

ENVIRONMENTAL IMPACT ASSESSMENT ORDINANCE (CAP. 499)
SECTION 5 (7)

ENVIRONMENTAL IMPACT ASSESSMENT STUDY BRIEF NO. ESB- 220/2011

**PROJECT TITLE: IN-SITU REPROVISIONING OF
SHA TIN WATER TREATMENT WORKS – SOUTH WORKS**
(hereinafter known as the “Project”)

NAME OF APPLICANT : WATER SUPPLIES DEPARTMENT
(hereinafter known as the “Applicant”)

1. BACKGROUND

- 1.1 An application (No. ESB-220/2011) for an Environmental Impact Assessment (EIA) Study Brief under section 5(1)(a) of the Environmental Impact Assessment Ordinance (EIAO) was submitted by the Applicant on 25 January 2011 with a project profile (No. PP-430/2011) (hereafter referred as the “Project Profile”).
- 1.2 The Project is to reprovision the South Works of the Sha Tin Water Treatment Works (STWTW) which has been operated since 1964 with an proposed output of 550 000m³ of treated water per day. Location plan of the Project is shown in Figure 1.1 of the Project Profile and is reproduced in Appendix A of this study brief. The Project will comprise the following major works:
- (i) Reprovisioning of the existing facilities at South Works of the STWTW in phases including south clarifier No. 1 - No. 4, the associated filter beds, the clear water tanks, the filtered water pumping station for South Works and common facilities for both North and South Works including chemical house, alum saturator tanks, administration building, and the Dangerous Goods (DGs) Store;
 - (ii) Reprovisioning of common facilities including an administration building, visitor centre, regional laboratory (Mainland East laboratory), pre-treatment facilities, chemical house, switch gears and power supply, treated water pumping station, surge suppression facilities, and wash water recovery facilities;
 - (iii) Cut-back of the existing man-made slope located west of the existing clarifiers for reprovisioning of chemical house and pretreatment facilities;
 - (iv) Construction of a new access road along the northern and western edges of the Filter Bed area of the North Works; and
 - (v) Provision of all associated civil, geotechnical, mechanical and electrical works.
- 1.3 The Project is a designated project under item E2 of Part 1, Schedule 2 of the EIAO, which specifies that “water treatment works with a capacity of more than 100 000m³ per day”. In accordance with section 5(1)(a) of the EIAO, a person who is planning a Designated Project shall apply to the Director of Environmental Protection (the Director) for a Study Brief to carry out an EIA study.

- 1.4 Pursuant to section 5(7)(a) of the EIAO, the Director of Environmental Protection (the Director) issues this EIA Study Brief to the Applicant to carry out an EIA study.
- 1.5 The purpose of this EIA study is to provide information on the nature and extent of environmental impacts arising from demolition, construction and operation of the Project, and the related activities taking place concurrently. This information will contribute to decisions by the Director on:
- (i) the acceptability of adverse environmental consequences that are likely to arise as a result of the Project and associated works;
 - (ii) the conditions and requirements for the design, demolition, construction and operation of the Project and associated works, including taking into account their interconnection, co-existence and development programmes, to mitigate against adverse environmental consequences; and
 - (iii) the acceptability of residual impacts after the proposed mitigation measures are implemented.

2. OBJECTIVES OF THE EIA STUDY

2.1 The objectives of the EIA study are as follows:

- (i) to describe the Project and associated works together with the requirements, implementation programme and any phasing programme for carrying out the Project;
- (ii) to identify and describe elements of community and environment likely to be affected by the Project and associated works and/or likely to cause adverse impacts to the Project and associated works, including both the natural and man-made environment and the associated environmental constraints;
- (iii) to provide information on the consideration of alternatives (such as location/siting, scale, size, layout, configuration, water treatment design options, sequence and method of construction, and programme for the Project) with a view to avoiding or minimizing the potential environmental impacts to (a) the environmentally sensitive areas and other sensitive uses, in particular, Hin Keng Estate, users of proposed Shatin to Central Link, and (b) the Project itself, in particular, the risk to life due to existence of the Potentially Hazardous Installations (PHIs) within the Project site;
- (iv) to compare the environmental benefits and disbenefits of each of the alternative options and to provide reasons for selecting the preferred option(s) by means of describing the part environmental factors played in the selection;
- (v) to identify and assess the potential risk to human life due to the construction works impact on the operation of the existing PHI (Chlorine Store), the 400kV overhead power line and other notifiable gas installations (NGIs), e.g. Beacon Hill North Offtake Station present or in the vicinity of Project site and to propose measures to mitigate these impacts;

- (vi) to identify and quantify emission sources, including noise emission, sewage and wastewater emission, and waste generation, and to determine the significance of impacts on sensitive receivers and potential affected uses;
- (vii) to identify and quantify any potential loss or damage and other potential impacts to ecological resources, flora, fauna and natural habitats and to propose measures to mitigate these impacts;
- (viii) to identify and quantify the potential risks due to the potential land contamination caused by the existing facilities in the Project site and to propose measures to mitigate these impacts;
- (ix) to identify any potential landscape and visual impacts and to propose measures to mitigate these impacts;
- (x) to identify any negative impacts on heritage resources and to propose measures to mitigate these impacts;
- (xi) to propose measures to avoid or the provision of infrastructures or mitigation measures to minimize risk, pollution, environmental disturbance and nuisance during demolition, construction and operation of the Project and associated works;
- (xii) to investigate the feasibility, practicability, effectiveness and implications of the proposed mitigation measures;
- (xiii) to identify, predict and evaluate the residual environmental impacts (i.e. after practicable mitigation) and the cumulative effects expected to arise during the demolition, construction and operation of the Project and associated works, taking into account the relevant programmes on reprovisioning of the affected facilities, in relation to the sensitive receivers and potentially affected uses;
- (xiv) to identify, assess and specify methods, measures and standards to be included in the detailed design, demolition, construction and operation of the Project and associated works which are necessary to mitigate these environmental impacts and cumulative effects and reduce them to acceptable levels;
- (xv) to investigate the extent of the secondary environmental impacts that may arise from the proposed mitigation measures and to identify constraints associated with the mitigation measures recommended in the EIA study, as well as the provision of any necessary modification;
- (xvi) to design and specify environmental monitoring and audit requirements to check the effective implementation of the recommended environmental protection and pollution control measures; and
- (xvii) to identify potential individual project(s) and associated works of the Project that fall under Schedule 2 of the EIAO; to ascertain whether the findings of this EIA study have adequately addressed the environmental impacts of the identified EIAO Schedule 2 designated projects; and, where necessary, to identify the outstanding issues that need to be addressed in any further detailed EIA study.

3. DETAILED REQUIREMENTS OF THE EIA STUDY

3.1 The Purpose

3.1.1 The purpose of this Study Brief is to scope the key issues of the EIA study and to specify the environmental issues that are required to be reviewed and assessed in the EIA report. The Applicant has to demonstrate in the EIA report that the criteria in the relevant sections of the Technical Memorandum on the Environmental Impact Assessment Process of the EIAO (hereinafter referred to as the “TM”) are met with.

3.2 The Scope

3.2.1 The scope of this EIA study shall cover the Project proposed in the Project Profile and mentioned in sections 1.2 above. The EIA study shall cover the impacts of the entire Project and the cumulative impacts of the existing, committed and planned developments in the vicinity of the Project based on relevant project programmes.

3.2.2 The EIA study shall address the likely key issues described below, together with any other key issues identified during the course of the EIA study:

- (i) exploration of alternatives to include but not limited to different water treatment options and different project layout to avoid serious environmental and ecological impacts which could not be satisfactorily mitigated;
- (ii) potential air quality impacts from the demolition and construction of the project, taking into account the cumulative impacts from the existing and planned sources of pollution in the vicinity of the project, on the sensitive receivers within the study area;
- (iii) potential noise impacts from the demolition, construction and operation of the project, taking into account the cumulative impacts from other concurrent projects in the vicinity of the project, on the sensitive receivers within the study area;
- (iv) potential water quality impacts from the demolition, construction and operation of the project taking into account the cumulative impacts from other concurrent projects in the vicinity of the project, on the relevant aquatic system(s);
- (v) potential impacts of various types of waste arising from the demolition, construction and operation of the project;
- (vi) potential hazard to life on construction workers, operational staff and other sensitive receivers to be identified, with STWTW is Potentially Hazardous Installations (PHI) due to the use of liquid chlorine on site and the Beacon Hill North Offtake Station and its associated 750mm diameter high pressure gas pipeline that runs through the old Beacon Hill Tunnel, and the possible use of explosives for blasting if applicable;
- (vii) potential aquatic and terrestrial ecological impacts from the demolition, construction and operation of the project areas arising from loss of habitats, removal of vegetation, the impact and disturbance to animal and plants. The

assessment shall identify and evaluate all direct, indirect and cumulative impacts resulting from the proposed Project during demolition, construction and the operational phases. Any adverse impact shall be fully addressed and mitigated;

- (viii) potential landscape and visual impacts from the construction and operation of the project;
- (ix) the potential impacts on cultural heritage items, e.g. Ex Kowloon-Canton Railway Beacon Hill Tunnel, if any;
- (x) the potential hazards and environmental impacts associated with the potential land contamination caused by the existing facilities and the secondary hazards and environmental impacts that may arise from the remediation of contaminated land; and
- (xi) cumulative environmental impacts of the Project, through interaction or in combination with other existing, committed and planned developments in the vicinity of the Project including Sha Tin to Central Link, etc., and that those impacts may have a bearing on the environmental acceptability of the Project.

