TERRITORY DEVELOPMENT
DEPARTMENT, HONG KONG

KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

(AMENDED VERSION)

JUNE 1998

MAUNSELL CONSULTANTS ASIA LTD
in association with
CES (ASIA) LTD

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GLOSSARY OF TERMS

ACM	Asbestos Containing Material
APCO	Air Pollution Control Ordinance
AQO	Air Quality Objectives
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CNP	Construction Noise Permit
EDP	Early Development Package
EIA	Environmental Impact Assessment
EIAO	Environmental Impact Assessment Ordinance
EM&A	Environmental Monitoring and Audit
EPD	Environmental Protection Department
HAECO	Hong Kong Aircraft Engineering Company
HPCL	Health Protection Concentration Levels
IRIS	Integrated Risk Information System
NAKTA	North Apron of Kai Tak Airport
NCO	Noise Control Ordinance
NSR	Noise Sensitive Receiver
OCTF	Oil Companies Tank Farm
NO_2	Nitrogen Dioxide
PME	Powered Mechanical Equipment
RfD	Recommended Reference Dose
SEKS	South East Kowloon Development Statement
SEKDFS	Feasibility Study for South East Kowloon Development
SVE	Soil Vapour Extraction
SWL	Sound Power Level
TM	Technical Memorandum
TPH	Total Petroleum Hydrocarbon
TSP	Total Suspended Particulates
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WDO	Waste Disposal Ordinance
WCZ	Water Control Zone
WPCO	Water Pollution Control Ordinance

1 INTRODUCTION

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1.1 BACKGROUND OF THE PROJECT

The relocation of the Kai Tak Airport (KTA) to the new airport at Chek Lap Kok in July 1998 provides an opportunity to develop the existing airport site to meet Hong Kong's urgent need for more housing and infrastructure.

Following the endorsement of the South East Kowloon Development Statement (SEKDS) by the Land Development Policy Committee in November 1993, the South East Kowloon Development Feasibility Study (SEKDFS) commenced in September 1995. The study aims to establish the engineering feasibility of the development of South East Kowloon and reprovisioning of affected marine facilities. A draft Outline Master Development Plan (OMDP) was produced in the Study A of this feasibility study and was endorsed by the Committee on Planning and Land Development (CPLD) in November 1997.

The SEKDS identifies a number of Early Development Packages (EDPs), including the Kai Tak Airport - Early Development Package (KTA - EDP) for further study in the SEKDFS to enable their early implementation to meet various land use demands, in particular for public and private housing.

The draft OMDP produced in the SEKDFS indicates that the north apron of Kai Tak Airport (NAKTA) will be primarily developed for housing and housing related uses. To meet the housing development programme at KTA, the KTA - EDP will comprise necessary site preparation and infrastructure works to permit early occupation of the housing sites.

As part of the environmental study in the SEKDFS, an initial assessment was made to determine the nature and extent of possible ground contamination at the KTA apron area resulting from historic leaks of aviation fuels and from other sources. From the field data acquired from the initial assessment, contamination is more pronounced in the vicinity of the HAECO and Oil Companies Tank Farm (OCTF) sites and the hydrant fuel system.

In order to meet the housing development programme and enable development of the housing sites and construction works to proceed, there is an urgent need to implement appropriate remediation measures to clean up the affected areas immediately after the airport closes.

To facilitate follow-on building construction, Housing Development also requested the breaking up and removed existing apron slab within the sites to be handled over to them for development.

The primary objectives of the Kai Tak Airport North Apron Decommissioning are:

- To clean-up the contaminated areas at the NAKTA. Thus the site will be safe and free of hazards for the planned uses, either temporary or permanent, and during construction.
- To undertake demolition of existing buildings, underground structures, services and

removal of ground slabs and site preparation for the apron site. Thus the site will be ready for the subsequent housing developments.

1.2 PURPOSE OF THE EIA STUDY

The purpose of this EIA Study is to provide information on the nature and extent of environmental impacts arising from the decommissioning of the NAKTA and all related activities taking place concurrently, including the demolition, decontamination and site preparation. The information provided by this EIA Study will contribute to the decision on:

i) the overall acceptability of any adverse environmental consequences that are likely to arise as a result of the proposed decommissioning project

ii) the conditions and requirements for the detailed design and implementation of the decommissioning project

iii) the acceptability of residual impacts after the proposed mitigation measures are implemented.

1.3 THE APPROACH

The EIA was carried out based on information available at the time. As all the environmental issues have been substantially addressed and resolved during the SEKDFS, the study has adopted information and findings in the SEKDFS where relevant to the study.

In accordance with the requirements of the Brief, the EIA covers the following aspects of impact assessment:

- Construction noise, air and water quality impacts
- Construction and Demolition waste impact study
- Ecological impact
- Land contamination issue

Considering the nature of decommissioning project, the visual and landscape impacts and impact on sites of cultural heritage (eg. Stone plaques) are considered to be minimal. Thus, they have not been included in the Study Brief and are outside the scope of this EIA. The issue of the need to prevent any damages to possible cultural remains buried within the airport site has been raised. Because this contract does not entail large-scale excavation, it is unlikely that stone blocks underground would be damaged. However, during the decommissioning phase, the relevant authority would be informed in the first instance in the unlikely event that stone blocks of concern are discovered in breaking up the concrete surface or excavation for reasons unforeseen. This requirement will be written into the contract documents of the decommissioning project. A Heritage Impact Assessment may be necessary for the future development projects at the airport site.

The report has been prepared in accordance with the requirements in the Annex 21 of the

Technical Memorandum (TM) of the Environmental Impact Assessment Ordinance (EIAO). This covers relevant project information, relevant legislation, existing environmental conditions, assessment criteria and methods, assessment findings and proposed mitigation measures.

The environmental monitoring and audit (EM&A) programme is presented in a separate EM&A manual.

2 DECRIPTION OF THE PROJECT

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2.1 KEY PROJECT REQUIREMENTS

The EIA Study Brief describes a number of tasks and objectives as listed below:

i) to describe the proposed project and associated works together with the requirements for carrying out the proposed project

ii) to identify and describe the elements of the community and environment likely to be affected by the proposed project, and/or likely to cause adverse impacts upon the proposed project, including both the natural and man-made environment

iii) to identify and quantify emission sources and determine the severity of impacts on sensitive receivers and potential affected uses

iv) to identify and quantify any potential losses or damage to flora, fauna and natural habitats

v) to propose the provision of mitigation measures so as to minimise pollution, environmental disturbance and nuisance during implementation of the project

vi) to identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the implementation of the project in relation to the sensitive receives and potential affected uses

vii) to identify, assess and specify methods, measures and standards, to be included in the detailed design and implementation of the project which are necessary to mitigate these impacts and reduce them to allowable levels within established standards/guidelines

viii) to identify and justify the need for environmental monitoring and audit and to define the scope of the requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted

ix) to investigate the extent of side-effects of proposed mitigation measures that may lead to other forms of impacts

x) to identify constraints associated with the mitigation measures recommended in the study

xi) to identify any additional studies necessary to fulfil the objectives to the requirements of this Environmental Impact Assessment Study.

2.2 STUDY AREA

The study area covers 164 ha, comprising the Planning Area 1 (north of the EDP) of about 40 ha, Planning Area 2 (south of the EDP) of about 64 ha, the western part of Planning Area 4 of about 14 ha and the road reserve, about 46 ha. This information is subject to further refinement.

The Study area is shown in Figure 2.1. It is a requirement of the Environmental Protection Department (EPD) that the study area boundary is extended outwards by 300 m from the boundary for the purpose of the environmental impact assessment.

2.3 CONSTRUCTION ACTIVITY AND PROGRAMME

2.3.1 Background Information of the SEKD Development Project

This NAKTA decommissioning project is part of the overall SEKD project. It is envisaged that the SEKD project will consist of a mix of public and private housing, a number of commercial, office and hotel areas, new industrial zones for high-tech activities, an interlinked open space incorporating waterfront promenades and a large Metropolitan Park. The development will also allow the extension of major new north-south and east-west highways and the expansion of the urban rail network. A new, larger cargo working area (CWA) and a typhoon shelter (TS) will be provided in the southeast of the site.

The development is planned to take place under the following four separate development packages as follows:

- Kai Tai Airport Development Package (KTA-DP)
- Kowloon Bay Reclamation Phase 1 Development Package (KBR1-DP)
- Kowloon Bay Reclamation (Phase 2) Development Package (KBR2-DP)
- Kai Tai Nullah/Kwun Tong Typhoon Shelter Development Package (KTN/KTTS-DP)

In addition to four development packages, there will be one redevelopment package, namely Priority Area Redevelopment Package - including priority area P1, P2 and P3). P1 is located in the north eastern part of Ma Tau Kok adjacent to Kai Tak Airport. P2 is located in To Kwa Wan. P3 is in Hung Hom.

The tentative development periods for each of development package are as follows:

- KTA-DP 1998 - 2009
- KBR1-DP 2000 - 2010
- KBR2-DP 2004 - 2017
- KTN/KTTS-DP 1999 - 2012

Under each of the development package, there will be a number of individual work package which are the lowest definition at which the project can be contracted out for design and construction. Each work package is standalone and have minimal interfaces with other work packages. The work packages have been grouped by their work type and they will include buildings, transportation, sewerage and drainage systems, drinking water supply, utilities, reclamation, typhoon shelter and marine services (eg, ferry pier), etc. The latest proposed development activities and programmes for development and redevelopment packages prepared under the SEKDFS are summarised in Appendix A.

2.3.2 Construction Activity and Programme of this Project

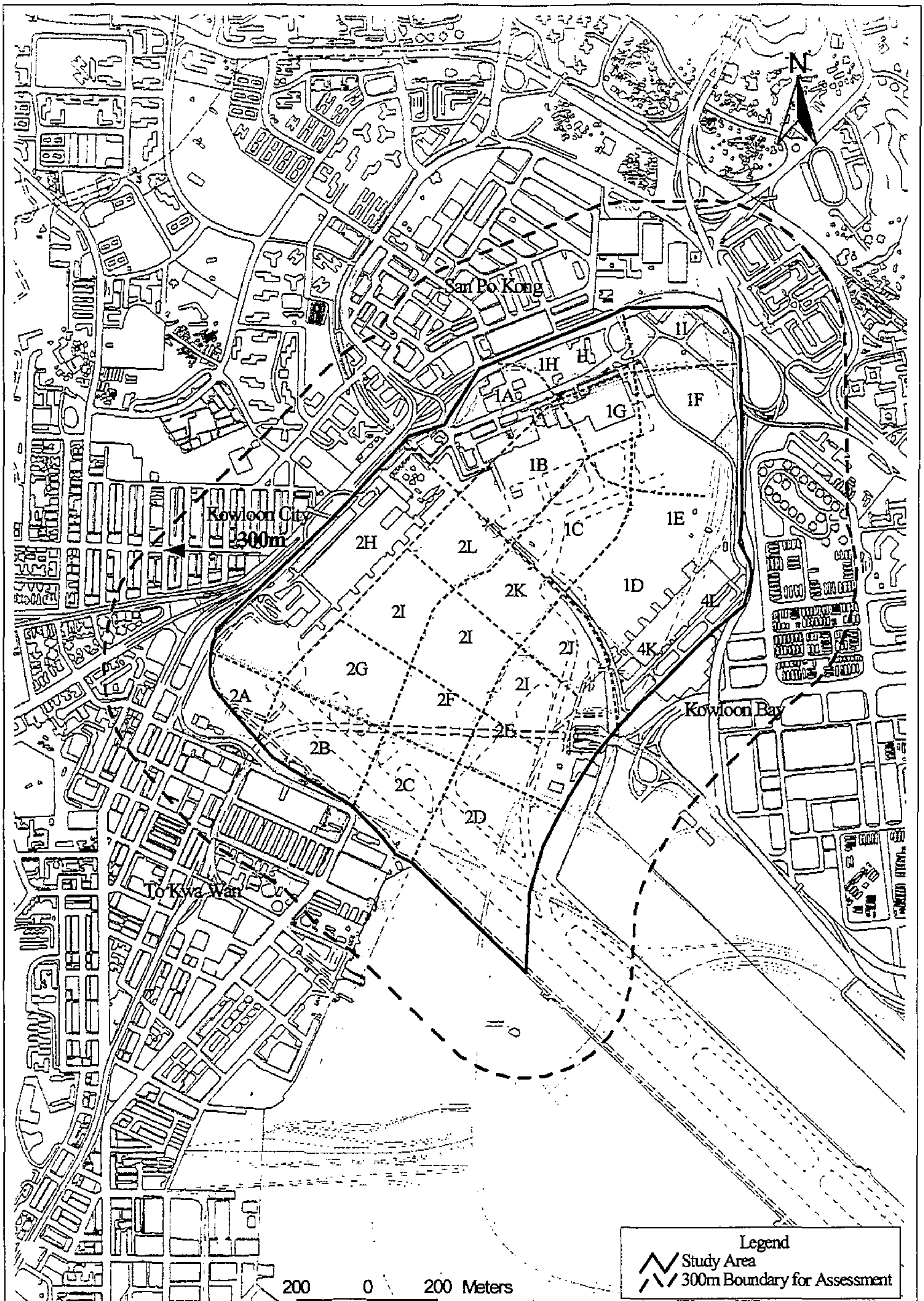
This NAKTA Decommissioning and Site Preparation project is under the KTA-EDP and is the first development project. The construction activities will include the following:

- Decommissioning of airport related facilities
- Removal of some airport related facilities
- Building and pavement demolition
- Site clearance and preparation
- Decontamination of ground under airport apron.

A summary of the project programme is provided in Table 2.1. The detailed construction programme is presented in Appendix B.

Table 2.1 Summary Project Programme

Period	Activity
1998-2000	Decontamination Commence pavement removal work Demolishing most existing structures, except for part of terminal building Setting up and operating a crushing plant
2001-2002	Completing most pavement removal work Operating a crushing plant
2003-2008	Demolishing the reminder of terminal building (in 2006) Completing pavement removal work Operating a crushing plant



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	TITLE Study Area	SCALE 1 : 15000	DATE March 1998
		DESIGNED Fanny Lau	DRAWN Fanny Lau
		CAD REF C415	DRAWING NO. Figure 2.1 REV 0

3 ENVIRONMENTAL LEGISLATION

3 ENVIRONMENTAL LEGISLATION

3.1 ENVIRONMENTAL IMPACT ASSESSMENT ORDINANCE

This EIAO requires all public and private sector projects with the potential for significant environmental impacts to be subject to the EIA process and applies to most of the major infrastructure projects.

The EIAO requires that completed EIAs be released for public review and comment after they have been reviewed by EPD. This represents the first legislated public consultation associated with EIAs. EIAs will also be released to the Advisory Council on the Environment (ACE) for their review and comment. While the views of the public and ACE are not binding on EPD, they may influence EPD's decision whether to accept or reject the EIA, and the conditions attached to the Environmental Permit.

A TM under the EIAO was enacted in April 1998. It sets out the guidelines for assessing a number of environmental parameters, including noise, air quality, water quality, ecological impact and land contamination.

3.2 NOISE LEGISLATION

Existing noise controls comprise two categories: statutory controls (the *Noise Control Ordinance* (NCO)) and non-statutory controls (primarily the *Hong Kong Planning Standards and Guidelines* (HKPSG) and *Practice Note for Professional Persons - Noise from Construction Activities* (ProPECC PN2/93)). These cover the following areas relevant to this assessment:

- noise from construction work other than percussive piling
- noise from construction work in the designated areas
- noise from percussive breakers and air compressors

The NCO provides the statutory framework for noise control of construction work other than percussive piling using powered mechanical equipment (PME) between 19.00 - 07.00 hours or at any time on Sundays and general holidays (i.e. restricted hours). Noise control of construction activities taking place at other times is only subject to non-statutory guidelines specified in the ProPECC PN 2/93.

3.2.1 Construction Noise: Restricted Hours

Construction noise during the evening (19.00-23.00 hrs) and night-time (23.00-07.00 hrs), or during a public holiday, is regulated under NCO.

For this first estimate of the impact of construction noise, the Basic Noise Levels (BNLs) from the *Technical Memorandum on Noise from Construction Work other than Percussive Piling* will be used as assessment criteria. These criteria depend on the Area Sensitivity Rating (ASR) in which the Noise Sensitive Receivers (NSRs) are located. For this study, an ASR of "C" is adopted. BNLs relevant to the study are summarised in Table 3.1:

Table 3.1 Construction Noise Impact: Evening and Night-time Assessment Criteria

Area Sensitivity Rating (ASR) and associated type of area		Basic Noise Level (BNL) (dB(A)Leq5min)	
		Evening[1] (19.00-23.00 hrs)	Night-time (23.00-07.00 hrs)
C	Urban area directly or indirectly affected by noise from an industrial area or major road[2]	70	55

Notes:

1 Applies also to general holidays during the daytime and evening (07.00-23.00 hrs).
2 An "urban area" is defined as an area of high density, diverse development, including mixture of such elements as industrial activities, major trade or commercial activities, and residential premises. "Major road" is defined as a road with an AADT in excess of 30,000.

Construction activities during the evening and night-time, or on a public holiday, require a Construction Noise Permit (CNP). The CNP permits the use of PME subject to conditions, such as permitted hours of operation, type and number of PME allowed, and noise control measures to be adopted.

3.2.2 Construction Noise: Non-restricted Hours

In accordance with ProPECC Practice Note 2/93 (May 1993) on *Noise from Construction Activities - Non-statutory Controls*, assessment criteria of 75 dB(A) L_{eq} (30 min) at dwellings, 70 dB(A) L_{eq} (30 min) at schools, and 65 dB(A) L_{eq} (30 min) at schools during examinations, will be applied to daytime (07.00-19.00 hrs) noise predictions.

3.2.3 Construction Noise: Percussive Breakers and Air Compressors

Since 1992, the noise emissions from air compressors and hand-held percussive breakers over 10 kg have been controlled under the NCO. These PME must comply with specified noise emission standards, and must bear a Noise Emission Label confirming that they comply.

3.3 EXISTING AIR QUALITY LEGISLATION AND GUIDANCE

3.3.1 Air Quality Objectives

The Air Pollution Control Ordinance (APCO) provides powers for controlling air pollutants from a variety of stationary and mobile sources, including fugitive dust emissions from construction sites. It encompasses a number of Air Quality Objectives (AQO) which stipulate concentrations for a range of pollutants, of which nitrogen dioxide (NO_2) and total suspended particulates (TSP) are relevant to this study. The AQO for these air pollutants are tabulated in Table 3.2 below.

Table 3.2 Hong Kong Air Quality Objectives

Air Pollutant	Maximum concentration in microgram per cubic metre[1]		
	Averaging Time		
	1-hour[2]	24-Hour[3]	Annual[4]
NO_2	300	150	80
TSP	500[5]	260	80

Note: 1 Measured at 298K and 101.325kPa.
2 Not to be exceed more than three times per year.
3 Not to be exceeded more than once per year.
4 Arithmetic mean.
5 Not an AQO but is a criteria for evaluating air quality impacts as stated in Annex 4 of *Technical Memorandum on Environmental Impact Assessment Process*.

3.3.2 Environmental Standards

The TM under APCO presents the Health Protection Concentration Levels (HPCL) in which a wide variety of environmentally important chemical compounds (38 numbers) are covered. The HPCL for the chemical compounds are defined for the purpose of protection of health. When the air pollutant emission as determined in accordance with the TM is causing or contributing to air pollution which is prejudicial to health to such an extent as to exceed HPCL by more than 100%, the Government may issue an air pollution abatement notice to require the owner of premises or the person carrying out the activities to cease the emission of air pollutants from the premises or operation of any relevant process.

Among the chemical compounds listed in the TM, benzene is a potential residual pollutant emitted after the catalytic oxidation of the soil contamination remediation process. The one-hour average HPCL defined for benzene is 185 μgm^{-3}.

3.3.3 Air Pollution Control Regulations

The Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations were made under the APCO. The main objective of the regulations is to prevent air pollution caused by the installation of unsuitably designed furnaces, ovens and chimneys or alterations to such plants. Under the regulations, the occupier of any premises, except those exempted, is required to obtain prior approval from the Authority before he may install, alter of modify a furnace, oven or chimney.

The regulations do not apply to very small users of fuel. Exemption is given where the furnace, oven, chimney or any flue connected thereto consumes not more than 25 litres of liquid fuel per hour, 35 kilograms of solid fuel per hour, or 1150 megajoules of gaseous fuel per hour. The regulations also do not apply to any furnace or oven which is heated solely by electricity or used for the conduct of a specified process licensed under the APCO.

It should be noted that the catalytic oxidation of the soil contamination remediation process is not a specified process designated under the APCO and the fuel consumption rate of the catalytic incinerator exceeded the exemption capacity, the contractor responsible for the installation of the catalytic incinerator should obtain prior approval from the Authority in accordance with the regulations.

3.4 WATER QUALITY LEGISLATION

The Water Pollution Control Ordinance (WPCO) Cap. 358 (1980) lays down the framework for designation of Water Control Zones (WCZ's) throughout the Territory. Each such zone is characterised by specific water quality objectives. Principal features of the WPCO and its subsidiary legislation (Table 3.3) are as follows:

- The Ordinance specifies prohibited discharges and deposits.
- The Ordinance is supported by the TM to the WPCO which further provides standards for effluent discharged into drainage and sewerage systems, inland waters and coastal waters.
- The Water Pollution Control (Amendment) Ordinance 1990 made various changes to the WPCO including the removal of the 'right to discharge' certain pollutants taking place prior to the gazettal of a Water Pollution Control Zone.

Table 3.3 Summary Of Legislation Relevant To Water Quality In This Study

*	Water Pollution Control Ordinance Chapter 358 (as amended by the Water Pollution Control (Amendment) Ordinance 1990 and 1993)
*	Water Pollution Control (General) Regulations (as amended by the Water Pollution Control (General) (Amendment) Regulations 1990 and 1994)
*	Water Pollution Control (Appeal Board) Regulations
*	Technical Memorandum Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters

Any discharges, run off, or flows discharging to the marine environment are regulated under the WPCO and the TM on *Standards for Effluent Discharged into Drains and Sewerage Systems, Inland and Coastal Waters*. In the case of the former the water quality objectives specified under the legislation are presented in Table 3.4.

The mechanism that will regulate discharges from the site including run off from storm drains and any effluent is the TM, '*Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*'. The Memorandum establishes effluent standards that apply to different receiving water bodies. All such effluents covered by this TM are required to be licensed. Tables 3.5 and 3.6 illustrate the standards required for discharge into the inshore and marine waters of the Victoria Harbour (Phase 1) WCZ. For the purposes of this legislation, inshore waters refer to all waters of less than 6 m depth at mean low tide, or within 200 m of the mean low water mark whichever position is further from the shore.

Table 3.4 Summary of Water Quality Objectives for the Victoria Harbour Water Control Zone

Parameters	Objectives	Sub-Zone
Offensive Odour, Tints	Not to be present	Whole zone
Colour	Not to exceed 50 Hazen units, due to human activity	Inland waters
Visible foam, oil scum, litter	Not to be present	Whole zone
E. coli	Not to exceed 1000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days	Inland waters
Dissolved Oxygen (DO) within 2 m of the seabed	Not less than 2.0 mgL^{-1} for 90% of samples	Marine waters
Depth averaged DO	Not less than 4.0 mgL^{-1} for 90% of samples	Marine waters
Dissolved Oxygen	Not less than 4.0 mgL^{-1}	Inland waters
pH	To be in the range of 6.5 - 8.5, change due to human activity not to exceed 0.2	Marine waters
	Not to exceed the range of 6.0 - 9.0 due to human activity	Inland waters
Salinity	Change due to human activity not to exceed 10% of ambient	Whole zone
Temperature	Change due to human activity not to exceed 2 °C	Whole zone
Suspended solids	Not to raise the ambient level by 30% caused by human activity	Marine waters
	Annual median not to exceed 25 mgL^{-1} due to human activity	Inland waters
Ammonia	Annual mean not to exceed 0.021 mg L^{-1} as unionised form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
	Annual mean depth average inorganic nitrogen not to exceed 0.4 mgL^{-1}	Marine waters
BOD_5	Not to exceed 5 mgL^{-1}	Inland waters
Chemical Oxygen Demand	Not to exceed 30 mgL^{-1}	Inland waters
Toxic substances	Should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms.	Whole zone
	Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Source: Statement of Water Quality Objectives (Victoria Harbour (Phases One, Two and Three) Water Control Zone).

Table 3.5 Standards for Effluent Discharged into the inshore waters of the Victoria Harbour Water Control Zone (All units in mgL^{-1} unless otherwise stated; all figures are upper limits unless otherwise indicated)

Flow rate (m^3/day) / Determinand	≤ 10	> 10 and ≤ 200	>200 and ≤ 400	>400 and ≤ 600	> 600 and ≤ 800	> 800 and ≤ 1000	>1000 and ≤ 1500	> 1500 and ≤ 2000	> 2000 and ≤ 3000	> 3000 and ≤ 4000	> 4000 and ≤ 5000	> 5000 and ≤ 6000
pH (pH units)	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
Temperature (°C)	40	40	40	40	40	40	40	40	40	40	40	40
Colour (lovibond units) (25 mm cell length)	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	20
Iron	15	10	10	7	5	4	2.7	2	1.3	1	0.8	0.6
Boron	5	4	3	2.7	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2.7	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.7	0.5	0.4	0.25	0.2	0.15	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1.4	1	0.8	0.5	0.4	0.3	0.2	0.14	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.13	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	100	100	100	100	80	80	50	50	50	50
Total phosphorus	10	10	10	10	10	10	8	8	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E. coli (count/100ml)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000

Source: EPD Technical Memorandum on Effluents Standards, Table 9a.

Table 3.6 Standards for Effluent Discharged into the marine waters of the Victoria Harbour Water Control Zone (All units in mgL^{-1} unless otherwise stated; all figures are upper limits unless otherwise indicated)

Flow rate (m^3/day) Determinand	≤ 10	> 10 and ≤ 200	>200 and ≤ 400	>400 and ≤ 600	> 600 and ≤ 800	> 800 and ≤ 1000	>1000 and ≤ 1500	> 1500 and ≤ 2000	> 2000 and	≤ 4000	> 4000 and ≤ 5000	> 5000 and ≤ 6000
pH (pH units)	6 - 10	6 - 10	6 - 10	6 - 10	6 - 10	6 - 10	6 - 10	6 - 10	6 - 10	6 - 10	6 - 10	6 - 10
Temperature (ºC)	45	45	45	45	45	45	45	45	45	45	45	45
Colour (lovibond units) (25 mm cell length)	4	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	700	600	600	500	375	300	200	150	100	75	60	40
BOD	700	600	600	500	375	300	200	150	100	75	60	40
COD	1500	1200	1200	1000	700	600	400	300	200	100	100	85
Oil & Grease	50	50	50	30	25	20	20	20	20	20	20	20
Iron	20	15	13	10	7.5	6	4	3	2	1.5	1.2	1
Boron	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Barium	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Mercury	0.1	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	2	1.5	1	0.8	0.6	0.5	0.32	0.24	0.16	0.12	0.1	0.1
Total toxic metals	4	3	2	1.6	1.2	1	0.64	0.48	0.32	0.24	0.2	0.14
Cyanide	1	0.5	0.5	0.5	0.4	0.3	0.2	0.1	0.1	0.08	0.06	0.04
Phenols	0.5	0.5	0.5	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	100	100	100	100	100	100	100	100	100	50
Total phosphorus	10	10	10	10	10	10	10	10	10	10	10	5
Surfactants (total)	30	20	20	20	15	15	15	15	15	15	15	15
E. coli (count/100ml)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000

Source: EPD Technical Memorandum on Effluents Standards, Table 9b.

3.5 WASTE LEGISLATION

The principal legislation controlling waste materials in Hong Kong is the Waste Disposal Ordinance [Cap.354] (WDO). Enacted in 1980, this ordinance generally encompasses all stages of the waste management chain, from place of arising to final disposal point.

There are a number of provisions under the WDO for dealing with certain types of waste. They include the Waste Disposal (Chemical Waste) (General) Regulation, which is relevant to this project. Enacted in 1992, this regulation controls all aspects of chemical waste disposal, including storage, collection, transport, treatment and final disposal.

HKPSG, Chapter 9 (Environment), provides additional information on regulatory compliance. It also provides standards and guidelines on siting of refuse transfer stations.

The Environmental Impact Assessment Ordinance (EIAO) includes the requirement for environmental permits for various kinds of projects, including waste storage, transfer and disposal facilities.

3.6 ECOLOGICAL LEGISLATION AND GUIDELINE

The Hong Kong Government legislation and guidelines relevant to ecological assessment include the following:

- Country Parks Ordinance (Cap.208): protects flora and fauna within the Country Parks.
- Forests and Countryside Ordinance (Cap. 96): protects both natural and planted forests.
- Forestry Regulations: protect specified local wild plant species.
- Wild Animals Protection Ordinance (Cap. 170): protects listed species of wild animals (excluding fish and marine invertebrates) by prohibiting hunting and the disturbance, taking or removal of animals and/or their nests or eggs.
- Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187): restricts import, export and possession of endangered species.
- Marine Parks Ordinance (Cap 476): provides for the designation, control and management of marine parks and reserves and contains provision for control over certain stated activities.
- Sites of Special Scientific Interest: are designated by Agriculture and Fishery Department as areas worthy of protection, but have no legal status.

3.7 EXISTING LEGISLATION FOR LAND CONTAMINATION ASSESSMENT

3.7.1 Soil Contamination

Relevant legislation and guidance relating to contaminated land includes the EPD guideline, ProPECC PN3/94 "*Contaminated Land Assessment and Remediation*". This makes reference to criteria developed in the Netherlands and has been applied to the assessment and remediation of contaminated sites in Hong Kong.

It should be noted that the Dutch system of guidance has now been replaced with a modified approach. The revised system is based on the assessment of risk to human health and ecosystems. However, the current approach, with reference to the ProPECC PN 3/94, is based on the old Dutch ABC system. The ABC values are not "standards" but rather guidelines for use in the assessment of contaminated land. The simplified explanation of the ABC levels are as follows:

- 'A' value represents the normal background level
- 'B' value is that 'delimiting value for soil having potential for harmful effects on human health or the environment and requiring further investigation'
- 'C' value indicates 'heavy pollution and requirement for remedial action'.

Relevant Dutch ABC guideline values are presented in Table 3.7

Table 3.7 Selected Dutch Values for Judging Significance of Soil Contamination

Parameter	Reference Values (mg kg^{-1} dry matter)		
	A	B	C
Total Petroleum Hydrocarbons (TPH)	100	1000	5000
Benzene	0.01	0.5	5
Toluene	0.05	3	30
Ethylbenzene	0.05	5	50
Xylenes	0.05	5	50
Lead	50	150	600

3.7.2 Groundwater Contamination

Dutch ABC guidelines for groundwater are also referenced by EPD for the determination of groundwater contamination (Table 3.8). It should be noted that the Dutch guidelines were formulated on the basis of a "good for all use" philosophy. Since the purpose of the Dutch guidelines is to preserve groundwater as a potable water resource it can be seen that these criteria may be considered overly stringent. In Hong Kong, where the aquifer is not used for potable water, as in case of the NAKTA area, it may not be entirely appropriate to apply the Dutch guidelines. The results of risk assessment are therefore used for the groundwater evaluation.

Table 3.8 Selected Dutch Values for Judging Significance of Groundwater Contamination (for reference only)

Parameter	Reference Values ($\mu g L^{-1}$)		
	A	B	C
Total Petroleum Hydrocarbons (TPH)	20	200	600
Benzene	0.2	1	5
Toluene	0.5	15	50
Ethylbenzene	0.5	20	60
Xylenes	0.5	20	60
Lead	20	50	200

4 DESCRIPTION OF THE ENVIRONMENT

4 DESCRIPTION OF THE ENVIRONMENT

4.1 EXISTING NOISE ENVIRONMENT

4.1.1 Existing Noise Environment

Existing noise emission sources in the area are summarised as follows:

- Operations at KTA, including aircraft movements and airport-related activities such as aircraft maintenance and cargo handling.

- Industrial areas:

  (i) in Kwun Tong and San Po Kong
  (ii) west of KTA, specifically medium rise flatted factories comprising light manufacturing such as metal products, textiles, clothing and plastics, along Mok Cheong Street, Yuk Yat Street, and Sheung Heung Road
  (iii) along Hung Hom Road in Hung Hom.

- Major roads:

  (i) in Kwun Tong/San Po Kong: Kwun Tong Bypass, Prince Edward Road East, Kai Cheung Road, Kai Fuk Road
  (ii) from Ma Tau Kok to Hung Hom: Prince Edward Road East, Ma Tau Chung Road, Ma Tau Wai Road, To Kwa Wan Road, Chatham Road North, Hung Hom Road/Hung Hom Bypass.

- Other sources:

  (i) existing Cha Kwo Ling and Kwun Tong CWAs (total length of 1851m)
  (ii) elevated MTR tracks between Lam Tin Station and Kowloon Bay Station (Telford Gardens).

4.1.2 Existing Noise Sensitive Receivers

The objective of this construction noise assessment is to identify the worst case impacts likely to be experienced at NSRs. Therefore, care was taken to select twenty five representative NSRs that lie in closest proximity to the proposed works. In this way worst case impacts should be identified, since the extent of an impact resulting from a given noise source is proportional to the distance the NSR is located from that source. Table 4.1 sets out details of the selected representative NSRs, and their relative locations are indicated in Figure 4.1.

Table 4.1 Selected Representative Construction Noise Sensitive Receivers (NSRs)

NSR ID	Description
NSR-S1	Emmanuel Primary School Kln, Ma Tau Wai
NSR-S2	Holy Trinity Primary School, Kowloon
NSR-S3	Fu Yan Primary School
NSR-S4	Lee Kau Yan Memorial School
NSR-S5	Ng Wah College
NSR-S6	Congnitio College
NSR-S7	St. Benedicts Secondary Technical School
NSR-H1	Hospital/Clinic, Ma Tau Wai
NSR-H2	Robert Black Health Centre, San Po Kong
NSR-R1	Chun Seen Mei Chuen (Chi Mei Lau)
NSR-R2	Choi Hung Estate (Bei Luk Lau)
NSR-R3	Choi Hung Estate (Kam Bei Lau)
NSR-R4	Choi Hung Estate (Luk Ching Lau)
NSR-R5	Richland Garden, Block 8
NSR-R6	Richland Garden, Block 7
NSR-R7	Richland Garden, Block 6
NSR-R8	Richland Garden, Block 5
NSR-R9	Richland Garden, Block 4
NSR-R10	Richland Garden, Block 3
NSR-R11	Richland Garden, Block 2
NSR-R12	Richland Garden, Block 1
NSR-R13	North-Western Part of Kai Lok Temporary Housing Area (THA)
NSR-R14	South-Western Part of Kai Lok Temporary Housing Area (THA)
NSR-R15	North-Western Part of Kai Cheung Temporary Housing Area (THA)
NSR-HL1	Hotel north of Passenger Terminal

S = Schools, H = Health Centres, R = Residential Buildings, and HL = Hotel

It should be noted that NSR-HL1 would be entirely screened from the line of sight to the site by the Passenger Terminal, and is included here to demonstrate the screening effect afforded by this structure.

4.2 EXISTING AIR QUALITY ENVIRONMENT

4.2.1 Existing Air Quality Condition

Existing air quality in the study area is influenced by emissions from the following sources:

- Kai Tak International Airport
- Road traffic in and near the study area
- Industrial sources in and around the study area
- Construction activities in and around the study area (impact on dust)
- Kai Tak Nullah and Typhoon Shelter (impact on odour).

There is no permanent air quality monitoring site operated by EPD in the study area. Information from EPD sites in nearby urban areas have been used to provide information on air quality in the region. The most recent year for which measurements have been published is 1996 (*Air Quality in Hong Kong 1996*, EPD, 1997). The most relevant sites are the following:

- Kwun Tong (6th floor, 6 Tung Yuan Street); 25 m above ground level
  [Levels of air pollutants in an industrial district upwind of the study area]

- Tsim Sha Tsui (12th floor, 68 Mody Road); 50 m above ground level
  [Levels of air pollutants in a commercial district downwind of industrial sources. Most representative of study area. Monitoring ceased in August 1993]

- Mong Kok (kerbside, 4E Mongkok Road); 2 m above ground level
  [Levels of air pollutants from road traffic in a commercial area]

Air pollutant levels recorded at the three most relevant EPD sites during 1996 are presented in Table 4.2.

Table 4.2 Air Pollutant Levels at EPD Sites (1996)

	Kwun Tong	Tsim Sha Tsui [a]	Mong Kok	AQO
SO_2 1 hour	234 μgm^{-3}	562 μgm^{-3}	237 μgm^{-3}	800 μgm^{-3}
SO_2 24 hour	99 μgm^{-3}	123 μgm^{-3}	122 μgm^{-3}	350 μgm^{-3}
SO_2 1 year	19 μgm^{-3}	22 μgm^{-3}	30 μgm^{-3}	80 μgm^{-3}
NO_2 1 hour	251 μgm^{-3}	-	**310 μgm^{-3}**	300 μgm^{-3}
NO_2 24 hour	**152 μgm^{-3}**	-	**172 μgm^{-3}**	150 μgm^{-3}
NO_2 1 year	65 μgm^{-3}	-	75 μgm^{-3}	80 μgm^{-3}
CO 1 hour	-	-	4.24 mgm^{-3}	30 mgm^{-3}
CO 8 hour	-	-	3.24 mgm^{-3}	10 mgm^{-3}
O_3 1 hour	**314 μgm^{-3} [b]**			240 μgm^{-3}
TSP 24 hour	202 μgm^{-3}	198 μgm^{-3}	**290 μgm^{-3}**	260 μgm^{-3}
TSP 1 year	**99 μgm^{-3}**	**82 μgm^{-3}**	**142 μgm^{-3}**	80 μgm^{-3}
RSP 24 hour	108 μgm^{-3}	149 μgm^{-3}	156 μgm^{-3}	180 μgm^{-3}
RSP 1 year	**59 μgm^{-3}**	49 μgm^{-3}	**77 μgm^{-3}**	55 μgm^{-3}

Notes: "1 hour" indicates the highest one-hour average concentration recorded during 1994.
"24 hour" indicates the highest 24-hour average concentration recorded during 1994.
Values in bold font indicate levels above the relevant AQO.
a: Data for 1993 (site ceased operation during August 1993).
b: Level recorded at Central/Western monitoring site (ozone levels were not monitored at the 3 sites, Central/Western is the site at which the highest values were recorded during 1996).

Data recorded since 1983 indicate that levels of sulphur dioxide in industrial areas decreased substantially after the enactment of the Air Pollution (Fuel Restriction) Regulations in mid 1990. These regulations restricted the sulphur content of fuel. Additional emission control measures also played a role in reducing sulphur dioxide levels. Data since 1991 does not show any significant trend, indicating that the full benefit of existing measures has probably been realised.

Levels of NO_2 and particulates do not show any significant long-term trends. This may be due to some reduction in industrial emissions being balanced by increases in road traffic emissions. The consistently high degree of construction activity in Hong Kong since 1983 has also been a significant source of particulate matter.

Road traffic makes a significant contribution to levels of air pollution in the study area and levels of respirable suspended particulates and NO_2 are likely to be high.

Emissions from Kai Tak International Airport also has significant adverse effect on air quality in the study area. Emissions from aircraft landing and take-off movements together with other airport operations are known to be sources of oxides of nitrogen, carbon monoxide and volatile organic compounds (VOCs).

4.2.2 Air Sensitive Receiver

Kai Tak Airport is located in the southeastern part of Kowloon. The surrounding areas including To Kwa Wan, Kowloon City, San Po Kong and Kowloon Bay are mixture of residential, commercial and industrial uses. These are typical urban areas in the territory. Existing air quality sensitive receivers surrounding the Airport include all the domestic premises, hotels, hospitals, clinics, schools, commercial buildings, industrial buildings, place of public worship and so on located in these areas.

For the purpose of this assessment, all the assessment results are presented in the form of air pollutant concentration contours covering areas in the vicinity of the airport. Air quality impacts at the existing air quality sensitive receivers are indicated by the predicted air pollutant concentration contours.

4.3 EXISTING WATER QUALITY ENVIRONMENT

4.3.1 Existing Water Quality Condition

The main water body within Study Area is the Kai Tak Nullah, which is an open channel running between San Po Kong, Wong Tai Sin, Kowloon City. The nullah drains into the Kai Tak Approach Channel alongside the runway. Water bodies that may be affected by the development also include waters on both sides of the runway, namely Kowloon Bay and Kai Tak Approach Channel.

Existing water quality is measured by EPD at several locations on Kai Tak Nullah, within the airport boundary and north of the airport. Monitoring data have shown marked improvement over recent years and water quality in the upper reaches is now classified as 'good' according to the Water Quality Index. This is a results of the progressive implementation of the WPCO and WDO, as well as implementation of the East Kowloon Sewerage Master Plan. Implementation of the Tolo Harbour Effluent Export Scheme has also improved flow in the channelised upper sections of the nullah.

However, in the lower reaches quality is consistently bad or very bad, in particular where the nullah traverses the airport site. Pollutants are brought into the nullah via overflows from surcharged sewers and expedient connections from the storm water network in the drainage basins. Table 4.3 summarises the water quality monitoring results for 1995 (the latest year for which data are published). The heavy organic load is reflected in the high annual median BOD value (> 70 mg l^{-1}) and low annual median DO (≤ 1.5 mg l^{-1}) in the lower section of the nullah.

Table 4.3 Summary of EPD's Water Quality Monitoring Results for Kai Tak Nullah (1995)

PARAMETER	Monitoring Station					
	KN1	KN2	KN3	KN4	KN5	KN7
Dissolved Oxygen (mg l^{-1})	1.5 (0.9 - 5.8)	1.4 (0.8-5.3)	2.7 (1.5 - 6.0)	7.2 (1.4 - 8.5)	9.7 (7.8 - 11.9)	7.2 (4.9 - 7.9)
Biochemical Oxygen Demand (mg l^{-1})	73 (33 - 86)	79 (5 - 92)	56 (10 - 94)	44 (7 - 172)	8 (6 - 33)	12 (5 - 36)
Suspended Solids (mg l^{-1})	25 (22 - 30)	25 (10 - 26)	16 (11 - 26)	65 (16 - 280)	14 (5 - 16)	26 (13 - 400)
Ammoniacal - N (mg l^{-1})	17.00 (3.00- 2.00)	15.50 (0.36-21.00)	2.00 (0.32-10.00)	1.70 (0.30 - 4.70)	0.40 (0.32 - 0.47)	0.25 (0.02 - 1.40)
E. coli (cfu per 100 mL)	NM	NM	NM	1,497,774 (4.0E5 - 4.0E6)	NM	92,170 (1.8E4 - 1.5E6)
pH (pH units)	7.2 (7.1 - 7.2)	7.3 (7.3 - 7.5)	7.4 (7.0 - 7.6)	7.5 (6.5 - 8.2)	8.2 (7.6 - 9.2)	8.0 (7.4 - 9.2)
Cadmium (μg l^{-1})	10 (10 - 10)	10 (10 - 10)	10 (10 - 10)	10 (10 - 10)	10 (10 - 10)	10 (10 - 10)
Chromium (μg l^{-1})	100 (100 - 100)	100 (100 - 100)	100 (100 - 100)	100 (100 - 1600)	100 (100 - 100)	100 (100 - 100)
Copper (μg l^{-1})	100 (100 - 200)	100 (100 - 100)	100 (100 - 200)	100 (100 - 400)	100 (100 - 100)	100 (100 - 100)
Lead (μg l^{-1})	10 (10 - 10)	10 (10 - 10)	10 (10 - 10)	10 (10 - 30)	10 (10 - 10)	10 (10 - 10)
Zinc (μg l^{-1})	40 (20 - 40)	55 (20 - 70)	40 (20 - 40)	55 (30 - 110)	30 (10 - 50)	55 (10 - 90)

Note: 1. Data presented are annual medians of monthly samples; except those for *E. coli* which are geometric means.
2. Those figures in brackets are the ranges.
3. NM = Not Measured

Source: River Water Quality in Hong Kong 1995.

Water quality of the water bodies on the either side of the runway can be reflected by EPD's routine monitoring data collected at the To Kwa Wan Typhoon Shelter (station VT11) and Kwun Tong Typhoon Shelter (station VT4). Results for 1995 are summarised in Table 4.4. The table clearly shows that water quality in the Kai Tak Approach Channel is very bad. Annual averaged dissolved oxygen content is of the order of 10% only, with a high BOD of about 5 mg l^{-1}. The very bad water quality in the channel is a result of pollutants input from upstream, i.e. the Kai Tak Nullah, together with the low flushing rate in this restricted water channel. Polluted sediments in this channel possess a high level of oxygen demand that contributes also to the reduction of oxygen in the overlying water column.

Water quality is comparatively better in Kowloon Bay. Averaged DO is about 60% saturated and the average BOD is 1.1 mg l^{-1}. The area is close to the outfall of the To Kwa Wan Sewage Screening Plant which is currently discharging at a rate of about 95,000 m^3 per day with a BOD loading of 21 tonnes per day. This outfall will be decommissioned when SSDS Stage 1 is implemented, anticipated before the end of 1999.

Table 4.4 Summary of EPD's Water Quality Monitoring Results for To Kwa Wan and Kwun Tong Typhoon Shelter (1995)

DETERMINANT		To Kwa Wan Typhoon Shelter (VT11)		Kwun Tong Typhoon Shelter (VT4)	
Temperature (°C)	Surface	22.5	(16.2 - 27.7)	22.7	(16.9 - 28.0)
	Bottom	22.2	(15.9 - 27.6)	21.9	(16.1 - 27.8)
Salinity (ppt)	Surface	31.3	(27.1 - 33.2)	29.8	(25.5 - 33.3)
	Bottom	31.7	(27.9 - 33.3)	32.0	(31.2 - 33.1)
Dissolved Oxygen (% saturation)	Surface	67	(43 - 103)	7	(3 - 9)
	Bottom	55	(27 - 74)	12	(0 - 54)
Dissolved Oxygen (mg l^{-1})	Surface	4.8	(3.0 - 6.9)	1.1	(0.2 - 4.0)
	Bottom	4.0	(1.9 - 5.4)	1.0	(<0.1 - 4.4)
Suspended Solids (mg l^{-1})		9.8	(4.4 - 23.3)	8.2	(3.0 - 17.3)
Biochemical Oxygen Demand (mg l^{-1})		1.1	(0.7 - 1.9)	5.3	(3.1 - 10.9)
Total Nitrogen (mg l^{-1})		0.79	(0.56 - 1.28)	2.20	(1.60 - 4.14)
Ammoniacal Nitrogen (mg l^{-1})		0.35	(0.05 - 0.74)	1.63	(1.14 - 3.43)
Total Inorganic Nitrogen (mg l^{-1})		0.45	(0.19 - 0.85)	1.67	(1.21 - 3.44)
Total Phosphorus (mg l^{-1})		0.12	(0.08 - 0.18)	0.35	(0.24 - 0.50)
E. coli (no./100ml)		1937	(717- 5233)	208122	(81000 - 472000)

Note: 1 Except as specified, data presented are depth-averaged data.
2 Data presented are annual arithmetic means except for *E. coli* data which are geometric means.
3 Data enclosed in brackets indicate the ranges.

4.3.2 SENSITIVE RECEIVERS

The main sensitive receiving water bodies include Kai Tak Nullah, Kai Tak Approach Channel, and Kowloon Bay.

4.4 EXISTING WASTE CONDITIONS

4.4.1 Municipal Solid Waste

Wastes generated from the airport operation are mainly from three sources: airport (airside), airport (landside) and airport related industries. Based on the data collected through a number of questionnaires sent to various organizations operating the airport during the SEKDFS, it was found that currently the collected wastes comprise 65.5 tonnes/day (tpd) of domestic, commercial, industrial and chemical wastes. Among them, only 10.5 tpd, mainly refuse, is collected by the Urban Services Department. After collection, this waste is compacted and containerized at the Kowloon Bay Transfer Station. The containerized waste is then transferred to a landfill for disposal.

The remaining wastes, including chemical, domestic and industrial wastes, a total of approximately 55 tpd, are collected by private collectors and then either recycled (for instance chemical waste) or disposed of at landfills. Tables 4.5 and 4.6 provide a summary in terms of source, quality, collection authorities and disposal points.

Table 4.5 Wastes Collected at the Airport Site by Urban Services Department

Waste Sources	Quantity (tpd)	Waste Characteristics
Airport Terminal Buildings (West Station, East Station & Electra Drive)	10.5	Wet and dry refuse and junk
Air Cargo Terminal		
Associate Engineering Co. Ltd.		
Cathay Pacific Technical building		
Lufthansa, KTA		
Aviation Club, Olympic Avenue		
Airport Police Division		

Table 4.6 Privately Collected Wastes Generated from the Airport Site

	Waste Characteristics	Quantity		Collection Agency	Disposal Point
		tpd	gpd[1]		
HAECO	Commercial waste: Food, paper wastes generated from offices and canteen and solid wastes removed from passenger aircraft	15	-	Cleaning company	Tseung Kwan O
	Industrial waste: Used oil, fuel, hydraulic fluids generated from equipment maintenance	3	-	Cleaning company	Tseung Kwan O
	Chemical waste: Lubricating oils, solvents, paint, spent batteries, herbicides and insecticides used on-site for routine airfield maintenance	0.3	-	Petrochemical company	-
HATS	Industrial waste: Used tires	-	-	Supplier	-
	Scrapped equipment and parts	-	-	Engineers firm	-
	Chemical waste Oil, grease and lubricant oil used in mobile vehicle equipment	-	35	Petrochemical company	-
HACTL	Commercial waste Paper	3	-	Recycling company	-
	Polyethylene sheets and wooden pallets	34	-	Cleaning company	Tseung Kwan O

Note: (1) gpd = gallons per day

4.4.2 Existing Fuel Storage Facility

The airport site contains a large tank farm, for the storage of aircraft fuels, and a buried distribution network of fuel pipelines beneath the airport apron. In addition, there is a fuel unloading dolphin situated at the western edge of the runway through which aircraft fuel is unloaded from barges before transfer to the tank farm for storage. More detailed description of these facilities are presented in Section 4.6.1.

There are also numerous petrol filling pumps on the airport apron for re-fueling cars and buses which operate on the airport apron.

4.5 EXISTING ECOLOGICAL CONDITION

4.5.1 Land Use and Habitats

The existing land under consideration for re-development is currently subject to urban land use.

In addition, most of Kowloon Bay within the Study Area is proposed to be reclaimed for new development.

The vegetation of Hong Kong was surveyed by World Wide Fund for Nature Hong Kong using aerial photography taken in December 1989 supported by field checks, and classified into 16 vegetation/ habitat types[1]. All of the study area was classified as 'high density urban', that is, any trees, shrubs and grasses which are present are mostly exotic species planted and maintained by man in a few small areas of amenity planting. No inland waters including streams were identified as present by the WWF survey, as Kai Tak Nullah was classified as a marine water body.

