
Soundscape: Quality of Life and Health: Paper ICA2016233**Loci for urban soundscape planning, design and management****A. L. Brown^(a) , C. J. Grimwood^(b)**

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Abstract

Soundscapes have a role in management of the acoustic environment of urban areas in the context of parks, historical and cultural places, and existing “quiet areas”, but also across residential precincts and other urban spaces. Soundscape planning is complementary to, not a substitute for, noise management approaches. It is generally clear where noise control principles should apply: viz. at sensitive receptors where adverse impacts and effects arise – under flight paths near airports or at the interface between industrial and residential precincts, for example. But the loci of application of soundscape management principles are less well understood. Set out here is a didactic schema of the spectrum of opportunities for planning of the soundscape of urban areas. Starting with a hypothetical distribution of sound levels across any area of interest, there will be a small proportion of that distribution with the highest sound levels. The rest of the distribution will be variously shaped – from highly positively skewed indicating that much of the area has lower sound levels, to distributions where a high proportion is at mid sound levels with a long tail of lower sound levels. The higher levels of sound are candidates for management through environmental noise control activities. The low end of the level distribution may be protected or managed as “quiet areas” to enhance urban soundscapes. This paper describes other loci for the application of soundscape principles across this distribution. Soundscape design and management can include creative design of the built environment to achieve places of high acoustic quality; ensuring the availability of urban acoustic diversity; encouraging attention to sub-criterion (noise) exposures and protection of place-defining sounds.

Keywords: soundscape, planning, design, health

Loci for urban soundscape planning, design and management

1 Introduction

The *acoustic environment* of a place or space is the sound from all sources that could be heard by someone in that place. This acoustic environment is shaped by the sources present and by modification of the sounds as they propagate along their paths from the sources to the receiver. The *soundscape* is a person's perceptual construct of this acoustic environment [1].

To date the dominant approach to management of the urban acoustic environment is noise control. In planning and infrastructure management, environmental noise is generally taken into account within current development planning procedures. The most common approach involves the level of noise exposure being predicted and compared to guidelines, then used in approval decisions or in specifying required mitigation conditions to protect people from the adverse effects of noise [2]. These noise management approaches in urban areas typically tend to recognize just one beneficial use—namely that of *residential use of dwellings*. For example, management of road, rail and air transport noise sources is based, almost exclusively, on setting façade-level acoustic criteria that should not be exceeded at residential dwellings. The intent is that the beneficial use of these dwellings is achieved by limiting resident's' annoyance, sleep disturbance, or other adverse effects. In this respect, environmental noise control is, for the urban acoustic environment, effectively a waste management approach (Table 1).

Table 1. Environmental noise management and soundscape approaches (modified from Brown, 2010)

Environmental Noise Management Approach	Soundscape Approach
sound managed as <i>a waste</i>	sound perceived as <i>a resource</i>
focus is on <i>sounds of discomfort</i>	focus is on <i>sounds of preference</i>
predominant beneficial use is residential use of <i>dwellings</i>	many potential beneficial uses (see text)

By contrast to noise management, the soundscape perspective recognizes a much broader range of users/uses that potentially draw benefit from the outdoor acoustic environment. As well as the beneficial use associated with residential living, others draw benefit from the acoustic environment of urban areas in terms of, for example:

- experience of the sounds of nature
- enjoyment of sense of community, or of community activity
- restoration of health and well-being
- respite, relaxation

enjoyment or excitement
stimulation
enhancement of culture
safety, security.

This list could be extended further, as there are many other activities and descriptors of the ways that people enjoy, or benefit from, the resource that is the urban acoustic environment, other than simply being able to live in a dwelling that is not impacted by high levels of unwanted sound. These need to be considered within the specific contexts of particular places and spaces, and are highly dependent on people, place and activity [3].

However, there is limited accumulated and shared experience as to where soundscape design and management approaches could potentially be utilized to achieve such benefits in outdoor urban spaces. Planners and designers need guidance on how to identify spaces and places for potential action with respect to the acoustic environment to achieve positive human outcomes. Further, they need to be able to translate the objectives of such soundscape design into acoustical criteria that underpin the different beneficial uses that can take place in these locations. What they require is analogous to what the designers of indoor spaces already have available in terms of acoustic objectives and criteria for, say, facilitating learning in classrooms or for enjoying speech or music in auditoria.