3.3 Consideration of Alternatives

The Applicant shall present in the EIA report the consideration of alternative options, including location, scale, size, scope, shape, configuration, layout, design, construction method, decontamination method, sequence of construction works, programme on re-provisioning of affected facilities, operational mode, etc., for developing the Project, with a view to recommending a preferred option(s) to avoid or minimize any hazards and adverse environmental impacts during demolition, construction and operation of the Project. The combined effect with respect to the severity and duration of the environmental impacts to the affected sensitive receivers shall be taken into consideration. Comparison of the environmental benefits and disbenefits of applying different development options shall be made. Other factors or constraints affecting the development options of the Project shall be stated.

3.3.1 Need for the Project

The Applicant shall study and review the need for the Project and provide information to justify the need. The Consultant shall explain clearly the purpose and objectives of the Project and describe the scenarios with and without the Project.

3.3.2 Consideration of Different Layout Options

In addition to the proposed layout set out in the Project Profile, the Applicant shall consider other feasible alternative options for the proposed project, provide justification for the selected layout, including description of the environmental factors considered in the selection process and attempts made to avoid ecological sensitive areas.

3.3.3 Consideration of Alternative Construction Methods and Sequences of Works

The Applicant shall present in the EIA report the consideration of alternative options, including location, scale, size, scope, shape, configuration, layout, design, construction

method, sequence of construction works, programme on reprovisioning of affected facilities, operational mode, etc., for developing the Project, with a view to recommending a preferred option(s) to avoid or minimize any hazards and adverse environmental impacts during demolition, construction and operation of the Project. The combined effect with respect to the severity and duration of the environmental impacts to the affected sensitive receivers shall be taken into consideration. Comparison of the environmental benefits and disbenefits of applying different development options shall be made. Other factors or constraints affecting the development options of the Project shall be stated.

3.3.4 Selection of Preferred Scenario

Taking into consideration of the findings above, the Applicant shall recommend with full justifications the adoption of the preferred scenario that will avoid or minimise adverse environmental effects arising from the Project, and adequately describe the part that environmental factors played in arriving at the final selection.

3.4 **Technical Requirements**

3.4.1 The Applicant shall conduct the EIA study to address all environmental aspects of the activities as described in Sections 3.1, 3.2 and 3.3 above. The assessment shall be based on the best and latest information available during the course of the EIA study. The Applicant shall include in the EIA report details of the reprovisioning programme of affected facilities, construction programme and methodologies. The Applicant shall clearly state in the EIA report the time frame and work programmes of the Project and other concurrent projects, and assess the cumulative environmental impacts from the Project and interacting projects as identified in the EIA study.

3.4.2 The EIA study shall include the following technical requirements on specific impacts.

3.4.3 **Hazard to Life**

3.4.3.1 The Applicant shall follow the criteria for evaluating hazard to life as stated in Annex 4 of the TM. The Applicant shall identify and assess hazard issues on dangerous goods related to the project including, but not limited to, the following:-

Explosives

3.4.3.2 The Applicant shall investigate alternative construction methods to avoid the use of explosives. If there is use of explosives for the construction activities and the storage or blasting location is in close proximity to populated areas and/or Potentially Hazardous Installation site (i.e. STWTW), the Applicant shall carry out hazard assessment as follows:

- (i) Identify hazardous scenarios associated with the transport, storage and use of explosives (including possible damage scenarios to gas and chlorine facilities) and then determine a set of relevant scenarios to be included in a Quantitative Risk Assessment (QRA);
- (ii) Execute a QRA of the set of hazardous scenarios determined in (i), expressing population risks in both individual and societal terms;

- (iii) Compare individual and societal risks with the criteria for evaluating hazard to life stipulated in Annex 4 of the TM; and
- (iv) Identify and assess practicable and cost-effective risk mitigation measures.

The methodology to be used in the hazard assessment should be consistent with previous studies having similar issues (e.g. Shatin-to-Central Link (Tai Wai to Hung Hom Section) (ESB-191/2008), and Central Kowloon Route (ESB-156/2006)).

Chlorine and other relevant hazardous materials

3.4.3.3 The Applicant shall investigate methods to avoid and/or minimize chlorine risks. The Applicant shall carry out hazard assessment to evaluate potential hazard to life during construction and operation stages of the Project due to STWTW. The hazard assessment shall include the following:

- (i) Identify hazardous scenarios associated with the transport, storage and use of chlorine at STWTW (including possible damage scenarios associated with construction activities, storage of liquid oxygen) and then determine a set of relevant scenarios to be included in a QRA;
- (ii) Execute a QRA of the set of hazardous scenarios determined in (i), expressing population risks in both individual and societal terms;
- (iii) Compare individual and societal risks with the criteria for evaluating hazard to life stipulated in Annex 4 of the TM; and
- (iv) Identify and assess practicable and cost-effective risk mitigation measures.

The methodology to be used in the hazard assessment should be consistent with previous studies having similar issues (e.g. Shatin-to-Central Link (Tai Wai to Hung Hom Section) (ESB-191/2008), and Integration of Siu Ho Wan and Silver Mine Bay Water Treatment Works (ESB-150/2006)).

3.4.4 Land Contamination

3.4.4.1 The Applicant shall follow the guidelines for evaluating and assessing potential land contamination issues as stated in Section 3.1 and 3.2 of Annex 19 of the TM.

3.4.4.2 The "Assessment Area" for the land contamination impact shall include any potential land contamination site(s) within the Project area, in particular areas used for pumping station, alum saturators tanks, dangerous goods stores and any other potential contaminated site(s) identified in this EIA study.

3.4.4.3 The Applicant shall provide a clear and detailed account of the present land use (including description of the activities, chemicals and hazardous substances handled, with clear indication of their storage and location, by reference to a site map) and a complete past land uses history in relation to possible land contamination (including accident records and change of land use(s) and the like).

3.4.4.4 During the course of the EIA study, the Applicant shall submit a Contamination

Assessment Plan (CAP) where applicable to the Director for endorsement prior to conducting the contamination impact assessment of the relevant land or site(s). The CAP shall include proposal with details on representative sampling and analysis required to determine the nature and the extent of the contamination of the relevant land or site(s). Alternatively, the Applicant may refer to other previously agreed and still relevant and valid CAP(s) for the concerned site(s).

3.4.4.5 Based on the endorsed CAP, the Applicant shall conduct a land contamination impact assessment and submit a Contamination Assessment Report (CAR) to the Director for endorsement. If land contamination is confirmed, a Remedial Action Plan (RAP) to formulate viable remedial measures with supporting documents, such as agreement by the relevant facilities management authorities, shall be submitted to the Director for approval. The Applicant shall then clean up the contaminated land or site(s) according to the approved RAP, and a Remediation Report (RR) to demonstrate adequate clean-up should be prepared and submitted to the Director for endorsement prior to the commencement of any development works within the site.. The CAP, CAR and RAP shall be documented in the EIA report.

3.4.4.6 If there is/are potential contaminated site(s) inaccessible for preparing sampling and analysis during the course of the EIA study, e.g. due to site access problem, the Applicant's CAP shall include :

- (i) a review of the available information;
- (ii) an initial contamination evaluation of this/these site(s) and possible remediation methods;
- (iii) a confirmation of whether the contamination problem at this/these site(s) will be surmountable;
- (iv) a sampling and analysis proposal which shall aim at determining the nature and the extent of the contamination of this/these site(s); and
- (v) a schedule of submission of revised CAP (if necessary), CAR, RAP and RR upon this/these site(s) is/are accessible.

3.4.4.7 The Applicant shall complete land contamination assessment and remediation (if necessary) at the potential contaminated site(s) prior to the commencement of the construction works at the respective site(s).

3.4.5 **Water Quality Impact**

3.4.5.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing water pollution as stated in Annexes 6 and 14 of the TM.

3.4.5.2 The assessment area for the purpose of this water quality impact assessment shall cover the project area(s) as shown in Appendix A and all areas within a distance of 500m from the boundary of the Project site, including any stream courses and the associated water system in the vicinity that may be affected by the project. The study area could be extended to include other areas if they are found also being impacted during the course of the EIA study and have a bearing on the environmental acceptability of the Project.

3.4.5.3 The Applicant shall identify and analyse in the assessment the physical, chemical and biological disruptions of estuarine, fresh water, existing and new drainage system, and the associated water system(s) in the vicinity arising from demolition, construction and operation of the Project.

