FINAL REPORT

Meinhardt Management Asia Ltd

Environmental Impact Assessment
HAECO/HAESL Facilities at Tseung Kwan O

30 March 1998

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CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

FINAL REPORT

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Environmental Impact Assessment
HAECO/HAESL Facilities at Tseung Kwan O

30 March 1998

Reference C1441

For and on behalf of ERM-Hong Kong, Ltd

Approved by: FREEMAN CHEUNG

Signed: [signature]

Position: Deputy Managing Director

Date: 30 March 1998

CONTENTS:

1 INTRODUCTION

1.1 BACKGROUND

ERM-Hong Kong, Ltd (ERM) was commissioned by Meinhardt Management Asia Ltd (Meinhardt) to provide environmental services for the development of a new facility for the Hong Kong Aircraft Engineering Company (HAECO) and the Hong Kong Aero Engine Services Ltd. (HAESL). The proposed facility, the Tseung Kwan O Aircraft Overhaul Division (the facility), will be constructed as part of the second phase (Phase II) of the replacement of the existing HAECO facility at Kai Tak Airport. The first phase (Phase I) was the construction of the Aircraft Engine Test Cell which is located adjacent to the site for the proposed facility. An additional facility is also being developed at the new Chek Lap Kok Airport.

This report presents findings of an Environmental Impact Assessment (EIA) of the construction and operation of the Tseung Kwan O Aircraft Overhaul Division.

1.2 THE PROPOSED DEVELOPMENT IN TSEUNG KWAN O

The site for the proposed facility is on a reclamation at the southern end of the Tseung Kwan O Industrial Estate where the northeast coast of Junk Island meets the reclamation. The location of the site and surrounding area are presented in *Figure 1.2a*. Chai Wan, on Hong Kong Island, is about 2.5 km to the south of the site beyond Junk Island and Victoria Harbour. To the west, at a similar distance on the other side of Junk Bay, there are various scattered dwellings and villages. To the east beyond the rest of the reclamation, is the South East New Territories (SENT) landfill. To the north at a distance of about 3 km, is the Tseung Kwan O new town development. The general layout of the site is shown in *Figure 1.2b*.

The nature of activities to be carried out at the Phase II facility will be broadly similar to many of those carried out in the existing facilities at Kai Tak. The proposed facility will support the maintenance requirements of major international air passenger carrier fleets. Principal activities to be undertaken will include aircraft engine inspection and overhaul. These activities will be undertaken mainly in a Chemical Plating Workshop, a Chemical Cleaning Workshop, a General Machinery Shop, Rework and Inspection facilities, Component Test Cells, a Non-Destructive Testing (NDT) Workshop, and General Workshops which will all be included in the facility.

1.3 SCOPE AND STRUCTURE OF THE EIA

The objective of the EIA is to identify and evaluate impacts that will arise from the construction and operation of the proposed facility and, where appropriate, to recommend mitigative measures to reduce those impacts. As part of this assessment, impacts have been compared to pertinent standards with which the construction and the operation of the proposed facility must comply.

The EIA has been based on the Process Design Brief, information supplied by the design team, previously published EIAs and other studies which have addressed environmental effects related to the development of the proposed facility. Information from the following sources was considered:

- "Environmental Audit Report of the HAECO Facility at Kai Tak" prepared by ERM in 1995 on behalf of Cathay Pacific Airways;
- "Tseung Kwan O Phase I EIA" prepared by ERM in 1995 for Meinhardt Consulting Engineering Ltd;
- "Process Engineering Design Brief" prepared by Process Design & Fabrication Pty Ltd in 1993 for HAECO;
- "New Airport Master Plan: EIA Supplement" prepared by Greiner & Maunsell in 1992 for the PAA;
- "New Airport Master Plan: EIA" prepared by a joint venture of Greiner International Ltd (Greiner) & Maunsell Consultants Asia Ltd (Maunsell) in 1991 for the Provisional Airport Authority (PAA) Hong Kong;
- "New Airport Master Plan: Planning" prepared by Greiner & Maunsell in 1991 for PAA; and
- "Contract 145 Waste Management Study" prepared by Montgomery Watson Ltd for the PAA.

The remainder of the report is structured as follows:

- *Section 2* presents findings of the assessment of environmental impacts with respect to noise;
- *Section 3* presents findings of the assessment of environmental impacts with respect to water quality;
- *Section 4* presents findings of the assessment of environmental impacts with respect to air quality;
- *Section 5* presents findings of the assessment of environmental impacts with respect to solid waste management; and
- *Section 6* presents a summary of the conclusions of the assessment including impacts associated with construction and operation of the proposed facility and recommended mitigation measures.

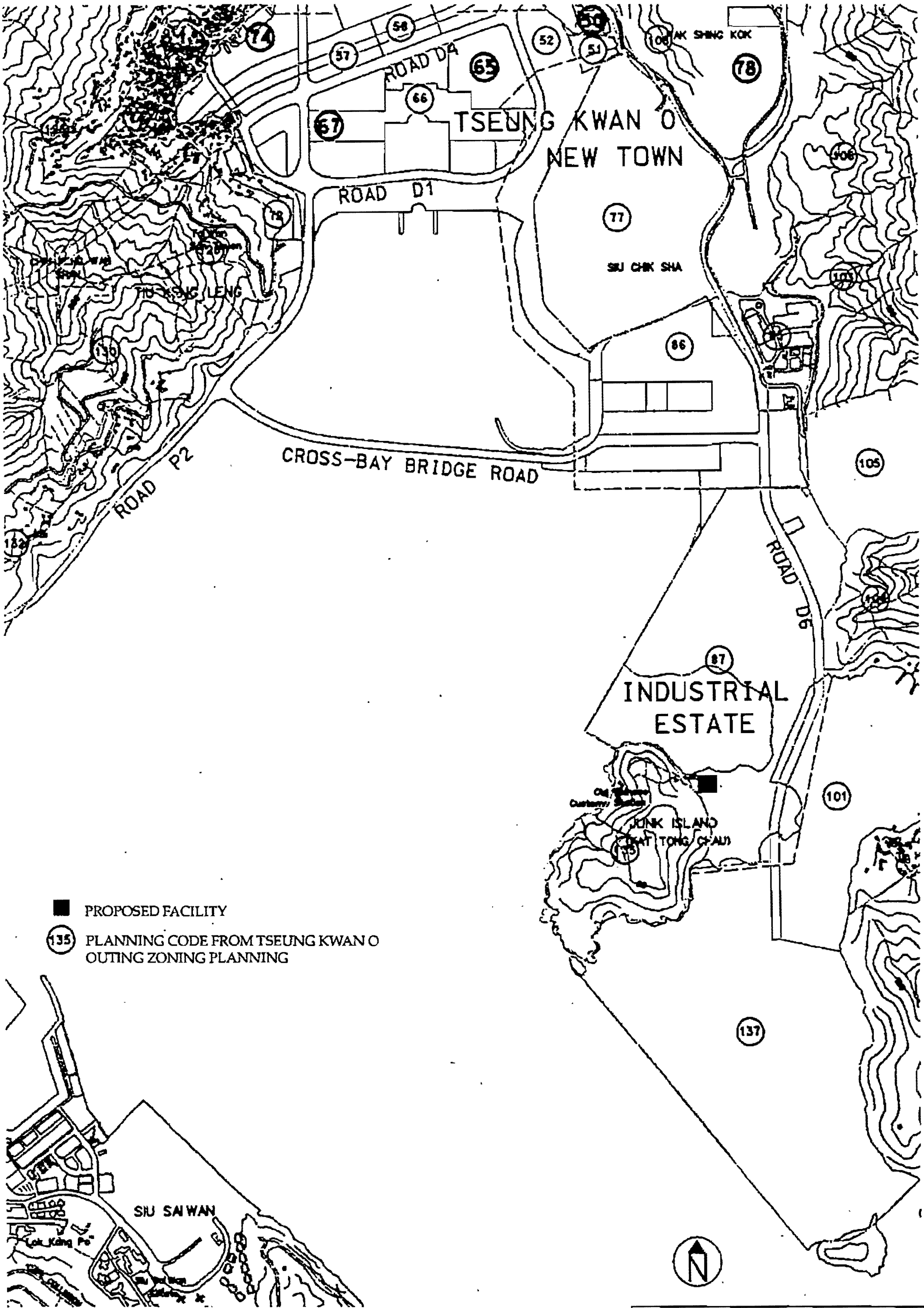

FIGURE 1.2a - SITE LOCATION AND SURROUNDING LAND AREA

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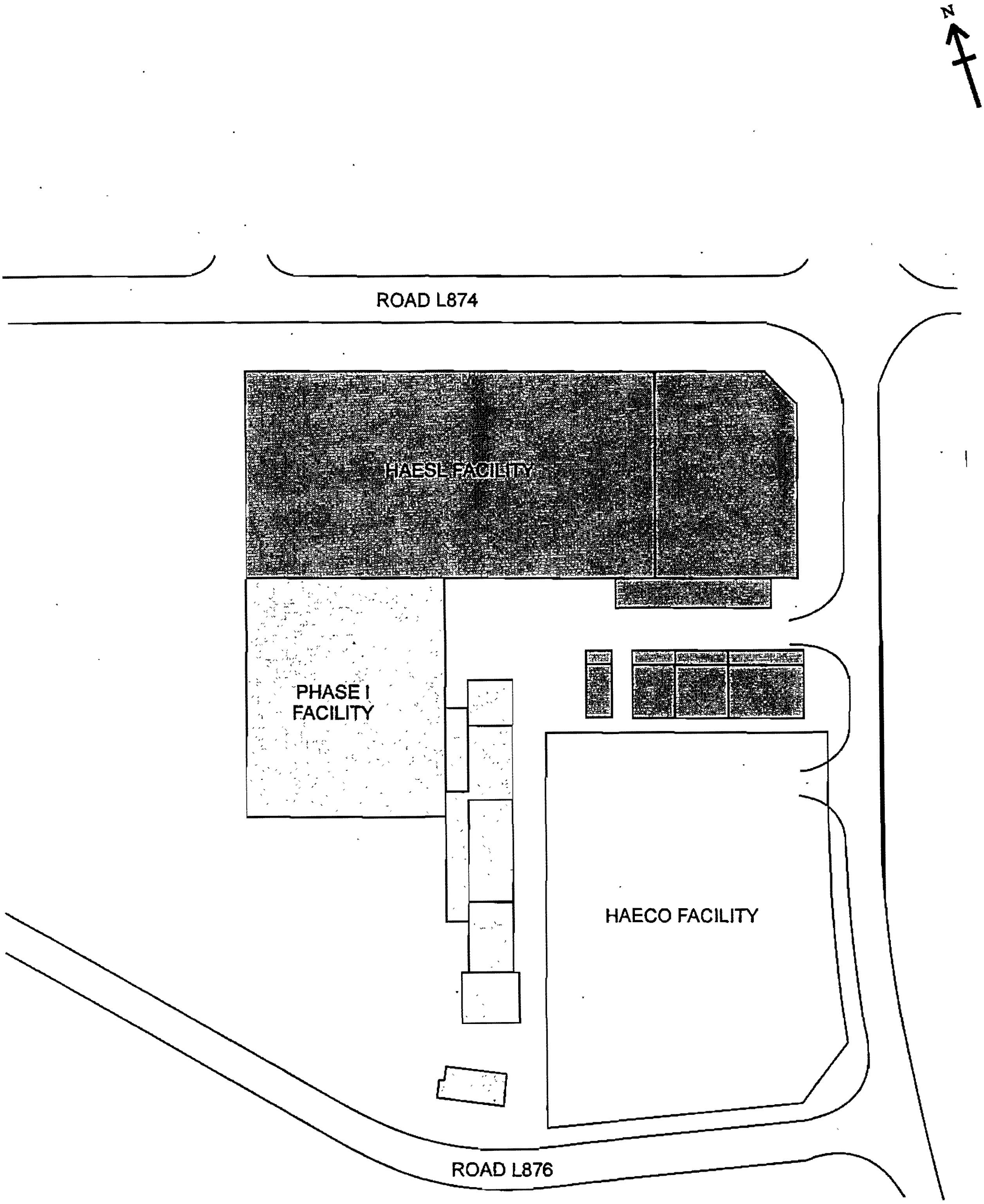

FIGURE 1.2b - SITE LAYOUT

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2 *NOISE*

2.1 *INTRODUCTION*

This section identifies and evaluates issues relating to noise arising from the construction and operation of the proposed facility. For the purposes of this assessment, it has been assumed that the nature of activities to be carried out at the proposed facility will be broadly similar to those in the existing facilities at Kai Tak.

Based on the environmental audit undertaken by ERM, the major sources of operational noise at the existing HAECO facility are the testing of aircraft engines and auxiliary power units (APUs) rather than workshop noise; however, the durations of these testing activities are limited. The workshop noise identified was principally due to metal beating and rivetting. Similar types of noise sources are expected at the proposed facility. Aircraft engine testing noise was addressed previously in the EIA for the Phase I facility and it is not planned to test APUs in the new facility.

2.2 *RELEVANT STANDARDS AND GUIDELINES*

2.2.1 *Construction Noise*

In Hong Kong the control of construction noise other than Percussive Piling outside of daytime, weekday working hours (0700-1900, Monday through Saturday), excluding Public Holidays, is governed by the *Noise Control Ordinance (NCO)* and the subsidiary technical memoranda, namely *Technical Memorandum on Noise From Construction Work Other Than Percussive Piling* (TM1), and *Technical Memorandum on Noise from Construction Work in Designated Area* (TM3). TM3 controls the construction noise related to the Prescribed Construction Work (PCW) such as erection/dismantling of formwork/scaffolding; loading/unloading/handling of rubble, wooden boards, steel bars, wood or scaffolding material; and hammering. The control of Percussive Piling (at all times) is governed by the *Technical Memorandum on Noise From Percussive Piling* (TM2). These technical memoranda prescribe the permitted noise levels for construction work depending upon working hours and the existing noise climate.

The *NCO* criteria for the control of noise from powered mechanical equipment (PME) are dependant upon the type of area containing the *Noise Sensitive Receiver* (NSR) rather than the measured background noise levels. The *NCO* requires that noise levels from construction at the affected NSRs be less than a specified *Acceptable Noise Level* (ANL) which depends on the *Area Sensitivity Rating* (ASR) for the NSR under consideration.

It is intended that the construction activities of the proposed works are planned and controlled in accordance with the *NCO*. Works requiring the use of PME during restricted hours (i.e. outside of 0700-1900 Monday through Saturday, and at all times during public holidays), particularly at night (2300-0700), will require a *Construction Noise Permit* (CNP) and will need to achieve the applicable ANL. The ANL is derived from the *Basic Noise Levels* (BNL) determined in TM1 by applying corrections for the duration of the works and the effect of any other nearby sites operating under a CNP. For this assessment, current information indicates that these corrections are negligible and so have been set to zero. As a result, the ANLs are equal to the BNLs. The ANLs for the construction work other than percussive piling and for the construction work in designated areas are shown in *Tables 2.2a and 2.2b*.

Table 2.2a ***Acceptable Noise Levels for Construction Noise Other than Percussive Piling (ANL, $L_{Aeq, 30 min.}$ dB)***

Time Period	ASR"A"	ASR"B"	ASR"C"
All days during the evening (1900-2300) and general holidays (including Sundays) during the day and evening (0700-2300)	60	65	70
All days during the night-time (2300-0700)	45	50	55

Table 2.2b ***Acceptable Noise Levels for Construction Noise in Designated Areas (ANL, $L_{Aeq, 5 min.}$ dB)***

Time Period	ASR"A"	ASR"B"	ASR"C"
All days during the evening (1900-2300) and general holidays (including Sundays) during the day and evening (0700-2300)	45	50	55
All days during the night-time (2300-0700)	30	35	40

Although the *NCO* does not control the construction activities during normal working hours, a limit of $L_{Aeq, 30 min}$ 75 dB is proposed in the *Practice Note For Professional Persons, Professional Persons Environmental Consultative Committee, Noise from Construction Activities - Non-statutory Controls, June 1993* (ProPECC *PN2/93*). This limit has been applied on major construction projects such as the Lantau and Airport Railway, and is now generally accepted in Hong Kong. Therefore, the $L_{Aeq, 30 min}$ 75 dB limit has been adopted in this Study for evaluating the potential impacts upon residential NSRs.