More detailed information was obtained for the current Feasibility Study from aerial photographs (taken during September 1995 at a height of 3, 500 feet) to determine the locations and areas of any habitats/vegetation in the study area, followed by ground truthing of areas that were unclear or that contained trees.

A habitat map was compiled (Figure 4.2). The area of each habitat type is given in Table 4.7.

Table 4.7 Habitat Types in South East Kowloon Study Area and Environs

Habitat Type	Area (m^2)	Length (m)	% Area
High density urban	4 687 520	-	45.8
Grass (planted)	508 100	-	5.0
Amenity planting	184 570	-	1.8
Marine	4 829 000	-	47.2
Freshwater/brackish	20 100	-	0.2
Quarry face	16 700	-	outside area
Artificial coastline	-	13 100	99.1 %
Original coastline remnants	-	120	0.9 %

4.5.2 Terrestrial Habitats and Flora

The airport runway is manmade, 242 m wide and 3392 m long, extending into Kowloon Bay. The surface of this promontory is occupied by runway, taxiway, road and large grass strips. Mostly drainage is good, and standing water only occurs after a heavy downpour, though there are several areas of poorer drainage, with enough standing water during the wet season to allow *Rana tigrina* (Chinese Bullfrog) to breed. Grass on the runway is the result of rough turfing with several plant species, the most common being *Cynodon dactylon* (Bermuda grass). There

1 World Wide Fund for Nature Hong Kong. *Hong Kong Flora and Fauna: Computing Conservation.* World Wide Fund for Nature Hong Kong, 1993.

are some woody species such as *Mimosa pudica*.

A tree survey was conducted at the Aviation Club during this study. Eleven trees were identified at the study site (Table 4.8). Of these species, three are native to Hong Kong, however all three are widely distributed and common locally. *Celtis sinensis* is common throughout tropical and temperate Asia, including most parts of China. In Hong Kong it is commonly planted along roads and in park areas. *Macaranga tanarius* is widely distributed through South Asia and down as far as Australia and is common locally, in thickets usually near the coast. *Ficus microcarpa* is a popular native tree in Hong Kong, growing generally along roadsides or near villages where it is used for shade and shelter.

Given the small number of trees, their common distribution in Hong Kong and their primary use as shade and shelter trees, their ecological value is rated as relatively low.

Table 4.8 Aviation Club Tree Survey Results

Species	Common Name	Exotic (E)/ Native (N)
Thevetia peruviana	Yellow Oleander	E
Psidium guajava	Guava	E
Morus alba	White Mulberry	E
Macaranga tanarius	Elephants Ear	N
Ficus microcarpa	Chinese Banyan	N
Delonix regia	Flame of the Forest	E
Bauhinia variegata	Camel's Foot tree	E
Citrus maxima	Pomelo	E
Casuarina equisetifolia	Horsetail tree	E
Celtis sinensis	Chinese Hackberry	N
Erythrina speciosa		E

4.5.3 Avifauna

Extensive observations on avifauna at KTA have been recorded during the 1970s and 1980s by the Kai Tak Birdstrike Research Unit of the Agriculture and Fisheries Department and by David Melville of World Wide Fund for Nature.

During the period between February 1974 and December 1979, 136 species were seen. Of these, five species were regularly present throughout the year (Black-eared Kite, Small Skylark, Richard's Pipit, Tree Sparrow and Pigeon). Reef Egret and Common Sandpiper have been recorded throughout one or more years. Several gull species and the White Wagtail are present throughout the winter and as passage migrants. However the remaining species are recorded only as passage migrants (including the Asiatic, Golden and Oriental Plovers & Yellow Wagtail) or are of irregular occurrence (including the Bonneli's Eagle, Australian Curlew & Wryneck).

It has been noted that the airfield at Kai Tak has little to offer most species in terms of food, cover, etc. and records of species often relate to migrants grounded by bad weather, such as that associated with the passage of cold fronts and tropical depressions[5]. The majority of waders are grounded migrants which are usually weak, tired, reluctant to fly, and move on as soon as possible, depending on weather and physical condition. The only records of breeding at Kai Tak are for Little Ringed Plover, Small Skylark and Richard's Pipit.

Records of Oriental Plover and Little Whimbrel are of interest as there are few Hong Kong records away from Kai Tak. The Oriental Plover was noted as a scarce spring migrant in small numbers, with occasional autumnal records. It was noted that the species appears to favour grassy areas which probably explains the paucity of records from elsewhere in Hong Kong[5]. Little Whimbrels were recorded at Kai Tak every year between 1974 and 1979 but not during every migration. Sightings outside of Hong Kong suggest that during the non-breeding season the bird favours areas of short grass and it is frequently seen at airfields[2, 3]. As with the Oriental Plover the lack of suitable habitat elsewhere in urban Hong Kong probably explains the paucity of records away from Kai Tak.

Black-eared Kites are resident in Hong Kong with a summer population of 200-300 (including many non-breeding adults) and a winter population of approximately 1,000. The annual pattern of occurrence at Kai Tak peaks in March and October (thought to be related to migrant birds) and a small increase in June (probably due to dispersal of locally fledged young). There is much variation in the number of birds present at one time at Kai Tak. The most important factor is the weather condition. Up to 48 have been recorded simultaneously, though the number is usually less than 10.

Kites are scavenger feeders, often feeding from the water around the runway promontory, on dead fish and in the past on slaughter house offal discharged from sewer outfalls[4]. The main night time roosts have been on Stonecutters Island and around Magazine Gap/Victoria Peak, although port development activity in the area of Stonecutters Island may have had an impact in recent years. Former sewer outfalls at Kai Tak and Kwun Tong provided an abundant supply of offal and other food items for kites, however these sewers were extended in 1985 and 1987 reducing the food supply in the area of the airport. In addition, since the 1980's there has also been a higher level of bird scaring activity by the airport Bird Control Unit. These two factors combined have reduced the number of kites at Kai Tak. Kites have more recently been seen at higher altitudes and it is hypothesised that most of the kites now recorded at Kai Tak are

2 Bell, HL. Some distribution notes on New Guinea highland birds. *Emu* 67(3): 211-214, 1968.

3 van Tets, GF, Vestijens, WJM, D'Andria, AH and Barker R. *Guide To the Recognition and Reduction of Aerodrome Bird Hazards*. Australian Department of Transport, Canberra, 1977.

4 Melville, D. *The Birdstrike Hazard at Kai Tak Airport Hong Kong: Final Summary Report 1974-79*. Agriculture & Fisheries Department, Hong Kong, 1979.

making use of the thermal currents induced by the runway[5].

Gulls are winter visitors to Hong Kong, arriving in late October/early November and departing late March/early April[6]. There has been a large increase in Black-headed Gulls in the Territory in recent years, although numbers of Herring gulls do not appear to have increased. Roost counts since 1975 indicate 20,000-25,000 Black-headed Gulls and 1,000 Herring Gulls. Movements within Hong Kong are not fully understood but it is known that there are three peaks: late November, late December/early January, and late February/early March. Gulls spend the daytime feeding either at sewer outfalls or at Kwun Tong Oil Storage depot or resting on the sea in Kowloon Bay. At night-time they roost in West Lamma Channel, movements being in early morning and early evening. Gut analyses showed they were feeding on small fish and there is no evidence that they eat raw sewage. The only records of birds resting on grass are oiled/injured individuals. The highest number of Black-headed Gulls recorded in the airport area was 3,284. However, as with the kites, the number of gulls recorded at Kai Tak in recent years has dropped. This may be due to the sewer extensions into areas of stronger currents so that mixing is promoted, and fewer fish are feeding at the surface for the gulls to prey on. There has also been an increase in boat traffic so the area would be less attractive for roosting on the water[7].

4.5.4 Other Fauna

As most of the habitat type is high density urban and the few areas of vegetation are typically planted exotic species, it would be expected that any fauna supported by these habitats is impoverished and would be of a low species diversity, of species types frequently found in the urban environment and habituated to, or unaffected by disturbance.

Fauna seen at KTA include *Rana tigrina* Chinese Bullfrog (breeding in standing water), water beetles (Dytiscidae), bats (Chiroptera) and dragonflies (Odonata) noted by the BRU[8]. However, recommendations were made to reduce the risks of birdstrike with aeroplanes, by removing food for waders through infilling standing waters. Therefore habitat for these species may since have been removed.

Other fauna have been observed at KTA including *Rattus norvegicus*, scarab beetles (Scarabaeidae), short horned grasshoppers (Orthoptera; Acrididae), common butterflies *Eurema* spp and *Precis orithya*. Earthworms were rare. Chinese Skink (*Eumeces chinensis*) was

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5 Melville, D. *Development Potential of Hong Kong International Airport: Kai Tak Birdstrike Study*. World Wide Fund for Nature, Hong Kong, 1988.

6 Viney, C, Phillips, K & Lam, CY. *Birds of Hong Kong and South China*. Government Printer, Hong Kong, 1994.

7 Melville, D. *Development Potential of Hong Kong International Airport: Kai Tak Birdstrike Study*. World Wide Fund for Nature, Hong Kong, 1988.

8 Melville, D. *The Birdstrike Hazard at Kai Tak Airport Hong Kong: Final Summary Report 1974-79*. Agriculture & Fisheries Department, Hong Kong, 1979.

widespread as was house mouse *Mus muscullus castaneus* but not common. There w occasional sightings of house shrew *Suncus murinus*. Snakes were very rarely seen, the only identification made was a single *Naja naja* Chinese Cobra. Three terrapins were reported, though thought to be escapees[9].

4.5.5 Protected Species

No references were found to protected species occurring in the study area.

4.5.6 Protected Areas

The study area does not contain any area protected for nature conservation value such as Sites of Special Scientific Interest, Country Parks, Special Areas, areas of restricted access under the Sixth Schedule of the Wild Animals Protection Ordinance (Cap. 170), nor any proposed or designated Marine Parks or Reserves.

The closest such site to the study area is Ma On Shan Country Park, the nearest limb of which is situated at a distance of about 1.5 km away. Due to the considerable distance from the study area, impacts are not anticipated upon the Country Park.

4.6 EXISTING LAND CONTAMINATION CONDITION

4.6.1 Internal Sources

Interviews have been carried out with personnel of HAECO and OCTF in September 1996 concerning site history and contamination records during the SEKDFS. Questionnaires completed during the interviews are shown in Appendix C.

HAECO

The HAECO site is bounded by Concorde Road, Convair Drive, the maintenance apron, and Comet Drive. The site is adjacent to the OCTF Fuel Farm (to the west), workshops and a car park (to the north), the CPA Building (to the east), and the airport apron (to the south). The site area is 95,260 m^2.

The site is used for maintenance of aircraft and overhaul of aircraft engines and components. It has been operating at the present site for 46 years. Fuel storage was located at this site prior to realignment of the runway during Japanese occupation.

Dangerous goods from all categories (Categories 1-8) are stored at the site, and the facilities include a radiographic room for x-raying jet engines.

9 Melville, D. *Birds at Kai Tak Airport Hong Kong* Birdstrike Research Unit, Agriculture & Fisheries Department, Hong Kong, 1980.

The HAECO site includes a number of underground tanks. A plan showing the location of underground storage tanks (and other facilities) is provided in Figure 4.3. Underground storage facilities at the site include decommissioned tanks at two former fuel stations. An underground storage tank at a former cyanide destruction plant was removed when the plant was decommissioned.

OCTF

The OCTF site is bounded by Concorde Road, Convair Drive, Electra Drive, and the aircraft parking apron. The site is adjacent to the HAECO Site (to the east), the airport terminal building (to the west), and the airport apron (to the south). The tank farm is associated with a dolphin near the Kowloon City Ferry Pier for the mooring of vessels for discharging and conveying aviation fuels and lubricants to the tank farm. The OCTF site is approximately 12,110 m^2 with the dolphin area of 283.7 m^2.

Figure 4.4 shows the fuel hydrant pipeline layout. The fuel hydrant lines are laid underground across the apron area.

The tank farm stores and handles aviation fuel (jet fuel and aviation gasoline) in bulk, along with a small quantity of aviation lubricant. Facilities have been upgraded several times since 1958, but records of renovations and underground facilities are not available to the consultant.

Figure 4.5 summarises the record of hydrant fuel system leakage provided by OCTF. A contamination assessment undertaken by OCTF indicated that there were potentially a number of sources of pollution in the apron area other than historical hydrant fuel system leakage. Some areas were due to old spills, examples being a significant area near HAECO, one at the OCTF gate, and several associated with the hydrant system near the stormwater culvert immediately north of the Airport Tunnel.

It should be noted that the groundwater table under the site is very close to ground level (averages 2.9 m). As the fuel pipes are at 2-5 m depth, it is likely that some of the leaks occurred below the water table. In this case, it is likely that the fuel floated to the top of the water surface and then contaminated the soil as the water table level rose and fell with tidal and seasonal influence. This is slightly unusual, in that most soil contamination tends to occur from the top downwards rather than from the bottom upwards, as in this case.

The amount of infiltration on the site is minimal because of the extensive concrete cover and there are few areas of exposed soil. It is likely that oil contamination has mainly occurred from the water table surface upwards. The highest level at which oil pollution is to be expected is at the maximum height of the water table or the maximum height of a pipe that has developed a leak, whichever is the higher.

4.6.2 External Sources

The areas surrounding KTA support a wide range of different land uses including a gas works, many vehicle repair workshops, filling stations and flatted factories, all of which represent sources of potential contamination. A site inspection to identify areas of possible land contamination was conducted in November 1995 during the SEKDFS. Table 4.9 provides information on various contaminative land uses. Locations of these sites are presented in Figure 4.6.

Table 4.9 Summary of Information on Various Contaminative Landuses

Potentially Contaminative Uses	Information obtained from field observations and questionnaires	
	General Information	Possible/potential sources of contamination
Car Repair Workshops	• size : typical 400 to 800 sq.ft • activities : car repair, maintenance, rarely some car washing • long history of operations at Ma Tau Wai (>5 years) • Two large clusters found in Ma Tau Wai, others scattered over Kowloon City	• waste oils e.g. lubricating oils, transmission fluid and engine coolant • at present, waste oils collected by licensed chemical waste collector but previously such wastes were drained to nearby sewers or stormwater drains.
Petrol Stations	• activities : refuelling, storage of fuel, replacing motor oil and car washing	• underground fuel storage tank leakage (none recorded) • accidental oil spillage (none recorded) • waste oils and car washing water contaminating drain (none recorded)
Ma Tau Kok Gas Works	• new site: N. Works size 12500 sq metres • old site: S. Works demolished 1993 company operating for 63 years • activities : town gas production, naphtha and diesel storage • underground pipelines for fuel and gas transportation	• leakage from storage facilities • leakage from pipelines • for the old site, a land contamination study report was produced in 1993
Bus Terminals	• no refuelling, bus washing or fuel storage at bus terminals	• not likely to cause significant land contamination
Ferry Terminals	• passenger ferry pier at Kowloon City • size : 1744 sq.m with 39 years of operation • no refuelling or fuel storage some ferry cleaning	• only application of lubricating oil, transmission fluids and paints (no disposal needed)
EMSD Workshop	• activities : government vehicle repairing and maintenance (about 3000 veh per month) • long history of operation	• a large underground waste oil tank was identified • wastes disposal and oil & fuel storage generally follows government environmental requirements at present
Light Industries	• as they are mostly located at multi-storey industrial premises, land contamination is unlikely	• contamination may have arisen around the sewerage utilities serving these premises as a result of leakage

A limited site investigation was also carried out in February 1997 under the SEKDFS. The investigation involved intrusive soil and ground water sampling inside the urban area in Kowloon City, Ma Tau Wai and Ma Tau Kok. The investigation was intended to obtain and review the general baseline conditions for future redevelopment. The investigation consisted of nine boreholes and ten trial pits located as shown in Figure 4.7

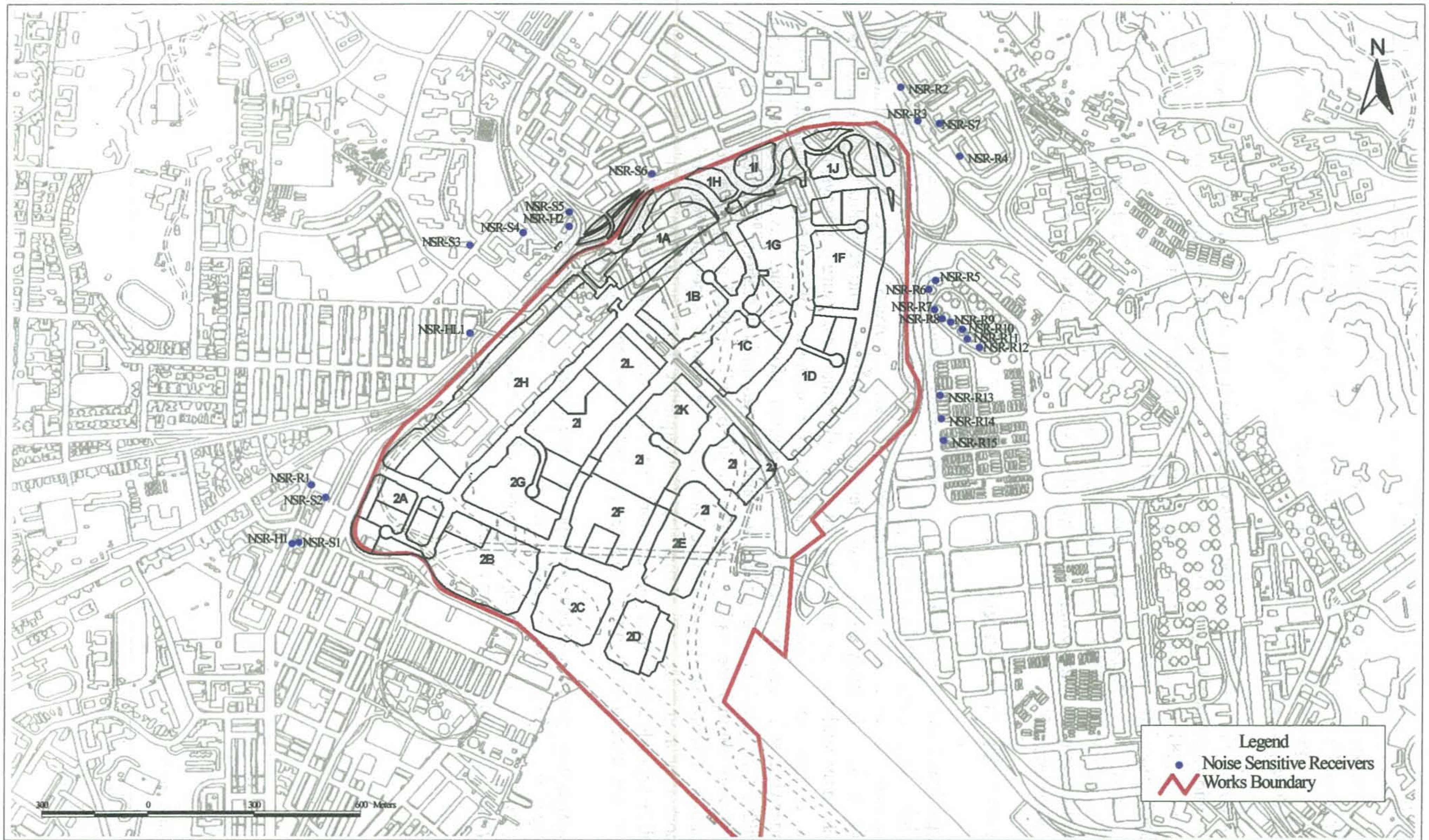
Soil contamination at sampling locations was generally lower than the Dutch B level except for a location immediately north of the gas work. At this location, TPH concentrations were found to be 24,281 mg/kg and 8,684 mg/kg respectively at 1.2m and 1.95m, and groundwater concentration was correspondingly high. This may be associated with the gas work activities. However, at sampling locations closer to the KTA, much lower TPH concentrations were found, indicating that the area as a whole did not have widespread contamination; only localised hot spots existed. No evidence was found for subsurface migration of external contamination sources into KTA.

4.7 SENSITIVE RECEIVERS

Typical land uses to be considered as sensitive receivers include residential gardens and grassed public areas, such as parks and play grounds. Few such sensitive receivers are represented in the study area, as most of the development in the area is covered with concrete hard standing. Almost all of the study area is totally developed and there are no agricultural or groundwater wells in the study area to create two potential contaminant exposure pathways, namely produce and potable water. This situation affords little exposure of above-ground population to underlying soil. As for underground population, (for example, basement of commercial buildings, car parks, tunnels, underpasses and underground rail stations[10]), vapour migration by permeation through the walls or along the utility backfill can be a potential odour problem and public health and safety risk (particularly when the vapour is combustible and migrates into poorly ventilated space such as tunnels). Consequently the identification of sensitive receivers will be dependent both upon the locations of the redevelopment of existing sites and when this will take place, and upon the proposed end use of the land.

Construction workers will be more exposed to the contaminated material during excavation and preparation of foundation works. Because of the explosive and mobile nature of jet fuel contamination, hazard during preparation of foundations and subsurface services will be significant. Special protection measures should be addressed.

10 such land uses will be present on the KTA apron area after redevelopment



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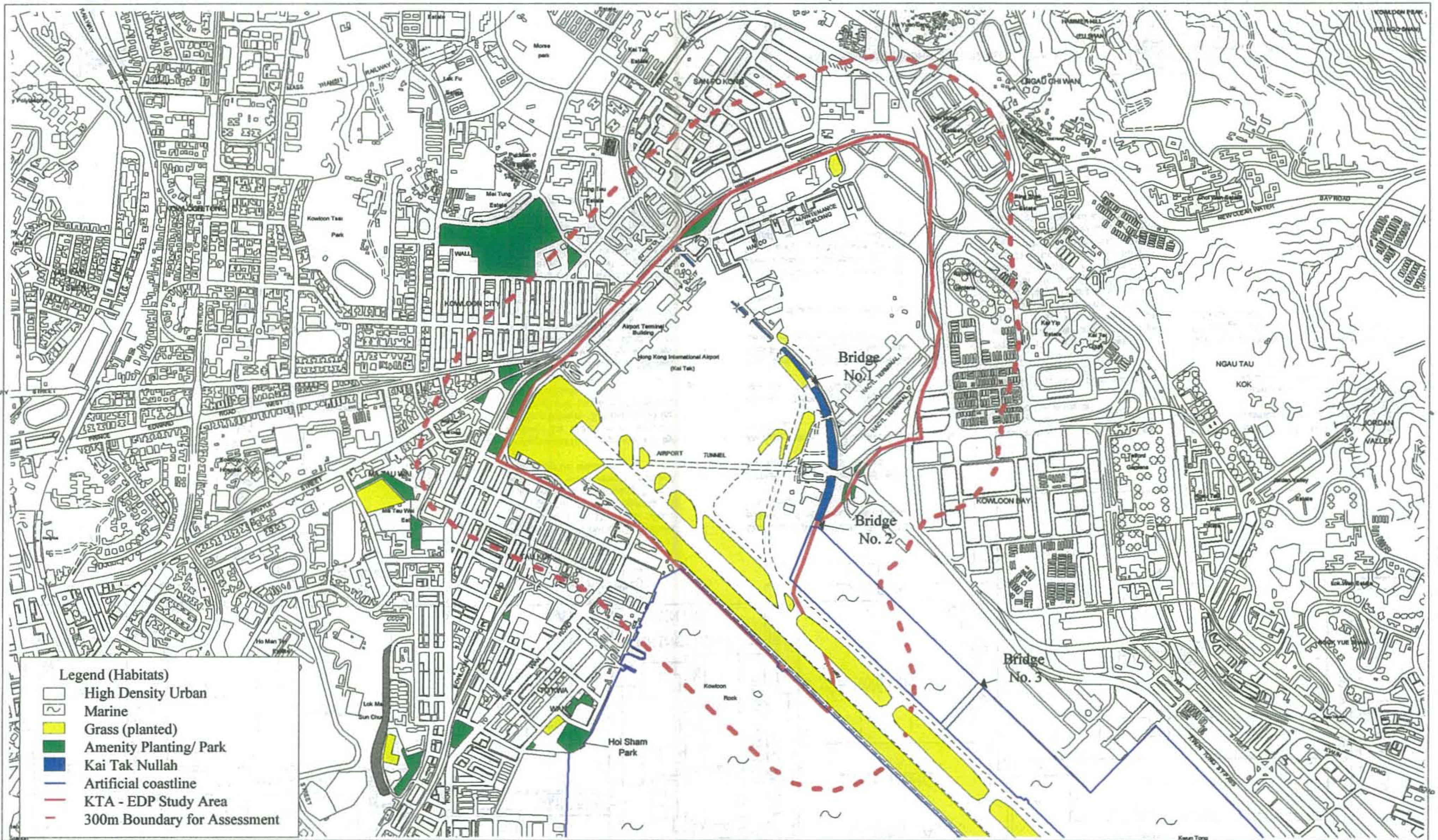
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

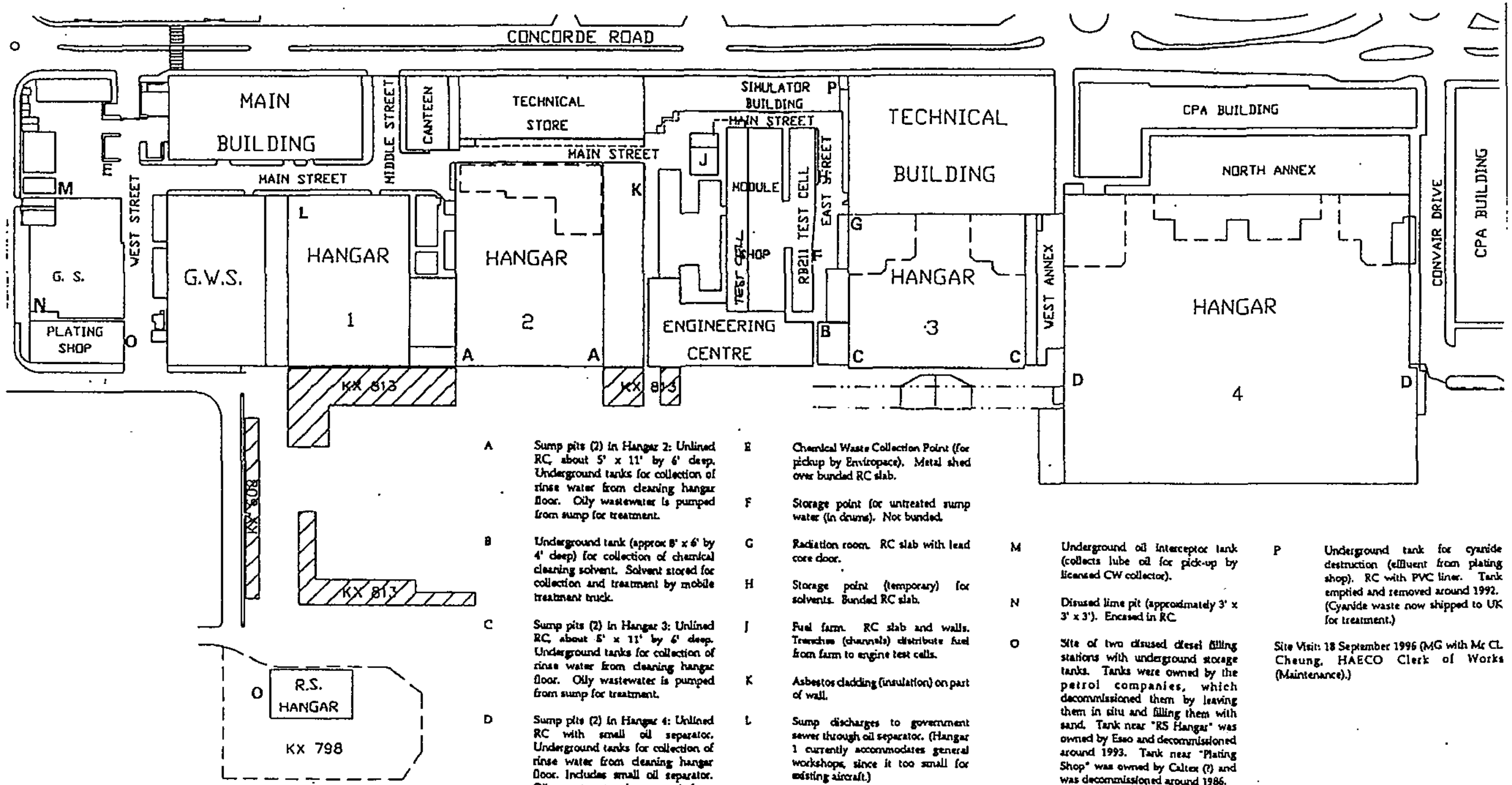
Territory Development Department, Hong Kong
Kowloon Development Office

TITLE
Representative Construction Noise Sensitive Receivers and Planning Sub-areas

SCALE	1 : 10000	DATE	Apr. 1998	
DESIGNED	Jim Shorthose	DRAWN	Fanny Lau	
CAD REF.	C415	DRAWING NO.	Figure 4.1	REV 0



Maunsell in association with 環科 CES	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department, Hong Kong Kowloon Development Office		
	TITLE Habitat Map : SE Kowloon	SCALE 1 : 20000	DATE June 1998	
		DESIGNED Fanny Lau	DRAWN Fanny Lau	
		CAD REF. C415	DRAWING No. Figure 4.2	REV 0



A Sump pits (2) in Hangar 2: Unlined RC, about 5' x 11' by 6' deep. Underground tanks for collection of rinse water from cleaning hangar floor. Oily wastewater is pumped from sump for treatment.

B Underground tank (approx 8' x 6' by 4' deep) for collection of chemical cleaning solvent. Solvent stored for collection and treatment by mobile treatment truck.

C Sump pits (2) in Hangar 3: Unlined RC, about 5' x 11' by 6' deep. Underground tanks for collection of rinse water from cleaning hangar floor. Oily wastewater is pumped from sump for treatment.

D Sump pits (2) in Hangar 4: Unlined RC with small oil separator. Underground tanks for collection of rinse water from cleaning hangar floor. Includes small oil separator. Oily wastewater is pumped from sump for treatment.

E Chemical Waste Collection Point (for pickup by Enviropace). Metal shed over bunded RC slab.

F Storage point (for untreated sump water (in drums). Not bunded.

G Radiation room. RC slab with lead core door.

H Storage point (temporary) for solvents. Bunded RC slab.

J Fuel farm. RC slab and walls. Trenches (channels) distribute fuel from farm to engine test cells.

K Asbestos cladding (insulation) on part of wall.

L Sump discharges to government sewer through oil separator. (Hangar 1 currently accommodates general workshops, since it too small for existing aircraft.)

M Underground oil interceptor tank (collects lube oil for pick-up by licensed CW collector).

N Disused lime pit (approximately 3' x 3' x 3'). Encased in RC.

O Site of two disused diesel filling stations with underground storage tanks. Tanks were owned by the petrol companies, which decommissioned them by leaving them in situ and filling them with sand. Tank near "RS Hangar" was owned by Esso and decommissioned around 1993. Tank near "Plating Shop" was owned by Caltex (?) and was decommissioned around 1986.

P Underground tank for cyanide destruction (effluent from plating shop). RC with PVC liner. Tank emptied and removed around 1992. (Cyanide waste now shipped to UK for treatment.)

Site Visit: 18 September 1996 (MG with Mr CL Cheung, HAECO Clerk of Works (Maintenance).)

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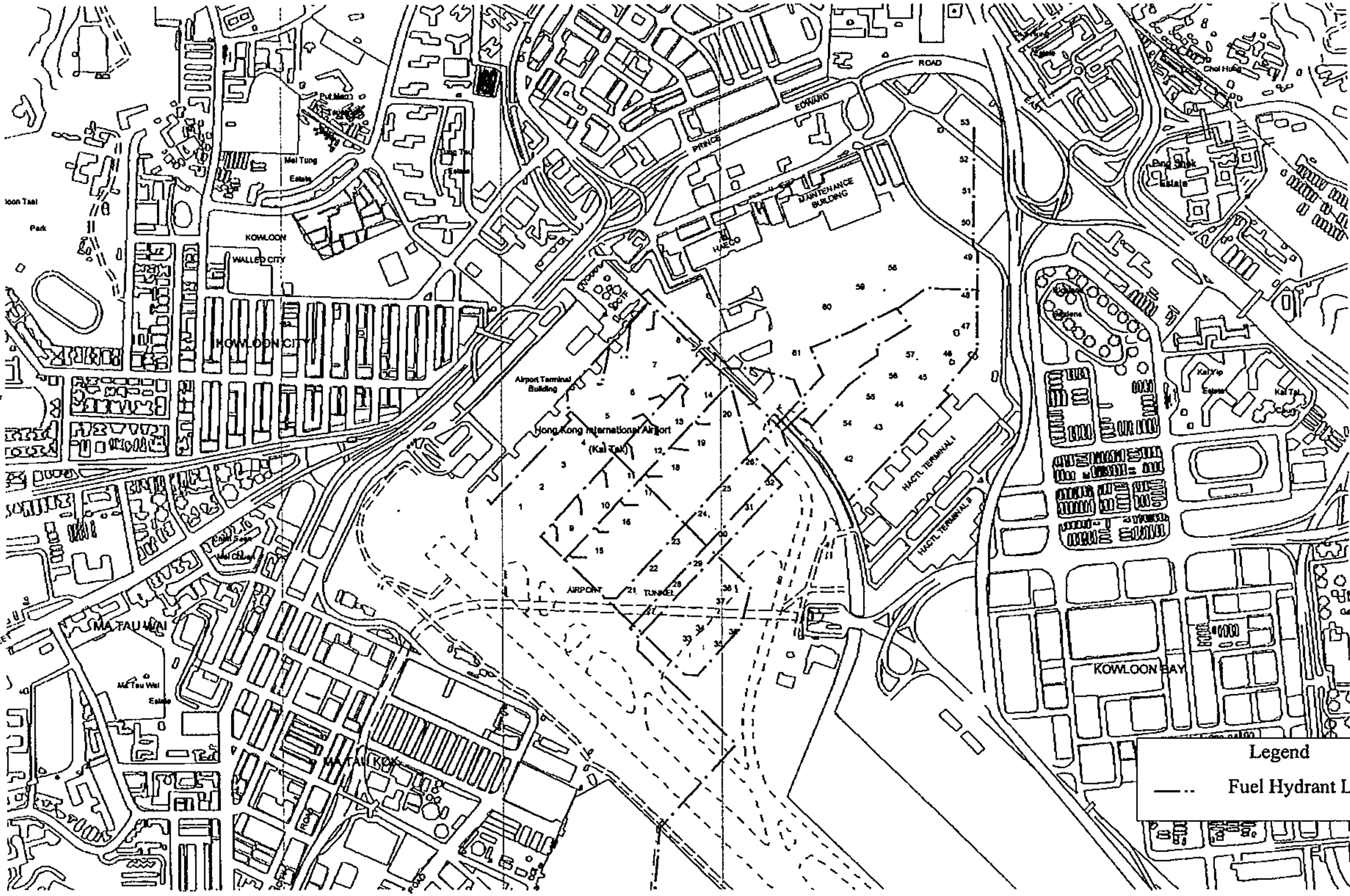
KAI TAK AIRPORT NORTH APRON DECOMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE

HAECO Site

SCALE	N.T.S	DATE	June 1998
DESIGNED	Wendy Tao	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING NO	Figure 4.3
		REV	0



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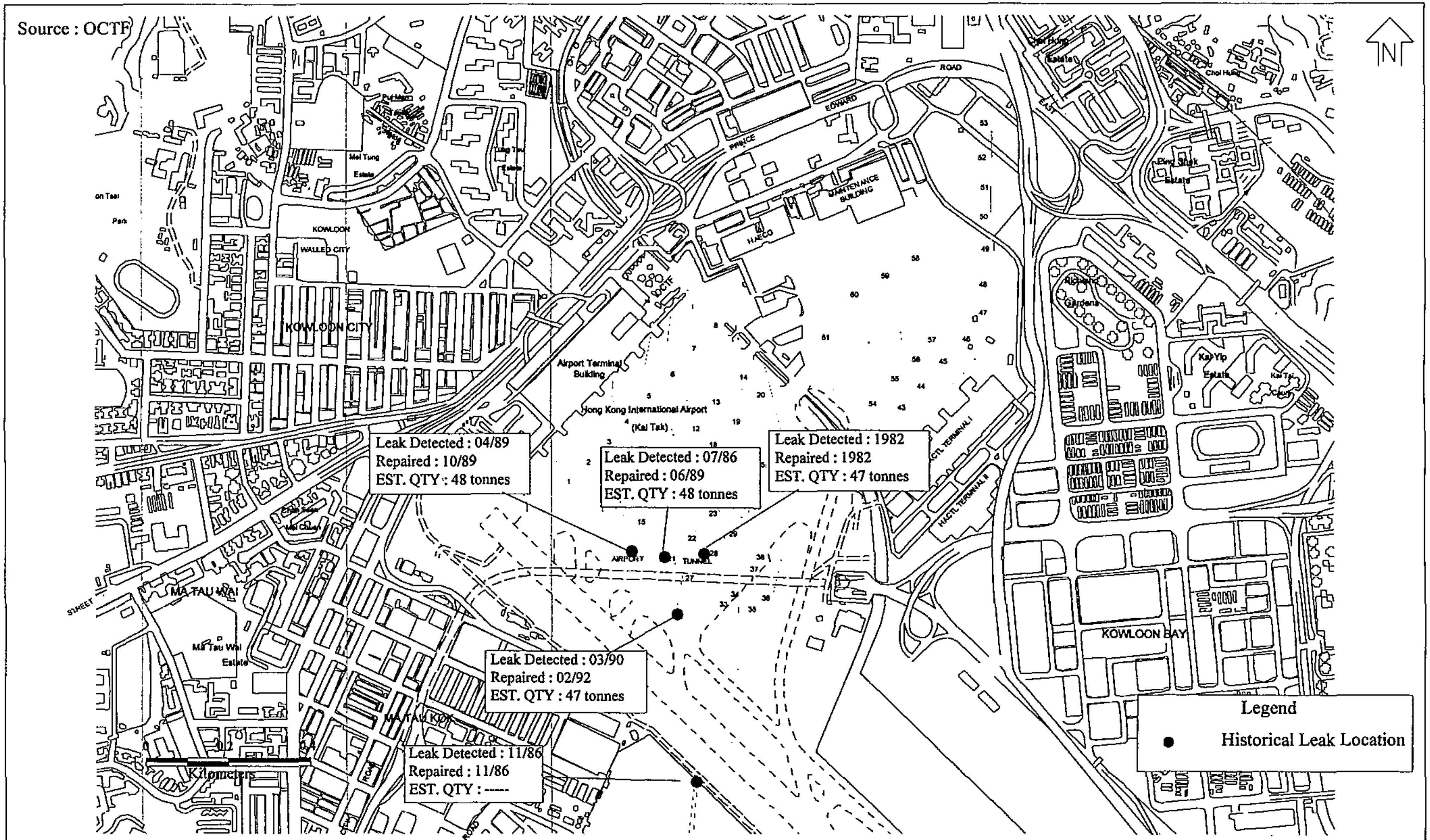
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE
Fuel Hydrant Pipeline Layout

SCALE	1 : 13000	DATE	March 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 4.4
		REV	0



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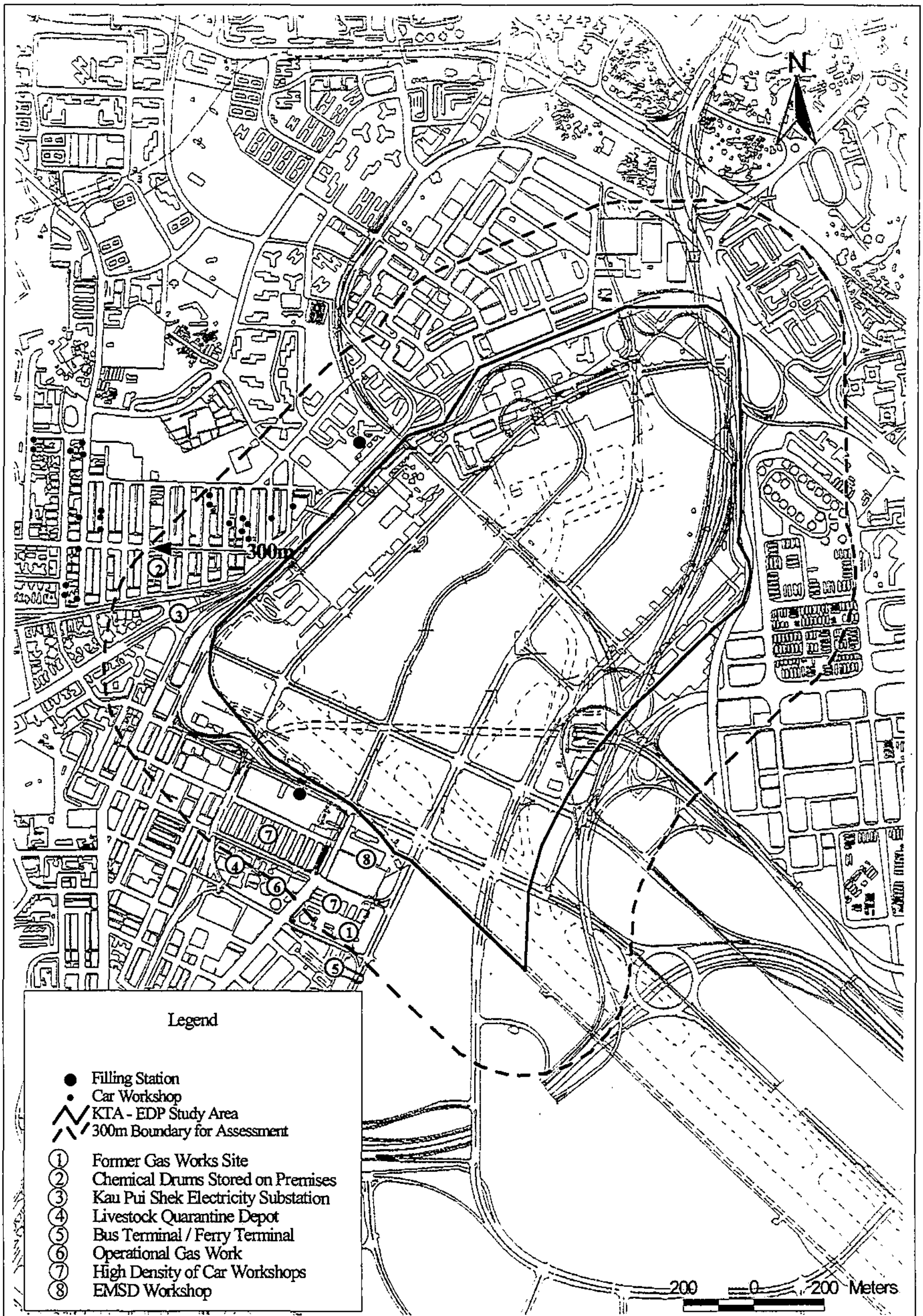
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

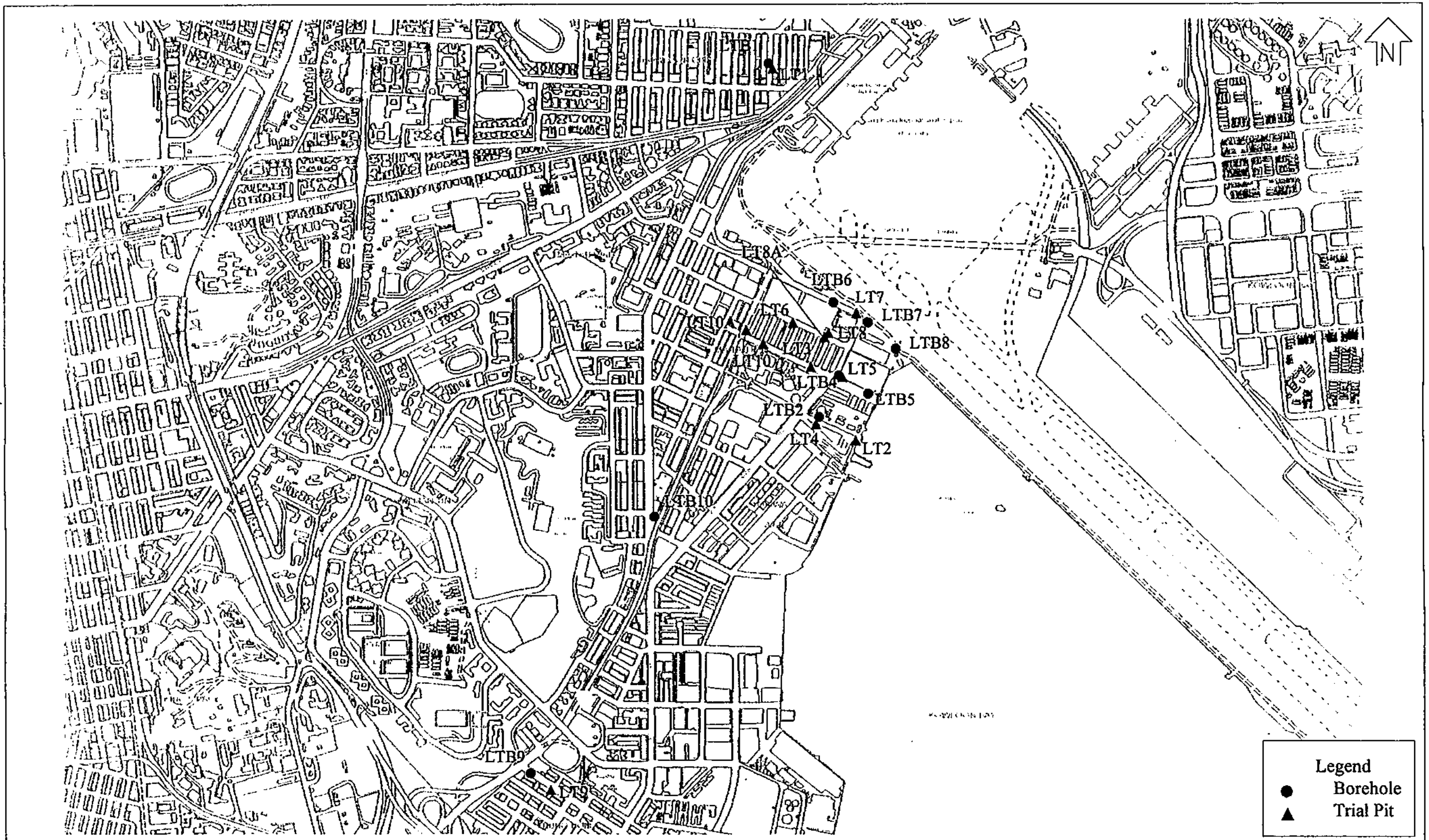
Territory Development Department Hong Kong
Kowloon Development Office

TITLE **OCTF Historical Hydrant Fuel System Leak Locations**

SCALE	1 : 13000	DATE	March 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 4.5
		REV	0



Maunsell in association with 環科 CES	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department, Hong Kong Kowloon Development Office			
	TITLE Identified Potentially Contaminative Land Uses	SCALE	1 : 15000	DATE	March 1998
		DESIGNED	Fanny Lau	DRAWN	Fanny Lau
		CAD REF	C415	DRAWING NO. Figure 4.6	REV 0



Maunsell in association with 環 C 科 E S	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING		Territory Development Department, Hong Kong Kowloon Development Office		
	TITLE Phase 3 Environmental Land SI Borehole and Trial Pit Locations	SCALE	1 : 17500	DATE	March 1998
		DESIGNED	Fanny Lau	DRAWN	Fanny Lau
		CAD REF.	C415	DRAWING No.	Figure 4.7 REV 0

5 ASSESSMENT METHODOLOGY

5 ASSESSMENT METHODOLOGY

5.1 NOISE ASSESSMENT METHODOLOGY

In accordance with the EIAO, the methodology outlined in the *Technical Memorandum on Noise from Construction Works other than Percussive Piling* (the *TM*) was used for the assessment of construction noise. All notional noise sources were identified in accordance with the requirements of the *TM*. For each specific works task, all items of PME required for that task were assumed to be located at the notional source position unless otherwise stated: for example, the actual position has been used for tasks associated with installation of remediation equipment (Figure 4.1). Sound power levels (SWLs) of PME were taken from Table 3 of the *TM*. In those cases where the sensitive receiver was a structure, a positive correction of 3 dB(A) was made to the calculated result in order to allow for facade effect.

Assessment was carried out on the basis of PME likely to be used for each of the three works tasks. The objective was to identify a worst case scenario representing those items of PME which would be in use at any one time for any given task. These PME lists and the tasks they represent are set out in Tables 5.1 - 5.3.

Table 5.1 Likely Powered Mechanical Equipment for Demolition of Existing Structures

Item	Number	SWL per Item, dB(A)	TM Reference
Excavator/loader	1	112.0	CNP 081
Bulldozer	1	115.0	CNP 030
Rock drill, hand held	1	116.0	CNP 183
Mounted breaker	1	122.0	CNP 027
	Total SWL, dB(A)	124.0	

Table 5.2 Likely Powered Mechanical Equipment for Installation of Remediation Equipment

Item	Number	SWL per Item, dB(A)	Reference
Excavator/Loader	4	112.0	CNP 081
Air compressor	1	100.0	CNP 001
Lorry	1	112.0	CNP 141
Breaker, hand held	1	108.0	CNP 024
Water pump	4	88.0	CNP 281
	Total SWL, dB(A)	119.5	

Table 5.3 Likely Powered Mechanical Equipment for Apron Concrete Removal

Item	Number	SWL per Item, dB(A)	Reference
Excavator/loader	1	112.0	CNP 081
Crawler rock drill	1	123.0	CNP 182
Hydraulic rock breaker	1	108.0	CNP 024
Total SWL, dB(A)		123.5	

It is understood that all construction works would be confined to normal day time hours (07:00 - 19:00), and would therefore fall outside statutory control by CNP under the NCO. As such, the criterion adopted for the current assessment is EPD's non-statutory guideline for normal daytime hours of 75 dB(A) (and generally 70 dB(A) for educational establishments).

5.2 AIR QUALITY ASSESSMENT METHODOLOGY

5.2.1 Dust Assessment Methodology

The major potential air quality impact during the demolition stage of the airport will be dust arising from the demolition of existing buildings, break-up of pavement, haul road emissions and open site erosion. In addition, operation of a temporary crushing plant and stockpiling areas will also cause emissions. Exhaust emissions from site vehicles and construction site plant are not considered to constitute a significant source of air pollutants based on previous experience from similar construction works. It was assumed that no blasting will be allowed on the sites.