3.4.5.4 The Applicant shall take into account and include the following in the water quality impact assessment:-

General

- (i) Collection and review of background information on the existing water system(s) and their respective catchments, and sensitive receivers which might be affected by the Project during demolition, construction and operation;
- (ii) Characterization of water and sediment quality of the related water system(s) and sensitive receivers, which might be affected by the Project based on existing information or appropriate site survey/tests as appropriate;
- (iii) Identification and analysis of existing and future activities and beneficial uses related to the water system(s) and identification of water sensitive receivers. The Applicant shall refer to *inter alia* those developments and uses earmarked on the relevant Outline Zoning Plans, Development Permission Area Plans, Outline Development Plans and Layout Plans;
- (iv) Identification of pertinent water and sediment quality objectives, criteria and standards for the water system(s) and the sensitive receivers;
- (v) Identification of any alteration of water courses, natural streams/ponds, wetland, change of shoreline or bathymetry, change of flow regimes, change of catchment types or areas and any other hydrological changes in the study area;
- (vi) Identification, analysis and quantification of existing and future water and sediment pollution sources, including point and non-point discharges to surface water runoff, and analysis of the provision and adequacy of future facilities to reduce such pollution. An emission inventory on the quantities and characteristics of these existing and future pollution sources in the assessment area shall also be provided. Field investigation and laboratory tests, as appropriate, shall be conducted to fill in any relevant information gaps;
- (vii) Report on the adequacy of the existing sewerage and sewage treatment facilities for the handling treatment and disposal of wastewater arising from the Project;

Impact Prediction

- (viii) Prediction and quantification, by mathematical modelling or other technique approved by the Director, of impacts on the water system(s) and the sensitive receivers due to those alterations and changes identified in (v) above and the pollution sources identified in (vi) above. Possible impacts include changes in hydrology, flow regime, silting, sediment erosion or deposition, water and sediment quality and the sewerage and sewage treatment facilities due to such changes. The prediction shall include possible different demolition stages or

sequences, different construction stages or sequences, and different operation stages for the preferred development option, and emergencies arising from the Project including emergency discharge, leakage and overflow from wastewater treatment facility;

- (ix) Prediction of potential water quality impact on the water system and sensitive receivers during different demolition stages or sequences, different construction stages or sequences, and different operation stages for the preferred development option;
- (x) Assessment of cumulative impacts due to other projects, activities or pollution sources in the vicinity of the identified water system(s) and sensitive receivers that may have a bearing on the environmental acceptability of the Project, subject to the agreement of the Director shall also be predicted and quantified;

Waste Water and Non-point Sources Pollution

- (xi) Proposal for upgrading or providing any effective infrastructure, water pollution prevention and mitigation measures to be implemented during the demolition, construction and operation stages so as to handle any wastewater generated including emergency wastewater discharge and to reduce the water and sediment quality impacts to within standards. Appropriate mitigation measures shall be implemented with a view to avoiding emergency sewage discharge, overflow and leakage of wastewater from wastewater treatment facilities. Requirements to be incorporated in the project contract document shall also be proposed;
- (xii) Investigation of and proposal for, as appropriate, best management practices to reduce storm water and non-point source pollution; and
- (xiii) Evaluation and quantification of residual impacts on the water systems(s) and the sensitive receivers with regard to appropriate water and sediment quality objectives, criteria, standards or guidelines.

3.4.6 Air Quality Impact

3.4.6.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing air quality impact as stated in Annexes 4 and 12 of the TM.

3.4.6.2 The study area for air quality impact assessment shall be defined by a distance of 500 metres from the Project boundary shown in Appendix A of this Study Brief or other project locations as identified in the EIA, which shall be extended to include major existing, planned and committed air pollutant emission sources that may have a bearing on the environmental acceptability of the Project. The assessment shall include the existing, planned and committed sensitive receivers within the study area as well as areas where air quality may be potentially affected by the Project. Such assessment shall be based on the best available information at the time of the assessment.

3.4.6.3 The Applicant shall assess the air pollutant concentrations with reference to the relevant sections of the guidelines in Appendices B-1 to B-3 attached to this Study Brief, or other methodology as agreed by the Director.

3.4.6.4 The air quality impact assessment shall include the following:

(i) Background and Analysis of Activities

- (a) Provision of background information relating to air quality issues relevant to the Project, e.g. description of the types of activities of the Project that may affect air quality during demolition and construction stages.
- (b) Giving of an account, where appropriate, of the consideration/measures that have been taken into consideration in the planning of the Project to abate the air pollution impact. The Applicant shall consider alternative construction methods and phasing programmes, and alternative operation modes to minimize the air quality impact during demolition and construction of the Project.
- (c) Presentation of the background air quality levels in the assessment area for the purpose of evaluating the cumulative air quality impacts during demolition and construction stages of the Project.

(ii) Identification of Air Sensitive Receivers (ASRs) and Examination of Emission/Dispersion Characteristics

- (a) Identification and description of existing, planned and committed ASRs that would likely be affected by the Project including those earmarked on the relevant Outline Zoning Plans, Development Permission Area Plans, Outline Development Plans, Layout Plans and other relevant published land use plans, including plans and drawings published by Lands Department and any land use and development applications approved by the Town Planning Board. The Applicant shall select the assessment points of the identified ASRs that represent the worst impact point of these ASRs. A map showing the location and description such as name of buildings, their uses and height of the selected assessment points shall be given. The separation distances of these ASRs from the nearest emission sources shall also be given.
- (b) Provision of a list of air pollutant emission sources, including any nearby emission sources which are likely to have impact related to the Project based on the analysis of the activities during demolition and construction stages of the Project in sub-section 3.4.6.4(i). Confirmation regarding the validity of the assumptions adopted and the magnitude of the activities (e.g. volume of construction material handled, etc.) shall be obtained from the relevant government departments /authorities and documented.

(iii) Construction Phase Air Quality Impact

- (a) The Applicant shall follow the requirements stipulated under the Air Pollution Control (Construction Dust) Regulation to ensure that construction dust impacts which may arise as a result of the works are controlled within the relevant standards as stipulated in section 1 of Annex 4 of the TM. A monitoring and audit programme for the construction phase shall be devised to verify the effectiveness of the control measures proposed so as to ensure proper construction dust control.

- (b) If the Applicant anticipates that the Project will give rise to significant construction dust impacts likely to exceed the recommended limits in the TM at the ASRs despite the incorporation of the dust control measures proposed in accordance with the sub-section 3.4.6.4(iii)(a) above, a quantitative assessment shall be carried out to evaluate the construction dust impact at the identified ASRs. The Applicant shall follow the methodology set out in sub-section 3.4.6.4(iv) below when carrying out the quantitative assessment.
- (iv) Quantitative Assessment Methodology
- (a) The Applicant shall apply the general principles enunciated in the modelling guidelines in Appendices B-1 to B-3 while making allowance for the specific characteristic of the Project. This specific methodology must be documented in such level of details, preferably assisted with tables and diagrams, to allow the readers of the EIA report to grasp how the model has been set up to simulate the situation under study without referring to the model input files. Detailed calculations of air pollutants emission rates for input to the modelling and maps shall be presented in the EIA report. The Applicant must ensure consistency between the text description and the model files at every stage of submissions for review. In case of doubt, prior agreement between the Applicant and the Director on the specific modelling details should be sought.
- (b) The Applicant shall identify the key/representative air pollutant parameters (types of pollutants and the averaging time concentrations) to be evaluated and provide explanation for selecting such parameters for assessing the impact from the Project.
- (c) The Applicant shall calculate the cumulative air quality impact at the ASRs identified under sub-section 3.4.6.4(ii) above and compare these results against the criteria set out in section 1 of Annex 4 in the TM. The predicted air quality impacts (both unmitigated and mitigated) shall be presented in the form of summary table(s) and pollution contours, to be evaluated against the relevant air quality standards and on any effect they may have on the land use implications. Plans of a suitable scale should be used to present pollution contours to allow buffer distance requirements to be determined properly.

(v) Mitigation Measures for Non-compliance

The Applicant shall propose remedies and mitigating measures where the predicted air quality impact exceeds the criteria set in section 1 of Annex 4 in the TM. These measures and other associated constraints on future land use planning shall be agreed with the relevant government departments/authorities and be clearly documented in the EIA report. The Applicant shall demonstrate quantitatively whether the residual impacts after incorporation of the proposed mitigating measures will comply with the criteria stipulated in section 1 of Annex 4 in the TM.

(vi) Submission of Model Files

All input and output file(s) of the model run(s), including those files for generating the pollution contours and emission calculation work sheets, shall be submitted to the Director in electronic format together with submission of the EIA report.

3.4.7 Noise Impact

3.4.7.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing noise impact as stated in Annexes 5 and 13 of the TM.

3.4.7.2 The noise impact assessment shall include the following :-

(i) Determination of Assessment Area

The study area for the noise impact assessment shall generally include areas within a distance of 300m from the Project boundary as shown in Appendix A of this Study Brief or other Project locations as identified in the EIA. Subject to the agreement of the Director, the assessment area can be reduced accordingly if the first layer of noise sensitive receivers (NSRs), closer than 300m from the outer Project limit, provides acoustic shielding to those receivers at distances further away from the Project. The assessment area shall be expanded to include NSRs at distances over 300m from the Project, if those NSRs are affected by the demolition, construction and operation of the Project. The assessment shall cover NSRs at Hin Keng Estate and along Keng Hau Road.

(ii) Provision of Background Information and Existing Noise Levels

- (a) The Applicant shall provide background information relevant to the Project, including relevant previous or current studies. Unless required for determining the planning standards, such as those for planning of fixed noise sources, no existing noise levels are particularly required.
- (b) For ground-borne noise impact, the background information and existing noise levels shall be measured and described in a way sufficient for identification and prediction of noise impacts, and for formulation of noise criteria. Where necessary, baseline noise surveys shall be carried out to determine the existing noise conditions inside NSRs likely to be affected during the decommissioning, construction and operation of the Project. The type and duration of baseline surveys shall be such that there will be adequate information taking account of natural variation to define the existing conditions. Where appropriate, results from relevant past studies should be used.

(iii) Identification of Noise Sensitive Receivers

- (a) The Applicant shall refer to Annex 13 of the TM when identifying the NSRs. The NSRs shall include existing NSRs and planned/committed noise sensitive developments and uses earmarked on the relevant Outline Zoning Plans, Outline Development Plans, Layout Plans and other relevant published land use plans, including plans and drawings published by Lands Department and any land use and development applications approved by the Town Planning

Board. Photographs of existing NSRs shall be appended to the EIA report.

