



*PRELIMINARY FEASIBILITY STUDY OF
IDENTIFIED ROAD SECTIONS*

7. **PRELIMINARY FEASIBILITY STUDY OF IDENTIFIED ROAD SECTIONS**

7.1. **Cheung Pei Shan Road**

7.1.1. Characteristics of Study Area

7.1.1.1. Cheung Pei Shan Road is a dual 2-lane carriageway linking Tsuen Kam Interchange and Wo Yi Hop Interchange. The land uses on both sides of the road are mainly residential development, which is sensitive to road traffic noise.

7.1.1.2. The residential developments include Cheung Shan and Shek Wai Kok Estate along the westbound carriageway. On the opposite side, the affected developments include villages of Sam Tung Uk, Hoi Pa Village on the elevated platforms.

7.1.1.3. The estate tower blocks vary from 22 to 28 storeys while the villages comprise 2- and 3-storey standard village houses.

7.1.2. Major Consideration and Constraints

7.1.2.1. In identifying noise mitigation measures, the following major underground structures have been taken into account. They include:

- a 17m (approx.) wide Tai Lek Ho Culvert running underneath Cheung Pei Shan Road fronting Shek Wai Kok Estate
- a 3.4m x 1.8m box culvert running underneath the middle-lane of westbound carriageway.
- Shek Wai Kok Road Underpass

7.1.2.2. Westbound footpath (2m to 2.5m wide) is fully occupied by existing utilities and underground services such as telephone cables, public lighting cable, CLP cables, etc.

7.1.2.3. Since Cheung Pei Shan Road is a heavily trafficked road, impacts on the existing traffic during the erection of mitigation measures will become a major constraint.

7.1.2.4. The westbound carriageway of Cheung Pei Shan Road fronting Tsui Shan House at Cheung Shan Estate is designated as EVA over a section of approximately 120 metres for both an Electric Sub-station and this estate block. This is based on the advice from Fire Services Department given in their letter with ref. (29) in FSD 4/130/94, dated 4th April 1997.

7.1.3. Recommendation

7.1.3.1. After undergoing a scheme evaluation analysis of two identified options the recommended mitigation measures for Cheung Pei Shan Road are:

- Combination of 3m plain barrier and cantilevered barrier - type A along the eastbound carriageway
- Partial enclosures - type G & A along westbound carriageway (See para. 7.1.3.3 and 7.1.3.4)

7.1.3.2. Further to comments given by Hong Kong Police Force (letter ref. (36) in LM(1/96) in CP/T/TMB 216/61 Pt.2 dated 16th March 1998 on Draft Final Report and the meeting held on 17th April 1998 in the presence of HKPF, EPD and the consultants, the recommended mitigation measures along the westbound carriageway (i.e. partial enclosures) have been further revised to provide sufficient access for operation of cranes from the opposite carriageway in the case of road accidents.

7.1.3.3 The recommended partial enclosures fronting Shek Lan House and Shek Kuk House of Shek Wai Kok Estate and Lok Shan House and Sau Shan House of Chung Shan Estate have been amended to cover the hard shoulder and slow lane of westbound carriageway only. Two additional emergency vehicle crush gates have also been proposed at the central divider along the down hill section of the westbound carriageway to provide access for emergency vehicles to enclosed section from the opposite carriageway in case of road accidents.

7.1.3.4 Confirmation has been given by Traffic Management Bureau in mid June 1998 that they have no further comments on the above amended noise mitigation measures at Cheung Pei Shan Road.

7.1.3.5 The number of dwellings to be protected and the direct construction cost for the recommended option are 1,171 and \$121M respectively. This option provides 53% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$103,000.

7.1.3.6 An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 115-172 µg/m³ and 129-192 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.2. Tung Tau Tsuen Road

7.2.1. Characteristics of Study Area

7.2.1.1. Tung Tau Tsuen Road is a dual 2-lane carriageway linking Sha Tin Pass Road and Junction Road. The land use on both sides of the road is a mix of residential, institutional and district open space in a typical urban setting. The noise sensitive receivers, which are directly exposed to road traffic noise are mainly residential blocks and a secondary school alongside the road.

7.2.1.2. Tung Tau Estate is located on the eastern side of the road. This is a medium-rise public housing estate of five 12-storey housing blocks situated along the road.

7.2.1.3. On the western side of the road, towards the end of Junction Road is Mei Tung Estate, which is a linear housing block of 12 storeys. To the north of the estate, situated on an elevated platform, is Pui Man Village, which comprises rows of single storey village houses. Also on the western side of the road is Lower Wong Tai Sin Estate. This is situated between Sha Tin Pass Road and Tai Shing Road and has housing blocks of 26 storeys.

7.2.2. Major Consideration and Constraints

7.2.2.1. The existing underground utilities and services along the footpath adjacent to both sides of the carriageway, include public light cables, telephone cables, salt water mains, CLP cables and gas mains. Most of the fresh water mains, a few of the salt water mains and the high tension CLP cables are laid underneath the carriageway. A number of cross road ducts exist for telephone cables, CLP cables and public light cables along the road. There are also storm water drains up to 1425 ϕ and sewers up to 900 ϕ underneath the carriageway and footpaths throughout the study area.

7.2.2.2. The existing utilities underneath the footpath along both carriageways are so congested that it is difficult to accommodate the foundations of the identified barriers along the footpath. Subsequently, substantial diversions of these utilities would be required.

7.2.2.3. The road runs through an old district with a typical urban setting (i.e. surrounded by high rise blocks). Many road junctions are found along the study area of Tung Tau Tsuen Road. The road itself is a busy bus route and consists of bus stops together with loading/unloading activities. The visibility of road users and highway clearance as stipulated in TPDM are the major constraints.

7.2.2.4. The impact on the existing traffic ducting from the construction of the noise mitigation measures along this heavily trafficked road is also another major consideration that must be taken into account in the identification of appropriate noise mitigation measures.

7.2.3. Recommendation

7.2.3.1. In terms of total score of the selection process, the identified option for Tung Tau Tuen Road are:

- Combination of cantilevered barrier - type A and B along northbound carriageway
- Cantilevered barrier - type B along southbound carriageway.

The number of dwellings to be protected and the direct construction costs for the recommended option are 752 and \$45.8M respectively. This option provides 39% protection to the exposed façade. It is estimated to cost \$61,000 per dwelling.

- 7.2.3.2. As pointed out by AC for T/Kowloon's letter ref. () in KR 183/161-4 dated 14 May 1997, the identified barriers along the affected section of Tung Tau Tsuen Road would actually impose constraints on road safety for road users. Beside such low percentage of protection (less than 50%) for the exposed dwellings, a "Do Nothing Solution" is considered more appropriate for this section of road.
- 7.2.3.3 An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 81-156 µg/m³ and 86-145 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.3. Fung Shue Wo Road

7.3.1. Characteristics of the Study Area

- 7.3.1.1. Fung Shue Wo Road is a dual 2-lane carriageway linking Tam Kon Shan Interchange and Tsing Yi Heung Sze Wui Road Interchange. The land use on both sides of the road is mainly residential which is sensitive to road traffic noise from the road. A primary school, which is also noise sensitive, is situated adjacent to the road.
- 7.3.1.2. Tsing Yi Estate, located on the eastern side of the road, nearer to the Tam Kon Shan Interchange, is a high rise rental housing estate with housing blocks of 35 storeys high. Further to the south was Tsing Kin temporary housing area, which was cleared in 1997. Behind this area is Tsing Yi Garden, which has 25-storey tower blocks overlooking the road. To the western side of the road, there are three-storey village houses at San UK Tsuen, Tai Wong Ha Resite Village and Chung Mei Lo Uk Tsuen.