The height used for the analysis was 1.5m above local ground level which is the average height of human breathing zone and TSP concentrations were calculated at grid points spaced 100 metres apart over the airport.

Dust Emissions Calculations

The prediction of dust emissions was based on typical values and emission factors from USEPA *Compilation of Air Pollution Emission Factors (AP-42)*, 5th Edition. A ten-hour working day and six-day working week were assumed during the demolition stage. Based on the demolition programme, it was assumed that a maximum of 30 percent of the site area will be actively operated at any one time during the demolition stage.

In this assessment, dust suppression measures and estimated mitigation efficiencies were incorporated into the dust emission calculations. A 50 percent reduction of the dust generated from wind erosion of open site and general demolition activities may be achieved with twice daily watering of the active site area with complete coverage as suggested by AP-42.

Dust emissions from the temporary crushing plants were estimated based on a capacity of 330 tonnes of demolished material processed per hour. It was assumed that primary crushing and general material handling operations will be undertaken at the plant. References for the calculations of dust emission factors from different dust generating activities are tabulated in Table 5.4 below.

Table 5.4 References on Dust Emission Factors from Different Activities

Activities	References (AP-42, 5th Edition)
General demolition activities	Section 13.2.3
Crushing operations	Section 11.19.2
Wind erosion of open site and stockpiling area	Table 11.9.4

Dust Dispersion Modelling

Dispersion modelling was undertaken using the USEPA approved Fugitive Dust Model (FDM) to assess potential dust impacts arising from demolition activities. Wind data recorded at the closest weather station, KTA station, operated by the Hong Kong Observatory were combined with surface observations recorded at the Hong Kong Observatory Headquarters to derive the best available data set. Surface roughness was taken as 1 metre in the FDM model to represent the rolling terrain of the area.

For the purpose of this assessment, it is considered that dust emissions from vehicles moving on unpaved road surfaces would constitute the major dust source for most of the sites. Since no site specific information was available relating to particle size distribution, and the unpaved road emission equation from AP-42 (5th Edition) is applicable for different geographical conditions, the particle size distribution used in the FDM model was estimated based on the particle size multipliers for the unpaved road emission equation. With particle size classes of 0-2.5 μm, 2.5-5 μm, 5-10 μm, 10-15 μm and 15-30 μm, the percentage in each class was estimated to be 9.5%, 10.5%, 16%, 14% and 50% respectively.

Modelling was undertaken to establish the TSP concentrations over the airport for 1-hour and 24-hour average time periods. It was assumed that actual construction work would take place during day-time from 08.00 to 18.00 hours and the wind erosion of open sites and stockpiling area would take place over the whole day. Hourly variations of each dust emission activity were incorporated in the model.

A background TSP concentration of 99 μgm^{-3} has been added to the maximum 1-hour average and maximum 24-hour average results. This background TSP concentration is the annual average TSP level recorded at EPD Kwun Tong Air Quality Monitoring Station, the closest station to the site, for year 1996. No additional baseline monitoring was carried out for this assessment to provide modelling input data.

The predicted maximum 1-hour average and maximum 24-hour average TSP concentrations, incorporating 50% dust suppression, are shown in Figures 7.1 and 7.2 respectively. The dispersion modelling was undertaken based on the meteorological data of KTA station for year 1993. A sample FDM model output file is included in Appendix D of this report.

5.2.2 Nitrogen Dioxides and Benzene Assessment Methodology of the Soil Treatment System

The major potential air quality impacts from the operation of the catalytic incinerator will be emissions from fuel combustion and residual benzene emitted after the catalytic oxidation of soil vapour extracted from the contaminated site. The catalytic incineration is scheduled to commence operation in early 1999.

The catalytic incinerator is an emission control device where fuel, in this case Towngas, and soil vapour extracted from the contaminated site are added to a combustion chamber to maintain a high minimum operating temperature. A catalyst is used to promote oxidation of the vapour at the operating temperature. A typical destruction efficiency of 95% would be achieved by the catalytic incinerator as suggested by the engineer. All the emissions from the catalytic incinerator will be exhausted to the atmosphere through a stack.

Air quality impacts were assessed at different elevations (every 5 metres intervals starting from ground level) over the catalytic incinerator. The worst affected elevation was predicted to be 25 metres above local ground level. Pollutant concentration contours are presented at this elevation to visualise the predicted air quality impacts.

Nitrogen Dioxides and Benzene Emissions Calculations

Nitrogen oxides (NO_x) are considered as the major pollutants of concern when burning Towngas in the catalytic incinerator. The prediction of NO_x emissions was based on typical values and emission factors for natural gas combustion from USEPA *Compilation of Air Pollution Emission Factors (AP-42)*, 5th Edition. With a designed maximum heat input of 1,700,000 BTU per hour for the incinerator, the total NO_x emission was calculated using the emission factor for commercial boilers. For the purpose of this assessment, a conservative assumption of 100% conversion of NO_x to NO_2 was taken.

With reference to the results of the soil gas monitoring conducted as part of the contamination assessment conducted in 1997 during the SEKDFS, the highest benzene concentration in the soil gas extracted from the site was 4,500 ppbv or 14.4 mgm^{-3}. Based on the designed maximum extraction rate of the soil vapour extraction system at 8000 scfm and a typical destruction efficiency of the catalytic incinerator of 95%, the benzene emission factor of the catalytic incinerator was calculated to be 2.8 mgs^{-1}. For the purpose of this assessment, a safety factor of 10 was multiplied to the benzene emission factor to produce a conservative assessment.

Nitrogen Dioxides and Benzene Dispersion Modelling

Dispersion modelling was undertaken using the USEPA approved Industrial Source Complex Short Term (ISCST) model to assess potential air quality impacts from the catalytic incinerator.

Gradual plume rise and stack-tip downwash options were taken in the model. Wind data recorded at the closest weather station, KTA station, operated by the Hong Kong Observatory were combined with surface observations recorded at the Hong Kong Observatory Headquarters to derive the best available data set. Urban Mode 3 was taken in the ISCST model to represent the dispersion patterns in the vicinity of the site area.

For predicting the impacts of stack emissions from the catalytic incinerator, detailed information on the stack characteristics was provided by the engineer and are listed below:

Stack height	:	12.2m above ground
Stack top diameter	:	0.66m
Stack exit temperature	:	227°C
Stack exit velocity	:	19 ms^{-1}

Modelling was undertaken to establish the NO_2 concentrations over the airport for 1-hour, 24-hour and annual average time periods and the benzene concentrations for 1-hour time period. It was assumed that the operation of the catalytic incinerator will take place over 24-hour a day for a period of more than a year. Sample model output files are included in Appendix D of this report.

A background NO_2 concentration of 65 μgm^{-3} has been added to the maximum 1-hour average, maximum 24-hour average and annual average results for NO_2. This background NO_2 concentration is the annual average NO_2 level recorded at EPD Kwun Tong Air Quality Monitoring Station, the closest station to the site, for year 1996. No additional baseline monitoring was carried out for this assessment to provide modelling input data.

Ambient benzene concentration over the airport was measured during the contamination assessment carried out in 1997 under the SEKDFS. The measurement results showed a benzene concentration of lower than the detection limit of 10 ppbv or 32 μgm^{-3}. For the purpose of this assessment, a background benzene concentration of 32 μgm^{-3} has been added to the maximum 1-hour average results for benzene to produce conservative estimates.

The predicted maximum 1-hour average, maximum 24-hour average and annual average NO_2 concentration contours at the worst affected elevation of 25m above ground are shown in Figures 7.3, 7.4 and 7.5 respectively. The predicted maximum 1-hour average benzene concentration contours at the worst affected elevation of 25m above ground are shown in Figure 7.6. The dispersion modelling was undertaken based on the meteorological data of KTA station for year 1993.

Additional assessment was undertaken to determine the potential air quality impacts due to malfunction of the catalytic incinerator. Two scenarios were considered in this assessment, namely the soil vapour extraction system operate at 10% and 20% of the maximum extraction rate and the 0% destruction efficiency due to the malfunction of the catalytic incinerator. All the extracted vapour was assumed to be exhausted from the stack at ambient air temperature. The predicted maximum 1-hour average benzene concentration contours at the worst affected elevation of 15m above ground are shown in Figures 7.7 and 7.8.

5.2.3 Assessment Methodology of Benzene during Excavation of Contaminated Soil

Potential emissions will be generated during the excavation and removal of contaminated soil when the soil is disturbed. This section presents an assessment on the potential air quality impacts from the excavation of the contaminated soil undertaken during the contamination remediation stage of the project.

Assessment Methodology and Emissions Calculations

The major potential air quality impacts from the excavation of contaminated soil will the benzene emitted to the atmosphere when the contaminated soil is disturbed. Since all the excavation pits are at ground level, air quality impacts were assessed at 1.5m above ground level, 1.5m above ground being the average breathing height for human.

Emissions Calculations

With reference to the findings of the Technical Report RA16, Kai Tak Airport Contamination Assessment Phase 1, the highest benzene concentration for the soil at the hot spots was estimated to be 21.27 ppm. Consider a worst-case scenario, most or all of the benzene are assumed to be lost to the atmosphere during soil handling. For the purpose of this assessment, a safety factor of 10 was multiplied to the benzene emission factor to produce a conservative assessment. Benzene emission from handling of contaminated soil is estimated to be 681mg / m^3 of soil handled.

Dispersion Modelling

Dispersion modelling was undertaken using the USEPA approved Industrial Source Complex Short Term (ISCST) model to assess potential air quality impacts from the excavation of contaminated soil. Wind data recorded at the closest weather station, Kai Tak Airport station, operated by the Hong Kong Observatory were combined with surface observations recorded at the Hong Kong Observatory Headquarters to derive the best available data set. The dispersion modelling was undertaken based on the meteorological data of Kai Tak Airport station for year 1993. Urban Mode 3 was taken in the ISCST model to represent the dispersion patterns in the vicinity of the site area.

With reference to a typical scenario for excavation of contaminated soil in a large-scale project given in the Control of Air Emissions from Superfund Sites, USEPA, total volume of soil moved in an hour is about 240 m^3 with excavation pit dimensions of 10m x 12m x 2m (depth). The excavation pit was taken as an area source of benzene emission with surface area of $120m^2$. The benzene emission factor for the area source is therefore estimated to be 163.4g/hr ($681mg/m^3$ of soil x $240m^3$ of soil / hr) or 3.78×10^{-4} $g/s/m^2$. Besides, an excavation scenario with half the excavation rate of $120m^3$ of contaminated soil per hour was considered in this assessment.

Modelling was undertaken to establish the benzene concentrations for 1-hour time period at assessment points located at 10m to 150m from the centre of the excavation pit at different direction. Ambient benzene concentration over the airport was measured during the contamination assessment carried out in 1997. The measurement results showed a benzene concentration of lower than the detection limit of 10 ppbv or 32 μgm^{-3}. For the purpose of this assessment, a background benzene concentration of 32 μgm^{-3} has been added to the maximum 1-hour average results for benzene to produce conservative estimates.

The air quality impact of the pilot plant is addressed in Section 8.6.5.

5.3 ECOLOGICAL ASSESSMENT METHODOLOGY

The assessment is based on investigation and findings obtained from the SEKDFS. During the study, the existing ecological conditions of the study area were examined through a literature review. A site visit was carried out on 15 May 1996 by an experienced ecologist. Photographs of study area habitats were taken and observations on any fauna, flora and avifauna in the study area were recorded. Results of the field check were used in conjunction with the literature review in the ecological assessment.

Existing literature and documentation (for example, local and international journals and publications, KTA Birdstrike Research Unit, World Wide Fund for Nature publications, government reports) were researched for background ecological information on terrestrial, coastal and marine ecosystems in the area. Relevant Government Departments including Agriculture and Fishery Department and EPD were consulted.

Analysis of maps and aerial photographs, corroborated where necessary by site investigation, were undertaken to provide a description of the physical environmental background and a habitat characterisation. Information was sought on the existing flora and fauna likely to be affected and if available, on population sizes, community structures and interdependent relationships. If any part of the subject site, or species known to occur at or near the subject site, are protected under legislation for nature conservation or mariculture, this was identified. Species lists and counts were compiled for the subject area from available literature, identifying the presence /absence of rare or endangered species.

Identification and quantification was made where possible of any direct / indirect and onsite / offsite impacts that could potentially lead to destruction, displacement or adverse effects on flora and fauna (including loss of shelter or food, reduced species diversity, loss of breeding grounds, loss of fisheries, species extraction, loss of carrying capacity). Potential ecological impacts and constraints on the KTA-EDP have been identified and if applicable recommendations made for protection or rehabilitation of the natural environment.

5.4 LAND CONTAMINATION ASSESSMENT PLAN

5.4.1 Purpose of Investigation

Based upon the historical data and previous studies, it was concluded that land contamination was likely to occur. Thus, during the SEKDFS, substantial contamination investigation was carried out to specifically determine the extent of any soil contamination which may have occurred as a result of historical aviation fuel leakage. This work was undertaken in two stages:

- Phase 1 involved the collation of background/historical information relating specifically to KTA operations, and to conduct a survey of existing soil gas conditions in order to indirectly identify likely soil contamination levels. This information served as predictive computer modelling input data for risk assessment to determine the requirement for groundwater remediation.

- Phase 2 involved the installation of 77 groundwater observation wells across the KTA site on the basis of Phase 1 site investigation and modelling findings. This permitted direct assessment of the characteristics and distribution of any subsurface contamination present. Thus, it in turn allowed the formulation and recommendation of feasible remediation options.

Details of these investigations were documented in Report RA16 and RA24 of the SEKDFS.

5.4.2 Phase I Investigation

Soil Gas Monitoring

Soil gas monitoring (Figure 5.1) was carried out by measuring total VOCs, methane, carbon dioxide and oxygen at the installed soil gas monitoring probes. The concentrations of total VOCs were measured by a photoionization detector (PID). A Foxboro TVA-1000 Toxic Gas Analyser was used for the measurement. The concentrations of methane, carbon dioxide and oxygen were measured by an ADC Landfill Gas Analyser.

Risk Assessment

A baseline risk assessment was carried out using a screening risk assessment model, CalTOX™ for nine hot spots identified according to the total VOC measurements. CalTOX™ was used to evaluate the migration pathways of organic contaminants in unsaturated soil and to predict exposure levels and the associated carcinogenic risks to the construction workers who are considered as the most susceptible risk group.

The model calculated total unmitigated individual incremental lifetime risks for a specified contamination-exposure scenario. Losses of contaminant mass from unsaturated soil due to volatilization, leaching and chemical degradation were considered. Estimates of the time-dependent average contaminant concentrations in the air, surface soil, root-zone soil, vadose-zone soil and ground water over a specified exposure duration were obtained. The average contaminant concentrations were used to calculate exposure-route specific unmitigated individual incremental lifetime risks and total risk estimates as a function of contaminant concentration in unsaturated soil. The model was used to recommend soil clean up concentration for a target carcinogenic risk level.

Benzene, a chemical of concern in jet fuel specified under the ASTM Standard Guide E1739-95[3] was selected as the modelled contaminant. It has been classified by the USEPA as a Group A carcinogen (with sufficient evidence from epidemiological studies), which has a cancer potency factor of 0.1 kg mg^{-1} dy^{-1}.

CalTOX™ incorporates an on-site receptor exposure scenario. In the on-site receptor exposure scenario, a construction worker is assumed to work on site and assumptions account for daily exposure (12 hr dy^{-1} for 286 dy yr^{-1}, equivalent to 5.5 working days per week) over a 3-year exposure representing a nominal worst case construction programme for remediation works. The exposure pathways considered include inhalation exposure, soil ingestion, and dermal contact exposure. The model suggested an appropriate soil clean up target based on a target risk. In this study, the target health risk has set to 1×10^{-6} which represents the worst case scenario.

5.4.3 KTA Contamination Assessment - Phase 2

Sampling Location and Measurement Parameters

Phase 2 assessment included installation of a total of 77 ground water wells using the Geoprobe hydraulic drilling rig, collection of soil and ground water samples for chemical analysis to confirm the extent and nature of contamination. Figure 5.2 shows the 77 soil and ground water sampling locations. Results of the site investigation have been used to verify computer modelling results reported in Phase 1 assessment; where appropriate, modification was made for further model runs. Modelling results were used to establish clean up goals and optimize the design of necessary remediation work.

Soil and Groundwater

A full suite (Table 5.5) of chemical analysis for both soil and ground water has been conducted.

Table 5.5 Sample Analysis Suite

Parameter	Testing Status and Methodology			
	Soil		Ground water	
	Conducted	Methodology	Conducted	Methodology
TPH	✓	USEPA 8015 (mod.)	✓	USEPA 8015 (mod.)
Total organic carbon	✓	APHA 5310B	✓	APHA 5310B
Metals	✓	USEPA 6020	✓	USEPA 6020
Polyaromatic hydrocarbon	✓	USEPA 8270	✓	USEPA 8270
Particle size distribution	✓	BS 1377, 1975	×	-
Chlorinated hydrocarbons	✓	USEPA 8270	✓	USEPA 8270
BTEX[1]	✓	USEPA 8015 (mod.)	✓	USEPA 8015 (mod.)

1 BTEX = benzene, toluene, ethylbenzene, xylene

Following the recommendation of the Phase 1 report, soil gas samples from 10 soil probes were collected for radiocarbon dating of the methane gases in order to provide:

1) a semi-quantitative assessment of the methane content in the raw sample gases
2) a determination of the stable isotope C-13 and radioactive carbon C-14 enrichment values
3) an assessment of the relative contribution of 'recent biogenic' and/or 'fossil thermogenic' carbon as the methane source.

In addition, a test was also carried out for 10 soil samples to establish the presence of hydrocarbon-degrading bacteria. This investigation will be of use to the design of feasible remediation options.

Risk Assessment

In the Phase 2 assessment, the model setup used in the Phase 1 assessment was refined using site specific landscape parameters. The contaminant concentrations used in the model were based on the results of the laboratory analysis of soil and ground water samples. The potential risk generated from the following sources of concern has been assessed, which include:

1) benzene (a representative carcinogen of concern) in the unsaturated soil layer
2) toluene (a representative non-carcinogen of concern) in the unsaturated soil layer
3) benzene in ground water
4) toluene in ground water
5) tetrachloroethylene (a representative carcinogenic chlorinated hydrocarbon) in ground water.

Toluene was selected as an additional modelled contaminant to estimate the risk imposed by a non-carcinogenic chemical of concern in jet fuel. Non-carcinogenic risk of a chemical is quantified by the hazard quotient which is the ratio of the estimated daily intake of the chemical to its recommended reference dose (RfD). The RfD value is the estimated daily intake that is not believed to be associated with adverse health effects. A target hazard quotient is set at 1.0 as recommended by the United States Environmental Protection Agency (USEPA). A hazard quotient greater than 1.0 indicates the possibility for an adverse health effect from the exposure.

Table 5.6 summarises the RfD values of ethylbenzene, toluene and xylenes, which are three non-carcinogenic chemicals of concern in jet fuel specified under the ASTM Standard Guide E1739-95, for three exposure routes which include inhalation, ingestion and dermal contact. The RfD values are based on the USEPA Integrated Risk Information System (IRIS) database. Among these three chemicals, toluene is shown to have the lowest RfD value for inhalation, and the second lowest RfD values for ingestion and dermal contact. It was therefore selected as the modelled non-carcinogenic contaminant.

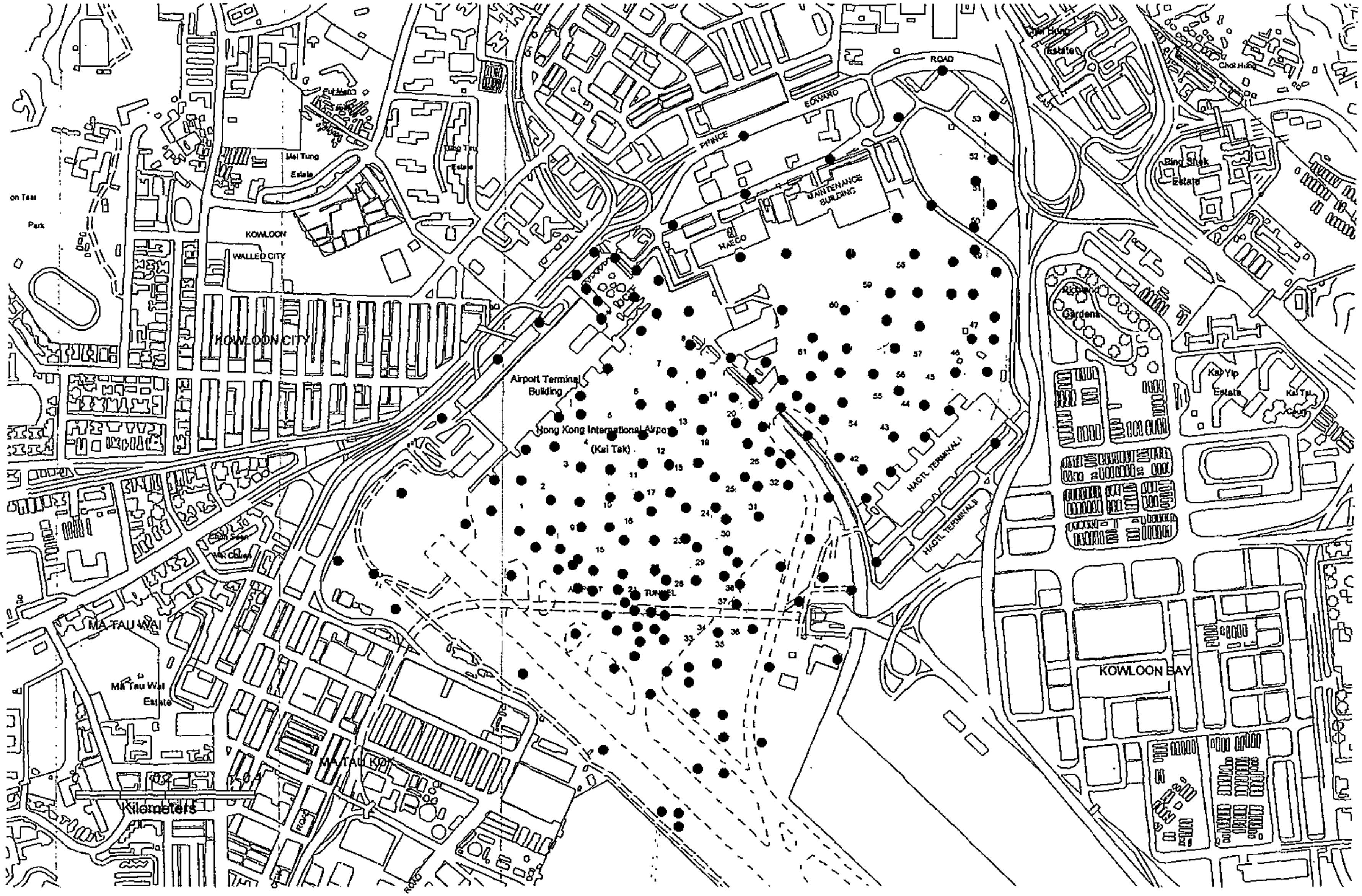
Table 5.6 Reference Dose Values of Ethylbenzene, Toluene and Xylenes

	Ethylbenzene	Toluene	Xylenes
Reference dose (inhalation), mg kg^{-1} dy^{-1}	0.3	0.03	2.0
Reference dose (ingestion), mg kg^{-1} dy^{-1}	0.1	0.2	2.0
Reference dose (dermal contact), mg kg^{-1} dy^{-1}	0.1	0.2	2.0

The chlorinated hydrocarbon analysis of ground water at sampling location MW207 (adjacent to the HAECO building) (Figure 5.2) indicated relatively high levels of selected chlorinated hydrocarbons among which tetrachloroethylene was selected as the contaminant to be assessed for health risk. Tetrachloroethylene has been classified by USEPA as a carcinogen, which has a cancer potency factor of 0.021 kg $mg^{-1}dy^{-1}$ via inhalation and 0.051 kg $mg^{-1}dy^{-1}$ via ingestion and dermal contact. The cancer potency factors are based on the USEPA IRIS database.

As the CalTOX™ model is not designed for the estimation of risk or hazard quotient arising from contamination sources originating in ground water, the potential carcinogenic and non-carcinogenic risks arising from benzene, toluene and tetrachloroethylene in ground water were assessed using modified equations described in Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A (RAGS/HHEM, USEPA 1989b).

Risk to a construction worker assumed to work on site arising from ground water contaminated with benzene / toluene / tetrachloroethylene were assessed. Assumptions were made as to daily exposure (8 hr dy^{-1} for 286 dy yr^{-1}, equivalent to 5.5 working days per week) over a 1-year exposure representing a nominal worst case scenario. These assumptions are considered representative of the work scenarios where ground water contact is possible. Exposure pathway includes dermal contact and it is assumed that 10% of the total body surface area is in contact with the benzene/toluene/tetrachloroethylene contaminated ground water during decontamination activities.



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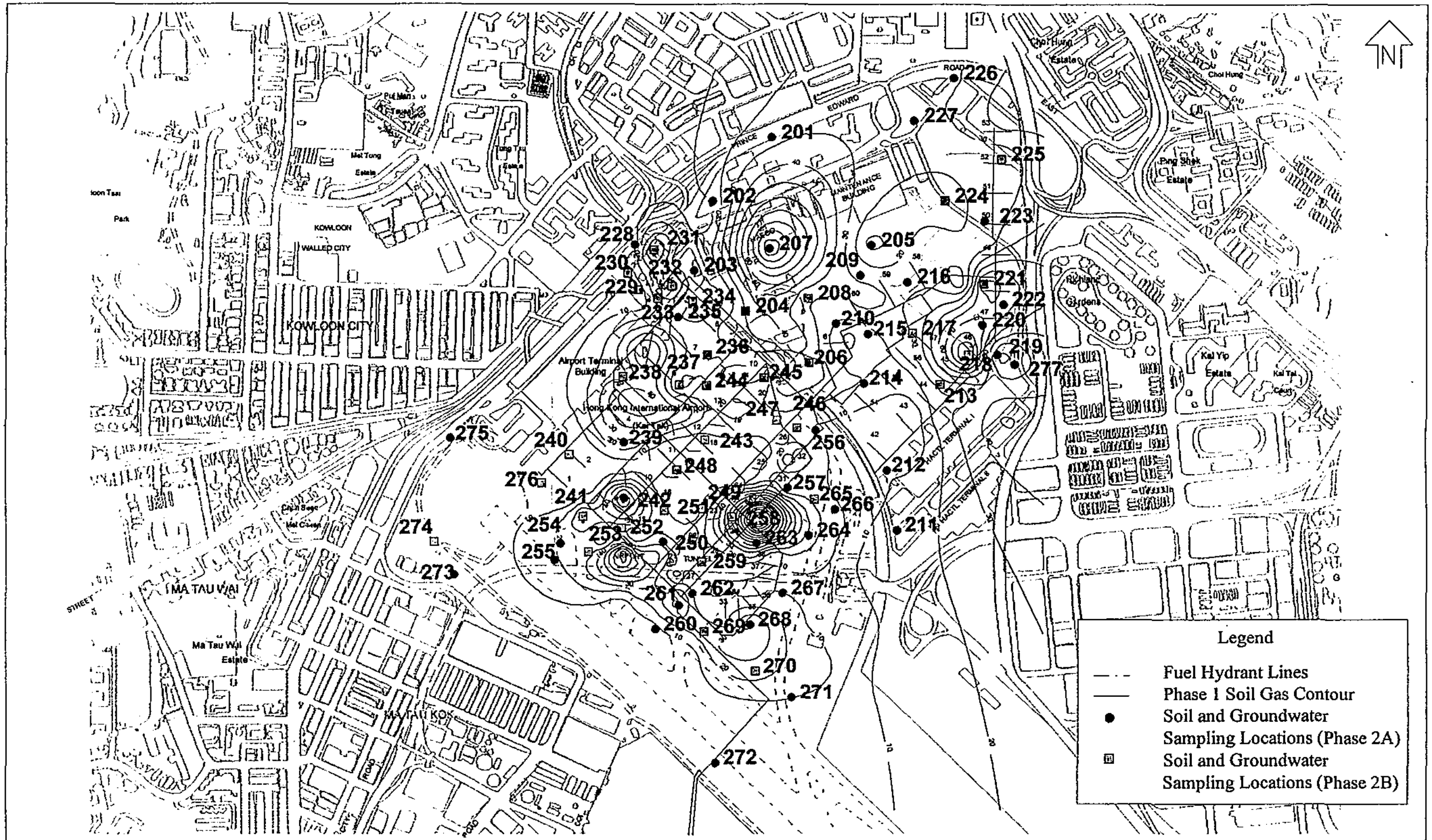
	TITLE	Locations of Soil Gas Monitoring Probes (Phase 1)	SCALE	1 : 13000	DATE	March 1998
			DESIGNED	Fanny Lau	DRAWN	Fanny Lau
			CAD REF	C415	DRAWING No.	Figure 5.1 REV 0



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KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE Phase 2 Soil and Groundwater Sampling Locations

SCALE	1 : 13000	DATE	March 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF	C415	DRAWING No.	Figure 5.2 REV 0

7 PREDICTION AND EVALUATION OF ENVIRONMENTAL IMPACT

6.3 WATER QUALITY IMPACT

Key issues for construction phase water quality impacts include :

- Possible release of contaminated groundwater during decontamination process of the KTA apron
- Effects of site runoff during decommissioning and site preparation
- Wastewater and production water generated during construction activities

6.4 WASTE ARISING STREAMS

In the KTA North apron, construction work will include the following activities:

- decommissioning of airport related facilities (eg. fuel pipelines and storage facility)
- Removal of most of the airport related facilities (except for HACTL2, airport police station & electricity substation) and equipment
- Building and pavement demolition
- Site clearance and preparation
- Decontamination of ground under airport apron

The above activities will generate various kinds of wastes, including:

- Construction waste including materials from demolition and pavement removal
- Chemical waste
- Workforce waste

6.5 ECOLOGICAL IMPACT

No major ecological impact is anticipated.

6.6 LAND CONTAMINATION

Land contamination can cause polluted groundwater and contaminated soil. The decontamination process can also cause noise, air quality impacts and health and safety to construction workers. The environmental impact due to land contamination and decontamination are addressed in noise, air quality, water quality and waste sections.

6 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

6.1 NOISE IMPACT

The proposed remediation and site preparation works at KTA will entail the completion of the following key construction tasks: demolition of existing structures (excluding the passenger terminal); installation of equipment for remediation of sub-surface contamination; and, breaking and removal of concrete aircraft parking apron. Noise will be generated from these activities using PME.

6.2 AIR QUALITY IMPACT

6.2.1 Dust Impact

Dust will emit from the following activities:

- General demolition activities
  (including demolition of existing buildings, break-up of pavement, ground excavation, and equipment traffic over the site area)
- Operations of the temporary crushing plant
- Wind erosion of open site and stockpiling area.

In accordance with the proposed programme, most of the demolition work will be undertaken during years 1998 to 2001. During this period, demolition work will be carried out in Planning Areas 1, 2, 4K and 4L and this period is considered to be the most intensive period for demolition work and used for the assessment. Besides demolition work, a temporary crushing plant and stockpiling area will be located at the middle of the airport runway for processing the material from the demolition work.

6.2.2 Nitrogen Dioxide and Benzene Impacts of SVE/AS System

The major potential air quality impacts from the operation of the catalytic incinerator will be emissions from fuel combustion and residual benzene emitted after the catalytic oxidation of soil vapour extracted from the contaminated site. The catalytic incineration is scheduled to commence operation in early 1999.

Since the biopile vapour would be vented to the blower and catalytic oxidizer of the SVE/AS system, it is assessed under this section also.

6.2.3 Benzene Impacts During Excavation of Contaminated Soil

The potential impact would be benzene emission during excavation of contaminated soil. The soil at Hotspot A and C would be excavated, the free product contaminated soil at Hotspot B may be excavated depending on the effectiveness of the SVE system.

6 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

7 PREDICTION AND EVALUATION OF ENVIRONMENTAL IMPACT

7.1 NOISE IMPACT

7.1.1 Noise Impact from Individual Activity

Table 7.1 sets out construction noise levels predicted to result from all construction activities associated with the proposed works. Distances from NSRs to notional sources are included. These predicted noise levels were calculated on the assumption that no mitigation measures were in place.

Table 7.1 Predicted Noise Level by Works Task: Unmitigated

NSR ID	Noise Level by Works Task					
	Demolition of Existing Structures		Installation of Remediation Equipment		Apron Concrete Removal	
	Dist., m	dB(A)	Dist., m[1]	dB(A)	Dist., m	dB(A)
S1	165	**74.6**	715	57.3	165	**74.1**
S2	165	**74.6**	640	53.3	165	**74.1**
S3	355	67.9	395	62.5	355	67.5
S4	250	**70.9**	225	67.3	250	**70.5**
S5	205	**72.7**	150	**70.9**	205	**72.2**
S6	110	**78.1**	325	64.1	110	**77.6**
S7	190	**73.3**	1155	47.1	190	**73.9**
H1	195	73.1	755	56.8	195	72.7
H2	160	74.8	115	73.2	160	74.4
R1	170	74.3	665	57.9	170	73.8
R2	250	70.9	1230	52.6	250	70.5
R3	205	72.7	1140	53.2	205	72.2
R4	270	70.3	1085	53.7	270	69.8
R5	155	**75.1**	670	57.9	155	74.7
R6	140	**76.0**	630	58.4	140	**75.5**
R7	155	**75.1**	590	59.0	155	74.7
R8	190	73.3	580	59.1	190	72.9
R9	205	72.7	580	59.1	205	72.2
R10	245	71.1	590	59.0	245	70.7
R11	265	70.4	595	58.9	265	70.0
R12	315	68.9	615	58.6	315	68.5
R13	145	**75.7**	410	62.1	145	**75.2**
R14	155	**75.1**	385	62.7	155	74.7
R15	195	73.1	375	62.9	195	72.7
HL1[2]	110	68.1	328	64.1	110	67.6

Note: 1 distance to actual source
2 NSR will be screened from all works by passenger terminal, therefore negative correction of 10 dB(A) applied to PNL in line with relevant NCO *TM (Section 2.10 - Step 10)*
Assessment criterion for educational establishments is generally 70 dB(A)
Bold text denotes exceedance of noise criteria

Table 7.1 demonstrates that relatively minor exceedances of the relevant non-statutory day time criteria would occur at some NSRs during the works without any mitigation in place.

In order to set these findings in the correct context, it should also be noted that these assessment results are conservative in two respects: it is assumed that all PME listed for a given task would operate concurrently (which in practice is unlikely); and, that all PME would be located together at the notional source (which is again unlikely for practical reasons). However, it is clear that all practical mitigation measures should be implemented in order to reduce noise levels as far as possible. Further, since many of the construction tasks are likely to proceed in a predominantly linear fashion across the study area (such as installation of remediation equipment and apron concrete removal), it should be appreciated that the duration for which any given NSR is exposed to the worst case scenario modelled here is in any case likely to be relatively short.

7.1.2 Cumulative Impacts

As can be seen from Figure 4.1, individual works task areas would be predominantly spatially discrete. Further, in those cases where spatial overlap may occur for different tasks (for example, remediation works and apron concrete breaking and removal), the works would, in fact, be temporally discrete. The implication of this situation is that the construction noise climate, with respect to each NSR, would be dominated by the closest works area: noise levels from other works tasks would be greatly reduced due to distance attenuation and cumulative impacts would generally be negligible as a result. To take an example, an NSR at Richland Gardens estate may be situated approximately 140m from the notional source for apron concrete breaking tasks, but the same NSR may be situated approximately 630m from the notional source for remediation works. The difference in the noise levels from the respective construction works at that NSR would be in the order of 14 dB(A). According to Table 4 of the *TM*, a difference of greater than 12 dB(A) between independent noise sources would cause zero increase in total noise levels at an NSR. Further, it is understood that not all tasks would be programmed to run concurrently. For example, remediation works would not be completed prior to apron removal in those areas where these tasks overlap spatially. For these reasons cumulative construction noise impacts are not in this case considered a key issue, with the exception of the following scenario.

However, although it has been demonstrated that different construction tasks would generally be spatially and temporally discrete, it is feasible that in one particular area the task of structure demolition may take place at more than one location at a given time. In other words, for this task more than one 'demolition team' may be operational at one time, resulting in the existence of two notional sources. Therefore, this scenario could potentially represent a cumulative construction noise impact at nearby NSRs. Specifically, this issue is of concern only in the area immediately to the south of NSR-S6 (Figure 4.1). This is expected to be the only scenario under which cumulative impacts may cause perceptible changes in construction noise level at any NSR, given that land uses surrounding NSR-S6 are non-sensitive.

The following table demonstrates this worst case cumulative impact, where it is assumed that two demolition teams would operate separate notional sources, both the same distance from NSR-S6.

Table 7.2 Worst Case Cumulative Noise Impacts at NSR-S6 due to Demolition Works: Unmitigated

Notional Source	Distance, m	Predicted SPL, dB(A)
Demolition Team #1	110	78.1
Demolition Team #2	110	78.1
Cumulative Impact		81.1*

* calculated in accordance with Table 4 of the *TM*

7.2 AIR QUALITY IMPACT

7.2.1 Predicted Dust Impacts

The modelling results (Figures 7.1 and 7.2) showed that with 50% dust suppression, the 1-hour average guideline level and the 24-hour average AQO for TSP would not be exceeded outside the site areas in Planning Areas 1, 2, 4K and 4L except some areas near the boundary with To Kwa Wan area. Figures 7.1 and 7.2 show that 50% dust suppression is generally sufficient to reduce the dust impacts over the demolition areas.

To further reduce the dust impact near the boundary with To Kwa Wan area to an acceptable level, 75% dust suppression maybe implemented over the area by watering every 1.5 hours. The resulting dust impacts can be estimated with reference to the contours shown in Figure 7.1 and the Table 7.3 below.

Table 7.3 Comparison of Predicted Dust Levels with 50% and 75% Dust Suppression

Predicted dust levels in microgram per cubic metre	
With 50% dust suppression	With 75% dust suppression
200	150
300	200
400	250
500	300
600	350
700	400

Exceedances of the 1-hour average guideline level for TSP were predicted around the temporary crushing plant and stockpiling area. These exceedances are restricted to areas within

60 metres from the boundary of the temporary crushing plant and stockpiling area. Temporary uses planned adjacent to the crushing plant include material stockpiling area, construction supporting area and public fill barging point and these uses are considered not sensitive to dust impacts. No sensitive temporary uses are located in close proximity to the temporary crushing plant and stockpiling area. Adverse dust impacts at sensitive receivers are therefore not expected.

7.2.2 Predicted NO_2 and Benzene Impacts during Soil Treatment

As shown in Figures 7.3, 7.4 and 7.5, exceedances of the AQOs for NO_2 are not predicted in the vicinity of the catalytic incinerator at the worst affected elevation of 25m above ground. Adverse air quality impacts on sensitive receivers at both ground level and higher levels due to Towngas combustion of the catalytic incinerator are therefore not expected.

The modelling results showed that exceedances of the 1-hour average HPCL for benzene of 185 μgm^{-3} would be expected in close proximity to the incinerator stack at the worst affected elevation of 25m above ground (Figure 7.6). Exceedances are not predicted at more than 20 metres away from the incinerator stack. Considering the conservative assumptions taken in the assessment and the closest existing sensitive receivers are located at more than 150 metres away from the incinerator stack, adverse air quality impacts at sensitive receivers at both ground level and higher levels due to residual benzene emissions from the catalytic incinerator are therefore not expected.

In the case of malfunction of the catalytic incinerator, there will be no fuel combustion and hence potential air quality impacts due to NO_2 emissions would not be expected. Instead, the destruction efficiency of the system will be reduced to zero. Benzene in the soil vapour extracted from the system will emit directly to the atmosphere through the stack at ambient temperature. In order to reduce the potential air quality due to benzene emissions under such a situation, it is suggested that the soil vapour extraction rate should be reduced to an acceptable level to prevent adverse impacts at nearby sensitive receivers during the malfunction of the catalytic incinerator. As shown in Figures 7.7 and 7.8, with the soil vapour extraction rate reduced to 10% and 20% of the maximum extraction rate respectively, exceedances of the 1-hour average HPCL for benzene of 185 μgm^{-3} would be expected in the proximity to the incinerator stack at the worst affected elevation of 15m above ground. Exceedances are not predicted at more than 80 metres and 120 metres away from the incinerator stack for 10% and 20% soil vapour extraction rate respectively. Adverse air quality impacts at the closest existing sensitive receivers located at more than 150 metres away from the stack under these two scenarios would not be expected.

7.2.3 Predicted Benzene Impacts during Excavation

The predicted maximum 1-hour average benzene concentrations at different distance from the centre of the excavation pit are listed in Table 7.4. A background benzene concentration of 32 μgm^{-3} is incorporated in all the results.

Table 7.4 Predicted Maximum 1-hour Average Benzene Concentrations at Different Distance from an Excavation Pit

Distance from Centre of Excavation Pit (m)	Predicted Benzene Concentration (μgm^{-3})	
	Excavation Rate of $240m^3/hr$	Excavation Rate of $120m^3/hr$
10	1309	671
20	1293	663
30	1059	546
40	817	425
50	624	328
60	484	258
70	385	209
80	314	173
90	262	147
100	223	128
110	193	113
120	169	101
130	151	92
140	136	84
150	124	78

As shown in Table 7.4, exceedances of the 1-hour average HPCL for benzene of 185 μgm^{-3} would be expected in close proximity to the excavation pit. At an excavation rate of $240m^3$ and $120m^3$ of contaminated soil per hour, exceedances are not predicted at more than 120m and 80m away from the centre of the excavation pit respectively under worst-case scenario.

7.3 WATER QUALITY IMPACT

7.3.1 Decontamination of Ground Under Airport Apron

Decontamination of ground under the airport apron will be carried out immediately after the closure of the airport. The nature of contamination mainly relates to total petroleum hydrocarbons and BTEX (butene, toluene, ethylene, and xylene). Details of the contamination issues are discussed under the Land Contamination of this report.

The decontamination processes include *in-situ* method: soil vapour extraction (SVE)/ air sparging and *ex-situ* method: excavation and biopiling. Water quality impact relating to *in-situ* treatment should be minimal and insignificant, because there is no pump-extracted groundwater. The small quantity of entrained groundwater in the vapour stream would be collected and skimmed of free oil by an oil interceptor and re-injected into ground for *in-situ* treatment by air-sparging.

Groundwater Extraction during excavation is not expected. Instead, large backhoes with arm extension length of 5-6m would be used to reach down to soil underneath the groundwater table. The excavation would form small temporary stockpiles (lined) to clear leachate before transport to biopile. Leachate from the temporary stockpiles would be drained to the perimeter trench/ sump, which will be pumped to trucks for transport to off-site facility for treatment. Excavation of contaminated soil would be scheduled in the dry season to prevent heavy rainfall causing site run-off.

The biopile will be covered with flexible LDPE material and lined with geotextile drainage mesh and HDPE liner which is impermeable to water and is very durable. These material have been used in sanitary landfill linings in Hong Kong. The covered biopile will be stabilised with heavy weights such as sandbags to prevent wind from blowing off the cover. This has been practice in a few overseas sites. Leachate will be disposed offsite for treatment at suitable treatment facilities. Perimeter trench to collect runoff has been specified in the tender. The height of the biopile will be 3m average, the highest point can reach 5m. This would create a natural gradient for rainwater to be drained to the perimeter trench. Given the large area of biopile and the need for large mechanical equipment to manoeuvre within the site, the use of roof structure is not practicable.

During the demolition of the OCTF depots, special measures, including use of sand bags, formation of temporary bund and drainage to interceptors, would be used to prevent the spread of oil in the unlikely event of accidental spillage during tank demolition. Small patches of spilled oil would be soaked up by oil adsorbent and disposed of as chemical waste.

In this decommissioning project, there would not be construction of basement or deep foundations. Therefore, extraction of groundwater is not anticipated. However, if there are any sources of contaminated groundwater produced during the decontamination work, they will be treated to comply with the WPCO Technical Memorandum *"Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Water"*.

7.3.2 Construction Site Runoff and Wastewater

Before site preparation for development can commence, decommissioning of airport related facilities has to be undertaken. These activities include decommissioning of underground pipes and tanks and demolition of buildings. Residual oil inside pipes and tanks would be recovered by OCTF as a reusable product. The water used for plugging pipes should be properly drained, collected and treated to avoid release of chemicals or wastewater. The treatment would likely be oil separation, filtering and carbon adsorption. The discharge of plugged water would comply with the WPCO Technical Memorandum Discharge Standards. Other demolition activities would result in an increase in solid particles and dust in the environment, which may be carried by site storm runoff into the marine environment. Mitigation measures similar to those usually adopted for construction activities should be provided to minimise the impact due to these demolition works.

During site formation, topsoil would be exposed and an elevated level of suspended particles would be present in the surface run-off. Water used for wheel washing would also have an increased level of suspended solids. Sediment laden runoff may carry pollutants (adsorbed onto the particle surfaces) that can travel downstream, eventually polluting the receiving marine waters. Proper mitigation measures should be implemented to minimize the chances of introducing sediment and pollutants to the natural environment, which are further discussed in subsequent sections.

Domestic sewage from the workforce and wastewater from the canteen and mechanical workshops, if any, would also be generated during both decommissioning and construction phases. It is unlikely that sewage generated from the site would have a significant impact on the nearby environment, provided that sewage is not discharged directly to surface waters, and provided that septic tanksor chemical toilets and grease traps are established and properly maintained.

7.4 WASTE ARISINGS

7.4.1 Construction Waster - Demolition Materials

During development of the site, most of the existing buildings and facilities, except for those three buildings mentioned above, will be demolished to maximise the development potential. Table 7.5 is a summary of annual waste generation rate.

Table 7.5 Summary of Demolition Waste Generation Rate (m^3)

	1998	1999	2000	2001	2002	2003	Total
Inert	11364	78826	49714	0	128008	3236	271148
Non-inert	7577	52565	48306	0	70562	1784	180794
Total	**18941**	**131391**	**98020**	**0**	**198570**	**5020**	**451942**

The existing buildings to be demolished are predominately of reinforced concrete construction, but also consist of those non-inert materials, including wood/timber, bamboo, glass, and plastics, steel, non-ferrous metal and ferrous metal from electronic equipment, plumbing fittings, ventilation equipment, lighting, framework and pipes. It is estimated that approximately 271,148m^3 of inert material will be generated and 180,794 m^3 of non-inert material (approximately 40%), consisting of insulation material and wood pieces, etc. The former will be processed and re-used on-site and the latter will have to be disposed of at a landfill.

7.4.2 Construction Waste - Pavement Removal

Construction of roads and facilities will require the excavation of pavements, stormwater drains, sewers, water mains other utilities and other ducting and services. It is estimated that a total of 531,024 m^3 construction waste will be generated, of which, a total of 279,219 m^3, approximately 52.6%, will be re-used for roads and rail (Table 7.6). The rest will be used on-site for reclamation and other purposes.

Table 7.6 Summary of Waste Generation Rate from the Removal of Pavement (m^3)

	1998	1999	2000	2001	2002	2003	2004	Total
1	34316	43911	223441	130825	32168	53397	12966	531024
2	0	0	11342	79523	32168	43220	12966	279219

Notes: 1. Total waste material to be generated
2. Material to be re-used for roads and rails.

There is some contamination of the ground within the KTA site as a consequence of oil storage tank leakage and aviation fuel spillage. The degree of contamination and proposed remediation measures for soil are addressed in detail under the Land Contamination of this report. The excavated contaminated soil will be treated on site under this remediation project. It is recommended that such soil should not be re-used for roads, rail, on-site reclamation or other purpose unless it has been cleaned to acceptable standards.

7.4.3 Chemical Waste

The existing fuel pipes and oil storage depot will be removed before the commencement of the KTA development. They will be emptied by pumping followed by a washing process to ensure that the residual fuel inside the pipes is kept to a minimum. The residual fuel would be collected by the OCTF as a fuel product and properly carried off site.

It is understood that the land lease would require the site owners to clear any chemical wastes like solvent and lube oil used in some of the aircraft maintenance facilities, oil storage sites and fire stations through proper disposal or recycling by licensed chemical waste collectors.

During the decontamination process, most of the free oil in the ground would be collected by vacuum air stream and then destroyed by a vapour treatment system (catalytic oxidation). The small amount of free oil separated from the entrained groundwater during the SVE process would be disposed off site as chemical waste.

The excavation, land reclamation and construction of new developments will require numerous and various earth moving equipment. This construction plant and equipment will require regular maintenance and servicing which will use and generate chemical waste. Substances generated are likely to include oil, lubricants, cleaning fluid, solvents and rags.

Asbestos has often been used in buildings for various purposes, including fire protection and heat, sound and electrical insulation. Thus it is likely that there will be asbestos containing material (ACM) in buildings scheduled for demolition, particularly in the existing old blocks. Asbestos surveys should be carried out to confirm the presence of ACM, so as to determine appropriate removal and handling procedures. If ACM is found, it will be disposed of in accordance with the relevant regulations.

7.4.4 Workforce Waste

Throughout the construction, the workforce on site will generate general refuse, comprising food scraps, paper and empty containers, etc. In addition to the refuse, human waste will require suitable disposal.

7.5 ECOLOGICAL IMPACT

7.5.1 Terrestrial Habitats

Much of the existing terrestrial area will be redeveloped, resulting in loss of grassed areas (approximately 23 ha), including KTA apron and some amenity planted areas (approximately 1.6 ha). However, the existing vegetated area is small, in fragmented patches and without linking corridors. Most vegetation is planted with exotic introduced species, in highly disturbed environments with few trees and little habitat heterogeneity and is, therefore, considered to be of low ecological value.

7.5.2 Avifauna

The use of Kai Tak Runway by avifauna has been well documented. Only five species were regularly present throughout the year (Black-eared Kite, Small Skylark, Richard's Pipit, Tree Sparrow and Pigeon), species which are common in urban or grassy areas. Large numbers of gulls are present throughout the winter and as passage migrants. However, most records are of passage migrants grounded by bad weather which move on as soon as possible, or are species of irregular occurrence.

Numbers of kites and gulls at the airport have declined in recent years due to increased bird scaring activity and because of improved sewage disposal. The amount of untreated sewage to be discharged into Kowloon Bay will decrease further as a result of the Strategic Sewage Disposal Scheme. Therefore, it is likely that there would be a substantial decrease in the numbers of small fish and the scavenge items available for kites and gulls.

Oriental Plover and Little Whimbrel are rarely recorded in Hong Kong; records seem to be mainly at Kai Tak or at Mai Po Marshes[11]. The Oriental Plover was noted as a scarce spring migrant in small numbers, with occasional autumnal records. The species appears to favour grassy areas which probably explains the paucity of records from elsewhere in urban Hong Kong. Passage migrants use the runway when grounded by bad weather conditions, but it has been noted that the airfield has little to offer most species in terms of food, cover or other

11 Hong Kong Bird Watching Society. *Hong Kong Bird Report.* Hong Kong Bird Watching Society, 1992, 1993, 1994.

resources and it is therefore only a resting place used very briefly[12].

