversity Strategy.² This chapter is structured under the following headings:

- Urban renaissance
- Housing, schools and health facilities
- Mixed uses, town centres and the late night economy
- Sound-conscious urban design
- Open spaces and the wider public realm.

Urban renaissance

4F.2 Compact cities can enable more people to gain access to more facilities while generating less noise, notably from mechanised transport. Such cities, with all their benefits for sustainability could, however, be destroyed in the long run if planning policies were to preclude development in all currently noisy areas. Relying only on the spatial segregation of people and transport facilities would progressively reduce densities, segregate land uses and increase dependence on motorised transport - itself the main source of ambient noise. High density medium-rise development with fairly continuous frontages can create or protect quieter areas. By contrast, low density suburban development with widely separated buildings can allow noise to spread. Ultimately noise would spread over wider and wider areas, driving out tranquillity. By contrast, meeting the demands associated with people's attraction to London offers the prospect of moving towards more sustainable soundscapes. Good sound-conscious city design is needed to seize these opportunities.

4F.3 Regeneration of brownfield land, and securing higher density development near centres of high public transport accessibility can present design challenges in the short term. However, by no means all brownfield sites are noisy. Quiet areas can be found, and created, in higher density older districts. New development can include noise reduction measures which benefit the wider community, as well as immediate occupants. Mechanisms such as land exchanges and transfers



of development rights can help to locate more noise-sensitive development in quieter areas.

4F.4 The London Plan seeks to accommodate the demands of a growing London population and economy while directing it in ways which secure environmental and social improvements. Development provides the opportunity to use best modern technology, design and operation - not just minimising noise generation and spread, and protecting users, but wherever possible improving soundscapes around it. New development presents opportunities progressively to improve soundscapes across the city. Project proposers need to consider the mutual benefits of noise control in four key respects, along with improving sound quality where sound is integral to the use:

- Avoiding, containing or minimising noise generation from the project;
- Protecting noise-sensitive project users from noise;
- Minimising noise transfer between activities within the project, particularly vital with more mixed-use development; and
- Contributing where possible to wider improvement, which can feed back into project benefits, e.g. designing roadside business units to improve road noise screening to housing beyond the project, or avoiding reflecting sound into quiet areas.

4F.5 Noise assessments carried out in accordance with Planning Policy Guidance Note 24 will need to be used as pro-actively as possible, not just to identify and secure noise protection for dwellings, but to influence mix, layout and design. This includes, as far as possible, creation of protected outdoor spaces within developments. In support of the objectives of London Ambient Noise Strategy, the Mayor will, in relevant strategic referrals³, seek specific evidence on the action to be taken to address noise, detailing, for example, the noise issues considered, in terms of sources, levels, methods and assumptions, and the noise mitigation measures incorporated to achieve the appropriate level of protection. This could in future take the form of a Noise Action Statement (see glossary). Types of measures are referred to in paragraphs 13-19 of Planning Policy Guidance Note 24, and paragraphs 4F.23-27 below. All PPGs, including PPG24, are expected to be reviewed by 2005 (see Appendix A5). Issues such as the contribution of urban form to noise reduction and the application of Noise Action Statements, the latter not being at this stage a specific requirement of the London Plan, will need to be addressed in its first review. For many strategically important developments, Environmental Impact Assessment will, in any event, apply. Where there is potential for significant noise impact, noise assessments would be expected to be included within the Environmental Statement.⁴



4F.6 The Mayor will work with strategic partners to ensure that the transport, spatial and design policies of the London Plan support the objectives, policies and proposals set out in the London Ambient Noise Strategy. Particular attention should be paid to sensitive periods such as night-time and weekends.

- policy 69 The London Plan, 2004 (Policy 4A.14) states that the Mayor will and boroughs should reduce noise by:
- minimising the existing and potential adverse impacts of noise on, from, within, or in the vicinity of, development proposals;
 - separating new noise sensitive development from major noise sources wherever practicable;
 - supporting new technologies and improved practices to reduce noise at source, especially in road, rail and air transport;
 - reducing the impact of traffic noise through highway management and transport policies (see Chapter 3, Part C of London Plan);
 - containing noise from late night entertainment and other 24-hour activities, and where appropriate promoting well-managed designated locations (see Chapter 3, Part D of London Plan, and Policy 76 of this strategy).

policy 70 The Mayor will, in strategic referrals which include residential development on sites with noise levels higher than Noise Exposure Category A of Planning Policy Guidance Note 24, or the equivalent level in any revision of guidance, seek specific evidence on the action to be taken to address noise.

Housing, schools and health facilities

4F.7 In a busy city, a quiet place to rest is a basic need. People want choice over the sounds they experience within their homes, and also in gardens, balconies and other outside spaces. Many Londoners live in flats converted from larger houses, with poor standards of sound insulation between different units, as well as poor external insulation. Levels of insulation are likely to be particularly low in older, private rented housing. Problems of affordability give many people limited choice between quiet and noisy locations. High noise levels may restrict the use made of rooms on the 'noisy side', especially for sleeping, reducing effective housing space available to Londoners. Noise may also deter opening of windows for ventilation, with implications for indoor air quality if adequate alternative ventilation arrangements are not available.



4F.8 Population growth in London, and the formation of smaller households, often with differing lifestyles, together with more flexible hours of work, rest and play, and more home-working, pose challenges. Many other



northern European countries with higher urban densities than the UK also have higher standards of external and internal noise insulation. Higher standards of building management are also common, with more restrictions and/or shared understandings, such as on times for noisy activities.

- 4F.9 Poor internal noise insulation increases the risk of problems between neighbours, adding to the stress people experience and demands on public services, including the nuisance noise services of local authority Environmental Health departments. While parties, excessively powerful home entertainment systems, and other unneighbourly behaviour may present the most acute problems, many homes are so poorly insulated that the ordinary everyday activities of neighbours may cause distress. Problems may be particularly severe in some flats in converted houses, where households may be separated only by suspended timber floors and thin plasterboard partitions. Poor internal design of flats or terraces, with conflicting uses adjacent to each other (for example a living room of one flat above a bedroom of another) can further increase the likelihood of neighbour noise conflicts. Cases in 1999 in the House of Lords (often referred to as 'Baxter and Mills'⁵) resulted in a ruling that a landlord did not have to rectify poor sound insulation between dwellings or pay damages to a tenant due to any resulting nuisance. It was also ruled that reasonable activities by the neighbouring tenants could not be an actionable nuisance. Property owners and occupiers may be unaware of all the measures they could take to reduce the impact of external or internal noise. High costs and uncertain quality of building work may deter people from improving noise insulation. Acoustic performance is easily undermined by poor skills, incorrect materials, and inadequate regulation.
- 4F.10 People may suffer from poor insulation, both against external noise, and from noise generated within adjacent flats or attached buildings. Just reducing external noise could make internal noise more apparent. Internal and external noise problems need to be considered together. Proposals to raise sound insulation standards and extend the scope of Part E of the Building Regulations were made by the Government in January 2001. In addition to new houses and self-contained flats, scope would be extended to include hotel rooms, hostels, student accommodation, nurses' homes and homes for older people. Standards regarding low frequency noise transmission, such as from TV and sound system bass notes, would be raised. BRE estimated⁶ that in new dwellings, as many as 40% of new separating floors, and up to 25% of new separating walls might fail to meet the then current standards. Testing was therefore proposed before final building completion. The Government announced⁷ that amendments to Part E on sound insulation would come into force on 1 July 2003. This introduced the standards proposed in January 2001, including pre-

completion testing. However, pre-completion testing was not to be introduced immediately for new houses and flats. This was to allow the House Builders' Federation time to develop 'Robust Standard Details' - for designs which were to perform consistently well so that they would not need routine testing. Government consultation on 'Robust Standard Details' as an alternative to pre-completion testing ended in November 2003.⁸ Concerns remain as to the reliability of relying only on set forms of construction. Establishing and retaining consumer confidence is considered likely to require some element of on-going, on-site testing. If alternative forms of compliance with the Building Regulations are allowed, the purchaser needs to be provided with an approved non-technical explanation of the difference between the alternatives, together with advice on what action may be taken if a deficiency is suspected.

4F.11 Improvements in the existing poorly insulated housing stock across London are also needed. A new Housing Health and Safety Rating System (HHSRS) is being prepared.⁹ This would replace the existing concept of 'unfit' housing, and be broader ranging. Local authorities will be able to assess hazards from noise but it is not clear how effective the system will be in achieving improvements. The Government has also adopted a target to bring all social housing up to a 'Decent Homes' standard by 2010.¹⁰ However, this includes 'adequate noise insulation against external noise (where external noise is a problem)' - not referring to internal insulation - and is only among options for improvement. A dwelling could be defined as decent because of other characteristics and still be unsatisfactory in noise terms in 2010. Landlords can carry out work falling outside the standard, and, under new housing renewal arrangements, authorities have been promised discretion in allocating housing resources. However, there is a risk that the importance of both internal and external noise problems may not receive sufficient recognition. In the London context, given the enormous pressures on housing, there is a strong argument for specific 'quiet homes' initiatives, including targeting of dwelling improvements and sensitive allocation processes, to open up new opportunities to vulnerable people who currently lack choice.

4F.12 Consistent London-wide information is not available on installation of purpose-designed noise insulation measures in homes, or other buildings. Information on thermal insulation in London's homes is shown in the following table. Thermal insulation typically offers some noise benefits, but design specifications for effective thermal and acoustic glazing, for example, differ significantly.



Table 4 Thermal insulation in Greater London homes¹¹

	All households	Owner occupied	Council rented	Private rented
	%	%	%	%
With thermal double glazing	46	58	37	25
With thermal draught proofing	24	20	37	18

source: National Energy Action, The London Assembly and Fuel Poverty, 2000 (GfK Marketing Services, 1997).

- 4F.13 Upgrading London's social housing offers opportunities to reduce noise exposure without net losses in housing capacity. Area regeneration programmes could include measures to reduce traffic noise, encourage cycling and walking, upgrade windows, increase noise screening, and reduce reverberation in high density courtyards. The Mayor's Energy Strategy proposes an independent London Energy Partnership which could implement a London Fuel Poverty Programme. Noise measures need, as far as possible, to be integrated with action on fuel poverty and energy efficiency. It is important that 'equality of access to quiet' is sought in relevant planning negotiations, avoiding situations in which, for example, social rented and affordable housing within a larger development is used as a noise screen for open market or higher income housing.
- 4F.14 Good acoustic conditions are particularly important for children's concentration and learning, including when acquiring language skills. Many children may be affected by temporary hearing difficulties, in addition to those with more severe hearing impairment. Studies by Professor Bridget Shield at South Bank University and Julie Dockrell at the Institute of Education, BRE and others¹² have drawn attention to poor classroom acoustics and associated problems. Many schools suffer from high levels of internally generated noise, including 'crosstalk' from competing activities, as well as noise from road, rail, aircraft and other external sources. Temporary classrooms or buildings of lightweight construction with large areas of glazing may be especially vulnerable.
- 4F.15 Population projections for the London Plan indicate a significant growth in the capital's school age population, of both primary and secondary ages, over the period to 2016. Some new schools may be provided in association with large new housing development, such as in Thames Gateway. In other cases, school extensions may be needed. It is important that the planning system identifies sites with suitable noise environments, and that opportunities are taken, when expanding or extending existing

schools, to rectify existing acoustic deficiencies. Building Bulletin 93 (see box below) focuses on upper limits for internal levels and sound insulation in new schools, but also recommends upper limits for external noise.

Box 51: School acoustic design

Existing and new school premises are required to comply with the Education (School Premises) Regulations 1999 (Statutory Instrument 1999 No 2). Building Bulletin 93¹³ provides a regulatory framework for the acoustic design of schools in support of the Building Regulations, relevant exemptions from which ended in 2003. BB93 also gives supporting advice and recommendations for school planning and design. The requirements of the Disability Discrimination Act 1995 reinforce the need for good acoustic conditions, as do the requirements of the Special Educational Needs and Disability Act 2001 for integration of children with special needs into mainstream schools.



- 4F.16 More Government funding is now becoming available for maintenance and improvement works to schools. Acoustic improvement can, however, be complex. Innovations such as 'School Works', set up by the Architecture Foundation, have highlighted the impact of design on educational achievement. The work of SENJIT, Institute of Education, University of London, Makeover at School and other organisations is relevant. Environmental education can be integrated with pupil/teacher participation in the preparation of design improvement proposals. Such work in the acoustics field could help busy schools and local education authorities to decide on spending priorities. Some London boroughs already carry out noise education work in schools. Wider activities related to sound and soundscapes (see glossary) would have rich links with many parts of the curriculum, and could help young people to look after their hearing (see paragraphs 5.5-6).
- 4F.17 The acceptable level of noise depends on the activities within the different parts of the school. Clearly, libraries and areas for formal teaching need quieter conditions than gyms. Some schools may benefit from installation of noise barriers, subject to safety and security issues. Barriers can also reduce the impact of playground noise on the locality. Dense planting within school grounds may also help qualitatively. On some roads near schools, variable speed limits or other traffic measures could reduce noise.
- 4F.18 Hospitals and other health facilities generate noise, through the traffic they create, including ambulances, helicopters, delivery of supplies, workers and people visiting; and through other activities such as boiler-houses, emergency generators, pumps, workshops, laundries, kitchens and building works. Noise from travel and other activities may be a particular





issue in the evening or at night, notably for new primary care facilities in residential areas. Providing high quality health care services for patients also means that noise needs to be controlled, particularly in very noise sensitive areas such as wards, operating theatres, delivery rooms, treatment rooms, examination and consulting rooms, and staff sleeping areas. The National Health Service has its own guidelines for managing noise. Hospitals are exempt from the parts of the Building Regulations dealing with sound transmission in buildings. Health Technical Memorandum 2045¹⁴ gives advice and guidance to healthcare management, design engineers, estates managers and operations managers on legal requirements, design implications, maintenance and other measures. Environmental noise criteria for noise emissions from hospital developments are typically specified by local planning authorities for site boundaries, following guidance in PPG24.

- policy 71 The Mayor will urge the Government to provide an effective framework of regulation, enforcement, information and resources for external and internal noise insulation in support of trends towards higher density housing and mixed-use development. Elements include:
- Rigorously monitoring implementation of Building Regulations on sound transmission. In particular, if 'Robust Standard Details' are used, requiring an element of independent on-site acoustic testing to ensure that constructions do in practice always meet or exceed the necessary standards, and ensuring provision of suitable information to purchasers;
 - Including noise in Decent Homes criteria, the new Housing Health and Safety Rating System (HHSRS), and other mechanisms, in such ways as to ensure effective action to target the worst-affected housing;
 - Support for training and information on practical noise reduction in housing for building trades, materials and equipment suppliers, landlords and occupiers.
- policy 72 The Mayor will urge boroughs and other social housing providers to, where practicable and cost-effective:
- Demonstrate good acoustic design practice both in new housing, and in regeneration, refurbishment and maintenance, with particular regard to courtyard remodelling, replacement window programmes, and internal sound insulation;
 - Provide information on practical noise reduction in both existing and new housing for landlords and occupiers;
 - Integrate action on noise as far as possible with programmes to address fuel poverty.

- policy 73 In support of Policy 4A.14 of the London Plan, 2004, the Mayor will urge boroughs to include in their Unitary Development Plans, or other mechanisms, measures to minimise the adverse impacts of noise, having regard to Government guidance and to this strategy. Equality of access to quiet for social rented and affordable housing as for other housing should be sought in consideration of specific planning applications. Measures to protect housing, and noise-sensitive activities within schools, hospitals and other developments, would include:
- Reducing noise at source, such as through traffic management;
 - Clustering, or limiting dispersal of, noise-generating activities;
 - Improving boundary design to screen noise;
 - Locating less noise-sensitive activities to screen or otherwise protect noise-sensitive uses; and
 - Promoting on-going maintenance and management, through conditions, licensing, agreements or other means.

- policy 74 The Mayor will urge the Government to support further measures to raise the profile of noise in schools, such as through developing a School Soundscapes Programme, and making available a Sound Roadshow for Schools combining diagnosis of problems on-site, preliminary acoustic design proposals, science and other teaching, and promotion of 'healthy hearing' to appropriate age groups.

Mixed uses, town centres and the late night economy

- 4F.19 Government policy encourages more housing in town centres, and promotes mixed-use development,¹⁵ although it also recognises that particular care is needed over location and design with respect to some uses.¹⁶ The Urban Task Force encouraged higher densities and more diverse mixes of activities at transport hubs and in town centres, but also drew attention to the risk of conflict between housing and late night activities.¹⁷ The London Plan promotes mixed use. London's first Economic Development Strategy¹⁸ recognised that: 'Best contemporary noise management and design will be important if economic activities, housing and other uses are to mix sustainably.'



- 4F.20 Mixed use can, however, also offer noise benefits. In higher density mixed use developments, offices, retail and other uses can screen housing. In many cases, vibrant frontages can be reconciled with quiet rear courtyards or gardens. Housing on upper floors can be screened by set-backs or balconies. The Mayor's policies for transport, spatial and economic development seek to promote higher densities in areas of good transport accessibility. High public transport accessibility in town centres offers the opportunity to reduce the amount of car parking, increasing space for

other uses and reducing noise. Car free developments can be designed and marketed as havens of relative tranquillity.

- 4F.21 Urban vitality can be achieved with different degrees and types of mix – it is ready access to local facilities and a rich urban texture which are important.¹⁹ These can be obtained without ‘cheek by jowl’ mixing of uses which have the most conflicting demands for buzz or quiet. ‘Pepperpotting’ of late night bars, restaurants and clubs, and poorly insulated flat conversions, invites conflict, particularly where they share adjoining structure, or the same otherwise quiet street or rear area. The degree and type of mix sought or permitted should be related to the specific characteristics of the local building fabric,²⁰ including how suitably it can be adapted. Local planning and area development frameworks can seek to identify suitable locations for late night activities while maintaining quieter conditions for housing in most of the area.²¹
- 4F.22 The need for effective premises-focused measures to tackle noise at source is well-established.²² However, it is much harder to protect residents from noise in the street, such as from exuberant revellers leaving entertainment premises late at night. Staggering of closing times and operator good practice may reduce street noise, but cannot solve all problems. Larger, youth-oriented late night venues will typically be best located where users can access transport most quickly, and where effective acoustic screening/separation from existing or prospective housing exists or can be achieved (see box 53). Some element of zoning or clustering will, of course, be easier to achieve in town centres undergoing land use change than in established areas like the West End. In any event, enhanced area management is also likely to be required. Several recent reports²³ have recommended an area management approach. A recent report for the GLA²⁴ also suggested Entertainment Management Zones – areas including entertainment venues and other elements of the evening economy, designated by boroughs in their UDPs, in which planning, licensing, policing, transport and street management issues would be managed and co-ordinated. Such approaches are likely to be focused in central London, City fringe areas and town centres (see Policy 3D.4 and paragraph 3.236 of the London Plan). Designation needs to be handled with great care, particularly for established pockets of housing. The planning system should aim to reduce uncertainty regarding the noise environment, for existing and potential residents and businesses alike. The concept is a natural extension of town centre management, an already established and proven practice. Reform of alcohol and entertainment-related licensing in England and Wales has given rise to a range of concerns.^{25 26 27} Many stakeholders consider that the Licensing Act 2003 could mean rapid growth in late opening, but that resources might not be available for the extra cleansing, police, transport,

noise enforcement and other local services which could be needed. Ensuring sufficient resources for area management is particularly important in mixed use centres. This includes sufficient staff in borough Environmental Health Departments to provide efficient and responsive services.²⁸

Box 52: 24 hour society?

- People's lifestyles are changing, with growing demand for eating, drinking and other facilities, not just leisure, to be open for longer hours. Home banking, home shopping and other demands imply more late night activities from call centres to hot food deliveries. More late night eating out, drinking and entertainment, in Central London, in town centres or elsewhere, means more noise in traditionally quieter parts of the day. However, although activities in some locations may extend into the evening and beyond, this does not mean that all parts of London are equally affected, or need be in future.
- Late night London is not just about consumption. Some media, finance and other businesses, including those with real time global links, work round the clock. Courier firms have extensive night operations. The National Health Service and other public and utility services need to operate 24 hours a day. Concern has been expressed as to the health implications of 24 hour activity patterns.²⁹
- Those who work at night may themselves be trying to sleep during the day, rather than the night. With more flexible working practices, more people are likely to be going to bed and/or getting up outside the traditionally quieter 'core' 11 pm to 6 or 7 am period. This reinforces the need for reducing ambient noise levels across day, evening and night, and achieving effective standards for sleeping accommodation.



Box 53: Some locational issues

- Local clustering of bars and other late night venues in suitable streets or on frontages well-screened from noise-sensitive uses could enable limited sound 'break-out' to be permitted. This could be a positive city soundscape feature in recognised entertainment locations. In this context, limited use separation could add to the richness of the urban experience, rather than detract from it.
- Location and orientation of venue entrances, street design, and lighting should encourage patrons to use routes to night bus stops, night taxi points or other facilities which minimise the risk of disturbance to residents. Clustering late night activities on distinct nodes and links can make the system more 'legible' for users. Noise from people departing from late night pubs, clubs and other venues could become more noticeable where traffic noise is most reduced. Relating late night activities clearly to main transport routes should help to minimise exposure.

Box 54: E-tailing and e-deliveries

Home deliveries could potentially increase noise in sensitive locations at sensitive times. With many small working households, late evening deliveries may become a particular issue for London, with many subdivided properties where direct home deliveries are difficult. Consumer e-shopping deliveries to intermediate points such as 'electronic corner shops', workplaces, or points on the public transport system, rather than just the home, could reduce the noise risk. Mixed use developments could include flexible spaces adaptable to use as 'electronic corner shops', for use by local workers and residents, as well as providing e-access for the digitally excluded.

- policy 75 The Mayor will urge the Government to provide a policy and funding context for higher density mixed use and town centre development which supports effective spatial planning, premises design and management. This includes:
- Ensuring that planning legislation and guidance provides for effective control of activities most likely to put existing and potential noise-sensitive uses at risk;
 - Ensuring that alcohol and entertainments licensing or taxation provide adequate resources for managing the community impacts, notably of the late night economy;
 - Providing for adequate noise enforcement powers and staffing, including Environmental Health and Planning Officer activity, warden and policing initiatives; and
 - Monitoring the effects of licensing reform, and introducing any necessary further measures promptly.
- policy 76 The Mayor will urge boroughs, in their Unitary Development Plans, or through other mechanisms, to indicate how potential conflicts between night noise-generating and noise-sensitive uses, notably between late night entertainment and housing, will be resolved, in terms of land use planning, building design, and management. Civic engagement and participation need to be reflected in alcohol and entertainments licensing as they are in planning. Issues include:
- Planning and design of late night eating, drinking and entertainment venues to prevent nuisance to established and prospective noise-sensitive uses, notably housing;
 - Where appropriate, considering designation of suitable areas for late night facilities, and where necessary considering the designation of Entertainment Management Zones (see glossary), in which planning, licensing, policing, transport and street management issues can be managed and co-ordinated; and

- Planning and design of noise-sensitive uses, notably conversions to housing, to protect occupants from the reasonable operation of defined areas of late night activity, and established 24 hour facilities, especially where these are of importance to London's world city role.

Sound-conscious urban design

4F.23 Urban designers should not just abate or mitigate noise, as a negative afterthought, but work consciously with sound as a positive element of good design. Sound quality can define place. Designers need to understand how sounds will behave in a space, to create soundscapes which are attractive to everyone, as well as supportive to those with special needs (see paragraphs 2.9 and 5.4). Some 'barrier blocks' with unduly hostile façades may have given noise-reducing design a bad image. However, good design can retain 'eyes on the street' while locating the most sensitive rooms, and windows which people can open, on a quiet side. Many of the most visually attractive building materials are sound-reflecting, while the choice of sound-absorbing building finishes is relatively limited. This tends to increase ambient noise levels in compact urban environments. The visual quality of much UK urban design has improved enormously over recent decades. The quality of soundscapes in and around new developments may not have been given the same attention. Talented designers can innovate with people-friendly design which pleases the ear as well as the eye.