7.3.2. Major Consideration and Constraints

- 7.3.2.1. The existing underground utilities and services run along the adjacent footpath leading to Greenfield Garden. The affected utilities and services include telephone cables, a salt water main, a fresh water main, a high-tension CLP cable, a medium pressure gas main and a Cable TV cable. The utilities underneath the footpath adjacent to the opposite carriageway include a telephone cable, a fresh water main, a salt water main and high-tension CLP cables.
- 7.3.2.2. In spite of the above, the existing footpath together with the amenity strip is considered adequate to accommodate a noise barrier. However, diversion of utilities and underground services would be required, especially along the footpath adjacent to the near side carriageway.
- 7.3.2.3. Three existing footbridges are found across Fung Shue Wo Road and these will impose another constraint for the erection of barriers.
- 7.3.2.4. The visibility approaching the junction with Fung Shue Wo Road and for passengers and bus drivers at the existing bus bay is another major constraint for the erection of barriers.

7.3.3. Recommendation

7.3.3.1. After carrying out a scheme evaluation analysis of two identified options, the recommended mitigation measures are:

- Combination of 3m and 4m plain barrier alongside the far edge of northbound amenity strip
- Combination of cantilevered barrier - type A and type B alongside the far edge of southbound amenity strip and/or far edge of southbound footpath.

7.3.3.2. The number of dwellings to be protected and the direct construction costs for the recommended option are 787 and \$25M. This option provides 84% protection to the exposed facades and it is estimated to cost \$32,000 per dwelling.

7.3.3.3 An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 78-134 µg/m³ and 75-109 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.4. **Yuen Wo Road**

7.4.1. Characteristics of the Study Area

7.4.1.1. Yuen Wo Road is a dual 3-lane carriageway linking Sha Tin Rural Committee Road and Fo Tan Road. It is a major corridor to link Lek Yuen Estate and Wo Che Estate to the other parts of Sha Tin area. The road separates the recreational facilities such as the sports complex, swimming pool, sports ground etc. from high rise blocks at Lek Yuen/Wo Che Estates, which are sensitive to road traffic noise from Yuen Wo Road.

7.4.1.2. The residential developments include Hong Wo House and Hip Wo House of Wo Che Estate alongside the northbound carriageway.

7.4.2. Major Consideration and Constraints

7.4.2.1. The eastbound footpath fronting Hip Wo House is congested with underground services and utilities which make erection of foundation for any barrier structure along this footpath difficult.

7.4.2.2. The existing bus bay in front of Hip Wo House could be another major constraint since the sight line of passengers and bus drivers at bus bay would be much degraded after the erection of a barrier structure.

7.4.2.3. Existing pedestrian access such as ramp and stairs to Yuen Wo Road in front of Hip Wo House should not be blocked after the implementation of noise mitigation measures.

7.4.3. Recommendation

7.4.3.1. After carrying out a scheme evaluation analysis of three identified options, the recommended mitigation measures for Yuen Wo Road are:

- Cantilevered barrier - type B for protecting both Hong Wo House and Hip Wo House.

7.4.3.2. The number of dwellings to be protected and the direct construction costs for the recommended option are 261 and \$10M, respectively. This option provides 73% protection to the exposed facades and it is estimated to cost \$38,000 per dwelling.

7.4.3.3 An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 83-158 µg/m³ and 82-178 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.5. **Tai Chung Kiu Road**

7.5.1. Characteristics of the Study Area

7.5.1.1. Tai Chung Kiu Road is a dual 3-lane carriageway running along Shing Mun River and linking Shek Mun Interchange at Siu Lik Yuen and Lion Rock Tunnel Road. It also forms a major corridor to link both private and public residential estates such as City One Sha Tin, Belair Garden, Sha Kok Estate and Jat Min Cheun to other major distributors.

7.5.1.2. Noise sensitive receivers are mainly the high rise residential developments along the westbound footpath, which are directly exposed to road traffic noise from the road. The sections of Tai Chung Kiu Road under investigation are in front of Yue Shing Court and also Ming Shun Lau and Ming Yiu Lau, both in Jat Min Chuen.

7.5.2. Major Consideration and Constraints

7.5.2.1. The westbound amenity strip fronting Yue Shing Court is occupied by a 1.8m drainage pipe together with few underground cables. Whilst the footpath fronting Jat Min Chuen is also occupied by underground services.

7.5.2.2. The major constraints that affect the erection of a noise barrier structure include,

- the existing subway together with its ramp across Tai Chung Kiu Road in front of Ming Yiu Lau,
- the existing pedestrian access to Jat Miu Chuen fronting Ming Yiu Lau and
- the existing 2.9m x 2.75m box culvert across Tai Chung Kiu Road adjacent Shing Yan House.

7.5.2.3. The visibility splays at the existing bus bay in front of Ming Yiu Lau should be taken into account in the erection of any noise barrier structure.

7.5.3. Recommendation

7.5.3.1. After carrying out a scheme evaluation of three identified options, the recommended mitigation measures for Tai Chung Kiu Road are:

- Cantilevered barrier - type B for protecting Ming Shun Lau, Ming Yiu Lau of Jat Min Chuen and Yue Shing Court along the eastbound carriageway.

7.5.3.2. The number of dwellings to be protected and the direct construction costs for the recommended option are 670 and \$26M respectively. This option provides 50% protection to the exposed facades and it is estimated to cost \$39,000 per dwelling.

7.5.3.3. An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 83-158 µg/m³ and 95-166 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.6. **Ma On Shan Road**

7.6.1. Characteristics of Study Area

7.6.1.1. Ma On Shan Road is a dual 2-lane carriageway with cycle tracks and amenities on both sides of the road. It forms a major corridor to link private and public residential estates such as Yiu On Estate, Heng On Estate, Sunshine City etc. to Shatin and Sai Kung. Noise sensitive receivers are mainly high rise blocks at Heng On and Yiu On Estate, along the eastbound footpath, which are directly exposed to road traffic noise.

7.6.1.2. The sections of Ma On Shan Road under investigation are in front of Heng Fung House, Heng Shan House, Heng Kong House, Yiu Shun House, Yiu Chung House, Yiu Yan House and Yiu Wing House.

7.6.2. Major Consideration and Constraints

7.6.2.1. Although the existing utilities and underground services are along the amenity strip fronting Yiu Wing House and alongside the slope in front of Heng On Estate, it is unlikely to create an insurmountable obstacle. The presence of the existing storm water drains, box culvert and drainage in the reserve zone could create problems and make it difficult to erect a noise barrier structure.

7.6.2.2. The existing 5m (approx.) wide EVA located in front of Heng Shun Road, subway with 7m (approx.) width across Ma On Shan Road are other major constraints for the development of noise mitigation measures.

7.6.2.3. The visibility splays at the junction of Ma On Shan Road and On Shan Lane would be affected in the event that one of the identified mitigation options is implemented. Changing the control to a signalised T-junction would be more appropriate if the scheme were adopted.

7.6.3. Recommendation

7.6.3.1. After carrying out a scheme evaluation analysis of three identified options, the recommended mitigation measures for Ma On Shan Road are:

- combination of 6m plain barrier and cantilevered barrier - type A and B along the eastbound carriageway.

7.6.3.2. The number of dwellings to be protected and the direct construction costs for the recommended option are 963 and \$33M, respectively. This option provides 71% protection to the exposed facades and it is estimated to cost \$34,000 per dwelling.

7.6.3.3. An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 64-158 µg/m³ and 73-137 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.7. **Che Kung Miu Road**

7.7.1. Characteristics of Study Area

7.7.1.1. Che Kung Miu Road is a dual three-lane road linking Hin Keng Estate and Tai Chung Kiu Road. There are trees planted along the amenity strips with bus bays provided at approximately 200 metre intervals. The land uses on both sides of the road are mainly high rise residential developments

7.7.1.2. The sections of Che Kung Miu Road under investigation are in front of Shek Yuk House and Shek Fai House of Chun Shek Estate. The estate is situated by the westbound carriageway.

7.7.2. Major Consideration and Constraints

7.7.2.1. These sections of Che Kung Miu Road have high quality landscape treatments on both sides of the dual carriageways, comprising tall avenue tree planting and a low ground cover verge.

7.7.2.2. The existing amenity strip and footpath along the westbound carriageway are fully occupied by utilities and underground services. Details include CLP 132KV cables together with the existing 3m x 2.5m twin box culvert running across Che Kung Miu Road adjacent to Shek Yuk House. These utilities and services are a crucial constraint for the erection of noise barrier structure.