Little Whimbrels were recorded at Kai Tak every year between 1974 and 1979 but not during every migration. Collated records of regional abundance for the Little Whimbrel indicate that it was recorded by LaTouch (1925-34) as 'common in the delta of the Canton River during April to the middle of May' and as 'very common' at Foochow in April. Sightings outside of Hong Kong suggest that during the non-breeding season the bird favours areas of short grass and it is frequently seen at airfields[13, 14].

Large areas of short grass are not common in Hong Kong. Alternative habitat for opportunistic landings exists at Mai Po, and the majority of records in the *Bird Report* for both Oriental Plover and Little Whimbrel during 1992 to 1994 are at Mai Po Marshes, though this may be a factor of more frequent observations at Mai Po. Passage migrants are occasionally sighted at Happy Valley Racecourse and at King George V School Playing fields. The areas of short grass lost to the KTA-EDP will be replaced by a new area of habitat which will be created in the large Metropolitan Park which is central to the SEKD proposals. These areas are likely to be much more extensive, better linked and more diverse (thus more attractive) than those which they replace.

7.6 CONTAMINATION ASSESSMENT REPORT

7.6.1 Findings Of Phase 1 Investigation

Soil Gas Monitoring

Figure 7.9 shows a contour plot of the total VOC concentration. The hot spots are located at different parts of the airport. Most of the hot spots are located close to the fuel transfer lines except one which is close to the HAECO Maintenance Building. With reference to a guidance note released by the manufacturer of the PID meter, total sample headspace hydrocarbon concentration of soil in the ranges of <10 ppm, 10 to 500ppm and >500 ppm correspond to 'clean', 'contaminated' and 'excessively contaminated' soil respectively. PID readings are a good indication of the headspace hydrocarbon concentrations in soil around the gas monitoring probes. The recorded PID readings fall within the range of 10 to 500 ppm and therefore indicate moderate, but not excessive, soil contamination around the identified hot spots.

As indicated by the measurement results of methane, carbon dioxide and oxygen (Figures 7.10, 7.11 and 7.12 respectively), most of the possible contamination hot spots are also spots of high methane concentration, high carbon dioxide concentration and low oxygen concentration.

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12 Melville, D. *Birds at Kai Tak Airport Hong Kong*. Birdstrike Research Unit, Agriculture & Fisheries Department, Hong Kong, 1980.

13 Bell, HL. Some distribution notes on New Guinea highland birds. *Emu* 67(3): 211-214, 1968.

14 van Tets, GF, Vestijens, WJM, D'Andria, AH and Barker R. *Guide To the Recognition and Reduction of Aerodrome Bird Hazards*. Australian Department of Transport, Canberra, 1977.

These indicate anaerobic gas generation due to contaminated soil. Nine hot spots were identified and they are shown in Figure 7.13. The locations of the hot spots roughly coincide with the historical leak locations (Figure 4.5).

Baseline Risk Assessment

Based on a health risk point of view, the Monte Carlo[15] analysis of the CalTOX™ modelling results suggests that hot spots 3, 4 and 5 would have a possibility to impose a risk higher than the acceptable level of 1×10^{-6} based on a 95% confidence level and as a worst case scenario, a reduction of about 57%, 54% and 52% of the estimated existing root-zone soil benzene concentration would be required for hot spots 3, 4 and 5 respectively to meet the acceptable risk level.

Methane Explosion Hazard

The methane concentrations recorded at the airport site were in the range of 20% (v/v) to more than 90% (v/v). Three hot spots were found to exceed the upper explosive limit (UEL) of 15% (v/v) (Figure 7.10) Control limits are often set at levels which provide a significant margin of safety, typically 10% - 20% of the lower explosive limit (LEL) which is 5% (v/v) (ie 0.5 - 1% (v/v) methane).

7.6.2 Findings of Phase 2 Investigation

Hydrocarbon Contamination

The laboratory analysis of TPH was broken down into four carbon number fractions (C_6-C_9, C_{10}-C_{14}, C_{15}-C_{28} and C_{29}-C_{36}). At those locations where TPH contamination was heavy, the C_{10}-C_{14} was usually found to be the dominant fraction. This provides evidence that the contamination might have been derived from jet fuel leakage, since jet fuel exhibits similar characteristics.

Contour plots of the TPH level in the soil 1 m above the ground water level, 1 m below the ground water level and in ground water are shown in Figures 7.14, 7.15 and 7.16 respectively. According to the laboratory analyses and direct field observations the locations within the study area subject to the heaviest TPH contamination in terms of both soil and ground water are centred around wells MW208, MW212, MW220, MW231, MW233, MW239, MW241, MW242, MW250, MW253, MW259, MW261, MW262 and MW269 (refer to Figure 5.2 for locations). TPH levels in the vicinity of these locations were well above the Dutch 'C' level, and as previously mentioned substantial free product layers were recorded at three of these locations (MW250, MW259 and MW261). These correspond to hot spots 2, 4, 5, 7, 8 and 9 identified in the Phase 1 soil gas survey (Figure 7.13).

15 Monte Carlo analysis is an uncertainty estimation procedures carried out on final output variables, total unmitigated individual lifetime risk and root-zone clean up concentration. The Monte Carlo analysis of the risk assessment is performed by a computer software "Crystal Ball®". Detailed description of the Monte Carlo analysis are in Report RA16 of the SEKDFS.

BTEX are specified as chemicals of concern in jet fuel under the ASTM E1739-95[6]. Benzene in particular is a known carcinogen, and as such has the potential to pose significant health risks to humans. The laboratory analyses have demonstrated that benzene levels would exceed the Dutch 'C' criteria for either soil or ground water at five locations: MW242, MW246, MW257, MW262 and MW264. Again, these locations generally correspond to hot spots identified in the Phase 1 soil gas survey (Figure 7.13).

Based on carbon chain analysis results of the soil, significant volatile portion still exists. Also, the soil gas monitoring data also indicate that there are a substantial amount of volatile compounds currently in the soil gas. This reflects that there is a significant portion of volatile material in the free product.

Metal Contamination

Seven metals were selected for laboratory analyses for both soil and ground water: cadmium, chromium, copper, nickel, lead, zinc and mercury. With regard to ground water, all samples demonstrated that metal levels were present in background concentrations according to the Dutch 'ABC' criteria. For the soil samples tested, levels of cadmium, chromium, copper, zinc and nickel were all at or below background. At only eight of the tested locations were lead levels found to exceed background levels, and in none of these cases was the 'C' level denoting heavy contamination breached. In general it could be stated that metal levels were acceptable across the site, and that those areas where lead levels were recorded at higher than background coincided with the previously identified TPH hot spots. It was therefore possible that these metals were associated with jet fuel itself, possibly in the form of a performance additive, although they were not considered in themselves a contamination issue.

Polycyclic Aromatic Hydrocarbons and Chlorinated Hydrocarbons

Polycyclic aromatic hydrocarbons and chlorinated hydrocarbons comprise a large group of organic compounds that can also pose health risks to humans. However, for those locations where samples were taken for these analyses, exceedances of background levels were recorded on only one or two occasions: chlorinated hydrocarbon analysis of ground water at location MW207 (adjacent to the HAECO building) indicated relatively high levels of trichloroethane, a solvent. However, this indicates the presence of significant contamination that may have resulted from activities associated with aircraft maintenance, and this would require remediation.

Methane Radiocarbon Dating

The measured C-14 enrichment values within methane samples demonstrated that with the exception of two samples, the methane content in the soil gas samples was derived predominantly from carbon that was geologically old, ie. a derivative of oil or natural gas. In other words, it was almost certain the methane was derived from jet fuel. In two areas, results indicated that methane was new in origin, and derived from the diagenesis of organic material. Since these areas coincided with areas heavily contaminated with hydrocarbons, it was likely that this methane was derived from the metabolism of the longer chain hydrocarbons.

Hydrocarbon-Degrading Bacteria Tests

The results of Hydrocarbon-Degrading Bacteria Tests indicated that there was a strong correlation between the locations of high concentrations of hydrocarbon-metabolizing bacteria and contamination hot spots. This observation was significant to the design and proposal of feasible remediation methodologies, as it suggested that microbial populations capable of hydrocarbon metabolism already existed in the areas of key concern and might therefore be exploited.

Ground Water Gradients

The ground water depths were generally shallow and not homogeneous across the site (Figure 7.17). Depths fluctuated from 0.8m to 3.7m with an average depth across the site of approximately 2.9m. There are several ground water sinks across the study area: these being areas where the local ground water level is below that of the surrounding vicinity. These coincide with contamination identified near hot spot #2, and around sampling location MW212 (Figure 5.2) In these cases it is possible that, although leaks have not been reported in the immediate surrounding area, contamination has over time migrated along the hydraulic gradients created by these sinks, and has accumulated at the lowest point. Especially with regard to hot spot #2, it is feasible that low level chronic leakage of fuel from the OCTF compound itself has migrated along the hydraulic gradient to this final location.

Soil Permeability

The particle size analysis results as contained in "OCTF Kai Tak International Airport Environmental Site Assessment Phase II Part II Site investigation Draft Final Report" found that the percentage of particles with sizes > 75μm range from 45% to 98%, which is considered moderately to very permeable (According to ASTM D422 & D653, particles< 75 μm are defined as silt and clay). Subsequently, a detailed analysis of the soil characteristics was carried out on soil samples collected during Phase 2 SI, and concluded that soil in both the saturated and unsaturated zones appeared to be relatively permeable to air and is composed of mostly sand. This is also supported by records of previous Geotechnical Site Investigation conducted in another contract. Appendix E shows the soil permeability data. However, for a site of this size, it is admittedly impossible to generalise. Excessive heterogeneity in soil property would affect the performance of SVE/AS and therefore pilot tests on the system performance are recommended.

Baseline Risk Assessment

a) Benzene and Toluene in Unsaturated Soil

Hot spots 3 and 4 have been modelled for soil benzene and soil toluene respectively. The hot spots are delineated according to the laboratory testing results on benzene and toluene concentrations in soil 1 m above the ground water table (see Figures 7.18 and 7.19 respectively). The Monte Carlo estimates of the carcinogenic and non-carcinogenic risk estimates of all soil benzene and toluene hot spots were found to be within acceptable risk levels based on a 95% confidence level. Therefore, remediation is not warranted for benzene and toluene in soil.

Based on a acceptable risk level of 1 x 10^{-6} and an acceptable hazard quotient of 1.0, the target ground water concentrations of benzene, tetrachloroethylene and toluene are and summarised in Table 7.7. The estimated clean up level is represented by a range of concentrations. Considering the worst case scenario, the lower end of the clean up value will be adopted. The estimated target soil concentrations for benzene (hot spots SB1 - SB3), based on an acceptable carcinogenic risk level of 1 x 10^{-6}, range from 6.5 to 8.6 mg kg^{-1} which are about 65 - 215 times higher than the corresponding existing concentrations in soil. For toluene, which is a non-carcinogen, the target concentrations in soil of hot spots GT1 - GT4 to achieve an acceptable hazard quotient of 1.0 are estimated to range from 1.8 to 4.4.mg kg^{-1} which are about 30 - 90 times higher than the corresponding existing concentrations in soil.

Table 7.7 Target Soil Benzene Concentrations at Hot Spots SB1, SB2, SB3, and Toluene Concentrations at Hot Spots ST1, ST2, ST3 and ST4 Based on an Acceptable Risk Level of 1 x 10^{-6} and an acceptable Hazard Quotient of 1.0

Hot Spot	Initial Benzene/Toluene Concentration in Root Zone/Vadose Zone Soil (mgkg^{-1})	Recommended Soil Benzene/Toluene Concentration in Root Zone/Vadose Zone Soil (mgkg^{-1}) (Based on 95% Confidence Level)
SB1	0.10	6.5 - 170
SB2	0.04	8.6 - 240
SB3	0.04	8.5 - 200
ST1	0.07	2.8 - 760
ST2	0.09	2.7 - 410
ST3	0.06	1.8 - 670
ST4	0.05	4.4 - 1100

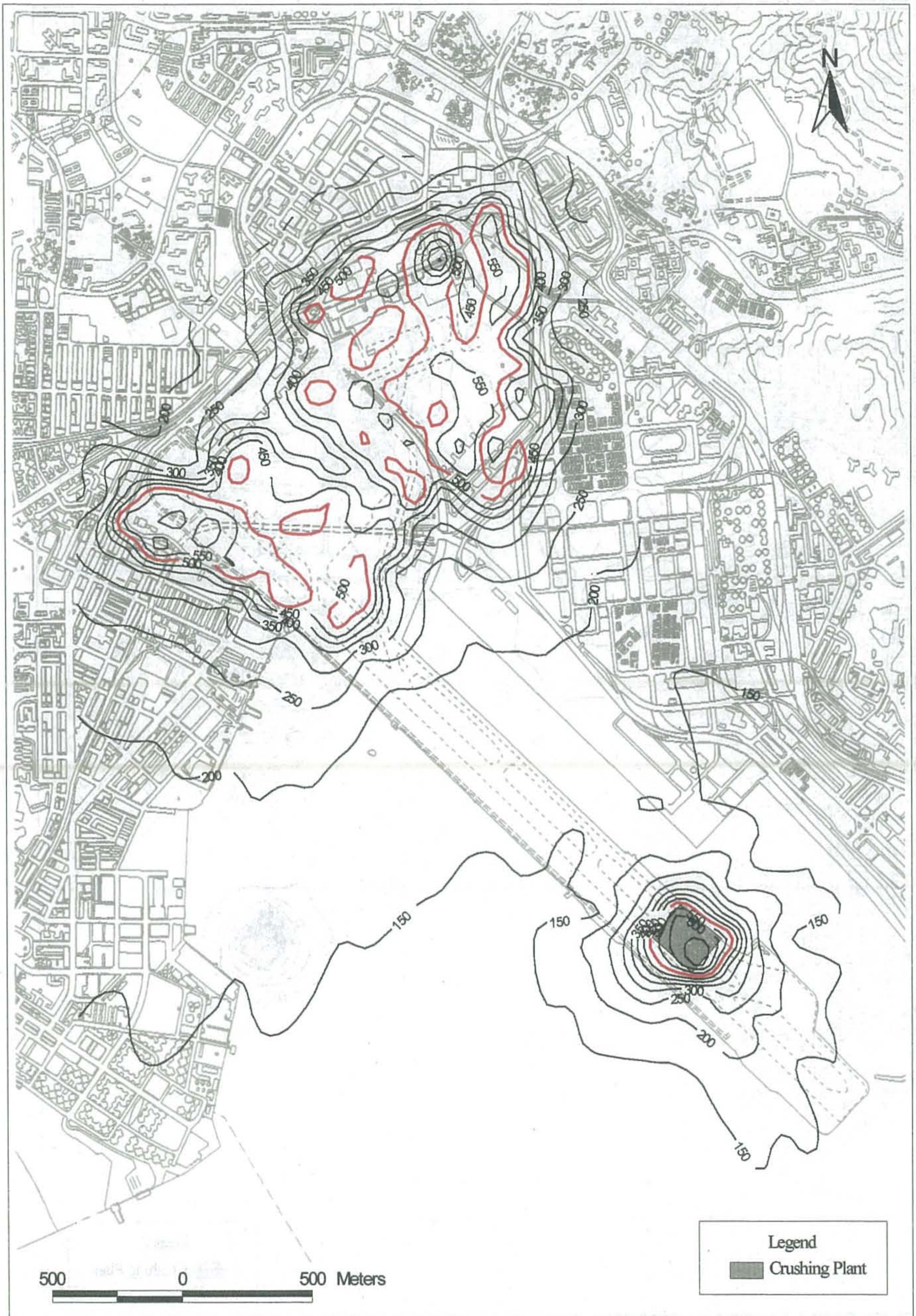
(b) Benzene, Toluene and Tetrachloroethylene in Ground Water

Three hot spots were found for benzene, one for toluene and one for tetrachloroethylene based on the measured ground water concentrations (see Figures 7.20, .7.21 and 7.22 respectively). The Monte Carlo estimates of the total unmitigated individual lifetime risk of all ground water benzene and tetrachloroethylene hot spots are shown to be 3-4 times lower than the acceptable risk level based on a 95% confidence level. Monte Carlo estimates of the total unmitigated individual hazard quotient of the ground water toluene is found to be 4,000-fold lower than the acceptable hazard quotient based on a 95% confidence level. Therefore remediation is not warranted for benzene, tetrachloroethylene and toluene in ground water based on available data of the site. However, we would still propose remediation targets of these key parameters if later investigation (after the airport closes) identifies groundwater clean up is required.

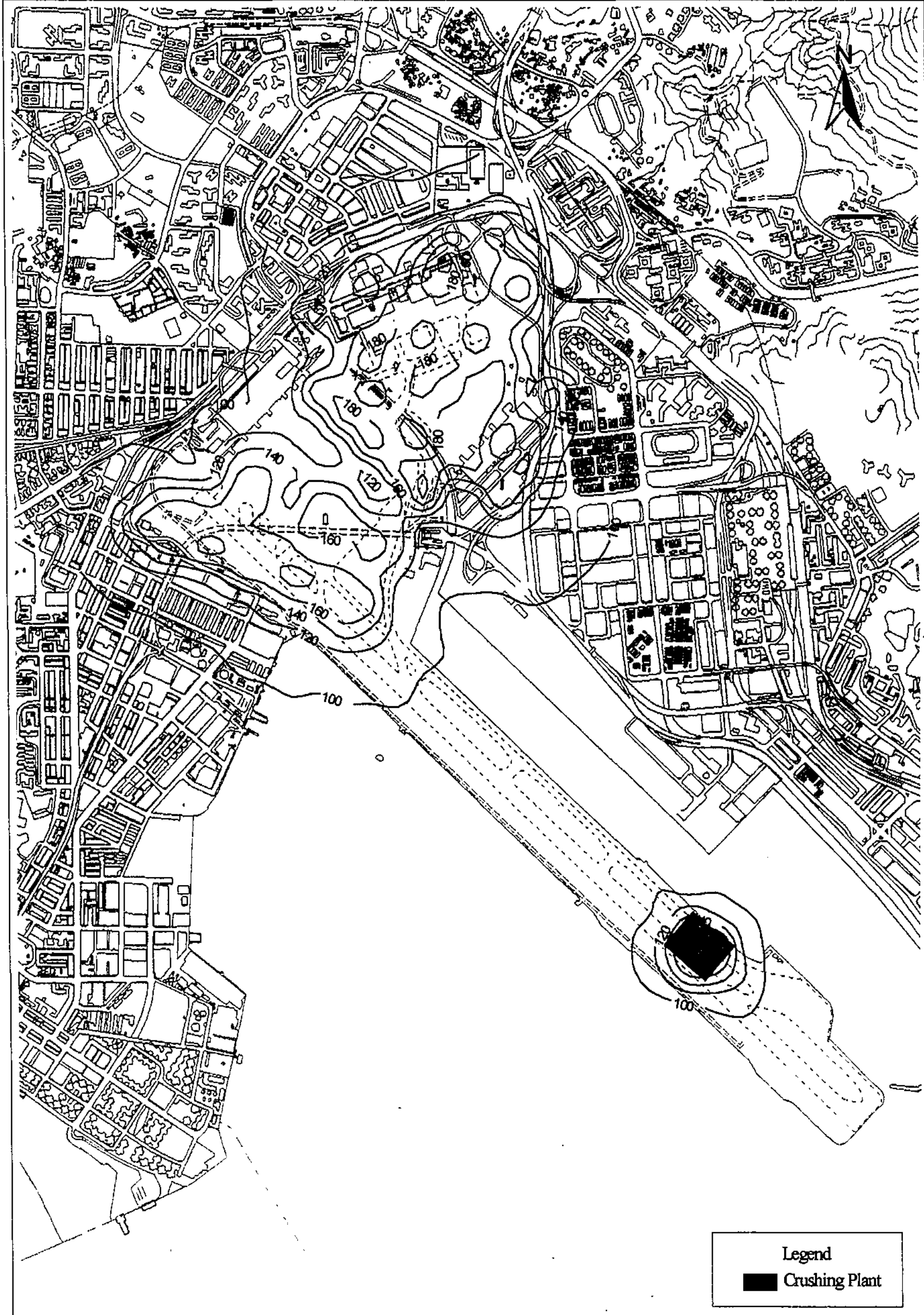
Based on an acceptable risk level of 1 x 10^{-6} and an acceptable hazard quotient of 1.0, the target ground water concentrations of benzene, tetrachloroethylene and toluene are summarised in Table 7.8. The estimated target ground water concentrations for benzene (hot spots GB1, GB2 and GB3) and tetrachloroethylene (hot spot GTE1), based on an acceptable carcinogenic risk level of 1 x 10^{-6}, are 17 $\mu g l^{-1}$ and 110 $\mu g l^{-1}$ respectively, which are about 35 and 2.5 times higher than the corresponding existing concentrations in ground water. For toluene, which is a non-carcinogen, the target concentration in ground water of hot spot GT1 to achieve an acceptable hazard quotient of 1.0 is estimated to be 25,000 $\mu g l^{-1}$. The estimated target toluene ground water concentration is about 4,000 times higher than the existing toluene concentration in ground water.

Table 7.8 Target Ground Water Concentrations at Hot Spots (Benzene: GB1, GB2, GB3), (Toluene: GT1) and (Tetrachloroethylene: GTE1) Based on an Acceptable Risk Level of 1 x 10^{-6} and an acceptable Hazard Quotient of 1.0

Hot Spot	Initial Ground Water Concentration ($\mu g\ l^{-1}$)	Recommended Ground water Benzene Clean Up Concentration ($\mu g\ l^{-1}$)
GB1	5.14	17
GB2	4.47	17
GB3	3.79	17
GT1	6.73	25,000
GTE1	43	110



Maunsell in association with 環科 CES	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department, Hong Kong Kowloon Development Office	
	TITLE Predicted Maximum 1-hour Average TSP Concentrations	SCALE 1 : 20000	DATE March 1998
		DESIGNED Peter Lee	DRAWN Fanny Lau
		CAD REF. C415	DRAWING NO. Figure 7.1 REV 0



Maunsell in association with 環科 CES	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department, Hong Kong Kowloon Development Office	
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		DESIGNED Peter Lee	DRAWN Fanny Lau
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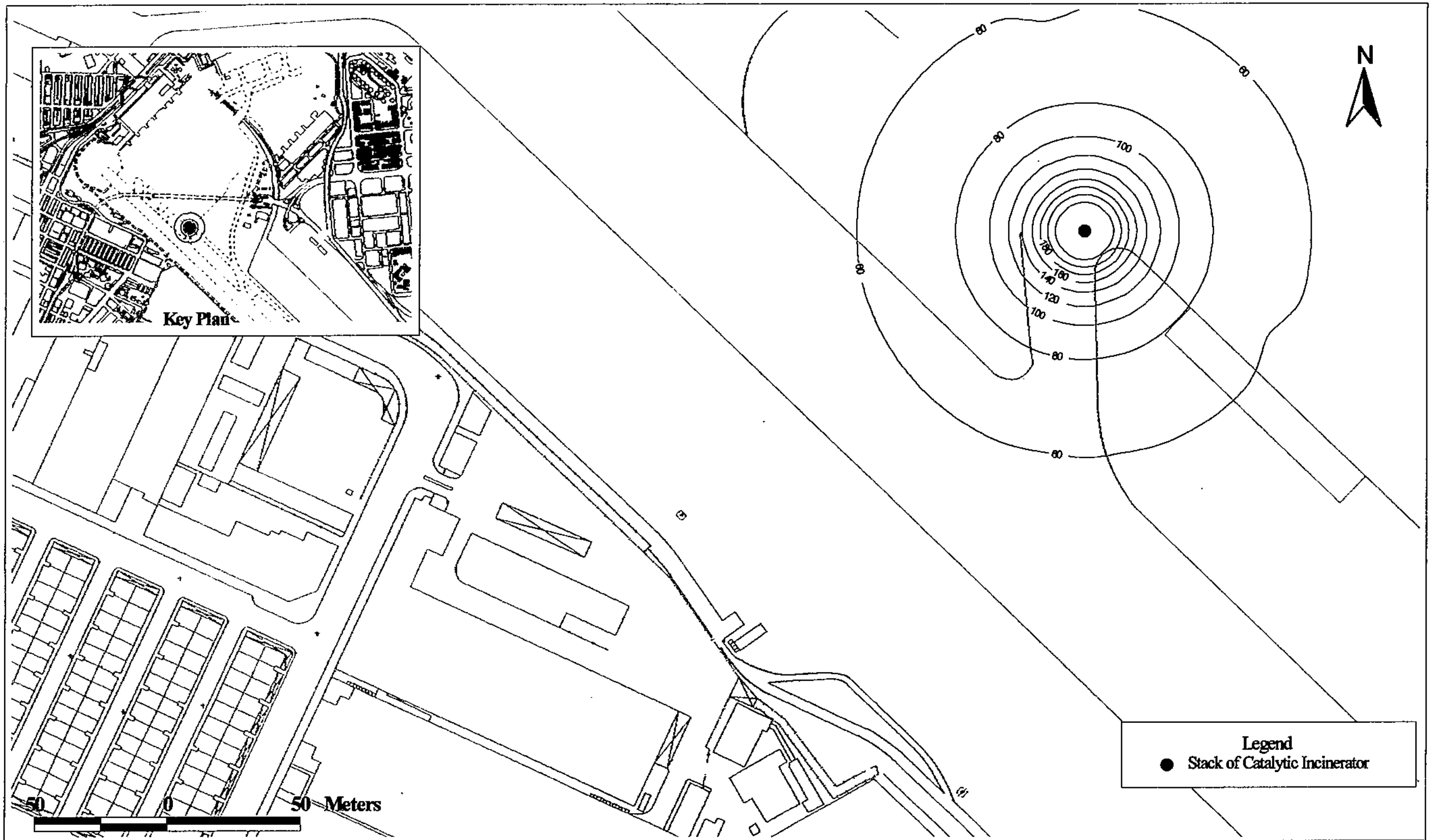

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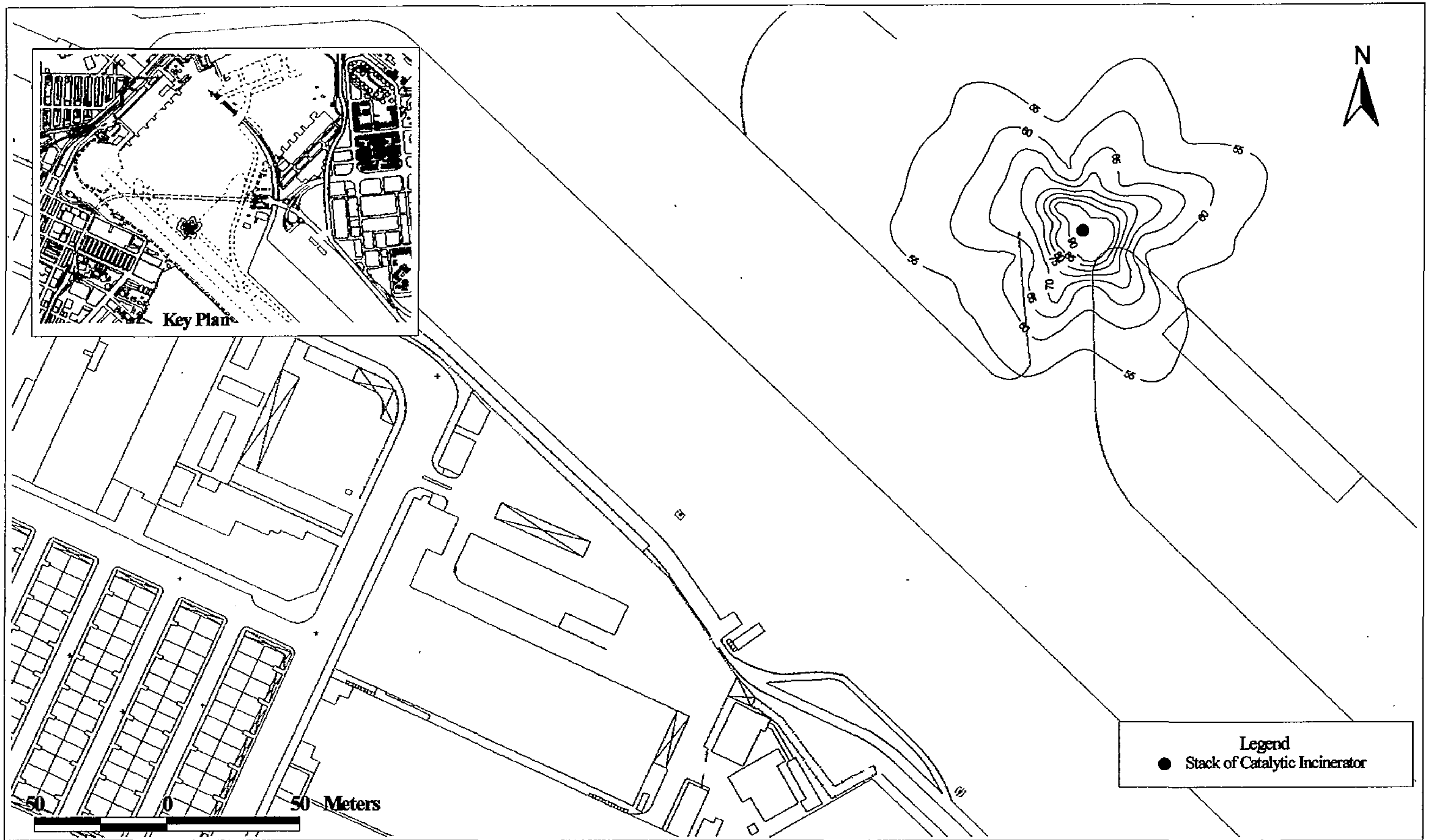
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department, Hong Kong Kowloon Development Office
TITLE Predicted Maximum 1-hour Average NO2 Concentrations at 25m Height	SCALE 1 : 2000
	DATE Mar. 1998
	DESIGNED Peter Lee
	DRAWN Fanny Lau
	CAD REF. C415
	DRAWING NO. Figure 7.3
	REV 0



Maunsell in association with 環 C E 科 S	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department, Hong Kong Kowloon Development Office			
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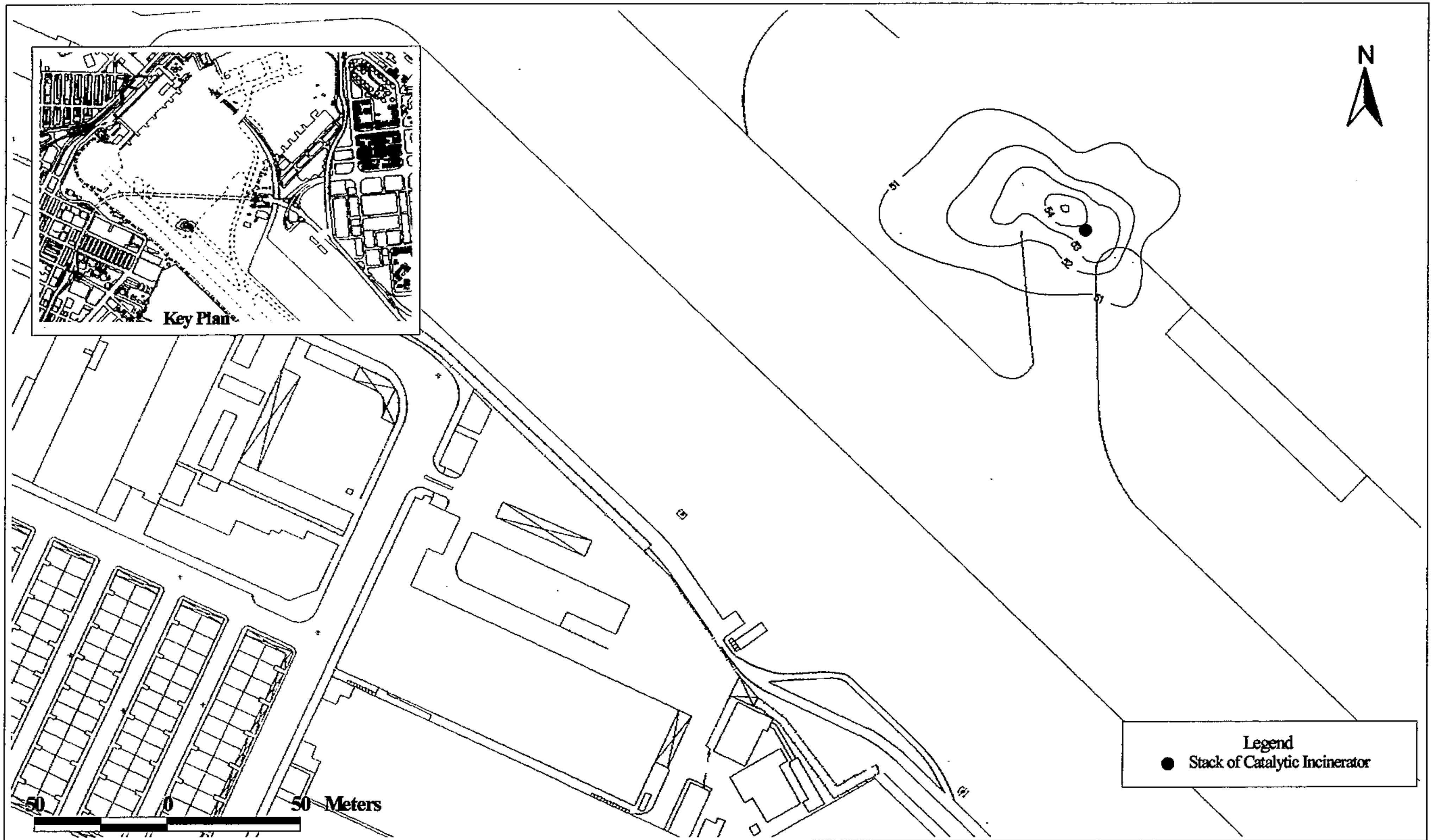
		CAD REF.	C415	DRAWING NO.	Figure 7.4 (REV 0)



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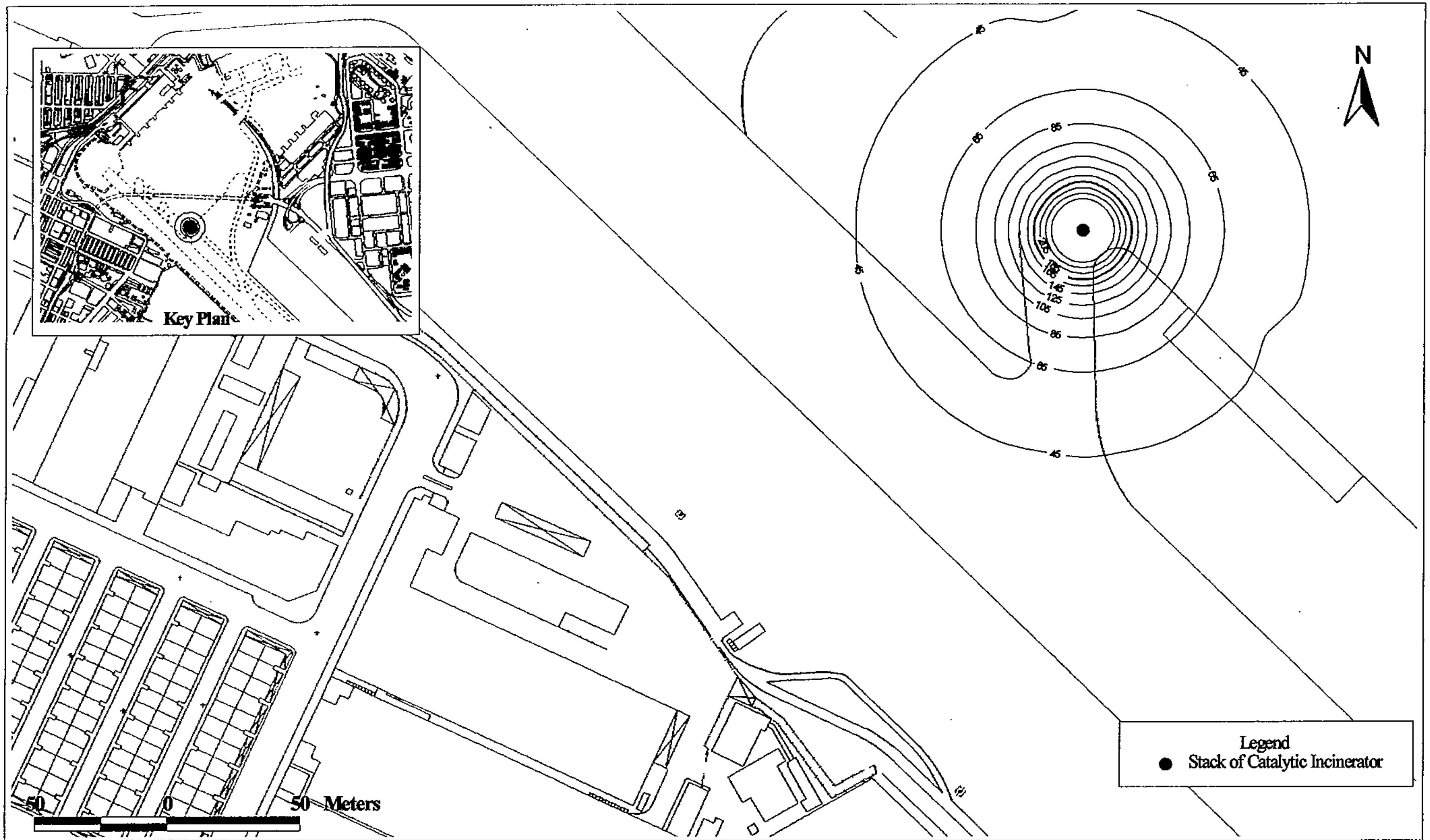
	TITLE Predicted Annual Average NO2 Concentrations at 25m Height	SCALE 1 : 2000	DATE Mar. 1998	
		DESIGNED Peter Lee	DRAWN Fanny Lau	
		CAD REF. C415	DRAWING NO. Figure 7.5	REV 0



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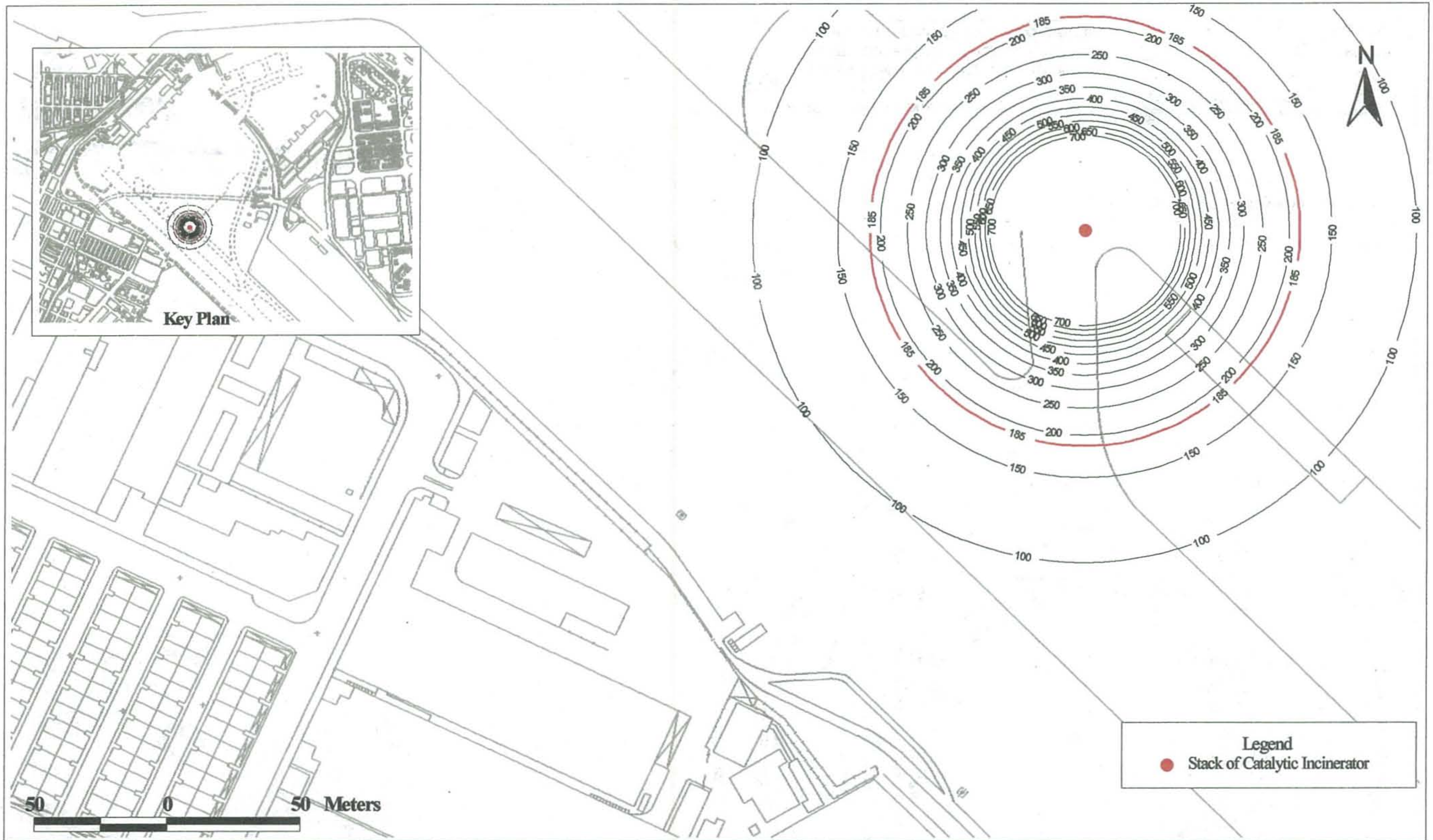
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

TITLE
Predicted Maximum 1-hour Average
Benzene Concentrations at 25m Height

Territory Development Department, Hong Kong
Kowloon Development Office

SCALE	1 : 2000	DATE	Mar. 1998
DESIGNED	Peter Lee	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING NO.	Figure 7.6
		REV	0



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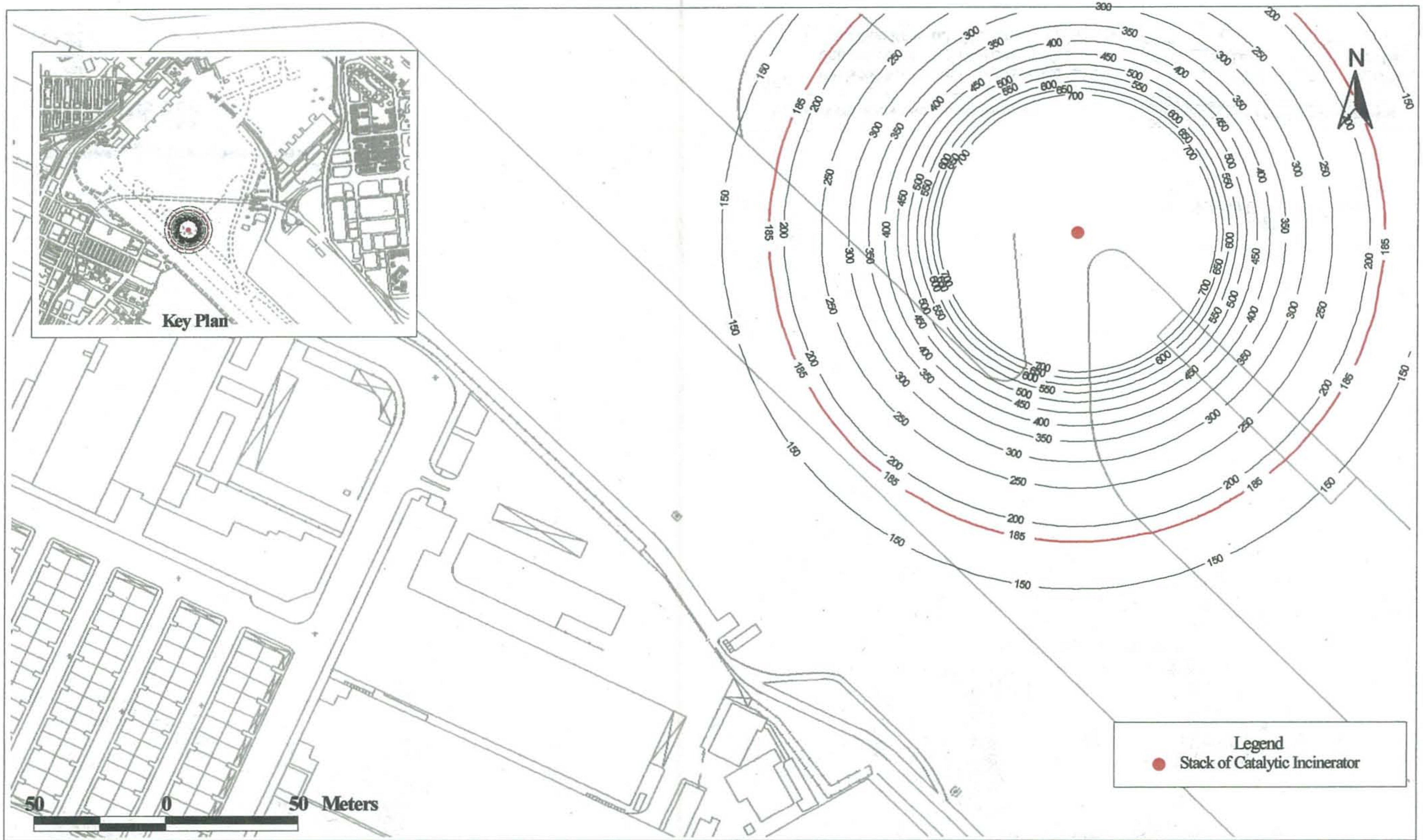
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE	Predicted Maximum 1-hour Average Benzene Concentrations at 15m Height, at 10% Extraction Rate and 0% Destruction Efficiency		
SCALE	1 : 2000	DATE	June 1998
DESIGNED	Peter Lee	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING NO.	Figure 7.7
		REV	0



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in association with
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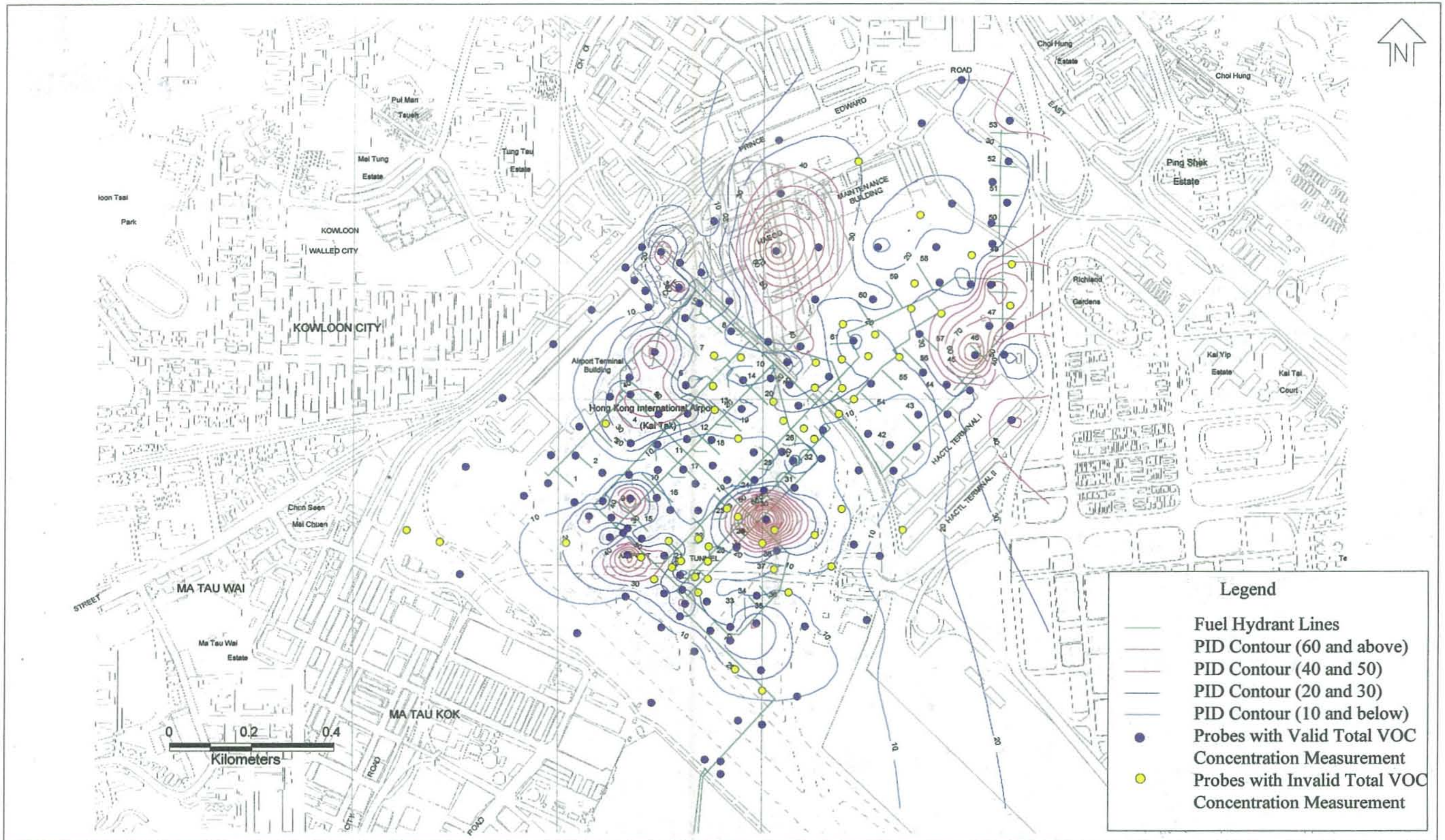
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

TITLE	Predicted Maximum 1-hour Average Benzene Concentrations at 15m Height, at 20% Extraction Rate and 0% Destruction Efficiency		
Territory Development Department, Hong Kong Kowloon Development Office			
SCALE	1 : 2000	DATE	June 1998
DESIGNED	Peter Lee	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING NO.	Figure 7.8
REV	0		



