

2. STUDY METHODOLOGY

2.1 General Approach

This study is much-needed to identify the extent of the noise impacts by existing roads in Hong Kong. However, given the scope of the study and the limited study period (4 months), it was considered necessary to adopt a reasonable and practical approach for this scoping study. To this end, a set of pre-determined screening criteria has been established to select these roads using the constraint mapping technique. Development of the screening criteria are described in Section 5.

The selected roads have been investigated in turn for possible direct technical remedies, and the number of dwellings to be benefitted from the measures and the cost of implementing the measures have been estimated.

This study has therefore comprised the following main tasks :

- (a) development and establishment of screening criteria for the selection of noisy roads,
- (b) initial noise impact assessment,
- (c) compilation and appraisal of selected roads with potential for practicable direct technical remedies,
- (d) evaluation of the effectiveness of available direct technical remedies for the selected roads, and
- (e) compilation of a broad priority list for further investigation.

For the purpose of this study, all existing roads are classified into four broad types, namely highways (i.e. expressways and trunk roads), primary roads (i.e. primary distributors), district roads (i.e. district distributors) and local access roads (i.e. local distributors and rural roads). Noise sensitive receivers (NSRs) include those defined in the Hong Kong Planning Standards and Guidelines. However, at the First Study Management Group Meeting held on 12 September 1994 to discuss the approach and methodology for this Study, it was agreed that:

- Courts of law would not be regarded as noise sensitive buildings as they had been centrally air-conditioned.
- Educational institutions would be covered by a separate program, "Noise Abatement Measures in Schools", and they should be excluded from this study.

The application of friction course and other low noise road surfaces would not be considered as a direct technical remedy under this study since:

- EPD is currently implementing "Quiet Road Surface Programme" project to reduce traffic noise by applying low noise road surfacing material on high speed roads.
- EPD and the Highways Department (HyD) are currently studying the feasibility of applying low noise road surfacing material on local roads.

To avoid duplicating efforts, existing roads or road sections have been excluded from the identification process and noise assessment if any one of the following circumstances arises:

- The road/road section is under a concurrent noise impact or abatement study. This includes situations where the road/road section is being improved or widened to significantly impact on the NSRs around. According to the standing environmental policy, direct mitigation measures will be provided wherever practicable to reduce noise impact on nearby existing dwellings.

- Noise mitigation measures have already been provided or will be provided in accordance with previous EIA studies, except where serious complaints have been lodged.
- No existing/committed NSRs can be identified in close proximity to the road/road section. This includes situations where NSRs are recently demolished/removed; housing estates are being redeveloped; roads run in industrial estates or commercial centres.
- The road/road section runs in tunnel or underpass because the noise impact is unlikely to be significant due to the enclosed road environment.

2.2 Noise Assessment Criteria

At present, there is no policy or standard to address the noise problem arising from existing roads. Whilst road traffic noise problem is more amendable through planning process, for the purpose of identifying "noisy" roads for a retroactive noise mitigation feasibility study, it is considered reasonable to adopt similar criteria as for planning new roads or siting new NSRs. These criteria, according to the Hong Kong Planning Standards and Guidelines (HKPSG), require that the maximum permissible noise levels, $L_{10}(1\text{-hour})$, at the external facade due to road traffic should not exceed 70 dB(A) for domestic premises, 65 dB(A) for places of worship and 55 dB(A) for medical establishments. These noise criteria have also formed the basis for noise mitigation, i.e. the identified noise mitigation must aim to achieve the above noise criteria.

2.3 Initial Assessment of Noise Impacts

An initial noise assessment has been conducted to determine the extent of the noise impacts from existing roads on existing/committed NSRs in Hong Kong. The noise calculations have been based on the UK Department of Transportation (DOT) procedure "*Calculation of Road Traffic Noise*", 1988. In order to manage the large volume of calculations and data which would have been involved, the assessment has been based on the calculated noise levels at the nominal facade of each road which is defined as a fictitious facade located at the average distance from the road, 5m above the road surface and having a 160-degree angle of view of the road. In addition, several simplifying assumptions as described below have been used to estimate the input data for the calculations.