7.7.2.3. The pedestrian access to Chun Shek Estate on the westbound footpath near Shek Yuk House should not be blocked after the implementation of noise mitigation measures. Moreover, the noise mitigation measures should not reduce the degree of road safety, by reducing the visibility and turning radius of the signalised T-junction of Che Kung Miu Road with Sha Tin Tau Road.

7.7.3. Recommendation

7.7.3.1. After carrying out a scheme evaluation analysis of two identified options, the ranking of cantilever barrier- type B along the westbound carriageway is higher than that of partial enclosure - type B. However, by considering the low noise attenuation of cantilevered barrier - type B (14%), option II (i.e. partial enclosure - type B) is recommended.

7.7.3.2. The number of dwellings to be protected and the cost for the recommended option are 228 and \$30M, respectively. This option provides 53% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$132,000.

7.7.3.3. An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 83-158 µg/m³ and 102-168 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.8. **Tin Sam Street**

7.8.1. Characteristics of Study Area

7.8.1.1. Tin Sam Street is a dual 2-lane carriageway linking Tin Sam Village, Carado Garden and Lung Hang Estate to Che Kung Miu Road and Hung Mui Kuk Road with a cycle track and trees by the roadside. The land uses on both sides of the road are mainly residential developments, which are sensitive to road traffic noise. A primary and a secondary school, which are also sensitive to road traffic noise, are situated alongside the westbound carriageway of Tin Sam Street.

7.8.1.2. Lung Hang Estate, which is located to the south of Tin Sam Street is a high rise rental housing estate overlooking the road. To the north of Tin Sam Street there are low-rise village houses, Tin Sam Village and a high-rise building estate, Carado Garden.

7.8.2. Major Consideration and Constraints

7.8.2.1. A 2 x 1.6m and 2.5 x 1.8m box culvert and a twin 2.5 x 2m box culvert have been identified next to a block in Caradon Garden across Tin Sam Street.

7.8.2.2. A number of signalised road junctions are located within the Study area and they are Tin Sam Street J/O Hung Mui Kuk Road, Fu Kin Street, non-signalised junction and the main vehicle entrance of Lung Hang Estate. The identified barriers and enclosure should consider this constraint so that the visibility at these junctions can be maintained.

7.8.2.3. There is a subway across Tin Sam Street in front of block 6 at Carado Garden. It is in close proximity to the existing vehicular entrance of Lung Hang Estate from Tin Sam Street. These facilities are a constraint which must be considered in the development of noise mitigation measures.

7.8.3. Recommendation

7.8.3.1. After undergoing a scheme evaluation analysis of two identified options, the recommended mitigation measures for Tin Sam Street are:

- cantilevered barrier - type B along westbound carriageway
- partial enclosure - type A and B along eastbound carriageway

7.8.3.2. The number of dwellings to be protected and the direct construction cost for the identified option are 446 and \$58M, respectively. This option provides 78% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is 130,500.

7.8.3.3. An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 83-120 µg/m³ and 77-122 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.9. **Junction of Che Kung Miu Road and Hung Mui Kuk Road**

7.9.1. Characteristics of Study Area

7.9.1.1. At this corner of Che Kung Miu Road, only the southern edges of the route are under assessment. This section runs through a landscape of urban/village character, with low-rise buildings and small shops set back from the road behind a wide footpath and a roadside amenity strip.

7.9.1.2. The signalised road junction was upgraded to a roundabout in 1997 and a footbridge system was constructed. The adjacent sites will be affected by a future flyover across the junction along Che Kung Miu Road and the Route 16 connections by 2005.

7.9.1.3. The traffic moving through this junction affects the residential developments at Tin Sam Village, south of the junction, and Sun Chui Estate, east of the junction.

7.9.2. Major Consideration and Constraints

- 7.9.2.1. The southbound footpath of Hung Mui Kuk Road is fully occupied by public light cables, telephone cables and gas mains.
- 7.9.2.2. A 3.5m x 3.5m 6 cell box culvert is running underneath Che Kung Miu Road fronting Tin Sam Village and this culvert is connected to branch culverts. A 1050mm diameter sewer also runs next to this culvert and adjacent to the westbound amenity strip of Che Kung Miu Road.
- 7.9.2.3. The existing signalised junction is being modified to a roundabout with a footbridge system. The alignment of the footbridges, realigned carriageway and bus bays dictate the choice and erection of noise barrier structure. As advised by Director of Territory Development (letter ref. () in TDD 2/1/234 Pt. dated 15th May 1997, possible conflicts between the identified mitigation measures with the proposed road widening of Che Kung Miu Road under Che Kung Miu Road Flyover Project fronting Tin Sam Village would be resulted. Moreover, TIA and EIA for this project will be carried out separately, thus, no identified barrier for protecting Tin Sam Village along Che Kung Miu Road has been proposed.

7.9.3. Recommendation

- 7.9.3.1. After carrying out a scheme evaluation analysis for two identified options, the recommended mitigation measures for Che Kung Miu Road J/O Hung Mui Kuk Road are:
- combination of 3 to 6m plain barrier to shield the gaps between the ground level and the soffit of the east ramp;
 - cantilevered barrier-type B and partial enclosure - type B alongside, southbound of Hung Mui Kuk Road to protect Sun Chui Estates;
 - combination of 3 to 6m plain barrier to shield the gaps between the ground level and the soffit of the south ramp;
 - 5m plain barrier alongside northbound of Hung Mui Kuk Road to protect Tin Sam Village.
- 7.9.3.2. The number of dwellings to be protected and the cost for the recommended option are 581 and \$47M, respectively. This option provides 64% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$81,000
- 7.9.3.3. An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 101-139 µg/m³ and 105-145 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.10. Tseung Kwan O Road**7.10.1. Characteristics of Study Area**

7.10.1.1. Tseung Kwan O Road is a dual 3-lane carriageway linking Kwun Tong Bypass and Tseung Kwan O Tunnel. It is a heavily trafficked highway with high rise residential blocks overlooking the road from both sides.

7.10.1.2. The sensitive developments include Tsui Ping Estate (Blocks A to F), public rental housing at Lam Tin Estate (Blocks 4, 5, 7, 8 and 10), Hing Tin Estate (Yan Tin House, Mei Tin House and Choi Tin House) and Chung Hong House and Yee Hong House of Hong Wah Court.

7.10.2. Major Consideration and Constraints

7.10.2.1. The westbound (2-3m wide) footpath is fully occupied with utilities and underground services such as 10 nos. 11KV, 2 nos. 33KB CLP cables, telephone cables, public light cables, etc.

7.10.2.2. Two numbers of large diameter fresh water mains at 1400 ϕ have been identified running along the central profile barrier, while 600 ϕ water mains together with 5 nos. 11KV and 4 nos. 33KV CLP cables and public light cable have also been found running along the eastbound footpath. Since 2 nos. 1400 ϕ fresh water mains are found running along the existing central profile barrier of the road section in question and these mains are essential for providing fresh water supply to Kowloon East area as Hong Kong Island as advised by CE/MSE, WSD's letter ref. (3) in WSD/MSE 1744/2003/96 Pt.3 dated 13th October 1997, thus, diversion of these mains for the accommodation of barrier foundation along the central profile barrier is highly undesirable.

7.10.2.3. A left-in-left-out junction with Kai Tin Road is located at westbound carriageway opposite Block A of Tsui Ping Estate. An EVA which is currently blocked by a crash barrier is also identified at eastbound carriageway adjacent to Block A of Tsui Ping Estate.

7.10.2.4. A sign gantry is located at the westbound carriageway fronting Hing Tin Commercial Centre.

7.10.2.5. About 15m of the westbound slow lane carriageway of Tseung Kwan O Road fronting Ma Yau Tong Salt Water Service Reservoir was designed for maintenance of this reservoir (i.e. loading/unloading activities).