For schools, the ProPECC PN2/93 recommends noise levels during normal school days of $L_{Aeq, 30 min}$ 70 dB, and is further lowered to 65 dB during student exam periods.

There are further subsidiary regulations, *Noise Control (Hand Held Percussive Breakers) Regulations* and *Noise Control (Air Compressors) Regulations* for controlling the noise from hand held breakers and air compressors. These equipment items require compliance with the relevant noise emission standards and the fixing of noise emission labels to the plant (i.e. 114 dB for hand-held breakers and 109 dB for air compressors).

Percussive piling is only permitted within the constraints of a CNP. TM2 sets out the requirements for working under a CNP, including permitted hours for piling operations and other provisions which may be required in order to limit potential noise impacts. Percussive piling is prohibited during restricted hours (1900-0700) unless specifically exempted. ANLs for percussive piling are set out in TM2 and are dependent on the type of NSR. ANLs for daytime percussive piling are presented in *Table 2.2c*.

Table 2.2c *Acceptable Noise Levels for Daytime Percussive Piling*

Type of Receptor	Acceptable Noise Level (dB(A))
Noise Sensitive Receiver (NSR) with no windows or other openings	100
NSR with central air conditioning systems	90
NSR with windows or other openings but without central air conditioning system	85

Note:
ANLs will be 10dB(A) lower for NSRs which are hospitals, medical clinics, educational institutions, courts of laws or other NSRs considered by Environmental Protection Department to be particularly sensitive to noise.

The permitted hours of operations are determined by comparing the Corrected Noise Level (CNL) and the ANL at the NSR. *Table 2.2d* presents the permitted hours of operation for percussive piling.

Table 2.2d *Permitted Hours of Operation for Percussive Piling*

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a holiday
More than 10 dB(A)	0800 to 0900 AND 1230 to 1330 AND 1700 to 1800
Between 1 dB(A) and 10 dB(A)	0800 to 0930 AND 1200 to 1400 AND 1630 to 1800
No exceedance	0700 to 1900

2.2.2 *Industrial Noise*

Noise from industrial sources is controlled by the *NCO*, and its associated *Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites* (TM4). New developments are governed by the *Hong Kong Planning Standards and Guidelines* (HKPSG) which recommend that noise levels at the nearest NSRs should be 5 dB(A) below the appropriate ANL referenced under TM4, or equal to the prevailing background noise levels, whichever is lower. For the operational phase, the presence of the new industrial estate and associated roads will introduce influencing factors into the Tseung Kwan O area. According to TM4, Noise sensitive Receivers (NSRs) which are located within a rural or an urban fringe environment in which they are indirectly affected by influencing factors (roads and industrial complexes) are given an ASR of 'B'. The ANLs for ASR 'B' are presented in *Table 2.2e*.

Table 2.2e *Acceptable Noise Levels for Industrial Noise Sources ($L_{Aeq, 30 min.}$ dB)*

Time Period	*NCO* Limit for ASR 'B', dB(A)	HKPSG Criterion (ANL-5 dB(A))
Daytime (0700-1900)	65	60
Evening (1900-2300)	65	60
Night time (2300-0700)	55	50

2.3 *BASELINE CONDITIONS*

2.3.1 *Existing Conditions*

Figure 1.2a, which has been extracted from the proposed Tseung Kwan O Development Plan, shows the area surrounding the site. The proposed facility will be located in the Tseung Kwan O Industrial Estate, as shown in *Figure 1.2a*. At present, several infrastructure development projects are under construction in the area; these include reclamation for Tseung Kwan O New Town and its construction and construction of the Tseung Kwan O Industrial Estate and infrastructure within the area. Thus, the existing noise environment is already affected by construction activities and road traffic.

2.3.2 *Future Conditions*

After the completion of the current infrastructure projects, the Tseung Kwan O region will contain the Tseung Kwan O Industrial Estate, the Tseung Kwan O New Town, local roads, bridges and the operational SENT Landfill. With the reduction in construction noise levels, it is anticipated that road traffic and the industrial operations will dominate the local noise climate.

2.3.3 *Noise Sensitive Receivers*

Various NSRs, as defined under the HKPSG and the *NCO*, have been identified in the vicinity of the proposed facility. The principal source of guidance was the Technical Memorandum for the Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites. Further NSR selection procedures included the following factors: distance to the proposed development, potential for topographic screening and the ASR ratings. *Table 2.3a* presents the distances between these NSRs and the notional centre of the proposed facility. In all cases they are considered remote (over 1 km away). The locations of the NSRs are shown in *Figure 2.3a*.

Table 2.3a ***Potentially Affected Noise Sensitive Receivers Identified for Construction and Operational Noise Impact Assessments***

NSR Name	Distance (m)	Area Sensitivity Rating	
		Construction phase	Operational phase
NSR1 - Proposed residential development in Area 86	1,150	B	B
NSR 2 - Tseung Kwan O Area 50	3,100	A	B
NSR 3 - Haven of Hope Hospital	4,100	A	A
NSR 4 - Tseung Kwan O Area 73 Villages	3,300	A	A
NSR 5 - Heng Fa Chuen Estate	3,400	B	B
NSR 6 - Tsai Wan Estate	3,500	B	B
NSR 7 - Siu Sai Wan Estate	2,600	B	B

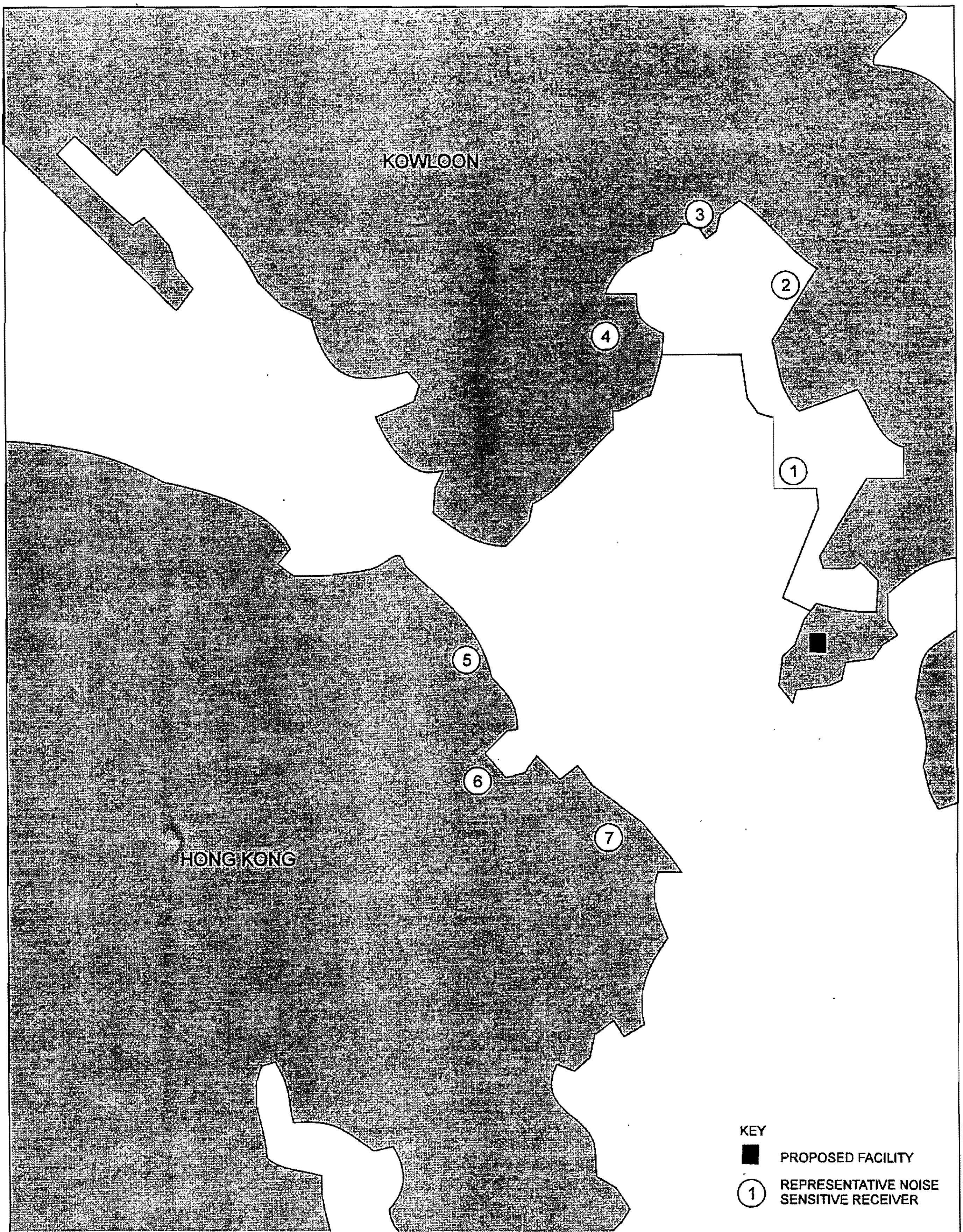

FIGURE 2.3a - NOISE SENSITIVE RECEIVERS NEAR THE PROPOSED FACILITY

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Currently, there are no Influencing Factors in the Tseung Kwan O area so that the NSRs in the Tseung Kwan O area have an Area Sensitivity Rating 'A'. Heng Fa Chuen Estate, Tsai Wan Estate, Siu Sai Wan Estate and the proposed residential development in Area 86 are affected by road traffic and industrial activity, and have therefore been assigned a rating of 'B'. Information from the Planning Department indicated that both the Shek Miu Wan Villages and the villages on Junk Island have been relocated as a result of works associated with the SENT Landfill and the Tseung Kwan O Industrial Estate and Reclamation, respectively; these NSRs have therefore been excluded from this EIA.

2.4 *CONSTRUCTION PHASE*

2.4.1 *Potential Sources of Impact*

As the proposed facility will be constructed primarily on reclaimed land, there will be little necessity for site clearance or site excavation, although foundation and building superstructure construction may have the potential to create noise impacts at the NSRs, particularly if evening and nighttime works are required.

2.4.2 *Construction Noise Assessment Methodology*

A methodology for assessing noise from the construction of the proposed facility has been developed based on the *Technical Memorandum on Noise from Construction Work Other Than Percussive Piling* (TM1) and the *Technical Memorandum on Noise from Percussive Piling* (TM2). Details of the methodology are as follows:

- identify NSRs and their distances to the notional source point at the construction site;
- calculate the total sound power level from the construction equipment inventory for each type of construction activity;
- calculate distance attenuation and barrier corrections to NSRs from worksite notional noise source location;
- calculate the resultant noise levels at the NSRs from the total sound power levels and corrections for distance attenuation, barrier screening and façade reflections;
- assess the predicted noise levels against the relevant criteria; and
- where necessary, recommend possible mitigation measures to reduce noise levels at the NSRs to comply with the criteria.

Noise levels from each construction activity were calculated for each NSR in order to quantify the impacts from individual construction activities. This allows identification of the predominant noise sources and determination of whether control measures are necessary to reduce the noise levels they generate to meet the criteria.

It has been assumed that the scale of construction work for the proposed facility will be similar to that for HAECO Phase I. The same types and number of plant teams for the foundation and building superstructure construction have therefore been assumed. The plant inventory has been estimated by Meinhardt Consulting Engineers Ltd, the Design Engineers for the development project.

Foundation Construction

It has been assumed that three diesel hammer driving steel piles (each with a sound power level of 132 dB(A)), will be required which will produce an estimated total site sound power level of 137 dB(A).

Building Superstructure Construction

Construction of the foundations will be followed by construction of the building superstructure. The assumed plant inventory is presented in *Table 2.4a*.

Table 2.4a ***Superstructure Construction Plant Inventory***

Plant	Number	TM Reference Number	Sound Power Level(dB(A))
Tower Crane	2	CNP 049	95+3
Concrete Truck	2	CNP 044	109+3
Concrete Vibrator	4	CNP 170	113+6
Hand-tools	Various	N/A	105
Compressor	2	CNP 003	104+3
Generator	1	CNP 101	108

The calculated total sound power level for all plant acting at one notional point is 120 dB(A). As distances to the NSRs are over 300 m, specific formulae for the distance attenuation approved by EPD, have been used to assess potential noise impacts from percussive piling and construction of the superstructure. These formulae are as follows[1]:

- Percussive piling:
  Facade $L_{Aeq, period}$ = Sound Power Level - 23.27*log(distance) - 5.269
- Superstructure:
  Facade $L_{Aeq, period}$ = Sound Power Level - 20*log(distance) - 5.0

The formula for percussive piling includes an atmospheric absorption correction factor, whereas that for the superstructure construction does not. Atmospheric absorption provides additional attenuation when sound is propagating outdoors over a distance of several kilometres. Therefore, the predicted noise levels in the table below, for the superstructure construction, should be considered as worst-case predictions.

2.4.3 *Predicted Impacts*

Predicted construction noise levels at the nearby NSRs are presented in *Table 2.4b*. They range between 48-59 dB(A) for percussive piling and 43-54 dB(A)for building construction.

(1) ERM-Hong Kong, Ltd. (1995) Environmental Impact Assessment for HAECO Engine Test Facility at Tseung Kwan O. Prepared for Meinhardt Consulting Engineers Ltd.

Table 2.4b *Predicted Façade Noise Levels ($L_{Aeq,5min}$) at each NSR*

NSR	Percussive Piling	Building Construction
Proposed residential development in Area 86	59	54
Tseung Kwan O Area 50	51	45
Haven of Hope Hospital	48	43
Tseung Kwan O Area 73 Villages	50	45
Heng Fa Chuen Estate	50	44
Tsai Wan Estate	49	44
Siu Sai Wan Estate	52	47

No exceedances of any of the applicable noise criteria are predicted, for the percussive piling or the building construction, at any of the nearby NSRs. Hence, no mitigation measures are necessary for these construction activities.

2.4.4 *Mitigation Measures*

As construction noise impacts are unlikely, mitigation measures are not required. Nevertheless, in view of the potential of cumulative impacts from various construction works due to other planned developments in the Tseung Kwan O area, the following good site practices should be followed during each phase of the construction:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;
- machines and plant (such as trucks) used in intermittently should be either shut down, or throttled down to a minimum, between work periods;
- plant known to emit noise strongly in one direction, should, where possible, be orientated so as to directed away from nearby NSRs;
- silencers or mufflers on construction equipment should be utilised and should be properly maintained; and
- material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

A CNP is required for any construction work other than percussive piling to be carried out during the restricted hours. A CNP is also required for any percussive piling work.

2.5 OPERATIONAL PHASE

2.5.1 *Potential Sources of Impact*

The principal source of noise that will be generated by the proposed facility will be the workshops and plant rooms located mainly on the ground and second floors as well as the Air Handling Units (AHUs) and chiller units mounted on the building roof. Noise generated by the Phase II facility will add to noise generated from the adjacently situated Aircraft Engine Test Cell (Phase I) which was studied in the HAECO Phase I EIA [(2)]. The EIA concluded that the Aircraft Engine Test Cell would produce predicted facade noise levels of only 47 dB(A) and that there would be no exceedances at the NSRs. The test cell has since been built and a series of preliminary commissioning tests have been carried out. Noise levels, during commissioning tests, were measured by ERM-Hong Kong Ltd . The results are summarised in *Table 2.5a* and indicate that noise levels of up to 59 dB(A) at a distance of 75 m from the facility could be expected during operation of the test cell. The measured levels were lower than those predicted in the EIA, which was attributed to the fact that the EIA used a conservative approach to making the noise predictions. The results of these noise measurements have therefore been used, in preference to the EIA predicted results, in order to determine potential cumulative noise impacts.