- (b) The Applicant shall select assessment points to represent the identified NSRs for carrying out quantitative noise assessment described below. A map showing the location and description such as name of building, use, and number of floors of each and every selected assessment point shall be given. For planned noise sensitive land uses without committed site layouts, the Applicant shall use the relevant planning parameters to work out representative site layouts for noise assessment purpose.

(iv) Provision of an Emission Inventory of the Noise Sources

The Applicant shall provide an inventory of noise sources including representative construction equipment for the purpose of carrying out the construction noise assessment, such as those used for tunnelling and other construction works, and vehicular and marine traffic flow, fixed plant equipment and helicopter noise sources, as appropriate, for operational noise assessment. Confirmation of the validity of the inventory shall be obtained from the relevant government departments/authorities and documented in the EIA report. For each selected assessment point, the Applicant shall separate the noise sources into two groups (one having unblocked line of sight to the assessment point and one with blocked line of sight to the assessment point) in the noise impact assessment. For such purpose, the Applicant shall produce plans showing the screened portion of the site and the unscreened portion of the site for each selected assessment point at the beginning of the noise impact assessment.

(v) Construction Noise Assessment

- (a) The assessment shall cover the cumulative noise impacts due to the construction works of the Project and other concurrent projects identified during the course of the EIA study.
- (b) The Applicant shall carry out assessment of noise impact from construction (excluding percussive piling) of the Project during daytime, i.e. 7am to 7pm, on weekdays other than general holidays in accordance with methodology in paragraphs 5.3 and 5.4 of Annex 13 of the TM. The criteria in Table 1B of Annex 5 of TM shall be adopted in the assessment. In case blasting works is involved, it shall be carried out, as far as practicable, outside the sensitive hours of 7 p.m. to 7 a.m. on Monday to Saturday and any time on a general holiday, including Sunday. For blasting that must be carried out during the above-mentioned sensitive hours, the noise impact from the removal of debris and rocks shall be fully assessed and adequate mitigation measures shall be recommended to reduce the noise impact.
- (c) To minimize the construction noise impact, alternative construction methods to replace percussive piling and blasting shall be proposed as far as practicable.
- (d) For noise impact (including air-borne noise and ground-borne noise) associated with the operation of powered mechanical equipment, in particular, tunnel boring machines or equivalent, shall be assessed. If the equipment, such as a tunnel boring machine, are used and it is likely that ground-borne

noise will affect NSRs, the assessment methodology/model for ground-borne noise shall be consistent with previous studies having similar issues or agreed with the Director prior to the assessment. Methodology and the empirical parameters required in the ground-borne noise model shall be documented in the EIA report.

- (e) If the unmitigated construction noise levels are found exceeding the relevant criteria, the Applicant shall propose practicable direct mitigation measures (including movable barriers, enclosures, quieter alternative methods, rescheduling and restricting hours of operation of noisy tasks) to minimize the impact. If the mitigated noise levels still exceed the relevant criteria, the duration of the noise exceedance at the affected NSR shall be given.
- (f) The Applicant shall, as far as practicable, formulate a reasonable construction programme so that no work will be required in restricted hours as defined under the Noise Control Ordinance (NCO). In case the Applicant needs to evaluate whether construction works in restricted hours as defined under the NCO are feasible or not in the context of programming construction works, reference should be made to relevant technical memoranda issued under the NCO. In case the Applicant considers that there is an unavoidable need to conduct certain type of construction works during the restricted hours, detailed justifications shall be provided with the assessment of the degree and duration of the noise impact. Regardless of the results of construction noise impact assessment for restricted hours, the Noise Control Authority will process Construction Noise Permit (CNP) application, if necessary, based on the NCO, the relevant technical memoranda issued under the NCO, and the contemporary conditions/situations. This aspect shall be explicitly stated in the noise chapter and the conclusions and recommendations chapter in EIA report.

(vi) Operational Noise Assessment – Fixed Noise Sources

(a) Assessment of Fixed Noise Source Levels

The Applicant shall calculate the expected noise using standard acoustics principles. Calculations for the expected noise shall be based on assumed plant inventories and utilization schedule for the worst-case scenario. The Applicant shall calculate noise levels taking into account correction of tonality, impulsiveness and intermittency in accordance with Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites issued under the NCO. The Applicant shall provide justification for the sound power level of each type of fixed noise sources. For some equipment having more than one notional sources, e.g. the hoisting motor at the high level and the wheels at the low level of a gantry, the Applicant shall separately assess the noise contribution from each notional source. For equipment having notional source at a very high level, e.g. crane, the notional source shall be assumed at a representative height above the ground level.

(b) Presentation of Noise Levels

The Applicant shall present the existing and future noise levels in L_{eq} (30 min) at the NSRs at various representative floor levels (in m P.D.) on tables and plans of suitable scale. A quantitative assessment at the NSRs for the fixed noise sources shall be carried out and compared against the criteria set out in Table 1A of Annex 5 of the TM.

(c) **Proposals for Noise Mitigation Measures**

The Applicant shall propose direct technical remedies within the Project limits in situations where the predicted noise level exceeds the criteria set out in Table 1A of Annex 5 of the TM to protect the affected NSRs.

3.4.8 **Waste Management Implications**

3.4.8.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing waste management implications as stated in Annexes 7 and 15 of the TM.

3.4.8.2 The assessment of waste management implications shall cover the following:

(i) Analysis of Activities and Waste Generation

The Applicant shall identify the quantity, quality and timing of the wastes arising as a result of the demolition, construction and operation activities of the Project, based on the sequence and duration of these activities, e.g. any construction and demolition materials and other wastes which will be generated during demolition, construction and operation stages. The Applicant shall adopt appropriate design, general layout, construction methods and programme to minimize the generation of public fill/inert construction and demolition (C&D) materials and maximize the use of public fill/inert C&D materials for other construction works, e.g. reclamation work.

(ii) Proposal for Waste Management

- (a) Prior to considering the disposal options for various types of wastes, opportunities for reducing waste generation, on-site or off-site re-use and recycling shall be fully evaluated. Measures that can be taken in the planning and design stages e.g. by modifying the design approach and in the construction stage for maximizing wastes reduction shall be separately considered;
- (b) After considering the opportunities for reducing waste generation and maximizing re-use, the types and quantities of the wastes required to be disposed of as a consequence shall be estimated and the disposal methods/options for each type of waste shall be described in detail. The disposal methods/options recommended for each type of wastes shall take into account the result of the assessment in item (c) below;
- (c) The impact caused by handling (including stockpiling, labelling, packaging & storage), collection, transportation and re-use/disposal of wastes shall be addressed in detail and appropriate mitigation measures shall be proposed.

This assessment shall cover the following areas:

- potential hazard;
- air and odour emissions;
- noise;
- wastewater discharge; and
- public transport.

3.4.9 Ecological Impact

3.4.9.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing ecological impact as stated in Annexes 8 and 16 of the TM.

3.4.9.2 The assessment area for the purpose of terrestrial ecological impact assessment including freshwater habitats shall include areas within 500m distance from the site boundary of the Project and also any other areas likely to be impacted by the Project.

3.4.9.3 In the ecological impact assessment, the Applicant shall examine the flora, fauna and other components of the ecological habitats within the assessment area. The aim shall be to protect, maintain or rehabilitate the natural environment. In particular, the Project, shall avoid or minimise impacts on recognised sites of conservation importance such as SSSIs and wildlife groups or habitats/species of conservation interests such as *Aquilaria sinensis*. The assessment shall identify and quantify as far as possible the potential ecological impacts to the natural environment and the associated wildlife groups and habitats/species arising from the Project including the demolition, construction and operation phases as well as the subsequent management and maintenance of the proposals.

3.4.9.4 The assessment shall include the followings:

- (i) Review of the findings of relevant studies/surveys and collation of the available information regarding the ecological characters of the assessment area;
- (ii) Evaluation of information collected and identification of any information gap relating to the assessment of potential ecological impact;
- (iii) Carrying out of necessary ecological field surveys and investigation of at least 4 months covering the wet season to verify the information gaps identified in (ii) above and to fulfil the objectives of the EIA study;
- (iv) Establishment of the general ecological profile of the Study Area based on data of relevant previous studies/surveys and results of the ecological field surveys, and description of the characteristics of each habitat found; major information to be provided shall include :
 - (a) description of the physical environment, including recognized sites/ habitats of conservation importance, and assessment of whether these sites/habitats will be affected by the Project or not;
 - (b) habitat maps of suitable scale showing the types and locations of habitats/species in the Study Area with special attention to those with conservation interests, including the followings:

- *Aquilaria sinensis*
 - wildlife (e.g. avifauna and mammal); and
 - any other habitats/species identified as having special conservation interest by this EIA study.
- (c) ecological characteristics of each habitat type such as extent, substrate, size, type, species present, dominant species found, species diversity and abundance, community structure, ecological value and inter-dependence of the habitats and species, and presence of any features of ecological importance;
- (d) representative colour photos of each habitat type and any important ecological features identified; and
- (e) species found that are rare, endangered and/or listed under local legislation, international conventions for conservation of wildlife/ habitats or red data books.
- (v) Investigation and description of the existing wildlife uses of the various habitats with special attention to those wildlife groups and habitats with conservation interests by this study;
- (vi) Description of all recognized sites of conservation importance in the proposed development site and its vicinity and assessment on whether these sites will be affected by the proposed development or not;
- (vii) Using suitable methodology and considering also other works activities from other projects reasonably likely to occur at the same time, identification and quantification as far as possible of any direct (e.g. loss of habitats due to site formation and other associated works, etc), indirect (e.g. noise and other disturbance generated by the demolition, construction and operation activities, etc), primary, secondary and cumulative ecological impacts from destruction of habitats, reduction of species abundance/diversity, loss of feeding grounds, reduction of ecological carrying capacity, habitat fragmentation, and in particular potential destruction or disturbance to natural habitats for *Aquilaria sinensis*;
- (viii) Evaluation of significance and acceptability of the ecological impacts by making reference to the criteria in Annex 8 of the TM;
- (ix) Recommendations for possible alternatives, such as modification/change of construction methods, position, scale, size, layout and configuration of Project, and practicable mitigation measures to avoid, minimize and/or compensate for the adverse ecological impacts identified during demolition, construction and operation of the Project;
- (x) Evaluation of the feasibility and effectiveness of the recommended mitigation measures and definition of the scope, type, location, implementation arrangement, resources requirement, subsequent management and maintenance of such measures;
- (xi) Determination and quantification as far as possible of the residual ecological impacts after implementation of the proposed mitigation measures; and

- (xii) Review of the need for and recommendation on any ecological monitoring and audit programme required.