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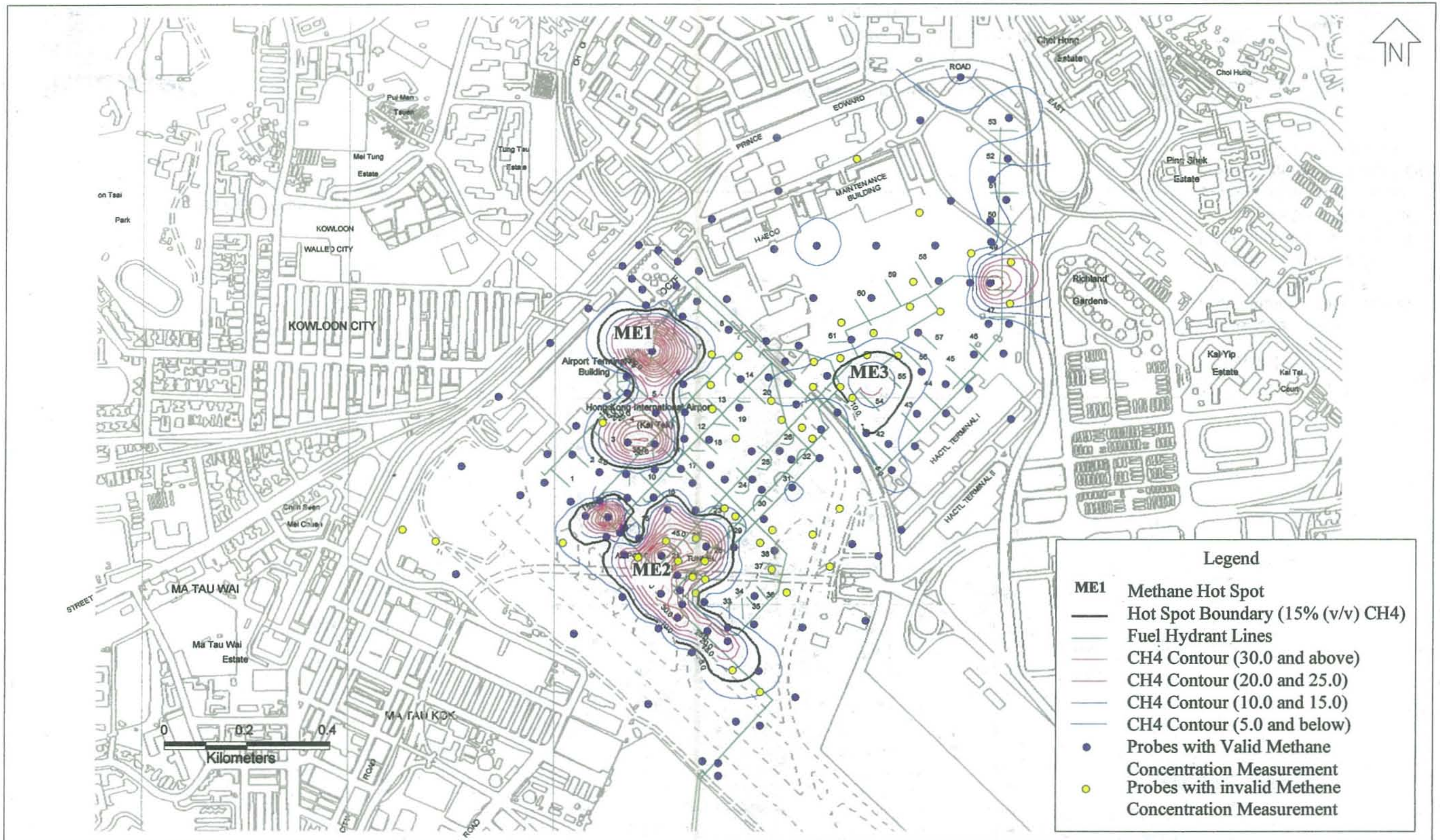
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department,Hong Kong
Kowloon Development Office

TITLE: Total VOC Concentrations Measured at Soil Gas Monitoring Probes (ppm Isobutylene Equivalent/PID Units)

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.9 REV 0



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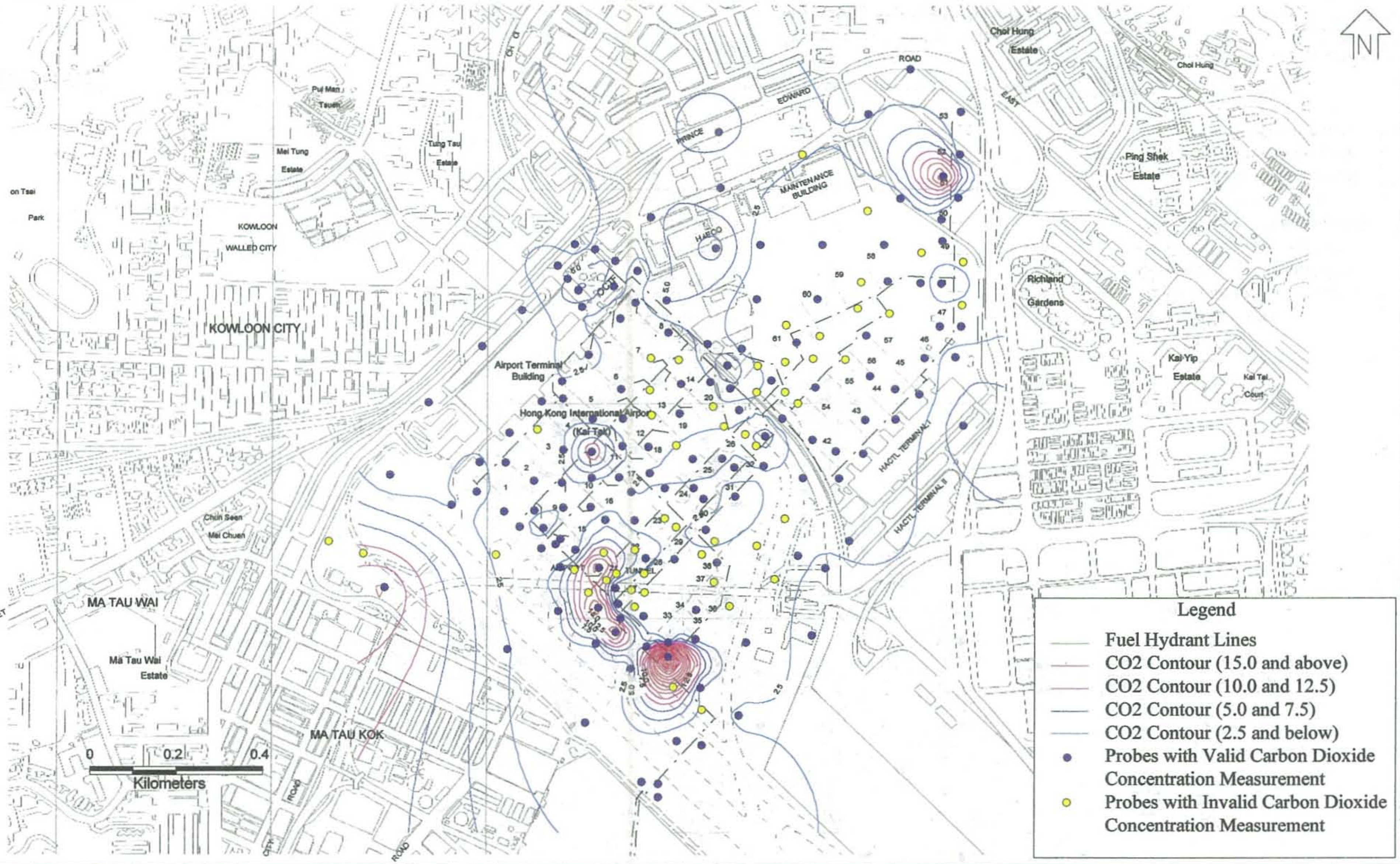
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

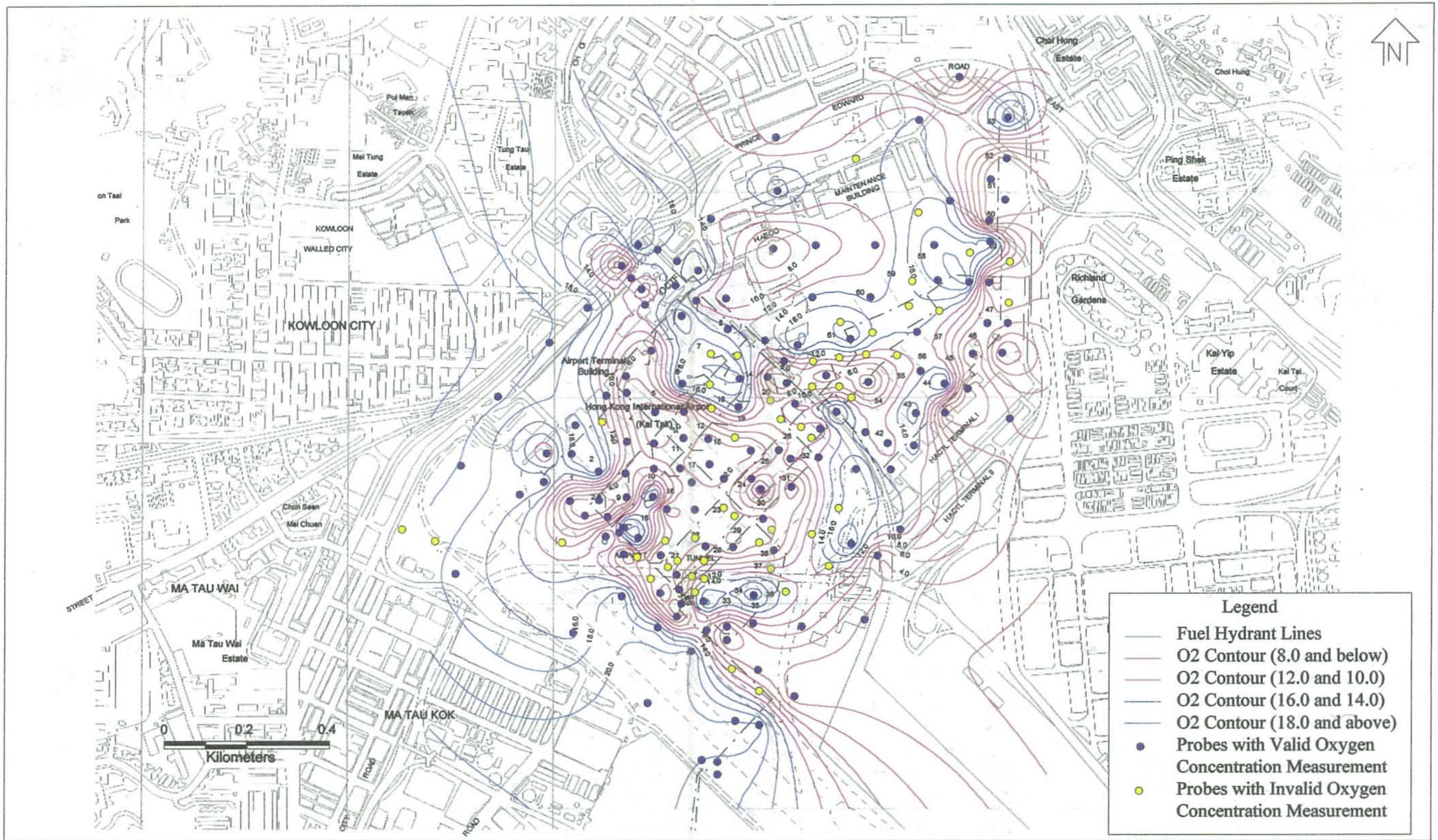
TITLE

Methane Concentrations Measured at Soil Gas Monitoring Probes (% volume)

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.10
		REV	0



Maunsell in association with 環科 CES	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING		Territory Development Department, Hong Kong Kowloon Development Office	
	TITLE Carbon Dioxide Concentrations Measured at Soil Gas Monitoring Probes (% volume)	SCALE 1 : 13000	DATE June 1998	
		DESIGNED Fanny Lau	DRAWN Fanny Lau	
		CAD REF. C415	DRAWING No. Figure 7.11	REV 0



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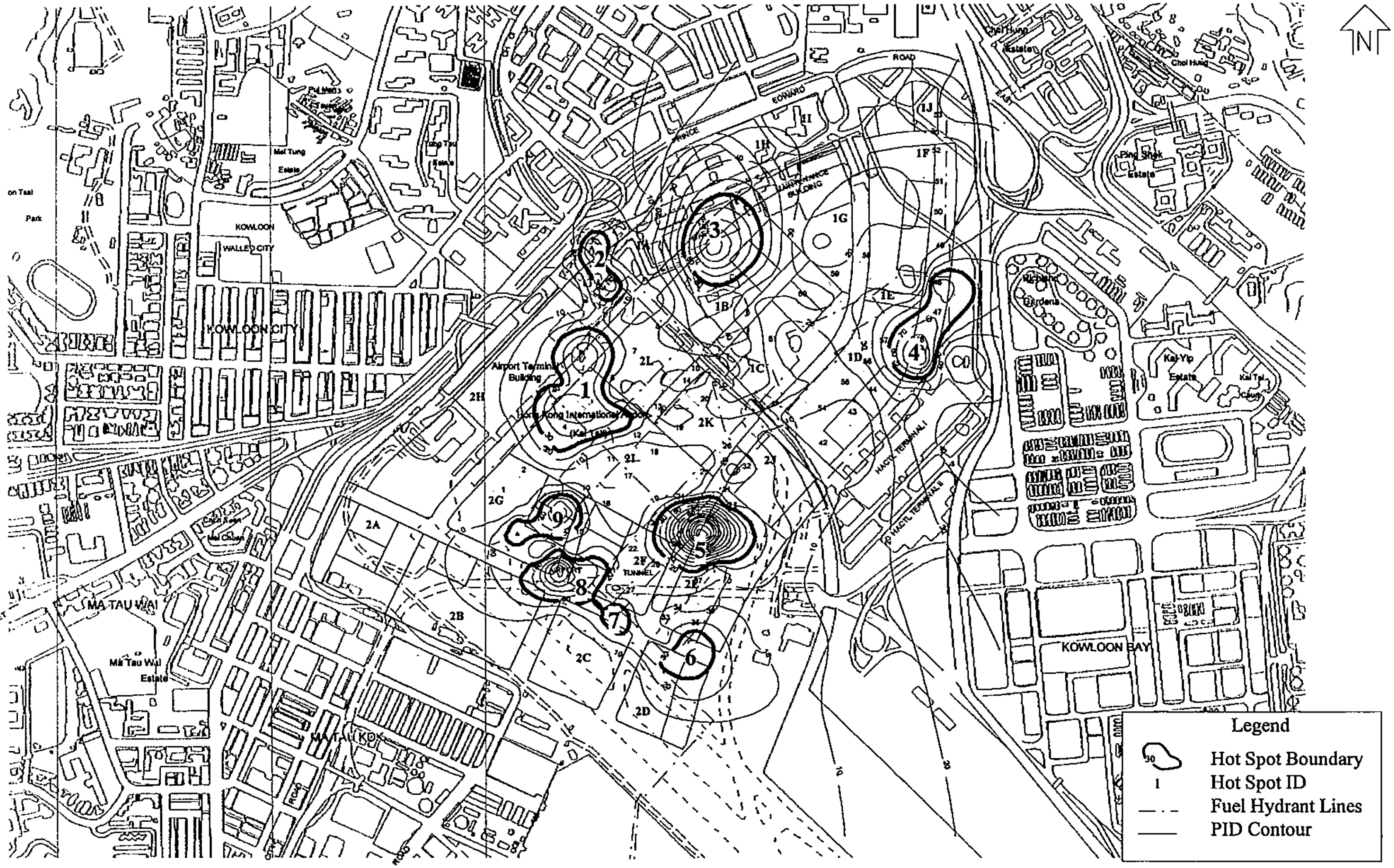
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department,Hong Kong
Kowloon Development Office

TITLE Oxygen Concentrations Measured at Soil Gas Monitoring Probes (%volume)

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.12
		REV	0



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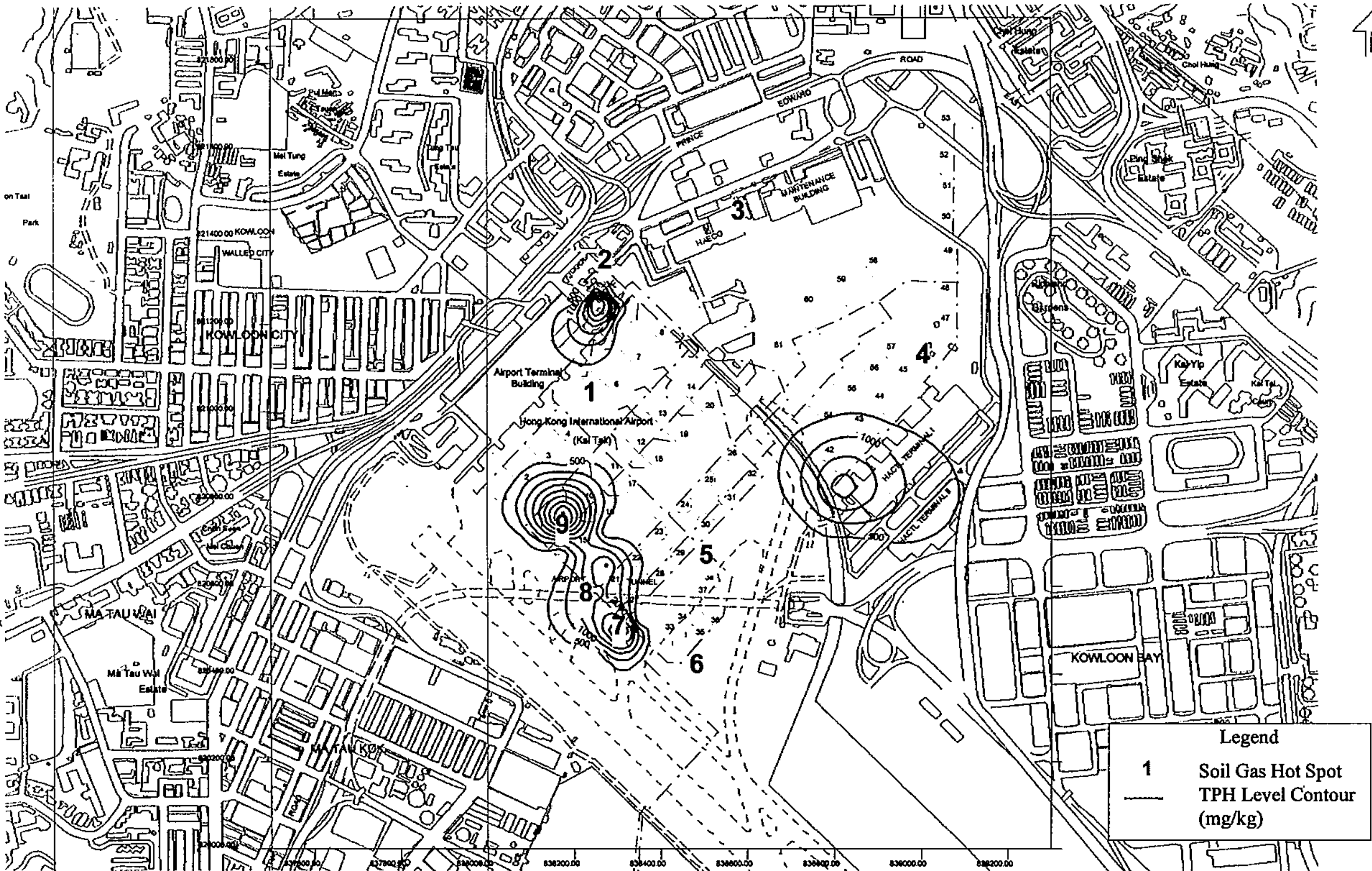
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

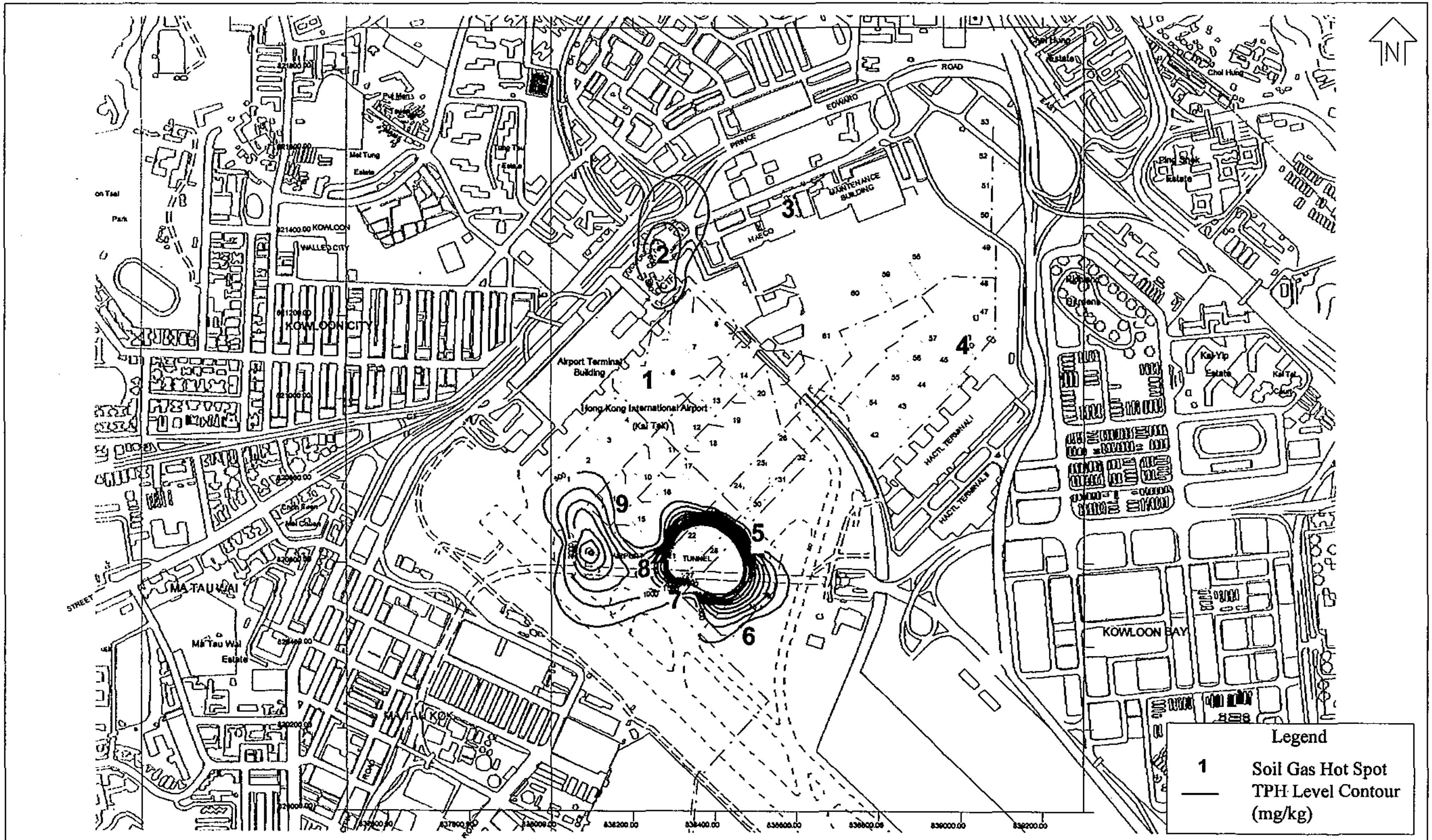
Territory Development Department, Hong Kong
Kowloon Development Office

TITLE Locations of Identified Hot Spot of Soil

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.13
REV	0		



Maunsell in association with 環科 CES	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING		Territory Development Department,Hong Kong Kowloon Development Office	
	TITLE	TPH Level for Soil 1m Above Groundwater Level	SCALE 1 : 13000	DATE June 1998
			DESIGNED Fanny Lau	DRAWN Fanny Lau
			CAD REF. C415	DRAWING No. Figure 7.14 REV 0



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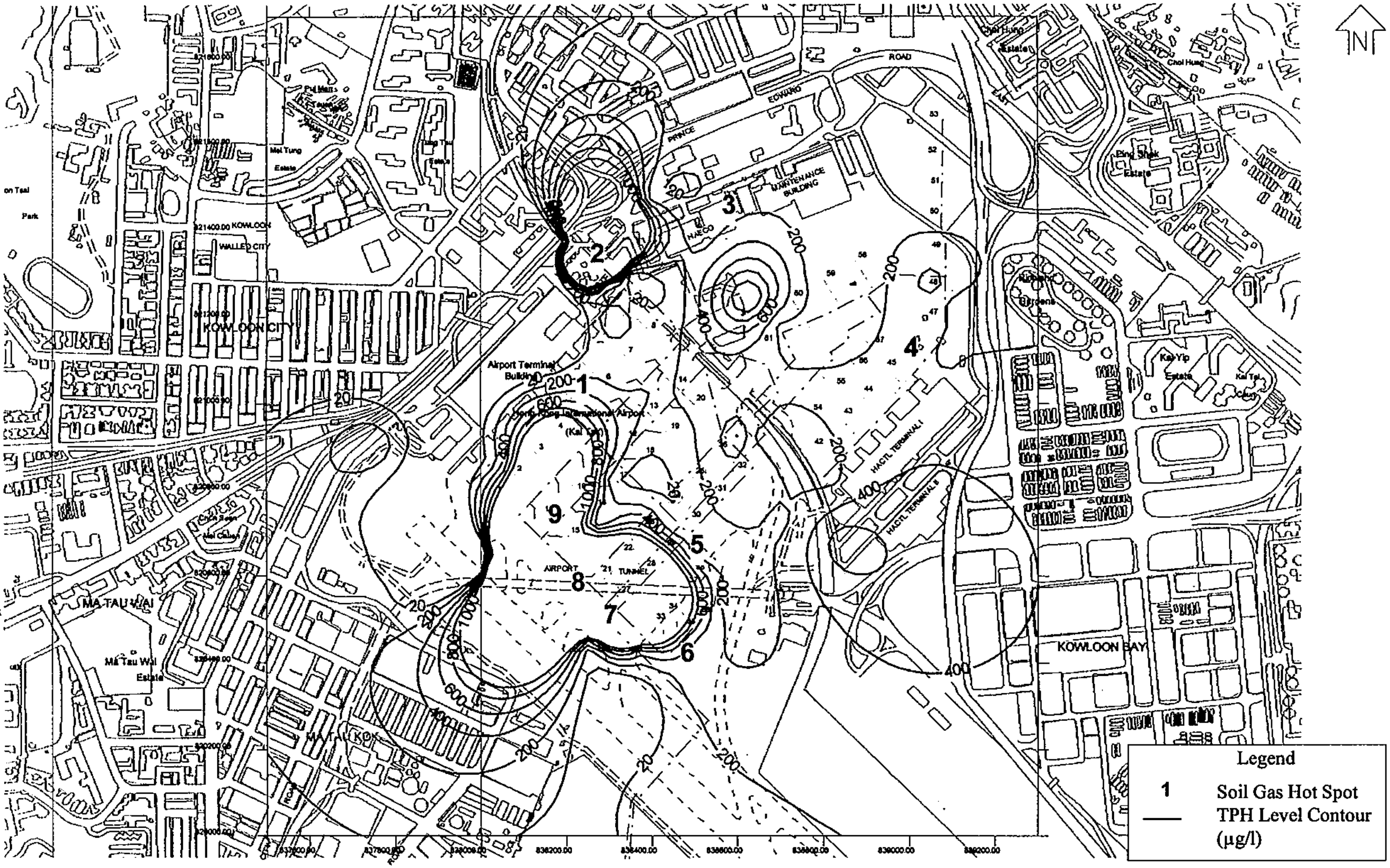
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

TITLE TPH Level for Soil 1m Below Groundwater Level

Territory Development Department, Hong Kong
Kowloon Development Office

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.15 REV 0



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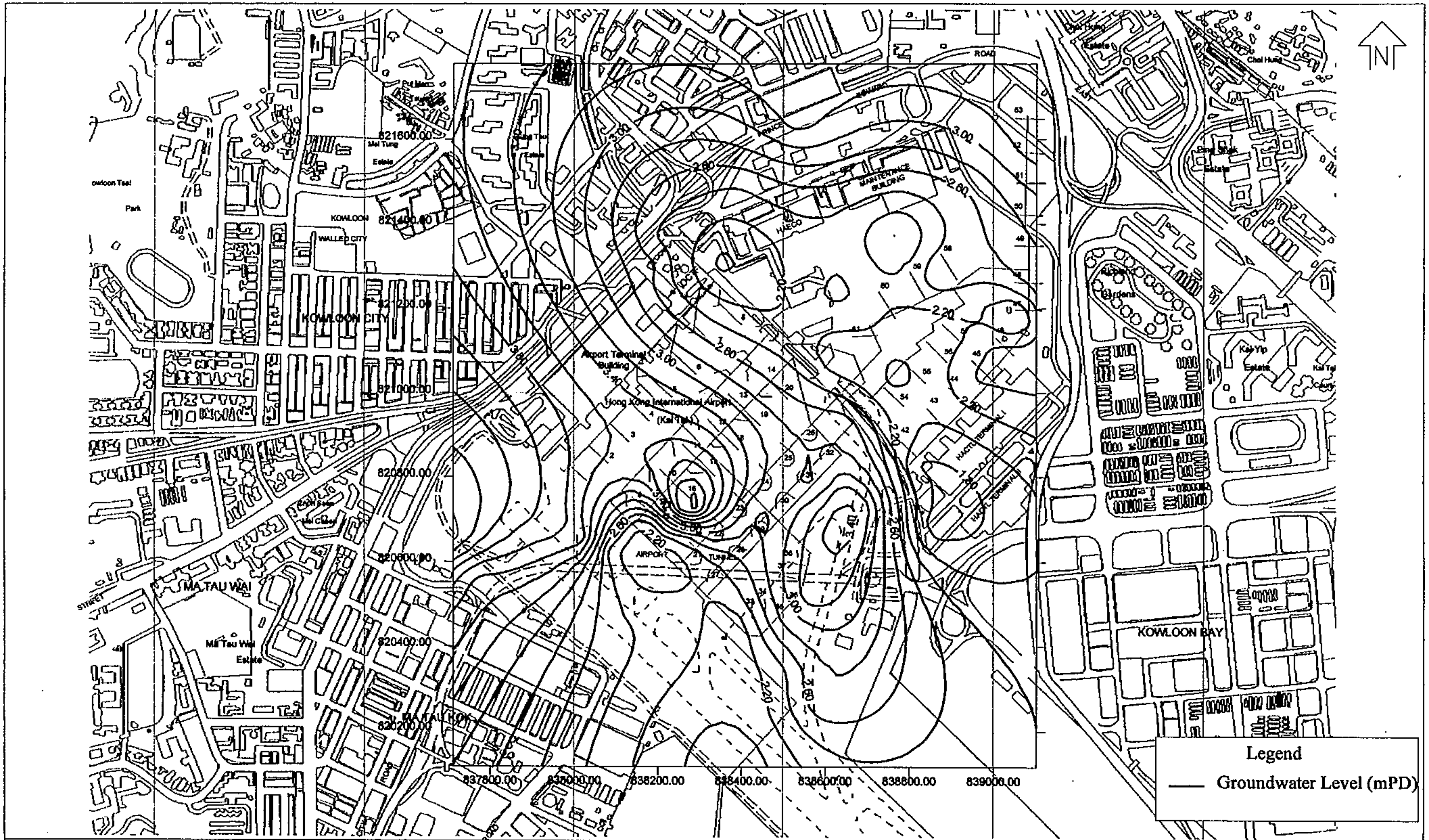
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department,Hong Kong
Kowloon Development Office

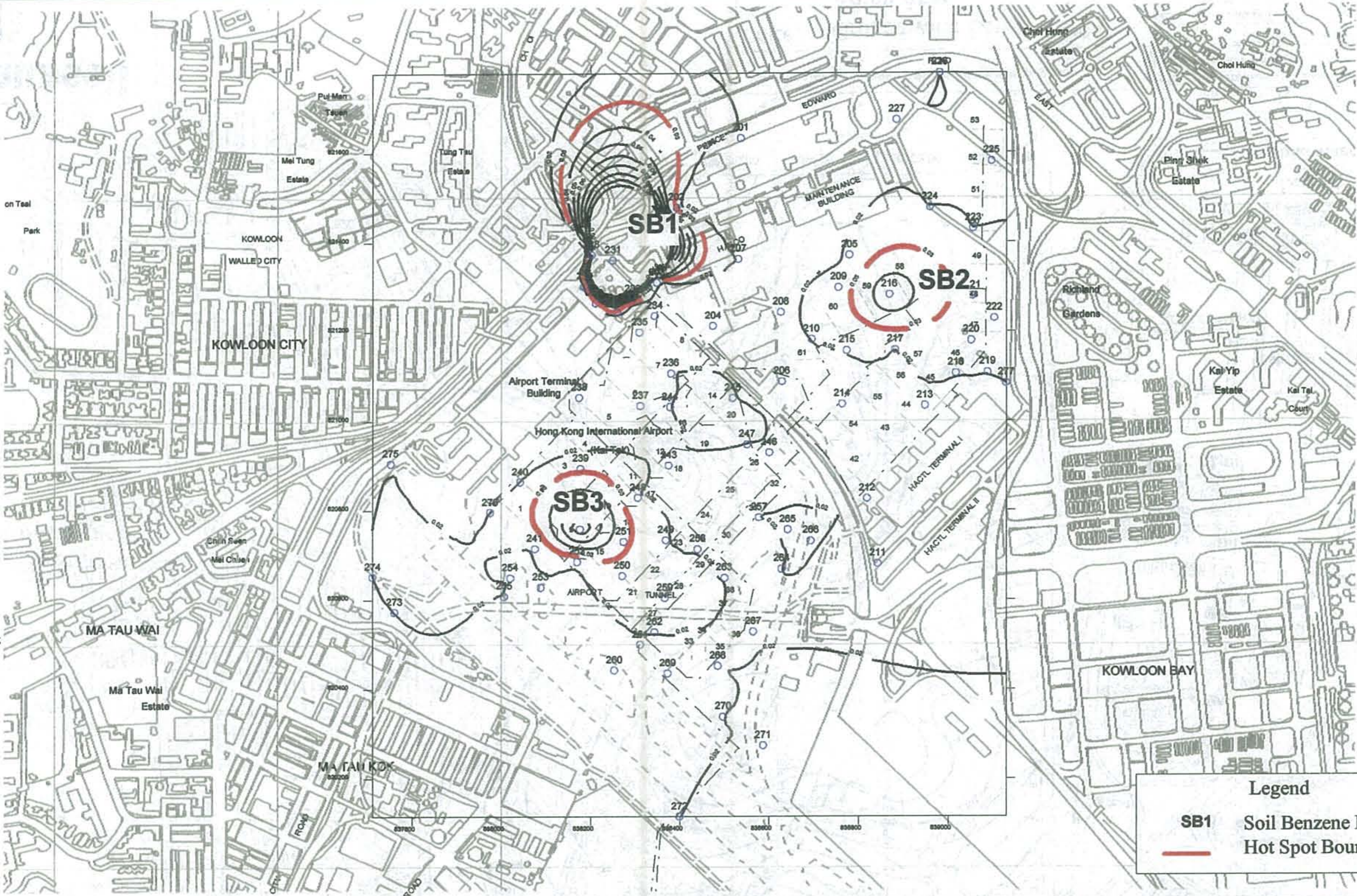
TITLE
TPH Levels in Groundwater

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.16 REV 0



Maunsell in association with 環科 CES	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING		Territory Development Department, Hong Kong Kowloon Development Office
	TITLE	Groundwater Level of KTA Apron Area	

SCALE	1 : 12000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.17 (REV 0)



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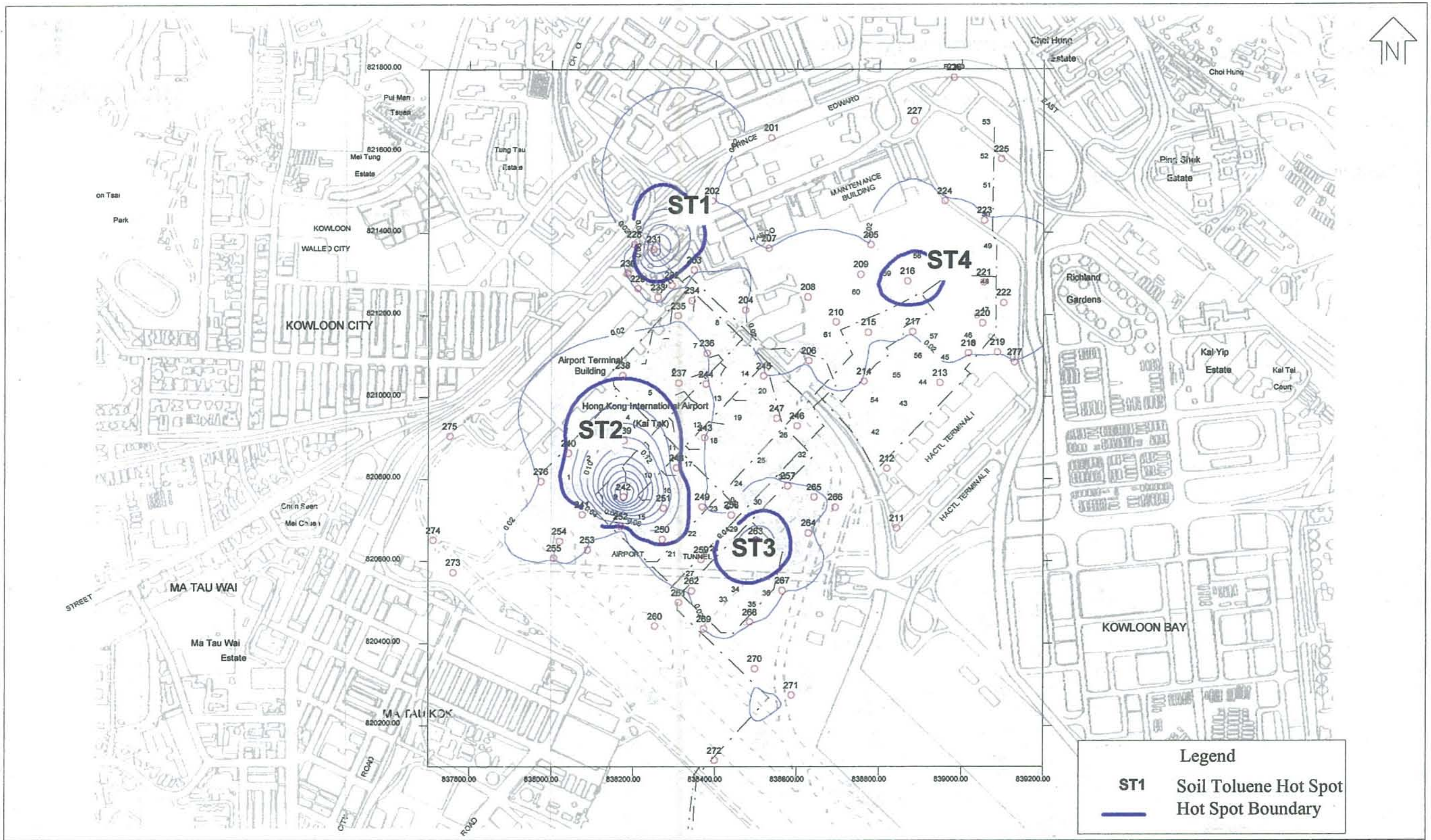
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department, Hong Kong Kowloon Development Office				
TITLE Soil Benzene Hot Spots (1m above Ground Water Table)	SCALE	1 : 13000	DATE	June 1998	
	DESIGNED	Fanny Lau	DRAWN	Fanny Lau	
	CAD REF.	C415	DRAWING No.	Figure 7.18	REV 0



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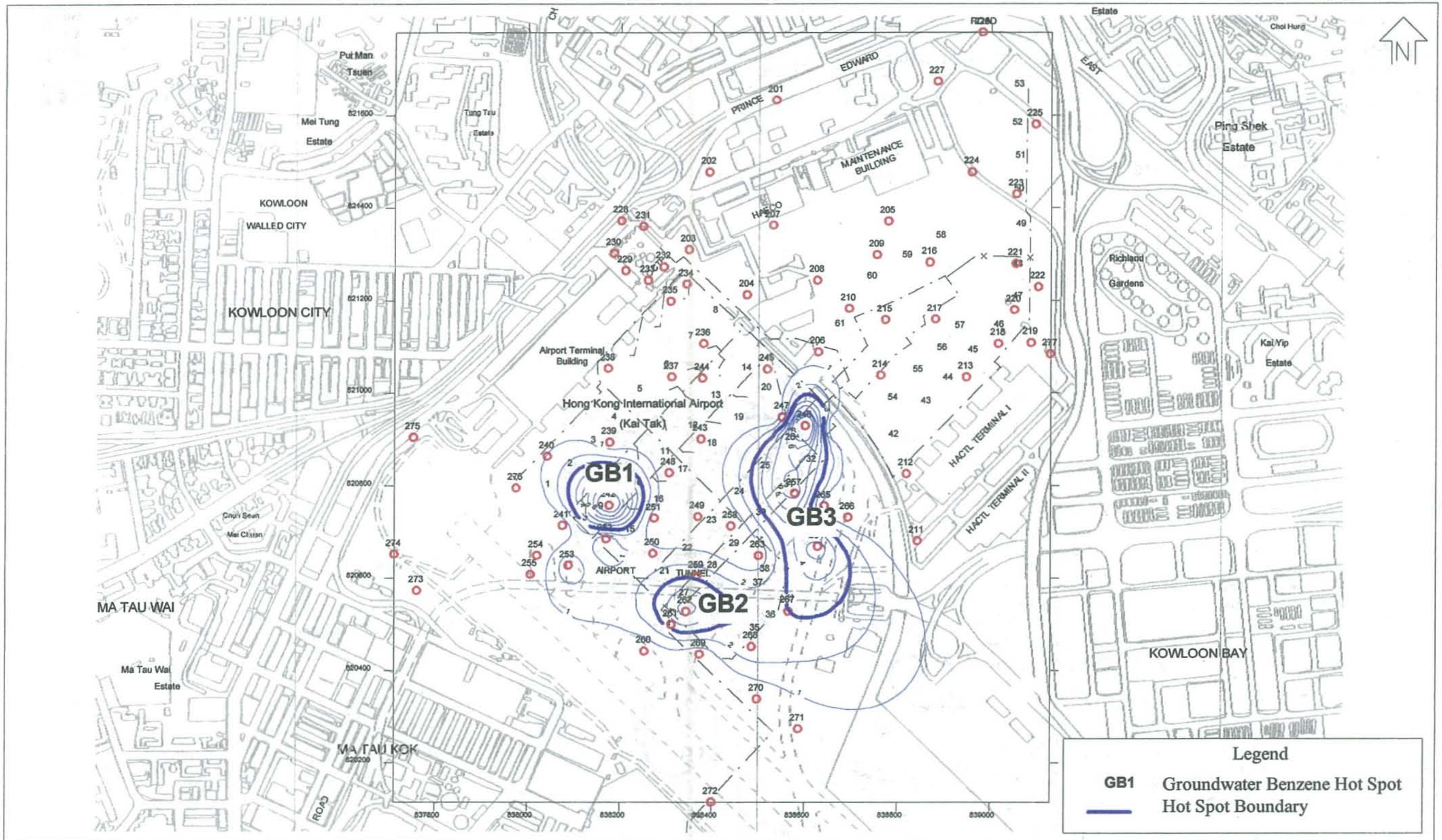
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE Soil Toluene Hot Spots (1m above Ground Water Table)

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.19
		REV	0



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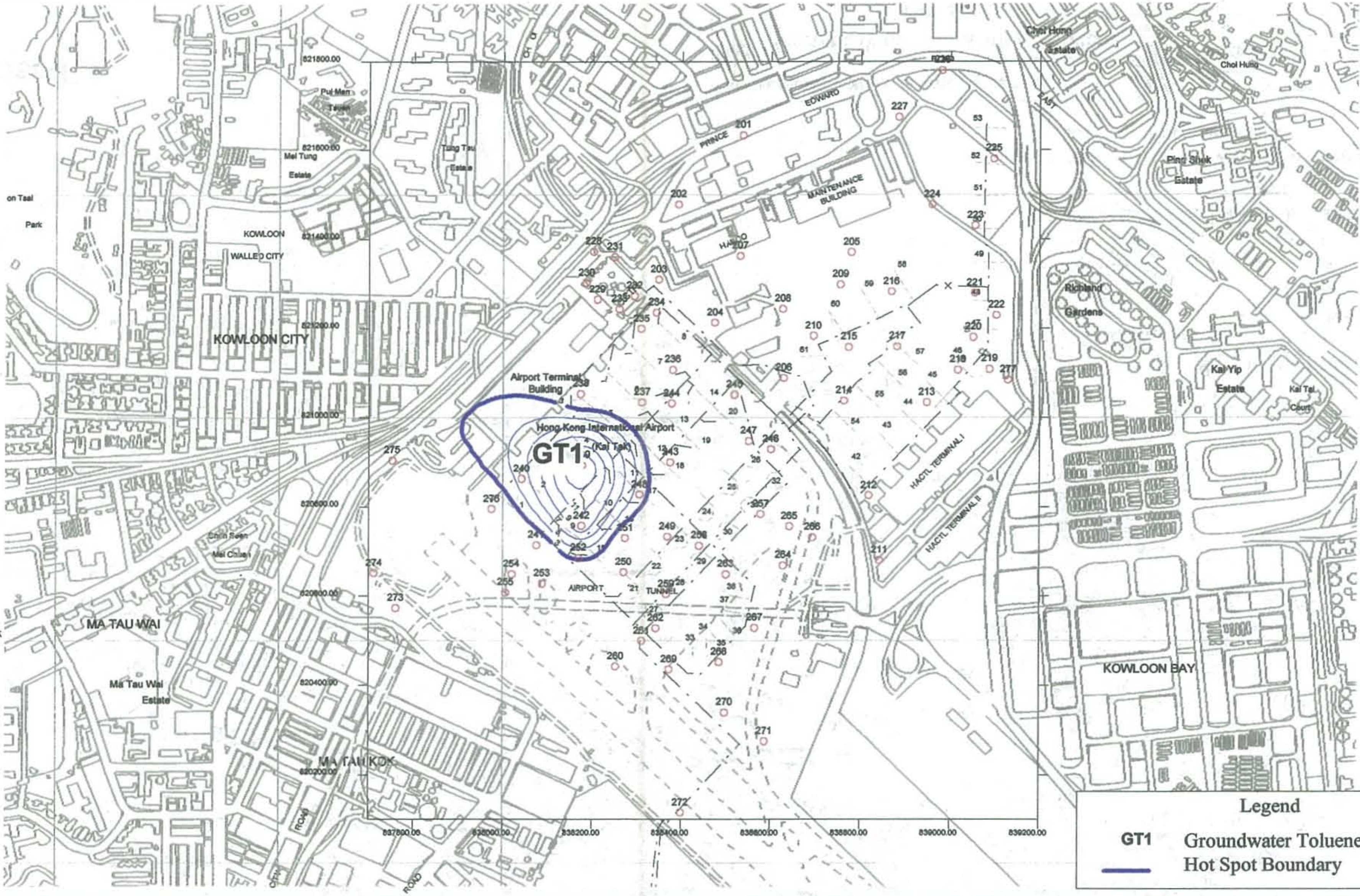
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE

Ground Water Benzene Hot Spots

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.20
		REV	0



Legend

GT1	Groundwater Toluene Hot Spot
(blue line)	Hot Spot Boundary

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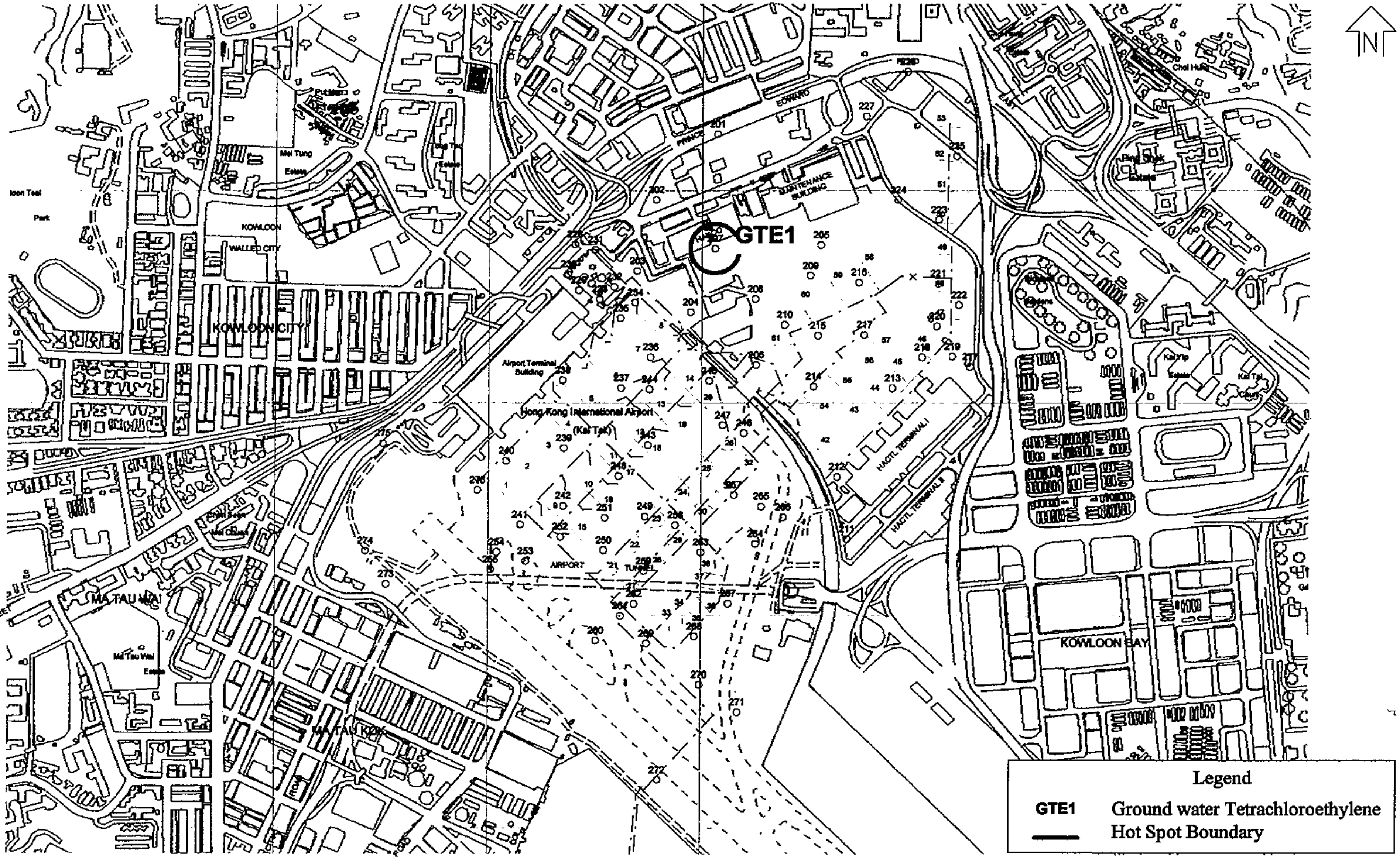
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department,Hong Kong
Kowloon Development Office

TITLE

Ground Water Toluene Hot Spots

SCALE	1 : 13000	DATE	June 1998
DESIGNED	Fanny Lau	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 7.21
		REV	0



Maunsell 環科 CES	KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department Hong Kong, Kowloon Development Office		
	TITLE Ground Water Tetrachloroethylene Hot Spot	SCALE 1 : 13000	DATE June 1998	
		DESIGNED Fanny Lau	DRAWN Fanny Lau	
		CAD REF. C415	DRAWING No. Figure 7.22	REV 0

8 MITIGATION MEASURES

8 MITIGATION MEASURES

8.1 NOISE

An effective approach to noise reduction would be to employ quieter plant. For each item of PME already identified, corresponding SWLs of quieter alternative plant have been identified from BS5228: Part 1: 1984, where these exist (Tables 8.1 - 8.3). Table 8.4 demonstrates the lower noise levels that would be experienced at NSRs if these items of quieter plant were employed. Under this scenario the total number of exceedances of noise criteria would fall from 20 to 8; a reduction of 60%. As can be seen from the table, residual impacts would only then be predicted to occur at five NSRs, all of which are schools (S1, S2, S5, S6 and S7).

