Territory Development Department
New Territories North Development Office
Hong Kong Government

Maunsell

Agreement No. CE 90/96

Feasibility Study for Pak Shek Kok Development Area

PAK SHEK KOK DEVELOPMENT - ENVIRONMENTAL IMPACT ASSESSMENT

- FINAL REPORT

June 1998

MAUNSELL CONSULTANTS ASIA LTD

in association with

City Planning Consultants Ltd
Roger Tym & Partners
RTKL International Ltd
EDAW TSD
Nomura Research Institute Ltd

Belt Collins HK Ltd
David C Lee Surveyors Ltd
MVA Asia Ltd
ERM Hong Kong Ltd

HKQAA
ISO 9001 : 1994
Certificate No: CC354

Territory Development Department
New Territories North Development Office
Hong Kong Government

Agreement No. CE 90/96

Feasibility Study for Pak Shek Kok Development Area

PAK SHEK KOK DEVELOPMENT - ENVIRONMENTAL IMPACT ASSESSMENT

- FINAL REPORT

June 1998

MAUNSELL CONSULTANTS ASIA LTD.

CONTENTS:

1 INTRODUCTION

1.1 Preamble

1.1.1 Following the completion of the North East New Territories Development Strategy Review in July 1995, the Committee on Planning and Land Development (CPLD) endorsed the PSK Action Area Plan (PSKAAP) in January 1996. The PSKAAP identified the following land uses for the Pak Shek Kok Development Area (PSKDA) which include: Playing Fields for the Hong Kong Institution of Education (HKIEd); Tertiary Education Institution; Hong Kong Science Park; Recreation Area; Housing; and Promenade/Open Space.

1.1.2 On 10 April 1997, the Territory Development Department (TDD) of the Hong Kong Government commissioned Maunsell Consultants Asia Ltd (hereafter known as Maunsell) as the lead consultant for the Feasibility Study on the Pak Shek Kok Development Area (hereafter referred to as the Study) under Agreement No. CE 90/96. The purpose of this Study is to identify the alternative concept options for the PSKDA and then recommend the preferred development option for which Preliminary Design will be developed.

1.1.3 The Study comprises two parts:

- to examine and review the Preferred Development Concept and prepare a Recommended Outline Development Plan (RODP) including a Master Landscape Plan (MLP) for the Study Area; and
- to conduct a detailed engineering feasibility study including the necessary Environmental Impact Assessment (EIA), Traffic and Transport Impact Assessment, Drainage Impact Assessment, infrastructure and landscape proposal for the implementation of the PSKDA in accordance with the Recommended Outline Development Plan.

1.1.4 As part of this Assignment, ERM-Hong Kong, Ltd. have been commissioned to undertake the Environmental Impact Assessment (EIA) to assess the environmental feasibility of the Recommended Outline Development Plan (RODP) to ensure compliance with Government standards and guidelines. Belt Collins have been commissioned to undertake the Landscape/Visual Impact studies which have been included as part of this EIA.

1.2 Objectives of the Environmental Impact Assessment

1.2.1 The purpose of the EIA is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the PSKDA and related activities which includes the borrowing and spoil dumping taking place concurrently for the Pak Shek Kok Reclamation - Public Dump (PSKRPD). This information will contribute to decisions on:

- the overall acceptability of any adverse environmental impacts arising from the proposed PSKDA;

- any conditions and requirements to be included into the detailed design, construction and operation of the PSKDA; and

- the acceptability of any residual impacts after the implementation of mitigation measures.

1.2.2 One major objective of this Feasibility Study is to recommend an environmentally acceptable option for the PSKDA, taking into account the three stages of the Planning and Landscape Study. The Environmental Team has identified and compared environmental constraints and opportunities, particularly in terms of water quality, ecology, noise, air quality and contributed to the ultimate selection of an optimum option.

1.2.3 The EIA has investigated the potential environmental impacts associated with construction and operation of the preferred option to ensure compliance with environmental legislation and standards. In particular, direct noise mitigation measures has been recommended to ensure proposed sensitive receivers are within the standards specified in the *Hong Kong Planning Standards and Guidelines* (HKPSG) and the *Environmental Impact Assessment Ordinance* (EIAO).

1.2.4 For the purpose of formulation of the full environmental protection requirements and the necessary mitigation measures, the following tasks will be undertaken:

- to describe the PSKDA proposals and associated works together with the requirements for carrying out these proposals;

- to identify and describe the elements of the community and environment likely to be affected by the PSKDA proposals, and/or likely to cause adverse impacts upon the PSKDA proposals, including both the natural and man-made environment;

- to identify and quantify emission sources where appropriate and determine the significance of impacts on sensitive receivers;

- to identify and quantify any potential losses or damage to flora, fauna and natural habitats, where possible;

- to propose the provision of practical and cost-effective infrastructure or mitigation measures so as to minimize pollution, environmental disturbance and nuisance during construction and operation of the PSKDA proposals;

- to identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the construction, operation phases of the PSKDA proposals in relation to the sensitive receivers and potential affected uses;

- to identify, assess and specify methods, measures and standards to be included in the preliminary design, construction, operation of the PSKDA proposals which are necessary to mitigate these impacts and reduce them to acceptable levels;

- to design and specify the environmental monitoring and audit requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted;

- to investigate the extent of side-effects of proposed mitigation measures that may lead to other forms of impacts;
- to identify constraints associated with the mitigation measures recommended in the EIA Study; and
- to identify any additional studies necessary to fulfil the objectives to the requirements of this EIA study.

1.2.5 The objectives of this EIA Report are:

- to review the findings of the existing environmental conditions, EIA - IAR and relevant Planning and Landscape; Engineering and Traffic studies within the context of Government standards and guidelines and to identify potential key environmental issues and constraints that may affect or be affected by the PSKDA proposals;
- to provide a detailed assessment of the Recommended Outline Development Plan;
- to recommend environmental mitigation measures for incorporation into the EM&A Manual; and
- to recommend issues that would warrant further detailed assessment at the detailed design stage, as required.

1.2.6 The enforcement of the Environmental Impact Assessment Ordinance (EIAO) on 1 April 1998 has meant that the PSKDA is subject to requirements in addition to the PSKDA Study Brief.

1.2.7 The Study Brief for the PSKDA has been registered (Reference SB-018/BC) with EPD under Section 15(1) (b) of the Ordinance (Part I List : Brief issued prior to commencement of Ordinance).

1.2.8 The EIA Study for PSKDA will be required to follow the Study Brief SB-018/BC, but in addition will also be required to adhere to the approval requirements under the EIAO.

1.3 EIA Study Deliverables

1.3.1 The EIA will produce various deliverables during the Assignment for consideration by the Environmental Study Management Group which include the following deliverables:

- **Environmental Demonstration Paper** The purpose of this Demonstration Paper was to comparatively assess the previous PSKRPD EIA and only assess the changes made in the reclamation phasing to determine that the impacts are no greater than that previously assessed;
- **EIA - Initial Assessment Report (EIA - IAR)** The purpose of this report was to review existing data and highlight key issues and constraints of the PSKDA proposals. The findings of this report have been used to provide input into the selection of a preferred development option. Further issues that need to be studied in this *EIA Report* were also identified;

- **EIA Report** The purpose of this report is to consolidate all the findings of the environmental impact assessment based on the preferred PSKDA option. The findings and recommendations of this report will be incorporated into the Preliminary Design of the PSKDA;

- **Environmental Monitoring and Audit (EM&A Manual)** The purpose of this manual is to design and specify the EM&A requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures recommended in the EIA Report; and

- **Executive Summary** The purpose of the Executive Summary is to provide a non technical summary of all the findings in the EIA Study.

1.4 Study Area

1.4.1 The Study Area with a total of approximately 117 ha, stretches along the Tolo Harbour coastline from Tai Po Kau on the north to the Chinese University in the south. It comprises 23 ha of existing reclamation west of the KCR and a central 21 ha transport corridor (mostly occupied by the KCR and Tolo Highway). To the east is the Pak Shek Kok Reclamation for Filling which will be a 70 ha area to be reclaimed by public filling, plus 3 ha of existing land. The area is surrounded by the ridges and spurs of the Grassy Hill to the west and opens up to the Tolo Harbour to the east.

1.4.2 Surrounding developments include the Chinese University buildings, village houses and private residential blocks which are scattered on the foothills and the valleys to the west of the Study Area. There are no buildings within the Study Area apart from the two Hong Kong Institute of Biotechnology (HKIB) buildings and a small temple. The Study Area and Study Related Area are shown in *Figure 1.4a*.

1.4.3 However, due to the inclusion of the Northern and Southern Access Roads which extend outside the Study Area, a distance of 300 m either side of each road has been adopted in the assessment. This extended Study Area is shown in *Figure 1.4b*.

1.4.4 A number of studies have already been undertaken in the Study Area and Study Related Area to assess the potential impacts of the PSK reclamation and formation works on which the PSKDA will eventually be developed. The following endorsed reports represent the most relevant studies to the PSKDA:

- *Pak Shek Kok Reclamation - Public Dump (PSKRPD)EIA Study (April 1994)*. This study assessed the potential impacts due to the construction and operation of the proposed filling at PSK. The Study quantitatively assessed the water quality impacts generated by the dredging and reclamation work for the PSK reclamation on which the PSKDA will be developed.

- *Tai Po Development: Formation & Servicing of Area 12 (Part) & 39 EIA (June 1996), Agreement No. TP28/95*. This study assessed the potential environmental impacts caused by the formation and servicing works for Area 12 (Part) and 39. These two areas comprise the existing reclamation area on which the PSKDA will be developed.

- *Widening of Tolo Highway and TSIS Feasibility Assignment (Agreement No.CE 35/95) EIA Final Report (April 1997)* This study quantitatively assessed the potential environmental impacts caused by the Tolo Highway and associated widening project on the proposed PSKDA. In particular, recommendations on noise mitigation measures as well as suitable road noise setbacks for both noise and air quality were provided.

1.4.5 It should be noted that the EIA Reports of all three studies have been registered with EPD under Section 15(1) (f) of the EIA Ordinance. The three studies are registered with EPD under the following reference numbers:

- Pak Shek Kok Reclamation - Public Dump (PSKRPD) EIA Study (EIA-036/BC);
- Tai Po Development: Formation & Servicing of Area 12 (Part) & 39 EIA (EIA-094/BC); and
- Widening of Tolo Highway and TSIS Feasibility Assignment EIA Final Report (EIA-116/BC).

1.5 Structure of the EIA Report

1.5.1 The structure of this EIA Report has been organised into the following sections:

Section 1	Introduction;
Section 2	Project Description;
Section 3	Noise;
Section 4	Air Quality;
Section 5	Water Quality;
Section 6	Waste;
Section 7	Ecology;
Section 8	Visual Impact;
Section 9	Environmental Monitoring and Audit Requirements; and
Section 10	Overall Conclusions.

1.5.2 The land contamination section has been scooped out at the EIA - IAR stage, as this section was not considered to be an issue.

2 PROJECT DESCRIPTION

2.1 Introduction

2.1.1 Following the completion of the North East New Territories Development Strategy Review in July 1995, the Committee on Planning and Land Development (CPLD) endorsed the PSK Action Area Plan (PSKAAP) in January 1996 shown in *Figure 2.1a*. The Plan provided the basis for undertaking the planning and engineering feasibility study for the PSKDA.

2.1.2 The PSKAAP identified the following land uses for the PSKDA which include: Playing Fields for the Hong Kong Institution of Education (HKIEd); Tertiary Education Institution; Hong Kong Science Park; Recreation Area; Housing; and Promenade/Open Space.

2.2 Construction Phase

2.2.1 The construction of the proposed PSKDA is expected to proceed in three stages, with the development of the Science Park proceeding in the southern section first by the year 2001, followed by the development of residential development in the north in 2003 and recreation in the central area by the year 2006. A preliminary construction programme is shown in *Figure 2.2a*. At present, it is not known how the development on the existing Area 12 (Part) and 39 reclamation will proceed, apart from the area reserved for HKIEd playing fields should be completed by the year 2000.

Key programme dates can be summarised as follows:

- CED reclamation programme is essentially fixed, with land for the Science Park Phase 1 being produced first (in portions from February 1998 to June 1999), followed by the northern portion (December 2000), then the remaining central section of land (July 2004).
- Substantial additional sewerage disposal capacity, beyond that needed for the Science Park Phase 1, is not expected to be available until 2003.

2.2.2 It should, however, be noted that the construction programme will be subject to ongoing change and refinement due to design development and Government review, as well as change and refinement as the design progresses. Any subsequent significant changes to the programme will necessitate an environmental review to confirm that impacts, including cumulative impacts, are no greater than those predicted in this PSKDA EIA. It should also be noted that under Section 7 (Public Inspection of Reports) and 8 (Approval of EIA Report) of the EIAO may require additional information provided as a result of comments from the public consultation or from the Advisory Council on the Environment (ACE).

2.2.3 A summary of concurrent projects within the PSKDA is given in *Table 2.2a* and described in the following sections:

Table 2.2a Concurrent Projects

Development	Proposed/Likely Programme
Tolo Highway Widening	December 1998 - December 2001
Tai Po Development - Formation and Servicing of Area 12 (part) and 39, Phase I	March 1998 - March 2000
Tai Po Development - Formation and Servicing of Area 12 (part) and 39, Phase II	mid 1999 - end 2001

Tai Po Areas 12 (part) and 39

2.2.4 The proposed formation and servicing works have been divided into two phases. Phase I will include the following works:

- Site formation in the northern part of Area 39 (filling to approximately +6.0 m PD and associated drains);
- Widening of the existing Yau King Lane and construction and construction of Road L39/1 (north) to link Area 39 to Tai Po Road. Part of Road L39/1 will be constructed on the existing KCR embankment and track;
- Provision of pedestrian footways; and
- Provision of associated drains.

2.2.5 Phase II Works will include completion of the site formation and servicing in the southern part of Area 39, completion of Road L39/1 and construction of Roads L39/2, L12/1, L12/2, culverting of the existing nullah, training of stream channels and other associated works. The duration of Phase II works is expected to be from mid 1999 until mid 2001. The potential environmental impacts caused by these activities have been assessed in the Tai Po Development: Formation & Servicing of Area 12 (Part) & 39 EIA which has been registered under the EPD EIA register as reference EIA-094/BC.

PSK Reclamation

2.2.6 The construction of the Pak Shek Kok Reclamation is to be undertaken under a Civil Engineering Department (CED) Public Dump Contract and has been environmentally assessed previously in the Pak Shek Kok Reclamation Public Dump (PSKRPD), EIA Study undertaken by Mouchel (April 1994). The proposed construction programme was expected to commence in the south and proceeding in three stages (Stages I to III) to the north. The potential environmental impacts caused by these activities have been assessed in the PSKRPD EIA Study which has been registered under the EPD EIA register as reference EIA-036/BC.

2.2.7 Subsequent to the findings of the previous PSKRPD EIA, a revised staging programme was proposed in the PSKDA Study Reclamation Options Working Paper ET/02, Addendum No.1 in order to cater for the housing demand identified. The revised programme proposed a change in the staging, so that Stage III (northern section) would be completed before Stage II (central section) in order to cater for the early implementation of this stage for housing requirements as shown in *Figure 2.2b*. An environmental Demonstration Paper was undertaken, as part of the PSKDA EIA Study, and submitted on 27 August 1997 to comparatively assess the proposed changes with previous PSKRPD EIA to determine that the impacts were no greater than that previously assessed.

PSKDA Construction Sequence

2.2.8 The formation of the sites and provision of infrastructure to be undertaken will in accordance with the construction programme as shown in *Figure 2.2a*. The construction programme forecasts the availability of land for various types of developments. The programme also incorporates other Government engineering and construction projects including roads and other infrastructure constructions, the provision of public housing estates and other government and community facilities. As shown in *Figure 2.2a*, the PSKDA will be implemented in stages, broadly following the completion of the reclamation which will be progressively completed from first commencement (late 1996) to 2004.

Infrastructural Works

2.2.9 Infrastructural works to be conducted on the reclamation will include construction of the Science Park, residential development and recreational uses and the associated road works, infrastructural services and pipe laying.

2.2.10 The HKIEd Sports Centre, as a committed use, can commence construction once the extension of Yau King Lane is completed, which will be the only access to that site during the construction period.

2.2.11 The first phase of the Science Park is intended to open in mid 2001 on land nearest the Hong Kong Institute of Biotechnology (HKIB). The advanced works which will include the Southern Access Road and will supply the necessary infrastructure to allow the Science Park to operate is expected to be open by mid 2001.

2.2.12 The residential areas north of the nullah will commence in 2001 and should be completed by mid 2003. The residential area south of the nullah will commence in 2004 and should be completed by the 2007.

Southern and Northern Access Roads

2.2.13 The Southern and Northern access roads have been proposed in the PSKDA Study *Access Road Options Working Paper (ET/03), Working Paper (ET/07)* and *PPFS*. Access options to the north and south have been proposed due to the implementation of the proposed developments and potential connections with the Tolo Highway. *Figures 2.2c-e* show the alignments of the proposed access roads. There will also be small reclamation requirements (3.5 ha for the Southern Access Road Reclamation and 0.5 ha for Northern Access Road Reclamation) associated with both these access roads as shown in *Figures 2.2d-e*.

KCRC Station

2.2.14 The options for rail access have been proposed in the PSKDA Study *Access Road Options Working Paper (ET/03)* and *KCRC Provisions Report (ET/06)* which would involve the option of the provision of a station along a straight section of rail in the middle of the site as shown in *Figure 2.2f*. It should be noted that there is still some uncertainty on the location of a station within the PSKDA.

2.3 Operation Phase

2.3.1 As part of the requirements for the PSKDA Study, various land uses options have been evaluated in the Planning and Land Use Study which has resulted in the selection of a preferred land use concept for the PSKDA Study. The Recommended Outline Development Plan (ODP) was submitted as part of the *ODP Report (PL/10)* and is shown in *Figure 2.3a*.

2.3.2 The RODP provides a broad land use framework within which more detailed non-statutory plans for the Area are prepared by the Planning Department. These detailed plans are used as the basis for public works planning and site reservation within the Government departments. Disposal of sites will be undertaken by the Lands Department. Public works projects are undertaken by the TDD and some are in conjunction with the Architectural Services Department. It is likely a Science Park Corporation will be formed by the Industry Department to implement the Science Park. The Corporation's tasks will include the overall design as well as construction of some buildings. In the course of implementing the RODP, the District Boards would also be consulted as appropriate.

2.3.3 The five main land uses proposed for PSKDA RODP include the Science Park, residential, strategic recreation, other uses (education) and the Hong Kong Institute of Education Sports Centre and are discussed in the following sections. The proposed development parameters for the main land uses are summarised in *Table 2.3a*.

Table 2.3a ***Proposed Development Parameters for Main Land Uses***

	Plot Ratio	Max. Site Coverage	Max. Building Height (m)
Residential			
R1	5	-	70
R2	3	-	45
Recreation	Refer to design guidelines		
Science Park	Max. GFA 330,000 m²	50% net on developable site (60% of total area)	30

Science Park ("OU (Science Park)") (22 ha)

2.3.4 An area of 22 hectares was based on the Science Park Studies of 1992 - 95. A separate Science Park sub-study has been undertaken within this overall study to guide the more detailed aspects of planning and implementation. The Science Park has been located in the south as this is the land to be formed first (and the Science Park has priority for implementation) and that location allows for easiest linkages to the Chinese University. The plot ratio on average will be 2.5, with variation from site to site. Buildings will be of 2 types:

- multi-tenant buildings : built by the Science Park Corporation for rent to companies engaged in research and development and related activities; and

- owner-occupied buildings : some plots of land will be available for lease to technology-based companies who wish to build their own premises according to their specific needs.

2.3.5 Ancillary supporting facilities including restaurants, retail services and on-site residential quarters would be provided. The Science Park will be developed in 3 stages (8,7 and 7 hectares each) with the first stage expected to open in mid 2001. Total employment when full is expected to be 16,500 jobs. The Science Park may take up to 15 years to fill up, depending on the market situation. The Science Park Study has recommended a range of design parameters for the initial planning of the Science Park and are presented in *Table 2.3b*. The exact development layout of the Science Park will be determined by the Science Park Corporation.

Table 2.3b Science Park Recommended Design Parameters

Parameter	Value
Gross land area	22 ha
Net to gross area	Target for 60% maximum for design purposes. Actual figure will depend on the layout of roads and plots
Plot Ratio	Average of 2.5 across the whole of Science Park 1.5 - 2.5 for single occupiers 2.5 - 4.0 for multi tenancy buildings
Site Coverage	Maximum of 50%
Number of Storeys	2 - 8 storeys with a maximum of 30 m Distance between floors: Normal units : 3.75 m Ground floor workshops : 5 m Laboratories : 4 - 4.5 m
Gross Floor Area	Target of 330,000 m^3, excluding atrium area
Total Employment	16,500
Employment Density	Multi-tenancy building : 20 - 25 m^3 Single Occupier building : 25 -30 m^3 Average for planning : 20 m^3 Probable number : 14,200 Visitors +4% of employment on Science Park Conference : 300 attendeesonce per month
Car Parking	One space per 100 m^3 of GFA 3,300 spaces + 100 spaces for conference attendees and bus parking
Location of Car Parks	Semi-basement and multi-storey parking
Deliveries	Parking, loading, separate access and service lifts in each mult-tenancy building
Landscaping features	Development of promenade along waterfront Walkways between buildings and public transport access points
Layout of Buildings	Use of air-conditioned atrium areas within buildings Flexible approach towards building layout in relation to plot ratios and site coverage
Mult-tenanted Buildings	Approximately 66 - 80% of space for multi-tenanted buildings depending on demand GFA 218,000 to 272,000 m^3 Units from 25 m^3 to 2,000 m^3 15 -19 Blocks with an average size of 14,000 m^3
IT Related Firms	Basic office with access to fibre optic cable and uninterruptable power supply
Electronics, Advanced Engineering and Materials	Some firms require workshops with height of up to 4.5 - 5 m, 3 phase power and high floor loading
Medical, Chemical and Biotechnology	Laboratories (serviced with water, gas and air handling facilities required, though demand expected to be limited)
Space for Amenities	Initially 1,500 - 2,000 m^3 for administration, business centre, conference space, restaurant in a multi-tenancy building If demand justifies, build a separate 2-3,000 m^3 menities centre for leisure, restaurant, retail and business services
Service Plots	20 - 34 % of space for single occupiers 58,000 - 112,000 for single occupation 3.6 - 7.2 ha (including expansion area) required for 18 - 35 serviced plots with an average size of 0.2 ha
Residential Area	Up to 30 foreign firms, each with 2 - 3 expatriates needing family apartments : 60-90 apartments with an average of 200 - 250 m^3 required

2.3.6 From the Science Park Study, the Science Park is likely to comprise IT related uses, biotechnical and advanced engineering type industries. Within these industries, the types of activities are likely to comprise research type activities with limited manufacturing and development. This will limit the potential environmental impacts generated by the Science Park. It should noted that the exact types and makeup of the Science Park will not be known until the detailed design stage. However, a summary of the types of potential activities involved in the Science Park is presented in *Annex A*.

Residential ("R") Density Band 1 (plot ratio 5) (3.0 ha)

2.3.7 This area occupies a curving strip of land which has been defined by the requirements for environmental setbacks from the Tolo Highway. These taller block will create a tiered effect, allowing the taller buildings of this area to overlook the shorter residential buildings in front and closer towards Tolo Harbour. With an assumption of average flat size of 70 m^2 GFA and 2.8 persons per flat, the 2,143 flats would yield a population of about 6,000 persons. The maximum building height is proposed to be 70 metres.

Residential ("R") Density Band 2 (plot ratio 3) (6.2 ha)

2.3.8 This residential density faces the promenade and the Tolo Harbour. This site, will be on the remaining position of the PSK Reclamation to be completed in 2004. Assuming an average flat size of 85 m^2 GFA and 2.8 persons per flat this area would yield a total of 2,188 flats for 6,130 persons. The maximum building height is proposed to be 45 metres.

2.3.9 The R2 site facing both the nullah and the promenade will include the retail space and G/IC facilities through lease arrangements. The commercial GFA will be 9,000 to 11,000 m^2. G/IC facilities that include kindergarten and a care and attention centre for elderly will be integrated within the site and the G/IC floor areas will be excluded from the plot ratio calculation.

Education ("E") (9.8 ha)

2.3.10 The "E" zone includes an initial reprovisioning site for the Marine Science Laboratory (MSL) near the HKIB site. The "E" zone west of the KCR adjoining the nullah will be the site of a secondary school. A primary school (to fulfill a G/IC shortfall from outside the study area i.e. Tai Po) will go next to the secondary school. It is now marked as "E" also. The existing HKIB is included within this zoning because of its linkage to the Chinese University.

2.3.11 The HKIEd Sports Centre will serve the HKIEd's campus which is located at Tai Po. The only building will be a grandstand, otherwise most facilities will be for outdoor use, such as running track, tennis courts and similar. Construction of the Sports Centre can commence after Yau King Lane is extended to the site.

Possible Tertiary Education Institution ("E [Possible Tertiary Education Institution]") (6.8 ha)

2.3.12 This area is expected to be available for the potential tertiary education expansion of Chinese University. The University's student enrolment is likely to increase in future as a result of recently announced policy initiatives of the government. Currently the University has no firm expansion plans, though this could change once it has assimilated the impact of the government's policy initiatives in the education area. Part of this "E" area could be made available to the University as replacement land for that taken or sterilised for development by the Southern Access Road route through the eastern part of the campus, however this will need to be confirmed.

Strategic Recreation Site ("REC") (10 ha)

2.3.13 The possible uses of this site were considered and evaluated as part of the Visitor and Recreation Uses Study. The China Ecology Centre was found to be the more suitable than other possible uses such as the aquatic centre and sports complex in the assessment. The China Ecology Centre also had the potential for scientific linkages to the Science Park and CUHK. This site has been placed between the Science Park and residential areas to form a buffer between these proposed uses. The site is located 200 m from the proposed KCR rail station allowing for easy accessibility. The area will also allow for the possibility of a hotel within this site. However, this would be subject to the intention of the eventual developer.

Subsidiary & Supporting Uses & Facilities

2.3.14 These uses and facilities include items which are fixed or compulsory as well as some which are supporting or reprovisioned as described below.

Open Space ("O") (11.0 ha)

2.3.15 The areas of open space will provide land for both active and passive recreational opportunities. In some cases it will link one land use to another, in other cases it will help form the separation of one area from another or one area into zones. The largest open space area is the waterfront promenade (22 m) and the strip separating the Tolo Highway from the band of plot ratio 5 residential sites. The promenade will be followed in parallel by the reprovisioned bicycle path proposed to be 6 m wide. These two together will form a wide and spacious open space which links all 3 main land uses facing the Tolo Harbour. The area of the cyclepath is included under land apportioned for roads.

2.3.16 The open space proposed for Pak Shek Kok is more generous than the formal requirements (HKPSG) for the following reasons:

- The land uses surrounding Pak Shek Kok are low density, so it is desirable to try to harmonize with the surrounding environment.
- The Science Park is intended to be an area of park-like qualities and thus extra open space over the whole site of Pak Shek Kok has been allocated.
- Pak Shek Kok will become a major place of public access to the Tolo Harbour waterfront and thus a large allowance for the pedestrian promenade has been provided.

Government /Institution /Community ("G/IC") (2.0 ha)

2.3.17 The G/IC zones are intended to provide the required Government, Institution and Community facilities to serve Pak Shek Kok. The proposed population for Pak Shek Kok (approximately 12,000 people) is below the threshold population for most large G/IC facilities such as public libraries, swimming pools, cultural complexes and similar. Most of the smaller or local G/IC uses such as kindergartens, centres for the elderly and similar are expected to be placed on the ground or lower floors of composite use buildings. A divisional fire station/ambulance depot of size 3,500 m^2 is designed immediately south of the northern roundabout. It is close to the proposed fire tug pier at the waterfront.

Amenity ("A") (3.3 ha)

2.3.18 An area near the northern access road to the Tolo Highway has been allocated for amenity use. This will help improve the northern access to Pak Shek Kok by making it visually more attractive through use of landscaping.

Other Specified Uses ("OU") (1.9 ha)

KCR Station

2.3.19 The proposed station is located in an optimal position for both passenger use and railway operational purposes. The location is within walking distance of all the major land uses.

Public Landing Steps

2.3.20 The public landing steps will serve PSKDA and allow access to Tolo Harbour.

Fire Tug Pier

2.3.21 The proposed fire tug pier will serve future demands of the Tolo Harbour and wider sea area. Back up land of 0.05 ha will be included in the divisional fire station across the road.

Refuse Collection Points (RCP)

2.3.22 Each major land use will have a RCP incorporated within their site. In addition, two refuse collection points with associated parking space for refuse vehicles are designated on both sides of the Tolo Highway. One will be on the Yau King Lane extension near the open space ("O" zoning) and the other next to the ESS next to Science Park.

2.3.23 The two RCPs will comprise enclosed structures which will minimise noise generated on any nearby sensitive receivers during refuse collection.

Traffic and Transport

Rail

2.3.24 The existing KCR line consists of a double track railway, which now follows the alignment of the Tolo Highway across the Study Area. A station has been proposal proposed to serve the Study Area. New stations are recommended to be on straight sections of track. The proposed position is both central to the study area and on straight track. The station consists of two platforms and a concourse above. Should the station not be built, the area of land not already used by the KCR would revert to OU(Ed), which is the intended surrounding land use.

Road

Tolo Highway

2.3.25 The existing Tolo Highway (3 lanes each direction) will be widened to 4 lanes each direction within the next 3 years. Pak Shek Kok's connections to this highway are at the northern end of the study area (Northern Access) and beyond the southern boundary of the study area (Southern Access).

District Distributor Road D1

2.3.26 The main internal access road (Road D1) for PSKDA runs parallel to the Tolo Highway (on the east side) and connects the 2 access points to the Tolo Highway. Road D1 is positioned near to the Tolo Highway in order to make suitable use of the buffer zone generated by Tolo Highway.

Local Roads

2.3.27 The local roads within PSKDA are provided to access major sites and facilities. These include a road connecting to Yau King Lane extension, which will form the third road access to Pak Shek Kok. (For emergency vehicle access, a fourth road access will be possible via the University's road system).

Bus Services

2.3.28 A transport interchange is proposed at the north end of the proposed KCR station to allow for easy transport interchange. This terminus would have provision for bus, mini-bus and taxi services as well as drop-off / pick-up for cars. As there is some uncertainty to the station, a temporary bus terminus is proposed near the main residential area.

Pedestrian Routes and Cycle Paths

Cycle Path

2.3.29 The existing cycle path across Pak Shek Kok is to be reprovisioned next to the pedestrian promenade. Along the waterfront promenade a 6 m wide track has been proposed to allow for separate directional flow, whilst a 3.5 m wide track has been reserved for other areas.

Pedestrian Routes

2.3.30 Most pedestrian routes will be parallel to the PSKDA road network. However, at some locations, these will be independent of the road system to allow movement between areas where no roads exist and to improve the linkage provided by the promenade.

Utility Services

Water Supply

2.3.31 Existing water mains near the boundary of the Plan area can be extended. A new reservoir will be built near Tai Po Road which will serve Pak Shek Kok.

Drainage

2.3.32 The existing nullah will be extended to the new seawall and this will be the main drainage for most of the north and central part of the Plan area. A proposed carrier drain in the form of a box culvert will travel across the Science Park, serving some of the southern part of the Plan area, including the Science Park.

Sewage Disposal

2.3.33 Sewage will be treated at the extended Shatin sewage treatment works. As the first phase of the Science Park will open before the sewage treatment works extension opens, a system of underground covered equalisation tank with a capacity of 1,300 m^3 will transfer waste to the Shatin works at off-peak times.

2.3.34 The final sewage disposal system will comprise an additional two sewage pumping stations as shown in *Figure 2.3c*. The capacity of each of the three pumping stations are as follows:

• Sewage pumping station 1	0.32 m^3/s	(5,000 m^3/day);
• Sewage pumping station 2	0.77 m^3/s	(12,000 m^3/day);
• Sewage pumping station 3	0.81 m^3/s	(15,000 m^3/day);

2.3.35 The approximate size for the pumping station structure are 5 m x 10 m and are all underground structures. These underground structures will be covered and not be open, except for maintenance purposes.

2.3.36 It has been proposed by the Engineering Team that negative pressure be applied to the pumping stations, so that air will be drawn in from the outside, with little chance for odour release.

2.3.37 It is proposed that all pumping stations will be located underground and suitably covered. All three sewage pumping stations have a daily capacity of less than 300,000 m^3/day.

2.3.38 Two of the Sewage Pumping Stations (Sewage Pumping Stations 1 and 3) have been identified as designated projects, as they are both over 2,000 m^3/day installed capacity and are closer than 150 m from the nearest planned/existing sensitive receiver and falls under Schedule 2, Part I, F.3 (b)of the EIAO.

2.3.39 Sewage Pumping Station 2 is not a designated project, as it is located over 150 m from the nearest planned/existing sensitive receiver and does not fall under Schedule 2, Part I, F.3 (b)of the EIAO.

Electricity, Telephone & Gas Supply

- Electricity will serve the Plan area, requiring a sub-station which is proposed to be near the existing HKIB building. The sub-station is expected to comprise a 132 kV and 11 kV transmission cable. The Electrical Substation does not comprise a designated project as the size of the transmission cables (132kV and 11kV) falls below the 400 kV stated under Schedule 2, Part I, H.1 of the EIAO;
- Telephone service can be provided from the boundaries of the Plan area. A new telephone exchange will be constructed near Tai Po Road which will have capacity for Pak Shek Kok; and
- Gas supply can also be supplied via extension and improvement of gas mains near the boundaries of the Plan area.

2.4 Traffic Data for the PSKDA

2.4.1 For the purposes of this *EIA Report*, traffic forecasts have been provided by the Traffic Consultants for the years 2011 and 2016 for both the noise and air quality assessments and are shown in *Figure 2.4a and 2.4b*, respectively.

2.5 Designated Projects

2.5.1 Under the EIAO, environmental permits are issued prior to the construction of a designated project. A designated project is a project that is deemed to require detailed environmental assessment prior to EPD approval. A list of designated projects are listed under Schedule 2 and 3 of the EIAO.

2.5.2 The PSKDA falls under the Schedule 3 - "Major Designated Projects Requiring EIA Reports" category of projects. These projects are described as "engineering feasibility study of urban development projects with a study area covering more than 20 ha".

2.5.3 Within PSKDA, a number of individual designated projects under Schedule 2 have been identified and are presented in *Table 2.5a*. *Figure 2.5a* shows that the identified designated projects within the PSKDA will comprise the PSKDA road networks and the two sewage pumping stations.

Table 2.5a Designated Projects

Project	Description	EIAO Reference	Designated Project	Section Reference
PSKDA Internal Road Network	District and local distributor road network	Schedule 2, Part I, A.1	✓	Sections 2.2.13, 2.3.26-27, 3.6.3-4, 4.5.7-8, 4.6.2-4, 6.3.30
Northern Access Road	District distributor	Schedule 2, Part I, A.1	✓	Sections 2.2.13, 3.4.4, 3.6.3-4, 4.5.7-10, 5.5.1, 5.7.3, 6.1.4, 6.3.23
Southern Access Road	District distributor	Schedule 2, Part I, A.1	✓	Sections 2.2.13, 3.4.4, 3.6.3-4, 4.5.7-13, 5.5.1, 5.7.3, 6.1.4, 6.3.17, 6.3.23-30, 9.5.1, 9.5.5, 10.4.3, 10.5.2
KCRC Station	KCRC Station within PSKDA (Option)	Schedule 2, Part I, A.2	✓	Sections 2.3.19, 2.3.24, 3.6.49, 5.5.2, 5.6.7-9, 5.7.6, 10.4.6
Southern Access Reclamation	Reclamation less than 5 ha and over 100 m away from the Shatin WSD seawater intake	Schedule 2, Part I, C.1, C.2	✗	Sections 2.2.13, 3.5.5, 5.5.22-34, 5.5.44, 5.6.4, 5.7.3, 6.3.3, 6.3.11, 6.3.26, 6.7.2
Sewage Pumping Station 1	Sewage Pumping Station closer than 150m to sensitive receiver	Schedule 2, Part I, F.3 (b)	✓	Sections 2.3.33-39, 3.6.55-56, 3.7.6, 4.6.20-21, 4.7.7, 10.2.6
Sewage Pumping Station 2	Sewage Pumping Station more than 150m to sensitive receiver	Schedule 2, Part I, F.3 (b)	✗	Sections 2.3.33-39, 3.6.55-56, 3.7.6, 4.6.20-21, 4.7.7, 10.2.6
Sewage Pumping Station 3	Sewage Pumping Station closer than 150m to sensitive receiver	Schedule 2, Part I, F.3 (b)	✓	Sections 2.3.33-39, 3.6.55-56, 3.7.6, 4.6.20-21, 4.7.7, 10.2.6
Science Park	Science Park	-	✗	Sections 2.3.4-6, 3.4.6, 3.6.71, 4.4.1-3, 4.5.13-14, 4.6.5, 4.6.20, 4.7.2-3, 5.5.16, 5.6.6, 5.6.12-14, 5.7.7, 6.6.2-5, 6.6.12, 6.7.3-4, 8.5.1-2, 8.8.1, 10.4.7, 10.5.3-4, Annex A
Electrical Substation	Electrical Substation with cables of 132kV and 11 kV (less than 400 kV)	Schedule 2, Part I, H.1	✗	Sections 2.3.20, Section 3.6.58-63
Recreational Use	China Ecology Centre	Schedule 2, Part I, O	✗	Sections 2.3.13, 6.6
Residential Use	Residential ("R") Density Band 1 (plot ratio 5)	Schedule 2, Part I, P.2	✗	Sections 2.3.7,3.4.1-6, 3.5,3.6.6, 3.6.18-28, 3.6.34-42
Residential Use	Residential ("R") Density Band 2 (plot ratio 3)	Schedule 2, Part I, P.2	✗	Sections 2.3.8, 2.3.7,3.4.1-6, 3.5,3.6.6, 3.6.18-28, 3.6.34-42

3 NOISE

3.1 Introduction

3.1.1 Following the- initial noise assessment undertaken for the EIA-IAR, this section presents a detailed study of the potential construction and operational noise impacts associated with PSKDA. Noise impacts affecting the existing Noise Sensitive Receivers (NSR)s and those planned on the PSKDA reclamation area will be assessed in accordance with standards specified in the EIAO, NCO and the subsidiary Technical Memoranda. Practical mitigation measures will be recommended, where necessary, to reduce the noise impacts to within acceptable levels.

3.2 Government Legislation and Standards

Construction Phase

3.2.1 The principal legislation on the control of construction noise is the Noise Control Ordinance (NCO) (Cap 400) and the EIAO (Cap 499). Various Technical Memoranda (TMs), which stipulate control approaches and criteria, have been issued under the NCO and EIAO. The following TMs are applicable to the control of noise from construction activities:

- Technical Memorandum on Noise from Percussive Piling (PP-TM);
- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM);
- Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM); and
- Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM).

Percussive Piling

3.2.2 Percussive piling is prohibited at any time on Sundays and public holidays and during the weekday evening and nighttime hours (1900-0700 hours, Monday through Saturday). A Construction Noise Permit (CNP) is required for such works during the weekday daytime hours (0700-1900 hours, Monday through Saturday).

3.2.3 When assessing a CNP application for the carrying out of percussive piling, the Environmental Protection Department (EPD) is guided by the PP-TM. The EPD will look at the difference between the Acceptable Noise Levels (ANLs), as promulgated in the PP-TM, and the Corrected Noise Levels (CNLs) that are associated with the proposed piling activities. Depending on the level of noise impact on nearby NSRs, the EPD would allow 3, 5 or 12 hours of daily piling time (see *Table 3.2a* below).

Table 3.2a Permitted Hours of Operation for Percussive Piling

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a holiday
more than 10 dB(A)	0800 to 0900 and 1230 to 1330 and 1700 to 1800
between 0 dB(A) and 10 dB(A)	0800 to 0930 and 1200 to 1400 and 1630 to 1800
no exceedance	0700 to 1900

3.2.4 The Government is committed to phase out the use of diesel, pneumatic and steam hammer pile drivers, which are particularly noisy. Such pile drivers cannot be used after 1 October 1999. In preparation for the incoming legislative control, the Government has already (since July 1997) administratively banned the use of diesel hammers in Government projects.

General Construction Works

3.2.5 Noise impacts arises from general construction works during normal working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday) at the openable windows of buildings is controlled by the EIAOTM. The recommended noise standards are presented in *Table 3.2b* below.

Table 3.2b EIA-TM Daytime Construction Noise Limit ($L_{eq,\ 30\ min}$ dB(A))

Uses	Acceptable Noise Standards
Domestic Premises	75
Educational institutions (normal periods)	70
Educational institutions (during examination periods)	65

3.2.6 The NCO provides statutory controls on general construction works during the restricted hours (ie 1900-0700 hours Monday to Saturday and at any time on Sundays and public holidays). The use of powered mechanical equipment (PME) for the carrying out of construction works during the restricted hours would require a CNP. The EPD is guided by the GW-TM when assessing such an application.

3.2.7 When assessing an application for the use of PME, the EPD will compare the ANLs, as promulgated in the GW-TM, and the CNLs (after accounting for factors such as barrier effects and reflections) associated with the proposed PME operations. A CNP will be issued if the CNL is equal to or less than the ANL. The ANLs are related to the noise sensitivity of the area in question and different Area Sensitivity Ratings have been drawn up to reflect the background characteristics of different areas. The relevant ANLs are shown in *Table 3.2c* below.

Table 3.2c Acceptable Noise Levels (ANL, $L_{eq, 5 min}$ dB(A))

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

3.2.8 In addition to the general controls on the use of PME during the restricted hours, the EPD has implemented a more stringent scheme via the DA-TM. The DA-TM regulates the use of five types of Specified Powered Mechanical Equipment (SPME) and three types of Prescribed Construction Work (PCW), which are non-PME activities, in primarily densely populated neighbourhoods called Designated Areas (DAs). The SPME and PCW are:

SPME:

- Hand-held breaker
- Bulldozer
- Concrete lorry mixer
- Dump truck
- Hand-held vibratory poker

PCW:

- Erection or dismantling of formwork or scaffolding
- Loading, unloading or handling or rubble, wooden boards, steel bars, wood or scaffolding material
- Hammering

3.2.9 In the interest of offering additional protection to the population, the carrying out of PCW is generally banned inside a DA. As for the use of SPME, it would be necessary to comply with DA-TM noise level requirements that are 15 dB more stringent than those listed in the GW-TM before a CNP would be issued. As the proposed site is not within a DA, the requirements stated in the DA-TM will not be applicable for this study.

Operational Phase

3.2.10 Road traffic noise levels at the openable windows of buildings have been limited by the EIA-TM and the relevant criteria are shown in *Table 3.2d.*

Table 3.2d EIA-TM Road Traffic Noise Planning Criteria

Uses	Road Traffic Noise $L_{10, (1 hr)}$ dB(A)
Domestic Premises	70
Hotel and Hostels	70
Offices	70
Educational institutions	65

3.2.11 Noise from fixed sources, including that from industrial-type establishments, is controlled by the EIA-TM and the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM). The EIA-TM stated that the level of the intruding noise at the facade of the nearest sensitive use should be at least 5 dB(A) below the appropriate ANL shown in the IND-TM or, in the case of the background being 5 dB(A) lower than the ANL, should not be higher than the background.

3.2.12 Rail noise is controlled by the EIA-TM and IND-TM. The EIA-TM stated that the level of the intruding noise at the external facade of the sensitive use should not exceed the appropriate ANL shown in the IND-TM and L_{max} (2300-0700 hours) 85 dB(A).

3.2.13 The IND-TM states ANLs for fixed noise sources depending upon the sensitivity of the area where the NSR is located and the relevant ANLs are shown in *Table 3.2e*.

Table 3.2e Acceptable Noise Levels for Fixed Noise Sources ($L_{eq, 30 min}$ dB(A))

Time Period	Area Sensitivity Rating		
	A	B	C
Day and Evening (0700 to 2300 hours)	60	65	70
Night (2300 to 0700 hours)	50	55	60

3.3 Baseline Conditions

3.3.1 The background noise in the vicinity of the site are dominated by road traffic on Tolo Highway as well as the noise from the KCRC line. The existing Tolo Highway is a dual three-lane rural trunk road with a posted speed of 100 kph. Traffic flow on Tolo Highway is currently high during the peak hour period with high percentage of heavy vehicles in the traffic stream.

3.3.2 The traffic volume will increase in the future after the widening of Tolo Highway, scheduled for 1998 to 2001 and will lead to an increase in the ambient noise level during the operational phase of the development.

3.3.3 Operational noise from the KCRC line also contributes to the ambient noise levels including, rolling noise emissions from the operation of Electric-Multiple Units (EMUs) of KCR line, PRC Passenger Trains and Freight Trains.

3.4 Sensitive Receivers

Construction Phase

3.4.1 Representative NSRs, as defined in EIA-TM, have been identified based on the previously endorsed PSKRPD EIA, THW EIA and PSKDA EIA - Initial Assessment Report (EV/01) as well as the Recommended Outline Development Plan (RODP) and survey maps. *Table 3.4a* lists all representative NSRs withing the Study Area and their sensitive uses. Locations of the NSRs are shown in *Figure 3.4a*.

Table 3.4a Location of NSRs During Construction Phase

NSR Ref.	Location	Sensitive Uses
N1	HKIB Staff Accommodation	Residential Use
N2	CUHK: Residence No. 10	Residential Use
N3	Cheung Shue Tan Village	Residential Use
N4	Tsiu Hang Village	Residential Use
N5	Deerhill Bay	Residential Use
N6	Villa Castell	Residential Use
N7	Educational Uses in Area 12 (1)	Educational Use
N8	Possible Tertiary Education Institution in Area 39 (1)	Educational Use
N9	Residential Development - R1 (1)	Residential Use
N10	Residential Development - R2 (1)	Residential Use
N15	CUHK: Chung Chi Campus Block C24	Residential Use

Note: (1) NSR N7 to N10 are planned NSRs within the PSKDA

3.4.2 The residential development on the Stage II reclamation, ie southmost proposed "R2" land use, will not be occupied during the construction stage, these NSRs will therefore not be included as NSRs during the construction phase period.

Operational Phase

3.4.3 The future noise sensitive land uses on the new reclamation will mainly consist of residential developments and educational institutions. Existing NSRs that may potentially be affected by the PSKDA include sensitive uses along the proposed southern and northern access roads. *Table 3.4b* lists all the representative NSRs. Locations of the NSRs are shown in *Figure 3.4b*. Detailed locations of NSRs are also shown in *Figure 3.6c to g*.

Table 3.4a Location of NSRs During Operational Phase

NSR Ref.	**Location**	**Representative Floors**	**mPD of Assessment Point (m)**
N1	HKIB Staff Accommodation	1st / 3rd / 6th	10.4 / 16 / 24.4
N2	CUHK: Residence No. 10	1st / 3rd / 5th	14.4 / 20 / 25.6
N5	Deerhill Bay	1st / 6th / 12th	44.4 / 58.4 / 75.2
N7	Educational Uses in Area 12 (1)	1st / 3rd / 6th	12.2 / 19 / 29.2
N8	Possible Tertiary Education Institution in Area 39 (1)	1st / 3rd / 6th	12.2 / 19 / 29.2
N9	Residential Development in Stage III Reclamation - R1 (1) Site A	1st / 6th / 12th	18.4 / 32.4 / 48.6
N10	Residential Development in Stage III Reclamation - R2 (1) Site B	1st / 10th / 21st	18.4 / 43.6 / 74.4
N11	Residential Development in Stage II Reclamation - R2 (1) Site C	1st / 6th / 12th	18.4 / 32.4 / 48.6
N12	Educational Uses in Stage III Reclamation (1)	1st / 3rd / 6th	12.2 / 19 / 29.2
N13	Residential Development in Stage II Reclamation (High Density) - R2 (1) Site D	1st / 10th / 21st	18.4 / 43.6 / 74.4
N15	CUHK: Chung Chi Campus Block C24	1st / 3rd / 5th	14.4 / 20 / 25.6

Note: (1) NSR N7 to N12 are planned NSRs within the PSKDA

3.4.4 Representative NSRs, Deerhill Bay, CUHK: Residence No. 10 and Chung Chi Campus Block 24 (N5, N2 and N15) have been included in the operational phase assessment to illustrate that NSRs located on the western side of Tolo Highway and along the Northern and Southern Access are affected by road traffic noise from the existing Tolo Highway rather than from the PSKDA internal roads.

3.4.5 As Cheung Shue Tan Village, Tsiu Hang Village and Villa Castell (NSRs N3, N4 and N6) are further away from the existing Tolo Highway and the PSKDA internal roads when compared to Deerhill Bay, CUHK: Residence No. 10 and Chung Chi Campus Block 24 (N5, N2 and N15), it is expected that the traffic noise impacts from the existing Tolo Highway and PSKDA internal roads at these NSRs would be lower than Deerhill Bay, CUHK: Residence No. 10 and Chung Chi Campus Block 24. Hence, these NSRs have been excluded from the operational phase assessment.

3.4.6 The on-site residential quarters of the Science Park (N14) located on the waterfront will be considered as an NSR. This location will minimise the noise impacts at this planned NSR from Road D1 and Tolo Highway. However, no traffic information is available for the internal road network of the Science Park and it is recommended that a noise assessment be carried out to identify the potential noise impact when the traffic data and layout plan for the Science Park are available as part of the detailed design study for the Science Park.

3.4.7 The new CUHK Marine Science Lab (MSL) will be relocated to the proposed "E" land use on the eastern side of Road D1. Based on existing available information, air-conditioning will be provided for the noise sensitive use of the MSL which would not rely on openable windows for ventilation. With the provision of the air-conditioning, it is considered that the MSL will be less sensitive to noise and therefore has been excluded in the operational phase assessment.

3.5 Construction Phase Assessment

Potential Sources of Impact

3.5.1 The main construction activities in the project programme are planned to be undertaken between May 1998 to January 2007. The individual major tasks are described in detail in *Section 2.*

3.5.2 As the scale and size of the construction activities is complex, the potential noise impact has been broken down into stages to allow for the assessment of cumulative impact from concurrent activities. *Table 3.5a* lists the principal noisy construction activities and their dates of commencement and completion.

3.5.3 The PSK Reclamation is scheduled to be completed in three stages with the construction of the first phase already underway. The potential noise impacts due to the reclamation of PSK Reclamation have already been addressed in the PSKRPD EIA, and indicated the noise levels arises from the reclamation works would be within the daytime construction noise criteria at all NSRs.

3.5.4 A review of the reclamation staging has been proposed and the *Reclamation Options, Addendum Reclamation Staging, Working Paper ET/02, Addendum No. 1* (May 1997) has been produced in response to the changes in the reclamation stages. It is proposed that the reclamation of Stage III should be carried out prior to Stage II-Phase II. The cumulative effects of the Stage II and III reclamation with other concurrent activities will therefore be assessed in this assessment. Since the Stage II-Phase I reclamation has already been assessed in the PSKRPD EIA, the noise impacts associated with this activity has been excluded from this assessment.

Table 3.5a Potential Sources of Impact

Task		Activity Ref.	Commencement	Completion
STAGE 1				
1A	Reclamation Stage II - Phase I	a1	05/98	07/99
STAGE 2				
2A	Reclamation Stage III	a1	07/99	01/01
2B	Roadworks for Southern Access - Stage I	a2	12/99	04/01
2C	Sewerage Pumping Station	a3	12/99	07/01
2D	Marine science Laboratory	a3	12/99	12/00
2E	Reclamation for Northern Access	a1	12/99	09/00
2F	Roadworks for Northern Access	a2	06/00	08/01
2G	Southern Access - Subway	a4	12/99	03/01
2H	Science Park Construction - Phase I	a3	07/99	07/01
2I	Widening of Tolo Highway	a2	07/99	12/01
2J	Area 12 & 39 Construction	a3	07/99	04/00
STAGE 3				
3A	Reclamation Stage II - Phase II	a1	01/01	08/04
3B	Pak Shek Kok Nullah Extension	a5	07/01	01/03
3C	Roadworks for Southern Access - Stage II	a2,a6	10/01	01/03
3D	Reclamation for Southern Access - Stage II	a1	07/01	08/02
3E	Roadworks for Road D1	a2	01/02	08/03
3F	Stage III reclamation Site Development - R1	a3	01/01	07/03
3G	Stage III reclamation Site Development - R2	a3	01/01	07/03
3H	Stage III reclamation Site Development - G/IC	a3	11/01	05/03
3I	Roadworks for Road L1, L2, L5 & L6	a2	01/02	08/03
STAGE 4				
4A	Road works from remainder roads	a2	08/04	02/07
4B	Stage II reclamation Site Development - R2	a3	01/04	02/07
4C	Site Development - Recreational Facility	a3	06/05	12/06
4D	Science Park Construction - Phase II	a3	08/04	08/07

3.5.5 A detailed plant inventory has been established based on information supplied by the Engineering Design Team and is summarised in *Table 3.5b* below. *Annex B (Table B1)* presents the SWLs for each construction activity obtained from GW-TM.

Table 3.5b Plant Inventory

Activity	Activity Ref.	Plant Type	TM Ref.	No. of units
Reclamation	a1	Grab dredger	CNP 063	2
		Derrick barges	CNP 061	2
		Tug boat	CNP 221	2
		Dump truck	CNP 067	3
Roadworks	a2	Dump truck	CNP 067	2
		Excavator	CNP 081	1
		Road roller	CNP 185	1
		Lorry	CNP 141	1
		Asphalt Paver	CNP 004	1
		Loader	CNP 081	1
Structural works	a3	Piling, large diameter bored, grab and chisel	CNP 164	2
		Excavator	CNP 081	1
		Air compressor	CNP 001	1
		Breaker, hand-held	CNP 026	1
		Dump truck	CNP 067	1
		Generator, standard	CNP 101	1
		Concrete lorry mixer	CNP 044	1
		Poker vibrator	CNP 170	1
		Bar bender and cutter	CNP 021	1
		Lorry	CNP 141	1
		Mobile crane	CNP 048	1
		Saw, circular, wood	CNP 201	1
Subway construction	a4	Excavator	CNP 081	1
		Air compressor	CNP 001	1
		Breaker, hand-held	CNP 026	1
		Dump truck	CNP 067	1
		Bar bender and cutter	CNP 021	1
		Generator, standard	CNP 101	1
		Concrete lorry mixer	CNP 044	1
		Poker vibrator	CNP 170	1
		Lorry	CNP 141	1
		Saw, circular, wood	CNP 201	1
Nullah construction	a5	Excavator	CNP 081	1
		Mobile crane	CNP 048	1
		Truck	CNP 141	1
		Poker vibrator	CNP 170	1
		Concrete lorry mixer	CNP 044	1
		Water pump	CNP 282	1
		Generator, standard	CNP 101	1
Viaduct construction	a6	Piling, large diameter bored, grab and chisel	CNP 164	2
		Bar bender and cutter	CNP 021	1
		Generator, standard	CNP 101	1
		Concrete lorry mixer	CNP 044	2
		Mobile crane	CNP 048	2
		Lorry	CNP 141	1
		Excavator	CNP 081	1
		Air compressor	CNP 001	1
		Breaker, hand-held	CNP 026	1
		Dump Truck	CNP 067	2
		Poker vibrator	CNP 170	2

Evaluation Methodology

3.5.6 A methodology for assessing general construction noise has been developed based on the GW-TM. In general, the methodology is as follows:

- locate NSRs that may be affected by the worksite;
- calculate distance attenuation and barrier corrections to NSRs from worksite notional noise source point;
- calculate the maximum total sound power level (SWL) for each construction activities using the plant list and the SWL data given for each plant in the technical memorandum; and
- predict construction noise levels at NSRs in the absence of any mitigation measures.

3.5.7 If the noise assessment criteria are exceeded at NSRs, mitigation measures must be considered. A re-evaluation of the total SWL for each activities will be made assuming the use of practical mitigation measures such as silenced equipment and barriers. If the criteria are still exceeded, further mitigation measures such as reduction in noisy plant working simultaneously would be considered.

Prediction of Impacts

General Construction Works

3.5.8 The minimum distances from the notional source point of each construction activity to the representative NSRs are given in *Annex C*. *Table 3.5b* indicates that NSRs will be affected by noise from more than one activity during each stage of the construction works. The total predicted noise levels at representative NSRs during each construction stages has been predicted and are shown in *Table C1* of *Annex C*. A summary of the cumulative impact during each stage is presented in *Table 3.5c*. All NSRs have been assumed to have a direct line of sight to the appropriate construction activity and rely on opened windows for ventilation.

Table 3.5c ***Predicted Noise Levels***

NSRs		**Stage 2**	**Stage 3**	**Stage 4**
N1	HKIB Staff Accommodation	88	75	65
N2	CUHK: Residence No.10	79	76	72
N3	Cheung Shue Tan Village	77	71	69
N4	Tsiu Hang Village	74	76	67
N5	Deerhill Bay	74	75	67
N6	Villa Castell	72	73	65
N7	Educational Uses in Area 12 (1)	N/A	72	72
N8	Tertiary Education Institution in Area 39 (1)	N/A	74	75
N9	Residential Development - R2 (1)	N/A	N/A	76
N10	Residential Development - R1 (1)	N/A	N/A	74
N15	CUHK: Chung Chi Campus Block C24	73	77	N/A

Note: (1) NSR N7 to N10 are planned NSRs within the PSKD

3.5.9 The results give in *Table 3.5c* are considered as 'worst case' since all construction activities during each construction stage are assumed to operate concurrently.

Stage 1 Construction

3.5.10 Stage II-Phase I reclamation has already been assessed in the PSKRPD EIA, the noise impacts associated with this activity will be excluded from this assessment.

Stage 2 Construction

3.5.11 Owing to the close proximity of the work sites to NSRs N1 (HKIB Staff Accommodation), N2 (CUHK Residence No.10) and N3 (Cheung Shue Tan Village), exceedances of the daytime construction criteria are predicted. *Table C1 (Annex C)* indicates that NSR N1 (HKIB Staff Accommodation) are mainly affected by the construction of Roadworks and Structural Works within the Stage I reclamation (ie activities 2B, 2C, 2D and 2H); while NSRs N2 (CUHK Residence No.10) and N3 (Cheung Shue Tan Village) are mainly affected by the widening of Tolo Highways and construction within Area 12 & 39 respectively. Mitigation measures are therefore required to reduce the noise impacts at these NSRs.

Stage 3 Construction

3.5.12 *Table C1 (Annex C)* indicated that noise levels associated with individual construction activities at all NSRs will be in compliance with the daytime construction noise criteria. However, noise modelling shows that except for NSRs N3 (Cheung Shue Tan Village) and N6 (Villa Castell), the cumulative noise levels at all NSRs will exceed the recommended noise criterion, $L_{eq\ 30\ min.}$ 70 and 75 dB for school and residential development respectively. Mitigation measures for the various construction work will be required to control the noise level at N2 (CUHK Residence No.10), N4 (Tsiu Hang Village), N7 (Educational Uses in Area 12) & N8 (Tertiary Education Institution in Area 39) & N15 (CUHK Chung Chi Campus Block C24) to within the acceptable limits.

Stage 4 Construction

3.5.13 *Table C1 (Annex C)* indicated that noise levels associated with individual construction activities at all NSRs will be in compliance with the daytime construction noise criteria. Noise modelling shows that except for N7 (Educational Uses in Area 12), N8 (Tertiary Education Institution in Area 39) and N9 (Low density residential development), all NSRs will be in compliance with the recommended noise criterion, $L_{eq\ 30\ min.}$ 70 and 75 dB for school and residential development respectively. Mitigation measures for the various construction work will be required to control the noise level at N7 (Educational Uses in Area 12), N8 (Tertiary Education Institution in Area 39) and N9 (Low density residential development) to within the acceptable limits.

Mitigation Measures

Recommended Mitigation Measures

3.5.14 Mitigation measures for each construction site are detailed below, and the following forms of mitigation measures are recommended and should be incorporated into the Contract Specification:

- selection of quieter plant and working methods; and
- reduction in number of plant operating in critical areas close to NSRs.

General Mitigation Measures

3.5.15 The Contractor may develop a different package of mitigation measures to meet the required noise standards, but the following illustrates suitable measures to demonstrate a feasible mitigation approach.

Selecting Quieter Plant and Working Methods

3.5.16 The Contractor may be able to obtain particular models of plant that are quieter than standard types given in GW-TM. The benefits achievable in this way will depend on the details of the Contractor chosen methods of working, and it is considered too restrictive to specify that a Contractor has to use specific items of plant for the construction operations. It is therefore both preferable and practical to specify an overall plant noise performance specification to apply to the total sound power level of all plant on the site so that the Contractor is allowed some flexibility to select plant to suit his needs.

3.5.17 Quiet plant is defined as PME whose actual SWL is less than the value specified in GW-TM for the same piece of equipment. Examples of SWLs for specific silenced PME taken from the BS5228: Part 1:1984, which are known to be used are shown in *Table 3.5d.*

Table 3.5d *SWLs for specific silenced PME*

PME	Table No.	Ref No.	max SWL (dB(A))
Bulldozer	7	65	110
Breaker (Hand held)	6	10	110
Compressors	10	26	100
Concrete Pumps	9	36	106
Dump Truck	12	29	109
Excavator	7	97	105
Generator	10	62	100
Lorry	12	27	105
Loader	7	97	105
Poker Vibrator	9	32	100

3.5.18 It should be noted that various types of silenced equipment can be found in Hong Kong. However, EPD, when processing a CNP application, will apply the noise levels contained in the relevant statutory TM unless the noise emission of a particular piece of equipment can be validated by certificate or demonstration.

3.5.19 With the above quiet plant substituted in the equipment inventories given in *Table B2 (Annex B)*, the mitigated noise levels at each NSR would be shown in *Table C2 (Annex C)*.

3.5.20 With the use of the above quiet plant, the noise levels could be reduced by 3 to 6 dB(A), depending on the type of construction activities operating. The construction noise levels at the NSRs have generally been reduced.

Stage 2 Construction

3.5.21 With the use of quiet plant, the noise impacts from all construction activities could be mitigated to comply with the daytime construction noise criteria at all NSRs except for NSR N1 (HKIB Staff Accommodation). Owing to the proximity of NSR N1, high levels of construction noise levels are still predicted for the individual construction activities 2B, 2C and 2D (construction of Roadworks and structural works within Stage I reclamation). Further mitigation measures are therefore required.

Stage 3 Construction

3.5.22 With the use of quiet plant, the noise impacts from all construction activities could be mitigated to comply with the daytime construction noise criteria at all NSRs (see *Table C2 (Annex C)*).

Stage 4 Construction

3.5.23 With the use of quiet plant, the noise impacts from all construction activities could be mitigated to comply with the daytime construction noise criteria at all NSRs except for NSRs N8 (Tertiary Education Institution in Area 39). *Table C2 (Annex C)* indicated that noise levels associated with individual construction activities at NSR N8 will be in compliance with the daytime construction noise criteria. However, the cumulative noise levels at NSR N8 will exceed the recommended noise criterion, $L_{eq\ 30\ min.}$ 70 dB for school. Further mitigation measures are therefore required.

Reducing the Number of Plant Operating in Critical Areas Close to NSRs

3.5.24 With the use of quiet PME, exceedances of the daytime noise criterion are still predicted at NSR N1 and N8, hence further mitigation measures have been investigated. In general the number of plants should be left to the choice of the Contractor. However, in some cases it may be appropriate to restrict the number of particularly noisy plant operating within certain parts of the site that are very close to the NSRs. The effect of limiting the number of plants working concurrently have been investigated and the results are presented in *Table C3 (Annex C)*. The use of this measure has only been applied to roadworks and structural works activities during the stage 2 and stage 4 of the construction works for the following quiet PMEs:

- replacing the dump truck by lorry during the roadworks operations; and
- reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the roadworks operations during the structural works.

Stage 2 Construction

3.5.25 Results indicated that with the incorporation of quiet plant and limiting the number of plant operating concurrently, the noise impacts from roadworks construction for Southern Access could be mitigated to comply with the daytime construction noise criteria at NSR N8. However, owing to the proximity of NSR N1 (CUHK Staff Accommodation), exceedances of the daytime construction noise criteria are still predicted for the structural works within Stage I reclamation, ie activities 2C and 2D. Further mitigation measures are therefore required.

Stage 4 Construction

3.5.26 With the use of quiet plant, the noise impacts from all construction activities could be mitigated to comply with the daytime construction noise criteria at all NSRs.

Constructing Temporary and Movable Noise Barriers

3.5.27 Based on site geometry, NSRs in the vicinity of the worksite are not expected to be protected by the use of temporary noise barriers located along site boundaries. However, movable barriers could be very effective in providing noise screening from a particular plant. It is anticipated that a movable noise barrier with a skid footing and a cantilevered upper portion located close to the noise generating part of the PME such that the line of sight could be blocked by the barriers when viewed from the NSRs, can produce at least 10 dB(A) screening for stationary plant and 5 dB(A) for mobile plant. The noise screening benefit for each plant considered in this assessment is listed as follows:

- stationary plant - assuming 10 dB(A) reduction: vibratory poker, compressor, generator, circular saw and various hand tools;
- mobile plant - assuming 5 dB(A) reduction: excavator and loader;
- large plant - assuming 5 dB(A) reduction when the noise generating part of the PME, such as engine and exhaust are blocked by the barriers: drilling rigs and crane.

The use of this measure has only been applied to the roadworks and structural works during the stage 2 activities within worksite 2B, 2C and 2D (see *Figure 3.4c*) :

- movable noise barriers located close to excavator and loader during the roadworks activities within worksite 2B;
- movable noise barriers located close to large diameter bored pile machine (reverse circulation drill), excavator, breaker, generator, concrete lorry mixer, crane and various hand tools during the structural works within worksite 2C and 2D.

Stage 2 Construction

3.5.28 Results indicated that with the incorporation of quiet plant, limiting the number of plant and movable barriers, the noise impacts from sewerage pumping station and Marine Science Laboratory construction (ie activities 2C and 2D) could be mitigate to comply with the daytime construction noise criteria at NSR N1. However, owing to the proximity of NSR N1 (HKIB Staff Accommodation), the cumulative noise levels from all the construction activities during the Stage 2 period still exceed the recommended noise criterion, $L_{eq\ 30\ min.}$ 75 dB (A).

3.5.29 As can be seen from *Table C4* in *Annex C*, the use of the above described mitigation measures are insufficient in reducing the cumulative construction noise levels at NSR N1 to below the daytime noise criteria. To further reduce the noise impacts from all the construction activities, it is therefore recommended that the construction works associated with the roadworks for Southern Access - Stage I (activity 2B), Sewerage Pumping Station (activity 2C) and Marine Science Laboratory (activity 2D) be scheduled such that the construction of the above facilities would carry out sequentially. With the incorporation of this mitigation measure, the noise levels from the construction activities during the Stage 2 period could be mitigate to comply with the daytime construction noise criteria at NSR N1.

3.5.30 Regular monitoring of noise as part of the Environmental Monitoring and Audit (EM&A) Programme at the NSRs reported in *Table C4 (Annex C)*, will be required during the construction phases. This will enable the contractor to react if the assessment criteria are approached and to reduce noise emission at specific areas. *Table 3.5e* below summarises the predicted noise levels from each construction activities.

Table 3.5e *Predicted Construction Noise Levels*

NSR Ref.	**No Mitigation**	**Mitigation 1**	**Mitigation 2**	**Mitigation 3**	**Mitigation 4**
N1 - HKIB Staff Accommodation					
Stage 2	88	85	83	79	75
Stage 3	75	70	-	-	-
Stage 4	65	62	-	-	-
N2 - CUHK Residence No 10					
Stage 2	79	74	-	-	-
Stage 3	76	71	-	-	-
Stage 4	72	68	-	-	-
N3 - Cheung Shue Tan Village					
Stage 2	77	73	-	-	-
Stage 3	71	67	-	-	-
Stage 4	69	66	-	-	-
N4 - Tsiu Hang Village					
Stage 2	74.	70	-	-	-
Stage 3	76	72	-	-	-
Stage 4	67	64	-	-	-
N5 - Deerhill Bay					
Stage 2	74	70	-	-	-
Stage 3	75	71	-	-	-
Stage 4	67	63	-	-	-
N6 - Villa Castell					
Stage 2	72	68	-	-	-
Stage 3	73	69	-	-	-
Stage 4	65	62	-	-	-
N7 - Educational Uses in Area 12 [1]					
Stage 2	-	-	-	-	-
Stage 3	72	68	-	-	-
Stage 4	72	69	-	-	-

NSR Ref.	No Mitigation	Mitigation 1	Mitigation 2	Mitigation 3	Mitigation 4
N8 - Tertiary Education Institution in Area 39[1]					
Stage 2	-	-	-	-	-
Stage 3	74	70	-	-	-
Stage 4	75	72	70	-	-
N9 - Residential Development - R2[1]					
Stage 2	-	-	-	-	-
Stage 3	-	-	-	-	-
Stage 4	76	72	-	-	-
N10 - Residential Development - R1[1]					
Stage 2	-	-	-	-	-
Stage 3	-	-	-	-	-
Stage 4	74	70	-	-	-
N15 - CUHK: Chung Chi Campus Block C24					
Stage 2	73	67	-	-	-
Stage 3	77	73	-	-	-
Stage 4	-	-	-	-	-

Note:(1) NSRs N7 to N10 are planned NSRs within the PSKDA

3.5.31 If there is any construction work during the restricted hours, it is the responsibility of the contractors to comply with the NCO and relevant TMs. The contractor should submit CNPs application and will be assessed by the Noise Control Authority. Conditions stipulated in CNPs should be strictly followed.

3.5.32 A summary of the recommended mitigation measures for each construction stage is presented in *Table 3.5f* below.

Table 3.5f *Summary of Proposed Mitigation Measures*

Task		Mitigation Measures
STAGE 2		
2A	Reclamation Stage III	Use of quiet PME
2B	Roadworks for Southern Access - Stage I	Use of quiet PME, replacing the dump truck by lorry and the use of movable noise barriers located close to excavator and loader during the roadworks activities
2C	Sewerage Pumping Station	Use of quiet PME, reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works and the use of movable noise barriers located close to large diameter bored pile, excavator, breaker, generator, concrete lorry mixer, crane and various hand tools during the structural works
2D	Marine science Laboratory	Use of quiet PME, reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works and the use of movable noise barriers located close to large diameter bored pile, excavator, breaker, generator, concrete lorry mixer, crane and various hand tools during the structural works
2E	Reclamation for Northern Access	Use of quiet PME
2F	Roadworks for Northern Access	Use of quiet PME
2G	Southern Access - Subway	Use of quiet PME
2H	Science Park Construction - Phase I	Use of quiet PME and reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works
2I	Widening of Tolo Highway	Use of quiet PME and replacing the dump truck by lorry
2J	Area 12 & 39 Construction	Use of quiet PME and reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works
STAGE 3		
3A	Reclamation Stage II - Phase II	Use of quiet PME
3B	Pak Shek Kok Nullah Extension	Use of quiet PME
3C	Roadworks for Southern Access - Stage II	Use of quiet PME
3D	Reclamation for Southern Access - Stage II	Use of quiet PME
3E	Roadworks for Road D1	Use of quiet PME
3F	Stage III reclamation Site Development - R1	Use of quiet PME
3G	Stage III reclamation Site Development - R2	Use of quiet PME
3H	Stage III reclamation Site Development - G/IC	Use of quiet PME

Task		Mitigation Measures
3I	Roadworks for Road L1, L2, L5, L6 & L7	Use of quiet PME
STAGE 4		
4A	Road works from remainder roads	Use of quiet PME and replacing the dump truck by lorry
4B	Stage II reclamation Site Development - R2	Use of quiet PME and reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the roadworks operations during the structural works
4C	Site Development - Recreational Facility	Use of quiet PME and reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the roadworks operations during the structural works
4D	Science Park Construction - Phase II	Use of quiet PME and reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the roadworks operations during the structural works

EM&A Requirements

3.5.33 It is recommended that noise monitoring be carried out as part of the EM&A programme during the construction period of the PSKDA at NSRs N1 (CUHK Staff Accommodation), N2 (CUHK), N3 (Cheung Shue Tan Village), N4 (Tsiu Hang Village), N5 (Deerhill Bay) and N8 (Tertiary Education Institution in Area 39), N10 (Residential Development R1) and N15 (CUHK: Chung Chi Campus Block C24). The monitoring is required to ensure compliance with the EIAO in providing feedback to the Contractors for the management of their operations. The EM&A programme has been presented separately in the EM&A Manual and is summarised in *Section 9.3*.

3.6 Operational Phase Assessment

Road Traffic Noise

Potential Sources of Impact

3.6.1 Traffic on Tolo Highway will cause noise impact on the PSKDA. Tolo Highway is a major trunk road with a design speed of 100 kph and currently carries a traffic volume of over 10,000 vehicles/hour during the peak hour period, with a high percentage of heavy vehicles in the traffic stream. Noise emission from Tolo Highway will be significant and without mitigation would affect the sensitive uses within the PSKDA. It is also anticipated that an additional source of traffic noise will be generated from the PSKDA internal road network.

Assessment Methodology

3.6.2 Road traffic noise calculations have been carried out in accordance with the UK methodology Calculation of Road Traffic Noise (CRTN), which is currently required by the EPD.

3.6.3 The road scheme within the PSKDA Study Area was divided up into 160 road segments, each of which was assigned one of 35 road layouts (a list of the roads included in the assessment are presented in *Table 3.6a* and *Figure 2.4a*). A road layout defines the road width, surface type, traffic conditions and, if applicable, the height and locations of roadside noise barriers. The segmentation process was carried out in accordance with the CRTN procedure and the noise modelling was carried out using *HFANoise* road traffic noise model which fully implements CRTN procedures and methodologies. Hard ground, as defined by CRTN, was assumed throughout the Study Area and all other features that may result in noise screening or reflection were defined in the model.

3.6.4 A package of optimum noise barriers, previously agreed with the Government in November 1997 and gazetted as part of the Tolo Highway widening works to minimise the noise impact from Tolo Highway, including a combination of 5.5m x 4.5m and 5.5m x 3.5m canopy road side noise barrier and 5 m high vertical central barrier, have been developed as part of this study. As the angle of the 5.5m x 4.5m and the 5.5m x 3.5m canopy barriers are different, it will be visually more pleasing if the angle of the canopy remains the same throughout. Since the performance of the 5.5m x 4.5m canopy barriers are not less than the 5.5m x 3.5m canopy barriers, the 5.5m x 4.5m barriers have been recommended throughout the Northbound carriageway and were accepted by the Highways Department. With the introduction of the Northern Access Road, the noise barriers previously recommended and agreed have therefore been revised taking into account sight line constraints imposed near the Northern Access Road / Tolo Highway junction. The extent of the revised noise barriers which include an 8 m high cantilevered barrier have been recommended along the Northern Access Road and Tolo Highways (see *Figure 3.6a1-a*).

Table 3.6a ***Roads Included in The Traffic Noise Assessment***

Road	**Description**	**2011 Am Peak Hour Traffic Flow (veh/hr)**
L1 - Local Road	Single 2 lane carriageway	230 - 240
L2 - Local Road	Single 2 lane carriageway	960 - 970
L4 - Local Road	Single 2 lane carriageway	1640
L5 - Local Road	Single 2 lane carriageway	300 - 560
L6 - Local Road	Single 2 lane carriageway	30 - 80
L7 - Local Road	Single 2 lane carriageway	560
D1 - District Distributor Road	Single 2 lane carriageway	540 - 2170
Tolo Highway	Dual 4 lane carriageway	11060
Yau King Lane - Local Road	Single 2 lane carriageway	260

3.6.5 In order to predict impacts from future traffic conditions, the EPD recommends that, in line with CRTN procedures, traffic noise should be modelled based on the worst case year traffic forecast within 15 years after the opening of the development. Year 2011 is considered as the worst case year and have been used in this assessment to assess the road traffic noise impacts associated with the PSKDA internal road network.

Prediction of Impacts

3.6.6 A preliminary assessment of the PSKDA internal road network was undertaken at the *EIA - IAR (EV/01)* and was not considered to be a constraint. However, subsequent to the submission of *EIA - IAR*, a road bridge was proposed to provide an east-west link for the PSKDA and resulted in a large increase in traffic along the local road network around the PSKDA residential development area.

3.6.7 Further initial assessment indicated that traffic from both Tolo Highway and PSKDA internal roads would be a constraint to the noise sensitive uses on PSKDA. Relevant setback distance from major noise sources together with restriction of the height of the residential buildings have been incorporated into the RODP. In addition, an 8 m high podium has been incorporated in the residential layout plan to provide further noise screening protection to the residential developments within PSKDA. An example of the possible positions of tower blocks within residential sites are shown in *Figure 3.6b*.

3.6.8 The use of standard school layouts have been adopted for the proposed school site situated in Area 12 and in Stage III Reclamation to assess the likely noise impact at these education institutions (see *Figure 3.6c & d*). However, since N8 are zoned for Tertiary Education Institution, the use of standard schools layout will not be applicable for this site. Road traffic noise levels will be predicted at 10 m from the site boundary to provide an indication of the likely noise impact at this education institution.

3.6.9 Peak hour traffic noise levels were predicted at the sensitive facade of residential and education uses within PSKDA. Location of the assessment location for each representative NSRs are shown in *Figure 3.6c to g*. $L_{10,\ \text{peak hour}}$ facade traffic noise levels, predicted at three representative floors (low, medium and top) of the residential blocks and schools at 1 m from the centre of openable window are given in *Table D1 of Annex D*.

Existing NSRs

3.6.10 Owing to the proximity of Road D1 without mitigation, exceedances of the road traffic noise criterion (4 - 6 dB(A)) were predicted at the CUHK Staff Accommodation (NSRs 1A, 1B and 1C) (see *Table D1* (*Annex D*)). Mitigation measures will be necessary to reduce the noise impact to acceptable levels.

3.6.11 As indicated in *Table D1* (*Annex D*), the noise levels at CUHK: Residence No. 10 (N2) are within the $L_{10,\ \text{peak hour}}$ 70 dB(A) limit. The noise contribution from PSKDA road network are in general 7-12 dB(A) below the noise contribution from Tolo Highway. This NSR is therefore excluded from the consideration of mitigation measures.

3.6.12 As indicated in *Table D1* (*Annex D*), the noise levels at Deerhill Bay (N5) are within the $L_{10,\ \text{peak hour}}$ 70 dB(A) limit. The noise contribution from PSKDA road network are in general 5 dB(A) below the noise contribution from Tolo Highway. This NSR is therefore excluded from the consideration of mitigation measures.

3.6.13 The noise levels at the CUHK Chung Chi Campus Block C24 (N15) are mainly from traffic noise on the altered road network (Tolo Highway). The noise levels from the altered road (Tolo Highway) will already exceed the $L_{10,\text{ peak hour}}$ 70 dB(A) limit. *Table D1 (Annex D)* indicates that the noise contribution from PSKDA road network are in general 10 dB(A) below the noise contribution from Tolo Highway. This NSR is therefore excluded from the consideration of mitigation measures.

Planned NSRs (Without Mitigation)

3.6.14 For the secondary school (NSR 7a) situated in Area 12 (part), exceedances of the road traffic noise criterion (up to 2 dB(A)) were predicted at the high levels of the south eastern corner of the school (NSRs 7a-2 to 5).

3.6.15 For the primary school (NSR 7b) situated in Area 12 (part), the predicted road traffic noise levels at this NSR are within the $L_{10,\text{ peak hour}}$ 65 dB(A) limit. This NSR is therefore excluded from the consideration of mitigation measures. It is recommended the proposed school layout should be adopted to mitigate the noise impacts from nearby road networks.

3.6.16 For the Tertiary Education Institutions in Area 39, exceedances of the road traffic noise criterion (up to 6 dB(A)) were predicted at the facade facing Tolo Highway and Road L7.

3.6.17 For the primary school (NSR 12) situated in the Stage III Reclamation, exceedances of the road traffic noise criterion (1 to 7 dB(A)) were predicted at the facade facing Tolo Highway and Road D1 (NSR facades 12A, 12B, 12C and 12D).

Site A

3.6.18 For Site A which comprised the residential block with Plot Ratio 3 (NSR 9), exceedances of the road traffic noise criterion (1 - 4 dB(A)) were predicted at the eastern facade and south eastern corner (ie facade facing the roundabout and Road L5 (NSR facades 9D, 9E, 9F and 9G respectively).

3.6.19 An approximate number of dwellings affected by traffic noise have been calculated and the total number of dwellings affected without mitigation measures are found to be in the region of 80 flats. Assuming the total number of flats within the propose Site A are 864, the overall compliance rate for this scheme were found to be approximately 91%.

Site B

3.6.20 For Site B (NSR 10) which comprised the residential block with Plot Ratio 5, exceedances of the road traffic noise criterion (1 - 7 dB(A)) were predicted at all facades facing roadway including, Tolo Highways (NSRs 10D, 10E, 10F and 10G), Road L2 (NSR facades 10B and 10C), Road L1 (NSR facade 10H) and Road L5 (NSR facades 10A and 10J).

3.6.21 An approximate number of dwellings affected by traffic noise have been calculated and the total number of dwellings affected without mitigation measures are found to be in the region of 370 flats. Assuming the total number of flats within the propose Site B are 1008, the overall compliance rate for this scheme were found to be approximately 63%.

Site C

3.6.22 For Site C (NSR 11) which comprised the residential block with Plot Ratio 3, the predicted noise levels at the residential towers will comply with the road traffic noise criterion of $L_{10,\text{ peak hour}}$ 70 dB(A) except for the north eastern corner (NSR facade 11E).

3.6.23 An approximate number of dwellings affected by traffic noise have been calculated and the total number of dwellings affected without mitigation measures are found to be in the region of 30 flats. Assuming the total number of flats within the propose Site C are 1632, the overall compliance rate for this scheme were found to be approximately 98%.

Site D

3.6.24 For Site D which comprised the residential block with Plot Ratio 5 (NSR 13), exceedances of the road traffic noise criterion (up to 4 dB(A)) were predicted at the facade facing Tolo Highways (NSR facades 13C, 13D and 13E). Owing to the noise screening from the education institutions located to the east of Site D, exceedances of the noise criterion were only predicted at the mid to high level receivers of NSRs 13C, 13D and 13E. Owing to the addition of the Northern Access Road, hence the use of discontinuous barriers near the junction of Northern Access/Tolo Highway to maintain sightline safety, the noise benefit from the 5.5m x 4.5m canopy noise barrier located along Tolo Highways has been reduced. However, modelling results indicate that the noise contribution from Tolo Highway alone exceeds the road traffic noise criterion.

3.6.25 As a requirement of *Section 6.6.5e* of the Brief, a review of the adequacy of direct mitigation measures proposed in the Tolo Highway Widening Project (Agreement No. CE 35/95) was undertaken. If the use of direct measures were not found to be adequate nor feasible, appropriate indirect mitigation measure should be recommended and incorporated into the RODP.

3.6.26 An approximate number of dwellings affected by traffic noise have been calculated and the total number of dwellings affected without mitigation measures are found to be in the region of 130 flats. Assuming the total number of flats within the propose Site D are 1176, the overall compliance rate for this scheme were found to be approximately 89%. *Table 3.6b* below summaries the % of compliance rate for each development site.

Table 3.6b   Percentage of Compliance Rate

Development Site	Area (ha)	% of Compliance Rate Without Mitigation Measures
Site A	2.07	91%
Site B	1.36	63%
Site C	4.13	98%
Site D	1.69	89%

Mitigation Measures

3.6.27 The assessment in the above sections indicates that the areas adjacent to Road L1, L2, L5, L6, L7 and Tolo Highway without mitigation will be affected by road traffic noise that exceed the HKPSG 70dB(A) criteria. Therefore mitigation measures will be necessary to alleviate the noise impacts to within acceptable levels.

3.6.28 According to the Noise Mitigation Works for Public Roads (NOMPRO), for local roads and district distributor, 3 m and 5 m high noise barriers located from roadside carriageway are considered to be the maximum practicable height, respectively. As required by Transport Department and Highways Department, visibility splays and sight lines at road junctions must comply with the requirements in Chapters 3 and 4 of the Transport Planning and Design Manual (TPDM). For a junction or curved section with speed limit of 50 and 70 kph, a minimum sight line of 70 m and 125 m are required respectively. The use of barriers located at 1m from road kerb would therefore have to stop short of these junctions approximately 70m away. As there are a number of junctions along roads within the PSKDA, the provision of 3 m or 5 m high noise barriers is therefore considered to constrained by these safety constraints. These constraints are illustrated in *Figure 3.6h*.

3.6.29 To mitigate the noise impact at the CUHK Staff Accommodation, a 5 m cantilevered roadside noise barrier along Road D1 was investigated. *Figure 3.6i* and *Figure 3.6a/9* shows the location of the 5 m barrier tested and the predicted noise levels for the NSR are shown in *Table D2 (Annex D)*. Predicted results indicated that with the use of the noise barrier, total noise reduction of 2 to 15 dB(A) have been achieved and the noise levels at all levels will comply with the road traffic noise criterion of $L_{10, \text{peak hour}}$ 70 dB(A) (see *Table D2 (Annex D)*). Therefore, the use of the 5 m cantilevered barrier is recommended.

3.6.30 Due to sightline problem, the northern section of the roadside noise barrier have to stop short of the open space. It is considered that a short length of barrier could be located further north to avoid the sight line constraint. However the discontinuity of barriers are considered to be not effective in reducing the noise levels. In addition, extending the barrier further southward would not provided additional noise benefit. Considering all the safety constraints, the best practicable mitigation package was modelled, comprising 5m high cantilevered roadside noise barriers located at back of cycle path of the southbound carriageway for Road D1 (see *Figure 3.6j* and *Figure 3.6a/8* and *Figure 3.6a/9*). With the use of the roadside noise barriers, the predicted noise levels for the worst affected NSRs (NSRs 10, 12 and 13) are shown in *Table D3* (*Annex D*).

3.6.31 As indicated from *Table D3* (*Annex D*), the use of noise barriers on roads within the planned residential developments are considered to be acoustically effective for the lower level of some NSRs only (ie NSR 12A, 12C, 10E to 10G, 13A to 13C, 13E to 13G) . It is considered that the use of 5m cantilevered barried would be an option in mitigating the road traffic noise impacts for lower level receivers. However, the noise barriers were not effective in mitigating the noise at mid to high level receivers and NSRs particularly high level receivers are still affected by adverse road traffic noise impacts. The benefit from mitigation measures in the form of increasing building setback, the use of suitable building design have been investigated. Further modelling has been undertaken to provide several options to mitigate the noise impacts to comply with the HKPSG 70dB(A) noise criterion.

Site A

3.6.32 For Site A (NSR 9), exceedances of the road traffic noise criterion are predicted at the south eastern (residential block facing roundabout) and eastern facade (residential block facing L5). It is recommended that this facade of the development (NSRs 9D, 9E and 9F) should take account of the noise constraints in their design to mitigate the noise impact. It is considered that with a 25 m (between roundabout and Road L1) and 35 m radius setback from the road kerb of facing Road L5 and roundabout respectively, the noise levels could be mitigated to comply with the HKPSG 70dB(A) noise criterion.

3.6.33 A potential practicable mitigation option has been considered to reduce noise levels for Site A (NSRs) to within the HKPSG 70dB(A) noise criterion and are as follows:

- increase the setback distance of the residential block 15 m from podium edge facing Road L5 (NSR 9E and 9F); and
- increase the setback distance of residential block (NSR 9D) 25 m from podium edge facing roundabout.

Based on the above recommendation, the predicted noise levels of the revised layout plan (see *Figure 3.6k*) have been assessed and are presented in *Table D4* (*Annex D*).

3.6.34 An approximate number of dwellings affected by traffic noise have been calculated and the total number of dwellings affected with mitigation measures are found to be in the region of 30 flats. Assuming the total number of flats within the propose Site A are 864, the overall compliance rate for this scheme were found to be approximately 97%. It is recommended that window insulation should be provide to the remaining affected dwellings.

Site B

3.6.35 With the use of 5m cantilevered barriers along Road D1, about 50 premises will comply with the road traffic noise criterion. However, exceedances of the road traffic noise criterion are still predicted. It is recommended that these facade of the development (NSRs 10A to 10H and 10 J) should take account of the noise constraints in their design to mitigate the noise impact. It is considered that with a 50 m setback from road kerb of

Road L6, the facade facing L6 could comply with the road traffic noise criterion. If the plot ratio of 5 for Site B is to be maintained, there is no space to provide additional setback distance to the residential towers facing Road L1 and L2 from the podium edge. The only practicable mitigation option that could be considered to reduce noise levels is to increase the setback distance of the centre residential block 50m from road kerb of Road L6 (NSR 10E and 10F). Based on the above recommendation, the predicted noise levels of the revised layout plan (see *Figure 3.6k*) have been assessed and are presented in *Table D4* (*Annex D*).

3.6.36 An approximate number of dwellings affected by traffic noise have been calculated and the total number of dwellings affected with mitigation measures are found to be in the region of 215 flats. Assuming the total number of flats within the propose Site B are 1008, the overall compliance rate for this scheme were found to be approximately 79%.

Site C

3.6.37 For Site C (NSR 11), noise exceedances are predicted at the north eastern corner. It is recommended that this facade of the development (NSR facade 11E) should take account of the noise constraints in their design to mitigate the noise impact. It is considered that with a 70 m radius setback from the road kerb of roundabout (ie north eastern corner) the road traffic noise levels could be mitigated to comply with the noise criterion. However, to maintain the plot ratio, the affected block could be relocated adjacent to the promenade (see *Figure 3.6k*).

3.6.38 Based on the above recommendation, no dwellings will be affected by traffic noise, hence the overall compliance rate for this scheme were found to be approximately 100%.

Site D

3.6.39 With the use of 5m cantilevered barriers along Road D1, about 30 premises will comply with the road traffic noise criterion. However exceedances of the road traffic noise criterion are predicted at the facade facing Tolo Highway. It is, therefore, recommended that these facade of the development (NSR facades 13C to 13E, 13G and 13H) should take account of the noise constraints in their design to mitigate the noise impact. It is considered that with a120 m setback from road kerb of Road D1 (north of Road L1), the facade facing Tolo Highway could comply with the road traffic noise criterion. However, if the plot ratio, of 5 for Site D is to be maintained, it is not feasible to provide this additional 120 m setback distance to the residential towers from the road kerb edge of Road D1. The only practicable mitigation option that could be considered to reduce noise levels to within the noise criterion is to relocate block with NSR 13D adjacent to Road L5. Based on the above recommendation, the predicted noise levels of the revised layout plan have been assessed (see *Figure 3.6k*) and are presented in *Table D4* (*Annex D*).

3.6.40 An approximate number of dwellings affected by traffic noise have been calculated and the total number of dwellings affected with mitigation measures are found to be in the region of 85 flats. Assuming the total number of flats within the propose Site D are 1176, the overall compliance rate for this scheme were found to be approximately 94%. It is recommended that window insulation should be provide to the remaining affected dwellings.

Primary School in Stage III Reclamation

3.6.41 With the use of 5m cantilevered barriers along Road D1, about 10 classrooms will comply with the road traffic noise criterion (see *Table D3* of *Annex D*). Although exceedances of the noise criterion are still predicted at high level receivers, it is considered that the orientation of the proposed school layout has provided the best noise protection as the most sensitive part of the school is located away from the noise source. In view of the above conditions, the use of window insulation would be the most practicable solution to mitigate the road traffic noise.

Secondary School in Area 12 (part)

3.6.42 For the secondary school in Area 12 (part), exceedances of the noise criterion are predicted at high levels of the south eastern corner (NSR N7b-3). The benefit of a 3m high roadside barrier along Road L7 have been investigated (see *Figure 3.6l*) but was found to be ineffective in reducing the noise levels at the high level receivers (see *Table D5* of *Annex D*). It is considered that the orientation of the proposed school layout has provided the best noise protection as the non sensitive part of the school is already providing noise screening to the noise sensitive rooms. In view of the above conditions, the use of window insulation would be the most practicable solution to mitigate the road traffic noise.

3.6.43 For the education use in Area 39, exceedances of the noise criterion are predicted at the facade facing Tolo Highway (NSR 8B) at all levels and at high level receivers for the facade facing Road L7 (NSR 8A). The use of a 3 m high roadside barrier along Road L7 was investigated (see *Figure 3.6l*) but was found to be ineffective in reducing the noise levels particularly at high levels receivers (see *Table D5* of *Annex D*). Since the use of 8m cantilevered barriers have been provided along Tolo Highway and Road L7 is not the dominant noise source, the use of direct technical remedies on the nearby roadworks are considered to be exhausted. Therefore, it is recommended that the proposed development should take account of the noise constraints of the roadworks in their building design and as a last resort to use window insulation and air-conditioning if the future use is noise sensitive.

KCRC Rail Noise

Potential Sources of Impact

3.6.45 The operation of the existing KCRC line will cause noise impact on the PSKDA. Rolling noise from the Electric-Multiple Units (EMUs), Freight Trains and the PRC Passenger Trains are the dominant noise sources and will adversely affect the surrounding environment. Noise emission from the trains will be dependent on the train type, operating speed, brake system and the rail supporting system. In this assessment, Freight Trains and the EMUs are considered to be the dominant noise contributing factors and potentially constraining the development potential for residential uses.

Assessment Methodology

3.6.46 Basic acoustic principles has been used for the assessment and the calculation of noise levels in the units of $L_{eq,\ 30\ min}$ dB(A). The results were compared with the NCO and EIAOTM criteria to check whether the facade noise levels at the proposed development would be acceptable.

3.6.47 The calculation have taken account of various factors, namely noise attenuation due to distance, barrier corrections and facade corrections. Barriers corrections have been calculated based on a modified version of the analytical expression provided by Kurze and Anderson, which closely fits the experimental results obtained by Maekawa. In addition, procedures for the calculation of Lmax noise levels have been incorporated using the algorithms adopted for the LAR Environment Impact Study (1); these provide geometric spreading corrections for distance, based on a number of moving point sources, and a point source speed corrections. Details of the methodologies for calculation railway noise levels are shown in *Annex E*.

3.6.48 It was considered that the option of including a KCRC station within the PSKDA should be evaluated. However, it is considered that the exclusion of the proposed KCRC station, which allow higher speed of trains and thus noisier operations, would be the worst case scenario and was evaluated in this assessment.

3.6.49 The Lmax rolling stock noise emission data used for this assessment are based on the measurements undertaken by Mott MacDonald in 1992 for KCRC(2); while the SEL noise emission data are based on the measurements undertaken by ENPAC/Halcrow JV in 1995 for KCRC(3). All the data are relative to continuously welded rail on concrete ties on ballasted track bed at a reference distance of 25 m. The source noise levels used in this assessment are presented below:

- for Electric-Multiple Unite (EMUs), SEL 90.5 dB(A) and Lmax 84.9 dB(A) at 25 m with a train speed of 105 kph.
- for Freight Train, SEL 95.6 dB(A) and Lmax 93.2 dB(A) at 25 m with a train speed of 60 kph.
- for PRC Passenger Train, SEL 93.2 dB(A) and Lmax 81.3 dB(A) at 25 m with a train speed of 60 kph.

3.6.50 Based on the time table of train operation from KCRC, there would be a total of 19 EMU and 1 PRC Passenger Train in 30 minutes during the daytime period (0700 - 1700 hours).

(1) Lantau and Airport Railway: Environmental Impact Study Final Report, ERM-Hong Kong Ltd for MTRC, January 1994

(2) Noise Mitigation Measures, Final Report, Mott MacDonald for KCRC, November 1992

(3) Noise Mitigation Measures, Overall Review, Stage I Report, ENPAC/Halcrow JV for KCRC, November 1995

3.6.51 During the night-time period (2300-0700 hours), there would be a total of 16 EMU, 2 Freight Train and 1 PRC Passenger Train in 30 minutes period based on the time table of train operation from KCRC. Railway noise levels at the worst affected facades have been predicted and the results are shown in *Tables 3.6b & 3.6c*. Details of the calculations are shown in *Annex E*.

Table 3.6c Predicted Train Noise Levels at Identified NSRs for Residential Development

NSRs	Predicted Night-time Lmax Noise Levels (dB(A))	Predicted Night-time $L_{eq,\,30\,min}$ Noise Levels (dB(A))	Predicted Day time $L_{eq,\,30\,min}$ Noise Levels (dB(A))
NSR 10D			
1st Floor	70	46	45
10th Floor	73	50	48
20th Floor	76	52	50
NSR 13E			
1st Floor	70	46	45
10th Floor	72	50	48
20th Floor	76	53	52

Table 3.6d Predicted Train Noise Levels at Identified NSRs for Schools

NSRs	Predicted Night-time Lmax Noise Levels (dB(A))	Predicted Day-time $L_{eq,\,30\,min}$ Noise Levels (dB(A))
N7A4 - Secondary School in Area 12 (part)		
1st Floor	N/A	67
3rd Floor	N/A	67
6th Floor	N/A	67
N12C - School in Stage III Reclamation		
1st Floor	N/A	46
3rd Floor	N/A	47
6th Floor	N/A	48
N8A - Tertiary Education Institution		
1st Floor	N/A	71
3rd Floor	N/A	71
6th Floor	N/A	70

N/A: Lmax noise criterion only applies to period between 2300 to 0700 hours

3.6.52 The noise levels predicted at the NSRs are the worst case estimate as directivity and angle of view corrections have not been taken into account in the assessment. The results show that the predicted rail noise levels at the residential developments (NSRs 10D and 13E) during the nighttime period are within the EIAO-TM of L_{max} (2300 - 0700 hours) 85 dB(A) and the night-time noise criterion of $L_{eq, 30 min}$ 60 dB(A) without the incorporation of any mitigation measures.