4F.24 Action to influence 'design for noise' has tended to focus either on overall policy guidelines (e.g. Planning Policy Guidance Note No. 24) or the detail of building acoustics and noise control standards or specifications. There are few 'intermediate level' practical and accessible tools for those involved in town planning, neighbourhood regeneration, building layout and design, and urban management. The Mayor aims to carry out work in this area, subject to availability of resources. Government funding could play a valuable role in filling this gap, as an early part of developing National Ambient Noise Strategy. A review of UK and international experience and best practice in sound-conscious urban design would support the urban renaissance.



Box 55: Sound-conscious urban design - noise reduction issues

- **Façade continuity and 'quiet side'** - Buildings can be designed not only to protect their occupants, but to screen other areas from noise. High density development following traditional street blocks can reduce noise on the 'quiet side' by 10 to 20 dB(A).
- **Spaces between buildings** - Although enclosed spaces can often be tranquil, tightly-enclosed spaces can also 'trap' sound, including from poorly designed, installed or maintained ventilation plant, waste facilities, vehicle manoeuvring, neighbours, or aircraft. The balance of advantage between contained and more open layouts will depend on the relative contributions of different noise sources. In noisy areas, acoustic absorbency within 'courtyard' areas should normally be maximised, especially from dense vegetation and soft ground. Roof-top planting may be useful on lower level roofs. In quieter spaces, sound reflection can help people sense where they are. Paving design should consider noise not just from road vehicles, but trolleys, and, particularly over or near bedrooms, footfall. 'Solar pergolas' with photovoltaic panels, could modify sound propagation.
- **Side streets and 'side on' buildings** - Orienting blocks, terraces or streets of housing at right angles rather than parallel to a road or railway reduces façade noise levels, but means that both sides of a building can be equally noisy, and noise can spread. Staggering of units in terraces, projecting service cores, wing walls or fins, and other 'self-protecting' design can screen façades and openings. For side streets, diffusing façades, and cantilevered or bridging 'gateway' development (with absorptive soffits) can reduce propagation. Architectural noise barriers, transparent screens, or end-of-row infill development could be considered.
- **Façade reflectivity** - Multiple reflection between opposing, acoustically hard building surfaces increases noise levels, particularly in 'urban street canyons' (see glossary). Façades at the wrong angle can reflect sound into quiet areas, as can curved and outward sloping buildings. Sound absorbing panels, deep acoustic profiling, 'absorptive banners' and other elements should be considered. A wider choice of acoustically absorptive materials needs to be developed, ideally using recycled materials. In compact urban environments, making barrier surfaces more absorptive is generally preferable to inclining them to reflect sound upwards.
- **Noise and height** - High buildings, with less shielding from other buildings, may receive noise from a wider area. Stepping-back of upper floors, canopies and other projections can offer screening. Acoustic balconies, with high imperforate parapets and absorptive linings to the

soffit of any projection above, can reduce noise at a window by 5 dB³⁰. The predictive capabilities of noise models need to be improved, for both towers and 'urban canyons'³¹.

- **Dual façades and window design** - Conservation policies will need to be balanced with the noise and energy benefits of innovative design, including design of window surrounds to offer screening, secondary glazed façades and photovoltaic exterior secondary glazing.
- **Shallow floor plates, ventilation and cooling** - Growing demand for air handling, cooling and other plant poses risk from 'creeping ambient' (see para 4E.11 and glossary). Much recent prime UK office development has been air-conditioned, with large floorplates. Sealed environments are suited to the noisiest locations, but plant can create noise. More continental European-style shallower floorplates should be sought, with greater use of natural ventilation. Such development is well-suited to mixed-use areas, avoiding the risk of noise from air-conditioning plant. Noise from mechanical plant can also be reduced with 'borehole cooling'. Any fans and vents on the 'quiet side' should be well-silenced and/or screened, with regular maintenance. Visually attractive ways of incorporating vents on street frontages should be considered, such as in 'banner' light features. Where more sustainable alternatives cannot be achieved, effective ways need to be secured to control noise from mechanical plant throughout operational life. This applies especially to growing numbers of small 'bolt-on' cooling or air handling units in dense, mixed use areas.
- **Vehicle access and parking** - Car free developments could reduce the need for hard paving, as well as noise sources. Waste storage and collection should be located away and/or screened from noise-sensitive uses. Car parking and service areas should be screened, enclosed, or buffered with less sensitive uses. Enclosed car parks and bays should be designed to minimise sound reverberation and break-out. Lockable gates to residential courtyards at night can reduce disturbance from vehicles and on-street revellers, especially in mixed use areas, while avoiding the sort of exclusion associated with the 24-hour gated enclave.
- **Maintenance and cleaning** - Quiet equipment and processes should be specified (e.g. raking, sweeping and local composting, rather than leaf blowing and carting away).
- **Features of soundscape interest** - Many sounds may be positive or negative depending on context (e.g. active water, wind in trees or rushes, loose surfaces, gratings, reverberant spaces).
- **Balancing needs** - Passive solar design, in which homes need to face roughly south, may make it difficult to create a 'quiet side'. Noise



screening could increase shading. More linking of buildings to reduce noise propagation may mean accepting some change in local character, although visual monotony can be avoided by set-backs and many other design features. Very long or deep 'urban canyons' may inhibit dispersion of air pollutants. The balance between noise reduction and other needs should be struck on a place-specific basis, taking account of potential changes in noise sources, and in competing needs, over the lifetime of the development.

- 4F.25 Building over car parks, servicing ways, depots, yards and other noise sources, as well as railways and roads (see Chapters 4A and 4B) could provide valuable space for mixes of recreation, housing, commercial and other needs, as well as shielding people in the surrounding area from noise. Rising land values mean that more locations may be viable. Development gain could potentially support noise screening or other mitigation beyond the bridging development itself. Design must, of course, protect occupants of development over transport facilities from structure-borne vibration. Absorptive linings can address reverberant noise from openings.
- 4F.26 City soundscapes can be part of their distinctive historic character. However, it is rarely possible to 'preserve' something as inherently transient as sound. Nevertheless, urban noise management should consider distinctive features such as bells, water, wind in trees, and reverberant spaces such as railway arches and street arcades. Sound-radiating structures such as metal bridges may be annoying in one context, but features of interest in another. Audible features, as well as specific signals, can aid orientation and wayfinding by people with a visual impairment.
- 4F.27 The Mayor has proposed preparation of additional guidance on issues including sustainable design and construction, urban design, public realm, and sustainable suburbs. For example, greater use of natural ventilation and innovative forms of cooling need to be encouraged, reducing potential noise from air conditioning plant. Opportunities will be identified to develop and promote the various elements of better design for noise, integrated with other needs, including in association with the work of the Mayor's Architecture and Urbanism Unit.



- policy 77 The Mayor will urge the Government, as part of developing National Ambient Noise Strategy, to support:
- Review of international good practice in sound-conscious urban design, including costs, effectiveness, administrative and policy mechanisms;

- Preparation of technical guidance giving practical tools for people involved with planning and urban design, neighbourhood regeneration and management, with particular reference to higher density mixed use development where noise nuisance can otherwise be a risk; and
- In particular, review of the framework governing design, installation and maintenance of ventilation, cooling and air handling equipment, including practical measures to address 'creeping ambient' (see glossary).

proposal 25 The Mayor will work with others, including London boroughs and developers, and in particular the London Development Agency for developments and land disposals with which it is involved, to develop and promote exemplary sound-conscious urban design and noise management.

Open spaces and the wider public realm

4F.28 London is a relatively green city with many different kinds of open spaces and public areas, characterised by many different natural and human-made sounds. Noise issues arise not only for formal parks, informal parklands, commons, recreation grounds, playing fields, urban squares, 'pocket parks' and children's play areas, but for woodlands, farmland and city farms, community gardens, ecology centres, allotments, nature reserves and other natural habitats, cemeteries and churchyards, wasteland, private gardens and other spaces. Many spaces may provide 'reservoirs of tranquillity' giving subjective relief, even when not publicly accessed, as well as some sound absorption. Noise may affect the number or location of certain animals, such as breeding birds, and affect human appreciation of wildlife, as well as overall human enjoyment of open spaces as places to rest, relax and reflect.



4F.29 Many of London's open spaces are exposed to road, rail or aircraft noise, and some to industrial noise. Particular concern has been expressed at the extent to which many well-known open spaces are overflowed by aircraft.³² Conditions on roadside land and along railways need to be considered in the context of Chapters 4A and 4B. Water soundscapes are considered in Chapter 4D. Simon Rendel, in 'Tranquil Area' maps developed for the CPRE, demonstrated how the infrastructure of an industrialised economy had eroded rural tranquillity between 1960 and 1992.³³ Issues are very different in cities, of course. However, soundscape qualities in many of London's open spaces are likely to have been eroded over recent decades. Absolute tranquillity - where natural or semi-natural sounds dominate rather than those of human activities - is, almost by definition, rare in cities. Urban tranquillity is often best seen as 'relative quiet' - an open space on the edge of London could feel quiet by contrast with other parts of the city, though noisy in a rural context. It is no less valuable for that. Soundscapes in urban squares and other parts of the public realm need to





be considered as well as open spaces. It is also important to consider features of positive soundscape interest (see paragraph 4F.26), which may constitute 'soundmarks' (see glossary). Area-wide noise mapping could become a more popular and accessible tool if supplemented by measurement and attitude surveys, including engaging people in the identification of sound features they value positively, as well as 'relative quiet.' Having full regard to the needs of other noise-sensitive uses, and local play and community access, exploration of the value of designating 'Areas of Relative Tranquillity or Special Soundscape Interest' is encouraged, although they are not, at this stage, included as a London Plan policy³⁴.

4F.30 As London's built form becomes more compact and intensive, the value of open spaces is likely to grow, although they should not, of course, be regarded as substitutes for good domestic noise environments. The London Plan encourages functional and physical linkages within the network and to the wider public realm. Green Corridors (see glossary) may allow animals and plants to be found further into the built-up area than would otherwise be the case and provide an extension to the habitats of the sites they join. Green Chains (see glossary) provide landscaped routes for pedestrians or cyclists, and may help people to gain access to more tranquil areas when they need it, as may Greenways, or Thames Gateway's Green Grid. Routes and public spaces more generally can be considered in terms of sequences of soundscapes characterised by diversity and special local interest, including in education and public engagement, and for visitors (see glossary under 'soundscape').



4F.31 Some uses of open spaces are more noise-sensitive than others. Some recreational activities in open spaces can generate significant noise. Some animals in open spaces may cause disturbance (e.g. peacocks). Both natural and human-made sound levels can vary widely across the same space, and by time of day, week and year. Noise from maintenance activity can reduce the peace and calm of open spaces. Noise from mowers and other mechanised equipment can be particularly annoying. Use of some equipment, such as leaf blowers, can be substituted by quieter methods. Where quieter equipment cannot be obtained, the noise of some mechanised equipment can be reduced by using lower power settings, without significantly reducing efficiency. 'Quiet Zones' have been signposted in some New York Parks, offering diverse users more choice. Park and other byelaws need to be periodically reviewed as noise sources change.

4F.32 Well-designed hard paving is visually powerful in many parts of the public realm. However, 'soft ground' and dense vegetation, where these can be

balanced with other concerns, such as community safety, would help to minimise noise in compact urban environments. Tensions exist between the use of open spaces and parts of the public realm for quiet relaxation or contemplation, and more active leisure pursuits. Informal games, organised sports, and events, such as open air concerts can generate considerable noise. Reducing the impact of traffic noise, combined with climate and social changes, could mean more people enjoying more time outdoors in public spaces. The new sounds of crowds may not be what residents first expect. A fair balance between competing uses needs to be struck, recognising the need for attractive areas for children's play, both formal and informal, and other access for local communities. This may be best achieved through community consultation and responsive management. Neighbourhood and parks wardens could make valuable contributions to resolving local conflicts. Sound-conscious design can help. Location and design should provide for noisier and quieter activities in ways which reduce potential conflict, such as by using the screening provided by changes in level or structures.



Box 56: Access to tranquillity and soundscape interest

- Many of London's smaller households may not in future want private gardens. However, they may want relatively quiet outdoor areas within walking distance. High density development can provide 'pocket' open spaces of high quality.
- Longer distance 'access to tranquillity' should also be considered. 'Community Forests', such as at Thames Chase, and wildlife sites may offer tranquil paths and glades, or provide relief even where full public access may not be available.
- Features which can make a distinctive contribution to soundscape quality need to be explored.
- Provision for noisy recreational activities needs be considered on both a local and a wider basis.
- Development of noise mapping and other noise data provide opportunities to assess the costs and benefits of 'access to quiet'. The European Directive (2002/49/EC) requirement for reporting noise exposure at a 4 metre receptor height should not preclude the use of lower receptor heights, such as 1.5 metres, for assessing noise in open spaces, although the accuracy of current noise mapping models at this height may be lower.



Box 57: 100 Public Spaces

The Mayor's '100 Public Spaces for London' programme aims to demonstrate how existing networks of local public spaces can be enhanced, and to show how new public spaces can make real differences to individual quality of life, community vitality and Londonwide livability. The Mayor's Architecture and Urbanism Unit is working with Transport for London, the London Development Agency and other partners on the first 24 schemes and will continue to involve the functional bodies in realising other public spaces.

**Box 58: Outdoor Events and Festivals, and Fireworks**

For outdoor pop concerts, festivals and other events, the 'Code of Practice on Environmental Noise Control at Concerts' Noise Council, 1995, provides guidance on noise levels for use in license conditions, or abatement notices. The Code acknowledges the tensions between the rights of organisers, performers and audiences, and local residents. 'The Event Safety Guide: a guide to health, safety and welfare at music and similar events' Health and Safety Executive, 1999, covers noise exposure and risk of hearing damage, alongside other health and safety issues.

The Fireworks Act 2003 enables the Government to impose a noise limit on fireworks available to the public; ban the use of fireworks during anti-social hours; license the sale of fireworks; allow local authorities to revoke the licenses of retailers; and create a compulsory training course for operators of public firework displays.

policy 78 The Mayor will urge London boroughs and others with responsibilities for open spaces and public realm management to consider the need for frameworks for managing soundscapes in open spaces and the wider public realm. Elements include noise mapping, measurement and attitude surveys, access to quiet, and exploring designation of Areas of Relative Tranquillity or Special Soundscape Interest.

proposal 26 The Mayor will work with others to develop and promote exemplary measures to improve soundscapes, including, where appropriate and practicable, as elements within the '100 Public Spaces for London' programme.

References and notes

- 1 'The London Plan' Greater London Authority, 2004, particularly Policy 4A.14 and paragraphs 4.28 and 3.236. See <http://www.london.gov.uk/approot/mayor/strategies>
- 2 'Connecting with London's Nature: The Mayor's Biodiversity Strategy' Greater London Authority, July 2002.
- 3 Planning applications referred to the Mayor under the Town and Country Planning (Mayor of London) Order 2000 (Statutory Instrument 1493)
- 4 The Town and Country Planning (Environmental Impact Assessment)(England and Wales) Regulations 1999 implement the requirements of EC Directive 85/337/EEC as amended by Council Directive 97/11/EC for environmental assessment to be carried out of certain projects before permission is granted. The potential impact of noise is typically one of the considerations dealt with in the environmental statement prepared by the developer and submitted with the planning application to the local planning authority.
- 5 Opinions of the Lords of Appeal for Judgment in the case London Borough of Southwark (Respondents) and another v. Mills and others (Appellants) Baxter (A.P.) (Appellant) v. Mayor etc. of the London Borough of Camden (Respondents), 21 October 1999
- 6 'Proposals for Amending Part E of the Building Regulations 2000: Part 1, Regulatory Impact Assessment' DETR, January 2001
- 7 Announcement by Minister responsible for Building Regulations, Chris Leslie, on 5 July 2002. See <http://www.odpm.gov.uk/news/0207/0027.htm>
- 8 ODPM 'The Building Regulations 2000: Amendment of the Building Regulations to allow Robust Standard Details to be used as an alternative to pre-completion testing' Office of the Deputy Prime Minister, August 2003. See http://www.odpm.gov.uk/stellent/groups/odpm_control/documents/contentservertemplate/odpm_index.hcst?n=3644&l=2
- 9 Following Government consultation in 1998, a number of reports on HHSRS have been published by the Government. At the time of writing, the full package of HHSRS technical guidance was expected to be available in Spring 2004.

- 10 'Quality and Choice: a Decent Home for All: the Housing Green Paper', DETR, April 2000.
- 11 This table refers only to thermal insulation. Technical specifications for acoustic and thermal insulation differ. Consistent London wide information is not available on the proportion of homes which have special insulation against noise.
- 12 See www.doh.gov.uk/hef/airpol/cognitiveperf.htm, www.bre.co.uk, www.ranchproject.org
- 13 Department for Education and Skills. 'Acoustic Design of Schools' Building Bulletin 93, DfES, 2003. See <http://www.teachernet.gov.uk/acoustics>. This replaces Part A of 'Guidelines for Environmental Design in Schools' Building Bulletin 87 (Revision of Design Note 17), 1997, available from 2003 without Acoustics, see <http://www.teachernet.gov.uk/acoustics>
- 14 NHS Estates. 'Acoustics: Design considerations' Health Technical Memorandum 2045, NHS Estates, 1996
- 15 'Planning Policy Guidance Note 3: Housing' and DETR; 'Our Towns and Cities: the future' CM4911, Department for Transport, Environment and the Regions, The Stationery Office, 2000
- 16 'Planning Policy Guidance Note 6: Town centres and retail developments', June 1996, available from the Office of the Deputy Prime Minister, see http://www.odpm.gov.uk/stellent/groups/odpm_control/documents/contentservertemplate/odpm_index.hcst?n=3392&l=3. A revised policy statement was being consulted upon at the time of writing. See Appendix A5.
- 17 Urban Task Force 'Towards an urban renaissance' E&F Spon, 1999
- 18 LDA, London Development Strategy, 2001, page 81
- 19 'Mixed-Use Development, Practice and Potential' Department for Transport, Local Government and the Regions, 19 March 2002.
- 20 Roberts M et al. 'Licensing Reform: A cross-cultural comparison of rights responsibilities and regulation' Central Cities Institute, University of Westminster, September 2002, page 72.
- 21 On 28 November 2003, the Government announced use class changes, to come into effect in summer 2004, allowing local planning authorities to

control certain changes of use, such as from restaurants to pubs. See http://www.odpm.gov.uk/pns/DisplayPN.cgi?pn_id=2003_0252

- 22 Institute of Acoustics. 'Good Practice Guide on the Control of Noise from Pubs and Clubs' IoA, March 2003.
- 23 Town Centres Ltd. 'West End Entertainment Impact Study' Report for Westminster City Council, 2001

EDAW 'West End Public Spaces' Final Report to Westminster City Council, October 2001

Tony Travers 'Managing the Balance: Quality of life in the centre of London' Westminster Property Owners' Association, October 2001
- 24 'Late Night London: Planning and Managing the Late Night Economy' URBED, CASA and Dr Andy Lovatt for GLA, LDA and TfL, 2002
- 25 London Assembly Culture Sport and Tourism Committee. 'Whatever gets you through the night: 24 hour licensing in London' Greater London Authority, December 2002
- 26 House of Commons: ODPM: Housing, Planning, Local Government and the Regions Committee. 'The Evening Economy and the Urban Renaissance' Twelfth Report of Session 2002-03, HC 396-1, The Stationery Office, August 2003. One of its more controversial recommendations was for dispersal of venues, which is not the approach adopted in Government Planning Policy Guidance Note 6, or this strategy.
- 27 DEFRA. 'Implications for noise disturbance arising from the liberalisation of licensing laws' Report of research and consultation conducted by MCM Research Ltd for the Department for Environment, Food and Rural Affairs, October 2003. See <http://www.defra.gov.uk/environment/noise/mcm/index.htm>
- 28 London Assembly Environment Committee. 'Scrutiny of the Mayor's Draft Noise Strategy' Greater London Authority, October 2002, reported, paragraph 5.10: 'Some local authorities may have a problem with recruiting Environmental Health Officers. The Committee met with residents from Covent Garden and Soho who proposed that licensees should contribute to the cost of managing, policing and cleaning up these entertainment management zones.'

- 29 Rajaratnam SMW, Arendt J. 'Health in a 24-hour society' *Lancet*, No. 358, 2001, pp 999-1005
- 30 'Sound Control of Homes' BRE/CIRIA, 1993
- 31 Wilson M, Nicol F. 'Noise in Offices and Urban Canyons' *Institute of Acoustics Proceedings*, Vol 23(5), 2001, pp 41-44
- 32 HACAN ClearSkies. 'London's Blighted Parks' London, October 2000
- 33 Available from www.cpre.org
- 34 See paragraph 3.245 of the London Plan. The Environmental Noise Directive 2002/49/EC will require preparation of action plans, purposes of which include 'preserving environmental noise quality where it is good'. It includes very broad definitions of 'quiet areas', distinguishing between those in urban and rural areas, and implying an absolute noise level in urban areas. Cross-European Working Groups are developing guidance on interpreting the Directive. This strategy promotes work on 'Areas of Relative Tranquillity or Special Soundscape Interest' in this context. It aims at exploring the value of areas that provide respite within their urban context, even if they do not (yet) meet an absolute noise level criterion. It also seeks to take account of sounds which may have positive value to people. One parallel is with development in the 1980s of urban biodiversity policy, where the need was seen, from an equalities perspective, for areas of local value, accessible to local communities, even if these did not meet thresholds of absolute scientific value.

5 integrated noise management

- 5.1 Noise is a complex pollutant, with many different implications for people, many of them highly dependent on context. Improving the noise environment of a changing city, with its many competing pressures, will require concerted analysis and action across many levels. Relationships between 'ambient' and 'nuisance' noise have been considered where relevant in previous chapters. Recognising that the Greater London Authority Act 1999 excludes certain noise sources from the definition of 'ambient noise', this final chapter highlights the need for an integrated approach.



Box 59: Issues for national strategy

'Noise occupies a paradoxical position in terms of UK environment policy. By contrast with other pollutants, it is almost universal in our urban areas, is increasingly encroaching on rural, "tranquil" areas, and is progressively eroding the period of night-time quiet. Despite this, the control of noise has never been subject to an overarching policy or legislative framework, in the same way as, for example, air quality or waste disposal. This neglect may be partially explained by the fact that the effects of noise on the general population have been historically easy to overlook. In addition, the nature of noise, and the reaction of people to it, does not lend it easily to the sort of mechanistic approach available to other pollutants.'¹

- 5.2 UK noise policy and legislation has developed incrementally, seeking to contain the worst problems. A shift to more pro-active approaches increases the importance of integrating action on ambient noise with other noise issues. For example, reducing road traffic in a mixed use town centre could mean that noise from pubs or cafés becomes more perceptible to residents. An integrated approach could include securing support from venue operators for better area management. Noise policy needs to take an integrated view across all sources, if cost-effectiveness is to be secured (see also paragraph 4.2).
- 5.3 When discussing what annoys them, people often refer to specific noises rather than broad categories of noise - 'motor bikes' rather than traffic; 'music' or 'dogs' rather than the general noise level in their neighbourhood. Policy needs to consider not just long term 'averaged noise', but the 'noise events' within it. Policy needs to consider people's overall exposure as they move through their daily lives - on the way to work, at work, and in leisure activities. Understanding of combined effects needs to be further developed. People's priorities may vary across London, and between different groups of Londoners. A multi-source approach focused on the individual implies action at the level closest to communities.

policy 79 The Mayor will urge the Government, in its proposed work on adverse effects, to support studies of personal noise exposure in complex urban

environments, in overall exposure terms, including at work, while travelling, and in leisure activities.

Hearing-friendly design and management



- 5.4 It has been estimated that about one in seven people in the UK has some form of hearing loss, from slight impairment to profound deafness. Hearing loss does not necessarily mean less concern about noise. In many cases, people need lower levels of interfering sound in order to hear what they want to hear. Inductive loop systems make the use of aids more effective, but will not answer all needs. Noise which can interfere with communication includes traffic and 'wallpaper' music, which can also be annoying to people in general. People with a visual impairment may need to rely on clear aural cues. Environments which are supportive, both acoustically and visually, to people with a hearing difficulty, are likely to reduce stress for people as a whole. The 'Good Practice Guide: Providing access to public services for deaf people' UK Council on Deafness, 2001 offers advice. Better skills and understanding of hearing-friendly design are needed across the development industry.²

- policy 80 The Mayor will urge those commissioning, designing, regulating, altering and managing buildings and spaces to which people need access to adopt hearing-friendly design and management good practice.