3.4.10 **Landscape and Visual Impact**

- 3.4.10.1 The Applicant shall follow the criteria and guidelines as stated in Annexes 10 and 18 of the TM and the EIAO Guidance Note No. 8/2010 on the preparation of Landscape and Visual Impact Assessment under the EIAO. Landscape and visual impacts during demolition, construction and operation phases within the study area shall be assessed. The assessment area for the landscape impact assessment shall include areas within a 500m distance from the site boundary of the Project while the assessment area for the visual impact assessment shall be defined by the visual envelope of the Project.
- 3.4.10.2 The Applicant shall review relevant outline development plan(s), outline zoning plan(s), layout plan(s), planning briefs and/or studies which may identify areas of high landscape value and recommend country park, green belt, conservation area and woodland areas with sensitive landscape designations and visually sensitive areas/receivers. Any guidelines on landscape and urban design strategies and frameworks that may affect the appreciation of the Project shall also be reviewed. The aim is to gain an insight to the future outlook of the area affected so as to assess whether the Project can fit into the surrounding setting. Any conflict with the statutory town plan(s) and any published land use plans shall be highlighted and appropriate follow-up action shall be recommended.
- 3.4.10.3 The Applicant shall describe, appraise, analyse and evaluate the existing and planned landscape resources and character of the assessment area. A system shall be derived for judging landscape and visual impacts significance. Annotated oblique aerial photographs and plans of suitable scale showing the baseline landscape character areas and landscape resources and mapping of impact assessment shall be extensively used to present the findings of impact assessment. Descriptive text shall provide a concise and reasoned judgement from a landscape and visual point of view. The sensitivity of the landscape framework and its ability to accommodate change shall be particularly focused on. The Applicant shall identify the degree of compatibility of the Project with the existing and planned landscape setting, recreation and. The landscape impact assessment shall quantify the potential landscape impact as far as possible so as to illustrate the significance of such impacts arising from the proposed development. Clear mapping of the landscape impact is required. Tree survey shall be carried out and the impacts on existing trees shall be addressed.
- 3.4.10.4 The Applicant shall assess the visual impacts of the Project. Clear illustration including mapping of visual impact is required. The assessment shall include the following:
 - (i) Identification and plotting of visual envelope of the Project;
 - (ii) Identification of the key groups of existing and planned sensitive receivers within the visual envelope with regard to views from ground level, sea level and elevated vantage points. Among other receivers, sensitive receivers shall include, but not limited to, nearby residents, villagers, users of country parks, access road users, rail users and walkers pass-by. Both distance view and short distance view shall be covered in the assessment;
 - (iii) The assessment shall take into account the factors affecting the sensitivity of

receivers (including value and quality of existing views, availability and amenity alternative views, type and estimated number of receiver population, duration of view and degree of visibility) and the magnitude of change in view (including compatibility of the project with the surrounding landscape and planned setting, duration of impacts under construction and operation phases, scale of development. Reversibility of change, viewing distance and potential blockage of view) for evaluating of visual impacts. The visual impacts of the Project with and without mitigation measures shall also be included so as demonstrate the effectiveness of the proposed mitigation measure; and

- (iv) Clear evaluations and explanations of the factors considered in arriving the significance thresholds of visual impacts, and the factors/constraints in recommending the mitigation measures for visual impact.

3.4.10.5 The Applicant shall evaluate the merits of preservation in totality, in parts or total destruction of existing landscape and the establishment of a new landscape character area. In addition, alternative location, configuration, alignment, site layout, design, built-form, operational mode and construction method that will avoid or reduce the identified landscape and visual impacts shall be evaluated for comparison before adopting other mitigation or compensatory measures to alleviate the impacts. The mitigation measures proposed shall not only be concerned with damage reduction but shall also include consideration of potential enhancement of existing landscape and visual quality. The Applicant shall recommend mitigation measures to minimise adverse effects identified above, including provision of a master landscape plan.

3.4.10.6 The mitigation measures shall also include the preservation of vegetation, transplanting of mature trees, provision of screen planting, re-vegetation of disturbed lands, compensatory planting, woodland restoration, design of structure, provision of finishes to structure, colour scheme and texture of material used and any measures to mitigate the impact on the existing and planned land use and visually sensitive receivers. Parties shall be identified for the on going management and maintenance of the proposed mitigation works to ensure their effectiveness throughout the demolition, construction and operation phases of the Project. A practical programme and funding proposal for the implementation of the recommendation measures shall be provided.

3.4.10.7 Annotated illustration materials such as colour perspective drawings, plans and section/elevation diagrams, annotated oblique aerial photographs, photographs taken at vantage points, and computer-generated photomontage, particularly from but not limited to the most severely affected vantage points shall be adopted to illustrate the significance of the landscape and visual impacts of the Project in four stages i.e. existing conditions, unmitigated impacts at Day 1, mitigated impacts at Day 1 and residual impact at Year 10 so as to demonstrate the effectiveness of the proposed mitigation measures. Computer graphics shall be compatible with Microstation DGN file format. True colour samples may be requested if found necessary and appropriate. The Applicant shall record the technical details in preparing the illustration, which may need to be submitted for verification of the accuracy of the illustration.

3.4.11 **Cultural Heritage Impact**

3.4.11.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing the cultural heritage impacts as stated in Annexes 10 and 19 of the TM.

3.4.11.2 The Applicant shall engage an archaeologist to review information about the Study Area of the Project to identify whether there is any possible existence of sites or remains of archaeological interest that will be affected by the demolition and construction works of the Project. If the review result reveals the existence of such possibility, an Archaeological Survey will be required to further assess the archaeological potential of the Study Area. Should sites or remains of archaeological interest be identified during the survey, appropriate mitigation measures should be designed and implemented prior to the commencement of any construction works. The Archaeological Survey should be conducted by an archaeologist who shall obtain a licence from the Antiquities Authority under the provision of the Antiquities and Monuments Ordinance (Cap 53).

3.4.12 **Summary of Environmental Outcomes**

3.4.12.1 The EIA report shall contain a summary of the key environmental outcomes arising from the EIA study, including estimated population protected from various environmental impacts, the environmentally sensitive areas protected, environmentally friendly options considered and incorporated in the preferred option, environmental designs recommended, key environmental problems avoided, compensation areas included and the environmental benefits of the environmental protection measures recommended.

3.4.13 **Environmental Monitoring and Audit (EM&A) Requirements**

3.4.13.1 The Applicant shall identify in the EIA study whether there is any need for EM&A activities during the demolition, construction and operation phases of the Project, and, if affirmative, to define the scope of the EM&A requirements for the Project in the EIA study.

3.4.13.2 Subject to the confirmation of the EIA study findings, the Applicant shall comply with the requirements as stipulated in Annex 21 of the TM. The Applicant shall also propose real-time reporting of monitoring data for the Project through a dedicated internet website.

3.4.13.3 The Applicant shall prepare a project implementation schedule (in the form of a checklist as shown in Appendix C to this EIA study brief) containing all the EIA study recommendations and mitigation measures with reference to the implementation programme of the Project. A stand-alone implementation schedule shall be prepared for each of the EIAO Schedule 2 designated project identified in this EIA study.

4. DURATION OF VALIDITY

4.1 The Applicant shall notify the Director of the commencement of the EIA study. If the EIA study does not commence within 36 months after the date of the issuance of this EIA study brief, the Applicant shall apply to the Director for a fresh EIA study brief before commencement of the EIA study.

