4. ASSESSMENT FOR MITIGATION MEASURES ON AP LEI CHAU BRIDGE

4.1 Identification of Noise Sensitive Receivers (NSRs)

4.1.1 Ap Lei Chau Bridge consists of a dual two lane carriageway which forms a link between Aberdeen and Ap Lei Chau. The Ap Lei Chau approach of the bridge is a major noise source for the residents in Shan Ming Street, Ping Lam Street and San Shi Street.

4.1.2 Based on site surveys, existing representative NSRs were identified along the alignment and shown in Fig 4-1. Details of these NSRs is provided as follows:

NSR ID	Name of Building	No. of Storey	No. of Dwellings per Floor
TC	Toho Court	22	2
RH	Rousseau Heights	10	3
SM	Sun Ming Building	7	6
NT	Nam Tack Mansion	5	2
NF	Ning Fung Mansion	22	6
WF	19 Wai Fung Street	5	2
HL	Hoi Lee Building	23	6
SO	Shan On House	35	8
CO	Choi On House	35	8

4.1.3 Planned receivers including the proposed HOS development in Ap Lei Chau was not identified as NSR in the Study and the noise impacts would be addressed in their respective noise impact assessments. NSRs WF, HL, SO and CO are facing away and/or distanced from the flyover. Results of noise impact assessment indicate that noise levels at these NSRs are dominated by traffic noise arising from other existing roads and hence these NSRs are excluded from further evaluation in the Study.

4.2 Traffic Noise Impact Assessment

4.2.1 <u>Ap Lei Chau Bridge</u>

The prevailing road traffic noise levels at the representative NSRs along Ap Lei Chau Bridge in year 1998 are shown in Table 2 of Appendix A1. About 77 dwellings are predicted to be exposed to noise levels exceeding the HKPSG by up to 9 dB(A). The highest overall noise level of 79 dB(A) is predicted to be at the top floor of SM-2, a sensitive facade overlooking the heavy trafficked bridge and road (i.e. Ap Lei Chau Bridge and Ap Lei Chau Bridge Road), of which the traffic noise contributed by Ap Lei Chau Bridge Road is 78.3 dB(A). The noise levels at the rest of the facades range between 62 to 77 dB(A).

4.3 Proposed Mitigation Scenarios for Engineering Consideration

4.3.1 In order to mitigate the noise impact at the upper-floor receivers along Ap Lei Chau Bridge, two effective mitigation options were identified in the Technical Paper for Traffic Noise Impact Assessment (Appendix A1) assuming barriers were located at the edge of the flyovers and were described as follows:

Option I: Two 5m plain barriers, separated by a subway entrance, of a total length of 130m long, are to be erected along the northbound carriageway at the edge of structure to protect the receivers at various heights along Ap Lei Chau Bridge. The location of these barriers is shown in Fig. 3.5 of Appendix A1.

Option II: Instead of two 5m plain barriers, two 4.5m Inverted L-shaped barriers with 1.5m canopy at 45° are to be erected along the exact same extent and location as *Option I*. The type of configuration of the Inverted L-shaped barrier is shown in Figure 3.6 of Appendix A1.

4.3.2 In the case of barriers supported on independent structures, Option I or II can simply be modified by adding or increasing the length of canopy to provide an equal level of noise protection to the receivers.

4.3.3 As the study area is located within urban character, the use of absorptive barrier panels along the side and with transparent reflective panels at the canopy are considered more appropriate.

4.4 Engineering Feasibility

4.4.1 Both Options involves the erection of cantilevered barriers on the existing flyover approach structure which is mainly high retaining wall of 10-15 m. The original design calculations of the retaining wall have been examined in the HyD office. Structural assessment was carried out to examine the capacity of the retaining structure for resisting additional lateral loads, i.e. wind loads, acting on the noise barriers under the current Highways design standard. Details of the assessment calculations are given in Appendix C.

4.4.2 It was found that the retaining wall did not allow for provisions of the above noise barriers in its design As height of the barriers is substantial, existing structure did not have adequate spare capacity to carrying these additional loading, direct installation of the barriers on the existing structure were not considered as feasible. Therefore both options should only be considered with independent support.

4.4.3 Buildability

4.4.3.1 The feasible extent and location of the proposed barriers to be supported by independent support structure were further examined for other constraints at grade on site and is finalised in Fig. 4-2 & 4-3. The preliminary land requirement plan is shown in Fig. 4-7.

4.4.3.2 Details of the existing utilities and services including stormwater drains and sewers within the study area have been obtained from various utility companies and government departments and is shown in Fig. 4-4. The layout of existing utilities and services are shown in Fig. 4-5. It was noticed that the extent and location of the barriers would affect the existing drains and associated drainage reserve within the USD (Urban Services Department) recreational area. However, DSD has commented in their letter ref : (11) in DSD HK 8/CE 9597 dated 7.10.98 that the affected drains and drainage reserves can be realigned to suit the proposed barrier subject to detailed design and USD's agreement to surrender the land concerned.

4.4.3.3 Details of land status in the vicinity of the flyover are shown in Fig. 4-6. The extent and location were constrained by the adjacent recreational ground, church site and subway staircase access. USD has commented in their letter ref. : (4) in USDP 6/402/97 IV dated 13.10.98 that any proposed structure should be located outside their recreational ground in order not to affect the operation of the facilities and cause disturbances to the users of the venues. USD has further indicated in their letter ref: (11) in USDP 6/402/971V dated 2.11.99 that suitable measures should be taken so that the operation and use of their venues would not be affected during the construction period of the noise barrier structure.

