A1 AIR QUALITY IMPACT ASSESSMENT

A1.1 INTRODUCTION

This Section presents an air quality impact assessment associated with the construction and operation of the Project, which is undertaken in accordance with the *Air Pollution Control Ordinance (APCO)*.

The primary sources of the air pollution in this Project is expected to be the dust-generating activities during construction phase and traffic emission during the operational phase, particularly from heavy goods vehicles that constitute more than 70% of the existing traffic.

The *Air Sensitive Receivers (ASRs)* within the study area have been identified, and the potential air quality impacts on these ASRs are examined.

A1.2 GOVERNMENT LEGISLATION AND STANDARDS

A1.2.1 Environmental Impact Assessment Ordinance (EIAO)

The Hong Kong *Air Quality Objectives (AQOs)* stipulate maximum acceptable concentration of air pollutants and the maximum allowable numbers of exceedence over a specific period. The relevant AQO requirements are shown in *Table A1.1*.

Table A1.1 – Hong Kong Air Quality Objectives (AQOs)

Pollutants	Concentration in mircograms per cubic metre ($\mu g/m^3$)		
	Average Time		
	1 hour [a]	24 hours [b]	1 year [c]
Nitrogen Dioxide (NO_2)	300	150	80
Respirable Suspended Particulates (RSP)[d]	-	180	55

a Hourly criteria not to be exceeded more than 3 times per year
b Daily criteria not to be exceeded more than once per year
c Arithmetic means
d Respirable suspended particulates means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometer (μm) or smaller.

A1.3 AIR SENSITIVE RECEIVERS

Existing Air Sensitive Receivers

Three representative ASRs have been identified through site inspections and a review of land use plans according to the criteria set out in TM-EIA. The identified ASRs are mainly low-rise village houses located adjacent to the fishponds. Details of the representative ASRs are summarised in *Table A1.2* and their locations shown in *Figure A1.1*:

Table A1.2 – Location of ASRs

ASR	Location	No. of ASRs represented	Ground level (mPD)	Buffer distance (m)	Sensitive Uses
ASR-1	East of proposed alignment.	1	+3.4	50	Two-storey village house
ASR-2	East of proposed alignment.	1	+3.9	123	Two-storey village house
ASR-3	East of proposed alignment.	55	+3.7	155	Two-storey village house

Planned Air Sensitive Receivers

As the works site is located within the Lok Ma Chau boundary control area with restricted access, there is currently no plan for either private or public air sensitive development in the vicinity.

A1.4 BASELINE CONDITIONS

The land within the study area is mainly undeveloped land that has been used for aqua-cultural purposes in the form of fishponds. Many of these fishponds have, however, become inactive in recent years.

The population density in the vicinity is considered low with less than dozen village houses found within the study area.

Existing Air Conditions

The ambient air quality of the study area has been established using EPD's data from the air monitoring station at Yuen Long. The concentration levels of NO_2, SO_2, Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) at the Yuen Long Station during 2000 are shown in *Table A1.3*:

Table A1.3 – Air pollutants concentrations at Yuen Long EPD Station (2000)

Pollutant	Concentration in µg/m3					
	1 hour		24 hour		Annual	
	Max	AQOs	Max	AQOs	Max	AQOs
TSP	N/A	500	288	260	95	80
RSP	281	N/A	176	180	56	55
NO_2	260	300	148	150	57	80
SO_2	251	800	79	350	19	80

Note: "N/A" means Not Applicable

It is likely that the high TSP and RSP levels observed have been attributed to the ongoing infrastructure construction works in the vicinity, the West Rail projects and the industrial activities across the border in Shenzhen.

A1.5 CONSTRUCTION PHASE

A1.5.1 Potential Source of Impact

During the construction phase of the project, it is anticipated that the level of TSP and RSP will rise. Although emission from heavy construction vehicles and plants may contribute towards pollution during construction, the number of such vehicles and plants is likely to be negligible compared with the goods and containers vehicles trafficking at the Crossing.