5. REPORTING REQUIREMENTS

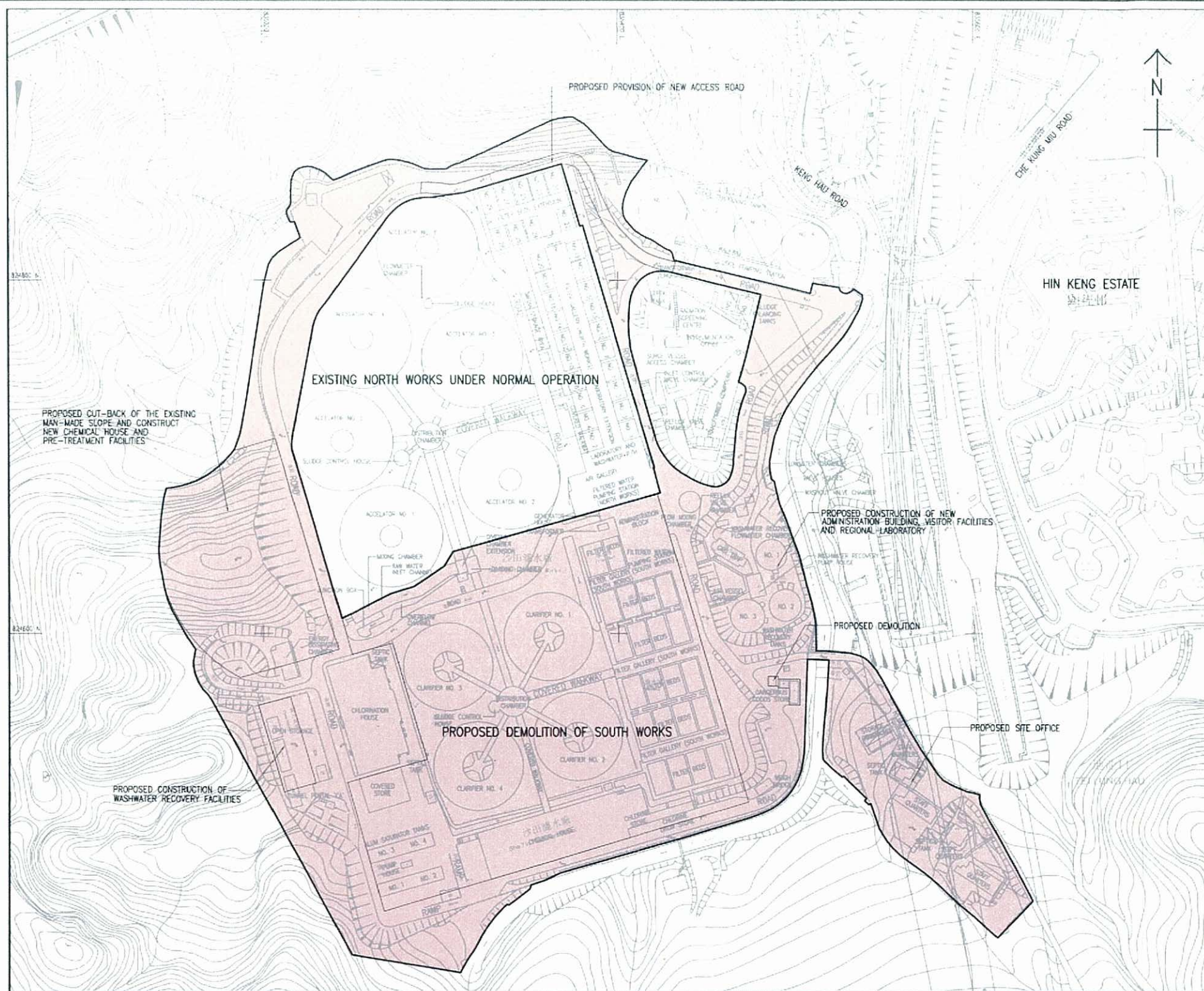
- 5.1 In preparing the EIA report, the Applicant shall refer to Annex 11 of the TM for the contents of an EIA report. The Applicant shall also refer to Annex 20 of the TM, which stipulates the guidelines for the review of an EIA report.
- 5.2 The Applicant shall supply the Director with the following number of copies of the EIA report and the executive summary:
- (i) 40 copies of the EIA report in English and 80 copies of the executive summary (each bilingual in both English and Chinese) as required under section 6(2) of the EIAO to be supplied at the time of application for approval of the EIA report.
 - (ii) When necessary, addendum to the EIA report and the executive summary submitted in sub-section 5.2 (i) above as required under section 7(1) of the EIAO, to be supplied upon advice by the Director for public inspection.
 - (iii) 20 copies of the EIA report in English and 50 copies of the executive summary (each bilingual in both English and Chinese) with or without Addendum as required under section 7(5) of the EIAO, to be supplied upon advice by the Director for consultation with the Advisory Council on the Environment.
- 5.3 The Applicant shall, upon request, make additional copies of the above documents available to the public, subject to payment by the interested parties of full costs of printing.
- 5.4 In addition, to facilitate the public inspection of the EIA report via the EIAO Internet Website, the applicant shall provide electronic copies of both the EIA report and the executive summary prepared in HyperText Markup Language (HTML) (version 4.0 or later) and in Portable Document Format (PDF version 1.3 or later), unless otherwise agreed by the Director. For the HTML version, a content page capable of providing hyperlink to each section and sub-section of the EIA report and the executive summary shall be included in the beginning of the document. Hyperlinks to figures, drawings and tables in the EIA report and executive summary shall be provided in the main text from where the respective references are made. Graphics in the report shall be in interlaced GIF format unless otherwise agreed by the Director.
- 5.5 The electronic copies of the EIA report and the executive summary shall be submitted to the Director at the time of application for approval of the EIA report.
- 5.6 When the EIA report and the executive summary are made available for public inspection under section 7(1) of the EIAO, the content of the electronic copies of the EIA report and the executive summary must be the same as the hard copies and the Director shall be provided with the most updated electronic copies.
- 5.7 To promote environmentally friendly and efficient dissemination of information, both hardcopies and electronic copies of future EM&A reports recommended by the EIA study shall be required and their format shall be agreed by the Director.

6. OTHER PROCEDURAL REQUIREMENTS

- 6.1 If there is any change in the name of Applicant for this EIA Study Brief during the course of the EIA study, the Applicant must notify the Director immediately.
- 6.2 If there is any key change in the scope of the Project mentioned in sections 1.2 of this EIA Study Brief and in Project Profile (No. PP-430/2011), the Applicant must seek confirmation from the Director in writing on whether or not the scope of issues covered by this EIA Study Brief can still cover the key changes, and the additional issues, if any, that the EIA study must also address. If the changes to the Project fundamentally alter the key scope of the EIA study brief, the Applicant shall apply to the Director for a fresh EIA Study Brief.

--- END OF EIA STUDY BRIEF ---

March 2011
Environmental Assessment Division,
Environmental Protection Department



Project Title: In-situ Reprovisioning of Sha Tin Water Treatment Works – South Works – Design and Construction
Figure 1: Location Plan (Plan originated from the Figure 1.1 of the Project Profile)

Appendix A: EIA Study Brief
Application No.: ESB-220/2011



Appendix B-1**Guidelines on Choice of Models and Model Parameters**

[The information contained in this Appendix is only meant to assist the Applicant in performing the air quality assessment. The Applicant must exercise professional judgment in applying this general information for the Project.]

1. Introduction

- 1.1 To expedite the review process by the Authority and to assist project proponents or environmental consultants with the conduct of air quality modelling exercise which are frequently called for as part of environmental impact assessment studies, this paper describes the usage and requirements of a few commonly used air quality models.

2. Choice of Models

- 2.1 The models which have been most commonly used in air quality impact assessments, due partly to their ease of use and partly to the quick turn-around time for results, are of Gaussian type and designed for use in simple terrain under uniform wind flow. There are circumstances when these models are not suitable for ambient concentration estimates and other types of models such as physical, numerical or mesoscale models will have to be used. In situations where topographic, terrain or obstruction effects are minimal between source and receptor, the following Gaussian models can be used to estimate the near-field impacts of a number of source types including dust, traffic and industrial emissions.

| <u>Model</u> | <u>Applications</u> |
|--------------|---|
| FDM | for evaluating fugitive and open dust source impacts (point, line and area sources) |
| CALINE4 | for evaluating mobile traffic emission impacts (line sources) |
| ISCST3 | for evaluating industrial chimney releases as well as area and volumetric sources (point, area and volume sources); line sources can be approximated by a number of volume sources. |

These frequently used models are also referred to as Schedule 1 models (see attached list).

- 2.2 Note that both FDM and CALINE4 have a height limit on elevated sources (20 m and 10m, respectively). Source of elevation above these limits will have to be modelled using the ISCST3 model or suitable alternative models. In using the latter, reference should be made to the 'Guidelines on the Use of Alternative Computer Models in Air Quality Assessment' in Appendix C-3.
- 2.3 The models can be used to estimate both short-term (hourly and daily average) and long-term (annual average) ambient concentrations of air pollutants. The model results, obtained using appropriate model parameters (refer to Section 3) and assumptions, allow direct comparison with the relevant air quality standards such as the Air Quality Objectives (AQOs) for the relevant pollutant and time averaging period.

3. Model Input Requirements**3.1 Meteorological Data**

- 3.1.1 At least 1 year of recent meteorological data (including wind speed, wind direction, stability class, ambient temperature and mixing height) from a weather station either closest to or having similar characteristics as the study site should be used to determine the highest short-term (hourly, daily)

and long-term (annual) impacts at identified air sensitive receivers in that period. The amount of valid data for the period should be no less than 90 percent.

- 3.1.2 Alternatively, the meteorological conditions as listed below can be used to examine the worst case short-term impacts:

Day time: stability class D; wind speed 1 m/s (at 10m height); worst-case wind angle; mixing height 500 m

Night time: stability class F; wind speed 1 m/s (at 10m height); worst case wind angle; mixing height 500 m

This is a common practice with using the CALINE4 model due to its inability to handle lengthy data set.

- 3.1.3 For situations where, for example, (i) the model (such as CALINE4) does not allow easy handling of one full year of meteorological data; or (ii) model run time is a concern, the followings can be adopted in order to determine the daily and annual average impacts:

- (i) perform a frequency occurrence analysis of one year of meteorological data to determine the actual wind speed (to the nearest unit of m/s), wind direction (to the nearest 10°) and stability (classes A to F) combinations and their frequency of occurrence;
- (ii) determine the short term hourly impact under all of the identified wind speed, wind direction and stability combinations; and
- (iii) apply the frequency data with the short term results to determine the long term (daily /annual) impacts.