Table 2.5a *Noise Measurements During Commissioning Tests at the Jet Engine Test Facility at TKO (19 to 23 June 1997), dB(A)*

Facade	Northern	Southern	Eastern	South Western
$L_{Aeq,t}$	59	56	53	57

Notes:

(1) Noise levels presented refer to a distance of 75m from the test cell building.

(2) Measurements made during tests on RR Trent 800 at 85,000 lbs of thrust.

(3) The duration of the measurements, t, were variable (generally less than 2 minutes), dependent on the presence of extraneous noise and the restrictions imposed by the actual engine tests. Since the noise level generated by the engine is relatively constant at constant thrust, these measurements are considered to give a good approximation.

2.5.2 *Operation Noise Assessment Methodology*

The major sources of noise associated with the operation of this facility will be the workshops and plant rooms. Noise level predictions have been carried out at the nearest NSRs based on the individual sound power levels generated by each noise source. The sound power level (SWL) of each source was calculated as follows:

- determine the internal noise levels of each plantroom and workshop - specified by Meinhardt[(3)];
- calculate the area of the building facade as a radiating source comprising elements for each room;
- determine the sound reduction indices (SRIs) of each of the building elements[(4)];
- calculate an average SRI for the radiating structure;
- calculate the individual SWLs for each element of the facade; and
- sum the individual contributing SWLs.

A total SWL was calculated for both the northern and southern facades. In each case a contribution of 105 dB(A) has also been included to allow for the noise

(2) Environmental Impact Assessment for HAECO Aircraft Engine Test cell Facility at Tseung Kwan O. Prepared by ERM- Hong Kong, Ltd. for Meinhardt Consulting Engineers Ltd. September 1995.

(3) Overhaul Building Ground Floor Plan, Drawing No. 912B-160

(4) Based on typical manufacturers data

generated by the chiller plant and air handling units which are to be located on the roof. Although these units will be screened to the south and south west by the parapet around the roof edge, no correction has been applied to the predictions.

Details of the major noise sources associated with this facility, the sound reduction indices (SRIs) of the individual building elements and the overall SWLs generated are provided in *Table 2.5b* and in *Figure 2.5a*. Further details of the calculations are provided in *Annex A*.

Table 2.5b *Noise Sources Within the Proposed Aircraft Overhaul Facility*

Noise Source	Internal SPL dB(A)	$S_{walls/doors}$, m^2	$S_{Windows}$, m^2	$S_{Louvres}$, m^2	S_{Total}, m^2	SRI_{av} dB(A)	SWL dB(A)
Northern Facade							
Ground Floor							
Workshop	85	74.0		0.2	74.3	37	61
Bottle Room	80	25.3	5.0		30.3	32	57
Welding room	75	13.4		0.4	13.8	30	50
Chiller test Room	75	13.8			13.8	40	40
2nd Floor							
Workshops	85	99.9	28.1		128.0	31	69
AHU Plant Room	100	32.6		6.6	39.2	23	87
TOTAL							87
Southern Facade							
Ground Floor							
HP Comp Vac Pump	125	19.8		5.0	24.8	22	111
Fuel Workshop	125	29.5		0.8	30.3	30	104
Test Room	100	31.8		4.0	35.8	24	85
Drive & Control	125	25.0		2.5	27.8	25	108
1st Floor							
Facilities Workshops	85	40.0	7.2		47.3	32	63
2nd Floor							
Workshops	85	178.4	21.6		200.0	34	68
TOTAL							113

2.5.3 *Predicted Impacts*

The cumulative impact from the two facilities at the identified NSRs have been evaluated. Predicted noise levels are presented in *Table 2.5c*.

Table 2.5c ***Predicted Noise Levels (dB(A)) from the Proposed Aircraft Overhaul Facility and the Cumulative Noise Levels including the Aircraft Engine Test Cell***

NSR Name	Distance (m)	HKPSG ANL-5 dB	TKO Aircraft Overhaul Facility (facade)	Aircraft Engine Test Cell [b] (facade)	APU Test Cell + Aircraft Engine Test Cell (facade)
Proposed residential development in Area 86[a]	1,150	60/50	39	37	41
Siu Sai Wan Estate	2,600	60/50	30	30	33

Notes:
(a) Upper floors of high rise NSRs within Area 86 which will be the worst affected NSRs.
(b) Predicted noise levels from the Aircraft Engine Test Cell were calculated from the results of noise measurements during commissioning testing[5].

The noise levels for the proposed facility, and the combined levels with the Aircraft Engine Test Cell given in *Table 2.5c*, are all within the HKPSG ANL-5 criteria. Therefore, the operational noise levels generated by the Aircraft Engine Test Cell and the proposed facility would be acceptable.

It should be noted that the above assessment has assumed that the design and construction of the plant rooms and workshops (and any other noisy area) within the facility, having an external wall, will have minimum specifications as listed below for the individual building elements:

- walls with SRI of 40 dB(A);
- secondary glazing for all windows with an SRI of 25 dB(A);
- acoustic louvres with a minimum SRI of 15 dB(A); and
- doors with SRI of 30 dB(A).

2.5.4 *Mitigation Measures*

The operational noise abatement requirements are presented in the previous section: the basic design and construction of the workshops and plantrooms within the proposed facility should be sufficient to prevent noise impacts at neighbouring NSRs. Noise monitoring, on commissioning of the facility is, however, recommended to identify any potential weakness in the construction of the facility.

(5) HAESL Jet Engine Testing Facility, Tseung Kwan O: Noise Measurements, by ERM HK June 1997 on behalf of Aero Systems Engineering Inc.

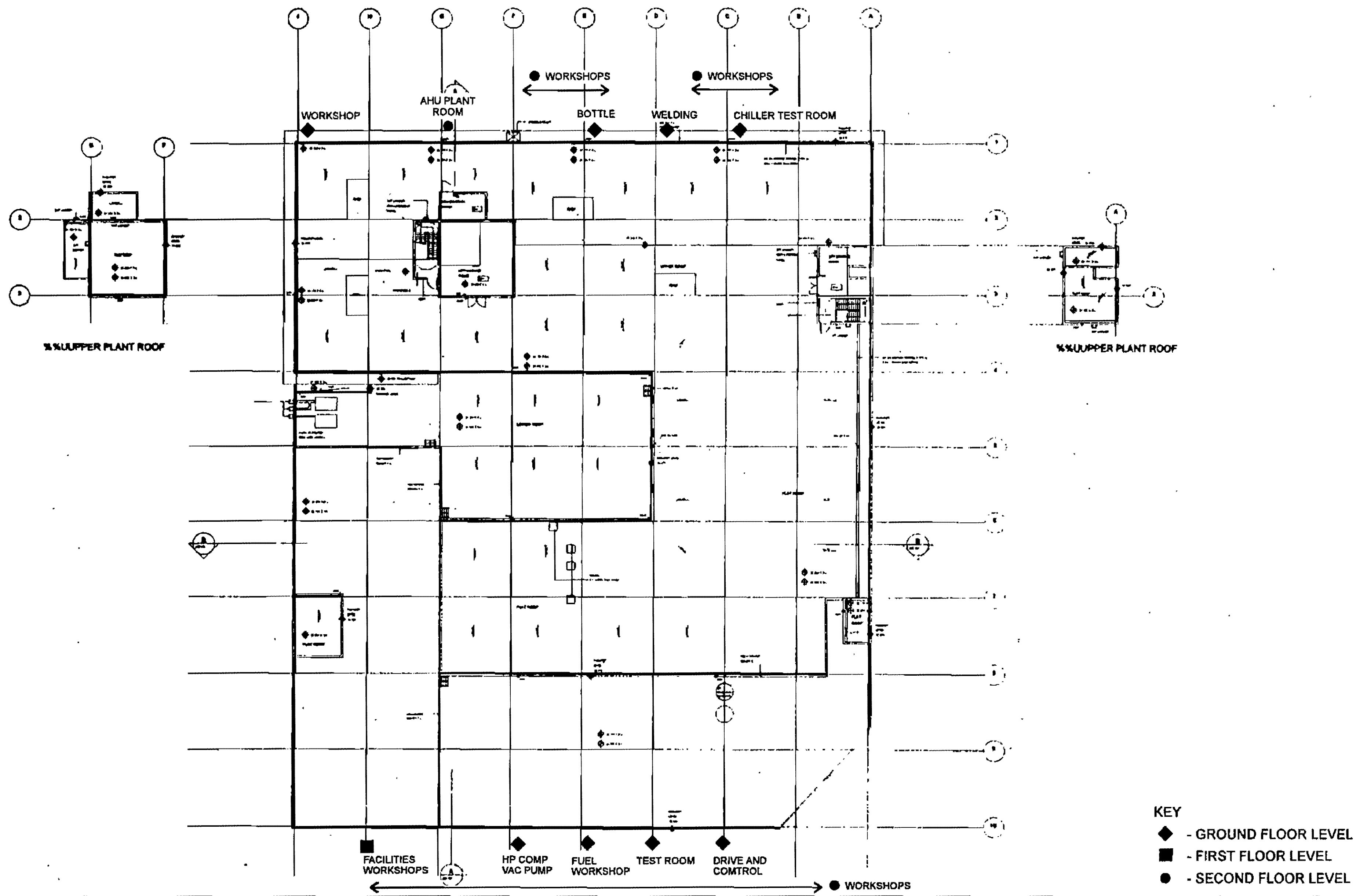

FIGURE 2.5a

MAJOR NOISE SOURCES IN AIRCRAFT OVERHAUL FACILITY

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DATE: 31/03/98

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2.6 *CONCLUSIONS*

It is unlikely that either the construction or the operation of the proposed facility will cause unacceptable noise impacts at the residential NSRs in the vicinity of the site. Noise monitoring on commissioning of the facility is, however, recommended to ensure that noise abatement measures are functioning correctly. Such monitoring should be undertaken at a reference distance from the building facade (in the order of 50 m).

3 *WATER QUALITY*

3.1 *INTRODUCTION*

This section identifies and evaluates potential water quality impacts arising from the construction and operation of the proposed facility and recommends mitigation measures where appropriate.

3.2 *PERTINENT STANDARDS AND GUIDELINES*

The *Water Pollution Control Ordinance (Cap 358) (WPCO)* and *Waste Disposal Ordinance (Cap 354)* (*WDO*) enable regulations which will apply to the potential impacts arising from the construction and operation of the proposed facility.

Under the *WPCO*, Hong Kong waters are divided into ten Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). The proposed site falls within the Junk Bay Water Control Zone, which was declared in August 1989.

The *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM), issued under Section 21 of the *WPCO*, defines acceptable discharge limits to different types of receiving waters for different daily flow rates.

The *WDO* provides an overall management framework for the collection and disposal of waste in Hong Kong. The *Waste Disposal (Chemical Waste) (General) Regulations (Cap 354)* control chemical wastes and specify requirements for the packaging, labelling, storage, collection and disposal of chemical wastes. Under these regulations, all chemical waste generators have to register with the Environmental Protection Department (EPD) and all chemical wastes generated have to be treated and disposed of at the Chemical Waste Treatment Centre (CWTC) at Tsing Yi.

In addition to the statutory requirements summarised above, guidelines on the handling and disposal of effluent in EPD's *Practice Notes for Professional Persons on Construction Site Drainage* (ProPECC PN 1/94) and in EPD's *Drainage Plans Subject to Comment by the Environmental Protection Department* (ProPECC PN 5/93) should be taken into account during the design and construction of the proposed facility.

3.3 *BASELINE CONDITIONS*

3.3.1 *Existing Conditions*

Water quality in Junk Bay is measured as part of the EPD's routine marine water quality monitoring programme. A summary of the EPD monitoring data for 1996 is presented in *Table 3.3a*. Monitoring locations are shown in *Figure 3.3a*.

Data published by EPD indicate that the water quality is generally poor, characterised by high turbidity, high concentrations of inorganic nutrients (in terms of total inorganic nitrogen and phosphorus), and especially for outer Junk Bay high *E. coli* and faecal coliform counts. Water quality at JM4 is slightly worse than at JM3 and this has been attributed to the influence of highly polluted seawater in the adjacent Victoria Harbour. High levels of *E. coli* and faecal coliforms indicate that the bay is polluted by sewage.

Table 3.3a *Summary of EPD Marine Water Quality Monitoring Data for Junk Bay in 1996*

Determinant		JM3	JM4
Number of samples		12	12
Temperature (°C)	Surface	23.1 (17.2-28.2)	23.0 (17.3-28.1)
	Bottom	22.3 (17.1-27.9)	22.3 (17.3-27.9)
Salinity (ppt)	Surface	32.5 (28.5-34.3)	32.5 (28.6-34.4)
	Bottom	33.5 (31.8-34.3)	33.5 (31.8-34.3)
DO (% saturation)	Surface	77.7 (51.5-118.7)	76.6 (52.8-96.4)
	Bottom	71.3 (51.2-90.4)	74.5 (51.4-92.9)
DO (mg l^{-1})	Surface	5.5 (3.5-8.1)	5.5 (3.5-7.0)
	Bottom	5.1 (3.6-6.3)	5.3 (3.6-6.8)
pH value		7.9 (7.6-8.3)	8.0 (7.8-8.4)
Secchi disc (m)		2.8 (1.8-5.0)	2.8 (2.0-3.7)
Turbidity (NTU)		3.5 (1.6-4.5)	3.7 (1.5-7.1)
Suspended solids (mg l^{-1})		3.7 (1.9-7.3)	4.1 (1.8-7.0)
Silica (as SiO_2) (mg l^{-1})		0.8 (0.4-1.3)	0.8 (0.4-1.3)
BOD_5 (mg l^{-1})		0.6 (0.3-1.2)	0.5 (0.1-0.9)
Nitrite N (mg l^{-1})		0.02 (<0.01-0.03)	0.02 (<0.01-0.03)
Nitrate N (mg l^{-1})		0.07 (0.02-0.16)	0.06 (0.01-0.22)
Ammoniacal N (mg l^{-1})		0.19 (0.03-0.34)	0.15 (0.02-0.31)
Total Inorganic N (mg l^{-1})		0.27 (0.16-0.40)	0.23 (0.07-0.39)
Total N (mg l^{-1})		0.53 (0.27-0.94)	0.48 (0.26-0.80)
Ortho-phosphate (mg l^{-1})		0.03 (0.02-0.06)	0.03 (0.01-0.06)
Total P (mg l^{-1})		0.12 (0.08-0.19)	0.12 (0.07-0.19)

Determinant	JM3	JM4
Phaeo-pigment (µg l^{-1})	1.89 (0.20-6.87)	1.80 (0.20-8.90)
Chlorophyll-a (µg l^{-1})	3.92 (0.43-16.70)	3.92 (0.50-23.67)
E.coli (cfu/100ml)	728 (75-1827)	927 (133-6867)
Faecal Coliform (cfu/100ml)	1019 (103-2660)	1442 (217-11567)

Notes:
1. Data presented are depth-averaged data unless specified
2. Data presented are annual means except for *E.coli* and Faecal Coliform data which are geometric means
3. Data in parentheses indicate the ranges

3.3.2 *Future Conditions*

The level of organic pollution in the Territory as a whole is expected to decrease in the future with the progressive implementation of various Government pollution abatement measures. They include continuing improvement and upgrading of the sewerage networks and treatment facilities in accordance with the Sewerage Master Plans and other sewage disposal schemes. As organic pollution drops water quality should improve.

Sewage from the area around Junk Bay is currently discharged into Tathong Channel through a submarine outfall following screening at the Tseung Kwan O treatment plant. As part of Strategic Sewage Disposal Scheme Phase I (SSDS I) sewage flows to the Tseung Kwan O plant will be transferred on to Stonecutters Treatment Works via a deep tunnel system. This will mean that the organic pollution load discharged to Junk Bay will be substantially reduced and water quality is expected to improve accordingly.