3.6.53 For the secondary and primary schools (N7A4 & N12C), results show that the predicted rail noise levels during the daytime period are within the daytime noise criterion of $L_{eq, 30 min}$ 70 dB(A) without the incorporation of any mitigation measures. Therefore, it can be concluded that the railway noise will not be a constraint upon the proposed residential and educational developments.

3.6.54 For the Tertiary Education Institution, results show that the predicted rail noise levels during the daytime period will exceed the daytime noise criterion of $L_{eq, 30 min}$ 70 dB(A) without the incorporation of any mitigation measures. However, if the future use of the new development is considered to be noise sensitive, it is considered a 3m high boundary wall located along the site boundary could be effective in reducing the noise levels to within the daytime noise criterion. It is recommended that the proposed development should take account of the noise constraints of the rail noise in their building design if the future use is noise sensitive.

Fixed Noise Sources

Potential Sources of Impact

Sewage Pumping Stations

3.6.55 The three pumping stations proposed (shown in *Figure 2.3c*) in the PSKDA have the potential to cause noise impacts on the noise sensitive development both within and surrounding the PSKDA.

3.6.56 Preliminary engineering designs indicate that the three pumping stations which have been identified as Designated Projects will be located underground and enclosed within a building structure with an odour removal system for which a small opening is required for ventilation (see *Figure 2.3f*). Due to the distance separation of the pumping stations and the NSRs, The noise arises from the small opening is unlikely to pose a constraint on the nearby NSRs. In addition, it is expected that the noise could be mitigated by using suitable silencers. In view of the above, noise impact arising from these pumping stations are therefore considered unlikely and has been excluded in this assessment. It is recommended the ventilation opening should locate away from NSRs where possible.

Refuse Collection Point

3.6.57 The proposed Refuse Collection Point (RCP) described in *Section 2.3* in the PSKDA has the potential to cause noise impacts on the noise sensitive development both within the PSKDA and the nearby surrounding. The RCP will be built as an enclosed structure. All the noisy activities associated with the RCP such as the compaction of the refuse, will be carried out within the enclosed building using Refuse Collection Vehicle (RCV). The noise impacts arise from these facilities are therefore not expected to cause adverse impacts at the nearby NSRs. It is recommended the RCP should locate away from NSRs where possible.

Electric Substation

3.6.58 The proposed electric substation (shown in *Figure 3.6m*) in the PSKDA has the potential to cause noise impacts on the noise sensitive development both within and surrounding the PSKDA.

3.6.59 The electric substation (ESS) can be mitigated through good engineering design, with the noise sources being effectively treated at source, to meet the NCO criteria at NSRs.

Assessment Methodology

3.6.60 The limiting $L_{eq,\ period}$ levels at 1 m from the louvers of the ESS have been predicted to establish the limiting atmospheric noise specifications, which will ensure that no exceedances of the noise criteria will result from the operation of the plant.

3.6.61 The location of the ESS is shown in *Figure 3.6m*. The CUHK Staff Accommodation is the only receiver (as defined by the NCO) identified near the proposed ESS and is also shown in *Figure 3.6m*. The target levels at the receivers are the nighttime Acceptable Noise Level (ANL) minus 5 (in line with the HKPSG), i.e. $L_{eq,\ 30\ min}$ 55 dB(A), since an Area Sensitivity Rating (ASR) of C (Tolo Highway being the Influencing Factor) will be applicable.

3.6.62 The preliminary design of the ESS indicates there will be 18 louvres of an area 0.72 m^2 located at the facade facing CUHK Staff Accommodation. Assuming a limiting SWL of each louvre is 78.6 dB(A), the 1 m façade noise levels of the NSR taking into account distance correction are given in *Table 3.6e*.

Table 3.6e *Predicted Noise Levels ($L_{eq,\ 30\ min}$ dB(A))*

NSRs	Minimum Distance to NSRs	Predicted Facade Noise Levels
CUHK Staff Accommodation	35 m	55

3.6.63 The noise levels predicted at the NSRs are the worst case estimate as directivity and screening corrections have not been taken into account in the assessment. *Table 3.6d*, indicates that the noise generated from the ESS will comply with the EIA-TM night-time criteria at the CUHK Staff Accommodation. It is anticipated that sizeable attenuators will be needed to achieve the recommended limiting SWL for each louvre and adequate space should be allocated to attenuators in the design.

Ferry Noise

Potential Sources of Impact

3.6.64 Public landing steps and fire tug pier have been proposed within the PSKDA. The public landing steps which has been proposed at the centre of the PSKDA will serve PSKDA and allow access to Tolo Harbour. The proposed fire tug pier which is presently proposed in the northern section of the PSKDA will serve future demands of the Tolo Harbour and wider sea area. The number of boats expected to use the pier and the landing steps are anticipated to be low and therefore, the potential noise associated with the use of these facilities will be low. It is anticipated that the fire tug pier will only be used during the night-time period for emergency situations.

3.6.65 A review of the RODP shows that the public landing steps and fire tug pier will be located at a distance of 60 m and 70 m from the nearest residential development site respectively. In order to further minimise the potential noise impacts arise from the public landing steps and fire tug pier, the locations of these facilities have been relocated such that the buffer distance from the nearest NSRs to the public landing steps and fire tug pier have increased to 100 m and 90 m respectively. Location of these facilities are shown in *Figure 2.3a*. In view of the buffer distance, the noise is unlikely to pose a constraint on the nearby residential developments.

Bus Terminus and Transport Interchange

Potential Sources of Impact

3.6.66 A transport interchange, temporary bus terminus and taxi/minibus station have been proposed within the PSKDA. The transport interchange which has been proposed at the northern end of the proposed KCR station to allow for easy transport interchange. The proposed temporary bus terminus and taxi/minibus station has been proposed to the west of residential development in stage III reclamation -R1 and west of the public landing steps, respectively. It is expected the potential noise impact associated with the use of these facilities particularly during the night-time period would pose a constraint upon the nearby proposed residential blocks.

Transport Interchange

3.6.67 The landuse to the south of the Transport Interchange have been reserved for the Tertiary Education Institution. However, there is no information on the likely usage of this site at this stage. If the future use of the new development is considered to be noise sensitive, due to small separation from the transport interchange, potential noise issues are likely at the new development, if no control measures are applied. The use of roof cover on the bus terminus is recommended and should be incorporated into the Planning and Landscape Study. The roof cover structure should be design such that the cover will completely block the line of sight from the NSRs.

3.6.68 In addition, the landuse to the west of the Transport Interchange have been zoned for G/IC use. However, if the future use is noise sensitive, due to small separation from the transport interchange, potential noise issues are likely at the new development, if no control measures are applied. The use of roof cover on the bus terminus is recommended and should be incorporated into the Planning and Landscape Study. The roof cover structure should be design such that the cover will completely block the line of sight from the NSRs.

Temporary Bus Terminus

3.6.69 As the nearby residential buildings are high rise in nature and due to small separation from the nearby temporary bus terminus, potential noise issues are likely at the nearest residential blocks, if no control measures are applied. The use of roof cover on the bus terminus is therefore recommended and will be incorporated into the Planning and Landscape Study. The roof cover structure should be design such that the cover will completely block the line of sight from the nearest residential buildings.

Taxi/minibus station

3.6.70 It is anticipated that the taxi/minibus station would not be frequently used. However, due to the small separation from the nearby residential buildings, potential noise issues are likely at the nearest residential blocks, if no control measures are applied. The use of roof cover on the taxi/minibus station is therefore recommended. The roof cover structure should be design such that the cover will completely block the line of sight from the nearest residential buildings.

Science Park

Potential Sources of Impact

3.6.71 From the Science Park Study, the Science Park is likely to comprise IT, related, biotechnical and research and development business. As described in *Section 2.3* and *Annex A*, the types of activities are likely to comprise research and development type activities with very limited manufacturing. Although some of these activities may generate some noise, all activities will be conducted in air conditioned and insulated buildings and any noise impacts generated will be minimal

3.7 Conclusions

Construction Phase

3.7.1 Unmitigated construction activities of PSKDA would cause exceedances of the daytime construction criteria of 75 dB(A) at the nearby NSRs during the weekday daytime hours as well as the 70 dB(A) noise criteria for schools. The worst affected NSRs during the Stage 2 and 3 construction are NSRs N1 to N3 (CUHK Staff Accommodation, CUHK and Cheung Shue Tan Village) and NSRs N2, N4 to N5 (CUHK, Tsiu Hang Village and Deerhill Bay) respectively; while the planned NSRs within PSKDA, N8 and N9 (Tertiary Education Institution in Area 39 and low density residential development) are the worst affected NSRs during the Stage 4 construction.

3.7.2 It is therefore recommended that adequate control measures will be necessary for the works to meet the criteria. It is recommended that mitigation measures including the use of quiet plant, on-site movable noise barriers, limiting the number of plant operating concurrently are required. It is also recommended that regular monitoring of noise as part of the EM&A programme which will be presented in a separate EM&A Manual at NSRs will be required during the construction phase.

3.7.3 If construction works are to be carried out during restricted hours (19:00 - 07:00 hours on weekdays and all hours on Sundays and Public Holidays), further mitigation measures will be required. Such work will require the granting of a Construction Noise Permit by the EPD.

Operational Phase

3.7.4 Without mitigation adverse road traffic noise impacts are predicted at both the existing and planned NSRs. A 5 m high cantilevered road side noise barrier is recommended along Road D1 adjacent to the CUHK Staff Accommodation to mitigate the noise impact caused by the nearby road networks. As a requirement of *Section 6.6.5e* of the Brief, a review of the adequacy of direct mitigation measures proposed in the Tolo Highway Widening Project (Agreement No. CE 35/95) was undertaken. If the use of direct measures were not found to be adequate nor feasible, appropriate indirect mitigation measure should be recommended and incorporated into the RODP. This study recommended a package of 8 m roadside cantilevered barriers and 5 m central barriers and agreed with government in November 1997 and gazetted as part of the THW Project.

3.7.5 For the planned PSKDA residential developments, the use of road side noise barriers along local roads were considered to be effective in mitigating the noise levels at the low level receivers. In addition, it was considered that the noise exceedances could be mitigated by careful building layout and design such as increasing setback distance. Where the size of the site was a constraint, the use of direct measures were not found to be impracticable for the local road network and as a last resort, the use of window insulation were recommended. Similarly, the planned schools development are constrained by road traffic noise. Due to the size of the site, the use of window insulation was found to be the most practicable solution.

3.7.6 Potential noise impacts associated with the KCRC rail and the operation of the ESS, RCP, sewage pumping station, public interchange, public landing steps and fire tug pier have been assessed. The assessment showed that both the rail and other operational noise sources will not be a constraint upon the PSKDA.

4 AIR QUALITY

4.1 Introduction

4.1.1 The purpose of the EIA Study is to provide environmental input to the Pak Shek Kok Development Area (PSKDA) Study, including the consideration of potential air quality constraints on proposed developments in the PSKDA during both the construction and operational phases. Substantial environmental input has been provided into the formulation of the RODP, prior to this assessment to ensure that the RODP complies with the relevant AQOs.

4.1.2 A number of studies have already been undertaken in the Study Area and Study Related Area to assess the potential air quality impacts of the PSK Reclamation and formation works on which the PSKDA will eventually be developed. This assessment has reviewed the findings of the previous studies and provided additional assessment where necessary for both the construction and operational air quality impacts associated with the PSKDA.

4.1.3 Following the initial air quality assessment undertaken for the IEIA, this section presents a detailed study of the potential construction and operational air quality impacts associated with PSKDA. Air quality impacts affecting the existing Air Sensitive Receivers (ASR)s and those planned on the PSKDA will be assessed in accordance with standards specified in the EIAO, APCO and the associated *Technical Memorandum on Environmental Impact Assessment Process* (EIAOTM). Practical mitigation measures will be recommended, where necessary, to reduce the air quality impacts to within AQO and other relevant criteria.

4.1.4 During the construction phase, fugitive dust impacts will be the major concern, while vehicle emissions are expected to be the major pollutants during the operational phase. Any mitigation measures necessary to protect the Air Sensitive Receivers (ASR)s from exceedance of environmental criteria, will be recommended.

4.2 Environmental Legislation and Guidelines

4.2.1 The criteria for evaluating air quality impacts are laid out in the EIAOTM. The relevant criteria for this Study are given below.

4.2.2 The principal legislation for the management of air quality is the *Air Pollution Control Ordinance* (APCO) (Cap 311). The Hong Kong *Air Quality Objectives* (AQOs) stipulate the statutory limits of typical air pollutants and the maximum allowable numbers of exceedance over specific periods. These AQOs apply to the whole of the Hong Kong SAR and are shown in *Table 4.2a* below.

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

Pollutant	Averaging Time			
	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	1 Year (iv)
Total Suspended Particulates (TSP)	-	-	260	80
Respirable Suspended Particulates (v) (RSP)	-	-	180	55
Sulphur Dioxide (SO_2)	800	-	350	80
Nitrogen Dioxide (NO_2)	300	-	150	80
Carbon Monoxide (CO)	30,000	10,000	-	-

Note:

(i) Measured at 298K (25°C) and 101.325 kPa (one atmosphere).

(ii) Not to be exceeded more than three times per year.

(iii) Not to be exceeded more than once per year.

(iv) Arithmetic means.

(v) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometres and smaller.

4.2.3 In addition, the EIAOTM stipulates that an hourly dust (TSP) level of 500 $\mu g\ m^{-3}$, measured at 298K and 101.325 kPa, should not be exceeded for construction dust. An odour criterion of 5 odour units, based on an averaging time of 5 seconds, should also be met.

4.2.4 The design and operation of transport termini should complied with the *Control of Air Pollution in Semi-Confined Public Transport Interchanges*, PN 1/98. The air quality of the transport termini should be maintained in accordance with the Transport Terminus Air Quality Guidelines (TTAQG) presented in *Table 4.2b*.

Table 4.2b Transport Terminus Air Quality Guidelines (TTAQG)

Air Pollutants	Averaging Time	Maximum Concentration($\mu g\ m^{-3}$)
Carbon Monoxide	5 minutes	115,000
	1 hour	30,000
Nitrogen Dioxide	5 minutes	1,800
	1 hour	300
Sulphur Dioxide	5 minutes	1,000
	1 hour	800

Note: All limits are expressed as at referenced of 298K and 101.325 kPa

4.2.5 The Air Pollution Control (Construction Dust) Regulation stipulates the mitigation measures for construction sites.

4.2.6 Under the Air Pollution Control (Fuel Restriction) Regulations, with the exception of construction plants, the use of solid and liquid fuels is prohibited in Shatin.

4.2.7 Buffer distance requirements for active and passive recreational uses are given in the *Hong Kong Planning Standards and Guidelines* (HKPSG), as shown in *Table 4.2c* below.

Table 4.2c HKPSG on Usage of Open Sites

Type of Road	Buffer Distance	Permitted Use
Trunk Road and Primary Distributor	> 20 m	Active and passive recreational uses
	3 - 20 m	Passive recreational uses
	< 3 m	Amenity areas
District Distributor	>10 m	Active and passive recreational uses
	< 10 m	Passive recreational uses
Local Distributor	> 5 m	Active and passive recreational uses
	< 5 m	Passive recreational uses
Under Flyover		Passive recreational uses

Source: Hong Kong Planning Standards and Guidelines, Planning Department, Revised 1992

4.3 Baseline Conditions

4.3.1 The PSKDA is located within the Sha Tin airshed, where dispersion of air pollutants is generally poor. The nearest EPD fixed air quality monitoring station is located at the Shatin Government Secondary School. The ambient air quality data from the Shatin EPD air monitoring station for the year 1996, was used as the background conditions of PSKDA and are shown in *Table 4.3a* below:

Table 4.3a Background Air Quality at Shatin for 1996 (μg m^{-3})

Pollutant	Annual Average
TSP	69
RSP	46
SO_2	13
NO_2	45
NO	31
CO	1100 (1)

Note: (1) Monitored at the Mongkok Station.

4.4 Air Sensitive Receivers

4.4.1 The following land uses on the PSKDA have been identified in the RODP as described in *Section 2.3*, for the existing and proposed reclaimed land:

Existing Reclamation - Area 39 and Area 12 (part)

- Hong Kong Institution of Education Playing Fields (site north of the nullah on the existing reclamation);
- Tertiary Education Institution;
- Expansion of Tolo Highway; and
- Open Space.

Proposed Reclamation - PSK Reclamation for Filling

- Hong Kong Science Park;
- Recreation Area;
- Residential Housing; and
- Promenade/Open Space.

4.4.2 It is expected that the proposed land uses in the Area 39 and Area 12 (part) will be occupied by the year 2001 and thus be considered as ASRs from the year 2001.

4.4.3 From a review of the construction programme provided in *Section 2*, it is also assumed that the Residential Development in the PSK Stage III Reclamation area and the Science Park Phase I in the Reclamation Stage 1 area will be occupied by the year 2004 and thus considered as ASRs from the year 2004.

4.4.4 Representative ASRs have been identified from a review of the previously endorsed *PSKRPD EIA*, the *Tai Po Development Areas 12 (part) and 39 EIA* and the *THW EIA*, as well as through site visits and review of the land use plans of the PSKDA Study Area. The identification of ASRs were carried out in accordance to the criteria set out in the HKPSG and the EIAO TM.

4.4.5 The representative ASRs and their horizontal distances from the boundary of the PSKDA Study Area are listed in *Table 4.4a*. Locations of the ASRs are shown in *Figures 4.4a-b*.

Table 4.4a Location of Representative Air Sensitive Receivers

ASR	Location	Distance from PSKDA Boundary (m)	Height (mPD)
A1	Hong Kong Institute of Biotechnology (HKIB)	30	24 (1)
A2	HKIB Staff Accommodation	12	6
A3	Chinese University of Hong Kong (CUHK) Playing Fields	150	24
A4	CUHK Residence No.10	50	30
A5	Cheung Shue Tan Village	30	10
A6	Wong Nai Fai Village	200	20
A7	Tsiu Hang Village	100	40
A8	Deerhill Bay	80	50
A9	Villa Castell	280	50
A10	Hong Kong Institute of Education (HKIE) Playing Fields	150	6
A11	Education Uses in Area 12	150	6
A12	Tertiary Education Institution in Area 39	150	6
A13	School	50	6
A14	Residential Development R1	100	6
A15	Residential Development R2	200	6
A16	Residential Development R2	200	6
A17	Recreational Area	50	6
A18	Science Park (Stage 2 Section 1)	200	6
A19	Marine Science Laboratory	40	6
A20	Science Park (Stage 2 Section 2)	190	6
A21	Open Space (Stage 2)	30	6
A22	Open Space (Stage 3)	40	6
A23	G/IC Site in Area 39	30	6

Note: (1) Elevation of fresh air intake of centralised air-conditioning system.

4.4.6 ASRs A1 to A9 are existing receivers while ASRs A10 to A23 are planned receivers of the PSKDA. As discussed above, ASR A11- A15, A18 - 19 and A22 - 23 will be in operation by year 2004, while ASRs A16, A17, A20 and A21 will be operated after year 2004.

4.4.7 The air quality impacts on ASRs A1 - A15, A18 - 19 and A22 - 23 were assessed for the construction phase shown in *Figure 4.4a*, while all 23 ASRs were assessed for the operational phase of PSKDA shown in *Figure 4.4b*.

4.5 Construction Impacts

Potential Sources of Impacts

Pak Shek Kok Reclamation

4.5.1 Dust nuisance arising from the PSK Reclamation and construction of both the PSKDA infrastructure and road network will be a major source of pollutants for this assessment. It is expected that activities such as material handling, bulldozing, infrastructure and development construction, wind erosion and truck movement over haul roads will be the main dust generating activities.

4.5.2 The PSK Reclamation is scheduled to be completed in three stages with the construction of the first phase already underway. The potential air quality impacts due to the PSK Reclamation has already been assessed in the previously endorsed PSKPDR EIA which predicted that the TSP dust criteria for the year 2001 scenario will be satisfied at the ASRs identified.

4.5.3 A review of the PSK Reclamation staging was undertaken in the *Reclamation Options, Addendum Reclamation Staging, Working Paper ET/02, Addendum No.1 (January1998)* in response to the proposed changes in the reclamation staging. It was proposed that the reclamation of Stage III should be carried out between prior to Stage II, Phase 2.

4.5.4 The revised construction programme for the PSK Reclamation for Filling is given in *Section 2.3* and is summarised in *Table 4.5a* below.

Table 4.5a Revised Construction Programme

Stage of PSK Reclamation	**Reclamation Period**		**Area Formed (+6.0 mPD)**	**Land use**
	starts	**ends**		
Stage I	-	04/1998	5 ha	Science Park
Stage II				
Phase I	05/1998	06/1999	12 ha	Science Park
Remaining	01/2001	07/2004	35.4 ha	Residential Development and Recreational uses
Stage III	07/1999	12/2000	15.6 ha	Residential Development

4.5.5 It is understood that public fill materials will be brought in by barge for the revised Stages II (Phase I and II) and Stage III Reclamation, rather than by truck as was assumed in the previously endorsed PSKRPD EIA. Only the Stage II (Remaining) will be reclaimed by dump truck. This approach will reduce the filling period for the trucks along the haul route assumed in the PSKRPD EIA and thus reduce the dust impacts as assessed in the previous PSKRPD EIA. In particular, ASRs such as HKIB (A1), HKIB Staff Accommodation (A2) and CUHK Playing Fields (A3) located along the previously proposed access roads should be benefit from this approach.

4.5.6 The formation activities of PSK Reclamation will be unchanged and thus the proposed mitigation measures recommended for these activities in the previously endorsed PSKRPD EIA will still be valid and will reduce the dust impacts to within the TSP dust criteria.

Access Roads and Infrastructure Works

4.5.7 Two access roads, the Southern Access and Northern Access Roads, have been recommended in the *Engineering Report ET/13* along with a proposed internal road network to serve the PSKDA. The access roads will be constructed in stages as proposed options have been shown in *Figures 2.2c-e*.

4.5.8 For the construction of the PSKDA infrastructure, concrete materials will be transported to site. If the material is delivered by land, the hauling of vehicles over the site may increase the dust emissions of the site. It is understood from discussions with the Engineering Team that no on-site concrete batching plant will be proposed, as this will be a major pollutant source and a licence will be required for its operation.

4.5.9 As the number of diesel-power mechanical plant required on site will be limited, the gaseous emissions from the site will be minor and is not expected to cause an exceedance of the AQO.

Southern and Northern Access Roads Reclamation

4.5.10 It should be noted that there may be some further reclamation requirements for the Southern and Northern Access Roads. It is presently understood that the reclamation for the Southern Access Road will require approximately 219,000 m^3 of material dredged and approximately 310,000 m^3 of fill material and be constructed in the mid 2001 and take approximately 15 months to complete.

4.5.11 For the Northern Access Road there is only a minor reclamation requirement of only 0.5 ha. It is presently understood that the reclamation for the Northern Access Road will require approximately 60,000 m^3 of material dredged and approximately 85,700 m^3 of fill material.

Stages of Construction

4.5.12 A review of the construction programme in *Section 2.3* provided by the Engineering Team shows that the worst case construction period in terms of dust for the PSKDA will be for the years 2001 and 2004 and the construction activities for these two scenarios are listed in *Table 4.5b*.

4.5.13 For the year 2001, it is assumed that the Science Park - Phase 1, PSK Reclamation Stage III, Southern Access Road - Stage 1, reprovisioning of the MSL and Tolo Highway Widening will be constructed concurrently. It is expected that public fill materials for the PSK Reclamation Stage III will be brought in by barge.

4.5.14 For the year 2004, both the PSK Reclamation Stage II - Phase II and Science Park - Phase II will be constructed in parallel. However, in this scenario, it is assumed that all public fill material for the PSK Reclamation Stage II remaining will be brought in by truck using either the Southern or Northern Access Road. As stated in the previously endorsed PSKRPD EIA, it was estimated that the maximum number of dump trucks employed will be 450 per day. It was also assumed that the access roads will be paved and traffic speed will be limited to 20 kph.

Table 4.5b Worst Impacted Construction Period

Year	Construction Activity in PSK Development	Other Projects constructed concurrently
Year 2001	• Science Park - Phase 1 • Southern Access - Stage 1 • Northern Access Construction • Marine Science Lab Reprovisioning	• Tolo Highway Widening • PSK Reclamation Stage III
Year 2004	• Science Park - Phase II	• PSK Reclamation Stage II - Remaining

Odour

4.5.15 The previous PSKRPD EIA reported that the channel that runs through the PSKDA Study Area is unlikely to give rise to deterioration in water quality. Furthermore, under the project for the sewering of unsewered areas, those villages currently discharging septic tanks to the streams will be sewered. Sewerage improvement works for Wong Nai Shai and Pak Shek Kok will begin in 1996 and be completed by 2000 and the remainder beginning in 1997 and completed by 2002. CED has confirmed (30 October 1997, Ref (23) in PM CE 90/96/1 VI) that the extension of the existing nullah as part of the PSK Reclamation Stage III reclamation works to divert discharges away from the temporarily open body of water comprising the Stage II (Remaining) area. Additionally, CED will maintain at least a 200 m gap to ensure adequate flushing during the PSK Reclamation Stage II (Remaining) formation period. It is therefore considered that odour nuisance attributed to accumulation of organic pollutants will not occur.

Assessment Methodology

4.5.16 Potential dust impacts were predicted by the air dispersion model, *Fugitive Dust Model* (FDM). Worst case hourly and daily averages for the worst case scenarios have been modelled. Emission factors to be used in the FDM model were based on the *Compliance of Air Pollutant Emission Factors, 5th edition, USEPA* (AP42) developed by USEPA and are shown in *Table 4.5c*. An average dust density of 2,500 kg m^{-3} was assumed in this assessment.

Table 4.5c Emission Rates for Identified Dust Sources

Activity	Emission Rate	Remarks
Bulldozing	0.5 g s^{-1}	- 30% of the site is active - silt content: 6.9% - moisture content: 7.9%
Material Handling	0.062 g Mg^{-1}	- moisture content: 7.9%
Truck Haulage on Paved Road	0.00125 g m^{-1} s^{-1}	- silt content: 8.4% - vehicle speed: 20 km hr^{-1} - vehicle weight: 25 Mg
Infrastructure and Development Construction	2.49 x 10^{-4} g s^{-1} m^{-2}	- 30% of the site is active
Wind Erosion over Exposed Area	2.7 x 10^{-6} g m^{-2} s^{-1}	

4.5.17 Meterological data (wind speed, wind direction, stability class, temperature and mixing height) obtained from the Hong Kong Observatory's Shatin weather station for the year 1994, were utilised for the model runs. Meteorological data for the hours between 08.00 and 20.00 were used to calculate the hourly maximum pollutant levels, while meterological data during the working period were used to model the daily average pollutant concentrations. The receivers will not receive any TSP from the construction site during non-working period.

Evaluation of Impacts

PSKDA and PSK Reclamation

4.5.18 FDM modelling was initially undertaken for the two worst case scenarios identified at the ASRs for the PSKDA and PSK Reclamation activities. Modelling results for 1-hour and 24-hour average TSP concentrations for these activities are presented in *Table 4.5d* below.

Table 4.5d Predicted TSP Dust Levels at the ASRs ($\mu g\ m^{-3}$) (1)

ASR	Year 2001		Year 2004	
	1-Hour Average	24-hour Average	1-Hour Average	24-hour Average
A1	411	122	328	99
A2	445	127	364	103
A3	215	88	238	86
A4	175	79	387	90
A5	125	74	224	83
A6	123	75	230	82
A7	108	73	177	80
A8	126	74	188	79
A9	161	81	176	77
A10 (2)	-	-	232	88
A11 (2)	-	-	261	90
A12 (2)	-	-	254	92
A13 (2)	-	-	238	90
A14 (2)	-	-	256	93
A15 (2)	-	-	313	101
A18 (2)	-	-	437	103
A19 (2)	-	-	400	100
A22	-	-	254	89
A23	-	-	215	85

Note: (1) Background concentrations have been included in the modelled results.
(2) ASR A10 to A15, A18, A19, A22 and A23 are under construction in year 2001.

4.5.19 For year 2001 scenario, the predicted 1-hour TSP dust levels at the HKIB (A1) and HKIB Staff Accommodation (A2) are high with levels of 411 and 445 $\mu g\ m^{-3}$, respectively. These high levels can be attributed to the close proximity of the ASRs to the construction sites of Marine Science Laboratory and the Science Park - Phase 1. As shown in *Table 4.5d*, the TSP dust levels at all ASRs will comply with both the 1-hour (500 $\mu g\ m^{-3}$) and 24-hour (260 $\mu g\ m^{-3}$) criteria.

4.5.20 For year 2004 scenario, the haul road emission, Phase II (remaining) Reclamation and Science Pak - Phase II construction will be the major dust sources. The ASRs located in the vicinity of the proposed sites will be affected. 1-hour TSP dust level of 400 $\mu g\ m^{-3}$ and 24-hour level 100 $\mu g\ m^{-3}$ were predicted at the Marine Science Laboratory (A19). Nevertheless, as with the year 2001 scenario, the TSP dust criteria will be complied with at all ASRs.

Cumulative Impacts

4.5.21 Further FDM modelling was undertaken for the year 2001 scenario, to include the cumulative impacts associated with the concurrent Tolo Highway Widening works.

4.5.22 For the year 2001 scenario, the Tolo Highway Widening will be constructed concurrently with the PSK development, and the ASRs may be impacted by both Projects. The dust impacts of Tolo Highways Widening were obtained from the *Final Report, Feasibility Assignment for Widening of Tolo Highway and Traffic Surveillance and Information System, Maunsell, 1997* (THW EIA). The cumulative dust impacts at each ASR are presented in *Table 4.5e*.

Table 4.5e Predicted Cumulative TSP Dust Levels at 2001 ($\mu g\ m^{-3}$) (1)

ASR	PSK Development (1)		Tolo Highway (2)		Cumulative (1)	
	1-Hour	24-hour	1-Hour	24-hour	1-Hour	24-hour
A1	411	122	107	53	**518 (3)**	175
A2	445	127	193	96	**638 (3)**	223
A3	215	88	37	19	252	107
A4	175	79	50	25	225	104
A5	125	74	36	18	161	92
A6	123	75	36	18	159	93
A7	108	73	36	18	144	91
A8	126	74	55	27	181	101
A9	161	81	55	27	216	108

Note: (1) Background concentrations included in the modelled results.
(2) Source: Final Report, Feasibility Assignment for Widening of Tolo Highway and Traffic Surveillance and Information System, Maunsell, 1997.
(3) Exceedances of the established criteria are shown in bold font.

4.5.23 It can be seen from *Table 4.5e* that the 1-hour TSP dust criteria would be exceeded at the A1 (HKIB) and A2 (HKIB Staff Accommodation). Mitigation measures are therefore required to reduce the dust emission to within the TSP dust criterion at PSKDA and PSK Reclamation.

Mitigation Measures

4.5.24 As presented in *Table 4.5e*, the cumulative construction work is likely to cause exceedance of the TSP dust criterion at some ASRs A1 and A2 in 2001. In addition to following the Air Pollution Control (Construction Dust) Regulation, the following dust control measures are also recommended to be incorporated in the Contract Specification of the PSKDA and PSK Reclamation to minimise dust nuisance arising from the works:

- the heights from which fill materials are dropped should be controlled to a practical height to minimize the fugitive dust arising from unloading;
- during transportation by truck, materials should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport;

- all stockpiles of aggregate or spoil should be enclosed or covered and water applied in dry or windy condition;
- effective water sprays should be used on the site at potential dust emission sources such as unpaved area;
- the haul road should be paved and vehicle speed should be limited to 20 kph;
- the haul road should be located away from the sensitive receivers, regular watering is recommended; and
- wheel washing facilities should be provided at the exit of work site.

4.5.25 It is expected that with the above measures, dust emission from infrastructure and development construction, materials handling and bulldozing could be reduced by 50% and the mitigated dust levels are shown in *Table 4.5f* below.

Table 4.5f Mitigated Cumulative TSP Dust Levels at ASRs ($\mu g\ m^{-3}$) (1)

ASR	**Year 2001**		**Year 2004**	
	1-Hour Average	**24-hour Average**	**1-Hour Average**	**24-hour Average**
A1	345	148	210	87
A2	448	194	228	90
A3	178	98	155	78
A4	172	99	227	80
A5	133	90	149	77
A6	132	90	151	76
A7	124	89	123	75
A8	152	98	139	75
A9	169	102	130	74
A10 (2)	-	-	157	81
A11 (2)	-	-	171	80
A12 (2)	-	-	164	82
A13 (2)	-	-	168	83
A14 (2)	-	-	180	85
A15 (2)	-	-	211	91
A18 (2)	-	-	265	90
A19 (2)	-	-	264	90
A22	-	-	178	83
A23	-	-	162	80

Note: (1) Background concentrations have been included in the modelled results.
(2) ASR A10 to A15, A18, A19, A22 and A23 are under construction in year 2001.

4.5.26 Environmental monitoring and audit (EM&A) for dust generated during the construction phase should be undertaken at representative ASRs, to ensure that the TSP dust criteria will not be exceeded. The EM&A programme and requirements are presented in the EM&A Manual and presented separately.

4.6 Operational Impacts

Traffic Emissions

Potential Sources of Impacts

4.6.1 During the operational phase of the PSKDA, it is anticipated that vehicular exhaust emissions from the adjacent Tolo Highway will be the major contributing source of air pollutants in the Study Area. Also, vehicular emissions generated from vehicles travelling along the PSKDA local road network, will be an additional pollutant source. Vehicular emissions from both the Tolo Highway and the new road network will primarily consist of NO_2, CO, and RSP.

Assessment Methodology

4.6.2 The *CALINE 4* model was used to predict the 1-hour concentrations of NO_2, CO and RSP due to the combined vehicle emissions from the widened Tolo Highway and the PSKDA local road network. The emission factors used for NO_X, CO and RSP, were calculated based on those derived by the EPD from the EUROII criteria

4.6.3 NO_2 was modelled by the discrete parcel method, assuming background concentrations of 31 $\mu g\ m^{-3}$ for NO and 45 $\mu g\ m^{-3}$ for NO_2 (as monitored at the Shatin station in 1996). Ozone was not monitored at the Shatin station in 1996, hence the average maximum daily O_3 monitored at the Yuen Long air quality monitoring station in 1996 (typical of a new residential development area), of 56 $\mu g\ m^{-3}$ was assumed as the O_3 background concentration.

4.6.4 The traffic flow data and traffic mix were supplied by the traffic consultant and shown in *Section 2.3*. Traffic flow data for the Study Area including Tolo Highway and the PSKDA local road network, were utilised in the modelling runs. Traffic mix of Tolo Highway is shown in *Table 4.6b* below.

Table 4.6b Traffic Mix of Tolo Highway (2011 AM Peak)

	Car	**Taxi**	**LGV**	**HGV**	**Cont**	**Coach**	**Bus**
Northbound	51%	4%	10%	19%	8%	6%	1%
Southbound	56%	4%	13%	18%	8%	2%	2%

4.6.5 It is assumed that Stage 1 of the Science Park will be in operation by the year 2001. However, the vehicular exhaust emissions in the year 2001 will be limited, as most of the infrastructure associated with PSKDA will still be under construction, hence only the years 2011 and 2016 were considered for the assessment.

4.6.6 As discussed above, the Tolo Highway will be the major pollutant source of the area. A comparison of the total emission rates of the critical pollutant, NO_X, from the Tolo Highway for various years has been carried out and the results are shown in *Table 4.6a* below. A review of the traffic data provided by the traffic consultants for the years 2011 and 2016, has indicated that the year 2011 will be the worst year, therefore, traffic data for 2011 (morning peak) were employed for this Study to identify the worst case scenario for the PSKDA.

Table 4.6a Comparison of NO_X Emissions of Tolo Highway

Year	**Traffic Flow (veh hr^{-1})**	**Total NO_X Emissions (g km^{-1})**
2001⁽¹⁾	10,650	8,070
2011	11,060	8,387
2016	9,840	7,774

Note: (1) Widening of Tolo Highway and TSIS Feasibility Assignment (Agreement No.CE 35/95) EIA Final Report (April 1997)

4.6.7 As peak hour traffic occurs during daytime, typical, neutral meterological conditions were assumed in the model. The worst case input parameters used in the model are listed below:

Wind Speed	1 m s^{-1};
Wind Direction	worst case for each receiver;
Stability Class	D;
Mixing Height	500 m;
Terrain Roughness	80 cm;
Standard Deviation of Wind Direction	17 degrees;
Temperature	25°C.

4.6.8 Canopy barriers of 8 m height were recommended along Tolo Highway in *Section 3.7*. With the barriers in place, pollutants will tend to accumulate at alignment level and disperse at a higher level (immediately above the barrier). In the model, the profile of Tolo Highway were assumed at 8 m above alignment level to simulate the effect of barriers on the dispersion of pollutants.

Evaluation of Impacts

4.6.9 To assess the adequacy of the buffer distances allocated in the RODP, contours of the predicted hourly concentrations of the critical pollutant NO_2, at 1.5 m above ground level were plotted and impacts at all ASRs identified in *Section 4.4* have been assessed.

Modelling Results

4.6.10 NO_2, CO and RSP concentrations were assessed, based on the worst case traffic results given in *Table 4.6a*. The modelling results predicted using *CALINE 4* are presented in *Tables 4.6c* below.

Table 4.6c Predictions of Hourly Concentrations of Pollutants ($\mu g\ m^{-3}$) at Receptor Height

ASR	Predicted NO_2 Concentrations (1)	Predicted CO Concentrations (2)	Predicted RSP Concentrations (3)
A1	169	2595	83
A2	150	2365	76
A3	75	1445	55
A4	113	1905	66
A5	94	1560	56
A6	75	1445	53
A7	75	1445	54
A8	94	1790	62
A9	94	1675	61
A10	113	1905	66
A11	132	1790	64
A12	150	2135	73
A13	150	2250	74
A14	113	1790	63
A15	132	1675	59
A16	94	1560	58
A17	113	1905	66
A18	94	1675	60
A19	113	1905	65
A20	94	1675	60
A21	169	2480	77
A22	150	2250	74
A23	169	2595	84

Note: (1) NO_2 background concentration of 45 $\mu g\ m^{-3}$ has been included (from Shatin EPD station).
NO background concentration of 31 $\mu g\ m^{-3}$ has been included (from Shatin EPD station).
O_3 background concentration of 56 $\mu g\ m^{-3}$ has been included (from Yuen Long EPD station).
(2) CO background concentration of 1100 $\mu g\ m^{-3}$ has been included (from Shatin EPD station).
(3) RSP background concentration of 46 $\mu g\ m^{-3}$ has been included (from Shatin EPD station).

4.6.11 As presented in *Table 4.6c*, there were no exceedances of the hourly AQO of 300 $\mu g\ m^{-3}$ for NO_2 at any of the ASRs. The NO_2 concentrations modelled at the ASRs ranged between 75 $\mu g\ m^{-3}$ and 169 $\mu g\ m^{-3}$.

4.6.12 No exceedances of the AQO of 30,000 $\mu g\ m^{-3}$ for CO were modelled. CO concentrations predicted at the ASRs ranged from 1445 $\mu g\ m^{-3}$ to 2595 $\mu g\ m^{-3}$.

4.6.13 Similarly, no exceedances of the AQO of 180 $\mu g\ m^{-3}$ for RSP were predicted, with RSP concentrations ranging between 53 $\mu g\ m^{-3}$ and 84 $\mu g\ m^{-3}$.

4.6.14 It can therefore be concluded during the operational phase, the present layout of the RODP will result in no exceedances of the AQOs at any of the ASRs assessed.

Buffer Distance

4.6.15 Contours of the distribution of the critical pollutant, NO_2, were plotted at 1.5 m above ground and are shown in *Figures 4.6a - d*. As the largest source of air pollution in the area, the Tolo Highway has been predicted to have the highest resulting maximum NO_2 concentrations generally decreasing with increasing distance from the Tolo Highway. NO_2 concentrations of less than 200 $\mu g\ m^{-3}$ have been predicted at the boundary of the sensitive uses of the PSKDA and the AQOs will therefore be satisfied.

4.6.16 From the contour plot, it can be seen that NO_2 concentrations predicted near the local PSKDA road network are relatively small, with concentrations mainly below 200 $\mu g\ m^{-3}$. Since the traffic flows along the local road network are relatively low, adverse air quality impacts are not expected. However, it is recommended that any sensitive uses along local roads should follow the HKPSG's buffer requirements to minimise the accumulation of pollutants at the ground level.

4.6.17 The NO_2 contours shown in *Figures 4.6b-d* indicate that no exceedances of the AQO of 300 $\mu g\ m^{-3}$ for NO_2, have been predicted in any part of the sensitive uses of the PSKDA.

Transport Interchange

4.6.18 The semi-confined bus termini proposed in the PSKDA will either be located near the residential development or next to the KCR Station, if the Station is constructed. The vehicle exhaust inside the termini will be ventilated by mechanical fans and discharged via ventilation shafts. It is understood that the ventilation design will ensure that TTAQG will be satisfied. As both the 1-hr TTAQG criteria and 1-hr AQO are identical for CO, NO_2 and SO_2, it is expected that the AQO criteria will be satisfied at the surrounding ASRs and that potential air quality impacts are unlikely. It is, however, suggested that the ventilation shafts should be located away from the ASRs by a distance of at least 10 m to avoid any potential air quality impacts.

4.6.19 Ventilation designs will be designed to meet the requirements specified in the ProPECC PN1/98.

Science Park

Potential Sources of Impacts

4.6.20 From the Science Park Study, the Science Park is likely to comprise IT related uses, biotechnical and advanced engineering type industries. As described in *Section 2.3* and *Annex A*, the types of activities are likely to comprise research type activities with limited manufacturing process. Emissions from the Science Park will be limited and adverse air quality impacts from the Science Park are not expected.

Sewage Pumping Station

Potential Sources of Impacts

4.6.21 Three sewage pumping stations (PS1, PS2 and PS3) have been proposed for the PSKDA and their locations are shown in *Figure 2.3b*. An equalization tank of 1300 m^3 located at the PS3 is also suggested to reduce the wasteload from PSKDA as shown in *Figures 2.3e-f*. Sewerage odour consist mainly of hydrogen sulphide would be generated from the pumping stations. However, odour nuisance from the pumping stations is unlikely as all the three pumping stations, including the equalization tank, will be located underground and enclosed, together with the negative pressure generated in the pumping stations with the flowing of sewerage, odour nuisance attributed from the sewerage is therefore unlikely.

4.6.22 However, to ensure that the odourous gas will not be emitted to the surroundings, odour control system such as activated carbon filter or scrubber system is recommended at the exhausts of the pumping stations. Any odour generated by the plant will be controlled by good engineering measures and odour nuisance is therefore not expected.

Mitigation Measures

4.6.23 The buffer distances from the Tolo Highway are adequate for ensuring compliance with the HKAQOs. Hence, no mitigation measures are required.

4.7 Conclusions

Construction Phase

4.7.1 Fugitive Dust Modelling was undertaken for two worst case scenarios year 2001 and 2004. For FDM undertaken for the PSKDA and PSK Reclamation, both scenarios the dust levels predicted at all ASRs will comply with both the 1-hour and 24-hour TSP dust criteria. However, for the year 2001 scenario, high TSP dust levels were predicted at the HKIB (A1) and HKIB Staff Accommodation (A2). For the year 2001 scenario, cumulative dust modelling was undertaken to take into account the concurrent Tolo Highway Widening works.

4.7.2 Cumulative dust levels in excess of the TSP criterion were predicted under certain dry conditions at some ASRs during the construction phase in the year 2001, due to the close proximity of the ASRs to the construction sites of Marine Science Laboratory and the Science Park - Phase 1.

4.7.3 For the year 2004, TSP dust levels attributed to the Stage II Reclamation (Remaining) and Science Park (Phase II) construction will also be high, but are not expected to exceed TSP dust criterion.

4.7.4 Dust suppression measures have been recommended which included the Air Pollution Control (Construction Dust) Regulation to be included in the Contract Specification to minimize dust nuisance arising from the PSKDA and PSK Reclamation. The TSP dust criterion will be achieved at all ASRs with the incorporation of the proposed mitigation measures. EM&A have also been recommended to ensure the TSP dust criteria would be complied at the ASRs and will be presented separately in the EM&A Manual.

4.7.5 The PSK Reclamation for Filling will not result in odour impacts due to the extension of the existing nullah as part of the PSK Reclamation Stage III reclamation works to divert discharges away from the temporarily open body of water comprising the Stage II (Remaining) area.

Operational Phase

4.7.6 Setback distances from Tolo Highways have already been incorporated into the RODP during the Planning Study. Due to the incorporation of these setbacks, the air quality in the PSKDA and all ASRs will comply with the AQO requirements.

4.7.7 The sewage pumping stations and equalization tank proposed for the PSKDA will be underground and enclosed and any odour generated by the plant should therefore not cause an odour nuisance to the surrounding sensitive receivers.

5 WATER QUALITY

5.1 Introduction

5.1.1 The construction and operation of the PSKDA could potentially impact on the marine water quality of the Study Area. The potential environmental impacts caused from the construction of the reclamation through public filling (previously known as public dumping) activities have already been assessed in the previously endorsed EIA study - Pak Shek Kok Reclamation - Public Dump EIA Study, April 1994 (PSKRPD EIA).

5.1.2 The objectives of this final water quality assessment are to assess the potential environmental impacts to water quality from the construction of any additional reclamation associated with the PSKDA and to assess potential water quality impacts due to the operation of the PSKDA. This *EIA Report* details the mitigation measures adopted to reduce any unacceptable water quality impacts identified in the EIA - Initial Assessment Report (*EIA - IAR*) and will indicate the likely residual (i.e. after mitigation) acceptability of resultant water quality impacts. Environmental Monitoring and Audit (EM&A) requirements for water quality will be presented in a separate EM&A Manual.

5.2 Government Legislation and Standards

5.2.1 The criteria for evaluating water quality impacts are laid out in the Technical Memorandum on Environmental Impact Assessment Process (Environmental Impact Assessment Ordinance, i.e. EIAO). The relevant criteria to this EIA Study are given in the following sections.

Marine Waters

5.2.2 The Water Pollution Control Ordinance (WPCO) is the legislation for the control of water pollution and water quality in Hong Kong. Under the WPCO, Hong Kong waters are divided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). The proposed PSKDA Study Area falls within the Tolo Harbour WCZ which is divided into three subzones as Channel, Buffer and Harbour Subzones. The Tolo Harbour and Channel WCZ was declared in 1982 but the regulations were not finalized until April 1987. According to the *Sewerage Disposal Working Paper* (*ET/08*) (September 1997), the Tolo Harbour and Channel WCZ has a stringent control on the discharge of sewage into Tolo Harbour with all treated effluent conveyed via a regional pumping station and effluent tunnel under the Effluent Export Scheme for disposal in Kai Tak Nullah. A figure showing boundaries between the three subzones of the WCZ is shown in *Figure 5.1a*. Tolo Harbour is a partially enclosed water body which includes four mariculture zones as well as several non gazetted bathing beaches at Lung Mei, Hoi Ha, Sha Lan, Yim Tin Tsai and Lok Wo Sha (shown in *Figure 5.1a*). The WPCO Water Quality Objectives (WQOs) set limits for different parameters that should be achieved in order to maintain the water quality within each specific WCZ.

Assessment Criteria

Water Quality Objectives

5.2.3 The WQOs for the Tolo Harbour and Channel WCZ, are presented in *Annex F*, will be applicable as evaluation criteria for assessing compliance of the PSKDA proposals against statutory requirements.

Project Specific Criteria

5.2.4 The potential water quality impacts have been assessed in the previously endorsed PSKRPD EIA.

5.2.5 However, in view of the proposed revision to the PSK Reclamation staging, described in *Section 2.2*, EPD have requested this study to undertake a comparative quantitative water quality evaluation based on the assumptions and methodology used in the previously endorsed PSKRPD EIA Study including the filling rates for the reclamation staging based on the revised PSKRPD construction programme. This was reported in the PSKDA "Demonstration Paper on Environment due to Change of Reclamation Sequence".

5.2.6 EPD requested that in order to avoid duplication of effort that the Demonstration Paper only comparatively assessed the changes made in the reclamation phasing to determine that the impacts are no greater than that previously assessed. EPD stated that if the impacts were less than or the same, then the endorsed PSKRPD EIA mitigation measures and EM&A recommendations would still be valid, otherwise additional mitigation measures and EM&A recommendations would have to be proposed.

5.2.7 For the seawater intakes, the Water Supplies Department (WSD) and Marine Science Laboratory (MSL) have their specific "WQO" standards and these are presented in *Table 5.2a*. With respect to Suspended Solids (SS), Biological Oxygen Demand (BOD_5) and *Escheria. coli* (*E. coli*), target quality standards for MSL seawater intake (MSL intake) are more stringent than those of WSD due to the reported purpose of the MSL intake which supplies the MSL fish and invertebrate stock holding, culture and experimental facilities. The SS concentration for WSD and MSL intakes should not be more than 10 mg l^{-1} (with an upper tolerance level of 20 mg l^{-1}) and 5 mg l^{-1}, respectively.

5.2.8 AFD has set a specific water quality (SS) criterion in Fish Culture Zones (FCZs), beyond which damage to fish stocks may occur. Presently mariculture will be eligible for extra allowance when the SS at the FCZ, as a result of dredging or filling works of the project, is detected to reach 50 mg l^{-1} or 100% more than the highest level recorded at the zone during the 5 years before commencement of the works in the vicinity. When such criteria are exceeded, appropriate mitigatory measures, including cessation of works, if necessary, should be adopted to keep the impact to within acceptable levels.

5.2.9 Another water quality issue appropriate to the PSKDA proposals comprises the potential use of the WCZ for secondary contact recreation such as diving, sail-board and dinghy sailing. For secondary contact, the most relevant water quality parameter is *E. coli* which should not exceed the WQO limit of 610 cfu 100 ml^{-1}.

Table 5.2a Water Quality Criteria for Seawater to be used by MSL and WSD (for Flushing Water) intakes

Parameter	MSL Target Limit	WSD Flushing Target Limit
Colour (HU)	-	< 20
Secchi Disc Depth (m)	> 2	-
Salinity (ppt)	> 25	-
pH	> 7.5	-
Turbidity (NTU)	-	< 10
Threshold Odour Number	-	< 100
Ammoniacal Nitrogen (mg l^{-1})	-	< 1
Total Nitrogen (mg l^{-1})	< 1	-
Total Phosphate (mg l^{-1})	< 0.1	-
SS (mg l^{-1})	< 5	< 10 (20 - upper threshold)
Dissolved Oxygen (mg l^{-1})	-	> 2
Dissolved Oxygen (% saturation)	> 10-30	-
Biochemical Oxygen Demand (mg l^{-1})	< 5	< 10
Synthetic Detergents (mg l^{-1})	-	< 5
Chlorophyll-a (μg l^{-1})	< 10 - 50	-
E. coli (cfu 100 ml^{-1})	< 100 - 1,000	< 20,000

5.2.10 In addition, in accordance with WBTC Nos. 6/92 and 22/92 and Building Ordinance Office Practice Note for Authorized Persons and Registered Structural Engineers No. 155, any proposal to remove more than 500,000 m^3 of clean mud or any quantity of contaminated mud must be justified on both cost and environmental grounds and the rationale for such removal should be provided to enable an allocation for disposal to be considered. It is desirable therefore to demonstrate that the proposed mud dredging is the minimum necessary, and to obtain in-principle agreement from the GEO at the early stage.

5.3 Sensitive Receivers

5.3.1 In order to evaluate the water quality impacts during the construction and operation phases, the proximity of Water Sensitive Receivers (WSRs) to the reclamation site must be considered. These have been identified in accordance with the *Hong Kong Planning, Standards and Guidelines (HKPSG)*, which provides guidance for including environmental considerations in the planning of both public and private developments.

5.3.2 The nearest WSRs identified (shown in *Figure 5.1a*) in the previous PSKRPD EIA include: the gazetted Tolo Harbour WCZ; the MSL intake; the FCZ at Yim Tin Tsai; the WSD seawater intakes for flushing at Sha Tin and Tai Po seafronts; and non gazetted bathing beaches at Lung Mei, Hoi Ha, Sha Lan, Yim Tin Tsai and Lok Wo Sha.

5.3.3 The Yim Tin Tsai East and West FCZs have an area of 149,500 m^2 and 136,300 m^2 respectively and are not in the vicinity of the PSKDA Study Area. The FCZ relevant assessment criteria are described in *Section 5.2.8.*

5.4 Baseline and Future Conditions

Marine Water Quality Monitored by EPD

5.4.1 For the purpose of this *EIA Report*, the EPD marine water quality monitoring data routinely collected in the vicinity of the site, which document the water quality in the Tolo Harbour and Channel WCZ have been used. The EPD monitoring stations of most relevance include TM2, TM3 and TM4 of Harbour Subzone as shown in *Figure 5.1a*. A summary of the most recently published EPD monitoring data (for the year 1996) collected at these station are presented in *Table 5.4a*. Although providing a good indication of water quality, these monitoring stations are located in the main flow channel of the harbour as opposed to the near-shore area to be reclaimed, site specific water quality data, obtained as part of the ongoing PSK Reclamation Stage I EM&A are presented in the following sub-section.

Table 5.4a Summary Statistics of 1996 Marine Water Quality in the Vicinity of PSKDA.

Parameter		**EPD Monitoring Station**			**PSK Reclamation Stage I Baseline Monitoring July-October 1996**
		TM2	**TM3**	**TM4**	
Temperature (°C)	Surface	23.7 (14.0 - 29.7)	24.0 (14.6 - 30.2)	23.9 (14.7 - 30.4)	28.2 (24.4-30.5)
	Bottom	23.1 (14.6 - 28.7)	22.5 (15.2 - 27.9)	22.3 (14.7 - 27.9)	(Depth Averaged)
Salinity (ppt)	Surface	29.7 (16.8 - 32.7)	29.8 (16.5 - 33.6)	30.2 (16.9 - 33.7)	29.1 (18.9-33.3)
	Bottom	31.6 (27.3 - 33.4)	32.8 (30.4 - 34.0)	32.9 (30.8 - 34.0)	(Depth Averaged)
DO (% saturation)	Surface	123.1 (65.6 - 194.1)	134.2 (79.9 - 220.0)	129.2 (67.6 - 197.0)	114 (6.75-197.8)
	Bottom	123.6 (47.5 - 204.0)	113.4 (70.9 - 209.5)	104.3 (26.2 - 183.1)	65.3 (0.29-151.6)
DO (mg l^{-1})	Surface	8.7 (5.0 - 12.6)	9.4 (6.0 - 16.1)	9.1 (4.5 - 13.5)	9.15 (2.17-13.75)
	Bottom	8.7 (3.1 - 13.8)	8.2 (4.7 - 15.9)	7.5 (1.7 - 12.3)	5.83 (0.31-11.42)
pH value		8.2 (7.5 - 8.9)	8.3 (8.0 - 8.7)	8.3 (7.9 - 8.7)	NM
Secchi disc (m)		1.6 (0.7 - 3.5)	1.8 (0.6 - 3.5)	1.8 (0.5 - 3.8)	NM
Turbidity (NTU)		3.5 (1.3 - 7.8)	2.7 (0.9 - 4.6)	2.5 (0.9 - 4.7)	6.5 (0.2-23.8)
SS (mg l^{-1})		4.4 (1.3 - 9.2)	3.2 (1.2 - 5.3)	3.2 (1.4 - 7.2)	5.6 (0.7-42.5)
Silica (as SiO_2) (mg l^{-1})		0.9* (0.1 - 2.8)	0.7 (0.1 - 2.1)	0.8 (0.1 - 2.0)	NM
BOD_5 (mg l^{-1})		4.0 (1.0 - 7.3)	3.0 (0.7 - 5.0)	2.7 (0.6 - 4.5)	3.53 (0.31-35.0)
Nitrite Nitrogen (mg l^{-1})		0.02* (<0.01 - 0.09)	<0.01 (<0.01 - 0.02)	<0.01 (<0.01 - 0.02)	0.01 (<0.01-0.24)
Nitrate Nitrogen (mg l^{-1})		0.08* (<0.01 - 0.45)	0.03 (<0.01 - 0.16)	0.03 (<0.01 - 0.19)	0.43 (0.18-1.14)
Ammoniacal Nitrogen (mg l^{-1})		0.13* (0.02 - 0.35)	0.10 (0.01 - 0.26)	0.09 (0.01 - 0.23)	0.15 (<0.01-1.13)
Total Inorganic N (mg l^{-1})		0.23* (0.03 - 0.52)	0.13 (0.01 - 0.36)	0.13 (0.01 - 0.30)	0.59 (0.3-1.73)
Total N (mg l^{-1})		0.69* (0.31 - 1.13)	0.52 (0.22 - 0.95)	0.49 (0.28 - 0.81)	NM
Ortho -Phosphate (mg l^{-1})		0.07* (0.02 - 0.42)	0.03 (0.01 - 0.07)	0.04 (0.01 - 0.10)	0.1 (<0.01-0.56)

Parameter	EPD Monitoring Station			PSK Reclamation Stage I Baseline Monitoring July-October 1996
	TM2	TM3	TM4	
Total P (mg l^{-1})	0.20* (0.12 - 0.36)	0.16 (0.09 - 0.25)	0.16 (0.09 - 0.30)	NM
Phaeo-pigment (μg l^{-1})	14.18* (1.50 - 71.50)	8.22 (1.33 - 46.87)	7.82 (0.97 - 31.13)	
Chlorophyll - a (μg l^{-1})	17.83* (1.05 - 49.00)	12.49 (0.80 - 36.00)	11.26 (0.70 - 24.87)	15.41 (0.01-62.03)
E. coli (cfu 100 ml^{-1})	486 (75 - 6,650)	69 (2 - 1,380)	49 (3 -2,167)	73 (1-5,700)
Faecal Coliform (cfu 100 ml^{-1})	836 (135 - 7,950)	151 (5 - 3,500)	103 (8 - 6,867)	NM
Total Kjeldahl N (mg l-1)	NM	NM	NM	0.04 (0.00-5.05)
Total Lead (μg l^{-1})	NM	NM	NM	27 (2-127)
Total Zinc (μg l^{-1})	NM	NM	NM	36 (3-92)
Total Copper (μg l^{-1})	NM	NM	NM	19 (1-69)

Note:
1. Except as specified, data presented are depth-averaged data.
2. Data presented are annual arithmetic means except data for *E. coli* and Faecal Coliform which are geometric means.
3. Data enclosed in parentheses indicate the ranges.
4. *Data presented are based on 23 samples collected in 1996.
5. NM denoted that data did not measured.

5.4.2 The water quality at TM2 inside the Harbour Subzone, being closet to the Sha Tin Sewage Treatment Works (STW) and the mouth of Shing Mun River, is more turbid, richer in nutrient content (high in total nitrogen and phosphorus) and higher in chlorophyll-a and *E. coli* content. The water quality at TM3 (close to Shuen Wan Landfill and Tai Po River) and TM4 was better than that at TM2.

5.4.3 The closest EPD monitoring station to the WSRs at MSL and Sha Tin seafront is TM2, which is located at the vicinity of the Harbour Subzone. Summary data for TM2, which is influenced occasionally by the sewage outfall from the Sha Tin STW and the flow from the Shing Mun River, was found to be more turbid and contained high levels of inorganic nutrient contents (total nitrogen ranges from 0.31 to 1.13 mg l^{-1} and total phosphorus ranges from 0.12 to 0.36 mg l^{-1}) and bacterial counts (*E. coli* levels range from 75 to 6,650 cfu 100 ml^{-1}). These factors also serve to create prominent seasonal and vertical variations in DO.

5.4.4 In the summer, the DO concentration in the bottom water layer decreases due to the large quantity of organic matter with high BOD_5 entering the water column and the sediment oxygen demand being exerted, while the surface layer can become supersaturated with oxygen as a result of algal growth. Oxygen depletion in the bottom layer is compounded by the lack of vertical mixing during the summer months as opposed to the well-mixed winter conditions. DO and BOD_5 at TM2 range from 3.1 to 13.8 mg l^{-1} and from 1.0 to 7.3 mg l^{-1} respectively. The DO saturation was calculated to range from 47.5 to 204.0 %, with depth-averaged BOD_5 at 4.0 mg l^{-1}. The SS concentrations range from 1.3 to 9.2 mg l^{-1}, with the depth-averaged value at approximately 4.4 mg l^{-1}.

5.4.5 TM3 is closest to the sensitive seawater intake at Tai Po seafront and the Yim Tin Tsai West FCZ. The summary data for TM3 indicates that the northern portion of Harbour Subzone is influenced occasionally by the sewage outfall from the Tai Po STW (which is approximately 2-3 km from the proposed PSKDA) and the leachate from Shuen Wan Landfill (which is approximately 2 km from the proposed PSKDA), which contains high levels of inorganic nutrient contents (total nitrogen ranges from 0.22 to 0.95 mg l^{-1} and total phosphorus ranges from 0.09 to 0.25 mg l^{-1}) and relatively lower bacterial counts (*E. coli* levels range from 2 to 1,380 cfu 100 ml^{-1}). These factors also serve to create prominent seasonal and vertical variations in DO, and may be responsible for fluctuations in temperature and salinity.

5.4.6 For DO at TM3, concentrations are slightly greater than that of TM2 with a range of 4.7 to 16.1 mg l^{-1}. For BOD_5 at TM3, concentrations are similar to TM2 with a range from 0.7 to 5.0 mg l^{-1}. The DO saturation was calculated to be 70.9 to 220.0 %, with depth-averaged BOD_5 of 3.0 mg l^{-1}. The SS concentrations at TM3 are lower than that of TM2 and range from 1.2 to 5.3 mg l^{-1}, with the depth-averaged value at approximately

3.2 mg l^{-1}.

5.4.7 TM4 is less influenced by discharge from the STWs. The summary data for TM4 indicates that water quality is better than TM2, with the lowest level 49 cfu 100 ml^{-1} of *E. coli* ranging from 3 to 2,167 cfu 100 ml^{-1}. This upper limit still exceeds the most stringent proposed value of 100 cfu 100 ml^{-1} by MSL intake.

5.4.8 For DO at TM4, concentrations are similar to TM2 with a range from 1.7 to 13.5 mg l^{-1}. BOD_5 at TM4 is smaller than that of TM2 and ranges from 0.6 to 4.5 mg l^{-1}. The surface DO saturation ranged from 67.6-197.0% and bottom DO saturation ranged from 26.2 to 183.1%, with depth-averaged BOD_5 of 2.7 mg l^{-1}. The SS concentrations at TM4 are lower than that of TM2 and range from 1.4 to 7.2 mg l^{-1}, with the depth-averaged value at approximately 3.2 mg l^{-1} which is the same as of TM3.

5.4.9 A review of the water quality in 1996 indicates that the annual geometric mean of *E. coli* within the whole of the Tolo Harbour and Channel WCZ was in full compliance with the 610 cfu 100 ml^{-1} *E. coli*. WQO for secondary contact waters. It is therefore considered that the WCZ should not impose a constraint to the PSKDA proposals in terms of the use for recreational water activities involving secondary contact although in general, eutrophic water enriched with high levels of nutrient and chlorophyll-a was evident that algal activity is present in the Study Area.

Water Quality Monitored by PSK Reclamation Stage I EM&A

5.4.10 Water speeds, verified by use of a float release undertaken in the PSKRPD EIA study, showed low velocities were in the order of 0.02 m s^{-1}. This result was consistent with the formation of a large slowly moving circulation in the PSK area of Tolo Harbour which would tend to carry public fill generated SS towards the MSL intake and Sha Tin WSD seawater intake (Sha Tin WSD intake) and away from the FCZs at Yim Tin Tsai and the Tai Po WSD intake. The PSKRPD EIA assessment of both mitigated and unmitigated dredging and filling activities predicted that there will not be excessively elevated levels of SS at the identified WSRs as a result of the public filling process.

5.4.11 Ten water quality monitoring stations (MS1-10) were identified in the PSK Reclamation Stage I EM&A. Relevant locations of MS1-10 are shown in *Figure 5.1a* and station descriptions are given in *Table 5.4b*. Baseline water quality monitoring, with sampling frequency of three times per week, was carried out in the period of 15 July 1996 to 16 October 1996. This PSK Reclamation Stage I baseline data was obtained from Civil Engineering Department (CED) is summarised in *Table 5.4a*, the summary statistics is presented in *Table 5.4c* and is subsequently discussed below.

Table 5.4b PSK Reclamation Stage I EM&A Water Quality Monitoring Station

Station Name	**Station Description**	**HK Metric Grid E**	**HK Metric Grid N**
MS1	50 m seaward of the centre of the Phase 1 Seawall	840220	831750
MS2	50 m seaward of the centre of the Phase 2 Seawall	839600	832330
MS3	50 m seaward of the centre of he Phase 3 Seawall	838970	832820
MS4	Sensitive Receiver at Tai Po Seawater Pumping Station	837660	834540
MS5	Sensitive Receiver Sha Tin Seawater Pumping Station	840200	830300
MS6	Sensitive Receiver at Yim Tin Tsai Mariculture Zone	839300	834800
MS7	Sensitive Receiver at MSL intake	840200	831120
MS8	Reference Control Station within Tolo Harbour	840700	833800
MS9	Nullah outfall draining the Tai Po Mei and Cheung Shue Tan Rivers (only required during impact and compliance monitoring)	838900	832300
MS10	One location spaced between the end of the seawall and the shoreline (only required during impact and compliance monitoring)	Moveable as the seawall is extended	Moveable as the seawall is extended

Table 5.4c Water Quality Summary Statistics From PSK Reclamation Stage I Baseline Monitoring in 1996

	Mean (Range)	90%ile (10%ile)	95%ile (5%ile)	99%ile (1%ile)
Temperature (°C) (15 Jul - 19 Sep)	28.2 (24.4-30.5)	29.6	29.9	30.2
Salinity (ppt) (15 Jul - 19 Sep)	29.1 (18.9-33.3)	31.8	32.2	33.1
DO (mg l^{-1}) surface & middle (5 Aug - 19 Sep)	9.15 (2.17-13.75)	(6.63)	(5.73)	(2.81)
DO (mg l^{-1}) bottom (5 Aug - 19 Sep)	5.83 (0.31-11.42)	(0.53)	(0.47)	(0.33)
Turbidity (NTU) (15 Jul - 19 Sep)	6.5 (0.2-23.8)	12.1	13.7	18.2
Suspended Solids (mg l^{-1}) (15 Jul - 10 Aug)	5.6 (0.7-42.4)	9.7	11.1	21.3
Total Lead (μg l^{-1}) (15 Jul - 10 Aug)	27 (2-127)	46	56	85
Total Zinc (μg l^{-1}) (15 Jul - 10 Aug)	36 (3-92)	69	72	78
Ammoniacal Nitrogen (mg l^{-1}) (16 Jul - 16 Oct)	0.15 (0.00-1.13)	0.27	0.37	0.54
Nitrite-Nitrogen (mg l^{-1}) (16 Jul - 16 Oct)	0.01 (0.00-0.24)	0.02	0.04	0.12
Nitrate-Nitrogen (mg l^{-1}). (16 Jul - 16 Oct)	0.43 (0.18-1.14)	0.55	0.59	0.71
Total Inorganic N (mg l^{-1}) (16 Jul - 16 Oct)	0.59 (0.3-1.73)	0.78	0.89	1.24
Total Kjeldahl N (mg l^{-1}) (16 Jul - 16 Oct)	0.40 (0.00-5.05)	0.81	0.98	2.31
Total PO_4 (mg l^{-1}) (16 Jul - 16 Oct)	0.10 (0.00-0.56)	0.15	0.17	0.25
Total Copper (μg l^{-1}) (16 Jul - 16 Oct)	19 (1-69)	30	36	48
Chlorophyll-a (μg l^{-1}) (23 Sep - 30 Oct)	15.41 (0.01-62.03)	33.21	42.63	55.93
E. coli (cfu 100 ml^{-1}) (16 Jul - 16 Oct)	73 (1-5700)	136	300	1059
BOD_5 (mg l^{-1}) (16 Jul - 16 Oct)	3.53 (0.31-35.00)	6.26	7.04	12.49

5.4.12 Water quality monitoring stations in the vicinity of the PSK Reclamation are MS1, MS2 and MS3. According to the baseline data of PSK Reclamation Stage I, majority of the DO readings complied with the statutory level in the WQO, although occasional breaches of the WQO did occur at MS1-MS3 and in stations MS4 and MS8. Comparing the PSK Reclamation Stage I baseline DO readings and EPD's 1996 marine water quality, the former has average surface DO falls within EPD's DO range but consisted of a lower minimum level. Similar observation was also found in terms of DO saturation.

5.4.13 MS4-7 comprise WSRs in the vicinity of the PSK Reclamation Stage I reclamation with MS5 and MS7 the closest. The baseline water quality data showed that the majority of the surface and middle averaged DO readings comply with the water quality standards of MSL intake, Sha Tin WSD intake as well as WQO.

5.4.14 Turbidity is affected largely by the concentration of SS and algae in the water. Comparing the readings of SS and turbidity of the PSK Reclamation Stage I baseline to EPD's water monitoring data, PSK Reclamation Stage I baseline has higher average and maximum levels for both parameters.

5.4.15 In terms of the SS readings, all the baseline monitoring stations complied with the WQO apart from MS6. However, few non-compliancies were found in MS5 and MS7 relative to the water quality standards of MSL intake and Sha Tin WSD intake.

5.4.16 All baseline monitoring data for ammoniacal nitrogen comply with the WQO. The data also fulfilled the Sha Tin WSD intake water quality standards.

5.4.17 All the stations were found with some non-compliance in WQO in terms of BOD_5 readings during baseline monitoring. However, In the view of water quality standards Sha Tin WSD intakes, MS5 had very few breaches, whereas MS7 had higher numbers of breaches in BOD_5 in terms of MSL intake water quality standards.

Inland Waters

5.4.18 The previous PSKRPD EIA reported that two water quality surveys were undertaken as part of the Tolo Catchment Study on Unsewered Developments (4) and showed that the water quality of the discharge differed significantly between the two samples in terms of BOD_5 and ammoniacal nitrogen (see *Table 5.4d*). Although the concentrations of BOD_5 and ammoniacal nitrogen were high during times of low flow, the actual loads were low. The low concentrations during high flow and high dilutions are unlikely to give rise to deterioration in water quality. Furthermore, under the project for the sewering of unsewered areas, those villages currently discharging septic tanks to the streams will be sewered. Sewerage improvement works for Wong Nai Shai and Pak Shek Kok will begin in 1996 and be completed by 2000 and the remainder beginning in 1997 and completed by 2002. Thus the input of BOD_5 and ammoniacal nitrogen into the water course will be expected to be further reduced in the vicinity of MS9 (see *Section 5.4.17*) and thus it is considered that no degradation of water quality will occur during the interim period prior to complete infilling of the PSK Reclamation Stage II Phase 2 area by public filling.

---

(4) Tolo Harbour Catchment, Study on Unsewered Development , Hon g Kong Government, EPD 1990.

Table 5.4d Water Quality in the Nullah Below Cheung Shue Tan Village

	Flow ($m^3 d^{-1}$)	BOD_5 ($mg l^{-1}$)	NH_4-N ($mg l^{-1}$)
Occasion 1	7,833	1.2	0.02
Occasion 2	8	28	3.75

5.5 Construction Phase

Sources of Impact

5.5.1 Based upon the findings of previously endorsed PSKRPD EIA and the PSKDA *EIA - IAR*, it has been determined that water quality impacts which may arise in addition to the construction activities of the PSK Reclamation by public filling will include the following activities:

- filling and dredging activities;
- stormwater discharges;
- Northern and Southern Access Roads reclamation activities;
- general construction activities; and
- construction run-off and drainage.

5.5.2 In addition, a PSKDA KCRC Station may potentially be located at the southern part of the PSKDA i.e. south of the stormwater drainage nullah, and the northern limit of the KCRC Station is about 100 m south of the stormwater drainage nullah. The potential water quality implications during the construction phase of KCRC Station and alignment will be similar to the generic construction impacts described below.

5.5.3 Evaluation of the potential water quality impacts is provided in the following sections.

Evaluation of Impacts

Filling and Dredging Activities

5.5.4 A Demonstration Paper as part of the PSKDA Study entitled "Demonstration Paper on Environment due to Change of Reclamation Sequence" has been produced in response to the reclamation staging changes (Option 2) proposed in the PSKDA Study Working Paper ET/02, Addendum No.1 (May 1997) and subsequent Engineering and Traffic Working Group Meeting held on 18 June 1997. In response to EPD's request, a comparative water quality evaluation based on the assumptions and methodology used in the previous endorsed PSKRPD EIA was undertaken and included the filling rates for the reclamation staging based on the revised CED construction programme.

5.5.5 The PSKDA Study Demonstration Paper comparatively assessed the changes made in the reclamation phasing with the previous PSKRPD EIA, to determine that the impacts are no greater than that previously assessed. In this regard, EPD stated that if the impacts are less than or the same as those predicted in the PSKRPD EIA, then the endorsed mitigation measures will still be valid, otherwise additional mitigation measures and EM&A requirements would have to be proposed in this PSKDA EIA.

5.5.6 A revised CED construction programme and reclamation sequence for the Pak Shek Kok Reclamation was distributed on 13 February 1998 (Ref. (101) in PM 2/3/13 II) and shown in *Table 5.5a*. Importantly, CED has confirmed (13 February 1998 Ref. (101) in PM 2/3/13 II) that the Stage III reclamation works will also include the extension of the existing nullah through the PSK Reclamation, to divert discharges away from the temporarily open body of water comprising the Stage II Phase 2 area. The most updated reclamation staging is shown in *Figure 2.2b*.

Table 5.5a CED Revised Construction Programme

Stage	**Date by which reclamation work**		**Area Formed (+6.0 mPD)**	**Remarks**
	starts	**ends**		
I	10/1996	02/1998	5 ha	for Science Park
II				
Phase 1	04/1998	06/1999	12 ha	for Science
Phase 2	01/2001	07/2004	35.4 ha	Park and other uses
III	07/1999	12/2000	15.6 ha	for Housing

5.5.7 It has been assumed that for all stages, the public fill material will be brought in by barge and truck as assumed in the previously endorsed PSKRPD EIA. CED has advised that, despite the reclamation staging changes, the dredging and filling activities in PSK Reclamation can be maintained at the same rates assumed in the PSKRPD EIA.

5.5.8 The comparative water quality evaluation, requested by the EPD, based on the same assumptions and methodology used in the previous PSKRPD EIA has been undertaken to comparatively assess the scale of impacts which will occur as a result of the proposed staging changes relative to the staging previously proposed in the PSKRPD EIA. A comparative assessment of impacts to noise and air quality are also described in *Sections 3* and *4*, respectively.

5.5.9 The previous PSKRPD EIA only assessed Stage I (worst case) and considered that Stages II and III were all too far away from the MSL and Sha Tin WSD intakes to be affected by public filling activities. In addition, the reprovisioned MSL will be located in the southern edge of Stage I reclamation and its operation will overlap with the construction of Stage II phase 2 (600 m away) and Stage III reclamation (1,360 m away) (see *Sections 5.5.21* also). Therefore it was considered that the sediment plume impact should also be calculated for the revised Stages II and III to confirm that there were no impacts to sensitive receivers identified.

Dredging Activities Sediment Plume Results

5.5.10 Results of the revised reclamation staging dredging are shown in *Table 5.5b*, which, due to the same rates of dredging as assumed in the previously endorsed PSKRPD EIA, show that the sediment plume for all stages should settle within 1,000 m of the dredging area. The previous PSKRPD EIA concluded that there would be no impacts to the MSL and Sha Tin WSD intakes, provided suitable mitigation measures such as the use of silt screens were incorporated. As Stages III and Stage II Phase 2 are further away from the MSL (1,660 m and 900 m respectively) and Sha Tin WSD intakes (2,560 m and 1,800 m respectively) compared with Stage I (400 m from MSL and 1,300 m from Sha Tin WSD intakes), the results predict that the MSL and Sha Tin WSD intakes will not be impacted by the revised reclamation staging public filling activities. However, slight exceedance of reprovisioned MSL SS standard (< 5 mg l^{-1}) by less than 0.2 mg l^{-1} was found, after reduction by a factor of 2.5 through deployment of the silt screen (as recommended in PSKRPD EIA). Therefore an extra mitigation measure of deploying the silt screen at receiver (i.e. reprovisioned MSL intake) to further reduce the SS level below the target level will be required.

Table 5.5b Revised Staging Dredging Activities - Sediment Plume Results

		Width Averaged SS Concentration (mg l^{-1})					
Wind Speed ($m\ s^{-1}$)	Plume Average	Dredger	50 m	100 m	550 m	700 m	1000 m
0	140	350	70	0	0	0	0
6	25	64	56	50	0	0	0
12	14	35	27	25	13	8	0

Filling Activities Sediment Plume Results

5.5.11 According to the PSKRPD EIA, the current velocities in the region of the filling face will be low because of the short fetch of the wind and consequently will be less than 0.05 m s^{-1}. Results of the revised reclamation staging public filling/filling are shown in *Table 5.5c*, which, due to same rates of filling as assumed in the previously endorsed PSKRPD EIA, show that the sediment plume concentration should fall to 14 mg l^{-1} at 100 m from the filling area. The use of a silt screen around the filling face will further reduce losses to the surrounding water by a factor of 2.5 (5). This measure would result in a reduction to approximately 5.5 mg l^{-1} at the end of the seawall. The previous PSKRPD EIA concluded that there would be no public filling impacts to the MSL and Sha Tin WSD intakes, provided suitable public filling mitigation measures are incorporated. As Stages III and Stage II Phase 2 are further away from the MSL (1,660 m and 900 m respectively) and Sha Tin WSD intakes (2,560 m and 1,800 m respectively) compared with Stage I, the results predict that the MSL and Sha Tin WSD intakes will not be impacted by the revised reclamation staging public filling activities. The operation of the reprovisioned MSL will commence in July 2000, during the reclamation of Stage II Phase 2 and Stage 3. However, no SS impact will be expected from the sediment plume results (with distance of 600 m from Stage II Phase 2 and 1,360 m from Stage III), provided that the suggested mitigation measures at filling face are implemented.

Table 5.5c Filling Activities - Sediment Plume Results

	Width Averaged SS Concentration (mg l^{-1})				
Current Speed (m s^{-1})	Plume Average	Face	50 m	75 m	100 m
0.02	28	141	28	14	0
0.05	11	56	18	16	14

Stormwater Discharges

5.5.12 The revised staging will lead to the formation of an open body of water, comprising Stage II Phase 2 area shown in *Figure 2.2b* which will start being filled one month after completion of Stage III and 19 months after completion of Stage II Phase 1. It will then be filled until completed in July 2004 as given in *Table 5.5a*, although the Stage II Phase 2 area will be filled above water level significantly before this time. The only discharge to the Stage II Phase 2 area will be the water course which is fed by the Tai Po Me and Cheung She Tan rivers, which will be properly sewered in 2002. Additionally, CED will maintain at least a 200 m gap to assist adequate flushing during this Stage II Phase 2 formation period. Runoff and drainage from construction sites may contain considerable loads of SS and contaminants during construction activities, especially at the extension of existing nullah at Stage III reclamation (see *Section 5.5.12*) and Stage II reclamation temporary drainage (see *Section 5.5.14*). Potential sources of water pollution from site runoff include:

---

(5) Pak Shek Kok Reclamation -Public Dump Environmental Impact Assessment Study, Final Report, Mouchel Asia Limited, April 1994.

- runoff and erosion of exposed bare soil and earth, drainage channels, earth working area and stockpiles;
- wash water from dust suppression sprays and vehicle wheel washing troughs; and
- fuel, oil, and lubricants from maintenance of construction vehicles and mechanical equipment.

Local and coastal water pollution will be substantial if the construction site runoff is allowed to drain into the storm sewer or natural drainage without mitigation.

5.5.13 The Stage III reclamation will begin from the north and a minimum leading section of 100m of seawall from the active dumping face will always be maintained during the filling operation. In addition, CED has confirmed (13 February 1998 Ref. (101) in PM 2/3/13 II) that the Stage III reclamation works will also include the extension of the existing nullah (finished in December 2000) to divert discharges away from the temporarily open body of water (formed from January 2001) comprising the Stage II Phase 2 area.

5.5.14 According to the *Drainage Impact Assessment Report (DIA) ET/11* (11 February 1998), there are four existing culverts (see *Figure 5.5a*) draining the study related area having the total catchment area of 262.78 ha (see *Table 5.5d* for details). During the construction of the Stage I reclamation, temporary drainage channels will be constructed to intercept outfalls C9, C10, C11 and HKIB. The design of existing drainage situation took into account of the future development at the west of Tolo Highway (see also *Figure 5.5a*). Essentially the Stage I reclamation will influence the existing outfall C11 and the pipe near the HKIB.

Table 5.5d *Existing Catchment Areas and Peak Discharge*

Culvert No.	**Tolo Highway (Existing) (ha)**	**Catchment Upstream of Tolo Highway (ha)**				**Total Catch-ment (ha)**	**Max. Discharge Return Period (1 in 200) ($m^3 s^{-1}$)**
		Resident-ial G/1C, OU	**Village**	**Natural**	**Pavement**		
C8-Pak Shek Kok	-	-	-	-	-	238.48	62.40
C9-2x900 dia	0.73	3.24	3.24	-	-	3.97	2.29
C10-Plover Cove	1.76	12.17	12.17	-	-	13.93	7.89
C11-900 dia	1.77	4.63	4.63	-	-	6.40	3.82

5.5.15 The DIA for the Stage I and II reclamation has been submitted and approved by DSD which shows a temporary open channel aligned parallel to the existing seawall intercepting all the discharges from the drainage outlets below Tolo Highway. The proposed temporary open channel parallel to the seawall is aligned so that it caters for the future reclamation required for the Tolo Highway widening project (see *Figure 5.5b*). DIA prepared by CED reveal that the capacity of the temporary channel is satisfactory, based on a 5 year rainfall/10 year tidal surge and a 10 year rainfall/5 year tidal surge conditions. This channel having collected the flows, will then convey them to Tolo Harbour at a temporary seawall within the boundary of the Stage I works.

5.5.16 Two options of drainage system are proposed depend on the internal road layout of the Science Park development and should be further considered as part of the detail design. Illustrations of the two options are shown in *Figure 5.5c*.

Northern Access Road Reclamation

5.5.17 It should be noted that further minor reclamation will be required to form land for the Northern Access Road. This access road reclamation consists an area of only 0.5 ha and comprises three slip roads to and from Tolo Highway including a single northbound flyover on a skew alignment to join Tolo Highway northbound and two single southbound slip roads onto and from the reclaimed area plus associated drainage. The Northern Access Road minor reclamation will be built in six months, and will start in mid 1999 and will be completed at the end of 1999. The first 2 months will be used for dredging and the final 4 months will be used for filling. This proposed minor reclamation will require approximately 60,000 m^3 of dredging and 85,700 m^3 of fill. The closest WSR to Northern Access Road will be Tai Po WSD intakes, MSL intake and Yim Tin Tsai West FCZ, which are all remote at approximately 1,200 m, 2,200 m and 2,000 m from the Northern Access Road (see *Figure 5.1a*).

Assumptions

5.5.18 The assumed criteria for estimating the SS released by Northern Access Road reclamation, using the previously endorsed sediment plume model, are shown in *Table 5.5e*.

Table 5.5e Sediment Plume Model Assumption for Northern Access Road

Criteria	**Dredging**	**Filling**
Rate (m^3 hr^{-1})	78	55
Density (t m^{-3})	0.5	0.5
Loss (%)	5	5
Current (m s^{-1})	0.02	0.02
Wind (%)	1.5	1.5
Depth (m)	5	5
Width (m)	50	50
Settling (m s^{-1})	0.001	0.001
S time (s)	5000	5000
Barge (m)	20	20

5.5.19 SS concentration has been estimated during dredging and filling for consistency and comparison, using the sediment plume calculation previously endorsed in PSKRPD EIA. The results predict no SS concentration caused by minor reclamation dredging activities would be detected at the closest WSR (i.e. Tai Po WSD intake) (see *Table 5.5f*), provided that the mitigation measures of the same type endorsed in the PSKRPD EIA are properly implemented for this minor reclamation.

5.5.20 According to the PSKRPD EIA, the current velocities in the region of the filling face will be low because of the short fetch of the wind and consequently will be less than 0.05 m s^{-1}. Similar calculation for the potential release of SS concentration was performed for the filling activities. Again, the predicted SS concentration at the Tai Po WSD intake will not be increased by the filling activities (see *Table 5.5g*).

Table 5.5f Northern Access Road Dredging Activities - Sediment Plume Results

		Width Averaged SS Concentration (mg l^{-1})				
Wind Speed (ms^{-1})	Plume Average	Dredger	50 m	250 m	700 m	1000 m
0	108	271	108	0	0	0
6	20	49	36	21	0	0
12	11	27	21	16	7	0

Table 5.5g Northern Access Road Filling Activities - Sediment Plume Results

	Width Averaged SS Concentration (mg l⁻¹)					
Current Speed (m s⁻¹)	Plume Average	Face	50 m	250 m	700 m	1000 m
0.02	76	191	76	0	0	0
0.05	31	76	49	0	0	0

5.5.21 The Northern Access Road and PSK Reclamation Stage III will be constructed concurrently. According to the sediment plume calculation (see *Section 5.5.9*, *5.5.10*, *5.5.18* and *5.5.19*), no SS arising from either Northern Access Road and PSK Reclamation Stage III will be detected at the closest WSR (i.e. Tai Po WSD intake), provided that the relevant mitigation measures described in *Section 5.5.42* and the endorsed PSKRPD EIA are properly implemented.

Southern Access Road Reclamation

5.5.22 It is proposed that the Southern Access Road will be built at the southern side of PSKDA. The proposed Southern Access Road will require further reclamation of 3.5 ha, shown in *Figure 5.5d* which will be located at a distance of 200-300 m from the Sha Tin WSD intake. The MSL intake located along the existing seafront will be reclaimed and will thus be reprovisioned and relocated on the southern edge of PSK Reclamation Stage I as shown in *Figure 5.5e*. The construction of new MSL will be carried out during 15 June 1999 to 14 June 2000 and the reprovisioning of MSL to new MSL will be conducted between 15 June 2000 and 29 July 2000 (6). In the view of construction timescale, the reclamation of Southern Access Road will only affect the reprovisioned of MSL which is 500 m away.

5.5.23 The Southern Access Road will be constructed during June 2000 to August 2001. A total of two phases (five stages) are proposed (see *Figure 5.5f* to *5.5h*). The reclamation work will follow the main construction programme. Within an envisaged 15 months' construction period, a suggested dredging and filling programme is shown in *Figure 5.5i*.

5.5.24 After discussion with the Engineering Team, it is presently understood that the reclamation for the Southern Access Road will require approximately 250,000 m^3 of material to be dredged. Within the dredged material, 40% (by volume) (i.e. 105,000 m^3) will be disposed within the reclamation footprint (ie: on-site), and 60% (140,000 m^3) will be disposed off-site. The method of disposal will depend on the heavy metal concentration found in the site investigation. The dredging rates are described in *Section 5.5.27* and *Table 5.5f*. It is assumed that the thickness of contaminated mud layer to be the top 2 m (7), suggested by the endorsed PSKRPD EIA, which will be confirmed by site investigation, and is discussed further in *Section 6*.

---

(6) Agreement No. CE 90\96, Feasibility Study for Pak Shek Kok Development Area, Project Cost And Implementation Report, Report ET/13 (Final), April 1997, Maunsell Consultants Asia Ltd.

(7) Agreement No. CE 90/96, Feasibility Study for Pak Shek Kok Development Area, Engineering Report, Report ET/12, March 1998, Maunsell Consultants Asia Ltd.

5.5.25 A total of 320,000 m^3 of sandfill, 210,000 m^3 of rockfill and 180,000 m^3 of public fill will be required for the reclamation; rockfill will have no impact on SS concentration. The reclamation will be formed by both general filling and public filling, of which the 320,000 m^3 of sand fill will be used up to + 1 mPD and public fill of 180,000 m^3 will be used up to + 6 mPD. Dredged marine deposits within this area will be placed behind the seawall, with a thickness of 3 m. Above -1 mPD, there will be 2 m thick sandfill up to +1 mPD, which is assumed to be the mean sea level. After dredging below the seawall, sandfill will be placed in layers between -14.0 mPD to -5.0 mPD, at which level geotextile will be paced and then 1.0 m thick rockfill type A will be placed. It is considered that a reasonable estimate of the volume of public fill that can be transported by road haulage would be about 1,200 m^3 per working day.

5.5.26 Two methods of dredging and general filling were proposed for the Southern Access Road reclamation. The first method is truck end-tipping whereas the other method is suction dredging/filling. Estimated SS concentration for both dredging and filling methods, using the previously endorsed PSKRPD EIA sediment plume model for consistency and comparison, are presented below.

5.5.27 In the view of the truck end-tipping method, three months is assumed to be used for dredging and disposing 3 m of marine deposit above the seabed level (-4.0 mPD). It is expected that all sandfill and rockfill will be transported by land transportation to be unloaded from trucks using end-tipping methods. Based on the assumed 6 months of sand filling period, an average rate of sandfill transport of 52,500 m^3 per month, in estimating the construction programming of the reclamation. However, an average rate of placement of about 30,000 m^3 per month is assumed for public fill, considering another extra 6 month public filling period.

5.5.28 For the suction dredging/filling method, the dredging and filling rates will be higher than the truck end-tipping method. *Table 5.5f* shows the dredging and filling rates for the Southern Access Road using the suction dredging/filling method.

Table 5.5h Construction Rates Using the Suction Dredging/Filling

Activity	**Production Rate (m^3 per week)**
Dredging	
Contaminated Mud	17,000
Clean Mud	34,000
Sand filling	150,000

Assumptions

5.5.29 The following assumed criteria listed in *Table 5.5g* was used in the calculations of SS for dredging and filling activities.

Table 5.5i *Sediment Plume Model Assumptions for Southern Access Road*

Criteria	Dredging		Filling	
	Grab	Suction	Grab	Suction
Rate (m^3 hr^{-1})	217	531	138	1562
Density (t m^{-3})	0.5	0.5	0.5	0.5
Loss (%)	5	5	5	5
current (m s^{-1})	0.02	0.02	0.02	0.02
Wind (%)	1.5	1.5	1.5	1.5
Depth (m)	9	9	9	9
Width (m)	50	50	50	50
Settling (m s^{-1})	0.001	0.001	0.001	0.001
S time (s)	9000	9000	9000	9000
Barge (m)	20	20	20	20

Dredging Activities Sediment Plume Results

5.5.30 Quantity of the SS released has been estimated for the grab dredging deployed in the truck end-tipping method, and is shown in *Table 5.5j*. The unmitigated results predict that the SS concentration at the closest WSR (200-300 m), i.e. Sha Tin WSD intake, will range from 33-50 mg l^{-1} if the wind speed is 6 m s^{-1}, and will range from 25-30 mg l^{-1} if the wind speed is 12 m s^{-1}. Whereas the unmitigated results revealed that the SS concentration at reprovisioned MSL will range from 17-33 mg l^{-1} if the wind speed is 6 m s^{-1} and 25-30 mg l^{-1} if the wind speed is 12 m s^{-1}. After deploying the silt screen, as recommended in PSKRPD EIA, a factor of 2.5 can be deducted from the unmitigated SS concentration. Compared to the standards of Sha Tin WSD intake, the mitigated SS concentration will meet the 20 mg l^{-1} upper threshold but will exceed the 10 mg l^{-1} standard. However, non-compliance will be found in terms of the SS standard for reprovisioned MSL intake (< 5 mg l^{-1}) which will require additional mitigation. In order to comply with the reprovisioned MSL SS standard, the dredging period should be extended from 3 months to 7.5 moths. Assuming the other criteria of the sediment plume model are unchanged, the required new dredging rate will be 86 m^3 hr^{-1} (see *Table 5.5k*).

Table 5.5j *Southern Access Road Grab Dredging (3 months) Activities - Sediment Plume Results*

		Width Averaged SS Concentration (mg l^{-1})				
Wind Speed (m s^{-1})	Plume Average	Dredger	50 m	180 m	450 m	720 m
0	167	419	242	0	0	0
6	30	76	58	50	33	17
12	17	42	33	30	25	20

Table 5.5k Southern Access Road Grab Dredging (7.5 months) Activities - Sediment Plume Results

		Width Averaged SS Concentration (mg l^{-1})				
Wind Speed (m s^{-1})	Plume Average	Dredger	50 m	180 m	450 m	720 m
0	66	166	96	0	0	0
6	12	30	23	20	13	7
12	7	17	13	12	10	8

5.5.31 The estimated SS concentration produced in the suction dredging method, at the Sha Tin WSD and reprovisioned MSL, will range from 81-122 mg l^{-1} and 41-81 mg l^{-1} respectively if the wind speed is 6 m s^{-1} and will range from 74-61 mg l^{-1} and 49-61 mg l^{-1} respectively if the wind speed is 12 m s^{-1}. Therefore the SS requirement from the Sha Tin WSD and reprovisioned MSL intakes will not be met if the suction dredging method is used, even if a silt screen is adopted as mitigation. In addition, the dredging of the seriously contaminated sediment classified under EPDTC No. 1-1-92 must be carried out by means of closed grab dredger. Special mitigation measures for handling Class B and C material can be found in *Section 5.5.43*.

Filling Activities Sediment Plume Results

5.5.32 The estimated SS concentration caused by both proposed filling methods will approach to zero up to a distance of 180 m, base on a current speed of 0.02 m s^{-1}. Therefore no increase of SS concentration at Sha Tin WSD intake and reprovisioned MSL due to either filling methods are expected (see *Tables 5.5l* and *5.5m*). However, if the current speed is up to 0.05 m s^{-1}, then the SS standard for Shatin WSD intake will not be met. Although, according to the PSKRPD EIA, the current velocities in the region of the filling face will be low because of the short fetch of the wind and consequently will be less than 0.05 m s^{-1}, suction filling should be avoided and, therefore, truck end-tipping method should be used.

Table 5.5l Southern Access Road Grab Filling Activities - Sediment Plume Result

		Width Averaged SS Concentration (mg l^{-1})				
Current Speed (m s^{-1})	Plume Average	Face	50 m	180 m	450 m	720 m
0.02	106	266	154	0	0	0
0.05	43	106	76	51	0	0

Table 5.5m Southern Access Road Suction Filling - Sediment Plume Results

		Width Average SS Concentration (mg l^{-1})				
Wind Speed (m s^{-1})	Plume Average	Face	50 m	180 m	450 m	720 m
0.02	1205	3013	1741	0	0	0
0.05	482	1205	857	579	0	0

Overall Sediment Plume Impacts from Southern Access Road Reclamation

5.5.33 In the view of the SS predicted to be released into the water column due to the construction of Southern Access Road, it is considered that extra mitigation, i.e. at pollution source and at receiver (i.e. Sha Tin WSD and reprovisioned MSL intakes) will be required to ensure compliance of required standards as described in the mitigation section.

5.5.34 In terms of the construction schedule of PSKDA, the reclamation of Southern Access Road overlaps with the early dredging and filling of the PSK Reclamation Stage II Phase 2. However, no SS impact to the Sha Tin WSD intake will be caused by the reclamation of PSK Reclamation Stage II Phase 2 (1,800 m away) but only the dredging works of the Southern Access Road (see Section 5.5.9, *5.5.10*, *5.5.29* and *5.5.30*). Therefore no cumulative impact is expected. It is considered that the addition mitigation measures for the Southern Access Road to be adequate in preventing further SS impact to the Sha Tin WSD intake provided that mitigation measures mentioned in *Section 5.5.42* and the endorsed PSKRPD EIA are implemented properly. Regarding the cumulative impact of Southern Access Road and Stage II Phase 2 reclamation to reprovisioned MSL intake, an SS exceedance of less then 3 mg l^{-1} to the MSL, 5 mg l^{-1}, standard will result, even deployment of silt screen at both source and receiver are adopted. As the Stage II Phase 2 reclamation does not significantly contribute to the cumulative impact, further mitigation measures mentioned in *Section 5.5.42* comprising a revision to programming and reduced dredging rates of the Southern Access Road Reclamation will be required.

Southern Access Road Drainage

5.5.35 A temporary drainage channel which may consist of precast concrete sections should be lowered into place, once the reclamation level reaches the invert levels of the existing stormwater outlets.