The traffic flows and percentages of heavy vehicles during peak hours have been obtained from "The Annual Traffic Census" 1993 published by Transport Department. For those traffic counting stations (i.e. coverage stations) where only Annual Average Daily Traffic (AADT) data are available, the following method has been adopted to estimate the traffic data at the station:

$$Q = \text{AADT} \times K_{av} \quad \dots\dots\dots (1)$$

$$P = P_{av} \quad \dots\dots\dots (2)$$

where

Q = Nominal peak hour traffic flow at coverage station

AADT = Annual Average Daily Traffic at coverage station

- K_{av} = Average proportion of daily traffic in the peak hour of the core stations within the same traffic counting station group
- P = Percentage of heavy vehicles at coverage station
- P_{av} = Average percentage of heavy vehicles of the core stations within the same traffic counting station group

The vehicle speed is taken as the speed limit of each type of roads (i.e. 50 km/h for urban roads, 70/80 km/h for expressways) and the road gradient is taken as either 0, 3, 6, 9, 12 or 15% as estimated from 1:5000 survey maps.

For roads where no traffic data is available, it has been found by analyzing the traffic noise complaints data that seldom noise complaints arise from these roads. Appendix B summarizes the noise complaint records supplied by EPD, and an analysis of the complaint statistics is given in Table 1.

Table 1 Analysis of Traffic Noise Complaints Statistics

Road Type	Roads with $L_{10} > 70$ dB(A) ¹		Roads with Traffic Data	
	No. ²	Percentage based on All Road Types (%)	No. ²	Percentage based on Each Road Type (%)
EX	14	16.9	14	100
UT	5	6.0	5	100
PD	24	28.9	24	100
DD	30	36.1	29	96.7
RA	1	1.2	1	100
LD ³	9	10.8	8	88.9
Total	83	100	81	97.6
Notes:	1	Noise level dominated by road traffic noise only.		
	2	Roads are counted separately if they appear in different records.		
	3	Including 1 local street.		
Legends:	EX	Expressway		
	UT	Urban Trunk		
	PD	Primary Distributor		
	DD	District Distributor		
	RA	Rural Road		
	LD	Local Distributor (including local street)		

According to these records, traffic noise complaints were lodged against 83 roads (the roads are counted separately if they appear in different complaint records) where noise levels L_{10} of over 70 dB(A), mainly due to road traffic, were recorded. However, of these 83 roads only one is a local street; the rest (82 roads) are highways, distributors and rural road, for which the majority of the traffic information can be readily obtained from "*The Annual Traffic Census*" published by Transport Department. Statistically, it is apparent that local streets only receive occasional traffic noise complaints, probably because of the lower traffic volumes and the associated insignificant noise impacts. As such, exclusion of the local streets is unlikely to degrade the quality of this study. Also on a collective basis, over 97% of the roads analyzed have published traffic flow data. Therefore, for the purpose of this study, it is considered reasonable to conduct this initial noise impact assessment based on roads with published traffic data.

In addition, facade noise levels have also been obtained from traffic noise complaint records/statistics, and school survey reports supplied by the EPD where the noise sources were identified to be road traffic.

2.4

Assessment of Potential for Noise Mitigation

Following the selection of roads with potential for provision of retroactive noise mitigation, each section of the selected roads has been subject to a more detailed, site specific noise assessment to identify the need for and the most appropriate form of noise mitigation. The effectiveness of implementing the identified measures, in terms of the noise reduction which may be achieved and the number of dwellings to be benefitted has also been evaluated.

The assessment is based on the calculated noise levels using the DOT procedure at representative noise sensitive facades selected from the particular road section where the need for noise mitigation has been identified. Noise calculations are made for the first floor mid-window level (which is at 5m AG unless otherwise indicated), the mid-floor level and the top-floor level (based on 2.8m per floor level). Only those storeys above the road level have been taken into account. Site-specific conditions, e.g. angle of view, road gradient, screening by adjoining structures, etc. are used as much as practicable. All roads likely to affect the NSR have been included to determine the overall noise levels.

While the form of noise mitigation has been established (see Section 3.2), the horizontal extent of coverage e.g. length of barriers, has not been determined. For the purpose of the noise assessment, it has been assumed that the proposed barrier/enclosure must screen at least 135 degrees of the angle of view of the road at each exposed NSR. The exact configuration will be subject to detailed design to be conducted in Phase 2. To better utilize the limited resources, there is a need to give priority to measures which could protect higher percentage of dwellings. As such, it was decided that the identified form of the noise mitigation measure must aim to achieve the HKPSG noise criteria at 50% or more of the exposed population over a vertical section for high-rise buildings or over a horizontal section for low-rise buildings such as village houses.