3.4 *IMPACT ASSESSMENT CRITERIA*

3.4.1 *Assessment Criteria*

Potential water quality impacts arising from the construction and operation of the proposed facility have been assessed with respect to the WQOs for Junk Bay WCZ and with respect to the standards for effluents discharged to drainage and sewerage systems specified in the TM.

During construction of the proposed facility, there is the potential for discharges from the site including surface water run off, to pollute Junk Bay. Of particular concern are potential changes to Suspended Solid (SS) and Dissolved Oxygen (DO) concentrations in the Bay. The WQOs for these parameters are as follows:

SS levels: Activities during the construction phase must not cause the natural ambient SS level to be raised by more than 30% nor give rise to accumulation of SS.

DO levels: DO levels should not fall below 4 mg l^{-1} (depth-averaged) for 90% of the sampling occasions during the year and should not be less than

2mg l^{-1} within 2 m of the seabed for 90% of the sampling occasions during the year.

During the operation of the proposed facility, discharges to Junk Bay should not occur because effluents will be collected and disposed of elsewhere. Highly contaminated effluents will transferred to drums for off-site treatment and disposal, and the remaining effluents will be discharged to sewer either directly or via an on-site treatment works. Standards for discharges to sewer are specified in Table 1 of the TM.

3.4.2 *Sensitive Receivers*

The nearest biological sensitive receiver to the site is Tung Lung Chau mariculture zone. However, this is located approximately 4 km to the south-east of the site and it is unlikely to be impacted by construction and operation of the proposed facility.

There are no other major biological sensitive receivers such as commercial fisheries, shell fisheries, or water gathering grounds in the vicinity of the site. This assessment is therefore based on compliance with the WQOs and the TM discharge limits described in *Section 3.4.1* rather than on criteria for sensitive receivers.

3.5 CONSTRUCTION PHASE

3.5.1 *Potential Sources of Impact*

Potential sources of impact to water quality that will arise from the construction of the proposed facility will be similar to those of other land-based building construction activities. They include:

- construction site runoff and drainage; and
- sewage from the construction workforce.

Construction Site Runoff and Drainage

Runoff and drainage from construction sites may contain increased loads of SS and other contaminants. Potential pollutants include:

- material on site surfaces, material eroded from drainage channels, and material from earth working and stockpiles;
- dust contained in water used for dust suppression; and
- fuel, oil and lubricants from construction vehicles and equipment.

Domestic Sewage

Domestic sewage will be generated by the construction workforce.

3.5.2 *Potential Mitigation Measures*

Various measures should be undertaken during construction to minimise

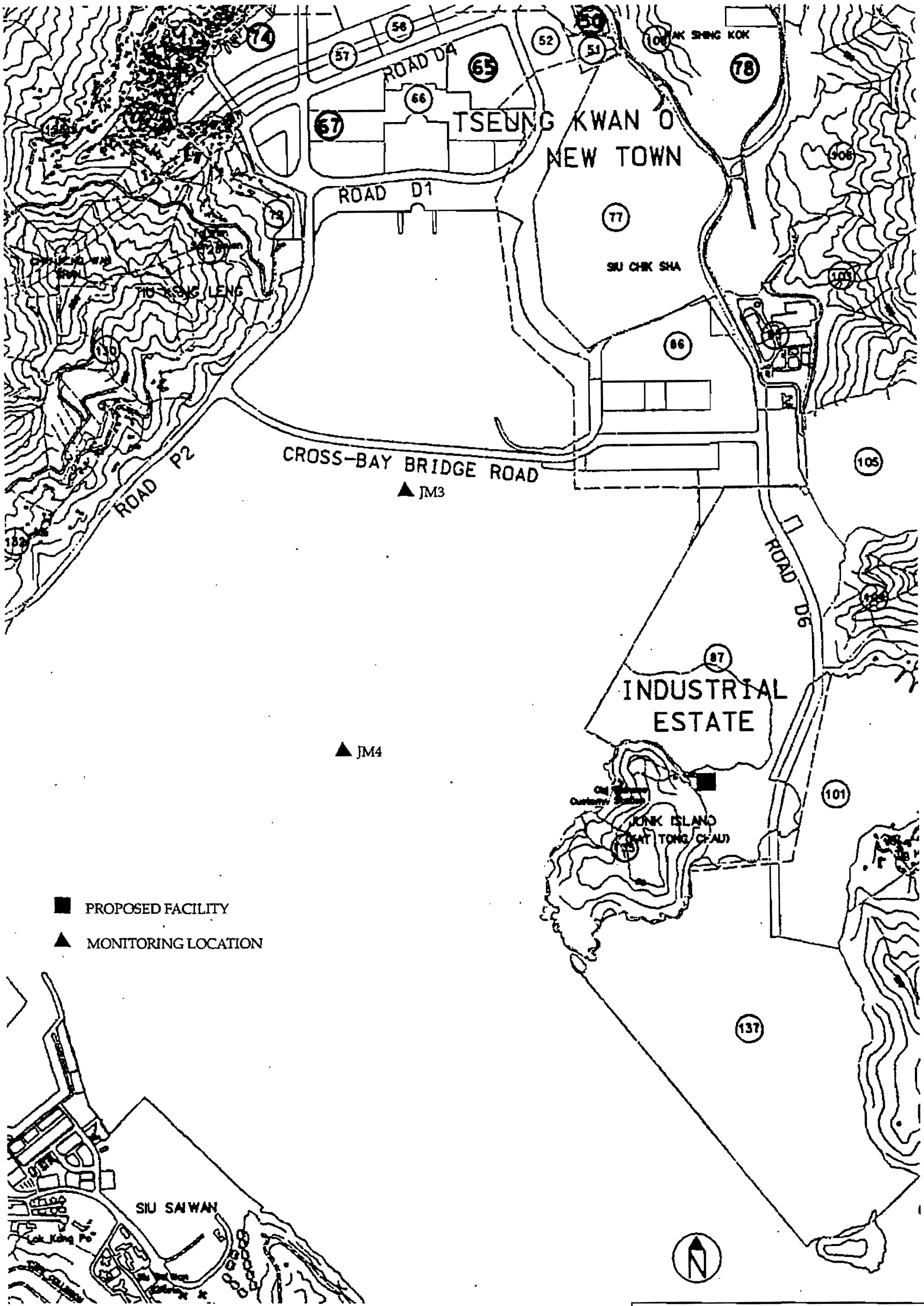

FIGURE 3.3a - SITE LOCATION, SURROUNDING AREA AND WATER QUALITY MONITORING LOCATIONS

ERM Hong Kong, Ltd

6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

impacts to water quality. The following measures are recommended.

Construction Site Surface Runoff and Drainage

All site construction runoff should be controlled and treated to prevent high levels of SS from entering surrounding waters. The following measures, which constitute good site practice should be implemented as far as possible:

- drainage channels should be provided to facilitate the collection of surface runoff, they should incorporate silt traps and sedimentation tanks/pits;
- maintenance and plant areas should be bunded and constructed on a hard standing with the provision of silt traps and oil interceptors;
- silt traps, sedimentation tanks/traps and oil interceptors should be cleaned regularly and maintained by the contractor. Daily inspections of these facilities should be conducted by the contractor;
- all drainage and associated de-silting facilities should be adequately designed for the controlled release of storm flows;
- exposed soil areas should be minimised and stockpiles should be covered to prevent excessive erosion and consequently silty runoff;
- existing water courses in the vicinity of the site should be kept free from obstruction by debris and excavated materials arising from the works; and
- fuel tanks and chemical storage facilities should be provided with locks and be placed on hard standing, within bunds of a capacity equal to 110% of the storage capacity for the containment of accidental spills.

The contractor should be required to adopt best practicable site management practices. These should include measures to prevent disposal of any solid materials, litter or construction wastes to Junk Bay.

Domestic Sewage

Sewage from the site should be collected and transferred to the nearest public foul sewer if one is available. Otherwise, portable toilet facilities should be provided and emptied regularly by a licensed contractor for treatment of the effluents off-site. Provided that the sewage generated on-site is collected and disposed of in a proper manner (ie either through discharge to sewer or the use of portable toilets), no adverse water quality impacts will result.

3.5.3 *Conclusions*

The potential for construction activities to impact water quality has been assessed. Construction will be entirely land based and there are no activities that will inherently cause water quality impacts. There are, however, various activities that could result in pollutants entering Junk Bay. Provided proper site management, good site practice and the implementation of the mitigation measures provided above, the entry of potential pollutants into Junk Bay will be prevented and therefore construction activities should not cause water quality impacts. Consequently Environmental Monitoring and Audit (EM&A) of water quality during construction should not be necessary and is not recommended.

3.6 OPERATIONAL PHASE

3.6.1 *Potential Sources of Impacts*

The operation of the proposed facility will generate a range of wastewater effluents and liquid wastes with the potential to cause water quality impacts. They can be broadly categorised as follows:

- metal processing and finishing effluents (industrial effluent);
- other workshop effluents (also industrial effluent);
- kitchen effluents; and
- sewage effluents.

Metal Processing and Finishing Effluents

Metal processing and finishing effluents will include metal cutting and machining wastes, aircraft component cleaning waste, painting waste, electroplating waste, non-destructive testing (NDT) waste, and other general workshop waste. Metal cutting and machining at the proposed facility will involve the use of cutting oil and lubricants. These processes are therefore likely to result in effluents containing suspended solids, oil and grease. Aircraft component cleaning is required prior to further processing, such as welding, electroplating or thermal/plasma spray. HAECO has indicated that both mechanical and chemical cleaning will be conducted.

Mechanical cleaning involves blasting of metal surface with abrasive particles such as aluminium oxide. Following cleaning, components are rinsed with water to wash off any remaining abrasive and metal debris. Waste rinse water contains elevated levels of suspended solids, and can contain oil and grease. Relatively small amounts of water are used for rinsing following mechanical cleaning and the volume of wastewater that is produced is estimated to be 1 m^3 day^{-1} on average.

Chemical cleaning involves washing components to remove oil, grease and other deposits. Chemicals employed will include proprietary chemical products (eg Ardrox 6025, Cee Bee J-84, Cee Bee J-88), organic solvents (eg kerosene), concentrated alkali (eg sodium hydroxide or caustic soda) and concentrated acids (eg nitric acid and chromic acid). Wastewater resulting will have varying pH (ranging from 4.8 to 12.1) and elevated levels of suspended solids, oil, grease, surfactants and chemical oxygen demand (COD). Chemical cleaning generates an estimated 45 m^3 day^{-1} of waste rinse water.

Electroplating operations are expected to generate large volumes of wastewater including spent acids, alkalis and solutions containing cadmium, manganese, chromium, nickel, lead and cyanide. These wastes are classified as chemical waste under the Chemical Waste Control Scheme. Provisions of the Scheme require their collection and transport to the CWTC for treatment and disposal. Following plating, components are rinsed and this results in relatively large volumes of wastewater contaminated to varying degrees with acids, alkalis, cyanide and heavy metals. It should be noted that such rinse waters are not classified as chemical wastes and are subject to independent treatment and control. Plating operations generate an estimated 50 m^3 day^{-1} of wastewater[6].

The degree and variation in the contamination of effluents arising from different stages and processes involved in electroplating was monitored by the Hong Kong Productivity Council (HKPC) at HAECO's existing facility during April to May 1996. Summaries of the results are presented in *Tables 3.6a* to *3.6c*.

Table 3.6a *Plating Effluent Quality Monitoring Results - Acid-Base Ion Exchange*

Parameter	19 April 1996	25 April 1996	1 May 1996	7 May 1996
Temperature (°C)	23.7	25.1	23.5	25.3
pH	6.7	6.1	7.4	7.3
BOD_5	30	<3	3.1	3.6
COD	95	16	11	120
SS	34	<5	11	<5
Oil & Grease	<10	<10	<10	<10
Total P	0.86	0.36	3.1	0.39
Ammonia nitrogen	5.2	0.7	0.9	0.87
Total surfactant	0.9	<0.4	0.6	2.8
Total Cr	0.6	0.1	0.1	0.4
Total Ni	7.2	0.2	0.4	0.5
Total Cd	2.8	1.5	0.26	12
Total Cu	0.5	0.7	0.1	0.2
Total Ag	0.1	0.5	0.3	0.3
Total CN	0.05	2	2.2	0.14
Total reactive P	0.46	0.15	2.8	0.11
Average Flow Rate at Kai Tak (l min^{-1})	1	1	3	1

Notes:
All units in mg l^{-1} unless otherwise stated
n/m = not monitored

(6) Euro Mark Technologies Limited (1997) *Report on the Detailed Design of a Wastewater Treatment Plant for the Aero Engine Services General Workshops.* Project No. 01005061, 12 June.

Table 3.6b *Plating Effluent Quality Monitoring Results - Cyanide Ion Exchange*

Parameter	25 April 1996	1 May 1996	7 May 1996	15 May 1996
Temperature (°C)	24.4	24.7	25.8	25.1
pH	9	8.7	8.4	8.9
BOD_5	<3	<3	4.5	5.6
COD	19	<5	16	18
SS	<5	<5	<5	<5
Oil & Grease	12	<10	<10	<10
Total P	0.02	<0.01	<0.01	0.28
Ammonia nitrogen	0.7	0.7	0.42	0.27
Total surfactant	<0.4	1.1	<0.4	1.3
Total Cr	<0.1	<0.1	<0.1	<0.1
Total Ni	0.2	0.1	0.1	<0.1
Total Cd	0.13	0.4	0.12	0.22
Total Cu	0.4	0.1	<0.1	<0.1
Total Ag	0.7	0.2	0.2	<0.1
Total CN	2.4	1.2	0.51	1.4
Total reactive P	<0.01	<0.01	<0.01	0.23
Average Flow Rate at Kai Tak ($l\ min^{-1}$)	0.6	1	1.8	7.8

Notes:
All units in $mg\ l^{-1}$ unless otherwise stated
n/m = not monitored
Average predicted flow rate at TKO is 8 $m^3 day^{-1}$

NDT techniques, which involve the use of organic solvents and dyes, will be used to detect damage and cracks in aircraft components. Organic solvents, emulsifier and water will be used for removing the penetrant dyes after testing. The effluents generated contain oil, grease, organic solvents, and proprietary chemicals including penetrant dyes and emulsifier, all of which contribute to the COD load. In some cases, metal components will be subject to X-ray examination for which film processing chemicals will be used. X-ray inspection is only carried out in the HAESL facility, as an independent process. Wastewater from X-ray film processing is likely to contain acids and therefore is expected to have a low pH. NDT operations generate an estimated 6 $m^3\ day^{-1}$ of effluent on average. The quality of NDT inspection effluents was monitored by HKPC in April and May of 1996 at HAECO's existing facility at Kai Tak. Results are presented in *Table 3.6d*.

Some metal components will be subjected to thermal or plasma spray treatment. During this process air will be extracted from the work area and passed through wet scrubbers to remove potential air pollutants. The scrubbing process will generate wastewater contaminated with components of the spray.

Table 3.6c *Plating Effluent Quality Monitoring Results - pH Adjustment System*

Parameter	25 April 1996	1 May 1996	7 May 1996	15 May 1996
Temperature (°C)	23.1	23.8	no data	23.2
pH	8.9	7.7	7.6	7.1
BOD_5	6.2	4.5	<3	3.4
COD	21	14	8.6	6.6
SS	<5	<5	<5	<5
Oil & Grease	11	<10	<10	<10
Total P	3.8	0.16	0.06	0.06
Ammonia nitrogen	2.1	0.1	0.78	0.36
Total surfactant	4.3	0.7	1.2	<0.4
Total Cr	6	1.1	2.9	2.6
Total Ni	0.7	0.2	0.4	2.8
Total Cd	0.15	0.02	0.25	0.3
Total Cu	<0.1	<0.1	<0.1	<0.1
Total Ag	<0.1	<0.1	<0.1	<0.1
Total CN	0.02	0.04	<0.01	<0.01
Total reactive P	0.67	0.1	0.03	0.02
Average Flow rate ($l\ min^{-1}$)	0.25	0.08	0.03	0.18

Notes:
All units in $mg\ l^{-1}$ unless otherwise stated
n/m = not monitored

Some components will be treated with acid before welding and being polished with abrasives. Effluents contaminated with acid and polishing debris may therefore arise from welding operations.