4.4.3.4 Since the independent structure would be of about 15 m high in order to support the proposed barriers, piled foundation would be required. In general, a minimum working space of 10 m width should be provided for the piling operation and construction. A further clearance of 2 m should be provided between the barriers and the flyover structure for future access of inspection and maintenance staffs. However, this 2m clearance should be reduced as much as possible in order to improve the structural effectiveness of the noise mitigation system, subject to agreement from the HyD/Str on maintenance requirement.

4.4.4 Traffic Engineering

4.4.4.1 The sitting of the proposed barriers on independent structure would not degrade the existing highway clearance to fall below the absolute minimum requirement as stated in the TPDM. The visibility of road users are generally maintained with the independent structure. The flyover does not have bus stop and pedestrian crossing within the study section.

4.4.5 Traffic Management During Construction

4.4.5.1 The proposed location of barriers would not have any significant impact on the existing traffic within the Study areas

4.4.6 Safety

4.4.6.1 The proposed barriers would not impose any potential hazard or reduce the degree of safety. Impacts on pedestrian safety, accessibility for emergency vehicles, fire fighting and rescue operation, loading/unloading activities etc. were considered insignificant.

4.5 Review on Acoustic Effectiveness and Findings

4.5.1 Following the engineering assessment based on physical constraints on site, the feasible extent and location of the barriers is given in Fig. 4-2 and traffic noise impact assessment was reviewed to assess their acoustic effectiveness. Details of the assessment is provided in the Supplementary Paper to the Traffic Noise Impact Assessment in Appendix A2.

4.5.2 The findings of the assessment indicated that the above proposed extent of location of the barriers could only provide 44% of protection for the affected dwellings. However, it would be feasible to construct the mitigation measures from engineering perspective. Other side effects such as air quality, visual and landscape impacts would be assessed in the following sections.

4.6 Air Quality Assessment

4.6.1 Details of the air quality impact assessment is given in Appendix B. In summary, as vertical or cantilevered barriers have limited potential for trapping air from the carriageway, it was considered that no adverse impact on the air quality near the proposed barriers would result from the their installation.

4.7 Visual/Landscape Assessment

4.7.1 The scale of independent structure for the proposed barrier, which is of 15m high, would be visually intrusive to the adjacent residents, pedestrians and users in the USD recreational ground and sitting area.

4.7.2 The independent structure would also disrupt the view of featured landscape finishes on the existing retaining walls and necessitate the loss of trees and plants at its location.

4.7.3 As the landscape character is well established and overall landscape quality is high, the visual/landscape impact of noise barrier and independent structure would be significant. Measures to reduce visual/landscape impacts will be developed for the generic design of the noise mitigation measures and for submission to the ACABAS for in-principle approval.

4.8 Environmental Gains and Losses Account

4.8.1 The environmental gains and losses of the recommended noise barriers to the flyover is summarised below:

Environmental Losses	Environmental Gains	Mitigation Measures
• Visual intrusion due to replacement of tree with noise barrier and its support structure. • Visual confinement of pedestrians and vehicles. • Landscape loss of tree, planting and featured wall finishes. • May have localized effects on the air quality but with no significant degradation of air quality at the exposed facades.	• 44% of exposed facades can be protected in terms of noise attenuation. • Screening of traffic for high-rise residents.	• sensitive design of noise mitigation to integrate it within the existing visual and landscape context.

4.9 Cost Estimation

4.9.1 The direct construction cost for the proposed bent top vertical noise barriers of 95m approximate in length as shown in Fig. 4-2 & 4-3 have been estimated based on the rates at December 98 Price Level and is summarised in the following table:

Item	Quantity	Unit	Rate (HK$)	Amount (HK$)
Excavation	60	m^3	100	6,000
Backfilling and Compaction	60	m^3	50	3,000
Formwork, Class F2	65	m^2	280	18,200
Formwork, Class F5	150	m^2	450	67,500
Blinding	10	m^3	880	8,800
Concrete Grade 30/20	190	m^3	930	176,700
Reinforcement	45	t	5,000	225,000
Structural Steelwork	150	t	25,000	3,750,000
Noise Barrier Sheeting	795	m^2	2,500	1,987,500
1200 dia. Bored Piles	495	m	10,000	4,950,000
Sub-Total				11,192,700
Add 20% for General Preliminaries & Site Safety				2,200,000
Total Base Cost Estimate (Dec 1998 Price Level)				13,392,700 (HK$13.4 M)

4.9.2 The indirect construction cost including cost for utilities, street furniture and traffic diversion is assumed to be 20% of the direct construction cost and estimated to be HK$2.7M.

4.9.3 Total construction cost is estimated to be **HK$16.1M** at Dec 98 Price Level.

4.9.4 The recurrent costs including the annual maintenance cost and annual staff cost at Dec 97 Price Level as obtained from HyD/Str are summarised as below:

Annual maintenance cost	=	HK$190.6/sq.m x 800 sq.m	≈	HK$0.15M
Annual staff cost	=	HK$57.2/sq.m x 800 sq.m	≈	HK$0.05M