The intent of this paper is to provide a conceptual framework within which to identify potential loci for soundscape planning and design in the outdoor spaces and places of urban areas and to suggest, at least in broad qualitative terms, approaches to setting acoustic design criteria for these. For soundscape design criteria, this paper adopts the guidance on setting *acoustic objectives* for these spaces described in Brown and Muhar [4] and Bento-Coehlo [5]. The term *high acoustic quality* to label preferred soundscapes below is as described in [6].

2 Loci for soundscape planning

In management of the urban acoustic environment, it is not a matter of choosing either a noise control or a soundscape approach, but rather noise control supplemented by soundscape planning. Genuit [7] has, for example, argued that environmental noise management should be considered as just one component of soundscape planning and management. Adams et al. [2] has suggested where soundscape expertise and soundscape tools can be incorporated in U.K. planning systems. The application of soundscape concepts opens up the potential for the same expertise that is brought to the control of the adverse components of the acoustic environment to be applied to the management of those parts of the outdoor acoustic environment that are of high quality and are valued by people—as a resource—by acoustic design or acoustic management of outdoor space. As Kang [8] suggests, the study of soundscapes is not only the passive understanding of human acoustic preference, but can be *...placed into the intentional design process comparable to landscape...and into the design process of urban public spaces*. Soundscape planning, by analogy with landscape planning,

involves design or management to manipulate the acoustic environment of a place in a way that results in improved human perception of its environment.

This application is likely to be primarily, but not exclusively, to outdoor areas such as streets and squares, city parks, gardens or other urban natural areas. The same principles and approaches will also apply to hybrid outdoor-indoor spaces such as malls and markets, transport terminals, sports arenas, or similar. It is also suggested that, given the notion of soundscape planning is relatively novel for many design professionals, the initial focus for soundscape planning/acoustic design should be on areas that are already undergoing other changes, such as the comprehensive renovation of a city mall, area-wide traffic calming through an urban precinct, the design of the public spaces within large private developments, or the creation or redevelopment of small open spaces and land in the public realm.

Over any place/area of interest, it is useful to first conceive how sounds and sound levels might be spatially distributed. Figure 1 shows a hypothetical distribution of sound levels over some area of interest arising from whatever sources are dominant in that area. In general terms, one can expect there will be a small proportion of that distribution with the highest sound levels, but the rest of the distribution will be variously shaped – from highly positively skewed where much of the area has lower sound levels, to distributions where a high proportion is at mid-levels of sound and with a long tail of lower sound levels. There will, of course, be multiple sound sources generating these levels, and these will be very different between different types of area under consideration. The nature of the sound sources is not relevant for this initial hypothetical discussion, but highly relevant in soundscape planning approaches described below.

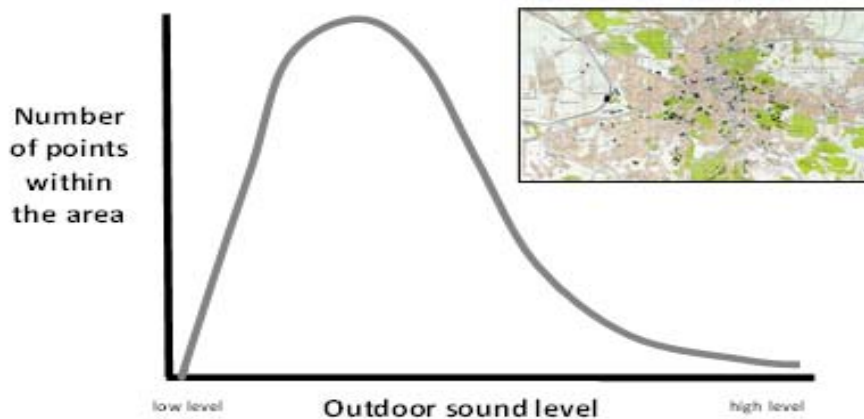


Figure 1: Hypothetical geographical distribution of sound levels over any area of interest: city, suburb, park, urban square etc.

As is suggested in Figure 2, the higher levels of sound in this area are likely to be managed, conventionally, by environmental noise control activities, and these aim to control or manage the sounds of discomfort. It is at sound levels below those of the criterion levels for noise management that there is potential for soundscape planning and design to focus on the sounds of preference for both residential and non-residential beneficial uses.