Effluents arising from plating operations are anticipated to be the major source of concern among all metal processing related effluents because of their volume and toxicity. Without appropriate treatment, discharge of these effluents would probably result in exceedance of the TM standards. Discharges of a number of substances generated from metal processing and finishing into public foul sewers are also prohibited. A list of the prohibited substances is presented in *Table 3.6e*. Proper collection and disposal of the liquid waste generated on-site will be required to avoid exceedance of TM standards to prevent adverse impacts on water quality. The collection scheme for these effluents are further discussed in *Section 3.6.2*.

Table 3.6d *NDT and Chemical Cleaning Effluent Quality Monitoring Results*

Parameter	10 April 1996		18 April 1996		24 April 1996		2 May 1996	3 May 1996
	Detection Area	Cleaning Area	Detection Area	Cleaning Area	Detection Area	Cleaning Area	Detection Area	Cleaning Area
Temperature (°C)	25.6	22.3	25.2	22.5	26.2	23.7	29.6	23.4
pH	7.6	12.1	7.3	6.7	7.5	9.8	7.3	4.8
BOD_5	410	560	1600	130	310	140	340	120
COD	1800	1900	9400	330	1600	540	1300	470
SS	20	54	<5	13	<5	120	<5	81
Oil & grease	290	61	620	14	310	15	170	17
Total phosphorus	0.3	9.8	0.14	1.9	0.06	4.5	0.17	0.3
Ammonia nitrogen	<0.1	0.3	<0.1	0.2	<0.1	7.8	<0.1	0.4
Total surfactant	26	150	75	31	160	57	72	40
Average Flow rate ($l\ min^{-1}$)	7.4	19	5.8	25	12	21	8	21

Notes:
All units in $mg\ l^{-1}$ unless otherwise stated
n/m = not monitored

Table 3.6e *Prohibited Substances - Foul Sewers*

Polychlorinated biphenyls (PCB)
Polyaromatic hydrocarbons (PAH)
Fumigant or pesticide
Radioactive substances
Chlorinated hydrocarbons
Flammable or toxic solvents
Petroleum oil or tar
Calcium carbide
Waste liable to form scum or deposits in any part of the public sewer
Any substance of a nature and quantity likely to damage the sewer or to interfere with any of the treatment processes

Source:
Technical Memorandum Standard for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters. EPD 1991

Other Workshop Effluents

Operations in workshops other than metal processing and finishing will also generate liquid wastes which will probably contain organic solvents, oil and grease. Volumes of these effluents are expected to be relatively small when compared to metal processing and finishing effluents. Industrial effluents from other workshops will probably contain organic solvents, oil and grease. As in the case of the metal processing and finishing effluents, discharge of certain substances (eg flammable or toxic solvents) from the other workshops into public foul sewers will be prohibited (see *Table 3.6e*). Removal of these prohibited substances prior to discharge of the effluents will be necessary to prevent water quality impacts.

Kitchen Effluents

The proposed facility will include canteens situated in the administration block of the HAESL development and in the HAECO Overhaul Building Rev 1 of 26 September 1996. Food preparation, cooking and dish washing will generate domestic wastewater. These effluents are likely to contain oil, grease, some surfactants and to have a high level of BOD and COD.

Domestic Sewage

Domestic sewage will be generated by the workforce of the proposed facility. Domestic sewage has high levels of nutrients, BOD and bacteria.

3.6.2 *Potential Mitigation Measures*

Industrial Effluents

Industrial effluents comprise all spent chemicals and rinse waters. They include metal processing and finishing effluents and other workshop effluents, as described above. Spent chemicals are generally more concentrated than rinse waters and it is considered essential that the two wastewater streams are segregated and treated separately.

Spent chemical streams contain chemicals that are classified as chemical waste. They will normally be pumped directly from the process tank to collection drums for off-site treatment. In the event of a spillage or leak, effluent will be collected in sump pits for transfer into drums and transported for off-site treatment and disposal at a licensed facility, such as the CWTC on Tsing Yi. The different types of sump pits to be installed and the corresponding source of liquid chemical wastes to be directed to these sumps are listed in *Table 3.6f* in accordance with information provided by Process Design & Fabrication Pty Ltd (PDF) (Meinhardt Drawing No 041-0001 dated 19 September 1996).

Table 3.6f ***Liquid Chemical Waste Streams and Sources***

Type of Sump	**Source of Chemical Wastes**		
	Building	**Work Area**	**Drain No**
General	HAESL	NDT Area	36D
	HAECO	NDT Area	56D
Acid	HAESL	Plating Area	1D
		Fan Blade Cell Workshop	21D
		Honeycomb Cell Workshop	41D
Alkali	HAESL	Plating Area	2D
		Chemical Clean Area	12D
		Fan Blade Cell Workshop	22D
		Honeycomb Cell Workshop	42D
	HAECO	Chemical Clean Area	62D
Cyanide	HAESL	Plating Area	3D
Chromate	HAESL	Plating Area	4D
Chromate/acid	HAESL	Chemical Clean Area	14D
	HAECO	Chemical Clean Area	64D
Wax	HAESL	Plating Area	5D
		Fan Blade Cell Workshop	25D
		Honeycomb Cell Workshop	45D
Kerosene	HAESL	Chemical Clean Area	15D
	HAECO	Chemical Clean Area	65D

Source:
TKO HAESL & HAECO Process Workshops Waste Water Sources (Drawing No. 041-0001)

Most of the industrial effluent streams from the workshops are likely to be contaminated with oil and grease. It is therefore recommended that oil interceptors be installed in the drainage/collection system for the separation of oil from these effluents. Oily waste collected from regular cleaning or from oil interceptors should be transported to a licensed facility, such as the CWTC, for proper treatment.

Rinse water streams will be less concentrated than the spent chemical streams and they will be treated at an on-site facility. According to the preliminary design of the on-site wastewater treatment facilities in the *Proposal for Tendering Waste Treatment Installation Named Sub-Contract for General Workshop at Tseung Kwan O - Phase 2* (jointly prepared by Euro Mark Technologies Ltd (EMT) and HKPC), rinse water effluents from different industrial processes will be collected as five separate streams. These five effluent streams include:

- plating acid/alkali rinse;
- plating cyanide rinse;
- plating chromate rinse;
- chemical clean rinse; and
- NDT rinse.

The five streams will be treated separately according to their physical and chemical characteristics. Treatment for each has been designed on the basis of the results of monitoring conducted by HKPC in April and May 1996 at HAECO's existing facility. A summary of the results for each stream is presented in *Table 3.6g*.

In addition to waste segregation and on-site treatment, the operator of the proposed facility should explore all practicable means for waste reduction, effluent reuse and recycling in consultation with the process design engineer and EPD. Implementation of waste reduction measures may lead to reductions in treatment requirements both on and off site.

Kitchen Effluents

Kitchen effluents arising from the on-site canteen will contain oil and grease. Oil and grease should be separated from these effluents prior to discharge into the foul sewer using grease traps. Requirements for grease trap capacities are given in the document *ProPECC PN 5/93* and the *Grease Traps for Restaurants and Food Processors* booklet published by EPD.

Domestic Sewage

All domestic sewage generated within the proposed facility should be directed to the public sewerage system via the three foul sewer connections already provided and approved by Buildings Department (BD).

Monitoring

Regular monitoring is recommended to ensure that the quality of effluents discharged to sewer does not exceed standards in the TM or the in discharge licence for the proposed facility, and that no prohibited substances are discharged.

Table 3.6g *Characteristics of Industrial Effluent Streams*

Parameter	Plating Acid/ Alkali Rinse	Plating Cyanide Rinse	Plating Chromate Rinse	Chemical Clean Rinse	NDT Rinse	WPCO TM Effluent Standard
Flow (m^3a^{-1})	880	880	102	3700	400	-
Flow (m^3d^{-1})	8	8	18	45	6	10-100
Inst. flow ($l\ min^{-1}$)	40	40	60	680	60	-
Inst. flow duration (min)	15	15	15	15	15	-
pH	6.98	8.75	7.83	4.8-12.1	7.43	6-10
BOD	9.93	4.08	4.28	274.67	420	1000
COD	60.25	14.50	12.55	795.00	1566.67	2500
SS	13.75	5.00	5.00	5.00	8.75	1000
Oil & grease	10.00	10.50	10.25	13.00	620	100
Total P	1.11	0.08	1.02	8.20	0.10	50
Ammonia nitrogen	1.72	0.52	0.84	2.23	0.10	200
Total surfactant	1.18	0.80	1.65	30.75	83.25	150
Total Cr	0.60	0.10	6.00	-	-	2
Total Ni	7.20	0.13	1.03	-	-	3
Total Cd	2.80	0.40	0.30	-	-	0.15
Total Cu	0.70	0.18	0.10	-	-	4
Total CN	0.10	6.70	0.02	-	-	2

Note:
All units in mg l^{-1} unless otherwise stated
Source:
Proposal for Tendering Waste Treatment Installation Named Sub-contract for General Workshop at Tseung Kwan O - Phase 2 prepared for Hong Kong Aero Engine Services Ltd by Euro Mark Technologies Ltd. & Hong Kong Productivity Council (16 December 1996)

3.6.3 *Conclusions*

Wastewater effluents generated by the proposed facility will include industrial wastewater, kitchen effluents and domestic sewage. The drainage system of the proposed facility has been designed to segregate effluents by source. Segregated effluents will be treated according to the characteristics of the waste stream prior to their disposal. Collection, treatment and disposal of wastewater generated by the proposed facility will prevent adverse water quality impacts in the neighbouring Junk Bay, at Government treatment works and in receiving waters.

Industrial wastewater will be further segregated. Concentrated wastewater including spent chemicals will be collected in sumps for transfer to a licensed facility such as the CWTC for treatment. Less concentrated wastewaters, including rinse waters, will be collected in five streams which will be passed to on-site treatment facilities. The streams have been segregated to ensure that treatment is appropriate to the characteristics of the wastewater. Regular monitoring of the treated effluents discharged to sewer is recommended to ensure that the quality of effluents complies with the established discharge standards and the discharge licence conditions.

In addition to waste segregation and on-site treatment, the operator of the proposed facility should explore all practicable means for waste reduction, effluent reuse and recycling in consultation with the process design engineer and EPD. Implementation of effluent reduction measures may allow the requirements for effluent treatment to be reduced.

Domestic sewage and kitchen wastewater will be directed to the public foul sewer via one of the three foul sewage connections approved by BD. Grease traps should be provided for kitchen drains.

4 AIR QUALITY

4.1 INTRODUCTION

The proposed facility will be located at the Tseung Kwan O Industrial Estate, adjacent to the Aircraft Engine Test Cell Facility (Phase I) which is a HAECO facility. The construction and operation air quality impacts from the Aircraft Engine Test Cell Facility have been assessed in the *Environmental Impact Assessment for HAECO Aircraft Engine Test Cell Facility at Tseung Kwan O*, details of which can be found in the final report issued in September 1995 and a number of addenda issued in May 1996.

This section identifies the potential air quality impacts due to construction and operation of the Tseung Kwan O Aircraft Overhaul Division (Phase II). Mitigation measures have also been recommended, where necessary.

4.2 PERTINENT STANDARDS AND GUIDELINES

The principal legislation for the management of air quality in Hong Kong is the *Air Pollution Control Ordinance (APCO)* (Cap 311). The statutory limits of specific air pollutants and the maximum allowable number of exceedances over specific time periods are stipulated by *APCO*. These limits and conditions on ambient air quality are shown in *Table 4.2a*.

Table 4.2a ***Hong Kong Air Quality Objectives ($\mu g\ m^{-3}$)[(a)]***

Pollutant	Averaging Time				
	1 Hour [(b)]	8 Hours [(c)]	24 Hours [(c)]	3 Months[(d)]	1 Year[(d)]
Total Suspended Particulates (TSP)	-	-	260	-	80
Respirable Suspended Particulates [(e)] (RSP)	-	-	180	-	55
Sulphur Dioxide (SO_2)	800	-	350	-	80
Nitrogen Dioxide (NO_2)	300	-	150	-	80
Carbon Monoxide (CO)	30,000	10,000	-	-	-
Ozone	240	-	-	-	-
Lead	-	-	-	1.5	-

Notes:
(a) Measured at 298 K (25°C) and 101.325 kPa (one atmosphere).
(b) Not to be exceeded more than three times per year.
(c) Not to be exceeded more than once per year.
(d) Arithmetic means.
(e) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometres and smaller.

Limits for additional air pollutants including volatile organic compounds (VOCs) and heavy metals, are stipulated in the *Technical Memorandum for Issuing Air Pollution Abatement Notices to Control Air Pollution From Stationary Polluting*

Processes (TM4). An *Air Pollution Abatement Notice* can be issued under the *APCO* to control such emissions to the specified acceptable levels.

Odour from malodourous materials is controlled as nuisance under the *APCO.* The EPD recommends a limit of two odour units (twice the detection limit) at the site boundary (averaging time of 3 minutes) and 5 odour units at sensitive receivers (averaging time of 5 seconds, ie in effect instantaneous) to control odours to acceptable levels.

Under the *Air Pollution Control (Specified Processes) Regulations,* licences are required for the conduct of the specified processes.

The Hong Kong Planning Standards & Guidelines (HKPSG) and *APCO* set out the criteria for identifying air sensitive receivers (ASRs) to be used in air quality impact assessment.

4.3 BASELINE CONDITIONS

4.3.1 Existing Conditions

The proposed facility is to be located on a section of reclaimed land adjacent to Fat Tong Chau (Junk Island) on the Tseung Kwan O Industrial Estate. Many major infrastructure projects and development projects are under construction currently. They include construction of Tseung Kwan O Industrial Estate and construction of Tseung Kwan O New Town. As a result the regional air quality is affected primarily by construction dust and traffic emissions.

Ambient air quality in the study area was monitored at the EPD Junk Bay monitoring station (Haven of Hope Sanatorium, Nansam Building, Po Lam Road, Junk Bay) prior to May 1993. Results for 1993 (January to May) are presented in *Table 4.3a*. Comparison of the values in this table with those in *Table 4.2a* show that NO_2 and SO_2 levels were well within their respective AQO, while TSP and RSP levels were close to their AQOs.

Table 4.3a *Background Air Quality in the Study Area*

Parameter	Annual Average $\mu g\ m^{-3}$ (a)
TSP	77
RSP	39
SO_2	9
NO_2	41
O_3	33

Note:
(a) The values presented should be considered indicative only as they were calculated from data collected in the period between January and May 1993 and not over an entire year.

4.3.2 Future Conditions

With the completion of the major infrastructure and development projects on the

Tseung Kwan O reclamation, the importance of construction dust as a factor affecting air quality in the Study Area will reduce and the importance of road traffic emissions as factors affecting air quality will increase. As a result it is anticipated that TSP levels' will reduce as levels of construction dust drop, and NO_2 and SO_2 levels will increase, as traffic levels and industrial emissions increase.

4.3.3 *Sensitive Receivers*

ASRs, as defined by HKPSG, have been identified with reference to previous environmental studies undertaken in the region of the Tseung Kwan O Industrial Estate, and have been updated by site surveys and by referring to survey sheets and development plans.

ASRs in the vicinity of the proposed facility are shown in *Figure 4.3a* and the distances between them and the proposed facility are shown in *Table 4.3b*.