7.10.3. Recommendation

7.10.3.1. After carrying out a scheme evaluation analysis for two identified options, the recommended mitigation measures for sections of Tseung Kwan O Road under investigation are:

- combination of partial enclosure and full enclosure spanning across both bounds of Tseung Kwan O Road for protecting Tsui Ping Estate and Lam Tin Estate; and
 - Partial enclosure spanning across both bounds of Tseung Kwan O Road and covering the westbound carriageway of Tseung Kwan O Road with sufficient height to accommodate the existing sign gantry in front of Hing Tin Estate for protecting Hing Tin Estate and Hong Wah Court.
- 7.10.3.2. The number of dwellings to be protected and the direct construction cost for the identified option are 2,538 and \$288M, respectively. This option provides 65% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$114,000.
- 7.10.3.3 An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 103-234 mg/m³ and 124-272 mg/m³, respectively. The recommended measures may have localized effects on the air quality. For a basketball field close to the eastern portal with the proposed full enclosure in place, the predicted 24-hour average RSP concentration may increase about 45%. As there is a substantial increase in RSP concentration due to the full enclosure further detailed assessment will be carried out in the detailed EIA Study. Nevertheless, under the current emission controls, the emission rates of the pollutants and hence the future RSP concentrations would be reduced with time in spite of the future increase in traffic flow.
- 7.10.3.4 Recommendations would also be made in the EIA Study for changing the basketball field to passive recreational uses or some other non-air sensitive uses to avoid any excessive air quality impact.
- 7.10.3.5 With regard to the air quality inside the proposed full enclosure, the maximum concentration of NO₂ under the worst case scenario is estimated to be 724 mg/m³. The concentration has taken into account the contributions from vehicles inside the full enclosure of 210m long as well as the boundary concentrations. Against the EPD's guideline of maximum NO₂ concentration (i.e. 1,800 mg/m³) inside the vehicle tunnel, the impact on the drivers inside the proposed full enclosure along Tseung Kwan O Road is considered minimal.

7.11. Po Lam Road North and Po Hong Road

7.11.1. Characteristics of Study Area

- 7.11.1.1. Po Lam Road North is a dual 2-lane carriageway adjacent to Po Lam Estate, Ying Ming Court, Yan Ming Court and King Lam Estate. It is a main distributor connecting these residential estates to other parts of Tseung Kwan O. Po Hong Road, which is a dual 2-lane carriageway running adjacent to Well On Garden and Finery Park, Links Po Lam Road North and Po Fung Road.
- 7.11.1.2. The sensitive developments include Po Lam Estate (Po Tak House and Po Yan House), Ying Ming Court (Ming Tat House, Ming Chi House and Ming On House), Yan Ming Court (Yan Kuk House, Yan Chung House and Yan Lan House), King Lam Estate (King Yu House, King Lui House, King Min House and King Nam House), Well On Garden and Finery Garden.

- 7.11.1.3. Po Chi House of Po Lam Estate is protected from the traffic noise along Po Lam Road North by Lok Sin Tong Lau Tak Primary School. Similarly Yan Mui House of Yan Ming Court is also protected by the existing commercial complex from the traffic noise along Po Lam Road North. King Yung House of King Lam Estate is located close to an existing roundabout where the sightline will be adversely affected by erection of barrier fronting this building, if any. In view of the above, they are excluded from the list of sensitive development in this Study.
- 7.11.1.4. The properties such as Well On Garden and Finery Garden along Po Hong Road are newly developed. The assessment has identified that these properties are all experiencing traffic noise level below 70 dB(A) $L_{10}(1\text{hour})$. No extra mitigation measures are therefore needed to be included on the existing Po Hong Road. With reference to Housing Department (letter ref. HD(P) 8/1/4/1 dated 28th January 1997) and Planning Department (letter ref. (9) in SS S/ENV/6II dated 3rd February 1997), Tseung Kwan O Temporary Housing Area (THA) has been planned for village type development. Temporary 4m plain barriers along the back of footpath adjacent to Po Lam Roads was identified for the protection of this THA. Should there be a need to extend the present THA for a long period, temporary plain barrier may be included as part of the measures proposed for Po Lam Road during the detailed design stage. Measures for the planned village type development should be excluded in this Study.
- 7.11.2. Major Consideration and Constraints
- 7.11.2.1. This section of road consists of three signalised junctions (i.e. Po Lam Road North J/O Po Hong Road; Po Lam Road North J/O Po Fung Road and Po Lam Road North J/O Yan King Road) and 4 nos. priority junctions (i.e. Po Lam Road North J/O entrance of Fire Station; Po Lam Road North J/O entrance to Po Lam Estate; Po Lam Road North J/O entrance to Ying Ming Court) and one left-in-left-out junction to King Lam Estate. Bus bays and loading/unloading bays have been identified along this road section.
- 7.11.2.2. This section of road lies within a suburban/rural fringe environment of good landscape and scenic value. Good quality avenue tree and shrub planting borders the roadside while a further shrub amenity strip separates the footpath and cycle-track creating a visually pleasing and high quality streetscape. The existing amenity strip (3-3.5m wide) is considered appropriate for erection of a noise barrier structure.
- 7.11.2.3. A 4m wide box culvert has been identified running underneath the westbound carriageway fronting Yan Kuk House and two numbers of 3.5m wide box culvert are running across Po Lam Road North to join the big box culvert running underneath Po Hong Road fronting Tseung Kwan O THA.
- 7.11.2.4. Subways are located across Po Lam Road together with an elevated walkway running across Po Lam Road North fronting Po Tak House.

7.11.3. Recommendation

7.11.3.1. After undergoing a scheme evaluation analysis of two identified options, the recommended mitigation measures for the section of Po Lam Road North and Po Hong Road North under investigation are:

- Combination of partial enclosures - type A and B for protecting Po Lam Estate;
- Cantilevered barrier - type B for protecting Yan Ming Court and King Lam Court
- Cantilevered barrier - type B for protecting Ying Ming Court

7.11.3.2. The number of dwelling to be protected and the direct construction cost for the identified option, 706, and \$75M, respectively. This option provides 53% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$106,000. Moreover, no mitigation along Po Hong Road is considered necessary as the unmitigated noise level of NSRs at Well On Garden and Finery Park Garden are found within noise requirement.

7.11.3.3 An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 84-159 µg/m³ and 83-149µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.12. **Tuen Mun Road (Tsuen Wan)**

7.12.1. Characteristics of Study Area

7.12.1.1. Tuen Mun Road is a dual three lane expressway linking Tsuen Wan and Tuen Mun. It is a heavily trafficked highway with several high-rise residential blocks overlooking both sides of the expressway

7.12.1.2. The section of Tuen Mun Road under consideration is adjacent to Belvedere Garden and Greenview Court near Yau Kom Tau Village and is elevated above the coastal edge of Tsuen Wan. Sensitive developments include Belvedere Garden (Phase I and II), GreenView Court and Yau Kom Tau Village.

7.12.2. Major Consideration and Constraints

7.12.2.1. Two numbers of 900φ and three numbers of 1500φ culvert have been identified running across both directions of carriageway together with sized 250φ to 550φ U-channels and 250 J-channels running within the study area.