A1.5.2 Evaluation of Impacts

The potential dust-generating activities would be from loading and unloading of construction materials, top soil removal, travel over dirt roads and wind erosion. There is no major site formation or excavation work required in this Project, thus no large stockpiling area will be required. The overall scale of earthworks for this project is therefore considered relative minor.

Bored-piles will be used for the foundation of bridge piers on land and the impact in terms of dust-generation is likely to be limited. Offshore piling will involve excavation of marine materials from the River with high moisture content, and hence unlikely to contribute towards dust-generation.

As said earlier, the emission from the construction vehicles and plants are considered negligible in comparison with the existing traffic at the Crossing.

The overall level of impact on air quality from the proposed works is considered low and acceptable.

A1.5.3 Recommended Mitigation Measures

Despite the conclusion that the level of air impact during the construction phase of the Project is low and acceptable, the following mitigation measures should be implemented as good site practices to minimize any residual impacts:

- Impose on-site vehicle speed restrictions and wheel washing facilities at all site access points;
- All dusty materials should be sprayed with water immediately prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet;
- Where breaking of rock/concrete is required, watering should be implemented to suppress dust generation, water spray should be used during the handling of excavated material at the site;
- Careful handing and the containment or damping of dusty material;
- The load on vehicles should be covered entirely by clean impervious sheeting to ensure that the dusty material do not leak from the vehicle; and
- Frequent watering or covering of exposed area of ground and prompt site restoration.

A1.6 OPERATIONAL PHASE

A1.6.1 Potential Source of Impact

As mentioned earlier, the main sources of pollution during the operational phase of the Project is the emission from moving vehicles.

The latest traffic figures indicate that the worst-case traffic flow within the 15-year period after the operation of the bridge will rise from 1150 vehicles/hr to 1500 vehicles/hr (i.e. 3000vehicles/hr including both north and southbound traffic), with 36% and 41% of which are goods vehicles and container goods vehicles. The traffic forecast within the 15-year period is expected to peak in year 2006, and hence traffic figures for 2006 is used to assess the worst-case scenario.

A1.6.2 Assessment Methodology

i. Traffic Forecast

The above traffic figures have been adopted in this assessment with effect from the queuing vehicles at inbound and outbound kiosks as shown in *Table A1.4*. The worst-case scenario at the immigration kiosks is considered in the model with the assumption that all the kiosks are queued with vehicles at the same time.

Table A1.4 – Queuing Forecast at Outbound Kiosks

Kiosk No	Vehicle Type	Maximum Steady Queue at Each Kiosk	
		AM Peak	PM Peak
1	Coaches	12 at alighting 20 at boarding	12 at alighting 20 at boarding
2-4	Cars	1 car	1 car
5-12	Goods Vehicles	1 vehicle	1 vehicle

Table A1.5 – Queuing Forecast at Inbound Kiosks

Kiosk No	Vehicle Type	Maximum Steady Queue at Each Kiosk	
		AM Peak	PM Peak
12	Coaches	12 at alighting 20 at boarding	12 at alighting 20 at boarding
12	Cars	1 car (Nominal)	1 car (Nominal)
1-11	Goods Vehicles	1 vehicle	1 vehicle

ii. Air Dispersion Modelling

The USEPA approved CALINE4 dispersion model has been used to predict the concentrations of NO_2 and RSP due to vehicle emissions. The hourly average concentration of NO_2 and RSP are modeled at the worst affected height, 1.5m above ground level, at the ASRs.

Mainland fuel emission factors for the year 2005, provided by EPD, have been used for this assessment. To take into account the effect of inbound traffic running on Mainland fuel, it is considered appropriate to increase the fuel emission factors by 20% for RSP and 5% for NO_x for southbound traffic coming into HKSAR via the Crossing. To ensure conservatism in the study, the same factors have also been assumed for the northbound traffic leaving the HKSAR. This would represent the worst-case scenario, in that it is unlikely that vehicles leaving the SAR would still be running on Mainland fuel, and hence the assumption of all vehicles, both south and northbound, having the same increased emission factors would be an upper bound assumption.