Table 4.3b *Air Sensitive Receivers*

ASR No.	ASR	Location	Distance (m)
ASR1	Area 50	Tseung Kwan O	3,100
ASR2	Area 65	Tseung Kwan O	3,000
ASR3	Area 67	Tseung Kwan O	3,000
ASR4	Area 72	Tseung Kwan O	2,800
ASR5	Area 74	Tseung Kwan O	3,400
ASR6	Area 77	Tseung Kwan O	2,200
ASR7	Area 78	Tseung Kwan O	2,800
ASR8	Area 128	Tiu Keng Leung	2,900
ASR9	Fullview Garden	Siu Sai Wan	2,700
ASR10	Siu Sai Wan Estate	Siu Sai Wan	3,200
ASR11	Area 86	Tseung Kwan O	1,150

ASRs such as the planned development in Tiu Keng Leng and Tseung Kwan O and the existing potential ASRs in Chai Wan and Siu Sai Wan are unlikely to be affected by the facility as they are located at least 2 km from the proposed site. However, it is expected there will be some ASRs scattered throughout the Tseung Kwan O Industrial Estate. One of the ASRs will be the HAECO Aircraft Engine Test Cell Facility (Phase I).

4.4 CONSTRUCTION PHASE

4.4.1 *Potential Sources of Impact*

In general the principal potential impact to air quality associated with construction work is dust nuisance which results from dust generated during site formation. Other factors that can impact air quality include emissions from plant including excavators, cranes, compressors, concrete pumps and trucks.

4.4.2 *Evaluation of Impacts*

Levels of dust generated have been evaluated by assessing the types of construction work that will be conducted. As most of the earthworks involved during site formation have already been completed (by the Hong Kong Industrial Estate Corporation), site formation works will be limited and therefore little dust generation during this type of work is anticipated. Other construction activities that will be carried out include making the foundations, including piling, and building of the superstructure including making formwork, steelfixing and concreting. These activities generally do not generate large amounts dust and therefore unacceptable levels of dust are not anticipated.

Emissions from plant used on site will be limited because of the relatively small number of such equipment that will be needed. Therefore, plant emissions are not anticipated to result in unacceptable impacts to air quality.

4.4.3 *Mitigation Measures*

As unacceptable impacts to air quality are not anticipated during construction, no mitigation measures are required. However, the following measures which relate to good site practice are recommended to minimise impacts to air quality.

- standard dust suppression measures such as water spraying on unpaved roads / site should be adopted to reduce the potential for dust generation;
- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme; and
- machines and plant (such as trucks) used in intermittently should be either shut down, or throttled down to a minimum, between work periods.

4.5 *OPERATIONAL PHASE*

4.5.1 *Potential Sources of Impacts*

General Activities

A canteen will be provided at the facility and minor air emissions might be associated with its operation. Pollutants from canteens are typically combustion gas emissions from boilers and potentially odorous emissions.

Aircraft Maintenance Works

The proposed facility is scheduled to replace the existing HAECO facility at Kai Tak and the nature of activities to be carried out will be broadly similar to the existing Kai Tak facility. As part of the design process for the new facility, opportunities for additional environmental protection measures have been identified and included in the facility design. The principal activities to be conducted at the proposed facility are refinishing and trimming, airframe inspection and maintenance, and engine inspection and overhaul. Potential air pollutants associated with these activities include:

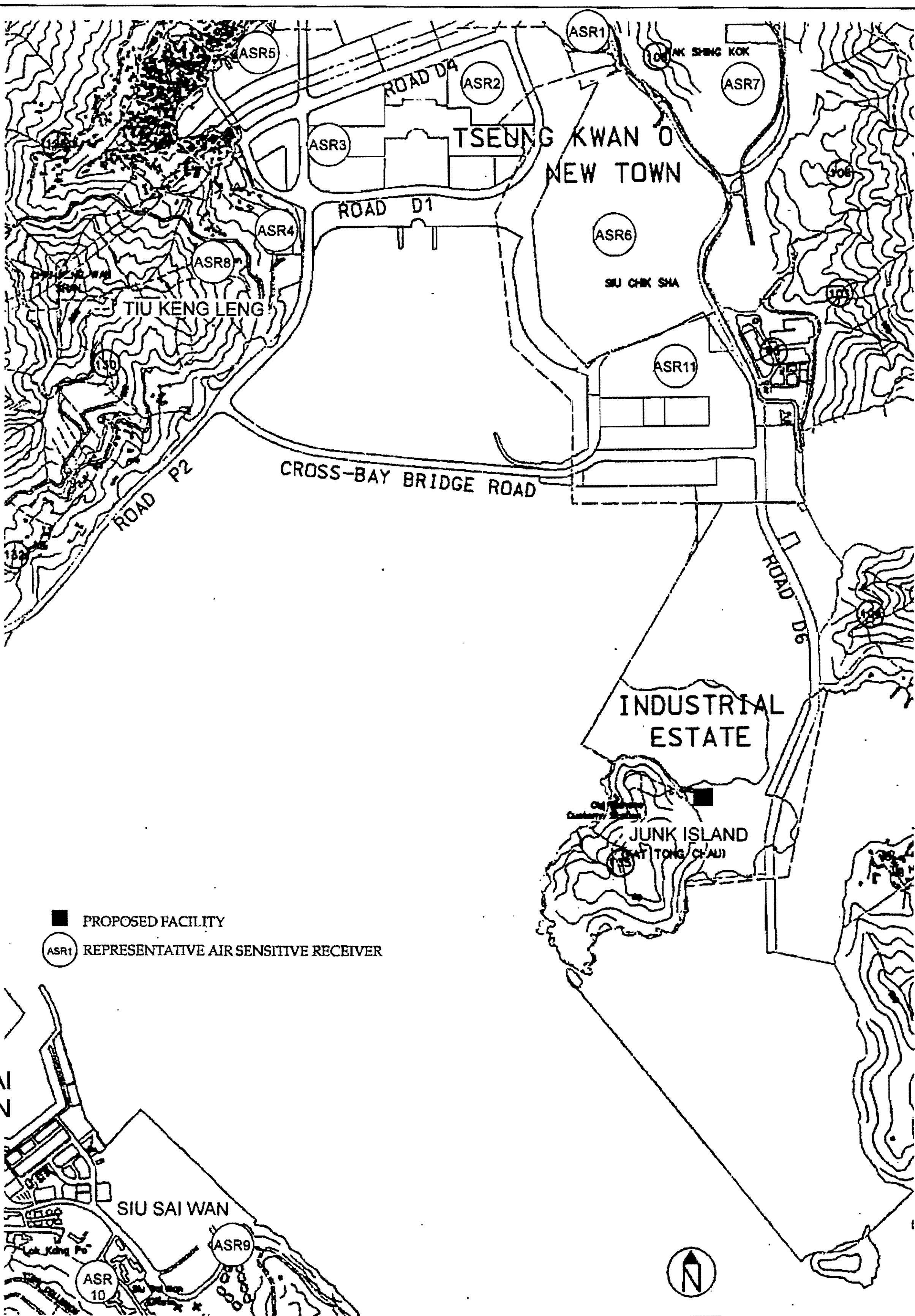

FIGURE 4.3a - AIR SENSITIVE RECEIVERS NEAR THE PROPOSED FACILITY

ERM Hong Kong, Ltd
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

- volatile organic compounds (VOCs) which are used in chemical cleaning and painting and include, degreasing solvents, thinners and fuel residues;
- acids and heavy metals (chromium, nickel etc) which result from chemical cleaning and plating operations; and
- dust and metal particulates which result from sand blasting of aircraft components for the removal of rust and paint.

4.5.2 *Evaluation of Impacts*

General Activities

Since the two canteens within the facility are catering for the HAECO and HAESL facilities individually, they will be relatively small with limited emissions from fuel consumption. Additionally, it is likely that the fuel for cooking will be town gas which is a relatively clean fuel and air quality impacts from the combustion process will be minimal. The only potential air quality impact will be the odour emission from the air discharged from the canteen kitchen. In considering the quantity of discharged air, the location of the extractor for the canteen (at the roof top) and the height of the surrounding buildings (test cell will be 1-2/F high and the overhaul building will be 4/F high), there will be adequate dilution of any odours. Therefore, general activities at the proposed facilities will not lead to unacceptable impacts to air quality in the vicinity.

Aircraft Engine and Component Maintenance Works

The scale of the plant operations is relatively small and their emissions are expected to be fairly low. Control measures will be provided for those polluting processes and air quality during operation of the facility will be mitigated. Details are discussed below.

Spray painting for interior parts will be carried out in a spraying booth which is designed to be maintained at negative pressure to prevent paint release to the atmosphere. Paint residues will be collected at the back of the painting booth; therefore, emission of paint will be limited and no air quality impacts are anticipated to result from painting operations.

Sand blasting of aircraft components for the removal of rust and paint is a potential source of dust. At the existing facility at Kai Tak, blasting operations are performed with an extraction system equipped with cyclone precipitation and filtering device which prevents emission of dust and particulates. The proposed facility will also employ this type of abatement system and therefore sand blasting operations should not cause impacts to air quality.

Air quality within the facility will be subjected to separate control and will meet the Hong Kong Government's occupational health criteria. The occupational health issue is assessed separately in the *Occupational Health and Safety (OHS) Report* (March 1996).

4.5.3 *Mitigation Measures*

No significant impacts to air quality are predicted to arise as a result of the operation of the facility. Consequently, no particular mitigation measures are recommended other than those included in the design and the adoption of good working practices for environmental protection. The facility will be equipped with a decentralised scrubbing system, designed to cater for emissions from each individual process. A total of sixteen such scrubbing systems will be provided.

Although air emissions will not be a major issue for the facility, periodic monitoring and maintenance programmes should be implemented to ensure performance and efficiencies of the air control equipment.

4.6 *CONCLUSIONS*

For construction of the proposed facility, most of the earthworks involved during site formation has been carried out by the Hong Kong Industrial Estate Corporation and the construction works for the facility will be limited to foundation works and building construction which are not considered to be dusty construction activities. In addition, only a relatively small number of construction plant will be used at the site and these are not anticipated to create significant vehicular emissions. Therefore, no adverse air quality impacts are anticipated during the construction period.

During the operation of the facility, as the plant room of the facilities will not be large in scale, air emissions from their operation will likely be minor. Major air impacts on ASRs will be unlikely. Should there be any air quality impacts, they can be mitigated by controlling the stack height or installing air pollution abatement equipment. A regular monitoring programme is recommended to ensure the statutory limits are not exceeded and that the performance of these mitigation measures is adequate.

5 SOLID WASTE MANAGEMENT

5.1 INTRODUCTION

This section identifies and evaluates issues relating to the management of solid wastes arising from the construction and operation of the proposed facility at Tseung Kwan O. Operations that will be conducted in the proposed facility include:

- chemical plating;
- chemical cleaning;
- non-destructive testing;
- collection, treatment and disposal facilities for various liquid and airborne effluent streams from the above three processes; and
- engine overhaul and machining of parts for repair.

Options for minimising, recycling, treating, storing, collecting, transporting and disposing waste arisings from the proposed facility have been examined. Procedures for waste reduction and management are considered and mitigation measures for minimising the impacts of the wastes are recommended.

5.2 PERTINENT STANDARDS AND GUIDELINES

The following legislation covers, or has some bearing upon, the handling, treatment and disposal of wastes in Hong Kong:

- *Waste Disposal Ordinance (Cap 354);*
- *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354);*
- *Crown Land Ordinance (Cap 28);* and
- *Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws (Cap 132).*

Waste Disposal Ordinance

The *Waste Disposal Ordinance (WDO)* prohibits the unauthorised disposal of wastes; waste is defined as any substance or article which is abandoned. Construction waste is not directly defined in the Ordinance but is considered to fall within the category of trade waste. Trade waste is defined as waste from any trade, manufacturer or business, or any waste building, or civil engineering materials; it does not include animal waste.

Under the *WDO*, wastes can only be disposed of at a licensed site. A breach of these regulations can lead to the imposition of a fine and/or a prison sentence. The *WDO* also provides for the issuing of licences for the collection and transport of wastes. Licences are not, however, currently issued for the collection and transport of construction and/or trade wastes.

Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)

Chemical waste as defined under the *Waste Disposal (Chemical Waste) (General) Regulation* includes any substance being scrap material, or unwanted substances specified under *Schedule 1* of the Regulation, if such substance or chemical occurs in such a form, quantity or concentration so as to cause pollution or constitute a danger to health or risk of pollution to the environment.

A person should not produce, or cause the production of, chemical wastes unless he is registered with the EPD. Any person who contravenes this requirement commits an offence and is liable upon conviction to a fine of up to HK$ 200,000 and to imprisonment for up to 6 months. The current fee for registration is HK$ 305.

Producers of chemical wastes must treat their wastes utilising on-site plant licensed by the EPD or have a licensed collector take the wastes to a licensed facility. For each consignment of wastes, the waste producer, collector and disposer of the wastes must sign all relevant parts of a computer generated trip ticket. The transfer of wastes from cradle to grave can therefore be traced.

The *Regulation* prescribes the storage facilities to be provided on site including labelling and warning signs. To minimise the risks of pollution and danger to human health or life, the waste producer is required to prepare and make available written procedures to be undertaken in the event of emergencies due to spillage, leakage or accidents arising from the storage of chemical wastes. The producer must also provide employees training in such procedures.

Crown Land Ordinance

The Crown Land Ordinance covers the disposal of materials suitable for use as reclamation fill. Construction wastes that are wholly inert may be taken to public dumps which usually form part of land reclamation schemes. Public dumps are operated by the Civil Engineering Department (CED) who issue dumping licenses to suitable individuals or companies under delegated authority from the Director of Building and Lands. Under the licence conditions, public dumps will accept only inert building debris, soil, rock and broken concrete. There is no size limitation on the rock and broken concrete, and a small amount of timber mixed with other suitable material is permissible. The material should, however, be free from marine mud, household refuse, plastic, metal, industrial and chemical waste, animal and vegetable matter and other material considered unsuitable by the dump supervisor.

Public Cleansing and Prevention of Nuisances By-laws

These *By-laws* provide a further control on the illegal tipping of wastes on unauthorised (unlicensed) sites. Illegal dumping of wastes can lead to fines of up to HK$ 10,000 and imprisonment for up to 6 months.

Additional Guidelines

Other 'guideline' documents which detail how the Contractor should comply with the regulations are as follows:

- *Waste Disposal Plan for Hong Kong (December 1989)*, Planning, Environment and Lands Branch Government Secretariat.

- *Environmental Guidelines for Planning In Hong Kong (1990)*, Hong Kong Planning and Standards Guidelines, Hong Kong Government.

- *New Disposal Arrangements for Construction Waste (1992)*, EPD & CED.

- *Code of Practice on the Packaging , Labelling and Storage of Chemical Wastes* (1992), EPD.

- *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste (1993)*, EPD.

5.3 IMPACT ASSESSMENT CRITERIA

The impact assessment criteria with respect to waste management are based on three main factors:

- the type of waste generated;

- the amount of principal waste types generated; and

- the proposed recycling, storage, transport, treatment and disposal methods, and the impacts of these methods.

5.4 CONSTRUCTION PHASE

The construction of the proposed facility will involve excavation and construction works for a building to house the workshops and associated treatment facilities as described in *Section 5.1*.

5.4.1 *Potential Sources of Impact*

Construction activities will result in the generation of a variety of wastes and can be divided into distinct categories based on their contents, as follows:

- excavated inert material, potentially including some contaminated material; such as sediment from below the reclamation fill.
- construction waste;
- chemical waste; and
- general refuse.

The volumes and nature of each of these waste types arisings from the construction of the proposed facility, and the potential impacts are discussed below.

Excavated Materials

Excavated material is defined as material removed from the ground and subsurface. Small volumes of this material will be generated primarily during the construction of foundations for the proposed facility. Material from the excavation will generally comprise of fill materials used for the Tseung Kwan O Reclamation.

