



Urban Noise Management in Singapore

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ABSTRACT

Noise is an important factor in determining the quality of life in Singapore. With rising urban density and intensification of economic and transport activities, residents in Singapore are expected to be exposed to more noise in the coming years. At the same time, there is growing public demand for a quieter living environment. For instance, the number of noise feedbacks has steadily risen in the last few years and are anticipated to increase further.

Singapore takes a holistic approach in managing urban noise sources and has put in place noise control requirements such as legislations, guidelines, etc to ensure that the quality of life for Singaporean could be maintained.

This paper provides a stocktake of the current urban noise management approach taken by Singapore and also the future challenges faced.

1. INTRODUCTION

Singapore is an island city state of about 719 square kilometers. We have a population of 5.5 million and a population density of about 7,700 per square kilometer. In this island state, we have about 3,500km of expressways, major arterial and collector and local access roads as well as 183km of mass rapid transit (MRT) and light rail transit (LRT) rail lines. We have also close to a million vehicle population. Other than land transport infrastructure, Singapore has one of the busiest airports in the world. Our airports receive about 55.4 million passengers a year; with about 6,800 flights land/depart each week. Our airports also manage about 18.5 million tonnes of cargos a year.

In addition to the transport network, Singapore also has a range of industries from biochemical manufacturing, chemical, precision engineering, transport engineering, electronics, general manufacturing, etc. There are also numerous construction activities for the various development projects which contributed to noise feedback.

2. URBAN NOISE MANAGEMENT

Urban noise management in Singapore consists of 4 main strategies: (i) prevention, (ii) compliance/enforcement, (iii) monitoring; and (iv) education.

On prevention, we focus on land-use planning. We work with various stakeholders to site potential noise

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sources away from residential premises or noise-sensitive premises such as hospitals and schools. For example, we site our residential developments away from our airport as well as pollutive industries. Figure 1 below shows Singapore’s Masterplan which is the statutory land use plan which guides Singapore's development in the medium term over the next 10 to 15 years.

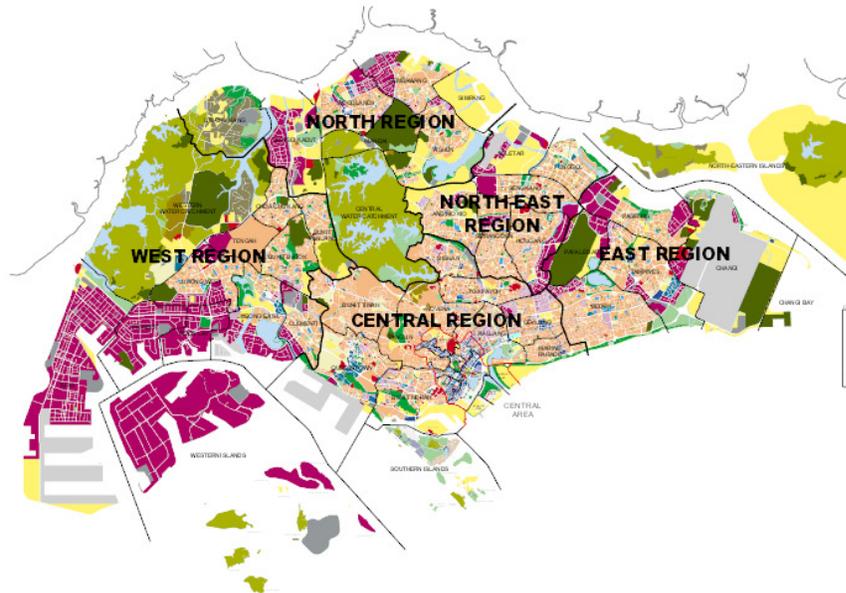


Figure 1: Singapore’s Master Plan 2014

For airports/airbases, Singapore has adopted the Noise Exposure Forecast (NEF) noise metric, which is a single number index for predicting cumulative exposure to aircraft noise over 24 hours, applying a 12 dB weighting to noise in the night (2200-0700 hours) period, for siting of residential developments since early 1990s. Table 1 below is the Singapore’s aircraft noise land-use planning criteria.