Healthy hearing and leisure sound - pubs, clubs, and other pastimes



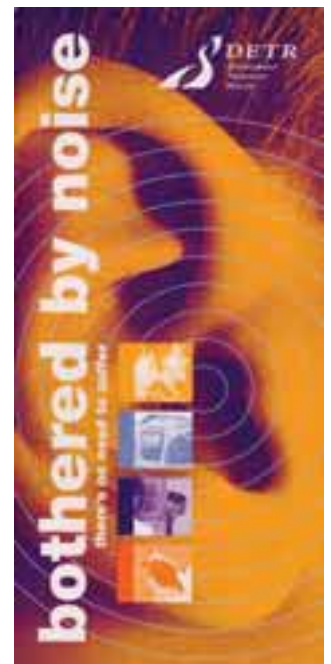
- 5.5 Piped music in general can seem oppressive to many people. High levels of noise in leisure venues, particularly from amplified sound, have become a cause for concern. Understanding speech in such conditions typically becomes more difficult as people's hearing changes with age. As well as deterring many users, this can also be a health issue. Noise exposure which can damage hearing is not confined to factories. Many people are exposed to loud noise in leisure activities, including amplification equipment in homes and leisure venues. High sound levels are encountered in restaurants, theatres, cinemas and concert halls, and at sporting events and festivals, as well as in many pubs and clubs. Percussive or impulsive noise, such as from fireworks, can pose particular risks. Risks have traditionally been considered most severe to workers. Venue visitors may be unaware of the risk to their hearing, which may have cumulative effects with regular exposure, added to that in other parts of their daily lives.
- 5.6 If people's hearing is damaged while clubbing, or using in-car sound systems or personal headphones at excessive volumes, they may not be able to listen to home entertainment without turning the volume control up to levels that annoy their neighbours. In due course, they may themselves come to need lower levels of 'interference noise'. Authors of a

recent international review³ considered that the general public needed to be informed of the risks. Boroughs have statutory responsibilities for the enforcement of health and safety law in the distribution, retail, office, leisure and catering sectors, liaising with the Health and Safety Executive. Health education needs, of course, to be targeted, avoid a killjoy or 'nanny' image, and work in terms of popular culture.

- policy 81 The Mayor will urge the Government to support provision of appropriate information to the public and to venue operators on the risks to hearing from over-exposure to high levels of amplified music, with particular attention to the risks faced by young people. Potential elements include promotion of 'healthy hearing' and 'safer sound' messages in clubs, pubs and other venues; and ensuring suitable resources for local health and safety regulation, funded from relevant revenues.

Neighbour noise

- 5.7 Reducing ambient noise can mean that residents hear neighbour noise which was previously less audible. Public engagement and communication on ambient noise needs to be linked as far as possible with that on neighbour noise. Typical neighbour noise problems include amplified music, TV or radio, voices, banging doors, children playing, barking dogs, and DIY activities. Secondary noise sources and non-noise issues appear to play important roles in many complaints to local Environmental Health Departments. A recent study suggested that, in many other European countries, the police authorities may play a larger role in certain types of noise complaint than in the UK.⁴ A Government-commissioned study⁵ highlighted the need for multi-agency working, better information systems, improved communication skills, and encouraging negotiation between neighbours. Mediation can avoid resort to legal action, which can leave a legacy of bitterness. Mediation UK⁶ includes information on mediators in the London area. The voluntary organization The Noise Network has argued for arbitration rather than mediation - with concern that mediation, in seeking a compromise or intermediate position, can imply denial of an individual's rights. Policies to improve housing standards, funding, staffing and training (Policies 71, 72, 75, 76, 94 and 96) should contribute to reducing neighbour problems.



Housing and neighbourhood management, crime and disorder

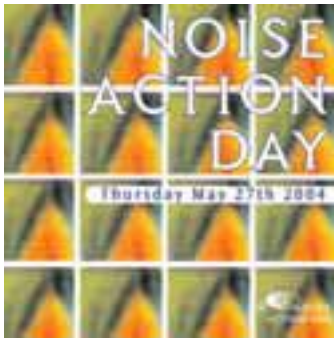
- 5.8 Local authorities and the police are required under the Crime and Disorder Act 1998 to develop local crime and disorder reduction partnerships. Local authorities and the police can seek Anti-Social Behaviour Orders (ASBOs) against any resident causing harassment, alarm or distress to others, for example, where noise nuisance may be part of a wider pattern of intimidating behaviour. Under the Housing Act 1996 social landlords can take action against tenants for anti-social behaviour. All landlords can

take out injunctions with the aim of preventing the nuisance. Neighbourhood and street warden schemes can play a role in reducing disorderliness, along with more police and police auxiliaries. Scarce resources and competing priorities mean that police support for local authority noise services may not always be available at the requested level. Vehicle noise enforcement is considered in Chapter 4A.

- policy 82 The Mayor will urge the Government to ensure that the complexities of dealing with noise nuisance and anti-social behaviour in metropolitan areas are fully reflected in allocation of resources for local authority Environmental Health functions, policing, police auxiliaries, neighbourhood and street warden schemes and related services.

Education and public awareness

- 5.9 The National Society for Clean Air and Environmental Protection (NSCA) co-ordinates Noise Action Day in the UK. Many local authorities, along with schools, mediation services and others take action to promote messages about noise. In a survey of noise enforcement officers by the NSCA⁷, many saw better education and informal resolution of noise disputes as preferable to more prescriptive legislation. It is important to find forms of public communication which work in a diverse metropolitan culture. There may be economies of scale in preparing and disseminating such material at a London level.



- policy 83 The Mayor will work with others, subject to resources and consultation, in developing appropriate forms of education and public communication on noise, for example where action at the metropolitan level could complement that at other levels.

Low frequency noise

- 5.10 There may be more low frequency noise in London than nationally.⁸ People complaining about low frequency noise may have difficulty describing it, perhaps using terms such as 'feeling the noise' or 'pressure sensations'.⁹ People can become more sensitive to it as they become older. It can be very difficult to detect the source. Sources and solutions are highly locally specific. It is important that borough responsive noise services have adequate resources to carry out or commission specialist work where it is required.¹⁰ Low frequency noise needs to be included in building up research and information, staffing and training (e.g. Proposals 20 and 21, Policies 87, 89 and 96).

Construction noise from building operations

- 5.11 Construction site noise is controlled by the London boroughs, and specifically excluded from the definition of 'ambient noise' in the Greater



London Authority Act 1999. There is some evidence that noise from construction activity is a problem for a higher proportion of Londoners than nationally (see Chapter 2). Construction activity is high in certain areas of London, notably the centre and docklands, including in some areas of social exclusion or deprivation. High levels of construction can be expected over the next decade. Six London boroughs have developed and use 'considerate contractor' schemes.¹¹ A London-wide code of practice has been seen as providing clarity and simplicity for the construction industry. Operators of facilities which generate noise need to demonstrate that they are taking all reasonable steps to minimise disturbance, and to explain the need for noise which cannot reasonably be avoided. Timing of noisy operations is critical. Re-use rather than demolition and reconstruction where possible, design for quiet erection, sensitive routing of construction vehicles, use of quieter methods, temporary noise barriers and many other measures need to be employed. The Mayor is investigating, with London boroughs and others, whether a London-wide construction best practice scheme would offer further clarity and consistency. Air quality is a primary concern. Noise issues will be integrated as far as possible.



policy 84 Acknowledging that construction noise is excluded from the legal definition of ambient noise, the Mayor will work in partnership with others, as far as resources allow, to minimise the adverse impacts of construction noise in London, including through re-use of existing buildings in preference to demolition and reconstruction where practicable.

Setting priorities

- 5.12 Individual noise reduction measures may not 'solve the problem' on their own. Full effectiveness often depends on what other noise sources are present. Policy needs to be 'joined up', so that changing one noise does not mean that people are just as annoyed by the next. A single measure may, however, be an essential step towards a bigger improvement - incremental gains can be cumulatively effective.
- 5.13 Some early priorities for action can be identified (see box 60). Public consultation during preparation of this strategy showed broad support for these priorities.¹² However, establishing more far-reaching priorities for selecting, designing, combining and sequencing potential measures requires much better information than is currently available. Given the very limited resources initially available to the Mayor, this will depend on an effective partnership with national strategy development, boroughs and specialist agencies, within the evolving European framework. Future revisions of this strategy will, of course, be the subject of further consultation.

Box 60: Priorities*Three key issues -*

- Securing good, noise reducing surfaces on Transport for London's roads.
- Securing a night aircraft ban across London.
- Reducing noise through better planning and design of new housing.

Other initial priorities are -

- Extending good, noise reducing surfaces across all roads where they would be effective, along with less disruptive and better reinstated streetworks.
- Encouraging quieter vehicles.
- Building in noise reduction in day-to-day traffic management - to maximise gains from reducing stop-start driving as congestion falls, smoothing traffic flow, allocating street space better, and other transport measures.
- Improving noise environments through 'Streets for People', in Home Zones, in town centres, and in exemplar Public Space projects.
- Developing a Traffic Noise Action Programme for the 580 kilometres of roads which Transport for London manages, including targeted traffic noise reduction projects.
- Trialling fuel cell buses, seeking to trial hybrid-electric buses, and seeking smoother and quieter driving, including through driver training.
- Establishing a London Ambient Noise Fund for exemplar noise reduction projects, and a London Domestic Noise Fund to improve internal and external noise, especially in poorly converted flats.
- Seeking improved railway track quality and maintenance on National Rail and Underground as far as organisation and funding allow.
- Securing support for exemplar noise barrier-integrated photovoltaic power generation along suitable roads and railways, and noise screening from safety and security fencing.
- Promoting development alongside or over suitable roads and railways, protecting wider areas from noise.
- Ensuring that 'polluter pays' levies compensate those affected by aircraft noise and other effects, such as through Aviation Environment Funds for each airport.
- Reducing noise through better planning and design, where London's growth in people and jobs presents challenges, but redevelopment and refurbishment also offer opportunities - high density, mixed-use development can create quiet outdoor spaces away from traffic.
- Examining the scope for a Mayor's Sound Award, and promoting exemplar City Soundscape projects.

- 5.14 Given the evolving national and European context, it would be premature for a London strategy to adopt specific quantified targets. Without resources and effective instruments, any targets cannot be meaningful. It is first for national Government to consider overall target setting, following analysis of exposure, and the costs and benefits of implementing effective measures. Crucially in the current UK fiscal and legal framework, the Government must ensure that adequate funding, incentives and legal powers are available, related to the practical options for noise reduction. The process proposed by the Government is a lengthy one. It will help set rational priorities, though it should not delay action where the need for it is clear.
- 5.15 This applies particularly to further reductions at source. These are likely to be increasingly important to cities. National noise mapping can assist in assessing the relative cost-effectiveness of noise reduction at source, on the pathway, or at the receptor. It is important that the national strategy process identifies the relative costs and benefits in ways that reflect the policy priorities of an urban renaissance. More active noise management in the local environment should not distract attention from the need for continued reductions at source.

policy 85 The Mayor will work with the Government, boroughs and others to contribute to National Ambient Noise Strategy, within the evolving European policy context. The process should not, however, delay action where the need for it is clear. This applies particularly to continued reductions at source, notably where international agreements are needed.

Noise mapping

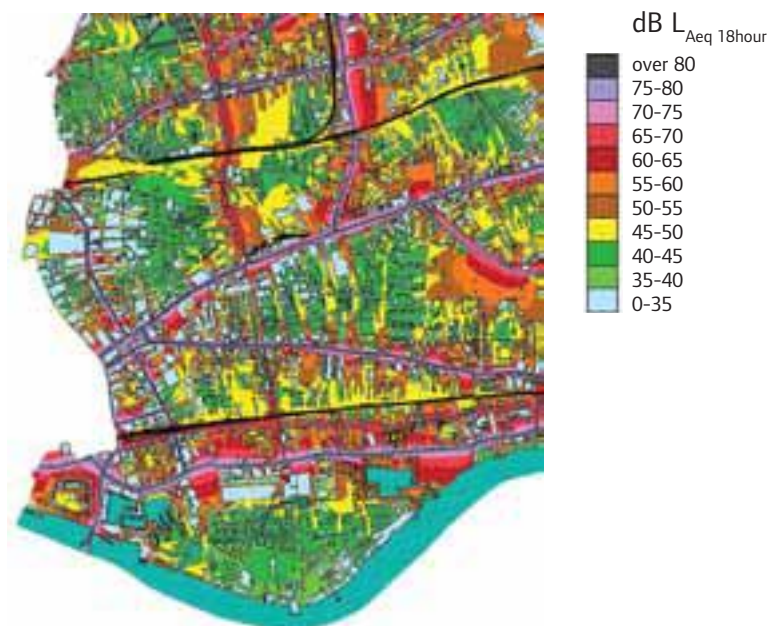
- 5.16 Government-supported noise mapping is welcomed. London is a key part of the national picture, given its exceptional size and complexity.¹³ The Mayor and Transport for London are assisting as far as scarce resources allow. It is, of course, important, that mapping does not become just a data collection exercise, but provides a practical tool for use by local authorities and other agencies, although computerised noise mapping cannot be relied on as the only tool for developing remedial measures. Further resources are likely to be needed to develop noise mapping at finer levels of resolution for local purposes.
- 5.17 It is vital that noise mapping does not dominate policy development or distort priorities. Maps as currently envisaged only describe part of a complex picture. Presentation to the public needs to make this clear. This is not just a 'level of detail' issue. Mapping long term 'averaged' environmental noise levels across urban areas should not lead to crude targets which focus action on the small number of parameters which would

'move' the map, rather than the larger range of actions which could reduce noise in the real world. Attention should not be distracted from dealing with the many distinct types of noise which can annoy people, nor from the need to protect or enhance soundscape quality and diversity.

- 5.18 Limitations on accuracy mean that maps may be suitable for quantifying broad national exposure, and highlighting relative concentrations across an area, but not for other purposes. First round noise maps may not be sufficiently accurate to be used as local or regional benchmarks, in the full meaning of those terms. They are nevertheless part of building a more proactive approach, in which a range of agencies need to participate. Maps should include information on error ranges and assumptions, and purposes for which maps are fit and not fit. Publication should be accompanied by outline information on typical characteristics of the types of noise mapped, including issues not captured by mapping long term 'averaged' noise.

policy 86 The Mayor and Transport for London will work with the Government and its consultants to implement noise mapping in ways which support integrated noise management, and, as far as possible, provide practical tools for day-to-day action, and will urge other specialist agencies and boroughs to do likewise. Government should provide adequate support for noise mapping to become embedded in local noise management and town planning, and integrated with other applications such as visualising proposals for buildings and managing solar gain (see glossary).

Figure 23 Sample noise map of part of Tower Hamlets



source: Tower Hamlets Borough Council, with acknowledgement to Paul Smith and WS Atkins

Effects and people's priorities

- 5.19 Attitudes to noise are highly related to context, which includes combinations of many different types of sound. The effects of different patterns of events across different times of the day, week and year need to be better understood. The National Noise Incidence and Attitude Surveys provide valuable data at national level. At a London level, these only provide information from some outer boroughs and extension of such surveys to be more representative of London is highly desirable. Information on people's exposure and their priorities needs to be established at regional and local level, and for different population groups, if resources can be found. In terms of integrating ambient and other sources, a recent study has demonstrated the potential for harmonising complaints data, as well as providing a tool for local authority officers to use in assessing the effects of domestic noise, and a survey tool for researchers.¹⁴
- 5.20 A work programme to establish people's priorities can be combined with carrying out practical noise reduction projects on the ground. 'Before and after' studies can provide a powerful test of the effectiveness of measures in matching people's priorities. The Mayor has been given a duty to prepare a strategy, but not the resources for such work. It could, however, contribute to the Government's proposed ambient noise policy development process. The Mayor wishes to see all parts of London, inner and outer, have the chance of an exemplar pilot project to demonstrate practical improvement, and gauge people's priorities.

policy 87 The Mayor will encourage specialist agencies, educational and professional institutions, and the London boroughs to work with the Government, and European partners where appropriate, to develop improved understanding of the effects of noise, soundscape quality and people's priorities to inform policy. Issues include assessing the needs and priorities of local and regional populations, such as through attitude surveys, and surveys of the incidence of noise exposure.

proposal 27 The Mayor will support development of a London Noise Survey, which can best be carried out with the support of, and in partnership with, the London Boroughs and other stakeholders. The Mayor urges boroughs and other stakeholders to participate and share information and resources.

Organisation

- 5.21 City noise management is likely to be most effective when integrated in design and operation, rather than mitigation 'after the event'. Primary responsibility for action should thus normally rest with bodies responsible for managing relevant systems or sub-systems, such as transport.

Monitoring data will normally be most useful when collected as part of active and responsive system management, independently verified where appropriate. Government, regional and local authorities should, where necessary, have legal sanctions of last resort. Also, however, noise and vibration impacts are highly dependent on precise local physical relationships between source and receiver - to a much greater extent than with many other pollutants. People's responses are strongly influenced by local context. These factors mean that many aspects of noise policy are best built 'from the ground up'. Issues include management of strategic roads, but also community plans, design input in development control negotiations - including in schemes not referred to the Mayor - urban regeneration, and local traffic management.

5.22 A pro-active approach to improving city soundscapes needs to be integrated into urban regeneration, transport, housing and parks management, town planning, urban design, and many other areas of urban management. Higher density living is likely to be most successful where noise management is built into urban management, such as through warden and concierge schemes. Requirements of the European Environmental Noise Directive include preparation of action plans.¹⁵ Work at the level of detail of neighbourhood planning is most likely to provide the 'fine grain' understanding of a locality which will identify improvements that genuinely reflect local needs, implemented in ways that can be sustained.

5.23 Partnership working will be vital to improving London's noise environment - including with the London boroughs and executive agencies, notably the Environment Agency. During consultation on this strategy, a number of authorities expressed informal interest in Londonwide working to develop and share good practice and make best use of scarce resources. Because of the lack of a dedicated budget for noise mitigation, and no framework of powers comparable, for example, with air quality management, this strategy has focused on identifying action using existing instruments. The work of Transport for London and links with the boroughs, both on transport and through the planning system, will be key.

policy 88 The Mayor will urge the Government to provide a framework for action which integrates noise management at all relevant levels of social, economic and environmental decision-making, including in strategy and planning, regulation, enforcement, provision of incentives and investment.

policy 89 The Mayor will work with area-based and other partnerships, boroughs, and specialist agencies to assess how improved noise management can be incorporated into their on-going planning and implementation

frameworks, as well as examining the scope for a London Noise Action Partnership or other mechanisms for joint working.

Costs

- 5.24 The costs, for the public sector, businesses and individuals, of significantly reducing ambient noise in London are not currently quantifiable, but would be high. Such costs need to be considered in the context of national noise policy development, which will include examination of the economic and social implications of potential noise reduction measures. Work on costing options for noise reduction needs to have full regard to equal opportunities issues, including implications for those on low incomes, and other population groups who, in that context, might be more vulnerable. It is essential, not just that noise problems are identified, but that Government ensures the necessary framework of resources for regional and local authorities, transport bodies and others to address them. Past under-funding needs to be recognised in future allocation of resources - in London, this particularly applies to the condition of road and railway infrastructure.
- 5.25 Additional duties need to be accompanied by appropriate powers and resources, or the process will become discredited. In making the case for more resources, or for actions with economic implications, the need to assess costs in relation to benefits¹⁶ is recognised. However, 'average' valuations of the worth of a decibel reduction should not be applied mechanistically. It is important to avoid potential sources of bias between different types of area. For example, noise mitigation funding should not be allocated simply in terms of the numbers within modelled exposure bands. Regard should be paid to the costs of different levels of reduction, which may be higher in urban rather than suburban areas, and higher for the worst-affected, rather than for similar levels of reduction at lower levels of ambient noise. It could be particularly expensive to make large reductions to a particular guideline level in busy, high density areas.
- 5.26 Recognising the need to protect soundscape quality where it is good, it is in the worst-affected areas where people are likely to expect noise mitigation expenditure to be initially concentrated. To build confidence in the national noise strategy process, an early fund should be established for targeted action, at first in the more highly exposed situations. Recognition should be given to the particular noise burden that London carries through being the gateway to the UK. This should be reflected by establishing a London Ambient Noise Fund. This can be justified independently from arrangements for the rest of the country. It would provide an essential component in fulfilling the duty to prepare this first ambient noise strategy given to the Mayor by Parliament.

- 5.27 An Organisation for Economic Co-operation and Development international review¹⁷ stated: 'It appears that anti-noise regulations and policies are better respected and implemented when a specific budget to reduce noise is allocated, and when the procedures for obtaining proper financial resources are established.' Ideally, those who generate noise should pay to reduce it. The national strategy process should consider new 'polluter pays' levies, or allocation of a portion of relevant existing revenue, for noise reduction. The wider benefits of public transport should be recognised in any new arrangements. In the UK, most taxes are collected by central government, but there would be benefits in administering centrally-collected funding regionally, including in co-ordination, project preparation and assessment. Successful regional allocation of the National Waste Minimisation and Recycling Fund through a partnership between the Mayor, Association of London Government and London Waste Action illustrates the potential. There is the same need for money from Central Government to kick-start work on noise as there is on waste.
- 5.28 Additionally, a London Domestic Noise Fund should be considered. Even with large external noise reductions, poor standards of noise insulation, both internal and external, are likely to remain of concern in much of London's housing. External ambient noise reduction can make poor internal noise insulation between neighbours more apparent. Such a fund would recognise the burden associated with London's 'gateway' role, and the age of much of its housing. London authorities, private landlords and tenants, and private owners would bid for improving both internal and external building insulation, linked to fuel poverty and energy saving. Local authorities, other bodies, and partnerships within London, would also be eligible for grants towards wider noise reduction measures or packages.
- 5.29 For both a London Ambient Noise Fund, and a London Domestic Noise Fund, a competitive bidding arrangement could have advantages in a limited initial period - in encouraging innovation and realising the aspirations of those most keen and ready to act. New resources for innovation in integrated noise management should be ring-fenced. Subsequently, as more extensive practice develops, a move to needs-based targeting would be appropriate. The level of fines awarded against those found guilty of noise-related offences has tended to be low, often bearing no relation to the cost of bringing a case. This is primarily a noise nuisance rather than an ambient noise matter. However, it would be consistent with action in other areas for fine income to be recycled into noise-related activity.

- policy 90 The Mayor will urge the Government to ensure that responsibilities for noise mapping, measurement, action planning and management are accompanied by realistic programme funding, incentives and necessary legal powers. Past under-funding, and equalities issues, should be recognised in future allocation of resources and duties, including with respect to infrastructure condition.
- policy 91 The Mayor will urge the Government, as part of National Ambient Noise Strategy, to:
- Assess the differential costs, in higher density urban relative to other areas, of both increments of noise reduction, and reducing noise to such guideline levels as it may promulgate; and
 - Allocate noise mitigation funding not simply on the basis of the numbers of people within noise mapped exposure bands, but having regard to the costs of noise reduction, recognising where costs may be higher in urban rather than suburban areas, and higher for the worst-affected.
- policy 92 Recognising the pioneering role envisaged by Parliament when it required the Mayor to prepare the country's first citywide Ambient Noise Strategy, and the noise impacts associated with the capital's 'gateway' role, the Mayor will request the Government to establish a pilot London Ambient Noise Fund, to support local activity.
- policy 93 The Mayor will invite each London borough to develop an exemplar pilot environmental noise project in each part of London to demonstrate the feasibility of practical local noise-targeted improvement, related to people's priorities. Boroughs are encouraged to work together and with the Mayor to make a joint case to Government for the necessary resources, having regard to the contribution which 'before and after' assessment could make to national noise strategy development, including costing implementation.
- policy 94 Recognising the particular scale and mix of both external and internal noise problems associated with London's housing, issues of availability and affordability, and the noise impact associated with the capital's 'gateway' role, the Mayor will urge the Government to establish a pilot London Domestic Noise Fund, to support local activity.
- policy 95 The Mayor considers that any fine income resulting from noise-related offences should be recycled into improved noise-related services. Other 'polluter pays' levies should feed through to actual mitigation and compensation.