Table 8.1 Likely Powered Mechanical Equipment for Demolition of Existing Structures: Quieter Plant

Item	Number	SWL per Item, dB(A)	Reference
Excavator/loader	1	105.0	BS5228, Table 7, Item 59
Bulldozer	1	109.0	BS5228, Table 7, Item 27
Rock drill, hand held	1	114.0	BS5228, Table 9, Item 55
Mounted breaker	1	122	CNP 027
Total SWL, dB(A)		122.5	

Table 8.2 Likely Powered Mechanical Equipment for Installation of Remediation Equipment: Quieter Plant

Item	Number	SWL per Item, dB(A)	Reference
Excavator/Loader	4	105.0	BS5228, Table 7, Item 59
Air compressor	1	100.0	CNP 001
Lorry	1	105.0	BS5228, Table 7, Item 59
Breaker, hand held	1	108.0	CNP 024
Water pump	4	88.0	CNP 281
Total SWL, dB(A)		113.5	

Table 8.3 Likely Powered Mechanical Equipment for Apron Concrete Removal: Quieter Plant

Item	Number	SWL per Item, dB(A)	Reference
Excavator/loader	1	105.0	BS5228, Table 7, Item 59
Crawler rock drill	1	119.0	BS5228, Table 6, Item 4
Hydraulic rock breaker	1	108.0	CNP 024
	Total SWL, dB(A)	119.5	

Table 8.4 Predicted Noise Level by Works Task: Mitigated

NSR ID	Noise Level by Works Task					
	Demolition of Existing Structures		Installation of Remediation Equipment		Apron Concrete Removal	
	Dist., m	dB(A)	Dist., m[1]	dB(A)	Dist., m	dB(A)
S1	165	**73.5**	715	48.6	165	**72.1**
S2	165	**73.5**	640	47.6	165	**72.1**
S3	355	66.9	395	56.8	355	63.5
S4	250	69.9	225	61.6	250	66.5
S5	205	**71.7**	150	65.2	205	68.3
S6	110	**77.1**	325	58.4	110	**73.7**
S7	190	**72.3**	1155	42.4	190	68.9
H1	195	72.1	755	51.1	195	68.7
H2	160	73.8	115	67.5	160	70.4
R1	170	73.3	665	52.2	170	69.9
R2	250	69.9	1230	46.9	250	66.5
R3	205	71.7	1140	47.5	205	68.3
R4	270	69.3	1085	48.0	270	65.9
R5	155	74.1	670	52.2	155	70.7
R6	140	75.0	630	52.7	140	71.6
R7	155	74.1	590	53.3	155	70.7
R8	190	72.3	580	53.4	190	68.9
R9	205	71.7	580	53.4	205	68.3
R10	245	70.1	590	53.3	245	66.7
R11	265	69.4	595	53.2	265	66.0
R12	315	67.9	615	52.9	315	64.5
R13	145	74.7	410	56.4	145	71.3
R14	155	74.1	385	57.0	155	70.7
R15	195	72.1	375	57.2	195	68.7
HL1[2]	110	67.1	328	48.4	110	63.7

Note: 1 distance to actual source
2 NSR will be screened from all works by passenger terminal, therefore negative correction of 10 dB(A) applied to PNL in line with relevant NCO *TM (Section 2.10 - Step 10)*
Assessment criterion for educational establishments is generally 70 dB(A)
Bold text denotes exceedance of noise criteria

With regard to cumulative impacts resulting from potential concurrent demolition tasks in the vicinity of NSR-S6 Table 8.5 sets out predicted worst case noise levels.

Table 8.5 Worst Case Cumulative Noise Impacts at NSR-S6 due to Demolition Works: Mitigated

Notional Source	Distance, m	Predicted SPL, dB(A)
Demolition Team #1	110	77.1
Demolition Team #2	110	77.1
Cumulative Impact		80.1*

* calculated in accordance with Table 4 of the *TM*

In accordance with the instructions of the brief for this study, section 5.1 i) instructs that "all background information relevant to the project" shall be provided. Further to this, it should be noted that through our personal communications with all of these NSRs we have established the following:

- NSR-S1, NSR-S2 and NSR-S7 do not have any noise sensitive facades facing the site (presumably design features to mitigate aircraft and traffic noise).

- NSR-S5 and NSR-S6 have air-conditioning and are fitted with noise insulating double glazing on affected facades to counter existing road traffic and aircraft noise.

As such, it is considered that construction noise impacts would be acceptable at all identified NSRs and there would be no residual impacts. Further, for the same reasons, it is considered that any worst case cumulative impacts resulting from demolition works would also prove acceptable at all affected NSRs.

In addition to the foregoing proposals, there are also many good site practices which would serve to reduce noise levels still further. Consequently, it is strongly recommended that any appointed contractor should observe the following measures:

- Noisy equipment and activities should be sited by the contractor as far from sensitive receivers as is practical. Also, temporary site offices (and other similar structures) should be located, as far as is possible, such that sensitive receivers are screened from the line of sight of the construction areas.

- Intermittent noisy activities should be scheduled to minimize exposure of nearby NSRs to high levels of construction noise. For example, noisy activities can be scheduled at times coinciding with periods when dwellings are unoccupied. Prolonged operation of noisy equipment close to dwellings should be avoided.

- Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

- Construction activities should be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.

- Where possible, the numbers of concurrently operating items of plant should be reduced through sensitive programming.

- Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g., compressor panels, and mufflers. Silencing measures should be properly maintained and utilized

In summary, it is recommended that quieter plant is used by the appointed contractor, where possible. With this mitigation in place it is predicted that there would be no residual impacts at any of the identified representative NSRs, some of which already have already been fitted with purpose built noise attenuating glazing or non-sensitive facades.

8.2 AIR QUALITY

In view of the potentially high levels of dust arising from the demolition activities and the operations of the temporary crushing plant and stockpiling area, it will be necessary to adopt dust mitigation measures wherever practicable. A commitment by the contractor to adopt good operational practices for dust minimisation should reduce the dust nuisance to a minimum. A number of practical measures are listed below:

(i) Dust

- Use of regular watering to reduce dust from exposed site surfaces, at least twice daily with complete coverage, particularly during dry weather. During periods of rainfall this will not be necessary as the dust will be naturally suppressed.

- Use of frequent watering for particularly dusty static site areas close to the site boundary and sensitive receivers.

- Side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this not practicable owing to frequent usage, watering should be employed to aggregate fines.

- Open stockpiles should be avoided or covered. Where possible, prevent placing dusty material storage piles near air quality sensitive receivers.

- Provision of barriers, which may be temporary noise barriers, between the site and nearby air quality sensitive receivers to act as dust barriers.

- Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations.

- Establishment and use of vehicle wheel and body washing facilities at the exit points of the site, combined with cleaning of public roads where necessary.

- Provision of wind shield and dust extractor at the loading and unloading points and use of water sprinklers at the loading and unloading areas.

- Imposition of speed controls for vehicles on dusty site areas.

- Where feasible, routing of vehicles and positioning of plant at maximum possible separation distance from air quality sensitive receivers.

- A crusher feedbox with a minimum number of openings should be installed for the crushing plant. Rubber curtains should be used to minimize dust escape and air flow.

- The crusher should be choke fed to reduce air entrainment and dust emission.

(ii) Treatment of Vapour from Soil Treatment

- A catalytic incinerator should be installed to exhaust fuel and oil vapour extracted from the contaminated site (SVE/AS system and biopile) prior to their discharge to atmosphere.

- Instigation of a control program to monitor the demolition and decontamination process in order to enforce controls and modify methods of work if dusty or vapour conditions arise.

(iii) Vapour Impact from Excavation of Contaminated Spots

Adverse air quality impacts at sensitive receivers due to benzene emissions from the excavation of contaminated soil would not be expected if the excavation rate for the remediation sites are controlled below the maximum rates below. The buffer distances indicate the minimum distances at which temporary receivers should be located away from the source (Figure 8.7).

Remediation Site	Maximum Excavation Rate	Buffer Distance
Hot Spot A	120m^3 contaminated soil per hour	80m
Hot Spot B (As a fall-back option only)	240m^3 contaminated soil per hour	120m
Hot Spot C	240m^3 contaminated soil per hour	120m

8.3 WATER QUALITY

Construction Site Run-off

All the discharges from the construction sites are subject to the control, thus the contractor should apply to EPD for wastewater discharge licences. The contractors should ensure that all discharges from the construction site comply with the relevant performance requirements specified in the Technical Memorandum, *Standards for Effluents Discharged into Drainage and Sewerage System, Inland and Coastal Waters*. A surface water quality monitoring programme (to be addressed in a separate EM&A manual) to control construction discharges should be instigated.

The good practices outlined in ProPECC PN 1/94 "*Construction Site Drainage*" should be followed as far as practicable in order to minimize surface runoff and the chance of erosion, and also to retain and reduce any suspended solids prior to discharge. These practices include, *inter alia*, the following items:

- Provision of perimeter channels to intercept storm-runoff from outside the site. These should be constructed in advance of site formation works and earthworks.

- Sand/silt removal facilities such as sand traps, silt traps and sediment basins should be provided at the discharge points to remove sand/silt particles from run-off prior to discharge outside the site.

- Careful programming of the works to minimize soil excavation works during rainy seasons.

- Exposed soil surface should be protected by shotcrete or hydroseeding as soon as possible to reduce the potential of soil erosion.

- Temporary access roads should be protected by crushed gravel.

- Open stockpiles of construction materials on site should be covered with tarpaulin or similar fabric during rainstorms.

- Before commencing any demolition works, all drainage connections should be sealed to prevent building debris, soil, sand etc. from entering public sewers/drains.

- Drainage serving an open oil filling point should be connected to storm drains via a petrol interceptor with peak storm bypass.

- For construction activities near existing storm drains/nullahs, precaution should be taken to prevent spillage of excess materials into the drain. If practical, the water run inside the channel should be separated from the construction activities, e.g. by means of sheet piles.

- Stockpiles should be placed at locations away from the edge of the channel to minimise introduction of materials into the channel, either due to surface runoff or accidents.

In addition, septic tanks or chemical toilets should be used as far as practicable during construction stage. Grease traps for wastewater generated from the canteen, should also be provided. Any such treatment facilities should be frequently maintained to ensure proper function. Production water should be re-cycled to minimize the wastewater discharge, where possible.

Wastewater from Decontamination

The small amount of entrained liquid in the SVE vapour line would be treated by an oil interceptor and re-injected to Air Sparging zone for further treatment.

Most of the soil to be excavated will be unsaturated soil, and no dewatering process is anticipated for these areas. Minimal amount of leachate will be produced and it will contained and disposed off site. For excavation below the groundwater, large size backhoes with excavation depth down to 5 m will be used. The temporary stockpiled will be lined and covered to contain any leachate, which will be disposed off site.

The excavation of the hotspots will start around November - December 1998 which is the start of the dry season. The excavation will be carried out during the dry season period as much as possible to minimise the water quality impact resulting from contaminated runoff.

The biopile will be covered with flexible LDPE material and lined with geotextile drainage mesh and HDPE liner which is impermeable to water and is very durable. This material has been used in sanitary landfill linings in Hong Kong. The flexible membrane used to cover the biopiles will be sealed in one piece for each pile (using seamless technology if necessary), thus minimising the chance of rain water seepage into the piles. The covered biopile will be stabilised with heavy weights such as sandbags to prevent wind from blowing off the cover. This has been practiced in a few overseas sites.

Leachate will be disposed offsite for treatment at suitable treatment facilities. The biopile area will be separated into 4 sections Perimeter trenches will be constructed for each of the four areas to collect and drain away rain water runoff. The height of the biopile will be 3m average, the highest point can reach 5m. This would create a natural slope for rainwater to be drained to the perimeter trench. Given the large area of biopile and the need for large mechanical equipment to manoeuvre within the site, roof structure is not practicable. It will be specified in the contract that the biopile should be covered at all times. During the transfer of the contaminated soil from excavation area to the biopile when full time coverage may not be possible, it will be specified that no soil pile larger than 10m by 10m shall be exposed at any one time, thereby minimising the exposure of contaminated soil to rain water.

Oil spill mitigation measures in the form of containment would be implemented during demolition of the fuel tanks. Residual water in the pipes would be collected and treated to comply with WPCO discharge standards before discharge.

The water quality impact of the pilot plant is discussed in Section 8.6.5.

8.4 WASTE MANAGEMENT

Different types of wastes should be segregated, stored, transported and disposed of separately in accordance with EPD's required procedures.

Construction Materials

A large quantity of construction waste will be generated resulting from demolition of buildings, removal of pavements and utility services. Under the WDO, construction waste is classified as a trade waste. The waste producers are responsible for its disposal. Its handling should comply with the *New Disposal Arrangement for Construction Waste* (1991), whereby wastes should be separated into non-inert and inert materials. The former, such as wood, glass, plastic, steel and other metals (including contaminated redundant and excavated pipelines), should be normally disposed of at strategic landfills. The latter, such as concrete and rubble, should only be disposed of at a public filling area. However, in order to minimise quantity of non-inert material to be disposed of at the landfill, steel and other metals should be separated for re-use and recycling.

Considering that a large quantity of construction material will be generated from the proposed work, on-site storage and crushing facilities have been considered. It is estimated that a total of 982,966m^3 construction material would be generated. Of which, 869,247m^3 construction waste (= 271,148m^3 inert material + 531,024m^3 pavement material) will be processed and re-used on site for road, rail and reclamation, etc. The remaining 180,794m^3 is non-inert construction material represents 18% of total solid waste. Of which, 5,500m^3 would be usable metallic material and should be recycled. The rest 175,294 m^3 will require to be disposed of at landfill.

If there is surplus waste required to be disposed of at public filling areas. It should be noted that the public filling materials should only consist of earth, building debris and broken rock and concrete. They shall be free from marine mud, household refuse, plastic, metals, industrial and chemical waste, animal and vegetable matter, and other material considered unsuitable by the Dump Supervisor. Small quantity of timber mixed with otherwise suitable material may be permitted.

Chemical Waste

Chemical waste (e.g. oily sludge, halogenated solvent) produced from decommissioning of underground pipes and tanks and other activity should be handled according to the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* and disposed of by a licensed contractor at Tsing Yi Chemical Waste Treatment Facility. The contractor should register with EPD as a chemical waste producer. In addition, mitigation measures must be adopted to prevent the uncontrolled disposal of chemical and hazardous waste into the air, soil and waters.

Where tanks or pipes are to be emptied or removed, precautionary measures should be taken to avoid the spillage of any petroleum products which may cause contamination to the ground. Any contaminated materials such as absorbent or cleaning stuffs should be disposed of properly.

An investigation to identify the presence of ACM should be carried out. If temporary on-site storage of ACM is required, the storage facilities will be designed in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* issued by EPD. ACM must be removed by registered contractors and disposed of at a landfill. The handling procedures must comply with the requirements specified in the EPD's *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste*. Site investigation for the presence of ACM should be carried out during the decommissioning.

A sewerage system or septic tanks must be provided to collect human waste. Sludge should be removed regularly by a hygiene service company to a suitable landfill site, subject to the sludge generated meeting the acceptance criteria (eg. dry solid content) for the landfill.

On-site refuse collection points must be provided. This waste would normally be collected by private waste collectors, then transferred to a transfer station for compaction and containerisation, and finally disposed of at a landfill.

Table 8.6 provides a summary of waste handling methods for different type of waste.

Table 8.6 Summary of Waste Handling Procedures

Waste Type	Mitigation Measures	
	Handling	Disposal
Construction Waste	Where possible should be re-used on-site	On-site for reclamation and road base
	If off-site disposal required, separate into: • Non-inert material - steel and other metals - remaining material • Inert material: concrete and rubble	 Re-use and recycling Landfill Public filling area or reclamation
Contaminated Soil	To be treated on site. Shall not be re-used either on-site or off-site for other purpose unless it is cleaned properly	-
Chemical Wastes	Recycle on-site or by licensed companies Stored on-site within suitably designed containers Contaminated soil would be treated on site	- Chemical Waste Treatment Facility
	Asbestos. Provision of appropriate on-site temporary storage facility where necessary To be removed off-site by registered contractors	Landfill
Workforce Waste	Provide on-site refuse collection facilities Main sewerage or septic tank	Refuse Station for compaction and containerisation and then to Landfill Private hygiene company

8.5 ECOLOGY

As impacts are anticipated to be either beneficial or of minimal adversity no mitigation measures are considered necessary.

8.6 CONTAMINATION REMEDIATION ACTION PLAN

8.6.1 Remediation Objectives

Results from the Phase 2 assessment indicate TPH (as the key contaminant of concern) is present in significant concentrations. Comparison of soil contamination levels above the ground water table with historical leakage records reveals a correlation between the contamination of soil relatively unaffected by ground water influence and the locations in proximity to the original point of leakage. The remaining contaminants are, generally speaking, present at background concentrations according to Dutch 'ABC' levels or the newer Dutch guideline.

Table 8.7 provides details of the remediation objectives. The remediation target for soil TPH is determined to be the Dutch B level (1000 $mgkg^{-1}$). The clean up levels for ground water are determined by the environmental risk assessment to meet the acceptable risk level of 1 x 10^{-6} and the acceptable hazard quotient of 1.0. For methane, the remediation target is set as the safety limits, 0.5 - 1% (v/v) methane.

Table 8.7 Summary of Remediation Objectives

Matrix	Key Remediation Parameter	Remediation Target	Justification
Soil	TPH	Dutch B level (1000 ppm TPH)	Remediation standard adopted by EPD in previous cases
Floating oil	TPH	Non detectable	Removal of source material
Ground Water	Benzene	17 $\mu g l^{-1}$	Remediation levels to meet acceptable risk level[1]
	Tetrachloroethylene	110 $\mu g l^{-1}$	Remediation levels to meet acceptable risk level[1]
	Toluene	25,000 $\mu g l^{-1}$	Remediation levels to meet acceptable hazard quotient[1]
Soil Gas	Methane	10% - 20% of the lower explosive limit (LEL)	Control limits to provide a significant margin of safety

8.6.2 Selection of Appropriate Technologies

Comparison of Potential Technologies

Both soil and ground water remediation options applicable to the subject site were considered in the SEKDFS. Comparison of the potential remediation technologies are summarised in Table 8.8 in terms of:

- principal application
- previous experience in Hong Kong
- constraints
- data requirement for remedial design or permit
- suitability to soil type
- duration
- approximate cost
- potential sites for application
- what other technologies can be used in combination

Table 8.8 Potential Remediation Technologies

Technologies	Principal Use	Experience in HK	Constraints	Data Requirement	Possible Regulation	Suitability to Soil Type				Duration	Cost	Potential Target Sites	Technologies in Combination
						Clay	Silt	Sand	Gravel				
Excavation/ Disposal	Shallow contamination, during reconstruction, one-time removal, address all contaminants	Widely practised for small sites	No treatment, long term liability to landfill, deplete landfill, handling creates occupational hazard, costly for large volume of soil, need backfill material	Very few	Waste	g1	g1	g1	g1	Days to weeks (location of landfill, approval)	Low for small to moderate volumes, high for large volumes	All sites	Landfilling/ incineration
Containment	Cut-wall to control water movement, capping to control vapour problem	Yes, for landfills	Does not remove contaminant, long term liability remains, require long term monitoring	Few	None	g1-2	g1-2	g1-2	g1-2	Weeks	Low to moderate	All sites with potential migration	Cement or clay cut-walls
Soil Venting/ Air Sparging	Volatile or volatile fractions by SVE/AS, non volatile fractions by bioremediation	Yes, for large sites	May need secondary pollution control	Moderate	Air and waste	f3	f3	g1-2	g1-2	Few months (depends on volatility)	Relatively inexpensive for gasoline/ solvents	Widespread contamination	Biotreatment
Biopiling	Long term site cleanup to background level, can decontaminate difficult-to-reach areas	Yes, only for large sites	Requires initial treatability study, large area, difficult to manage, H&S problem by diffuse vapour, long time required	Moderate	Air, water and waste	g3	g3	g3	f3	Months to years (depends on rate of bio-degradation)	Only effective for extensive contamination with long term cleanup	Widespread oil contamination at sites that can be closed for long time/ require very clean end use	Venting and hydrological controls
Pump and Treat (wells, trenches)	For wells, can be used at greatest depths, will collect water and free product, for trenches, control infiltration at sites with low water table	Yes, for large sites	Seasonal changes of water levels may affect process, need follow up treatment, may require long time (wells), not very effective	Moderate	Water, sewer, and chemical waste	f2	f2	f2	f2	Months to years (depends on permeability)	Trenches + skimming inexpensive, can be expensive for ground water depending on subsequent treatment	Useful in removing free product	Treatment like oil/water separation, biotreatment, aeration, chemical precipitation, activated carbon

Legend success of treatment : g = good, f = fair, p = poor; ease of accomplishment: 1 = good, 2 = fair, 3 = difficult

Site Characteristics

In selection of the most appropriate remediate technologies, it is important to take account of the site characteristics. Table 8.9 is a summary of the site characteristics.

Table 8.9 Summary of Site Characteristics

Characteristics	Comment
Remediation area (soil)	11 hectares total in 3 hot spots
Contaminated media	-soil in three hot spots -groundwater in similar areas but more spread out -free product (0.3m) confined in three boreholes
Depth of contamination	about 2-6 m below grade
Volume of unsaturated contaminated soil	282,400 m^3
Nature of contaminants	mainly TPH, middle carbon fraction (C_{10}-C_{14}), some BTEX
Contaminant mobility	moderate mobility via soil & groundwater, determined by groundwater gradient
Soil permeability	moderate to high at groundwater level
Nutrient levels	low to moderate
Oxygen level in soil and groundwater	deficient in hot spots, anaerobic
Moisture level in vadose zone soil	moderate
Microbiological activity	elevated in hot spots
Proposed end use of remediated site	mixed land use, with high rise residential areas

Screening And Recommendation Of Possible Technologies

Based on the above mentioned analysis of the relative disadvantages and advantages of the potential methods as well as the site characteristics, a screening process has been carried out to identify the most suitable technology for remediating the subject site. The screening comments and results are summarised in Figure 8.1 for soil remediation and Figure 8.2 for ground water remediation.

The alternative remediation methods that can achieve cleanup within the tight time frame will be ex-situ methods i.e. excavation and landfarming. We can minimise the impact from the landfarming by adopting the biopile method. However, health and safety impacts to workers and environmental impact to off-site receivers are expected for large scale excavation. Appendix F compares the SVE/AS system with landfarming/pump & treat method.

Air sparging (AS) and soil vapour extraction (SVE) have been demonstrated to be very effective at numerous sites and are commonly used for remediation of sites contaminated with petroleum hydrocarbons. Permeability is unlikely to be a wide spread problem over the site to invalidate the choice of SVE/AS. If it is a problem, it is most likely to be a localised problem confined to few locations. The pilot test for SVE/AS will be designed to determine SVE effectiveness under various permeable conditions. For less permeable soil, excavation and biopile may be used.

The recommended remediation technologies for cleaning up the subject site are SVE / bioventing for soil and air sparging for ground water / saturated soil.

Limited excavation of soil would be undertaken at the severely contaminated hot spots and the materials biopiled in an area at the NAKTA. Although *ex situ* methods such as excavation would create more secondary environmental effects (eg water and air), the tight development programme for some areas such as Hotspot A and C would not allow the construction and operation of SVE/AS systems. Measures have been designed to mitigate these secondary environmental effects.

8.6.3 Conceptual Process Of Remediation

Remediation Sequence

The recommended cleanup sequence is as follows:

1) Remove contaminated soil by excavation and biopile on site for fast track development areas

2) Treat the volatile fractions from residual hydrocarbons occurring in the unsaturated zone (to deal with vapour migration problems) by SVE

3) Treat the heavier fractions of hydrocarbons by bioventing

4) Use air sparging to clean up the soil and ground water in the saturated zone

5) As a fall-back option, recover the free product and remove the contaminated soil in the free product contaminated area and biopile on site

6) Use monitoring wells to assess off site migration of contaminant and progress of remediation, conduct post remediation monitoring to ensure no "rebound" of contamination.

The areas that will require remediation are illustrated in Figure 8.3a. The layout of the remediation systems is presented in Figure 8.3b. The remediation methods are summarised in Table 8.10.

Table 8.10 Summary of Proposed Remediation Methods

Matrix	Key Remediation Parameter	Remediation Methods
Soil	TPH (Hotspot B - southern apron)	SVE/ air sparging limited excavation (fall back option)
	TPH (Hotspot A - OCTF)	excavation
	TPH (Hotspot C- HACTL)	excavation
Floating oil	TPH thickness	SVE/ air sparging recovery wells (fall back option)
Ground Water	Benzene	air sparging
	chlorinated hydrocarbon in HAECO building (if confirmed)	*in situ* chemical oxidation (if necessary)
Soil Gas	Methane	SVE Concrete breaking for air diffusion, tilling during excavation

Excavated Soil for Biopile

A designated site for biopile is being identified in Planning Area 2I and the contaminated soil will be reused as filling material after treatment.

The biopile operates on the principle of volatilisation and biodegradation. The advantages are that it is more efficient than SVE because the permeability of soil is improved during the excavation process. The vented air from the biopile is connected to the blower and catalytic oxidizer for treatment before release to the atmosphere.

The basis of volume of biopile and the phasing are discussed in Section 8.6.6.

Methane Mitigation

Figure 7.8 shows hot spots for methane requiring remediation. Hot spots ME2 and ME3 would be addressed by the SVE plants proposed for TPH treatment. ME1 has not been shown to be a problem by TPH contamination data. The SVE and AS system would be able to cleanup the existing methane and the source of methane. Existing methane would be removed by the venting process. The biodegradation induced by the AS and SVE process will remove the non-volatile portion of the fuel which may generate methane if left untreated.

Ideally, one would also want to implement a venting plant at ME1, although methane takes much less time to vent (2-3 months), thus raising a question as to the cost-effectiveness of such a solution. However, depending on soil permeability, the SVE plants installed for TPH treatment would also address the methane problem in the ME1 area. Furthermore, breaking up the concrete will allow the atmospheric oxygen to diffuse into the soil promoting aerobic condition and gas exchange to alleviate the methane problem.

8.6.4 Programme of Remediation

Appendix A presents the proposed construction programmes for the decontamination and site preparation work. The decontamination work is scheduled to commence in October 1998 and complete with different target dates for different areas to meet the housing development programme. All decontamination is scheduled to be completed by December 2000.

8.6.5 Pilot tests of the SVE/AS system

As there is some uncertainty regarding the permeability of the site, pilot tests will be performed immediately after the airport closes to verify the feasibility of the SVE/AS in different areas within Hotspot B and to gather design data for system optimisation.

The overall work flowchart for decontamination works is indicated in Figure 8.5.

8.6.5.1 Objectives

The air sparging pilot tests are to be conducted in two phases. The first phase involves running the sparge test alone, and the second phase involves running both the sparge and SVE tests concurrently. The purpose of conducting the AS test is to evaluate the feasibility of AS as a remedial technology and to determine AS design parameters. Data collected during the test can be used to:

1) determine the radius of influence
2) determine air flow pathways
3) size the air compressor
4) evaluate effects of mounding
5) evaluate effectiveness of sparging.

The combined air sparge-SVE test provides useful data for designing the overall system. The purpose of the test is to evaluate how the effects of simultaneously inducing a vacuum in the vadose zone and applying a positive pressure in the saturated zone affects the following :

1) SVE radius of influence
2) water level changes
3) VOC concentration changes
4) possibility of free product migration.

8.6.5.2 Criteria of Pilot Test

The air sparging will be considered to be infeasible or need to be substantially changed if:

1. The Radius of Influence is found to be much less than the present design

2. The VOC removal rate is too low to achieve the remediation period of 18 months
3. There is a substantial lateral migration of free product outside the Radius of Influence
4. There are considerable preferential pathways in the combined SVE/AS system
5. There is no demonstratable biological action.

8.6.5.3 Outcome of the Pilot Test

If the pilot plant indicates there is potential migration of free product, then free product recovery wells will be designed. This will be incorporated into the contract document. The free product recovery will be concurrent with the SVE/AS construction. If low permeability is identified, design changes (eg increase in well density, increase in air pressure) will be incorporated into the contract document.

8.6.5.4 Environmental Impact of Pilot Test

Air Quality

The proposed sites for pilot tests are within Hotspot B, which is totally open and has maximum air dispersal capabilities, therefore there is no opportunity for vented air to accumulate.

The pilot plant equipment is purpose designed for the intended work and has an integrated carbon adsorption system specifically to remove hydrocarbons and ensure safe operation. The carbon filter has very high efficiency (>98%) in removing hydrocarbon vapour. Exhaust air would be monitored for VOC using portable equipment (PID) to comply with the 100 ppm criteria. The discharge VOC would be in the <100 ppm range, together with the low air flow (<100 cfm), the air quality impact would be low. Any methane that is extracted would be immediately diluted to fall below the explosive limit within a few meters (dispersion modelling shows that within 15m, the concentration will fall to 1% of the original concentration, ie the methane concentration would be about 25 times lower than the lower explosive limit (LEL)). Since the wells can extend to 30-50m from the central venting/sparging point, this distance also serves as a buffer distance for air quality/ safety protection.

When the system is not in operation, an air-tight cap will secure the venting hole during daytime to stop any air from escaping into the atmosphere. Even without the cap, negligible volumes of subterranean air would be expected to flow when the vacuum pump is not in use. The system is designed such that 25% of the lower explosive limit (LEL) (ie. combustion can only take place at 100% of the lower explosive limit) should not be exceeded.

From previous experience, no problems have arisen from the soil venting test already performed at the airport; these are similar to the proposed SVE/AS pilot test. Pilot test workers, however, would be required to wear personal protective equipment.

Water Quality

No groundwater would be extracted from the ground. However, some water/ free product may be entrained by the vapour steam and it would be separated in the air-water separator. The quantity of water, however, is minimum (typically < a gallon per day) and will be disposed of off site as chemical waste.

8.6.5.5 Schedule of Pilot Plant

The installation of the SVE/AS wells at 4 venting locations would take about 1 month. A mobile unit (consisting of blower/air compressor, knockout drum, and activated carbon) would be used for the actual SVE/AS test. Each location would take 1-2 weeks to complete both the Phase 1 (AS only) and Phase 2 (SVE/AS). Therefore, a minimum of 10 weeks would be needed for site work.

8.6.5.6 Areas Required for Pilot Plant

Figure 8.6 shows the four selected locations of Pilot test and the corresponding 'air quality buffer distance', where no access is allowed by public.

8.6.6 Fall-back Options

If the pilot plant shows that SVE/AS is not suitable for certain areas, the free product wells would be installed to recover the free product prior to the operation of the SVE/AS system in order to prevent any free product migration.

8.6.6.1 Free Product Recovery

Objectives

1. To remove the source of contamination
2. To prevent the lateral migration of free product to outside the treatment zone
3. To design a relatively easy to build and operate system so that it will not delay the programme of SVE/AS or compromise the effectiveness
4. To design a safe system so that it will not create hazards to SVE construction workers
5. To design a system that poses little environmental impact.

Operation of free product recovery wells

The recovery trench method will not meet the criteria 3-5 above, it will create workers exposure, "trip-and-fall" safety and air quality problem.

The free product will be recovered by pumping and bailing out the liquid at areas where free product is found. In areas of productive wells (ie higher permeability), submersible skimmer pumps will be used. If free product thickness is too thin, or if the recharge rate is sufficiently high, then a second water depression pump will be installed to thicken the free product. This is seldom necessary because if the free product is insignificant (a few mm), it will not create migration potential, and it will be easily cleaned up by the subsequent SVE/AS. In areas of less productive wells, the free product will be bailed out automatically or manually, at least twice a day. Large diameter wells will be used to speed up the recovery. About 50 recovery wells would be strategically located across contamination hotspot B. The large diameter wells will be backfilled and appropriately compacted so that it will not create a preferential channel or a barrier to air flow.

Environmental Impact of Free Product Recovery

There is no significant environmental impact of free product recovery by bailing. The free product will be classified as chemical waste and will be disposed of by licensed chemical waste collectors. Workers will be required to wear personal protective equipment.

8.6.6.2 Excavation and Biopile for Free product contaminated areas within Hotspot B

As a fall-back option, excavation and biopile will be used to treat the soil contaminated by free product in Hotspot B, if the SVE/AS is not demonstrated to show good clean up progress after an operation period of 8 months.

Capacity of Biopile

An area of 120m by 180m has been allocated for the use of biopile. It is assumed that the average height will be around 3m. The amount of soil that can be treated at the biopile will be 64,800 m^3.

Estimated Volume of Soil to be Treated

The sources of soil requiring treatment at the biopile include: Hotspot A, Hotspot C, well cuttings, and area in Hotspot B where free product is found (as a fall-back option if SVE/AS fails). The maximum amount of contaminated soil at each part is estimated as below.

Areas	Volumes
Hotspot A - soil below ground water table	23,400 m^3
Hotspot A - soil above groundwater table	22,000 m^3
Hotspot C	8,000 m^3
Well cuttings	110 m^3
Free product area in Hotspot B (only if SVE/AS is unsuccessful)	57,340 m^3

Proposed Phasing of Biopile Operation

Since the free product area would only require treatment at biopile when the cleanup target is not met by the SVE/AS system, it is proposed to carry out the biopile operation in two phases.

Phase 1 To excavate and transport to biopile all the above-mentioned areas except those at Hotspot B. Therefore, contaminated soil at Hotspot A, Hotspot C and the well cuttings would be treated at the biopile at the start of the contract. The estimated total volume of contaminated soil to be treated at Phase 1 is 53,510 m^3, leaving 11,290 m^3 capacity at the biopile for contingency.

Phase 2 If the soil testing results after 8 months of operation of the SVE/AS system show that the cleanup goal for the free product area in Hotspot B is not likely to be reached, then the soil within this area will be excavated and transferred to the biopile for treatment. By this time, the contaminated soil undergoing decontamination at the biopile would have achieved the cleanup target and the cleaned up soil can be removed and this will free up the space at the biopile for treatment of the contaminated soil obtained from hotspot B. The amount of soil to be obtained from Hotspot B is around 57,340 m^3. Since the contamination contained in the soil would have been treated to a certain extent by the SVE/AS system, the amount of time required for treatment at the biopile would be substantially less than the soil obtained in Phase 1.

The environmental impact of excavation of Hotspot B have been discussed in Section 7.2.3 (air quality) and Section 8.3 (Water Quality).

Soil General Response Actions	Remedial Technology	Process Options	Description/ Effectiveness	Implementability	Cost	Comment
No Action	None	Not applicable	Does not achieve remedial action objectives	Long term liability remains	None	NR
Institutional Actions	Access restrictions	Deed restrictions	Effectiveness depends on continued future implementation. Does not reduce contamination	Legal requirements and authority	Negligible cost	NA
	Planning Control	Restrict sensitive uses around site	Does not reduce contamination, migration of contaminant off-site possible	Require cooperation from Government	Negligible	NA
	Monitoring	Soil vapour monitoring	Ongoing monitoring of soil vapour. Useful for documenting conditions. Does not reduce risk by	Contaminant migration possible, may not be acceptable to government	Low capital, low O&M	NR
Collection	Excavation	Excavation	Contaminated soil dug up. Need backfilling.	Easy to implement but high cost for large amount of soil	Very high capital, low O&M	NR
Disposal	Offsite disposal	Landfill	Excavated soil disposed to landfill	Disposal permits required from Government. Landfill in Macau not prepared for	Low capital, high O&M	NR
Containment	Cap	Clay + soil	Compacted clay covered with soil over areas of contamination. Effective in stopping vertical migration of contaminated vapour, susceptible to	Easily implemented. Not useful for hydrocarbon contamination. Restrictions on future landuse	Low capital, low maintenance	NR
		Asphalt	Spray application of a layer of asphalt over areas of contamination. Effective in stopping vertical migration of contaminated vapour, susceptible to	Easily implemented. Not useful for hydrocarbon contamination. Restrictions on future landuse	Low capital, high maintenance	NR
		Concrete	Installation of concrete slab over areas of contamination. Effective in stopping vertical migration of contaminated vapour, susceptible to	Easily implemented. Not useful for hydrocarbon contamination. Restrictions on future landuse	Moderate capital, high maintenance	NR
Treatment	On-site treatment	landfarming	Contaminated soil dug up and lay out for natural biodegradation. Diffuse source of contaminated vapour, H&S hazard.	Need large area, may interfere with concurrent demolition work	High capital, moderate O&M	NR
	In situ treatment	Soil venting	Contaminated soil vapour extracted by vacuum pressure. Effective for volatile fractions.	Implementable for large volume of soil	High capital, moderate O&M	R
		Bioventing	System of injection of controlled air flow and extraction wells introduce bacteria to degrade contamination. Suitable for hydrocarbon clean-	Implementable for large volume of soil and heavy fractions of hydrocarbons	Moderate capital, moderate O&M	R

NN Need Negotiation
NA Not Applicable
NR Not Recommended
R Recommended

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Territory Development Department Hong Kong
Kowloon Development Office

TITLE
Evaluation of Process Options for Soil Remediation

SCALE		DATE	April 1998
DESIGNED	Wendy Tao	DRAWN	Fanny Lau
CAD REF.	C415.	DRAWING No.	Figure 8:1
		REV	0

Ground Water General Response Actions	Remedial Technology	Process Options	Description/ Effectiveness	Implementability	Cost	Comment
No Action	None	Not applicable	Does not achieve remedial action objectives	Long term liability remains	None	NN
Institutional Actions	Access restrictions	Deed restrictions	Effectiveness depends on continued future implementation. Does not reduce	Legal requirements and authority	Negligible cost	NA
	Planning Control	Restrict sensitive uses around site	Does not reduce contamination, migration of contaminant off-site possible	Require cooperation from Government	Negligible	NA
	Monitoring	Ground water monitoring	Ongoing monitoring of wells. Useful for documenting conditions. Does not reduce risk	Contaminant migration possible, may not be acceptable to government	Low capital, low O&M	NR
Collection	Surface/Subsurface drains	Interceptor trenches	Perforated pipe in trenches backfilled with porous media ro collect contaminated water.Effective for downgradient flow	Difficult to implement particularly with concurrent demolition work	Very high capital, low O&M	NR
Discharge	Onsite discharge	Storm drainage	Extracted water discharged to storm drains on site. Does not eliminate contamination	Discharge permits required	Low capital, low O&M	NR
	Offsite discharge	Public Wastewater Treatment Plant	Extracted water discharged to local WWTP for treatment. Transportation cost. Does not	Discharge permits required, transportation cost	High capital, low O&M	NR
Containment	Cap	Clay + soil	Compacted clay covered with soil over areas of contamination. Effective in stopping vertical migration of contaminated vapour, susceptible	Easily implemented. Not useful for hydrocarbon contamination. Restrictions on future landuse	Low capital, low maintenance	NR
		Asphalt	Spray application of a layer of asphalt over areas of contamination. Effective in stopping vertical migration of contaminated vapour, susceptible	Easily implemented. Not useful for hydrocarbon contamination. Restrictions on future landuse	Low capital, high maintenance	NR
		Concrete	Installation of concrete slab over areas of contamination. Effective in stopping vertical migration of contaminated vapour, susceptible	Easily implemented. Not useful for hydrocarbon contamination. Restrictions on future landuse	Moderate capital, high maintenance	NR
Treatment	Physical/chemical treatment	Precipitation	Conventional technology. Requires sludge disposal	Readily implementable	High capital, moderate O&M	NR
	In situ treatment	Bioreclamation	System of injection and extraction wells introduce bacteria and nutrients to degrade	May not be required for required level of clean up	High capital, moderate O&M	NR
		Air Sparging	System of wells to inject air into ground water to remove volatiles by air stripping, effective in	Implementable based on site conditions	Moderate capital, moderate O&M	R

NN Need Negotiation
NA Not Applicable
NR Not Recommended
R Recommended

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Territory Development Department Hong Kong
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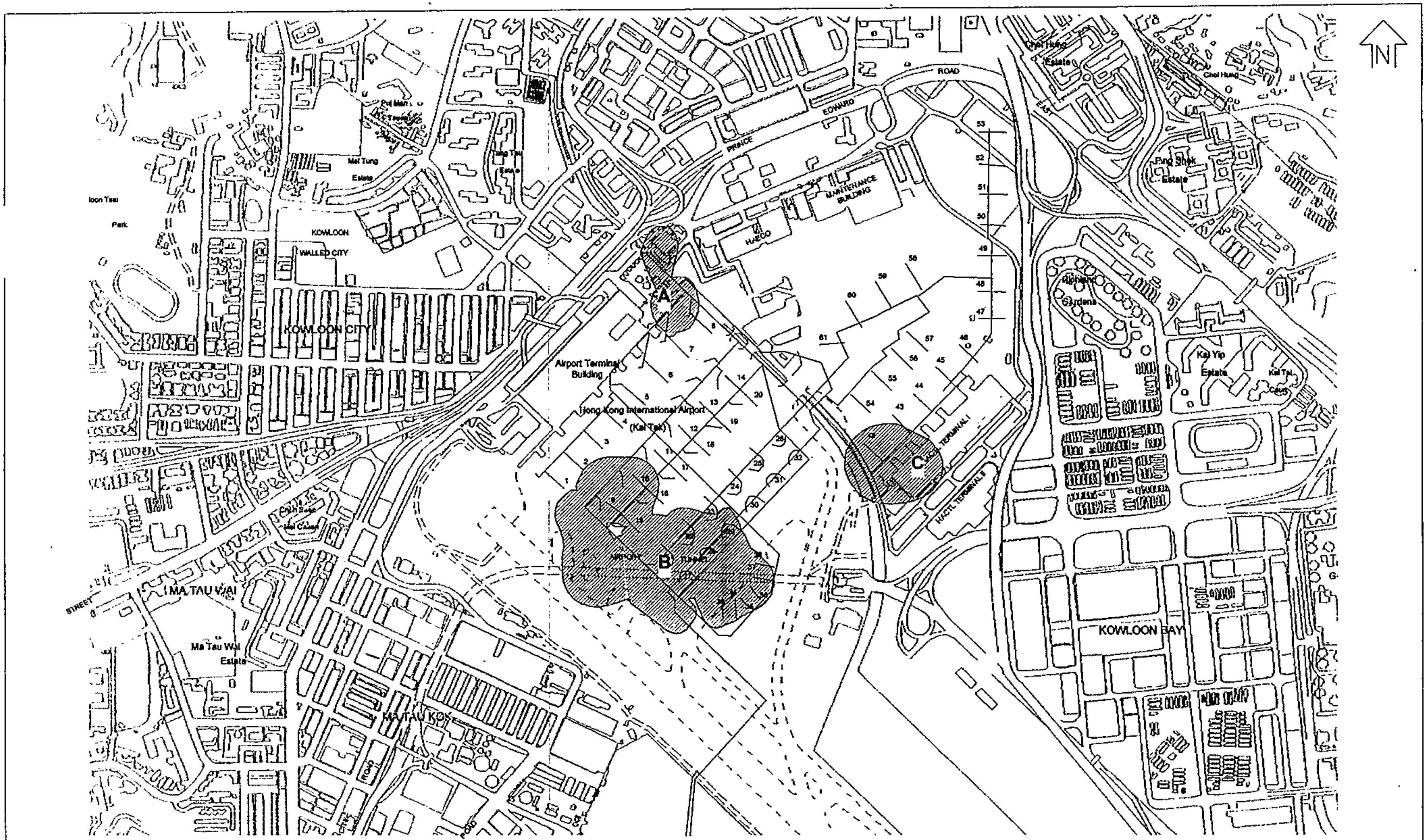
TITLE
Evaluation of Process Options for Groundwater Remediation

SCALE		DATE	April 1998
DESIGNED	Wendy Tao	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING No.	Figure 8.2
		REV	0



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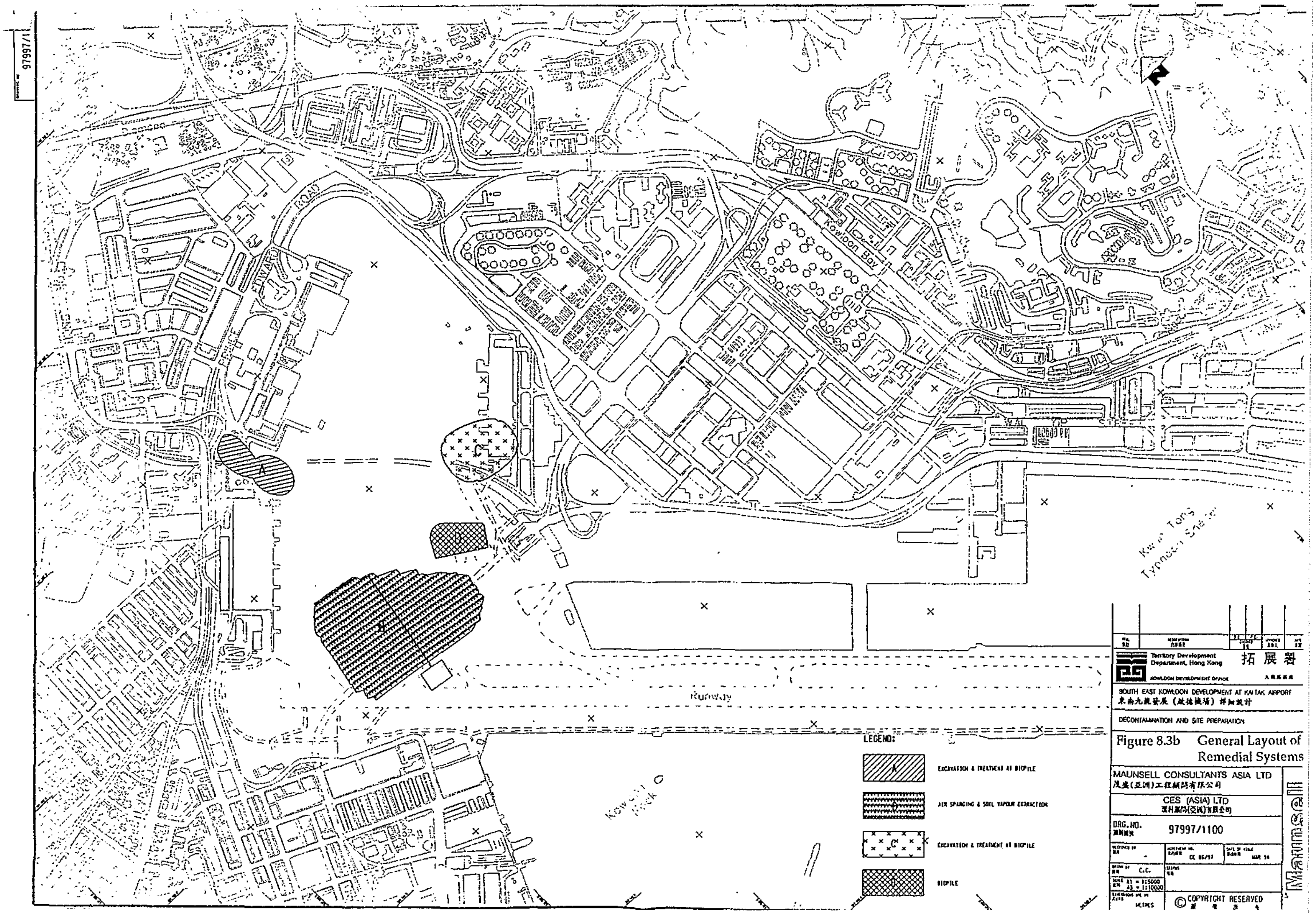
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING	Territory Development Department Hong Kong, Kowloon Development Office
TITLE: Remediation Areas : Overall Remediation Area	
SCALE: 1 : 13000	DATE: March 1998
DESIGNED: Fanny Lau	DRAWN: Fanny Lau
CAD REF.: C415	DRAWING No.: Figure 8.3a; REV: 0