General Construction Activities

5.5.36 The general construction works which will be undertaken for the road and infrastructure will be primarily land based and may have the potential to cause water pollution. These could result from the accumulation of solid and liquid waste such as packaging and construction materials, sewage effluent from the construction workforce, discharge of bilge water and spillage of oil, diesel or solvents by vessels and vehicles involved with the construction. If uncontrolled, any of these could lead to deterioration in water quality. Increased nutrient levels resulting from contaminated discharges and sewage effluent could also lead to a number of secondary water quality impacts including decreases in DO concentrations and localised increases in un-ionised ammonia (NH_3) concentrations which would stimulated algal growth, and reductions in oxygen levels.

5.5.37 However, the effects on water quality from construction activities are likely to be minimal, provided that site boundaries are well maintained and good construction practices are observed to ensure that litter, fuels, and solvents are managed, stored and handled properly.

5.5.38 Domestic sewage will arise from sanitary facilities provided for the onsite construction work force. Sewage is characterised by high levels of BOD_5, ammonia and *E. coli* counts. There will be no public sewers available for domestic sewage discharge. Owing to the lack of established guidelines of sewage generation rate for construction sites, the recommended design rate for office, specified in the *Guidelines for the Design of Small Sewage Treatment Plant, EPD Solid Waste Control Group, March 1990* has been used to estimated the sewage generation. Sewage production of 0.46 m^3 per worker per day is used. Therefore, assuming the whole PSK Reclamation construction site require 200-300 workers, a total of 92-138 m^3 of sewage will be generated. If the sewage is allowed to discharge directly into the surrounding water body without treatment, the WQO will not be met in terms of BOD_5 and *E. coli* concentration.

Construction Run-off and Drainage

5.5.39 Run-off from construction sites may contain increased loads of SS and contaminants. Potential sources of water pollution from site run-off include:

- run-off and erosion from site surfaces, drainage channels, earth working area and stockpiles;
- contaminated ground water from any dewatering activities as a result of excavation and disturbance of contaminated sediments;
- release of any bentonite slurries and other grouting materials with construction run-off, storm water or ground water dewatering process;
- wash water from dust suppression sprays and wheel washing facilities; and
- fuel, oil and lubricants from maintenance of construction vehicles and equipment.

5.5.40 Construction run-off and drainage may cause physical, chemical and biological effects. The physical effects could arise from any increase in SS from the site which could cause blockage of drainage channels and associated local flooding when heavy rainfall occurs, as well as local impacts on water quality in Tolo Harbour. High SS concentrations in marine waters could lead to associated reduction in dissolved oxygen levels.

5.5.41 It is important that proper site practice and good site management to be strictly followed to prevent run-off water and drainage water with high levels of SS from entering the surrounding waters. With the implementation of appropriate measures to control run-off and drainage from the construction site, it is considered that disturbance of water bodies will be localised and deterioration in water quality will be minimal. Thus unacceptable impacts on the water quality are not expected provided the recommended measures described in the PSKRPD EIA and the following mitigation section (*Section 5.5.43*) are implemented effectively.

5.5.42 Possible chemical and biological effects could arise as a result of construction run-off, depending upon the chemical and nutrient content. Primary chemical effects may result from liquids containing significant quantities of concrete and cement derived materials. These may include localised increases in turbidity and discolouration, localised elevations in pH, and accretion of pH solids. Bentonite slurry and other grouting material within run-off could also contribute to these chemical effects within the water column. A number of secondary effects may also result in toxic effects to marine biota due to elevated pH values, reduced decay rates of faecal microorganisms due to decreased light penetration, and a localised increase in the proportion of unionised ammonia.

Environmental Control Measures

5.5.43 The results of the comparative assessment of the revised PSK Reclamation staging proposals, based on the same assumptions and methodology used in the previous PSKRPD EIA demonstrate that the potential water quality impacts will not be greater than previously assessed. Therefore, assumed that the mitigation measures proposed in the previous PSKRPD EIA will be adequate for the PSK Reclamation (including Northern Access Road reclamation) mitigation measures are described below:

Dredging Activities

- use of sealed grab and silt screen to contain sediment losses during dredging;
- the receiving barges must not be allowed to overflow; and
- in the event of an exceedance, the dredging rate could be reduced to further limit the impact on adjacent receivers.

5.5.44 Owing to the potential adverse water quality impact caused by the dredging of Southern Access Road, in addition to the above mentioned mitigation measures, the following extra measures are also recommended:

- deploy silt screen at the at the Southern Access Road Reclamation face and at the Sha Tin WSD intake during the dredging of Southern Access Road Reclamation;

- the silt screens deployed will have efficient reduction in the SS concentration (a factor of 2.5 according the previous PSKRPD EIA). In addition the silt screen should be durable and easily maintainable. Regular surveillance and maintenance are also required;

- deploy silt screen at the reprovisioned MSL intake during the dredging of Southern Access Road reclamation; and

- reduction of the level of SS at reprovisioned MSL intake to comply with the 5 mgl^{-1} standard can be achieved by reduction of dredging rates of the Southern Access Road Reclamation, via extension of the Southern Access Road Reclamation dredging duration from 3 to 7.5 months.

5.5.45 Provided that the above mitigation measures are implemented properly, the mitigated SS concentration at the Sha Tin WSD intake and reprovisioned MSL intake will comply with the WSD and MSL standards.

Filling Activities

- construction of a leading seawall of 100 m from the active dumping face;

- use of refuse boom around the public filling area to contain any floating refuses within the site area and the motorised sampans would be deployed to collect floating refuses if required;.

- use of silt screen around the public filling face would be expected to reduce the losses to the surrounding water by a factor of 2.5;

- placement of a suitably protected surface boom supporting a hanging net or skirt around the tipping front to contain any floating debris;

- strict application of public filling licences and monitoring of material placed in the public fills should be implemented to control unauthorised material being placed in the public fills;

- use of a recirculation system to reduce SS and oil discharges from the vehicle wheel washing facility;

- fuel tanks on site should be housed within drainable trays and regularly drained of rain water. Vehicle maintenance should be carried out on paved areas, spillages controlled by absorbents and waste oils collected in designated tanks prior to disposal off site;

- permanent site offices and facilities should be connected to the most convenient sewer. Temporary chemical toilet facilities at distant locations on the reclamations should be serviced daily and the contents disposed of to the sewer; and

- at least a 200 m gap between seawalls will be maintained to assist adequate flushing during the filling of the Stage II Phase 2 formation period.

5.5.46 As it is anticipated that some of the dredged sediment is seriously contaminated, it should be noted that further mitigation measures may be needed and, therefore, to the following mitigation measures should also be included:

Dredging Activities

- the prohibition of stockpiling of any moderately or seriously contaminated (Class B and C) material, and careful control of stockpiling of any uncontaminated (Class A) material to prevent run-off, resuspension and odour nuisance.

- it should be note that currents may reduce the efficiency of silt screens. Pervious research indicates that current velocities of 0.5 m s^{-1} would be the upper limit for semi-permanent silt curtain/screens;

- all vessels should be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;

- all dredgers should be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

- the construction works should cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the site or public filling grounds;

- additional provisions will be required where sediments are contaminated. The locations and depths of any areas of contaminated sediments should be indicated int he construction contract following the completion of a detailed sediment quality survey which has been recommended by FMC, prior to construction. The Contractor should be required to ensure that contaminated sediments are dredged, transported and placed in approved special dumping grounds in accordance with the EPDTC 1-1-92, WBTC 22/92 and WBTC 6/92. Typical mitigation measures are list below:

- transport of contaminated mud to the marine disposal site should, wherever possible, be by split barge of not less than 750 m^3 capacity, well maintained and capable of rapid opening and discharge at the disposal site;

- the material should be placed in the pit by bottom dumping, at a location within the pit specified by the FMC;

- discharge should be undertaken rapidly and the hoppers should then immediately be closed, material adhering to the sides of the hopper should not be wash out of the hopper and the hopper should remain closed until the barge next returns to the disposal site;

- the dumping vessel should be stationary throughout the dumping operation;
- the Contractor must be able to position the dumping vessel to an accuracy of +/- 10 m;
- monitoring of the barge loading to ensure that loss of material does not take place during transportation;
- transport barges or vessels shall be equipped with automatic self-monitoring devices; and
- on site audit of the equipment and plant is essential to ensure it is used in the correct manner.

Filling Activities

- all vessels should be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
- all garbs should be fitted with tight fitting seals to their bottom openings to prevent leakage of filling material;
- loading of barges should be controlled to prevent splashing of filling material to the surrounding water, and barges or hoppers should not be filled to a level which will cause the overflow of materials of polluted water during loading or transportation;
- the works should cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds;
- a maximum 5% fines contents of marine fill sand arriving at site is recommended as the upper limit of the fines content to minimize the SS impact upon the Sha Tin WSD intake located 200-300 m from the construction site.

General Construction Activities

5.5.47 All site construction run-off should be controlled and treated to prevent high levels of SS entering surrounding waters in accordance with ProPECC PN 1/94. The following measures, which constitute good site practices, may be considered where applicable:

- temporary ditches should be provided to facilitate run-off discharge into the appropriate watercourses, via a sediment trap/sediment retention basin, prior to discharge;
- permanent drainage channels should also incorporate sediment basins or traps, and baffles to enhance deposition rates;
- all traps (temporary or permanent) should also incorporate oil and grease removal facilities;

- sediment traps must be regularly cleaned and maintained by the contractor. Daily inspections of such facilities should be required of the contractor;
- concrete batching plants should be bunded to contain the surface water run-off;
- water from concrete batching plants must also pass through sediment traps and settlement tanks prior to run-off into watercourses. These must be regularly cleaned and maintained by the contractor;
- collection of spent bentonite/other grouts in a separate slurry collection system for either cleaning and reuse/disposal to landfill;
- maintenance and plant areas should be bunded and constructed on a hard standing with the provision of sediment traps and petrol interceptors;
- all drainage facilities must be adequate for the controlled release of storm flows;
- minimising of exposed soil areas to reduce the potential for increased siltation and contamination of run-off;
- all chemical stores shall be contained (bunded) such that spills are not allowed to gain access to water bodies; and
- chemical toilets will be required to handle the sewage from the on-site construction workforce.

Construction Run-off and Drainage

5.5.48 The control of construction site runoff and drainage should be prevented or minimized in accordance with the guidelines stipulated in the EPD's *Practice Note for Professional Persons, Construction Site Drainage* (ProPECC PN 1/94), especially at the extension of nullah at Stage III reclamation and the Stage II temporary drainage. Good housekeeping and stormwater best management practices (BMPs), detailed in terms of location and form as follows, should be implemented to ensure that runoff from construction areas comply with the WPCO and no unacceptable impact on the WSRs arises due to the construction of the proposed reclamation. All discharges from the construction site should be controlled in order to comply with the standards for effluents discharged into the Victoria Harbour and Tolo Harbour and Channel WCZs under the TM.

5.5.49 Exposed soil areas should be minimized to reduce the potential for increased siltation, contamination of runoff, and erosion. Construction runoff related impacts associated with reclamation work and above ground construction activities can be readily controlled through the use of appropriate mitigation measures which include:

- boundaries of critical areas of earthworks should be marked and surrounded by dykes or embankments for flood protection;

- all temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge should be adequately designed for the controlled release of storm flows. All sediment traps should be regularly cleaned and maintained;

- sand and silt in the wash water from the wheel washing facilities, which ensure no earth, mud and debris is deposited on roads, should be settled out and removed before discharging into storm drains. A section of the road between the wheel washing bay and the public road should be paved with backfall to prevent wash water or other site runoff from entering public road drains; and

- oil interceptors should be provided in the drainage system and regularly emptied to prevent the release of oils and grease into the storm water drainage system after accidental spillages. The interceptor should have a bypass to prevent flushing during periods of heavy rain.

5.6 Operation Phase

5.6.1 This section assess any changes in local and far field water movement patterns including tidal flushing rates and any associated water quality impacts resulting from the formation of a new coastline configuration.

Sources of Impact

5.6.2 Based upon the PSKRPD EIA findings and review of the proposed operational PSKDA land uses in the RODP, it has been determined that operational water quality impacts could comprise:

- water movement;
- associated water quality impacts; and
- effluent discharge impacts.

No potential cooling water discharge impact is anticipated as no cooling water intake or discharges are required in the PSKDA.

5.6.3 An evaluation of the potential operational impacts is provided in the following sections.

Evaluation of Impacts

Water Movement

5.6.4 The final reclamation configuration has been assessed previously in the PSKRPD EIA and determined that any significant change in reclamation size and shape will require further assessment and evaluation. Due to the limited scale and profiles of both the Northern (0.5 ha) and Southern Access (3.5 ha) reclamations and due to site constraints imposed by the sewage effluent and gas pipelines along the length of the proposed coastline, there will be no significant alteration in reclamation size or shape. Therefore the PSKRPD EIA findings are still valid and no further quantitative assessment is required.

Water Quality

5.6.5 It is presently understood that the land uses proposed for the PSKDA in *Section 2.3* will include the Science Park, residential development, recreational uses and a potential KCR station. However, due to the general policy on sewage disposal within Tolo Catchment which will not accept any major new effluent discharge into Tolo Harbour, any discharges generated by the operational phase of the PSKDA will require appropriate connection to the respective sewer and stormwater system and will thus ensure that no adverse impacts will eventuate.

Science Park

5.6.6 A Science Park will be located on the Stage I of PSKDA. *Annex A* provides details of potential Science Park tenants which indicates that the Science Park will comprise only high technology based and Research and Development businesses and review of cases studies, provided in *Annex A*, for science parks in Asia and Europe also indicates that polluting activities will not be present. Therefore, provided that the conditions of the WPCO discharge licences for all Science Park operators are followed, residual water quality impact will not eventuate.

Proposed KCRC Station and Alignment

5.6.7 A PSKDA KCRC Station may potentially be located at the southern part of PSKDA, i.e. south of the stormwater drainage nullah, and the northern limit of the KCRC Station is about 100 m south of the stormwater drainage nullah (8). The length of any PSKDA KCRC Station would be approximately 300 m.

---

(8) Engineering Report, Report ET/12, Feasibility Study for Pak Shek Kok Development Area, Maunsell Consultants Asia Limited, March 1998.

5.6.8 Potential water quality impact during operation phase of a PSKDA KCRC Station and alignment includes:

- run-off from rail track and operational drainage;
- station run-off;
- sewage generation at any PSKDA KCRC Station; and
- cooling water discharge.

5.6.9 During operation phase of PSKDA KCRC Station and alignment, the run-off, cooling water and discharge may mainly contain rainwater, with limited quantities of oil, grease, rail grindings and grit. Provided that the condition of the WPCO discharge licences are followed, with proper mitigation measures such as silt and oil traps are deployed prior to discharge to existing stormwater drainage system, the residual water quality impact will be minimal. Any sewage effluents will be discharged directly to the existing sewerage infrastructure and therefore adverse water quality impact will not expected.

Stormwater Drainage

5.6.10 According to current information provided by the Engineering Team, the stream channel will be reprovided to the edge of the proposed reclamation, with the major stormwater drain running generally in the direction of the proposed coastline. The relocation of this stream channel will allow stormwater discharges from the Study Area to be located 400 m in to Tolo Harbour and closer to the main flows in Tolo Harbour such that no adverse impacts will arise.

5.6.11 According to the PSKDA DIA (11 February 1998), two drainage options (Option A and B) (as shown respectively in *Figure 5.5c*) were proposed to intercept C9, C10, C11 and the 750 mm diameter pipe at the HKIB.

5.6.12 Drainage for the Science Park will by means of a network of distribution and main drainage pipelines. Distribution pipes will be designed to the latest standards described in the Stormwater Design Manual and will be linked by the main pipes buried under access roads, with their layout derived rom the traffic circulation system. The main pipes will eventually be connected up to one of the primary outfalls shown in *Figures 5.5c*, thereby leading the discharges into Tolo Harbour or through outfalls direct to the sea. Appropriate access arrangements should be agreed with DSD during the design stage in order to satisfy maintenance requirements. Preliminary proposals have been discussed and would include desilting proposals, desilting openings on culverts and drainage reserves through the development.

5.6.13 During the operation phase, discharge of polluted stormwater into the surrounding waters of PSKDA, especially into any areas of slack water and embayment could be of concern. However, due to the smooth reclamation shape which will permanently eliminate any embayment and assuming all the works for sewerage of unsewered villages will have been completed before the commencement of works for the PSKDA presently programmed (*Section 2.2*), it is expected that the influence of untreated sewage on stormwater discharge will be eliminated such that no water quality impacts will arise during the operational phase of PSKDA.

Sewage Discharges

5.6.14 A review of the Working Paper on Sewerage Disposal (ET/08) (September 1997) estimated that an average flow of 14,500 m^3 per day under ultimate conditions (based on a population of 13,000 and 22 ha of Science Park industrial site) could be generated from PSKDA by 2015. This estimate assumes sewage flows from:

- domestic flows from the residential developments;
- industrial flows from the Science Park (65% of the total flowrate); and
- flows generated from the commercial / institutional developments.

Table 5.6a shows a breakdown of the population projection. However, the current flow generated form the Science Park is estimated based on the average sewage discharge rate from the Sha Tin and Tai Po industries. This industrial flowrate assumption should be checked when more information regarding the proposed industrial type at Pak Shek Kok is available.

Table 5.6a Development Projection for Pak Shek Kok Development Area

	2001	2003	2005	2015
Residential				
Population R1+R2	0	3,327	8,319	12,130
Industrial/Commercial				
Science Park				
Employment	1,100	3,300	5,500	16,500
Area (gross), ha*	1.6	4.8	8	22
Other Employment	0	534	1835	2085

Note: * Assumed developed area

The ultimate pollutant loads generated by the estimated flow from PSKDA will be:

BOD_5	3,480 kg per day
Suspended solids (SS)	2,320 kg per day
Total Kjeldahl nitrogen (TKN)	464 kg per day
Ammonia-nitrogen (NH_3-N)	304 kg per day

Noted that the industrial wasteloads is based on the flowrate estimated and the average pollution concentrations as follows:

BOD_5	240 mg l^{-1}
SS	160 mg l^{-1}
TKN	32 mg l^{-1}
NH_3-N	21 mg l^{-1}

At present, the existing facilities at Sha Tin STW are overloaded. Design work on an extension of the STW is underway and will upgrade to total capacity to 260,000 m^3 per day in late 2003. It is expected that the additional flow and wasteload from PSKDA is small when compared with the total plant capacity of the Sha Tin STW and should be able to adequately cater for the PSKDA, after the upgrading. The Working Paper recommended that the PSKDA should be connected to the Sha Tin STW.

The Science Park Phase 1 is currently planned for commissioning in mid 2001. However, the Sha Tin STW upgrade will not be commissioned until end of 2003. It is estimated that sewage flows from Science Park Phase 1 are estimated to be 686 m^3 per day in 2001 and increase to be 3,368 m^3 per day in 2003, after which year the Sha Tin STW upgrade work will be commissioned. The additional sewage flows are small and calculated to be about 0.4 to 2.2 % of the existing capacity of 150,000 m^3 per day.

Interim improvement measures of Sha Tin STW including provision of interim equalization tank at Pak Shek Kok and addition of chemical coagulants to reduce the wasteload at the secondary treatment process has been proposed. If the interim acceptance at the Sha Tin STW is not feasible, a temporary treatment plant will be constructed at Pak Shek Kok, designed at an estimated flow of 3,400 m^3 per day. A schematic flow diagram is shown in *Figure 5.6a*. The land requirement for this proposed temporary treatment plant is 4,000 m^2 to 6,000 m^2. Predicted sewage production and flow rates are detailed in *Table 5.6b*.

Table 5.6b Sewage Flow Calculations

Planning Area	**Population (h)/Area (ha)**	**Unit Flow $m^3h^{-1}d^{-1}$ or $m^3ha^{-1}d^{-1}$**	**Equivalent Population**	**Peak Factor**	**Flow Discharge m^3s^{-1}**
R1	6,000	0.240	-	4	0.0667
R2	6,130	0.300	-	4	0.0851
Primary School 1	1,000	0.025	-	6	0.0017
Primary School 2	1,000	0.025	-	6	0.0017
Secondary School	1,000	0.025	-	6	0.0017
Unsewer Village	200	0.150	-	8	0.0028
Science Park	22.0	429	37,786	3	0.3277
REC	10.0	429	17,160	3.5	0.1738
Education Institution	6.2	429	10,639	3.5	0.1077
G/IC	2.0	429	3,432	4	0.0397

Environmental Control Measures

5.6.15 The following measures are applicable to reduce stormwater run-off pollution during operation phase:

- provision of silt traps to reduce the concentration of silt/sediments in stormwater run-off. These silt traps should be cleaned and maintained regularly to ensure that they function properly;
- compliance of the WPCO for Tolo Harbour through the issuance of relevant discharge licences for the proposed development within PSKDA; and
- the stringent control on the discharge of sewage into Tolo Harbour with all treated effluent conveyed via a regional pumping station and effluent tunnel under the Effluent Export Scheme for disposal in Kai Tak Nullah.

As discussed previously, it should also be noted that future operation of the proposed sewerage systems for both the PSKDA and for the villages of Wong Nai Shai and Pak Shek Kok will effectively reduce effluent into the waters of Tolo Harbour.

5.7 Conclusions

Construction Phase

5.7.1 The potential environmental impacts caused from the construction of the reclamation through public filling activities have already been assessed in the previously endorsed PSKRPD EIA. However, due to a proposed change in reclamation staging proposed in PSKDA Study Working Paper ET/02, a PSKDA Demonstration Paper entitled "Demonstration Paper on Environment due to Change of Reclamation Sequence" was submitted to assess the changes proposed.

5.7.2 The purpose of this Demonstration Paper was to comparatively assess the differences proposed between the construction stages of the previous PSKRPD EIA and the revised staging for Stages II and III. The PSKDA Study Demonstration Paper has shown that the proposed changes in reclamation staging will not result in water quality impacts greater than previously predicted for Stages II and III in the PSKRPD EIA and thus the previously proposed mitigation measures will be sufficient to protect receiving water quality during public filling. In addition, CED has confirmed (30 October 1997, Ref (23) in PM CE 90/96/1 VI) that the Stage III reclamation works will also include the extension of the existing nullah to divert discharges away from the temporarily open body of water comprising the Stage II Phase 2 area. A temporary drainage channel is proposed during construction and the capacity is found to be satisfactory.

5.7.3 The SS impact caused by the construction of the Northern and Southern Access Road Reclamation is assessed using the same methodology as the PSKRPD EIA for consistency, and additional mitigation measures for Southern Access Road Reclamation are recommended.

5.7.4 The construction phase assessment, therefore, concludes that residual insurmountable water quality impact should not eventuate from PSKDA proposed construction, assuming mitigation is incorporated, as described.

Operation Phase

5.7.5 The formation of a new coastline configuration will not lead to water quality or movement impacts associated with changes in local and far field water movement patterns which has been examined in previous PSKRPD EIA.

5.7.6 No residual water quality impact to the PSKDA is anticipated from the proposed operation of PSKDA KCRC Station alignment, provided that proper mitigation measures broadly outlined in *Section 5.6.8* are implemented.

5.7.7 As the Science Park will comprise only high technology based and Research and Development businesses and as the conditions of the WPCO discharge licences for all Science Park operators will have to be followed, residual water quality impact from the Science Park will not eventuate.

5.7.8 It is considered that the influence of untreated sewage on the stormwater discharge will largely be eliminated due to the works for sewage of unsewered villages (9). Due to the general policy on sewage disposal within Tolo Catchment which will not accept any major new effluent discharge into the Tolo Harbour, the increased sewage due to the proposed population on PSKDA will be served by the Sha Tin STW for treatment and disposal.

5.7.9 Two options of drainage designs were proposed to serve the PSKDA, the choice of the option will depend on the internal layout of the Science Park development.

5.7.10 The sewage arising from the PSKDA will be handled by Sha Tin STW. However, because the Sha Tin STW is reaching capacity, STW upgrading work will commence in late 2003. In the interim, an equalization tank at PSKDA plus additional chemical coagulants will be used to reduce the wasteload. If the interim acceptance at the Sha Tin STW is not feasible, a temporary treatment plant will be constructed at Pak Shek Kok, designed at an estimated flow of 3,400 m^3 per day.

---

(9) Tolo Harbour Sewerage of Unsewered Areas Stage I Phase II

6 WASTE MANAGEMENT

6.1 Introduction

6.1.1 This assessment of the potential environmental impacts associated with the handling and disposal of waste during the construction and operation of the PSKDA is based on three factors:

- The type and nature of waste to be generated;
- The amounts and rates of waste arisings; and
- The proposed re-use, recycling, storage, collection, transport and disposal methods, and the impacts of these methods.

6.1.2 The environmental impacts associated with the construction of the PSK reclamation through public filling activities have already been assessed in the previously endorsed PSKRPD EIA, while the potential impacts caused by the formation and servicing works for Area 12 (Part) and 39 (existing reclamation area) has already been assessed in the previously endorsed *Tai Po Development: Formation & Servicing of Area 12 (Part) & 39 EIA (June 1996)*.

6.1.3 This section of the *EIA Report* reviews the findings of the previously endorsed reports, presents and discusses the nature and types of waste that may arise during the additional works required for the construction and operational phases of the PSKDA. Procedures for waste reduction and management as well as for recycling, treatment, storage, collection, transport and disposal of wastes are also reviewed and possible mitigation measures recommended, where appropriate.

6.1.4 The additional works for the PSKDA involve the following activities:

- The provision of roads and infrastructure for the PSKDA;
- The construction of the Southern and Northern Access Roads;
- The construction of the additional reclamation works required for the Northern and Southern Access Roads; and
- The reprovisioning activities associated with the Southern and Northern Access Roads

6.2 Government Legislation and Standards

6.2.1 The following legislation relates to the handling, treatment and disposal of wastes in the Hong Kong SAR and are used in assessing potential impacts:

- The Waste Disposal Ordinance (Cap 354);
- The Waste Disposal (Chemical Waste) (General) Regulation (Cap 354);
- The Crown Land Ordinance (Cap 28);

- The Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws; and
- Dumping At Sea Ordinance (Cap 466).

6.2.2 The *Waste Disposal Ordinance* (WDO) prohibits the unauthorised disposal of wastes. Construction waste is not directly defined in the WDO but is considered to fall within the category of "trade waste". Under the WDO, wastes can only be disposed of at sites licensed by the EPD.

6.2.3 Under the *Waste Disposal (Chemical Waste) (General) Regulations* all producers of chemical wastes (including asbestos) must register with the EPD and treat their wastes, either utilising on-site plant licensed by the EPD, or arranging for a licensed collector to take the wastes to a licensed facility. The regulation also prescribes the storage facilities to be provided on site, including labelling and warning signs, and requires the preparation of written procedures and training to deal with emergencies such as spillages, leakages or accidents arising from the storage of chemical wastes.

6.2.4 Construction and demolition materials which are wholly inert may be taken to public filling areas which usually form part of reclamation schemes. The *Crown Land Ordinance* requires that dumping licences are obtained by individuals or companies who deliver inert construction and demolition materials to public filling areas. The licences are issued by the Civil Engineering Department (CED) under delegated powers from the Director of Lands.

6.2.5 The *Public Cleansing and Prevention of Nuisances By-Laws* controls illegal tipping of wastes on unauthorised (unlicensed) sites.

6.2.6 The following documents and guidelines also relate to waste management and disposal in Hong Kong SAR:

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

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

- New Disposal Arrangements for Construction Waste (1992), Environmental Protection Department and Civil Engineering Department;

- Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (1992), Environmental Protection Department;

- Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste, Environmental Protection Department;

- Works Branch Technical Circular No 2/93, Public Dumps;

- Work Bureau Technical Circular No. 5/98, On Site Sorting of Construction Waste on Demolition Sites;

- Works Branch Technical Circular No 16/96, Wet Soil in Public Dumps;

- Environmental Protection Department Technical Circular No. 1-1-92, Classification of Dredged Sediments for Marine Disposal; and

- Technical Circular No. 22/92, Marine Disposal of Dredged Mud, Works Branch.

6.3 Construction Waste Impacts

Potential Sources of Impact

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

- dredged material;
- excavated material;
- construction and demolition waste;
- chemical waste; and
- general refuse

6.3.2 The nature of each of these waste types arising from the construction of the PSKDA are identified below.

Dredged Material

6.3.3 The potential environmental impacts caused from the construction of the proposed reclamation through public filling activities have already been assessed in the previously endorsed PSKRPD EIA. The additional reclamation works required for the PSKDA involve small reclamation requirements for the Northern and Southern Access Roads as shown in *Figure 5.4d*. A review of the previous PSKRPD EIA indicates that any material dredged during reclamation activities is likely to be contaminated and will thus need to be appropriately handled and disposed of at a specified disposal site.

6.3.4 Dredged material will be generated during the formation of reclamation or seawall where this material needs to be removed. Dredged material is classified according to the level of contamination under the *EPD Technical Circular (EPDTC) No. 1-1-92, Classification of Dredged Sediments for Marine Disposal* and needs to be disposed of according to the level of contamination. However, the quantities and level of contamination are not available and will be determined as part of the Site Investigation works to be undertaken in a separate study.

6.3.5 Marine disposal of dredged materials is controlled under the *Dumping at Sea Ordinance 1995*, which has recently replaced the *Dumping at Sea Act 1974 (Overseas Territories) Order 1975 (App. III, p.DK1)* in its application to Hong Kong.

6.3.6 Dredged sediments destined for marine disposal are classified according to their level of contamination by seven toxic metals as stipulated in the *EPDTC No. 1-1-92, Classification of Dredged Sediments for Marine Disposal*. The seven criteria metals are cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn). The contamination levels presented in the *EPDTC 1-1-92* serve as criteria for determining the disposal requirements of marine dredged sediments. Definition of the classification is as follows:

Class A- Uncontaminated material, for which no special dredging, transport or disposal methods are required beyond those which would normally be applied for the purpose of ensuring compliance with EPD's Water Quality Objectives (WQO), or for protection of sensitive receptors near the dredging or disposal areas.

Class B- Moderately contaminated material, which requires special care during dredging and transport, and which must be disposed of in a manner which minimizes the loss of pollutants either into solution or by resuspension.

Class C- Seriously contaminated material, which must be dredged and transported with great care, which cannot be dumped in the gazetted marine disposal grounds and which must be effectively isolated from the environment upon final disposal.

6.3.7 It should be noted that for sediments to be identified within a particular class, the concentration of only one metallic species needs to be exceeded. In the case of both Class B and Class C contamination, the final determination of appropriate disposal options, routing and the allocation of a permit to dispose of material at the designated disposal site will be made by the EPD and Fill Management Committee (FMC) in accordance with *WBTC 22/92* and *6/92*.

6.3.8 EPD's criteria for the classification of dredged sediments destined for marine disposal are shown below in *Table 6.3a*. Permits from the EPD are required for marine disposal of such materials.

Table 6.3a Classification of Sediments by Metal Content (mg.kg dry weight^{-1})

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Class A	0.0-0.9	0-49	0-54	0.0-0.7	0-34	0-64	0-149
Class B	1.0-1.4	50-79	55-64	0.8-0.9	35-39	65-74	150-199
Class C	1.5 or more	80 or more	65 or more	1.0 or more	40 or more	75 or more	200 or more

6.3.9 It should be noted that Appendix 1 Item (c) of *WBTC 22/92* stipulates that the concentrations of organic pollutants such as polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and tributyl tin (TBT) should also be tested, if suspected to be present. However, EPD has no specified criteria for any of these parameters.

Excavated Material

6.3.10 Any excavated materials other than marine sediments are expected to be disposed of at land-based disposal sites, but the final location of deposition will be based on a number of factors, including material type, moisture content, reuse potential, and contamination levels.

6.3.11 Materials excavated from the PSKDA works will be reused for the reclamation of the Northern and Southern Access Road. Since the public filling materials used for the PSK reclamation comply with the public dumping licence impacts associated with filling operations will be limited to those associated with the release of suspended solids into the water column.

6.3.12 Excavated material may also be generated from the construction of slip roads which may require excavation of slopes.

Construction and Demolition Waste

6.3.13 Construction waste comprises unwanted materials generated during construction, including rejected structures and materials, materials which have been over ordered or are surplus to requirements, and materials which have been used and discarded. Construction waste will arise from the construction and maintenance activities carried out by the Contractor and may include:

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

6.3.14 The volume of construction waste generated by the PSKDA construction will be dependent on the operating procedure and site practices. At this stage, it is not possible to predict accurately the amount of construction waste that will be generated.

6.3.15 The handling and disposal of any bentonite slurry used for construction works should comply with the requirements of *Pro PECC PN 1/94 - Construction Site Drainage*.

6.3.16 At the completion of works, temporary noise barriers or enclosures erected to reduce noise emanating from construction activities will be dismantled, producing a small amount of additional construction waste.

6.3.17 Demolition waste will be generated from the demolition of roads and buildings. The demolition waste arisings are likely to be restricted to demolition of the existing CUHK roads and reprovisioning of the MSL and the Pak Shek Kok Ferry Pier along the Southern Access Road where it connects with the existing road network at Ma Liu Shiu. The volumes of demolition wastes are therefore expected to be low.

Chemical Waste

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

- scrap batteries or spent acid/alkali from their maintenance;
- used engine oils, hydraulic fluids and waste fuel;
- shutter release agents (chemical/oil based emulsions);
- spent mineral oils/cleaning fluids from mechanical machinery; and
- spent solvents/solutions, some of which may be halogenated, from equipment cleaning activities.

6.3.19 Estimates from previous studies(10) suggest that the monthly arisings at the construction site with similar nature of construction activities and scale of works will consist primarily of a few hundred litres of used lubricating oils and small quantities of waste batteries.

General Refuse

6.3.20 The presence of a construction site with large numbers of workers and site offices and canteens will result in the generation of a variety of general refuse materials requiring disposal. General refuse may include food wastes and packaging, waste paper and packaging from construction materials.

6.3.21 Estimates of general refuse generated for the PSKDA construction sites are dependent on the numbers of workers. Based on previous relevant projects(11), it is estimated that about 200-300 workers will work on the PSKDA at any one time and are expected to generate approximately 200 -300 kg of waste per day.

Prediction and Evaluation of Impacts

General

6.3.22 The nature of the waste arising from the construction of the PSKDA and the potential environmental impacts which may arise from their handling, storage, transport and disposal are discussed under the headings of each waste type below.

---

(10) Central Reclamation Phase III EIA, Territorial Development Department, 1997

(11) Kowloon Point Development Feasibility Study EIA, Territorial Development Department 1997.

Dredged Material

6.3.23 In addition to the reclamation formed by the public filling activities, additional reclamations will be required for the formation of the Northern and Southern Access Roads which are shown in *Figure 5.4d*. After review of the *Engineering Report (ET/12)* and further discussion with the engineering team, it is presently understood that the reclamation for the Southern Access Road will need to dredge approximately 250,000 m^3 of marine mud, while the reclamation for the Northern Access Road is expected to minimal.

6.3.24 The quality of marine mud to be dredged for reclamation of the Southern Access Road will be determined as part of this Site Investigation works and will not be available for this Study. However, results from the previous PSKRPD EIA, suggest that the top 2 m of the marine mud is likely to be seriously contaminated (Type C) and will therefore require special handling and disposal at the East Sha Chau Contaminated Mud Pits. A summary of the volumes of dredged and fill materials for the reclamation of the Southern Access Road is given in *Table 6.4a.*

Table 6.4a Volumes of Material for the Southern Access Road Reclamation

Type of Material	**Volume**
Dredged Material*	250,000
Sand Fill#	340,000
Public Fill⊕	180,000

* to be disposed off-site # to be imported ⊕ Recycled from excavated material

6.3.25 It is presently understood that the reclamation for the Southern Access Road will require approximately 250,000 m^3 of material to be dredged. Within the dredged material, 40% (by volume) (i.e. 105,000 m^3) will be disposed within the reclamation footprint (ie: on-site), and 60% (140,000 m^3) will be disposed off-site. The method of disposal will depend on the heavy metal concentration found in the site investigation.

Excavated Materials

6.3.26 Excavated material will be generated from site formation or servicing works for the PSKDA. Due to the nature of the work, the majority of the excavated materials can be reused on-site for the construction of access roads. It is estimated that approximately 116,000 m^3 of excavated material could be reused for the Southern Access Road reclamation.

Construction and Demolition Waste

6.3.27 Construction and demolition wastes are expected to be generated from the demolition of the CUHK facilities and Pak Shek Kok Public Pier during the construction of the Southern Access Road and associated works.

6.3.28 The existing Pak Shek Kok Public Pier includes a canopy, bollards, timber fending, landing steps, lights and handrails. The depth alongside is unlikely to be much greater than -4 mPD with an overall length of around 40 m, generating around 200 m^3 of construction and demolition waste.

6.3.29 The existing CUHK facilities that will be reprovided, consist of the Marine Science Laboratory, Water Sports Centre, refuse compound and the access road. It has been estimated that the reprovisioning of these facilities will generate approximately 2,000 m^3 of construction and demolition waste.

6.3.30 The existing CUHK road that will be replaced by the Southern Access Road, generating approximately 600 m^3 of construction and demolition waste.

6.3.31 The storage, handling, transport and disposal of construction and demolition wastes have the potential to create visual, water, dust and associated traffic impacts.

6.3.32 The impacts associated with demolition wastes may be higher than construction wastes due to the following reasons:

- segregation and recycling of materials; and
- short-term impacts from construction and demolition wastes may arise from on-site handling of materials which may be dry/dusty, giving rise to possible air quality impacts.

6.3.33 To conserve void space at landfill sites, construction waste must not be disposed of at a landfill site if it contains more than 20% inert material by volume. It is therefore good practice to segregate wastes at construction sites before disposing of inert materials at public filling areas for reclamation works and putrescible materials at a controlled landfill site. Wherever, practical, the production of construction wastes should be avoided by the careful control of ordering procedures which can result in surplus materials. The avoidance of over ordering and the segregation of materials will minimise waste arisings requiring landfill disposal. It will also assist in minimising costs should landfill charges be introduced.

6.3.34 Construction and demolition wastes currently account for approximately 35% of the annual consumption of limited landfill void available in Hong Kong (although this proportion has varied widely over recent years). Therefore, it is important to minimise, wherever possible, the wastes being delivered to landfill.

Chemical Waste

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

- toxic effects to workers;
- adverse effects on air, water and land from spills;

- fire hazards; and
- disruption to sewage treatment works due to damage to the sewage biological treatment systems if waste is allowed to enter the sewage system.

6.3.36 Chemical wastes will arise principally as a result of maintenance activities. It is difficult to quantify the amount of chemical waste which will arise from the construction activities since it will be highly dependent on the Contractor's on-site maintenance intentions and the numbers of plant and vehicles utilised. However, it is anticipated that volumes will be relatively small.

General Refuse

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

6.3.38 The environmental impacts from the various waste types are summarised in *Table 6.4.a*

Table 6.4.a Summary of Waste Management Impacts

Waste Type	**General Evaluation**
Dredged Material	It is anticipated that approximately 290,000 m^3 of Marine mud will need to be dredged for reclamation of the Southern Access Road. The quality and quantities involved will need to be confirmed as part of the Site Investigation Works
Excavated Materials	Approximately 116,000 m^3 of public filling material will be excavated and reused as fill for the Southern Access Road Reclamation. Excavated materials may also be generated from the excavation of slopes, however, the quantity is likely to be low.
Construction and Demolition Waste	The quantities of demolition wastes which Ma Liu Shui will be generated from the reprovisioning of CUHK facilities and Public Piers are estimated to be approximately 2,800 m^3 and thus likely to be very small. Impacts will be reduced further if waste minimisation and reuse/recycling is practical.
Chemical Waste	A small volume of chemical waste, such as used lubricating oils from plant maintenance materials, may be produced. Storage, handling, transport and disposal must be in accordance with the *Code of Practice on the Packaging, Handling and Storage of Chemical Wastes.* Provided that this occurs, and chemical wastes are disposed of at a licensed facility, the contractor should be in compliance with all relevant regulations and there will be little environmental impact.
General Refuse	It is estimated that approximately 200-300 kg of general refuse will be generated daily. If good practice is adhered to and all feasible avoidance, reuse and recycling opportunities are taken, there should be minimal impact.

6.4 Mitigation Measures

Introduction

6.4.1 The proposed re-use, recycling, storage, collection, transport and disposal methods for various wastes which are recommended to avoid or minimise potential adverse impacts of the PSKDA are detailed below. Specifically, it is recommended that during the construction phase the Contractor incorporate the recommendations into an on-site waste management plan.

Waste Management Hierarchy

6.4.2 The various waste management options can be categorised in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long term context. Hence, the hierarchy is as follows:

- Avoidance and minimisation, ie not generating waste through changing or improving practices and design;
- Re-use of materials, thus avoiding disposal (generally with only limited reprocessing);
- Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and
- Treatment and disposal, according to relevant laws, guidelines and good practice.

6.4.3 The contractor should consult the Waste Disposal Authority on the final disposal of wastes.

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

6.4.5 Training and instruction of construction staff should be given at the site to increase awareness and draw attention to waste management issues and the need to minimise waste generation. The training requirements should be included in the site waste management plan.

Storage, Collection and Transport of Waste

6.4.6 Permitted waste hauliers should be used to collect and transport the wastes to the appropriate disposal points. The following measures to minimise adverse impacts including windblown litter and dust from the transportation of these waste should be instigated.

- Handle and store wastes in a manner which ensures that they are held securely without loss or leakage, thereby minimising the potential for pollution;
- Use waste hauliers authorised or licensed to collect the specific category of waste;
- Remove wastes in a timely manner;
- Maintain and clean the waste storage areas regularly;
- Minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;
- Obtain the necessary waste disposal permits from the appropriate authorities, if they are required, in accordance with the *Waste Disposal Ordinance)(Cap 354)*, *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)*, the *Crown Land Ordinance (Cap 28)*, *Dumping At Sea Ordinance (Cap 466)* and *Works Branch Technical Circular No. 22/92, Marine Disposal of Dredged Mud*;
- Dispose of waste at licensed sites;
- Develop procedures such as a ticketing system to facilitate tracking of loads, particularly for chemical waste, and to ensure that illegal disposal of wastes does not occur; and
- Maintain records of the quantities of wastes generated, recycled and disposed.

Dredged Material

6.4.7 The volume of material dredged should be minimised by limiting dredging during reclamation to seawall formation. Other no dredge options could also be investigated, subject to engineering feasibility. Suitable mitigation measures for handling of dredged material are dealt with, in *Section 5*.

Excavated Materials

6.4.8 Excavated materials are not considered likely to cause adverse impacts with respect to their disposal, since they will be reused on-site at the PSK Reclamation.

Construction and Demolition Waste

6.4.9 The likely generation rates of construction and demolition wastes from the CUHK facilities and Pak Shek Kok Public Pier is estimated to be approximately 2,800 m^3. In order to minimise waste arisings the mitigation measures described below should be adopted.

6.4.10 Careful design, planning and good site management can minimise over ordering and generation of waste materials such as concrete, mortars and cement grouts. If feasible, the temporary noise barrier or enclosures should be designed in such a way that they could be reused, after they have been dismantled and removed, thereby not generating construction waste. The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing should be considered to increase the potential for reuse.

6.4.11 The Contractor should recycle as much as possible of the construction waste on-site or the nearby Pak Shek Kok Public Filling Area. Proper segregation of wastes on site will increase the feasibility that certain components of the waste stream can be recycled specialised contractors. Concrete and masonry, for example can be crushed and used as fill and steel reinforcing bar can be used by scrap steel mills. Different areas of the work sites can be designated for such segregation and storage depending on site specific conditions.

6.4.12 The handling and disposal of bentonite slurries should follow the *Practice Note For Professional Persons, Construction Site Drainage, Professional Persons Consultative Committee, 1994 (ProPECC PN 1/94)*.

6.4.13 In accordance with the *New Disposal Arrangements for Construction Waste, Environmental Protection Department and Civil Engineering Department, 1992*, disposal of construction waste can either be at a specified landfill, or at a public filling area, with the latter being the preferred option. Inert material should be directed to the Pak Shek Kok Public Filling Area, where they have the added benefit of offsetting the need for removal of materials from terrestrial borrow areas for reclamation purposes. If landfill disposal has to be used, the wastes will most likely be delivered to the NENT Landfill.

6.4.14 At present, Government is developing a charging policy for the disposal of waste to landfill. When it is implemented, this will provide additional incentive to reduce the volume of waste generated and to ensure proper segregation to allow free disposal of inert material to public filling areas.

Chemical Waste

6.4.15 For those processes which generate chemical waste, it may be possible to find alternatives which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.

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

Containers used for the storage of chemical wastes should:

- be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- have a capacity of less than 450 l unless the specifications have been approved by the EPD; and
- display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

The storage area for chemical wastes should:

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

Disposal of chemical waste should:

- be via a licensed waste collector; and
- be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers; or
- be to a reuser of the waste, under approval from the EPD.

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

General Refuse

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

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

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

Summary

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

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

- dredged material for disposal at marine disposal sites;
- excavated material (inert) suitable for reclamation or fill;
- construction material for reuse at the Pak Shek Kok Public Filling Area;
- construction and demolition waste (non inert) for landfill;
- chemical waste; and
- general refuse.

6.4.22 The criteria for sorting solid waste is described in *New Disposal Arrangements for Construction Waste*. Waste containing in excess of 20% by volume of inerts should be segregated from waste with a larger proportion of putrescible material.

6.4.23 Proper storage and site practices will minimise the damage or contamination of construction materials. On site measures may be implemented which promote the proper disposal of wastes off-site. For example having separate skips for inert (rubble, sand, stone, etc) and non-inert (wood, organics, etc) wastes would help to ensure that the former are taken to the Pak Shek Kok Public Filling Area, while the latter are properly disposed of at controlled landfills. Since waste brought to public filling areas will not attract a charge, while that taken to landfill may attract some future charge, separating waste may also help to reduce waste disposal costs, should landfill charging be introduced. Specifically, it is recommended that:

- wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimising the potential for pollution;
- only reputable waste collectors authorised to collect the specific category of waste concerned should be employed;
- removal of demolition wastes should be arranged to coincide with the demolition work;
- appropriate measures should be employed to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers;
- the necessary waste disposal permits should be obtained from the appropriate authorities, if they are required, in accordance with the *Waste Disposal Ordinance (Cap 354), Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)* and the *Crown Land Ordinance (Cap 28)*;
- collection of general refuse should be carried out frequently, preferably daily;
- waste should only be disposed of at licensed sites and site staff and the civil engineering Contractor should develop procedures to ensure that illegal disposal of wastes does not occur;
- waste storage areas should be well maintained and cleaned regularly; and
- records should be maintained of the quantities of wastes generated, recycled and disposed (determined by weighing each load or by another method).

6.4.24 Training and instruction of construction staff should be given at the site to increase awareness and draw attention to waste management issues and the need to minimise waste generation. The training requirements should be included in the site waste management plan.

6.5 Construction Waste EM&A Requirements

6.5.1 It is recommended that auditing of each waste stream should be carried out periodically by the PSKDA contractor to determine if wastes are being managed in accordance with approved procedures and the site waste management plan. The audits should look at all aspects of waste management including waste generation, storage, recycling, treatment, transport, and disposal. An appropriate audit programme would be to undertake a first audit at the commencement of the construction works, and then to audit quarterly thereafter.

6.5.2 Any off site monitoring required at marine mud disposal sites will be presented in *Section 5.*

6.6 Operational Phase Assessment

Type and Nature of Solid Waste to be Generated

6.6.1 It is presently understood that the following developments proposed for the PSKDA in *Section 2.3* will comprise the Science Park, residential development, recreational uses and a potential KCR station, based on the RODP shown in *Figure 2.3a*. During the operational phase of the PSKDA, waste arisings will typically comprise general refuse, however, some construction and chemical waste may also be generated from renovation or modification works.

6.6.2 In addition the Science Park could also generate chemical waste. However, as the Science Park is likely to comprise IT related uses, biotechnical and advanced engineering type industries. Within these industries, the types of activities are likely to comprise research type activities with limited manufacturing and development. This will limit the potential environmental impacts generated by the Science Park. It should noted that the exact types and makeup of the Science Park will not be known until the detailed design stage. However, a summary of the types of potential activities involved in the Science Park is presented in *Annex A*. It is recommended that further review of the potential waste generated by the Science Park at the detailed design stage be undertaken to ensure that appropriate waste handling facilities are incorporated.

General Refuse

6.6.3 General refuse will be generated from the commercial and residential developments (hotel, residential apartments, offices, retail shops and the proposed recreational use), schools, and the Science Park. The general refuse is likely to be composed of food waste, wood, plastic, office wastes, paper, old tins/containers, cleaning materials and miscellaneous other wastes produced during daily activities.

Chemical Waste

6.6.4 Chemical wastes may be generated from the maintenance of plant and equipment within the buildings and facilities of the PSKDA including the Science Park. These may include waste oils and solvents, cleaning solutions and halogenated solutions from cleaning activities.

Quantities of Principal Waste Types to be Generated

6.6.5 Estimates of the quantities of the principal waste types generated during the operational phase will be based on information obtained from the Planning Study. The amount of waste arising from these sources is based on the RODP given in the *Planning Report (PL/10)*, staffing levels and facilities to be provided which will be further refined. An estimate of potential waste arisings, based on previously related EIA studies(12), along with population and employment estimates of the RODP is summarised in *Table 6.6a*. It should be noted that only general refuse can be estimated at this stage, as information on the types and mix of industry in the proposed Science Park is at present unknown.

Table 6.6a Potential Waste Arisings During Operational Phase

Development	**Estimated Population**	**Rate of waste generated per person (kg/day)**	**Total waste generated (tonne/day)**
Residential	12,000	1.2	14.4
Science Park	18,400	1.0	18.4
Recreational	na	1.0	-
Educational	na	1.0	-
Total	30,400		36.8

6.6.6 In accordance with the information presented in *Table 6.8a*, the estimated population of approximately 30,400 residents, workers, students and visitors per day will generate approximately 36.8 tonnes of general refuse per day.

Chemical Waste

6.6.7 Chemical wastes will be generated from the maintenance of plant and equipment within the buildings and facilities of the PSKDA. These may include, but need not be limited to the following:

- waste oils and solvents; and
- spent solvents/solutions, which may be halogenated, from equipment cleaning activities.

---

(12) Kowloon Point Development Feasibility Study EIA, Territorial Development Department 1997.

Evaluation of Impacts

6.6.8 The assessment of environmental impacts from waste generation is based on three factors:

- the type of waste to be generated;
- the amount of principal waste types to be generated; and
- the proposed recycling, storage, transport, treatment and disposal methods, and the impacts of these methods.

General Refuse

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

6.6.10 Contaminated water or liquor may arise if the waste is not properly stored in enclosed bins or if wastes are not entirely emptied during collections. The use of waste compaction units may also create liquor and, therefore, provisions should be made for its collection, storage and disposal.

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

Chemical Waste

6.6.12 Chemical waste, such as waste oils, may be generated from plant and equipment maintenance as well as activities within the Science Park. However, it is anticipated that the volume of chemical waste will be minimal due to the research type activities proposed for the Science Park.

6.6.13 It is considered that no unacceptable environmental impacts will occur provided that chemical wastes are handled in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation* and delivered to a facility licensed to receive chemical wastes.

Mitigation Measures

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

Waste Management Hierarchy

6.6.15 The waste management strategy for the PSKDA operation should follow the waste management hierarchy as discussed below.

- *Waste Avoidance and Minimisation* To mitigate the potential adverse impacts due to the generation of solid waste, waste reduction measures should be used where feasible, particularly if this will lead to reduced costs.

- *Recycling and Reuse* For the remaining solid waste, recyclable and reusable portions should be separated out where practical. Recyclable wastes (eg paper and aluminium cans) should be separated and stored until collected by a recycling contractor or individual collectors. Segregated materials should be stored in tidy, dry conditions to prevent intermingling and contamination of materials.

- *Treatment and Disposal* All wastes which cannot feasibly be recycled or reused, should be disposed of to landfill, or if chemical or other dangerous wastes, to the Chemical Waste Treatment Facility (CWTF), as follows:

- general refuse should be transported by a reputable private waste collector and disposed of at the NENT Landfill; and

- chemical waste as defined by *Schedule 1* of the *Waste Disposal (Chemical Waste) (General) Regulation*, should be stored in accordance with approved methods defined in the Regulations and the chemical waste, transported by a party licensed to transport chemical wastes by the EPD and disposed of at a facility licensed to receive chemical wastes by EPD.

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

General Refuse

6.6.17 Considerable scope exists to take waste reduction and management into account at the detailed design stage of the PSKDA, particularly at individual building and refuse collection points, by providing spaces or facilities for the segregation and storage of recyclable materials.

6.6.18 Public areas should be provided with bins and emptied frequently during each day, as necessary to prevent overspilling. The arisings of general refuse at the PSKDA may contain recyclable elements. Recycling bins for paper, bottles and aluminium cans may also be provided in public areas.

6.6.19 Waste collected from public areas should be taken to central refuse collection points. Hotels, retail areas and residential blocks should be provided with refuse collection points. Aluminium, paper and paperboard may be present in quantities large enough to warrant the provision of separate bins at the refuse collection points, the contents of which could be collected by, or sold to, recycling contractors. It may also be feasible to segregate organic materials, in particular food waste, for use as a composting medium. Organic materials have a high water content and may generate leachates and strong odours and therefore should be stored in sealed containers and collected daily.

6.6.20 Guidelines for the design of refuse collection points are given in the *HKPSG*. Drainage, storage and treatment facilities should be incorporated within the design of the refuse collection points for the collection of contaminated water and leachate arising from the compaction units.

6.6.21 General refuse from the PSKDA would most likely be taken directly to the NENT landfill by RSD or by private contractors.

Chemical Waste

6.6.22 Under the *Waste Disposal (Chemical Waste) (General) Regulation*, chemical waste producers should register with EPD. Chemical wastes should be transported by a registered chemical waste collector to a facility licensed to receive chemical wastes.

6.6.23 Chemical waste should be stored in safe and suitably resistant containers, labelled, and in an appropriate storage area, in accordance with the *Waste Disposal (Chemical Waste)(General) Regulation*, as discussed in *Section 6.4.5*. Enviropace, the operator of the CWTF, supplies approved containers for chemical waste which can be replaced with each collection.

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

6.7 Conclusions

Construction Phase

6.7.1 The general types of waste streams expected from the development have been described and reviewed above. Only preliminary information is presently available concerning the construction programming, processes and staffing which will be used to construct the development and therefore, only broad assessment can be undertaken at this stage. However given that the PSKDA is to be built on a newly reclaimed site, it is considered that only 2,800 m^3 of construction and demolition wastes will be generated and that any excess excavated material will primarily comprise previously filled materials and should therefore be suitable for re-use for later phase of the Pak Shek Kok Public Filling Area. It is considered also that construction, chemical and general refuse impacts should be no greater than for other developments of a similar scale and therefore, should be amenable to the standard mitigation measures described above.

6.7.2 The quality of marine mud to be dredged for reclamation of the Southern Access Road are presently not be available for this Study and will need to be determined as part of this Site Investigation works.

Operational Phase

6.7.3 It is presently understood that the various developments proposed for the PSKDA will include the Science Park, residential development, recreational uses and a potential KCR station, based on the Preferred Development Concept. An estimated 36.8 tonnes of potential waste will be generated by the PSKDA, based on the RODP. Mitigation measures and strategies to minimise waste have been assumed to be applicable as they have in the past to similar types of developments. There is no information to suggest that waste impacts during the operational phase will not be amenable to the standard forms of mitigation.

6.7.4 In addition the Science Park could also generate chemical waste. However, from the Science Park Study, the Science Park is likely to comprise IT related uses, biotechnical and advanced engineering type industries. Within these industries, the types of activities are likely to comprise research type activities with limited manufacturing and development. This will limit the potential environmental impacts generated by the Science Park. It is recommended that further review of the potential waste generated by the Science Park at the detailed design stage be undertaken to ensure that appropriate waste handling facilities are incorporated.

7 ECOLOGY

7.1 Introduction

7.1.1 This section presents the terrestrial and marine ecological impact assessment of the proposed Pak Shek Kok Development Area (PSKDA), with the aim to identify the potential constraints and assess the potential terrestrial and marine ecological impacts associated with the Project. The impacts to terrestrial and marine flora and fauna which may arise as a result of the proposed PSKDA will be assessed, based on information from previous studies and PSKDA Study additional confirmatory field surveys.

7.1.2 A review of existing terrestrial and marine ecological information for the PSKDA Study Area in Tolo Harbour has been conducted to collate information on the baseline ecological conditions in the Study Area. Terrestrial and marine ecological sensitive receivers have been identified, potential impacts discussed, and where appropriate, mitigation measures suggested.

7.1.3 The objectives of this impact assessment are as follows:

- to identify terrestrial and marine ecological sensitive receivers;
- to assess the scale of possible ecological impacts from the PSKDA; and
- to highlight unacceptable environmental impacts and propose practical and cost-effective mitigation measures to reduce impacts to acceptable levels.

7.1.4 This assessment of impacts has been performed in order to determine the ecological acceptability of the PSKDA.

Terrestrial Ecology

7.1.5 As the PSK Reclamation is presently under construction, the terrestrial ecological assessment has focused on the existing reclamation area for Tai Po Area 12 (part) and Area 39. Previous relevant studies for the Area 12 (part) and Area 39 and Tolo Highway have been undertaken and the ecological profile broadly described in the *Tai Po Development: Formation and Servicing of Area 12 (part) and Area 39* (TPDS) and Tolo Highway Widening Feasibility Study (THWFS) EIA, respectively. However, as a requirement of the Brief, a further review of the terrestrial ecological profile of the PSKDA Study Area has been undertaken as part of this assessment and supplemented through additional confirmatory field visits to update and field-check the terrestrial ecological conditions of the PSKDA Study Area, as well as to verify the validity of the information presented in the previous studies.

Marine Ecology

7.1.6 As no marine ecological or fisheries assessment has been undertaken for the PSK Reclamation in the previously endorsed PSKPDR EIA, this assessment has provided a supplementary assessment of the impacts that may arise as a result of the proposed PSK Reclamation.

7.2 Government Legislation and Standards

7.2.1 The criteria for evaluating both ecological and fisheries impacts are laid out in the Technical Memorandum on Environmental Impact Assessment Process (EIAO TM).

Terrestrial Ecology

7.2.2 There are a number of international and local regulations, legislation and guidelines which provide the framework for the protection of species and habitats of ecological importance, those related to the current project are:

- Forests and Countryside Ordinance (Cap 96), 1994;
- Wild Animals Protection Ordinance (Cap 170), 1994;
- Town Planning Ordinance (Cap 131);
- Hong Kong Planning Standards and Guidelines (Chapter 10);
- Technical Memorandum for Environmental Impact Assessment (EIA) Ordinance (Cap. 499); and
- United Nations Convention on Biodiversity, 1992.

7.2.3 The *Forests and Countryside Ordinance (Cap 96)* prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on government land. Related subsidiary Regulations prohibit the picking, felling or possession of listed rare and protected plant species. The list of protected species in Hong Kong which comes under the Forestry Regulations was last amended on 11 June 1993 under the Forestry (Amendment) Regulation 1993 made under section 3 of the *Forests and Countryside Ordinance (Cap 96).*

7.2.4 Under the *Wild Animals Protection Ordinance (Cap 170)*, designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals are protected under this Ordinance. The Second Schedule of the Ordinance which lists all the animals protected was last revised in June 1992.

7.2.5 The recently amended *Town Planning Ordinance* provides for the designation of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Green Belt or other specified uses that promote conservation or protection of the environment, e.g. conservation areas. The authority responsible for administering the Town Planning Ordinance is the Town Planning Board (Planning Department).

7.2.6 The new revised chapter 10 of the *Hong Kong Planning Standards and Guidelines (HKPSG)* covers "Conservation". This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also addresses the issue of enforcement. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.

7.2.7 EIAO TM Annex 16 sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. Annex 8 recommends the criteria that can be used for evaluating ecological impact.

7.2.8 PRC are Contracting Parties to the *United Nations Convention on Biological Diversity* of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. Hong Kong Government has stated that it will "committed to meeting the environmental objectives" of the Convention in 1996.

Marine Ecology

7.2.9 The criteria for evaluating both marine ecological and fisheries impacts are laid out in the EIAO TM which comprises part of the EIA Ordinance.

7.2.10 Annex 16 sets out the general approach and methodology for assessment of marine ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential marine ecological impacts. Annex 8 recommends the criteria that can be used for evaluating marine ecological impacts.

7.2.11 Annex 17 sets out the general approach and methodology for assessment of fisheries impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential fisheries impacts. Annex 9 recommends the criteria that can be used for evaluating fisheries impacts.

7.2.12 Other legislation which applies to marine species includes:

- The Wild Animals Protection Ordinance (Cap. 170) 1980 which protects all cetaceans; and
- The Fisheries Protection Ordinance (Cap. 171) 1987 which provides for the conservation of fish and other aquatic life and regulates fishing practices.

7.3 Terrestrial Ecology

Baseline Conditions

7.3.1 The proposed PSKDA is located in the North East New Territories (NENT), and includes the Tai Po Areas 12 (part) and Area 39, as well as the land to be acquired from the PSK Reclamation. Given that the PSK Reclamation is presently in operation and land not formed, this terrestrial ecological assessment has focused on the existing reclamation area for Tai Po Area 12 (part) and Area 39 (shown in *Figure 7.3a*) and its immediate vicinity area, including the cycle track along the seaward side of the Tolo Highway. The landward side of PSKDA is surrounded by village or residential areas and wooded hillslopes.

7.3.2 The proposed formation and servicing works in the *Tai Po Development: Formation and Servicing of Area 12 (part) and Area 39* (TPDS) will result in the areas being filled from the current level of approximately +4.0 m PD to approximately +6.0 mPD and thus the proposed development for the PSKDA will be developed on top of this newly formed site. The PSKDA Study Area also includes a cycle track along the Tolo Highway which includes an area of vegetation and will be resumed as part of the Tolo Highway Widening project.

7.3.3 The ecological profile of these two areas have been broadly described in the previously endorsed EIAs for the TPDS EIA and *Tolo Highway Widening Feasibility Study (THWFS) EIA*. However, as a requirement of the Brief, a review of the terrestrial ecological profile of the Study Area has been undertaken and supplemented through recent field visits from May 1997 to March 1998 to update and field-check the terrestrial ecological conditions of the Study Area, as well as to verify the validity of the information presented in the previous studies. The Study Area was surveyed on foot by an experienced ecological team covering representative areas of each habitat type. Areas of potential interest identified in earlier field visits were subsequently surveyed in more details.

7.3.4 Since the previous TPDS EIA study mainly focused on the ecological status of the village and woodland areas in the surrounding with only a brief description of the Area 12 (part) and Area 39 reclaimed areas, further ecological information of the Area 12 (part) and 39 reclaimed area were collected from field visits undertaken between May 1997 to March 1998. The findings of these field visits were undertaken as part of this Study and are presented below.

7.3.5 As Tai Po Kau Nature Reserve (TPKNR) and Tai Po egretry are located over 300 m from the Study Area, it was considered that no direct impacts would occur to the reserve and egretry, but indirect impacts may result and have been evaluated in the following sections.

Habitat/Vegetation

7.3.6 As shown in *Figure 7.3a*, the proposed PSKDA Study Area for terrestrial ecology is mainly bounded by the Tolo Highway to the east and the old KCR railway to the west. The area which comprises Area 12 (part) and Area 39 has been formed to a level of approximately +4 m PD as part of the previous reclamation project during construction of the Tolo Highway in 1985. The Tai Po Area 12 (part) and Area 39 are divided by a tidal channel flowing from west of Cheung Shue Tan and leading directly into the Tolo Harbour on the western side of Tsiu Hang.

7.3.7 Terrestrial habitats are absent along the cycle track of the Tolo Highway, with most of the vegetation planted for landscaping purposes. Other habitats that were identified during site visits between May 1997 to March 1998 included wasteland, orchard, abandoned agricultural field, fire-maintained grassland, woodland and drainage channel habitat, as shown in *Figure 7.3a*. A list of vegetation recorded during these site visits is shown in *Annex H*, which comprise plants typical to such habitat types in Hong Kong. A protected plant species *Pavetta hongkongensis* was found in the woodland along Yau King lane to the north of the PSKDA site during the previous TPDS EIA. A recent field visit by AFD in 1998 also found a few of the protected plants, *Spiranthes sinensis* and *Eulophia sinensis*, near the outlet of the tidal channel.

7.3.8 A brief description of each habitat type is provided below.

Wasteland

7.3.9 Open wasteland with patches of vegetation was the predominant habitat type occupying more than two thirds of the Study Area. These vegetation patches mainly comprised weedy plant species, with shrub *Sesbania cochinchinensis*, herbs *Wedelia chinensis* and *Pueraria lobata*, as well as the grass species *Miscanthus floridulus* and *Neyraudia arundinacea*, forming a habitat of simple floristic structure and poor in micro-habitat diversity. Dominant species were presumably absent because of the sparse coverage of the plant community, but the *Cyperus* spp. and *Sesbania cochinchinensis* were both presence in high abundance. Nonetheless, tree species such as *Casuarina equisetifolia* and *Hibiscus tiliaceus* were also found scattered in the habitat. According to the habitat characteristics identified during the site visits, the potential value for this habitat type to support rare or important animals was considered to be limited.

7.3.10 Scattered areas that are seasonally flooded during the wet season were identified within the Area 12 (part) and Area 39 among the shallow areas of the wasteland. These areas were not shown in the habitat map because of their seasonality and temporal changes in size and shape. They were open in nature comprising only approximately 20% vegetation coverage, and the maximum water depth ranged from 5 cm to 8 cm. Vegetation found during the wet season were mostly herbaceous in nature, such as the grass *Panicum repens* and the herbs *Utricularia spp.* and *Ludwigia adscendens*. Due to the transient nature of these seasonally flooded areas, mainly opportunistic species which could utilize such variable resources would be supported. These areas were observed to be heavily loaded with sediment and algal bloom during the dry season and no animal wildlife were recorded during field visits in February 1998.

Orchard/Agricultural Field

7.3.11 A large area comprising an abandoned orchard along with an abandoned agricultural field was located on the western portion of the existing reclamation area, covering a large portion of the Area 39 and the southern portion of Area 12 (part) directly seaward of Cheung Shue Tan Village (shown in *Figure 7.3a*). The orchard was mainly planted with *Musa paradisiaca* and *Clausena lansium* of various heights, and *Dimocarpus longan* and *Citrus maxima* which were also common on the edge of the reclamation area. Weedy herbaceous plants *Vernonia cinerea* and *Ageratum conyzoides* were the most dominant understorey vegetation beneath the orchard canopy. It is considered that this habitat is unlikely to be ecologically important in supporting animal wildlife, due to the low floristic and structural diversity

7.3.12 The abandoned agricultural field was densely covered by grassy species and dominated by *Digitatria cruciata* and *Colocasia esculens*. Several weedy species such as *Lantana camara* and *Mikania micrantha* were also found to be abundant. This habitat was flooded with water during site visits in the wet season of 1997, and the water surface was mostly covered with foam or oil that made the habitat unsuitable for support of any aquatic wildlife.

Woodland

7.3.13 There was a small area of woodland outside the PSKDA site to the north along the Tolo Highway, near Yau King lane. This woodland was secondary in nature with a mix of plantation and native species forming an extensive tree cover. The average height of the trees was about 8 to 10 m tall, *Lophostemon confertus, Acacia confusa, Sapium discolor* and *Schefflera octophylla* are the dominant species. The understorey of the woodland was species rich, with many tree saplings, as well as shade-tolerant scrub species, including *Psychotria rubra* and *Desmos cochinchinese*. Given the structural complexity and species diversity of this woodland habitat, it was considered that this woodland may provide a habitat to a range of wildlife.

7.3.14 Another small area of woodland was located along the seaward side of the Tolo Highway. However, this woodland area was a plantation woodland comprising exotic species including *Acacia confusa* and *Casuarina equisetalis*. Trees inside this small woodland area are quite dense with an average height of 6 to 8 m, forming a closed canopy. The sub-canopy of this plantation woodland was open and understorey growth was very poor. With respect to its origin, nature, size as well as the isolation and close proximity to Tolo Highway, it is considered unlikely that this plantation woodland could support any species of ecological importance.

Fire-maintained Grassland

7.3.15 A fire-maintained grassland was located on a slope behind the Study Area. This slope was covered mostly by *Dicranopteris linearis*, a usual indicator of the presence of fire for hillsides in Hong Kong and indicated that the area has suffered from frequent hill-fires in the past. This habitat type was simple in structure and poor in floristic diversity, and all species observed were common and wide-spread in Hong Kong.

Drainage Channel Habitat

7.3.16 There are several engineered drainage channels that flow through Areas 12 (part) and 39 and divert the fresh water from the uphill region to the main tidal channel before entering into Tolo Harbour. These channels which were constructed as part of the previous reclamation project were mostly lined with concrete surface and were muddy in nature because of the soil erosion over the bare reclaimed surface plus siltation from the uphill construction activities. No wildlife is expected to be supported in this habitat. However, upper sections of some of the channels were only lined with pebble and stones with clearer water and a population of Chinese Mitten Crab supported.

7.3.17 The main tidal channel was completely lined with concrete and ecological resources were found to be absent, except for some brackish water fish and the mollusc *Clithon faba*. The muddy bottom of the channel near the opening to the Tolo Harbour may provide a feeding ground for shore birds. Little Egrets were observed resting and wading along the edge of the channel during all site visits from May 1997 to March 1998.

7.3.18 It is believed that any freshwater inhabitants of the channel would have been flushed into the Tolo Harbour during peak flows, when large volumes of water drain from the uphill regions into the channel after heavy rains. Hence, the overall importance of the channel to wildlife is not considered to be significant because of the intermittent nature of the channels, as well as a lack of riparian cover on the channel side.

Fauna/Animal Wildlife

7.3.19 As discussed in the previous section, most of the ecological habitats found within Areas 12 (part) and 39 were established on bare reclaimed land formed in 1985, or which have been disturbed by previous activities and hence wildlife that can be supported in the Study Area is therefore considered to be limited.

Mammals

7.3.20 Regarding the mammal fauna, no mammals or signs of mammal existence were observed or noted (such as trails or burrows) during the site visits. Although sightings of several medium-sized mammals were reported from the residents of the surrounding village, such as civet, leopard cat, they are unlikely to be present within Areas 12 (part) and 39 as suitable hosting or feeding habitats for these animals are absent.

Avifauna

7.3.21 Only a few common and widespread bird species were observed during the recent site visits, such as Sandpipers, Chinese Bulbuls, Spotted Doves, Great Egrets and Little Egrets. According to the previous TPDS EIA study, 48 species of bird were recorded in the surroundings of the Study Area for that study with most of these species identified as common hillside and shore species.

7.3.22 The THWFS EIA also studied the avifauna along the coastline in between the Island House and Tai Hang Bridge in Summer 1996. Given the similar nature of the environment along the Tolo Highway, as well as the mobility of avifauna, similar assemblage of bird is expected to be found on the coastline within the Study Area. The survey result indicated that 6 species of bird were found along the coastline of the Tolo Highway, including 4 arheids species (Little and Great Egrets, Night and Chinese Pond Herons), Grey-tailed Tattler, and Crested Mynah. The Little Egret was observed to be the most abundant bird species.

7.3.23 It is believed that the poor habitat quality within the Areas 12 (part) and 39 provide no suitable habitat for woodland and scrubland birds. The small mud-flats exposed during low tide along the Tolo Harbour and Tidal Channel, and the flooded areas in the wet season, may provide feeding habitat to certain shore birds, in particular the Little Egret, as more than 30 individuals of this species were observed perching on such habitats during recent site visits.

7.3.24 Field observations of the flight path of the arheids within the Study Area suggested that they are either flew from Centre Island or Tai Po egretry and Little Egret, Great Egret and Chinese Pond Heron were seen taking live fish 4-6 cm long from the open water in the site visit made in March 1998.

7.3.25 The supplementary report of the TPDS Areas 12 (part) and 39 EIA reported that the resident shorebird Little Ringed Plover, "common" in the Deep Bay area and "regular" elsewhere in Hong Kong, shows preference for sandy reclamation areas in breeding but appears to adapt successfully to shifting breeding sites. The report concluded that the potential impact on the bird species due to loss of the reclamation site in TPDS was not a concern as sandy reclamation sites were not rare in Hong Kong and replacement habitat would be available elsewhere in Hong Kong. No sign of the bird was recorded in the recent field visits for PSKDA.

Reptile and Amphibian

7.3.26 Except for the Red-eared Terrapin observed in one of the muddy drainage channel during the summer site visit in May 1997, no other reptiles were recorded within the Study Area boundary. This Red-eared Terrapin is an exotic species and believed to be washed down to the channel from the upper stream, as suitable habitat for this animal is absent within the Areas 12 (part) and 39.

7.3.27 There was one amphibian adult sighting during the site visits in summer. A Two-strait Grass Frog was sighted in the upper part of one of the drainage channel with pebble stone stream bed (see *Figure 7.3a*). According to Lau (local herpetologist, pers. comm.), this species is a locally rare marsh species found near clean streams and wet grassy areas. There were several tadpoles of unknown amphibian species in the flooded areas of the wasteland. The identity of these tadpoles could not be confirmed as none could be found during further field visits.

7.4 Ecological Importance

7.4.1 Based on the field surveys and discussions presented above, the current ecological assessment shows that the terrestrial ecological resources present within the PSKDA boundary are considered of poor quality, with low flora diversity and poor structural complexity and hence provide limited micro-habitat to support a high faunal diversity. All species found within the site boundary during the field visits are either common or wide-spread in Hong Kong. The low ecological importance of the PSKDA site is determined based on the following considerations, in accordance with the EIAO TM Annex 8 Table 2 criteria:

- *Naturalness:* Habitats not natural as either man-made areas or areas subject to extensive human disturbance.
- *Size:* approximate habitat loss: wasteland 19 ha, orchard/agricultural field 4 ha, and 2000m drainage channel.
- *Diversity:* Low flora and fauna diversity.
- *Rarity:* No rare habitats nor species found.
- *Re-creatability:* These artificial habitats could be readily re-created.
- *Fragmentation:* The pre-dominant wasteland habitat generally not fragmented.
- *Ecological Linkage:* The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
- *Potential Value:* Low potential as significant management efforts or long natural processes would be required for the site to become an area with conservation interest.
- *Nursery/breeding Ground:* No records of significant nursery/breeding ground found in this study.
- *Age:* Very young artificial habitats.
- *Abundance/Richness of Wildlife:* Low wildlife richness and abundance.

7.4.2 However, based on the EIAO TM Annex 8 Table 3, the two plant species *Spiranthes sinensis* and *Eulophia sinensis* that were found near the tidal channel outlet within the PSKDA boundary, although not rare nor have restricted distribution in Hong Kong, are considered important as they are protected species. The Two-straited Grass Frog is considered an important species as it is rare with restricted distribution, although without protection status in Hong Kong.

7.5 Impact Assessment

7.5.1 As stated in the previous section, no terrestrial ecological impact is expected to be directly attributable to the PSKDA, as all of the existing terrestrial ecological resources present within Areas 12 (part) and 39 will be lost primarily due to Tolo Highway Widening project and the site formation and servicing works undertaken as part of the Tai Po Development: Area 12 (part) and Area 39. The impact assessment on the terrestrial ecological resources within these areas has already been assessed in the previously endorsed EIAs conducted for the TPDS and THWFS. The findings of the previous studies have been reviewed, further updated and the supplementary impact assessment presented below, based on the existing baseline conditions. The impact assessment is based on the current PSKDA engineering and planning information to identify potential landtake requirements in relation to direct habitat loss.

Potential Sources Of Impact

7.5.2 The potential sources of impact in association with the PSKDA project include:

- There will be direct habitat loss of the habitats including wasteland, orchard/agricultural field and drainage channel habitat (see *Figure 7.3a)* from land resumption for the Tolo Highway Widening and site formation for Area 12 (part) and Area 39 for PSKDA;
- There may be indirect impact to the habitats surrounding the PSKDA such as the woodland area to the north of the PSKDA due to increased human activities and trampling of vegetation associated with the PSKDA, if uncontrolled; and
- There may be potential direct or indirect impact to the wildlife inhabiting the areas.

Impact Evaluation

7.5.3 From the review of the previously endorsed TPDS and THWFS EIA Studies, as well as supplementary site visits undertaken from May 1997 to March 1998 as part of the PSKDA Study, it is considered that ecological impacts resulting from direct habitat loss of the identified areas within the Areas 12 (part) and 39 were considered to be limited. The area is considered to be of limited value as the area has only been reclaimed since 1985 and comprises habitats of generally poor ecological quality.

7.5.4 The potential indirect impacts on habitat areas surrounding the PSKDA, resulting from increased human activities and possible disturbance will depend on the scale of the disturbance and the type of habitat affected. The area surrounding the PSKDA was considered to be generally poor. The woodland area located to the north of the PSKDA near Yau King Lane or the upper stream areas, located outside the PSKDA, may be of some ecological value. However potential indirect impacts attributable to the PSKDA is considered to be limited, if appropriate construction practice as recommended in *Section 7.10.2* is implemented.

7.5.5 The potential impact to the wildlife found in or around the Study Area was also considered to be insignificant due to the commoners of the species found, as well as the poor species diversity found within the Areas 12 (part) & Area 39. The only exception may be the potential impact to the common shore birds and the Two-straits Grass Frog (one sighting) which may utilise the flooded areas of the wasteland in the wet season. However similar resources that are relatively more permanent than the transient reclaimed land can be found in the area surrounding PSKDA that perform similar functions to the identified seasonally flooded areas, such as the pond further north of Tolo Highway; the marshes located in the upper-stream area outside the PSKDA boundary; and the flooded abandoned agricultural fields in the Cheung Shue Tan and Tsiu Hang village areas along the old KCR line. It is therefore considered that the loss of this ecological resources in Area 12 (part) and 39 in relation to PSK development, as a result of the formation and servicing works is not significant.

7.5.6 Given the long distance (over 300 m) between the TPKNR and the development area, it is considered that potential indirect impacts would be minimal.

7.5.7 The potential impact to the ardeids arising from the PSKDA due to the loss of feeding habitat along the shore of the section of the existing Tolo Highway within the PSKDA was considered to be negligible, as this potential habitat type loss will only be short-term and will be replaced by the new longer coastline formed by the PSK Reclamation. A comparison of the loss of the mudflat and seasonally flooded areas within Areas 12 (part) and 39 is considered to be insignificant compared with the loss of similar habitats from the THW project. The findings of the THW EIA has stated that the impacts attributable to the THW will only be short-term and will gradually diminish in importance after new invertebrate communities are established along the restored shoreline.

7.5.8 Following the discussion above, the ecological impact associated with the PSKDA development on top of the reclaimed land is considered low. An evaluation of the impact in accordance with the EIAO TM Annex 8 Table 1 is presented as follows:

- *Habitat Quality*: Low quality artificial habitats.
- *Species:* Generally no species of conservation interest present, except the few individuals of the two protected plant species *Spiranthes sinensis* and *Eulophia sinensis*, and possibly the Two-straits Grass Frog that originated from the surrounding marshy habitats.
- *Size/Abundance:* The wasteland area is large but has limited ecological value.
- *Duration:* PSK development over the transient reclaimed area will be long term.
- *Reversibility:* Impacts permanent and irreversible.
- *Magnitude:* Developed into more urban environment.

The few individual plants of the two protected plant species will need to be protected as recommended in *Section 7.10.2*.

7.5.9 As the PSKDA will basically be developed on top of the present reclaimed land, any incremental impacts are not expected.

7.6 Marine Ecology

Baseline Conditions

7.6.1 The following description of the baseline for marine ecology in the PSKDA will be separated into five main components, commercial fishing operations, fisheries resources, intertidal habitat, subtidal habitat and marine mammals.

Fishing Operations

7.6.2 The PSKDA Study Area is surrounded by 7 fishery zones (AFD 1989-91 Port Survey) these are: 0133 - Tolo Channel North, 0134 - East Yim Tin Tsai, 0135 - Yim Tin Tsai West, 0136 - Chinese University, 0137 - Ma On Shan, 0138 - Yung Shue Au, 0139 - Lai Chi Chong. Catches reported by fishermen (during the AFD 1996-7 Fisheries Resources & Fishing Operations in Hong Kong Waters Study, ERM 1998) from these fishery zones indicate that some of the zones are ranked quite high in comparison with other areas in Hong Kong (*Table 7.6a*). These zones, however, are not close to the PSKDA Study Area. The Chinese University zone is the closest to the Study Area and although it has quite a high ranking in terms of catch weight per hectare, the ranking for catch value is very low in comparison with other zones in Hong Kong.

Table 7.6a Fisheries Production in terms of Adult Weight, Fry Abundance & Value from the Tolo Harbour and Tolo Channel Area. Rankings are relative to other fishery zones in Hong Kong.

Zone	Name	Total	Per Hectare	Rank (ha^{-1})
Adult Weight (kg)				
0133	Tolo Channel North	893,731	877.71	4 out of 179
0134	East Yim Tin Tsai	111,603	138.53	74 out of 179
0135	Tim Tin Tsai West	112,985	163.83	60 out of 179
0136	Chinese University	106,222	251.97	35 out of 179
0137	Ma On Shan	108,782	184.03	52 out of 179
0138	Yung Shue Au	829,862	1,981.20	1 out of 179
0139	Lai Chi Chong	904,046	873.05	5 out of 179
Catch Value ($)				
0133	Tolo Channel North	6,070,398	5,961.58	40 out of 179
0134	East Yim Tin Tsai	1,550,020	1,924.02	108 out of 179
0135	Tim Tin Tsai West	709,226	1,028.39	136 out of 179
0136	Chinese University	355,383	842.99	146 out of 179
0137	Ma On Shan	460,239	778.59	150 out of 179
0138	Yung Shue Au	6,286,186	15,007.5	5 out of 179
0139	Lai Chi Chong	5,852,398	5,999.37	39 out of 179
Fry Capture (Tails)				
0133	Tolo Channel North	36,377	35.72	56 out of 89
0134	East Yim Tin Tsai	0	0	none
0135	Tim Tin Tsai West	1,759	2.55	87 out of 89
0136	Chinese University	1,759	4.17	84 out of 89
0137	Ma On Shan	0	0	none
0138	Yung Shue Au	529,886	1,265.04	4 out of 89
0139	Lai Chi Chong	39,969	38.60	52 out of 89

7.6.3 The catches in all of these zones were derived mainly from night operating bright light purse seine vessels. As a consequence of this, the catches were composed of low-value pelagic species (*Table 7.6b*). The dominant group was the mixed species category. This group is composed of juveniles of *Caranx kalla*, *Siganus oramin*, *Sardinella* spp., *Leiognathus brevirostris* and *Clupanodon punctatus*. Catches of these species are of very low commercial value ($1.6 kg^{-1}) and are sold as fish feed to mariculturists. The blue crab *Portunus pelagicus* is an important commercial species but was reported in low abundances.

Table 7.6b Catch Composition from the PSKDA Study Area

Species	**% of Catch by Weight**	**Species**	**% of Catch by Weight**
All seven fishery zones		Area 0136 - Chinese University	
Mixed species	68 %	Mixed species	92.5 %
Stolephorus zollingeri	6.8 %	*Portunus pelagicus*	1.8 %
Leiognathus brevirostris	3.6 %	*Leiognathus brevirostris*	1.5 %
Siganus oramin	3.4 %	*Stolephorus zollingeri*	1.5 %
Others	18.2 %	Others	2.7 %

7.6.4 According to the 1997 AFD Vessel Count there are three home ports within the vicinity of the PSKDA Study Area. The table below details the composition of vessels in each of these home ports.

Table 7.6c Distribution of Vessels by Gear Type and Home Port that Operate in the Vicinity of the PSKDA (source = AFD 1997 Vessel Count)

Port	**MIX**	**P4/7**	**PS**	**PAT**	**SHT**	**STT**	**HAT**	**Sum**
Yim Tin Tsai	17	282	35	8	18	4	0	364
Kat O	1	95	12	0	0	0	0	108
Yung Shue Au	3	62	0	0	0	0	0	65
Shatin	1	3	0	0	0	0	0	4

Codes - MIX = Longline, Handline/Gillnet/Miscellaneous craft, P4/7 = Vessel <5m, PS = Purse Seine, PAT = Pair Trawler, SHT = Shrimp Trawler, STT = Stern Trawler, HAT = Hang Trawler.

7.6.5 Yim Tin Tsai provides a base for 364 vessels, the majority of which are P4 mariculture craft. The other ports, Kat O, Yung Shue Au and Shatin contain fewer vessels (108, 65 and 4 respectively) which are mainly mariculture craft (P4/7).

Fisheries Resources

7.6.6 The fisheries resources of the Tolo Harbour/Tolo Channel area have been extensively studied and reported on since 1977 (Chan & Tseng 1982, Wong 1982, Thompson and Horikoshi 1982, Thompson et al 1982, Lam 1986, Leung 1992, Leung 1997, ERM 1998). Since the results of the first surveys were reported it has been known that Tolo Harbour supports a low diversity fish assemblage dominated by fast growing low value species which appear to thrive in the harbours heavily eutrophicated waters.

7.6.7 Leung (1997) contains an analysis of the long term changes in the benthic fish fauna of Tolo and has revealed that though species diversity has increased recently the ecosystem is heavily stressed due to the combined pressures of heavy overfishing and development activities. The Study conducted ABC analysis of the benthic fishery community in order to evaluate ecological stress (Warwick 1986). In this technique, taxa are ranked in order of abundance or biomass on the *x* axis with percentage dominance on the *y* axis. Under stressed conditions communities become increasingly dominated by one or a few small-sized species and the abundance curve lies above the biomass curve throughout its length. In undisturbed communities, the biomass curve lies above the curve for abundance for its entire length. In moderately disturbed conditions the biomass and abundance curves are closely coincident. The Study found that the majority of the sampling stations were grossly under stress. Some stations, however, were classified as undisturbed though these occurred in Mirs Bay.

7.6.8 Trawls undertaken by Leung in 1995 (Leung 1997) in Tolo close to the PSKDA Study Area reveal that the fish fauna is composed of low value (<$ 5 kg^{-1}) species such as the black cardinalfish (*Apogonichthys niger*), the gizzard shad (*Clupanodon punctatus*) and the rockfish (*Sebasticus marmoratus*). Species diversity at the station close to Pak Shek Kok was similar to stations in less polluted areas (Shannon-Wiener Diversity Index), such as Mirs Bay, but evenness (Pielou Evenness Index) was very low. This indicates that the station was dominated by a few specific species.

7.6.9 More recent information is available from the AFD 1996-7 Fisheries Resources & Fishing Operations in Hong Kong Waters Study (ERM 1998). Trawl samples were taken monthly from a site in Inner Tolo Channel (between March 1996 and March 1997). The results revealed that of the eighteen stations sampled across Hong Kong the site at Inner Tolo recorded the lowest number of species, yet catches were high, ranking the area 4th of the 18 stations (mean monthly catch weight). As part of the same study gill net samples were taken in Tolo Channel at quarterly periods. The catches from this station were small, ranking the area 10th of the 11 stations. Purse seine surveys were also carried out in Tolo Channel and although catches were large, ranking the area second of the six stations surveyed, the catch was composed of small low value species (*Table 7.6d*).

Table 7.6d Fisheries Resources Information for Tolo Harbour and Tolo Channel (ERM 1998)

Station	Code	Most abundant organisms (by biomass)	Ranking in relation to other stations in Hong Kong in terms of mean catch size'
Trawl Sample			
Inner Tolo Harbour	T3	*Siganus oramin* (rabbitfish) *Metapenaeopsis palmensis* (southern prawn) *Charybdis cruciata* (red crab) *Leiognathus brevirostris* (ponyfish) *Chaeturichthys hexanema* (goby)	4th out of 18 (8.2 kg)
Gill Net Sample			
Inner Tolo	G3	*Leiognathus brevirostris* (ponyfish) *Lagocephalus lunaris* (pufferfish) *Muraenosox talabanoides* (conger pike eel) *Johnius belengeri* (croaker) *Nemipterus japonicus* (melon coat)	10th out of 11 (0.6 kg)
Purse Seine Sample			
Tolo	PS1	*Sardinella jussieui* (sardine) *Trichiurus haumela* (hairtail) *Stolephorus zollingeri* (anchovy) *Loligo edulis* (squid) *Siganus oramin* (rabbitfish)	2nd out of 6 (16 kg)
Spawning & Nursery Ground Trawl			
Wu Kwai Sha	S4	*Siganus oramin* (rabbitfish) *Apogon quadrifasciatus* (cardinalfish) *Leiognathus brevirostris* (ponyfish) *Clupanodon punctatus* (gizzard shad) *Metapenaeopsis palmensis* (southern velvet shrimp)	4th out of 12 (225 individuals)

7.6.10 As it can be seen from the table above few of the fish species collected from the area are of high commercial value (only large individuals of the southern velvet shrimp, *Metapenaeopsis palmensis* would be sold as high value, > $15 kg^{-1}). This is concurred by the fishing operations section above, which, reports that the majority of catches in this area are sold on to mariculturists for fish feed. Investigations into the composition of fisheries resources in 12 spawning and nursery grounds in Hong Kong identified the Wu Kwai Sha area as an important nursery ground for prawns (ERM 1998). This site is, however, far from the PSKDA and is unlikely to be affected by the reclamation works. AFD also report that Yim Tin Tsai East is an important spawning ground. As with Wu Kwai Sha the site is unlikely to be affected by sediment plumes associated with the reclamation works.

Hard Bottom Assemblages

7.6.11 A visit was undertaken on 6 August 1997 to survey the intertidal rocky shore present in the PSKDA Study Area (*Figure 7.6a*). The survey was undertaken using two methodologies. A quantitative survey was undertaken to assess the structure of the intertidal assemblage and a qualitative survey to ensure that any rare species or species of ecological interest had been identified and recorded.

7.6.12 **Quantitative Survey** - One representative area was selected (*Figure 7.6a)* along the shoreline at Pak Shek Kok. The substrate of the site was very homogeneous as it was mainly composed of large (> 1 m diameter) boulders that had been placed there during construction of the Tolo Highway. The shore was gently sloping and was open to small amounts of wave action from Tolo Channel.

7.6.13 A 10 m line transect was deployed at a height of 1 m above chart datum (CD) (determined from tide tables). The 1 m level was chosen for the survey as it was visually determined that the assemblage was most diverse at this level. Ten cross-string quadrats (50 × 50 cm) were located at random along the transect. All mobile organisms within the sampling quadrat were counted and the percentage cover of sessile organisms and encrusting algae determined.

7.6.14 **Qualitative Survey** - Two further sites were surveyed qualitatively. One site was a small natural rocky outcrop and, though not typical of the Study Area, was surveyed to see if there were any species of special ecological interest. The second site was similar to the quantitative site and was surveyed to ensure that a complete species list had been recorded. The methodology involved recording the presence of all animals and plants in the particular site from the infralittoral fringe at the bottom of the shore to the supralittoral fringe at the top of the shore.

7.6.15 **Quantitative Survey, Results** - At 1 m above CD, the shore was covered with tubeworms and encrusting algae, *Hildenbrandia* species. No other algal species were recorded at the site which is a commonly observed pattern in the summer on sheltered rocky shores in Hong Kong. High summer temperatures, coupled with daytime exposure at low tide, causes the algal assemblages present in the winter months to die off (Kaehler & Williams 1996). The only species that are tolerant of these changes are the encrusting algae, hence, they are the most abundant species in the summers. Herbivorous gastropods occurred in low numbers, whereas there were relatively high numbers of the dogwhelk, *Thais clavigera*. This may be due to a high abundance of their potential prey, like tubeworm and rock oyster, *Saccostrea cucullata* (29 % cover). The herbivorous crab, *Metopograpsus messor*, was recorded in large numbers. This crab, though, primarily herbivorous consumes large amounts of detritus and will scavenge across the shore.

7.6.16 **Qualitative Survey, Results** - In total, 25 animal species and one species of encrusting algae were observed in the surveyed areas. The species recorded were typical of sheltered rocky shores in Hong Kong (such as the assemblage at Tai Tam in southern Hong Kong or Starfish Bay in Tolo Channel). Sixteen species that had not been recorded in the quantitative survey were observed at the natural outcrop. In the high shore area (1 - 2 m above CD), littorinids and the topshell *Monodonta labio* were the most common species, though they were present in low numbers. At the mid shore area (1m above CD), the herbivorous gastropods *Batillaria multiformis*, *Striarca symmetrica*, *Clypeomorus humilis* and *Clithon oualaniensis* which are typical of estuarine muddy shores were observed in high numbers. On the lower levels of the shore, the sea slater *Ligia exotica* was frequently observed. These animals are highly mobile making it difficult to estimate their abundance. The value of 60 individuals per quadrat was, therefore, likely to be an underestimate. Large individuals of the green lipped mussel (> 10 cm in length), *Perna viridis*, were commonly observed at the waters edge.

7.6.17 The intertidal survey results indicate that the shores at the Study Area support a diverse faunal assemblage which was typical of sheltered shores in Hong Kong. Although no rare species were observed during the surveys, most of the species were very abundant and of large size. Such a pattern may arise from nutrient input to the shores from the eutrophicated waters of Tolo Harbour. *Section 5* presents more information on the baseline water quality conditions in Tolo Harbour.

Table 7.6e Common intertidal flora and fauna recorded at PSKDA. Mean number per quadrat and % cover (± 1 SD). Presence data were noted for the qualitative survey.

	Quantitative Survey		Qualitative
	Abundance	Percentage cover	Presence
Animals:			
Littorinids:			
Nodilittorina trochoides			✓
Nodilittorina radiata			✓
Nodilittorina vidua			✓
Littoraria articulata			✓
Peasiella lutulenta			✓
Topshells:			
Monodonta labio			✓
Planaxis sulcatus			✓
Chlorostoma rustica			✓
Nerita albicilla	1.33±2.96		✓
Nerita chamaeleon			✓
Lunella coronata			✓
Batillaria multiformis			✓
Striarca symmetrica			✓
Clypeomorus humilis			✓
Clithon oualaniensis			✓
Limpets:			
Patelloida pygmaea	1.1±1.91		✓
Dogwhelks:			
Thais clavigera	2.1±2.6		✓
Bivalves:			
Saccostrea cucullata	2±4.22		✓
Perna viridis	3.5±4.77		✓
Isognomon acutirostis	0.6±1.9		✓
Barbatia obliqua			✓
Crab:			
Metopograpsus messor	1.5±1.18		✓
Sea slater:			
Ligia exotica			✓
Barnacle:			
Tetraclita squamosa		5.3±15.72	✓
Tubeworm:			
Hydroides elegans		29±19.12	✓
Encrusting Algae:			
Hildenbrandia sp.		27.7±18.73	✓
Total number of animal species		25	
Total number of algal species		1	

Soft Bottom Assemblages

7.6.18 Apart from the southern and eastern shores which are rocky and coral encrusted, the majority of Hong Kong's seabed is soft and comprised of a mixture of sand and mud which varies in detailed composition depending on the site. The seabed of Hong Kong is now believed to be very polluted and the most obvious example of the effects of organic pollution have been described for Tolo Harbour.

7.6.19 Information on the infaunal benthic assemblages in Inner Tolo Harbour was obtained from a territory wide study of benthic community structure conducted using grab samples during 1976 to 1977 (Shin and Thompson 1982). The sediment in the PSKDA was mainly composed of silt (2-62 μm) with a mean silt content of 88.7%. The sediment type was typical of much of Hong Kong's benthos, especially sediments in eastern waters. The infaunal components of the benthos were mainly polychaetes (72.5 %) and crustaceans (9.5%). The most abundant species were *Nephtys* sp, *Aglaophamus lyrochaeta, Ophiura kinbergi, Terebellides stroemi* and *Sternaspis scutata.* The number of individuals (88.2 m^{-2}) was relatively low but the number of species (19.2 per 0.5 m^{-2}) was the highest of all the stations sampled in Hong Kong.

7.6.20 The epibenthic assemblages of Tolo Harbour were first investigated in 1977 using trawls in 1977 and 1978 (Horikoshi & Thompson 1980, Thompson et al 1982). Twenty six stations were sampled in Tolo Harbour and Tolo Channel, five of these were situated in the inner harbour close to the PSKDA Study Area. The inner harbour was inhabited by a characteristic assemblage of bivalve species that are known to be adapted to eutrophic coastal waters, eg *Arcuatula elegans* and *Paphia undulata.* The other more abundant species included *Cerianthus filiformis* (coelenterate), *Philine orientalis* (gastropod), *Portunus hastatoides* (crab), *Luidia hardwicki* (echinoderm) and *Callionymus richardsoni* and *Chaeturichthys hexanema* (fish). The survey was repeated in 1978 sampling at 6 stations in the inner harbour. The most abundant species were similar to 1977.

7.6.21 Subsequent sampling of epibenthic communities in Tolo in 1983, 1986 and 1989 has shown that there has been a progressive decline in species diversity (Morton et al 1996). The assemblages are now known to be dominated by opportunistic and scavenging species as opposed to the specialist species that once inhabited the area (Morton 1995). This pattern of change has occurred in the majority of Hong Kong's soft bottom benthic assemblages (Morton et al 1996). Outside of polluted areas such as Tolo and Victoria Harbours, this pattern is thought to be the result of intensive demersal trawling.