Training and staffing

- 5.30 More staff and more training will be required if effective strategy implementation is to be achieved. This will be particularly important as London accommodates more of national development demand with more higher density mixed-use projects. Borough Environmental Health Officers are the established body of staff with understanding of London's complex noise environments. However, demands on their time are many, and concerns have been expressed over available staffing. Targeted bursaries to encourage take-up of training by groups currently under-represented in the environment-related professions could play a role, including for courses with 'crossover' potential between acoustics and the music industry. Training in noise management for town planners, traffic engineers, parks and housing managers, and other specialists would help to ensure that opportunities to secure cost-effective improvements are not missed. The profile of 'sound-conscious design' needs to be raised among architects, landscape designers and other disciplines. Sound-related skills may also need to be more extensively applied in businesses dealing with heating and ventilation, in design, manufacture, installation and maintenance.

policy 96 The Mayor will urge the Government to ensure that imposition of noise management duties is accompanied by adequate resources, including for enforcement, extending staff skills and capacity building.

A Mayor's Sound Award?

- 5.31 Many environmental accreditation schemes exist. Noise has not generally been a focus. Environmental Management Systems assist organisations in meeting environmental commitments. The European Eco Management and Audit Scheme (EMAS) requires a policy statement, an environmental programme, management system and a regular audit cycle. All of these must be validated by an accredited external EMAS verifier. The Building Research Establishment, Construction Industry Research and Information Association and others, the British Standards Institution and its international counterparts publishes guides and standards on noise and vibration. The combining of technical, administrative and other measures at the urban environmental level is less recognised. The Mayor will consider the scope for a competition or award scheme to raise the profile of sound-related design and noise management, and encourage innovation for London.

proposal 28 The Mayor will examine the potential role of a competition or award scheme in encouraging innovation and exemplary practice, such as in sound-related design or operation, among a variety of organisations across the city.

Sounds of the city

- 5.32 Better soundscape management should not be seen as a 'killjoy' activity. Sound plays many positive roles in people's lives. Big cities have buzz, but they also need balance. Awareness-raising needs to be approached carefully in the case of noise. There is some indication that 'increased sensitivity to noise' may have been one of the outcomes of the Darlington Quiet Town Experiment.¹⁸ Some forms of noise awareness campaigning could be counter-productive if not cruel, if they increased individual's sensitivity to noise faster than noise was reduced.
- 5.33 However, encouraging creative exploration of city soundscapes, such as through cultural projects, could enrich personal experience while helping to create the context for practical improvements in city noise environments. Recognition of the value of cross-disciplinary soundscape work in understanding people's responses, and engaging people in new approaches to change, is growing.^{19 20} Cities need, not just more effective noise control, but more 'sound-conscious' design and management. Soundscape quality and diversity need to be enhanced, so that people have more chance to enjoy, rather than neglect or need to escape, their sound worlds.



- policy 97 The Mayor will encourage arts organisations, sponsors and others to promote creative exploration of city soundscapes, in ways which both enrich personal experience and help create the context for practical improvements.

References and notes

- 1 National Noise Committee of National Society for Clean Air and Environmental Protection. 'Towards a Noise Strategy for the UK' Clean Air, Vol 30(3), NSCA, May/June 2000.
- 2 The Royal National Institute for Deaf People www.rnid.org.uk and the British Deaf Association www.britishdeafassociation.org.uk can also provide advice on the specific needs of deaf people. The Mayor's 'Draft Supplementary Planning Guidance to the London Plan: Accessible London: Achieving An Inclusive Environment' Greater London Authority, July 2003 gives advice on implementing inclusive design. Such design is further explained in the Office of the Deputy Prime Minister's good practice guide 'Planning and Access for Disabled People' (March 2003) (www.odpm.gov.uk) and in the Disability Rights Commission's discussion paper 'What is an inclusive environment and how can it be achieved?' (2002) (www.drc-gb.org.uk). The Disability Discrimination Act 1995 and the Disability Rights Commission (DRC) Act 1999 provide powers and means of enforcing rights preventing discrimination against disabled people. Information on many issues is contained on the website <http://www.disability.gov.uk/>.
- 3 Maassen M, Babish W, et al. 'Ear damage caused by leisure noise' Noise & Health, Vol 4;13, pp 1-16
- 4 Mitchell S. 'Neighbour and Neighbourhood Noise - A review of European legislation and practices' Environmental Resources Management for DEFRA, March 2002.
- 5 Grimwood C, and Ling M. 'Domestic Noise Complaints - Furthering our understanding of the issues involved in neighbourhood noise disputes' BRE Acoustics Centre for DETR, December 1999
- 6 Mediation UK can be contacted at tel. 0117 904 6661 or www.mediationuk.org.uk
- 7 NSCA. 'National Noise Survey 2001' NSCA, June 2001.
- 8 Grimwood C and Skinner C. 'A review of London-related data from the 1990 and 2000 National Noise Incidence Studies' BRE, May 2002
- 9 Casella-Stanger. 'Low Frequency Noise' Technical Research Support for Department for Environment, Food and Rural Affairs, Noise Programme, 2001. See <http://www.defra.gov.uk/environment/noise/casella/index.htm>

- 10 Leventhall G, Pelmeur P and Benton S. 'A Review of Published Research on Low Frequency Noise and its Effects' Research Report, Department for Environment, Food and Rural Affairs, May 2003. See <http://www.defra.gov.uk/environment/noise/lowfrequency/index.htm>
- 11 The Corporation of London pioneered the Considerate Contractor Scheme and recently published a Code of Practice for construction and demolition sites.
- 12 A full report on consultation will be made available, including via the website, <http://www.london.gov.uk>
- 13 <http://LondonNoiseMap.com>
- 14 Stansfeld S, Brown B, Haines M, Cobbing C. 'The Development of a Standardised Interview to Assess Domestic Noise Complaints and their Effects (SCIANCE)' Department of Health, 2001, www.doh.gov.uk/hef/airpol/sciance.htm
- 15 Directive 2002/49/EC requires Member States to designate authorities and bodies for making, approving where relevant, and collecting noise maps and action plans, and to make this known by 18 July 2005. Government proposals for designation would be the subject of public consultation. In the London context, there are strong arguments for allocating responsibilities in a way similar to that for air quality - with a Londonwide strategy, and action plans for component areas that make maximum use of existing partnership arrangements.
- 16 DEFRA. 'Towards a National Ambient Noise Strategy' DEFRA, 2001
- 17 OECD. 'Roadside Noise Abatement.' OECD, Paris, 1995.
- 18 Noise Advisory Council. 'The Darlington Quiet Town Experiment' Report by a Working Group of the Council, HMSO, 1981
- 19 e.g. Lercher P and Schulte-Fortkamp B. 'The relevance of soundscape research to the assessment of noise annoyance at the community level' Proceedings of the 8th International Congress on Noise as a Public Health Problem, ICBEN, Rotterdam, 29 June - 3 July 2003.
- 20 Järviluoma H and Wagstaff G. 'Soundscape studies and methods' ISBN 951-96171-5-9 Finnish Society for Ethnomusicology, University of Turku, 2002.

A1 implementation framework

The Government has yet to take key decisions regarding the national legislative and resource framework for ambient noise. Responsibilities for noise action planning under European Directive 2002/49/EC have yet to be allocated across UK organisations, including the division of responsibility between the Mayor, the London boroughs and others.

Road traffic noise mapping of London, not completed at the time of writing, will need to be analysed to inform actions and priorities across the different organisations which are given duties. Noise mapping according to Directive requirements also needs to be carried out for railway, industrial and aircraft noise. The Directive sets a 5-yearly cycle of noise mapping as a primary monitoring mechanism. Other monitoring, evaluation and target-setting will need to be developed to make most cost-effective use of this framework.

At present, fewer bodies are active in managing ambient noise than is the case with other Mayoral strategies. Policy 89 states that the Mayor will work with existing partnerships, boroughs and others to assess how better noise management can be incorporated into their planning and implementation frameworks. It also states that he will examine the scope for a London Noise Action Partnership, or other mechanisms for joint working. Building effective partnerships for action requires that, as responsibilities are clarified, partners are encouraged to contribute creatively towards implementation planning.

For these reasons, fewer actions appear at this stage as 'Proposals' and more as 'Policies' than is the case with some of the Mayor's other strategies. Table 5 sets out London Ambient Noise Strategy Proposals under key themes. Actions, including projects, will, however, be initiated in pursuit of Strategy Policies, as opportunities occur, and as the legal framework and available resources allow. Table 6 summarises the Proposals, with information on implementation. Table 7 sets out key policy milestones on the timeline to 2016.

Table 5 Proposals by theme

Theme	Chapter	Proposals
Sustainability	4	1
	4E	24
Quieter vehicles and maintenance	4A	2, 3, 10, 12, 13, 14, 15
Roads and drivers	4A	4, 6, 8, (10)
Street works	4A	5
Noise assessment	4A	9, 11, 18, 19, 20, 21
	5	27
Traffic noise management	4A	16, 17
Aviation	4C	22, 23
Built environment	4A	7
	4F	25, 26
Awards	5	28

Table 6 Implementation Framework

No	Subject of proposal	Timescale for action	Responsible Organisations	Area of main impact	Potential contribution to reduced noise impact in the area affected	Equalities	Health	Sustainable development	Links with other Strategies /drivers
1	Use of noise and sustainability considerations in awarding GLA contracts	immediate in relevant GLA tenders	Core GLA, and developing processes in TfL, LDA, LFEPA, MPA/S	London wide	(depends on tender)	0	+	++	Transport, London Plan, Waste, Energy, Air Quality, Proposals 54, 55 & 67
2	Promotion of quieter vehicles and associated activities	immediate	GLA/TfL/LBs/LDA/Hydrogen Partnership	London wide	low (but could be medium in long term)	0	+	++	Energy Air Quality (general linkages)
3	Pursue further in-service vehicle noise opportunities	immediate	GLA/ALG/LBs	London wide	medium	0	+	+	Air Quality, Proposal 9, Policy 10

No	Subject of Proposal	Timescale for action	Responsible Organisations	Area of main impact	Potential contribution to reduced noise impact in the area affected	Equalities	Health	Sustainable development	Links with other Strategies /drivers
4	Smoothing traffic flows and promoting quieter driving	immediate	TfL/LBs/GLA	London wide and locally	low	+	+	+	Energy, Transport, Proposal 3.4 Air Quality, Policy 14 & Proposals 25 & 26
5	Improving management of streetworks and balancing needs of stakeholders	immediate	TfL/LBs	London wide and locally	low	+	+	+	Transport, Proposals 4G.23, 24, 25 & 26
6	Using noise-reducing road surfaces where effective	immediate (life cycle assessment to be resolved)	TfL/LBs	London wide and locally	high	+	+	+	Transport, Proposals 4G.25 & 26 (Improved information to inform future policy)
7	Using opportunities from roadside development	immediate	TfL/LBs	Locally	Potentially high	+	+	+	London Plan, Policy 4A.14
8	Optimising traffic calming, Streets-for-People, Controlled Parking Zones and improving conditions for walkers and cyclists	immediate	TfL/LBs	London wide and/or locally	low	+	+	+	Transport, Proposals 4G.9, 4G.10, 4G.11, 4I.2, 4I.5, 4J.4
9	Monitoring of Central London Congestion Charging	Began in 2003, ongoing	TfL	Central London and immediate surroundings	N/A	0	0	0	Transport, Proposal 4G.13 (Improved information to inform future policy)

No	Subject of Proposal	Timescale for action	Responsible Organisations	Area of main impact	Potential contribution to reduced noise impact in the area affected	Equalities	Health	Sustainable development	Links with other Strategies /drivers
10	TfL working with London Sustainable Development Partnership, including encouraging cleaner and quieter vehicles, better maintenance and smoother driving	ongoing	TfL/LSDP	London wide	low	0	+	++	Transport, Proposal 4K.4, Air Quality, Proposal 20
11	Review of London Lorry Ban by ALG, boroughs and TfL	Began in 2003	ALG/TfL/LBs	London wide and locally	medium	+	+	+	Transport, Proposal 4K.3 Air Quality, Proposal 5
12	Noise control and management on London Bus Network	immediate	TfL	London wide	low	0	+	+	Transport, Proposal 4F.17 (ref. paragraph 4F.48) Air Quality, Proposals 12 & 13 Transport, Proposal 3.2 Air Quality, Proposals 25 & 26 (Improved information to inform future policy)
13	London Coach Forum activities	immediate	TfL/London Coach Forum	Locally	low	0	+	+	Transport, Proposal 4F.21
14	Taxis and Private Hire vehicles	immediate	TfL	London wide	low	0	+	+	Transport

No	Subject of Proposal	Timescale for action	Responsible Organisations	Area of main impact	Potential contribution to reduced noise impact in the area affected	Equalities	Health	Sustainable development	Links with other Strategies /drivers
15	Motorcycles, mopeds and scooters	immediate	TfL/London Motorcycle Working Group	London wide	low	0	+	0	Transport, Proposal 4G.1 Air Quality, Proposal 24
16	Traffic Noise Action Programme for TfL Road Network	2005, subject to European and national policy on action plans	TfL	London wide and locally	high	+	+	++	Transport Air Quality etc. (general linkages)
17	Guidance on Borough spending	Aim for first projects in financial year 2005/2006	TfL	Locally (but wide-spread)	high	+	+	++	Transport Policy 5.4
18	Sound audit or other assessment	Immediate	TfL/LBs	Locally (but wide-spread)	med	0	+	++	Transport Air Quality (general linkages)
19	Noise mapping - assessment and communication	Immediate	TfL (as lead in partnership with Government, LBs, GLA)	London wide	N/A	Specific analysis to be carried out	0	0	(Improved information to inform future policy)
20	Noise monitoring - measurement	Started in 2002	TfL	London wide	N/A	0	0	+	(Improved information to inform future policy)

No	Subject of Proposal	Timescale for action	Responsible Organisations	Area of main impact	Potential contribution to reduced noise impact in the area affected	Equalities	Health	Sustainable development	Links with other Strategies /drivers
21	Analysis and evaluation of noise reducing measures, including equalities implications	As soon as resources secured	TfL /LBs/HA	London wide and locally	N/A	+	0	+	(Improved information to inform future policy)
22	Surface movements related to London area airports, including freight	Immediate	TfL	Locally	med	0	+	+	Transport Policy 4L.1, Air Quality, Proposal 29
23	Aviation Environment Funds	Regular discussion with Gov't	GLA - Government	London wide and locally	med	0	+	+	Air Quality Proposal 32
24	Recycled materials in noise reduction	Initial report within 1 year of obtaining funding	GLA	Nation wide	N/A	0	0	+	Waste Proposals 74 & 75 London Plan, Policy 3B 12 (Improved information to inform future policy)
25	Exemplary sound-conscious urban design and noise management	Immediate	LDA (with others including TfL/LUL/SRA/GLA)	Locally	high	0	0	++	Transport London Plan (general linkages)
26	Exemplary soundscape measures in open spaces and public realm	Immediate	Architecture and Urbanism Unit, GLA, TfL, LDA	Locally	med	+	0	+	London Plan (general linkages)

No	Subject of Proposal	Timescale for action	Responsible Organisations	Area of main impact	Potential contribution to reduced noise impact in the area affected	Equalities	Health	Sustainable development	Links with other Strategies /drivers
27	London noise survey	Started in 2003	GLA/LBs/ others	London wide	N/A	+	+	+	(Improved information to inform future policy)
28	Competition or award scheme	2005 (study) 2006 (first award)	GLA	Locally or London wide	high	0	+	+	Transport London Plan (general linkages)
Key	<p>++ strongly positive effect. + positive effect. 0 no significant effect. - negative effect. '4' in Equalities column assumes that many such measures would, over the period to 2016, be most applicable in disadvantaged locations where equality target groups are likely to be disproportionately represented. '0' means that the noise measure would not 'automatically' have an effect. It does not mean that no action would be taken to seek beneficial effects. In particular, equalities policies would, of course, continue to apply. For example, in relation to Proposal 1, GLA Equalities policies apply to procurement. Abbreviations - see Appendix A8.</p>								

Table 7 Key ambient noise policy milestones until 2016

London	Year	National/EU
	2004	
London road traffic noise map finalised. Demographic analysis of London road traffic noise map. London Noise Action Partnership formed. London Housing Capacity Study carried out.		European Commission (EC) review of existing environmental noise measures. Establish UK legal and administrative framework for complying with Environmental Noise Directive (END).
	2005	
Borough noise projects start if funding secured. Option analysis using London road traffic noise map. TfL Traffic Noise Action Programme under way. Scoping of Mayoral sound competition or award.		Phase 1 of National Ambient Noise Strategy development completed. Identification of major roads, railways, airports and agglomerations for END purposes. Member states to inform EC of existing noise limit values 'Competent Authorities' for END to be identified.

London	Year	National/EU
<p>Completion of London Noise Survey. Mayoral sound competition or award if funding secured. Joint work on strategic noise mapping.</p>	2006	<p>Phase 2 of National Ambient Noise Strategy development completed. EC to propose legislation to reduce noise emitted by major sources. Strategic noise mapping year for END.</p>
<p>Analyse strategic London noise mapping data. Co-ordinate/analyse London noise action planning (depending on legal division of responsibility).</p>	2007	<p>Strategic noise mapping data for 2006 to be sent to EC. National Ambient Noise Strategy published</p>
<p>Assess need for new London Noise Survey. Review of London Ambient Noise Strategy to reflect national strategy.</p>	2008	<p>'Competent Authorities' to have drawn up noise action plans for major sources and for agglomerations. Start of new END cycle (identification of major roads, railways, airports and agglomerations for END purposes).</p>
<p>Major London event to analyse and assess progress.</p>	2009	<p>Summary report of data from noise maps and action plans published by EC. EC to report to European Parliament on the implementation of END.</p>
<p>Completion of 2nd London Noise Survey.</p>	2011	<p>Strategic noise mapping year for END.</p>
<p>Analyse strategic London noise mapping data. Co-ordinate/analyse London noise action planning (depending on legal division of responsibility).</p>	2012	<p>Strategic noise mapping data for 2011 to be sent to EC.</p>
<p>Review of London Ambient Noise Strategy</p>	2013	<p>'Competent Authorities' to have drawn up noise action plans for major sources and for agglomerations.</p>
<p>Major London event to analyse and assess progress.</p>	2014	<p>Summary report of data from noise maps and action plans published by EC.</p>
<p>Initial planning horizon.</p>	2016	

A2 what is noise?

What is noise?

'**Noise**' is typically defined as '**unwanted sound**'. The term 'noise' therefore combines the objective physical phenomenon 'sound', and its subjective psychological effects on people. The sound in question may be unwanted by the recipient for a wide range of reasons, varying by time of day, place and other factors. The term 'noise pollution' may be used to reinforce negative associations. Subjective responses vary widely between individuals. Effects on individuals are harder to quantify than the physical attributes of sound.

'**Ambient**' or '**environmental**' noise is long term noise from transport and industry, as distinct from noise caused by neighbours, construction sites, other local nuisances, and noisy workplaces.

How is sound described?

'**Sound**' is a form of energy, normally transmitted through the air. Typically, a vibrating source sets up pressure variations. The vibrations set up a pattern of alternate regions of increased and decreased pressure. These pressure variations travel, as the energy is passed from one particle to the next, but the particles do not. The vibration can be transmitted through air, any other gas, water or a solid.

'**Frequency**' is the rate at which the source and the resulting pressure waves vibrates. It is measured in 'Hertz' (Hz). Older publications may use the equivalent term 'cycles per second' (cps). The more rapid the vibrations, the higher the pitch or tone. 'Wavelength' is the distance between successive pressure waves, during one cycle. Wavelengths of audible sound vary from a few millimetres to several metres - the higher the frequency, the shorter the wavelength. The human ear can detect from around 20 Hz to 20,000 Hz (20 kHz). Humming, throbbing or droning noises comprise mostly low frequency sounds. Whistling, squealing and hissing noises contain mainly high frequency sounds. The musical term 'octave' represents a doubling in frequency. For many practical purposes, a restricted frequency range may be used. It may also be divided into octave bands and one-third octave bands.

'**Amplitude**' is a measure of the energy of the sound wave and gives a comparison of the loudness of different sounds. It is the maximum excursion of the pressure difference of a sound wave. The particles vibrate back and forth about a given position. The further they move the greater the sound energy. Amplitude can be measured in audible sound pressure variations (using units for measuring pressure, Pascals, Pa). These pressure units are inconvenient to use, so the magnitude of a sound is generally described by its **sound pressure level (SPL)**. SPL is the logarithmic ratio

of the pressure variation of that sound to a reference level and is measured in **decibels (dB)**. The logarithmic unit dB has the advantage of compressing the numerical range, from 0 dB up to, for example, 120 dB for a nearby pneumatic drill. Also, the human ear responds roughly logarithmically rather than linearly to sound. That is, the ear becomes (logarithmically) less sensitive to increments of additional sound energy.

Sound can be described by its sound pressure level in each frequency band. However, the human ear typically notices higher frequency sounds more readily than low frequencies. **A-weighting** is commonly used to reflect this. The A-weighting scale attaches a lower weighting to lower frequencies relative to higher frequencies. The A-weighted sound pressure level is denoted '**dB(A)**'. **C-weighting** may be used when evaluating very loud sounds, or those with a lot of energy at lower frequencies. Other weightings may be used. With modern equipment, sound can readily be measured across a wide frequency spectrum and subsequently analysed.

Sound levels in the environment typically vary through time. For example, free flowing traffic on a busy motorway may be continuously audible, while overflying aircraft may be individual events separated by a return to pre-existing background levels. A variety of descriptors have been used to aggregate sound through time, for different sources and in different circumstances. Two commonly used descriptors are:

- **Equivalent continuous A-weighted sound pressure level** - This is the notional A-weighted level which would deliver the same energy as the actual fluctuating source if it were to be delivered continuously over the defined period. Notation for this measure is $L_{Aeq, \text{time period}}$. The time period must always be stated.
- **Percentile parameters** - This is the value exceeded for a given percentage of the measurement period. L_{A90} is the dB(A) level exceeded for 90% of the measurement period, whereas L_{A10} is the level exceeded for 10% of the measurement period.

L_{A10} has been widely used in the UK to describe road traffic noise. L_{A90} is commonly used to describe background noise. Railway noise, and, increasingly, other environmental noise, is commonly described using L_{Aeq} . A number of indices are used in different countries to describe aircraft noise. The UK Government has moved from using **NNI** (Noise and Number Index) to using L_{Aeq} , which is the commonest international measure. L_{Amax} and **SEL** (see glossary) are also commonly used in describing railway and aircraft noise events. The European Environmental Noise Directive will require mapping and reporting of a composite day-evening-night index, L_{den} . L_{den} combines the L_{Aeq} for a 12 hour day period, with L_{Aeq} for a 4 hour

evening period, using a weighting of +5 dB(A), and with L_{Aeq} for the 8 hour night period which is weighted by + 10 dB(A). The 8 hour night period, L_{night} , is also to be mapped and reported separately.

Combining sound levels

Sound pressure levels from different sources cannot be added or subtracted arithmetically - it a logarithmic scale. Thus, if the first vehicle gives a sound pressure level of 70 dB(A), the addition of a second identical vehicle results in a level of 73 dB(A), not 140 - see table.

Table 8 Combining Sound Levels

Difference between levels to be combined, dB	Add to higher level, dB
0 or 1	3
2 or 3	2
4 to 9	1
10 or more	0

A sound can be masked or partially masked by another. Reducing one annoying noise can thus make another more audible. Local combinations of continuous and intermittent noise sources are likely to affect the level of annoyance. In urban environments with high, but changing background noise levels, it may be difficult to predict human response to changes, even when the physical changes can be accurately predicted. Introducing a new noise source, or eliminating an old one, may have different impacts from those expected.

Human response to noise

Human response to noise can take many forms (see Chapter 2, adverse impacts). In terms of subjective reactions, like bother or annoyance, much depends on context - what people think about the sound, as well as its loudness or other physical characteristics. Sound has meaning. It is not just pressure fluctuation.

The likelihood of an adverse human response to noise in a given situation appears to depend on a large number of factors. These include:

- Absolute level of the noise;
- Margin by which the noise exceeds the background noise level;
- How continuous or intermittent the noise is;
- Nature of the noise, e.g. pitch, tonality, clatter, hum;
- Time of day, week and in some cases, year;
- Trends in local noise (e.g. is 'party night' getting louder each week);
- Perception as to whether or how far the noise is 'avoidable';

- Responsiveness of the noise-maker to complaints;
- 'Reputation' of the noise-maker, including on matters wider than noise;
- Relationship of the noise with traffic congestion, air pollution, safety or other issues;
- Economic and employment links between the recipient and the source (e.g. people may be more likely to think the noise is justified if they work there);
- Characteristics of the neighbourhood, including mix of uses, or types of housing, and attitude of recipient to it.
- Activity engaged in by recipient.
- State of health of recipient.