Within this range of sub-criterion level exposures, it is possible to identify at least seven generic loci for potential soundscape planning and design (Table 2). Some of these are specific types of locations; others are broader application across urban residential areas.

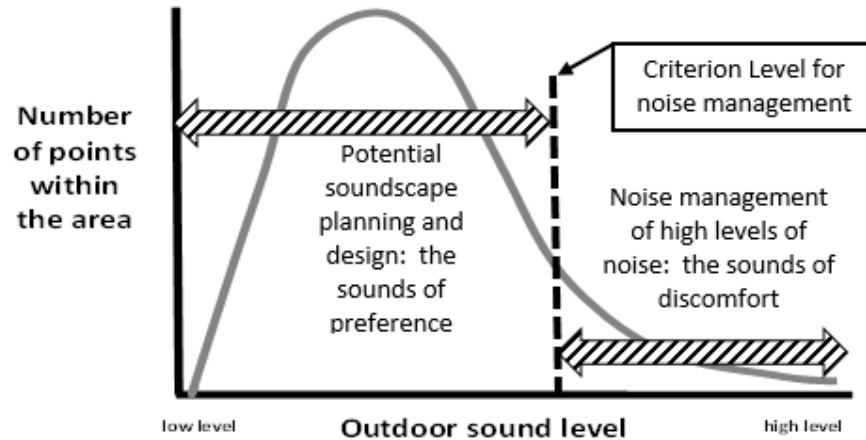


Figure 2: The noise management paradigm is largely restricted to the higher levels of outdoor sound. Potential soundscape planning and design is focussed on levels below those used as criteria for noise management. Loci for application of soundscape design are shown in Table 2.

Table 2: Loci for application of urban soundscape planning and design approaches.

Specific urban spaces/places	Broader application within residential and related areas
managing quiet areas	ensuring diversity in the urban acoustic environment
creative acoustic design of places/spaces of high acoustic quality	encouraging attention to sub-criterion exposures
protecting iconic or place-defining sounds/soundmarks	providing restorative access to better quality acoustic environment for those subject to adverse effects of noise at home
identifying locations for artistic sound installations	

2.1 Specific urban spaces/places

There will be many opportunities for the application of soundscape planning and design concepts related to specific spaces and places in urban areas. Four possible examples are discussed below: the management of quiet areas; the management/design of areas of high acoustic quality; the protection/management of iconic or place-defining sounds; and identifying locations for artistic sound installations. This discussion is not exhaustive, and it is also likely that other opportunities will emerge as practical experience grows in this field.

Managing quiet areas: In Europe, *quiet areas* have been recognized as a target for management of the urban acoustic environment, and a *Good Practice Guide on Quiet*

Areas has been published by the European Environment Agency [9]. There has been some mapping of quiet areas in urban and non-urban environments, though generally this has been through portrayal of the inverse of maps of predicted high levels of transportation noise rather than on any specific identification of characteristics of high acoustic quality. This is because, for the most part, identification of quiet areas has, inadequately, been based on low levels of integrated sound, with no distinction between sound sources. Whilst a low level of sound may be a characteristic of some areas that are of high acoustic quality, quiet is not the antithesis of noisy [6], and areas that have low levels of sound may not necessarily be ones in which the acoustic environment is of high quality. For example, there are many places in urban areas where sounds are at low levels but the source of these sounds is traffic on distant roadways. Most people would be unlikely to regard these environments as being of high acoustic quality. (Similarly, as will be suggested below, there are many urban places where noise levels may be fairly high but that nevertheless may be perceived to be tranquil or of high acoustic quality). There is increasing evidence that it is the congruence of the type of sound heard in a particular environment and people's expectations of that place that determines its acoustic quality [10,11]. In other words, identification of areas with low sound level in urban areas is potentially useful, as it could highlight areas that may have high acoustic quality - but this is not necessarily so. What is also needed is a parallel investigation as to whether the sounds in these areas meet peoples' expectations/preferences [11]. Raimbault and Dubois [12] largely reject physical acoustical parameters as measures of preferred soundscapes, and suggest that acoustic mapping of urban areas should be disaggregated according to sources - transportation soundscapes as against soundscapes generated by people, for example. Scale should not be a criterion with respect to identification of a quiet area – a single park bench could, for example, by comparison with other locations in a park in which the dominant source of sound is road traffic from the park peripheries, be well shielded from road traffic noise, and thus warrant specific protection. Having recognized which quiet areas are also areas of high acoustic quality, the acoustic objectives for managing such areas is to ensure maintenance of the low levels of sound.