- 7.12.2.2. An elevated walkway spans Tuen Mun Road in front of Belvedere Garden Phase II area and laybys are located at Tuen Mun bound carriageway in front of Greenview Court.
- 7.12.2.3. An vehicular underpass runs across both bounds of Tuen Mun road next to Block 2 of Greenview Court. A sign gantry is located at Tsuen Wan bound of Tuen Mun Road fronting Yau Kom Tau Village.
- 7.12.2.4. This section of road consists of a large 'S-curve' in front of Yau Kom Tau Village, followed by a 420m straight road. Thus, sight stopping distance has been identified to be one of the major constraints in providing the noise mitigation works.
- 7.12.2.5. It was advised by Highways Department's letters ref. () in HNT 602/TM/20, (63) in HYD MWPMO 52TH/GEN XV and (5) in HYD MWPMO 7052TH/GEN II dated 15th November 1996, 27th December 1996 and 5th August 1997, respectively that concrete profile barriers had been proposed to be erected alongside the slow lane of Tsuen Wan bound of Tuen Mun Road fronting Yau Kom Tau Village.
- 7.12.2.6. Since Tuen Mun Road is one of the most heavily trafficked expressways in Hong Kong, due consideration should be given to all likely impacts arising from the implementation of noise mitigation measures on this site.
- 7.12.2.7. Comments given by Hong Kong Police Force, Traffic Management Bureau (letter ref. (36) in LM (1/96) in CP/T/TMB 216/61 Pt.2 dated 16th March 1998 on the Draft Final Report stated they have serious reservations and strong objection to the reduced line of vision caused by the proposed erection of cantilevered and plain barriers on the dangerous downhill/uphill curved sections of Tuen Mun Road. Concerns at the safety of operation over this section of road during the emergency have also been expressed.
- 7.12.3. Recommendation
- 7.12.3.1. After undergoing a scheme evaluation analysis of two identified options and taking account of Hong Kong Police Force's comment, the recommended mitigation measures for Tuen Mun Road (Tuen Wan) excluding Yau Kom Tau Village as one of NSRs are:
- cantilevered barrier - type B for protecting Belvedere Garden, Greenview Court
- 7.12.3.2. The number of dwellings to be protected and the direct construction cost for the identified option are 1,540 and \$55M, respectively. This option provides 77% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$35,600.

7.12.3.3 An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 134-285 µg/m³ and 161-345 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.13. Tuen Mun Road (Tsing Lung Tau)

7.13.1. Characteristics of Study Area

7.13.1.1. Tuen Mun Road at Tsing Lung Tau is an expressway with dual three-lane carriageways linking Tsuen Wan and Tuen Mun. It is a heavily trafficked expressway with a few high-rise residential blocks, such as Hong Kong Garden, overlooking the road from the Tuen Mun bound side of the expressway.

7.13.1.2. The section of Tuen Mun Road under consideration is adjacent to Hong Kong Garden and is elevated above the coastal edge of Dragon Beach. Sensitive developments include Carmel Heights, Dominion Heights, Estoril Heights, Grenville Heights, Hoover Heights, Kingston Heights, Lincoln Heights, Manhattan Heights, Nelly Heights, Orchid Heights, Fontana Heights and Peony Heights of Hong Kong Garden.

7.13.2. Major Consideration and Constraints

7.13.2.1. Three culverts run across both bounds of carriageway within the study section. They are a 900φ culvert, a 2.0m x 2.0m box culvert and a 2.5m x 2.5m box culvert. Also running across the carriageway are 150mm to 550mm U-channels and 250mm J-channels and a drainage layer has been identified within the study area.

7.13.2.2. A subway which runs across both bounds of Tuen Mun Road is located in front of Peony Heights of Hong Kong Garden.

7.13.2.3. This section of road consists of a gentle bend in front of Fontana Heights of Hong Kong Garden, followed by a 433m straight road. Sufficient sight distance should be provided in the development of the proposed noise mitigation measures along this section of the road.

7.13.3. Recommendation

7.13.3.1. After carrying out a scheme evaluation analysis of two identified options, the recommended mitigation measures for Tuen Mun Road (Tsing Lung Tau) are:

- combination of 3m plain barrier and cantilevered barrier - type A for protecting Hong Kong Garden

7.13.3.2. The number of dwellings to be protected and the direct construction cost for the identified option are 339 and \$17M, respectively. This option provides 90% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$50,800.

7.13.3.3 An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 97-209 µg/m³ and 120-253 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.14. **Tuen Mun Road (Sam Shing Hui)**

7.14.1. Characteristics of Study Area

7.14.1.1. Tuen Mun Road at Sam Shing Hui is initially an expressway with dual three lanes carriageway linking Tsuen Wan and Tuen Mun. It is a heavily trafficked highway with a few high rise residential blocks such as Kam Fai Garden overlooking the road from the Tuen Mun bound side of the expressway.

7.14.1.2. As advised by Highways Department in their letter ref. () in HNT 602/TM/20 dated 15th November 1996, road widening works would be implemented along the Tsuen Wan bound of Yuen Mun Road fronting Kam Fai Garden. At the time of preparing this report, the improvement works have been completed and the street furniture such as public lighting and drains have been diverted along the new verge. The new Tsuen Wan bound carriageway consists of 4 traffic lanes

7.14.1.3. The section of Tuen Mun Road under consideration is fronting Kam Fai Garden. Sensitive developments include Block 1, Block 2 and Block 3 of Kam Fai Garden.

7.14.2. Major Consideration and Constraints

7.14.2.1. Apart from a sign gantry located at the Tuen Mun bound carriageway, no major constraints such as existing utilities and physical constraints are identified along this section of the road.

7.14.3. Recommendation

7.14.3.1. After undergoing a scheme evaluation analysis of two identified options, the recommended mitigation measures for Tuen Mun Road (Sam Shing Hui) are:-

- cantilevered barrier - type B for protecting Kam Fai Garden

7.14.3.2. The number of dwellings to be protected and the direct construction cost for the identified option area 100 and \$14M, respectively. This option provides 56% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$140,000.

7.14.3.3. An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 90-146 µg/m³ and 136-208 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.15. **Castle Peak Road (Hung Shui Kiu)**

7.15.1. Characteristics of Study Area

7.15.1.1. Castle Peak Road at Hung Shui Kiu is a dual three lane carriageway with Light Rail Transit (LRT) tracks running parallel to the road. Castle Peak Road is a busy distributor road running through an area of predominantly urban landscape with low to medium rise housing, small shops and commercial buildings on either side of the road.

7.15.1.2. The section of Castle Peak Road under consideration is fronting Parkview Garden.

7.15.1.3. It has been advised that an LRT reserve exists along this section of the road so that no mitigation measures should be proposed within this area.

7.15.2. Major Consideration and Constraints

7.15.2.1. The eastbound footpath fronting Parkview Garden is fully occupied with utilities and underground services such as water mains, CLP cable, telephone cables, etc.

7.15.2.2. The existing LRT reserve zone adjusted to the cycle-track fronting Parkview Garden should not be used for erection of any noise barrier structure.

7.15.2.3. Besides, drainage pipes of size 300φ, 375φ and 900φ, together with manholes have been identified running along the existing cycle track.

7.15.3. Recommendation

7.15.3.1. After undergoing a scheme evaluation analysis of two identified options, the recommended mitigation measures for Castle Peak Road (Hung Shui Kiu) are:

- 4m plain barrier for protecting Parkview Garden

7.15.3.2. The number of dwellings to be protected and direct construction cost for the identified option are 22 and 3.3M, respectively. This option provides 73% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$150,000.

7.15.3.3. An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 71-146 µg/m³ and 91-138 µg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.16. **Castle Peak Road (Ping Shan)**

7.16.1. Characteristics of Study Area

7.16.1.1. Castle Peak Road at Ping Shan is similar to that at Hung Shui Kiu and is a dual three lane carriageway with Light Rail Transit (LRT) running parallel to the road. This section of Castle Peak Road is a distributor road with a medium to heavy traffic flow and runs through an area of predominantly suburban landscape, with low to medium rise housing on either sides of the road.

7.16.1.2. The section of Castle Peak Road under consideration is fronting Fui Sha Wai Village and houses adjacent to Ping Tong Street West and Ping Shan Lane.

7.16.2. Major Consideration and Constraints

7.16.2.1. As mentioned above, there is an LRT reserve along the road in which no mitigation measures should be proposed.

7.16.2.2. The westbound footpath fronting Fui Sha Wai Village and houses adjacent to Ping Tong Street West and Ping Shan Lane is fully occupied with utilities and underground services.

7.16.2.3. A 1 metre wide kerb separates the cycle track from the westbound carriageway of Castle Peak Road fronting Fui Sha Wai Village. The existing cycle track running next to the kerb separator is 4m wide.

7.16.2.4. The raising kerb running in front of the facades at Ping Shan Lane is 2m wide with no utilities and services underground.