Experiencing environmental noise and vibration

Road traffic noise and vibration may be experienced in three ways:

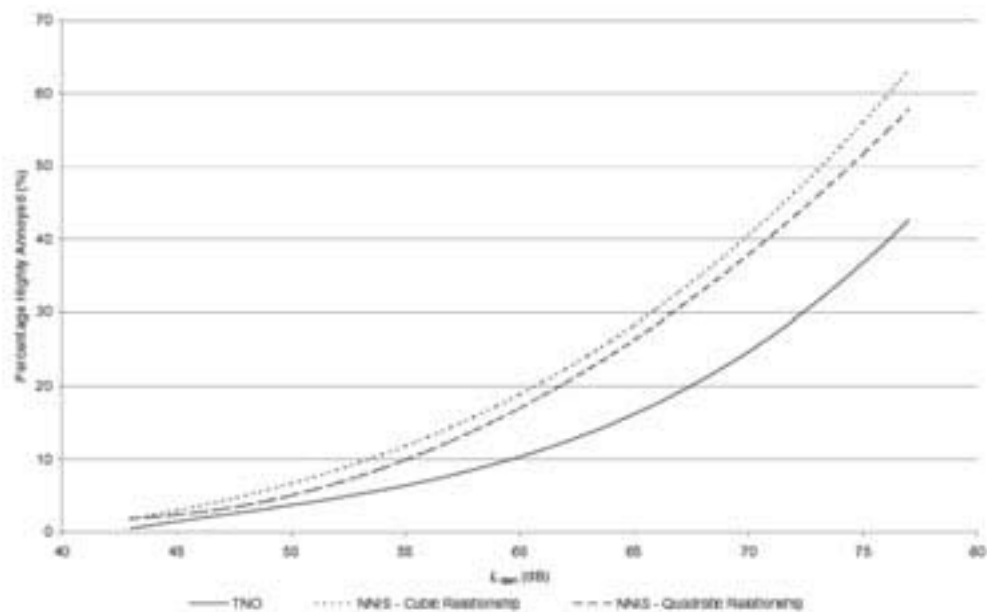
- Airborne noise - generally the key issue, mainly from engines when accelerating. Noise generated by interaction between tyres and the road surface becomes dominant as speed rises.
- Low frequency airborne sound, often from larger engines (especially at low speed), can be mistaken for (structure-borne) vibration if it causes windows, cups or other objects to rattle.
- Vibration - ground-borne or structure-borne - is usually generated by rapid changes in loading, as when vehicles pass over road surface irregularities. In general, subsoils in London, and the types of road and building materials used, mean that the city is not as vulnerable as some other areas to true ground-borne vibration. Structural damage to buildings as a result of ground-borne vibration from road traffic is considered highly unlikely.¹ BS 6472: 1992 provides advice on acceptable levels of vibration.

Rail traffic may be experienced similarly, although wheel-rail rolling noise generally dominates, and heavy freight trains can cause distinct ground-borne vibration. True structure-borne vibration can result in 're-radiated' noise (vibrating structural elements acting like loudspeakers) within buildings (e.g. low rumble from underground trains).

Airborne road and rail noise is often screened from the listener by buildings or landform. The height of an overflying aircraft means that it is often the most distinct source in an otherwise quiet area. Higher frequency sounds are attenuated more readily by atmospheric absorption than lower frequencies. This may increase the tonality of noise from overflying aircraft. The recipient's response may be influenced by anxiety about aircraft safety in general.

Many studies have been carried out into relationships between physical noise indices and human response. Respondents have typically been asked to rate their level of annoyance with their noise environment using numerical scales and/or adjectives such as 'annoyed' or 'highly annoyed'. Results typically show a wide scatter. Much depends on context. A large amount of work has been done to synthesise 'dose-response' curves from different surveys. However, such synthesis cannot be assumed to constitute an 'underlying' relation². Figure 24 shows the percentage 'highly annoyed' at different levels of road traffic noise in terms of L_{den} using data from the UK National Noise Incidence Study, compared with a synthesis of data from other studies. 'Dose-response' curves typically vary according to the type of source noise. At higher levels of noise, railways have often been reported to be less annoying than road noise (by perhaps 5 dB - often referred to as the 'railway bonus'), while aircraft noise has been found to be more annoying than road noise.

Figure 24 Relationships between noise levels in L_{den} and percentage of people highly annoyed by road traffic noise, from different datasets



note Two upper curves (dashed lines) fitted to data from UK National Noise Incidence Study using two alternative statistical formulations. Lowest curve (solid line) derived from different noise surveys, assembled by Dutch research organisation TNO.

source: from BRE report (including data from TNO)³

Vibration

Vibration is the oscillation of a mass in relation to a reference point. The number of oscillations per second gives the frequency of vibration (Hz). Audible sound is differentiated from vibration by the way people perceive

it. Sound is detected by hearing. Vibration is transmitted to other parts of the body. Vibration may occur at a single frequency, or more commonly, there are a number of different frequency components. A particle may vibrate in any one of three axes (vertical, longitudinal and transverse), or in combination. The perception range for vibration, 1 to 80 Hz, is much narrower than for audible sound, 20 to 20 kHz. Vibration can be quantified in terms of three parameters:

- Acceleration - the rate of change of velocity over time;
- Velocity - the rate at which displacement varies with time;
- Displacement, or amplitude - the distance moved from a fixed reference position.

Ground-borne vibration is typically measured in terms of velocity (millimetres per second) or acceleration (metres per second per second). For impulsive or intermittent sources, peak particle velocity or acceleration is measured, this being the maximum value recorded during the event.

BS 7385 Part 1 1990 gives advice on the measurement of vibration in buildings. Peak particle velocity is the preferred unit for assessing the risk of building damage. Either velocity or acceleration are used for assessing effects on people. BS 7385 Part 2 1993 gives guidance on acceptable vibration levels to avoid vibration-induced building damage. Vibration can be felt by people at levels much lower than those which could cause structural damage.

BS 6472:1992 provides guidance on satisfactory magnitudes of vibration in terms of human response. It defines Vibration Dose Values (VDV) which are expected to be acceptable, although a wide range of individual sensitivity is found in practice.

Assessing changes in noise

A wide range of actions can be taken to reduce noise. Many of them individually deliver modest improvements.

A change in sound level of 10 dB is generally perceived as a subjective doubling or halving of loudness. Under controlled laboratory conditions, a sound level change of 1 decibel (dB) has been found to be just perceptible when the sound consists of a single frequency, or limited range.

Observers typically find it more difficult to detect small changes in sounds which include a broad range of frequencies. In the latter case, a 2 dB change in sound level may be more likely to be noticeable. A 3 dB change in sound level has often been taken as the threshold at which

changes in complex sounds become noticeable to the average listener, over a period of time.

However, people can notice changes of under 1 dB in terms of a 'noise index', such as L_{Aeq} (as distinct from 'sound level'). Examples are where changes in noise are the result of changes in the number of events, rather than the loudness of each event, or where there is a change in the distribution of noise over the relevant measurement period⁴. The 'Design Manual of Roads and Bridges' (Volume 11, Section 3, Part 7, Chapter 3, Highways Agency, August 1994) states that, in the period following an abrupt change in traffic flow, people may find benefits or disbenefits from changes in the noise index of as low as 1 dB(A).

Noise needs to be considered across the whole 'footprint' spreading out from the source. A change that is only just perceptible within the footprint may reduce its extent. Noise may become indistinguishable from background, or inaudible as a noise event, nearer to the source than before. Small noise reductions could still be worth making as part of a cumulative programme of work to reduce noise. However, caution needs to be exercised in prominently advertising any particular measure in advance as 'noise reducing'. Action needs to be sustained and co-ordinated across a wide range of fronts. This is reinforced by the need to take inter-relationships between different noise sources into account. Reducing one noise can make apparent other noises that were previously masked.

Historically, the non-linear nature of the human response to sound has enabled large relative increases in sound energy to be put into the environment, with a less than proportionate adverse human reaction. However, moving the other way means, in many cases, removing large amounts of sound energy relative to the likely positive human perception. At the same time, most machines are only using very small amounts of their total energy to produce sound - typically one millionth⁵. Often, sound is being produced from many different sources on the machine, and as it relates with its environment. Reductions need to be sequenced optimally in social cost-benefit terms.

Attitudes to noise are highly related to context. Limitations on applying evidence gained from one situation to another need to be better understood. Implicit bias towards the attitudes, values or behaviour of the younger, fitter or economically stronger need to be avoided. However, there is no agreed, readily available way of identifying a psychologically 'noise-sensitive' population group⁶. Establishing an average cost effectiveness threshold in £ per decibel reduction might appear to be

neutral, but could favour richer areas - for example, if it were cheaper and easier to reduce noise in suburban or ex-urban areas with more space for barriers, more scope for further traffic calming, etc., than in denser urban areas. Studies for monetary valuation need to characterise noise exposure better than in much previous work. For example, if external noise indicators are used, any systematic variations in noise reduction provided by the building fabric need to be accounted for. Noise valuation based on property price differentials is likely to be highly problematic in a complex and stressed housing market such as London.

References

- 1 'Design Manual for Roads and Bridges' Volume 11, Section 3, Part 7 'Traffic Noise and Vibration' DETR, 1994
- 2 Wright P and Grimwood C. 'Strategic management of noise: a UK perspective' Clean Air and Environmental Protection, Vol 30(1), January/February 2000, pp 11-15
- 3 Skinner C et al. 'The National Noise Incidence Study 2000/2001 (UK)' Volume 2, BRE, February 2002, p 16.
- 4 Cobbing C and Rickaby M. 'Perception and Significance of Transport Noise Changes' Proceedings of Institute of Acoustics, Volume 21(2), 1999.
- 5 Kihlman T. 'Noise Abatement and Improvement: The Systematic Approach' Noise News International, June 2001, pp 97-101'
- 6 Wright P and Grimwood C. 'Strategic management of noise: a UK perspective' Clean Air and Environmental Protection, Vol 30(1), January/February 2000, pp 11-15

A3 typical noise levels and indicative noise reductions

Table 9 below shows approximate sound pressure levels for some typical noises. There is a very large variation around any of the following figures. In practice, environmental noise levels are continuously changing through time. More details would normally be specified for figures used in noise control practice.

Table 9 Typical noise levels

Noise source/situation	Sound Pressure Level in dB(A)	Typical subjective description
30 m from military jet at take-off	140	Painful, intolerable
Pop concert, near stage	105	
Night club (typical locations within)	100	Extremely noisy
Pneumatic drill, at 7 m	95	
Powered lawnmower at operator's ear, Older diesel lorry from footway	90	Very noisy
Ringing alarm clock at 1m	80	
Car or light van at 60 km/h from 7m	75	
Domestic vacuum cleaner at 3 m, Telephone ringing at 2 m	70	Noisy
Busy general office (typical locations within)	60	
Normal conversation at 1 m	55-60	
Boiling kettle at 0.5 m	50	
Refrigerator humming at 2 m	40	
British Museum Reading Room	35	
Bedroom in quiet area with windows shut	20-30	Very quiet
Remote rural location with no specifically identifiable sound	20	
Threshold of hearing	0	Uncanny silence

source: Various, including Draft Technical Guidance Note IPPC H3, Part 2, October 2001 and 'Bothered by Noise?' DETN/2, DETR (now DEFRA), 2001

Summary of indicative noise reductions

The following noise reductions are indicative only, and should be treated with considerable caution. They may be regarded as typical 'rule of thumb' assumptions, and are conservative. They are expressed as reductions over typical existing situations; in practice, of course, such situations can differ.

Table 10 Control at Source

Mode	Noise source	Indicative reduction dB(A)	Comments
Road	Power train	3	
	Tyres	2	
	Low noise road surfaces	3-4	
	Reduction of volume	3 per halving	Other factors unchanged
	Reduction of speed	2	50 -> 30 mph, other factors unchanged
	Smoother driving	up to 4	
Rail	Diesel power replaced by electric	up to 20	Highest on full power sections of track
	Diesel power unit improvements	up to 10	Highest on full power sections of track
	Grinding rails - normal degradation	3	
	Grinding rails - corrugated	5	Can be up to 20 in extreme cases
	Continuously Welded Rail	3	
	Optimised rail pads & tuned absorbers	up to 5	
	Replacing cast iron tread brakes	8-10	
	Removing wheel flats	2	Locally, damping reverberation
	Replacing bridges with quieter designs	up to 8	

Table 11 Control of propagation

Measure	Indicative reduction dB(A)	Comments
Barrier just blocking line of sight	5	Locally (includes buildings)
Barrier - theoretical maximum	20	Locally (includes buildings)
Very low trackside barriers (railways)	2	Locally
Tunnels	30+	Expensive, impractical in some locations
Vegetation	1 per 10m*	Tall, dense vegetation from ground to top layer

* Over and above that provided by distance over soft ground alone (effectiveness is frequently over-estimated, but the additional psychological benefit of obscuring source should not be overlooked).

Table 12 Improving sound insulation

Measure	Indicative reduction dB(A)	Comments
Single -> thermal double glazing	5 - 8	
Addition of secondary glazing to single	6 - 9	Existing windows to be in good repair
Single -> acoustic double or triple glazing	up to 20	Thick glass, large separation, good sealing

A4 who does what

The following is a brief summary of who is responsible for taking action under relevant legislation in relation to different types of noise.

Type of noise	Responsible authority	Main legislation
Aircraft – policy	DfT, Civil Aviation Authority	Civil Aviation Act 1982 International and national regulations for noise certification
Noisy aircraft	Airport operator	
Airports	DfT for Heathrow (designated airport) Borough (London City, Biggin Hill) MoD (Northolt)	Civil Aviation Act 1982 Town and Country Planning Act 1990 as amended – planning conditions and agreements
Construction sites	Borough	Control of Pollution Act 1974, sections 60 and 61 (reactive action or prior consent respectively)
Disorderly licensed premises	Police Borough	Criminal Justice and Police Act 2001, section 17/ Licensing Act 2003/Anti-social Behaviour Act 2003
Dogs and other domestic animals	Borough	Environmental Protection Act 1990, Part III – statutory nuisance
Entertainment noise	Borough	Environmental Protection Act 1990, Part III – statutory nuisance London Government Act 1963, section 52 and schedule 12 (as amended)/Licensing Act 2003 – licensing of premises and outdoor festivals
Industry	Environment Agency Borough	Integrated Pollution Prevention and Control Regulations 2000 Pollution Prevention and Control Act, 1999 (EA and Borough) Environmental Protection Act 1990, Part III – statutory nuisance Control of Pollution Act 1974, Noise Abatement Zones (few operated) Town and Country Planning (Environmental Impact Assessment) (England & Wales) Regulations 1999
Intruder alarms	Borough	Environmental Protection Act 1990, Part III (buildings) – statutory nuisance London Local Authorities Act 1991
Loudspeaker in street	Borough	Noise and Statutory Nuisance Act 1993 Control of Pollution Act 1974
Machinery and equipment in street, incl. car repairs, car radios and lorry refrigerator units	Borough	Noise and Statutory Nuisance Act 1993
Motor vehicles and motor cycles	DfT - regulation Police - enforcement	Road Traffic Act 1988 Road Vehicles (Type Approval) Regulations Motor Vehicles (Construction and Use) Regulations 1986 (as amended) Police Reform Act 2001, sections 59 and 60

Type of noise	Responsible authority	Main legislation
Neighbour or neighbourhood noise	Borough, Social landlords, police	Environmental Protection Act 1990, Part III – statutory nuisance Noise Act 1996 (as amended by Anti-social Behaviour Act 2003) – night time noise offence Housing Act 1996, Crime and Disorder Act 1998 – anti-social behaviour
Occupational noise exposure	Health and Safety Executive (HSE) Borough	Health and Safety at Work etc Act 1974 Noise at Work Regulations 1989 Factories – HSE Distribution, retail, office, leisure, residential care homes, hotels and catering - Boroughs
Planning	Borough	Town and Country Planning Act 1990 as amended Planning conditions and agreements, eg hours of operation Town and Country Planning (Environmental Impact Assessment) (England & Wales) Regulations 1999
Public works – new roads, railways etc	Highways Agency/ TfL/Borough Network Rail/TfL	Land Compensation Act 1973 Noise Insulation Regulations 1975 as amended in 1988 – new roads Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 as amended in 1998 – new railways
Railway noise	Borough	Environmental Protection Act 1990, Part III – statutory nuisance (but constrained to Best Practicable Means by 'Statutory Undertaker' status)
Waste sites	Environment Agency Borough	Waste Management Licensing Regulations 1994 Environmental Protection Act 1990, Part III – statutory nuisance
Vehicles (stationary, eg car alarms)	Borough	Noise and Statutory Nuisance Act 1993

source: Adapted from Environment Agency 'Integrated Pollution Prevention and Control (IPPC) Draft Noise Guidance, Part 1 - Regulation and Permitting, March 2001

A5 guidelines and standards

Table 13 WHO guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	L_{Aeq} [dB]	Time base [hours]	L_{Amax} fast [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoors	Sleep disturbance	30	sleeping time	45
School, playground outdoor	Annoyance (external source)	55	during play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time	30	8	40
	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music, etc, through headphones/earphones	Hearing impairment (free-field value)	85 #4	1	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	-	-	140 #2
	Hearing impairment (children)	-	-	120 #2
Outdoors in parkland and conservation areas	Disruption of tranquillity	#3		

#1 as low as possible

#2 peak sound pressure (not L_{Amax} fast), measured 100 mm from the ear

#3 existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low

#4 under headphones, adapted to free-field values.

World Health Organisation Guidelines

The guideline values for community noise published by the World Health Organisation (WHO) cover a wide range of issues, extending beyond 'ambient noise'. The guidelines follow a precautionary approach, and may be taken in general terms as levels below which adverse effects would not be expected.

See: Berglund B, Lindvall T, Schwela D H (editors). 'Guidelines for Community Noise' World Health Organisation, Geneva, 1999
http://www.who.int/environmental_information/Noise/ComnoiseExec.htm
 See also: 'Environmental Health Criteria 12 - Noise.' World Health Organisation, Geneva, 1980.

Planning Policy Guidance

Government planning guidance relevant to noise, issued by departments now within the Office of the Deputy Prime Minister (www.odpm.gov.uk), available from The Stationery Office, is referred to below. The Government is reviewing national policy guidance. This includes replacing planning policy guidance notes (PPGs) with national planning policy statements (PPSs).

Planning Policy Guidance Note 24 (PPG24) 'Planning and Noise' September 1994

PPG24 provides advice to local authorities on 'how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business' (paragraph 1). Guidance refers to 'proportionate and reasonable' measures to control the source of noise or to limit exposure to it, such measures including:

- **engineering** - e.g. using quieter machinery, containing or screening sources, or receptors;
- **layout** - e.g. distance, screening by other buildings, or non-critical rooms in a building;
- **administrative** - e.g. limiting source operating time, restricting activities on the site, specifying an acceptable noise limit.

PPG24 introduced the concept of Noise Exposure Categories (NEC), A to D, which local planning authorities should use when assessing proposals for **residential** development affected by road, rail, air traffic or mixed sources. Table 14 lists the noise levels used to classify different sites.

- NEC **A** sites - 'Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end

- of the category should not be regarded as a desirable level.'
- **NEC B** sites - 'Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.'
 - **NEC C** sites - 'Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.'
 - **NEC D** sites - 'Planning permission should normally be refused.'

Table 14 Noise levels used to determine Noise Exposure Categories (NEC)

Noise source	Noise levels ¹ for each Noise Exposure Category, dB L _{Aeq,T}			
	A	B	C	D
Road traffic				
07.00-23.00	<55	55-63	63-72	>72
23.00-07.00 ²	<45	45-57	57-66	>66
Rail traffic				
7.00-23.00	<55	55-66	66-74	>74
23.00-07.00 ²	<45	45-59	59-66	>66
Air traffic³				
07.00-23.00	<57	57-66	66-72	>72
23.00-07.00 ²	<48	48-57	57-66	>66
Mixed sources⁴				
07.00-23.00	<55	55-63	63-72	>72
23.00-07.00 ²	<45	45-57	57-66	>66

source PPG24

notes: 1 The noise levels (L_{Aeq,T}) used should be representative of typical conditions.
 2 Night time noise levels (23.00-07.00): sites where individual noise events regularly exceed 82 dB L_{Amax} (S time weighting) several times in any hour, should be treated as NEC C, regardless of L_{Aeq,8h} (except where L_{Aeq,8h} puts the site in NEC D).
 3 Aircraft noise: daytime values accord with the contour values adopted by the Department of Transport which relate to levels measured 1.2m above open ground. For the same amount of noise energy, contour values can be up to 2 dB(A) higher than those of other sources because of ground reflection effects.
 4 Mixed sources: this refers to any combination of road, rail, air and industrial noise sources. The 'mixed source' values are based on the lowest numerical values of single source limits in the table. See PPG24 for details.

PPG24 recognises that **schools** contain buildings and activities which are noise-sensitive, but that they are likely to contain a proportion of buildings and activities which are less noise-sensitive. Less noise-sensitive areas such as storerooms or corridors can 'buffer' classrooms from some noise sources. PPG24 recognises that **hospitals** contain buildings and

activities which are noise-sensitive, but also that they are likely to occupy sizeable sites and to contain a proportion of buildings and activities which are less noise-sensitive. It advises that internal noise standards in respect of each activity be used. For **recreational and sporting activities** (including open air pop concerts): 'the local planning authority will have to take account of how frequently the noise will be generated and how disturbing it will be, and balance the enjoyment of the participants against nuisance to other people'.

Planning Policy Guidance Note 3 'Housing' March 2000

PPG 3 promotes developments which combine a mix of land uses, including housing, either on a site or within individual buildings, such as flats over shops. It advises that this is important to bring new life into our towns and cities, and states that 'new housing and residential environments should be well designed and should make a significant contribution to promoting urban renaissance and improving the quality of life.' Local planning authorities should 'provide for more intensive housing development in and around existing centres and close to public transport routes' and 'identify and bring back into use empty housing, vacant commercial buildings and upper floors above shops.'

Planning Policy Guidance Note 4 'Industrial and Commercial Development and Small Firms' November 1992

PPG4 states that plans 'should provide specifically for the types of industry which, although necessary, may be detrimental to amenity or a potential source of pollution... plans should however ensure that development by such industries is separated from sensitive land uses.' On the other hand, PPG4 advises that 'many businesses can be carried residential areas without causing unacceptable disturbance through increased traffic, noise, pollution or other adverse effects.' However, it recognises that 'juxtaposition of incompatible uses can cause problems for the occupiers both of the new and of the existing development. For example, where residential development is proposed in the vicinity of existing industrial uses, the expectations of the residents may exceed the standards applied by the planning authority, and may give rise to pressure to curtail the industrial use.'

Planning Policy Guidance Note 6 'Town centres and retail development' June 1996 *(Consultation draft of new statement issued, December 2003).*

PPG6 sets out an approach to sustaining and enhancing the vitality and viability of town centres, encouraging mixed-use development and an increase in housing in town centres. It states that it may be appropriate for development plans 'to designate areas of the town centre for retaining

or enhancing the provision of particular uses, such as shopping, leisure, entertainment, education, health or employment.' In relation to the evening economy, PPG6 recognises that 'Leisure uses may disturb nearby residents. Before granting planning permission, local planning authorities should ensure that the design of the development and the conditions attached mean that the amenities of nearby residents are fully considered, not least to avoid subsequent refusal of licenses on amenity grounds.' Particular attention is given to noise from amusement centres.

Planning Policy Guidance Note 10 'Planning and Waste Management' October 1999

PPG10 advises on how the land-use planning system can contribute to sustainable waste management by providing the required facilities. Waste management facilities vary greatly in size, characteristics, and impacts. Recycling facilities include small community schemes, traditional metal recycling, scrapyards, and large multi-stream separation and materials recovery facilities. Sites in residential areas can generate unwelcome traffic and noise, which may be mitigated by careful location and site management, controlled by appropriate conditions, such as on operating hours, noise limits and traffic movements. PPG10 advises that industrial areas, especially those containing heavy or specialised industrial uses, may be appropriate for new waste management facilities. Advice on the location of recycling sites for construction and demolition wastes is contained in paragraphs 68-70 of Minerals Planning Guidance Note 1, General Considerations and the Development Plan System (MPG1), June 1996.