Mudflat

7.6.22 A small mudflat investigated with the Pak Shek Kok Study Area covered an area less then 5 m^2 (according to the EIA Technical Memorandum Annex 16, this is not of high value as it is less then 0.5 ha in area) Although the area is quite small, it supports large population of crabs, such as the fiddler crab, *Uca chlorophthalmus* and a smaller species, *Ilyoplax tenella.* Both crabs use their claws for signalling and attracting mates. Herbivorous gastropods were also recorded, with high abundance of *Clithon oualaniensis.* Other common mudflat species, *Batillaria multiformis, Striarca symmetrica* and *Clypeomorus humilis*, were also encountered. The halophytic grass *Zoysia sinica* and the succulent shrub *Scaevola frutescens* were also recorded.

Marine Mammals

7.6.23 At least one dozen marine mammal species occur in Hong Kong waters, however, only the Chinese White Dolphin (*Sousa chinensis*) in western waters and the finless porpoise (*Neophocaena phocaenoides*) in the east are considered to be permanent residents. Over the last 5 years research has been conducted on *Sousa chinensis* but information regarding other cetaceans is sparse. No sightings of *Sousa chinensis* have been reported east of Green Island and, therefore, the Study Area cannot be regarded as of importance to this dolphin.

7.6.24 Population size and ecology of the finless porpoise in unknown. Research in other parts of Asia suggests that this species prefers shallow waters. For example, in Japan this species is recorded as favouring inshore areas with a water depth of less than 30 m. In the Yangtze River, China, the porpoise has frequently been observed actively fishing in shallow water near sandbanks.

7.6.25 The lack of sightings from the inner Tolo Harbour area, coupled with the reported poor water quality indicate that the area is unlikely to be of importance to this porpoise. Recently published information (Parsons 1995, Jefferson 1997) on strandings in Hong Kong waters has revealed that the following cetaceans have been recorded from the Tolo Channel and Tolo Harbour area. In 1986 four individuals of Risso's dolphin (*Grampus griseus*) were stranded in Tolo, three of them at the mouth of the Lam Chuen river near Tai Po and the other at Cheung Shue Tan near to Tai Po Kau. In 1989 a juvenile male finless porpoise was stranded at Lai Chi Chong in Tolo Channel and in 1994 a bottlenose dolphin (*Tursiops truncatus*) was stranded close to this location. The most noteworthy stranding was that of a female bryde's whale (*Balaenoptera edenii*) which was stranded in Tolo Channel near to Lai Chi Chong. This whale is listed under CITES Appendix I and is thought to be an infrequent visitor to shallow inshore waters.

7.6.26 A recent survey carried out in Tolo Channel as part of AFD's multidisciplinary research program on marine mammals did not sight any mammals in the area (Jefferson pers comm). Based on the information presented above, no impacts to marine mammals are likely to occur as a result of the Pak Shek Kok reclamation works.

Sensitive Receivers

7.6.27 Based upon the above review of baseline ecological conditions at the PSKDA Study Area, marine ecological sensitive receivers which may be affected by the proposed development have been identified. These are as follows:

7.6.28 There are two Fish Culture Zones (FCZ) at Yim Tin Tsai and Yim Tin Tsai East. Information from the AFD Annual Report for 1996 indicates that the FCZ at Yim Tin Tsai consists of 278 licensed rafts with a total licensed area of 28,891m^2 (total gazetted area = 136,600 m^2). Yim Tin Tsai East FCZ supports 191 licensed rafts in a licensed area of 26,233 m^2 (total gazetted area = 149,500 m^2). There are no figures for individual production at these FCZs, although Hong Kong production in 1995 totalled 2,590t valued at $181 million. The main species cultured were the spotted grouper (*Epinephelus chlorostigma*), gold-lined seabream (*Rhabdosargus sarba*), mangrove snapper (*Lutjanus argentimaculatus*) and the pompano (*Trachinotus blochii*).

7.6.29 The only other marine ecological receiver identified based on this assessment was the nursery ground for penaeid prawns at Wu Kwai Sha.

7.7 Ecological Importance

7.7.1 Based on the field surveys and discussion presented above, the current ecological assessment shows that the marine ecological resources present within the PSKDA boundary are considered of low ecological value . All species found within the site boundary during the field visits are either common or wide-spread in Hong Kong. The low ecological importance of the PSKDA site is determined based on the following considerations, in accordance with the EIAO TM Annex 8 Table 2 criteria:

- *Naturalness:* Intertidal habitats are man-made areas and subtidal habitats have been subject to extensive human disturbance.
- *Size:* (not applicable as only meaningful if the habitats are of some value)
- *Diversity:* The faunal diversity is high but typical of a sheltered shore in Hong Kong. Diversity in the subtidal habitats was low.
- *Rarity:* No rare species found.
- *Re-creatability:* These artificial habitats could be readily re-created given the correct design specifications and recolonisation by typical fauna would be expected.
- *Fragmentation:* The man made shore is surrounded by shores of a similar nature.
- *Ecological Linkage:* The present habitats are not functionally linked to any highly valued habitat in close proximity.
- *Potential Value:* Low potential as significant management efforts or long natural processes would be required for the site to become an area with conservation interest.
- *Nursery/breeding Ground:* No records of significant nursery/breeding ground within the PSKDA development.

- *Age:* Very young artificial habitats.

- *Abundance/Richness of Wildlife:* The intertidal shores supported many different species in high abundances. The subtidal habitat was composed of few species in low abundances.

7.8 Impact Assessment

7.8.1 Impacts to ecological components of the marine community will be in two forms:

- Direct impacts will be permanent and will affect the intertidal and near shore subtidal assemblages as a result of habitat loss during the reclamation.

- Indirect impacts to the subtidal assemblage and fishery of Tolo Harbour within 1 km of the PSKDA are likely to occur during the construction phase of the project as a result of perturbations to water quality.

Intertidal Habitats

7.8.2 A large part of the intertidal habitat along the western coastline of Tolo Harbour consists of artificial sea walls as a result of the construction of Tolo Highway. The seawalls do, however, support a rich assemblage of intertidal organisms. Organisms present on intertidal shores in Hong Kong rely on larval settlement for recruitment. Assuming that there is a regular supply of larvae brought to the area through Tolo Channel, recolonisation of new seawalls resulting from the reclamation will occur. The design of the seawall will be critical in determining the extent to which the community re-establishes. The more heterogeneous the seawall, the more diverse a community the habitat can support. No adverse impacts are predicted during the operations phase of the project.

7.8.3 The intertidal habitats of the Study Area that will not be reclaimed could be affected during the construction of the reclamation through perturbations to water quality. The intertidal habitat is almost fully submerged at high tide and increases in suspended sediments can affect the habitat in a variety of ways. The abundant filter feeding oysters (*Saccostrea*) present on the low shore may be impacted by increases in SS levels in the water column through clogging of their delicate filter feeding mechanisms which can reduce their feeding efficiency and may inhibit respiration. Deposition of sediment on the shore may cause scouring which could inhibit the survival of algae and long term residence of the sediment may alter the species composition of the algal assemblage. Higher than normal sediment loads arising from nearby dredging works were deposited on an assemblage of coralline algae at Cape d'Aguilar. This resulted in overgrowth of the coralline assemblage by the red turf alga, *Gelidium pusillum*, which became the most abundant species(Kaehler & Williams 1996).

7.8.4 Annex 8 of the EIA Ordinance Technical Memorandum (EIAO TM) states that"undisturbed natural coastal areas larger than one hectare or longer than 500m in linear measurement" are considered as important habitats in Hong Kong. Although this habitat is larger than the said size the coastal habitat was disturbed during the construction of the Tolo highway and is now composed of a man-made seawall. The habitat is, therefore, not considered of high value. Construction phase and operational phase impacts to the intertidal habitats are not, based on this assessment, predicted to be severe based on the likely re-establishment of a similar habitat through seawall design modifications.

7.8.5 The Little Egret has been observed feeding from the intertidal shore. The egret feeds on fish in the low intertidal/high subtidal, and although the habitat will be replaced post-reclamation, there may be short term disturbance to the foraging activity of the bird during and after construction.

Subtidal Habitats

7.8.6 *Direct Impacts*: As for the intertidal habitats, an area of the natural seabed will be lost through the reclamation activities. The subtidal part of the seawalls constructed after the reclamation has been completed will offer potential surfaces for colonisation by benthic organisms. Should the seawall be designed to maximise substrate heterogeneity and water quality be maintained there is the possibility for the area to become more productive post-reclamation (hard surface habitats are known to be more productive than soft bottom habitats).

7.8.7 *Indirect Impacts*: During the construction phase-the subtidal assemblage of the Study Area could potentially be affected as a result of changes in water quality. Suspended sediment generated during the dredging and filling constructional stage will cause an increase in turbidity in the water column and higher rates of deposition on the seafloor. Such elevated suspended sediment concentrations may cause smothering of filter feeders such as bivalves (eg, green mussel *Perna viridis*) and clogging of gill filaments in fish and other organisms. Another potential indirect impact involves reduction in dissolved oxygen concentration caused by elevated concentrations of suspended sediments. An increase in solids in the water column will result in the following effects on dissolved oxygen:

- reduced sunlight penetration, lowered rate of photosynthesis of phytoplankton (primary productivity) and thus lower rate of oxygen production in the water column; and,
- higher energy retention from sunlight, resulting in higher temperatures, and thus possibly lower oxygen levels as oxygen is more soluble in colder water.

7.8.8 Construction phase and operational phase impacts to subtidal habitats are not, based on this assessment, predicted to be severe based on the likely re-establishment of a similar habitat through seawall design modifications and the low ecological value of the habitat.

Commercial Fisheries

7.8.9 *Direct Impacts*: The area that is to be reclaimed during the development is unlikely to impact commercial fishing operations in the area as the area is infrequently used by fishing vessels and production is low. The table below presents information on the dependency of fishing vessels on the PSKDA area.

Table 7.6f ***Dependence (%) of the Hong Kong Fleet on the PSKDA and Main Operation Undertaken at PSKDA***

Home Port	**Fleet Size**	**Main Operation**	**Percent Dependence By**			
			Adult Weight	**Time Fishing**	**Value**	**Fry**
Yim Tin Tsai	364	Purse Seine	0.41	0.17	0	0
Kat O	108	Gill Net	0	0.01	0	0.11
Yung Shue Au	65	Gill Net	0.07	0.03	0	0
Shatin	4	Gill Net	2.8	3.11	3	0

[1] dependence was calculated only on the area to be reclaimed (ie 70 ha of Fishery Zone 0136).

7.8.10 According to Annex 9 of the EIA TM, the criteria for evaluating whether a fisheries impact is rated as high, include an assessment of whether a large number of fishing vessels have a high dependence on the affected area. It can be clearly seen from *Table 7.6f* that dependency on the area to be reclaimed is very low. Although the Yim Tin Tsai home port contains over 300 vessels these vessels spend less than 1 % of their time fishing in the PSKDA and obtain less than 1 % of their catches from the area.

7.8.11 Another of the criteria listed in Annex 9 rates the impacts as high if the affected area constitutes a high proportion of the total fisheries production of Hong Kong. The PSKDA contributes approximately 0.1 % of the total adult weight of catches obtained in Hong Kong waters (*Table 7.6f*) and impacts to the area are consequently not rated as important.

Table 7.6g ***Fisheries Production from the PSKDA****

Catch Statistic	**PSKDA (Total)**	**PSKDA (per ha)**	**Hong Kong Waters (Total)**	**Hong Kong Waters (per ha)**	**Contribution to the HK Fishery (Total)**
Catch Weight (kg)	17,632	252	17,681,241	98	0.1 %
Value of Catch ($)	58,994	843	343,969,859	1,908	0.017 %
Fry Catch (tails)	292	4	6,383,430	35.4	<0.01 %

* - area defined as the actual area of the PSKDA proposed reclamation (70 hectares of Area 0136 Chinese University)

7.8.12 *Indirect Impacts*: Suspended sediment fluxes occur naturally in the marine environment, consequently fish have evolved behavioural adaptations to tolerate increased SS loads. These include clearing their gills by flushing water over them. Where SS levels become excessive fish will move to clearer waters. Susceptibility generally decreases with age, with eggs the most vulnerable and adults the least sensitive to effects from sediments. The rate, season and duration of SS elevations will influence the type and extent of impact upon fish. This assessment has indicated that the immediate area close to the proposed development does not appear to be an important spawning and nursery area and therefore impacts to Hong Kong's fishery as a whole are unlikely to occur. There is an important spawning and nursery ground for penaeid prawns at Wu Kwai Sha which would be sensitive to perturbations in water quality. Tidal flushing in Tolo Harbour is very slow and the water quality assessment from the previous PSKRPD EIA predict that sediments as a result of the construction works of the Pak Shek Kok Public Filling Area reclamation will be settled within a distance of 1 km. As Wu Kwai Sha is further away then 1 km no impacts are predicted to occur at this nursery ground.

Marine Mammals

7.8.13 Underwater noise and disturbance from reclamation activities and marine traffic can have a disruptive effect upon behaviour of marine mammals. However, based on the apparent low - no utilisation of the area by mammals (based on sighting records) impacts as a result of the PSKDA are not predicted to occur.

7.9 Impact Evaluation

Marine Ecology

7.9.1 Following the discussion above, the ecological impact associated with the PSKDA development is considered low. An evaluation of the impact in accordance with the EIAO TM Annex 8 Table 1 is presented as follows:

- *Habitat Quality*: Low quality artificial habitats.
- *Species:* No species of conservation interest present.
- *Size/Abundance:* The reclamation area is large but the seabed to reclaimed has low ecological value and the intertidal assemblages are likely to recolonise post reclamation.
- *Duration:* PSK development over the reclaimed area will be long term.
- *Reversibility:* Impacts to the seabed are permanent and irreversible, impacts to the intertidal shore are reversible.
- *Magnitude:* Developed into more urban enviroriment.

Fisheries

7.9.2 Following the information presented above, the fisheries impact associated with the PSKDA development is considered low. An evaluation of the impact in accordance with the EIAO TM Annex 9 is presented as follows:

- *Nature of Impact*: Permanent impact to demersal fisheries resources within the PSKDA, temporary impact to pelagic and demersal fisheries resources within 1 km of the PSKDA as a result of perturbations to water quality.

- *Size of affected area:* The reclamation area constitutes a small (16%) of one of the seven fishery zones in Tolo Harbour.

- *Size of fisheries resources/production:* Low ranking compared to other areas in Hong Kong and contributes less than 0.1% to the Hong Kong fishery.

- *Destruction and disturbance of nursery and spawning grounds:* The closest spawning grounds are located at Yim Tin Tsai East and Wu Kwai Sha and as the are located > 1km away they not predicted to be impacted by the PSKDA.

- *Impact on Fishing Activity:* No home ports have a dependence greater than 0.41 % (fisheries production) on the area.

- *Impact on Aquaculture Activity:* No impacts to the FCZs in Tolo Harbour are predicted.

7.10 Environmental Mitigation Measures

Terrestrial Ecology

7.10.1 The previously endorsed TPDS and THWFS EIAs provided no specific mitigation measures to mitigate the ecological impact on the ecological resources found within Areas 12 (part) and Area 39 as the habitat quality of the Study Area was considered to be low and limited.

7.10.2 As discussed in the previous sections, only low ecological impact is directly attributable to the PSKDA. The following mitigation measures in relation to protecting the two important plant species and good construction practice to minimise disturbance to the surrounding environment are recommended:

- survey and collect individuals of the protected plant species *Spiranthes sinensis* and *Eulophia sinensis* prior to work commencement for transplanting to adjacent planting areas within the Open Space zone.

- erect fences along the boundary of construction sites before the commencement of works to prevent tipping, vehicle movements, and encroachment of personnel into adjacent wooded areas;

- regular checks to ensure that the work site boundaries are not exceeded and that no damage to surrounding areas;

- avoid burning during construction, or such use if unavoidable should be carried out under close supervision;

- prohibit wild and uncontrolled open fires within the work site boundary, and install fire fighting equipment in the work area;

7.10.3 The mitigation measures should be included into contract clauses for the PSKDA development. The implementation of the measures should be checked as part of the environmental monitoring and audit procedures during the construction period, the procedures of which are presented in the separate Environmental Monitoring and Audit Manual.

Residual Impact

7.10.4 With the implementation of the recommended mitigation measures, no residual ecological impact from the proposed PSKDA development is anticipated.

Marine Ecology

Intertidal and Subtidal Habitats

7.10.5 The intertidal assemblage on the coastline at Pak Shek Kok will be lost through the reclamation works. Measures should be taken to ensure that the community lost can recolonise post-construction. Where feasible, alternative designs for seawall construction (as opposed to vertical seawalls) should be considered to mitigate for loss of natural coastline. Although no studies have as yet examined colonisation patterns of intertidal organisms on artificial structures, an example can be found on the seaward side of the High Island Reservoir. The "H-Jack" structure of the reservoir wall has recently been surveyed as part of an ongoing study on Hong Kong's coral communities by Hong Kong University. The site now has a well established coral community dominated by two species, *Montipora* and *Acropora*. The latter species has become rare in Hong Kong and this represents one of the last remaining mature and reproductive populations. This indicates that seawalls of this design would be useful in recreating habitats lost through the development. Although unlikely that any type of coral (soft or hard) will colonise in the turbid waters of Tolo Harbour, other more tolerant species, such as the green lipped mussel (*Perna viridis*) will colonise the seawalls more effectively should the design be heterogeneous.

Commercial Fisheries Resources

7.10.6 As impacts to commercial fisheries resources are not predicted to occur based on this assessment no special mitigation measures are necessary above and beyond measures that could be used to mitigate disturbance to the water column during the construction phase of the project.

Marine Mammals

7.10.7 As impacts to marine mammals are not predicted to occur based on this assessment no special mitigation measures are necessary.

7.10.8 The mitigation measures should be included into contract clauses for the PSKDA development. The implementation of the measures should be checked as part of the environmental monitoring and audit procedures during the construction period, the procedures of which are presented in the separate Environmental Monitoring and Audit Manual.

Residual Impact

7.10.9 With the implementation of the recommended mitigation measures, no residual ecological or fisheries impact from the proposed PSKDA development is anticipated.

7.11 Conclusions

Terrestrial Ecology

7.11.1 Based on literature review of previous relevant reports and recent field surveys, the existing baseline ecological condition of the PSKDA site is considered poor with limited ecological value. The PSKDA to be developed on the present reclaimed land is expected to have low ecological impact.

7.11.2 Mitigation measures for the PSKDA development in relation to transplanting the two protected plant species and good construction practice to minimise disturbance to the surrounding environment are recommended, and no residual impact is anticipated.

Marine Ecology

7.11.3 A review of existing information on the marine ecological resources located within and around the PSKDA has identified the area as supporting soft bottom benthic assemblages, rocky intertidal assemblages, fish and pelagic invertebrates few of which are of high commercial value. The subtidal benthic habitat of the area is considered to of low ecological value and the reclamation is considered to have a low ecological impact given the poor water quality in Tolo Harbour and the documented degradation that has occurred to benthic communities since the 1970s.

7.11.4 Fisheries resources in Tolo Channel, although abundant in comparison with other areas in Hong Kong, are dominated by small and low value species. The review identified an important nursery ground to the east of the PSKDA area at Wu Kwai Sha and at East Yim Tin Tsai. As sediment from the reclamation will settle within a 1 km radius of the PSKDA, no impacts were predicted at this sensitive receiver. Although the large home port of Yim Tin Tsai is close to the PSKDA, few vessels regularly fish in the vicinity of the works area or are dependent on it for catches. Potential impacts to fisheries resources and fishing operations were considered to be low and acceptable.

7.11.5 Intertidal habitats appear to be diverse and the existing man - made shore will be lost during the reclamation. However, any loss of habitat in the area can be mitigated, wherever possible, through seawall design. By ensuring that a gently sloping seawall that is heterogeneous in nature (ie high numbers of crevices and holes) is used at the edge of the reclamation, an assemblage of similar nature to that present, will establish.

7.11.6 Based on the information presented in this assessment no impacts are predicted to occur to marine mammals as a result of the PSKDA.

7.11.7 Mitigation measures for the PSKDA development and good construction practice to minimise disturbance to the surrounding environment are recommended, and no residual impact is anticipated.

7.12 References

Chan KL & Tseng WY 1982 A comparative study of benthic fishes of Tolo Harbour and the northeastern waters of Hong Kong. The Marine Flora and Fauna of Hong Kong and Southern China (ed B Morton and CK Tseng), 801-814. Proceedings of the First International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China 1980. Hong Kong University Press.

ERM 1998 Fisheries Resources and Fishing Operations in Hong Kong Waters. Final Report, AFD.

Horikoshi M & Thompson GB (1980)Distribution of subtidal molluscs collected by habitat segregation in two venerid bivalves. In: Proceedings of the First International Workshop on the Malacofauna of Hong Kong and southern China, Hong Kong, 1977. (Ed B Morton) Hong Kong University Press. pp 149-162.

Jefferson TA 1997 Multi-disciplinary research program on the Indo-pacific hump-backed Dolphin population. 5th quarterly progress report, AFD.

Kaehler S & Williams GA 1996 Distribution of algae on tropical rocky shores: spatial and temporal patterns of non-coralline encrusting algae in Hong Kong. Marine Biology 125: 177-188

Lam C 1986 Benthic ichthyofauna of Tolo Harbour and the entrance to Tolo Channel, Mirs Bay. Proceedings of the Second International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China. 899-905. Hong Kong University Press

Leung 1992 Abundance and diversity of benthic fishes in Tolo and Mirs Bay, Hong Kong. The Marine Flora and Fauna of Hong Kong and Southern China III (ed B Morton), 459-473. Proceedings of the First International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China 1980. Hong Kong University Press.

Leung AWY 1997 The epibenthic ichthyofauna of Tolo Harbour and Hong Kong's Northeastern waters: A long term record of change 463-487 The Marine Flora & Fauna of Hong Kong and Southern China IV (ed. B Morton). Proceedings of the Eighth International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China, Hong Kong, April 1995. Hong Kong University Press.

Morton B & Morton J 1983 The seashore ecology of Hong Kong. Hong Kong University Press.

Morton B 1995 Perturbated soft intertidal and subtidal marine communities in Hong Kong: the significance of scavenging gastropods. 1 - 15. In Morton B, Xu g, Zou R, Pan J and Cai G (eds) Proceedings of the Second International Conference on the Marine Biology of the South China Sea, Guangzhou, China. World Publishing Corporation.

Morton B, Williams GA, Lee SY 1996 The benthic marine ecology of Hong Kong: a dwindling heritage? In Coastal infrastructure in Hong Kong: a review. 233-267. Hong Kong Government, Hong Kong.

Parsons ECM, Felley ML, Porter LJ 1995 An annotated checklist of cetaceans recorded from Hong Kong's territorial waters. Asian Marine Biology 12: 79-100

Shin PKS & Thompson GB (1982) Spatial distribution of the infaunal benthos of Hong Kong. Marine Ecology Progress Series 10: 37-47.

Thompson GB & Horikoshi M 1982 Distribution of subtidal benthos collected by trawling in Tolo Harbour and Tolo Channel, Hong Kong. The Marine Flora and Fauna of Hong Kong and Southern China (ed B Morton and CK Tseng), 733-744. Proceedings of the First International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China 1980. Hong Kong University Press.

Thompson GB, Wu RSS, Phillips DJH 1982 A trawl survey of the benthos of Tolo Harbour and Tolo Channel in 1978. The Marine Flora and Fauna of Hong Kong and Southern China (ed B Morton and CK Tseng), 746-760. Proceedings of the First International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China 1980. Hong Kong University Press.

Warwick RM 1986 A new method of detecting pollution effects on marine macrobenthic communities. Marine Biology 92: 557-562.

Wong KC 1982 A preliminary survey of the benthic fishes of Tolo Harbour. The Marine Flora and Fauna of Hong Kong and Southern China (ed B Morton and CK Tseng), 921-933. Proceedings of the First International Marine Biological Workshop: The Marine Flora and Fauna of Hong Kong and Southern China 1980. Hong Kong University Press.

8 VISUAL AND LANDSCAPE IMPACTS

8.1 Introduction

8.1.1 This section assesses the potential visual impacts on the visual sensitive receivers (VSRs) in the PSKDA Study Area from both the construction and operational activities associated with the PSKDA.

8.1.2 The PSKDA Study Area is strategically situated between Tai Po and Sha Tin adjacent to the existing Tolo Highway and KCR line on the proposed reclamation area. It has a magnificent view of the Tolo Harbour with Lai Pek Shan to the north, Ma On Shan to the East and Tai Mo Shan to the South-West.

8.1.3 Site visits to both the proposed PSKDA site area and its hinterland on foot and by car has revealed opportunities and constraints. Photographic records of the view sheds, both from within and outside of the PSKDA were taken. Subsequent analysis identified three VSRs as samples of differing conditions to case study PSKDA's impact on them.

8.1.4 An initial Visual Impact Assessment has been carried out for the *EIA - IAR (EV/01)* which described the broad acceptability of the visual impacts generated by the PSKDA. Further assessment has been carried involving detailed three dimensional modelling. In response to a request by Planning Department at the 6th Planning and Landscape Working Group Meeting held on 11 February 1998, three photomontages were undertaken at three selected sites. The three selected VSRs are : Kam Fung Court, Ma On Shan; Chinese University; and Deer Hill Bay Development.

8.1.5 The findings of the visual impact assessment as well as the potential mitigation measures recommended are described in the following sections.

8.2 Government Legislation and Standards

8.2.1 The criteria for evaluating visual impacts are laid out in the Technical Memorandum on Environmental Impact Assessment Process (Environmental Impact Assessment Ordinance). The relevant criteria to this EIA Study are given in the following sections.

Criteria for Assessment of Visual and Landscape Impact

8.2.2 The evaluation of landscape and visual impact may be classified into five levels of significance based on type and extent of the effects concluded in the EIA study:

- The impact is *beneficial* if the project will complement the landscape and visual character of its setting, will follow the relevant planning objectives and will improve overall and visual quality;

- The impact is *acceptable* if the assessment indicates that there will be no significant effects on the landscape, no significant visual effects caused by the appearance of the project, or no interference with key views;

- The impacts is *acceptable with mitigation measures* if there will be some adverse effects, but these can be eliminated, reduced or offset to a large extent by specific measures;

- The impact is *unacceptable* if the adverse effects are considered too excessive and are unable to mitigate practically;

- The impact is *undetermined* if significant adverse effects are likely, but the extent to which they may occur or may be mitigated cannot be determined from the study. Further detailed study will be required for the specific effects in question.

8.2.3 The Visual Impact Assessment (VIA) will identify and predict the type and extent of visual impacts relating to:

- visual compatibility with surroundings such as massing, height, shape, proportion and rhythms of building elements, colour and material used;

- visual obstruction such as blocking of views towards existing landscape features; or existing/planned view corridors towards landmarks and notable features;

- improvement of visual quality such as clearance of visual obstruction and blight, appealing design features that enhance attractiveness of the landscape; and

- glare from direct or reflected sunlight or man-made light source such as uncomfortable eye feeling caused by light interference from structures faced with mirror or polished materials or from direct light sources generated from the proposed development.

8.3 Baseline Conditions

8.3.1 The PSKDA site is adjacent to institutions, residential estates and villages. The Chinese University of Hong Kong (CUHK) and Hong Kong Institute of Biotechnology (HKIB) are situated immediately to the south, southwest and west, while the villages of Tsiu Hang and Cheung Shue Tan are to the west.

8.3.2 The more upscale residential developments, Villa Castell and the mid rise development, Deer Hill Bay, currently under construction by Cheung Kong are to the north west.

8.3.3 There is scattered village development in the valley area to the west between the villages of Chung Shue Tan and Chek Nai Ping (next to Tai Po Road).

8.3.4 It is apparent that none of the village houses are oriented toward the harbour or sea view. Due to the clustering of buildings perhaps only 10% have any view of the sea, and in many cases this would be from side windows, bathrooms, etc.

8.3.5 The houses of Chek Nai Pang village may already have their sea view obscured by the ridge where the University's Shaw College is situated.

8.3.6 All of the aforementioned are located at the north eastern foothills of Tai Mo Shan.

8.3.7 The site has several panoramic view sheds of its surrounding neighbours as illustrated in *Figure 8.3a*. It is also the subject focus of the surrounding areas because of its strategic location as illustrated in *Figure 8.3b*. It's physical qualities and ambiance would have a dramatic impact on the users of the Tolo Highway and KCR line as well as the ferry service on the Tolo Harbour.

8.4 Sensitive Receivers

8.4.1 The above mentioned sites are potential VSRs of the PSKDA.

8.4.2 Any development on the PSKDA ideally should be in harmony with the existing semi-rural / semi-urban qualities to mitigate its visual impact on its surrounding. This can be achieved by adopting a general policy of providing a much higher ratio of green open space to building structures.

8.5 Proposed Structures / Developments

8.5.1 With the immediate surrounding developments and institutions situated much further up slope or higher than the reclamation site, the PSKDA will not block the seaviews of these VSRs. Only the harbour view of these identified VSRs towards the north shore of Tolo Harbour will be partially blocked, but the view of the central harbour and south shore will not be affected. The extent of this partial blockage will depend on the eventual height and bulk of the recreation site buildings and Science Park buildings.

8.6 Initial Visual Assessment

8.6.1 An initial visual assessment has been undertaken and presented in the *EIA - IAR (EV/01)*, using initial three-dimensional modelling outputs of the Preferred Development Concept.

8.6.2 The initial three-dimensional modelling outputs of the preferred option are presented as *Figures 8.6a-e*. The results available presented a broad overview of the proposed development and its surrounding landscape, including major natural and man-made features. In the simulated aerial views, the major parts of the development become clear in their functional and visual relationship. The initial finding of the VIA were as follows:

View from within PSKDA:

- The view of the housing area from the northern edge of the Science Park *(Figure 8.6d)* showed an acceptable visual impact even when there is a large gap between Science Park buildings. Only the top portions of the PSKDA residential blocks were visible above the Science Park buildings. .These new building were considered to be much better visually than the existing view of the industrial estate to the north in Tai Po. *Figure 8.6a* clearly demonstrated that the Science Park buildings would block all or most of the view of the residential towers to the north, except at the edge of the Science Park. Even at the edge of the Science Park, the 6-8 storey Science Park buildings would completely or substantially block the view of the higher buildings of the northern residential area. The same applies to buildings on the strategic recreation site;

- The view from within the residential area of the PSKDA to the north was not ideal as most of the industrial estate in Tai Po were in full view. The mountains behind the industrial estate do provide some distant visual relief beyond the industrial area. To mitigate this unpleasant view, the area immediately to the north of the residential development within the PSKDA should be heavily planted wherever possible. This will provide visual focus in the foreground to draw attention away from the industrial estates in the distant to the north; and

- The view south from the residential development in the north will be quite acceptable as the recreation development to the south will be extensively landscaped. It will be very spacious with lots of greenery to provide the sense of rural qualities.

View from outside of PSKDA :

- The aerial view of the whole of PSKDA *(Figure 8.6b)* showed the Science Park in its fully occupied state. It should be kept in mind that it will take some years to fill up and look as shown;

- The views from the Chinese University toward Tolo Harbour will not be blocked at all and thus have no significant visual impact. The taller residential towers may obscure part of the Tai Po industrial estate and may be of visual benefit. The main difference in elevation between most of the University on the hill and the limited height of Science Park buildings (6-8 storeys) will mean only a very minor change in terms of visual impact. The University's views of the largest visual elements (which are the mountains and the expanse of Tolo Harbour) will essentially not be impacted by any of the development at PSKDA and thus have no significant visual impact;

- The slight terracing effect among the Science Park buildings as shown *(Figure 8.6b)* should allow the upper floors of the buildings further from the Harbour to still enjoy a harbour view;

- The views from the villages situated at the valley floor, Tsiu Hang and Cheung Shu Tan will potentially be affected. The impact was considered to be severe. The only solution will be to provide as much greenery as possible to soften the resulting visual impact of the PSKDA on the villages. As mentioned previously the visual impacts will be dependent on the number of village houses that presently have a view of the harbour as well as the elevation of any particular village house;

- PSKDA will have a significant visually impact on the existing Ma On Shan developments due to it very close proximity as shown on *Figure 8.3b*. For the most part, it is the KCR line and the Tolo Highway that will be blocked from their view. In its place are new building forms and a seaside promenade lined with trees and substantial greenery. Thus, the impact was considered to be beneficial;

- Tai Po area west of the Tai Po Industrial Estate will receive little or no impact by the PSKDA as almost all the PSKDA is hidden from view by the landform immediately north of the PSKDA;

- Tai Po Industrial Estate will receive an oblique angled view of the PSKDA. This narrow angle will present a minimal visual impact. This impact will be in the form of residential towers flanked by a tree lined promenade to the east along the Tolo Harbour in lieu of the existing Tolo Highway. Therefore, the impact was considered to be quite acceptable and beneficial;

- All of the areas east of the Tai Po Industrial Estate facing the Tolo Harbour will also receive an oblique, but more broad, view of the PSKDA than Tai Po Industrial Estate receives and its effects and impact are identical. Because PSKDA is viewed at a shallower angle, more of its interesting architectural forms and green open spaces are visible. The visual impact to these areas were considered to be beneficial;

- The travellers of the Tolo Highway and the KCR rail line are most affected by the PSKDA. Their views of the expanse of Tolo Harbour to the east will be replaced by new development, punctuated with multiple view corridors (some 5-7) through PSKDA into the Harbour. But offsetting this impact is a substantial buffer strip between the primary access road and the development. This buffer of greenery will provide visual relief to soften the impact. The visual impact was considered to be acceptable with the incorporation of suitable mitigation measures.

8.7 Final Visual Assessment

8.7.1 Further detailed photomontages taken from 3 viewpoints VSR requested by Planning Department at the 6th Planning and Landscape Working Group Meeting held on 11 February 1998. Two of these viewpoints are illustrated in the photomontages as *Figures 8.7a-b* concur with the findings of the initial visual assessment presented in *Section 8.6*.

8.7.2 Case Studies :

- The view from Kam Fung Court, Ma On Shan illustrates that the visual impact created by PSKDA is acceptable and beneficial. It presents a semi-urban setting, not dissimilar to the image presented by the prominent Deer Hill Bay Development, which is almost one kilometre in length along the ridge from Tai Po Road

- The view from Chinese University demonstrates that the impact is acceptable as all of the distant vista are preserved and unhindered. With the appropriate landscape guidelines PSKDA in place, it should present a rather lush setting with interesting architectural forms to replace the existing view of the Tolo Harbour.

- The view from Deer Hill Bay Development indicates that the view of the inner harbour area vista will be partially blocked, representing approximately 20% of the total view. The middle to outer harbour and islands (distant) vistas as well as the mountains to the north and south east will all be unaffected. View corridors through PSKDA do exist to provide the visual relief. With the appropriate landscape guidelines for PSKDA implemented, the resulting view of PSKDA should present an acceptable lush greenery with interesting architectural forms to replace the existing view of the Tolo Harbour that is displaced.

8.7.3 Overall, the largest visual elements of the region are the expansive harbour and the mountains in three directions around the Tolo Harbour. Ma On Shan (700 m high) to the east, an unnamed mountain to the west in Tai Po Kau Nature Reserve (400 m high) and the Pat Sin Leng mountains to the north (600 to 700 m high) all dwarf the tallest buildings planned at Pak Shek Kok (70 m high maximum) by comparison. As the location of the existing surrounding VSR are some distance from the planned building structures at PSKDA, the affected viewsheds are only partial blocked and well within an acceptable tolerance.

8.8 Control Measures

Control measures to reduce visual impacts have been incorporated into the Preferred Development Concept as part of the SAR Report and subsequently incorporated into the RODP. The measures include the following:

- visual compatibility of conflicting land uses by separation of the Science Park and residential development;

- rejection of the residential development Plot Ratio 8 option due to the potential visual impacts on surrounding VSRs;

- avoidance of uniform building heights through the terracing effect of the Science Park buildings and residential developments as shown in *Figure 8.6b*;

- adoption of a well thought out architectural control guidelines to ensure visual interest;

- provision of view corridors through the development for highway and railway users as well as potential Deerhill development residents;

- adoption of open space network mitigates the potential wall effects and provides more open and distant sightlines;

- imposition of maximum building height of 70m for residential towers (plot ratio 5) including podium;

- adoption of an overall building height strategy for PSKDA of locating tallest at the north to the shortest at the south, which when viewed from the harbour and Ma On Shan, presents a descending profile, in keeping with the descending ridge lines around the site.

8.9 Landscape Impacts

General

8.9.1 The PSKDA is primarily a reclamation project and therefore has a minimum impact on the existing landscape landforms and vegetation. However, since the project is creating a new landscape in the area, the assessment of the adjoining land uses and landscape features is required to assess the compatibility of the new landscape with the existing area. The existing coastal area along the Tolo Highway abutting the PSKDA and the western roadway connections are the primary areas being effected by the project. These are discussed below in detail.

Baseline Conditions

Tolo Highway Coastal Frontage

8.9.2 The current coastline of Pak Shek Kok has been artificially created by the building of the Tolo Highway in the 1980's. It is not of high landform value, though it does provide good views of the outstanding landforms beyond the Study Area such as Tolo Harbour and islands. The ongoing Pak Shek Kok Reclamation for Filling which is currently being undertaken by CED will further alter the existing artificial coastline with the proposed development for the PSKDA built on the reclamation.

Impact Assessment

8.9.3 For landscape value, the PSKDA will be an improvement over the existing situation, as public accessibility will be greater, plus the large amount of public open space will be pleasantly landscaped. The coastal ponds beyond the Study Area northern boundary are unaffected by the proposed development.

8.9.4 Several groups of small trees and shrubs occur along this coastal zone, as well as coastal grasses, herbaceous plants, and intertidal species. No mangrove are present, however, as the shoreline is generally rocky or engineered highway fill. The construction of the Tolo Highway substantially altered the shoreline by a promenade in this area and any existing plants have been introduced or seeded in naturally since its construction. There are no large or old trees in this area. All of the existing vegetation in the existing coastal area of the PSKDA will be removed as a result of the development. There are no known rare or endangered plant species in this area. Two protected species are located near the outlet of the existing tidal channel as referenced in Section 7 will be transplanted due to the development.

Western Roadway Connections

8.9.5 This area of the PSKDA is primarily existing agricultural land consisting of small plots, shrubby borders occasional fruit trees and some larger trees. In general, however, it is anticipated that most vegetation in this area will be removed as a result of the project. Some existing vegetation may be retained if it falls within the tertiary education expansion area (depending on CUHK intentions). There are no known rare or endangered plant species in this area. Also, the existing gently sloping landforms in this area will be modified and levelled to create flat building pools for future development.

Surrounding Landscape / Landforms

The backdrop of hills and ridges surrounding the project site have been substantially altered from their natural condition by the construction of the Chinese University buildings on the southern ridge and the beer hill residential development to the north. Smaller scale village house developments have also modified the natural hillsides and ridge lines. The hillside areas between the developments are wooded and form a generally green backdrop to the project. This green backdrop will be augmented and extended into the project through the landscaped open spaces and street tree planting proposed for the project. The landform of the development is essentially a flat plateau that will form a base between the surrounding hills and the sea. With proper grading and landscape in the transition area the project will be compatible with the surrounding development. (See the Visual Impact Assessment for additional information on the surrounding environment and development).

Landscape Mitigation

8.9.6 The loss of the existing vegetation as a result of the project or described above is not considered to be significant and will be offset by the planting of thousands of new trees, shrubs and groundcover as part of the project. The proposed landscaping plans for the shoreline promenade, highway access ramps and perimeter roadways will, in time, create a much more desirable visual landscape then currently exists. The grading and landscape of the transition areas between the project and the surrounding landscape will help to create a compatible new environment within acceptable tolerances for new development. The overall impact of the project on the surroundings will be greatly mitigated by the proposed landscape treatments that create a green buffer and extended "Fingers" of green to the sea. The Master Landscape Plan shown in *Figure 8.9a* highlights the areas within the PSKDA with new planting.

8.10 Conclusions

Visual Impacts

8.10.1 The final VIA using three-dimensional modelling outputs of the Preferred Development Concept to test the case studies followed by actual photomontages to assimilate PSKDA in its fully developed state has revealed no detrimental visual effects on the surrounding VSRs.

8.10.2 The developments on the PSKDA will impose a visual impact onto the surrounding VSRs. However, through careful planning and appropriate massing hierarchy, interesting profiles and focal nodes softened with green open spaces will emerge to ultimately present a lush semi-urban setting.

8.10.3 Control measures to reduce visual impacts have already been incorporated into the Preferred Development Concept and further refined for the RODP.

8.10.4 The findings of the Visual Impact Assessment indicates that the visual impacts of the PSKDA on the surrounding VSRs is not considered unacceptable given the need to develop the area.

Landscape Impacts

8.10.5 The loss of the existing vegetation as a result of the PSKDA is not considered to be significant and will be offset by the planting of thousands of new trees, shrubs and groundcover as part of the project. The proposed development will replace the shoreline with a promenade. The proposed landscaping plans for the shoreline promenade, highway access ramps and perimeter roadways will, in time, create a much more desirable visual landscape then currently exists. The grading and landscape of the transition areas between the project and the surrounding landscape will help to create a compatible new environment within acceptable tolerances for new development. The overall impact of the project on the surroundings will be greatly mitigated by the proposed landscape treatments that create a green buffer and extended "Fingers" of green to the sea.

9 ENVIRONMENTAL MONITORING & AUDIT

9.1 Introduction

9.1.1 This section presents a brief summary of the Environmental Monitoring and Audit (EM&A) requirements that have been included into the separate EM&A Manual for the Project. This Section describes the necessary EM&A requirements based on the findings of the assessment in the previous sections of this report. As discussed in Sections 3 to 9, construction impacts will lead to exceedance of environmental criteria and therefore EM&A at the affected sensitive receivers are recommended, as summarised below. The Manual also covers general audit requirements in relation to water quality, waste management, ecology and landscaping mitigation measures.

9.2 Objectives of Environmental Monitoring & Audit

9.2.1 The objectives of carrying out EM&A for the Project include the following:

- to provide a database against which any short or long term environmental impacts of the project can be determined;
- to provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- to monitor the performance of the project and the effectiveness of mitigation measures;
- to verify the environmental impacts predicted in the EIA Study;
- to determine project compliance with regulatory requirements, standards and government policies;
- to take remedial action if unexpected problems or unacceptable impacts arise; and
- to provide data to enable an environmental audit.

The following sections summarises the recommended EM&A requirements proposed.

9.3 Noise

9.3.1 Noise produced during the construction phase will impact upon nearby noise sensitive receivers (NSRs) as assessed in *Section 3*. The primary noise sources include dredgers, barges, bulldozers, excavators, dump trucks, loaders and rollers. The construction noise criteria of 75 dB(A) will be exceeded at some of the representative NSRs if construction noise is unmitigated.

9.3.2 It is anticipated that if the mitigation measures described in *Sections 3.5.14 to 3.5.32* can be successfully applied, the noise levels experienced by the affected receivers will be reduced to within the noise criteria.

9.3.3 Noise monitoring requirements have been recommended in the EM&A Manual in order to ensure compliance with the criteria. It is recommended that noise monitoring be carried out as part of the EM&A programme during the construction period of the PSKDA at locations presented in *Table 9.3a* and any additional locations considered necessary, in agreement with the Environmental Protection Department (EPD). The monitoring locations are shown in *Figure 9.3a*

Table 9.3a Noise Monitoring Stations

Noise Monitoring Station	Noise Monitoring Location
NM1	CUHK Staff Accommodation
NM2	CUHK Residence No. 10
NM3	Cheung Shue Tan Village
NM4	Tsiu Hang Village
NM5	Deerhill Bay Development
NM6	Possible Tertiary Education Institution in Area 39
NM7	Residential Development (High Density) - R2
NM8	CUHK Chi Campus Block C24

Baseline Monitoring

9.3.4 Baseline noise monitoring should be carried out prior to the commencement of the construction works. The baseline monitoring should be carried out daily for a period of at least two weeks.

Impact Monitoring

9.3.5 Noise monitoring should be carried out at all the designated monitoring stations. The monitoring frequency shall depend on the scale of the construction activities. The following is an initial guide on the regular monitoring frequency for each station on a per week basis when noise generating activities are underway:

- one set of measurements between 0700-1900 hours on normal weekdays;
- one set of measurements between 1900-2300 hours;
- one set of measurements between 2300-0700 hours of next day; and
- one set of measurements between 0700-1900 hours on holidays.

9.3.6 General construction work carrying out during restricted hours is controlled by CNP system under the NCO.

9.3.7 The monitoring is required to ensure compliance with the EIAO in providing feedback to the Contractors for the management of their operations. The EM&A programme will be presented separately in the EM&A Manual.

9.4 Air Quality

9.4.1 Construction work will lead to dust (total suspended particulates (TSP)) emissions, mainly from bulldozing, excavation, truck haulage and material handling activities. It is predicted that the dust generated will exceed the hourly criteria of 500 ug m^{-3} at some ASRs.

9.4.2 Mitigation measures have been recommended in *Section 4.5.24 to 4.5.26* to limit the dust emission and dispersion. With proper dust control measures as part of good construction site practice, the TSP levels at the affected air sensitive receivers will comply with the dust criteria.

9.4.3 Dust monitoring requirements have been recommended in the EM&A Manual to ensure the efficacy of the control measures. It is recommended that dust monitoring be carried out as part of the EM&A programme during the construction period of the PSKDA at the locations presented in *Table 9.4a* and any additional locations considered necessary, in agreement with the Environmental Protection Department (EPD). The monitoring locations are shown in *Figure 9.4a*

Table 9.4a Air Quality Monitoring Stations

Air Quality Monitoring Stations	Monitoring Location
AM1	HKIB Staff Accommodation
AM2	Cheung Shue Tan Village
AM3	Villa Castell
AM4*	SW edge of Stage II reclamation

Note: * AM4 monitoring will not commence until the formation of nullah is finished.

Baseline Monitoring

9.4.4 Baseline monitoring should be carried out at all of the designated monitoring locations for at least 14 consecutive days prior to the commissioning of the construction works to obtain daily 24-hr TSP samples. 1-hr sampling shall also be done at least 3 times per day while the highest dust impact is expected.

Impact Monitoring

9.4.5 Impact monitoring should be carried out during the course of the Works. For regular impact monitoring, the sampling frequency of at least once in every six-days, shall be strictly observed at all the monitoring stations for 24-hr TSP monitoring. For 1-hr TSP monitoring, the sampling frequency of at least three times in every six-days should be undertaken when the highest dust impact occurs.

9.4.6 The monitoring is required to ensure compliance with the EIAO in providing feedback to the Contractors for the management of their operations. The EM&A programme will be presented separately in the EM&A Manual.

9.5 Water Quality

9.5.1 SS impact caused by the construction of the Northern and Southern Access Road have been assessed using the same methodology as the PSKRPD EIA for consistency, and additional mitigation measures for Southern Access Road have been recommended in *Sections 5.5.42. to 5.5.48.*

9.5.2 Water quality monitoring requirements have been recommended in the EM&A Manual to ensure the efficacy of the control measures. It has been recommended that water quality monitoring be carried out as part of the EM&A programme during the construction period of the PSKDA at locations summarised in *Table 9.5a* and shown in *Figure 9.5a.*

Table 9.5a Water Quality Monitoring Stations

Station Description	**HK Metric Grid E**	**HK Metric Grid N**	**Code**
Southern Access Reclamation	831725	840250	WM1
Southern Access Reclamation	831350	840150	WM2
Sha Tin WSD Seawater Pumping Station	830300	840200	WM3
MSL (existing)	831120	840200	WM4
MSL (reprovisioned)	831413	840270	WM5
Control Station within Tolo Harbour	830000	840370	C1
Control Station within Tolo Harbour	831685	840482	C2

Baseline Monitoring

9.5.3 Baseline conditions for water quality shall be established and agreed with EPD prior to the commencement of works. The purposes of the baseline monitoring are to establish ambient conditions prior to the commencement of the works and to demonstrate the suitability of the proposed impact, control and reference monitoring stations. The baseline conditions shall normally be established by measuring the water quality parameters specified below:

- Dissolved oxygen (DO) (in mg l^{-1} and % saturation)
- Temperature (°C)
- pH value
- Turbidity (NTU)
- Water depth (m)
- Salinity (mg l^{-1})
- Suspended Solids (SS) (mg l^{-1})
- Ash-free dry weight of SS (mg l^{-1})
- Chlorophyll a ($\mu g\ l^{-1}$)
- Total Lead ($\mu g\ l^{-1}$)
- Ammoniacal nitrogen (mg l^{-1})
- Total phosphate (mg l^{-1})

9.5.4 The measurements should be taken at all designated monitoring stations including control stations, 3 days per week, at mid-flood and mid-ebb tides, for four weeks prior to the commencement of marine works.

Impact Monitoring

9.5.5 During the course of the marine works for the Southern Access Road Reclamation, monitoring should be undertaken three days per week, at mid-flood and mid-ebb tides, with sampling/measurement at the designated monitoring stations. The interval between two sets of monitoring shall not be less than 36 hours except where there are exceedances of Action and/or Limit levels, in which case the monitoring frequency will be increased.

9.5.6 Samples shall be taken at 1 m below the surface, mid-water depth and 1 m above the seabed at both mid-flood and mid-ebb tide. If the water depth is less than 6 m, the mid-depth measurement may be omitted subject to the approval of the Engineer. If the depth is less than 3 m, only the mid-depth measurement need to be taken subject to the approval of the Engineer.

9.5.7 Upon completion of all marine activities, a post project monitoring exercise on water quality shall be carried out for four weeks in the same manner as the impact monitoring.

9.5.8 The monitoring is required to ensure compliance with the EIAO in providing feedback to the Contractors for the management of their operations. The EM&A programme will be presented separately in the EM&A Manual.

9.6 Waste Management

9.6.1 It has been recommended that auditing of each waste stream should be carried out periodically by the PSKDA contractor to determine if wastes are being managed in accordance with approved procedures and the site waste management plan. The audits should look at all aspects of waste management including waste generation, storage, recycling, treatment, transport, and disposal. An appropriate audit programme would be to undertake a first audit at the commencement of the construction works, and then to audit quarterly thereafter.

9.7 Ecology

9.7.1 The mitigation measures should be included into contract clauses for the PSKDA development. The implementation of the measures should be checked as part of the environmental monitoring and audit procedures during the construction period, the procedures of which are presented in the EM&A Manual.

10 OVERALL CONCLUSIONS

10.1 Introduction

10.1.1 This EIA Study was undertaken for the PSKDA to undertake a detailed assessment of the RODP to ensure that it complied with the *Environmental Impact Assessment Ordinance* (EIAO), *Technical Memorandum on Environmental Impact Assessment Process* (EIAOTM), *Hong Kong Planning Standards & Guidelines* (HKPSG) and other relevant government criteria. A summary of each of the issues assessed are given below. In addition, an impact summary table has been included to summarise the key findings of the study and to recommend any further studies assessment as part of the investigation and detailed design stage.

10.2 Noise

Construction Phase

10.2.1 Unmitigated construction activities of PSKDA would cause exceedances of the daytime construction criteria of 75 dB(A) at the nearby NSRs during the weekday daytime hours as well as the 70 dB(A) noise criteria for schools. The worst affected NSRs during the Stage 2 and 3 construction are NSRs N1 to N3 (CUHK Staff Accommodation, CUHK and Cheung Shue Tan Village) and NSRs N2, N4 to N5 (CUHK, Tsiu Hang Village and Deerhill Bay) respectively; while the planned NSRs within PSKDA, N8 and N9 (Tertiary Education Institution in Area 39 and low density residential development) are the worst affected NSRs during the Stage 4 construction.

10.2.2 It is therefore recommended that adequate control measures will be necessary for the works to meet the criteria. It is recommended that mitigation measures including the use of quiet plant, on-site movable noise barriers, limiting the number of plant operating concurrently are required. It is also recommended that regular monitoring of noise as part of the EM&A programme which will be presented in a separate EM&A Manual at NSRs will be required during the construction phase.

10.2.3 If construction works are to be carried out during restricted hours (19:00 - 07:00 hours on weekdays and all hours on Sundays and Public Holidays), further mitigation measures will be required. Such work will require the granting of a Construction Noise Permit by the EPD.

Operational Phase

10.2.4 Without mitigation adverse road traffic noise impacts are predicted at both the existing and planned NSRs. A 5 m high cantilevered road side noise barrier is recommended along Road D1 adjacent to the CUHK Staff Accommodation to mitigate the noise impact caused by the nearby road networks. As a requirement of *Section 6.6.5e* of the Brief, a review of the adequacy of direct mitigation measures proposed in the Tolo Highway Widening Project (Agreement No. CE 35/95) was undertaken. If the use of direct measures were not found to be adequate nor feasible, appropriate indirect mitigation measure should be recommended and incorporated into the RODP. This study recommended a package of 8 m roadside cantilevered barriers and 5 m central barriers and agreed with government in November 1997 and gazetted as part of the THW Project.

10.2.5 For the planned PSKDA residential developments, the use of road side noise barriers along local roads were considered to be effective in mitigating the noise levels at the low level receivers. In addition, it was considered that the noise exceedances could be mitigated by careful building layout and design such as increasing setback distance. Where the size of the site was a constraint, the use of direct measures were not found to be impracticable for the local road network and as a last resort, the use of window insulation were recommended. Similarly, the planned schools development are constrained by road traffic noise. Due to the size of the site, the use of window insulation was found to be the most practicable solution.

10.2.6 Potential noise impacts associated with the KCRC rail and the operation of the ESS, RCP, sewage pumping station, public interchange, public landing steps and fire tug pier have been assessed. The assessment showed that both the rail and other operational noise sources will not be a constraint upon the PSKDA.

10.3 Air Quality

Construction Phase

10.3.1 Fugitive Dust Modelling was undertaken for two worst case scenarios year 2001 and 2004. For FDM undertaken for the PSKDA and PSK Reclamation, both scenarios the dust levels predicted at all ASRs will comply with both the 1-hour and 24-hour TSP dust criteria. However, for the year 2001 scenario, high TSP dust levels were predicted at the HKIB (A1) and HKIB Staff Accommodation (A2). For the year 2001 scenario, cumulative dust modelling was undertaken to take into account the concurrent Tolo Highway Widening works.

10.3.2 Cumulative dust levels in excess of the TSP criterion were predicted under certain dry conditions at some ASRs during the construction phase in the year 2001, due to the close proximity of the ASRs to the construction sites of Marine Science Laboratory and the Science Park - Phase 1.

10.3.3 For the year 2004, TSP dust levels attributed to the Stage II Reclamation (Remaining) and Science Park (Phase II) construction will also be high, but are not expected to exceed TSP dust criterion.

10.3.4 Dust suppression measures have been recommended which included the Air Pollution Control (Construction Dust) Regulation to be included in the Contract Specification to minimize dust nuisance arising from the PSKDA and PSK Reclamation. The TSP dust criterion will be achieved at all ASRs with the incorporation of the proposed mitigation measures. EM&A have also been recommended to ensure the TSP dust criteria would be complied at the ASRs and will be presented separately in the EM&A Manual.

10.3.5 The PSK Reclamation for Filling will not result in odour impacts due to the extension of the existing nullah as part of the PSK Reclamation Stage III reclamation works to divert discharges away from the temporarily open body of water comprising the Stage II (Remaining) area.

Operational Phase

10.3.6 Setback distances from Tolo Highways have already been incorporated into the RODP during the Planning Study. Due to the incorporation of these setbacks, the air quality in the PSKDA and all ASRs will comply with the AQO requirements.

10.3.7 The sewerage pumping stations and equalization tank proposed for the PSKDA will be underground and enclosed and any odour generated by the plant should therefore not cause an odour nuisance to the surrounding sensitive receivers.

10.4 Water Quality

Construction Phase

10.4.1 The potential environmental impacts caused from the construction of the reclamation through public filling activities have already been assessed in the previously endorsed PSKRPD EIA. However, due to a proposed change in reclamation staging proposed in PSKDA Study Working Paper ET/02, a PSKDA Demonstration Paper entitled "Demonstration Paper on Environment due to Change of Reclamation Sequence" was submitted to assess the changes proposed.

10.4.2 The PSKDA Study Demonstration Paper has shown that the proposed changes in reclamation staging will not result in water quality impacts greater than previously predicted in the PSKRPD EIA and thus the previously proposed mitigation measures will be sufficient to protect receiving water quality during public filling.

10.4.3 The SS impact caused by the construction of the Northern and Southern Access Road is assessed using the same methodology as the PSKRPD EIA and additional mitigation measures for Southern Access Road are recommended.

10.4.4 The construction phase assessment, therefore, concludes that residual insurmountable water quality impact should not eventuate from PSKDA proposed construction, assuming mitigation is incorporated, as described.

Operational Phase

10.4.5 The formation of a new coastline configuration will not lead to water quality or movement impacts associated with changes in local and far field water movement patterns which has been examined in previous PSKRPD EIA.

10.4.6 No residual water quality impact to the PSKDA is anticipated from the proposed operation of PSKDA KCRC Station alignment, provided that proper mitigation measures are implemented.

10.4.7 As the Science Park will comprise only high technology based and Research and Development businesses and as the conditions of the WPCO discharge licences for all Science Park operators will have to be followed, residual water quality impact from the Science Park will not eventuate.

10.4.8 It is expected that the increased sewage due the proposed population on PSKDA will be served by the Sha Tin STW for treatment and disposal. However, due to the capacity at the Sha Tin STW, an equalization tank at PSKDA will be used in the interim until upgrading works have been completed by 2003.

10.5 Waste Management

Construction Phase

10.5.1 It is considered that only 2,800 m^3 of construction and demolition wastes will be generated and that any excess excavated material will primarily comprise previously filled materials and should therefore be suitable for re-use for later phase of the PSK Reclamation. It is considered also that construction, chemical and general refuse impacts should be no greater than for other developments of a similar scale and therefore, should be amenable to the standard mitigation measures recommended.

10.5.2 The quality of marine mud to be dredged for reclamation of the Southern Access Road are presently not be available for this Study and will need to be determined as part of this Site Investigation works.

Operational Phase

10.5.3 It is presently understood that the various developments proposed for the PSKDA will include the Science Park, residential development, recreational uses and a potential KCR station, based on the Preferred Development Concept. An estimated 36.8 tonnes of potential waste will be generated by the PSKDA, based on the RODP. Mitigation measures and strategies to minimise waste have been assumed to be applicable as they have in the past to similar types of developments. There is no information to suggest that waste impacts during the operational phase will not be amenable to the standard forms of mitigation.

10.5.4 In addition the Science Park could also generate chemical waste. However, from the Science Park Study, the Science Park is likely to comprise IT related uses, biotechnical and advanced engineering type industries. Within these industries, the types of activities are likely to comprise research type activities with limited manufacturing and development. This will limit the potential environmental impacts generated by the Science Park. It is recommended that further review of the potential waste generated by the Science Park at the detailed design stage be undertaken to ensure that appropriate waste handling facilities are incorporated.

10.6 Ecology

Terrestrial Ecology

10.6.1 Based on literature review of previous relevant reports and recent field surveys, the existing baseline ecological condition of the PSKDA site is considered poor with limited ecological value. The PSKDA to be developed on the present reclaimed land is expected to have low ecological impact.

10.6.2 Mitigation measures for the PSKDA development in relation to transplanting the two protected plant species and good construction practice to minimise disturbance to the surrounding environment are recommended, and no residual impact is anticipated.

Marine Ecology

10.6.3 A review of existing information on the marine ecological resources located within and around the PSKDA has identified the area as supporting soft bottom benthic assemblages, rocky intertidal assemblages, fish and pelagic invertebrates few of which are of high commercial value. The subtidal benthic habitat of the area is considered to of low ecological value and the reclamation is considered to have a low ecological impact given the poor water quality in Tolo Harbour and the documented degradation that has occurred to benthic communities since the 1970s.

10.6.4 Fisheries resources in Tolo Channel, although abundant in comparison with other areas in Hong Kong, are dominated by small and low value species. The review identified an important nursery ground to the east of the PSKDA area at Wu Kwai Sha and at East Yim Tin Tsai. As sediment from the reclamation will settle within a 1 km radius of the PSKDA, no impacts were predicted at this sensitive receiver. Although the large home port of Yim Tin Tsai is close to the PSKDA, few vessels regularly fish in the vicinity of the works area or are dependent on it for catches. Potential impacts to fisheries resources and fishing operations were considered to be low and acceptable.

10.6.5 Intertidal habitats appear to be diverse and the existing man - made shore will be lost during the reclamation. However, any loss of habitat in the area can be mitigated, wherever possible, through seawall design. By ensuring that a gently sloping seawall that is heterogeneous in nature (ie high numbers of crevices and holes) is used at the edge of the reclamation, an assemblage of similar nature to that present, will establish.

10.6.6 Based on the information presented in this assessment no impacts are predicted to occur to marine mammals as a result of the PSKDA.

10.6.7 Mitigation measures for the PSKDA development and good construction practice to minimise disturbance to the surrounding environment are recommended, and no residual impact is anticipated.

10.7 Visual and Landscape Impact

Visual Impacts

10.7.1 The final VIA using three-dimensional modelling outputs of the RODP to test the case studies followed by actual photomontages to assimilate PSKDA in its fully developed state has revealed no detrimental visual effects on the surrounding VSRs. The developments on the PSKDA will impose a visual impact onto the surrounding VSRs. However, through careful planning and appropriate massing hierarchy, interesting profiles and focal nodes softened with green open spaces will emerge to ultimately present a lush semi-urban setting. Control measures to reduce visual impacts have already been incorporated into the RODP.

10.7.2 The findings of the Visual Impact Assessment indicates that the visual impacts of the PSKDA on the surrounding VSRs is not considered unacceptable given the need to develop the area.

Landscape Impacts

10.7.3 The loss of the existing vegetation as a result of the PSKDA is not considered to be significant and will be offset by the planting of thousands of new trees, shrubs and groundcover as part of the project. The proposed development will replace the shoreline with a promenade. The proposed landscaping plans for the shoreline promenade, highway access ramps and perimeter roadways will, in time, create a much more desirable visual landscape which currently exists. The grading and landscape of the transition areas between the project and the surrounding landscape will help to create a compatible new environment within acceptable tolerances for new development. The overall impact of the project on the surroundings will be greatly mitigated by the proposed landscape treatments that create a green buffer and extended "Fingers" of green to the sea.

10.8 Overall Conclusion

10.8.1 The findings of this EIA has provided information on the nature and extent of environmental impacts arising from the construction and operation of the PSKDA. The EIA has, where appropriate, identified mitigation measures to ensure compliance with environmental legislation and standards.

10.8.2 The environmental input to the PSKDA Study has also provided continuous environmental planning input, from the study inception to ensure that necessary environmental consideration has been incorporated into the RODP. In particular, suitable noise and air quality mitigation measures have been recommended to ensure proposed sensitive receivers are within the standards specified in the *Hong Kong Planning Standards and Guidelines* (HKPSG).

10.8.3 A impacts summary of the key findings of the study are given in *Table 10.8a*.

10.8.4 The findings of the EIA Report indicate that the PSKDA, with the recommended good housekeeping practice and mitigation measures, will comply with the Government environmental criteria. The environmental mitigation requirements should be incorporated into the Contract Specifications of the PSKDA. *Table 10.8b* presents the environmental implementation schedule of the Project. The recommended environmental monitoring and audit (EM&A) procedures will ensure the efficiency of the environmental control measures as detailed in the separate EM&A Manual.

Table 10.8a EIA Report Impacts Summary

Issue	Construction Phase	Operational Phase
Noise	Unmitigated construction activities of PSKDA were predicted to cause exceedances of the daytime construction criteria at the nearby NSRs. Suitable control measures were recommended including the use of quiet plant, on-site movable noise barriers, limiting the number of plant operating concurrently will be required. It is also recommended that regular monitoring of noise as part of the EM&A programme.	Without mitigation, adverse road traffic noise impacts are predicted at both the existing and planned NSRs. A 5 m high cantilevered road side noise barrier is recommended along Road D1 adjacent to the CUHK Staff Accommodation to mitigate the noise impact caused by the nearby road networks. A package of 8 m roadside cantilever barriers and 5 m central barriers and agreed with government in November 1997 and gazetted as part of the THW Project. For the planned PSKDA residential developments, it was considered that the noise exceedances could be mitigated by careful building layout and design such as increasing setback distance. As a last resort, the use of window insulation were recommended. Similarly, the planned schools development are constrained by road traffic noise and the use of window insulation was found to be the most practicable solution. Potential noise impacts associated with the KCRC rail and the operation of the ESS, RCP, sewage pumping station, public interchange, public landing steps and fire tug pier have been assessed. The assessment showed that both the rail and other operational noise sources will not be a constraint upon the PSKDA.
Air Quality	Fugitive Dust Modelling was undertaken for the worst case scenarios year 2001 and 2004 and predicted that dust levels will comply with TSP dust criteria at all ASRs for both scenarios. For the year 2001, cumulative dust modelling was undertaken to take into account the concurrent Tolo Highway Widening works. Results of cumulative assessment predicted that under certain dry conditions there would be an exceedance of the TSP dust criteria at some ASRs. The TSP dust criteria will be achieved at all ASRs with the incorporation of the proposed mitigation measures which included the Air Pollution Control (Construction Dust) Regulation. EM&A have also been recommended to ensure the TSP dust criteria would be complied at the ASRs and will be presented separately in the EM&A Manual.	Setback distances from Tolo Highway have been already been incorporated into the RODP during the Planning Study. Due to the incorporation of these setbacks, the final assessment indicates that the air quality at the planned and existing ASRs will comply with the AQO requirements. In terms of odour impacts, the sewerage pumping station proposed for the PSKDA will be underground and enclosed and any odour generated by the plant should therefore not cause an odour nuisance to the surrounding sensitive receivers.

Issue	Construction Phase	Operational Phase
Water Quality	The potential environmental impacts caused from the construction of the reclamation through public filling activities have already been assessed in the previously endorsed PSKRPD EIA. However, proposed changes in reclamation staging will not result in water quality impacts greater than previously predicted in the PSKRPD EIA and thus the previously proposed mitigation measures will be sufficient to protect receiving water quality during public filling. The SS impact caused by the construction of the Northern and Southern Access Road is assessed using the same methodology as the PSKRPD EIA and additional mitigation measures for Southern Access Road are recommended.	The formation of a new coastline configuration will not lead to water quality or movement impacts associated with changes in local and far field water movement patterns which has been examined in previous PSKRPD EIA. As the Science Park will comprise only high technology based and Research and Development businesses and as the conditions of the WPCO discharge licences for all Science Park operators will have to be followed, residual water quality impact from the Science Park will not eventuate. It is expected that the increased sewage due the proposed population on PSKDA will be served by the Sha Tin STW for treatment and disposal. However, due to the capacity at the Sha Tin STW, an equalization tank at PSKDA will be used in the interim until upgrading works have been completed by 2003.
Waste Management	It is considered that only 2,800 m^3 of construction and demolition wastes will be generated and that any excess excavated material will primarily comprise previously filled materials and should therefore be suitable for re-use for later phase of the PSK Reclamation. It is considered also that construction, chemical and general refuse impacts should be no greater than for other developments of a similar scale and therefore, should be amenable to the standard mitigation measures recommended. The quality of marine mud to be dredged for reclamation of the Southern Access Road are presently not be available for this Study and will need to be determined as part of this Site Investigation works.	An estimated 36.8 tonnes of potential waste will be generated by the PSKDA, based on the RODP. Mitigation measures and strategies to minimise waste have been assumed to be applicable as they have in the past to similar types of developments. There is no information to suggest that waste impacts during the operational phase will not be amenable to the standard forms of mitigation. In addition the Science Park could also generate chemical waste. However, from the Science Park Study, the Science Park is likely to comprise IT related uses, biotechnical and advanced engineering type industries. Within these industries, the types of activities are likely to comprise research type activities with limited manufacturing and development. This will limit the potential environmental impacts generated by the Science Park. It is recommended that further review of the potential waste generated by the Science Park at the detailed design stage be undertaken to ensure that appropriate waste handling facilities are incorporated.

Issue	Construction Phase	Operational Phase
Ecology	*Terrestrial Ecology* Based on literature review of previous relevant reports and recent field surveys, the existing baseline ecological condition of the PSKDA site is considered poor with limited ecological value. The PSKDA to be developed on the present reclaimed land is expected to have low ecological impact. Mitigation measures for the PSKDA development in relation to transplanting the two protected plant species and good construction practice to minimise disturbance to the surrounding environment are recommended, and no residual impact is anticipated. *Marine Ecology* A review of existing information on the marine ecological resources located within and around the PSKDA has identified the area as supporting soft bottom benthic assemblages, rocky intertidal assemblages, fish and pelagic invertebrates few of which are of high commercial value. The subtidal benthic habitat of the area is considered to of low ecological value and the reclamation is considered to have a low ecological impact given the poor water quality in Tolo Harbour and the documented degradation that has occurred to benthic communities since the 1970s. Fisheries resources in Tolo Channel, although abundant in comparison with other areas in Hong Kong, are dominated by small and low value species. Potential impacts to fisheries resources and fishing operations were considered to be low and acceptable. Intertidal habitats appear to be diverse and the existing man - made shore will be lost during the reclamation. However, any loss of habitat in the area can be mitigated, wherever possible, through seawall design. By ensuring that a gently sloping seawall that is heterogeneous in nature (ie high numbers of crevices and holes) is used at the edge of the reclamation, an assemblage of similar nature to that present, will establish. Based on the information presented in this assessment no impacts are predicted to occur to marine mammals as a result of the PSKDA.	

Issue	Construction Phase	Operational Phase
Visual and Landscape Impact		The final VIA using three-dimensional modelling outputs of the RODP to test the case studies followed by actual photomontages to assimilate PSKDA in its fully developed state has revealed no detrimental visual effects on the surrounding VSRs. The developments on the PSKDA will impose a visual impact onto the surrounding VSRs. However, through careful planning and appropriate massing hierarchy, interesting profiles and focal nodes softened with green open spaces will emerge to ultimately present a lush semi-urban setting. Control measures to reduce visual impacts have already been incorporated into the RODP. The loss of the existing vegetation as a result of the PSKDA is not considered to be significant and will be offset by the planting of thousands of new trees, shrubs and groundcover as part of the project. The proposed landscaping plans for the shoreline promenade, highway access ramps and perimeter roadways will, in time, create a much more desirable visual landscape then currently exists. The grading and landscape of the transition areas between the project and the surrounding landscape will help to create a compatible new environment within acceptable tolerances for new development. The overall impact of the project on the surroundings will be greatly mitigated by the proposed landscape treatments that create a green buffer and extended "Fingers" of green to the sea.

Table 10.8b *Environmental Mitigation Implementation Schedule for Construction Phase*

Location	Reference Section	Mitigation Measure	Agent	Timing
TDD Assume Responsibility For The Implementation Of All The Measures				
Noise				
Within the PSKDA Study Boundary	Section 3.5.14 - 32, Table 3.5f	Environmental pollution control measures for minimising construction impacts.	TDD	During the construction period (2001 to 2007)
Southern Access Reclamation	Section 3.5.14 - 32	Environmental pollution control measures for minimising construction impacts.	TDD	During the construction period (2001-2002)
Reclamation Stage III	Table 3.5d, Table 3.5f	Use of quiet PME	CED	During the construction period (2A)
Roadworks for Southern Access - Stage I (1)	Section 3.5.27, 3.5.29, Table 3.5d, Table 3.5f	Use of quiet PME, replacing the dump truck by lorry and the use of movable noise barriers located close to excavator and loader during the roadworks activities	TDD	During the construction period (2B)
Roadworks for Southern Access - Stage II	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (3C)
Reclamation for Southern Access - Stage II	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (3D)
Sewerage Pumping Station (1)	Section 3.5.27, 3.5.29, Table 3.5d, Table 3.5f	Use of quiet PME, reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works and the use of movable noise barriers located close to large diameter bored pile, excavator, breaker, generator, concrete lorry mixer, crane, saw, compressor and various hand tools during the structural works	TDD	During the construction period (2C)
Marine science Laboratory (1)	Section 3.5.27, 3.5.29, Table 3.5d, Table 3.5f	Use of quiet PME, reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works and the use of movable noise barriers located close to large diameter bored pile, excavator, breaker, generator, concrete lorry mixer, crane , saw, compressor and various hand tools during the structural works	TDD	During the construction period (2D)
Reclamation for Northern Access	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (2E)
Roadworks for Northern Access	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (2F)

(1) only one of 2B, 2C and 2D construction activities should be carried out during any one time

Location	Reference Section	Mitigation Measure	Agent	Timing
TDD Assume Responsibility For The Implementation Of All The Measures				
Southern Access - Subway	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (2G)
Widening of Tolo Highway	Table 3.5d, Table 3.5f	Use of quiet PME, replacing the dump truck by lorry	HyD	During the construction period (2I)
Science Park	Section 3.5.14 - 32, Table 3.5f	Environmental pollution control measures for minimising construction impacts	Science Park Corporation	During the construction period (from 1999)
Science Park Construction - Phase I	Table 3.5d, Table 3.5f	Use of quiet PME and replacing the dump truck by lorry	TDD	During the construction period (2H)
Science Park Construction - Phase II	Table 3.5d, Table 3.5f	Use of quiet PME and reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works.	TDD	During the construction period (4D)
Recreational Facility	Section 3.5.14 - 32, Table 3.5f	Environmental pollution control measures for minimising construction impacts.	HKTA	During the construction period (from 2005)
Site Development - Recreational Facility	Table 3.5d, Table 3.5f	Use of quiet PME and reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works.	TDD	During the construction period (4C)
Residential Development (Sites A-D)	Section 3.5.14 - 32, Table 3.5d, Table 3.5f	Environmental pollution control measures for minimising construction impacts.	Developer	During the construction period
Stage III reclamation Site Development - R1	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (3F)
Stage III reclamation Site Development - R2	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (3G)
Stage II reclamation Site Development - R2	Table 3.5d, Table 3.5f	Use of quiet PME and reducing the number of large diameter bored pile to one and replacing the dump truck by lorry during the structural works	TDD	During the construction period (4B)
Educational Facility	Section 3.5.14 - 32, Table 3.5f	Environmental pollution control measures for minimising construction impacts	ASD	During the construction period
Pak Shek Kok Nullah Extension	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (3B)
Roadworks for Road D1, L1, L2, L5, L6 and L7	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (3E)
Roadworks for Remainder Road	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (4A)

Location	Reference Section	Mitigation Measure	Agent	Timing
TDD Assume Responsibility For The Implementation Of All The Measures				
Stage III reclamation Site Development - G/IC	Table 3.5d, Table 3.5f	Use of quiet PME	TDD	During the construction period (3H)
Air Quality				
Within the PSKDA Study Boundary	Section 4.5.26 - 27	Environmental pollution control measures for minimising construction impacts.	TDD	During the construction period (2001 to 2007)
KCRC Station	Section 4.5.26 - 27	Environmental pollution control measures for minimising construction impacts.	KCRC	na
Southern Access Reclamation	Section 4.5.26 - 27	Environmental pollution control measures for minimising construction impacts.	TDD	During the construction period (2001-2002)
Science Park	Section 4.5.26 - 27	Environmental pollution control measures for minimising construction impacts.	Science Park Corporation	During the construction period (from 1999)
Recreational Facility	Section 4.5.26 - 27	Environmental pollution control measures for minimising construction impacts.	HKTA	During the construction period (from 2005)
Residential Development (Sites A-D)	Section 4.5.26 - 27	Environmental pollution control measures for minimising construction impacts.	District Lands Office, Tai Po	During the construction period
Educational Facility	Section 4.5.26 - 27	Environmental pollution control measures for minimising construction impacts.	ASD	During the construction period
Water Quality				
Within the PSKDA Study Boundary	Section 5.5.40 - 45	Environmental pollution control measures for minimising construction impacts. These measures shall include stormwater Best Management Plans (BMP)s to reduce construction runoff and drainage impacts.	TDD	During the construction period (2001 to 2007)
KCRC Station	Section 5.5.42	Environmental pollution control measures for minimising construction impacts.	KCRC	na
Southern Access Reclamation	Section 5.5.40 - 42	Environmental pollution control measures for minimising construction impacts. Reduced rate of dredging for Southern Access Reclamation by increased duration to achieve reprovisioned MSL water intake SS criterion.	TDD	During the construction period (2001-2002)
Science Park	Section 5.5.42	Environmental pollution control measures for minimising construction impacts.	Science Park Corporation	During the construction period (from 1999)
Recreational Facility	Section 5.5.42	Environmental pollution control measures for minimising construction impacts.	HKTA	During the construction period (from 2005)

Location	Reference Section	Mitigation Measure	Agent	Timing
TDD Assume Responsibility For The Implementation Of All The Measures				
Residential Development (Sites A-D)	Section 5.5.42	Environmental pollution control measures for minimising construction impacts.	District Lands Office, Tai Po	During the construction period
Waste Management				
Southern Access Reclamation	Table 6.4a	Environmental pollution control measures for minimising construction impacts	TDD	During the construction period
Ecology				
Within the PSKDA Study Boundary	Section 7.10	The following mitigation measures in relation to protecting the two important plant species and good construction practice to minimise disturbance to the surrounding environment are recommended: • survey and collect individuals of the protected plant species *Spiranthes sinensis* and *Eulophia sinensis* prior to work commencement for transplanting to adjacent planting areas within the Open Space zone. • erect fences along the boundary of construction sites before the commencement of works to prevent tipping, vehicle movements, and encroachment of personnel into adjacent wooded areas; • regular checks to ensure that the work site boundaries are not exceeded and that no damage to surrounding areas; • avoid burning during construction, or such use if unavoidable should be carried out under close supervision; • prohibit wild and uncontrolled open fires within the work site boundary, and install fire fighting equipment in the work area.	TDD	During the construction period (2001 to 2007)
Visual and Landscape				
Within the PSKDA Study Boundary	Section 7.10	Mitigation measures in relation to protecting the two important plant species are referenced in Section 7.10.	TDD	During the construction period (2001 to 2007)

Table 10.8c ***Environmental Mitigation Implementation Schedule for Operation Phase***

Location	Reference Section	Mitigation Measure	Agent	Timing
TDD Assume Responsibility For The Implementation Of All The Measures				
Noise				
Tolo Highway Widening	Section 3.6.4, Figures 3.6a/1-7	5 m vertical and 8 m cantilever barrier along the Tolo Highway within the PSKDA. Details given in the Tolo Highway Widening Report.	HyD	As part of the Tolo Highway Widening Project (2001)
Southern Access Road	Section 3.6.29, Figure 3.6a/9 and Figure 3.6i	250 m long of 5 m cantilever barrier along the HKIB Staff Accommodation Building.	TDD	During the construction of Southern Access Road.
Northern Access Road	Section 3.6.34, Figure 3.6a/1, 3.6a/2 and 3.6a/6	8 m cantilever barrier along the Northern Access slip road to Tolo Highway.	HyD	During the construction of Northern Access Road
Road D1	Section 3.6.30, Figure 3.6a/8, 3.6j	2 sections of 5 m cantilever barrier of length 190 m and 230 m.	TDD	During the construction of Road D1
Electrical Substation	Section 3.6.58-63	Attenuators for Electrical Substation.	CLP	During the construction of ESS
Science Park on-site residential quarters	Section 3.4.6	Operational Noise Assessment to ensure no noise impact on NSRs.	ASD	Before the construction of residential quarters
Science Park	Sections 3.6.71	No polluting activities during operation and full compliance with Statutory Ordinances (NCO).	Science Park Corporation	From commencement of the operation period (from mid 2001)
Residential Development (Site A)	Section 3.6.7, 3.6.32, Figure 3.6k	8 m high podium all over site. 35 m setback from road edge of roundabout. 25 m setback from road edge of Road L5. Window insulations and air-conditionings for residential units expose to residual impacts.	Developer according to lease condition impose by DLO, Tai Po	During the construction of Site A
Residential Development (Site B)	Section 3.6.7, 3.6.35, Figure 3.6k	8 m high podium all over site. Window insulations and air-conditioning for residential units expose to residual impacts.	Developer according to lease condition impose by DLO, Tai Po	During the construction of Site B
Residential Development (Site C)	Section 3.6.7, 3.6.37, Figure 3.6k	8 m high podium all over site. 70 m setback from road edge of roundabout.	Developer according to lease condition impose by DLO, Tai Po	During the construction of Site C

Location	Reference Section	Mitigation Measure	Agent	Timing
TDD Assume Responsibility For The Implementation Of All The Measures				
Residential Development (Site D)	Section 3.6.7, 3.6.39, Figure 3.6k	8 m high podium all over site. Window insulations and air-conditioning for residential units expose to residual impacts.	Developer according to lease condition impose by DLO, Tai Po	During the construction of Site D
Primary School in Reclamation Stage III	Section 3.6.41	Building orientation. Window insulations and air-conditioning for classrooms and noise sensitive rooms expose to residual impacts.	ASD	During the construction of school.
Secondary School in Area 12 (part)	Section 3.6.42	Building orientation. Window insulations and air-conditioning for classrooms and noise sensitive rooms expose to residual impacts.	ASD	During the construction of school
Tertiary Educational Facility in Area 39	Section 3.6.43, 3.6.54	Operational Noise Assessment to ensure no noise impacts on NSRs.	CUHK	Before the construction of facilities
Temporary Bus Terminus	Section 3.6.69	Cover to mitigate noise generated.	HyD	During the construction of permanent Transport Interchange
Transport Interchange	Section 3.6.67-68	Cover to mitigate noise generated.	HyD	During the construction of the Transport Interchange
Minibus Stand	Section 3.6.70	Cover to mitigate noise generated.	HyD	During the construction of minibus stand
Sewage Pumping Station 1	Section 2.3.35, Figures 2.3c	Covered underground structure to minimise noise and odour impacts.	DSD	During the construction of Sewage Pumping Station 1
Sewage Pumping Station 2	Section 2.3.35, Figures 2.3c	Covered underground structure to minimise noise and odour impacts.	DSD	During the construction of Sewage Pumping Station 2
Sewage Pumping Station 3	Section 2.3.35, Figures 2.3c	Covered underground structure to minimise noise and odour impacts.	DSD	During the construction of Sewage Pumping Station 3

Location	Reference Section	Mitigation Measure	Agent	Timing
TDD Assume Responsibility For The Implementation Of All The Measures				
Air Quality				
Science Park	Section 4.6	No polluting activities during operation and full compliance with Statutory Ordinances (APCO).	Science Park Corporation	From commencement of the operation period (from mid 2001)
Temporary Bus Terminus	Section 4.4.2, 4.6.18-19	Air quality required to meet TTAQO.	HyD	2003 - construction of permanent Transport Interchange (Dependent on KCR Station)
Transport Interchange	Section 4.4.2, 4.6.18-19	Air quality required to meet TTAQO.	HyD	During Operational Phase(Dependent on KCR Station)
Water Quality				
Science Park	Section 5.6.6	No polluting activities during operation and full compliance with Statutory Ordinances (WPCO).	Science Park Corporation	From commencement of the operation period (from mid 2001)
Science Park	Section 5.6.6	Suitable treatment of wastewater prior to discharge to STW.	Science Park Corporation	During the operation period (from mid 2001)
Waste Management				
Science Park	Section 6.6.2	No polluting activities during operation and full compliance with Statutory Ordinances (WDO).	Science Park Corporation	From commencement of the operation period (from mid 2001)
Science Park	Section 6.6.12-13	Suitable handling and disposal of waste.	Science Park Corporation	During the operation period (from mid 2001)

Location	Reference Section	Mitigation Measure	Agent	Timing
TDD Assume Responsibility For The Implementation Of All The Measures				
Visual and Landscape				
Within the PSKDA Study Boundary	Section 8.8	Control measures to reduce visual impacts have been incorporated into the Preferred Development Concept as part of the SAR Report and subsequently incorporated into the RODP. The measures include the following:	TDD, Lands Department	Operation Phase
		• visual compatibility of conflicting land uses by separation of the Science Park and residential development;	already incorporated into RODP	Operation Phase
		• rejection of the residential development Plot Ratio 8 option due to the potential visual impacts on surrounding VSRs;	already incorporated into RODP	Operation Phase
		• avoidance of uniform building heights through the terracing effect of the Science Park buildings and residential developments;	already incorporated into RODP	Operation Phase
		• adoption of a well thought out architectural control guidelines to ensure visual interest;	already incorporated into RODP and MLP. Science Park Corporation and Lands Department	Operation Phase
		• provision of view corridors through the development for highway and railway users as well as potential Deerhill development residents;	already incorporated into RODP, Lands Department	Operation Phase
		• adoption of open space network mitigates the potential wall effects and provides more open and distant sightlines;	already incorporated into RODP	Operation Phase
		• imposition of maximum building height of 70 m for residential towers (plot ratio 5) including podium;	already incorporated into RODP	Operation Phase

Location	Reference Section	Mitigation Measure	Agent	Timing
		TDD Assume Responsibility For The Implementation Of All The Measures		
		- adoption of an overall building height strategy for PSKDA of locating tallest at the north to the shortest at the south, which when viewed from the harbour and Ma On Shan, presents a descending profile, in keeping with the descending ridge lines around the site.	already incorporated into RODP	Operation Phase
Within the PSKDA Study Boundary.	Section 8.9	Planting of new trees, shrubs and groundcover along the highway access ramps, perimeter roadways and cyclepath. The Master Landscape Plan shown in *Figure 8.9a* highlights the areas within the PSKDA with new planting. The management and maintenance of the proposed landscape works should refer to the "*WBTC 18/94 on the Management and Maintenance of both Natural Vegetation and Landscape Works*".	HyD	Operation Phase
		The funding arrangement for these mitigation measures have been included in the Feasibility Study as part of a fully integrated project proposal to be implemented by TDD. The funding for landscaping works is referenced in the Project Cost and Implementation Report ET/13.	TDD	Operation Phase
Within the PSKDA Study Boundary	Section 8.9	Planting of new trees, shrubs and groundcover along the open space and shoreline promenade. The Master Landscape Plan shown in *Figure 8.9a* highlights the areas within the PSKDA with new planting. The management and maintenance of the proposed landscape works should refer to the "*WBTC 18/94 on the Management and Maintenance of both Natural Vegetation and Landscape Works*".	RSD	Operation Phase
		The funding arrangement for these mitigation measures have been included in the Feasibility Study as part of a fully integrated project proposal to be implemented by TDD. The funding for landscaping works is referenced in the Project Cost and Implementation Report ET/13.	TDD	Operation Phase

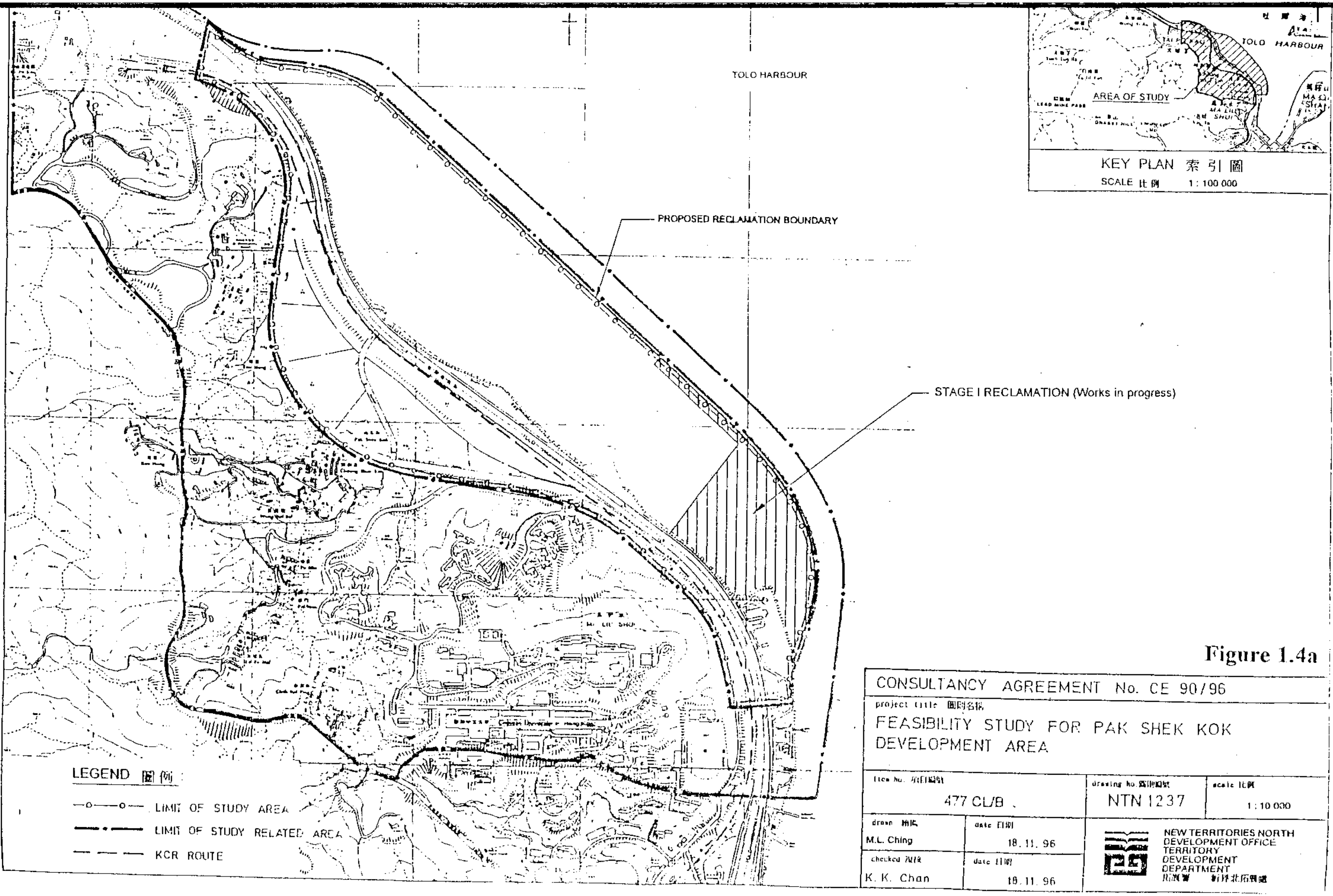
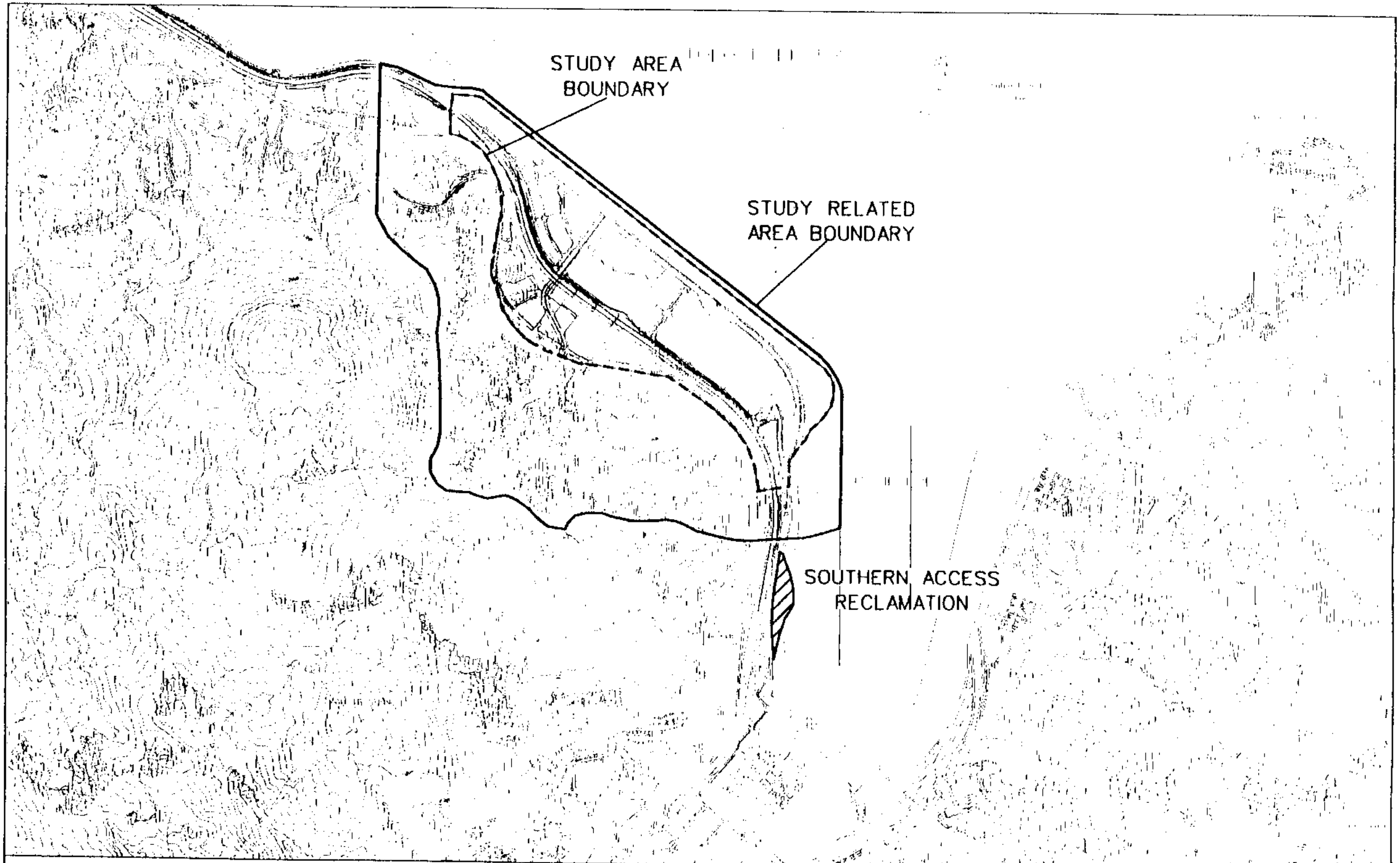


Figure 1.4a

CONSULTANCY AGREEMENT No. CE 90/96

project title 圖則名稱
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

item no. 項目編號		drawing no. 圖則編號	scale 比例
477 CL/B		NTN 1237	1 : 10 000
drawn 繪圖 M.L. Ching	date 日期 18. 11. 96	NEW TERRITORIES NORTH DEVELOPMENT OFFICE TERRITORY DEVELOPMENT DEPARTMENT 拓展署 新界北拓展處	
checked 複核 K. K. Chan	date 日期 18. 11. 96		