Apart from the above, any alternative approach that will capture the worst possible impact values (both short term and long term) may also be considered.

- 3.1.4 Note that the anemometer height (relative to a datum same for the sources and receptors) at which wind speed measurements were taken at a selected station should be correctly entered in the model. These measuring positions can vary greatly from station to station and the vertical wind profile employed in the model can be grossly distorted from the real case if incorrect anemometer height is used. This will lead to unreliable concentration estimates.

- 3.1.5 An additional parameter, namely, the standard deviation of wind direction, σ_{θ} , needs to be provided as input to the CALINE4 model. Typical values of σ_{θ} range from 12° for rural areas to 24° for highly urbanised areas under 'D' class stability. For semi-rural such as new development areas, 18° is more appropriate under the same stability condition. The following reference can be consulted for typical ranges of standard deviation of wind direction under different stability categories and surface roughness conditions.

Ref.(1): Guideline On Air Quality Models (Revised), EPA-450/2-78-027R, United States Environmental Protection Agency, July 1986.

3.2 Emission Sources

All the identified sources relevant to a process plant or a study site should be entered in the model and the emission estimated based on emission factors compiled in the AP-42 (Ref. 2) or other suitable references. The relevant sections of AP-42 and any parameters or assumptions used in deriving the emission rates (in units g/s, g/s/m or g/s/m²) as required by the model should be

clearly stated for verification. The physical dimensions, location, release height and any other emission characteristics such as efflux conditions and emission pattern of the sources input to the model should also correspond to site data.

If the emission of a source varies with wind speed, the wind speed-dependent factor should be entered.

Ref.(2): Compilation of Air Pollutant Emission Factors, AP-42, 5th Edition, United States Environmental Protection Agency, January 1995.

3.3 Urban/Rural Classification

Emission sources may be located in a variety of settings. For modelling purposes these are classed as either rural or urban so as to reflect the enhanced mixing that occurs over urban areas due to the presence of buildings and urban heat effects. The selection of either rural or urban dispersion coefficients in a specific application should follow a land use classification procedure. If the land use types including industrial, commercial and residential uses account for 50% or more of an area within 3 km radius from the source, the site is classified as urban; otherwise, it is classed as rural.

3.4 Surface Roughness Height

This parameter is closely related to the land use characteristics of a study area and associated with the roughness element height. As a first approximation, the surface roughness can be estimated as 3 to 10 percent of the average height of physical structures. Typical values used for urban and new development areas are 370 cm and 100 cm, respectively.

3.5 Receptors

These include discrete receptors representing all the identified air sensitive receivers at their appropriate locations and elevations and any other discrete or grid receptors for supplementary information. A receptor grid, whether Cartesian or Polar, may be used to generate results for contour outputs.

3.6 Particle Size Classes

In evaluating the impacts of dust-emitting activities, suitable dust size categories relevant to the dust sources concerned with reasonable breakdown in TSP ($< 30 \mu\text{m}$) and RSP ($< 10 \mu\text{m}$) compositions should be used.

3.7 NO₂ to NO_x Ratio

The conversion of NO_x to NO₂ is a result of a series of complex photochemical reactions and has implications on the prediction of near field impacts of traffic emissions. Until further data are available, three approaches are currently acceptable in the determination of NO₂:

- (a) Ambient Ratio Method (ARM) - assuming 20% of NO_x to be NO₂; or
- (b) Discrete Parcel Method (DPM, available in the CALINE4 model); or
- (c) Ozone Limiting Method (OLM) - assuming the tailpipe NO₂ emission to be 7.5% of NO_x and the background ozone concentration to be in the range of 57 to 68 $\mu\text{g}/\text{m}^3$ depending on the land use type (see also the EPD reference paper 'Guidelines on Assessing the 'TOTAL' Air Quality Impacts' in Appendix C-2).

3.8 Odour Impact

In assessing odour impacts, a much shorter time-averaging period of 5 seconds is required due to the shorter exposure period tolerable by human receptors. Conversion of model computed hourly average results to 5-second values is therefore necessary to enable comparison against recommended standard. The hourly concentration is first converted to 3-minute average value according to a power law relationship which is stability dependent (Ref. 3) and a result of the statistical nature of atmospheric turbulence. Another conversion factor (10 for unstable conditions and 5 for neutral to stable conditions) is then applied to convert the 3-minute average to 5-second average (Ref. 4). In summary, to convert the hourly results to 5-second averages, the following factors can be applied:

| <u>Stability Category</u> | <u>1-hour to 5-sec Conversion Factor</u> |
|---------------------------|--|
| A & B | 45 |
| C | 27 |
| D | 9 |
| E & F | 8 |

Under 'D' class stability, the 5-second concentration is approximately 10 times the hourly average result. Note, however, that the combined use of such conversion factors together with the ISCST results may not be suitable for assessing the extreme close-up impacts of odour sources.

Ref.(3): Richard A. Duffee, Martha A. O'Brien and Ned Ostojic, 'Odor Modeling – Why and How', Recent Developments and Current Practices in Odor Regulations, Controls and Technology, Air & Waste Management Association, 1991.

Ref.(4): A.W.C. Keddie, 'Dispersion of Odours', Odour Control – A Concise Guide, Warren Spring Laboratory, 1980.

3.9 Plume Rise Options

The ISCST3 model provides by default a list of the U.S. regulatory options for concentration calculations. These are all applicable to the Hong Kong situations except for the 'Final Plume Rise' option. As the distance between sources and receptors are generally fairly close, the non-regulatory option of 'Gradual Plume Rise' should be used instead to give more accurate estimate of near-field impacts due to plume emission. However, the 'Final Plume Rise' option may still be used for assessing the impacts of distant sources.

3.10 Portal Emissions

These include traffic emissions from tunnel portals and any other similar openings and are generally modelled as volume sources according to the PIARC 91 (or more up-to-date version) recommendations (Ref. 5, section III.2). For emissions arising from underpasses or any horizontal openings of the like, these are treated as area or point sources depending on the source physical dimensions. In all these situations, the ISCST3 model or more sophisticated models will have to be used instead of the CALINE4 model. In the case of portal emissions with significant horizontal exit velocity which cannot be handled by the ISCST3 model, the impacts may be estimated by the TOP model (Ref. 6) or any other suitable models subject to prior agreement with EPD. The EPD's 'Guidelines on the Use of Alternative Computer Models in Air Quality Assessment' should also be referred to in Appendix C-3.

Ref.(5): XIXth World Road Congress Report, Permanent International Association of Road Congresses (PIARC), 1991.

Ref.(6): N. Ukegunchi, H. Okamoto and Y. Ide "Prediction of vehicular emission pollution around a tunnel mouth", Proceedings 4th International Clean Air Congress, pp. 205-207, Tokyo, 1977.

3.11 Background Concentrations

Background concentrations are required to account for far-field sources which cannot be estimated by the model. These values, to be used in conjunction with model results for assessing the total impacts, should be based on long term average of monitoring data at location representative of the study site. Please make reference to the paper 'Guidelines on Assessing the 'TOTAL' Air Quality Impacts' in Appendix C-2 for further information.

3.12 Output

The highest short-term and long-term averages of pollutant concentrations at prescribed receptor locations are output by the model and to be compared against the relevant air quality standards specified for the relevant pollutant. Contours of pollutant concentration are also required for indicating the general impacts of emissions over a study area.

Copies of model files in electronic format should also be provided for EPD's reference.

Schedule 1

Air Quality Models Generally Accepted by Hong Kong Environmental Protection Department for Regulatory Applications as at 1 July 1998*

Industrial Source Complex Dispersion Model - Short Term Version 3 (ISCST3) or the latest version developed by U.S. Environmental Protection Agency

California Line Source Dispersion Model Version 4 (CALINE4) or the latest version developed by Department of Transportation, State of California, U.S.A.

Fugitive Dust Model (FDM) or the latest version developed by U.S. Environmental Protection Agency

EPD is continually reviewing the latest development in air quality models and will update this Schedule accordingly.

- END -

Appendix B-2**Guidelines on Assessing the 'TOTAL' Air Quality Impacts**

[The information contained in this Appendix is only meant to assist the Applicant in performing the air quality assessment. The Applicant must exercise professional judgment in applying this general information for the Project.]

1. Total Impacts - 3 Major Contributions

- 1.1 In evaluating the air quality impacts of a proposed project upon air sensitive receivers, contributions from three classes of emission sources depending on their distance from the site should be considered. These are:

| | |
|--|--|
| Primary contributions: | project induced |
| Secondary contributions: | pollutant-emitting activities in the immediate neighbourhood |
| Other contributions: (Background contributions) | pollution not accounted for by the previous two |

2. Nature of Emissions

2.1 Primary contributions

In most cases, the project-induced emissions are fairly well defined and quite often (but not necessarily) the major contributor to local air quality impacts. Examples include those due to traffic network, building or road construction projects.

2.2 Secondary contributions

Within the immediate neighbourhood of the project site, there are usually pollutant emitting activities contributing further to local air quality impacts. For most local scale projects, any emission sources in an area within 500m radius of the project site with notable impacts should be identified and included in an air quality assessment to cover the short-range contributions. In the exceptional cases where there is one or more significant sources nearby, the study area may have to be extended or alternative estimation approach employed to ensure these impacts are reasonably accounted for.