7.16.2.5. The cycle track is occupied by a gas main and a water main of 300φ and 700φ/800φ, respectively underneath.

7.16.2.6. A minor road junction with the existing cycle track and footpath is situated adjacent to the facades of Fui Sha Wai Village. In addition, an elevated walkway runs across Castle Peak Road fronting Ping Shan Lane. In particular, comments given by AC for T/NT's letter ref. NR 182/160-1 dated 21st October 1997 advised that no sightline obstruction to motorists coming out from the access road of Fui Sha Wai should be imposed by the proposed mitigation measures.

7.16.3. Recommendation

7.16.3.1. After undergoing a scheme evaluation analysis of two identified options and taking account of comments given by AC for T/NT on the Draft Final report, the recommended mitigation measures for Castle Peak Road (Ping Shan) are:

- combination of 2m and cantilevered barrier - type C for protecting the residents at Fui Sha Wai, Ping Tong Street West and Ping Shan Lane

7.16.3.2. The number of dwellings to be protected and the direct construction cost for the identified option are 64 and \$10M, respectively. This option provides 91% protection of the exposed facades and the estimated direct cost per dwelling for the implementation of this option is \$162,600.

7.16.3.3. An air quality study of the road shows that prior to the implementation of the scheme, the average hourly NO₂ and RSP concentrations at the most exposed facades of the dwellings and schools would be in the range of 71-127 μg/m³ and 88-133 μg/m³, respectively. The recommended measures may have localized effects on the air quality. However, no significant degradation of the air quality at the exposed facades can be determined as a result of implementing the measures.

7.17. **Environmental Gains and Losses Account**

7.17.1. The recommended noise mitigation measures as stated above may generate either positive or negative effects on the environment in vicinity of the affected road section. Table 2 summarize the environmental gains and losses account of the study road sections in respect of its recommend noise mitigation scheme.

Table 2 Environmental Gains and Losses Account

Location	Environmental Loss	Environmental Gain	Mitigation Measures
Cheung Pei Shan Road	<ul style="list-style-type: none"> ◦ visual intrusion to pedestrians ◦ creation of enclosed landscape character ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 53% of exposed facades can be protected in terms of noise attenuation ◦ screening of poor views for village and high-rise housing ◦ visual strengthening of route ◦ unifying landscape element within poor existing urban environment 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context
Fung Shue Wo Road	<ul style="list-style-type: none"> ◦ visual intrusion due to replacement of streetscape and trees with noise barrier ◦ visual confinement of pedestrians and vehicles ◦ loss of good views to vegetated hillsides, Chung Mei Lo Uk and parkland ◦ landscape loss of trees and streetscape ◦ introduction of irregular landscape features ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 84% of exposed facades can be protected in terms of noise attenuation 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting
Yuen Wo Road	<ul style="list-style-type: none"> ◦ screens views of lower level residents and users ◦ screens trees from pedestrians and vehicles ◦ introduction of irregular landscape feature ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 73% of exposed facades can be protected in terms of noise attenuation 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting
Tai Chung Kiu Road	<ul style="list-style-type: none"> ◦ screening of estate boundary trees from pedestrians and vehicles ◦ replacement of soft roadside edge with hard urban elements ◦ conflict of barrier with other streetscape elements, e.g. bus stops ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 50% of exposed facades can be protected in terms of noise attenuation 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting

Location	Environmental Loss	Environmental Gain	Mitigation Measures
Ma On Shan Road	<ul style="list-style-type: none"> ◦ major visual intrusion to pedestrians, cyclists and vehicular passengers adjacent to Yiu On Estate due to loss of trees and planting ◦ introduction of visually irregular elements along Yiu On Estate ◦ visual screening of trees to vehicular passengers adjacent to Heng On Estate ◦ landscape loss of trees and planting adjacent to Yiu On Estate ◦ introduction of hard landscape element along road ◦ may have localized effects on the air quality both with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 71% of exposed facades can be protected in terms of noise attenuation ◦ screening of traffic for high-rise residents 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting
Che Kung Miu Road	<ul style="list-style-type: none"> ◦ minor visual impacts due to screening of vegetation to pedestrians ◦ may have localized effects on the air quality both with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 53% of exposed facades can be protected in terms of noise attenuation 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting
Tin Sam Street	<ul style="list-style-type: none"> ◦ minor visual impacts due to screening of Carado Garden vegetation ◦ visual intrusion due to screening of vegetation introduction of hard edge to views of pedestrian and vehicular passengers adjacent to Lok Sam House and Wing Sam House ◦ landscape loss of trees and shrub planting adjacent to Lok Sam and Wing Sam Houses ◦ may have localized effects on the air quality both with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 78% of exposed facades can be protected in terms of noise attenuation 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting

Location	Environmental Loss	Environmental Gain	Mitigation Measures
Che Kung Miu Road J/O Hung Mui Kuk Road	<ul style="list-style-type: none"> ◦ minor visual impacts due to loss of open views at lower levels for pedestrians residents and vehicular passengers ◦ minor landscape intrusion due to restriction of open nature of site ◦ introduction of hard element within amenity planting ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 64% of the exposed facades can be protected in terms of noise attenuation ◦ screening of traffic flows 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting
Tseung Kwan O Road	<ul style="list-style-type: none"> ◦ visual intrusion to vehicular and pedestrians passengers due to enclosure ◦ landscape effect of introduction of hard urban enclosure elements along the roadside ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 65% of the exposed facades can be protected in terms of noise attenuation 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting ◦ change the basketball field to passive recreational uses or other non-air sensitive uses
Po Lam Road North	<ul style="list-style-type: none"> ◦ visual intrusion due to tunnelling of views to pedestrians and vehicular passengers ◦ introduction of irregular landscape element to the open nature of study area and at base of vegetated slopes ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 53% of the exposed facades can be protected in terms of noise attenuation 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context
Tuen Mun Road, Sam Shing Hui	<ul style="list-style-type: none"> ◦ intrusion due to shading of lower level apartments ◦ visual intrusion due to enclosure of views of vehicular passengers ◦ introduction of harsh vertical element to road ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 56% of the exposed facades can be protected in terms of noise attenuation ◦ screening of traffic flow ◦ physical boundary between housing and road 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting

Location	Environmental Loss	Environmental Gain	Mitigation Measures
Tuen Mun Road, Tsuen Wan	<ul style="list-style-type: none"> ◦ visual intrusion due to screening of views up hillside of Ha Fa Shan from vehicular passengers and residents ◦ landscape loss of substantial roadside trees and vegetation ◦ introduction of major hard elements within transport corridor ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 77% of the exposed facades can be protected in terms of noise attenuation ◦ partial screening of traffic flows 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting
Tuen Mun Road, Tsing Lung Tau	<ul style="list-style-type: none"> ◦ introduction of strong linear visual element screening views up the local hillside ◦ visual intrusion to vehicular passengers due to screening of vegetation ◦ landscape loss of substantial tree and shrub vegetation ◦ introduction of landscape barrier increasing segregation of upper and lower hillslopes ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 90% of the exposed facades can be protected in terms of noise attenuation ◦ screening of traffic flow for lower and middle level apartment 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting
Castle Peak Road, Hung Shui Kiu	<ul style="list-style-type: none"> ◦ minor visual intrusion due to relatively short section of barrier ◦ introduction of additional hard element within the already harsh environment ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 73% of the exposed facades can be protected in terms of noise attenuation ◦ screen views of transport corridor from Parkview Garden ◦ introduction of landscape barrier between Parkview Garden and transport corridor 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context

Location	Environmental Loss	Environmental Gain	Mitigation Measures
Castle Peak Road , Ping Shan	<ul style="list-style-type: none"> ◦ visual intrusion to pedestrians and cyclists due to enclosure on one side ◦ minor visual intrusion to housing due to remoteness and intermediate vegetative screening ◦ loss of visual interest to vehicular passengers ◦ introduction of dominant landscape elements along the roadside ◦ may have localized effects on the air quality but with no significant degradation of air quality at the exposed facades 	<ul style="list-style-type: none"> ◦ 91% of the exposed facades can be protected in terms of noise attenuation 	<ul style="list-style-type: none"> ◦ sensitive design of noise mitigation to integrate it within the existing visual and landscape context ◦ screen and amenity planting

Note: All the 13 study sites have an overall environmental gains after the implementation of these identified noise mitigation measures in terms of noise attenuation, air quality impact, visual and landscape impact, etc.