In this study, therefore, the Mainland fuel emission factors for both free flow and idling modes have been applied to the whole road network assessed for conservatism. *Table A1.6* shows the vehicle emission factors, both the traveling and idling, employed for this air quality assessment.

Table A1.6 – Vehicle Emission Factors

Vehicle Type	**Emission Factor**			
	Travelling (g/km)		**Idling (g/min)**	
	NO_x	**RSP**	**NO_x**	**RSP**
Passenger Car	0.71	0.03	0.21	Negligible
Goods Vehicle	5.52	0.89	2.1	0.06
Bus	7.91	0.81	2.1	0.06

Peak hour traffic is expected during the daytime and the worst-case scenario of neutral meteorological conditions was assumed in the model run. Typical input parameters for the model are listed below:

- Wind speed: 1 ms^{-1}
- Wind direction: worst case for each receiver
- Stability class: D
- Mixing height: 500 m
- Standard deviation of wind direction: 18 degree
- Surface roughness: 100 cm
- Temperature: 25 °C

The NO_x gas is assumed to be inert and the levels of NO_2 were taken as 20% of total NO_x emissions. Traffic emissions from the queuing of vehicles are modeled as "parking lot" in the CALINE4 model.

Modelling is undertaken to establish worst-case 1-hour average NO_2 and RSP concentrations at the ASRs. The 24-hour average NO_2 and RSP concentrations are assumed to be 40% of the respective hourly average, in accordance with the EPA's *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources*.

The annual average concentrations of pollutants at Yuen Long Station for the year 2000 were taken as background of this Study, and are as follows.

Table A1.7 - Annual Average Concentrations of Pollutants at Yuen Long Station

Pollutant	Concentration ($\mu g/m^3$) (1)
NO_2	57
RSP	56

(1) Air Quality in Hong Kong 2000, Environmental Protection Department

A1.6.3 Evaluation of Impacts

Assessment Results

Peak-hour average pollution contours (with background NO_2 and RSP concentrations included) are shown in *Figures A1.2, A1.3 and A1.4*. The predicted RSP and NO_2 concentrations at the identified ASRs are shown in below in *Table A1.8*.

Table A1.8 – Predicted NO_2 and RSP levels from vehicular emission at the ASRs

ASR	1-hr NO_2 concentration (μg/m3)		24-hr NO_2 concentration (μg/m3)		24-hr RSP concentration (μg/m3)	
	Predicted	AQO	Predicted	AQO	Predicted	AQO
1	180	300	110	150	82	180
2	< 150	300	< 90	150	68	180
3	< 150	300	< 90	150	66	180

The analysis results indicate that the maximum hourly and 24-hour NO_2 concentrations will be considerably lower than that of the AQO requirement. The peak-hour RSP concentrations will also meet 24-hour AQO requirement.

The above modeling results show that, during the operational phase of the Project, all of the three identified representative ASRs would be subject to air impact well within the standards laid down under the AQO. Furthermore, there is currently no planned ASR in the vicinity of the Project.

A1.7 CONCLUSION

The air impact assessment has examined potential impacts arisen during both the construction phase and the operational phase of the proposed Project.

It is concluded that the proposed construction activities and the use of construction vehicles and plants would not bring about a significant impact on air quality. However, it is recommended that good construction practices be implemented to further minimize any residual impact that could arise from the proposed works.

The effect of idling vehicles at the nearby kiosks and the use of Mainland fuel on southbound vehicles have been taken into account in the assessment for the operational phase. To ensure conservatism in this study, the Mainland fuel

emission factors for both free flow and idling modes have been applied to the whole road network assessed.

The results indicate that the deterioration in air quality, especially in terms of NO_2 and RSP concentration levels usually associated with traffic emission, will be within the acceptable levels as stipulated in the AQO requirements.