Planning Policy Guidance Note 13 'Transport' March 2001

Annex A of PPG 13 states that 'Greater London has its own arrangements for integration between planning and transport.' Guidance in Annex C states that 'In planning for local infrastructure, including roads, local authorities should ensure that their approach is compatible with the new approach to appraisal (NATA). Particular emphasis should be given to the need to explore a full range of alternative solutions to problems, including solutions other than road enhancement.' It adds: 'NATA has been enhanced to be applicable to transport investment for other modes. The enhanced version is described in detail in Guidance on the Methodology for Multi-Modal Studies.'

Planning Policy Guidance Note 17 'Planning for Open Space, Sport and Recreation' 24 July 2002

PPG17 states that local authorities should 'ensure that open spaces do not suffer from increased overlooking, traffic flows or other encroachment'. In identifying where to locate new areas of open space, sports and recreational facilities, local authorities should 'locate more

intensive recreational uses in sites where they can contribute to town centre vitality and viability' and 'avoid any significant loss of amenity to residents, neighbouring uses or biodiversity'.

Planning Policy Guidance Note No 22 'Renewable Energy' February 1993 (*Consultation draft of new statement issued, November 2003*)

An annex on wind energy gives advice on noise issues to be considered in relation to planning applications for wind turbines. See also Appendix A9, bibliography under Working Group on Noise from Wind Turbines, report for DTI (referred to in November 2003 consultation).

Planning Policy Guidance Note 23 'Planning and Pollution Control' February 1997

PPG23 advises that local planning authorities, environmental health authorities and the Environment Agency enter into discussion at an early stage to avoid unnecessary duplication under both planning and pollution control regimes.

Mineral Planning Guidance Note 11 'The Control of Noise at Surface Mineral Workings' April 1993

MPG11 provides advice on how the planning system can be used to keep noise emissions from surface mineral workings within environmentally acceptable limits without imposing unreasonable burdens on mineral extraction operators. It provides a method of determining the existing background noise levels and of estimating likely future noise levels. It also gives guidance on appropriate noise limits. The guidance was under review at the time of writing - 'Draft Minerals policy statement 2: Controlling and mitigating the environmental effects of mineral extraction in England: Annex 2. Noise' See http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_609221.pdf

Other guidance

'**Design Manual for Roads and Bridges**' Volume 11 'Environmental Assessment' Section 3, Part 7 'Traffic Noise and Vibration' Chapters 2-8, Highways Agency, August 1994.

HA65/94 '**Design guide for Environmental Barriers.**'

HA 66/95 '**Environmental Barriers, technical requirements.**'

'**Guidance on the methodology for multi-modal studies**' Volumes 1 and 2, DETR, March 2000; and New Approach to Appraisal.

'Railway Operations and the Environment: Environmental Guidance' (Office of the Rail Regulator, March 1996) e.g. paragraph 2.3 'mitigation of noise nuisance will require measures to be taken by train operators, rolling stock companies, Railtrack (now Network Rail) and the infrastructure maintenance companies for (co-ordinated or joint actions) to be effective.'

The Building Regulations, 2000 (as amended), Part E (2003) (Office of the Deputy Prime Minister) specifies sound insulation requirements in respect of both internal sound transmission and external noise. Some details of enforcement ('Pre Completion Testing' and/or 'Robust Standard Details') are due to be determined in 2004.

Building Bulletin 93 '**The Acoustic Design of Schools**' (Department for Education and Skills, July 2003) provides guidance on required internal noise levels and sound insulation for new school buildings.

Key Standards

BS 4142: 1997 'Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas' provides guidance on assessing the likelihood of complaints about noise impact from industrial development. 'Rating levels' of industrial sources are compared with existing background L_{A90} noise levels. If it is not possible to predict levels at noise-sensitive locations around the site, levels at a site boundary may be used. Where the rating level exceeds the background level by 10 dB or more, BS 4142 states that complaints are likely. It states that a difference of around 5 dB(A) is of marginal significance. The lower the value below 5 dB(A), the less is the likelihood that complaints will result and if the rating level is more than 10 dB below the background noise level, this is a positive indication that complaints are unlikely. The rating level of the noise is increased to take account of tones, whines or impulses in the audible noise, for example, from a compressor or transformer. BS 4142 is the subject of review.

BS 5228: Parts 1, 2, 3 and 5: 1997; BS 5228-4: 1992: Noise and vibration control on construction and open sites. Provides a method for predicting construction site noise and several parts are Codes of Practice under the Control of Pollution Act, 1974.

BS 6472:1992 Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)

BS 8233: 1999 Code of Practice for Sound Insulation and Noise Reduction for Buildings. It deals with control of noise from outside the

building, noise from plant and services within it and room acoustics for non-critical situations.

BS EN ISO 140 Measurement of sound insulation in buildings and building elements

Other Relevant standards

ISO 1996: Acoustics: Description and measurement of environmental noise (under revision)

ISO 1996: Part 1 1982: Basic quantities and procedures

ISO 1996: Part 2 1987: Acquisition of data pertinent to land use (amended 1998)

ISO 1996: Part 3 1987: Application to noise limits

ISO/DIS 3095: 2001

ISO 3891: 1978: Acoustics - Procedure for describing aircraft noise heard on the ground (under revision)

ISO 9613: Acoustics - Attenuation of sound during propagation outdoors

ISO 9613: Part 1 1993: Calculation of the absorption of sound by the atmosphere

ISO 9613: Part 2 1996: General method of calculation

BS 7445: 1991 Description and measurement of environmental noise

BS 7385: Part 1: 1990 Evaluation and measurement for vibration in buildings: Guide for measurement of vibrations and evaluations of their effects on buildings

BS 7385: Part 2: 1993 Guide to damage levels from groundborne vibration

BS EN 1793 part 1 - Sound absorption and stability.

BS EN 1793 part 2 - Airborne sound insulation and safety.

Royal Commission on Environmental Pollution

The Commission's Eighteenth Report: Transport and the Environment, RCEP, 26 October 1994, included the following objectives:

H: To reduce noise nuisance from transport.

H1: To reduce daytime exposure to road and rail noise to not more than 65 dB $L_{Aeq16\text{ hour}}$ at the external walls of housing.

H2: To reduce night-time exposure to road and rail noise to not more than 59 dB $L_{Aeq\ 8\text{ hour}}$ at the external walls of housing.

European Commission's 5th action programme on the environment

The European Commission's 5th action programme on the environment proposed, for night noise exposure at home:

- To phase out exposure above 65 dB L_{Aeq} ;
- To ensure that at no point in time a level of 85 dB L_{Aeq} is exceeded;
- To aim to ensure that the proportions of the population exposed to average levels between 55 and 65 dB L_{Aeq} should not increase; and
- That exposure in quiet areas should not increase beyond 55 dB L_{Aeq} .

UK Government consultation 'Towards a National Ambient Noise Strategy', November 2001, reported survey results suggesting that the level of 85dB(A) was not exceeded in England and Wales and that fewer than 1% of the population exposed to noise levels of greater than 65dB(A) at night. London-wide representative figures are not available.

OECD - Fighting Noise (1986)

The OECD identified the following 'thresholds for noise nuisance' in terms of day-time L_{Aeq} :

- At 55-60 dB(A), noise creates annoyance;
- At 60-65 dB(A), annoyance increases considerably; and
- Above 65 dB(A), constrained behaviour patterns, symptomatic of serious damage caused by noise arise.

A6 requirements of the Greater London Authority Act 1999 related to noise, and relevant international obligations notified to the Mayor

Mayor's powers and responsibilities

Section 370 of the Greater London Authority Act 1999 requires the Mayor to prepare and publish a "London ambient noise strategy". This must contain:

- information about ambient noise levels in Greater London,
- an assessment of the impact of the Mayor's other strategies on ambient noise levels, and
- a summary of action taken or proposed to be taken by the Mayor to promote action to reduce ambient noise levels, and the impact of such noise levels on those living and working in Greater London.

In this context, "ambient noise" may be taken to include industrial noise, as well as noise from road, rail, air and water transport, and vibration. Certain types of noise are specifically excluded (e.g. noise from construction works which may be controlled by a local authority).

In addition,

- The Mayor is required by section 370(6) to consult the Environment Agency.
- Providers of air navigation services are required to consult the Mayor on matters specified in section 371 (aircraft routes and management procedures).
- Section 372 makes the Mayor, acting on behalf of the Greater London Authority, a consultee under the Civil Aviation Act 1982 in relation to certain aerodrome matters.

Consultation is covered generally under Section 42. Consultation is required first with the Assembly and 'functional bodies' (Transport for London, Metropolitan Police Authority, London Fire and Emergency Planning Authority, and the London Development Agency, which are statutorily required to have regard to the Mayor's strategies) - and then with London boroughs and the City of London. The Mayor is also required to consider consulting others active in London - voluntary bodies, racial, ethnic, national and religious groups and businesses.

Sections 41(4) and (5)(a) state that the Mayor shall, in preparing this and other specified strategies, have regard to the need to ensure that the strategy is consistent with national policies and with such

international obligations as the Secretary of State may notify to the Mayor for this purpose.

Legal considerations as to information on ambient noise in London

Section 370(2)(a) of the GLA Act 1999 requires a London ambient noise strategy to include 'information about ambient noise levels in Greater London and the impact of such noise levels on those living and working in Greater London'. The extent of such information is not defined. However, the nature of noise is that it can vary widely from place to place. This depends on many factors, including proximity to road or rail vehicles, aircraft, industrial plant and other sources, the amount of screening provided by buildings or other obstacles, and the nature of ground surfaces. Considerable amounts of data can be considered necessary to provide useful, meaningful and representative information.

The Mayor has examined the availability of historical and contemporary data. He is grateful for the assistance of stakeholders, borough Environmental Health officers, and consultants (including Turner S. 'Selection of Areas for Noise Monitoring and Mapping' Stanger Science and Environment, 27 March 2001; Grimwood C, and Skinner C. 'A review of London-related data from the 1990 and 2000 National Noise Incidence Studies' BRE Report no. 204053f. BRE Acoustics Centre for GLA, May 2002; Grimwood C, and Skinner C. 'A review of London-related data from the 2000 National Noise Attitude Survey' BRE Report no. 205824f. BRE Acoustics Centre for GLA, May 2002). Evidence from attitude surveys of Londoners, noise measurements and other data have been considered. Chapter 2 contains a summary of information which the Mayor considers useful in informing the strategy's policies and proposals.

However, it is not claimed that the information that it has been possible to assemble with the resources available amounts to a comprehensive fulfilment of the strict legal terms of the GLA Act. The Mayor has had regard to the duty to act responsibly in using resources. The Government announced in its Rural White Paper in 2000 that it intended to consult on a National Ambient Noise Strategy, and that a strategy would 'include mapping the main sources and areas of noise - a major new exercise for which we have put aside £13m (for England).... We aim to complete the mapping by 2004'. Given the prospective availability of such mapping, and that mapping London could otherwise cost of the order of £1 million, the Mayor did not consider it prudent to undertake such major expenditure in advance of the Government's work. The Mayor will, of course, review the strategy if findings from noise mapping, or other work, indicate that it is necessary to do so.

Assessment

Section 370(2)(b) of the GLA Act 1999 requires a London ambient noise strategy to include 'an assessment of the impact of the Mayor's strategies... on ambient noise levels in Greater London'. The nature and extent of such assessment is not defined. As in respect of section 370(2)(a), the Mayor has had regard to the cost and time that would have been involved in establishing comprehensive, representative information on ambient noise levels across London, and to the duty to act responsibly in using resources. Government-supported noise mapping, expected by 2004 should enable the broad impact of strategic actions such as noise-reducing road surfaces to be assessed. A European Environmental Noise Directive is expected to take effect shortly. Requirements include noise mapping, and the preparation of action plans. The UK Government has not yet indicated how it would incorporate such requirements into domestic law, or what guidance it would give to those charged with relevant responsibilities.

Preparation of the Mayor's ambient noise strategy has been closely linked with his other strategies. Policies have been developed to be mutually supportive, as far as reasonable and practicable, and with regard to the need for consistency. Having regard to the limited availability of information, scarce resources, and the changing context, paragraphs 3.30 onwards in chapter 3 assess the impact of the Mayor's other strategies qualitatively. Much of the content of these other strategies will be most effectively and economically assessed as strategic policies and proposals are translated into site-specific form. Proposals with potential impact on ambient noise levels will be subject to noise assessment at a variety of stages, through to planning application stage.

Action

Section 370(2)(c) of the GLA Act 1999 requires a London ambient noise strategy to include 'a summary of action taken, or proposed to be taken, by the Mayor for the purpose of promoting measures to reduce ambient noise levels in Greater London and the impact of such noise levels on those living and working in Greater London'. The nature of such a summary is not defined. The Executive Summary at the beginning of this strategy, and Appendix A1 may be taken as fulfilling this duty, or the whole strategy may be taken as a summary of action taken or proposed to be taken.

International obligations notified to the Mayor

The Mayor must have regard to consistency with any European Union treaties and international obligations of which he is informed by the Secretary of State. The following were notified to the Mayor by the Minister for London on 27 November 2000:

Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 97/11/EC (the EIA Directive);

Council Directive 96/82/EC on the control of major accident hazards involving dangerous substances;

EC Council Directive on the Conservation of Wild Birds: The Birds Directive;

EC Council Directive on the Conservation of Natural Habitats and of Wild Flora and Fauna: the Habitats Directive;

Bern Convention on Conservation of European Wildlife and Natural Habitats;

Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat;

Bonn Convention on the Conservation of Migratory Species of Wild Animals.

A7 external noise insulation of housing

The Land Compensation Act 1973 provides for compensation for certain public works. Noise Insulation Regulations made in 1975 (amended 1988) provide for offers of noise insulation for 'habitable rooms' in homes badly affected by noise from a new road. They also give a discretion to provide insulation to properties affected by substantially altered roads, such as by widening for a new traffic lane within 300 metres. To qualify for a grant, all of the following conditions must be met:

- The relevant noise from the new or altered road must exceed a daytime noise level of 68 dB $L_{A10, 18\text{hour}}$
- The relevant noise level must be at least 1 dB(A) greater than the prevailing noise level
- The noise from the new or altered road makes an effective contribution to the relevant noise level of at least 1 dB(A).

Assessments of eligibility are to be made following procedures in 'Calculation of Road Traffic Noise' (published by the then Department of Transport in 1988). The relevant noise level is to be the highest expected within 15 years of opening of a scheme. The regulations provide for acoustic double windows, simple supplementary ventilation, venetian blinds on windows exposed to direct sunlight, and double or insulated doors. The 68 dB $L_{A10, 18\text{hour}}$ threshold for noise insulation has been described as the 'limit of the tolerable, not a standard of the acceptable' (Department of the Environment, Circular 10/73 'Planning and Noise').

Regulations made under the Act for railways offer broad parity. The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 (amended 1998) set separate limits for day and night-time. The regulations for railways apply if all of the following conditions are met:

- The noise from a new or additional railway system exceeds a daytime noise level of 68 dB $L_{Aeq 18\text{hour}}$ or the night-time noise exceeds a level of 63 dB $L_{Aeq 6\text{hour}}$
- The relevant noise level is at least 1 dB(A) greater than the prevailing noise level
- The noise from the railway makes an effective contribution to the relevant noise level of at least 1 dB(A).

Assessments are to be made following procedures in 'Calculation of Railway Noise' (Department of Transport, 1995, and Supplement 1, 1996).

In respect of aircraft noise, a number of noise insulation schemes have been implemented around London Heathrow Airport. A scheme is being implemented at London City Airport. Paragraphs 3.15 to 3.27 of the

December 2003 Air Transport White Paper include some outline criteria for insulation schemes, including a 3 dB(A) change criterion (see note to paragraph 4C.38 above).

One question for future noise policy, particularly in an old and dense city where noise problems may be particularly intractable, is whether a wider range of insulation options than in the above regulations should be available. Funding and attribution of responsibility will be crucial, particularly given issues of housing affordability and the potential role of 'polluter pays' levies.

A flexible hierarchy of dwelling noise insulation measures?

Any new dwelling noise insulation arrangements could consider a hierarchy of elements such as:

- extending Noise Insulation Regulations to cover significant noise increases associated with intensification, or changes in the nature of the noise;
- extending support to 'whole house' insulation in the light of modern patterns of dwelling use;
- incorporating energy saving measures, such as heat exchanging ventilation units, or whole house (ideally passive) ventilation/cooling;
- promoting integration with solar design, such as dual façades, and, as costs fall, transparent photovoltaic over-windows;
- tapering grants towards noise insulation according to the severity of noise impact (e.g. 100% grant in worst-affected areas, with reducing percentages as noise level reduces);
- a night noise insulation category for bedrooms only, with provision for summer cooling so that windows do not need to be opened to obtain room temperatures comfortable for sleep;
- joint information and marketing schemes to make the purchase of noise insulation, ventilation and cooling more predictable, quality assured and affordable;
- noise advice services, with information on acoustic design, ranging from the effectiveness of draughtstripping in traditional domestic properties, to promoting wider 'design for quiet'.

Noise-related measures need, of course, to be integrated with fuel poverty and energy efficiency policies. Any new measures would also need to be based on studies of cost-effectiveness in relation to specific adverse effects. The programme of work set out in 'Towards a national ambient noise strategy', DEFRA, November 2001, provides a suitable context for reassessment.

A8 abbreviations and glossary

Abbreviations

ALG	Association of London Government
BAT	Best Available Techniques
BPM	Best Practicable Means
BRE	Building Research Establishment
CIEH	Chartered Institute of Environmental Health
dB	decibel
dB(A)	A-weighted decibel
dB(C)	C-weighted decibel
DEFRA	or Defra - Department for Environmental, Food and Rural Affairs
DfT	Department for Transport
EA	Environment Agency
GLA	Greater London Authority
HA	Highways Agency
HSE	Health and Safety Executive
Hz	Hertz
IoA	Institute of Acoustics
IPPC	Integrated Pollution Prevention and Control
L_{A10}	A-weighted noise level exceeded for 10% of the measurement period (see also glossary)
L_{A90}	A-weighted noise level exceeded for 90% of the measurement period (see also glossary)
L_{Aeq}	equivalent continuous noise level (see also glossary)

L_{den}	A noise index that combines L_{Aeq} for separate day, evening and night periods (see also glossary)
L_{night}	L_{Aeq} for a defined night period.
LB	London borough
LDA	London Development Agency
LFEPA	London Fire and Emergency Planning Authority
LSDP	London Sustainable Distribution Partnership
MoD	Ministry of Defence
MPA	Metropolitan Police Authority
MPG	Minerals Planning Guidance
MPS	Metropolitan Police Service
NEC	Noise Exposure Categories in PPG24, see Appendix A5
NNAS	National Noise Attitude Survey
NNIS	National Noise Incidence Survey
NSCA	National Society for Clean Air and Environmental Protection
PPG	Planning Policy Guidance Note
SPL	Sound Pressure Level
SRA	Strategic Rail Authority
TfL	Transport for London
TNO	a Dutch research establishment (Toegepast Natuurwetenschappelijk Onderzoek)
TLRN	Transport for London Road Network

Glossary

Absorption Conversion of sound energy to heat. Sound absorption is a characteristic of the surface of a material, determining the extent to which sound striking it will be absorbed. Sound absorbents reduce reflection from a surface, and can reduce the 'canyon effect' otherwise associated with barriers on both sides of a road, or the reverberation of sound within an enclosed or partly enclosed space, such as a tunnel mouth.

Agglomeration defined by the EU Noise Directive as part of a territory with a population more than 100,000 with a population density which the member state considers to be urbanised.

Airborne sound Sound propagating through the air, transmitted by excitation of the air.

Alternation At Heathrow, a system of runway alternation was introduced in 1972 for the daytime period. Normally, one of the two parallel main runways is used for take off, and the other for landing, switching at 1500 hours. For one week, the northern runway will be used for take off, and the southern for landing until 1500 hours, at which time take offs will switch to the southern runway, and landings to the northern. In the following week, the southern runway will be used for take off in the first half of the day, and so on. It means that people under the flightpaths receive a predictable pattern of relief. It only operates fully on westerly operations due to the Cranford Agreement (see below).

Ambient noise ongoing unwanted sound in the environment such as from transport and industry, as distinct from individual events, such as a noisy all-night party. Specifically in this strategy, long term, systematically predictable noise emitted by road traffic, rail traffic, air traffic, water transport, and from sites of industrial activity. Unless stated otherwise, noise includes vibration. The term 'ambient noise' can also be used more widely, in terminology deriving from standard ISO 1996, to refer to the sound from all sources combined - not just road traffic and industry, but including birdsong, running water, etc.

ANCON UK civil aircraft noise computer model developed by Environmental Research and Consultancy Department of the Civil Aviation Authority (CAA). ANCON calculates contours from data describing aircraft movements, routes, noise generation and sound propagation. Aircraft noise contour maps show lines joining points of equal noise, in terms of the index used, as a way of showing the impact of aircraft noise around airports.

ANMAC Aircraft Noise Monitoring Advisory Committee. An example of its work is the ANMAC Technical Working Group study 'Noise from Arriving

Aircraft: Final Report' December 1999. See <http://www.aviation.dtlr.gov.uk/anmac/index.htm>

Annoyance In the context of this strategy, a feeling of irritation or displeasure associated with noise perceived or believed by someone adversely to have affected them.

Anti-noise (also termed 'sound cancellation') is the use of sound of an 'equal and opposite' frequency and amplitude to 'cancel' (in practice, reduce) the sound from a given source. Current commercial applications include fan assemblies and personal headphones.

Anti-social behaviour Local authorities can issue an anti-social behaviour order in respect of anyone causing 'harassment, alarm or distress', which can include noise. Disobeying an order carries a prison sentence of up to five years. Under the Housing Act 1996 social landlords can take action against tenants for anti-social behaviour. See also Anti-social Behaviour Act 2003.

Assistive device Equipment which helps people to hear better, such as by reinforcing speech level at a counter.

A-weighting a system of adjustments applied to sound of different frequencies to take account of the way the sensitivity of the human ear varies with sound frequency. It is sometimes criticised for not giving sufficient weight to low frequency sound. It has been found suitable for many types of environmental noise at the levels and mixes of frequencies commonly encountered, provided its limitations are understood.

Background noise The noise normally present for most of the time at a given site, usually described by the L_{A90} level, the level exceeded for 90% of the time.

Bad neighbour In noise terms, bad neighbour activities include those generating noise significantly above background, with a pronounced tonal or impulsive quality, and particularly at night. 'Open yard' uses or activities are particularly unsuitable near noise sensitive uses.

Basic noise level In 'Calculation of Road Traffic Noise' Department of Transport, The Stationery Office, 1988, the basic noise level is calculated for a reference distance of 10 metres from the nearside carriageway edge. Other reference distances could have been chosen. This calculation method assumes that noise propagates from a 'source line' 3.5 metres in from the kerb and 0.5 metres above the road surface. The source line is

an approximation, since road traffic noise comes from many vehicles, and from several places on each vehicle.

Best Available Techniques (BAT) are required for controlling pollution from large industry, and are defined as 'the most effective and advanced stage in the development of activities and their methods of operation which indicates the practicable suitability of particular techniques...' BAT not only covers the technology used but also the way in which the installation is operated, and takes into account the balance between the costs and environmental benefits. The aim of BAT for noise is to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary. The concept of reasonable cause for annoyance depends on many factors, including the type of noise, the nature of the receiving environment, the time of day or night, etc. Environment Agency Guidance H3 provides advice on the determination of BAT for noise and vibration in the context of Integrated Pollution Prevention and Control, and discusses the concept of reasonable cause for annoyance.

Best Practicable Means (BPM) – A legal defence used in respect of certain types of nuisance. It is defined in section 79(9) of the Environmental Protection Act 1990 in the following terms:

- reasonably 'practicable' having regard, among other things, to local conditions and circumstances, to the current state of technical knowledge, and to the financial implications;
- 'means' to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures;
- the test is to apply only so far as compatible with any duty imposed by law;
- the test is only to apply so far as compatible with safety and safe working conditions, and with the exigencies of any emergency or unforeseeable circumstances.

Regard should be had to any Code of Practice under section 71 of the Control of Pollution Act 1974.