NEF Level	Permitted Land Usage
> 40	Industrial developments
35-40	Private residential developments, industrial developments, and usage of non-noise sensitive developments
< 35	Public Residential developments without restrictions

Table 1: Singapore Aircraft Noise Land-use Planning Criteria

In 2010, a review was conducted and it is recommended to move towards using the day-evening-night noise indicator (Lden), which is based on the long term 24 hour average noise level or Leq noise metric, applying 5 dB weighting for evening and 10 dB weighting for night time. At the same time, it is also recommended to tighten the aircraft noise land-use planning criteria.

While planning plays an important role to ensure that developments could meet the planning criteria, legislative and regulatory requirements, enforcement is equally important to ensure compliance during the day-today operation when the developments are being constructed.

On compliance and enforcement, noise regulations and guidelines are developed to manage the noise

sources and to ensure the developments comply with the various noise limits. For factories, a set of regulatory boundary noise limits are imposed on the premises and the noise limits shall not be exceeded at all times for the operation of the factory. Table 2 below is the set of boundary noise limits imposed on factory premises.

MAXIMUM PERMISSIBLE NOISE LEVELS			
PART I			
Types of affected premises	Maximum permissible noise level (reckoned as an equivalent continuous noise level over the specified period) in decibels (A)		
	Day 7 a.m.-7 p.m.	Evening 7 p.m.-11 p.m.	Night 11 p.m.-7 a.m.
(a) Noise sensitive premises	60	55	50
(b) Residential premises	65	60	55
(c) Commercial premises	70	65	60

PART II			
Types of affected premises	Maximum permissible noise level (reckoned as an equivalent continuous noise level over 5 minutes) in decibels (A)		
	Day 7 a.m.-7 p.m.	Evening 7 p.m.-11 p.m.	Night 11 p.m.-7 a.m.
(a) Noise sensitive premises	65	60	55
(b) Residential premises	70	65	60
(c) Commercial premises	75	70	65
(d) Factory premises	75	70	65

Table 2: Boundary Noise Limits For Factory Premises

Similarly, regulatory noise limits are imposed on construction sites. The noise limits are being reviewed regularly to meet the technology advancements and also public demands. For example, construction activities were allowed to be carried out 24 hours a day and 7 days a week in the past. In the recent years, no construction activities would be allowed during Sunday and public holidays for construction sites within 150m away from the residents to allow residents staying near construction sites to enjoy at least a day of quiet. Table 3 below is the set of noise limits imposed on construction sites.

MAXIMUM PERMISSIBLE NOISE LEVELS FOR CONSTRUCTION WORK COMMENCED ON OR AFTER 1ST OCTOBER 2007			
PART I			
Types of affected buildings	Maximum permissible noise level for construction sites (reckoned as an equivalent continuous noise level over a period of 12 hours) in decibels (A)		
	7 a.m. — 7 p.m.	7 p.m. — 10 p.m.	10 p.m. — 7 a.m.
(a) Hospitals, schools, institutions of higher learning, homes for the aged sick, etc.	60	50	—
(b) Residential buildings located less than 150m from the construction site where the noise is being emitted	75	—	—
(c) Buildings (other than those in paragraphs (a) and (b))	75	65	—

PART II			
The maximum permissible noise levels for construction sites under Part I are subject to the overall maximum permissible noise levels for any one-hour period from Mondays to Saturdays as follows:			
Types of affected buildings	Maximum permissible noise level for construction sites (reckoned as an equivalent continuous noise level over a period of one hour) in decibels (A)		
	7 a.m. — 7 p.m.	7 p.m. — 10 p.m.	10 p.m. — 7 a.m.
(a) Hospitals, schools, institutions of higher learning, homes for the aged sick, etc.	—	—	—
(b) Residential buildings located less than 150m from the construction site where the noise is being emitted	—	65	55
(c) Buildings (other than those in paragraphs (a) and (b))	—	—	—

PART III			
The maximum permissible noise levels for construction sites under Part I are subject to the overall maximum permissible noise levels for any 5-minute period as follows:			
Types of affected buildings	Maximum permissible noise level for construction sites (reckoned as an equivalent continuous noise level over a period of 5 minutes) in decibels (A)		
	7 a.m. — 7 p.m.	7 p.m. — 10 p.m.	10 p.m. — 7 a.m.
(a) Hospitals, schools, institutions of higher learning, homes for the aged sick, etc.	75	55	55
(b) Residential buildings located less than 150m from the construction site where the noise is being emitted	—	—	—
(i) on Mondays to Saturdays	90	70	55
(ii) on Sundays and public holidays	75	55	55
(c) Buildings (other than those in paragraphs (a) and (b))	90	70	70