Kowloon Bay
Edward Road
Runway
Kwun Tong Typhoon Shelter
Kowloon Rock
LEGEND:
EXCAVATION & TREATMENT AT BIOPILE
AIR SPARGING & SOIL VAPOUR EXTRACTION
EXCAVATION & TREATMENT AT BIOPILE
BIOPILE
Territory Development Department, Hong Kong
拓展署
KOWLOON DEVELOPMENT OFFICE
SOUTH EAST KOWLOON DEVELOPMENT AT KAI TAK AIRPORT
DECONTAMINATION AND SITE PREPARATION
Figure 8.3b General Layout of Remedial Systems
MAUNSELL CONSULTANTS ASIA LTD
CES (ASIA) LTD
DRG. NO. 97997/1100
C.C.
MAR 98
A1 = 1:5000
A3 = 1:10000
METRES
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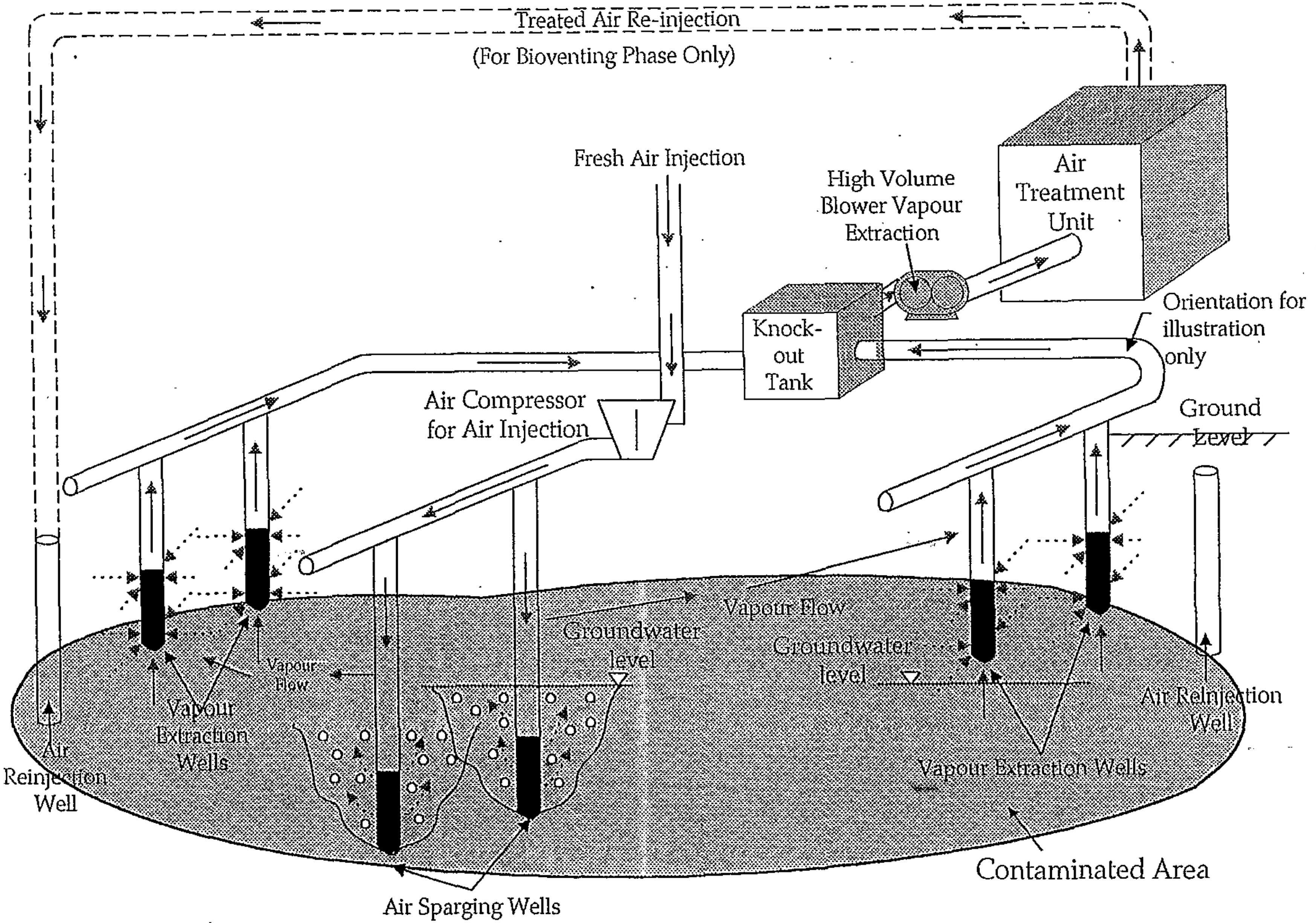

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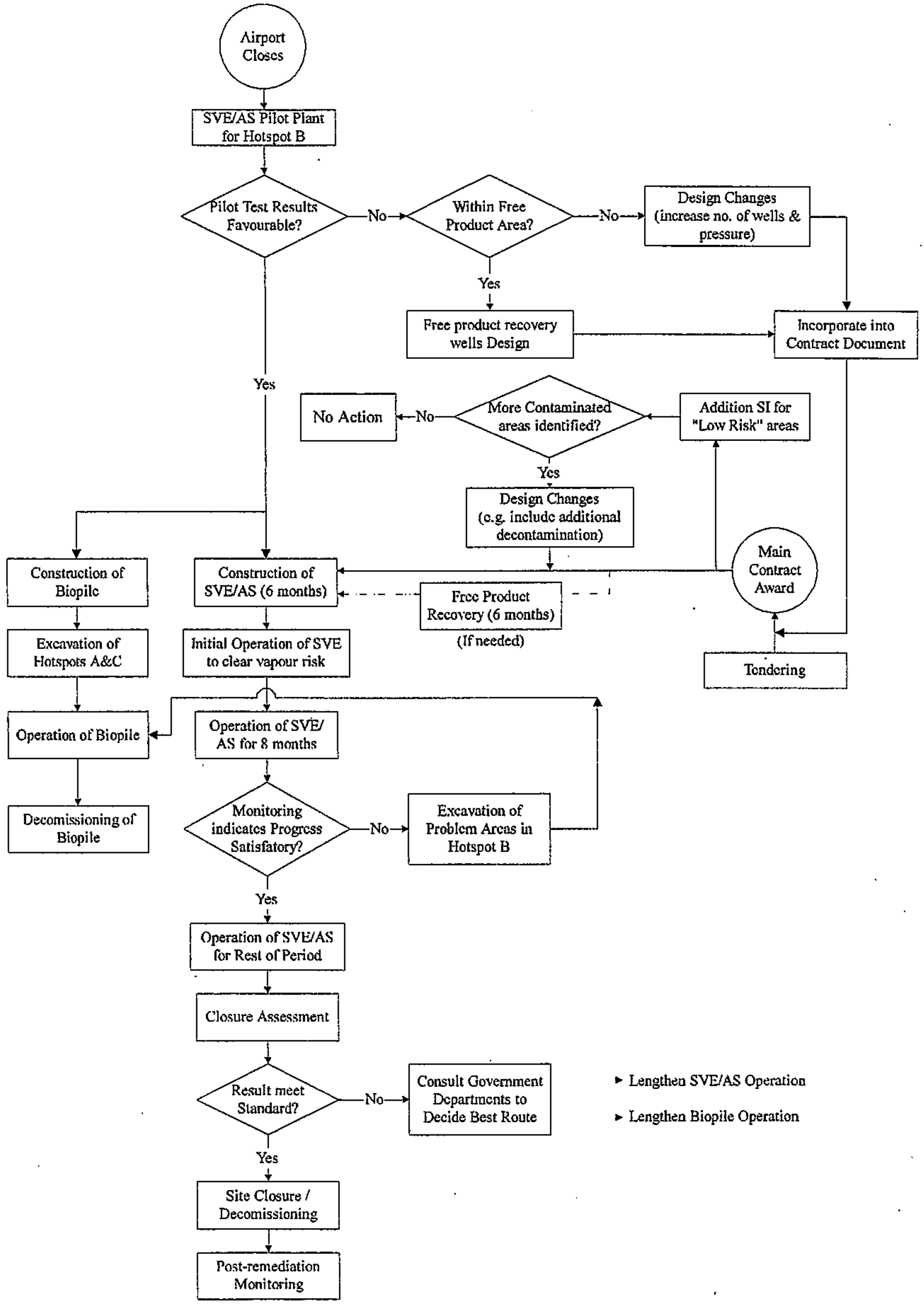
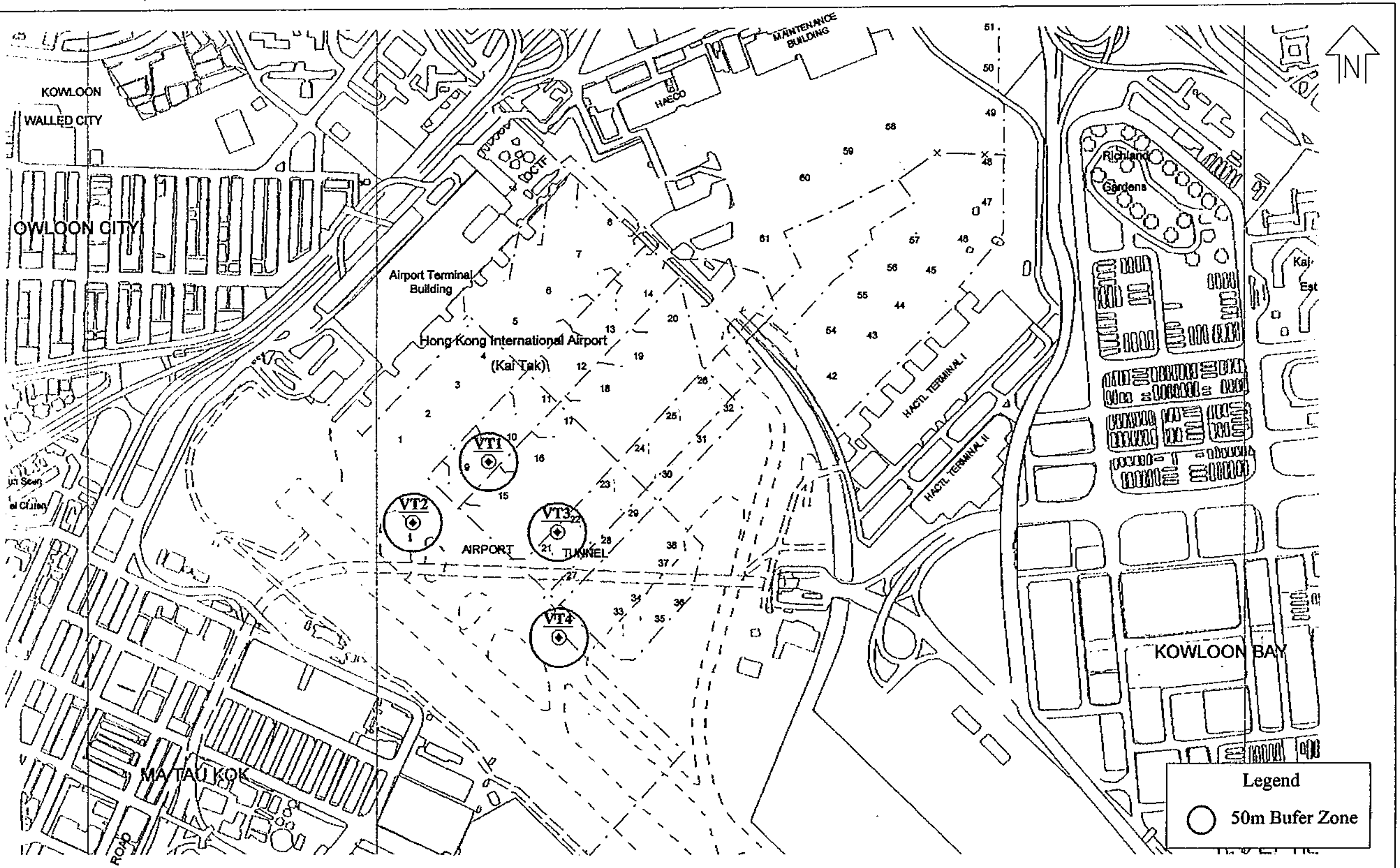
TITLE	Schematic Diagramme of Remediation Process		
SCALE	N.T.S	DATE	April 1998
DESIGNED	Matthew Ko	DRAWN	Whitney Tung
CAD REF.	C415	DRAWING NO	Figure 8.4
		REV	0



f:\...\C410\wsd\flowcht.vsd

環科 CES	TITLE Decontamination Flow-chart Showing Pilot Test & Fall Back Option	CES (ASIA) LIMITED		
		PROJECT NO	C415	DATE June 1998
		DESIGNED	Maggie Wong	DRAWING NO Figure 8.5



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TITLE
Buffer Distance for Pilot Test

SCALE	1 : 9500	DATE	June 1998
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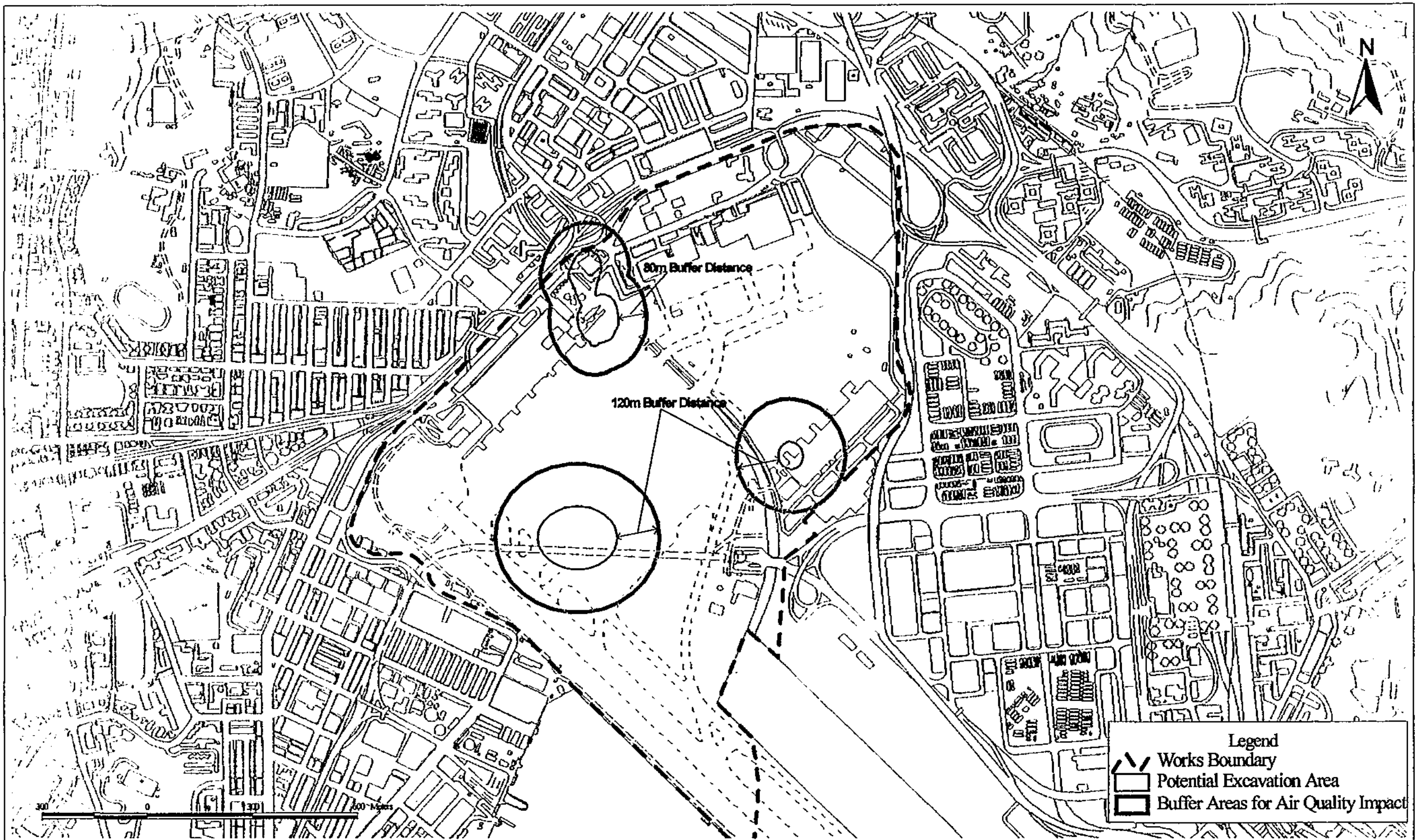
		REV	0



Maunsell

in association with

環科 CES

FEASIBILITY STUDY FOR SOUTH EAST KOWLOON DEVELOPMENT

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE

Buffer Areas to Mitigate Air Quality Impact during Excavation

SCALE	1 : 15000	DATE	June 1998
DESIGNED	Matthew Ko	DRAWN	Fanny Lau
CAD REF.	C415	DRAWING NO.	Figure 8.7
		REV	0

9 EVALUATION OF RESIDUAL ENVIRONMENTAL IMPACT

9 EVALUATION OF RESIDUAL ENVIRONMENTAL IMPACT

The residual impact after implementation of the mitigation measures would be within acceptable limits as stipulated in the standards in TM of EIAO.

10 ENVIRONMENTAL MONITORING AND AUDIT

10 ENVIRONMENTAL MONITORING AND AUDIT

10.1 EXISTING ENVIRONMENT AND BASELINE MONITORING

Baseline monitoring will be addressed in the detailed EM&A Manual which will be issued separately. The baseline monitoring parameters will include air quality and noise. The site closure and post-remediation monitoring are related to land contamination assessment.

10.2 METHODOLOGY PROPOSED AND SPECIFICATION OF EM&A PROGRAMME

It is likely that measurement of at least air quality, noise and surface water quality will be required during the construction phase. EM&A manual for each study will be produced with reference to the TM under the EIAO, EPD's Generic Environmental and Audit Manual as well as the EM&A Guidelines.

10.3 ENVIRONMENTAL PERFORMANCE SPECIFICATIONS AND ACTION PLANS

Based on the results of the quantitative assessments, environmental performance standards, specifications, action plans and implementation schedules for the mitigation measures will be put forward in the EM&A manuals.

10.4 ENVIRONMENTAL AUDIT REQUIREMENTS AND PROCEDURES

It is recognised that audit of the site to check on implementation of specified mitigation measures is an essential part of *pro-active* EM&A. Pro-formas will be produced for site auditors to complete. These will be included in the EM&A manual. In addition, a full check list of specified mitigation will be produced to facilitate production of the implementation status report.

11 CONCLUSION AND RECOMMENDATION

11 CONCLUSION AND RECOMMENDATION

Overall, environmental impacts can either be considered small or can be mitigated to an extent where the impacts on the receivers are acceptable. An EM&A programme will be required for noise, air quality, water quality and land contamination and such programme is addressed in a separate EM&A manual. A summary of findings and recommendations for further work is presented in the Table 11.1.

Table 11.1 Summary of Environmental Impacts

Potential Impact	Significant Residual Impacts after Mitigation	Remark
Noise		
Construction noise derived from decontamination, demolition and site preparation activities	None	Evening and/or night-time construction will be subject to the control of CNP(s) to be applied from EPD.
Air Quality		
Dust impact from demolition removal of pavement and operation of a crushing plant	None	None
Fuel combustion and residual benzene emission from operation of an catalytic incinerator during the decontamination	None on ASRs	Buffer Distance is specified such that no impact will be on temporary ASRs
Residual benzene impact from Excavation	None on ASRs	Buffer Distance is specified such that no impact will be on temporary ASRs
Water Quality		
Construction wastewater and polluted site runoff during construction and decommissioning	Should be minimal if proper site practices are adopted.	Any discharges from the work site will be subject to the control of discharge licence(s) to be applied from EPD.
Release of contaminated water during decontamination of ground	Should be minimal if proper site practices are adopted.	
Construction and Demolition Waste		
Various kinds of wastes will be generated, including • Very large quantity of construction waste from demolition of buildings and excavation work. • Chemical waste (incl. asbestos) • Domestic waste	None if different types of wastes are separated and handled as recommended.	Investigation to identify the presence of asbestos. Chemical waste producer(s) should be registered with EPD.
Ecology		
Loss of Terrestrial Habitats	None	None
Loss of Habitat for Avifauna which use the Airport Runway		
Land Contamination		
KTA land contamination	None	Pilot tests will be conducted to gather optimisation data. A fall back option is prepared to ensure the decontamination is successful.

12 SCHEDULE OF RECOMMENDED MITIGATION MEASURES

12 SCHEDULE OF RECOMMENDED MITIGATION MEASURES

Scheduled of recommendation measures for noise, air quality, water quality, waste management and land contamination are presented in Tables 12.1, 12.2, 12.3, 12.4 and 12.5 respectively.

No ecological mitigation measures are required. The mitigation measures for land decontamination have been included in the mitigation measures for noise, air quality, water quality and land contamination.

Table 12.1 Implementation Schedule for Noise Control

EIA Ref*	Environmental Protection Measures	Location/Timing	Implementation Agent	Implementation Stages**			
				Des	C	O	Dec
8.1	Careful programming construction activities to avoid parallel operation of several sets of equipment, reducing concurrently operating items of plant and minimise exposure of nearby receivers	work site / during construction	contractor		✓		
8.1	Siting noisy equipment away from receivers as far as practical	work site / during construction	contractor		✓		
8.1	Turning off or throttled down idle equipment	work site / during construction	contractor		✓		
8.1	Properly maintaining and operating construction equipment. Properly maintaining and using silencing equipment	work site/ during construction	contractor		✓		
8.1	Using quieter equipment[1]	work site / during construction	contractor	✓	✓		
8.1	Instigating a noise monitoring programme	closest NSR / during construction	Environmental Team	✓	✓		

* EIA Ref = section number of EIA report

** Des = Design, C = Construction, O = Operation, Dec = Decommissioning

1 Details of quieter equipment is presented in Appendix G

Table 12.2 Implementation Schedule for Air Quality Control

EIA Ref*	Environmental Protection Measures	Location/Timing	Implementation Agent	Implementation Stages**			
				Des	C	O	Dec
8.2	Regular watering the entire site	work site / during construction	contractor		✓		
8.2	Frequent watering for particularly dusty static areas close to site boundary and sensitive receivers	work site / during construction	contractor		✓		
8.2	Side enclosure and covering of any aggregate or dusty material storage piles.	work site / during construction	contractor		✓		
8.2	Covering stockpiles and placing them away from receivers	work site / during construction	contractor		✓		
8.2	Providing barriers where possible	work site / during construction	contractor		✓		
8.2	Covering all dusting vehicle loads transported to, form and between site location with tarpaulin	vehicles / during transportation	contractor		✓		
8.2	Establishing and using vehicle and body washing facilities at the exit points	site exit points / during construction	contractor	✓	✓		
8.2	Providing wind shield and dust extractor, as well as using water sprinklers at loading and unloading points	loading and unloading points / during construction	contractor		✓		
8.2	Imposing speed control for vehicles on dusty site areas	dusty site areas / during construction	contractor		✓		
8.2	Routing vehicles and positioning plant away from receivers where possible	work site / during construction	contractor		✓		
8.2	Installing a crusher feedbox with a minimum number of openings and use of rubber curtains for the crushing plant	crushing plant / during its operation	contractor	✓	✓		
8.2	Choking fed the crusher to reduce air entrainment and dust emission	crushing plant / during its operation	contractor		✓		
8.2	A catalytic incinerator should be installed to exhaust fuel and oil vapour extracted from the contaminated site prior to their discharge to atmosphere. Covering the biopile and exhaust to an incinerator. Controlling the excavation rates of contaminated soil.	work site / during decontamination	contractor	✓	✓		
8.2	Instigating a monitoring programme during the demolition and decontamination	work site / during demolition, and decontamination	Environmental Team	✓	✓		

* EIA Ref = section number of EIA report
* Des = Design, C = Construction, O = Operation, Dec = Decommissioning

Table 12.3 Implementation Schedule for Water Pollution Control

EIA Ref*	Environmental Protection Measures	Location/Timing	Implementation Agent	Implementation Stages**			
				Des	C	O	Dec
8.3	Providing perimeter channels to intercept run-off from outside the site	around the work area / beginning of construction	contractor	✓	✓		
8.3	Providing of sand/silt traps, oil inceptors and septic tanks/or chemical toilets. Proper maintaining these facilities.	work site / beginning of construction	contractor		✓		
8.3	Careful programming work to avoid excavation in the raining season	work site / all the time during construction	contractor		✓		
8.3	Recycling production water where practical	work site / during construction	contractor		✓		
8.3	Protecting exposed soil by shotcrete or hydroseedings and road by crushed gravel	work site / during construction	contactor		✓		
8.3	Covering stockpile with tarpaulin or similar material during rainstorms and placing stockpiles away from water course	work site / during construction	contractor		✓		
8.3	Protecting drains from spillages of excess materials and sealing drains prior to demolition work	work site / prior to demolition	contractor		✓		
8.3	Connecting drainage serving an open oil filling point to a petrol interceptor prior to discharge	work site / during construction	contractor		✓		
8.3	Lining biopile at the bottom, covering it at the top and weighting down by sand bags to prevent water from sipping through. Construction a perimeter berm to contain leachate. Collected leachate should be disposed off as chemical waste. Treating the entrained liquid in the SVE vapour line prior to discharge. Schedule excavation in dry season.	decontamination sites / during decontamination	contractor	✓	✓		
7.3.1	Using containment (eg sand bag and temporary bund) during demolition of fuel tanks to prevent oil spill. Soaking up small patches of spilled oil by oil adsorbent and disposed of as chemical waste	OCTF decontamination site/ during decontamination	contractor		✓		
8.3	Instigating a water quality monitoring programme	discharge points / during construction	Environmental Team	✓	✓		

* EIA Ref = section number of EIA report
** Des = Design, C = Construction, O = Operation, Dec = Decommissioning

Table 12.4 Implementation Schedule for Construction and Demolition Waste Control

EIA Ref*	Environmental Protection Measures	Location/Timing	Implementation Agent	Implementation Stages**			
				Des	C	O	Dec
8.4	Providing storage areas and processing (crushing plant) facilities for construction and demolition material	work site / during construction	contractor	✓	✓		
8.4	Separating non-inert and inert waste and responsible for their disposal to appropriate locations	work site / during construction	contractor		✓		
8.4	Storing chemical waste separately and engaging a licenced chemical contractors to disposal the waste to Tsing Yi Chemical Waste Treatment Plant	work site / during construction	contractor		✓		
8.4	Providing on-site refuse collection points	work site / during construction	contractor		✓		
8.4	Conducting investigation for the presence of asbestos	buildings / prior to demolition	contractor	✓	✓		
8.4	Register with EPD as chemical waste producer	- / prior to construction	contractor		✓		

* EIA Ref = section number of EIA report
** Des = Design, C = Construction, O = Operation, Dec = Decommissioning

Table 12.5 Implementation Schedule For Land Contamination

The implementation schedule FOR land contamination is the full scope of the remedial action plan (the present decontamination project).

EIA Ref	Environmental Protection Measures	Location/Timing	Implementation Agent	Implementation Stages**			
				Des	C	O	Dec
8.6	Construction and operation of SVE/AS plant FOR Hotspot B	work site / during construction	contractor		✓		
8.6	Excavation and biopiling of soil from Hotspot A nd Hotspot C	work site / during construction	contractor		✓		
8.6	Free product recovery wells (if required following recommendation of pilot plant)	work site / during construction	contractor		✓		
8.6	Excavation and biopiling of soil from free product areas from Hotspot B (Fall back option)	work site / during construction	contractor		✓		
8.6	Site closure assessment	work site / during construction	Environmental Team	✓	✓		
8.6	Post remediation monitoring	work site / during construction	Environmental Team	✓	✓		

* EIA Ref = section number of EIA report
** Des = Design, C = Construction, O = Operation, Dec = Decommissioning

APPENDIX A

SOUTH EAST KOWLOON DEVELOPMENT AND REDEVELOPMENT PACKAGES

APPENDIX A SOUTH EAST KOWLOON DEVELOPMENT AND REDEVELOPMENT PACKAGES

The detailed scope of works for each development package are presented in the following sections.

1 KTA-DP

Most of the works within KTA-DP are included in the Kai Tak Airport Early Development Package (KTA-EDP) which is under Category Public Works Package (PWP) Item 469CL. The scope of works comprises works both inside and outside the KTA North Apron Area:

1) In the KTA North Apron (i.e. SEK Planning Areas 1 and 2)

- Decommissioning of airport related facilities
- Removal of some airport related facilities
- Building and pavement demolition
- Site clearance and preparation
- Decontamination of ground under airport apron
- District and local distributor roads, and associated public transport facilities
- Drainage and sewerage services, including
  - Sewage pumping station and pumped main within KTA site
  - Section of San Po Kong - To Kwa Wan trunk sewer within KTA site (north of existing airport tunnel)
  - Diversion of existing culverts within KTA to match road layout
- Construction of a new culvert to replace the existing Kai Tak Nullah (KTN) from Prince Edward Road through to the south of the existing runway (excluding the marine section at the north end of the channel)
- Fresh and salt water systems

2) In and extending outside Planning Areas 1 and 2

- Access road to eastern section of existing runway to provide access for temporary users
- Rising sewer main from KTA through to the existing To Kwa Wan Sewage Treatment Plant
- Upgrading the existing Tai Wan Salt Water Pumping Station *
- Salt water mains to connect the Tai Wan Salt Water Pumping Station, the existing salt water service reservoir, and the site*
- Fresh water mains to connect the nearby fresh water systems with the site*
- Fresh water service reservoir to serve Planning Areas 1 and 2 at a site identified in Diamond Hill*
- Water mains to connect the service reservoir to the boundary of the site*

The items marked with '*' are now transferred to the new WSD managed PWP Item 085WC.

2 KTN/KTTS-DP

Similar to KTA-DP, most of the works within KTN/KTTS-DP are included in the Kai Tak Nullah/Kwun Tong Typhoon Shelter Early Development Package (KTN/KTTS-EDP) which is under Category Public Works Package (PWP) Item 465CL. The scope of works comprises:

- Reprovisioning of: -
    - * the Cha Kwo Ling and Kwun Tong Public Cargo Working Areas
    - * the To Kwa Wan Typhoon Shelter
    - * the Kwun Tong Typhoon Shelter
    - * temporary pier facilities for landing of liquid chlorine
    - * ASDE radar station and equipment
    - * mooring buoys
- Demolition and reprovisioning of the: -
    - * the Kwun Tong Vehicular Ferry Pier
    - * the Kwun Tong Passenger Ferry Pier
    - * the Kwun Tong Public Pier
- Construction of sections of the Kwun Tong Nullah
- Access roads to these new marine facilities and public transportation facilities at ferry piers
- Treatment of contaminated seabed sediments in Kai Tak channel and if necessary Kwun Tong typhoon shelter
- Reclamation of the waterway between Kwun Tong and the KTA Runway and the basic supporting infrastructure for temporary uses
- Nominal infrastructure on the KTA runway and south apron for temporary uses
- Seawalls
- Marine Refuse Transfer Station
- Diversion and/or protection of submarine water supply pipelines and other utilities
- Local roads, drains, and infrastructure to serve the CWA development and the sites designated to provide noise screening buildings (Sites 8B and 8C)
- Basic infrastructure (water supply, electric supply, sewers and drains) to the site of the reprovisioned piers and temporary use sites
- Hinterland drainage improvements in connection with the reclamation works
- Roads, drainage and basic infrastructure to serve development in Areas 7 and 8*
- Part of Trunk Road T2 which will improve accessibility to the CWA, and which is part of the strategic road network linking Central Kowloon Route and Western Coast Road*
- A second fresh water service reservoir, together with connecting pipework between supply source and SEKD*

The items marked with '*' are not yet included in the approved PWP item.

3 KBR1-DP

All work packages within KBR1-DP are included in the Kowloon Bay Reclamation - Early Development Package (KBR-EDP) which is under Category Public Works Package (PWP) Item 482CL. The scope of works comprises:

- Demolition of Kowloon City vehicular ferry, passenger ferry and public piers
- Reclamation and seawall works including dredging and preloading on areas reserved for major highways. Filling materials comprise imported marine sand, public dump material or suitable fill obtained from land-based sources
- Demolition of the Hong Kong and China Gas Company (HKCGC) naphtha unloading pier. Reprovisioning will be done by HKCGC at a point near the southern end of the runway
- Reprovisioning of gas pipeline and facilities (by HKCGC)
- Construction of a typhoon shelter to replace the existing To Kwa Wan Typhoon Shelter

- Removal of a section of the existing To Kwa Wan Typhoon Shelter breakwater
- Extension of KTN, Kowloon Bay Box Culvert and a number of stormwater culverts through the new reclamation
- Install sewerage network and part of the Trunk Sewer from San Po Kong to To Kwa Wan
- A section of Trunk Roads T1/T2 linking the proposed Central Kowloon Route (CKR) and the Hung Hom Bypass to the road network in SEKD and the proposed Western Coast Road in Tseung Kwan O
- Essential district and local distributor roads including their connection through to existing roads along the western boundary of the site, and related drainage
- Existing drainage improvements
- Relocation of Government mooring buoys within the Study Area
- Relocation of the water space for the Eastern Quarantine and Immigration Anchorage
- Replacement facility for Ma Tau Kok public pier
- Install water supply distribution network

4 KBR2-DP

The KBR2-DP works have been proposed to be included in an approved PWP item. The scope of works comprises:

- Reclamation of the harbour from the limit of the KBR1 limit to a point at the existing Hung Hom waterfront and across to the south-east end of the existing Kai Tak runway
- Construction of seawall and promenade along new seafront
- Construction of new saltwater pumping station (SWPS) and connecting mains to replace Tai Wan SWPS
- Diversion of cross-harbour water main
- Reprovisioning of Police SDU pier (outside SEKD)
- Construction of Roads D5, D6, L5, L7 P1 (part) and P2
- Construct drainage, sewers and services
- Diversion of 132kV cables and erosion protection (by others)
- Construction of Kai Tak Nullah extension

5 Redevelopment Packages

The redevelopment packages involve restructuring of adjoining urban existing areas, including Priority Areas P1, P2, and P3.

Priority Area P1 is located in the north eastern part of Ma Tau Kok adjacent to KTA. This area is bounded by Kowloon City Road to the west, KTA to the north, Kowloon Bay to the east and by San Shan Road, San Ma Tau Street, Long Yuet Street and Kwei Chow Street, which define the southern boundary of the are.

Priority Area P2 is bounded in the north by Chi Kiang Street, in the west by Ma Tau Wai and To Kwa Wan Road, in the south by Bailey Street and in the east by the newly constructed road linking Yuk Yat Street to Sung On Street.

Priority Area P3 is located in the extreme south-western corner of the Study Area. It is bounded to the north-west by Chatham Road North, to the north-east by Station Lan d and to the south east partially by Dock Street as well as the rear boundaries of residential plots along Whampoa

Street. The south-western edge of the area is formed by the Study Area boundary along Winslow Street, Hung Hom South Road and the adjacent Hung Hom Reclamation Area.]

The specific objectives of the restructuring proposals are:

- To improve the urban environment and urban layout by replacing old and run-down areas with new development which is properly planned and provided with adequate transport and other infrastructure and community facilities

- To minimise the problems of social disruption by ensuring that adequate arrangements are made for rehousing of domestic tenants and compensation of business tenants
- To achieve better utilisation of land in the urban area by thinning out population from over-crowded areas and making land available to meet various development need including housing
- To avoid major problems of urban decay in the long term

A summary programme of development of KTA, KTN/KTTS, KBR1 and KBR2 and Priority Area redevelopment are provided in the following Table.

Table A1 Summary Programme of KTA, KTN, KBR1, KBR2 Development Packages and Priority Area Redevelopment Packages

Period	Activity
1. KTA DEVELOPMENT PACKAGE	
1998-1999	Remediation to contamination within KTA Demolition and site preparation works - Area 1 Site development: Areas 1I, 4L
1999-2000	Remediation to contamination within KTA Demolition and site preparation works - Area 1 Establishment of Crushing Plant Site development: Areas 1A, 1B, 1C, 1D, 1F
2000-2001	Remediation to contamination within KTA Lay interim services - Area 1 Construct Kai Tak Nullah (KTN) diversion - 1st stage Construct Roads D1N, L1N, L2N, D1S, D4, L1S, L3, P1S, D3 and L2S Lay roads/drains/sewers/non government utilities - Areas 1 and 2 Construct water mains inside KTA Areas 1 and 2 Construct Service Reservoir No. 1 (Yuen Ling) Construct rising sewer main/sewer pumping station Construct existing drainage improvements (KTA) Demolition and site preparation works - Area 2 Construct seawater intake system and upgrade Tai Wan Saltwater Pumping Station Lay interim water mains outside KTA Site development: Areas 1A, 1B, 1C, 1D, 1F, 2A, 2B, 2D, 2E, 2F, 2J, 2K, 2L, 4J
2001-2002	Decommissioning of KTA Construct KTN diversion - 1st stage Construct Roads D1N, L1N, L2N, D1S, D4, L1S, L3, P1S, D3 and L2S Lay roads/drains/sewers/non government utilities - Areas 1 and 2 Construct D2 at grade over New Kai Tak Nullah Construct Service Reservoir No. 1 (Yuen Ling) Construct rising sewer main/sewer pumping station Construct existing drainage improvements (KTA) Demolition and site preparation works - Area 2 Construct seawater intake system and upgrade Tai Wan Saltwater Pumping Station Lay water mains outside KTA Site development: Areas 1A, 1B, 1C, 1D, 1F, 1J, 2A, 2B, 2C, 2D, 2E, 2F, 2I, 2J, 2K, 2L, 4J
2002-2003	Construct KTN diversion - 1st stage Construct Roads D1S, D4, L1S, L3, and P1S Lay roads/drains/sewers/non government utilities and landscaping - Areas 1 and 2 Construct D2 at grade over New Kai Tak Nullah Construct Service Reservoir No. 1 (Yuen Ling) Construct rising sewer main/sewer pumping station Construct existing drainage improvements (KTA) Demolition and site preparation works - Area 2 Construct seawater intake system and upgrade Tai Wan Saltwater Pumping Station Lay water mains outside KTA Construct D2 elevated link to Choi Hung Road Construct Section of P1 north of D2 Construct KTN extension through runway Site development: Areas 1A, 1B, 1C, 1D, 1F, 1G, 1H, 1J, 2A, 2B, 2C, 2D, 2E, 2F, 2I, 2J, 2K, 2L, 4J

Period	Activity
2003-2004	Landscaping - Area 1 Construct D2 at grade over New Kai Tak Nullah Demolition and site preparation works - Area 2 Lay water mains outside KTA Construct D2 elevated link to Choi Hung Road Construct Section of P1 north of D2 Construct T1 to Tate's Carin Carry out improvements to Concorde Road Construct SEKL railway depot - Area 2H Site development: Areas 1G, 2B, 2C, 2D, 2E, 2F, 2H, 2I, 2K, 2L
2004-2005	Construct D2 elevated link to Choi Hung Road Construct T1 to Tate's Carin Carry out improvements to Concorde Road Construct Concorde Road Flyover Construct SEKL railway depot - Area 2H Site development: Areas 2B, 2C, 2H, 4N
2005-2006	Construct D2 elevated link to Choi Hung Road Construct T1 to Tate's Carin Construct Concorde Road Flyover Construct SEKL railway depot - Area 2H Site development: Areas 2H
2006-2007	Construct T1 to Tate's Carin Construct Concorde Road Flyover Site development: Areas 4G, 4K
2007-2008	Site development: Areas 4G, 4H, 4I, 4K
2008-2009	Site development: Areas 4G, 4H, 4I, 4K
2. KTN/KTTS DEVELOPMENT PACKAGE	
1998-1999	Reprovisioning of Eastern Quarantine Immigration Anchorage (EQIA) & Associated Works Site Development: Area 4M
1999-2000	Nominal Infrastructure on Runway/South Apron (Government Uses) Kai Tak Nullah Sediment Remediation Reprovisioning of Eastern Quarantine Immigration Anchorage (EQIA) & Associated Works Construct Temporary PFBP on Runway
2000-2001	Kai Tak Nullah Sediment Remediation Reprovisioning of Eastern Quarantine Immigration Anchorage (EQIA) & Associated Works Construct Temporary PFBP on Runway Site Development: Areas 4A, 4E
2001-2002	Reprovisioning of Eastern Quarantine Immigration Anchorage (EQIA) & Associated Works Construct CWA South East Arm/East Arm, Section 1 Scour Protection of Eastern Harbour Crossing Construct New CWA Breakwater Construct KTN PCWA - North Side of Runway Construct Public Landing Steps at CKL Construct Temporary Chlorine Unloading Berth on Runway Construct New Vehicular Ferry Pier/Passenger Ferry Pier Construct KBR1 Public Pier Construct Seawalls for Fire Services Site/PFBP Site/RTS Site Transfer Operations to Chlorine Unloading Berth on Runway KTN Reclamation - Stage 1 Construct Kai Tak Nullah Diversion - 2nd Stage Construct Typhoon Shelter Breakwater (West/East) Site Development: Areas 4A, 4D, 4E

Period	Activity
2002-2003	Construct CWA South East Arm/East Arm, Section 1 Construct New CWA Breakwater Construct KTN PCWA - North Side of Runway Construct Public Landing Steps at CKL Construct New Vehicular Ferry Pier/Passenger Ferry Pier KTN Reclamation - Stages 1 and 2 Consolidation of KTN Reclamation - Stage 1 Construct Kowloon Bay Culvert Extension Construct Typhoon Shelter Breakwater (East/Central) Construct PFBP Site Transfer Operations Kwun Tong Public Pier to KBR Public Pier Construct MD RTS at Cha Kwo Ling Site Demolish 1st Part Existing KTTS Breakwater Demolish End of Runway Construct CWA Central Arm/East Arim Section 2 Demolish Kwun Tong Public Pier/Vehicular Ferry Pier/Passenger Ferry Pier Demolish Taxiway Bridge Site Development: Areas 4D, 8E
2003-2004	Transfer Kwun Tong PCWA to North Side to Runway Transfer MD RCP to Cha Kwo Ling Site Construct North West Portion of CWA Construct Roads and Drains Demolish Existing KTTS Breakwater (rem) Kwun Tong TS Reclamation (North) KTN Reclamation - Stage 2 Consolidation of KTN Reclamation - Stages 1 and 2 Construct Kowloon Bay Culvert Extension Construct Typhoon Shelter Breakwater (Central) Construct Typhoon Shelter Mooring Dolphins Move Existing Mooring Buoys to New Typhoon Shelter Transfer Kwun Tong Typhoon Shelter to New TS Construct Eastern TS Breakwater at Yau Tong Construct PFBP Site Construct Refuse Transfer Station Construct Western Portion of T2 (CKR to D3 Roundabout) Construct Central Portion of T2 (D3 Roundabout to KT) Site Development: Areas 8D, 8E
2004-2005	Transfer MD RCP to Cha Kwo Ling Site Transfer Operations from 60M of CKL PCWA to Runway Construct North West Portion of CWA Consolidation of KTN Reclamation - Stages 1 and 2 Construct Kowloon Bay Culvert Extension Lay Water mains - KTN & KTTS Lay Sewer Mains - KTN Kwun Tong TS Reclamation (North) Consolidation of Kwun Tong TS Reclamation (North) Area 8B (West Section) Reclamation Consolidation of 8B (West Section) Reclamation Complete CWA South Basin Complete Final Section of Kwun Tong Nullah Extension Construct CWA Pavement (South Basin) Construct Temporary Decking for CKL PCWA (150 m) Install ASDE Radar Station and Equipment Construct Refuse Transfer Station Lay Road Drainage/Local Water mains/Local Sewers/Non Government Utilities (Areas 4 and 7) Construct Roads/Ramps D3, P2 and D5 (part) Construct Western Portion of T2 (CKR to D3 Roundabout) Construct Central Portion of T2 (D3 Roundabout to KT) Site Development: Areas 4B, 4F, 8A, 8D

Period	Activity
2005-2006	Demolish Temporary KTN PCWA Berth Lay Water mains - KTN & KTTS Lay Sewer Mains - KTN Kwun Tong TS Reclamation (North) Consolidation of Kwun Tong TS Reclamation (North) Kwun Tong TS Reclamation (South) Consolidation of Kwun Tong TS Reclamation (South) Consolidation of 8B (West Section) Reclamation Area 8B (CKL Section) Reclamation Consolidation of 8B (CKL Section) Reclamation Transfer Operations from Temporary KTN PCWA to South Basin Transfer CKL PCWA to South Basin & Temporary Deck Complete New CWA North Basin Construct Section Road D7 Adjacent to Area 8B Construct Roads L15, L16 and L17 Lay Road Drainage/Local Water mains/Local Sewers/Non Government Utilities (Areas 4 and 7) Construct Roads/Ramps D3, P2 and D5 (part) Construct Western Portion of T2 (CKR to D3 Roundabout) Construct Central Portion of T2 (D3 Roundabout to KT) Construct Eastern Portion of T2 (Kwun Tong to Cha Kwo Ling) Site Development: Areas 4B, 4F, 7F, 8A
2006-2007	Consolidation of Kwun Tong TS Reclamation (North) Kwun Tong TS Reclamation (South) Consolidation of Kwun Tong TS Reclamation (South) Consolidation of 8B (West Section) Reclamation Consolidation of 8B (CKL Section) Reclamation Complete New CWA North Basin Construct CWA Pavement (North Basin) Transfer Operations from 150 m PCWA to North Basin Reprovision CWA Administration Building Construct Section Road D7 Adjacent to Area 8B Construct Roads L15, L16 and L17 Lay Road Drainage/Local Water mains/Local Sewers/Non Government Utilities (Areas 4 and 7) Construct Roads/Ramps D3, P2, P2 (part), D5, D5 (part), L11 and D7 (Remainder) Construct Eastern Portion of T2 (Kwun Tong to Cha Kwo Ling) Construct Service Reservoir No. 2 Site Development: Areas 4B, 7E, 7F, 8A, 8F, 8G, 8H
2007-2008	Kwun Tong TS Reclamation (South) Consolidation of Kwun Tong TS Reclamation (South) Consolidation of 8B (CKL Section) Reclamation Reprovision CWA Administration Building Demolish 150 m PCWA Berth in Typhoon Shelter Construct Main Drainage Demolish Existing CKL CWA Administration Building Construct Roads/Ramps D3, P2, P2 (part), D5, D5 (part), L11 and D7 (Remainder) Landscaping (Areas 4 and 7) Construct Service Reservoir No. 2 Construct Noise Screen Building Site Development: Areas 4B, 4C, 7A, 7B, 7E, 7F, 8B, 8F, 8G, 8H
2008-2009	Consolidation of Kwun Tong TS Reclamation (South) Demolish Existing CKL CWA Administration Building Construct Service Reservoir No. 2 Construct Noise Screen Building Site Development: Areas 4C, 7A, 7B, 7C, 7E, 7F, 8B, 8F, 8G, 8H, 8I
2009-2010	Consolidation of Kwun Tong TS Reclamation (South) Construct Noise Screen Building Site Development: Areas 4C, 7A, 7B, 7C, 7D, 8B, 8C, 8F, 8G, 8I
2010-2011	Construct Noise Screen Building Site Development: Areas 4C, 7A, 7B, 7C, 7D, 8C
2011-2012	Site Development: Area 7C

Period	Activity
3.	**KBR1 DEVELOPMENT PACKAGE**
1999-2000	Install New Submarine Gas Pipeline & Relocate
2000-2001	Install New Submarine Gas Pipeline & Relocate Transfer Operations to FS Berth Transfer Operations to PFBP on runway Construct Existing Drainage Improvements - TKW/HH Construct Existing Drainage Improvements - KB/KT
2001-2002	Relocate A36 Buoy as B Buoy Relocate A38 Buoy Off Site Relocate Mooring Buoys (37, 39 & 40) Relocate Moorings in Kwun Tong Typhoon Shelter Remove Buoys from Prohibited Area Demolish Light & Navigation Barrier Dolphins Relocate Eastern Quarantine and Immigration Anchorage Preparation of SEKD Internal Disposal Pit Install New Naphtha Pipeline and Relocate Construct Naphtha Jetty Construct Foundation Works for South Seawall (East) Construct Kowloon Bay Typhoon Shelter East End Construct Kowloon Bay Typhoon Shelter West End Construct Existing Drainage Improvements - TKW/HH Construct Existing Drainage Improvements - KB/KT
2002-2003	Transfer Operations KC Public Pier to KBR1 Public Pier Transfer Operations to Naphtha Jetty Demolish Existing Kowloon City Public Pier/Passenger Pier/Vehicle Ferry Pier Demolish Cement Works Pier KBR1A and KBR1B Reclamation Construct Kai Tak Nullah Extension Construct Kowloon Bay Culvert Extension Construct Mooring Dolphins for Kowloon Bay TS Transfer To Kwa Wan TS to Kowloon Bay TS Construct Existing Drainage Improvements - TKW/HH Extend D3 & D4 & Local Connections to Kai Fuk Road Construct Existing Drainage Improvements - KB/KT
2003-2004	Construct Trunk Sewer KBR1A and KBR1B Reclamation Consolidation of KBR1A and KBR1B Reclamation Construct Kai Tak Nullah Extension Construct Kowloon Bay Culvert Extension Construct Existing Drainage Improvements - TKW/HH Construct Existing Drainage Improvements - KB/KT
2004-2005	Construct Trunk Sewer Construct Extension of Road D1 to San Ma Tau St. KBR1A and KBR1B Reclamation Consolidation of KBR1A and KBR1B Reclamation Construct Kai Tak Nullah Extension Construct Kowloon Bay Culvert Extension Construct T1/T2 - CKR to Roundabout & Kai Fuk Road Construct C. K. R. (Portal & Approach) Site Development: Area 3A

Period	Activity
2005-2006	Construct D1 & Link to Hung Hom Road Construct Other Roads & Widening of TKW Road Construct Elevated Section of P1 over T2 Lay Local Water mains/Local Sewer/Road Drainage/Non Government Utilities KBR1A Reclamation Consolidation of KBR1A and KBR1B Reclamation Construct T1/T2 - CKR to Roundabout & Kai Fuk Road Construct Road L10 & Connection to Kai Cheung Road KBR1C (Areas 3 & 5) Reclamation Construct Seawall for KBR1 Consolidation of KBR1C (Areas 3 & 5) Reclamation Construct C.K.R. (Portal & Approach) Site Development: Area 3A
2006-2007	Construct D1 & Link to Hung Hom Road Construct Other Roads & Widening of TKW Road Construct Elevated Section of P1 over T2 Lay Local Water mains/Local Sewer/Road Drainage/Non Government Utilities Construct P1 at Grade KBR1A Landscaping Consolidation of KBR1A Reclamation Construct T1/T2 - CKR to Roundabout & Kai Fuk Road Construct Road L10 & Connection to Kai Cheung Road KBR1C (Areas 3 & 5) Reclamation Construct Seawall for KBR1 Consolidation of KBR1C (Areas 3 & 5) Reclamation Construct Main Drainage Construct C.K.R. (Portal & Approach) Site Development: Area 3A
2007-2008	Construct Elevated Section of P1 over T2 Lay Local Water mains/Local Sewer/Road Drainage/Non Government Utilities Construct P1 at Grade Construct D5 & Bailey St. Extension KBR1C Landscaping Consolidation of KBR1C (Areas 3 & 5) Reclamation Construct Main Drainage Site Development: Areas 3A, 3C, 3D
2008-2009	Construct D5 & Bailey St. Extension KBR1C Landscaping Consolidation of KBR1C (Areas 3 & 5) Reclamation Site Development: Areas 3A, 3B, 3C, 3D, 5A, 5B
2009-2010	Construct D5 & Bailey St. Extension KBR1C Landscaping Site Development: Areas 3B, 3C, 3D, 3E, 5A, 5B
2010-2011	Site Development: Areas 5A, 5B, 5C
2011-2012	Site Development: Areas 5A, 5B, 5C
4.	**KBR2 DEVELOPMENT PACKAGE**
2004-2006	Re-provide Police SDU Pier Off Site Existing Drainage Improvement
2006-2007	Reclamation of KBR2 (Area 5) - 1st stage Reclamation of KBR2 (Area 5) Consolidation - 1st stage Divert Submarine Freshwater Pipes Transfer Police SDU facilities Off Site Demolish Existing Police SDU Pier in KBR2 Divert Submarine 132kV Cables