Managing/making areas of high acoustic quality: Managing and protecting the acoustic environment of particular “quiet areas” is useful if they are of high acoustic quality. But there are many outdoor areas that are of high acoustic quality that are far from quiet: a forested urban park with wind in the trees; a fountain with loud splashing water; loud singing of birds or insects in urban parks and residential gardens; buskers in a mall or subway tunnel; church bells in a town square; the sounds of children playing, or of sports fans cheering; the hum of a market place (with people sounds as the dominant source and free from mechanical or recorded sounds). Within particular appropriate contexts, many people are likely to enjoy, even cherish, these sounds [13]. These areas of high acoustic quality contribute to the richness of urban life, and can be included in conscious management and planning of the urban acoustic environment. Clearly, design criteria for them cannot be based on sound level. Brown and Muhar [4] provide an approach based, for any particular human activities and specific contexts, on establishing objectives such as: *moving water should be the dominant sound heard; hear mostly the non-mechanical,*

non-amplified sounds made by people; or good for hearing unamplified speech or music. Management or acoustic design can ensure the wanted sounds in such areas are not masked by the unwanted sounds. This can be achieved by using standard noise control approaches to reducing source levels of unwanted sounds through source elimination or path control measures [11]. The inverse approach, of increasing the wanted sound, could be for example through design of reverberant space in a mall or similar, specifically for the purposes of creating a lively space for busking.

Protecting iconic or place-defining sounds: These types of sounds are highly specific to particular localities: bells, clocks, chimes (London's Big Ben, for example), waves on beaches of seaside cities, the sound of particular local transport (San Francisco's cable cars, for example), perhaps even sounds from agricultural or industrial processes which define the economic base of a town. These can be essential components of the identities of these urban areas, and could also have much wider values through management of cultural heritage and attraction of tourism [14]. Iconic sound events, such as co-ordinated multiple church bell happenings, could have a dramatic acoustic and socio-cultural impact. Once an iconic sound has been identified, the soundscape management objective becomes "*the iconic sound should be clearly heard over some [specified] area*", and this is achieved over the specified area through standard acoustic techniques such as eliminating or mitigating the unwanted sounds that could mask the iconic sound, or naturally reinforcing or amplifying the iconic sound. Schaefer [15] refers to these iconic sounds as *sound marks*.

Design for sound installations: Sound installations is used here as a generic term for public works of art that include some acoustic dimension. Examples include those which react to their environment – either driven by natural forces of wind or water, or responding to human interaction such as drums or chimes or voice trumpets etc. Others may incorporate recorded sound, of music, voice, or natural sounds, or fed-back amplification of sound from the immediate, or some remote, environment. The soundscaping issue here is two-fold – firstly the appropriateness of the introduced sound to the particular locality (is it a wanted sound by most of those who will hear it) and secondly if the sound generated by the work of art will be audible over the area intended, or whether this may be masked by unwanted sounds. The authors have experienced a range of acoustic art installations in various cities which are either not adequately supported by local stakeholders, or that are rendered ineffective through their masking by traffic noise or other mechanical sounds at the site of the installation – something that clearly had not been considered in the design.

2.2 Broader application within residential areas

The following components of urban soundscape planning and management are closely related to each other both in terms of their broader application over urban areas and in their focus on human health and well-being. These are: ensuring diversity in the urban acoustic environment; encouraging attention to sub-criteria exposures; and providing access to restorative soundscapes in locations distant from a person's dwelling.

Ensuring diversity in the acoustic environment Another concept in consideration of the acoustic environment as a resource is that of diversity. Diversity in genes, species and ecosystems underpins the management of systems of biological resources. Maintenance of natural diversity (and equally cultural diversity) is also a principle adopted in the planning of regions, natural areas, the countryside and urban areas. The same principle has relevance to management of the acoustic environment, as in the Dutch Fifth Spatial Planning Policy Memorandum (16) which initially included the acoustic environment in part of its discussion of diversity and sustainability. It suggested that matters such as the characteristic of local sounds, and tranquility, were important elements of the spatial quality of rural and urban areas. But in general the acoustic environment, let alone its diversity, receives little attention in most spatial planning exercises. In an early soundscape study in Boston, Southworth [17] hypothesized that changes in the soundscape are needed to increase (a) the identity of the soundscape, (b) the number of opportunities for delight in sounds and to provide responsive settings which contain novel sounds. He noted the grey blurring of the acoustic environment that is occurring in terms of transport noise sources becoming the dominant background everywhere in cities, masking natural sounds and local community sounds. Soundscapes studies have the potential to describe and articulate the extent of diversity of the urban acoustic environment [11], with subsequent infrastructure or urban design objectives being to maintain existing diversity, or to generate more.