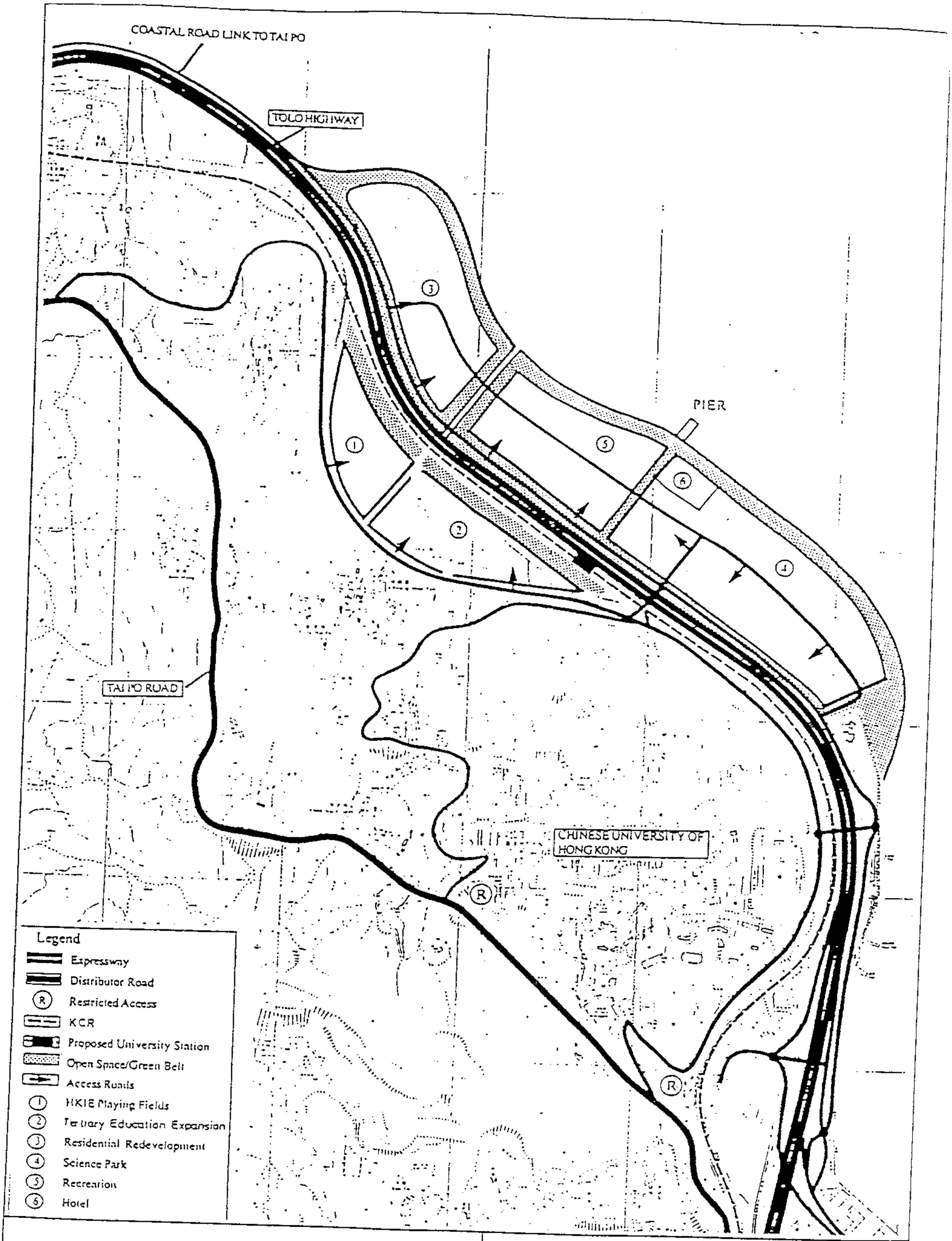


AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

PAK SHEK KOK STUDY AREA & RELATED AREA

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 07/05/98
FIGURE NO. : 1.4b

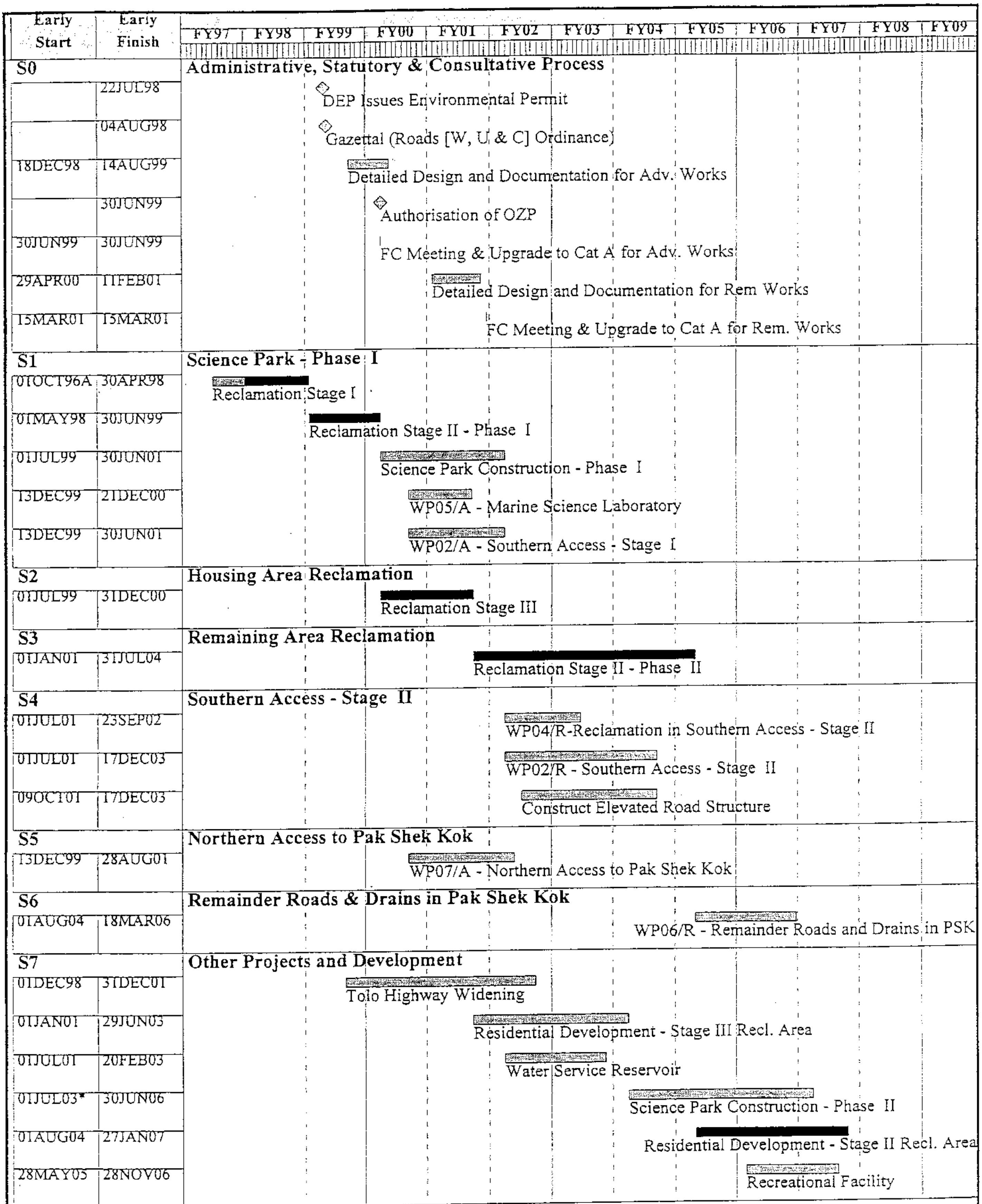


Scenario A Preferred Development Concept PSKAAP
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

METRES 0 200 400 600

Maunsell

FIGURE NO. 2.1a



Early Start	Early Finish	
S0		**Administrative, Statutory & Consultative Process**
	22JUL98	DEP Issues Environmental Permit
	04AUG98	Gazettal (Roads [W, U & C] Ordinance)
18DEC98	14AUG99	Detailed Design and Documentation for Adv. Works
	30JUN99	Authorisation of OZP
30JUN99	30JUN99	FC Meeting & Upgrade to Cat A for Adv. Works
29APR00	11FEB01	Detailed Design and Documentation for Rem Works
15MAR01	15MAR01	FC Meeting & Upgrade to Cat A for Rem. Works
S1		**Science Park - Phase I**
01OCT96A	30APR98	Reclamation Stage I
01MAY98	30JUN99	Reclamation Stage II - Phase I
01JUL99	30JUN01	Science Park Construction - Phase I
13DEC99	21DEC00	WP05/A - Marine Science Laboratory
13DEC99	30JUN01	WP02/A - Southern Access - Stage I
S2		**Housing Area Reclamation**
01JUL99	31DEC00	Reclamation Stage III
S3		**Remaining Area Reclamation**
01JAN01	31JUL04	Reclamation Stage II - Phase II
S4		**Southern Access - Stage II**
01JUL01	23SEP02	WP04/R-Reclamation in Southern Access - Stage II
01JUL01	17DEC03	WP02/R - Southern Access - Stage II
09OCT01	17DEC03	Construct Elevated Road Structure
S5		**Northern Access to Pak Shek Kok**
13DEC99	28AUG01	WP07/A - Northern Access to Pak Shek Kok
S6		**Remainder Roads & Drains in Pak Shek Kok**
01AUG04	18MAR06	WP06/R - Remainder Roads and Drains in PSK
S7		**Other Projects and Development**
01DEC98	31DEC01	Tolo Highway Widening
01JAN01	29JUN03	Residential Development - Stage III Recl. Area
01JUL01	20FEB03	Water Service Reservoir
01JUL03*	30JUN06	Science Park Construction - Phase II
01AUG04	27JAN07	Residential Development - Stage II Recl. Area
28MAY05	28NOV06	Recreational Facility

Figure 2.2a

Project Start	01OCT96
Project Finish	29JUL07
Data Date	10APR97
Run Date	24MAR98

▨ Current Bar
▭ Progress Bar
■ Critical Activity

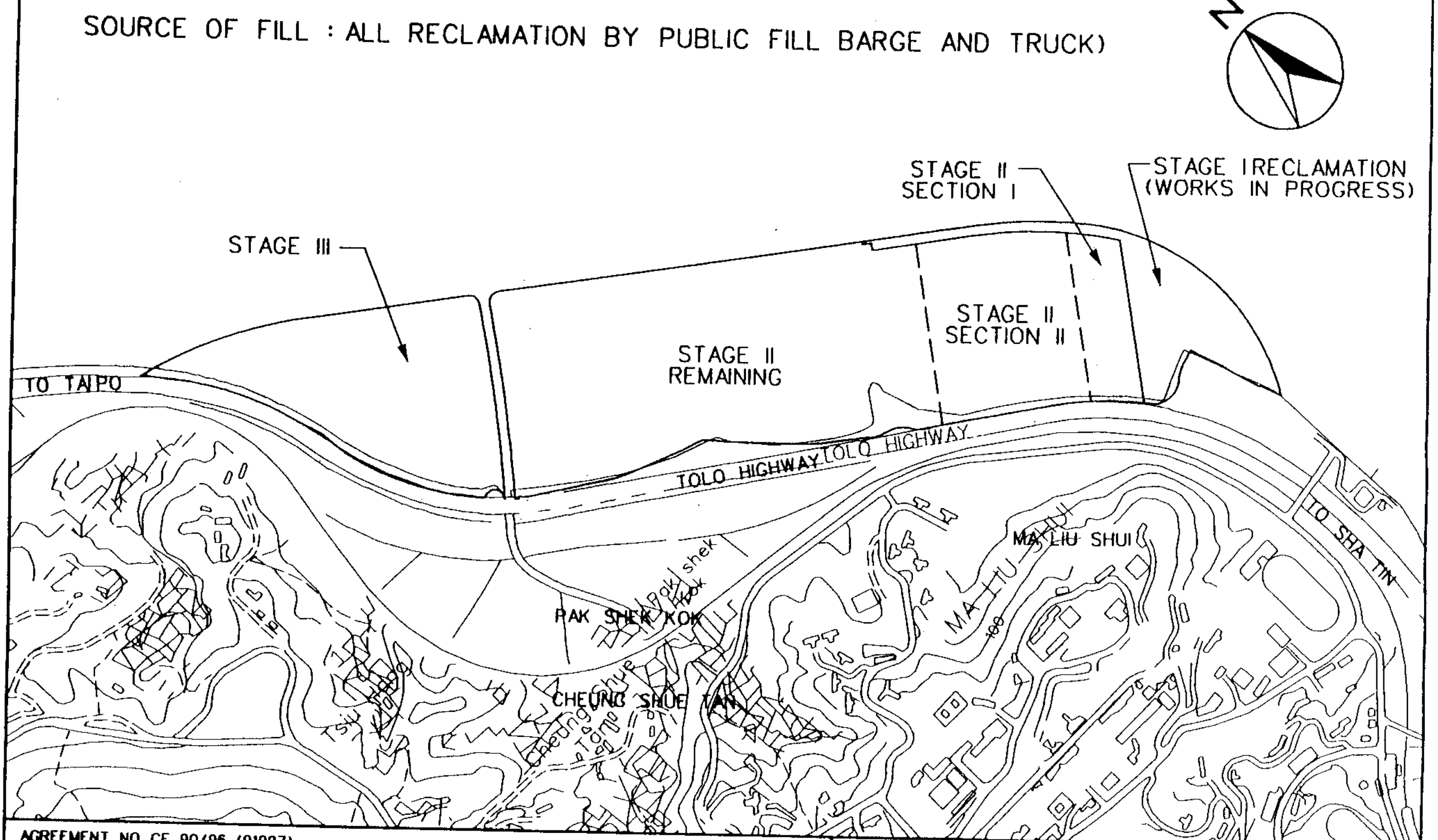
P106

Sheet 1 of 1

Territory Development Department
Pak Shek Kok Development
Summary Development Programme

FY03 Means
1 April 02 -
31 March 03

SOURCE OF FILL : ALL RECLAMATION BY PUBLIC FILL BARGE AND TRUCK)



AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

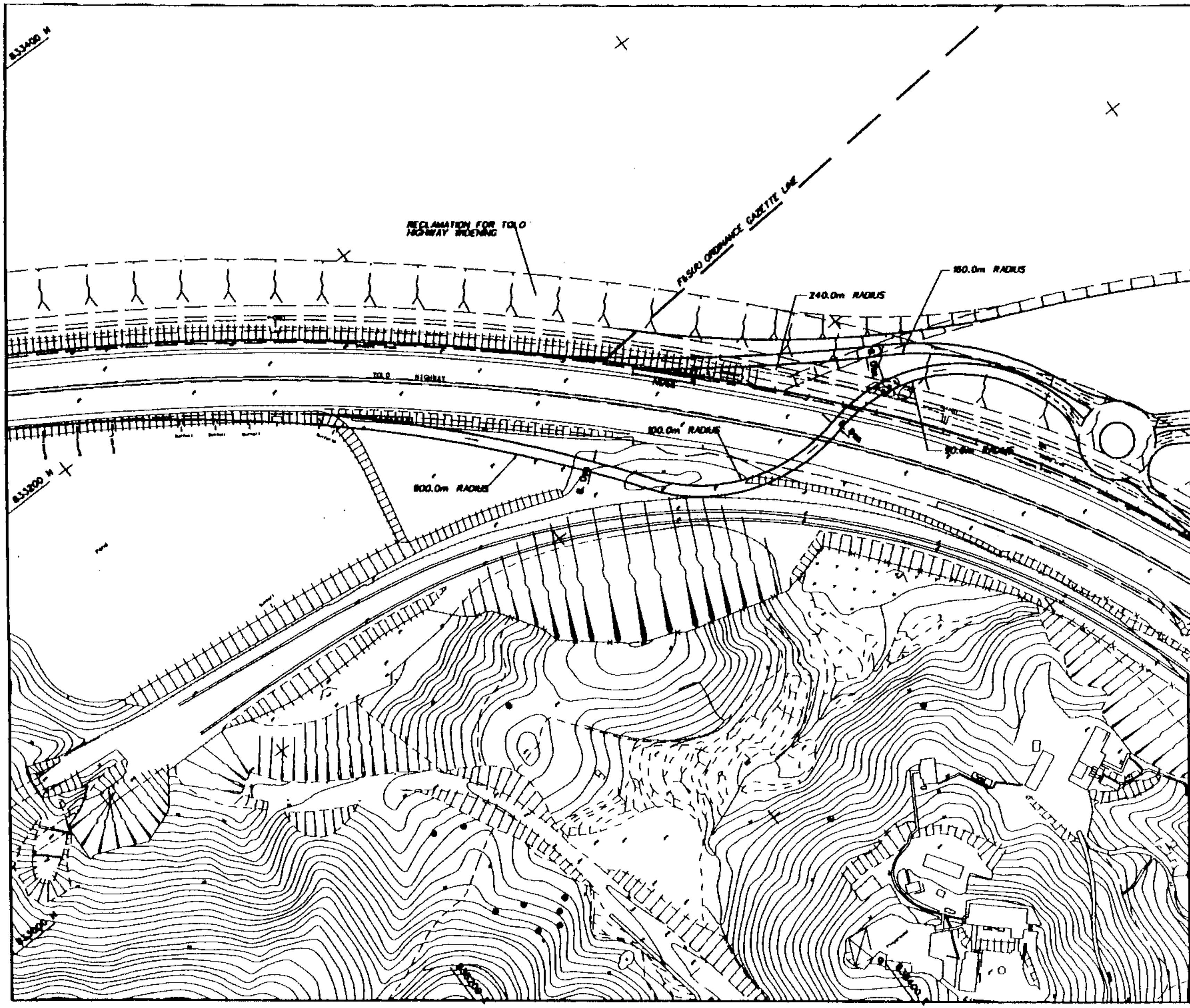
RECLAMATION - OPTION 2

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
N.T.S.

REVISED :
12/05/98

FIGURE NO. :
2.2b



Territory Development Department

NT NORTH DEVELOPMENT OFFICE

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

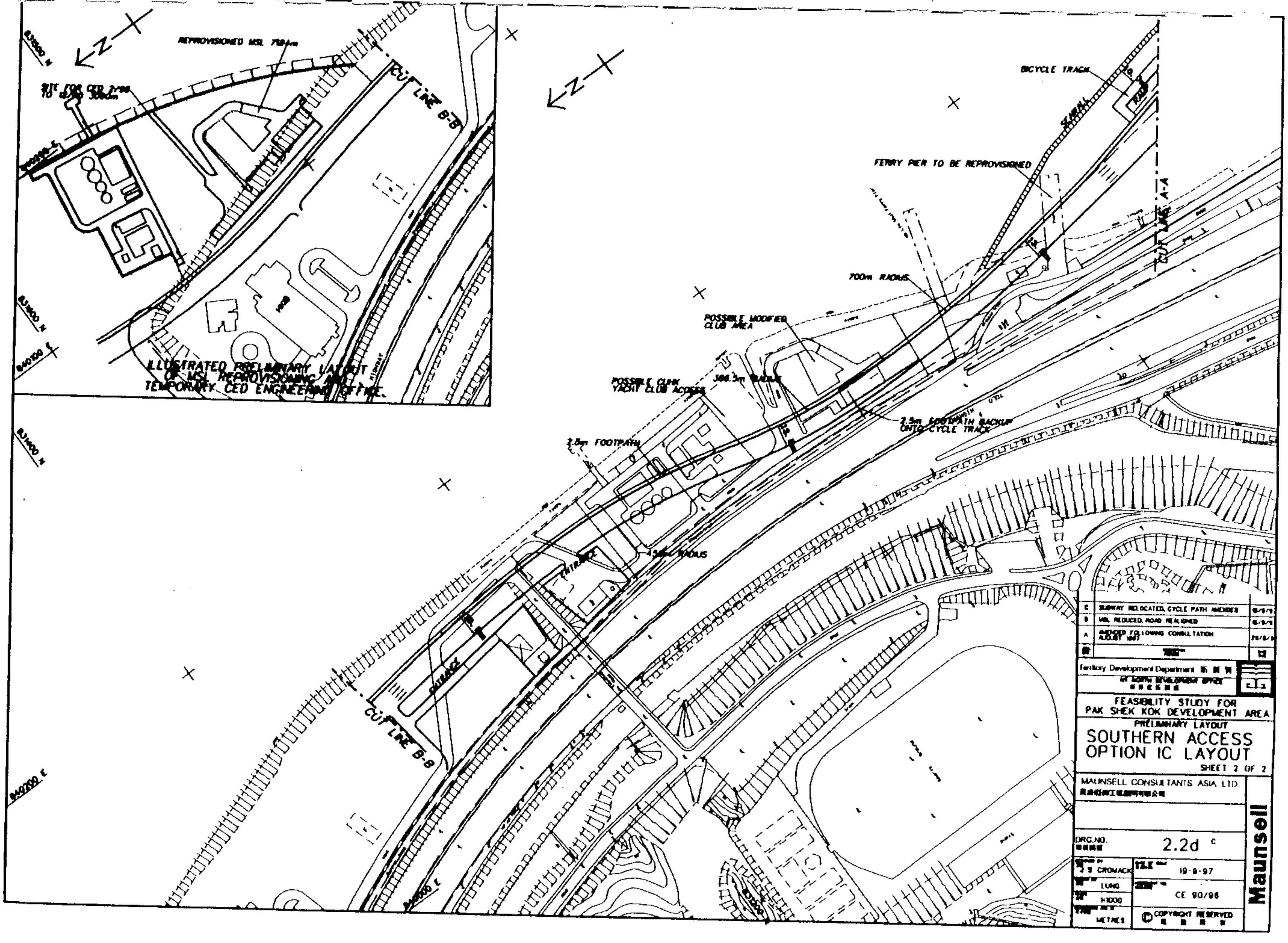
PRELIMINARY LAYOUT

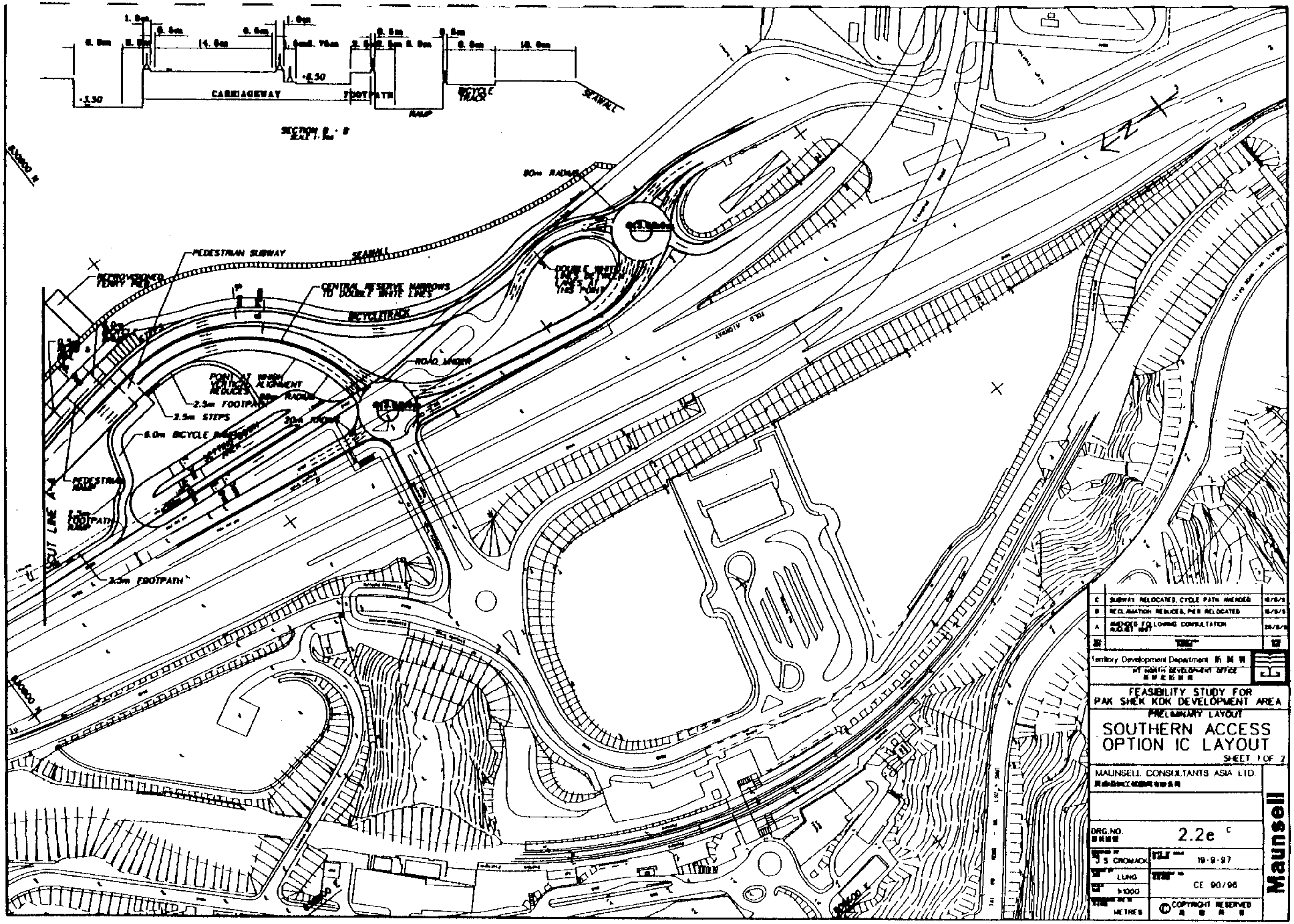
NORTHERN ACCESS
OPTION IIIE LAYOUT

MAUNSELL CONSULTANTS ASIA LTD.

Maunsell

DRG.NO.	2.2c
J S CROMAR	25-9-97
LUNG	CE 90/96
1:1000	
METRES	© COPYRIGHT RESERVED

REPROVISIONED MSL 75Rm
SITE FOR CED 2/98 TO 8/99 300m
CUT LINE B-B
ILLUSTRATED PRELIMINARY LAYOUT OF MSL REPROVISIONING AND TEMPORARY CED ENGINEERING OFFICE
831800 N
831600 N
840100 E
831400 N
840200 E
BICYCLE TRACK
SEAWALL
FERRY PIER TO BE REPROVISIONED
CUT LINE A-A
700m RADIUS
POSSIBLE MODIFIED CLUB AREA
POSSIBLE CUHK YACHT CLUB ACCESS
386.3m RADIUS
2.5m FOOTPATH BACKUP ONTO CYCLE TRACK
2.5m FOOTPATH
436m RADIUS
ENTRANCE
CUT LINE B-B
840000 E
N
C | SUBWAY RELOCATED, CYCLE PATH AMENDED | 8/9/97
B | MSL REDUCED, ROAD REALIGNED | 8/9/97
A | AMENDED FOLLOWING CONSULTATION AUGUST 1997 | 29/8/97
Territory Development Department
NT NORTH DEVELOPMENT OFFICE
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA
PRELIMINARY LAYOUT
SOUTHERN ACCESS OPTION IC LAYOUT
SHEET 2 OF 2
MAUNSELL CONSULTANTS ASIA LTD.
DRG.NO. 2.2d C
J S CROMACK
19-9-97
LUNG
CE 90/96
1:1000
METRES
© COPYRIGHT RESERVED
Maunsell



C	SUBWAY RELOCATED, CYCLE PATH AMENDED	
B	RECLAMATION REDUCED, PIER RELOCATED	
A	AMENDED FOLLOWING CONSULTATION AUGUST 1997	

Territory Development Department
NT NORTH DEVELOPMENT OFFICE

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

PRELIMINARY LAYOUT

SOUTHERN ACCESS OPTION IC LAYOUT

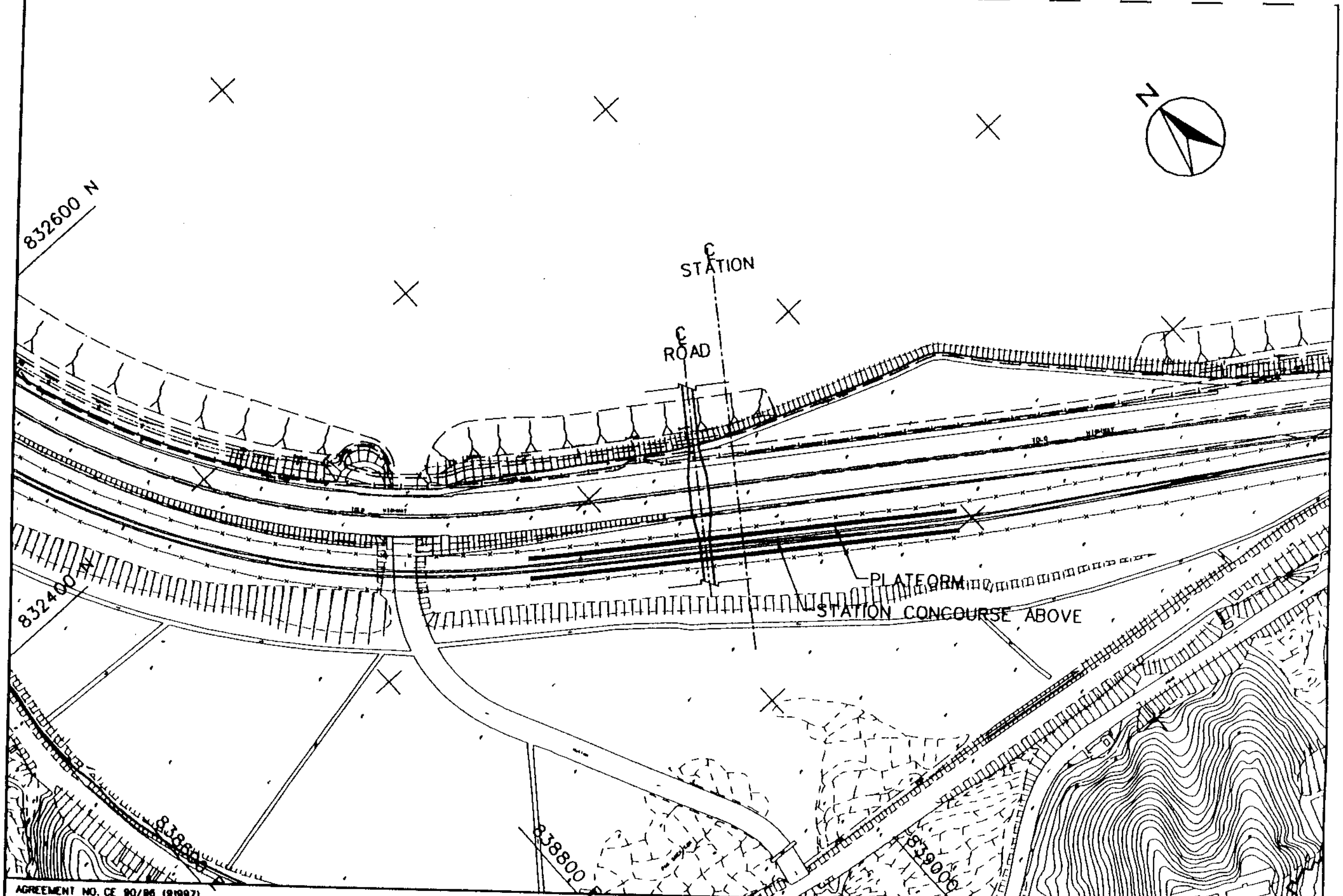
SHEET 1 OF 2

MAUNSELL CONSULTANTS ASIA LTD.

DRG. NO. 2.2e C

J S CROMACK
19-9-97
LUNG
CE 90/96
1:1000
METRES

Maunsell



AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

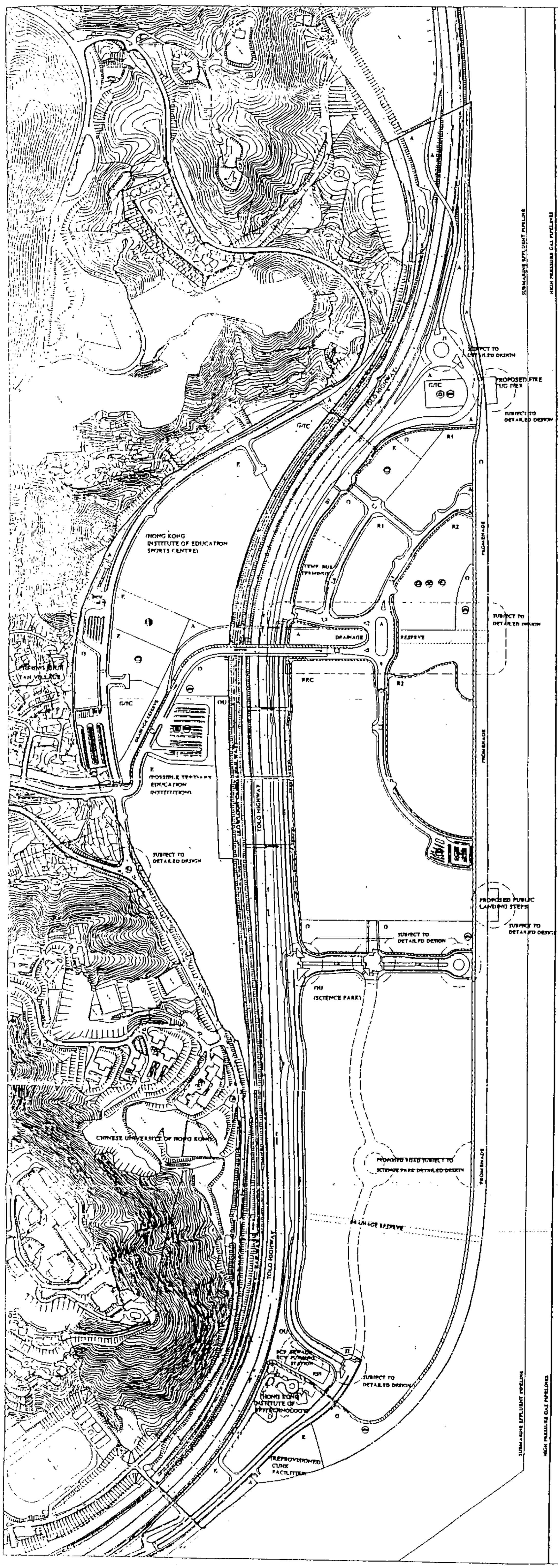
STATION LOCATION

Maunsell

SCALE : N.T.S

DATE : 18/9/97

FIGURE NO. : 2.2f



SCHEDULE OF USES AND AREAS

USES		NET SITE AREA & %	
		HA	%
R1	RESIDENTIAL - ZONE 1	3.0	2.54
R2	RESIDENTIAL - ZONE 2	6.2	5.26
REC	RECREATION	10	8.48
G/IC	GOVERNMENT/INSTITUTION/ COMMUNITY	2.0	1.70
E	EDUCATION	16.6	14.08
O	OPEN SPACE	11	9.33
A	AMENITY AREA	3.3	2.80
OU	OTHER SPECIFIED USES	30.3	25.70
——	ROADS	35.5	30.11
TOTAL		117.9	100

NOTATION

Ⓟ	CAR PARK
●	CYCLE PARKING AREA
●	PUBLIC LIGHT BUS STATION
Ⓑ	BUS TERMINUS
●	DIVISIONAL FIRE STATION
●	AMBULANCE DEPOT
●	COMMUNITY CENTRE (CARE AND ATTENTION HOMES)
©	LOCAL COMMERCIAL CENTRE
●	SECONDARY SCHOOL
●	PRIMARY SCHOOL
●	KINDERGARTEN
——	BOUNDARY OF STUDY AREA
D1	DISTRICT DISTRIBUTOR ROAD WITH NUMBER
L1	LOCAL DISTRIBUTOR WITH NUMBER
▨	CYCLE TRACK

Territory Development Department
New Territories North Development Office

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

RECOMMENDED OUTLINE DEVELOPMENT PLAN

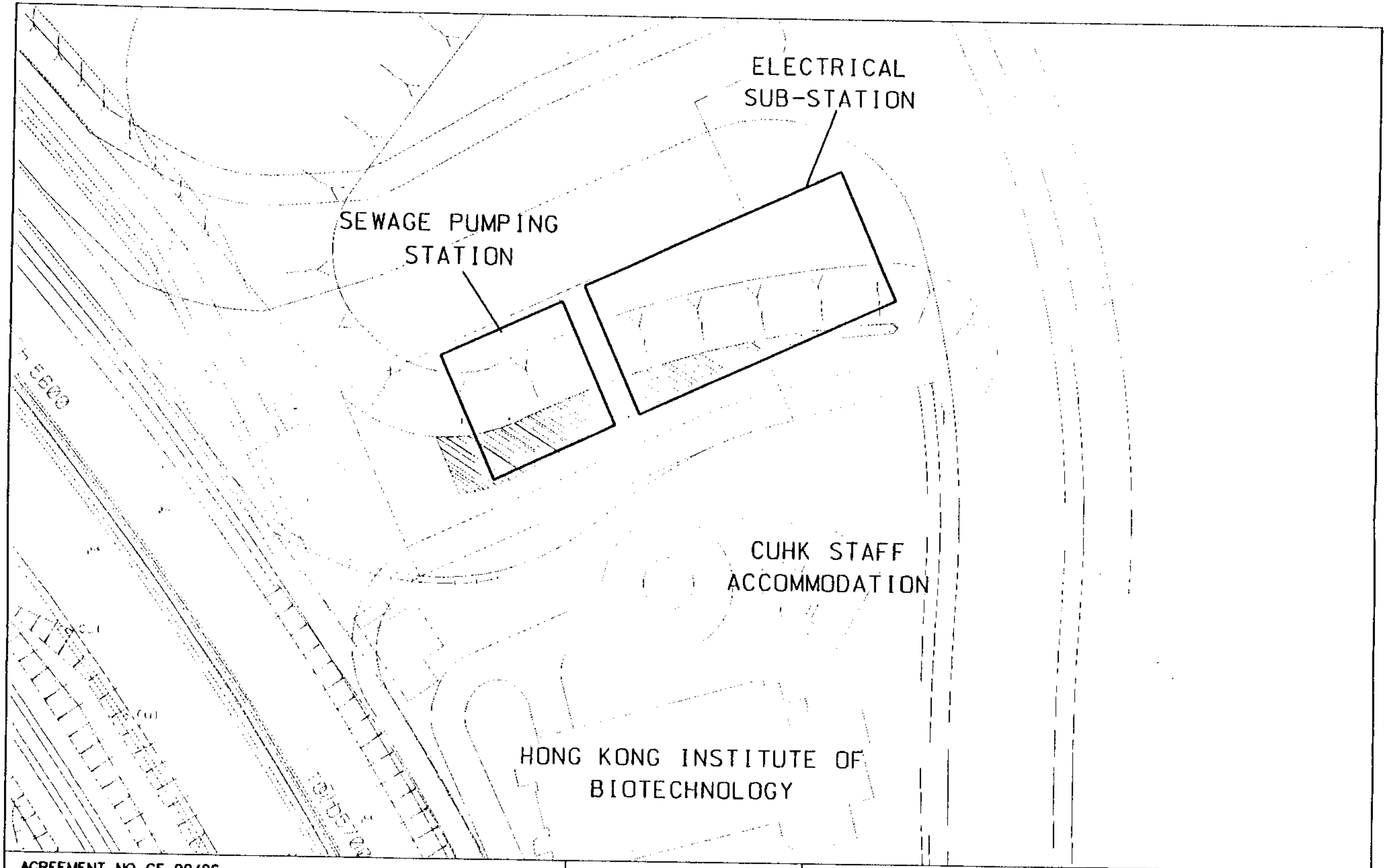
FINAL DRAFT 26 MAY 1998

0 50 200 m
10 100

© COPYRIGHT RESERVED

Maunsell

Figure 2.3a

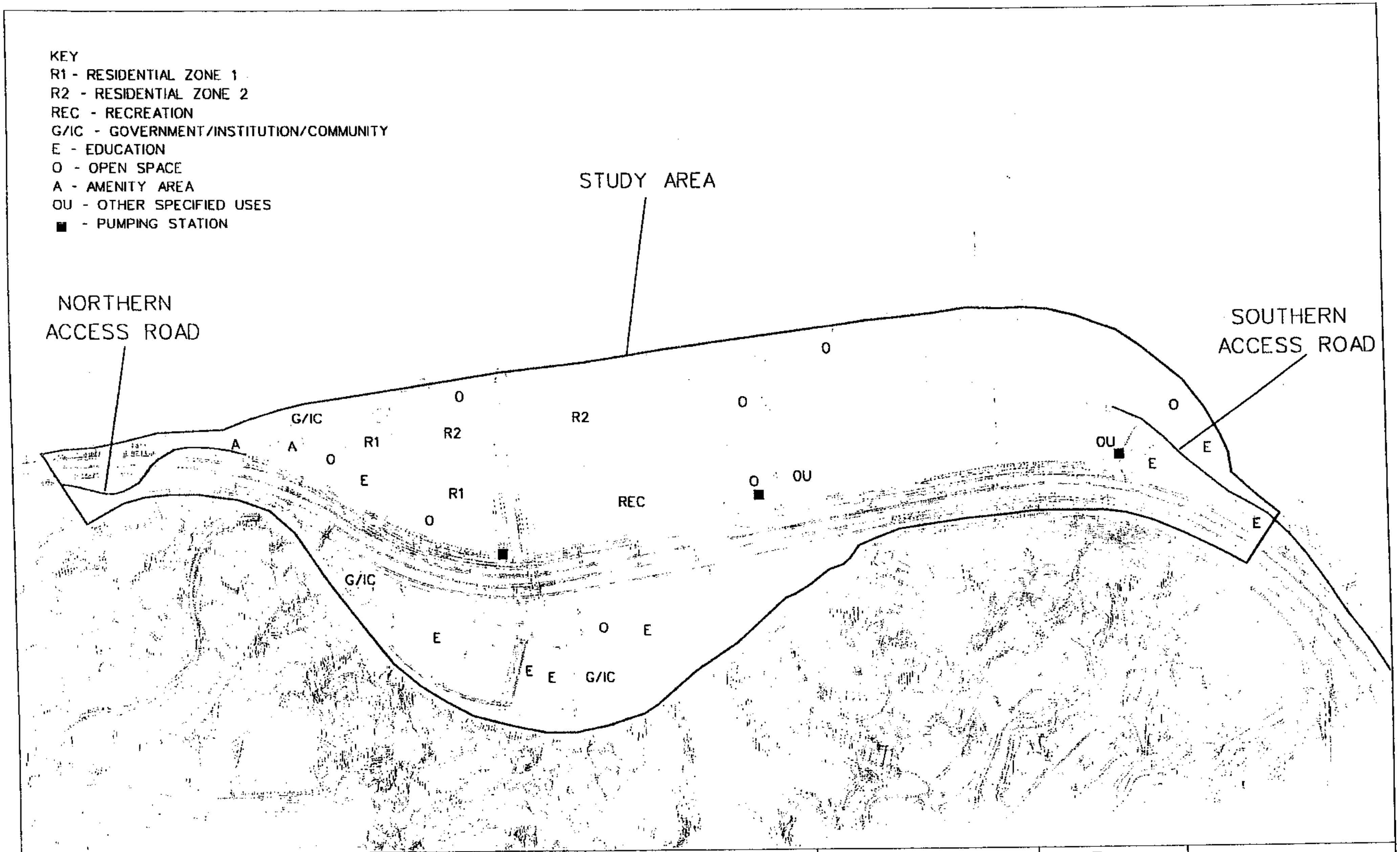


AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

LOCATION OF ELECTRICAL SUB-STATION AND SEWAGE PUMPING STATION

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 05/05/98
FIGURE NO. : 2.3b



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

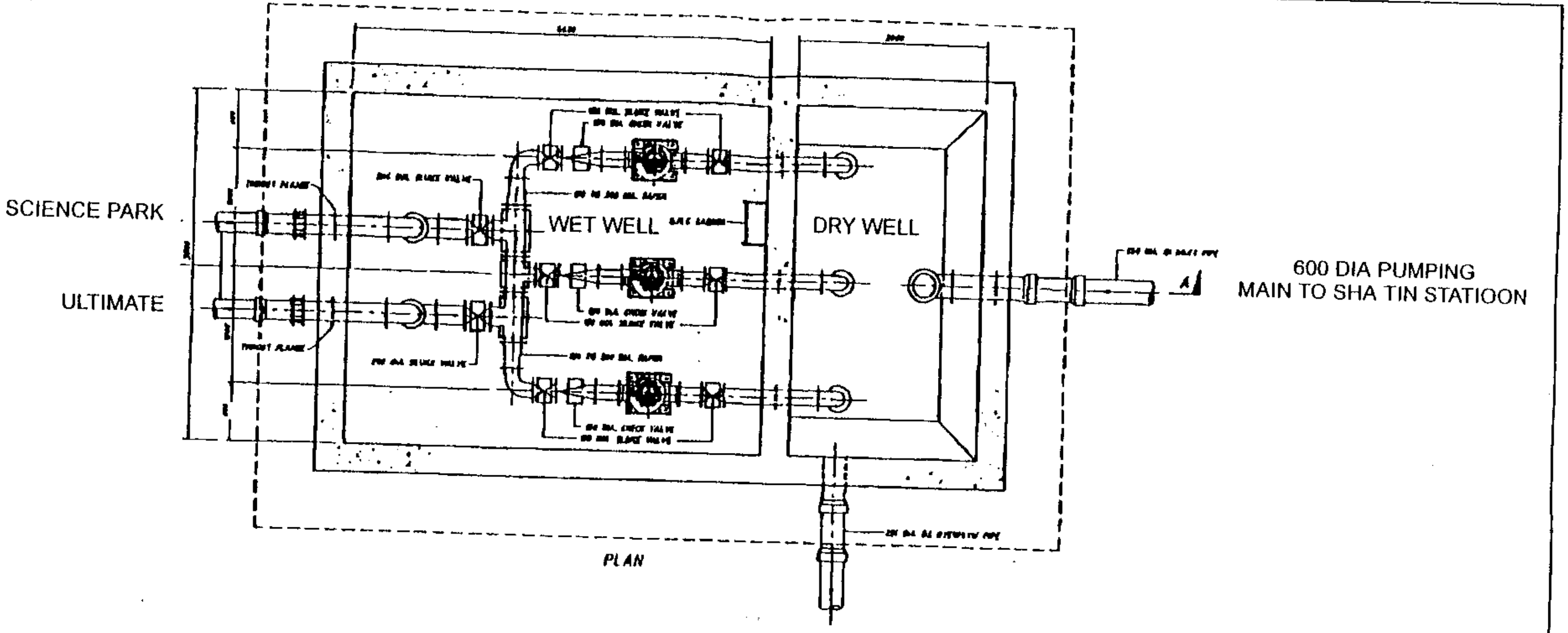
LOCATION OF THREE SEWAGE
PUMPING STATIONS

Maunsell
茂盛(亞洲)工程顧問有限公司

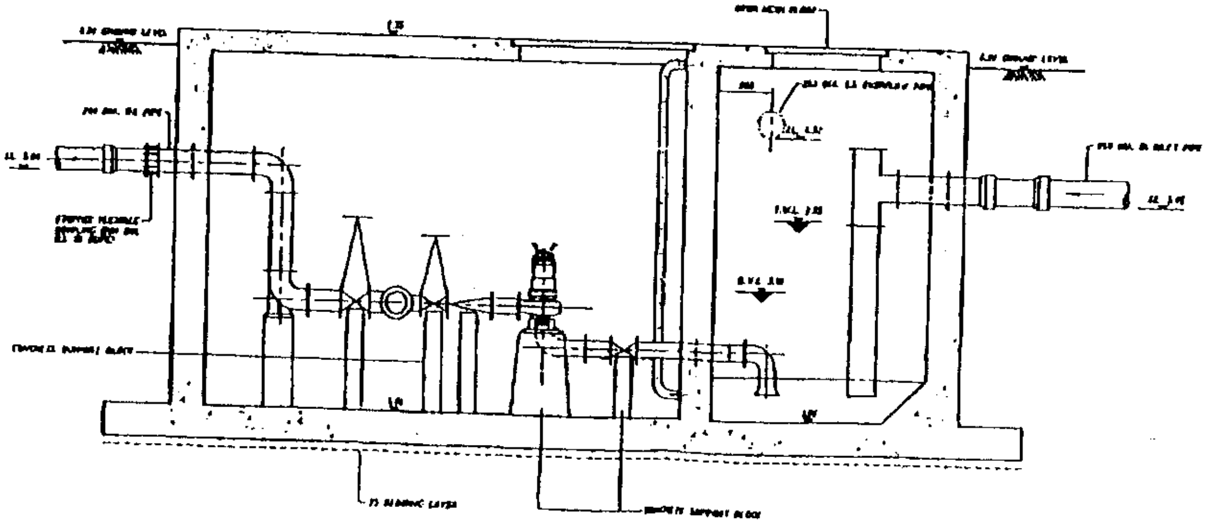
SCALE :
N.T.S.

DATE :
05/05/98

FIGURE NO. :
2.3c



PLAN

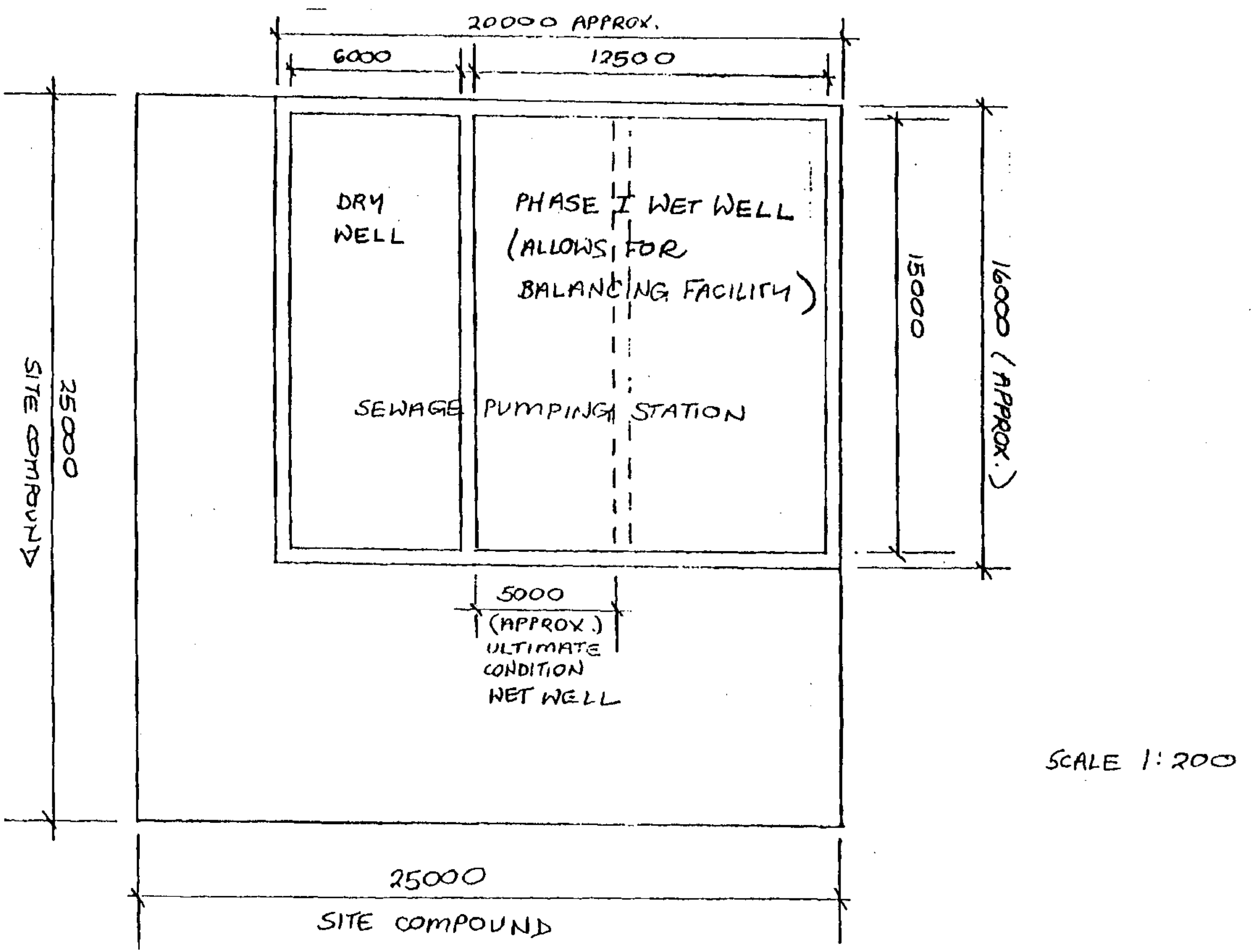


SECTION A - A

EFFLUENT PUMPING STATION LAYOUT PLAN AND SECTION

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

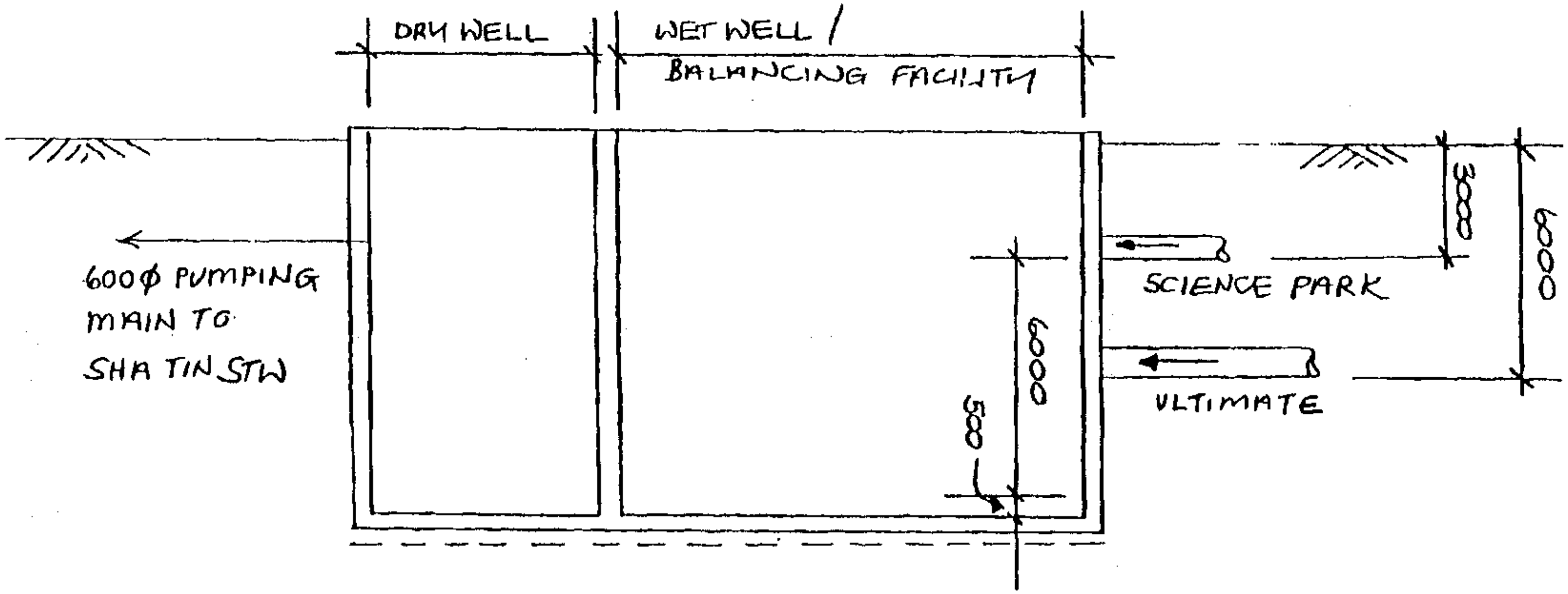
Maunsell	DATE : 06/05/98	FIGURE NO 2.3d



PLAN OF THE SEWAGE PUMPING STATION AND EQUALISATION TANK

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell		DATE 06/05/98	FIGURE NO 2.3e



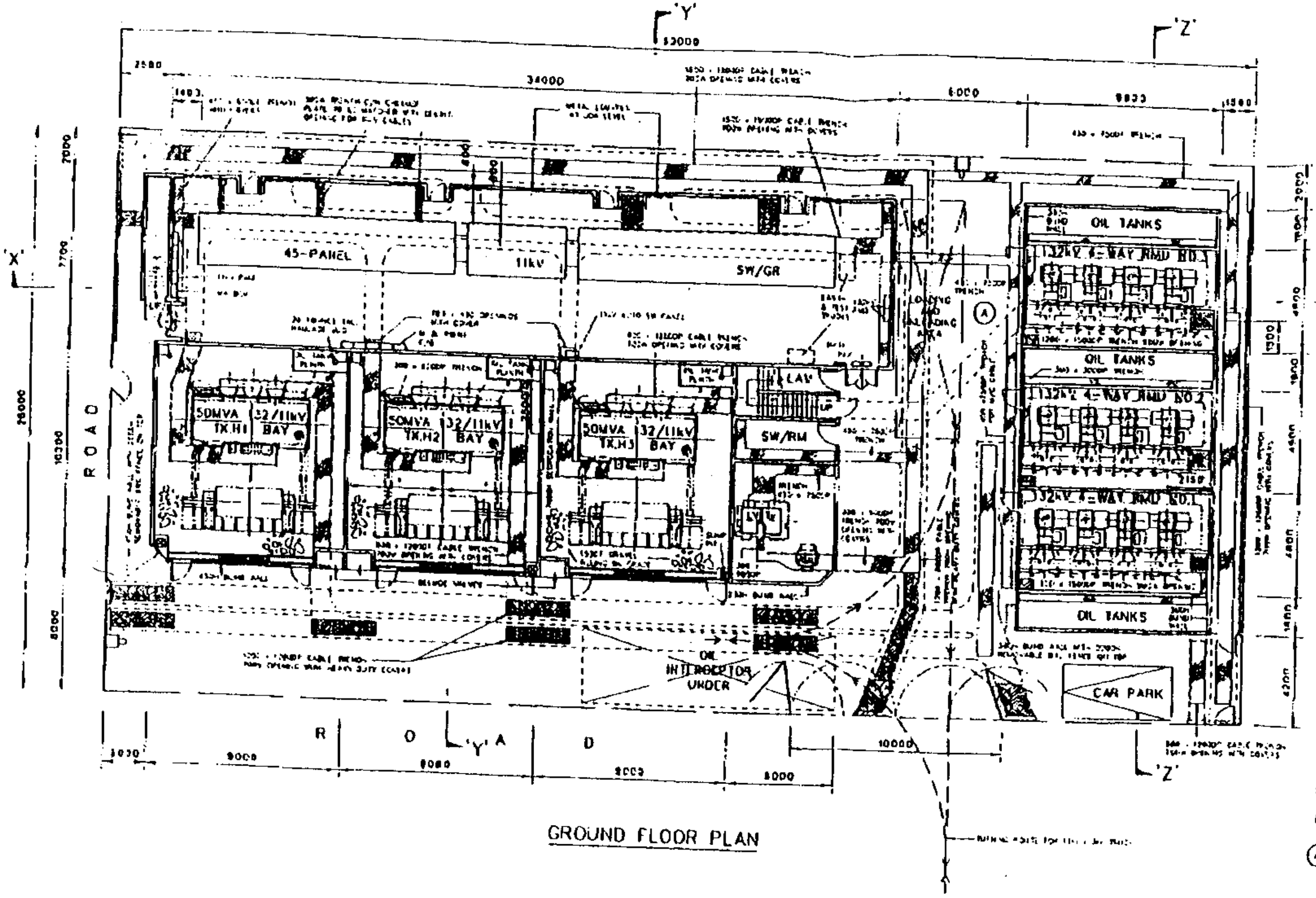
CROSS-SECTION OF THE SEWAGE PUMPING STATION AND EQUALISATION TANK

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE: 06/05/98

FIGURE NO 2.3f



GROUND FLOOR PLAN

NOTE:

1. ALL DOOR SILLS & BUND WALLS TO BE BUILT AFTER EQUIPMENTS INSTALLED.
2. THIS DRAWING ONLY SHOWS TYPICAL FOUNDATION AND TRENCH ARRANGEMENTS FOR PLANT, EXACT DETAILS FOR APPLICATION TO INDIVIDUAL PROJECT SHALL REFER TO APPROVED ENGINEERING DRAWINGS.
3. CABLE BRACKETS AND METALLIC COVER TO BE PROVIDED FOR CAPACITOR BANK 11kV CABLE ALONG THE WALL IN 11kV SWITCHGEAR ROOM
4. SEGREGATION CONCRETE PLATFORM TO BE PROVIDED AT EACH CABLE TRENCH CROSSOVER POINT.
5. MIN. CLEAR WIDTH OF 11kV SW/GR RM. IS 6500
6. 2m x 0.7m F.S INLET TO BE PROVIDED

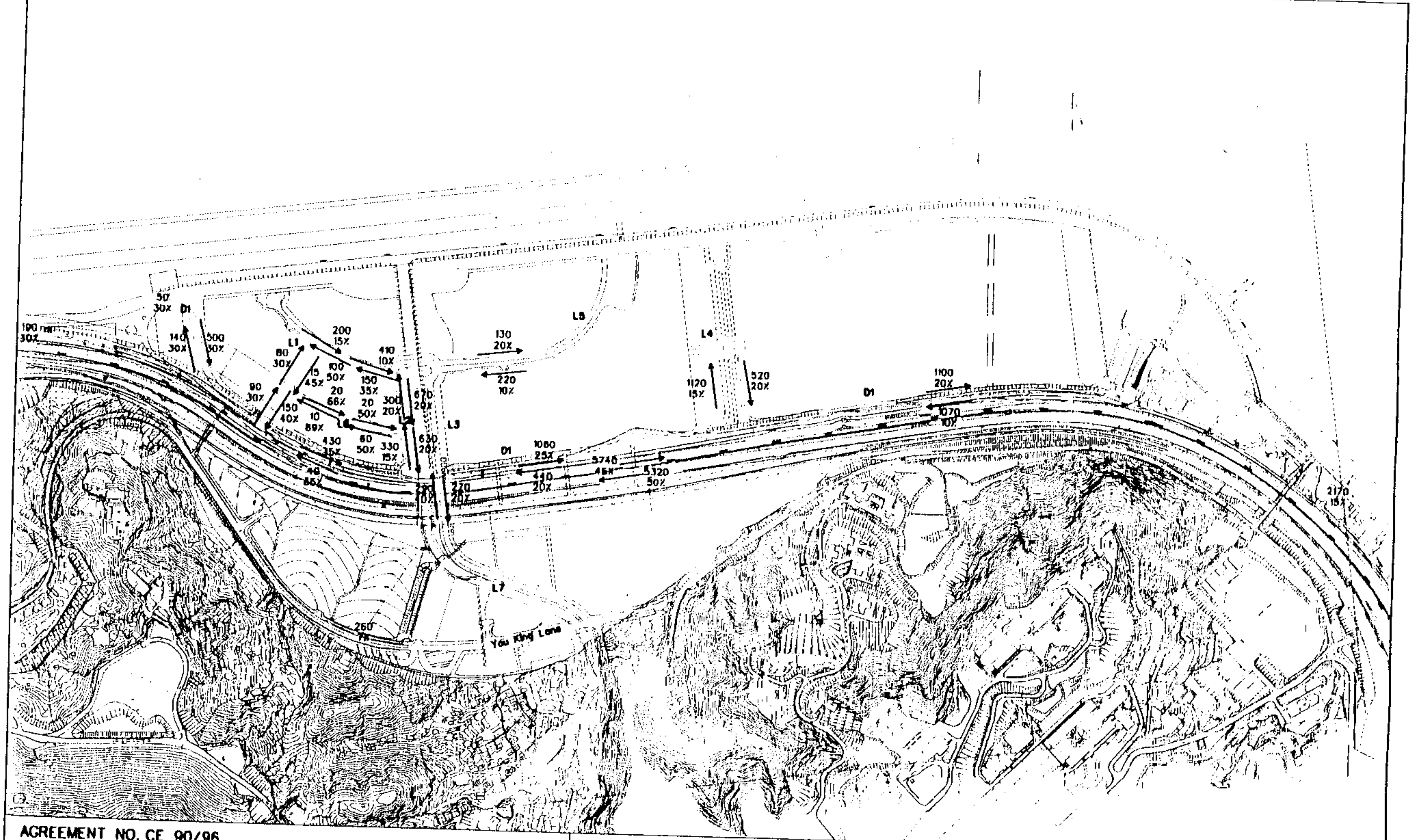
Ⓐ FOR 132kV PILOT CABLES

ALT B

PLAN OF TYPICAL ELECTRICAL SUB-STATION
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE:	FIGURE NO
06/05/98	2.3g



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

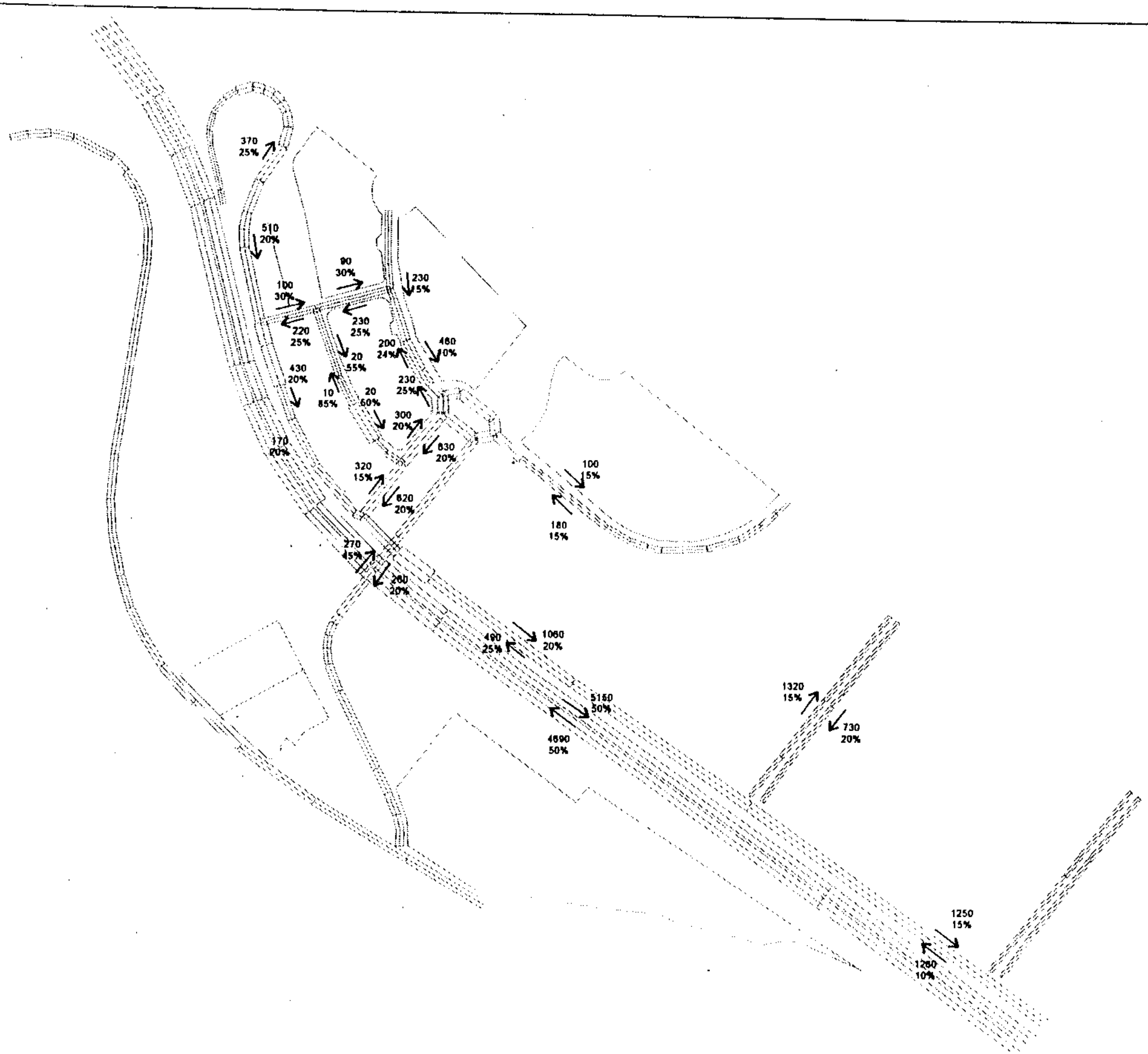
2011 FORECAST TRAFFIC FLOW (AM PEAK)

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
N.T.S.

DATE :
26/05/98

FIGURE NO. :
2.4a



KEY
100 - TRAFFIC FLOWS IN VEHICLES
50% - % OF HEAVY VEHICLES

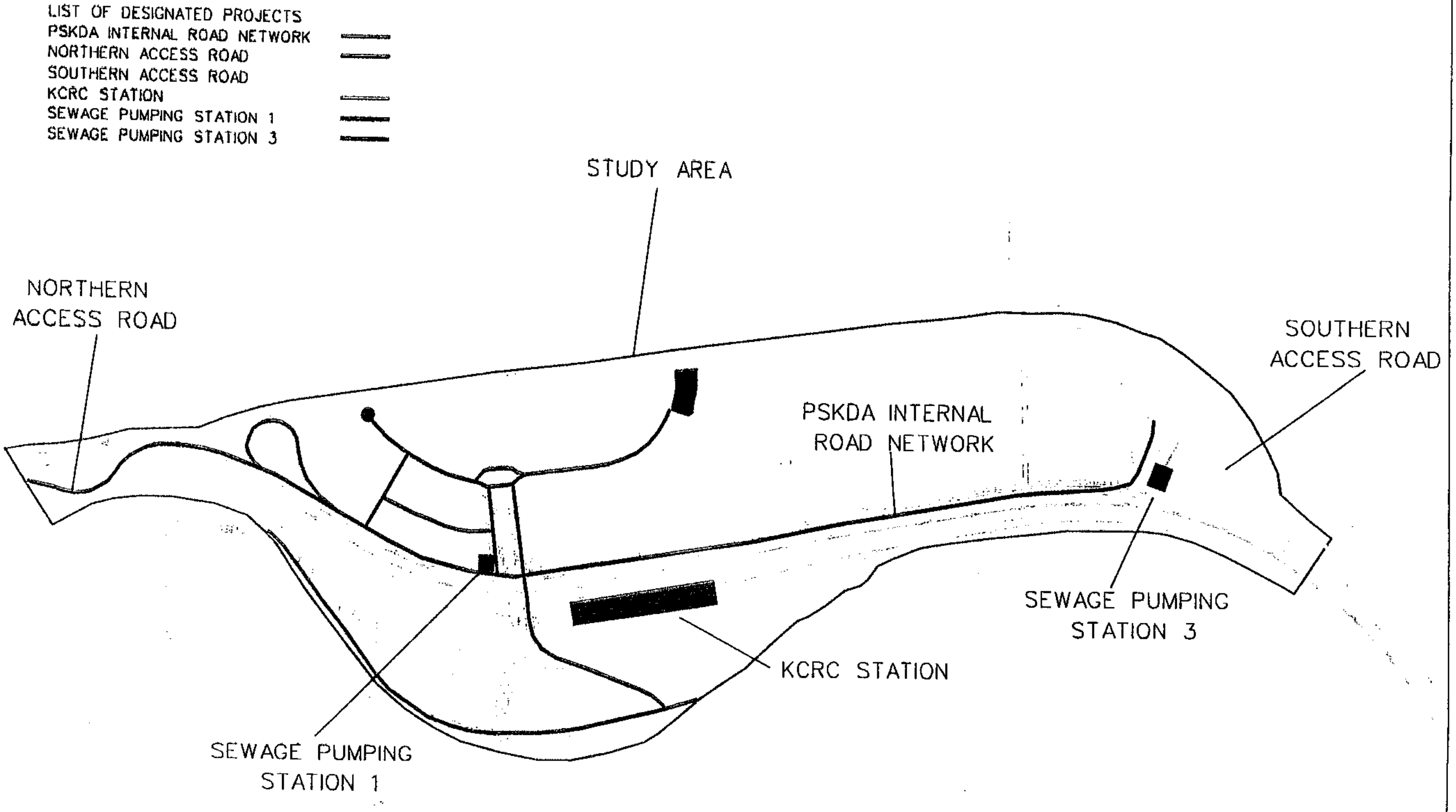
2016 FORECAST TRAFFIC FLOWS (AM PEAK)

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell
茂盛（亞洲）工程顧問有限公司

DATE: 02/04/98

FIGURE NO 2.4b



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

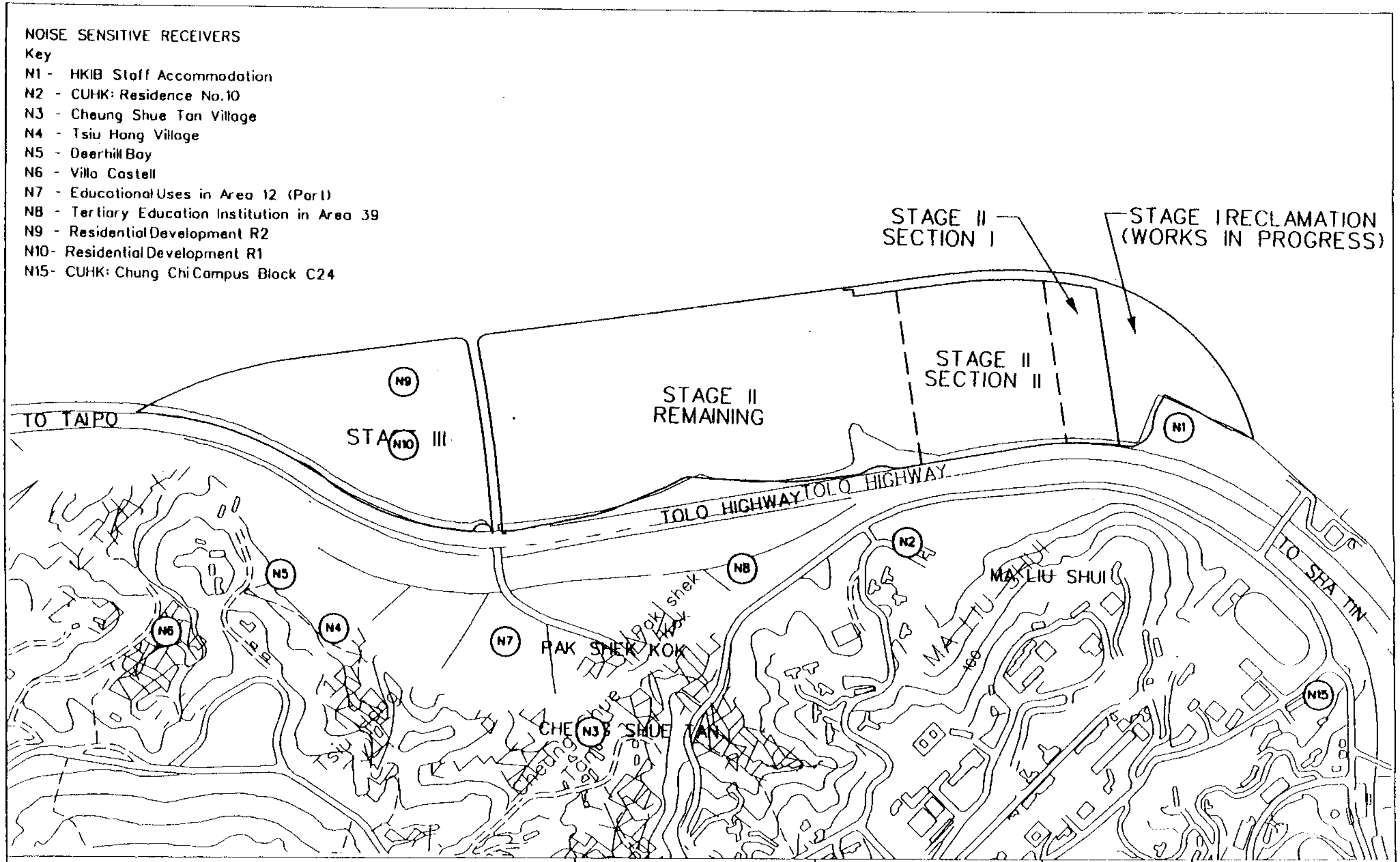
DESIGNATED PROJECTS

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

DATE : 05/05/98

FIGURE NO. : 2.5a



NOISE SENSITIVE RECEIVERS

Key

N1 - HKIB Staff Accommodation
N2 - CUHK: Residence No.10
N3 - Cheung Shue Tan Village
N4 - Tsiu Hong Village
N5 - Deerhill Bay
N6 - Villa Castell
N7 - Educational Uses in Area 12 (Part)
N8 - Tertiary Education Institution in Area 39
N9 - Residential Development R2
N10 - Residential Development R1
N15 - CUHK: Chung Chi Campus Block C24

AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

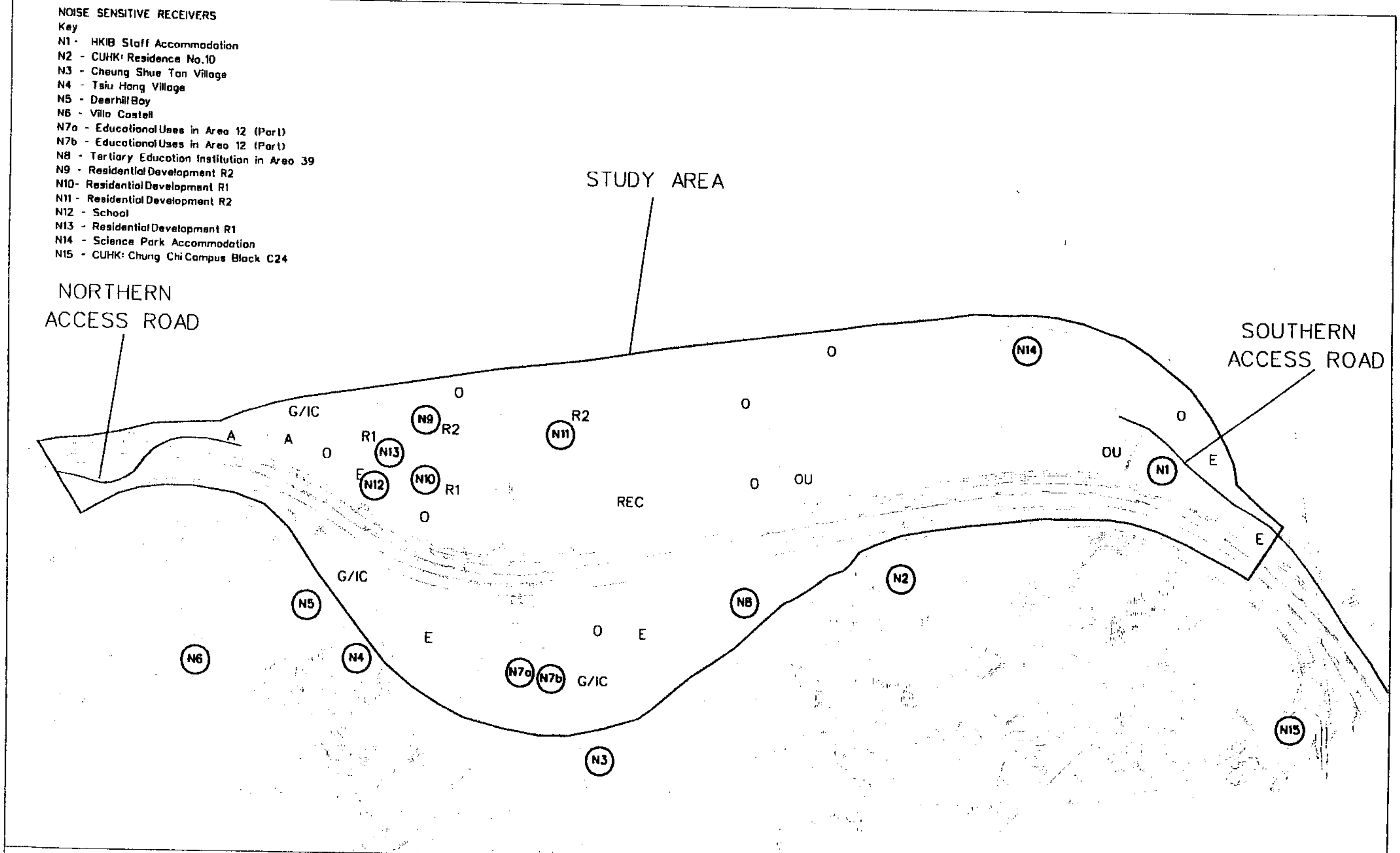
LOCATION OF NSRs DURING CONSTRUCTION

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

DATE : 12/05/98

FIGURE NO. : 3.4a



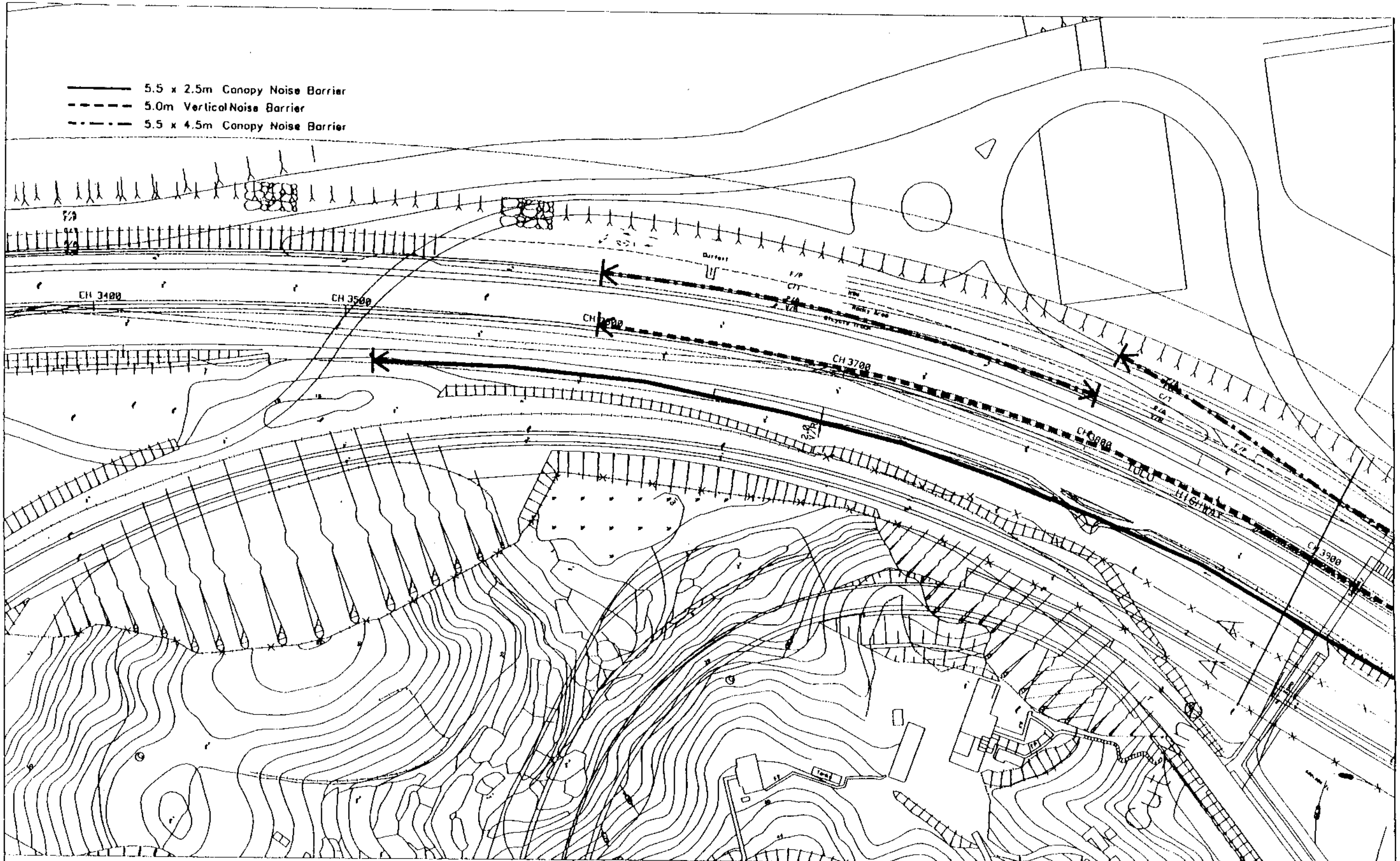
NOISE SENSITIVE RECEIVERS
Key
N1 - HKIB Staff Accommodation
N2 - CUHK: Residence No.10
N3 - Cheung Shue Tan Village
N4 - Tsiu Hang Village
N5 - Deerhill Bay
N6 - Villa Castell
N7a - Educational Uses in Area 12 (Part)
N7b - Educational Uses in Area 12 (Part)
N8 - Tertiary Education Institution in Area 39
N9 - Residential Development R2
N10- Residential Development R1
N11 - Residential Development R2
N12 - School
N13 - Residential Development R1
N14 - Science Park Accommodation
N15 - CUHK: Chung Chi Campus Block C24

AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

LOCATION OF NSRs DURING
OPERATION PHASE

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 12/05/98
FIGURE NO. : 3.4b



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

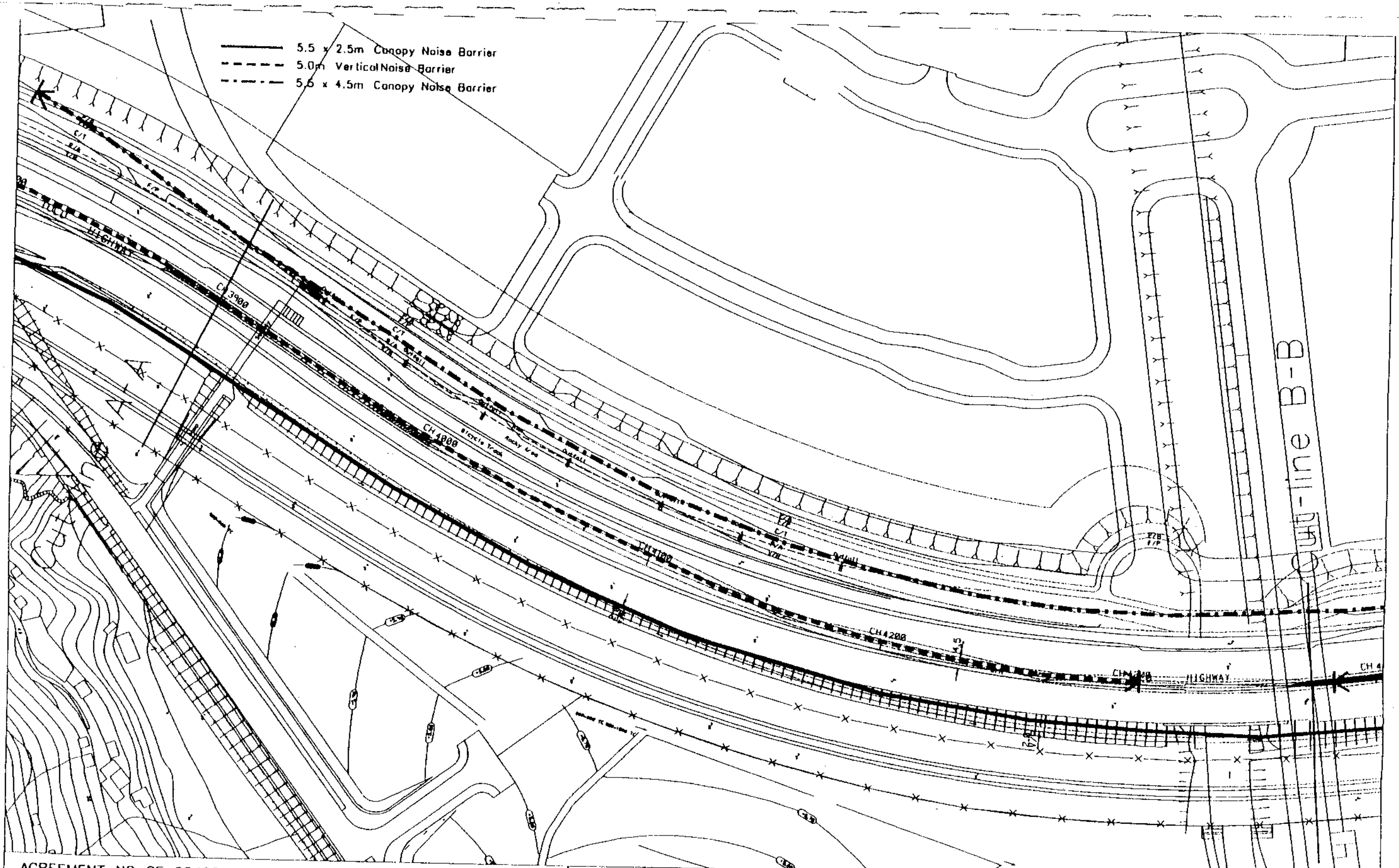
DETAILS OF NOISE BARRIERS FOR TOLO HIGHWAY

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

DATE : 26/05/98

FIGURE NO. : 3.6a/1



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

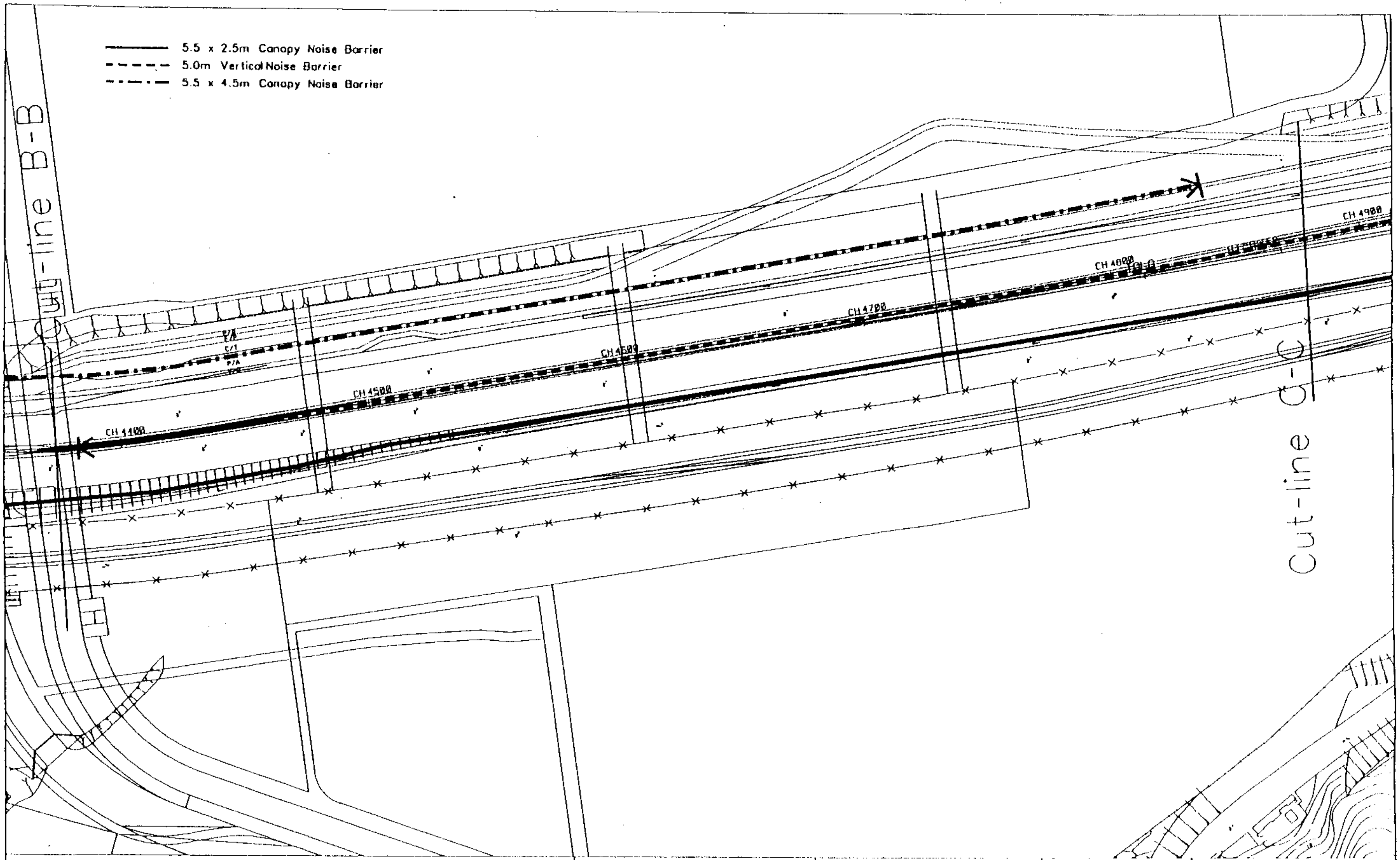
DETAILS OF NOISE BARRIERS FOR TOLO HIGHWAY

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

DATE : 26/05/98

FIGURE NO. : 3.6a/2



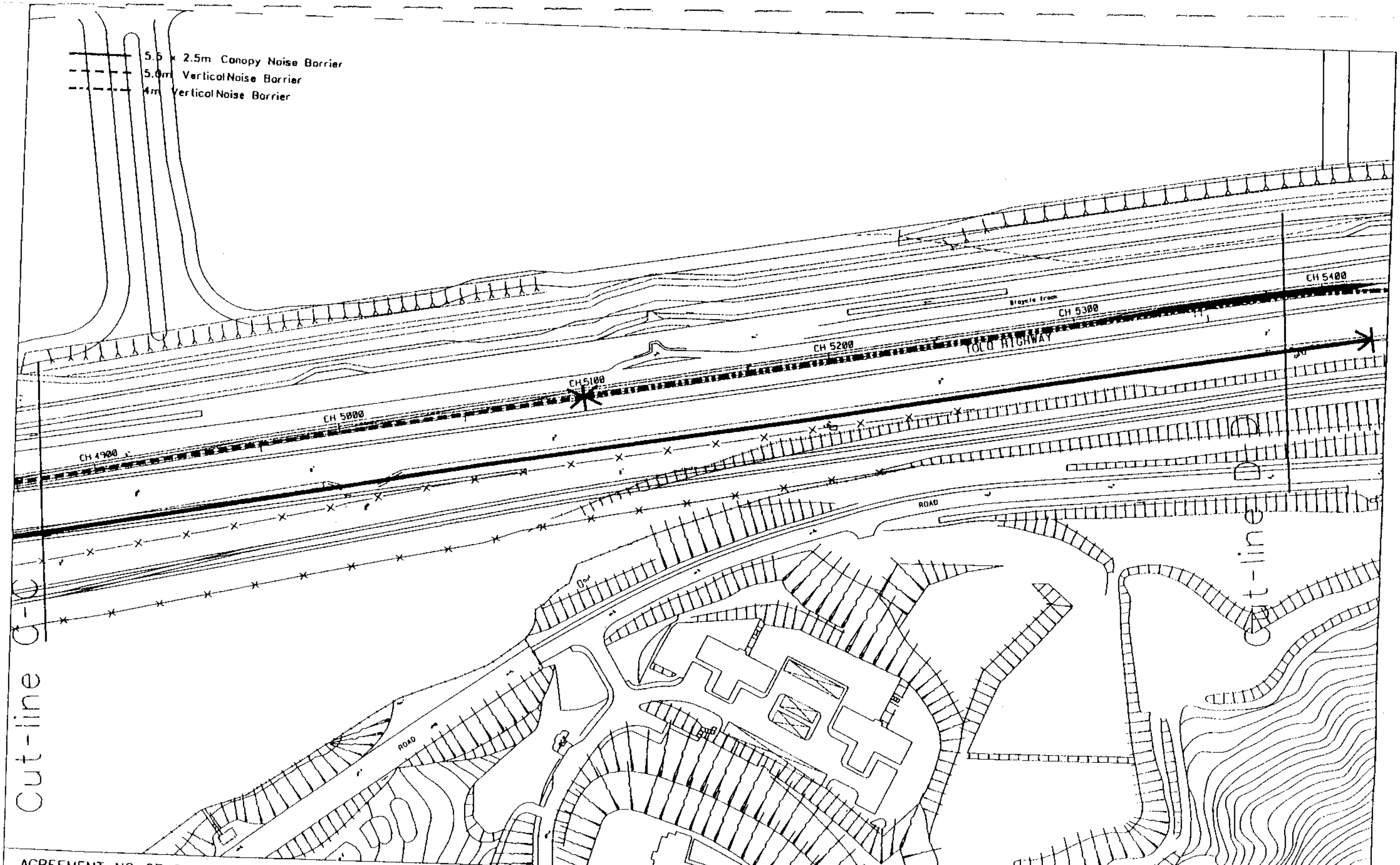
AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

DETAILS OF NOISE BARRIERS FOR TOLO HIGHWAY

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 26/05/98

FIGURE NO. : 3.6a/3



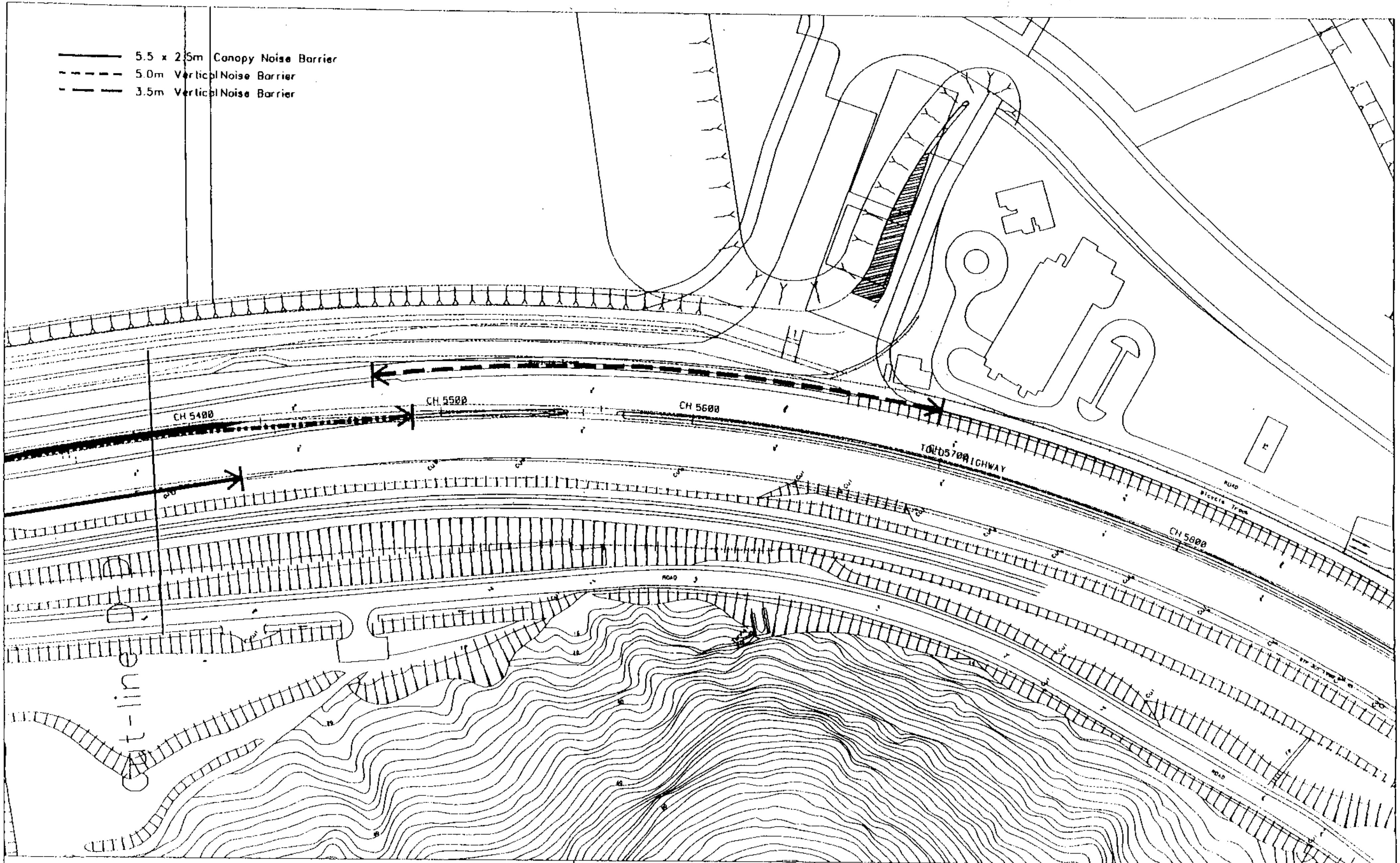
AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

DETAILS OF NOISE BARRIERS FOR
TOLO HIGHWAY

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
N.T.S.
DATE :
26/05/98

FIGURE NO. :
3.6a/4



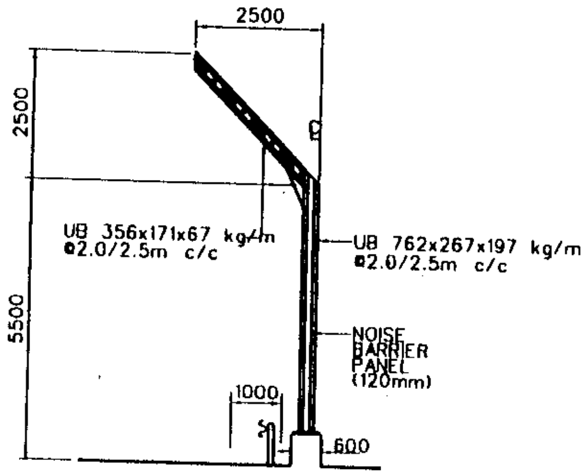
AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

DETAILS OF NOISE BARRIERS FOR TOLO HIGHWAY

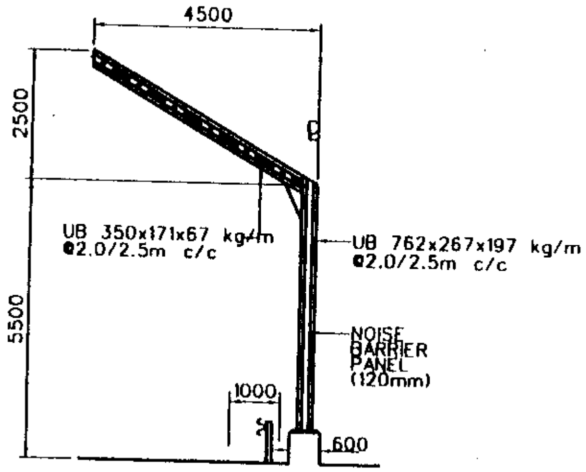
Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 26/05/98

FIGURE NO. : 3.6a/5



5.5mx2.5m CANOPY BARRIER TYPE II



5.5mx4.5m CANOPY BARRIER

AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

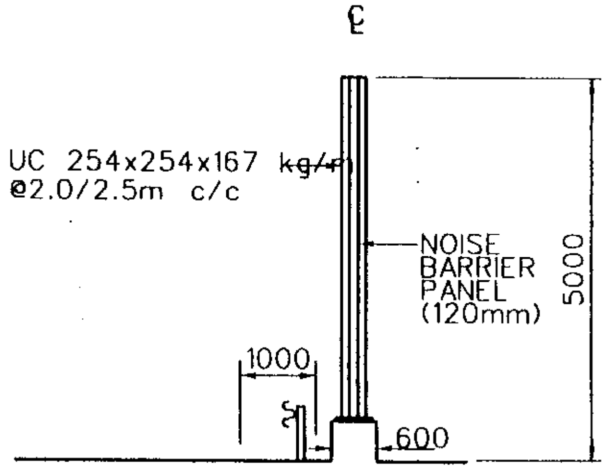
DETAILS OF NOISE BARRIERS FOR
TOLO HIGHWAY

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
N.T.S.