Poor management of the storage, transport and disposal of excavated material may result in visual impacts and impacts to air and water quality. However, provided the implementation of mitigation measures such as those presented in *Section* 5.5.2 and *Section* 3.5.2, these impacts can be minimised to acceptable levels. Rock and soil excavated from the foundation works will be reused on site as far as possible, provided that they meet the necessary engineering requirements or they will delivered to other reclamation sites or public filing areas.

Construction Waste

Construction waste is defined as any unwanted materials generated during construction, including rejected structures and materials and materials used and discarded. Waste will arise from a number of different activities carried out by the Contractor during construction and maintenance activities, and may include:

- wood from formwork;
- equipment and vehicle maintenance parts;
- materials and equipment wrappings;
- unusable cement/grouting mixes; and
- damaged or contaminated construction materials.

Storage, transport and disposal of construction wastes have the potential to create similar visual dust and associated traffic impacts as the storage and disposal of excavated materials.

It is expected that the volume of construction waste generated by the construction activities will not differ significantly from other similar projects, which suggest a level of approximately 20 cubic metres per month. If construction wastes are generated in large quantities they may hinder building operations and present a safety hazard.

The disposal of construction wastes is unlikely to raise any long term concerns because of the generally inert nature of these materials. To conserve void space at landfill sites, construction waste must not be disposed of at a landfill site if it contains more than 20% inert material by volume. It is therefore good practice to segregate wastes at construction sites before disposing of inert materials at public dumps for reclamation works and putrescible materials at a controlled landfill site. The production of construction wastes should be minimised by the careful control of ordering procedures to avoid the purchase of surplus materials.

Avoidance of over ordering and the segregation of materials will reduce/minimise waste arisings requiring landfill disposal which will also assist in minimising costs should landfill charges be introduced.

Mitigation measures recommended to ensure that impacts arising from construction wastes are minimised are presented in *Section* 5.5.2.

Chemical Waste

Chemical Waste as defined under the *Waste Disposal (Chemical Waste) (General) Regulation* includes any substance being scrap material, or unwanted substances specified under Schedule 1 of the *Waste Disposal Ordinance (Cap. 354)*. A complete list of such substances is provided under the Ordinance, however substances likely to be generated by construction activities will for the most part arise from the maintenance of equipment. These may include, but need not be limited to the following:

- scrap batteries or spent acid/alkali from their maintenance;
- used engine oil from oil changing;
- used air, oil and fuel filters from machinery;
- spent mineral oils/cleaning fluids from mechanical machining; and
- spent solvents/solutions, which may be halogenated, from equipment cleaning activities.

Chemical waste will arise primarily from vehicle maintenance. It is difficult to quantify the amount of chemical waste which will arise from construction activities since it will be highly dependent on the Contractor's on-site maintenance intentions and the numbers of plant and vehicles utilised. However, estimates suggest that monthly arisings at the site will be very small.

Chemical wastes may pose serious environmental and health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the *Chemical Waste Regulations* and the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. These hazards include:

- toxic effects to workers;
- adverse effects on air, water and land from spills;
- fire hazards; and
- disruption of sewage treatment works where waste enters the sewage system.

General Refuse

General refuse will include any waste that does not fit into any of the categories previously described. Normal operations on the construction site will result in the generation of a variety of general refuse materials requiring disposal such as food wastes, packaging and waste paper.

The construction site is expected to have approximately 100 hundred workers. Estimates based on these figures suggest that the general refuse produced by construction will be in the order of 50 kg per day.

The storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if waste is not collected frequently (eg daily), windblown litter, water quality impacts if waste enters water bodies, and visual impacts. The sites may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. In addition, disposal of wastes, at sites other than approved landfills, can also lead to similar adverse impacts at those sites.

Table 5.4a presents a summary of waste types that will be generated during construction and associated potential environmental impacts.

Table 5.4a *Summary of Potential Impacts from Solid Waste during Construction*

Waste Type	General Evaluation
Excavated materials	Excavated materials should not result in unacceptable environmental impacts provided they are handled appropriately because they are inert and because relatively low volumes will be produced. The majority will be used on site or reclamation fill elsewhere.
Construction waste	Construction wastes can create visual, dust and water pollution impacts if not properly managed. The wastes should be minimised to reduce the environmental impacts and to save landfill void. If the recommended mitigation measures are used the levels of impact should be acceptable.
Chemical waste	Monthly arisings are expected to be very low, arising from maintenance of plant and equipment. Given proper handling, the prevention of spills and delivery to a licensed chemical waste facility, no adverse environmental impacts should occur.
General refuse	If good practice is adhered to and all feasible avoidance, reuse and recycling opportunities are taken, no unacceptable environmental impacts will occur.

5.4.2 *Mitigation Measures*

This section sets out recycling, storage, transportation and disposal options which may be implemented to avoid or minimise potential adverse impacts associated with the construction of the proposed facility according to waste type. These options should be considered and the recommendations incorporated into a on-site waste management plan for construction. The plan should include requirements for training and instruction of construction staff to increase awareness and to draw attention to waste management issues and the need to minimise waste generation.

Various options within waste management can be categorised in terms of preference from an environmental viewpoint, as follows:

- *avoidance* of waste generation
- *reuse* of materials;
- *recycling* of materials; and
- *disposal* of waste as the last option.

This hierarchy should be used to evaluate waste management options, thus allowing maximum waste reduction and often reducing costs. For example, by reducing or eliminating over-ordering of construction materials, waste is avoided and costs are reduced both in terms of purchasing materials and in disposing of wastes. Waste reduction measures should be introduced at the design stage and carried through the construction activities, wherever possible, by careful purchasing control, reuse of formwork and good site management.

Excavated Inert Materials

Excavated materials are not considered likely to cause adverse impacts, since they will be reused on site. As such, mitigation measures are not considered necessary. Any uncontaminated inert materials which cannot be reused on site may be delivered to public dumps and fill sites. To ensure acceptance of this waste at fill sites or public dumps and hence to avoid the need for disposal at landfill, excavated materials should be segregated from other wastes to avoid contamination. The volume of excavated materials that arises during the construction at the proposed facility is expected to be very small and therefore disposal difficulties are not anticipated.

Construction Waste

It has been estimated that approximately 600 m^3 of construction wastes will arise through the construction of proposed facility. In order to minimise waste arisings and keep environmental impacts within acceptable levels, the following mitigation measures should be adopted:

- Careful planning and good site management should be applied to minimise over-ordering and hence the generation of waste materials such as concrete, mortars and cement grouts. The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing should be considered to increase the potential for reuse.

- Handling and disposal of bentonite slurries should follow the requirements given in *Practice Note For Professional Persons, Construction Site Drainage Professional Persons Consultative Committee, 1994 (ProPECC PN 1/94).*

- The Contractor should recycle as much as possible of the construction waste on-site. Proper segregation of wastes on site will increase the feasibility of recycling certain components of the waste stream by recycling contractors. Concrete and masonry can be ground up and used as fill and steel reinforcing bars can be used by scrap steel mills. Different areas can be designated for the storage and processing of the various materials which may be recycled depending on site specific conditions.

- Construction wastes should be segregated from other wastes to allow disposal to public dumps. This is preferred to the alternative disposal option, which is landfill, in accordance with the *New Disposal Arrangements for Construction Waste, Environmental Protection Department and Civil Engineering Department, 1992.*

Chemical Waste

Chemical waste, as defined by *Schedule 1* of the *Waste Disposal (Chemical Waste) (General) Regulation 1992*, generated should be handled in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* as follows.

Containers used for the storage of chemical wastes should:

- be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;

- have a capacity of less than 450 l unless the specifications have been approved by the EPD; and
- display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

The storage area for chemical wastes should:

- be clearly labelled and used solely for the storage of chemical waste;
- be enclosed on at least 3 sides;
- have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- have adequate ventilation;
- be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste if necessary); and
- be arranged such as to separate incompatible materials.

Disposal of chemical waste should:

- be via a licensed waste collector; and
- be to a facility licensed to receive chemical waste, such as the CWTC which also offers both a chemical waste collection service and can supply the necessary storage containers; or
- be to a re-user or recycler of the waste, under approval from the EPD.

The Centre for Environmental Technology operates a Waste Exchange Scheme which can assist in finding receivers or buyers for waste materials.

General Refuse

General refuse generated on-site should be stored in enclosed bins or compaction units separate from construction and chemical wastes. A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily or every second day basis to minimise odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law.

General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware should be used if feasible. Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible, so separate, labelled bins should be provided if feasible.

Office wastes can be reduced through recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if one is available.

Summary

This section describes waste management requirements and provides practical actions which can be taken to minimise the impacts arising as a result of the generation, storage, handling, transport and disposal of wastes during construction.

Waste reduction is best achieved at the planning and design stage, as well as by ensuring that processes are run in the most efficient way. Good management and control can prevent the generation of significant amounts of waste. For unavoidable wastes, reuse, recycling and optimal disposal are most practical when segregation occurs on the construction site, as follows:

- excavated material (inert) suitable for reuse or fill;
- construction waste (inert) for disposal at public dump;
- construction waste (non inert) for landfill;
- chemical waste; and
- general refuse.

Criteria for sorting solid waste are described in the *New Disposal Arrangements for Construction Waste*. Waste containing in excess of 20% by volume of inert material should be segregated from waste with a larger proportion of putrescible material.

Proper storage and site practices will minimise the damage or contamination of construction materials. On site measures may be implemented which promote the proper disposal of wastes once off-site. For example having separate skips for inert wastes (rubble, sand, stone, etc) and non-inert wastes (wood, putrescible waste, etc) would help ensure that the former are taken to public dumps, while the latter are properly disposed of at controlled landfills. Since waste brought to public dumps will not attract a charge, while those brought to landfill may be charged, separating waste may also help to reduce waste disposal costs, should landfill charging be introduced.

Specifically, it is recommended that:

- a waste management plan for the construction of the proposed facility be produced specifying how waste arisings are to be managed. In addition, the plan should include training and instruction requirements for construction staff in order to increase their awareness of waste management and the need to minimise waste generation.

- wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimising the potential for pollution;

- only reputable waste collectors authorised to collect the specific category of waste concerned should be employed;

- appropriate measures should be employed to minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;

- the necessary waste disposal permits should be obtained from the appropriate authorities, if they are required, in accordance with the *Waste Disposal Ordinance (Cap 354), Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)* and the *Crown Land Ordinance (Cap 28)*;

- collection of general refuse should be carried out frequently, preferably daily;

- waste should only be disposed of at licensed sites and site staff and the civil engineering Contractor should develop procedures to ensure that illegal disposal of wastes does not occur;

- waste storage areas should be well maintained and cleaned regularly; and

- records should be maintained of the quantities of wastes generated, recycled and disposed, determined by weighing each load or by another method.

5.4.3 *Conclusions*

Provided that the recommendations put forward in this report are conscientiously acted upon, no unacceptable waste related environmental impacts are envisaged as a result of the storage, handling, collection, transport, and disposal of wastes arising from the construction of the proposed facility.

5.5 *OPERATIONAL PHASE*

This section describes the likely waste streams arising from the operation of the proposed facility at Tseung Kwan O. It is understood that of the aircraft maintenance activities, airframe maintenance will occur on Chek Lap Kok and other maintenance activities will occur at Tseung Kwan O. As such, the proposed facility will most likely conduct the following activities:

- chemical plating;

- chemical cleaning;

- non-destructive testing;

- collection, treatment and disposal facilities for various liquid and airborne effluent streams from the above three processes; and

- engine overhaul and machining of parts for repair and refurbishment.

General information gained through an environmental audit of the existing HAECO facility at Kai Tak, which was undertaken by ERM in March 1995, has been used in the preparation of this report.

5.5.1 *Potential Sources of Impact*

Due to the nature of the proposed facility, the primary sources of potential environmental impact relate to the handling , storage, collection and disposal of chemical wastes and industrial wastes.

Wastes can be categorised as follows:

- general refuse;
- industrial waste; and
- chemical waste.

General Refuse

General refuse arising from the proposed facility will generally be composed of food waste, wood, plastics, office wastes, old tins/containers, cleaning materials and miscellaneous other wastes produced during daily activities. There are a variety of impacts associated with the storage and handling of waste which can largely be controlled by good practice.

Litter may accumulate on or near to the proposed facility site if waste is not properly collected, stored, handled, transported and disposed of in accordance with good management practice.

Contaminated water or leachate may arise if the waste is not properly stored in the enclosed bins or the waste management area or if it is not entirely emptied during collections. The future use of waste compaction units may also create leachate and, therefore, when installed will require that provisions should be made for its collection, storage and treatment.

Pests and vermin may be attracted to the waste if the waste is not properly contained, and if the storage area is not regularly cleaned and well maintained. Odour problems may be caused if the waste management area is not properly cleaned and emptied frequently. Other impacts may occur if wastes other than the approved types are allowed to be deposited at the waste management area (such as chemical or hazardous wastes).

Industrial Waste

Industrial waste will be generated from the maintenance and overhaul activities and upkeep of the proposed facility. The primary waste categories are likely to be as follows.

- *Metals obtained from machining operations* which consist of high and low value materials. Ferrous metals are of low value and disposed of with general waste. High value metal wastes such as aluminium and copper (primarily windings) are collected and recycled.

- *Redundant smoke detectors* which are important because they contain low level radioactive isotopes.

Other industrial wastes which may arise from HAECO's operations include waste wood from carpentry work; spent lead acid batteries; dried out glues, adhesives; needles and dressings from any medical or clinic facilities; and old chemical, aerosol and adhesive cans from the workshops.

Industrial wastes have the potential to create similar environmental impacts to general refuse as described above, particularly if they have a high organic content.

Chemical Waste

Chemical Waste as defined under the *Waste Disposal (Chemical Waste) (General) Regulation* includes any substance being scrap material, or unwanted substances specified under Schedule 1 of the *Waste Disposal Ordinance (Cap. 354)*. A complete list of such substances is provided under the Ordinance, however substances likely to be generated by operational activities will for the most part arise from aircraft maintenance and overhaul activities. These may include, but not be limited to the following:

- *Spent cleaning solvents*, including methylene chloride, trichloroethylene, phenols, surfactants, ethylene glycol monobutyl ether, citrous acid-based cleaner (lemonene Citrasafe) and phosphoric acids, and *spent ion exchange resins* from the plating shop, totalling an estimated 33 m^3 per year.

- *Spent plating solutions* produced periodically from the plating shop when a tank requires emptying, including spent cyanide solution, and spent chromate solution and spent sulphuric acid. Plating wastes are estimated to amount to 4 m^3 per year.

- *Screenings and sludges from plating shop pretreatment plant*, which will most likely require specialists treatment by the CWTC, amounting to an estimated 0.13 m^3 per day and 1 m^3 per day, respectively.

- *Other liquid chemical wastes*, totalling an estimated 58 m^3 per year, which may include:

  used oils and hydraulic fluids, including residual oil from empty oil cans generated from topping up activities, and spent non-halogenated solvent containing kerosene;

  oily wastes obtained from the on site oil/grease interceptors;

  silver-containing developer solutions produced on site in the non-destructive testing activities;

  waste paint/thinner water mixtures from the water cleaning of paint spray drums.

- *Filter solids and sludges* comprising primarily of paint sludges and miscellaneous coagulated solids, obtained from treatment of paint stripping rinse water, spent carbon from active carbon filters.
- *Scrap batteries* or spent acid/alkali from their maintenance.

Chemical wastes can given rise to environmental hazards as described in *Section 5.1.1* if they are not handled in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation* and delivered to a facility licensed to receive chemical wastes.