Broadband where much of the sound energy is spread across a broad range of frequencies (see, by contrast, 'Tonal noise').

Business Improvement District (BID) a concept originally developed in the USA for increasing investment within defined areas of a city such as town centres. This is achieved through changes to local taxation, based on a supplementary rate levied on businesses within that defined area.

Chapters 2, 3, and 4 Noise standards for aircraft agreed internationally through the International Civil Aviation Organisation (ICAO), a specialist agency of the United Nations. Noise standards for aircraft were first introduced in Volume I of Annex 16 to the Convention on International Civil Aviation, 1944 (the 'Chicago Convention'). The reference is to the relevant Chapter of Volume 1 of Annex 16. Chapter 2 refers to the first standards developed for subsonic jet aircraft. New Chapters have been inserted. Chapter 4 standards were agreed in 2001, through ICAO's Committee on Aviation Environmental Protection (CAEP). The noise reduction agreed was 10 dB 'cumulatively', while many European Governments, airport operators through the Airports Council International, and others had been arguing for 14 dB. These reductions refer to the sum of three measured reductions used for noise certification. Noise levels are measured during:

- a take off at maximum power with a subsequent power cutback, where the noise is measured under the flight path at 6.5 kilometres from start of roll;
- b a maximum power/no-power cutback climb flight, where the maximum sideline noise is measured at a lateral distance of 450 metres, and
- c a 3 degree slope landing approach, where the noise under the flight path is measured 2000 metres before touch-down.

In the new Chapter 4, some trading off is allowed between the different elements of the agreed 10 dB total reduction.

Clear Zone Area in which traffic is reduced and streets made more pedestrian-friendly.

Continuous Descent Approach (CDA) is defined as a noise abatement technique for arriving aircraft in which the pilot, when given clearance below the transition altitude by air traffic control (ATC), will descend at the rate which (s)he judges will be best suited to the achievement of continuous descent whilst meeting the ATC speed control requirements. The objective is to join the glide path at the appropriate height for the distance without recourse to level flight. Low engine power settings during CDA reduce overall sound energy emitted, as well as saving fuel. A Code of Practice has been developed to reduce noise from each aircraft arrival. 'Low power-low drag' is defined as a noise abatement technique for arriving aircraft in which the pilot delays the extension of wing flaps and undercarriage until the final stages of the approach, subject to compliance with ATC speed control requirements and the safe control of the aircraft.

Controlled Parking Zone Areas in which on-street parking is managed, usually through a permit system, typically where demands for limited space from residents, commuters, shoppers and others are in conflict.

Cranford Agreement The Cranford Agreement at Heathrow has been in effect since the 1950s, when Cranford village was the worst-affected settlement, near the eastern end of the northern runway. The two main runways were later extended towards the west, meaning that other settlements were affected to not dissimilar extents. The Cranford Agreement means that, on easterly operations, take-offs normally use only the southern runway.

Creeping ambient Also referred to as 'creeping background.' A new noise source, or an increase in the noise intensity of an existing activity, might typically be considered not to make a readily perceptible contribution to noise levels in areas which are already, at least to some extent, 'noisy' - where one noise would tend to be masked by another. However, an accumulation of such additional noise may, over time, lead to a deterioration.

Damping Conversion of vibrational energy into heat. Damping of an object, such as an engine component or a section of rail, is a way of making it a less efficient radiator of sound.

Day-time Generally taken as the 12 hour period between 0700 and 1900 hours.

decibel (dB) A unit of sound pressure level on a logarithmic scale - the logarithmic ratio of a sound pressure relative to a reference level.

dB(A) 'A' weighted decibel - see 'A-weighting'.

Diffraction The deflection of a sound wave caused by an obstruction in a medium. Diffraction of sound, such as over a noise barrier, makes a 'noise shadow' less effective than a shadow cast by light.

Designated airports Airports regulated by the Government, designated under the Civil Aviation Act 1982.

Disability The Disability Discrimination Act 1995 defines disability as: 'A physical or mental impairment which has a substantial and long term adverse effect on a person's ability to carry out normal day to day activities.' However, disabled people's organisations prefer a social approach which defines disability as: 'The loss or limitation of

opportunities that prevent people who have impairments from taking part in the life of the community on an equal level with others due to physical and social barriers.'

Disabled person A disabled person is someone who has an impairment, experiences externally imposed barriers and self-identifies as a disabled person.

Easterly operations When aircraft make their final approach to land from the west, and take off towards the east.

Easterly preference A mode of operation at Heathrow which would mean that aircraft would maintain easterly operations when there was a light westerly wind - only changing when wind speed became stronger.

Emission A measure of sound emitted by a given source.

EPNdB Effective Perceived Noise decibel; a metric used internationally in the noise certification of aircraft.

Entertainment Management Zone (EMZ) An area where agencies work together to tackle issues associated with the evening and night-time economy. An EMZ can be designated in areas where there is a concentration of entertainment activities, or in locations where growth of entertainment uses is planned.

Environmental noise The European Environmental Noise Directive 2002/49/EC defines 'environmental noise' as 'unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport, road traffic, rail traffic, air traffic, and from sites of industrial activity.'

Environmentally Enhanced Vehicle (EEV) A potential new category, particularly for heavy vehicles, with quieter and cleaner engines, control of body rattle and other incidental noise, including loading/unloading.

Equal energy principle Implicit in the L_{eq} measure (see above) is that, within certain limits and in certain contexts, a smaller number of louder events, or a larger number of quieter events, may have similar effects in terms of human response.

Evening Generally taken as the period between 1900 and 2300 hours.

Event level the 'Guide to health, safety and welfare at pop concerts and similar events' Health and Safety Executive/Home Office, 1999 advises that audience sound level exposure should be restricted to below an equivalent continuous level over the event as a whole (Event L_{eq}) of 107 dB(A). Exposure in terms of peak sound pressure level should not exceed 140 dB.

Façade level a sound pressure level at a position typically between 1 and 2m from a sound reflecting surface, such as the façade of a building, typically assumed to be 3 dB(A) higher than a free field level (see below), unless a more accurate figure is available.

Flanking transmission Sound transmitted between rooms via building elements common to both of them, such as a supporting wall, rather than the element separating them, such as a floor.

Free field level a sound pressure level unaffected by reflection from any surfaces other than the ground, typically taken to be at least 3.5m from any sound reflecting object.

Frequency number of oscillations in pressure of a sound wave, about the ambient static air pressure. Usually measured using Hertz.

Frequency band a continuous range of frequencies between specified upper and lower limits.

Functional bodies the Mayor has responsibility for appointing members to, and setting budgets for, four new organisations: Transport for London (TfL), London Development Agency (LDA), London Fire and Emergency Planning Authority (LFEPA), Metropolitan Police Authority (MPA). The term 'GLA family' or 'GLA group' includes the Greater London Authority, which is the core organisation serving the Mayor and the London Assembly.

Glide path or glideslope Part of the Instrument Landing System (ILS). This includes the localiser signal, which provides guidance to aircraft in the horizontal plane, and the glide path (or glideslope) which supplies vertical guidance. Pilots manoeuvre under the instruction of air traffic control to intercept the localiser beam, and descend on the glideslope to land. The glideslope at Heathrow and other major airports is 3 degrees from the horizontal. During the day, aircraft are required to join the glidepath at or above 2,500 feet. On a 3 degree slope, this is about 8.5 miles (13.5 kilometres) from touchdown, although they may join further out. There are no fixed routes for landing aircraft before they join the glide path. At night, aircraft are required to join the glide path at or above 3,000 feet.

GLA group or GLA family see Functional bodies.

Green Chains linked, but separate, open spaces forming strategic walking or cycling routes. Some overlap with 'Green Corridors'.

Green Corridors relatively continuous areas of open space leading through the built environment, which may link sites to each other and to the Green Belt or Metropolitan Open Land. They often consist of railway embankments and cuttings, roadside verges, canals, parks, playing fields and rivers. They may allow animals and plants to be found further into the built-up area than would otherwise be the case and provide an extension to the habitats of the sites they join. Some overlap with 'Green Chains'.

Green Wave Co-ordination of the timing of a sequence of traffic signals so that a vehicle driven at a certain steady speed can encounter signals successively at green, rather than having to stop repeatedly. This is more difficult to achieve in a congested city with many conflicting movements than, for example, in a town with a simple radial road network.

Groundborne vibration see **Vibration**.

Hard ground An acoustically reflecting surface, such as concrete, most other paving materials, and water. Contrasts with 'soft ground'.

Hertz or Hz Measure of sound frequency, sometimes referred to as cycles per second.

Home working Working at home. This should be acceptable in most housing situations provided the business use does not generate noise or vibration from equipment, visitors, traffic or other activities which exceed levels which could reasonably be expected from housing use alone. Home workers would be advised to seek a determination in writing from their local planning authority as to whether or not planning permission is needed.

Home Zones Residential streets designed and managed to allow people to share former carriageways and pavements. Vehicles should only be able to travel a little faster than walking pace (less than 10mph). This means that the street can be modified to include children's play areas, larger gardens or planting such as street trees, cycle parking and facilities such as seats at which residents can meet. Home Zones should therefore make residential areas safer for pedestrians and cyclists, and improve the quality of the street environment.

Hybrid-electric vehicles Hybrid-electric drive can take several forms. For example, a petrol engine can be used to generate electricity, with batteries buffering peak acceleration demands. The engine, or other power source such as fuel cells, can be smaller, and noise and vibration can be more readily controlled. The engine can run at an optimum speed, enabling noise control systems to be more effective.

Hyperacusis abnormal discomfort caused by sounds which are usually tolerable to other listeners.

ILS (Instrument Landing System) see Glidepath.

Immission A measure of sound pressure at a given receptor point.

Impact sound Sound energy generated by direct impact on a building element, such as a hard-heeled shoe on a floor.

Infra-red (hearing) systems Systems which enable deaf people wearing a special receiver to hear specially-transmitted sounds accurately, with good sound quality. The systems restrict sound to an individual room, and so are appropriate for cinemas and conference centres.

Infrasound Noise at frequencies below about 20 Hz is sometimes referred to as infrasound (see also Low frequency noise).

Insulation Sound insulation is the prevention of the transmission of sound through a barrier such as a wall or window. There is no direct and inherent relation between the sound insulation value of a barrier and the sound absorption performance of its surface. 'Impact insulation' is typically provided by a resilient layer, such as a carpet or foam-backed vinyl sheet on floors.

Isolation The introduction of a discontinuity between two elements in an energy transmission chain. The process of isolating a specific source of sound from existing background noise.

Integrated Pollution Prevention and Control (IPPC) A permit system for controlling pollution from industrial activities, introduced to comply with European Commission Directive 96/61.

Line source A sound source which can be idealised as a line in space, such as road or rail traffic.

L_{max} the maximum sound pressure level observed in any specified period.

L_{eq} Equivalent continuous sound level: a measure of long term average noise exposure. It is the level of steady sound which, if heard continuously over a period of time, would contain the same total sound energy as the actual varying sound events occurring during that time period.

The 57 dB L_{Aeq} level is used in official UK published aircraft noise contours (previously 35 NNI, Noise and Number Index) as indicating the 'onset of community annoyance' (Directorate of Operational Research and Analysis, 1981; Brooker P et al, 1985; Critchley JB and Ollerhead JB, 1990). A new survey is being carried out which should enable the validity of the contour to be tested.

L_{den} An environmental noise indicator for annoyance, derived from the average sound energy level over the day, evening and night periods for one year. It has a 12 hour daytime period, a 4 hour evening period and a 8 hour night period. Weightings are imposed to reflect additional annoyance, of 5 dB for the evening, and 10 dB for the night. L_{den} may be adequate for large scale aggregate reporting, but are not suitable for all situations. If noise is confined to a particular period during the day, it could have an effect without necessarily shifting the overall L_{den} indicator.

L_{night} An environmental night noise indicator. It is used for the 8 hour night period without weighting. L_{den} and L_{night} may be adequate for large scale aggregate reporting, but are not suitable for all situations. As with L_{den}, if noise is confined to a particular period during the night, it could have an effect without necessarily shifting the overall L_{night} indicator.

Live-Work the flexible use of buildings and spaces to allow both functions within them. See also Work-Live and Homeworking.

Loop systems Systems working on the principle of a wire around a room carrying an amplified sound signal via a magnetic field to people with hearing aids switched to loop mode. The signal can, however, spill into adjacent spaces. Loops can be fitted to desks, or made portable.

Low Emissions Zone (LEZ) a defined area from which certain vehicles that do not comply with set air pollutant emissions standards are barred from entering.

Low frequency noise Term generally used to refer to sound below a frequency of about 100 to 150 Hz, especially in the 40-60 Hz range. Compared with sound of mid and high frequencies, low frequency sound is much less attenuated by passage through air, or by passage over

acoustically soft ground such as grassland. Low frequencies can thus become more prominent at greater distances.

Major airport Defined by Environmental Noise Directive 2002/49/EC as a civil airport with more than 50,000 aircraft movements (a movement being a take-off or a landing) a year.

Major railway Defined by Environmental Noise Directive 2002/94/EC as a railway with more than 30,000 train passages a year.

Major road Defined by the EU Environmental Noise Directive as a road with more than 3 million vehicle passages a year.

Mixed Mode A form of runway use at Heathrow when both main parallel runways are used simultaneously for landings and take offs (both in the same direction, of course). Alternation (see above) may be suspended exceptionally, for example, when unusual weather conditions mean that the holding stacks have become full.

Music Noise The noise from the music and vocals during a concert or sound checks, and not affected by other local noise sources, such as traffic.

Music Noise Level (MNL) The A-weighted continuous equivalent sound level of the Music noise measured at a particular location. The 'Code of Practice on Environmental Noise Control at Concerts' Noise Council, 1995, refers to a 15 minute A-weighted continuous equivalent sound level, $L_{Aeq, 15 \text{ min}}$ of the music noise, measured 1 metre from the façade of relevant noise sensitive premises.

Neighbour or Neighbourhood noise Noise from household appliances, radios, televisions, music systems, noisy pets, DIY activities, construction sites, intruder alarms, parties or similar events.

Night time Generally taken as the period from 2300 to 0700 hours, unless otherwise specified.

Noise 'Unwanted sound'. Noise includes vibration, except where the context indicates otherwise. Noise is classified as a pollutant in the European Directive on Integrated Pollution Prevention and Control.

Noise Abatement Zone The Control of Pollution Act 1974 introduced powers to declare Noise Abatement Zones. These provided local authorities with a relatively sophisticated means of controlling and, where justified, reducing noise from commercial and industrial premises. For

example, noise reduction notices could be served. Few zones were implemented, but powers remain available.

Noise Action Statement Statement, to accompany 'strategic referrals' (see below). It would specify the Noise Exposure Category or Categories (see Appendix A5, Table 9) into which the site fell; the noise issues considered, in terms of sources, levels, methods and assumptions; and the noise mitigation measures incorporated (for types of measures, see paragraphs 13-19 of Planning Policy Guidance Note 24, and paragraphs 4F.22-26 of this strategy).

Noise audit Systematic examination of a situation, building or proposal (e.g. traffic management scheme) to identify any noise and vibration implications and how best to mitigate them, or, where practicable, secure improvements (see also 'Sound audit').

Noise and Number Index (NNI) an index formerly used to describe aircraft noise around airports.

Noise and Track Keeping (NTK) system A computerised system for monitoring noise levels measured on site and using radar track data to identify aircraft which are not keeping within required limits. Due to changes in wind direction and other factors, aircraft cannot follow tracks perfectly. An aircraft would typically be counted as 'off track' if it was more than 1.5 kilometres either side of the nominal centre line of a Noise Preferential Route (see below). In London, NTK systems are in use at Heathrow and London City Airports.

Noise or sound environment This term is used to refer to the all-encompassing experience of noise and/or sound in a place. It includes issues of context, meaning and sound quality as well as loudness.

Noise map Noise mapping is the representation of acoustic data in a cartographical format. Noise maps are in most cases computer-generated drawings showing outdoor noise levels laid over a base of geographical information, such as building outlines and streets. They typically show 'sound immission contours' (see 'immission' above).

Noise nuisance has been defined by the World Health Organisation as 'a feeling of displeasure evoked by noise'. Statutory nuisance has a more specific meaning and is subject to legal action under the Environmental Protection Act 1990.

Noise Preferential Routes The initial part of Standard Instrument Departures (SIDs) which lead from take-off runways to the upper level airways. Pilots of all jet aircraft and larger propeller aircraft are required to follow NPRs up to an altitude of 4,000 feet, unless otherwise instructed by air traffic control (ATC) for safety reasons. Above 4,000 feet, ATC may give pilots a different heading, a practice referred to as vectoring. Adherence to NPRs is monitored at some airports by Noise and Track Keeping systems (see above).

Noise Rating (NR) curves A system for quantifying frequency-dependent noise levels with a single number.

Noise-sensitive Planning Policy Guidance Note 24: Planning and Noise, September 1994, states: 'The Secretary of State considers that housing, hospitals and schools should generally be regarded as noise-sensitive development, but planning authorities may wish to include other developments or uses within this definition, depending on local circumstances and priorities and, if so, these should be explained in the development plan' (paragraph 6). In the 'Code of Practice on Environmental Noise Control at Concerts' Noise Council, 1995, 'noise-sensitive premises' includes premises used for residential purposes, hospitals or similar institutions, education establishments (when in use), or places of worship (during recognised times and days of worship), or any premises used for any other purposes likely to be affected by Music Noise. There is no agreed, readily available way of identifying a psychologically 'noise-sensitive' population group (last paragraph, Appendix A2).

Pascal A unit of pressure corresponding to a force of 1 Newton acting on an area of 1 square metre.

Permanent threshold shift See also Temporary threshold shift. If hearing does not recover completely after about 48 hours, the remaining loss is considered to be permanent. There are two categories of permanent threshold shift. Noise-induced or occupational hearing loss is associated with regular exposure to hazardous levels of noise over a long period of time. Hearing loss will be similar in each ear and will initially get worse if exposure to the noise continues. Acoustic trauma can occur when a person is exposed to 'impulse sound' a very high sound level for a short period of time, such as due to explosion, or gunfire.

Photovoltaics The direct conversion of solar radiation into electricity by the interaction of light with the electrons in a semi-conductor device or cell.

Point source A sound source which can be idealised as a point in space, such as an opening to a ventilation plant.

Precautionary principle Where significant environmental damage may occur, but knowledge on the matter is incomplete, decisions made and measures implemented should err on the side of caution.

Pre completion testing (PCT) In the context of Building Regulations on sound transmission, carrying out an on-site acoustic test to ensure that the relevant part of a building meets the required standard before the unit can be considered to have been completed.

Presbycusis Hearing loss due to age.

Public Private Partnership (PPP) A partnership between the public and private sectors.

Quiet area in an agglomeration Defined by the EU Environmental Noise Directive as an area, delimited by the competent authority, for instance which is not exposed to a value of L_{den} or of another appropriate noise indicator greater than a certain value set by the Member State, from any noise source.

Quiet façade Defined in the EU Environmental Noise Directive as a dwelling façade at which the value of L_{den} 4 metres above the ground and 2 metres in front of the façade is more than 20 dB(A) lower than at the façade having the highest value of L_{den} . Smaller differences would, however, also provide benefit.

Radio aids These enable people with a suitable microphone to hear signals within spaces such as schools, exhibitions and galleries, although the signal can be subject to interference.

Railway bonus It is widely believed that people are less annoyed by rail noise than by a similar level of road noise, particularly at higher levels, although this has been disputed.

Rating level The value of L_{Aeq} for the specified time period associated with the relevant industrial noise. Used in BS 4142, including an adjustment for the character of the noise.

Reflection The phenomenon by which a sound wave is returned at a boundary between two media, such as from a solid 'acoustically hard' building surface.

Reverberation The persistence of sound within a space after the source has ceased to generate sound.

Reverberation time (RT) The time in seconds for a sound to decay to inaudibility of generation at source ceases. Strictly, the time in seconds for the sound level to decay 60 dB.

RNAV An airspace procedure facilitating area navigation based on global positioning systems, in which routes are defined on the basis of grid waypoints rather than ground navigational aids, such as radar beacons.

Robust Standard Details are said to be high performance constructions that are capable of providing consistently good sound insulation, and so should not need the check provided by Pre-completion testing (see above). Designed by the House Builders Federation.

SEL Sound Exposure Level, a measure of noise from a single event which accounts for both the duration and intensity of the noise event. It is the A-weighted level which if maintained constant for a period of one second would have the same acoustic energy as the actual noise event.

Soft ground Acoustically absorbent surface, such as grass, or tilled earth, which attenuates sound propagating over it, notably for points near the ground. See also 'hard ground'.

Solar gain The net solar irradiation on a surface or building which can be harnessed as heat energy.

Sound a pressure wave (periodic fluctuation in pressure) transmitted through air, water or other medium.

Sound Audit systematic examination of a situation, building or proposal (e.g. traffic management scheme), to identify any noise and vibration implications and how best to mitigate them, and opportunities for soundscape or sound quality improvement. It may vary from a checklist for small schemes to formal assessment of large schemes.

Sound cancellation see **Anti-sound**.

Sound insulation special insulation of a building against one or more types of environmental noise, combined with ventilation or air conditioning arrangements so designed that high levels of insulation against environmental noise can be maintained.

Sound power The total sound energy radiated by a source per second.

Sound Pressure Level The amplitude of the changes in pressure level of a sound wave, measured in either pressure units (Pa) or using the decibel logarithmic reference scale.

Sound quality Not just the overall sound level, but the mix of sound frequencies and other characteristics of sound through time, which may be appraised using a range of terms such as 'roughness'. Can include issues of meaning, context, and other qualitative aspects.

Soundscape The overall quality of an acoustic environment as a place for human experience. Soundscape design may encompass reduction or elimination of certain sounds ('noise abatement'), preservation of certain sounds ('soundmarks'), and the combination and balancing of sounds to create or enhance an attractive and stimulating acoustic environment (analogous to the sound engineering of products). A 'soundwalk' is a walk, often guided, designed to enhance awareness of the richness of the sound world.

Standardised mode or **standard mode** In the context of aircraft noise contours for Heathrow, the use of a 20 year rolling average for the percentages of easterly and westerly movements, used to distinguish year on year change due to changes in aircraft noise from those which may be due to changes in the balance between easterly and westerly operations.

Statutory nuisance Under the Environmental Protection Act 1990, 'noise emitted from premises so as to be prejudicial to health or a nuisance' may constitute a statutory nuisance.

Strategic referrals planning applications of potential strategic importance referred to the Mayor under the Town and Country Planning (Mayor of London) Order 2000 (Statutory Instrument No 1493).

Street canyon a street contained by buildings which are tall relative to the street width, and which line up continuously on both sides (see Nicholson SE. 'A pollution model for street level air' Atmospheric Environment 9, 1975, pp 19-33). Continuous façades, or fairly continuous building frontages with small gaps between buildings can screen noise from areas to the rear. However, multiple reflection of sound between façades facing the street can increase noise levels. Designers should consider the need for acoustically absorptive façades, including deep, acoustic profiling, as well as absorptive panels. Very deep and long

canyons can reduce opportunities for polluted air to disperse. In practice, most urban streets have frequent junctions with side streets.

Streets-for-People Areas where a comprehensive package of measures are aimed at improving the street environment to enhance the sense of community, increase priority for public transport, walking and cycling, and improve social inclusion.

Sustainable mobility services Systems providing people with easy, linked access to and information on a range of transport options, such as city cars, bicycles, taxis and trains, so that people can obtain the optimum means of mobility for each trip, rather than using the same vehicle for every trip.

TEL Transit Exposure Level, a noise descriptor used, for example, where there is a small number of distinct noise events, such as one or two night freight trains (see ISO/DIS 3095: 2001).

Temporary threshold shift most commonly noticed as a temporary dullness in hearing when a person has been exposed to loud noise. Recovery time depends on factors such as loudness and duration of noise exposure. Insufficient recovery time - such as when noisy working conditions are followed by leisure exposure - may mean loss becoming permanent. See also Permanent threshold shift.

Tinnitus Typically 'ringing in the ears'. The disorder can also take the form of a buzzing or an engine sound in the ears, either continuously, or intermittently. Some sufferers can associate onset with a particular period of high noise exposure.

Tonal noise Where much of the sound energy is concentrated into narrow frequency bands.