DATE :
25/05/98

FIGURE NO. :
3.6a/6



5-METRE VERTICAL BARRIER

AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

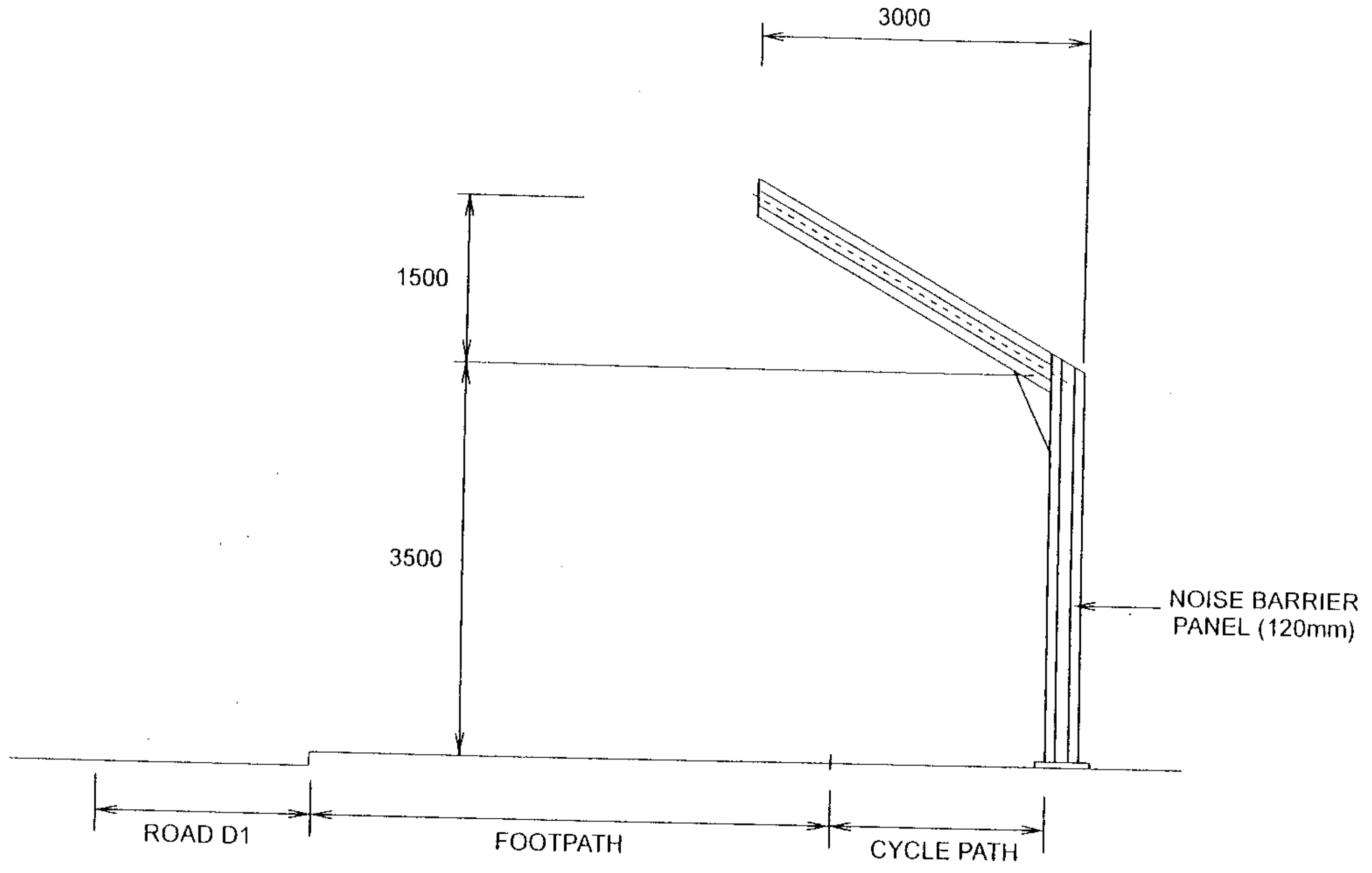
DETAILS OF NOISE BARRIERS FOR
TOLO HIGHWAY

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
N.T.S.

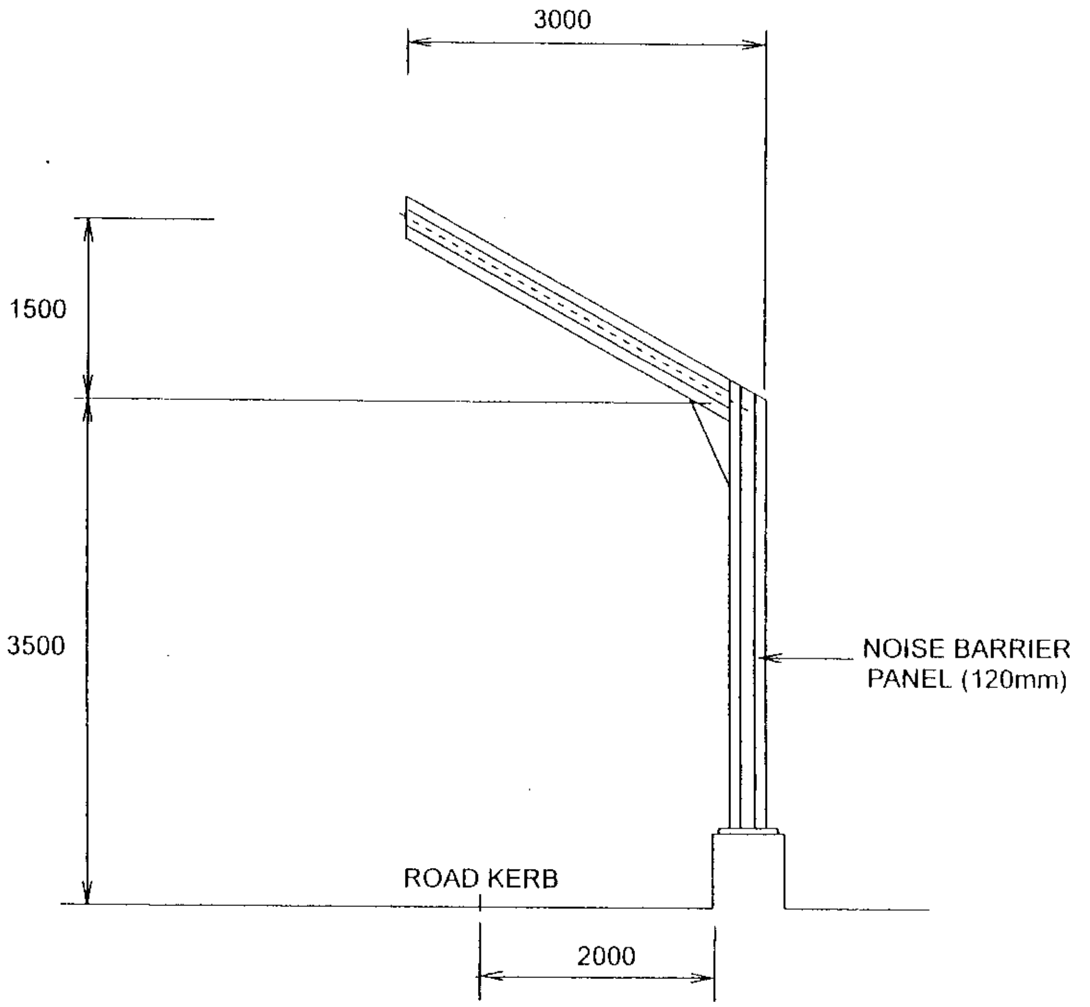
DATE :
25/05/98

FIGURE NO. :
3.6a/7



3.5mx3m CANOPY BARRIER

TYPICAL NOISE BARRIER - ALONG ROAD D1 LOCATED AT THE BACK OF CYCLE PATH FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA	Maunsell	NTS	DATE 02/06/98	FIGURE NO 3.6a/8



3.5mx3m CANOPY BARRIER

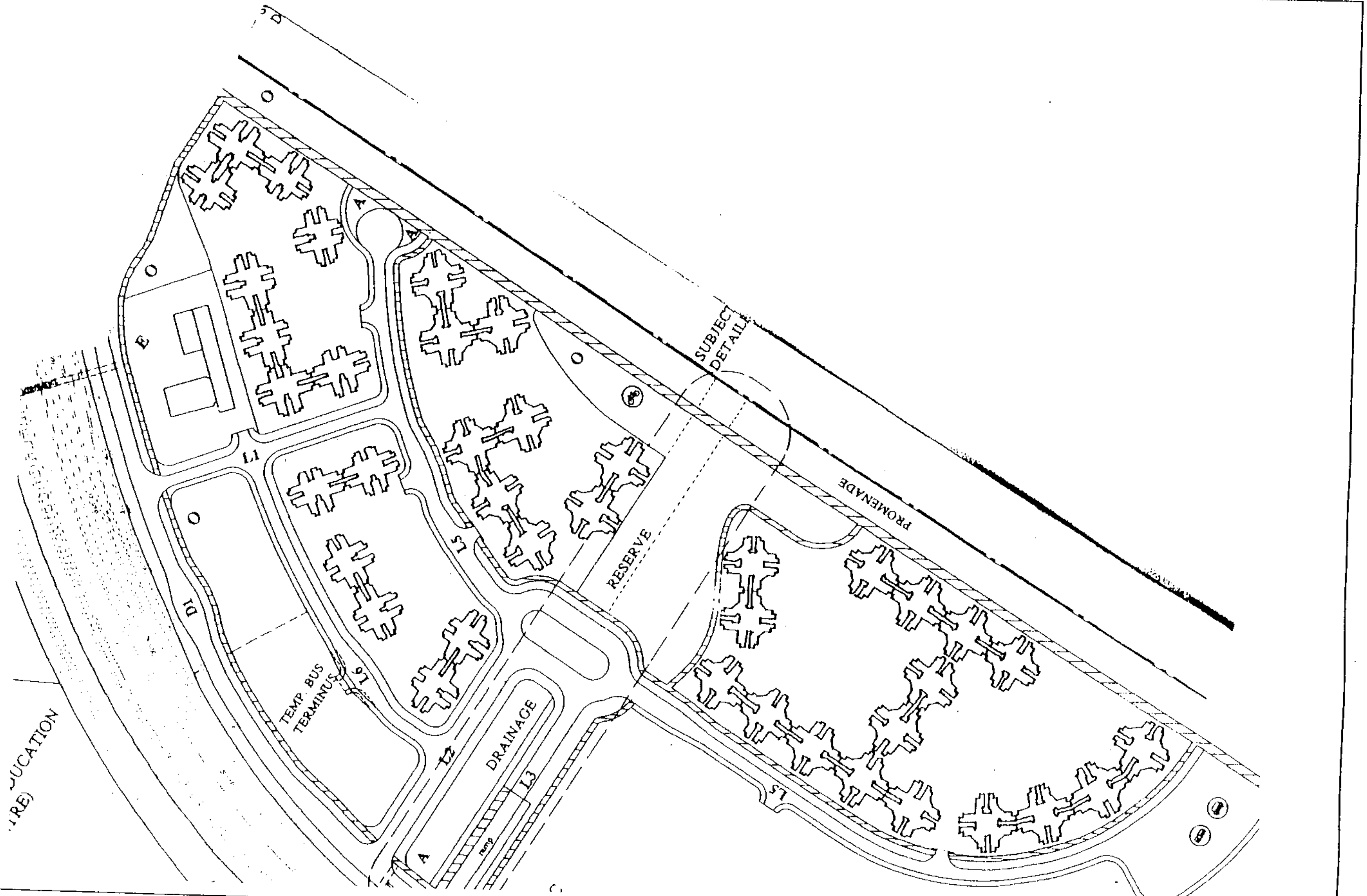
TYPICAL NOISE BARRIER - ALONG ROAD D1 LOCATED AT 2m FROM ROAD KERB
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

NTS

DATE 02/06/98

FIGURE NO 3.6a/9

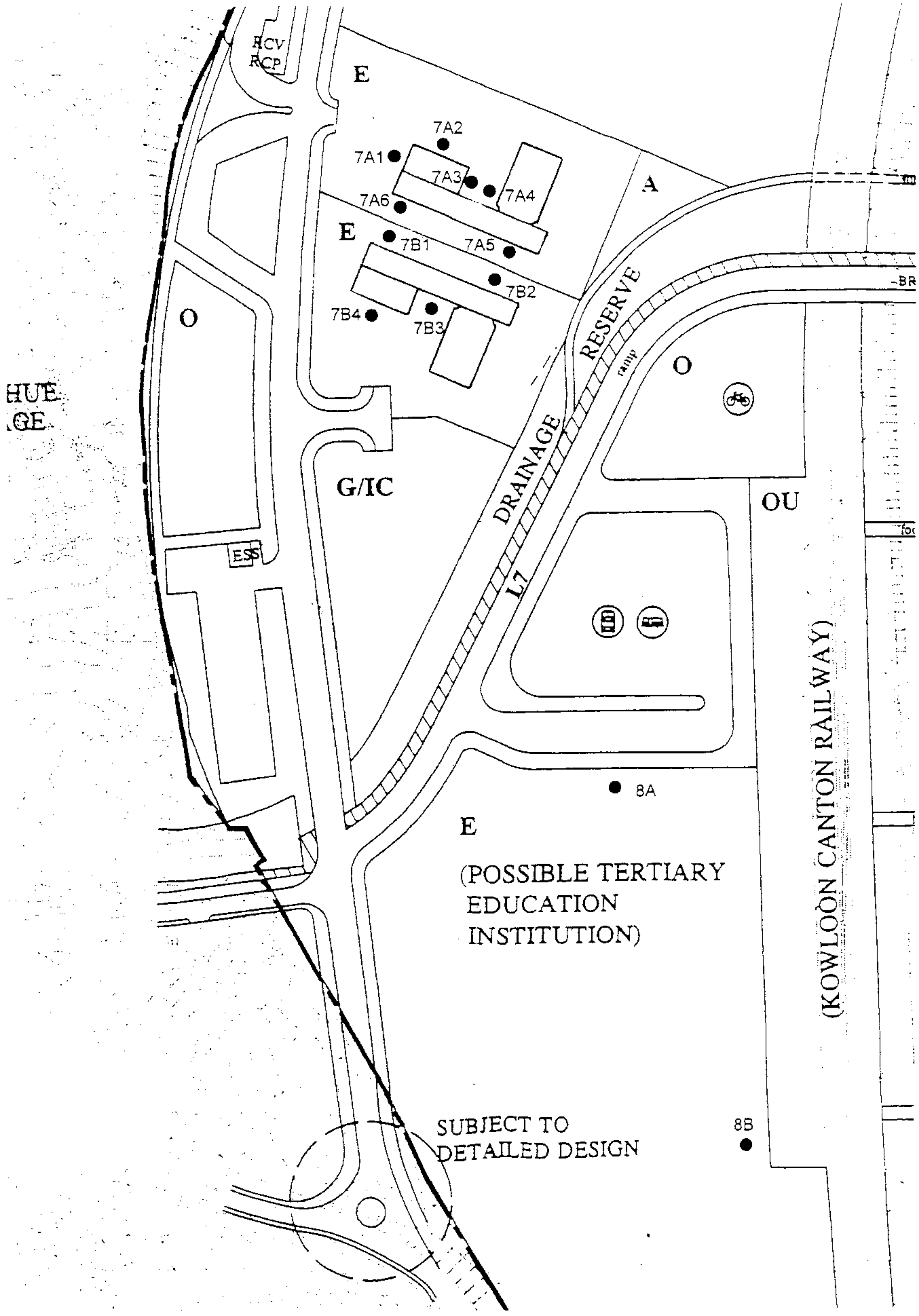


TYPICAL LAYOUT PLAN

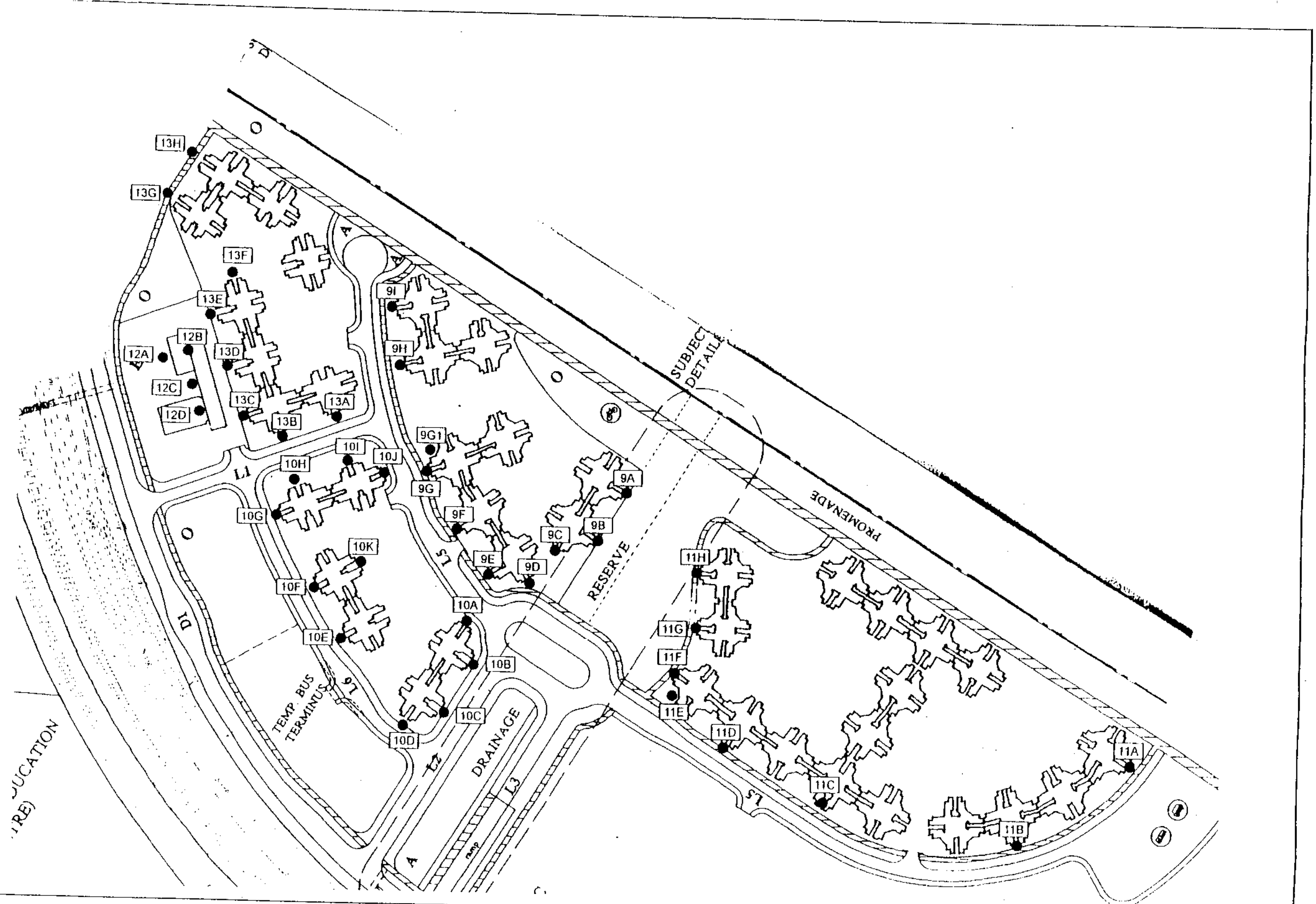
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE	FIGURE NO
02/06/98	3.6b



LOCATION OF PLANNED NSRs (AREA 12 & 39)	Maunsell	DATE 26/05/98	FIGURE NO. 3.6c

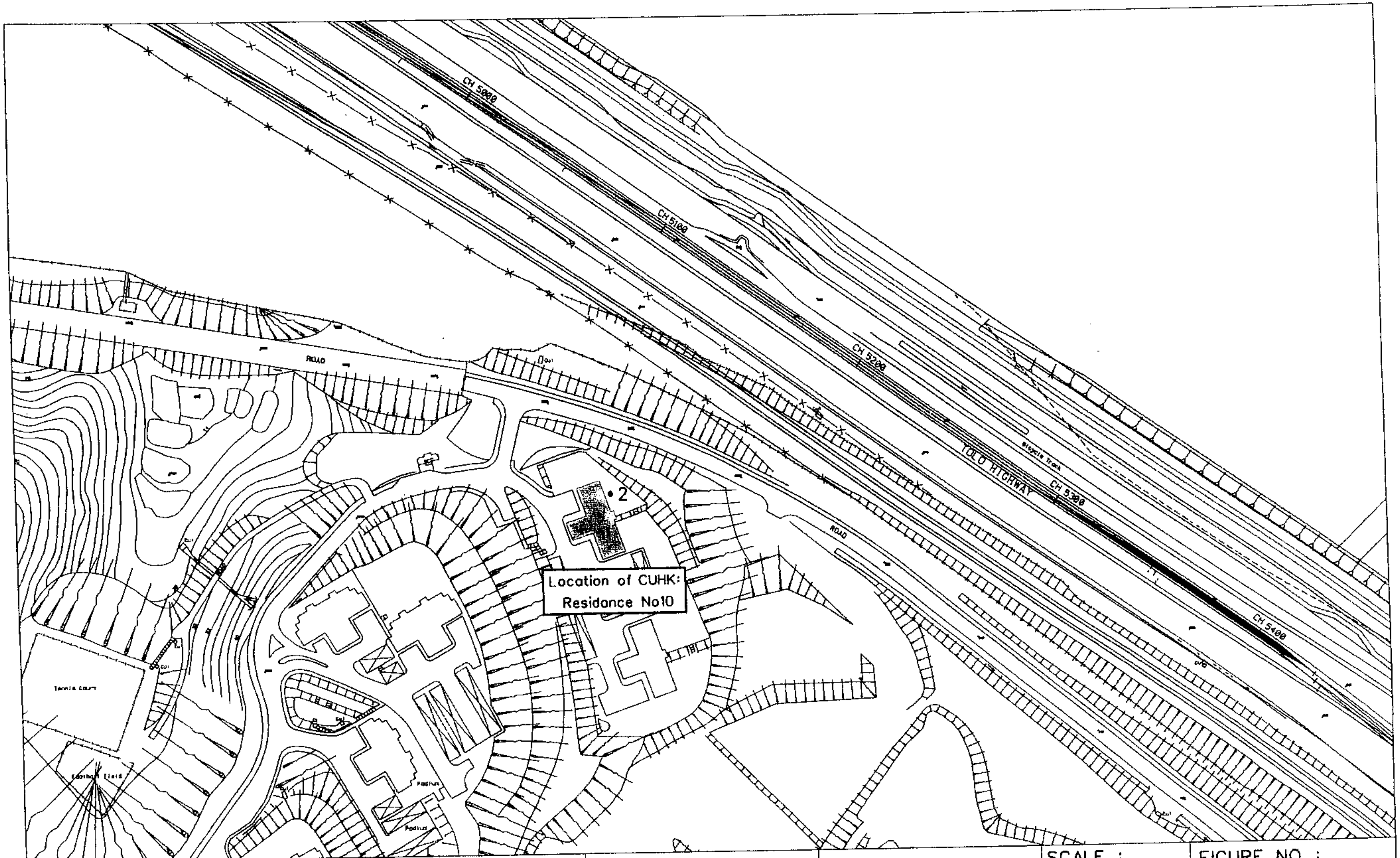


LOCATION OF NSRs DURING OPERATIONAL PHASE

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE	FIGURE NO
02/06/98	3.6d



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

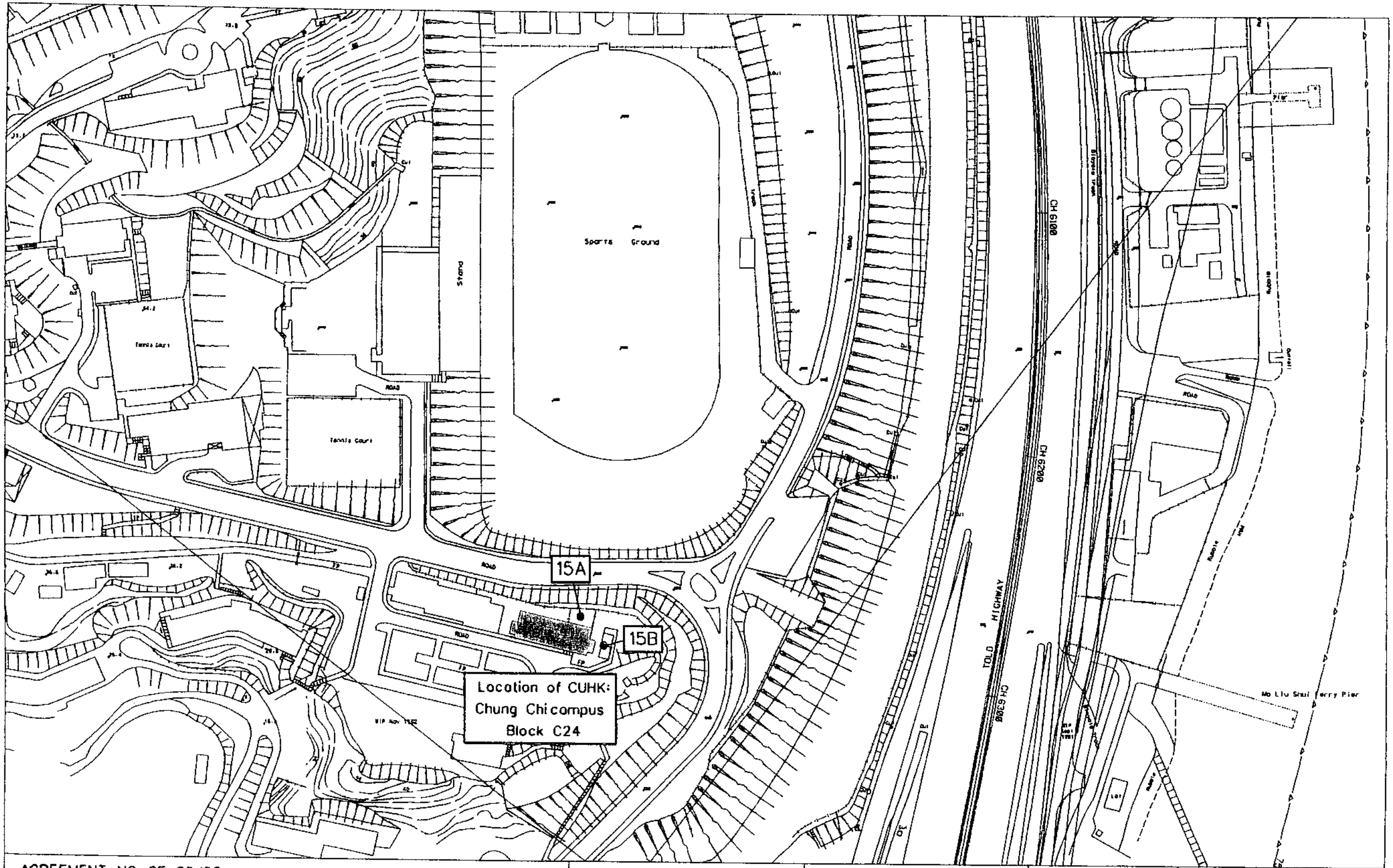
NSR LOCATION

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
N.T.S.

DATE :
26/05/98

FIGURE NO. :
3.6e



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

NSRs LOCATION

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
N.T.S.

DATE :
26/05/98

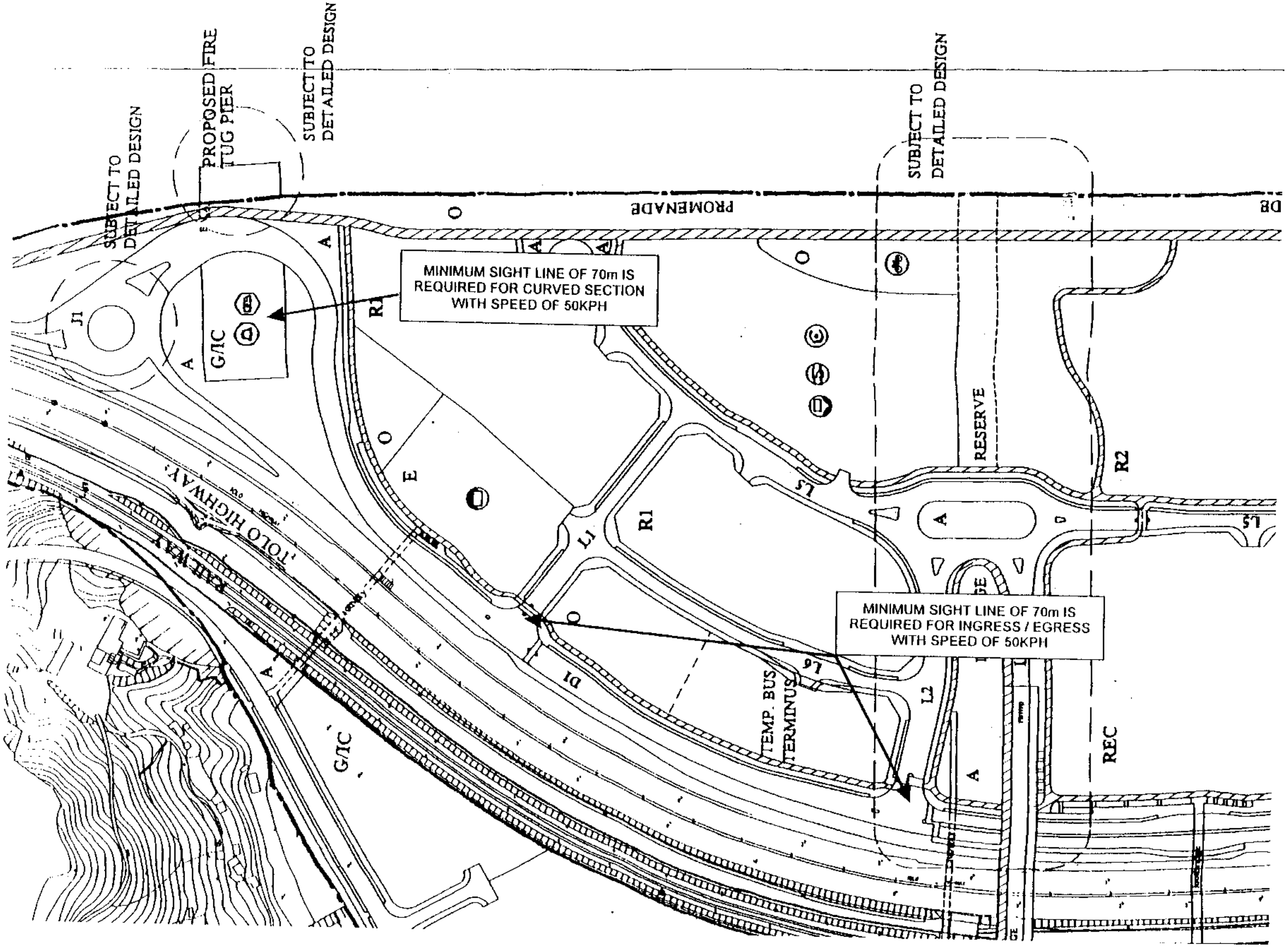
FIGURE NO. :
3.6f

KEY
● NSR LOCATION

LOCATION OF EXISTING NSRs
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE	FIGURE NO
26/05/98	3.6g

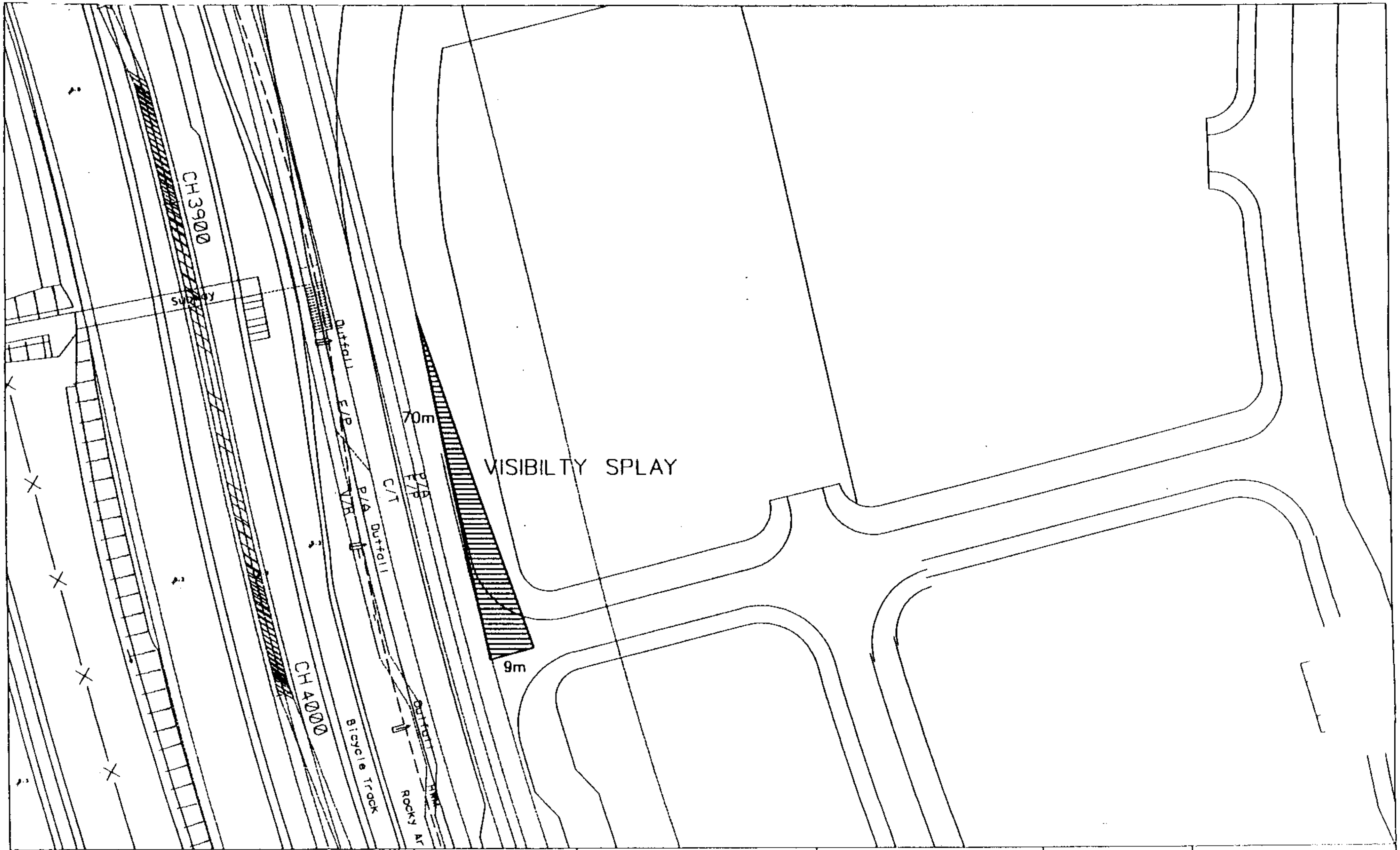


SAFETY CONSTRAINTS FOR DIRECT TECHNICAL REMEDIES

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE	FIGURE NO
03/06/98	3.6h-1



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

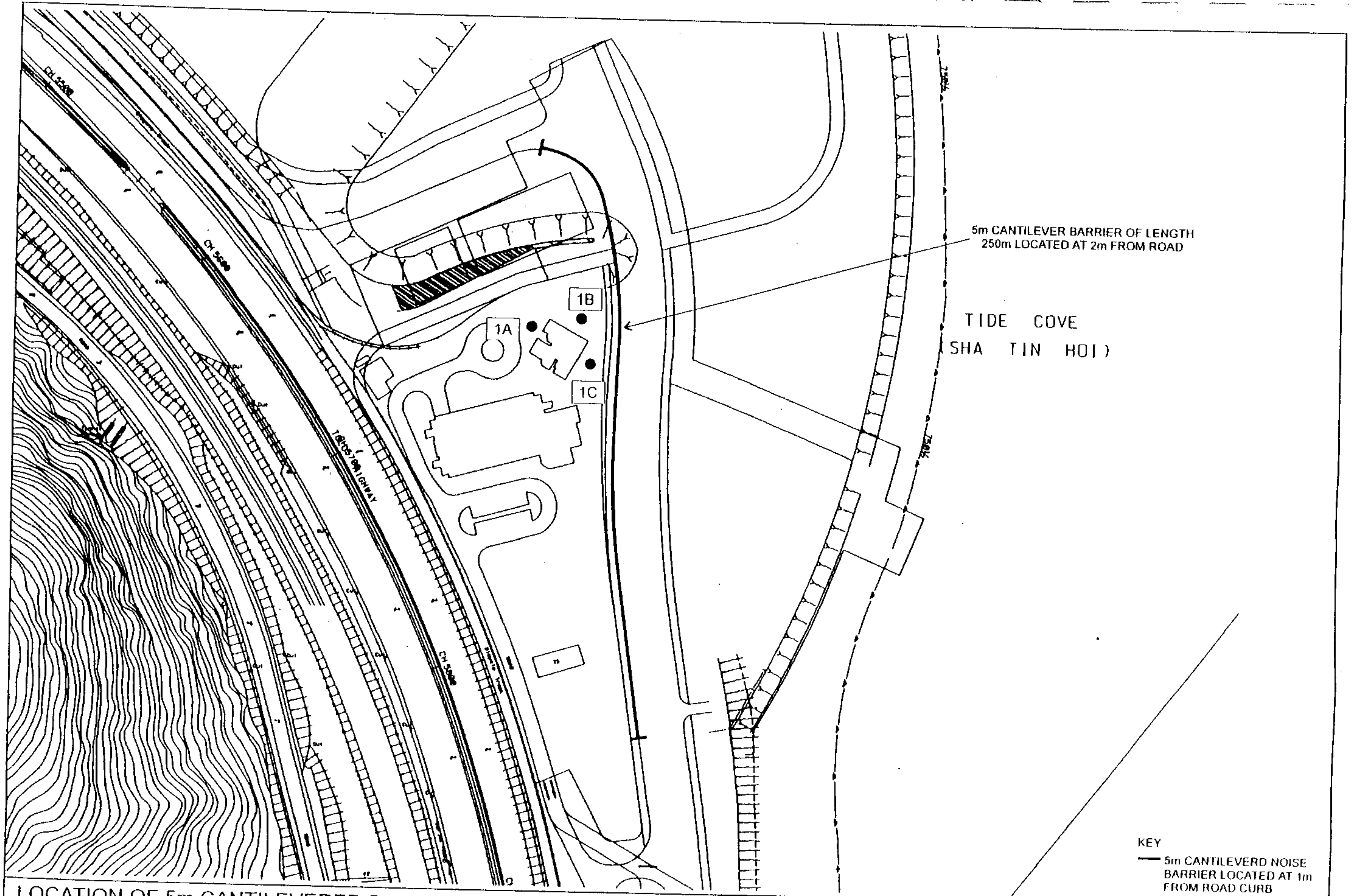
TYPICAL VISIBILITY SPLAY

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : 1:1000

DATE : 26/05/98

FIGURE NO. : 3.6h-2

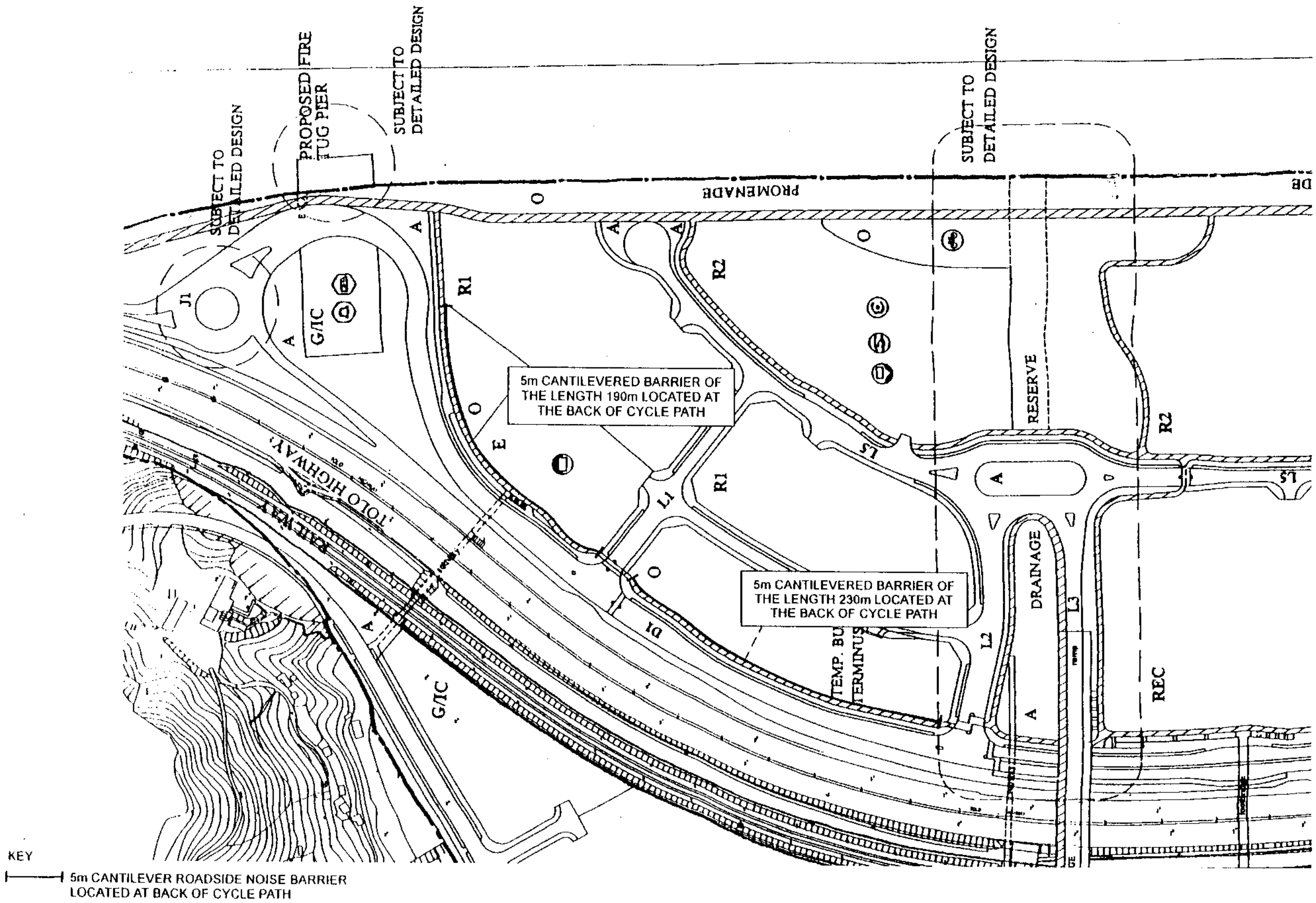


LOCATION OF 5m CANTILEVERED BARRIER ALONG ROAD D1

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE	FIGURE NO
03/06/98	3.6i



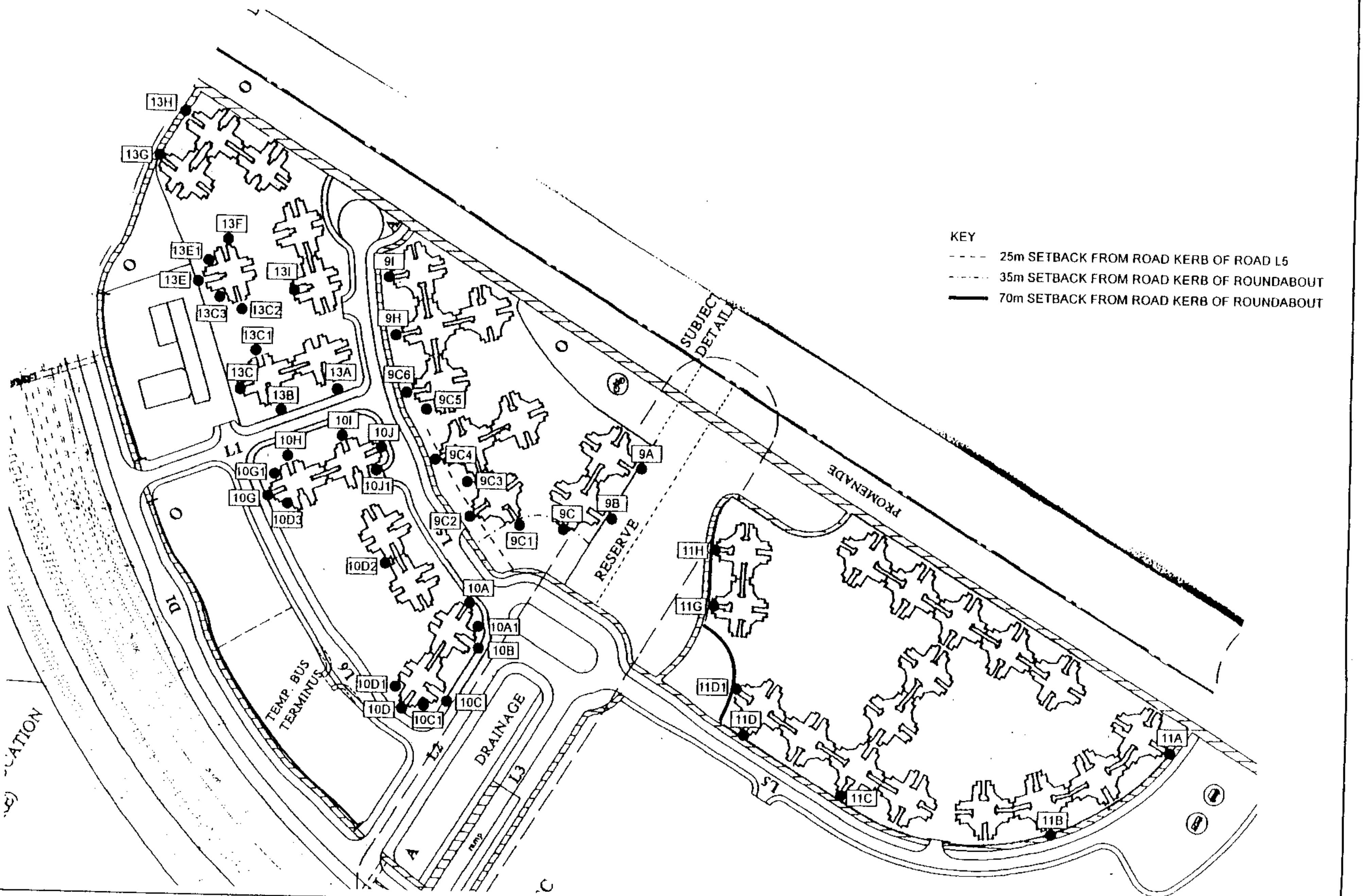
LOCATION OF NOISE BARRIER ALONG ROAD D1

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell
茂盛(亞洲)工程顧問有限公司

DATE
26/05/98

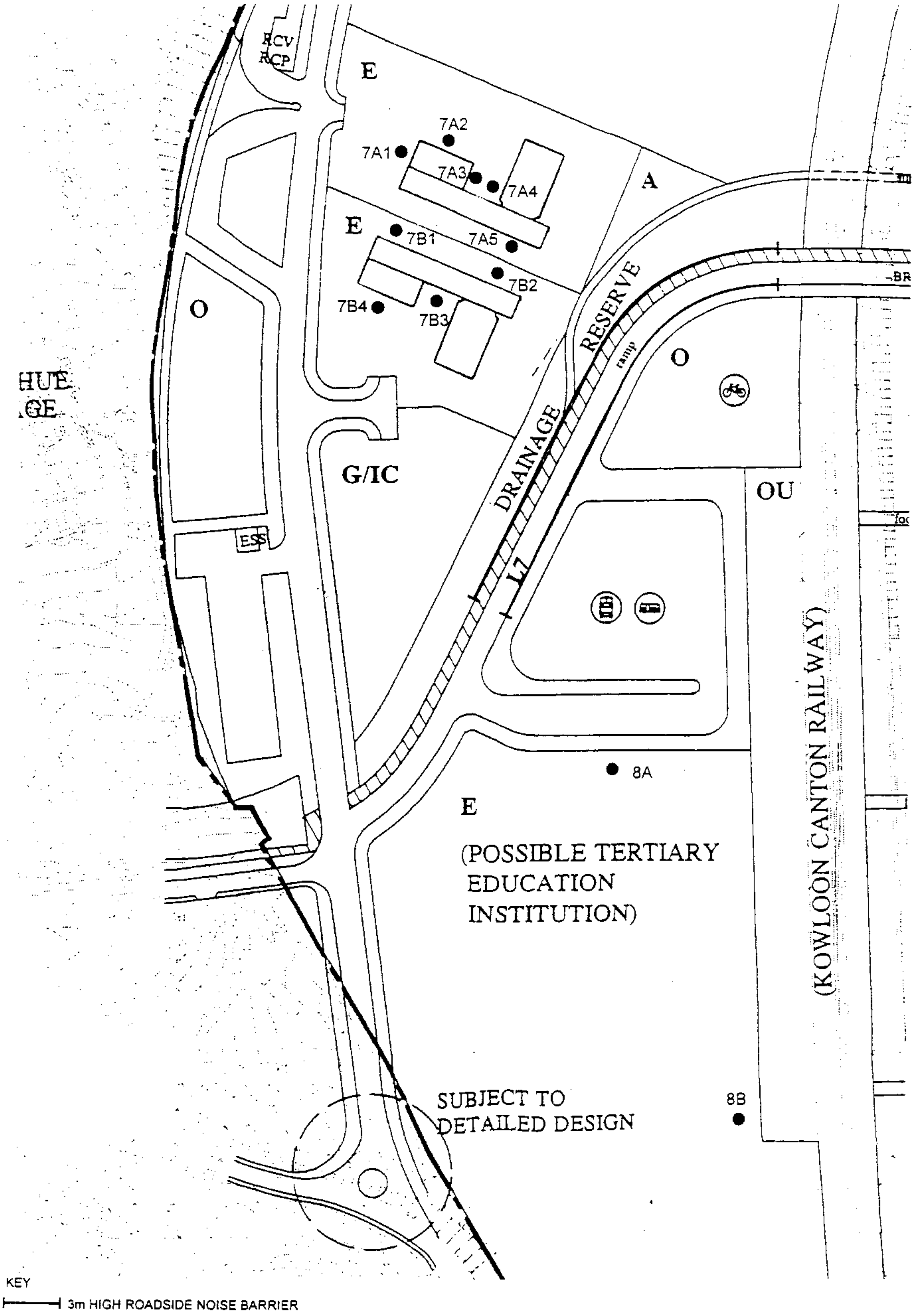
FIGURE NO
3.6j



REVISED LAYOUT PLAN

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell 茂盛(亞洲)工程顧問有限公司	SCALE: NTS	DATE 02/06/98	FIGURE NO 3.6k

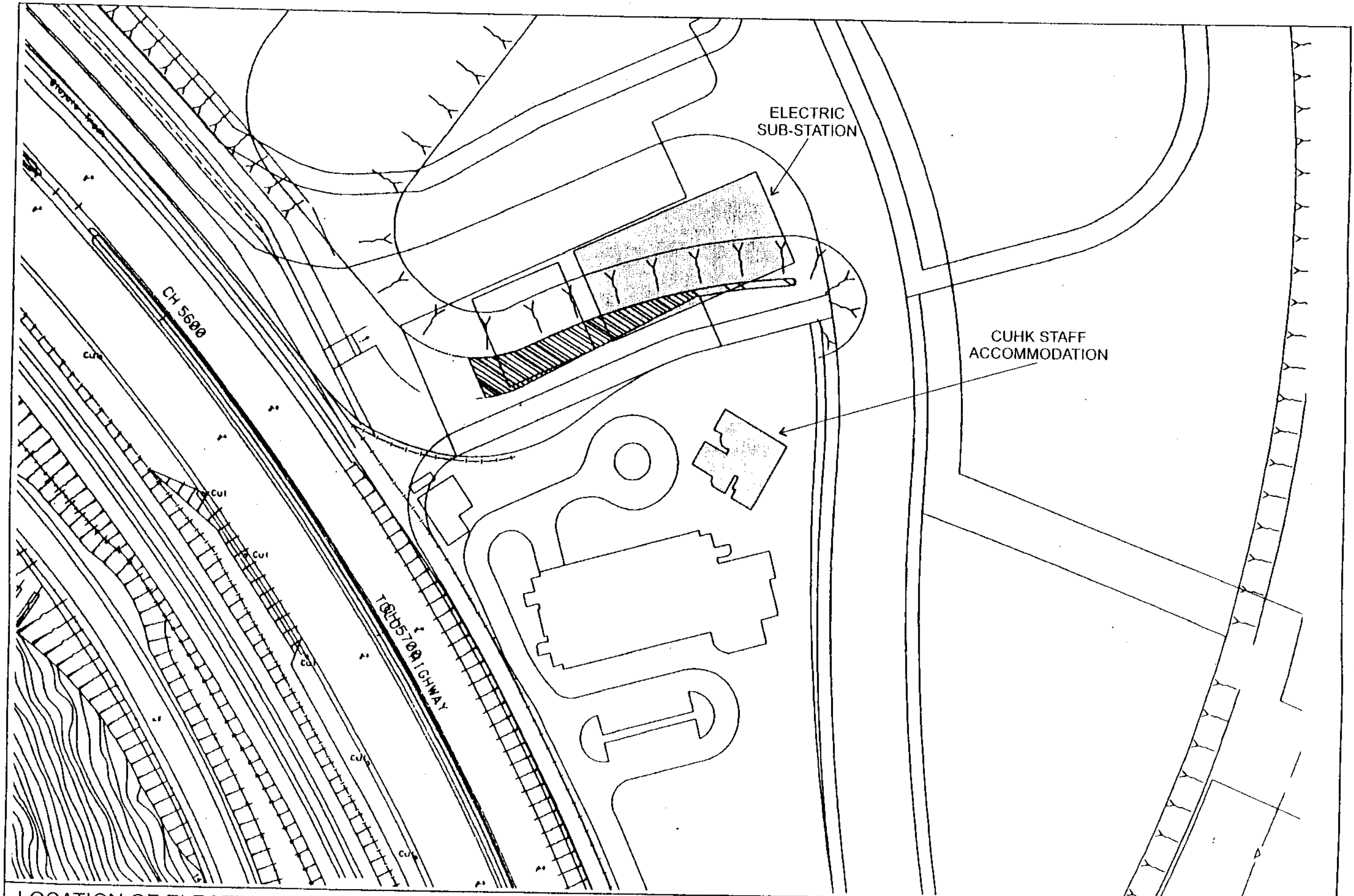


LOCATION OF NOISE BARRIER ALONG ROAD L7

Maunsell

DATE : 26/05/98

FIGURE NO. 3.61



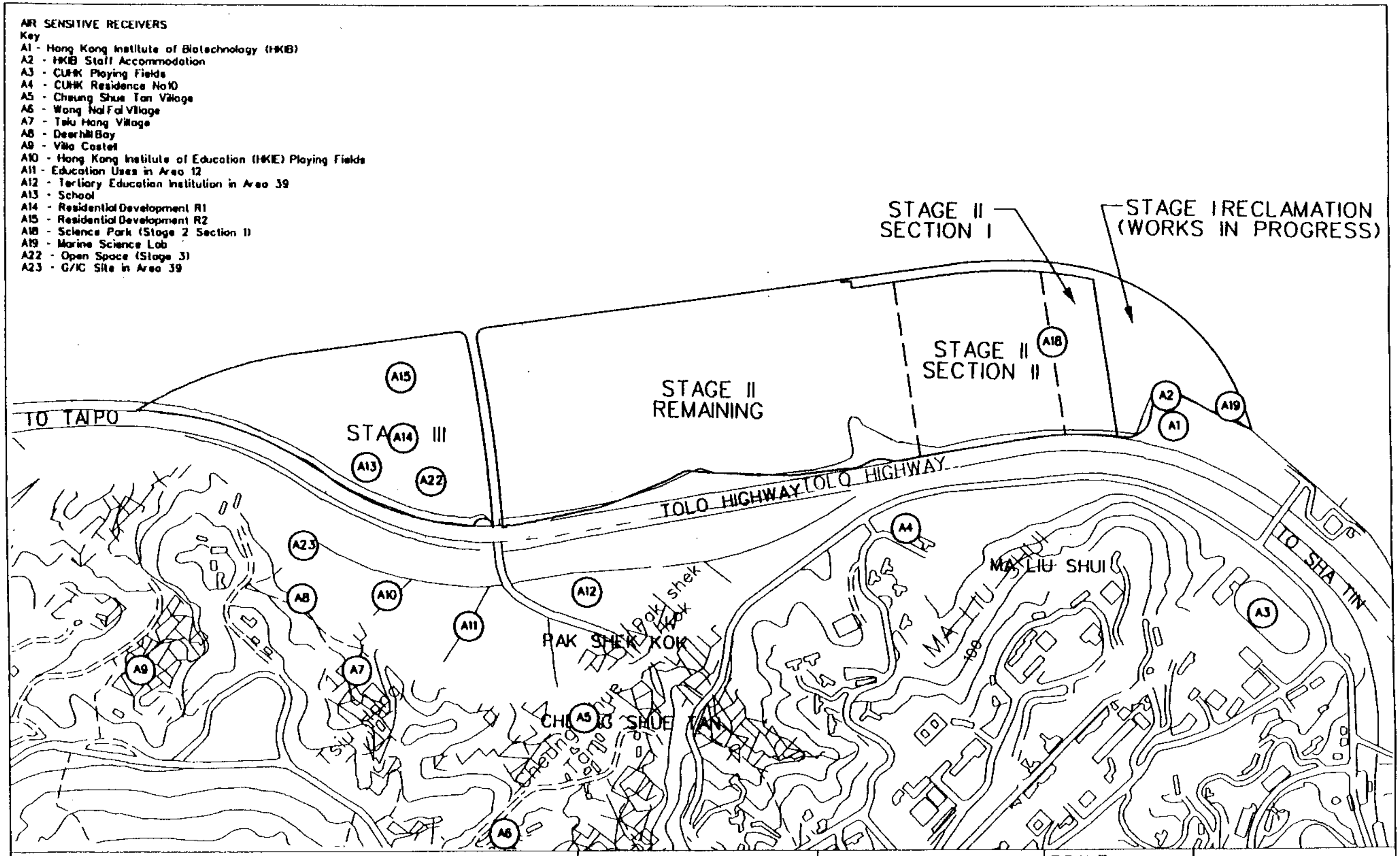
LOCATION OF ELECTRIC SUB-STATION

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE 26/05/98

FIGURE NO 3.6m



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

LOCATION OF ASRs DURING CONSTRUCTION

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

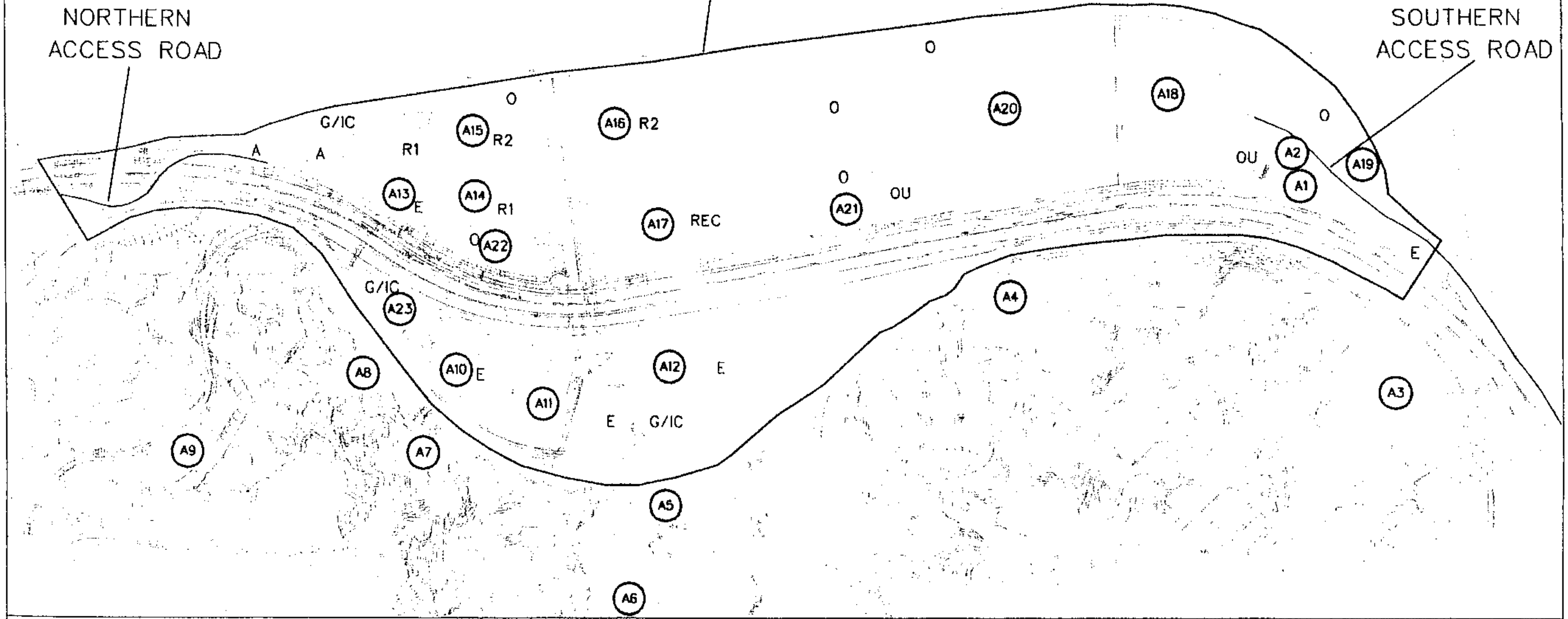
DATE : 02/06/98

FIGURE NO. : 4.4a

AIR SENSITIVE RECEIVERS

Key

A1 - Hong Kong Institute of Biotechnology (HKIB)
A2 - HKIB Staff Accommodation
A3 - CUHK Playing Fields
A4 - CUHK Residence No10
A5 - Cheung Shue Tan Village
A6 - Wong Nai Fai Village
A7 - Tsiu Hang Village
A8 - Deerhill Bay
A9 - Villa Castell
A10 - Hong Kong Institute of Education (HKIE) Playing Fields
A11 - Education Uses in Area 12
A12 - Tertiary Education Institution in Area 39
A13 - School
A14 - Residential Development R1
A15 - Residential Development R2
A16 - Residential Development R2
A17 - Recreational Area
A18 - Science Park (Stage 2 Section 1)
A19 - Marine Science Lab
A20 - Science Park (Stage 2 Section 2)
A21 - Open Space (Stage 2)
A22 - Open Space (Stage 3)
A23 - G/IC Site in Area 39



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

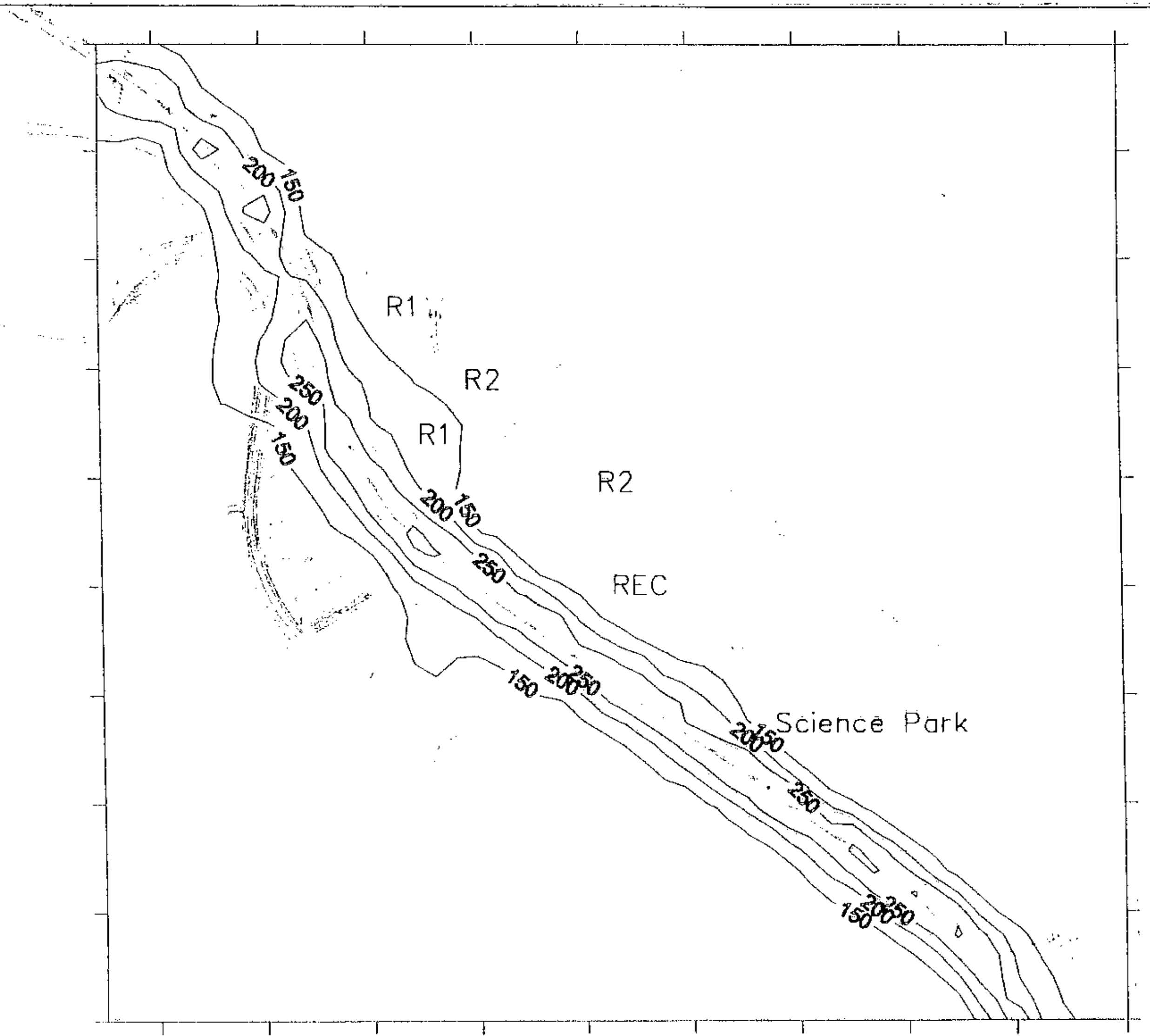
LOCATION OF ASRs DURING OPERATION

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

DATE : 02/06/98

FIGURE NO. : 4.4b



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

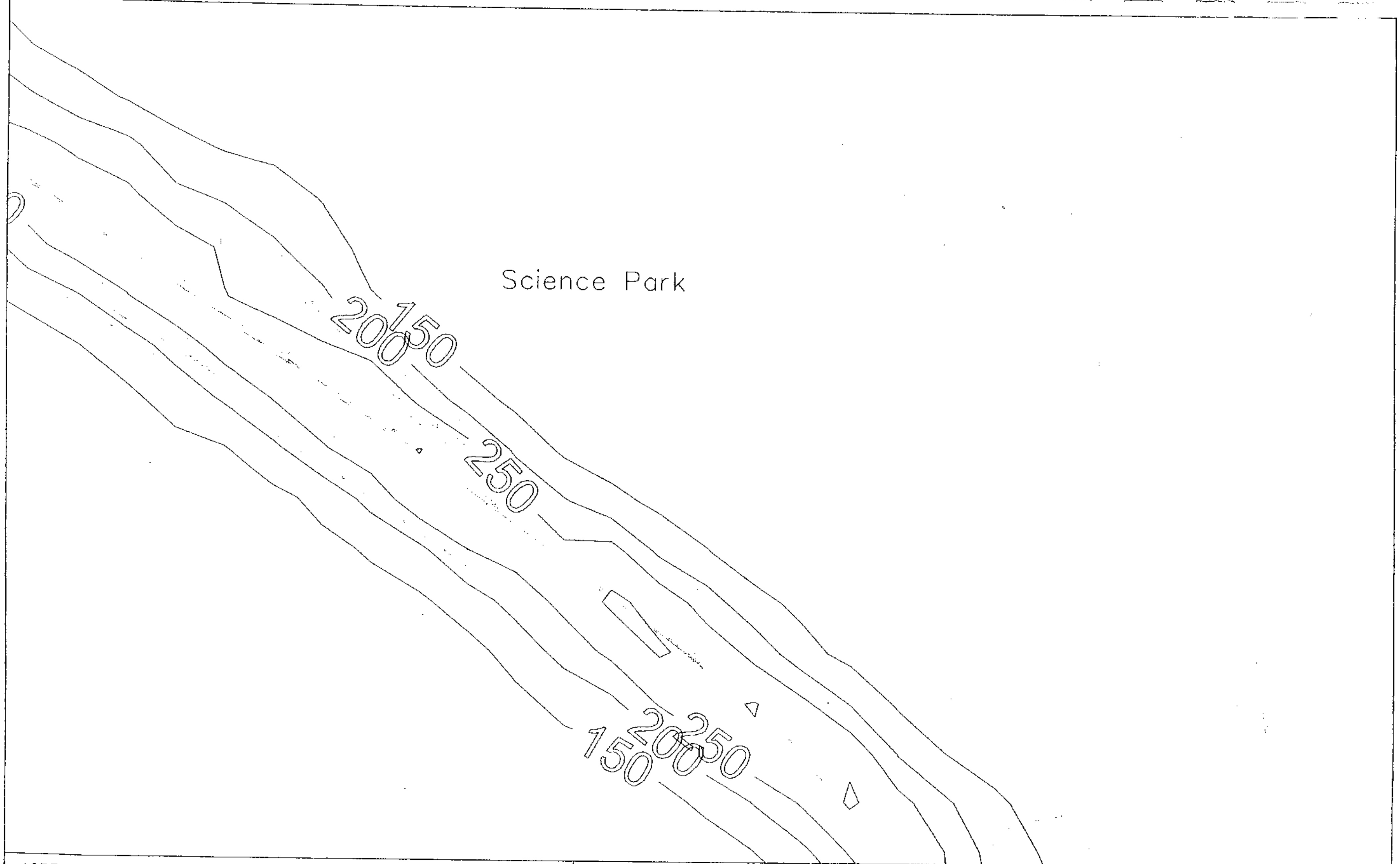
NO2 CONTOUR PLOT AT 1.5m ABOVE
GROUND LEVEL ($\mu g/m3$)

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

DATE : 02/06/98

FIGURE NO. : 4.6a



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

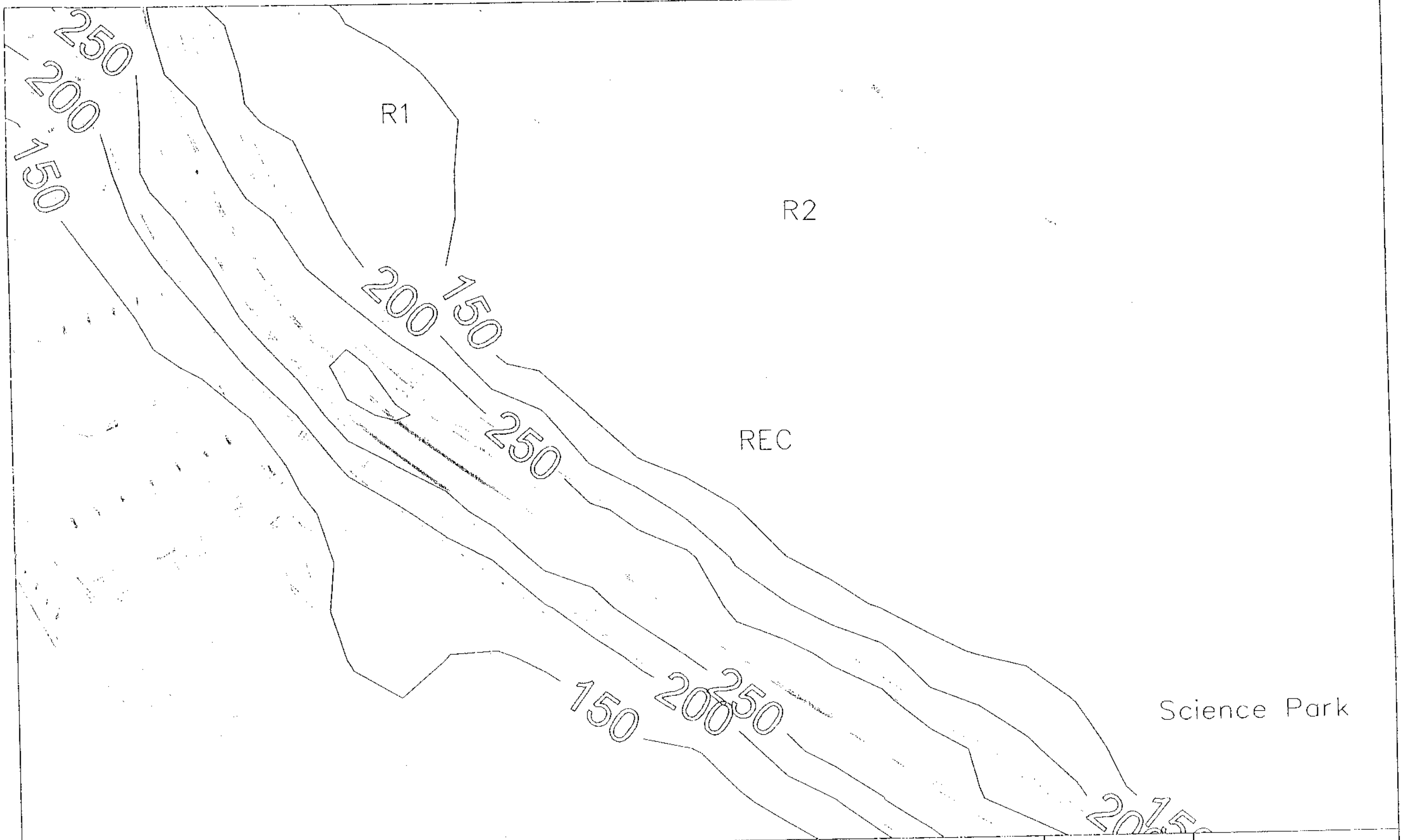
NO2 CONTOUR PLOT AT 1.5m ABOVE GROUND LEVEL ($\mu g/m3$) STAGE I AND STAGE II PHASE I

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : 1:4000

DATE : 11/05/98

FIGURE NO. : 4.6b



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

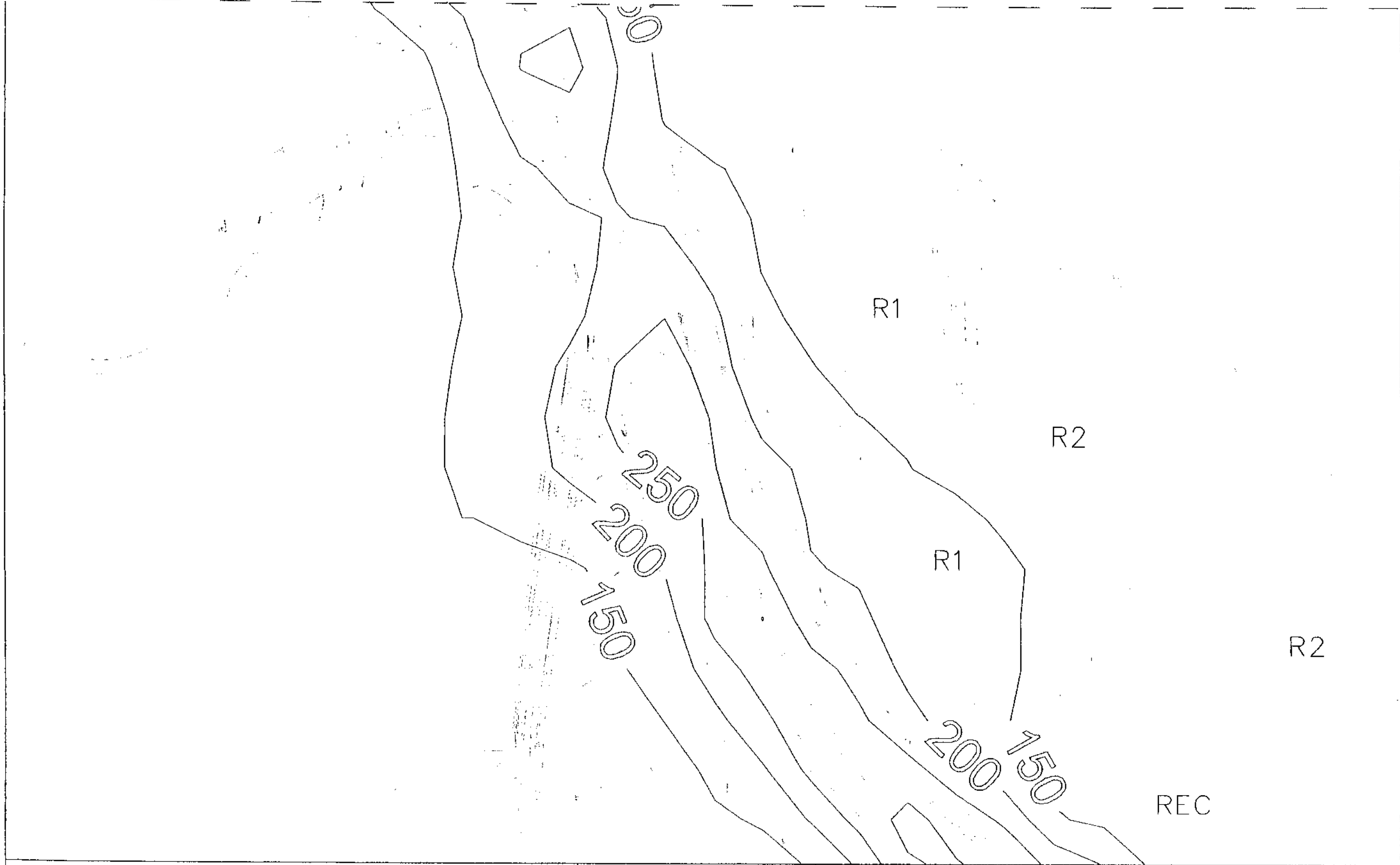
NO2 CONTOUR PLOT AT 1.5m ABOVE GROUND LEVEL ($\mu g/m3$) STAGE II PHASE II

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : 1:4000

DATE : 11/05/98

FIGURE NO. : 4.6c



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

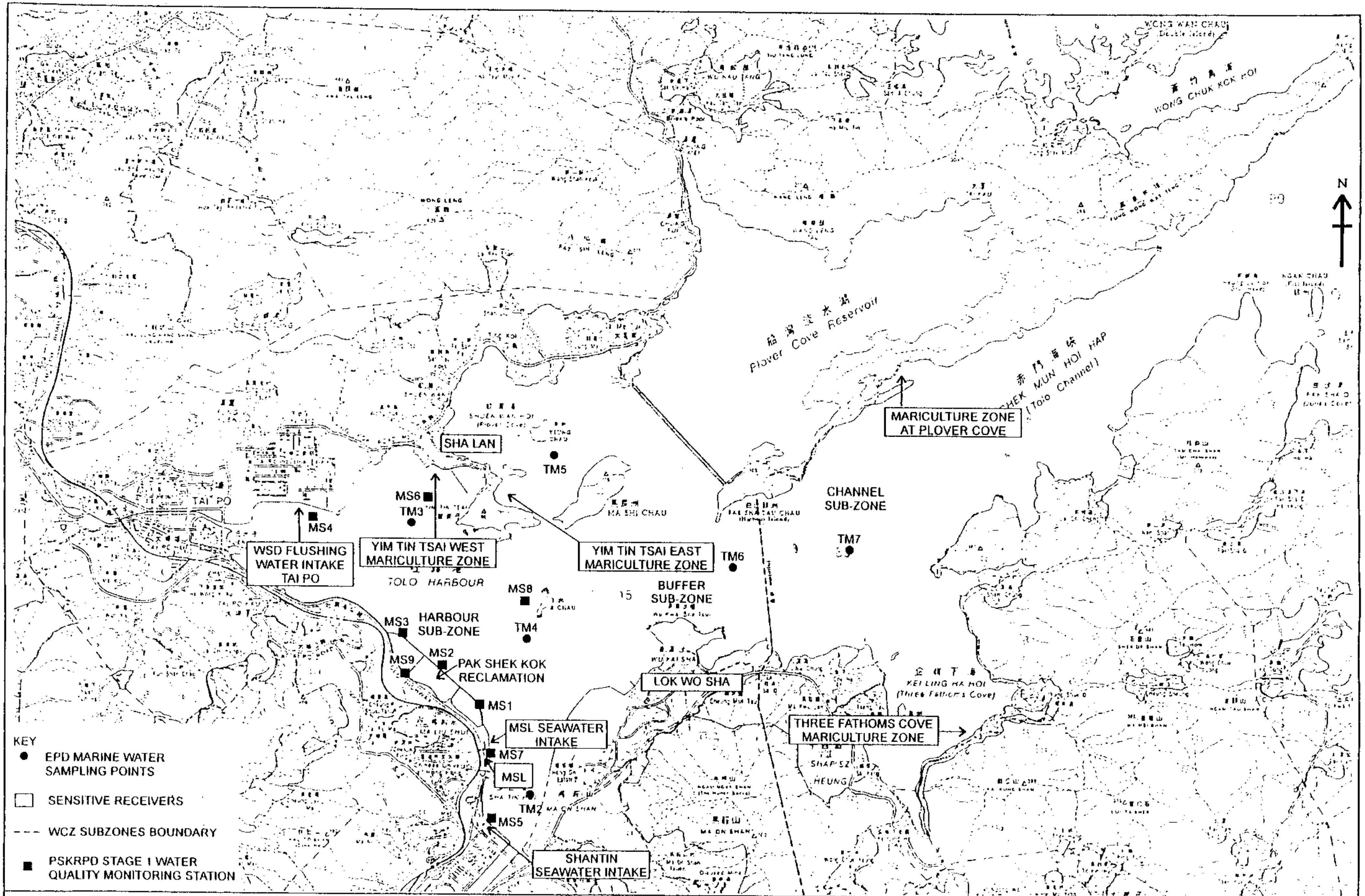
NO2 CONTOUR PLOT AT 1.5m ABOVE
GROUND LEVEL (μg/m3) STAGE III

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
1:4000

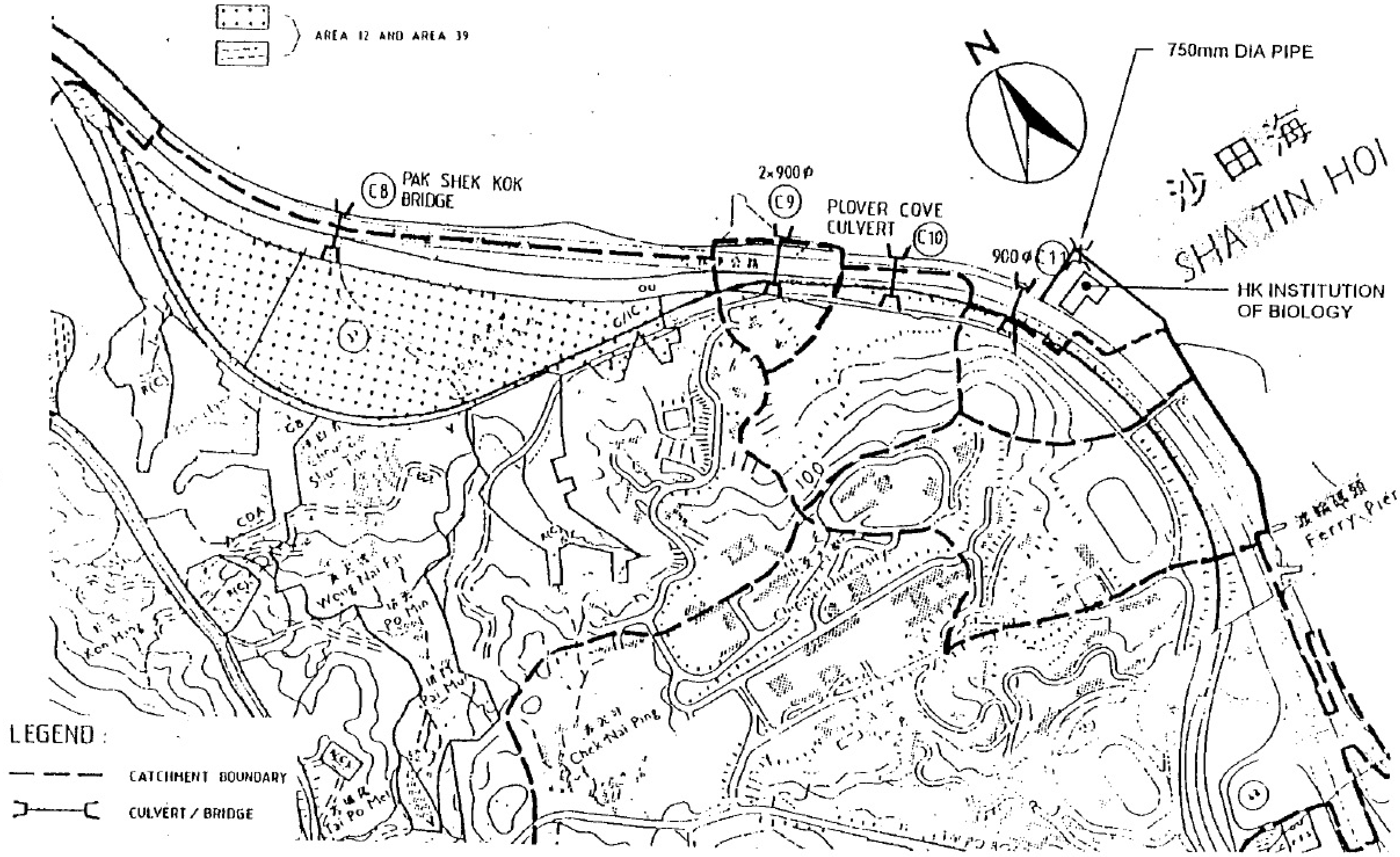
DATE :
11/05/98

FIGURE NO. :
4.6d



TOLO HARBOUR WCZ AND MARINE WATER QUALITY MONITORING LOCATIONS

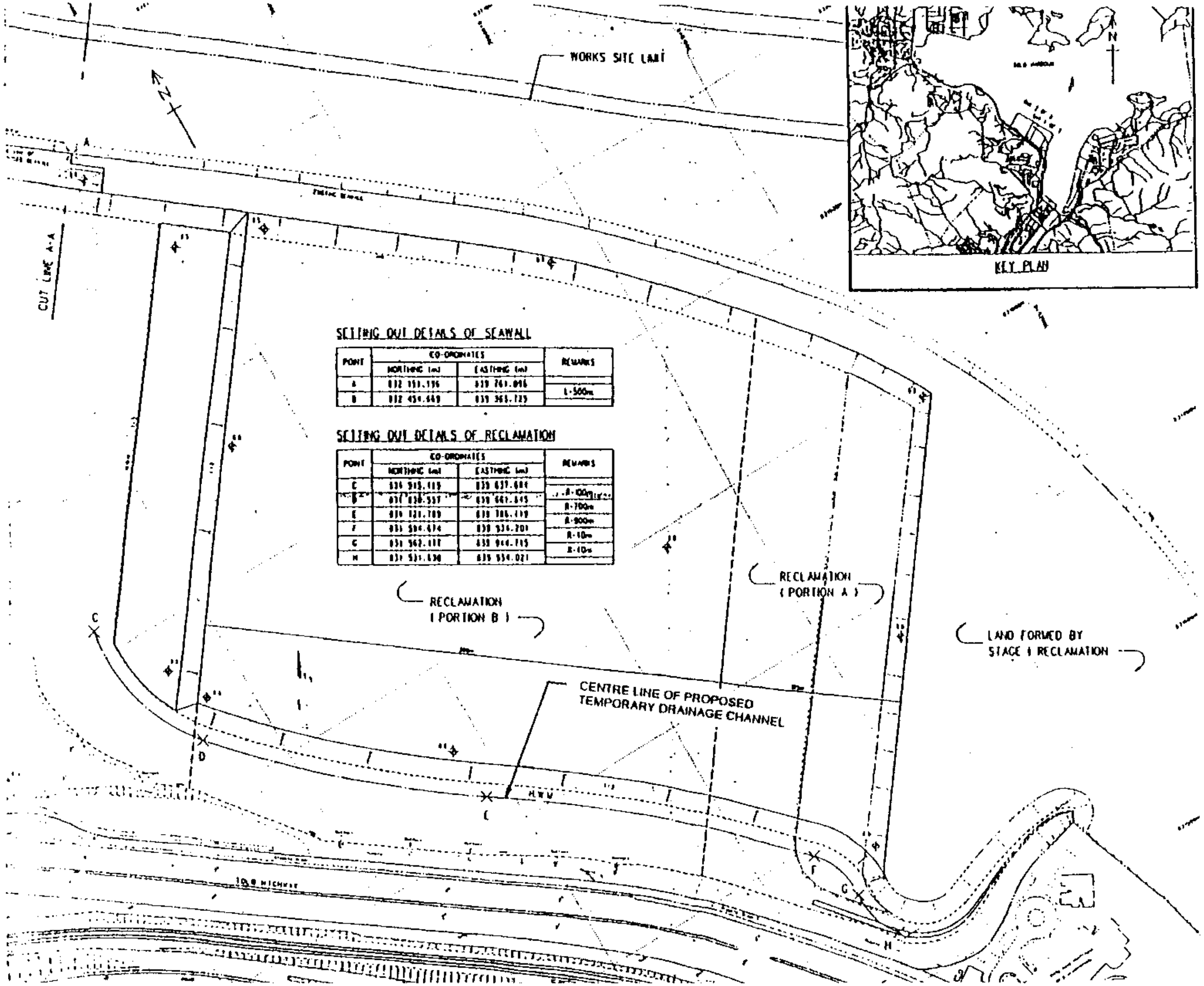
Maunsell	NOT TO SCALE	DATE	FIGURE NO 5.1a



LOCATION OF MAJOR EXISTING OUTFALLS

DATE :

FIGURE NO.
5.5a



SETTING OUT DETAILS OF SEAWALL

POINT	CO-ORDINATES		REMARKS
	NORTHING (m)	EASTING (m)	
A	812 151.156	839 761.016	L=500m
B	812 454.449	839 365.725	

SETTING OUT DETAILS OF RECLAMATION

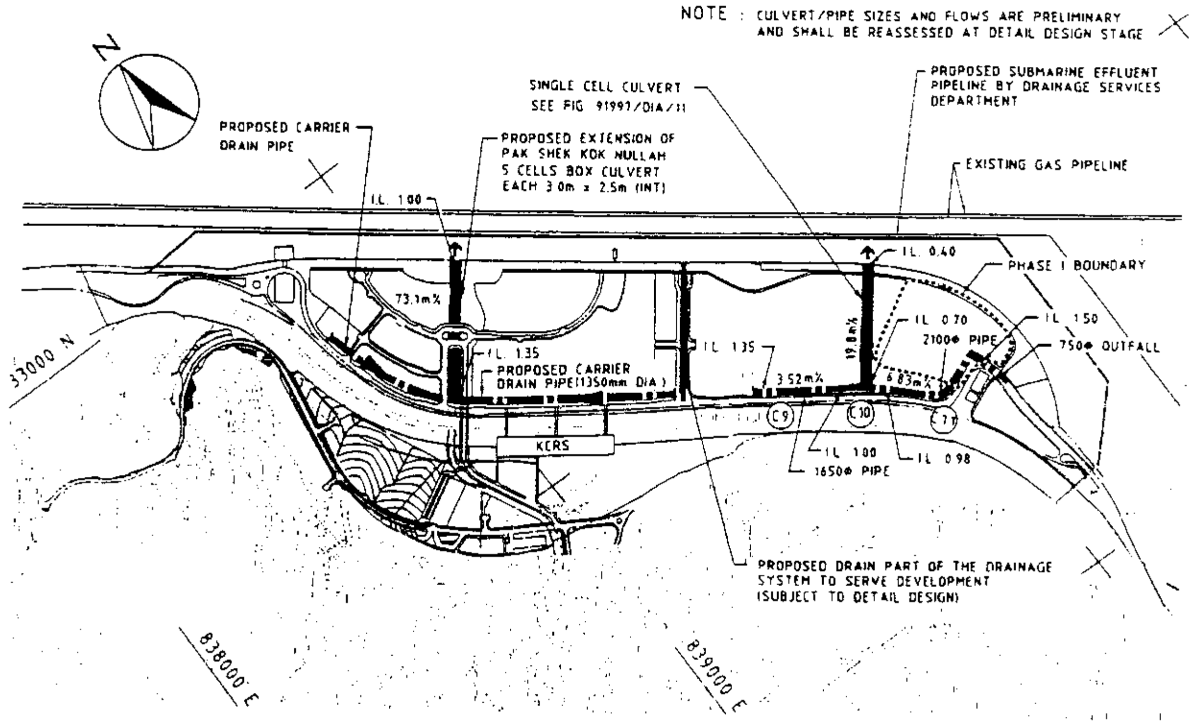
POINT	CO-ORDINATES		REMARKS
	NORTHING (m)	EASTING (m)	
C	836 915.115	833 637.684	R=100m
D	836 830.557	838 661.645	R=700m
E	836 121.709	838 786.119	R=900m
F	833 594.674	838 936.701	R=10m
G	831 562.117	838 944.715	R=10m
H	831 531.630	838 934.021	