7.18 Preliminary Landscape and Townscape Design suitable for Submission to ACABAS

7.18.1 Preliminary landscape / townscape proposals have been outlined within the individual working papers and set out appropriate landscape measures to mitigate the visual and landscape impacts of the proposed noise barriers as identified in the Landscape and Visual Impact Assessments.

7.18.2 The working papers identify the fact that the major impacts, on the existing visual and landscape context will be from the introduction of the proposed noise barriers along each of the road sections. It is therefore important that the design of the noise barriers, together with the selection of the materials used in their construction, be considered carefully in order to reduce their visual impact.

7.18.3 As stated in the Inception Report it is proposed that a generic design for the noise mitigation measures be established for site-wide use throughout Hong Kong. This generic design would not only ensure the quality of all future noise barriers, but also reduce the visual clutter associated with individual schemes pursuing their own design solutions. Furthermore, the generic design would standardise all retroactive noise barriers ensuring a cost effective, easily maintainable and visual sensitive barrier which would provide continuity to Hong Kong road edges.

7.18.4 Based on this concept it is proposed that the ACABAS submissions be progressed in two stages. Firstly, to present and gain approval for the generic design approach for each of the barrier types. Secondly, to make separate individual submissions for each of the road sections. These individual submissions will be carried out during the detailed design stage to identify the exact alignment and type of noise barrier to be implemented along with any additional mitigation proposals, e.g. planting.

7.18.5 Generic Design Approach

- 7.18.5.1 As outlined above the generic design approach for the noise barriers proposes a standardised approach in the selection of finishes. The types of noise barriers which will be employed for noise mitigation purposes can be classified as follows, vertical (from 1m to 6m height), cantilevered, partial enclosure and full enclosure. The design finishes for each of these types are discussed below.

Vertical Noise Barriers (See Figures 7-19 and 7-20)

- 7.18.5.2 Two separate finishes, either absorptive or reflective are proposed for these barriers. Absorptive barriers will consist of a proprietary brand perforated anodised aluminium clad absorption panel system. All supports and frames will be painted with an anodised aluminium paint finish.
- 7.18.5.3 Reflective noise barriers will consist of a propriety brand transparent module units in an anodised aluminium frame. All supports will be painted with an anodised aluminium paint finish.

Cantilevered Noise Barrier (See Figures 7-21 and 7-22)

- 7.18.5.4 The finishing treatments for these noise barriers will be consistent with those identified for the vertical noise barriers above.

Partial Enclosure Noise Barriers (See Figure 7-23)

- 7.18.5.5 The finishing treatments for these noise barriers will be consistent with those identified for the vertical noise barriers above.

Full Enclosure Noise Barriers (See Figure 7-24)

- 7.18.5.6 The finishing treatments for these noise barriers will be consistent with those identified for the vertical noise barriers above.

7.19 **Priority Ranking of the Recommended Schemes**

- 7.19.1. Based on the priority ranking system as described in Chapter 5 of this report, the recommended schemes have been prioritised and summarized in terms of recommended noise mitigation measures and cost of these options. Table 3.1 presents the summary of these mitigation options, Table 3.2 presents the cost summary of these options and Table 3.3 shows priority ranking based on population exposure (ie. Z (dB exceedance of 70 dB(A) x no. of dwelling), has been proposed for implementation.
- 7.19.2 Apart from the capital cost estimation for the implementation of these recommended options, the recurrent consequence in terms of financial and staffing implication were also estimated based on the latest information such as annual unit maintenance and annual unit staff cost for noise barriers/enclosures obtained from Chief Highway Engineer/Structures, Highways Department. They are summarized in Table 2.1.

Table 2.1 Recurrent Financial and Staffing Implication

Location	Annual Maintenance Cost (\$M/year)	Annual Staff Cost (\$M/year)
Cheung Pei Shan Road	3.81	1.14
Fung Shue Wo Road	0.83	0.25
Yuen Wo Road	0.30	0.09
Tai Chung Kiu Road	0.73	0.22
Ma On Shan Road	1.03	0.31
Che Kung Miu Road	0.10	0.03
Tin Sam Street	1.84	0.55
Che Kung Miu Road J/O Hung Mui Kuk Road	1.40	0.42
Tseung Kwan O Road	7.41	2.22
Po Lam Road North	2.46	0.74
Tuen Mun Road, Tsuen Wan	1.59	0.48
Tuen Mun Road, Tsing Lung Tau	0.63	0.19
Tuen Mun Road, Sam Shing Hui	0.40	0.12
Castle Peak Road, Hung Shui Kiu	0.09	0.03
Castle Peak Road, Ping Shan	0.30	0.09

Table 3.1 Mitigation Summary Table

Location	Protected NSRS	No. of exposed dwellings	No. of dwelling protected	No. of dwelling benefited	Recommended noise mitigation measures	% of Protection
Cheung Pei Shan Road	a) Cheung Shan Estate- Sau Shan House and Lok Shan House b) Shek Wai Kok Estate- Shek Tsui House, Shek Kuk House, Shek Lan House and Shek To House c) Hoi Pa Village South d) Hoi Pa Resite Village e) Sam Tung Uk Resite Vilalge	2, 200	1, 171	1, 996	3M on footing - 127m 4.5C on footing- 607m PE(A) - 103m PE(G) - 555m	53
Fung Shue Wo Road	a) Tsing Yi Estate - Yee Yat House, Yee Yip House and Yee Kui House b) Tsing Yi Garden - Block 1 to 5 c) Chung Mei Lo Uk Village d) Tai Wong Ha Resite Village	936	787	812	3M on footing- 68m 4M on footing- 51m 4.5C on footing - 202m 4.5C on pile - 86m 5.5C on footing - 151m 5.5C on pile - 65m	84
Yuen Wo Road	a) Wo Che Estate - Hong Wo House and Hip Wo House	357	261	305	5.5C on pile - 110m 5.5C on footing - 75m	73
Tai Chung Kiu Road	a) Jat Min Chuen - Ming Shun Lau and Ming Yiu Lau b) Yue Shing Court	1, 340	670	793	5.5C on pile - 447m	50
Ma On Shan Road	a) Heng On Estate - Heng Fung House, Heng Shan House and Heng Kong House b) Yiu On Estate - Yiu Shun House, Yiu Chung House, Yiu Yee House and Yiu Wing House	1,355	963	1,143	6M on footing - 96m 4.5C on footing - 340m 5.5C on footing - 264m	71

Location	Protected NSRS	No. of exposed dwellings	No. of dwelling protected	No. of dwelling benefited	Recommended noise mitigation measures	% of Protection
Che Kung Miu Road	a) Chun Shek Estate - Shek Yuk House and Shek Fai House	428	228	408	PE(B) - 134m	53
Tin Sam Street	a) Lung Hang Estate - Wing Sam House and Lok Sam House b) Carado Garden - Block 4 to 6	573	446	514	5.5C on pile - 255m PE(A) - 80m PE(B) - 138m	78
Che Kung Miu Road J/O Hung Mui Kuk Road	a) Sun Chui Estate - Sun Ming House, Sun Yuet House and Sun Yee House b) Tin Sam Village	907	581	859	3M on footing - 20m 4M on footing - 28m 5M on footing - 28m 5M on pile - 45m 6M on footing - 35m 5.5C on pile - 60m PE(B) - 155m	64
Tseung Kwan O Road	a) Hong Wah Court - Chung Hong House and Yee Hong House b) Lam Tin Estate - Block 4,5,7,8 and 10 c) Tsui Ping Estate - Block A to F	3,903	2,538	3,730	PE(C) - 96m PE(D) - 133m PE(E) - 311m PE(F) - 70m FE - 210m	65
Po Lam Road North	a) Po Lam Estate - Po Tak House and Po Yau House b) Ying Ming Court - Ming On House, Ming Chi House and Ming Tat House c) Yan Ming Court - Yan Chung House, Yan Kuk House and Yan Lan House d) King Lam Estate - King Yu House, King Lui House, King Min House and King Nam House	1,334	706	746	5.5C on pile - 662m PE(A) - 142m PE(B) - 112m	53