Encouraging attention to sub-criteria exposures: Figure 2 showed that noise management interventions focus on levels of exposure above some criterion level. However, studies of the burden of disease for environmental noise [18] also show that sub-criterion exposures contribute as much, if not more burden of disease in terms of outcomes such as annoyance and sleep disturbance. This is because, while the risk of any particular outcome response is lower at lower exposure levels, the numbers of people within an urban area exposed to the lower levels is higher – resulting in these lower levels contributing significantly to the burden of disease in a community. The consequence is that any action to reduce exposures across the dwellings of a community will have health benefits. The relevance of this for soundscape planning is that it is unlikely that traditional noise control approaches will ever set noise limits for particular sources lower than the criteria limits. However, lowering of levels of sound over parts of a residential area may be the outcome of some broader soundscaping plan, and it is important to recognize that broad level reductions to improve the soundscape [11] have health benefits through reducing the burden of disease.

Providing access to Type 2 restoration: This is somewhat more speculative, being based on observations from a review of a relatively small number of studies regarding the potential restorative value for humans through the experience of better quality acoustic environments. van Kamp et al. [19] defined human restoration by way of an immediate pathway to direct experience of a high quality acoustic environment as Type 1, with Type 2 restoration referring to the effect of availability in the neighbourhood (even knowledge) of a high (better) quality acoustic environment to a person who otherwise is subject to adverse effects of noise (at home). This includes availability of a quiet side in an otherwise high noise exposure dwelling, or

access to/knowledge about nearby green areas. Both are regarded as potentially providing restoration by way of mediation. Again, the relevance of this for soundscape planning is that schemes that introduce quiet sides on dwellings, or increase the prevalence of high quality acoustic environments elsewhere in a neighbourhood, may have health benefits through reducing the burden of disease similar to those described in the previous paragraph, though through a quite different mechanism.

3 Conclusions

One focus of soundscape management techniques is to protect and enhance the acoustic environment of spaces and places so as to seek to improve quality of life for residents, workers and visitor [20]. The interest is primarily, but not exclusively, in outdoor areas such as streets and squares, city parks, gardens, natural areas or wilderness, but many of the observations, principles and approaches will also apply to hybrid outdoor-indoor spaces such as malls and markets, transport terminals, sports arenas, and similar. The essential message is that it is not a matter of choosing either a noise control or a soundscape approach, but rather noise control supplemented by soundscape planning.

At present, outdoor sound only enters the design parameters for most built-environment professions where there is a problem and where there is community reaction to high levels of noise resulting from their activities. Introducing the concepts of soundscape planning, and particularly by providing approaches and tools to do so, has the prospect of spreading interest and responsibility for the urban acoustic environment in a positive way to a much wider range of professions—planning, landscape design, architecture, road engineering and housing. This paper has set out a schema regarding the potential loci for soundscape design and management that includes creative design of the built environment to achieve places of high acoustic quality; ensuring the availability of urban acoustic diversity; encouraging attention to sub-criterion (noise) exposures and protection of place-defining sounds.

There are some signs that city managers and built environment professionals are responding to the opportunities presented by soundscape management. For example, the second -author is currently working alongside the City of London Corporation (residential population under 10,000, typical workday population around 400,000) to prepare a bespoke local Noise Strategy that not only sets out policies for noise control in the Square Mile, but that also encourages the management of soundscape in outdoor spaces and hybrid indoor-outdoor places in the City. The City of London Strategy [21] is expected to include support for measures to promote iconic sounds, lost and disappearing sounds, wanted sounds, added sounds, sound walks, sound art installations as well as the continuation of an ongoing initiative regarding the identification of relatively tranquil areas in the City and the development of policies to protect and enhance these spaces. The City Corporation will be seeking opportunities to encourage both new and existing partners to support soundscape initiatives in the vibrant business centre of London.