LAYOUT PLAN OF PROPOSED TEMPORARY DRAINAGE FOR STAGE II RECLAMATION

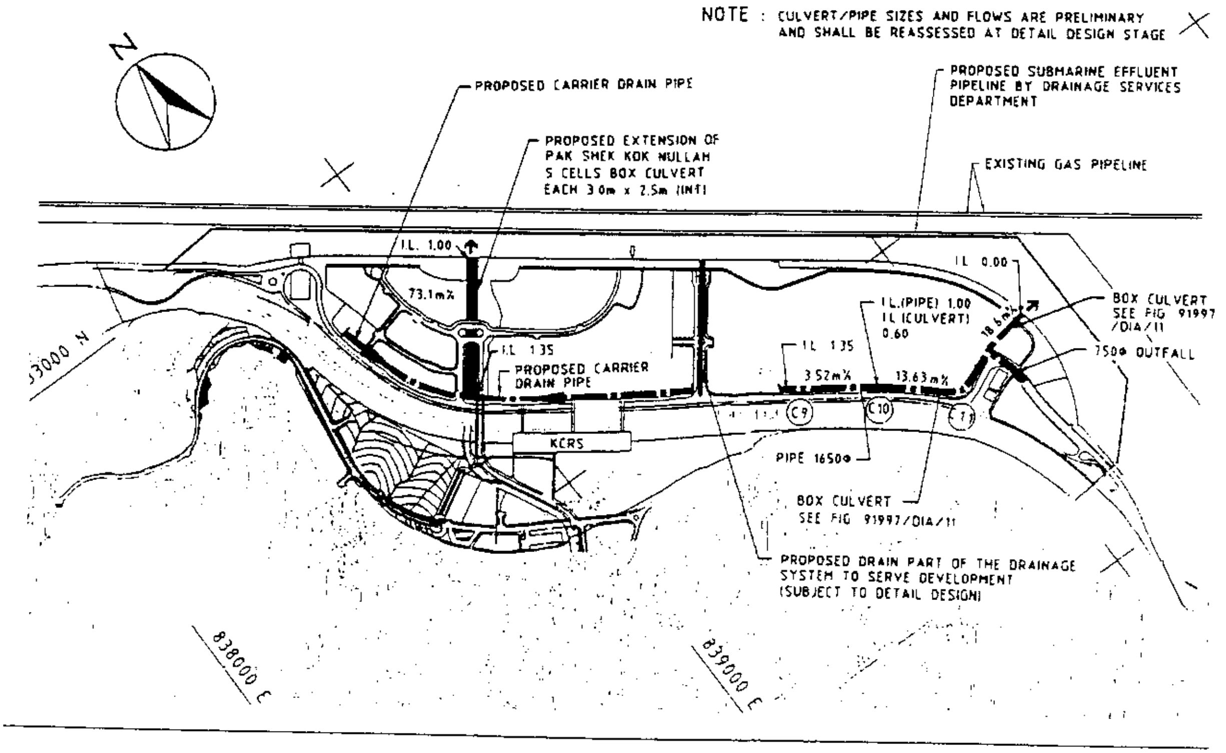
Maunsell

DATE :

FIGURE NO
5.5b

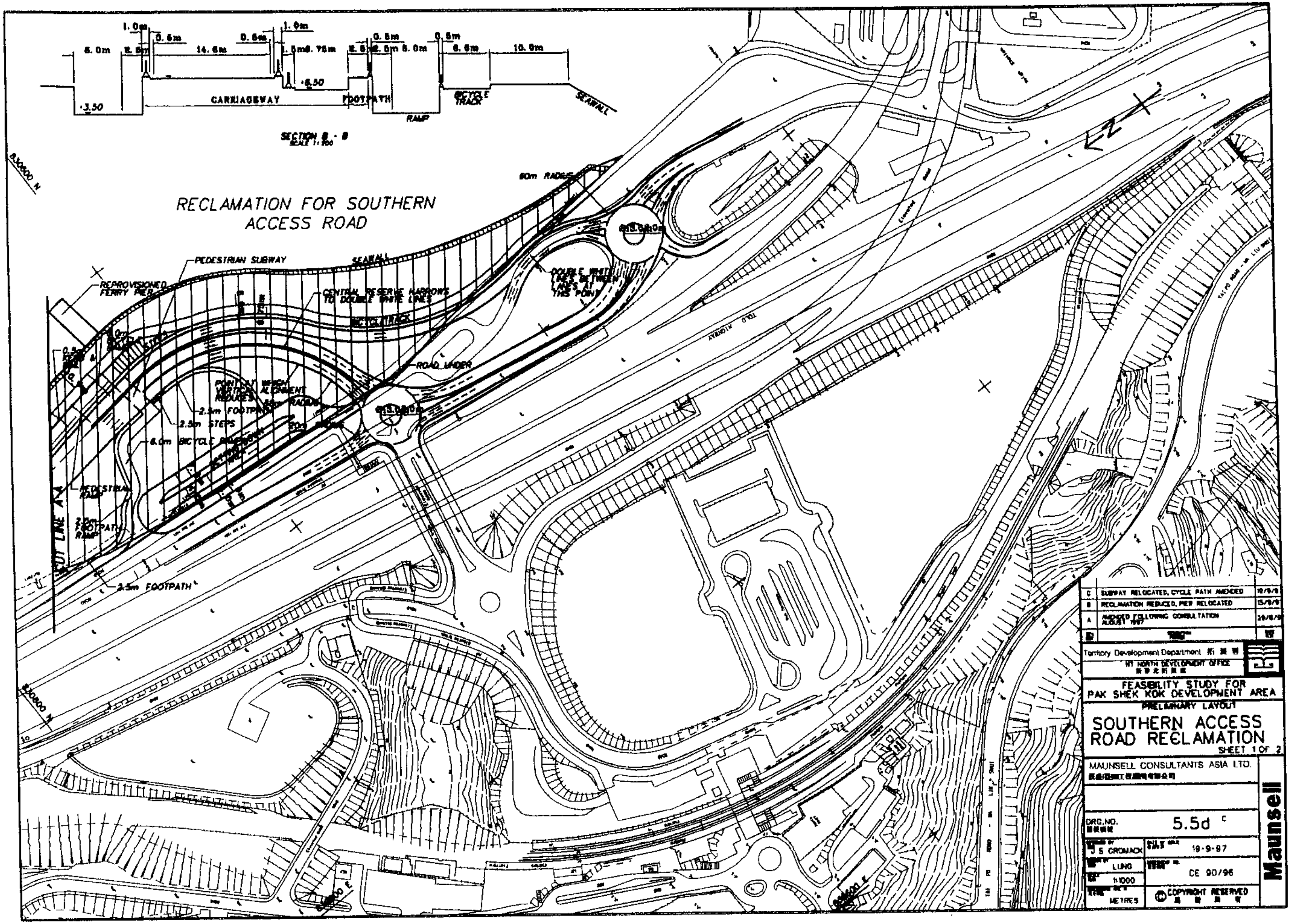


OPTION A

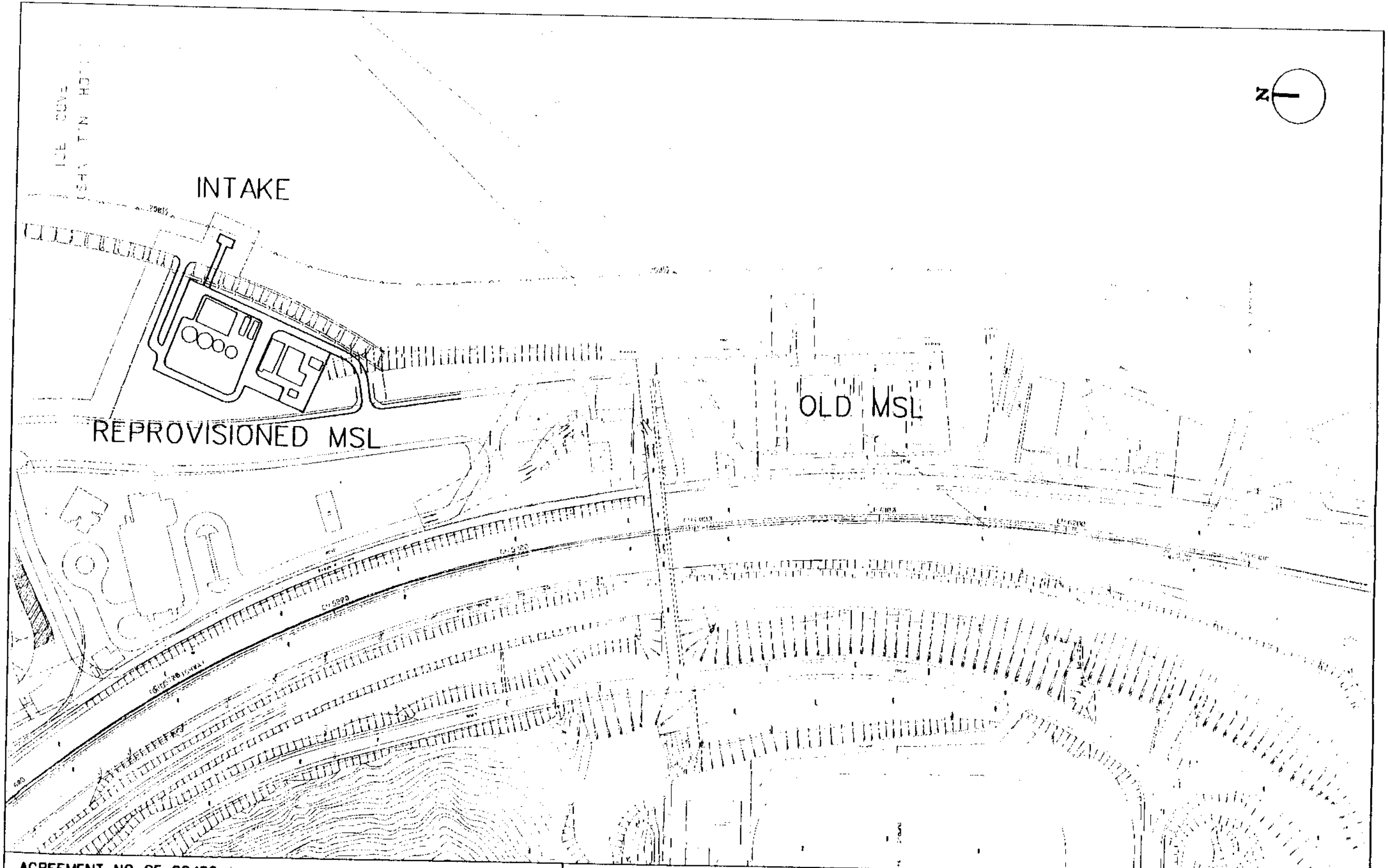


OPTION B

PAK SHEK KOK DEVELOPMENT - OPTION A AND B DRAINAGE PROPOSAL	Maunsell 茂盛(亞洲)工程顧問有限公司	DATE :	FIGURE NO. 5.5c



1.0m
0.5m
8.0m
0.5m
14.6m
0.5m
1.0m
1.5m
8.75m
0.5m
0.5m
0.5m
8.0m
0.5m
6.6m
10.0m
+3.50
+6.50
CARRIAGEWAY
FOOTPATH
RAMP
BICYCLE TRACK
SEAWALL
SECTION B - B
SCALE 1:200
830600 N
60m RADIUS
RECLAMATION FOR SOUTHERN ACCESS ROAD
PEDESTRIAN SUBWAY
SEAWALL
REPROVISIONED FERRY PIER
CENTRAL RESERVE NARROWS TO DOUBLE WHITE LINES
BICYCLE TRACK
DOUBLE WHITE LINES BETWEEN LANES AT THIS POINT
ROAD UNDER
POINT AT WHICH VERTICAL ALIGNMENT REDUCES
RADIUS
2.5m FOOTPATH
2.5m STEPS
6.0m BICYCLE ROAD
PEDESTRIAN RAMP
2.5m FOOTPATH RAMP
CUT LINE A-A
2.5m FOOTPATH
TOLO HIGHWAY
TAI PO ROAD - MA LIU SHUI
830600 N
C
SUBWAY RELOCATED, CYCLE PATH AMENDED
B
RECLAMATION REDUCED, PIER RELOCATED
15/9/9
A
AMENDED FOLLOWING CONSULTATION AUGUST 1997
Territory Development Department 拓展署
NT NORTH DEVELOPMENT OFFICE
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA
PRELIMINARY LAYOUT
SOUTHERN ACCESS ROAD RECLAMATION
SHEET 1 OF 2
MAUNSELL CONSULTANTS ASIA LTD.
DRG.NO.
5.5d C
J S CROMACK
19-9-97
LUNG
CE 90/96
1:1000
METRES
© COPYRIGHT RESERVED
Maunsell

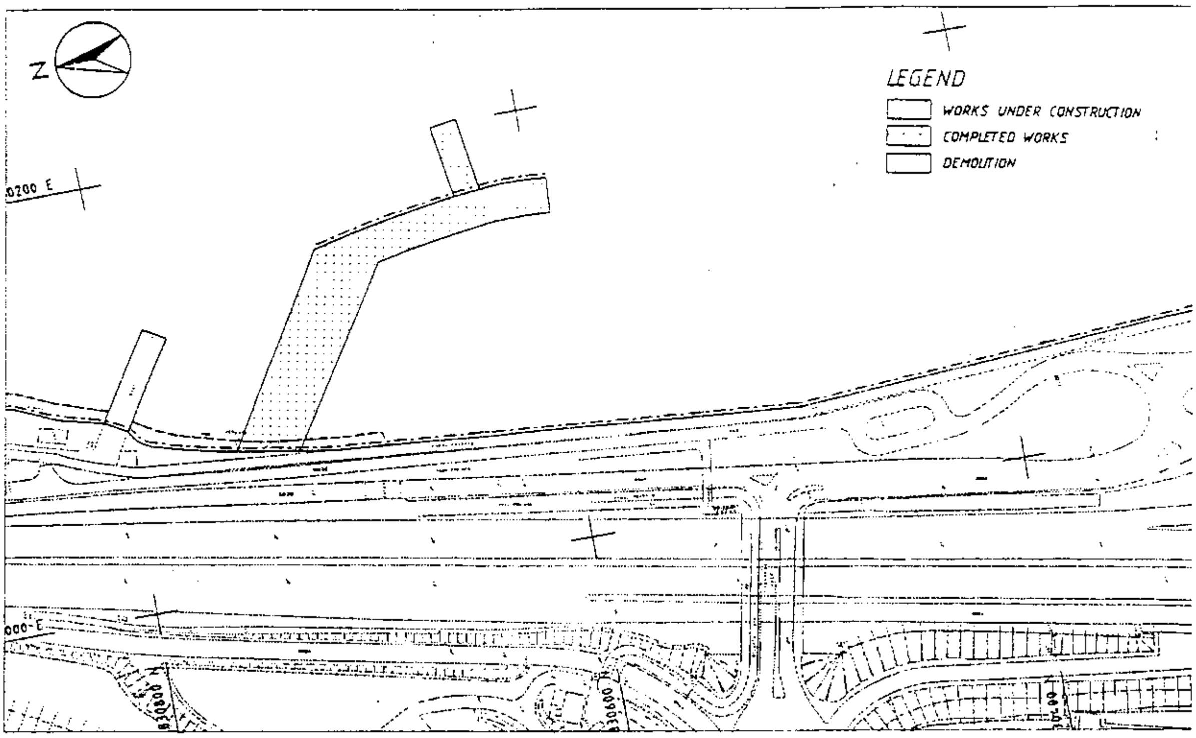


AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

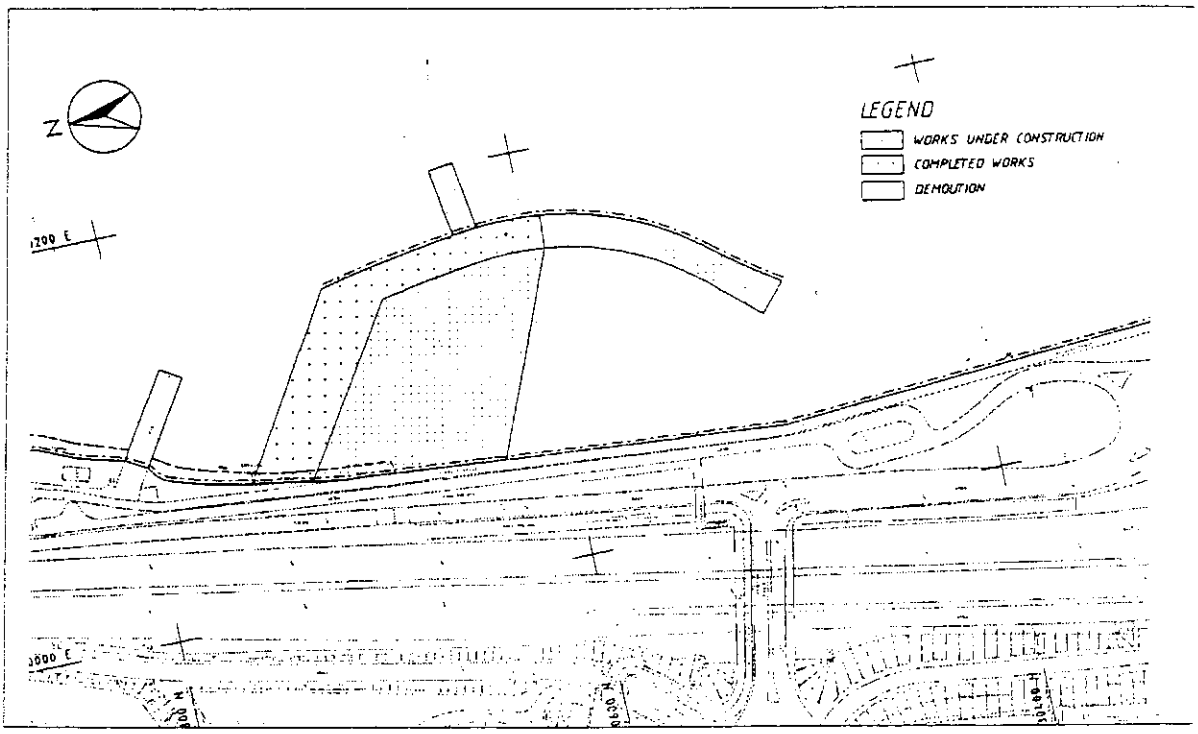
LOCATION OF REPROVISIONED MSL &
ITS INTAKE

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 11/05/98
FIGURE NO. : 5.5e

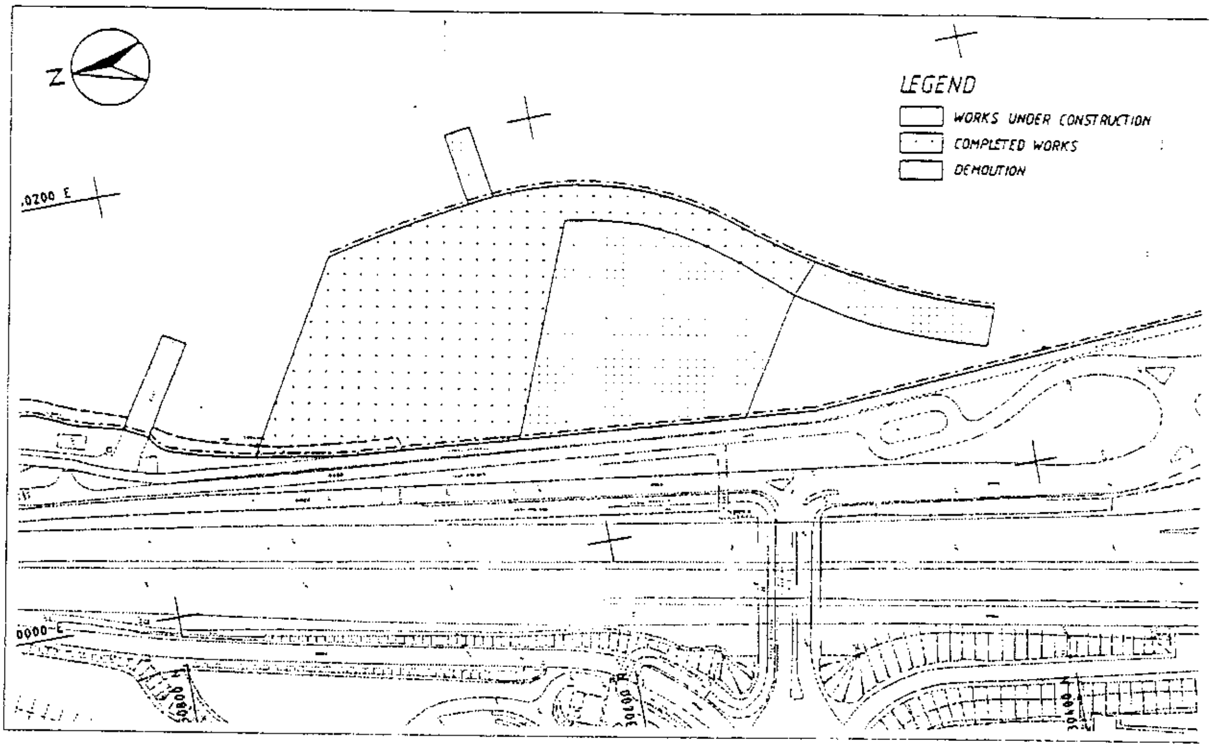


STAGE 1

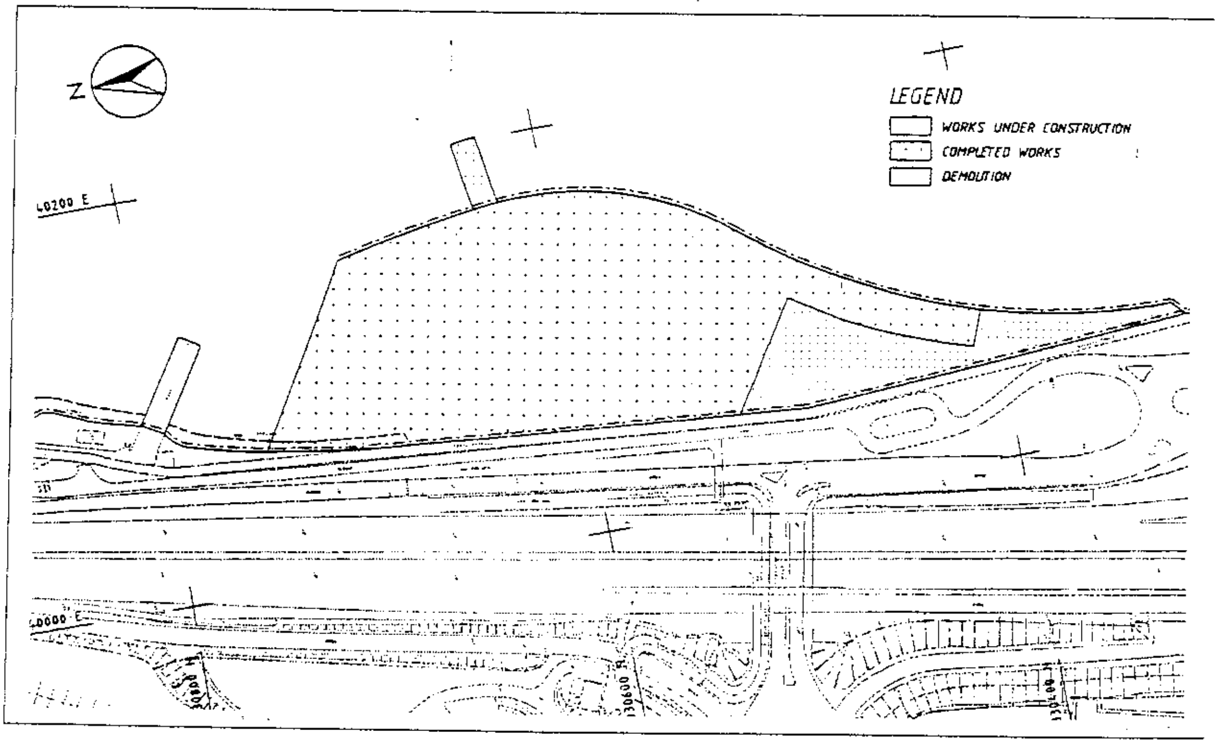


STAGE 2

MARINE DEVELOPMENT PHASING (STAGE 1 & STAGE 2)	Maunsell	DATE :	FIGURE NO. 5.5f



STAGE 3



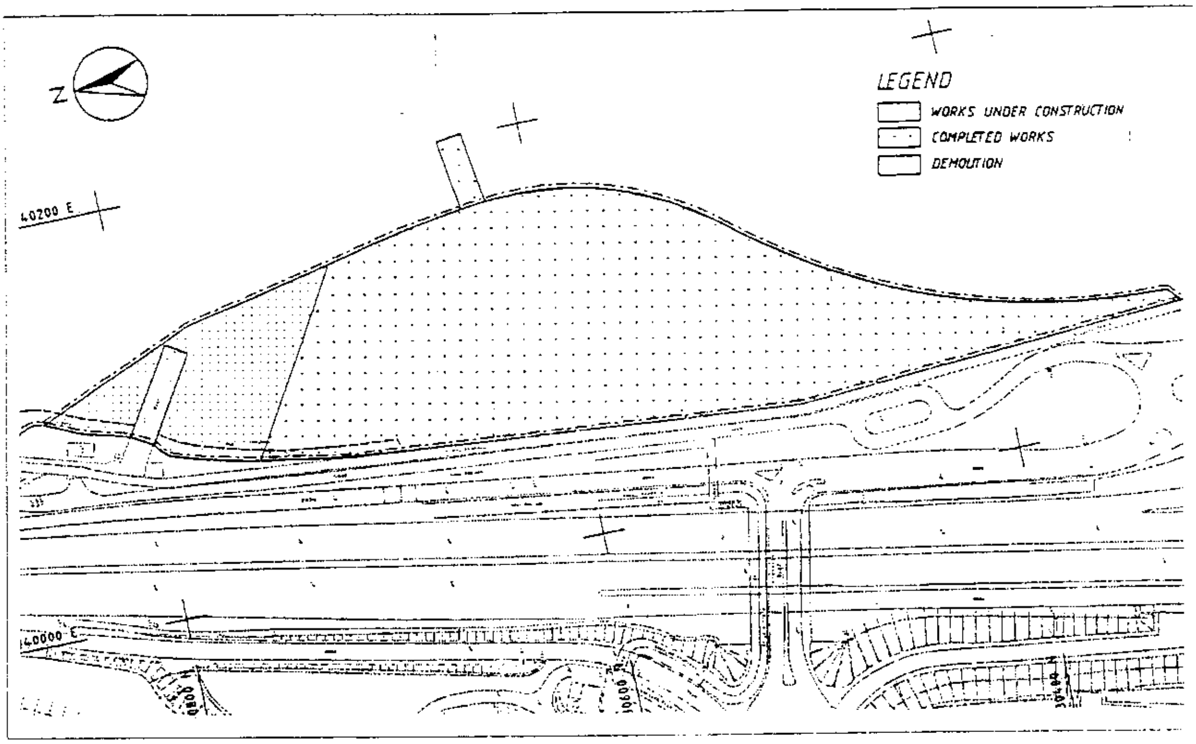
STAGE 4

MARINE DEVELOPMENT PHASING (STAGE 3 & STAGE 4)

Maunsell
茂盛(亞洲)工程顧問有限公司

DATE :

FIGURE NO.
5.5g



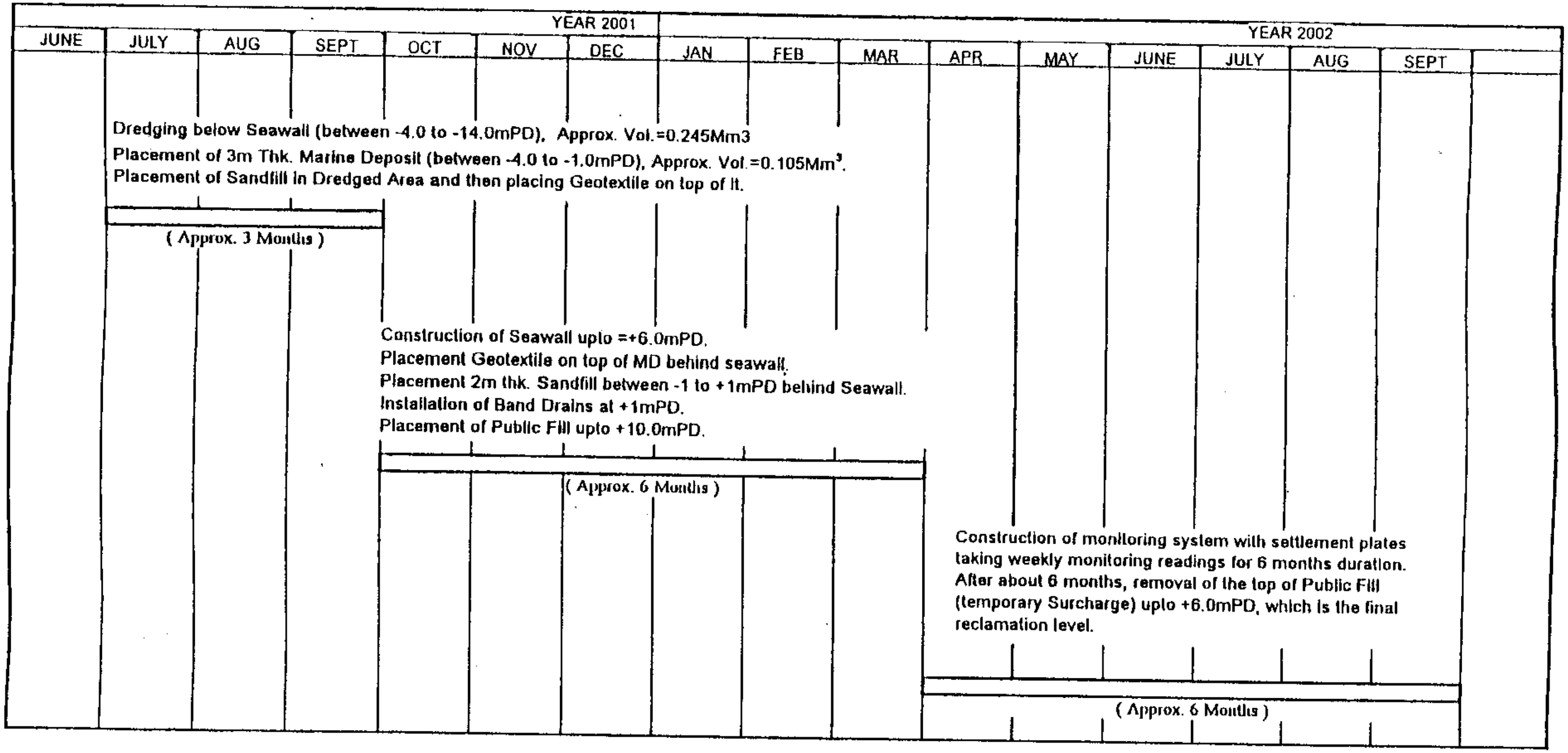
STAGE 5

MARINE DEVELOPMENT PHASING (STAGE 5)

Maunsell

DATE :

FIGURE NO.
5.5h



Dredging below Seawall (between -4.0 to -14.0mPD). Approx. Vol.=0.245Mm3
Placement of 3m Thk. Marine Deposit (between -4.0 to -1.0mPD), Approx. Vol.=0.105Mm^3.
Placement of Sandfill in Dredged Area and then placing Geotextile on top of it.

Construction of Seawall upto =+6.0mPD.
Placement Geotextile on top of MD behind seawall.
Placement 2m thk. Sandfill between -1 to +1mPD behind Seawall.
Installation of Band Drains at +1mPD.
Placement of Public Fill upto +10.0mPD.

Construction of monitoring system with settlement plates taking weekly monitoring readings for 6 months duration. After about 6 months, removal of the top of Public Fill (temporary Surcharge) upto +6.0mPD, which is the final reclamation level.

Notes:

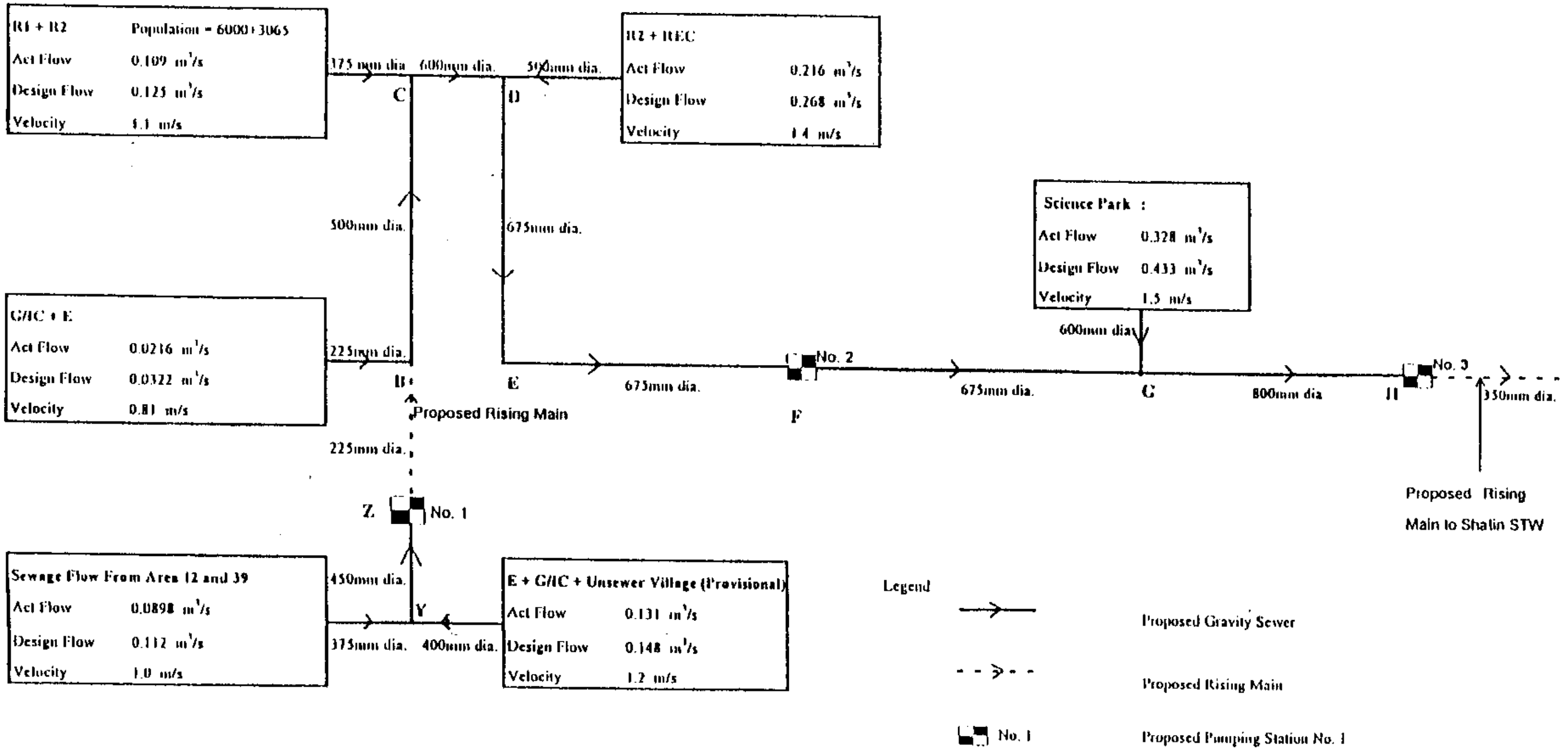
1. Total Reclamation Period for Southern Access Area is approx. 15 months.
2. Schedules are subject to change due to progress of Works.

SUGGESTED RECLAMATION PROGRAM CHART (3/2000 TO 6/2001)

Maunsell

DATE :

FIGURE NO. 5.5i

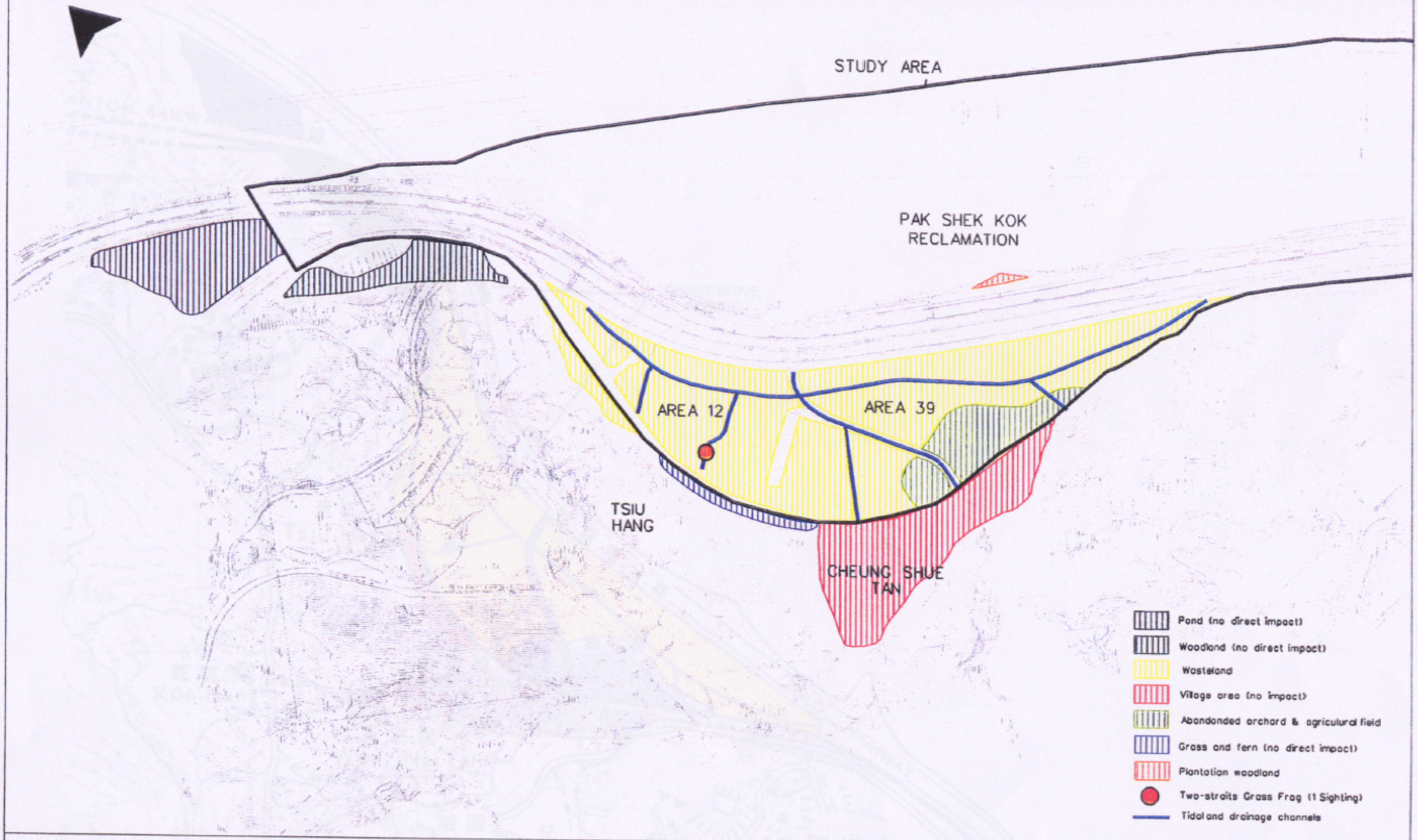


SCHEMATIC FLOW DIAGRAM

Maunsell
茂盛(亞洲)工程顧問有限公司

DATE :

FIGURE NO.
5.6a



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

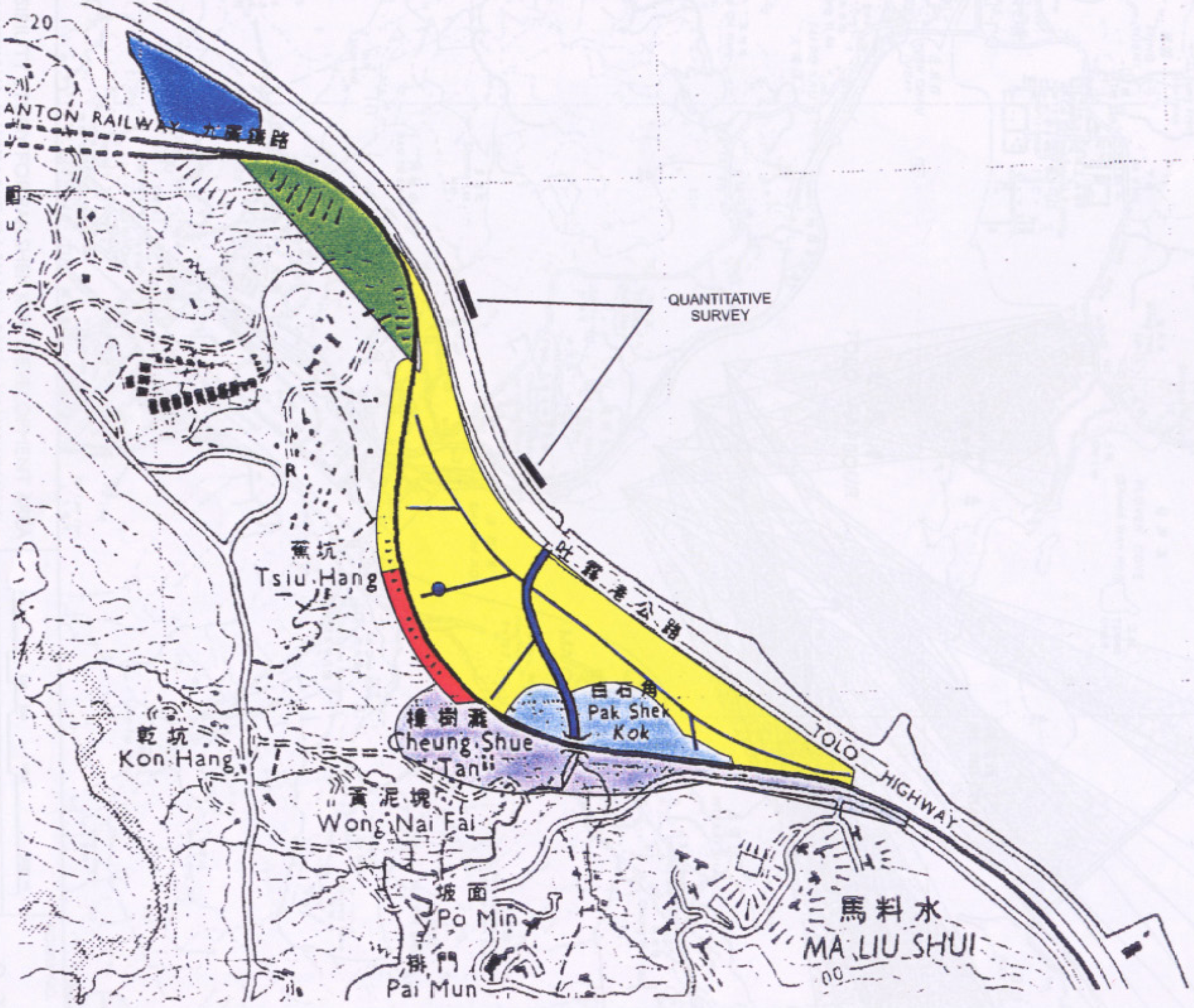
HABITAT MAP OF THE PSKDA STUDY AREA AND PROPOSED DEVELOPMENT

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE :
1:10000

DATE :
07/05/98

FIGURE NO. :
7.3a



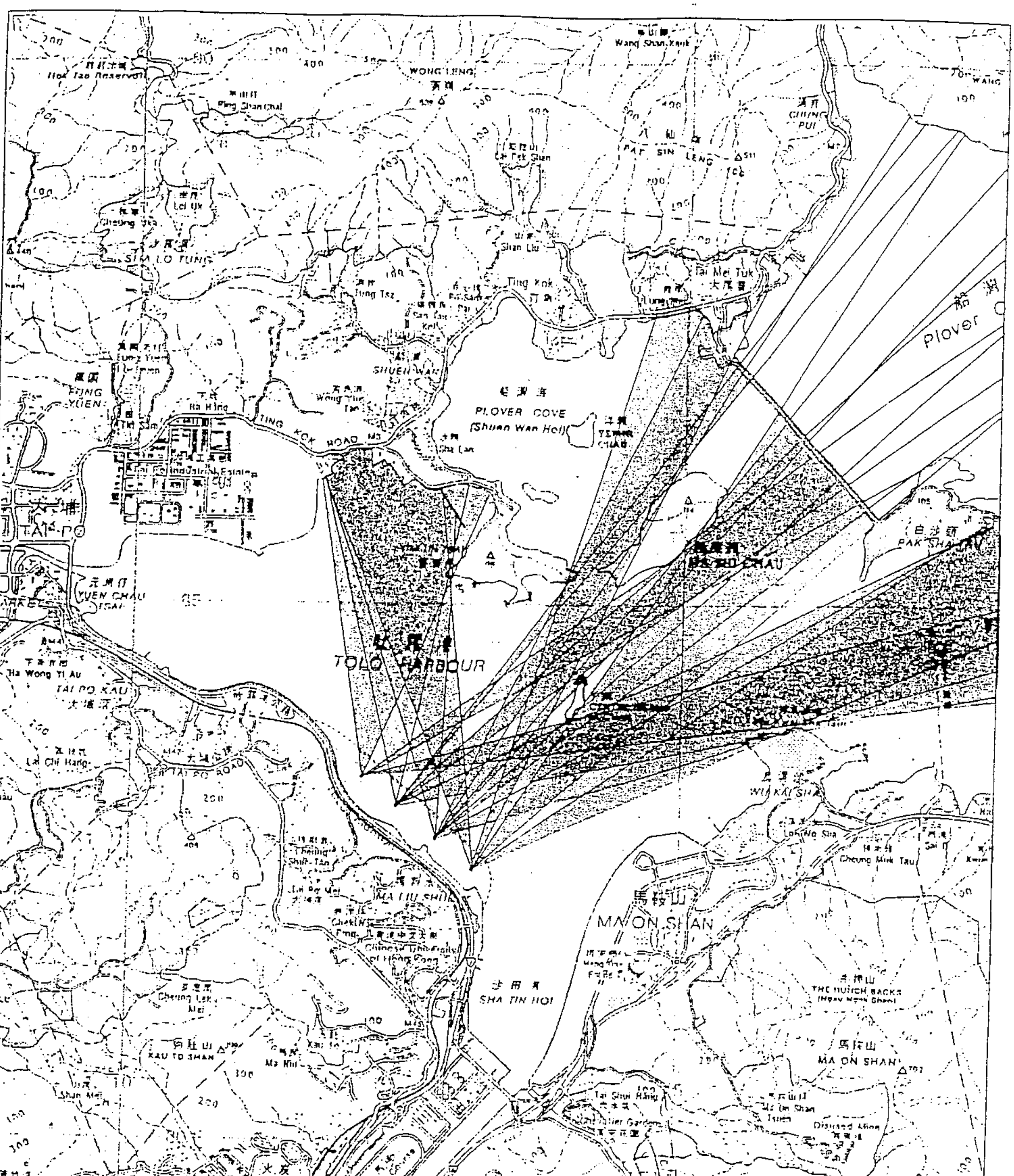
SURVEY SITES PSKDA INTER-TIDAL STUDY

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE : 12/05/98

FIGURE NO. 7.6a



FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

POSITIVE DISTANT PANORAMIC VIEWSHEDS FROM WITH STUDY SITE

500 0 250 500 1000 2000 m

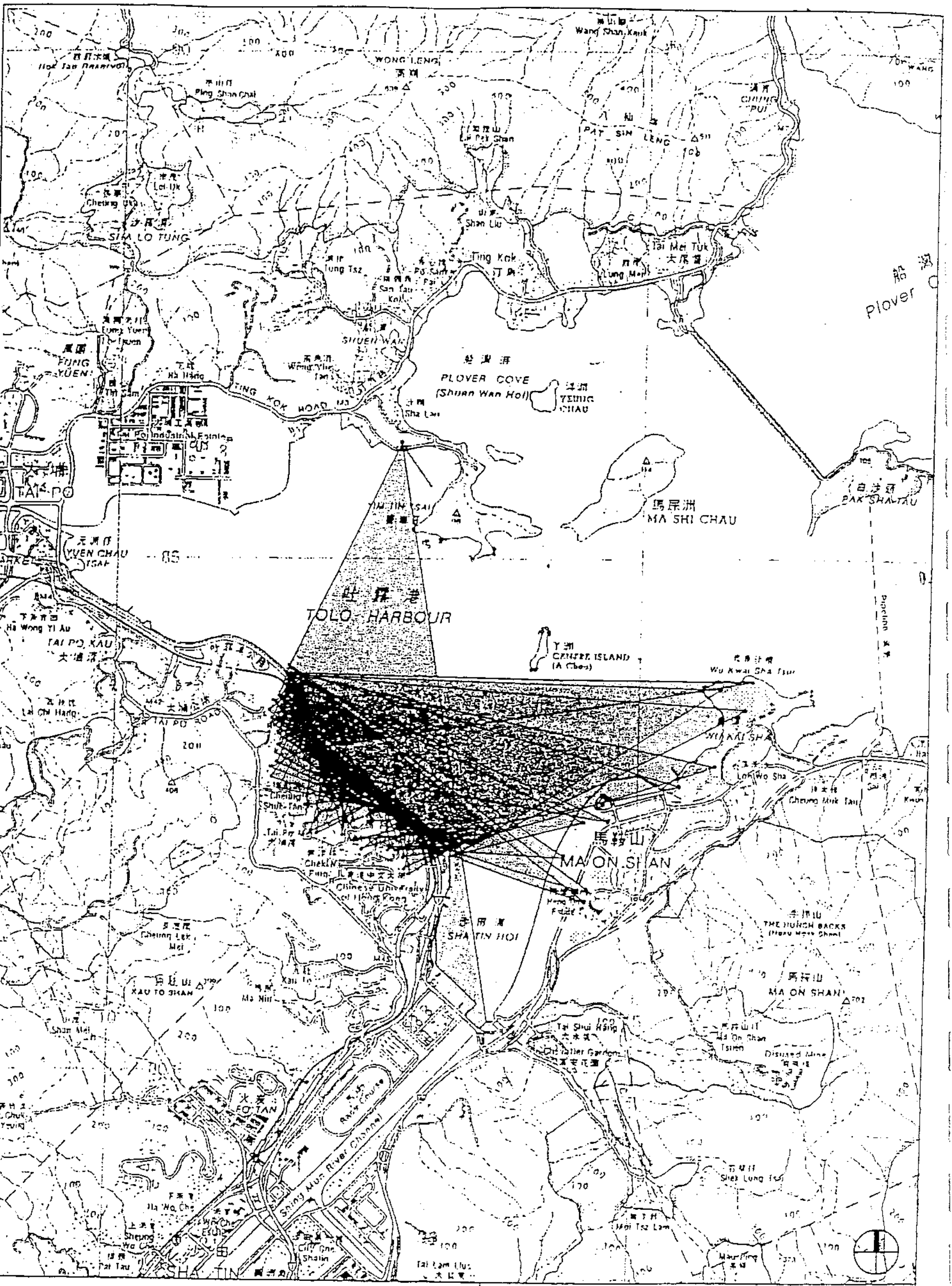
Maunsell

茂盛(亞洲)工程顧問有限公司

DATE :

FIGURE NO.

8.3a



FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

SURROUNDING NEIGHBOURS AFFECTED BY VISUAL IMPACT OF STUDY SITE

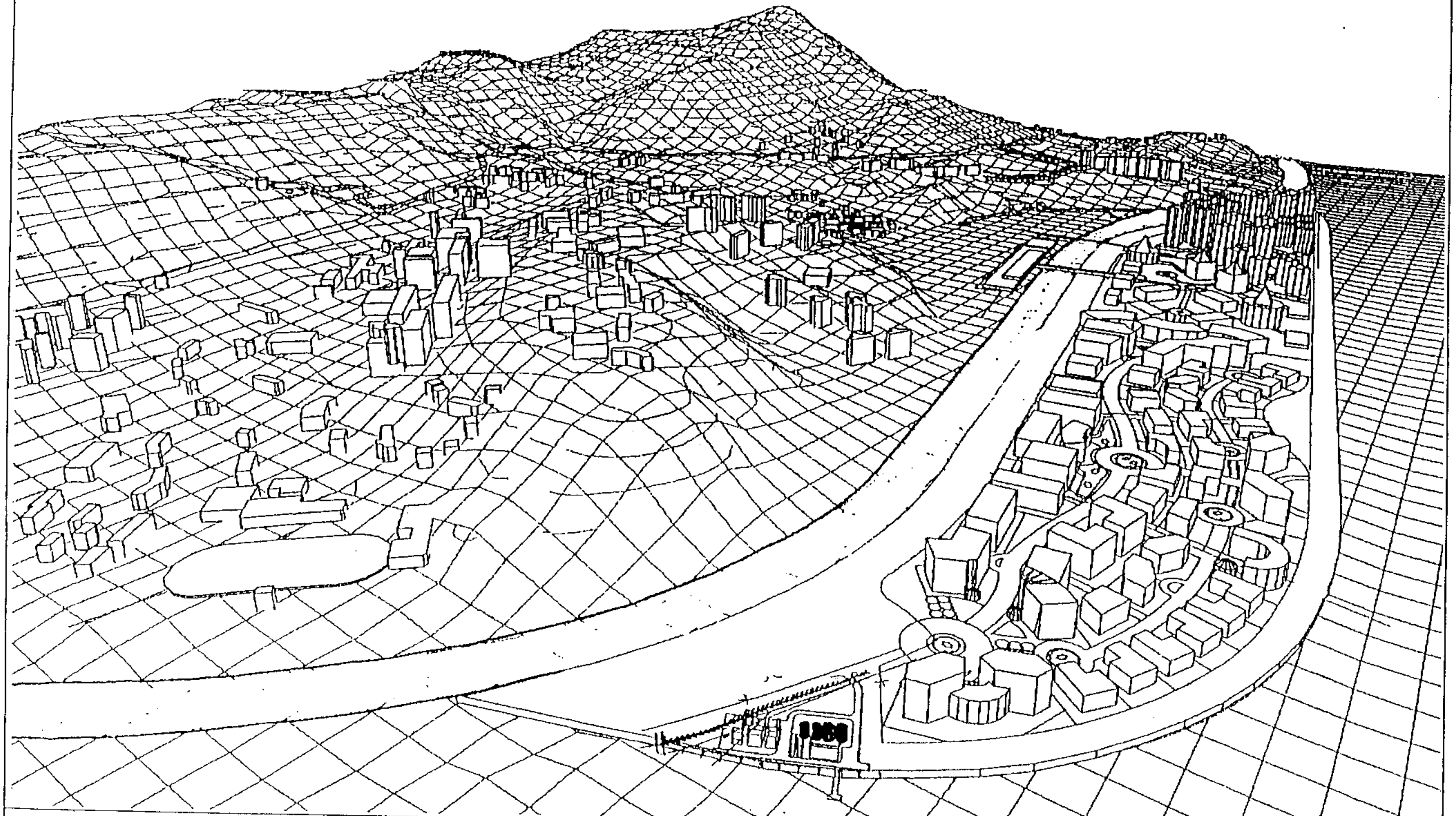
Maunsell

茂盛(亞洲)工程顧問有限公司

DATE :

FIGURE NO.

8.3b



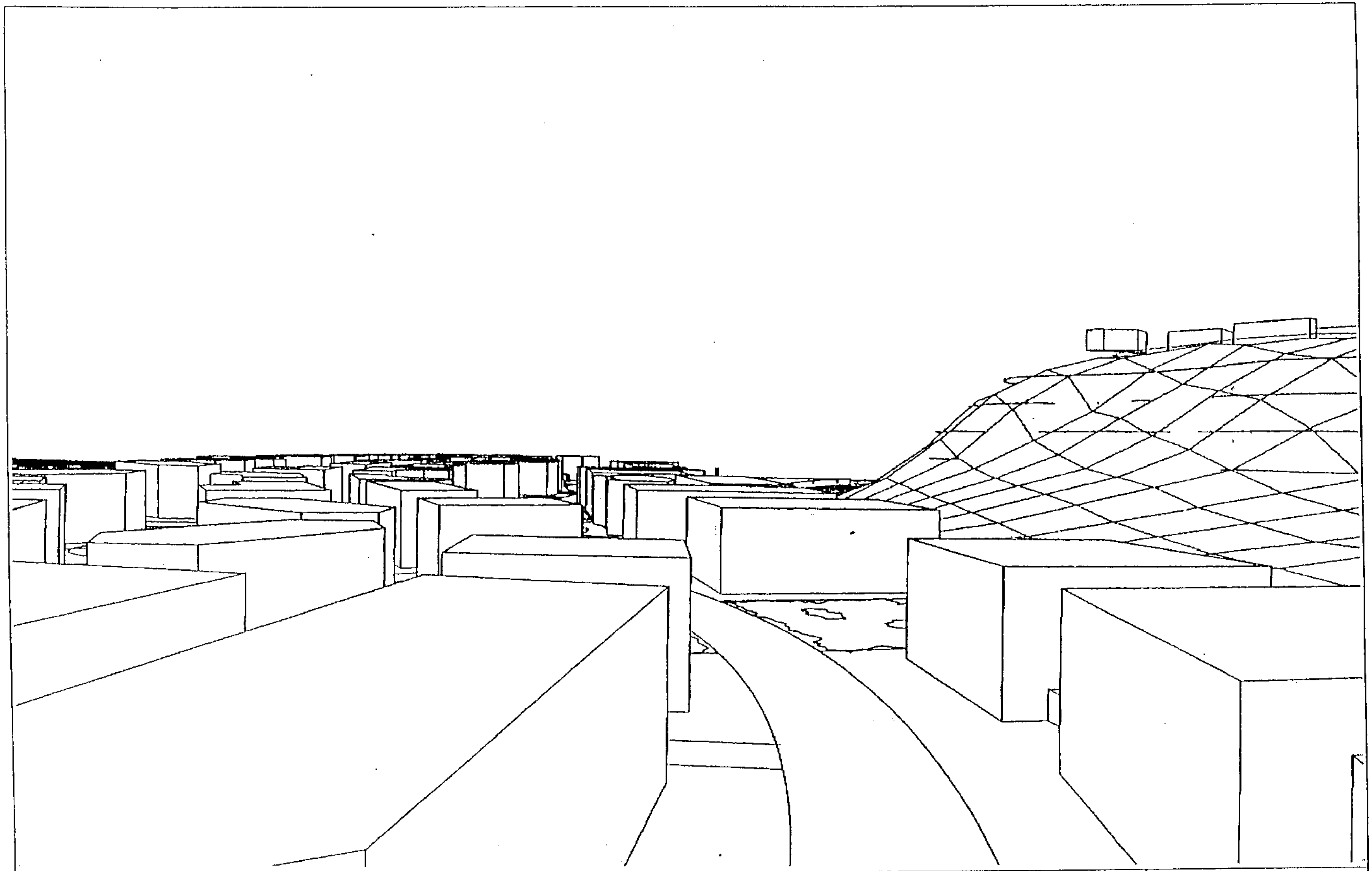
Pak Shek Kok Development Area Feasibility Study

Aerial View of Preferred Option looking North West

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE: N.T.S.

FIGURE NO. 8.6b



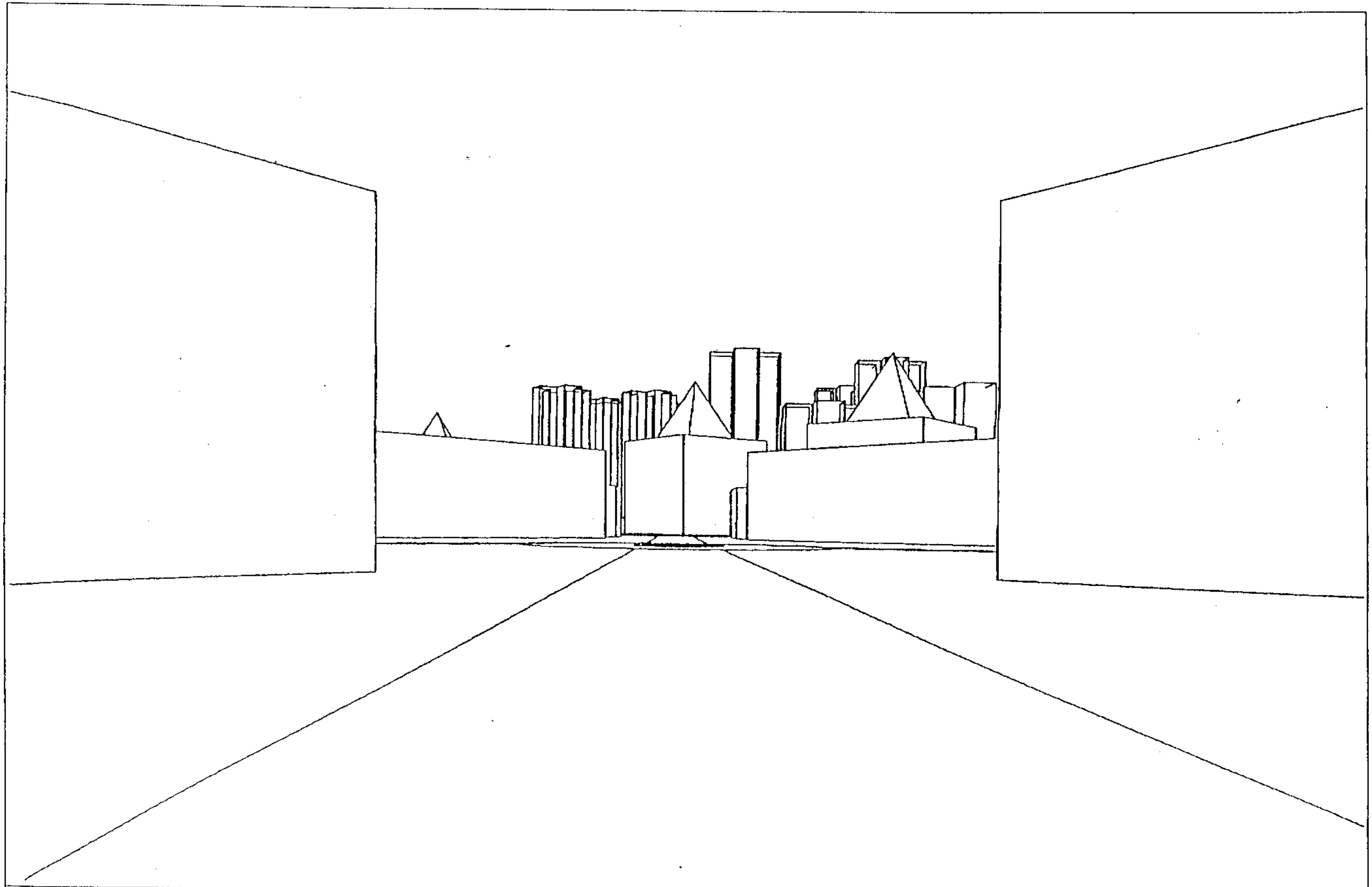
Pak Shek Kok Development Area Feasibility Study

Preferred Option: Rooftop View within Science Park, looking toward Ma On Shan

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE: N.T.S.

FIGURE NO. 8.6c



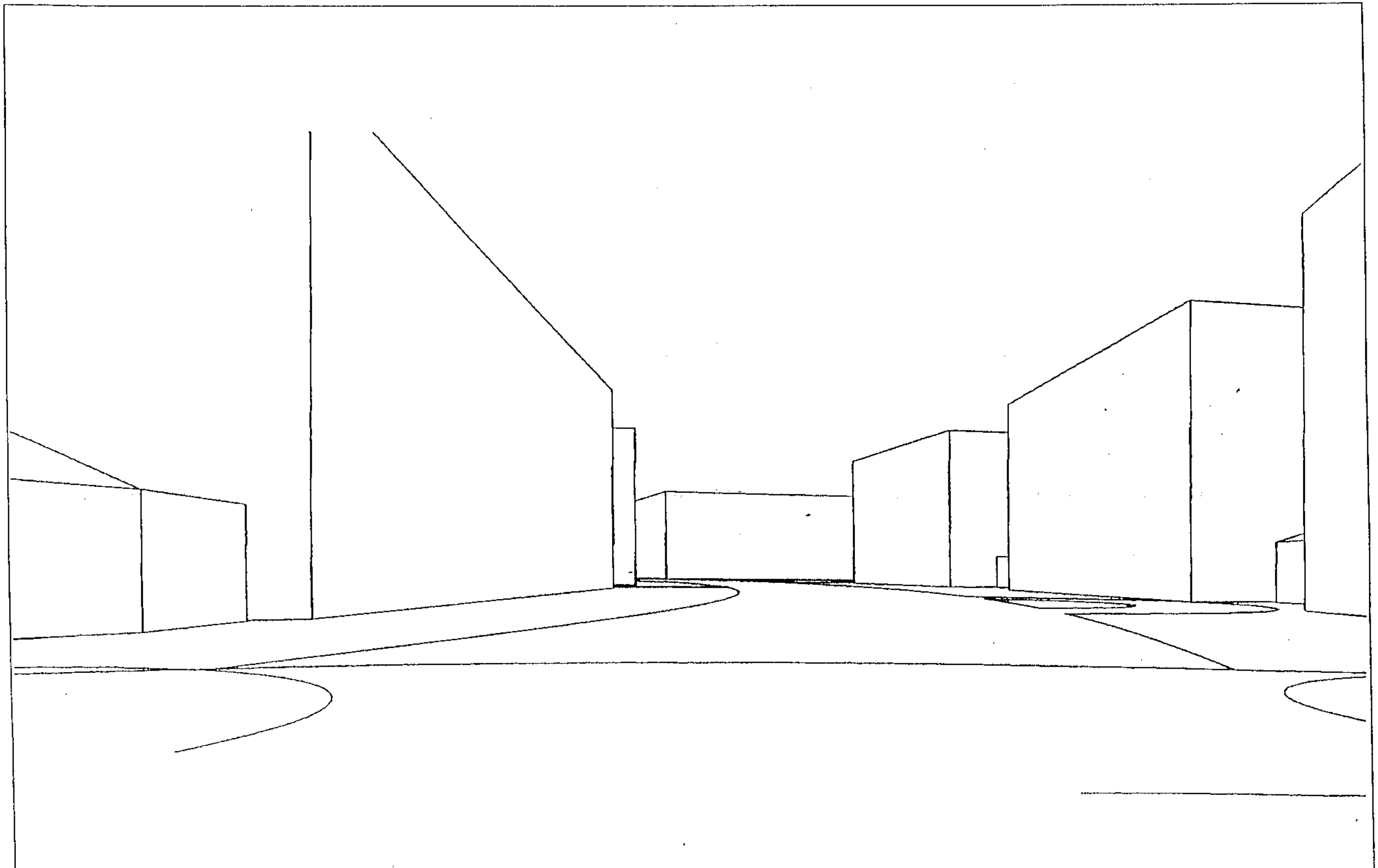
Pak Shek Kok Development Area Feasibility Study

Preferred Option: View from North Edge of Science Park (recreation site & housing beyond)

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE: N.T.S.

FIGURE NO. 8.6d



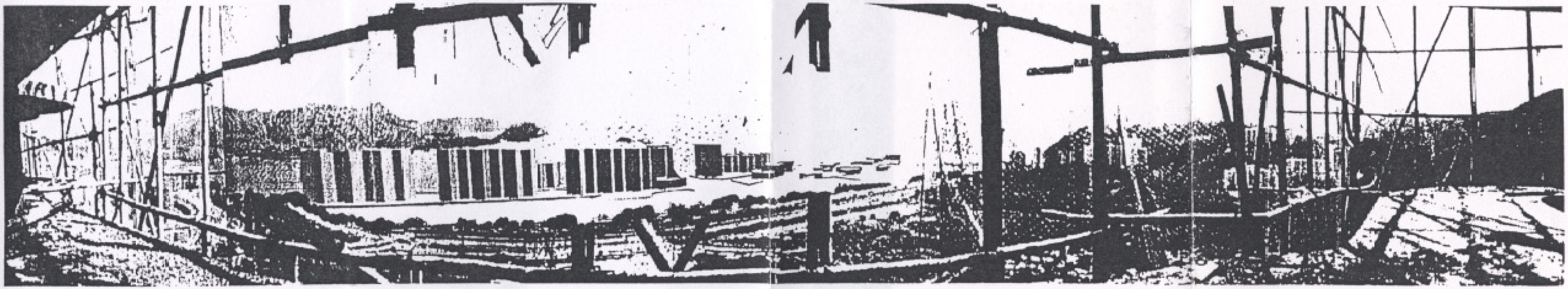
Pak Shek Kok Development Area Feasibility Study

Preferred Option: Street level view within Science Park (main Science Park Road) (6-8 storey buildings)

Maunsell
茂盛(亞洲)工程顧問有限公司

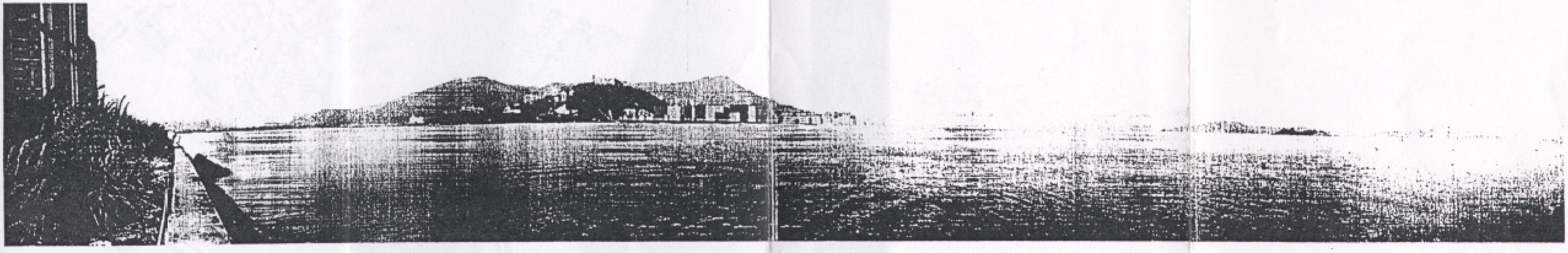
SCALE: N.T.S.

FIGURE NO. 8.6e



PAK SHEK KOK DEVELOPMENT AREA - VIA PHOTO MONTAGE VIEW GENERATED FROM DEER HILL BAY DEVELOPMENT

Figure 8.7c

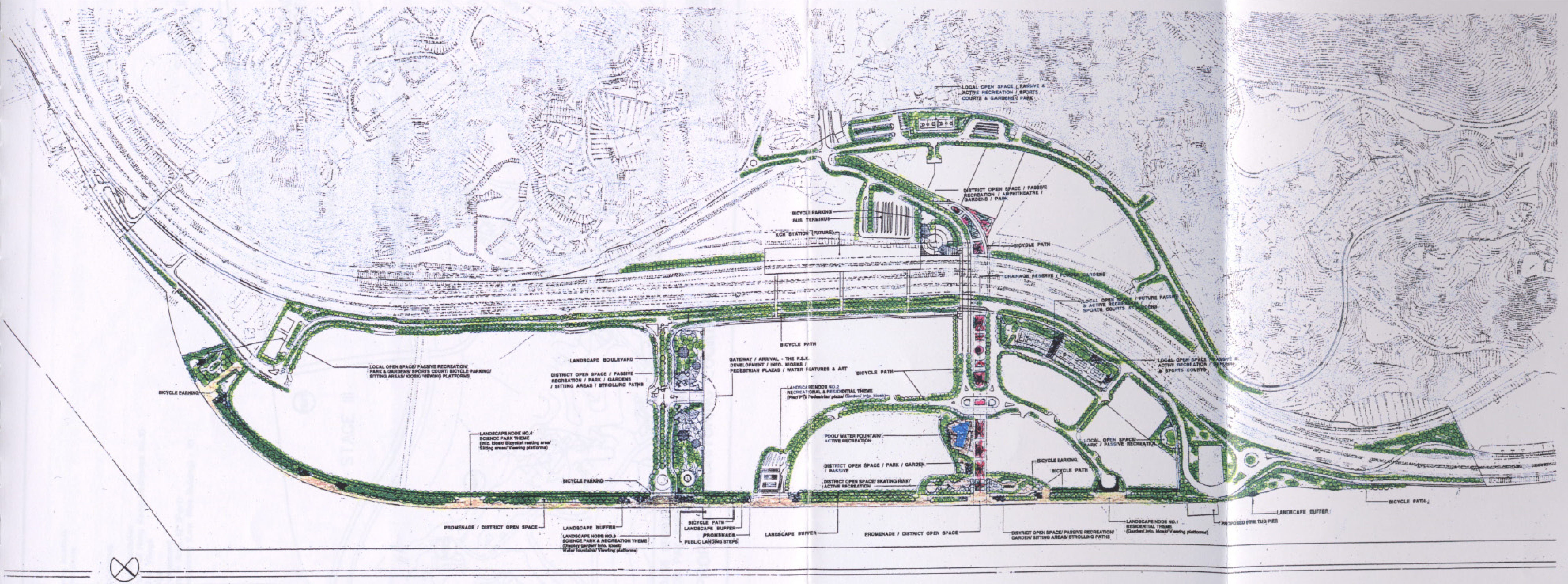


PAK SHEK KOK DEVELOPMENT AREA - VIA PHOTO MONTAGE VIEW GENERATED FROM KAM FUNG COURT, MA ON SHAN

Figure 8.7a

PAK SHEK KOK DEVELOPMENT AREA - VIA PHOTO MONTAGE VIEW GENERATED FROM CHINESE UNIVERSITY

Figure 8.7b



Territory Development Department
New Territories North Development Office

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

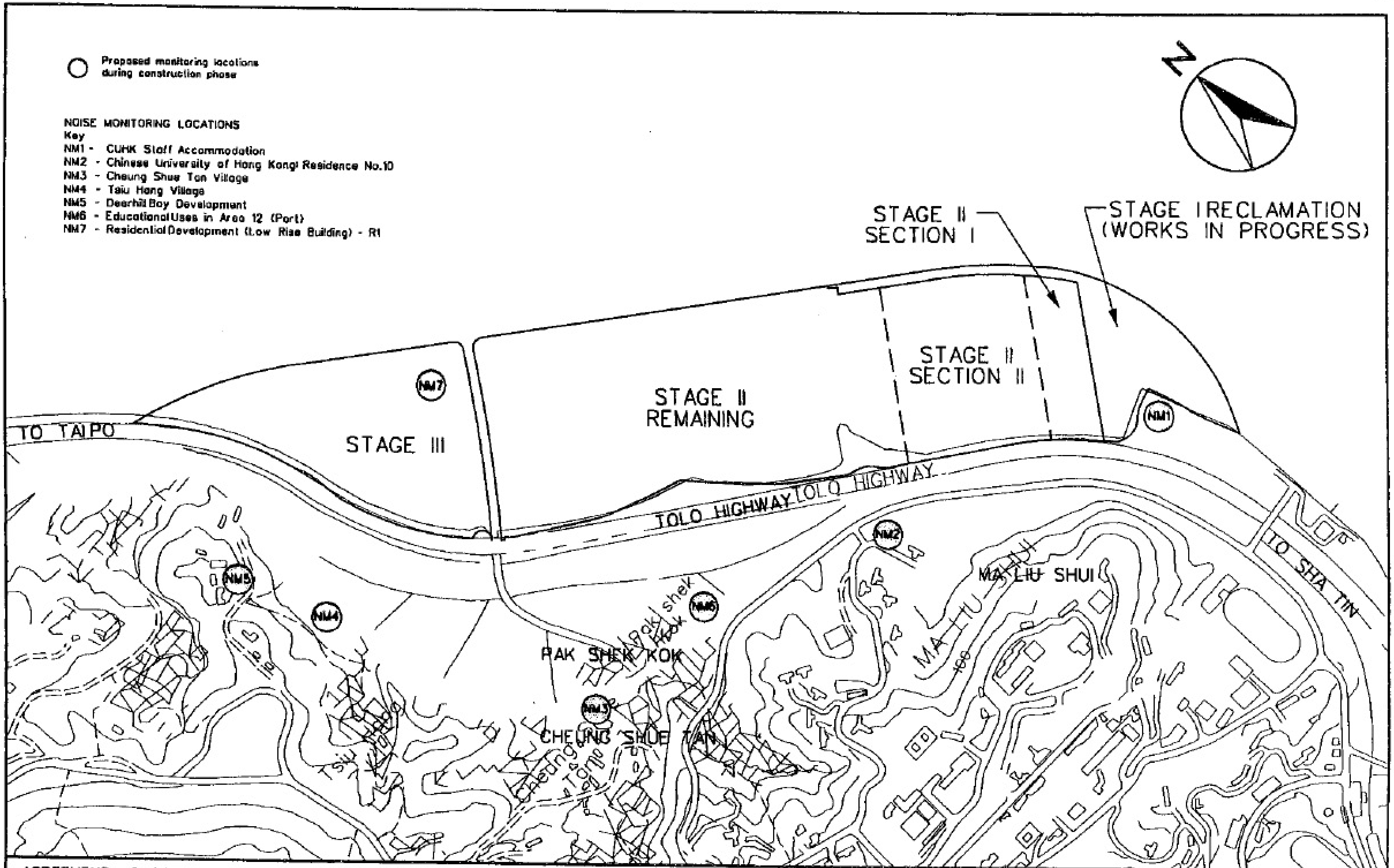
MASTER LANDSCAPE PLAN

FINAL DRAFT 26 May 1998

SCALE 1: 2,000
0 10 50 100 200 m

Maunsell

Figure 8.9a Master Landscape Plan



○ Proposed monitoring locations during construction phase

NOISE MONITORING LOCATIONS
Key
NM1 - CUHK Staff Accommodation
NM2 - Chinese University of Hong Kong Residence No.10
NM3 - Cheung Shue Tan Village
NM4 - Taiu Hang Village
NM5 - Deerhill Bay Development
NM6 - Educational Uses in Area 12 (Port)
NM7 - Residential Development (Low Rise Building) - R1

AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

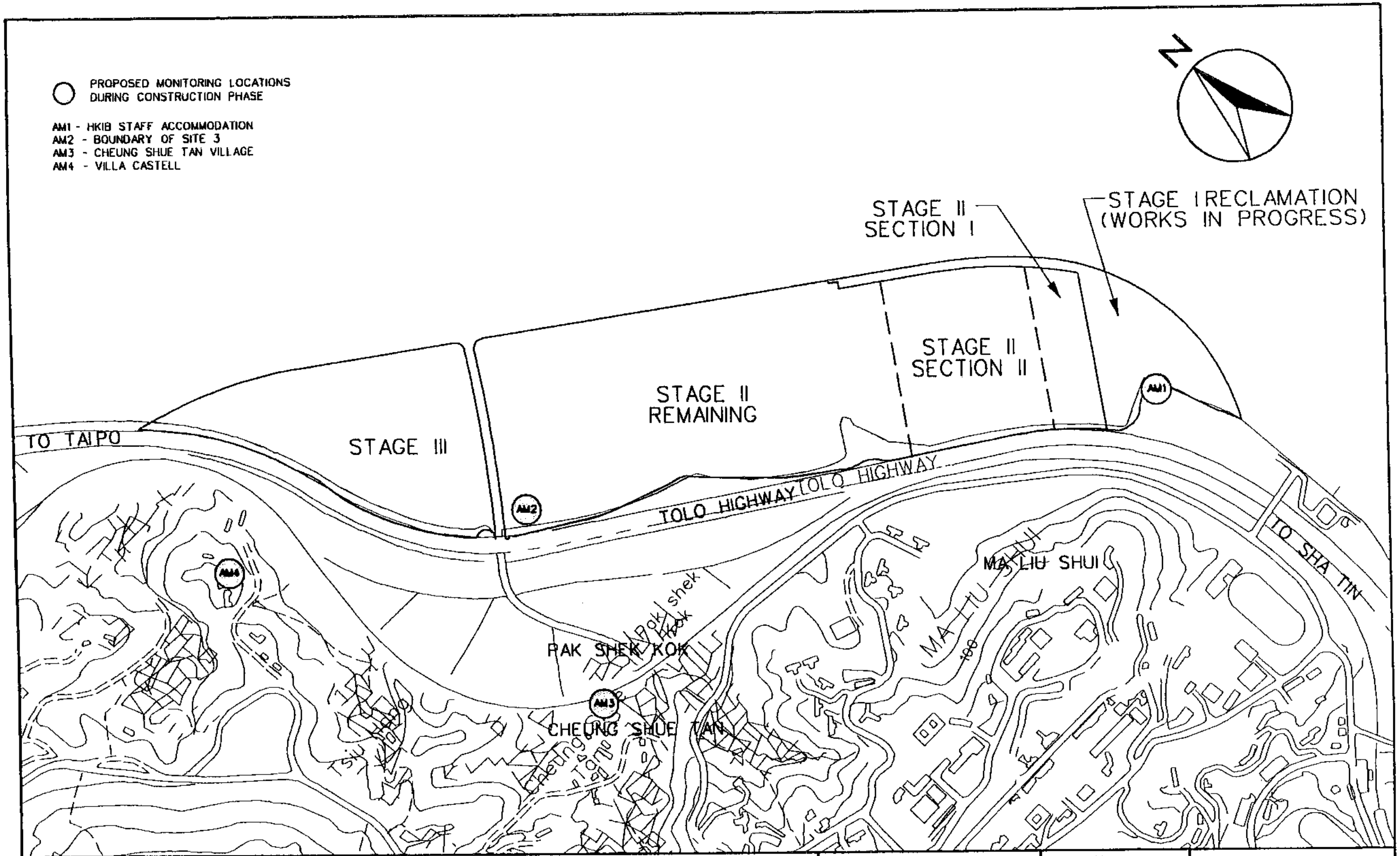
LOCATION OF PROPOSED MONITORING LOCATIONS

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

REVISED : 08/05/98

FIGURE NO. : 9.3a



AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

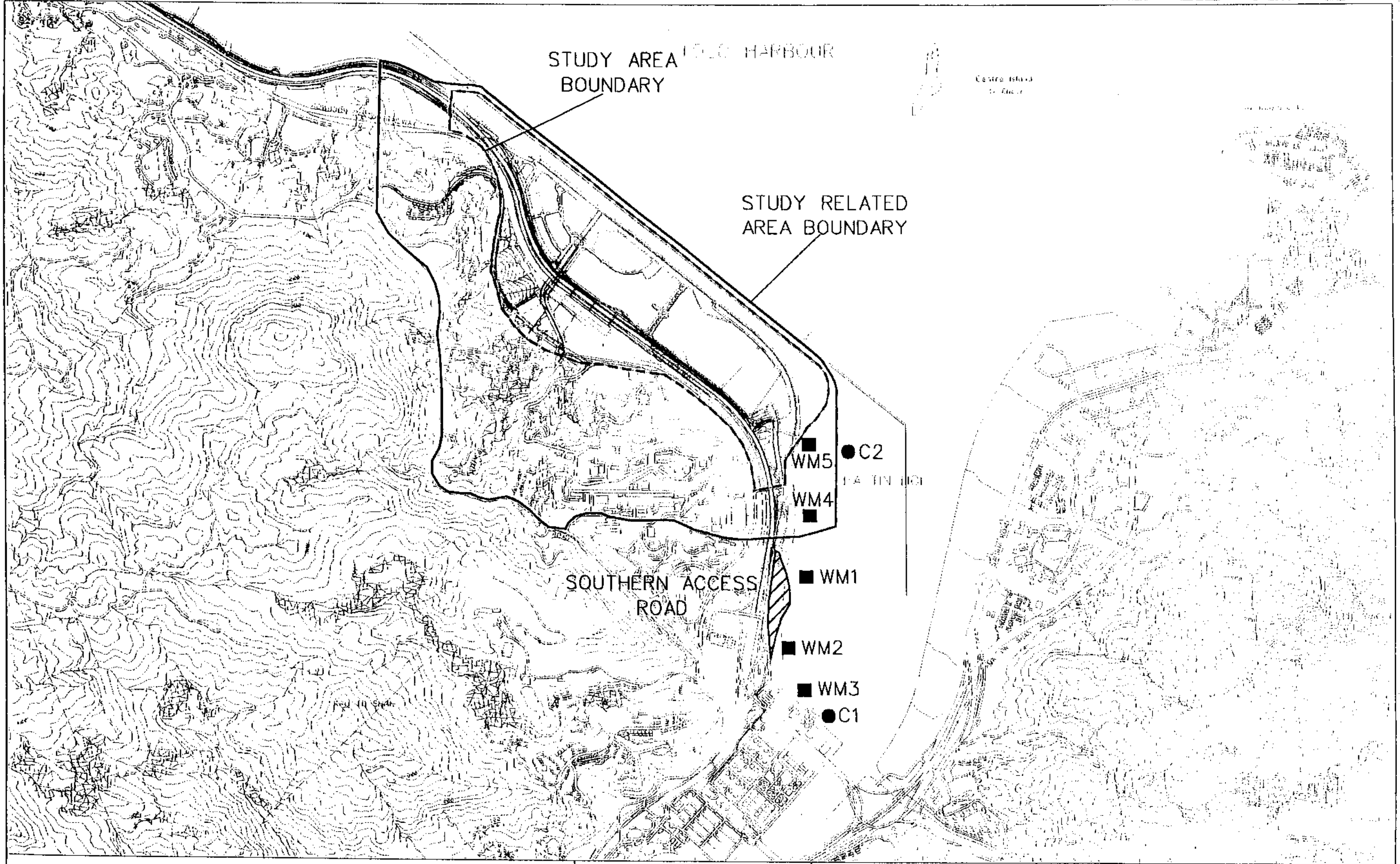
LOCATION OF PROPOSED MONITORING LOCATIONS

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

REVISED : 08/05/98

FIGURE NO. : 9.4a



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

WATER QUALITY MONITORING LOCATIONS

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 07/05/98

FIGURE NO. : 9.5a

Annex A

Science Park

ANNEX A

This is an annex to describe on the environmental implications of Science Park with reference to the findings from the Science Park Study (PL/05, PL/06 and PL/07).

The International Association of Science Parks has defined science park as a property based initiative which:

- is designed to encourage the formation and growth of knowledge based businesses and other organizations normally resident on site,
- has formal and operational links with a university or other higher education institution or major centre of research; and
- has a management function which is actively engaged in the transfer of technology and business skills to the organizations on site.

The science parks are designed to service: the small and medium sized businesses engaged in the exploitation of promising new technologically-based developments. Science parks offer three broad groups of services, namely property links with research institutions, on-site management, technology and business services.

Based on the international case study of science parks in PL/05, the main sectors of industries located in these science parks indicate the likely uses as below:

- IT and software development
- Telecommunications
- Innovative consumer electronics
- Medicines and biotechnology
- Environmental management
- Advanced engineering
- Materials sciences
- Testing, consultancy and other industrial support services
- Related business services (e.g. bank, accounting, legal, patenting, etc)

The main activities involved in the science park are:

- Research, design customisation and -development
- Marketing, service, training and support
- Limited manufacture and assembly (to be decided)
- Technical consultancy and testing services
- Other knowledge-based services

Environmental Impact and Control, Interface Issues with Surrounding Developments

The Science Park Study reported that the development of science park should comply with the government standards and regulations on environment. Although different industries would have different environmental requirements such as indoor air quality, water quality standards etc, the industry environmental requirements would ultimately need to be satisfied and complied by each individual occupier. Flexibility in design was considered essential. In addition, it was considered that the incorporation of specialist requirements such as fitted out washrooms to prevent flooding and avoidance of water in the fire fighting systems to avoid damage to computers would be necessary.

Science Park is generally considered as a good neighbour and would have minimal environmental impacts on its neighbours. Conversely, there were more concerns on the impact of external environment on the Science Park such as noise / vibration / other effects of road, rail, waterfront and surrounding uses. In order to control the extent of these external environmental impacts on the Science Park, comprehensive land use planning and the use of buffer zones from road, rail, construction activities were considered important.

There was concern on the nature of leisure facilities to be developed adjacent to the Science Park. Participants generally felt that any high volume theme park, sports stadium type of use would be incompatible with the Science Park. Conversely, a more educational type of theme park with a "hi-tech" theme would be more compatible and related to the R&D activity in the Science Park. Another compatible leisure uses would be a Science Museum.

Environmental Implications of the Pak Shek Kok Science Park

For Pak Shek Kok Science Park, the projected main primary sectors are: software, multi-media, telecom related, electronics, ICs, consumer electronics and components. The main secondary sectors are biotechnology, advanced engineering, materials, environmental, consultancy, training, analysis and testing. The main activities would be reserach & product development, product adaptation, engineering & production engineering, marketing, sales and technical support, commissioning, training and service, prototype and small batch production of high value added products. Accordingly, the industries to be operating in Pak Shek Kok are mainly technology or knowledge based. This tertiary nature of the science park will have minimal environmental impacts as a result of minimal manufacture/production and assesmbly.

A summary of recommended design parameters for the Science Park are introduced in the Science Park Study. In terms of landscaping and design parameters for the science park and its layout, these recommendations should be adopted as described below. Waterfront facilities and landscaped walkways are important features of the science park to be built to enhance its pedestrian environment near the Tolo Harbour. However, landscaping should take in to considerations of the Hong Kong's climate.

The Study also mentioned on the provision of residential facilities within the Science Park as described below. The proposed development of high quality serviced apartments and residential units within the science park for foreign investors and managers should be designed to avoid possible air and noise impacts while commanding views of the harbour. Nevertheless, the environmental considerations recommended in the Science Park Study should be taken on board in the development and operation of Science Park as stated below:

- tenants should comply with both government and industry standards and regulations on environmental control
- different industries have their own environmental standards and requirements; thus flexibility in design is an important key
- the Science Park is widely accepted as a good neighbour

- comprehensive land use planning and the use of buffer zones are among the possible solutions to control the impact of external environment on the Science Park
- "educational"/"hi-tech" theme park or science museum are considered compatible type of leisure use with the Science Park

Summary of Recommended Design Parameters of Science Park

Parameter	**Value**	**Comment**
Gross land area	22 ha	As per SP Stage 2 Report
Net to Gross Area	Target for 60% maximum for design purposes	Actual figure will depend on the layout of roads and plots
Plot Ratio	Average of 2.5 across the whole Science Park. Single occupiers 1.5 - 2.5 Multi tenancy buildings 2.5 - 4.0	The plot ratio should be related to the useable floor space rather than the gross area of the envelope including atrium/covered area
Site Coverage	Maximum of 50%	Figure should be based on usable floor plate, and exclude atrium area
Number of Storeys	2-8 storeys with a maximum building height of 30m Distance between floors: Normal units: 3.75 m Ground floor workshops: 5 m Laboratories: 4 - 4.5 m	Number of storeys would depend on the distance between floors. Study to consider potential for building height of 35m - 10 storeys.
Gross Floor Area	Target of 330,000 sq m maximum excluding atrium area	As recommended in ID paper to SPPC
Employment Density	Multi-tenancy buildings: 20-25 sq m per employee Single occupier buildings: 25-30 sq m per person Average for planning: 20 sq m Maximum employees: 16,600 Probably number: 14,200 Visitors + 4% of employment on Science Park Conference: 300 attendees around once per month	
Car Parking	One space per100 sq m of GFA (55% employees cars, 20% visitors, 25% vans) Up to 3,300 spaces + 100 spaces for conference attendees + bus parking	
Location of Car Parks	Basement and multi-storey parking	
Deliveries	Parking, loading, separate access and service lifts in each multi-tenancy building	To cater for 2-3 ton vans and 12m artic trucks
Landscaping Features	Development of promenade along water front Walkways between buildings and public transport access points	Development of landscaped areas to suit the Hong Kong environment
Layout of buildings	Use of air conditioned atrium areas within buildings Flexible approach towards building layout in relation to plot ratios and site coverage	Avoid 'bitty' development.

Parameter	Value	Comment
Multi-tenanted buildings	Approx.66% of space for multi-tenanted buildings depending on demand. GFA of 218 - 272,000 sq m Units from 25 sq m to 2,000 sq m 15-19 Blocks with an average size of 14,000 sq m	
IT related firms	Basic office with access to fibre optic cable and uninteruptable power supply	
Electronics, advanced engineering and materials	Some firms require workshops with height of up to 4.5 - 5 m, 3 phase power and high floor loading	High precision work (e.g. silicon wafer developments) requiring a vibration free environment cannot be accommodated
Medical, chemical, and biotechnology	Laboratories (serviced with water, gas, and air handling facilities required, though demand expected to be limited)	Location of laboratories to be close to service duct or on top storey in multi-tenancy buildings or specialist building depending on demand
Entrance, atrium and common area	25% common areas for entrance, passages, lifts, plant rooms etc 2.5% for common services to include reception, meeting rooms etc	
Space for amenities	Initially 1,500 - 2,000 sq m for administration, business centre, conference space, restaurant etc. in a multi-tenancy building If demand justifies, build a separate 2 - 3,000 sq m Amenities Centre for leisure, restaurant, retail and business services	
Serviced plots	20 - 34% of space for single occupiers 58 - 112,000 sq m for single occupation; 3-6 - 7.2 ha (including expansion area) required for 18 - 35 serviced plots with an average size of 0.2 ha	Assumes that single occupation sites will have 2-4 storeys and average plot ratio of 1.5. Single occupiers will be firms with more than 100 employees Size from 3 - 9,000 sq m
Residential area	Up to 30 foreign firms, each with 2-3 ex pats needing family apartments: 60-90 apartments with av. 200-250 sq m required	Foreign ex-patriots require high quality affordable flats Range of options for provision including on Science Park, in association with development on adjacent land (e.g. Station), or secured access to developments by others e.g. private devolopers, serviced apmnts.

Case Study on Izumi Park Town Industrial Park / Science Park in Japan

Date Founded	1984 for Industrial Park and 1992 for Science Park
Area	158 ha for Industrial Park and 20.6 ha for Science Park
Developments	whole development completed in 4 phases with the last phase specifically for a Science Park 5 ha of land for phase 1, 75 ha for phase 2, 45 ha for phase 3 and 17 ha for phase 4 firms are responsible for building its own factories design restrictions for buildings are 25 m setback from the front road, building colour not too bright, existing greenery should be preserved 60% building coverage plot ratio of 2
Tenants	there are 44 firms at the Park, 7% are foreign companies Motorola Research Centre is the anchor tenant triggering the pull of R&D activities at the Park 94% take-up after 2 years of operation for the Science Park
Sectors	R&D activities are largely in electronics, semi-conductor and telecom sectors
Activities	22% of tenants in R&D centre, 35% factory, 19% distribution centre, 12% office and another 12% for other uses
Incentives	low interest loan subsidy tax break
Comments	the park is successful in selling all developed lots to occupiers and attracting R&D activities to the area

Case Study on Hakusan Hi-Tech Park in Japan

Date Founded	masterplan adopted in 1981 development plan completed in 1985 land sales in 1986-88 construction and operation by firms in 1986-1990
Area	7 ha
Developments	40% building coverage ratio plot ratio 2 20% green coverage ratio 31 metres height restrictions largely 5-6 storey buildings 15 metres setback from front road
Tenants	21 firms, of which 15 are foreign companies a clear scheme to attract foreign firms, has a German Industry Centre targeted to attract German firms who wish to make a presence in Japan basic maintenance and infrastructure is provided by the City of Yokohama no specific promotion to establish links with universities or between tenants
Sectors	most tenants are electronics, optical and semi-conductor manufacturers
Activities	focus on design and development some production and sales functions on site no polluting activities allowed
Incentives	not much incentives provided as the site is considered attractive subsidies for high-tech companies low interest loans
Comments	a clear marketing strategy to use a German-developed centre to attract German companies no incentives are required provided the site is attractive enough

Case Study on the Singapore Science Park

<table>
<tr><td>Date Founded</td><td>Concept developed in the late 1970's.
First tenants came in 1982.</td></tr>
<tr><td>Area</td><td>63 ha</td></tr>
<tr><td>Developments</td><td><i>Phase 1 (1982-1995)</i>
30 ha (gross), Development: 245,000 sq.m, 138 multi-tenant buildings, 60 buildings for single occupiers + Amenity Centre
<i>Phase 2 (1994-2000)</i>
33 ha(gross)
2 single occupier1 buildings, and three multi-tenancy buildings (2 are now under construction)</td></tr>
<tr><td>Tenants</td><td><i>Growth in numbers over time</i>
1982 - 1 (Start), 1997 - 25, 1992 - 85, 1997 - 177 (66%(116) are foreign firms 56% from US: 15% from Europe; 19% from Japan and 10% others). Only 60 firms (mainly SMEs) are local
Size distribution
<table>
<tr><th>Area (sq m)</th><th>% of firms</th><th>No. of firms</th><th>% of space</th></tr>
<tr><td>> 100</td><td>11%</td><td>18</td><td>1%</td></tr>
<tr><td>100--400</td><td>36%</td><td>60</td><td>69%</td></tr>
<tr><td>401-800</td><td>24%</td><td>40</td><td>10%</td></tr>
<tr><td>801-1,200</td><td>10%</td><td>17</td><td>7%</td></tr>
<tr><td>1,201- 1,600</td><td>4%</td><td>8</td><td>4%</td></tr>
<tr><td>1,601- 6,000</td><td>8%</td><td>13</td><td>20%</td></tr>
<tr><td>> 6,000</td><td>5</td><td>8</td><td>52%</td></tr>
</table></td></tr>
<tr><td>Sectors</td><td>42% information technology
26% electronics
10% chemical
8% materials
6% biotechnology
4% government agencies
4% other</td></tr>
<tr><td>Activities</td><td>45% R & D, product design and testing
30% sales and marketing
20% technical support/services
5% prototype development</td></tr>
<tr><td>Criteria</td><td>at least 30% of activities must be in R & D
Sales and marketing activities permitted
No manufacturing except prototype -development</td></tr>
<tr><td>Comments</td><td>the Science Park is located in part of a major industrial technology corridor
foreign investment accounts for 41% of GDP
well–developed policies including incentives to support indigenous small high tech firms and attract foreign firms in high-technologies.
high proportion of major foreign investors use Singapore as a their Regional Office, engaged to product development, adaptation and customisation and technical support</td></tr>
</table>

Case Study on the Sophia Antipolis Science Park in France

Date Founded	1969
Area	2,300 of which 800 ha for development. Development to date is 230 ha
Developments	Total of 800,000 sq m on 230 ha of land 537,000sq m space for single occupiers and a further 261,000 sq m of multi-tenanted rented space
Tenants	1982 - 100 firms with 4,000 employees occupying 20,000 sqm. 1985 - 230 firms with 5,900 employees occupying 45,000 sqm 1990 - 740 firms with 12,300 employees occupying 140,000sqm 1995 - 1,000 firms with 15,800 employees occupying 520,000 sqm. 72% of tenants employ less than 10 people. 22% employ 10 to 50 people % of companies are foreign investors employing 27% of employees 50% from US, 45% from Europe, 3% from Asia Largest firms: Thomson -800 people, Legrand 593, Air France 290
Sectors	37 firms in information technology 8 firms in health care 19 firms in earth sciences firms in higher education & research 36 firms in service and manufacturing 123 firms in trade 11 firms in associations
Criteria	Strict criteria for architecture design standards, landscape and activity: technological nature of activity, absence of pollution, investment, type and number of jobs, surface area occupied.
Incentives	Serviced sites, job creation grant (10 to 20 jobs over 5 years), a decentralisation grant for a minimum of 20 jobs over 3 years and additional grants from the Regional Council. Support for decentralising firms and their employees.
Comments	A major regional development initiative to support decentralisation from Paris, backed by central and local government to create a new town and centre of technology, building on its outstanding environment and good communications Initial focus (up to 1982) on serviced plots for single occupiers for large high tech firms (French and foreign). After 1982, development of multi-tenant buildings for smaller firms. and diversification towards services. Surplus space due to job losses.