Table 3: Noise Limits For Construction Sites

Other than stationary sources, regulatory noise limits are imposed on moving sources, particular vehicles. Vehicular noise emission control is an essential part of the urban noise management as residential premises are sited closer to roads. Table 4a and 4b below is the set of noise limits imposed on new and existing motor vehicles respectively.

STANDARD FOR NOISE EMISSION FOR NEW MOTOR VEHICLES

Motor vehicles of the following classes shall not emit any noise exceeding the noise level specified in the second column when measured 0.5 metre from the open end of the exhaust pipe of the vehicle or shall conform to the standards for exhaust noise emission specified in the third column:

First column Class of vehicle	Second column Noise level in Decibels (A)	Third column Standard for exhaust noise emission
(a) Motor cycle (with or without a side car), scooter or trivan	94	(i) Directive 97/24/EC of the European Parliament and of the Council of 17th June 1997 on certain components and characteristics of 2 or three-wheel motor vehicles; or (ii) Articles 30 and 65 of the Safety Regulations for Road Vehicles as amended by the Ministry of Transport Ordinance No. 5 of 21st February 2000 and No. 66 of 20th December 1996, respectively, of Japan
(b) Motor car, taxi or station wagon (whether for passengers only or for goods and passengers)	96 or (if the engine is at rear end) 100	(i) EC Council Directive 70/157/EEC of 6th February 1970 as last amended by Commission Directive 96/20/EC of 27th March 1996; or (ii) Articles 30 and 65 of the Safety Regulations for Road Vehicles as amended by the Ministry of Transport Ordinance No. 5 of 21st February 2000 and No. 66 of 20th December 1996, respectively, of Japan
(c) Goods vehicle or bus with gross vehicle weight not exceeding 3.5 tons	97	(i) EC Council Directive 70/157/EEC of 6th February 1970 as last amended by Commission Directive 96/20/EC of 27th March 1996; or (ii) Articles 30 and 65 of the Safety Regulations for Road Vehicles as amended by the Ministry of Transport Ordinance No. 5 of 21st February 2000 and No. 66 of 20th December 1996, respectively, of Japan
(d) Goods vehicle or bus with gross vehicle weight exceeding 3.5 tons	99	(i) EC Council Directive 70/157/EEC of 6th February 1970 as last amended by Commission Directive 96/20/EC of 27th March 1996; or (ii) Articles 30 and 65 of the Safety Regulations for Road Vehicles as amended by the Ministry of Transport Ordinance No. 5 of 21st February 2000 and No. 66 of 20th December 1996, respectively, of Japan.

[S 364/2010 wef 01/10/2010]

Table 4a: Noise Limits For New Motor Vehicles

STANDARD FOR NOISE EMISSION FOR IN-USE MOTOR VEHICLES REGISTERED (IN SINGAPORE OR ELSEWHERE) BEFORE 1ST JULY 1999

1. Motor vehicles of the following classes shall not emit any noise exceeding the noise level specified in this Schedule when measured 0.5 metre from the open end of the exhaust pipe of the vehicle:

Class of vehicle	Noise level in Decibels (A)
(a) Motor cycle (with or without a side car), scooter or trivan	106
(b) Motor car, taxi or station wagon (whether for passengers only or for goods and passengers)	105
(c) Light goods vehicle	109
(d) Goods vehicle or bus with engine capacity not exceeding 10,000 cubic centimetres	113
(e) Goods vehicle or bus with an engine capacity exceeding 10,000 cubic centimetres	115.