References

- [1] ISO 12913-2014 Acoustics—Soundscape- Part 1: Definition and conceptual framework.
- [2] Adams M, Davies B Bruce N. Soundscapes: an urban planning map, Proc. INTER-NOISE 09, in09-857, 2009.
- [3] Brown, A. L., Gjestland, T. and Dubois, D. Acoustic Environments and Soundscapes. Chapter 1 in Kang, J. and Schulte-Fortkamp, B. (eds) *Soundscape and the Built Environment*. CRC Press; Boca Raton. ISBN-10: 1482226316 ISBN-13: 978-1482226317, pp 1- 16, 2015.
- [4] Brown, A.L. and Muhar, A. An Approach to the Acoustic Design of Outdoor Space. *Journal of Environmental Planning and Management*, 47(6) 827-842, 2004.
- [5] Bento Coelho, J.L. Approaches to urban soundscape management, planning and design. Chapter 8 in Kang, J. and Schulte-Fortkamp, B. (eds) *Soundscape and the Built Environment*. CRC Press; Boca Raton. ISBN-10: 1482226316 ISBN-13: 978-1482226317, 2015.
- [6] Brown, A.L. Rethinking “Quiet Areas” as “Areas of High Acoustic Quality. Proceedings of Internoise 06, Honolulu, November 2006..
- [7] Genuit K. The need for transdisciplinary actions – psychoacoustics, sound quality, soundscape and environmental noise. Proc. INTER-NOISE 13, Innsbruck, Austria, 2013.
- [8] Kang J. *Urban Sound Environment*, Taylor and Francis, London, 2007.
- [9] European Environment Agency. Good practice guide on quiet areas. EEA Technical Report No 4/2014. Luxembourg.
- [10] Brambilla G, Maffei L. Responses to noise in urban parks and in rural quiet areas, *Acta Acustica United with Acustica*, 92(6), 881-886, 2006.
- [11] Vogiatzis, K. and Remy, N. From environmental noise abatement to soundscape creation through strategic noise mapping in medium urban agglomerations in South Europe. *Science of the Total Environment* 482-483, 420-431, 2014.
- [12] Raimbault M., and Dubois D. Urban soundscapes: experiences and knowledge”. *Cities*, 22(5), 339-350, 2005.
- [13] Hiramatsu, K. “A review of soundscape studies in Japan”, *Acta Acustica United with Acustica*, 92(6), 857-864, 2006.

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- [14] Maffei, L., Brambilla, G. and Di Gabriele, M. Soundscape as part of the cultural heritage. Chapter 9 in Kang, J. and Schulte-Fortkamp, B. (eds) *Soundscape and the Built Environment*. CRC Press; Boca Raton. ISBN-10: 1482226316 ISBN-13: 978-1482226317, pp 215- 242, 2015.
- [15] Schafer, R.M. *The Tuning of the World*. Alfred A. Knopf: New York, 1977.
- [16] Ministry of Housing, Spatial Planning and the Environment, "Creating space, sharing space", Fifth Spatial Planning Policy Memorandum 2000/2020, The Hague,, 2001.
- [17] Southworth, The sonic environment of cities. *Environment and Behaviour*, 1, 49-70, 1969.
- [18] Fritschi, L., Brown, A.L., Kim, R., Schwela, D. and Kephelopoulos, S. (eds) *Burden of Disease from Environmental Noise: Quantification of healthy life years lost in Europe*. World Health Organisation, Regional Office for Europe, Bonn, and European Commission Joint Research Centre. 106pp, 2011.
- [19] van Kamp, I., Van Kempen, E., Klæboe, R., Kruize, H., Brown, A.L. and Lercher, P. *Soundscapes, human restoration and quality of life*. Proceedings of *Internoise 2016*, Hamburg, 2016
- [20] Lavia, L., Dixon, M., Witchel, H. and Goldsmith, M. Applied soundscape practices. Chapter 10 in Kang, J. and Schulte-Fortkamp, B. (eds) *Soundscape and the Built Environment*. CRC Press; Boca Raton. ISBN-10: 1482226316 ISBN-13: 978-1482226317, pp 243-301, 2015.
- [21] City of London Corporation, *City of London Noise Strategy 2016 – 2026*, Consultation Draft, personal communication, June 2016