Location	Protected NSRS	No. of exposed dwellings	No. of dwelling protected	No. of dwelling benefited	Recommended noise mitigation measures	% of Protection
Tuen Mun Road (Tsuen Wan)	a) Belvedere Garden- Block 1 to 3 and 5 to 9 b) Greenview Court - Block 2 and 3	2,006	1,540	1,879	5.5C on footing - 1,153m	77
Tuen Mun Road (Tsing Lung Tau)	a) Hong Kong Garden - Carmel Height, Dominion Height, Estoril Height, Fontana Height, Greenville Height, Hoover Height, Kingston Height, Lincoln Height, Manhattan Height, Welling Height, Orchid Height and Peony Height	377	339	373	3M on footing - 416.5m 3M on pile - 3.5m 4.5C on footing - 270m	90
Tuen Mun Road (Sam Shing Hui)	Kam Fai Garden - Block 1 to 3	180	100	180	5.5C on footing - 292m	56
Castle Peak Road (Hung Shui Kiu)	Parkview Garden	30	22	22	4M on pile - 110m	73
Castle Peak Road (Ping Shan)	a) Fui Sha Wai - village houses b) Ping Tong Street West - village houses c) Ping Shan Lane - village houses	70	64	70	2M on footing - 241m 4.5C on pile - 150m	91

Note 1:

- 2M - 2m plain barrier
- 3M - 3m plain barrier
- 4M - 4m plain barrier
- 5M - 5m plain barrier
- 6M - 6m plain barrier
- 4.5C - cantilevered barrier - type A
- 5.5C - cantilevered barrier - type B
- PE(A) - partial enclosure - type A
- PE(B) - partial enclosure - type B
- PE(C) - partial enclosure - type C
- PE(D) - partial enclosure - type D
- PE(E) - partial enclosure - type E
- PE(F) - partial enclosure - type F
- PE(G) - partial enclosure - type G
- FE - full enclosure

Table 3.2 Summary of Cost Estimates

Location	Direct Construction Cost	Indirect Construction Cost	Total Construction Cost	Total Cost/dwelling protected	Total Cost/dwelling Benefited
Cheung Pei Shan Road	\$121M	\$36.3M	\$157.3M	\$0.13M	\$0.08M
Fung Shue Wo Road	\$25M	\$5M	\$30M	\$0.04M	\$0.04M
Yuen Wo Road	\$10M	\$2M	\$12M	\$0.05M	\$0.04M
Tai Chung Kiu Road	\$26M	\$5.2M	\$31.2M	\$0.05M	\$0.04M
Ma On Shan Road	\$33M	\$6.6M	\$39.6M	\$0.04M	\$0.03M
Che Kung Miu Road	\$30M	\$6M	\$36M	\$0.16M	\$0.09M
Tin Sam Street	\$58M	\$11.6M	\$69.6M	\$0.16M	\$0.14M
J/O Che Kung Miu Road and Hung Mui Kuk Road	\$47M	\$9.4M	\$56.4M	\$0.10M	\$0.07M
Tseung Kwan O Road	\$288M	\$57.6M	\$345.6M	\$0.14M	\$0.09M
Po Lam Road North	\$75M	\$15M	\$90M	\$0.13M	\$0.12M
Tuen Mun Road (Tsuen Wan)	\$55M	\$16.5M	\$71.5M	\$0.05M	\$0.04M
Tuen Mun Road (Tsing Lung Tau)	\$17M	\$5.1M	\$22.1M	\$0.07M	\$0.06M
Tuen Mun Road (Sam Shing Hui)	\$14M	\$4.2M	\$18.2M	\$0.18M	\$0.10M
Castle Peak Road (Hung Shui Kiu)	\$3.3M	\$0.7M	\$4M	\$0.18M	\$0.18M
Castle Peak Road (Ping Shan)	\$10M	\$2M	\$12M	\$0.19M	\$0.17M

Note 1: Cost of construction includes the followings:

- (a) direct construction cost (capital cost);
- (b) indirect construction cost includes cost for utilities, street furniture and traffic diversion (assuming 30% of the capital cost for major diversion, 20% of the capital cost for medium diversion, 10% of the capital cost for minor diversion); and
- (c) unit construction cost at December 96 prices for each type of barriers/enclosures per metre are :
 - 2m plain barrier on footing - \$12,300
 - 3m plain barrier on footing - \$16,700
 - 4m plain barrier on footing - \$23,600
 - 4m plain barrier on pile - \$29,700
 - 5m plain barrier on footing - \$31,000
 - 5m plain barrier on pile - \$39,200
 - 6m plain barrier on footing - \$42,000
 - cantilevered barrier - type A on footing - \$37,000
 - cantilevered barrier - type A on pile - \$49,600
 - cantilevered barrier - type B on footing - \$47,500
 - cantilevered barrier - type B on pile - \$59,200
 - partial enclosure - type A on pile - \$150,200
 - partial enclosure - type B on pile - \$225,200
 - partial enclosure - type C on pile - \$185,900
 - partial enclosure - type D on pile - \$266,100

partial enclosure - type E on pile	- \$ 345,100
partial enclosure - type F on pile	- \$401,600
partial enclosure - type G on pile	- \$142,700
full enclosure on pile	- \$474,000

Note 2: No resumption on private land is considered necessary for the implementation of the recommended option at each study site.

Note 3: Land resumption on "semi-government land" for erection of the recommended option fronting Jat Min Chuen at Tai Chung Kiu Road is considered necessary.

Table 3.3 Priority of Mitigation

Priority Ranking	Location	Total No. of dwellings exposed	Sum of Exposure Levels (priority criterion)	Recommended noise mitigation measures	Total Cost
1	Cheung Pei Shan Road	2,200	19,094	3M, 4.5C, PE(A) & PE(G)	\$157.3M
2	Tseung Kwan O Road	3,903	18,228.5	PE(C), PE(D), PE(E), PE(F) & FE	\$345.6M
3	Tuen Mun Road (Tsuen Wan)	2,006	9,839	5.5C	\$71.5M
4	Tai Chung Kiu Road	1,340	4,338.6	5.5C	\$31.2M
5	Po Lam Road North	1,334	3,243	5.5C, PE(A) & PE(B)	\$90M
6	J/O Che Kung Miu Road and Hung Mui Kuk Road	907	2,972.5	3M, 4M, 5M, 6M, 5.5C & PE(B)	\$56.4M
7	Ma On Shan Road	1,355	2,732.5	6M, 4.5C & 5.5C	\$39.6M
8	Che Kung Miu Road	428	2,156	PE(B)	\$36M
9	Fung Shue Wo Road	936	1,976	3M, 4M, 4.5C & 5.5C	\$30M
10	Tuen Mun Road (Sam Shing Hui)	180	1,698	5.5C	\$18.2M
11	Tin Sam Street	573	1,677.5	5.5C, PE(A) & PE(B)	\$69.6M
12	Yuen Wo Road	357	1,283.5	5.5C	\$12M
13	Tuen Mun Road (Tsing Lung Tau)	377	1,249.5	3M & 4.5C	\$22.1M
14	Castle Peak Road (Ping Shan)	70	213	2M & 4.5C	\$12M
15	Castle Peak Road (Hung Shui Kiu)	30	141	4M	\$4M

Note 1:

2M - 2m plain barrier	3M - 3m plain barrier
4M - 4m plain barrier	5M - 5m plain barrier
6M - 6m plain barrier	4.5C - cantilevered barrier - type A
5.5C - cantilevered barrier - type B	PE(A) - partial enclosure - type A
PE(B) - partial enclosure - type B	PE(C) - partial enclosure - type C
PE(D) - partial enclosure - type D	PE(E) - partial enclosure - type E
PE(F) - partial enclosure - type F	PE(G) - partial enclosure - type G
FE - full enclosure	

Note 2: Exposure Level = Σ(Mean Exceedance x No. of Dwellings)