Touch and go is a landing by an aircraft which is immediately followed by a take off, often used in training and test flights.

Tranquillity There are many possible dimensions to tranquillity. It includes relative quiet, relative absence of sounds associated with human activity, particularly mechanised. Human perception of tranquillity may be influenced by the character of a place, including visual quality, as well as by its soundscape.

Unitary Development Plan Statutory plans produced by each borough which integrate strategic and local planning responsibilities through policies and proposals for development and use of land in their area.

Under Government proposals, they may be replaced by Local Development Frameworks.

Urban street canyon see **Street canyon**.

UIC Union International de Chemins de Fer, international railway organisation.

Vibration Is the oscillation of a mass in relation to a reference point, perceived by people other than by hearing (see Appendix A2).

Westerly operations When aircraft make their final approach to land from the east, and take off towards the west.

Westerly preference A system of westerly preference was introduced at Heathrow in 1962. It means that aircraft land from the east, and take off towards the west, unless wind direction and speed is such as to require operating in the reverse direction (easterly, see above). Optimally, aircraft take off and land into the wind, but can both take off and land with a moderate tail wind. Westerly preference at Heathrow reduces the number of take offs over the more highly populated areas east of the airport.

Work-Live Such units may be seen as an intermediate step between working at home and using a separate small business unit. The business area may occupy 50% or more of total internal floor area, and be clearly separated from the residential element. The work space would include standards of noise insulation, ventilation, services and provision for equipment capable of accommodating a range of business uses which would not normally be acceptable in a home. See also **Live-work**.

Worst mode noise contour On a long term average basis, aircraft operations at Heathrow are predominantly westerly, i.e. most of the time, aircraft land and take off towards the west. On a 20 year basis, some 77% of summer movements have been westerly, and 22% easterly. However, in any particular year, wind direction can be such that easterly operations can be a much higher proportion of total movements. A 'worst mode' noise contour might assume that operations were wholly easterly (e.g. typical easterly day), for certain planning purposes.

A9 bibliography

Abbott PG, Phillips SM, Nelson PM. 'Vehicle Operation and Road Traffic Noise Reduction' Institute of Acoustics Proceedings, Volume 23(5), 2001, pp 53-60

Arthur D Little Ltd (2000), 'Study into the Potential Impact of Changes in Technology on the Development of Air Transport in the UK' Report to DETR, November 2000.

BAA Heathrow. 'Noise Strategy 2000-2005' BAA Heathrow Planning & Environment Department, April 2001.

Batho W J S (Chairman). 'Report of the Noise Review Working Party 1990' Department of the Environment, 1990.

Berglund B, Lindvall T (editors). 'Community Noise' Document prepared for World Health Organisation. Archives of Centre for Sensory Research, 2, 1995, pp 1-195, <http://www.who.int/peh/>.

Berglund B, Lindvall T, Schwela D H (editors). 'Guidelines for Community Noise' World Health Organisation, Geneva, 2000; <http://www.who.int/peh/noise/noiseindex.html>, 26 February 2001.

Berry B F, Porter N D. 'The evaluation of acoustic features in industrial noise' Proceedings of Internoise 94, Yokohama, Japan, 1994, pp 803-808.

Berry B F, Porter N D, Flindell I H. 'The feasibility of linking future noise standards to health effects' Proceedings of 'Noise Effects 98', Sydney, Australia. Volume 2, pp 729-732.

Berry B F, Flindell I H. 'Noise effects research: the importance of estimating exposure properly' Proceedings of 'Noise Effects 98', Sydney, Australia. Volume 2, pp 627-630.

Berry B F, Porter N D, Flindell I H. 'Health effect based noise assessment methods' Institute of Acoustics, Acoustics Bulletin, January/February 1999, pp 13 - 16.

Berry B F, Jiggins M. 'An inventory of UK research on noise and health from 1994 to the present day' National Physical Laboratory, Report CMAM 40, September 1999.

British Standard 4142:1997 'Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.'

British Standard 8233: 1999 'Sound Insulation and Noise Reductions for Buildings.'

Building Research Establishment. 'National Noise Incidence Survey 1990'

Brooker P, et al. 'United Kingdom Aircraft Noise Index Study: Final Report' Civil Aviation Authority DR Report 8402, January 1985.

Casella-Stanger. 'Low Frequency Noise' Technical Research Support for Department for Environment, Food and Rural Affairs, Noise Programme, 2001. See www.defra.gov.uk

CIEH. 'Guidance on the creation and maintenance of effective noise management policies and practice for local authorities and their officers' CIEH, 1997.

Civil Aviation Authority. 'United Kingdom Aircraft Noise Index Study: Main Report' DR Report 8402, CAA, January 1985.

Clarke, Lord Justice. 'Thames Safety Inquiry' Interim and Final Reports, 1999 and 2000, The Stationary Office.

Cloke J, Harris G, Latham S, Quimby A, Smith L, Baughan C. 'Reducing the environmental impact of driving: A review of training and in-vehicle technologies' Transport Research Laboratory Report TRL 384, 1999.

Council for the Protection of Rural England. 'Tranquil Areas maps' S Rendel, Ash Consulting for CPRE and Countryside Commission, 1995.

Critchley JB and Ollerhead JB. 'The Use of L_{eq} as an Aircraft Noise Index' Civil Aviation Authority DORA Report 9023, September 1990.

Danish Environmental Protection Agency and Danish Ministry of Transport. 'Traffic Noise Reduction' Report No 30541-03, June 1998.

Department for Education and Skills. 'The Acoustic Design of Schools' Building Bulletin 93, DfES, The Stationery Office, 2003.

Department of the Environment. 'Building and Buildings. The Noise Insulation Regulations' Statutory Instrument No 1763, HMSO, 1975.

Department of the Environment. 'Building and Buildings. The Noise Insulation (Amendment) Regulations' Statutory Instrument No 2000, HMSO, 1988.

Department of Environment. 'Town centres and retail developments' Planning Policy Guidance Note 6, HMSO, June 1996.

Department of the Environment. 'Planning and Noise' Planning Policy Guidance Note 24, HMSO, September 1994.

Department of the Environment. 'Building and Buildings. The Noise Insulation (Railways and Other Guided Transport Systems) Regulations' Statutory Instrument No 428, HMSO, 1996.

Department of the Environment. 'Building and Buildings. The Noise Insulation (Railways and Other Guided Transport Systems)(Amendment) Regulations' Statutory Instrument No 1701, HMSO, 1998.

Department of the Environment, Transport and the Regions. 'A New Deal for Transport: Better for Everyone' DETR, 1998.

Department of the Environment, Transport and the Regions. 'A New Deal for Trunk Roads in England: Guidance on the New Approach to Appraisal' DETR, July 1998.

Department of the Environment, Transport and the Regions. 'Quality and Choice: A Decent Home for All: The Housing Green Paper' The Stationery Office, April 2000.

Department of the Environment, Transport and the Regions. 'Air Quality Strategy for England, Scotland, Wales and Northern Ireland' The Stationery Office, 2000

Department of the Environment, Transport and the Regions. 'Modern Ports: A UK Policy' DETR, 2000. Available from <http://www.shipping.dft.gov.uk/index.htm>

Department of the Environment, Transport and the Regions. 'Sustainable Distribution: A Strategy' DETR, March 1999.

Department of the Environment, Transport and the Regions. 'Guidance on Full Local Transport Plans' DETR, March 2000.

Department of the Environment, Transport and the Regions. 'Waterways for Tomorrow' DETR, June 2000.

Department of the Environment, Transport and the Regions. 'Transport 2010: The 10 Year Plan' DETR, July 2000.

Department of the Environment, Transport and the Regions. 'The Future of Aviation: The Government's Consultation Document on Air Transport Policy' DETR, December 2000.

Department of the Environment, Transport and the Regions. 'Proposals for Amending Part E of the Building Regulations 2000: Resistance to the Passage of Sound: Consultation' DETR, January 2001.

Department of the Environment, Transport and the Regions. 'Control of Body Noise from Commercial Vehicles - Guide to best practice' DETR, October 2000.

Department of the Environment, Transport and the Regions. 'Traffic calming bibliography' Traffic advisory leaflet 5/01, 2001

Department for Environment, Food and Rural Affairs. 'Towards a National Ambient Noise Strategy' Consultation paper, DEFRA, November 2001.

Department for Environment, Food and Rural Affairs. 'Integrated Pollution Prevention and Control A Practical Guide - Edition 2' DEFRA, June 2002.

Department for Environment, Food and Rural Affairs. 'Implications for noise disturbance arising from the liberalisation of licensing laws' Report of research and consultation conducted by MCM Research Ltd for DEFRA, October 2003.

Department for Transport. 'Night Flying Restrictions at Heathrow, Gatwick and Stansted' DfT, April 2003.

Department for Transport. 'The Future of Air Transport' Cm 6046. Presented to Parliament by the Secretary of State for Transport, 16 December 2003.

Department for Transport, Local Government and the Regions 'Mixed-Use Development, Practice and Potential', DfT, 19 March 2002.

Department for Transport, Local Government and the Regions et al. 'Noise from arriving aircraft: an industry code of practice' DTLR, CAA, NATS, BAA, BA, Airtours International, September 2001.

Department of Transport. 'Calculation of Road Traffic Noise' The Stationery Office, 1988.

Department of Transport. 'Design Manual of Roads and Bridges, Volume 11, Section 3, Part 7: Traffic Noise and Vibration' The Stationery Office, August 1994.

Department of Transport. 'Calculation of Railway Noise' The Stationery Office, 1995 (and Supplement 1).

Department of Transport and Regional Services. 'Discussion Paper: Expanding Ways to Describe and Assess Aircraft Noise' DOTARS, Australia, August 2002. See <http://www.dotars.gov.au>.

Diamond I, Stephenson R, et al. 'Perceptions of Aircraft Noise, Sleep and Health' University of Southampton, Cardiff University, Building Research Establishment, Queen Mary and Westfield College, December 2000. www.socstats.soton.ac.uk/News

Directorate of Operational Research and Analysis. 'The Noise and Number Index' DORA Communication 7907, Second Edition, September 1981.

Disability Rights Commission. 'What is an inclusive environment and how can it be achieved?' Discussion paper, DRC, 2002.

European Commission. 'Future noise policy', European Commission Green Paper COM (96) 540, published in 1996.

European Commission. 'Directive of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise.' 2002/49/EC, published in the Official Journal on 18 July 2002.

Evans G, Hygge S, and Bullinger M. 'Chronic noise and psychological stress' *Psychological Science*, Vol 6(6), 1995, pp 333-338.

Evans G, Bullinger M, and Hygge S. 'Chronic noise exposure and psychological response: A prospective study of children living under environmental stress' *Psychological Science*, Vol 9, 1998, pp 75-77.

Flindell I H, Porter N D, Berry B F. 'The assessment of environmental noise - the revision of ISO 1996' *Acoustics Bulletin*, vol. 22, no. 6, 1997, pp 5-10.

Flindell I, Bullmore A, et al. 'Aircraft Noise and Sleep - 1999 UK Trial Methodology Study' Institute of Sound and Vibration Research Consultancy Services, University of Southampton; Centre for Human

Sciences, Defence Evaluation and Research Agency; Centre for Mechanical and Acoustical Metrology, National Physical Laboratory; MVA Consultancy. ISVR, 27 November 2000. <http://www.isvr.co.uk/envirom/sleep.htm>

Frommer, G 'Noise Control Engineering for the Airport Railway in Hong Kong - Setting the Standards' Noise/News International, December 2000, pp154-159.

Garcia A (editor). 'Environmental Urban Noise' WITPress, Southampton, 2001.

Government Office for London. 'Strategic Planning in London', GOL Circular 1/2000.

Greater London Authority. 'London's warming: The impacts of climate change on London' Summary Report, GLA/London Climate Change Partnership, October 2002.

Grimwood C, and Ling M. 'Domestic Noise Complaints - Furthering our understanding of the issues involved in neighbourhood noise disputes' BRE Report no. 204732. BRE Acoustics Centre for DETR, December 1999.

Grimwood C, and Skinner C. 'A review of London-related data from the 1990 and 2000 National Noise Incidence Studies' BRE Report no. 204053f. BRE Acoustics Centre for GLA, May 2002.

Grimwood C, and Skinner C. 'A review of London-related data from the 2000 National Noise Attitude Survey' BRE Report no. 205824f. BRE Acoustics Centre for GLA, May 2002.

HACAN ClearSkies. 'London's Blighted Parks' London, October 2000.

Haines M, Stansfeld S, Job R, Berglund B, Head J. 'Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children' Psychological Medicine, 31, 2001, pp 265-277.

Haines M, Stansfeld S, Job R, Berglund B, Head J. 'A follow-up study of the effects of chronic aircraft exposure on child stress responses and cognition' International Journal of Epidemiology, 30, 2001, pp 839-845.

Haines M, Stansfeld S, Brentnall S, Head J, Berry B, Jiggins M, and Hygge S. 'West London Schools Study: Aircraft noise at school and child

performance and health' *Psychological Medicine*, 31, 2001, pp 1385-1396.

Hemsworth B and Jones RRK. 'Silent Freight Project - Final Report' European Rail Research Institute, 2000.

Hemsworth B. 'Silent Track Project - Final Report' European Rail Research Institute, 2000.

Hepworth P, Rasmussen S. 'Noise Strategy - European Experience' *Institute of Acoustics Proceedings Volume 23(5)*, 2001, pp 27-31.

HM Treasury and Department for Transport. 'Aviation and the Environment: Using Economic Instruments' HM Treasury and DfT, March 2003.

Huddart L. 'The Use of Vegetation for Traffic Noise Screening' Report No. 238, Transport Research Laboratory, Crowthorne, 1990.

Järviluoma H and Wagstaff G. 'Soundscape studies and methods' ISBN 951-96171-5-9 Finnish Society for Ethnomusicology, University of Turku, 2002.

Jones RRK. 'Railway noise control using combined vehicle and track treatments' World Congress on Railway Research, Paris, November 1994.

Jones RRK. 'Remote monitoring systems for rail corrugation and curve squeal' Paper presented at Railway Technology Conference, Railtex 2000, NEC Birmingham, 23 November 2000.

Institute for Environment and Health. 'Report on the non-auditory effects of noise.' Report R10, IEH, September 1997. Executive summary: <http://www.le.ac.uk/ieh/pdf/ExsumR10.pdf>

Institute of Acoustics. 'Good Practice Guide on the Control of Noise from Pubs and Clubs' IoA, March 2003.

Kemper GD. 'Noise emissions from road vehicles and provisions for noise reductions.' Proceedings of Inter-Noise 85 conference, Munich, 1985

Kihlman T. 'Noise Abatement and Improvement: The Systematic Approach' *Noise News International*, June 2001, pp 97-101.

Kotzen B, English C. 'Environmental noise barriers: A guide their acoustic and visual design' E & FN Spon, London, 1999.

Kragh J. 'Road Traffic Noise Attenuation by Belts of Trees and Bushes' Report No 31, Danish Acoustical Laboratory, Lyngby, Denmark, 1982.

Lambert J, Vallet M. 'Study related to the preparation of a communication on a future EC Noise Policy, Final Report' LEN Report No.9420, December 1994.

Lercher P and Schulte-Fortkamp B. 'The relevance of soundscape research to the assessment of noise annoyance at the community level' Proceedings of the 8th International Congress on Noise as a Public Health Problem, ICBEN, Rotterdam, 29 June-3 July 2003

Leventhall G, Pelmeur P and Benton S. 'A Review of Published Research on Low Frequency Noise and its Effects' Research Report, Department for Environment, Food and Rural Affairs, May 2003.

London Assembly Culture Sport and Tourism Committee. 'Whatever gets you through the night: 24 hour licensing in London' Greater London Authority, December 2002.

London Assembly Environment Committee. 'Scrutiny of the Mayor's Draft Noise Strategy' Greater London Authority, October 2002.

London Assembly Transport Committee. 'Flying into the Future' Response to the Government's aviation consultation. Greater London Authority, July 2003.

London Borough of Camden. 'Noise Strategy' (Quentin Given/Peter Carey), LB Camden, September 2002.

London Climate Change Partnership. 'A Climate Change Impacts in London Evaluation Study' Entec UK Limited, October 2002.

Maassen M, Babish W, et al. 'Ear damage caused by leisure noise' Noise & Health, Vol 4;13, pp 1-16.

Mayor of London. 'Safeguarded Wharves on the River Thames' Consultation Draft, Greater London Authority, April 2003.

Mayor of London. 'Mayor of London's response to the consultation document "The Future Development of Air Transport in the United Kingdom: South East"' Greater London Authority, June 2003.

Mayor of London. 'Green Capital: The Mayor's State of the Environment Report for London' Greater London Authority, May 2003.

Mayor of London. 'Accessible London: Achieving An Inclusive Environment' London Plan Draft Supplementary Planning Guidance, Greater London Authority, July 2003

Mayor of London. 'Industrial Capacity' London Plan Draft Supplementary Planning Guidance, Greater London Authority, September 2003.

Mayor of London. 'The London Plan: Spatial Development Strategy for Greater London' Greater London Authority, February 2004.

McCubbin I. 'Development of a Renewable Energy Assessment and Targets for London' Report to Government Office for London and the Greater London Authority by the Energy Technology Support Unit, AEAT, December 2001

Miedema H M E, and Vos H. 'Exposure-response relations for transportation noise' Journal of the Acoustical Society of America, Vol 104 (6), December 1998, pp 3432-3444.

Mitchell, chair. 'Railway Noise and the Insulation of Dwellings' Report of committee chaired by CGB Mitchell, London: HMSO, 1991.

Mitchell S. 'Neighbour and Neighbourhood Noise - A review of European legislation and practices' Environmental Resources Management for DEFRA, March 2002.

MORI 'State of London 2000: Quantitative Survey - Final Report' MORI for Greater London Authority, October-November 2000.

NHS Estates. 'Acoustics: Design considerations' Health Technical Memorandum 2045, NHS Estates, 1996.

National Noise Committee. 'Proposals for a national noise strategy' NSCA, 1999.

National Society for Clean Air and Environmental Protection. 'Neighbour Noise Problems: NSCA Local Authority Guidelines' NSCA, October 1994.

National Society for Clean Air and Environmental Protection. 'National Noise Survey 2001' NSCA, June 2001.

Nelson PM, Phillips SM. 'Quieter Road Surfaces' TRL Annual Review, Transport Research Laboratory, 1997.

Office of Passenger Rail Franchising. 'Planning Criteria: A guide to the appraisal of support for passenger rail services' OPRAF, 16 July 1999.

Office of the Deputy Prime Minister. 'Draft Minerals Policy Statement 2: Controlling and mitigating the environmental effects of mineral extraction in England: Annex 2. Noise' ODPM, February 2003.

Office of the Deputy Prime Minister. 'Planning and Access for Disabled People' Good practice guide, ODPM, March 2003.

Office of the Deputy Prime Minister. 'The Building Regulations 2000: Amendment of the Building Regulations to allow Robust Standard Details to be used as an alternative to pre-completion testing' ODPM, August 2003.

Office of the Rail Regulator. 'Railway operations and the environment: Environmental guidance' ORR, March 1996.

Office of the Rail Regulator. 'Consultation on proposed modifications to Railtrack's network licence.' ORR, September 2000.

Organisation for Economic Co-operation and Development. 'Fighting Noise in the 1990s.' OECD, Paris, 1991.

Organisation for Economic Co-operation and Development. 'Roadside Noise Abatement.' OECD, Paris, 1995.

OXERA Environmental. 'The Wider Impacts of Rail and Road Investment.' The Railway Forum, March 2000.

Passchier-Vermeer W, Vermeer W F. 'Noise Exposure and Public Health' Environmental Health Perspectives, Vol. 108, Supplement 1, March 2000.

Porter N D. 'The assessment of industrial noise - a review of various national practices' Institute of Acoustics Bulletin, 1995, Vol. 20, No. 2, pp 31-37. Also, NPL Report RSA(EXT)0057B, May 1995

Porter N D. 'Night noise contours: a feasibility study' National Physical Laboratory, Report CMAM 4, December 1997.

Porter N D, Flindell I H, Berry B F. 'Health effect based noise assessment methods: a review and feasibility study' National Physical Laboratory Report CMAM 16. DETR, September 1998. <http://www.environment.defra.gov.uk/airq/nnp>

Porter N D, Kershaw A D, Ollerhead J B. 'Adverse effects of night-time aircraft noise' R&D Report 9964. Department of Operational Research and Analysis, National Air Traffic Services Ltd for DETR, London, March 2000.

Roberts M et al. 'Licensing Reform: A cross-cultural comparison of rights responsibilities and regulation' Central Cities Institute, University of Westminster, September 2002.

Royal Commission on Environmental Pollution. 'Eighteenth Report: Transport and the Environment' RCEP, 26 October 1994.

Sandberg U. 'Noise Emissions of Road Vehicles: Effect of Regulations' Final Report 01-1, I-INCE Working Party on Noise Emissions of Road Vehicles (WP-NERV), International Institute of Noise Control Engineering, July 2001.

Shield B, Dockrell J. 'The effects of noise on the attainments and cognitive performance of primary school children' Department of Health, 2002.

Smith A P, Jones D M. 'Noise and Performance' In Jones D M, Smith A P (eds). 'Handbook of Human Performance' London: Academic Press, 1992, 1: pp 1-28.

Stansfeld S, Haines M, Brown B. 'Noise and health in the urban environment' Reviews on Environmental Health, Vol 15, No 1-2, 2000, pp 43-82.

Stansfeld S, Haines M, Head J, Berry B, Jiggins M, Brentnall S, Roberts R. 'Aircraft noise at school and child performance and health: Initial results from the West London schools study.' Proceedings of Inter-noise, Nice, August 2000.

Stansfeld S, Brown B, Haines M, Cobbing C. 'The Development of a Standardised Interview to Assess Domestic Noise Complaints and their

Effects (SCIANCE)' Department of Health, 2001. <http://www.doh.gov.uk/hef/airpol/sciance.htm>

Stansfeld S, Haines M, Curtis, S, Brentnall, S, Brown B. 'Rapid Review on Noise and Health for London' Report to inform preparation of Mayor's Ambient Noise Strategy, April 2001.

Stansfeld S, et al. 'Aircraft and road traffic noise and children's cognition and health: Preliminary results on dose-response relationships from the RANCH study' Proceedings of the 8th International Congress on Noise as a Public Health Problem, ICBEN, Rotterdam, 29 June-3 July 2003. Also, <http://www.ranchproject.org>.

Urban Task Force. 'Towards an Urban Renaissance' Final Report of the Urban Task Force chaired by Lord Rogers of Riverside. Department of the Environment, Transport and the Regions. The Stationery Office, 1999. Distributed by E & FN Spon.

Vallet M. 'Effects of noise on health' in Garcia A. 'Environmental Urban Noise' WIT Press, Southampton, 2001

Watts GR, Harris GJ, Layfield RE. 'Traffic calming: Vehicle generated ground-borne vibration alongside speed control cushions and road humps' TRL Report 235, Transport Research Laboratory, Crowthorne, 1997

Waye K P, Bengtsson J et al. 'Low frequency noise "pollution" interferes with performance' Noise & Health, vol 4;13. pp 33-49.

Working Group on Noise from Wind Turbines 'The Assessment and Rating of Noise from Wind Farms' Final Report, ETSU-R-97, Energy Technology Support Unit for Department of Trade and Industry, September 1996. See <http://www.dti.gov.uk/energy/renewables/publications/noiseassessment.shtml>

W S Atkins 'Determination of the Potential Synergies and Conflicts between Noise and Air Quality Action Plans' a report for DETR, March 2001. Available from <http://www.defra.gov.uk>.

Wright P and Grimwood C. 'Strategic management of noise: a UK perspective' Clean Air and Environmental Protection, Vol 30(1), January/February 2000, pp 11-15.

World Health Organisation. 'Environmental Health Criteria 12 - Noise.'
World Health Organisation, Geneva, 1980. See also Berglund et al, above.

The Mayor of London's Environment Strategies:

'Connecting with London's Nature: The Mayor's Biodiversity Strategy'
Greater London Authority, July 2002.

'Cleaning London's Air: The Mayor's Air Quality Strategy' Greater London
Authority, September 2002.

'Rethinking Rubbish in London: The Mayor's Municipal Waste
Management Strategy' Greater London Authority, September 2003.

'Green Light to Clean Power: The Mayor's Energy Strategy' Greater
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