2.3 Background contributions

The above two types of emission contributions should account for, to a great extent, the air quality impacts upon local air sensitive receivers, which are often amenable to estimation by the 'Gaussian Dispersion' type of models. However, a background air quality level should be prescribed to indicate the baseline air quality in the region of the project site, which would account for any pollution not covered by the two preceding contributions. The emission sources contributing to the background air quality would be located further afield and not easy to identify. In addition, the transport mechanism by which pollutants are carried over long distances (ranging from 1km up to tens or hundreds of kms) is rather complex and cannot be adequately estimated by the 'Gaussian' type of models.

3. Background Air Quality - Estimation Approach

3.1 The approach

In view of the difficulties in estimating background air quality using the air quality models currently available, an alternative approach based on monitored data is suggested. The essence of

this approach is to adopt the long-term (5-year) averages of the most recent monitored air quality data obtained by EPD. These background data would be reviewed yearly or biennially depending on the availability of the monitored data. The approach is a first attempt to provide a reasonable estimate of the background air quality level for use in conjunction with EIA air quality assessment to address the cumulative impacts upon a locality. This approach may be replaced or supplemented by superior modelling efforts such as that entailed in PATH (Pollutants in the Atmosphere and their Transport over Hong Kong), a comprehensive territory-wide air quality modelling system currently being developed for Hong Kong. Notwithstanding this, the present approach is based on measured data and their long term regional averages; the background values so derived should therefore be indicative of the present background air quality. In the absence of any other meaningful way to estimate a background air quality for the future, this present background estimate should also be applied to future projects as a first attempt at a comprehensive estimate until a better approach is formulated.

3.2 Categorisation

The monitored air quality data, by 'district-averaging' are further divided into three categories, viz, Urban, Industrial and Rural/New Development. The background pollutant concentrations to be adopted for a project site would depend on the geographical constituency to which the site belongs. The categorization of these constituencies is given in Section 3.4. The monitoring stations suggested for the 'district-averaging'(arithmetic means) to derive averages for the three background air quality categories are listed as follows:

Urban: Kwun Tong, Sham Shui Po, Tsim Sha Tsui and Central/Western
 Industrial: Kwun Tong, Tsuen Wan and Kwai Chung
 Rural/New Development: Sha Tin, Tai Po, Junk Bay, Hong Kong South and Yuen Long

The averaging would make use of data from the above stations wherever available. The majority of the monitoring stations are located some 20m above ground.

3.3 Background pollutant values

Based on the above approach, background values for the 3 categories have been obtained for a few major air pollutants as follows:

| POLLUTANT | URBAN | INDUSTRIAL | RURAL / NEW DEVELOPMENT |
|------------------|--------------|-------------------|--------------------------------|
| NO ₂ | 59 | 57 | 39 |
| SO ₂ | 21 | 26 | 13 |
| O ₃ | 62 | 68 | 57 |
| TSP | 98 | 96 | 87 |
| RSP | 60 | 58 | 51 |

All units are in micrograms per cubic metre. The above values are derived from 1992 to 1996 annual averages with the exception of ozone which represent annual average of daily hourly maximum values for year 1996.

In cases where suitable air quality monitoring data representative of the study site such as those obtained from a nearby monitoring station or on-site sampling are not available for the prescription of background air pollution levels, the above tabulated values can be adopted instead. Strictly speaking, the suggested values are only appropriate for long term assessment. However, as an interim measure and until a better approach is formulated, the same values can also be used for short term assessment. This implies that the short term background values will be somewhat under-estimated, which compensates for the fact that some of the monitoring data are inherently

influenced by secondary sources because of the monitoring station location.

Indeed, if good quality on-site sampling data which cover at least one year period are available, these can be used to derive both the long term (annual) and short term (daily / hourly) background values, the latter are usually applied on an hour to hour, day to day basis.

3.4 Site categories

The categories to which the 19 geographical constituencies belong are listed as follows:

| DISTRICT | AIR QUALITY CATEGORY |
|-------------------|-----------------------------|
| Islands | Rural / New Development |
| Southern | Rural / New Development |
| Eastern | Urban |
| Wan Chai | Urban |
| Central & Western | Urban |
| Sai Kung | Rural / New Development |
| Kwun Tong | Industrial |
| Wong Tai Sin | Urban |
| Kowloon City | Urban |
| Yau Tsim | Urban |
| Mong Kok | Urban |
| Sham Shui Po | Urban |
| Kwai Tsing | Industrial |
| Sha Tin | Rural / New Development |
| Tsuen Wan | Industrial |
| Tuen Mun | Rural / New Development |
| Tai Po | Rural / New Development |
| Yuen Long | Rural / New Development |
| Northern | Rural / New Development |

3.5 Provisions for 'double-counting'

The current approach is, by no means, a rigorous treatment of background air quality but aims to provide an as-realistic-as-possible approximation based on limited field data. 'Double-counting' of 'secondary contributions' may be apparent through the use of such 'monitoring-based' background data as some of the monitoring stations are of close proximity to existing emission sources. 'Primary contributions' due to a proposed project (which is yet to be realized) will not be double-counted by such an approach. In order to avoid over-estimation of background pollutant concentrations, an adjustment to the values given in Section 3.3 is possible and optional by multiplying the following factor:

$$(1.0 - E_{\text{Secondary contributions}}/E_{\text{Territory}})$$

where E stands for emission.

The significance of this factor is to eliminate the fractional contribution to background pollutant level of emissions due to 'secondary contributions' out of those from the entire territory. In most cases, this fractional contribution to background pollutant levels by the secondary contributions is minimal.

4. Conclusions

- 4.1 The above described approach to estimating the total air quality impacts of a proposed project, in particular the background pollutant concentrations for air quality assessment, should be adopted with immediate effect. Use of short term monitoring data to prescribe the background concentrations is no longer acceptable.

- END -

Appendix B-3**Guidelines on the Use of Alternative Computer Models
in Air Quality Assessment**

[The information contained in this Appendix is only meant to assist the Applicant in performing the air quality assessment. The Applicant must exercise professional judgment in applying this general information for the Project.]

1. Background

- 1.1 In Hong Kong, a number of Gaussian plume models are commonly employed in regulatory applications such as application for specified process licences and environmental impact assessments (EIAs). These frequently used models (as listed in Schedule 1 attached; hereafter referred to as Schedule 1 models) have no regulatory status but form the basic set of tools for local-scale air quality assessment in Hong Kong.
- 1.2 However, no single model is sufficient to cover all situations encountered in regulatory applications. In order to ensure that the best model available is used for each regulatory application and that a model is not arbitrarily applied, the project proponent (and/or its environmental consultants) should assess the capabilities of various models available and adopt one that is most suitable for the project concerned.
- 1.3 Examples of situations where the use of an alternative model is warranted include:
- (i) the complexity of the situation to be modelled far exceeds the capability of the Schedule 1 models; and
 - (ii) the performance of an alternative model is comparable or better than the Schedule 1 models.
- 1.4 This paper outlines the demonstration / submission required in order to support the use of an alternative air quality model for regulatory applications for Hong Kong.

2. Required Demonstration / Submission

- 2.1 Any model that is proposed for air quality applications and not listed amongst the Schedule 1 models will be considered by EPD on a case-by-case basis. In such cases, the proponent will have to provide the followings for EPD's review:
- (i) Technical details of the proposed model; and
 - (ii) Performance evaluation of the proposed model

Based on the above information, EPD will determine the acceptability of the proposed model for a specific or general applications. The onus of providing adequate supporting materials rests entirely with the proponent.

- 2.2 To provide technical details of the proposed model, the proponent should submit documents containing at least the following information:
- (i) mathematical formulation and data requirements of the model;
 - (ii) any previous performance evaluation of the model; and
 - (iii) a complete set of model input and output file(s) in commonly used electronic format.

- 2.3 On performance evaluation, the required approach and extent of demonstration varies depending on whether a Schedule 1 model is already available and suitable in simulating the situation under consideration. In cases where no Schedule 1 model is found applicable, the proponent must demonstrate that the proposed model passes the screening test as set out in USEPA Document "Protocol for Determining the Best Performing Model" (Ref. 1).
- Ref.(1): William M. Cox, 'Protocol for Determining the Best Performing Model'; Publication No. EPA-454/R-92-025; U.S. Environmental Protection Agency, Research Triangle Park, NC.*
- 2.4 For cases where a Schedule 1 model is applicable to the project under consideration but an alternative model is proposed for use instead, the proponent must demonstrate either that
- (i) the highest and second highest concentrations predicted by the proposed model are within 2 percent of the estimates obtained from an applicable Schedule 1 model (with appropriate options chosen) for all receptors for the project under consideration; or
 - (ii) the proposed model has superior performance against an applicable Schedule 1 model based on the evaluation procedure set out in USEPA Document "Protocol for Determining the Best Performing Model" (Ref. 1).
- 2.5 Should EPD find the information on technical details alone sufficient to indicate the acceptability of the proposed model, information on further performance evaluation as specified in Sections 2.3 and 2.4 above would not be necessary.
- 2.6 If the proposed model is an older version of one of the Schedule 1 models or was previously included in Schedule 1, the technical documents mentioned in Section 2.2 are normally not required. However, a performance demonstration of equivalence as stated in Section 2.4 (i) would become necessary.
- 2.7 If EPD is already in possession of some of the documents that describe the technical details of the proposed model, submission of the same by the proponent is not necessary. The proponent may check with EPD to avoid sending in duplicate information.

Schedule 1

Air Quality Models Generally Accepted by Hong Kong Environmental Protection Department for Regulatory Applications as at 1 July 1998*

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EPD is continually reviewing the latest development in air quality models and will update this Schedule accordingly.

- END -