2. For the purposes of paragraph 1, "light goods vehicle" means —

- (a) a goods vehicle the maximum laden weight of which does not exceed 3 metric tons and which is registered in Singapore using a certificate of entitlement issued before 1st July 1999, or *[S 364/2010 wef 01/04/2011]*
- (b) a goods vehicle the maximum laden weight of which does not exceed 3.5 metric tons and which is registered in Singapore using a certificate of entitlement issued on or after 1st July 1999, *[S 364/2010 wef 01/04/2011]*

but does not include any construction equipment, engineering plant, recovery vehicle, vehicle used as a mobile canteen or mobile bank and any vehicle used for a specific purpose such as a horse float. *[G.N. Nos S 291/99; S 554/2000; S 238/2003; S 570/2005; S 158/2006]*

STANDARD FOR NOISE EMISSION FOR IN-USE MOTOR VEHICLES REGISTERED (IN SINGAPORE OR ELSEWHERE) ON OR AFTER 1ST JULY 1999

Motor vehicles of the following classes shall not emit any noise exceeding the noise level specified in this Schedule when measured 0.5 metre from the open end of the exhaust pipe of the vehicle:

First column Class of vehicle	Second column Noise level in Decibels (A)
(a) Motor cycle (with or without a side car), scooter or trivan	99
(b) Motor car, taxi or station wagon (whether for passengers only or for goods and passengers)	103
(c) Goods vehicle or bus with gross vehicle weight not exceeding 3.5 tons	103
(d) Goods vehicle or bus with gross vehicle weight exceeding 3.5 tons	107.

[S 364/2010 wef 01/04/2011]

Table 4b: Noise Limits For Existing Motor Vehicles

While we control noise emission from each vehicle at the exhaust point, this is not sufficient to reduce road traffic noise as the key component of road traffic noise is road and tires interaction. Hence, noise guidelines are imposed on road infrastructures (such as expressways, major arterial roads, mass rapid transit (MRT) stations and lines) that is in close proximity to residential developments and vice versa. The noise guidelines stipulate that the façade noise level shall not exceed 67 dBA (1 hour Leq) and an indoor noise level of not exceeding 57 dBA (1 hour Leq) under natural ventilated conditions for residential developments. In addressing traffic noise, we take a holistic approach and noise abatement measures are to

be implemented at all fronts i.e. at source, pathway and recipients' end to achieve greater noise reduction.

To enhance accessibility, roads are usually built close to the residential developments. Similarly, many commercial developments, institutes of learning, places of worships, etc, which are non-industrial developments, are also built close to the residential developments as they serve the residents. They too are potential noise sources to the residents, particularly the air-conditioning and mechanical ventilation systems. As such, noise guidelines have also been introduced to ensure that the air-conditioning and mechanical ventilation systems from these non-industrial developments do not posed noise problem. Likewise, noise guidelines are being used to control noise from entertainment outlets as part of the licensing conditions of the entertainment outlets. Table 5 below is the set of noise limits imposed on non- industrial developments.

Type of affected premises	Boundary noise limit (reckoned as the equivalent continuous noise level over 15 minutes) in decibels (dBA)		
	Day 7 am to 7 pm	Evening 7 pm to 11 pm	Night 11 pm to 7 am
Noise Sensitive Premises such as hospital, home for the aged sick, library, etc	60	55	50
Residential Premises	65	60	55

Table 5: Noise Limits For Non-Industrial Developments

Besides carrying out enforcement to ensure compliance, there is a need to regularly monitor the effectiveness of the planning criteria, legislation and regulations as well as the guidelines. We have carried out studies to better understand the urban noise profile in Singapore and using the data collected to tweak the planning criteria, legislation and regulations and guidelines. For example, we have real-time noise monitoring for construction activities and the enforcement officers could access the noise levels at the construction sites without the need to visit the sites. We are also test-bedding real-time noise monitoring at estates and exploring the possibility of generating urban noise map.

Lastly, we also need to bear in mind that legislation or regulatory approaches may not resolve some noise nuisance issues. Hence, education would be the key approach to manage such noise issues, particularly community noise i.e. noise from loud neighbours, dog barking, inconsiderate actions, etc. We will have to continue educating the public to be more considerate and not pose noise nuisance to their neighbours.

3. SUMMARY

While this paper gives an overview of the 4 strategies under the current urban noise management approach taken by Singapore, there are more challenges ahead. The urban density continues to rise and economic and transport activities continue to intensify. The residents in Singapore are expected to be exposed to more noise nuisance in the coming years. At the same time, there is growing public demand for a quieter living environment. We will continue to look for innovative solutions and strategies to manage

urban noise.

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