Period	Activity
2007-2008	Reclamation of KBR2 (Area 5) Consolidation - 1st stage Reclamation of KBR2 (Area 5) - 2nd stage Construct Temporary Access Road to KBR1 Pier Construct Public Pier Transfer Operations from Kowloon Bay TS to New TS Demolish Kowloon Bay TS Mooring Dolphins Construct KBR South Seawall Central (Area 6) Reprovisioning Police, F.S. Berths & HHM7
2008-2009	Reclamation of KBR2 (Area 5) Consolidation - 1st and 2nd stages Transfer Operations from KBR1 Public Pier to New Pier Transfer PFBP to New PFBP Demolish KBR1 Public Pier Demolish PFBP, Chlorine Berth & Naphtha Jetty Reclamation for KBR2 (Area 4A) Reclamation for KBR2 (Area 6)
2009-2010	Reclamation of KBR2 (Area 5) Consolidation - 2nd stage Construct Saltwater Pumping Station Construct Main Drainage Construct D5, D6 & L5 Lay local water mains/sewers/road drainage/non government utilities Landscaping Reclamation for KBR2 (Area 4A) and Consolidation Reclamation for KBR2 (Area 6) and Consolidation Construct Kai Tak Nullah Extension Site Development: Area 5D, 5E, 5F,
2010 - 2011	Construct Saltwater Pumping Station Construct Main Drainage Construct D5, D6 & L5 Lay local water mains/sewers/road drainage/non government utilities Landscaping Reclamation for KBR2 (Area 4A) and Consolidation Reclamation for KBR2 (Area 6) and Consolidation Site Development: Areas 5D, 5E, 5F, 5G
2011 - 2012	Construct Main Drainage Reclamation for KBR2 Consolidation (Area 6) Construct KBR South Seawall East (Area 6) Construct Roads and Drains (Area 6) Construct P2 in KBR2 Metropolitan Park Development Site Development: Areas 5D, 5E, 5F, 5G
2012 - 2013	Reclamation for KBR2 Consolidation (Area 6) Construct P2 in KBR2 Metropolitan Park Development Site Development: Areas 5D, 5G, 5H
2013 - 2014	Site Development: Areas 5G, 5H, 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H
2014 - 2015	Site Development: Areas 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H
2015 - 2016	Site Development: Areas 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H, 6I
2016 - 2017	Site Development: Areas 6A, 6B, 6C, 6D, 6E, 6H, 6I
5. PRIORITY AREA REDEVELOPMENT PACKAGE	
2000-2001	Demolish Old Buildings: Area P1A
2001-2002	Demolish Old Buildings: Areas P1A, P1C, P1E1 Decant Existing User of Area P1G to New Site 2L Construction: Area P1(v)

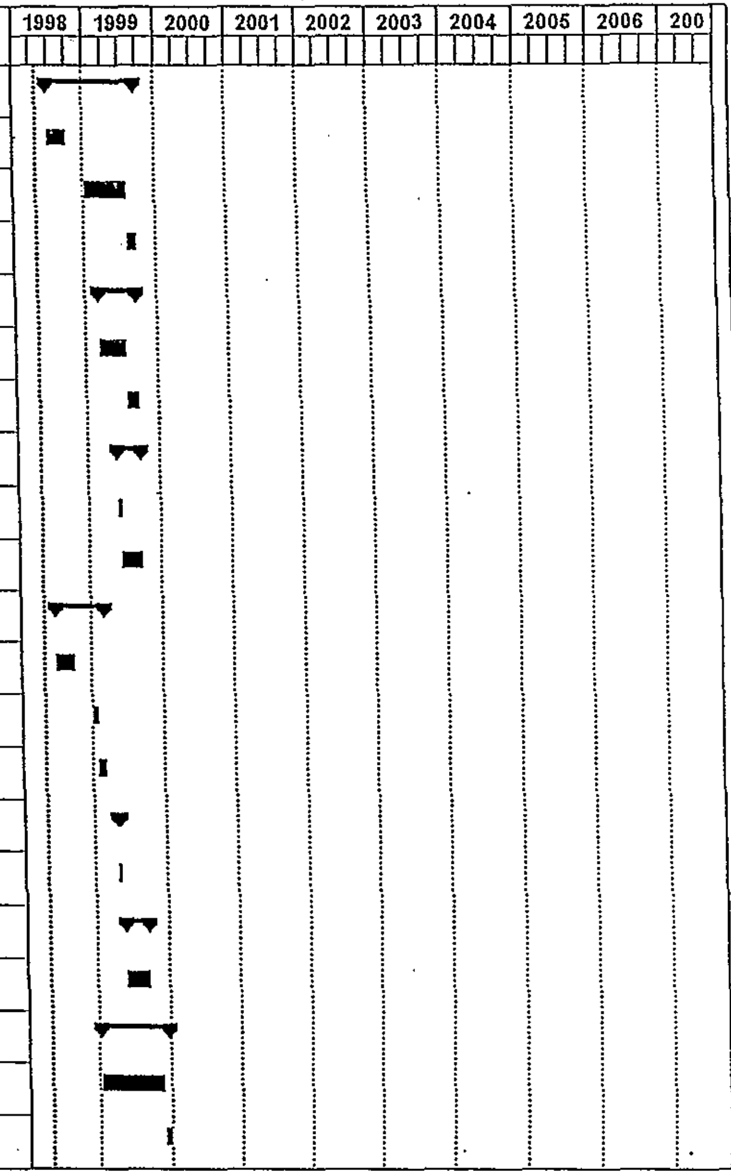
Period	Activity
2002-2003	Demolish Old Buildings: Areas P1E1, P1G Decant User of Area P1Gto New Site 2L Decant Residents from Old to New Sites (Areas 1D and 1F): P1B, P1F1, P1I, P1J, P2A, P2B, P2C, P2D Decant Residents from Old EMSD to New Site 4D
2003-2004	Demolish Old Buildings: Areas P1B, P1E, P1F, P1I, P1J, P2A, P2B, P2C, P2D Decant Residents from Old to New Sites (Areas 1D and 1F): P1B, P1F1, P1I, P1J, P2A, P2B, P2C, P2D Construction: Areas P1(i), P1(ii), P1(iii), P1(iv), P1(m), P2(i), P2(ii), P2(iii), P2(iv)
2004-2005	Demolish Old Buildings: Areas P1D, P1F2 Construction: Areas P1(i), P1(ii), P1(iii), P1(iv), P1(m), P2(i), P2(ii), P2(iii), P2(iv)
2005-2006	Construction: Areas P1(ii), P1(iii), P1(iv), P1(vi), P1(vii), P1(viii), P1(m), P2(i), P2(ii), P2(iii), P2(iv)
2006-2007	Construction: Areas P1(ii), P1(iii), P1(vi), P1(vii), P1(m), P2(iv)
2008-2011	Construction: Areas P1(ix)

APPENDIX B

PROPOSED CONSTRUCTION PROGRAMME

APPENDIX B

ID	Task Name	Start	Finish	Predecessors
1	**Area 1A**	**06/07/98**	**24/09/99**	
2	Contamination Remediation Works (A)	06/07/98	06/10/98	
3	Demolition of Existing Building (HAECO & Luftansa)	11/01/99	11/08/99	
4	Break-up Pavement (1A)	12/08/99	24/09/99	
5	**Area 1B**	**15/03/99**	**23/09/99**	
6	Demolition of Existing Building (HAECO Hanger 1 & 2)	15/03/99	25/07/99	
7	Break-up pavement (1B)	27/07/99	23/09/99	6
8	**Area 1C**	**30/05/99**	**29/09/99**	
9	Demolition of Existing Building (Substation D)	30/05/99	17/06/99	
10	Break-up pavement (1C)	18/06/99	29/09/99	9
11	**Area 1D**	**06/07/98**	**09/03/99**	
12	Contamination Remediation Works (C)	06/07/98	06/10/98	
13	Demolition of Existing Building (HACTL1 Part)	03/01/99	31/01/99	
14	Break-up pavement (1D)	01/02/99	09/03/99	13
15	**Area 1E**	**01/05/99**	**15/05/99**	
16	Break-up pavement (1E)	01/05/99	15/05/99	
17	**Area 1F**	**30/05/99**	**25/09/99**	
18	Break-up pavement (1F)	30/05/99	25/09/99	
19	**Area 1G**	**14/01/99**	**26/12/99**	
20	Demolition of Existing Building (CPA Blk D & E etc)	14/01/99	26/11/99	
21	Break-up pavement (1G)	30/11/99	26/12/99	20



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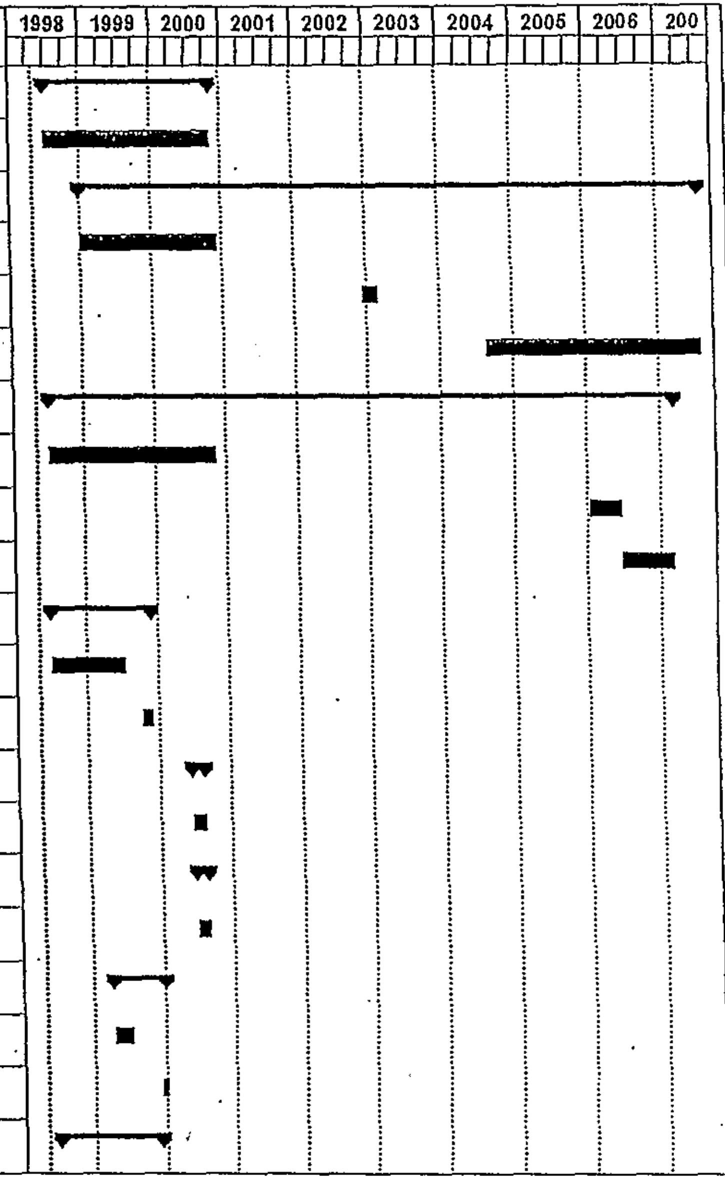
KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE
Proposed Project Programme

SCALE	N.T.S	DATE	April 1998
DESIGNED	Wendy Tao	DRAWN	Whitney Tung
CAD REF.	C415	DRAWING NO	Figure 1.4
		REV	0

ID	Task Name	Start	Finish	Predecessors
43	**Area 2G**	**06/07/98**	**09/11/00**	
44	Contamination Remediation Works (B)	06/07/98	09/11/00	
45	**Area 2H**	**01/01/99**	**03/08/07**	
46	Contamination Remediation Works (A) - SVE or excavati	01/01/99	07/12/00	
47	Break-up pavement (2H) (By others)	11/12/02	28/02/03	
48	Site Development - 2H (R1/School/Railway Department)	22/08/04	03/08/07	
49	**Area 2I**	**06/07/98**	**09/03/07**	
50	Contamination Remediation Works (B)	06/07/98	09/11/00	
51	Demolition of Existing Building (Terminal - Part) (By othe	12/01/06	22/06/06	
52	Break-up pavement (2I) (By CED)	23/06/06	09/03/07	51
53	**Area 2J**	**06/07/98**	**01/12/99**	
54	Contamination Remediation Works (C)	06/07/98	14/07/99	
55	Break-up pavement (2J)	08/10/99	01/12/99	
56	**Area 2K**	**14/06/00**	**16/08/00**	
57	Break-up pavement (2K)	14/06/00	16/08/00	
58	**Area 2L**	**29/06/00**	**01/09/00**	
59	Break-up pavement (2L)	29/06/00	01/09/00	
60	**Area 4K**	**16/04/99**	**07/01/00**	
61	Contamination Remediation Works (C)	16/04/99	14/07/99	
62	Break-up pavement (2K)	12/12/99	07/01/00	
63	**Area 4L**	**06/07/98**	**11/12/99**	



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Maunsell

in association with

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KAI TAK AIRPORT NORTH APRON DECOMMISSIONING

Territory Development Department, Hong Kong
Kowloon Development Office

TITLE

Proposed Project Programme

SCALE	N.T.S	DATE	April 1998
DESIGNED	Wendy Tso	DRAWN	Whitney Tung
CAD REF.	C415	DRAWING NO	Figure 1.4
		REV	0

APPENDIX C

HAECO AND OCTF SITE HISTORY REVIEW QUESTIONNAIRE

APPENDIX C
HAECO and OCTF SITE HISTORY REVIEW QUESTIONNAIRE

Information Provided by: Mr K W Lau (Facilities Engineering Superintendent, HAECO)
Mr C L Cheung (Clerk of Works (Maintenance), HAECO)
Mr Peter A Kilgour (General Manager (Finance), HAECO)
Mr Danny Ho (OCTF)

Recorded by: MGibbs

Date of interview/site visit: 18 September 1996 (HAECO) and 23 September 1996 (OCTF)

Information	OCTF	HAECO
Description of subject property and adjacent properties (size, location, status of development)	Site size: approx 12,110 m^2 Location: Kai Tak Airport, NKIL 5449	Site is bounded by Concorde Road, Convair Drive, the maintenance apron, and Comet Drive. The site is adjacent to the OCTF Fuel Farm (to the west), workshops and a carpark (to the north), the CPA Building (to the east), and the airport apron (to the south). Total site area is 95,260 m^2.
Description of current operations at the existing property Length of operation	Storage and handling of aviation fuel (jet fuel and aviation gasoline) in bulk, and with small quantity of aviation lubricant. Since 1958 (38 years)	maintenance of aircraft, and overhaul of aircraft engines and components 46 years
Historical land use	Not available	Prior to HAECO's presence, the site was part of Kai Tak Airport. Fuel storage was located at this site prior to realignment of the runway during Japanese occupation.
Business records, e.g., leases and deeds, ownership details	site leased from Lands Department to OCTF consortium since 1958	N/A
Has the facility (HAECO or OCTF) received notices of violation of environmental regulations or public complaints of nuisance?	To be checked against HK (EPD) Regulations	1. Noise due to engine testing (rectified 3 years ago) 2. August '96 query from FSD about improper CW collection container 3. August '96 query from EPD about discharges into Victoria Harbour
Internal records of tank truck spillage/ leakage Type, duration and quantities	Hydrant leakage record provided.	Only small quantities that were immediately cleaned up. Isolated events.
Lists of registered Hazardous Installations and other hazardous practices as maintained by local governments	Wasted oil disposed by licensed contractor. Occasionally used by FSD in their fire drill.	DG Stores (all Categories 1 to 8). Radiographic Room (for x-ray of jet engines).

Information	OCTF	HAECO
Details of applications and decisions concerning planning, environmental health, building control, etc.	According to HK (EPD) Regulations and Shell environmental guidelines.	N/A
Records of major renovation of site, or rearrangement of underground utilities, pipework/ underground tanks	Not available. Facilities being upgraded from time to time since 1958.	Demolition of two fuel stations with underground tanks, and one cyanide destruction plant with underground tank. Plans showing locations of underground storage tanks (and further information) attached.
Record of drainage defects/ wastewater treatment malfunction	None	August '96 query from EPD about discharges into Victoria Harbour
HAECO/OCTF permits from EPD	N/A	1. Chemical Waste Producer 2. Discharge License to Victoria Harbour WCZ (in process of applying)
Have any areas on the site been used for on-site disposal of wastes?	N/A	no

Please indicate whether the following materials have been used at this site

MATERIAL	YES/NO (If YES, Method of Disposal[1])	
	OCTF	HAECO
Fuels	Yes. Various sources.	Yes. Waste aircraft fuel disposed of by (ii)
Lubricating oils, hydraulic fluid	Yes. Various sources.	Yes (lube oil and oil from aircraft engines). Disposal by (ii).
Anticorrosive paints, thinners	Tanks, pipelines and vehicles.	Yes. Disposal by (ii).
Cleaning solvents	No	Yes. Chemical cleaning rinsing water disposed by (iii) after treatment by mobile treatment truck[2].
Acids (diluted)	No	Historical disposal by lime pit (see plan). Currently disposed of by (iii) after treatment by mobile treatment truck[2].
Asbestos	No	Section of wall cladding (see plan). Disposal by (ii).
Transformer Oil (PCB)	No	Transformer in plating shop was removed by contractor about 20 years ago. All existing transformers owned by CLP.
Coal, ash, oily tank and bilge sludges	Yes	Oily sludge from engine cleaning. Disposed of by (ii).
Finely divided metal wastes	No	From machine shop. Disposed of by (i).
Electrical wiring	Yes	Disposed of by (i).
Low-level radioactive waste	No	None.
Wood preservatives	No	None.
Polyurethane foam	N/A	Disposed of by (i).

NOTES:

1 Methods of disposal include:
- i) collection by a municipal solid waste collector
- ii) collection by a licensed chemical waste collector (Enviropace and Dunwell)
- iii) disposal at sewage drain in liquid form
- iv) disposal at storm drain in liquid form
- v) burial at pits within the site.

2 Mobile treatment truck uses a neutralizing tank followed by activated charcoal filter to reduce BOD, COD and phenols to standards in the Technical Memorandum. Used charcoal filter disposed by method (ii) above.

APPENDIX D

SAMPLE OUTPUT FILES OF AIR QUALITY MODELS

APPENDIX D

Sample FDM Model Output File (Dust Impact During Demolition Stage)

```
1

                FUGITIVE DUST MODEL (FDM)
                VERSION 95279
                OCT, 1995
          DATE AT START OF RUN: 04/21/98    TIME AT START OF RUN: 15:01:47.92


     RUN TITLE:
          PHXAB

          INPUT FILE NAME: phxab.IN
          OUTPUT FILE NAME: phxab.OUT
          PLOT OUTPUT WRITTEN TO FILE NAME: phxab.DAT


          CONVERGENCE OPTION 1=OFF, 2=ON                          1
          MET OPTION SWITCH, 1=CARDS, 2=PREPROCESSED              1
          PLOT FILE OUTPUT, 1=NO, 2=YES                           2
          MET DATA PRINT SWITCH, 1=NO, 2=YES                      1
          POST-PROCESSOR OUTPUT, 1=NO, 2=YES                      1
          DEP. VEL./GRAV. SETL. VEL., 1=DEFAULT, 2=USER           1
          PRINT 1-HOUR AVERAGE CONCEN, 1=NO, 2=YES                2
          PRINT 3-HOUR AVERAGE CONCEN, 1=NO, 2=YES                1
          PRINT 8-HOUR AVERAGE CONCEN, 1=NO, 2=YES                1
          PRINT 24-HOUR AVERAGE CONCEN, 1=NO, 2=YES               1
          PRINT LONG-TERM AVERAGE CONCEN, 1=NO, 2=YES             1
          BYPASS RAMMET CALMS RECOGNITION, 1=NO, 2=YES            1
          READ HOURLY EMISSION RATES, 1=NO, 2=YES                 0
          NUMBER OF SOURCES PROCESSED                            34
          NUMBER OF RECEPTORS PROCESSED                           1
          NUMBER OF PARTICLE SIZE CLASSES                         5
          NUMBER OF HOURS OF MET DATA PROCESSED                   1
          LENGTH IN MINUTES OF 1-HOUR OF MET DATA               60.
          ROUGHNESS LENGTH IN CM                             100.00
          SCALING FACTOR FOR SOURCE AND RECPTORS             1.0000
          PARTICLE DENSITY IN G/CM**3                          2.50
          ANEMOMETER HEIGHT IN M                              10.00


          GENERAL PARTICLE SIZE CLASS INFORMATION

                                  GRAV.                  FRACTION
            PARTICLE      CHAR.  SETTLING   DEPOSITION   IN EACH
                SIZE       DIA.  VELOCITY    VELOCITY      SIZE
               CLASS       (UM)   (M/SEC)     (M/SEC)     CLASS
               -----  ---------- --------  ----------  --------
                   1   1.2500000       **          **    0.0950
                   2   3.7500000       **          **    0.1050
                   3   7.5000000       **          **    0.1600
                   4  12.5000000       **          **    0.1400
                   5  22.5000000       **          **    0.5000
          ----------
          ** COMPUTED BY FDM
1

          RECEPTOR COORDINATES (X,Y,Z)

(838000., 821000.,   2.)  (
1

          SOURCE INFORMATION

                ENTERED EMIS.    TOTAL
                 RATE (G/SEC,  EMISSION    WIND
                  G/SEC/M OR      RATE   SPEED      X1        Y1       X2        Y2  HEIGHT   WIDTH
          TYPE   G/SEC/M**2)   (G/SEC)    FAC.     (M)       (M)      (M)       (M)     (M)     (M)
          ---- -------------- ---------- ------ -------  -------- -------  -------- ------- -------
             3    0.000015970    0.51104  0.000 838420.  820328.     200.     160.    0.50   67.00
             3    0.000015970    0.63880  0.000 838224.  820420.     200.     200.    0.50   67.00
             3    0.000015970    0.97736  0.000 837976.  820540.     204.     300.    0.50   65.00
             3    0.000015970    0.70268  0.000 837724.  820620.     220.     200.    0.50   65.00
             3    0.000015970    0.45994  0.000 838376.  821104.     160.     180.    0.50   48.00
             3    0.000015970    0.15331  0.000 838876.  820808.     120.      80.    0.50   65.00
             3    0.000015970    0.51743  0.000 839120.  821000.     324.     100.    0.50   63.00
             3    0.000015970    0.34495  0.000 839016.  820772.     180.     120.    0.50   63.00
             3    0.000015970    0.05826  0.000 838940.  820672.      48.      76.    0.50   63.00
             3    0.000015970    0.63880  0.000 838836.  820980.     200.     200.    0.50   46.00
             3    0.000015970    0.38328  0.000 838922.  821100.     120.     200.    0.50   46.00
```

Sample ISCST Model Output File (NO_2 Impact During Contamination Remediation Stage)

```
1                      ISCST - (DATED 90346)

                       IBM-PC VERSION (2.05)
                       (C) COPYRIGHT 1990, TRINITY CONSULTANTS, INC.
                       SERIAL NUMBER 5792 SOLD TO C.E.S.
                       RUN BEGAN ON 04-21-98 AT 15:27:22


1

                            *** NO2, 25m                                                        ***

                   CALCULATE (CONCENTRATION=1,DEPOSITION=2)                            ISW(1) =    1
                   RECEPTOR GRID SYSTEM (RECTANGULAR=1 OR 3, POLAR=2 OR 4)             ISW(2) =    4
                   DISCRETE RECEPTOR SYSTEM (RECTANGULAR=1,POLAR=2)                    ISW(3) =    1
                   TERRAIN ELEVATIONS ARE READ (YES=1,NO=0)                            ISW(4) =    0
                   CALCULATIONS ARE WRITTEN TO TAPE (YES=1,NO=0)                       ISW(5) =    0
                   LIST ALL INPUT DATA (NO=0,YES=1,MET DATA ALSO=2)                    ISW(6) =    1

                   COMPUTE AVERAGE CONCENTRATION (OR TOTAL DEPOSITION)
                   WITH THE FOLLOWING TIME PERIODS:
                     HOURLY (YES=1,NO=0)                                               ISW(7) =    1
                     2-HOUR (YES=1,NO=0)                                               ISW(8) =    0
                     3-HOUR (YES=1,NO=0)                                               ISW(9) =    0
                     4-HOUR (YES=1,NO=0)                                              ISW(10) =    0
                     6-HOUR (YES=1,NO=0)                                              ISW(11) =    0
                     8-HOUR (YES=1,NO=0)                                              ISW(12) =    0
                     12-HOUR (YES=1,NO=0)                                             ISW(13) =    0
                     24-HOUR (YES=1,NO=0)                                             ISW(14) =    1
                   PRINT 'N'-DAY TABLE(S) (YES=1,NO=0)                                ISW(15) =    1

                   PRINT THE FOLLOWING TYPES OF TABLES WHOSE TIME PERIODS ARE
                   SPECIFIED BY ISW(7) THROUGH ISW(14):
                     DAILY TABLES (YES=1,NO=0)                                        ISW(16) =    0
                     HIGHEST & SECOND HIGHEST TABLES (YES=1,NO=0)                     ISW(17) =    1
                     MAXIMUM 50 TABLES (YES=1,NO=0)                                   ISW(18) =    0
                   METEOROLOGICAL DATA INPUT METHOD (PRE-PROCESSED=1,CARD=2)          ISW(19) =    1
                   RURAL-URBAN OPTION (RU.=0,UR. MODE 1=1,UR. MODE 2=2,UR. MODE 3=3)  ISW(20) =    3
                   WIND PROFILE EXPONENT VALUES (DEFAULTS=1,USER ENTERS=2,3)          ISW(21) =    1
                   VERTICAL POT. TEMP. GRADIENT VALUES (DEFAULTS=1,USER ENTERS=2,3)   ISW(22) =    1
                   SCALE EMISSION RATES FOR ALL SOURCES (NO=0,YES>0)                  ISW(23) =    0
                   PROGRAM CALCULATES FINAL PLUME RISE ONLY (YES=1,NO=2)              ISW(24) =    2
                   PROGRAM ADJUSTS ALL STACK HEIGHTS FOR DOWNWASH (YES=2,NO=1)        ISW(25) =    2
                   PROGRAM USES BUOYANCY INDUCED DISPERSION (YES=1,NO=2)              ISW(26) =    1
                   CONCENTRATIONS DURING CALM PERIODS SET = 0 (YES=1,NO=2)            ISW(27) =    1
                   REG. DEFAULT OPTION CHOSEN (YES=1,NO=2)                            ISW(28) =    2
                   TYPE OF POLLUTANT TO BE MODELLED (1=SO2,2=OTHER)                   ISW(29) =    2
                   DEBUG OPTION CHOSEN (YES=1,NO=2)                                   ISW(30) =    2
                   ABOVE GROUND (FLAGPOLE) RECEPTORS USED (YES=1,NO=0)                ISW(31) =    1

                   NUMBER OF INPUT SOURCES                                             NSOURC =    1
```

(DEGREES KELVIN PER METER)

STABILITY CATEGORY	WIND SPEED CATEGORY 1	2	3	4	5	6
A	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
B	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

1

*** NO2, 25m ***

X,Y-COORDINATES OF THE CENTER OF THE POLAR RECEPTOR GRID (METERS) = (838320., 820400.)

*** RANGES OF POLAR GRID SYSTEM ***
(METERS)

50.0,

*** RADIAL ANGLES OF POLAR GRID SYSTEM ***

(DEGREES)

360.0,

1

*** NO2, 25m ***

* ABOVE GROUND RECEPTOR HEIGHTS IN METERS *
* FOR THE RECEPTOR GRID *

DIRECTION / (DEGREES) /	RANGE (METERS) 50.0
360.0 /	25.00000

1

*** NO2, 25m ***

*** SOURCE DATA ***

EMISSION RATE TEMP. EXIT VEL.

Sample ISCST Model Output File (NO_2 Impact During Contamination Remediation Stage)

```
* CALM HOURS (=1) FOR DAY 140 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0
* CALM HOURS (=1) FOR DAY 141 *  0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1
* CALM HOURS (=1) FOR DAY 142 *  0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 143 *  0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 144 *  0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 145 *  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 146 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
* CALM HOURS (=1) FOR DAY 148 *  0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 149 *  0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 150 *  0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 153 *  0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 157 *  0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 158 *  0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 162 *  0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 167 *  0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 171 *  1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 174 *  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
* CALM HOURS (=1) FOR DAY 175 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
* CALM HOURS (=1) FOR DAY 177 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 189 *  0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 190 *  0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 194 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
* CALM HOURS (=1) FOR DAY 195 *  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 196 *  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 197 *  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 204 *  0 1 1 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 208 *  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 212 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0
* CALM HOURS (=1) FOR DAY 215 *  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 216 *  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
* CALM HOURS (=1) FOR DAY 217 *  0 0 1 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 222 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 225 *  0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 228 *  0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 231 *  0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 237 *  0 1 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0
* CALM HOURS (=1) FOR DAY 238 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0
* CALM HOURS (=1) FOR DAY 243 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
* CALM HOURS (=1) FOR DAY 244 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 245 *  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
* CALM HOURS (=1) FOR DAY 247 *  0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 248 *  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 254 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
* CALM HOURS (=1) FOR DAY 255 *  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 256 *  0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 257 *  0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 259 *  0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 264 *  0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 266 *  0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0
* CALM HOURS (=1) FOR DAY 271 *  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0
```

Sample ISCST Model Output File (NO_2 Impact During Contamination Remediation Stage)

```
    360.0 /       .35844
1
                                                                                                        HIGH
                                                                                                         1-HR
                                                                                                        SGROUP#   1

                        *** NO2, 25m                                                        ***

                       * HIGHEST  1-HOUR AVERAGE CONCENTRATION (MICROGRAMS/CUBIC METER)      *
                                        * FROM ALL SOURCES *
                                      * FOR THE RECEPTOR GRID *

                     * MAXIMUM VALUE EQUALS     28.47692 AND OCCURRED AT (       50.0,      360.0) *

  DIRECTION /                                            RANGE (METERS)
  (DEGREES) /                50.0
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

    360.0 /      28.47692 ( 87, 3)
1
                                                                                                        2ND HIGH
                                                                                                         1-HR
                                                                                                        SGROUP#   1

                        *** NO2, 25m                                                        ***

                     * SECOND HIGHEST  1-HOUR AVERAGE CONCENTRATION (MICROGRAMS/CUBIC METER)      *
                                        * FROM ALL SOURCES *
                                      * FOR THE RECEPTOR GRID *

                     * MAXIMUM VALUE EQUALS     28.47692 AND OCCURRED AT (       50.0,      360.0) *

  DIRECTION /                                            RANGE (METERS)
  (DEGREES) /                50.0
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

    360.0 /      28.47692 (187, 3)
1
                                                                                                        HIGH
                                                                                                        24-HR
                                                                                                        SGROUP#   1

                        *** NO2, 25m                                                        ***

                       * HIGHEST 24-HOUR AVERAGE CONCENTRATION (MICROGRAMS/CUBIC METER)      *
                                        * FROM ALL SOURCES *
                                      * FOR THE RECEPTOR GRID *

                     * MAXIMUM VALUE EQUALS      4.89796 AND OCCURRED AT (       50.0,      360.0) *

  DIRECTION /                                            RANGE (METERS)
  (DEGREES) /                50.0
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

Sample ISCST Model Output File (Benzene Impact Duirng Contamination Remediation Stage)

```
1                    ISCST - (DATED 90346)

                     IBM-PC VERSION (2.05)
                     (C) COPYRIGHT 1990, TRINITY CONSULTANTS, INC.
                     SERIAL NUMBER 5792 SOLD TO C.E.S.
                     RUN BEGAN ON 04-21-98 AT 15:27:36


1

                          *** Benzene, 25m                                           ***

                 CALCULATE (CONCENTRATION=1,DEPOSITION=2)                          ISW(1) =   1
                 RECEPTOR GRID SYSTEM (RECTANGULAR=1 OR 3, POLAR=2 OR 4)           ISW(2) =   4
                 DISCRETE RECEPTOR SYSTEM (RECTANGULAR=1,POLAR=2)                  ISW(3) =   1
                 TERRAIN ELEVATIONS ARE READ (YES=1,NO=0)                          ISW(4) =   0
                 CALCULATIONS ARE WRITTEN TO TAPE (YES=1,NO=0)                     ISW(5) =   0
                 LIST ALL INPUT DATA (NO=0,YES=1,MET DATA ALSO=2)                  ISW(6) =   1

                 COMPUTE AVERAGE CONCENTRATION (OR TOTAL DEPOSITION)
                 WITH THE FOLLOWING TIME PERIODS:
                   HOURLY (YES=1,NO=0)                                             ISW(7) =   1
                   2-HOUR (YES=1,NO=0)                                             ISW(8) =   0
                   3-HOUR (YES=1,NO=0)                                             ISW(9) =   0
                   4-HOUR (YES=1,NO=0)                                            ISW(10) =   0
                   6-HOUR (YES=1,NO=0)                                            ISW(11) =   0
                   8-HOUR (YES=1,NO=0)                                            ISW(12) =   0
                   12-HOUR (YES=1,NO=0)                                           ISW(13) =   0
                   24-HOUR (YES=1,NO=0)                                           ISW(14) =   0
                 PRINT 'N'-DAY TABLE(S) (YES=1,NO=0)                              ISW(15) =   0

                 PRINT THE FOLLOWING TYPES OF TABLES WHOSE TIME PERIODS ARE
                 SPECIFIED BY ISW(7) THROUGH ISW(14):
                   DAILY TABLES (YES=1,NO=0)                                      ISW(16) =   0
                   HIGHEST & SECOND HIGHEST TABLES (YES=1,NO=0)                   ISW(17) =   1
                   MAXIMUM 50 TABLES (YES=1,NO=0)                                 ISW(18) =   0
                 METEOROLOGICAL DATA INPUT METHOD (PRE-PROCESSED=1,CARD=2)        ISW(19) =   1
                 RURAL-URBAN OPTION (RU.=0,UR. MODE 1=1,UR. MODE 2=2,UR. MODE 3=3) ISW(20) =  3
                 WIND PROFILE EXPONENT VALUES (DEFAULTS=1,USER ENTERS=2,3)        ISW(21) =   1
                 VERTICAL POT. TEMP. GRADIENT VALUES (DEFAULTS=1,USER ENTERS=2,3) ISW(22) =   1
                 SCALE EMISSION RATES FOR ALL SOURCES (NO=0,YES>0)                ISW(23) =   0
                 PROGRAM CALCULATES FINAL PLUME RISE ONLY (YES=1,NO=2)            ISW(24) =   2
                 PROGRAM ADJUSTS ALL STACK HEIGHTS FOR DOWNWASH (YES=2,NO=1)      ISW(25) =   2
                 PROGRAM USES BUOYANCY INDUCED DISPERSION (YES=1,NO=2)            ISW(26) =   1
                 CONCENTRATIONS DURING CALM PERIODS SET = 0 (YES=1,NO=2)          ISW(27) =   1
                 REG. DEFAULT OPTION CHOSEN (YES=1,NO=2)                          ISW(28) =   2
                 TYPE OF POLLUTANT TO BE MODELLED (1=SO2,2=OTHER)                 ISW(29) =   2
                 DEBUG OPTION CHOSEN (YES=1,NO=2)                                 ISW(30) =   2
                 ABOVE GROUND (FLAGPOLE) RECEPTORS USED (YES=1,NO=0)              ISW(31) =   1

                 NUMBER OF INPUT SOURCES                                           NSOURC =   1
```

Sample ISCST Model Output File (Benzene Impact Duirng Contamination Remediation Stage)

(DEGREES KELVIN PER METER)

STABILITY CATEGORY	WIND SPEED CATEGORY 1	2	3	4	5	6
A	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
B	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

1

*** Benzene, 25m ***

X,Y-COORDINATES OF THE CENTER OF THE POLAR RECEPTOR GRID (METERS) = (838320., 820400.)

*** RANGES OF POLAR GRID SYSTEM ***
(METERS)

50.0,

*** RADIAL ANGLES OF POLAR GRID SYSTEM ***

(DEGREES)

360.0,

1

*** Benzene, 25m ***

* ABOVE GROUND RECEPTOR HEIGHTS IN METERS *
* FOR THE RECEPTOR GRID *

DIRECTION / (DEGREES) /	RANGE (METERS) 50.0
360.0 /	25.00000

1

*** Benzene, 25m ***

*** SOURCE DATA ***

EMISSION RATE TEMP. EXIT VEL.

Sample ISCST Model Output File (Benzene Impact Duirng Contamination Remediation Stage)

```
 * CALM HOURS (=1) FOR DAY 140 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  1  0
 * CALM HOURS (=1) FOR DAY 141 *  0  0  0  0  0  1  1  1  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  1
 * CALM HOURS (=1) FOR DAY 142 *  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 143 *  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 144 *  0  0  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 145 *  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 146 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1
 * CALM HOURS (=1) FOR DAY 148 *  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 149 *  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 150 *  0  1  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 153 *  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 157 *  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 158 *  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 162 *  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  1  1  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 167 *  0  0  0  0  0  0  0  0  0  0  0  1  0  1  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 171 *  1  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 174 *  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1
 * CALM HOURS (=1) FOR DAY 175 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0
 * CALM HOURS (=1) FOR DAY 177 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 189 *  0  1  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 190 *  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 194 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0
 * CALM HOURS (=1) FOR DAY 195 *  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 196 *  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 197 *  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 204 *  0  1  1  0  0  0  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 208 *  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 212 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0
 * CALM HOURS (=1) FOR DAY 215 *  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 216 *  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0
 * CALM HOURS (=1) FOR DAY 217 *  0  0  1  0  0  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 222 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 225 *  0  0  0  0  0  0  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 228 *  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 231 *  0  0  1  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 237 *  0  1  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  1  0  0  0  1  0
 * CALM HOURS (=1) FOR DAY 238 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0
 * CALM HOURS (=1) FOR DAY 243 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1
 * CALM HOURS (=1) FOR DAY 244 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 245 *  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1
 * CALM HOURS (=1) FOR DAY 247 *  0  0  0  0  1  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 248 *  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 254 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0
 * CALM HOURS (=1) FOR DAY 255 *  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 256 *  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 257 *  0  0  1  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 259 *  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 264 *  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 266 *  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0
 * CALM HOURS (=1) FOR DAY 271 *  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  1  0
```

Sample ISCST Model Output File (Benzene Impact Duirng Contamination Remediation Stage)

```
     360.0 /      37.02531 ( 87, 3)
1
                                                                                                        2ND HIGH
                                                                                                         1-HR
                                                                                                        SGROUP#  1

                         *** Benzene, 25m                                          ***

                    * SECOND HIGHEST  1-HOUR AVERAGE CONCENTRATION (MICROGRAMS/CUBIC METER)     *
                                              * FROM ALL SOURCES *
                                            * FOR THE RECEPTOR GRID *

                    * MAXIMUM VALUE EQUALS      37.02531 AND OCCURRED AT (       50.0,      360.0) *
 DIRECTION /
 (DEGREES) /               50.0                              RANGE (METERS)
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     360.0 /      37.02531 (187, 3)

RUN ENDED ON 04-21-98 AT 15:27:48
```

APPENDIX E

SOIL PERMEABILITY DATA

APPENDIX E SOIL PERMEABILITY DATA

Additional analyses of a total of 47 residual Phase 2 soil samples were undertaken in March 1998. The soil analyses include:

- Bulk density (BS 1377: Part 2: 1990)
- Total porosity (BS 1377: Part 2: 1990)
- Air content (BS 1377: Part 2: 1990)
- Permeability (BS 1377: Part 5: 1990)
- Soil type (In-house qualitative description)

Samples were obtained from both 1 m above and below ground water table at sampling locations across the KTA apron area particularly at the remediation hot spots A and B where the SVE/AS method has been proposed. The findings are useful in delineating the vertical and spatial geological profile of the site. Data from soils at 1 m above and below ground water table represents the geology of the unsaturated and saturated layers respectively. Table 1 summarises the testing results and the detailed data set is presented in Appendix 1.

Although geological heterogeneity is illustrated among individual samples across the site, the general vertical and spatial geological profiles of hot spots A and B and the area outside HAECO are largely similar and the corresponding geological parameters are of the same order of magnitude. All soil samples are described as sand of various kinds ranging from clayey/silty sand to gravelly sand except three samples which are described as sandy silt. This finding is also supported by the available drillhole records from selected previous site investigations carried out at the KTA apron area (Appendix 2).

The soil samples of hot spots A and B and those outside HAECO have a similar average bulk density ranging from 1700 - 1900 kgm^{-3} and an average total porosity ranging from 0.38 - 0.45. For hot spot A, the unsaturated and saturated layers have a similar average air content within the range of 0.16 - 0.19. Both the saturated and unsaturated layers have an average permeability of the order of 10^{-4} ms^{-1}, which are considered as moderately permeable soil since in general, the soil with a permeability approaching 10^{-9} ms^{-1} or smaller will be characterised as low permeability material.[1]

Soil in hot spot B is generally less permeable and has a lower air content than that in hot spot A. Both unsaturated and saturated layers of hot spot B have an average air content of 0.09. Similar to hot spot A, both the unsaturated and saturated layers are considered as moderately permeable soil, which have a permeability of the order of 10^{-6} ms^{-1} and 10^{-5} ms^{-1} respectively.

The area outside the HAECO building generally demonstrate similar geological characteristics to hot spots A and B. Regarding its vertical geological profile, the unsaturated layer has a higher air content, with an average of 0.2 compared to the saturated layer, an average of 0.07 and is relatively more permeable than the unsaturated layer. However, both layers are considered as moderately permeable soil as they have a permeability between the order of 10^{-4} ms^{-1} and 10^{-5} ms^{-1}.

In view of the vertical geological profile of hot spots A and B, both the unsaturated and saturated layers are found to be moderately permeable sandy soil and they demonstrate similar soil characteristic, which suggest that significant preferential migration pathways are unlikely to be formed and adverse impacts on the operation of the SVE/AS system are not expected. Nevertheless, further pilot trails are recommended to be undertaken to prove the effectiveness of the SVE/AS method.

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1 Patrick A. Domenico & Franklin W. Schwartz (1990). Physical and Chemical Hydrogeology, John Wiley & Sons.

Table 1 Summary of KTA Phase 2 Additional Soil Sample Testing Results

Hot Spot	Borehole No.[a]	Sample Depth[b]	Bulk Density (kgm^{-3})	Total Porosity	Air Content	Permeability, K_{20}^{c} (ms^{-1})	Description
A	MW202, 203, 230, 231, 232	1	1.79×10^3 (1.44×10^3 - 2.09×10^3)	0.41 (0.30 - 0.49)	0.19 (0.01 - 0.42)	4.86×10^{-4} (9.33×10^{-7} - 1.93×10^{-3})	sandy SILT, silty/gravelly SAND
A	MW 203, 230, 231, 232	2	1.86×10^3 (1.77×10^3 - 1.99×10^3)	0.38 (0.33 - 0.41)	0.16 (0.10 - 0.22)	4.10×10^{-4} (2.98×10^{-5} - 8.24×10^{-4})	silty/gravelly SAND
B	MW239, 241, 242, 248, 250, 251, 252, 253, 258, 259, 260, 262, 263, 267, 268, 269	1	1.90×10^3 (1.63×10^3 - 2.06×10^3)	0.40 (0.33 - 0.49)	0.09 (0.03 - 0.22)	1.61×10^{-6} (5.75×10^{-8} - 1.36×10^{-5})	clayey/silty/gravelly SAND
B	MW239, 241, 242, 248, 250, 251, 252, 253, 254, 258, 260, 262, 263, 268, 269	2	1.87×10^3 (1.77×10^3 - 2.08×10^3)	0.43 (0.32 - 0.54)	0.09 (0.05 - 0.21)	2.25×10^{-5} (8.65×10^{-8} - 2.96×10^{-4})	silty/clayey/gravelly SAND
NA	MW207, 209, 216, 217	1	1.70×10^3 (1.42×10^3 - 1.86×10^3)	0.45 (0.42 - 0.51)	0.20 (0.09 - 0.40)	3.05×10^{-4} (1.93×10^{-7} - 9.90×10^{-4})	sandy SILT, silty/gravelly SAND
NA	MW207, 209, 217	2	1.85×10^3 (1.78×10^3 - 1.90×10^3)	0.45 (0.44 - 0.46)	0.07 (0 - 0.16)	1.29×10^{-5} (1.42×10^{-6} - 3.61×10^{-5})	sandy SILT, silty/gravelly SAND

a Sampling locations refer to Figure 1

b Sample Depth 1 = 1 m above ground water level
Sample Depth 2 = 1 m below ground water level

c The permeability value is corrected to 20 °C condition according BS 1377: Part 5: 1990 requirement.

NA Not Applicable (The sampling locations are located outside HAECO)

Data presented are average values. Those figures in brackets are the ranges.

Appendix 1 KTA Phase 2 Additional Soil Sample Testing Results

Table 1.1 KTA Phase 2 Additional Soil Sample Testing Results (1 m above Ground Water Table)

Hot Spot	Borehole No.	Bulk Density x 10E+3 (kgm-3)	Dry Density x 10E+3 (kgm-3)	Moisture Content (w%)	Specific Gravity, Gs	Void Ratio, e	Total Porosity, n = e/(1+e)	Degree of Saturation, Sr = w(Gs)/e	Air Content, A = n(1-Sr)	Permeability, K20 (m/s)	Description
A	MW202	2.09	1.83	14.1	2.65	0.447	0.303	0.836	0.05	1.03E-05	Greyish brown silty SAND
A	MW203	1.44	1.37	5.1	2.66	0.941	0.485	0.144	0.415	1.93E-03	Yellowish brown silty SAND
A	MW230	1.7	1.53	11	2.64	0.724	0.42	0.401	0.252	4.39E-04	Greyish brown gravelly SAND with silt
A	MW231	1.74	1.5	16.2	2.67	0.783	0.439	0.552	0.197	4.74E-05	Greyish brown silty gravelly SAND
A	MW232	1.97	1.58	24.9	2.66	0.686	0.407	0.965	0.014	9.33E-07	Greyish black sandy SILT
B	MW239	1.88	1.52	24	2.66	0.754	0.43	0.846	0.066	3.06E-06	Yellowish brown silty SAND with gravel
B	MW241	1.87	1.67	12.2	2.65	0.59	0.371	0.548	0.168	3.20E-06	Greyish brown silty SAND
B	MW242	1.63	1.38	20.2	2.60	0.976	0.494	0.555	0.22	1.36E-05	Yellowish brown silty gravelly SAND
B	MW248	1.99	1.65	20.6	2.68	0.624	0.384	0.885	0.044	1.66E-06	Greyish brown clayey/silty SAND
B	MW250	1.94	1.58	23.1	2.68	0.701	0.412	0.884	0.048	2.78E-07	Greyish brown clayey/silty SAND with gravel
B	MW251	1.97	1.64	20.1	2.7	0.646	0.392	0.84	0.063	1.34E-07	Brwon silty SAND with gravel
B	MW252	1.84	1.48	24.3	2.64	0.783	0.439	0.819	0.079	4.35E-07	Yellowish brown clayey SAND with gravel
B	MW253	1.9	1.59	19.5	2.67	0.678	0.404	0.768	0.095	5.75E-08	Dark brown silty SAND with gravel
B	MW258	1.93	1.64	17.9	2.68	0.636	0.389	0.75	0.097	1.06E-06	Greyish dard yellow clayey SAND with gravel
B	MW259	1.67	1.42	18	2.65	0.872	0.466	0.547	0.211	5.45E-07	Yellowish brown silty SAND with gravel
B	MW260	1.97	1.61	22.7	2.66	0.657	0.396	0.919	0.032	2.76E-07	Yellowish brown silty gravelly SAND
B	MW262	2.04	1.24	17.5	2.64	0.521	0.343	0.887	0.039	4.36E-07	Greyish brown silty gravelly SAND
B	MW263	2.06	1.76	17.1	2.64	0.501	0.334	0.902	0.033	2.64E-07	Greyish brown silty gravelly SAND
B	MW267	1.93	1.61	19.6	2.66	0.648	0.393	0.804	0.077	4.47E-07	Dark yellowish brown silty SAND
B	MW268	1.86	1.52	22.4	2.67	0.757	0.327	0.79	0.069	1.90E-07	Yellowish brown clayey/silty SAND
B	MW269	2.02	1.69	19.6	2.66	0.578	0.366	0.912	0.032	1.49E-07	Greyish yellow silty gravelly SAND
NA	MW207	1.86	1.54	21	2.64	0.717	0.418	0.773	0.095	1.93E-07	Yellowish brown silty SAND with gravel
NA	MW209	1.82	1.46	24.9	2.67	0.832	0.454	0.799	0.091	3.80E-06	Greyish brown sandy SILT
NA	MW216	1.42	1.31	8.4	2.69	1.053	0.513	0.215	0.403	2.26E-04	Greyish brown silty SAND
NA	MW217	1.71	1.51	13.5	2.65	0.759	0.431	0.417	0.228	8.90E-04	Grey gravelly SAND

Note: NA - Not Applicable (The sampling locations are located outside HAECO)

The permeability value is corrected to 20 oC condition according to the BS1377: Part5: 1990 requirement.

E-4

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APPENDIX F

COMPARISON OF IN-SITU AND EX-SITU DECONTAMINATION METHODS

APPENDIX G

COMPARISON OF SWL BETWEEN NORMAL AND QUIETER PME

APPENDIX G COMPARISON OF SWL BETWEEN NORMAL AND QUIETER PME

Item	Number	Unmitigated PME		Quieter PME	
		SWL per Item, dB(A)	TM Reference	SWL per Item, dB(A)	Reference
Demolition of Existing Structure					
Excavator/loader	1	112.0	CNP 081	105.0	BS5228, Table 7, Item 59
Bulldozer	1	115.0	CNP 030	109.0	BS5228, Table 7, Item 27
Rock drill, hand held	1	116.0	CNP 183	114.0	BS5228, Table 7, Item 55
Mounted breaker	1	122.0	CNP 027	122	CNP 027
Total SWL, dB(A)		124.0		122.5	
Installation of Remediation					
Excavator/Loader	4	112.0	CNP 081	105.0	BS5228, Table 7, Item 59
Air compressor	1	100.0	CNP 001	100.0	CNP 001
Lorry	1	112.0	CNP 141	105.0	BS5228, Table 7, Item 59
Breaker, hand held	1	108.0	CNP 024	108.0	CNP 024
Water pump	4	88.0	CNP 281	88.0	CNP 281
Total SWL, dB(A)		119.5		113.5	
Apron Concrete Removal					
Excavator/loader	1	112.0	CNP 081	105.0	BS5228, Table 7, Item 59
Crawler rock drill	1	123.0	CNP 182	119.0	BS5228, Table 6, Item 4
Hydraulic rock breaker	1	108.0	CNP 024	108.0	CNP 024
Total SWL, dB(A)		123.5		119.5	