Storage of Oils and Chemicals

A variety of oils, fuels and chemicals are likely to be stored on site. There is the possibility that ground or surface waters may become contaminated due to the spillage or leakage of chemicals from storage facilities. Underground storage tanks present a particular risk of this problem due to the difficulty of detecting leaks and compromises in the integrity of the container. Chemicals stored on the site are likely to include:

- flammable adhesives;
- resins;
- surfactants;
- volatile and non-flammable solvent cleaners, primers and thinners;
- hardeners;
- fire retardant coatings;
- scale, rust and carbon removers;
- paint strippers containing methylene chloride, white spirits, trichloroethylene;
- paints;
- cutting fluids;
- acids and alkalies;
- cyanide; and
- miscellaneous cleaning agents eg phenols, surfactants, ethylene glycol monobutyl ether, citrous acid-based cleaner (eg lemonene Citrasafe) and phosphoric acids.

5.5.2 *Potential Mitigation Measures*

This Section sets out the recycling, treatment, storage, transportation and disposal options which may be implemented to avoid or minimise potential adverse impacts associated with waste arisings from the operation of the proposed facility. These options should be considered and the recommendations incorporated into a comprehensive on-site waste management plan for the operation of the proposed facility. The plan should incorporate site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.

The waste management strategy for the proposed facility operation should follow the waste management hierarchy as discussed in the Construction *Section 5.5.2*. Specifically, for operational wastes, the following guidelines should be used:

- *Waste Avoidance.* To mitigate the generation of solid waste, waste avoidance measures should be used where feasible, particularly if this will lead to reduced costs and increased efficiency.

- *Recycling and Reuse.* For the remaining solid waste, recyclable and reusable portions should be separated out where practical. Considerable scope exists to take waste reduction and management into account in the design stage of the proposed facility, such as by providing spaces or facilities for the segregation and storage of recyclable materials.

- *Treatment and Disposal.* All wastes which cannot feasibly be recycled or reused, should be disposed of to landfill, unless the wastes are chemical in nature or they are dangerous wastes, in which case they should be disposed of to a facility licensed to receive such wastes.

Based on the above principles, mitigation measures for the three operational waste types are given below.

General Refuse

The arisings of general refuse from the operation of the proposed facility may contain recyclable elements. Wastepaper may be present in quantities large enough to warrant separation and recycling. Paperboard boxes received as transit packaging for supplies and parts should be separated for recycling. If recyclable materials are collected in large volumes, recycling contractors may be interested in buying and collecting them. If volumes are smaller, such contractors may require payment for collection. To ensure that recycling occurs effectively, education and communication by management are necessary, combined with effective collection and the provision of storage and possibly processing locations.

General refuse should be collected from small bins and delivered to a central collection point for storage in enclosed bins or compaction units. Removal of recyclables may occur before or after the delivery of wastes to the central collection point, which may have a section specifically for the storage of recyclable wastes. If volumes are sufficient, the provision of a compaction unit or baling machine for waste paper may be feasible. Compaction units assist in reducing the volumes of wastes transported for disposal, and are therefore recommended. General refuse designated for landfill disposal should be removed on a daily basis to minimise any potential odour impacts, to minimise the presence of pests and vermin and to prevent the unsightly accumulation of waste.

General refuse from the proposed facility would most likely be delivered to the SENT Landfill for disposal. Only reputable haulers authorised to collect general refuse and industrial waste should be employed.

Industrial Waste

Arisings of recyclable industrial wastes, such as scrap metal, may be considerable from the depot. Where volumes generated warrant recycling, a scrap metal contractor should be contacted to arrange for collection. Aluminium (including used beverage containers), copper and brass have relatively high value and if separated, a recycling contractor will most likely be willing to collect and pay for the metals. Scrap iron and steel are of lower value and must be accumulated in larger volumes before collection becomes worthwhile for recycling contractors.

The recommended procedures for the handling, transport, collection and disposal of industrial waste are the same as that for general refuse described above.

Asbestos waste must be stored, handled transported and disposal of in accordance with the Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste.

Chemical Waste

Chemical wastes must be stored, handled, transported and disposed of in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation*, and the *Code of Practice on Packaging, Labelling and Storage of Chemical Wastes*. Under the

Waste Disposal (Chemical Waste) (General) Regulation, all chemical waste producers, including contractors, should register with EPD.

The volume of chemical waste requiring disposal should be kept to a minimum by separation of waste streams and good management which reduce the potential for contamination.

Oils and solvents can be recycled, or reused as fuel, depending upon their chemical nature and level of contamination. Transportation of used oils and other chemicals for reuse, recycling or disposal requires a chemical waste licence from the EPD. Other recycling options may be arranged, for instance through the *Waste Exchange* operated by the Centre for Environmental Technology.

Containers used for the storage of chemical wastes should be suitable for the substance they are holding, resistant to corrosion and maintained in a good condition. The containers should be stored safely and securely closed. Chemical wastes should not be stored in any container with a capacity exceeding 450 litres unless the specifications have been approved by the EPD. Every container of chemical waste should display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

The storage area for any containers should not be used for any purpose except for the storage of chemical wastes and should be fully labelled in accordance with the Regulations. Chemicals which are incompatible and could cause fire or explosion if they are mixed should be segregated in separate areas. The storage area should be enclosed on at least three sides by a wall, partition or fence which is at least 2 m in height or the height of the tallest container, whichever is the greater. Adequate ventilation and space for the handling of containers should be provided, with the area being kept clean and dry.

Liquid chemical wastes should be stored in an area which has an impermeable floor and retention structure with the capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest. When calculating the available retaining capacity, the volume occupied by the containers being stored should be taken into consideration. Bunded areas should be kept clean and dry, possibly by covering. If water does collect within the bund it must be tested before being disposed. This requirement does not apply to large, approved below ground containers.

Chemical wastes should be transported by a registered chemical wastes hauler to a facility licensed to receive chemical wastes. Enviropace, the operator of the CWTC, supplies approved containers for chemical waste which can be replaced with each collection.

Disposal of chemical wastes in this manner will ensure that environmental and health and safety risks are reduced to a minimum, provided that correct storage, handling and transfer procedures are instigated on-site and on the collection vehicles. HAECO should also contact the EPD to ensure that the handling and disposal methods for the wastes in question are appropriate.

Waste Treatment

With regard to the specific chemical waste arisings from the proposed facility, it is likely that most of the liquid chemical waste effluents will be most efficiently treated on site, as described in *Section 3.6.2*. However, spent acid and alkali, and cyanide, will require specialist treatment at the CWTC.

Environmental Monitoring and Auditing

It is recommended that auditing of each waste stream should be carried out periodically by HAECO staff or independent consultants to determine whether wastes are being managed in accordance with regulations, HAECO policy and targets, and good practice as expressed by the waste management hierarchy. The audits should look at all aspects of waste management including waste generation, storage, recycling, treatment, transport, and disposal. A mechanism should be established to ensure that the recommendations of the audits are carried through.

5.5.3 *Conclusions*

Significant volumes of chemical waste, industrial waste and general refuse will be produced by the operation of the proposed facility. However, provided waste reduction and management measures recommended in *Section 5.6.2* are implemented, no unacceptable waste related environmental impacts are envisaged to result from the storage, handling, collection, transport, and disposal of wastes arise from the operation of the proposed facility.

5.6 CONCLUSION

This Section of the report has identified the streams of solid waste that will arise during the construction and operation of the proposed facility. Potential impacts have been described and mitigation measures recommended for the construction and operational phases. Central to the solid waste management during both phases will be waste management plans which will specify how waste avoidance, waste segregation reuse, recycling and disposal should be conducted.

During construction, the main waste types generated will be excavated material, construction waste (inert and non-inert) and general refuse. Mitigation measures related to wastes storage, handling, collection, transportation and disposal are recommended to control impacts associated with these wastes to acceptable levels.

During operation, the main type of waste arising from the proposed facility will be chemical wastes. Dilute chemical wastes will be passed through a licensed on-site treatment facility to achieve EPD standards prior to discharge. More concentrated wastes, including chemical residues, will be disposed of to a facility licensed to receive chemical wastes by the EPD.

6 CONCLUSIONS

Environmental impacts associated with the construction and operation of a proposed aircraft maintenance facility, the Tseung Kwan O Aircraft Overhaul Division, have been identified and assessed. Impacts with respect to noise, water quality, air quality and solid waste management have been considered. In all cases provided the implementation of various mitigation measures, impacts are predicted to be acceptable. This section provides further details of the conclusions with respect to each of the various issues addressed.

6.1 CONSTRUCTION PHASE

6.1.1 Noise

Noise will be generated from various construction activities including percussive piling and the operation of plant such as cranes, generators and compressors. Levels of noise levels that will be generated during construction have been predicted and compared to relevant standards for Noise Sensitive Receivers (NSRs) stipulated under the *Noise Control Ordinance* (*NCO*) and its associated Technical Memoranda (TM). No exceedances are predicted and therefore no mitigation measures are necessary. However, various measures relating to good site practice are recommended (see *Section 2.6.1*) to minimise noise disturbance. It should be noted that there are various other current and planned infrastructure developments on the Tseung Kwan O Industrial Estate each of which is or will be associated with the generation of construction noise.

6.1.2 Water Quality

The construction of the proposed facility will be entirely land based and will involve no activities that will inherently cause water quality impacts. There are, however, various activities that could result in the discharge of pollutants to Junk Bay. Potential discharges include site run off and domestic sewage. Provided proper site management, good site practice and the implementation of the mitigation measures detailed in *Section* 3.5.2, contamination of run off can be limited and sewage can be collected and disposed of elsewhere. Consequently, the entry of potential pollutants into Junk Bay can prevented and construction activities should not cause water quality impacts.

6.1.3 Air Quality

The construction of the facility will involve the use of various plant which emit exhaust gases. However, because the earthworking has already been completed and because of the relatively small number of plant that will be required, neither are anticipated to result in unacceptable impacts to air quality. Consequently no mitigation measures are required but various measures constituting good site practice are recommended.

6.1.4 Solid Waste Management

Various wastes will be generated during the construction of the facility including excavated materials, construction waste, chemical waste and general refuse.

Provided that appropriate waste management practices detailed in *Section 5.5.2* are implemented, impacts associated with wastes are predicted to be acceptable. Central to the recommended practices is the development of a waste management plan specifying how wastes should be stored, handled, transported and disposed.

6.2 OPERATION PHASE

6.2.1 *Noise*

During the operation of the facilities noise will be generated from the workshops. Noise from both operations have been predicted using data from tests conducted at the existing Kai Tak facility. These resulting level has been combined with noise generated by the adjacent Aircraft Engine Test Cell and cumulative levels at the Noise Sensitive Receivers (NSRs) have been predicted. Provided that the noise levels in each of the workshops/plant rooms do not exceed the levels assumed in this assessment, no exceedances of the relevant standards stipulated under the *Noise Control Ordinance* (*NCO*) are predicted and noise levels during operation of the proposed facility should be acceptable.

6.2.2 *Water Quality*

The operation of the proposed facility will produce various effluent streams which have the potential to cause impacts at wastewater treatment works and receiving waters. Provided the inclusion of various mitigation measures included in the design of the facility (see *Section 3.6.2*), these impacts can be avoided and no unacceptable impacts should occur. The drainage system has been designed to segregate effluents according to their source. Concentrated chemical wastes will be collected for transfer to an appropriately licensed treatment facility. Other industrial effluents will be passed to on-site treatment. The effluent from the treatment facility will be discharged to foul sewer along with domestic sewage. Regular discharge monitoring is recommended to ensure that its quality complies with the standards in the Technical Memorandum and that the on-site treatment plant operates effectively.

6.2.3 *Air Quality*

Emissions from the operation of the proposed facility are not to anticipated to be significant and arise from a number of small scale sources with localised controls. Therefore, unacceptable air quality impacts at the ASRs will be unlikely. Should there be any air quality impacts, they can be mitigated by installing further air pollution abatement equipment. A regular monitoring programme is recommended to ensure the statutory limits are not exceeded.

6.2.4 *Solid Waste Management*

The operation of the proposed facility will result in the generation of general refuse, industrial waste and chemical waste. Provided mitigation measures recommended in *Section 5.6.2* are implemented, no unacceptable waste related environmental impacts are envisaged. Periodic auditing of the waste streams is recommended to check whether wastes are being managed in accordance with regulations, HAECO policy and targets, and good practice.

Annex A

Operational Noise

Operational Noise Calculations.

In the calculations of operational noise it is assumed that the noise generated by this facility is made up of a number of individual noise sources, in particular the plant rooms and workshops. The total Sound Power Level (SWL) for the facility is therefore the sum of the SWLs of each individual noise source considered to contribute to noise levels at a particular Noise Sensitive Receiver (NSR).

This annex contains a sample calculations of the noise level at an NSR which is based on the following procedure.

- Determine which facade of the building directly faces the NSR;
- Identify the areas(rooms) within this facade likely to be major noise contributors (internal noise levels for plant rooms and workshops have been supplied by Meinhardt Management Asia Ltd);
- Calculate the total surface area of the external wall of each room considered.
- Calculate the area (A) of each of the building components making up the external wall, ie wall, windows and louvres.
- Estimate the sound reduction indices (SRIs) for each of the building components. In this assessment it is assumed that the SRIs for walls, windows and louvres are 40, 25 and 15 dB(A) respectively.
- Calculate the transmission coefficient (T) for each of the building elements.

$$SRI = 10 \log (1/T) \quad dB(A)$$

- Calculate the average SRI for the external wall for each plant room/workshop as follows:

$$SRI_{(av)} = 10 \log(1/T_{(av)}) \quad dB(A)$$

where,

$$T_{(av)} = (Area_{(wall)}.T_{(wall)} + Area_{(window)}.T_{(window)} + Area_{(louvres)}.T_{(louvres)}) / Area_{(Total)}$$

- It is assumed that the plant rooms/workshops will be reverberant therefore the SWL of each plant room/workshop can be calculated using the following equation:

$$SWL = SPL_{(int)} - 6 - SRI_{(av)} + 10 \log(Area_{(Total)}) \quad dB(A)$$

where $SPL_{(int)}$ is the internal (reverberant) noise level, dB(A)

- Sum the individual SWLs to obtain the SWL for the entire building facade.
- Add the SWL of roof mounted plant (screened or unscreened) to obtain the Total SWL.
- Predict the noise level at the facade of each NSR assuming hemispherical radiation:

$$SPL_{(NSR)} = SWL_{(Total)} - 20 \log(r) - 8 + 3 \quad dB(A)$$

where, r = separation between the source and receiver.

Sound Reduction Indicies			T					
Walls	40	dB(A)	0.0001					
Windows/doors	25	dB(A)	0.0032					
Louvres	15	dB(A)	0.0316					
North Facing			Area m^2					
	Internal SPL	Wall	Windows	Louvres	Total Area	Tav	SRIav	SWL
Ground Floor								
Workshop	85	74.0		0.24	74.3	202E-6	37	61
Bottle	80	25.3	5.00		30.3	606E-6	32	57
Welding	75	13.4		0.40	13.8	1E-3	30	50
Chiller Test Room	75	13.8			13.8	100E-6	40	40
2nd Floor								
Workshops	85	99.9	28.13		128.0	773E-6	31	69
AHU Plant Room	100	32.6		6.60	39.2	5E-3	23	87
							TOTAL	87
South Facing								
Ground Floor								
HP Comp vac Pump	125	19.8		5.00	24.8	6E-3	22	111
Fuel Workshop	125	29.5		0.80	30.3	934E-6	30	104
Test Room	100	31.8		4.00	35.8	4E-3	24	85
Drive & Control	125	25.0		2.50	27.5	3E-3	25	108
1st Floor								
Facilities Workshop	85	40.1	7.20		47.3	567E-6	32	63
2nd Floor								
Workshops	85	178.4	21.60		200.0	431E-6	34	68
							TOTAL	113
Roof								
AHUs and Chiller Plant SWL)	105							
(unscreened)								
Northern NSR								
Northern Facade SWL	87							
Total SWL	105							
Distance, m	1150							
Topographical Screening	0							
$L_{Aeq(30min),facade}$, dB	39							
Southern NSR								
Southern Facade SWL	113							
Total SWL	114							
Distance, m	2600							
Topographical Screening	-10							
$L_{Aeq(30min),facade}$, dB	30							