Case Study on the Louvain La Neuve Science Park in Belgium

Date Founded	concept conceived in 1968 officially opened in 1971
Area	225 ha
Developments	plots of land on long-term lease basis land can be bought by occupiers different sizes of plot area are available multi-purposes building ready for immediate occupation for rental purposes
Tenants	first firm established in 1972 real push took place from 1976 onwards 7 firms in 1976 14 firms in 1979 25 firms in 1983 66 firm in 1988 81 firms in 1997 19% international (all large occupiers) 55% owner occupiers taken over about 10 years to reach an acceptable critical mass over 80 companies at the Park employing over 3,200 people
Sectors	specialised in fine chemicals (10%), new materials (6%), pharmaceutical products (12%), agro-food (2%), computer sciences (11%), electronic (10%) telecommunications, publishing activities (2%), 45% services
Activities	research activities account for 75% research centres, hi-tech production centres and laboratories, spin-off companies from the universities, education centres, publishing, service, computer and engineering companies
Criteria	have to comply with urban planning regulations, e.g. budgeting FB 80 per sq. m. on green space, spending 2% of the cost of construction for a work of art, building no more than 40% of total plot area types of firms allowed are research firms, manufacturing firms actively engaged in advanced technologies, service firms which are beneficial to research activities on site no polluting activities allowed
Comments	the park has significant contribution to commercialisation of research at the University probably due to close proximity to the university and its close involvement in the management and marketing of the Park the Park also contributes to the economic development of the area, e.g. in employment generation and attraction of hi-tech industries / companies

Case Study on the University of Warwick Science Park in the UK

Date Founded	Science Park founded in 1982; first building completed in 1983
Area	17 ha almost fully developed
Developments	31,000sqm developed 10 multi-tenant buildings of 16,500 sq m for rent - 33 tenants occupying 3,300sq m of the Venture Centre - another 9 buildings of 13,200sq m providing units of 230-460 sq. m for 23 tenants 14,500sqm floor area for 10 single occupiers site coverage: around 18-20% employment density: around 23 sq. m per employee
Tenants	1984 --19 firms in 2,700 sq.m. floor area 1985 --29 firms with 200 employees in 2,700 sq m floor area 1990 - 58 firms with 1,100 employees in 24,600 sq m floor area 1995 - 71 firms with 1,308 employees in over 31,000 sq m floor area 42 % local companies, 10% regional firms, 39% from the rest of the UK and 8% are foreign investments
Sectors	37% computing/telecom 30% advanced engineering 6% bio/medical 3% materials 3% environmental 17% technical consultancy 14% financial & business services
Activities	36% R&D 59% design 23% production 61% sales 14% training/teaching 44% consultancy 13% commercial services
Criteria	High-technology and knowledge-based activities where research, development and design are the pre-dominant activities
Incentives	No special incentives. All companies in the region can obtain grants for new or expansion projects creating jobs. Some firms also can obtain financial assistance for R & D and new product developments.
Comments	A partnership between the University and Local Councils, which has created new jobs, improved the profile of the region, enhanced the University's interaction with regional industry and provided services to help small high- tech firms to grow

Case Study on Surrey Research Park in the UK

Date Founded	concept formed in 1979, construction began in 1984, first tenant 1985
Area	28 ha, of which 20 ha has been developed to date
Developments	development to date amounts to 55,000 sq m maximum capacity is 71,000sq m building footprint averages 15% of gross site area maximum plot ratio is 0.25 : 1 mostly two-storey brick buildings there are now 26 buildings with an average size of 2,100 sq m 75% of tenants occupy less than 500sq m
Tenants	1995 - 71 firms, 1996 - 82 firms, 8% are independent start-ups, 15% spin-offs from the University, 17% are mobile foreign investments (of this 50% is from the US)
Sectors	8% specialist R & D 18% product- based businesses 22% software developers 10% computer/telecom sales 29% consultants/professional advisers 5% testing, analysis and training 8% other
Activities	total employment in 1996 is 2,065 in 82 firms, average size is 29 employees, 29% employed in R & D activities (an average of 20 people per firm)
Criteria	planning restricts uses to R & D and design in science, social sciences and engineering, ancillary offices and related services such as venture capital,.patents etc., and limited high value, low volume manufacturing, the University's aim is for start-ups, growth companies with less than 25-30 employees, R & D headquarters of large corporations, University spin-off and government research laboratories
Incentives	No financial incentives available
Comments	focus is on attracting firms of value to the University (technically and financially) the Park is owned, financed and run by the University to generate an income for the University its excellent location ensures a steady flow of demand, able to pay commercial rents, it is thus able to selective about who it will admit onto the science park only a limited number of businesses with products (hardware) are based on the Park

Comments of Landscaping of Common Areas

Great importance is attached to the quality of the landscaped areas on science parks to create a distinct environment attractive for occupants and their customers. This has been particularly important in urban environments where science parks offer a different and superior environment designed to attract discerning firms aware that image and environment can enhance the recruitment and retention of high quality employees and improve the profile and positioning of the firm with customers. The importance attached to landscaping and environmental considerations has also enabled science parks to be developed in more sensitive locations close to a university or a residential area.

Landscaping and environment needs to take account of weather conditions and local habits of the workforce. Most science parks are planned to cater for the private motor vehicle. Thus much of the landscaping tends to be designed around the road layout and car parking arrangements to maximise the benefits of the journey to the science park, the walk from the car park to the building, and the view from the building itself.

Arguably the priorities in Hong Kong are somewhat different. Since public transport is likely to be the main way that most employees and visitors reach the Science Park, greater importance should be placed on the location, design of the collection and delivery points (station, bus shelters etc) and the walkways between these points and the main buildings.

Special consideration should also be given to the design of recreational space, to take account of people's habits during break periods (at lunch time and after work etc). A key feature of the Science Park is the water front and the views across the bay, offering an opportunity to provide a promenade for people, and an alternative location for restaurant, retail and other shared facilities. Consideration will need to be given on how this special feature can be integrated into the overall design of the Science Park, to reduce the potential barrier between the buildings and the water front e.g. by keeping the promenade free from cars, and by providing adequate cover and shade against rain and the sun.

The landscaped areas also need to take account of Hong Kong's climate and the importance of in-door air conditioned space. Whereas European Parks have tended to opt for developments with low plot areas and site coverage ratios (leading to the use of lakes and trees) but common areas within the building envelopes tend to be minimal, it will be important to arrive at a new balance for the Hong Kong Science Park to take account of climate, and local preferences. In Hong Kong, this has led to more attention being given to the design of larger and more impressive common areas as part of a building's overall design.

Within the Science Park, it may be appropriate to accept higher plot ratios and site coverage to compensate for the provision of more generous common areas, particularly in the multi-tenanted buildings. The Master Plan needs to consider the trade off between site coverage, plot ratio and the greater provision of common areas, rather than adopt a rigid set of overall design criteria which may limit the overall design of the Science Park. Thus it may be necessary to set controls for plot ratios and site coverage in terms of the amount of usable space rather than the size of each building envelope as a whole. Another key factor will be the opportunity for considering the juxta-position of the various multi-tenanted buildings, which, it is expected, will be the predominant form of development on the Science Park. There would seem to be considerable benefits in grouping the various multi-tenanted units to facilitate close interchange between tenants, rather than spreading the buildings out across the park as a whole. This approach will need to be balanced against the phased development plan envisaged in Stage 2 Report. This envisaged that a more uniform development of buildings on a plot by plot basis would be carried out, resulting in a more uniform development of each of the three separate 7-8 ha phases of the Science Park. The Master Plan will need to counter the danger of a "bitty" development dictated by the phased release of land as the reclamation is completed.

The Provision of Residential Facilities on the Science Park

The Stage 2 Report included a strong recommendation that "sheltered" residential accommodation should be offered to encourage Chinese managers engaged in leading edge technologies in western countries to return to Hong Kong, either to establish a new division for their employer or to start a new business. These people (and other foreign ex-patriots working for foreign companies attracted to the Science Park) will require high quality affordable housing. Whilst there is general recognition of the importance of residential facilities, there are some in-principle doubts about whether it could or should be provided and if so where.

A number of potential development options exist. One option would be for the Science Park Corporation to develop a special low rise, high quality development on the Science Park, or to do so in partnership with a private developer. An alternative is development by the Science Park (or in partnership) on the adjoining reclamation area or, for example in association with a station development, and included as part of its package to inward investors. It has been suggested that if it is to be provided, existing accommodation should be rented by the Science Park on surrounding existing or proposed private sector developments (including for example serviced apartments), although a contrary view is that 'standard' high rise accommodation would not be large enough or of a sufficiently high standard for foreign investors. We beleive that the preferred option would be for the Science Park itself to develop suitable high quality serviced apartments on the Science Park overlooking the bay, which it would assign to foreign investors on a concessionary basis for specific periods of time according to the needs of the investor and taking account of other demands for the apartments. This would ensure that it retained control of a small but critical feature of the package for foreign investors given the need to develop a high quality community. We suggest that they may be benefits of linking the serviced apartments to either the central amenities facility described above, or a hotel (see below) as has been done at Park View. Occupiers would have easy access to supporting facilities. And the management of the serviced apartments would be a function that would be an extension of managing the Amenities Centre or the Hotel.

On the assumption that the Science Park attracts around 30 inward -investments over a period of 15 years and each foreign firm employs on average 2-3 ex-patriots, of whom 2 would require sheltered family standard accommodation (typical floor area of around 200 - 250 sq m), there would be a total requirement for around 60-90 special apartments. This would amount to no more than 20-30 new apartments in each of the three 5 year periods of development of the Science Park. One option would be to locate the first 20-30 apartments on land close to the second phase, so that the number of apartments could be expanded once the value of providing residential facilities has been assessed. A six storey block of 30 apartments each with an area of 250 sq m would require a land area of around 0.30 hectare assuming a plot ration of 2.5. There will also be a need to offer affordable basic accommodation to scientists and technologists from mainland China. The location and standard is less critical and there would thus be no over-riding reason why this accommodation should be included on the Science Park.

Annex B

Construction Plant

Table B1 Plant Inventory - No Mitigation Measures

Activities							
Reclamation	a1	**Noise Source**	**TM ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Grab dredger	CNP 063	2	112	0	115
		Derrick barges	CNP 061	2	104	0	107
		Tug boat	CNP 221	2	110	0	113
		Dump truck	CNP 067	3	117	0	122
							123
Roadworks	a2	**Noise Source**	**TM ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Dump truck	CNP 067	2	117	0	120
		Excavator	CNP 081	1	112	0	112
		Road roller	CNP 185	1	108	0	108
		Lorry	CNP 141	1	112	0	112
		Asphalt Paver	CNP 004	1	109	0	109
		Loader	CNP 081	1	112	0	112
							122
Structural works	a3	**Noise Source**	**TM ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Piling, large diameter	CNP 164	2	115	0	118
		Excavator	CNP 081	1	112	0	112
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held	CNP 026	1	114	0	114
		Dump truck	CNP 067	1	117	0	117
		Generator, standard	CNP 101	1	108	0	108
		Concrete lorry mixer	CNP 044	1	109	0	109
		Poker vibrator	CNP 170	1	113	0	113
		Bar bender and cutter	CNP 021	1	90	0	90
		Lorry	CNP 141	1	112	0	112
		Mobile crane	CNP 048	1	112	0	112
		Saw, circular, wood	CNP 201	1	108	0	108
							124
Subway construction	a4	**Noise Source**	**TM ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Excavator	CNP 081	1	112	0	112
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held	CNP 026	1	114	0	114
		Dump truck	CNP 067	1	117	0	117
		Bar bender and cutter	CNP 021	1	90	0	90
		Generator, standard	CNP 101	1	108	0	108
		Concrete lorry mixer	CNP 044	1	109	0	109
		Poker vibrator	CNP 170	1	113	0	113
		Lorry	CNP 141	1	112	0	112
		Saw, circular, wood	CNP 201	1	108	0	108
							122
Nullah construction	a5	**Noise Source**	**TM ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Excavator	CNP 081	1	112	0	112
		Mobile crane	CNP 048	1	112	0	112
		Truck	CNP 141	1	112	0	112
		Poker vibrator	CNP 170	1	113	0	113
		Concrete lorry mixer	CNP 044	1	109	0	109
		Water pump	CNP 282	1	103	0	103
		Generator, standard	CNP 101	1	108	0	108
							119
Viaduct construction	a6	**Noise Source**	**TM ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Piling, large diameter	CNP 164	2	115	0	118
		Bar bender and cutter	CNP 021	1	90	0	90
		Generator, standard	CNP 101	1	108	0	108
		Concrete lorry mixer	CNP 044	2	109	0	112
		Mobile crane	CNP 048	2	112	0	115
		Lorry	CNP 141	1	112	0	112
		Excavator	CNP 081	1	112	0	112
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held	CNP 026	1	114	0	114
		Dump Truck	CNP 067	2	117	0	120
		Poker vibrator	CNP 170	2	113	0	116
							125

Table B2 Plant Inventory - Mitigation 1 (Use of quiet plant)

Activities							
Reclamation	a1	Noise Source	Ref	UNIT	SWL	Barrier Atten	sub-SWL
		Grab dredger	CNP 063*	2	112	0	115
		Derrick barges	CNP 061	2	104	0	107
		Tug boat	CNP 221	2	110	0	113
		Dump truck (qp)	T12 R29**	3	109	0	114
							119
Roadworks	**a2**	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Dump truck (qp)	T12 R29	2	109	0	112
		Excavator (qp)	T7 R97	1	105	0	105
		Road roller	CNP 185	1	108	0	108
		Lorry (qp)	T12 R27	1	105	0	105
		Asphalt Paver	CNP 004	1	109	0	109
		Loader (qp)	T7 R97	1	105	0	105
							116
Structural works	**a3**	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Piling, large diameter	CNP 164	2	115	0	118
		Excavator (qp)	T7 R97	1	105	0	105
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held (q	T6 R10	1	110	0	110
		Dump truck (qp)	T12 R29	1	109	0	109
		Generator, standard (	CNP 101	1	100	0	100
		Concrete lorry mixer	CNP 044	1	109	0	109
		Poker vibrator (qp)	T9 R32	1	100	0	100
		Bar bender and cutter	CNP 021	1	90	0	90
		Lorry (qp)	T12 R27	1	105	0	105
		Mobile crane	CNP 048	1	112	0	112
		Saw, circular, wood	CNP 201	1	108	0	108
							121
Subway construction	**a4**	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Excavator (qp)	T7 R97	1	105	0	105
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held (q	T6 R10	1	110	0	110
		Dump truck (qp)	T12 R29	1	109	0	109
		Bar bender and cutter	CNP 021	1	90	0	90
		Generator, standard (	CNP 101	1	100	0	100
		Concrete lorry mixer	CNP 044	1	109	0	109
		Poker vibrator (qp)	T9 R32	1	100	0	100
		Lorry (qp)	T12 R27	1	105	0	105
		Saw, circular, wood	CNP 201	1	108	0	108
							116
Nullah construction	**a5**	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Excavator (qp)	T7 R97	1	105	0	105
		Mobile crane	CNP 048	1	112	0	112
		Lorry (qp)	T12 R27	1	105	0	105
		Poker vibrator (qp)	T9 R32	1	100	0	100
		Concrete lorry mixer	CNP 044	1	109	0	109
		Water pump	CNP 282	1	103	0	103
		Generator, standard (	CNP 101	1	100	0	100
							115
Viaduct construction	**a6**	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Piling, large diameter	CNP 164	2	115	0	118
		Bar bender and cutter	CNP 021	1	90	0	90
		Generator, standard (	CNP 101	1	100	0	100
		Concrete lorry mixer	CNP 044	2	109	0	112
		Mobile crane	CNP 048	2	112	0	115
		Lorry (qp)	T12 R27	1	105	0	105
		Excavator (qp)	T7 R97	1	105	0	105
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held (q	T6 R10	1	110	0	110
		Dump Truck (qp)	T12 R29	2	109	0	112
		Poker vibrator (qp)	T9 R32	2	100	0	103
							122

Table B3 Plant Inventory - Mitigation 2 (Use of quiet plant and limiting no. of plant)

Activities							
Reclamation	a1	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Grab dredger	CNP* 063	2	112	0	115
		Derrick barges	CNP 061	2	104	0	107
		Tug boat	CNP 221	2	110	0	113
		Dump truck (qp)	T12 R29**	3	109	0	114
							119
Roadworks	a2	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Dump truck (qp)	T12 R29	0	109	0	0
		Excavator (qp)	T7 R97	1	105	0	105
		Road roller	CNP 185	1	108	0	108
		Lorry (qp)	T12 R27	2	105	0	108
		Asphalt Paver	CNP 004	1	109	0	109
		Loader (qp)	T7 R97	1	105	0	105
							114
Structural works	a3	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Piling, large diameter	CNP 164	1	115	0	115
		Excavator (qp)	T7 R97	1	105	0	105
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held (q	T6 R10	1	110	0	110
		Dump truck (qp)	T12 R29	0	109	0	0
		Generator, standard (	CNP 101	1	100	0	100
		Concrete lorry mixer	CNP 044	1	109	0	109
		Poker vibrator (qp)	T9 R32	1	100	0	100
		Bar bender and cutter	CNP 021	1	90	0	90
		Lorry (qp)	T12 R27	2	105	0	108
		Mobile crane	CNP 048	1	112	0	112
		Saw, circular, wood	CNP 201	1	108	0	108
							119
Subway construction	a4	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Excavator (qp)	T7 R97	1	105	0	105
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held (q	T6 R10	1	110	0	110
		Dump truck (qp)	T12 R29	1	109	0	109
		Bar bender and cutter	CNP 021	1	90	0	90
		Generator, standard (	CNP 101	1	100	0	100
		Concrete lorry mixer	CNP 044	1	109	0	109
		Poker vibrator (qp)	T9 R32	1	100	0	100
		Lorry (qp)	T12 R27	1	105	0	105
		Saw, circular, wood	CNP 201	1	108	0	108
							116
Nullah construction	a5	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Excavator (qp)	T7 R97	1	105	0	105
		Mobile crane	CNP 048	1	112	0	112
		Lorry (qp)	T12 R27	1	105	0	105
		Poker vibrator (qp)	T9 R32	1	100	0	100
		Concrete lorry mixer	CNP 044	1	109	0	109
		Water pump	CNP 282	1	103	0	103
		Generator, standard (	CNP 101	1	100	0	100
							115
Viaduct construction	a6	**Noise Source**	**Ref**	**UNIT**	**SWL**	**Barrier Atten**	**sub-SWL**
		Piling, large diameter	CNP 164	2	115	0	118
		Bar bender and cutter	CNP 021	1	90	0	90
		Generator, standard (	CNP 101	1	100	0	100
		Concrete lorry mixer	CNP 044	2	109	0	112
		Mobile crane	CNP 048	2	112	0	115
		Lorry (qp)	T12 R27	1	105	0	105
		Excavator (qp)	T7 R97	1	105	0	105
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held (q	T6 R10	1	110	0	110
		Dump Truck (qp)	T12 R29	2	109	0	112
		Poker vibrator (qp)	T9 R32	2	100	0	103
							122

Table B4 Plant Inventory - Mitigation measures 3 (Use of quiet plant, limiting no. of plant and movable barriers)

Activities							
Reclamation	a1	Noise Source	Ref	UNIT	SWL	Barrier Atten	sub-SWL
		Grab dredger	CNP* 063	2	112	0	115
		Derrick barges	CNP 061	2	104	0	107
		Tug boat	CNP 221	2	110	0	113
		Dump truck (qp)	T12 R29**	3	109	0	114
							119
Roadworks	a2	Noise Source	Ref	UNIT	SWL	Barrier Atten	sub-SWL
		Dump truck (qp)	T12 R29	0	109	0	0
		Excavator (qp)	T7 R97	1	105	-5	100
		Road roller	CNP 185	1	108	0	108
		Lorry (qp)	T12 R27	1	105	0	105
		Asphalt Paver	CNP 004	1	109	0	109
		Loader (qp)	T7 R97	1	105	-5	100
							113
Structural works	a3	Noise Source	Ref	UNIT	SWL	Barrier Atten	sub-SWL
		Piling, large diameter	CNP 164	1	115	-5	110
		Excavator (qp)	T7 R97	1	105	-5	100
		Air compressor	CNP 001	1	100	-10	90
		Breaker, hand-held (q	T6 R10	1	110	-10	100
		Dump truck (qp)	T12 R29	0	109	0	0
		Generator, standard (	CNP 101	1	100	-10	90
		Concrete lorry mixer	CNP 044	1	109	-5	104
		Poker vibrator (qp)	T9 R32	1	100	-10	90
		Bar bender and cutter	CNP 021	1	90	0	90
		Lorry (qp)	T12 R27	2	105	0	108
		Mobile crane	CNP 048	1	112	-5	107
		Saw, circular, wood	CNP 201	1	108	-10	98
							114
Subway construction	a4	Noise Source	Ref	UNIT	SWL	Barrier Atten	sub-SWL
		Excavator (qp)	T7 R97	1	105	0	105
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held (q	T6 R10	1	110	0	110
		Dump truck (qp)	T12 R29	1	109	0	109
		Bar bender and cutter	CNP 021	1	90	0	90
		Generator, standard (	CNP 101	1	100	0	100
		Concrete lorry mixer	CNP 044	1	109	0	109
		Poker vibrator (qp)	T9 R32	1	100	0	100
		Lorry (qp)	T12 R27	1	105	0	105
		Saw, circular, wood	CNP 201	1	108	0	108
							116
Nullah construction	a5	Noise Source	Ref	UNIT	SWL	Barrier Atten	sub-SWL
		Excavator (qp)	T7 R97	1	105	0	105
		Mobile crane	CNP 048	1	112	0	112
		Lorry (qp)	T12 R27	1	105	0	105
		Poker vibrator (qp)	T9 R32	1	100	0	100
		Concrete lorry mixer	CNP 044	1	109	0	109
		Water pump	CNP 282	1	103	0	103
		Generator, standard (	CNP 101	1	100	0	100
							115
Viaduct construction	a6	Noise Source	Ref	UNIT	SWL	Barrier Atten	sub-SWL
		Piling, large diameter	CNP 164	2	115	0	118
		Bar bender and cutter	CNP 021	1	90	0	90
		Generator, standard (	CNP 101	1	100	0	100
		Concrete lorry mixer	CNP 044	2	109	0	112
		Mobile crane	CNP 048	2	112	0	115
		Lorry (qp)	T12 R27	1	105	0	105
		Excavator (qp)	T7 R97	1	105	0	105
		Air compressor	CNP 001	1	100	0	100
		Breaker, hand-held (q	T6 R10	1	110	0	110
		Dump Truck (qp)	T12 R29	2	109	0	112
		Poker vibrator (qp)	T9 R32	2	100	0	103
							122

Annex C

Construction Noise Assessment

Table C1 Predicted Noise Levels - No mitigation measures

			Unmitigated Predicted Noise Levels from each different activities											Minimum distance to different construction activities									
	activity	SWL	HKIB	CUHK	Cheung	Tsui Han	Deerhill	Villa Ca	Educatio	Tertiary	Residen	Residen	CUHK: C24										
worksite	ref		NSR 1	NSR2	NSR3	NSR4	NSR5	NSR6	NSR7	NSR8	NSR9	NSR10	NSR 15	NSR 1	NSR2	NSR3	NSR4	NSR5	NSR6	NSR7	NSR8	NSR9	NSR10
1A	a1	123	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A
2A	a1	123	54.0	57.8	61.8	70.6	70.6	67.5	N\A	N\A	N\A	N\A	N\A	1620	1040	660	240	240	340	N\A	N\A	N\A	N\A
2B	a2	122	**83.1**	61.8	54.6	52.2	51.4	51.1	N\A	N\A	N\A	N\A	71.1	50	580	1340	1760	1920	2000	N\A	N\A	N\A	N\A
2C	a3	124	**84.6**	64.8	56.6	54.4	53.2	53.0	N\A	N\A	N\A	N\A	N\A	50	490	1260	1620	1860	1900	N\A	N\A	N\A	N\A
2D	a3	124	**80.5**	61.8	55.5	53.1	52.3	51.9	N\A	N\A	N\A	N\A	N\A	80	690	1420	1880	2060	2160	N\A	N\A	N\A	N\A
2E	a1	123	52.2	55.0	58.2	65.3	67.1	66.1	N\A	N\A	N\A	N\A	N\A	1980	1440	1000	440	360	400	N\A	N\A	N\A	N\A
2F	a2	122	51.2	53.9	57.1	64.2	66.0	65.1	N\A	N\A	N\A	N\A	N\A	1980	1440	1000	440	360	400	N\A	N\A	N\A	N\A
2G	a4	122	60.1	56.3	52.4	49.7	48.6	48.6	N\A	N\A	N\A	N\A	67.2	680	1050	1650	2250	2550	2550	N\A	N\A	N\A	N\A
2H	a3	124	75.1	67.0	57.6	56.3	55.2	54.7	N\A	N\A	N\A	N\A	N\A	150	380	1120	1300	1480	1560	N\A	N\A	N\A	N\A
2I	a2	122	64.2	**78.0**	65.5	65.1	61.8	60.7	N\A	N\A	N\A	N\A	N\A	440	90	380	400	580	660	N\A	N\A	N\A	N\A
2J	a3	124	58.4	65.3	**76.3**	67.5	64.3	62.7	N\A	N\A	N\A	N\A	N\A	1020	460	130	360	520	620	N\A	N\A	N\A	N\A
			88	**79**	**77**	74	74	72					73										
3A	a1	123	62.1	69.9	62.1	61.3	59.5	58.9	64.6	68.9	N\A	N\A	N\A	640	260	640	700	860	920	480	290	N\A	N\A
3B	a5	119	51.5	55.8	59.9	61.0	58.7	58.0	·64.7	60.8	N\A	N\A	N\A	1380	840	520	460	600	650	300	470	N\A	N\A
3C	a2,a6	127	65.2	61.4	57.5	54.8	54.8	54.8	57.0	57.5	N\A	N\A	75.8	680	1050	1650	2250	2250	2250	1730	1650	N\A	N\A
3D	a1	123	61.5	57.8	53.8	51.1	51.1	51.1	53.4	53.8	N\A	N\A	72.2	680	1050	1650	2250	2250	2250	1730	1650	N\A	N\A
3E	a2	122	74.2	74.2	64.6	71.5	68.8	65.8	64.6	61.3	N\A	N\A	N\A	140	140	420	190	260	370	420	620	N\A	N\A
3F	a3	124	54.8	58.4	61.9	68.5	68.0	66.1	62.5	65.5	N\A	N\A	N\A	1540	1020	680	320	340	420	640	450	N\A	N\A
3G	a3	124	54.8	58.4	61.9	68.5	68.0	66.1	62.5	65.5	N\A	N\A	N\A	1540	1020	680	320	340	420	640	450	N\A	N\A
3H	a3	124	54.8	58.4	61.9	68.5	68.0	66.1	62.5	65.5	N\A	N\A	N\A	1540	1020	680	320	340	420	640	450	N\A	N\A
3I	a2	122	53.4	56.9	60.5	67.0	66.5	64.6	61.0	64.1	N\A	N\A	N\A	1540	1020	680	320	340	420	640	450	N\A	N\A
			75	**76**	71	**76**	75	73	**72**	**74**			**77**										
4A	a2	122	59.3	68.8	60.7	57.1	62.2	55.1	62.2	69.2	71.1	70.3	N\A	780	260	660	1000	560	1260	560	250	200	220
4B	a3	124	57.7	62.2	62.2	62.3	60.9	60.0	65.3	66.3	71.0	68.8	N\A	1110	660	660	650	770	850	460	410	240	310
4C	a3	124	58.3	64.6	65.0	63.9	61.8	60.7	69.0	70.6	69.6	68.2	N\A	1030	500	480	540	690	780	300	250	280	330
4D	a3	124	60.3	67.0	61.6	56.9	57.6	56.9	62.7	69.0	62.3	61.4	N\A	820	380	710	960	1120	1220	620	300	650	720
			65	72	69	67	67	65	**72**	**75**	**76**	74											

SPL (NSRs) = SWL - 10 log (2*pi*distance^2) +3

N\A = Not Applicable

Table C2 Predicted Noise Levels - Mitigation Measures 1 (Use of quiet plant)

			Mitigation of Predicted Noise Levels from each different activities (Quiet Plant)											Minimum distance to different construction activities									
	activity	SWL	HKIB	CUHK	Cheung	Tsui Han	Deerhill	Villa Ca	Educati	Tertiary	Residen	Residen	CUHK: C24										
worksite	ref		NSR 1	NSR2	NSR3	NSR4	NSR5	NSR6	NSR7	NSR8	NSR9	NSR10	NSR 15	NSR 1	NSR2	NSR3	NSR4	NSR5	NSR6	NSR7	NSR8	NSR9	NSR10
1A	a1	119	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A	N\A
2A	a1	119	49.9	53.7	57.7	66.5	66.5	63.4	N\A	N\A	N\A	N\A	N\A	1620	1040	660	240	240	340	N\A	N\A	N\A	N\A
2B	a2	116	**77.0**	55.7	48.5	46.1	45.3	45.0	N\A	N\A	N\A	N\A	65.0	50	580	1340	1760	1920	2000	N\A	N\A	N\A	N\A
2C	a3	121	**81.9**	62.0	53.8	51.6	50.4	50.3	N\A	N\A	N\A	N\A	N\A	50	490	1260	1620	1860	1900	N\A	N\A	N\A	N\A
2D	a3	121	**77.8**	59.1	52.8	50.4	49.6	49.1	N\A	N\A	N\A	N\A	N\A	80	690	1420	1880	2060	2160	N\A	N\A	N\A	N\A
2E	a1	119	48.1	50.9	54.1	61.2	63.0	62.0	N\A	N\A	N\A	N\A	N\A	1980	1440	1000	440	360	400	N\A	N\A	N\A	N\A
2F	a2	116	45.1	47.8	51.0	58.1	59.9	59.0	N\A	N\A	N\A	N\A	N\A	1980	1440	1000	440	360	400	N\A	N\A	N\A	N\A
2G	a4	116	54.6	50.8	46.9	44.2	43.1	43.1	N\A	N\A	N\A	N\A	61.7	680	1050	1650	2250	2550	2550	N\A	N\A	N\A	N\A
2H	a3	121	72.3	64.2	54.9	53.6	52.4	52.0	N\A	N\A	N\A	N\A	N\A	150	380	1120	1300	1480	1560	N\A	N\A	N\A	N\A
2I	a2	116	58.1	71.9	59.4	59.0	55.7	54.6	N\A	N\A	N\A	N\A	N\A	440	90	380	400	580	660	N\A	N\A	N\A	N\A
2J	a3	119	53.9	60.8	71.8	63.0	59.8	58.2	N\A	N\A	N\A	N\A	N\A	1020	460	130	360	520	620	N\A	N\A	N\A	N\A
			85	74	73	70	70	68					67										
3A	a1	119	58.0	65.8	58.0	57.2	55.4	54.8	60.5	64.8	N\A	N\A	N\A	640	260	640	700	860	920	480	290	N\A	N\A
3B	a5	115	47.5	51.9	56.0	57.1	54.8	54.1	60.8	56.9	N\A	N\A	N\A	1380	840	520	460	600	650	300	470	N\A	N\A
3C	a2,a6	123	61.1	57.3	53.4	50.7	50.7	50.7	53.0	53.4	N\A	N\A	71.7	680	1050	1650	2250	2250	2250	1730	1650	N\A	N\A
3D	a1	119	57.4	53.7	49.7	47.0	47.0	47.0	49.3	49.7	N\A	N\A	68.1	680	1050	1650	2250	2250	2250	1730	1650	N\A	N\A
3E	a2	116	68.1	68.1	58.5	65.4	62.7	59.6	58.5	55.2	N\A	N\A	N\A	140	140	420	190	260	370	420	620	N\A	N\A
3F	a3	121	52.1	55.7	59.2	65.7	65.2	63.4	59.7	62.8	N\A	N\A	N\A	1540	1020	680	320	340	420	640	450	N\A	N\A
3G	a3	121	52.1	55.7	59.2	65.7	65.2	63.4	59.7	62.8	N\A	N\A	N\A	1540	1020	680	320	340	420	640	450	N\A	N\A
3H	a3	121	52.1	55.7	59.2	65.7	65.2	63.4	59.7	62.8	N\A	N\A	N\A	1540	1020	680	320	340	420	640	450	N\A	N\A
3I	a2	116	47.2	50.8	54.3	60.9	60.4	58.5	54.9	57.9	N\A	N\A	N\A	1540	1020	680	320	340	420	640	450	N\A	N\A
			70	71	67	72	71	69	68	70			73										
4A	a2	116	53.2	62.7	54.6	51.0	56.0	49.0	56.0	63.0	65.0	64.1	N\A	780	260	660	1000	560	1260	560	250	200	220
4B	a3	121	54.9	59.4	59.4	59.6	58.1	57.2	62.6	63.6	68.2	66.0	N\A	1110	660	660	650	770	850	460	410	240	310
4C	a3	121	55.6	61.9	62.2	61.2	59.1	58.0	66.3	67.9	66.9	65.5	N\A	1030	500	480	540	690	780	300	250	280	330
4D	a3	121	57.6	64.2	58.8	56.2	54.9	54.1	60.0	66.3	59.6	58.7	N\A	820	380	710	960	1120	1220	620	300	650	720
			62	68	66	64	63	62	69	**72**	72	70											

SPL (NSRs) = SWL - 10 log (2*pi*distance^2) +3

N\A = Not Applicable

Table C3 Predicted Noise Levels - Mitigation Measures 2 (Use of quiet plant and limiting no of plant)

Mitigation of Predicted Noise Levels (Quiet Plant & Limiting No. of Plant)				
			CUHK	Tertiary
			Staff	E I in
	activity	SWL	Accom	Area 39
worksite	ref		NSR 1	NSR8
2A	a1	119	49.9	N\A
2B	a2	114	75.3	N\A
2C	a3	119	80.3	N\A
2D	a3	119	76.2	N\A
2E	a1	119	48.1	N\A
2F	a2	114	43.4	N\A
2G	a4	116	54.6	N\A
2H	a3	119	70.8	N\A
2I	a2	114	56.4	N\A
2J	a3	119	54.1	N\A
			83	
4A	a2	114	N\A	61.4
4B	a3	119	N\A	62.0
4C	a3	119	N\A	66.3
4D	a3	119	N\A	64.7
				70
SPL (NSRs) = SWL - 10 log (2*pi*distance^2) +3				
N\A = Not Applicable				

Table C4 Predicted Noise Levels - Mitigation Measures 3 (Use of quiet plant, limiting no of plant and movable barriers)

Mitigated Predicted Noise Levels (Quite Plant, Limitin
No of Plant and Barrier)

worksite	activity ref	SWL	CUHK Staff Accommodation NSR 1
2A	a1	119	49.9
2B	a2	113	73.9
2C	a3, a7	114	75.3
2D	a3	114	71.3
2E	a1	119	48.1
2F	a2	113	42.0
2G	a4, a7	116	54.6
2H	a3	114	65.8
2I	a2	113	55.0
2J	a1	119	53.9
			79

SPL (NSRs) = SWL - 10 log (2*pi*distance^2) +3

N\A = Not Applicable

Annex D

Traffic Noise Assessment

Table D1 Predicted Noise Levels - No Mitigation Measures ($L_{10,\ peak\ hour}$ dB(A))

NSRs	Floor	Altered	New	Total
1A	1/F	67.4	64.1	69.1
	3/F	67.4	64.3	69.1
	6/F	67.5	65.3	69.5
1B	1/F	57.9	74.8	74.9
	3/F	68.8	74.5	75.5
	6/F	69	73.7	75.0
1C	1/F	66.5	76.5	76.9
	3/F	66.3	75.9	76.4
	6/F	65.7	74.8	75.3
2	1/F	68.9	56.6	69.1
	3/F	69.2	59.2	69.6
	5/F	69.6	62.6	70.4
5A	1/F	68.8	62.3	69.7
	6/F	69	63.2	70.0
	12/F	69.4	63	70.3
5B	1/F	66.4	61.5	67.6
	6/F	66.6	62.4	68.0
	12/F	66.7	62.3	68.0
7a1	1/F	54.5	61.4	62.2
	3/F	55.4	61.7	62.6
	6/F	58.1	61.6	63.2
7a2	1/F	60	56.3	61.5
	3/F	61.6	57.9	63.1
	6/F	63	60.6	65.0
7a3	1/F	63.4	48.5	63.5
	3/F	64.2	52.9	64.5
	6/F	64.7	59.4	65.8
7a4	1/F	57.4	50.1	58.1
	3/F	60.4	53	61.1
	6/F	67	60	67.8
7a5	1/F	61.9	56.3	63.0
	3/F	62.8	59.2	64.4
	6/F	64	62.7	66.4
7a6	1/F	50.5	59	59.6
	3/F	51.7	59.1	59.8
	6/F	56.6	59.3	61.2
7b1	1/F	55.2	59.8	61.1
	3/F	56.5	59.9	61.5
	6/F	59.5	60	62.8

Table D1 Predicted Noise Levels - No Mitigation Measures ($L_{10,\ \text{peak hour}}$ dB(A))

NSRs	Floor	Altered	New	Total
7b2	1/F	56.3	55	58.7
	3/F	57.1	56.3	59.7
	6/F	59.6	60.2	62.9
7b3	1/F	50.1	55.8	56.8
	3/F	54.5	57.2	59.1
	6/F	59.4	60.2	62.8
7b4	1/F	55.5	62	62.9
	2/F	56.9	62	63.2
7b5	4/F	58	56.1	60.2
	6/F	59.6	63	64.6
8A	1/F	60.8	62.7	64.9
	3/F	62.2	64	66.2
	6/F	65.8	65.3	68.6
8B	1/F	64.6	57.9	65.4
	3/F	66.5	61.6	67.7
	6/F	68.9	65.7	70.6
9A	1/F	52.4	65.3	65.5
	6/F	53.3	65.4	65.7
	12/F	55.4	65.1	65.5
9B	1/F	53.9	68.1	68.3
	6/F	54.7	68.1	68.3
	12/F	56.6	67.6	67.9
9C	1/F	59.9	67.3	68.0
	6/F	61.5	69.1	69.8
	12/F	62.3	68.9	69.8
9D	1/F	63.2	72.6	73.1
	6/F	64.7	71.2	72.1
	12/F	65.5	70.1	71.4
9E	1/F	60.7	73.3	73.5
	6/F	61.6	72.3	72.7
	12/F	62.4	71.2	71.7
9F	1/F	52.9	71.8	71.9
	6/F	53.5	71	71.1
	12/F	55.8	69.8	70.0
9G	1/F	51	71.1	71.1
	6/F	51.6	70.2	70.3
	12/F	54.1	69	69.1
9G1	1/F	50.4	61.7	62.0
	6/F	50.9	67.5	67.6

Table D1 Predicted Noise Levels - No Mitigation Measures ($L_{10,\text{ peak hour}}$ dB(A))

NSRs	Floor	Altered	New	Total
	12/F	54.6	66.8	67.1
9H	1/F	51.1	63	63.3
	6/F	52.3	67.4	67.5
	12/F	55.6	66.7	67.0
9I	1/F	49.5	65.2	65.3
	6/F	50.1	66	66.1
	12/F	52.9	65	65.3
10A	1/F	48.7	72.3	72.3
	10/F	48.7	69.8	69.8
	21/F	56.9	67.7	68.0
10B	1/F	64.2	76	76.3
	10/F	65.5	74.1	74.7
	21/F	67.4	72.4	73.6
10C	1/F	64.5	76.2	76.5
	10/F	66.5	74.3	75.0
	21/F	69.5	72.8	74.5
10D	1/F	65.3	73.4	74.0
	10/F	67.9	72.8	74.0
	21/F	70.9	71.6	74.3
10E	1/F	63.3	69.8	70.7
	10/F	67.5	70.1	72.0
	21/F	70.3	69.5	72.9
10F	1/F	63	69	70.0
	10/F	67.4	69.3	71.5
	21/F	70.1	68.9	72.6
10G	1/F	61	69.9	70.4
	10/F	67.7	69.9	71.9
	21/F	70.2	69.3	72.8
10H	1/F	57.1	63.9	64.7
	10/F	66.3	68.5	70.5
	21/F	68.1	67.4	70.8
10I	1/F	54.1	60.6	61.5
	10/F	55.9	68.5	68.7
	21/F	59.4	66.8	67.5
10J	1/F	59.1	71.6	71.8
	10/F	60.4	69.1	69.6
	21/F	64	67.3	69.0
10K	1/F	49.7	54.5	55.7
	10/F	49.7	61.8	62.1

Table D1 Predicted Noise Levels - No Mitigation Measures ($L_{10,\ peak\ hour}$ dB(A))

NSRs	Floor	Altered	New	Total
	21/F	57.7	63.9	64.8
11A	1/F	66	68	70.1
	6/F	67.2	66.7	70.0
	12/F	67.9	65.7	69.9
11B	1/F	67	67.1	70.1
	6/F	67.4	67.3	70.4
	12/F	67.8	66.7	70.3
11C	1/F	67	67	70.0
	6/F	67.5	67.4	70.5
	12/F	68.2	66.4	70.4
11D	1/F	64.8	69.1	70.5
	6/F	65.5	68.7	70.4
	12/F	66.1	68.2	70.3
11E	1/F	56.3	70.5	70.7
	6/F	57.1	70.8	71.0
	12/F	58.7	70	70.3
11F	1/F	53.8	70	70.1
	6/F	54.6	69.7	69.8
	12/F	58	69.3	69.6
11G	1/F	53	68.4	68.5
	6/F	53.8	68.3	68.5
	12/F	56.9	67.9	68.2
11H	1/F	52.5	66.6	66.8
	6/F	53.3	66.6	66.8
	12/F	56.2	66.3	66.7
12A	1/F	62.5	70.1	70.8
	2/F	64	70.1	71.1
12B	4/F	68.3	65.5	70.1
	6/F	69.4	69.8	72.6
12C	1/F	59.5	65.3	66.3
	3/F	62.2	65.4	67.1
	4/F	66.9	66.1	69.5
	6/F	68.2	68.7	71.5
12D	4/F	67.2	65.7	69.6
	6/F	68.5	69	71.9
13A	1/F	54.3	65.9	66.2
	10/F	56.1	68.7	68.9
	21/F	63	67	68.5

Table D1 Predicted Noise Levels - No Mitigation Measures ($L_{10,\ \text{peak hour}}$ dB(A))

NSRs	Floor	Altered	New	Total
13B	1/F	61.4	68.2	69.0
	10/F	62.9	71.1	71.7
	21/F	65.8	69.3	70.9
13C	1/F	62	68.4	69.3
	10/F	69.2	69	72.1
	21/F	71.2	69.1	73.3
13D	1/F	59.9	60.1	63.0
	10/F	69.2	67.5	71.4
	21/F	71.6	68.3	73.3
13E	1/F	65	66.3	68.7
	10/F	68.7	68.1	71.4
	21/F	71.3	68.1	73.0
13F	1/F	60.2	61.5	63.9
	10/F	66.3	64.4	68.5
	21/F	67.8	63.7	69.2
13G	1/F	65.3	72.8	73.5
	10/F	68.4	70.7	72.7
	21/F	70.4	68.9	72.7
13H	1/F	66.1	71.3	72.4
	10/F	67.8	69.6	71.8
	21/F	68.5	67.8	71.2
15A	1/F	75.3	61.4	75.5
	6/F	75.7	62.6	75.9
	12/F	76.5	63.7	76.7
15B	1/F	77.2	63	77.4
	6/F	77.6	64.1	77.8
	12/F	77.9	64.7	78.1

Table D2 - Predicted Noise Levels : 5m high cantilevered noise barriers along Road D1 ($L_{10, peak hour}$ dB(A))

NSRs	Floor	Altered	New	Total
1A	1/F	67.4	64.1	69.1
	3/F	67.4	64.3	69.1
	6/F	67.5	65.2	69.5
1B	1/F	57.9	62.5	63.8
	3/F	68.8	63.9	70.0
	6/F	69	64.9	70.4
1C	1/F	66.5	62.8	68.0
	3/F	66.3	64.6	68.5
	6/F	65.7	65.9	68.8

Table D3 - Predicted Noise Levels with 5m cantilevered barrier along Road D1 ($L_{10, \text{peak hour}}$ dB(A))

NSRs	Floor	Altered	New	TOTAL
PRIMARY SCHOOL				
12A	1/F	62.5	61	64.2
	2/F	64	61.7	66.0
12B	4/F	68.3	63.1	69.4
	6/F	69.4	67.1	71.4
12C	1/F	59.5	54.1	60.6
	3/F	62.2	57.9	63.6
	4/F	66.9	61.1	67.9
	6/F	68.2	65.9	70.2
12D	4/F	67.2	64.1	68.9
	6/F	68.5	67.2	70.9
SITE B				
10A	1/F	48.7	72.3	72.3
	10/F	48.7	69.8	69.8
	21/F	56.9	67.7	68.0
10B	1/F	64.2	76	76.2
	10/F	65.5	74.1	74.7
	21/F	67.4	72.4	73.6
10C	1/F	64.5	76.2	76.5
	10/F	66.5	74.3	75.0
	21/F	69.5	72.8	74.5
10D	1/F	65.3	72.7	73.4
	10/F	67.9	72.3	73.6
	21/F	70.9	71.6	74.3
10E	1/F	63.3	67.1	68.6
	10/F	67.5	68.8	71.2
	21/F	70.3	69.4	72.9
10F	1/F	63	65.2	67.3
	10/F	67.4	67.8	70.6
	21/F	70.1	68.7	72.4
10G	1/F	61	66.1	67.4
	10/F	67.7	68.4	71.1
	21/F	70.2	68.7	72.5
10H	1/F	57.1	61.5	62.8
	10/F	66.3	68.2	70.4
	21/F	68.1	67.4	70.8
10I	1/F	54.1	59.5	60.6
	10/F	55.9	68.2	68.4
	21/F	59.4	66.8	67.5

Table D3 - Predicted Noise Levels with 5m cantilevered barrier along Road D1 ($L_{10,\ peak\ hour}$ dB(A))

NSRs	Floor	Altered	New	TOTAL
10J	1/F	59.1	71.6	71.8
	10/F	60.4	68.8	69.4
	21/F	64	66.9	68.7
10K	1/F	49.7	54.5	55.7
	10/F	49.7	61.8	62.1
	21/F	57.7	63.9	64.8
SITE D				
13A	1/F	54.3	65.5	65.8
	10/F	56.1	68.5	68.7
	21/F	63	67	68.5
13B	1/F	61.4	64.9	66.5
	10/F	62.9	68.4	69.5
	21/F	65.8	67.3	69.6
13C	1/F	62	64.9	66.7
	10/F	69.2	68	71.7
	21/F	71.2	68.5	73.1
13D	1/F	59.9	57.4	61.8
	10/F	69.2	66.5	71.1
	21/F	71.6	68.2	73.2
13E	1/F	65	60.8	66.4
	10/F	68.7	67.2	71.0
	21/F	71.3	68	73.0
13F	1/F	60.2	57.7	62.1
	10/F	66.3	63.5	68.1
	21/F	67.8	63.7	69.2
13G	1/F	65.3	72.6	73.3
	10/F	68.4	70.7	72.7
	21/F	70.4	68.9	72.7
13H	1/F	66.1	71.2	72.4
	10/F	67.8	69.6	71.8
	21/F	68.5	67.8	71.2

Table D4 Predicted Noise Levels - revised layout 5m cantilevered barrier along Road D1 ($L_{10,\text{ peak hour}}$ dB(A))

NSRs	Floor	Altered	New	TOTAL
9A	1/F	52.4	64.8	65.0
	6/F	53.3	64.9	65.2
	12/F	55.4	64.6	65.1
9B	1/F	53.9	67.8	68.0
	6/F	54.7	67.8	68.0
	12/F	56.6	67.2	67.6
9C	1/F	59.9	66.9	67.7
	6/F	61.5	69	69.7
	12/F	62.3	69.1	69.9
C1	1/F	63.2	68.1	69.3
	6/F	64.2	70.5	71.4
	12/F	64.7	70.1	71.2
C2	1/F	55.9	65.2	65.7
	6/F	56.5	70.2	70.4
	12/F	58.3	69.6	69.9
C3	1/F	55.6	61.7	62.7
	6/F	57.4	68.7	69.0
	12/F	59.8	68.3	68.9
C4	1/F	54.6	63	63.6
	6/F	55.3	69.4	69.6
	12/F	57.5	68.5	68.8
C5	1/F	53.6	58.3	59.6
	6/F	54.3	66.3	66.6
	12/F	56.8	66.2	66.7
C6	1/F	53.7	63.2	63.7
	6/F	54.5	68.4	68.6
	12/F	56.6	67.5	67.8
9H	1/F	51.1	62.2	62.5
	6/F	52.3	67.1	67.2
	12/F	55.6	66.5	66.8
9I	1/F	49.5	65.1	65.2
	6/F	50.1	65.7	65.8
	12/F	52.9	64.7	65.0
10A	1/F	48.7	72.3	72.3
	10/F	48.7	69.8	69.8
	21/F	56.9	67.7	68.0
10A1	1/F	63	71.7	72.2
	10/F	64.2	71	71.8
	21/F	65.1	69.1	70.6

Table D4 Predicted Noise Levels - revised layout 5m cantilevered barrier along Road D1 ($L_{10,\text{ peak hour}}$ dB(A))

NSRs	Floor	Altered	New	TOTAL
10B	1/F	64.2	76	76.3
	10/F	65.5	73.7	74.3
	21/F	67.4	72.2	73.4
10C	1/F	64.5	76	76.3
	10/F	66.5	74	74.7
	21/F	69.5	72.6	74.3
10C1	1/F	65.4	71.9	72.8
	10/F	67.4	72.7	73.8
	21/F	70.5	71.7	74.2
10D	1/F	65.3	72.4	73.2
	10/F	67.9	72	73.4
	21/F	70.9	71.6	74.3
10D1	1/F	62.2	60.8	64.6
	10/F	67	64.9	69.1
	21/F	69.4	66.4	71.2
10D2	1/F	60	60.5	63.3
	10/F	63	64.4	66.8
	21/F	66.4	66.2	69.3
10D3	1/F	60.3	63	64.9
	10/F	63.4	65.3	67.5
	21/F	67	66.8	69.9
10G	1/F	61	66.3	67.4
	10/F	67.7	68	70.9
	21/F	70.2	68.7	72.5
10G1	1/F	58.6	64.4	65.4
	10/F	66.7	67	69.9
	21/F	69.4	67.3	71.5
10H	1/F	57.1	63.9	64.7
	10/F	66.3	68.1	70.3
	21/F	68.1	67.4	70.8
10I	1/F	54.1	62.3	62.9
	10/F	55.9	68	68.3
	21/F	59.4	66.6	67.4
10J	1/F	59.1	71.5	71.7
	10/F	60.4	68.7	69.3
	21/F	64	67.1	68.8
10J1	1/F	62.1	65.4	67.1
	10/F	63.4	66.8	68.4
	21/F	64.4	65	67.7

Table D4 Predicted Noise Levels - revised layout 5m cantilevered barrier along Road D1 ($L_{10,\ \text{peak hour}}$ dB(A))

NSRs	Floor	Altered	New	TOTAL
13A	1/F	54.3	65.7	66.0
	10/F	56.1	68.5	68.7
	21/F	63	66.9	68.4
13B	1/F	61.4	64.8	66.4
	10/F	62.9	68.3	69.4
	21/F	65.8	67.3	69.6
13C	1/F	62	64.9	66.7
	10/F	69.2	67.1	71.3
	21/F	71.2	68.4	73.0
13C1	1/F	53.8	50.2	55.4
	10/F	67.3	58.1	67.8
	21/F	69.3	63.9	70.4
13C2	1/F	54.5	47.3	55.3
	10/F	59.8	57.1	61.7
	21/F	63.7	64.1	66.9
13C3	1/F	55.5	49.4	56.5
	10/F	62.8	60.7	64.9
	21/F	67.4	65.7	69.6
13E	1/F	65	60.8	66.4
	10/F	68.7	67.2	71.0
	21/F	71.3	68	73.0
13E1	1/F	62.7	60.7	64.8
	10/F	67.4	65.1	69.4
	21/F	69.6	64.9	70.9
13F	1/F	60.2	59.1	62.7
	10/F	66.3	63.9	68.3
	21/F	67.8	63.5	69.2
13G	1/F	65.3	72.6	73.3
	10/F	68.4	70.7	72.7
	21/F	70.4	68.9	72.7
13H	1/F	66.1	71.2	72.4
	10/F	67.8	69.6	71.8
	21/F	68.5	67.8	71.2
13I	1/F	54.6	45.1	55.1
	10/F	60.2	52.2	60.8
	21/F	62.7	59.9	64.5
11A	1/F	66	68	70.1
	6/F	67.2	66.7	70.0
	12/F	67.9	65.7	69.9

Table D4 Predicted Noise Levels - revised layout 5m cantilevered barrier along Road D1 ($L_{10,\ peak\ hour}$ dB(A))

NSRs	Floor	Altered	New	TOTAL
11B	1/F	67	67.1	70.1
	6/F	67.4	67.3	70.4
	12/F	67.8	66.7	70.3
11C	1/F	67	67	70.0
	6/F	67.5	67.4	70.5
	12/F	68.2	66.4	70.4
11D	1/F	64.8	69.1	70.5
	6/F	65.5	68.7	70.4
	12/F	66.1	68.2	70.3
11D1	1/F	64.8	69.1	70.5
	6/F	65.5	68.7	70.4
	12/F	66.1	68.2	70.3
11G	1/F	53	68.4	68.5
	6/F	53.8	68.3	68.5
	12/F	56.9	67.9	68.2
11H	1/F	52.5	66.6	66.8
	6/F	53.3	66.6	66.8
	12/F	56.2	66.3	66.7

Annex E

Rail Noise Assessment

Maekawa Analysis of Barriers Noise Reduction

Sound barrier wall attenuations were calcuated with a modified version of the analytic expression provided by Kurze and Anderson⁽¹⁾, which closely fits the experimental results obtained by Maekawa⁽²⁾. The analytic expression developed by them which determines the excess attenuation of noise from a point source provided by thin barriers with no noise absorption applied is:

$$\Delta L_{barrier} = 5\ dB + 20\ \log \left\lfloor \frac{(2\pi N)^{1/2}}{\tanh\ (2\pi N)^{1/2}} \right\rfloor$$

where N, the Fresnel number, is defined as:

$$N = \frac{2}{\lambda}\ (P.L.D)$$

and where P.L.D is the Path Length Difference between the direct and diffracted sound paths. As the attenuation calculated by this equation is dependent on frequency, all calculations were made in 1/1 obtave bands (using the centre frequency of the band) and the A-weighted values were derived from these spectra.

It has been considered for this study the 12 car long train appears as a line source. The attenuation equation presented above must therefore be modified to correct for the difference (decrease) in attenuation between a point and a line source. By integrating a point source along a line, Beranek⁽³⁾ shows the difference in barrier attenuation between an infinite line source and a point source as a function of the maximum Fresnel Number (see Figure D1). This correction which is utilized in this model, is identified as the function, PL(N). By substracting the point to line source correction function from the above attenuation equation, the analytic expression are as follow:

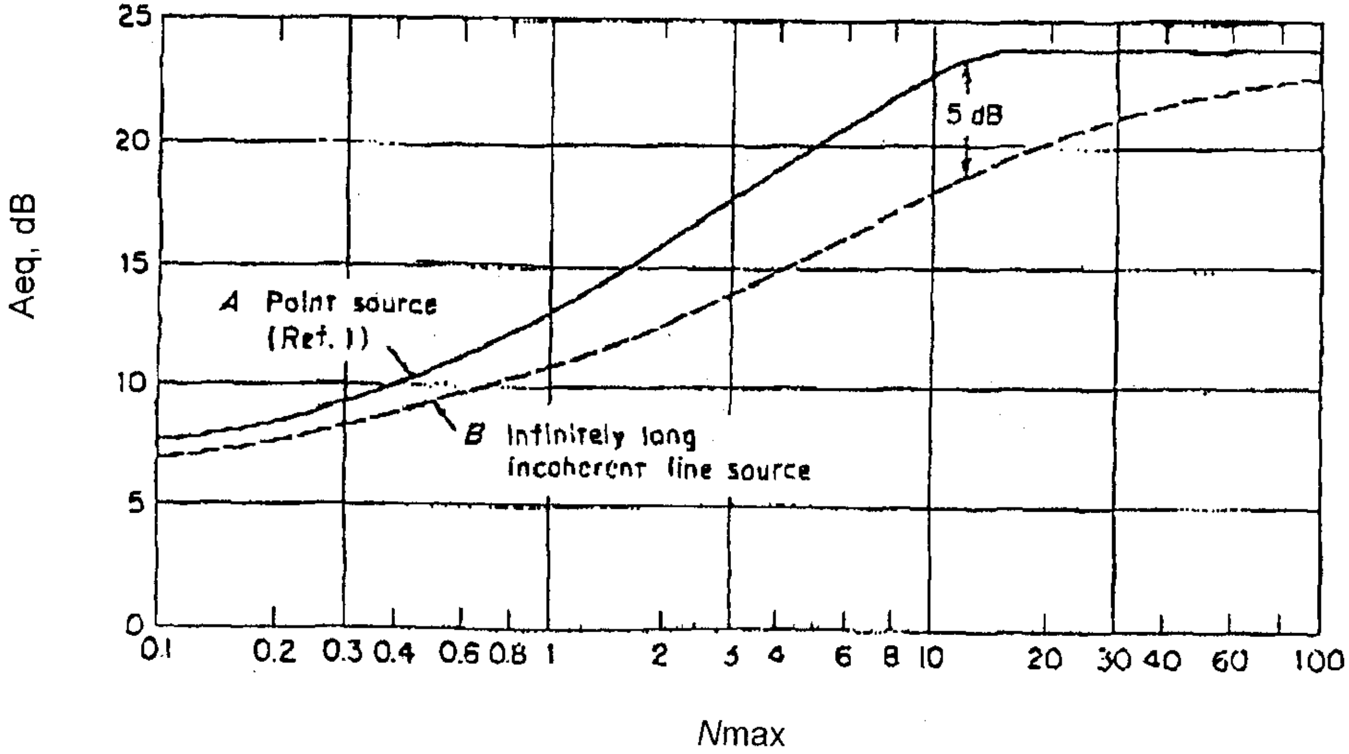
$$\Delta L_{barrier} = 5\ dB + 20\ \log \left\lfloor \frac{(2\pi N)^{1/2}}{\tanh\ (2\pi N)^{1/2}} \right\rfloor - PL(N)$$

The rolling stock noise emission data used for this assessment are based on the measurement data undertaken by Mott MacDonald in 1992 for KCRC. Both speed and distance corrections have been applied to the measurement data. The octave band spectrum of the locomotive is taken from Figure 15.4 of Transportation Noise Reference Book (see Figure D2) and the source noise levels used in this assessment are presented below:

Table D1 *Source Noise Levels*

Train	SEL (dB(A))	Lmax (dB(A))	Ref distance (m)	Train speed (kph)
Electric-Multiple Unit (EMUs)	90.5	84.9	25	105
Freight Train (FT)	95.6	93.2	25	60
PRC Passenger Train	93.2	81.3	25	60

⁽¹⁾ U.J. Kurze and G. S. Anderson, *Sound Attenuation by Barriers*, Applied Acoustics (4) (1971) pp. 35-53.
⁽²⁾ Z. Maekawa, *Noise Reduction by Screens*, Applied Acoustics (1) (1968) pp. 157-173.
⁽³⁾ L.L. Beranek, *Noise and Vibration Control*, McGraw-Hill (1971) pp. 391-393.



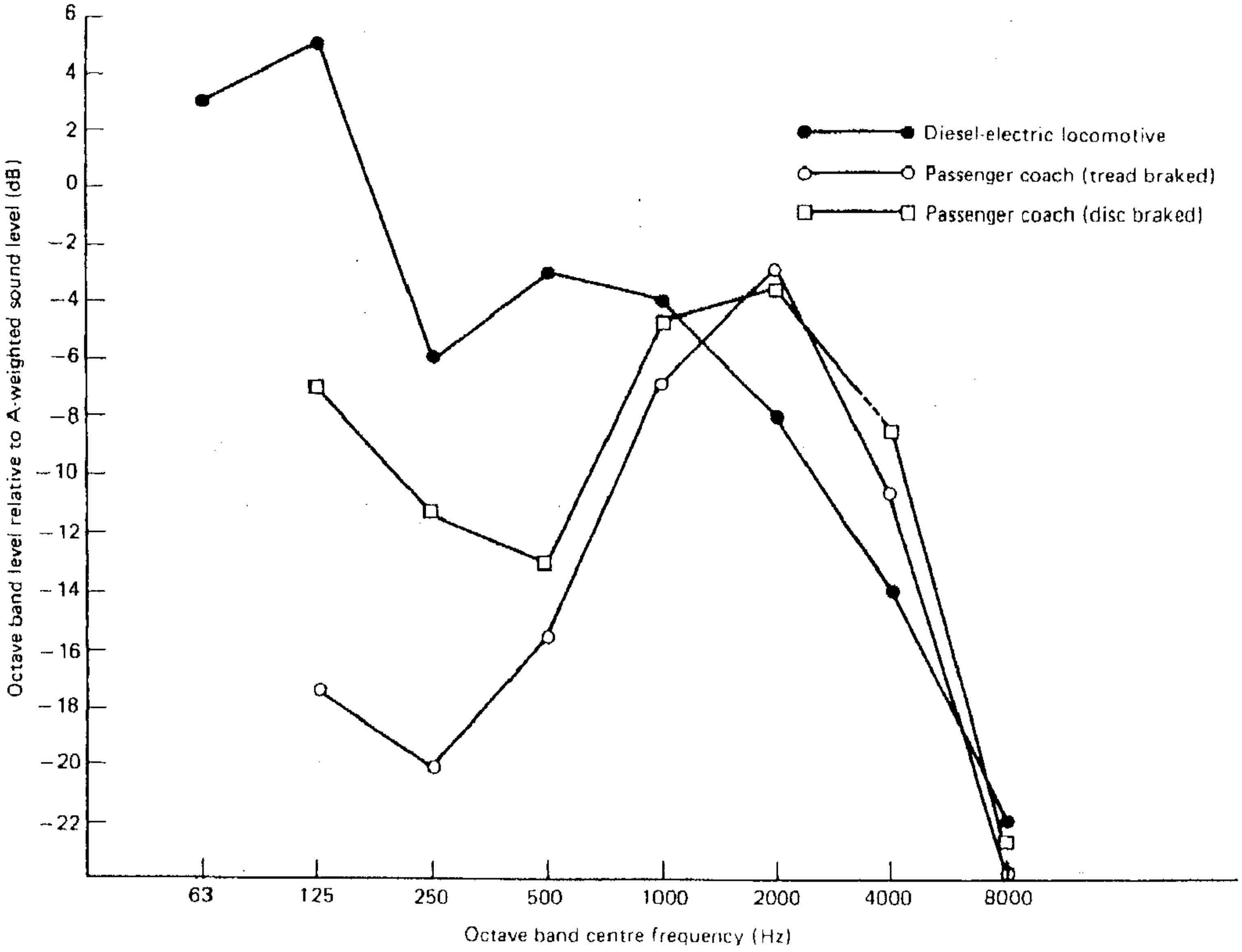
PL (N) CORRECTION

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE :
14/05/98

FIGURE NO.
E 1



TYPICAL OCTAVE BAND SPECTRUM

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

Maunsell

DATE : 14/05/98

FIGURE NO E2

NSR 10D	**Trains**	**Night-time $L_{eq, 30 min}$ dB(A)**	**Total $L_{eq, 30 min}$ dB(A)**	**Trains**	**Day time $L_{eq, 30 min}$ dB(A)**	**Total $L_{eq, 30 min}$ dB(A)**
1/F	EMU	43.4	***46.4***	EMU	44.1	***44.9***
	FT	42.4		PRC	36.9	
	PRC	36.9				
10/F	EMU	47.1	***49.7***	EMU	47.8	***48.4***
	FT	45.2		PRC	39.7	
	PRC	39.7				
20/F	EMU	48.7	***52.4***	EMU	49.4	***50.4***
	FT	48.9		PRC	43.4	
	PRC	43.4				

NSR 13E	**Trains**	**Night-time $L_{eq, 30 min}$ dB(A)**	**Total $L_{eq, 30 min}$ dB(A)**	**Trains**	**Day time $L_{eq, 30 min}$ dB(A)**	**Total $L_{eq, 30 min}$ dB(A)**
1/F	EMU	43.2	***46.4***	EMU	43.9	***44.7***
	FT	42.4		PRC	36.9	
	PRC	36.9				
10/F	EMU	46.8	***49.4***	EMU	47.5	***48.1***
	FT	44.9		PRC	39.4	
	PRC	39.4				
20/F	EMU	50.6	***53.1***	EMU	51.7	***52.2***
	FT	48.4		PRC	42.9	
	PRC	42.9				

N7A4	**Trains**	**Day time $L_{eq, 30 min}$ dB(A)**	**Total $L_{eq, 30 min}$ dB(A)**
1/F	EMU	66.7	***67.0***
	PRC	55.9	
3/F	EMU	66.7	***67.0***
	PRC	55.9	
6/F	EMU	66.7	***67.0***
	PRC	55.9	

N12C	**Trains**	**Day time $L_{eq, 30 min}$ dB(A)**	**Total $L_{eq, 30 min}$ dB(A)**
1/F	EMU	45	***45.8***
	PRC	37.9	
3/F	EMU	45.8	***46.5***
	PRC	38.3	
6/F	EMU	47.7	***48.4***
	PRC	39.8	

N8B	**Trains**	**Day time $L_{eq, 30 min}$ dB(A)**	**Total $L_{eq, 30 min}$ dB(A)**
1/F	EMU	70.5	***70.8***
	PRC	59.7	
3/F	EMU	70.4	***70.7***
	PRC	59.6	
6/F	EMU	70.1	***70.4***
	PRC	59.3	

	Time Period	Trains	SEL	Lmax	Train Frequency during any 30 minute period (Noisiest 30 min)	Leq, 30 min	Total Leq,
Scenario 1	2300 - 0700 hours	EMU	90.5	84.9	16	70.0	71.2
	following morning	FT	95.6	93.2	1	63.0	
		PRC	93.2	81.3	1	60.6	
Scenario 2	2300 - 0700 hours	EMU	90.5	84.9	13	69.1	71.2
	following morning	FT	95.6	93.2	2	66.1	
		PRC	93.2	81.3	1	60.6	
Scenario 3	2300 - 0700 hours	EMU	90.5	84.9	16	70.0	71.8
	following morning	FT	95.6	93.2	2	66.1	
		PRC	93.2	81.3	1	60.6	
Scenario 4	0700-2300	EMU	90.5	84.9	19	70.7	71.1
	0700-2300	FT	95.6	93.2	0	0.0	
	0700-2300	PRC	93.2	81.3	1	60.6	
Scenario 5	0700-2300	EMU	90.5	84.9	14	69.4	70.8
	0700-2300	FT	95.6	93.2	1	63.0	
	0700-2300	PRC	93.2	81.3	1	60.6	

KCRC EMU, disc braked

NSR 10D, 1st Floor

Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	70.0	70.0	70.0	70.0	70.0	70.0	70.0	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.0	59.0	57.0	65.0	66.0	62.0	48.0	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	46.9	50.4	53.8	65.0	67.2	63.0	47.0	**70.4**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	175.4	175.4	175.4	175.4	175.4	175.4	175.4	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	161.1	161.1	161.1	161.1	161.1	161.1	161.1	
Path difference, delta (m)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.1	10.3	20.5	41.1	82.2	
PL(N) (3)	2.5	3.5	4.0	4.0	3.5	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	22.6	26.6	30.1	
Corrected Noise Levels	26.9	28.4	29.3	37.4	36.1	27.9	8.4	**40.9**
Facaded corrected Noise Levels	29.4	30.9	31.8	39.9	38.6	30.4	10.9	**43.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

NSR 10D, 10th Floor

Frequency	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.0	70.0	70.0	70.0	70.0	70.0	70.0	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.0	59.0	57.0	65.0	66.0	62.0	48.0	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	46.9	50.4	53.8	65.0	67.2	63.0	47.0	**70.4**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	179.0	179.0	179.0	179.0	179.0	179.0	179.0	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	163.7	163.7	163.7	163.7	163.7	163.7	163.7	
Path difference, delta (m)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.2	2.4	4.9	9.8	19.5	39.0	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.3	11.3	13.9	15.4	18.4	21.4	26.4	
Corrected Noise Levels	29.0	30.5	31.4	41.1	40.3	33.1	12.1	**44.6**
Facaded corrected Noise Levels	31.5	33.0	33.9	43.6	42.8	35.6	14.6	**47.1**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

NSR 10D, 20th Floor

Frequency	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.0	70.0	70.0	70.0	70.0	70.0	70.0	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.0	59.0	57.0	65.0	66.0	62.0	48.0	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	46.9	50.4	53.8	65.0	67.2	63.0	47.0	**70.4**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	186.9	186.9	186.9	186.9	186.9	186.9	186.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	171.0	171.0	171.0	171.0	171.0	171.0	171.0	
Path difference, delta (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.3	0.7	1.3	2.7	5.3	10.7	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.3	7.3	9.7	12.2	13.2	15.8	18.8	
Corrected Noise Levels	32.9	34.3	35.3	44.0	45.2	38.5	19.5	**48.7**
Facaded corrected Noise Levels	35.4	36.8	37.8	46.5	47.7	41.0	22.0	**51.2**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains									
NSR 10D, 1st Floor									
								A-weighted levels	
Frequency (Hz)	125	250	500	1000	2000	4000	8000		
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1		
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0		
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1		
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0		
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	**65.8**	
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4		
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0		
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0		
Slant distance, d' (m)	175.4	175.4	175.4	175.4	175.4	175.4	175.4		
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*		
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0		
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0		
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1		
slope BR	161.1	161.1	161.1	161.1	161.1	161.1	161.1		
Path difference, delta (m)	1.7	1.7	1.7	1.7	1.7	1.7	1.7		
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0		
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0		
Fresnel no. N (2)	1.3	2.6	5.1	10.3	20.5	41.1	82.2		
PL(N) (3)	2.5	3.5	4.0	4.0	3.5	2.5	2.0		
Attenuation (dB)	11.6	13.6	16.1	19.1	22.6	26.6	30.1		
Corrected Noise Levels	35.0	29.5	33.4	34.5	28.2	18.0	4.5	**39.9**	
Facaded corrected Noise Levels	37.5	32.0	35.9	37.0	30.7	20.5	7.0	**42.4**	

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains								
NSR 10D, 10th Floor								
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	**65.8**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	179.0	179.0	179.0	179.0	179.0	179.0	179.0	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	163.7	163.7	163.7	163.7	163.7	163.7	163.7	
Path difference, delta (m)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.2	2.4	4.9	9.8	19.5	39.0	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.3	11.3	13.9	15.4	18.4	21.4	26.4	
Corrected Noise Levels	37.1	31.6	35.5	38.2	32.4	23.2	8.2	**42.7**
Facaded corrected Noise Levels	39.6	34.1	38.0	40.7	34.9	25.7	10.7	**45.2**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains								
NSR 10D, 20th Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	**65.8**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	186.9	186.9	186.9	186.9	186.9	186.9	186.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	171.0	171.0	171.0	171.0	171.0	171.0	171.0	
Path difference, delta (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.3	0.7	1.3	2.7	5.3	10.7	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.3	7.3	9.7	12.2	13.2	15.8	18.8	
Corrected Noise Levels	41.0	35.4	39.4	41.1	37.3	28.6	15.6	**46.4**
Facaded corrected Noise Levels	43.5	37.9	41.9	43.6	39.8	31.1	18.1	**48.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Trains								
NSR 10D, 1st Floor								
								A-weighted levels
Frequency (Hz)	125	250	500	1000	2000	4000	8000	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	175.4	175.4	175.4	175.4	175.4	175.4	175.4	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	161.1	161.1	161.1	161.1	161.1	161.1	161.1	
Path difference, delta (m)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.1	10.3	20.5	41.1	82.2	
PL(N) (3)	2.5	3.5	4.0	4.0	3.5	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	22.6	26.6	30.1	
Corrected Noise Levels	29.5	24.0	27.9	29.0	22.7	12.5	-1.0	**34.4**
Facaded corrected Noise Levels	32.0	26.5	30.4	31.5	25.2	15.0	1.5	**36.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Trains

NSR 10D, 10th Floor

								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	179.0	179.0	179.0	179.0	179.0	179.0	179.0	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	163.7	163.7	163.7	163.7	163.7	163.7	163.7	
Path difference, delta (m)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.2	2.4	4.9	9.8	19.5	39.0	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.3	11.3	13.9	15.4	18.4	21.4	26.4	
Corrected Noise Levels	31.6	26.1	30.0	32.7	26.9	17.7	2.7	**37.2**
Facaded corrected Noise Levels	34.1	28.6	32.5	35.2	29.4	20.2	5.2	**39.7**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Trains								
NSR 10D, 20th Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	186.9	186.9	186.9	186.9	186.9	186.9	186.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	171.0	171.0	171.0	171.0	171.0	171.0	171.0	
Path difference, delta (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.3	0.7	1.3	2.7	5.3	10.7	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.3	7.3	9.7	12.2	13.2	15.8	18.8	
Corrected Noise Levels	35.5	29.9	33.9	35.6	31.8	23.1	10.1	**40.9**
Facaded corrected Noise Levels	38.0	32.4	36.4	38.1	34.3	25.6	12.6	**43.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked **NSR 10D, 1st Floor**								
Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	175.4	175.4	175.4	175.4	175.4	175.4	175.4	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	161.1	161.1	161.1	161.1	161.1	161.1	161.1	
Path difference, delta (m)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.1	10.3	20.5	41.1	82.2	
PL(N) (3)	2.5	3.5	4.0	4.0	3.5	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	22.6	26.6	30.1	
Corrected Noise Levels	27.6	29.1	30.0	38.1	36.8	28.6	9.1	**41.6**
Facaded corrected Noise Levels	30.1	31.6	32.5	40.6	39.3	31.1	11.6	**44.1**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked								
NSR 10D, 10th Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	179.0	179.0	179.0	179.0	179.0	179.0	179.0	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	163.7	163.7	163.7	163.7	163.7	163.7	163.7	
Path difference, delta (m)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.2	2.4	4.9	9.8	19.5	39.0	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.3	11.3	13.9	15.4	18.4	21.4	26.4	
Corrected Noise Levels	29.7	31.2	32.1	41.8	41.0	33.8	12.8	**45.3**
Facaded corrected Noise Levels	32.2	33.7	34.6	44.3	43.5	36.3	15.3	**47.8**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked **NSR 10D, 20th Floor**								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	186.9	186.9	186.9	186.9	186.9	186.9	186.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	171.0	171.0	171.0	171.0	171.0	171.0	171.0	
Path difference, delta (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.3	0.7	1.3	2.7	5.3	10.7	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.3	7.3	9.7	12.2	13.2	15.8	18.8	
Corrected Noise Levels	33.6	35.0	36.0	44.7	45.9	39.2	20.2	**49.4**
Facaded corrected Noise Levels	36.1	37.5	38.5	47.2	48.4	41.7	22.7	**51.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Trains

NSR 10D, 1st Floor

Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	175.4	175.4	175.4	175.4	175.4	175.4	175.4	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	161.1	161.1	161.1	161.1	161.1	161.1	161.1	
Path difference, delta (m)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.1	10.3	20.5	41.1	82.2	
PL(N) (3)	2.5	3.5	4.0	4.0	3.5	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	22.6	26.6	30.1	
Corrected Noise Levels	29.5	24.0	27.9	29.0	22.7	12.5	-1.0	**34.4**
Facaded corrected Noise Levels	32.0	26.5	30.4	31.5	25.2	15.0	1.5	**36.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Trains								
NSR 10D, 10th Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	179.0	179.0	179.0	179.0	179.0	179.0	179.0	
distance correction (dB)	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	*8.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	163.7	163.7	163.7	163.7	163.7	163.7	163.7	
Path difference, delta (m)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.2	2.4	4.9	9.8	19.5	39.0	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.3	11.3	13.9	15.4	18.4	21.4	26.4	
Corrected Noise Levels	31.6	26.1	30.0	32.7	26.9	17.7	2.7	**37.2**
Facaded corrected Noise Levels	34.1	28.6	32.5	35.2	29.4	20.2	5.2	**39.7**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Trains

NSR 10D, 20th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	175.0	175.0	175.0	175.0	175.0	175.0	175.0	
Slant distance, d' (m)	186.9	186.9	186.9	186.9	186.9	186.9	186.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	161.0	161.0	161.0	161.0	161.0	161.0	161.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	171.0	171.0	171.0	171.0	171.0	171.0	171.0	
Path difference, delta (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.3	0.7	1.3	2.7	5.3	10.7	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.3	7.3	9.7	12.2	13.2	15.8	18.8	
Corrected Noise Levels	35.5	29.9	33.9	35.6	31.8	23.1	10.1	**40.9**
Facaded corrected Noise Levels	38.0	32.4	36.4	38.1	34.3	25.6	12.6	**43.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

NSR 13E, 1st Floor

Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	70.0	70.0	70.0	70.0	70.0	70.0	70.0	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.0	59.0	57.0	65.0	66.0	62.0	48.0	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	46.9	50.4	53.8	65.0	67.2	63.0	47.0	**70.4**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	180.4	180.4	180.4	180.4	180.4	180.4	180.4	
distance correction (dB)	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	166.1	166.1	166.1	166.1	166.1	166.1	166.1	
Path difference, delta (m)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.2	10.3	20.7	41.3	82.6	
PL(N) (3)	2.5	3.5	4.0	4.0	3.5	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	22.6	26.6	30.2	
Corrected Noise Levels	26.7	28.2	29.1	37.3	36.0	27.8	8.3	**40.7**
Facaded corrected Noise Levels	29.2	30.7	31.6	39.8	38.5	30.3	10.8	**43.2**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked								
NSR 13E, 10th Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	70.0	70.0	70.0	70.0	70.0	70.0	70.0	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.0	59.0	57.0	65.0	66.0	62.0	48.0	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	46.9	50.4	53.8	65.0	67.2	63.0	47.0	**70.4**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	183.9	183.9	183.9	183.9	183.9	183.9	183.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	168.6	168.6	168.6	168.6	168.6	168.6	168.6	
Path difference, delta (m)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.3	2.5	5.0	10.1	20.2	40.4	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.5	11.5	14.0	15.5	18.5	21.5	26.5	
Corrected Noise Levels	28.8	30.2	31.1	40.8	40.0	32.8	11.8	**44.3**
Facaded corrected Noise Levels	31.3	32.7	33.6	43.3	42.5	35.3	14.3	**46.8**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

NSR 13E, 20th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.0	70.0	70.0	70.0	70.0	70.0	70.0	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.0	59.0	57.0	65.0	66.0	62.0	48.0	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	46.9	50.4	53.8	65.0	67.2	63.0	47.0	**70.4**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	191.6	191.6	191.6	191.6	191.6	191.6	191.6	
distance correction (dB)	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	175.7	175.7	175.7	175.7	175.7	175.7	175.7	
Path difference, delta (m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.4	0.7	1.5	3.0	5.9	11.9	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.5	7.8	10.2	12.7	13.7	16.2	19.2	
Corrected Noise Levels	32.5	33.8	34.8	43.5	44.6	37.9	18.9	**48.1**
Facaded corrected Noise Levels	35.0	36.3	37.3	46.0	47.1	40.4	21.4	**50.6**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains								
NSR 13E, 1st Floor								
Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	**65.8**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	180.4	180.4	180.4	180.4	180.4	180.4	180.4	
distance correction (dB)	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	166.1	166.1	166.1	166.1	166.1	166.1	166.1	
Path difference, delta (m)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.2	10.3	20.7	41.3	82.6	
PL(N) (3)	2.5	3.5	4.0	4.0	5.0	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	21.1	26.6	30.2	
Corrected Noise Levels	34.8	29.3	33.2	34.4	29.6	17.9	4.4	**39.9**
Facaded corrected Noise Levels	37.3	31.8	35.7	36.9	32.1	20.4	6.9	**42.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains								
NSR 13E, 10th Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	**65.8**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	183.9	183.9	183.9	183.9	183.9	183.9	183.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	168.6	168.6	168.6	168.6	168.6	168.6	168.6	
Path difference, delta (m)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.3	2.5	5.0	10.1	20.2	40.4	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.5	11.5	14.0	15.5	18.5	21.5	26.5	
Corrected Noise Levels	36.9	31.3	35.2	37.9	32.1	22.9	7.9	**42.4**
Facaded corrected Noise Levels	39.4	33.8	37.7	40.4	34.6	25.4	10.4	**44.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains

NSR 13E, 20th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1	**65.8**
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	191.6	191.6	191.6	191.6	191.6	191.6	191.6	
distance correction (dB)	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	175.7	175.7	175.7	175.7	175.7	175.7	175.7	
Path difference, delta (m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.4	0.7	1.5	3.0	5.9	11.9	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.5	7.8	10.2	12.7	13.7	16.2	19.2	
Corrected Noise Levels	40.6	34.9	38.9	40.6	36.7	28.0	15.0	**45.9**
Facaded corrected Noise Levels	43.1	37.4	41.4	43.1	39.2	30.5	17.5	**48.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains

NSR 13E, 1st Floor

Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	180.4	180.4	180.4	180.4	180.4	180.4	180.4	
distance correction (dB)	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	166.1	166.1	166.1	166.1	166.1	166.1	166.1	
Path difference, delta (m)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.2	10.3	20.7	41.3	82.6	
PL(N) (3)	2.5	3.5	4.0	4.0	5.0	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	21.1	26.6	30.2	
Corrected Noise Levels	29.3	23.8	27.7	28.9	24.1	12.4	-1.1	**34.4**
Facaded corrected Noise Levels	31.8	26.3	30.2	31.4	26.6	14.9	1.4	**36.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains

NSR 13E, 10th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	183.9	183.9	183.9	183.9	183.9	183.9	183.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	168.6	168.6	168.6	168.6	168.6	168.6	168.6	
Path difference, delta (m)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.3	2.5	5.0	10.1	20.2	40.4	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.5	11.5	14.0	15.5	18.5	21.5	26.5	
Corrected Noise Levels	31.4	25.8	29.7	32.4	26.6	17.4	2.4	**36.9**
Facaded corrected Noise Levels	33.9	28.3	32.2	34.9	29.1	19.9	4.9	**39.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains

NSR 13E, 20th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	191.6	191.6	191.6	191.6	191.6	191.6	191.6	
distance correction (dB)	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	175.7	175.7	175.7	175.7	175.7	175.7	175.7	
Path difference, delta (m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.4	0.7	1.5	3.0	5.9	11.9	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.5	7.8	10.2	12.7	13.7	16.2	19.2	
Corrected Noise Levels	35.1	29.4	33.4	35.1	31.2	22.5	9.5	**40.4**
Facaded corrected Noise Levels	37.6	31.9	35.9	37.6	33.7	25.0	12.0	**42.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains								
NSR 13E, 1st Floor								
Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	**65.8**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	180.2	180.2	180.2	180.2	180.2	180.2	180.2	
distance correction (dB)	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope·SB	14.6	14.6	14.6	14.6	14.6	14.6	14.6	
slope BR	166.1	166.1	166.1	166.1	166.1	166.1	166.1	
Path difference, delta (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.1	0.3	0.6	1.1	2.3	4.5	9.0	
PL(N) (3)	2.5	3.5	4.0	4.0	5.0	2.5	2.0	
Attenuation (dB)	3.5	4.2	6.5	9.5	11.5	17.0	20.5	
Corrected Noise Levels	43.0	38.7	42.8	44.0	39.2	27.5	14.0	**49.1**
Facaded corrected Noise Levels	45.5	41.2	45.3	46.5	41.7	30.0	16.5	**51.6**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains **NSR 13E, 10th Floor**								**A-weighted levels**
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	**65.8**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	183.1	183.1	183.1	183.1	183.1	183.1	183.1	
distance correction (dB)	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	14.6	14.6	14.6	14.6	14.6	14.6	14.6	
slope BR	168.6	168.6	168.6	168.6	168.6	168.6	168.6	
Path difference, delta (m)	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	-0.5	-1.0	-2.1	-4.2	-8.3	-16.6	-33.3	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	46.4	42.9	49.3	53.5	50.7	44.5	34.5	**57.1**
Facaded corrected Noise Levels	48.9	45.4	51.8	56.0	53.2	47.0	37.0	**59.6**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC Freight Trains **NSR 13E, 20th Floor**								
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	66.1	66.1	66.1	66.1	66.1	66.1	66.1	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	71.1	60.1	61.1	62.1	58.1	52.1	44.1	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	55.0	51.5	57.9	62.1	59.3	53.1	43.1	**65.8**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	190.2	190.2	190.2	190.2	190.2	190.2	190.2	
distance correction (dB)	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	14.6	14.6	14.6	14.6	14.6	14.6	14.6	
slope BR	175.7	175.7	175.7	175.7	175.7	175.7	175.7	
Path difference, delta (m)	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	-1.0	-1.9	-3.9	-7.7	-15.4	-30.9	-61.7	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	46.2	42.7	49.1	53.3	50.5	44.3	34.3	**57.0**
Facaded corrected Noise Levels	48.7	45.2	51.6	55.8	53.0	46.8	36.8	**59.5**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

NSR 13E - EMU (day)

KCRC EMU, disc braked								
NSR 13E, 1st Floor								
								A-weighted levels
Frequency (Hz)	125	250	500	1000	2000	4000	8000	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	180.4	180.4	180.4	180.4	180.4	180.4	180.4	
distance correction (dB)	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	166.1	166.1	166.1	166.1	166.1	166.1	166.1	
Path difference, delta (m)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.2	10.3	20.7	41.3	82.6	
PL(N) (3)	2.5	3.5	4.0	4.0	3.5	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	22.6	26.6	30.2	
Corrected Noise Levels	27.4	28.9	29.8	38.0	36.7	28.5	9.0	**41.4**
Facaded corrected Noise Levels	29.9	31.4	32.3	40.5	39.2	31.0	11.5	**43.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

NSR 13E, 10th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	183.9	183.9	183.9	183.9	183.9	183.9	183.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	168.6	168.6	168.6	168.6	168.6	168.6	168.6	
Path difference, delta (m)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.3	2.5	5.0	10.1	20.2	40.4	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.5	11.5	14.0	15.5	18.5	21.5	26.5	
Corrected Noise Levels	29.5	30.9	31.8	41.5	40.7	33.5	12.5	**45.0**
Facaded corrected Noise Levels	32.0	33.4	34.3	44.0	43.2	36.0	15.0	**47.5**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

NSR 13E, 20th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	191.6	191.6	191.6	191.6	191.6	191.6	191.6	
distance correction (dB)	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	175.7	175.7	175.7	175.7	175.7	175.7	175.7	
Path difference, delta (m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.4	0.7	1.5	3.0	5.9	11.9	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.5	7.8	10.2	12.7	13.7	16.2	19.2	
Corrected Noise Levels	33.2	34.5	35.5	44.2	45.3	38.6	19.6	**48.8**
Facaded corrected Noise Levels	35.7	37.0	38.0	46.7	47.8	41.1	22.1	**51.7**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains
NSR 13E, 1st Floor

Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	180.4	180.4	180.4	180.4	180.4	180.4	180.4	
distance correction (dB)	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	166.1	166.1	166.1	166.1	166.1	166.1	166.1	
Path difference, delta (m)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.3	2.6	5.2	10.3	20.7	41.3	82.6	
PL(N) (3)	2.5	3.5	4.0	4.0	5.0	2.5	2.0	
Attenuation (dB)	11.6	13.6	16.1	19.1	21.1	26.6	30.2	
Corrected Noise Levels	29.3	23.8	27.7	28.9	24.1	12.4	-1.1	**34.4**
Facaded corrected Noise Levels	31.8	26.3	30.2	31.4	26.6	14.9	1.4	**36.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
NSR 13E, 10th Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	37.6	37.6	37.6	37.6	37.6	37.6	37.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	183.9	183.9	183.9	183.9	183.9	183.9	183.9	
distance correction (dB)	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	*8.7*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	168.6	168.6	168.6	168.6	168.6	168.6	168.6	
Path difference, delta (m)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.6	1.3	2.5	5.0	10.1	20.2	40.4	
PL(N) (3)	1.5	2.5	3.0	4.5	4.5	4.5	2.5	
Attenuation (dB)	9.5	11.5	14.0	15.5	18.5	21.5	26.5	
Corrected Noise Levels	31.4	25.8	29.7	32.4	26.6	17.4	2.4	**36.9**
Facaded corrected Noise Levels	33.9	28.3	32.2	34.9	29.1	19.9	4.9	**39.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
NSR 13E, 20th Floor								
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	65.6	65.6	65.6	65.6	65.6	65.6	65.6	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	180.0	180.0	180.0	180.0	180.0	180.0	180.0	
Slant distance, d' (m)	191.6	191.6	191.6	191.6	191.6	191.6	191.6	
distance correction (dB)	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	*8.8*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	166.0	166.0	166.0	166.0	166.0	166.0	166.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	175.7	175.7	175.7	175.7	175.7	175.7	175.7	
Path difference, delta (m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.2	0.4	0.7	1.5	3.0	5.9	11.9	
PL(N) (3)	1.0	1.0	1.5	2.0	4.0	4.5	4.5	
Attenuation (dB)	5.5	7.8	10.2	12.7	13.7	16.2	19.2	
Corrected Noise Levels	35.1	29.4	33.4	35.1	31.2	22.5	9.5	**40.4**
Facaded corrected Noise Levels	37.6	31.9	35.9	37.6	33.7	25.0	12.0	**42.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked								
Secondary School, 1st Floor								
Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
Slant distance, d' (m)	120.2	120.2	120.2	120.2	120.2	120.2	120.2	
distance correction (dB)	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	120.2	120.2	120.2	120.2	120.2	120.2	120.2	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	40.8	44.3	47.7	58.9	61.1	56.9	40.9	**64.2**
Facaded corrected Noise Levels	43.3	46.8	50.2	61.4	63.6	59.4	43.4	**66.7**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

Secondary School, 3rd Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
Slant distance, d' (m)	120.7	120.7	120.7	120.7	120.7	120.7	120.7	
distance correction (dB)	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	120.7	120.7	120.7	120.7	120.7	120.7	120.7	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	40.8	44.3	47.7	58.9	61.1	56.9	40.9	**64.2**
Facaded corrected Noise Levels	43.3	46.8	50.2	61.4	63.6	59.4	43.4	**66.7**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked								
Secondary School, 6th Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
Slant distance, d' (m)	122.3	122.3	122.3	122.3	122.3	122.3	122.3	
distance correction (dB)	*6.9*	*6.9*	*6.9*	*6.9*	*6.9*	*6.9*	*6.9*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	122.3	122.3	122.3	122.3	122.3	122.3	122.3	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	40.7	44.2	47.6	58.8	61.0	56.8	40.8	**64.2**
Facaded corrected Noise Levels	43.2	46.7	50.1	61.3	63.5	59.3	43.3	**66.7**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
Secondary school, 1st Floor								
Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
Slant distance, d' (m)	120.2	120.2	120.2	120.2	120.2	120.2	120.2	
distance correction (dB)	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	120.2	120.2	120.2	120.2	120.2	120.2	120.2	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	42.7	39.2	45.6	49.8	47.0	40.8	30.8	**53.4**
Facaded corrected Noise Levels	45.2	41.7	48.1	52.3	49.5	43.3	33.3	**55.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
Secondary School, 3rd Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
Slant distance, d' (m)	120.7	120.7	120.7	120.7	120.7	120.7	120.7	
distance correction (dB)	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	*6.8*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	120.7	120.7	120.7	120.7	120.7	120.7	120.7	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	42.7	39.2	45.6	49.8	47.0	40.8	30.8	**53.4**
Facaded corrected Noise Levels	45.2	41.7	48.1	52.3	49.5	43.3	33.3	**55.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains

Secondary School, 6th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
Slant distance, d' (m)	122.3	122.3	122.3	122.3	122.3	122.3	122.3	
distance correction (dB)	*6.9*	*6.9*	*6.9*	*6.9*	*6.9*	*6.9*	*6.9*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	122.3	122.3	122.3	122.3	122.3	122.3	122.3	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	42.6	39.1	45.5	49.7	46.9	40.7	30.7	**53.4**
Facaded corrected Noise Levels	45.1	41.6	48.0	52.2	49.4	43.2	33.2	**55.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked								
Primary School, 1st Floor								
								A-weighted levels
Frequency (Hz)	125	250	500	1000	2000	4000	8000	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	140.0	140.0	140.0	140.0	140.0	140.0	140.0	
Slant distance, d' (m)	140.1	140.1	140.1	140.1	140.1	140.1	140.1	
distance correction (dB)	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	126.0	126.0	126.0	126.0	126.0	126.0	126.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	126.0	126.0	126.0	126.0	126.0	126.0	126.0	
Path difference, delta (m)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.5	2.9	5.9	11.8	23.5	47.1	94.1	
PL(N) (3)	3.0	4.0	4.5	5.0	3.5	2.0	1.0	
Attenuation (dB)	11.7	13.7	16.2	18.7	23.2	27.7	31.7	
Corrected Noise Levels	28.5	29.9	30.8	39.5	37.2	28.5	8.5	**42.5**
Facaded corrected Noise Levels	31.0	32.4	33.3	42.0	39.7	31.0	11.0	**45.0**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked								
Primary School, 3rd Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	140.0	140.0	140.0	140.0	140.0	140.0	140.0	
Slant distance, d' (m)	140.6	140.6	140.6	140.6	140.6	140.6	140.6	
distance correction (dB)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	126.0	126.0	126.0	126.0	126.0	126.0	126.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	126.1	126.1	126.1	126.1	126.1	126.1	126.1	
Path difference, delta (m)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.2	2.4	4.8	9.5	19.1	38.2	76.3	
PL(N) (3)	2.0	3.0	4.5	4.5	4.0	2.5	1.5	
Attenuation (dB)	11.7	13.8	15.3	18.3	21.8	26.3	30.3	
Corrected Noise Levels	28.4	29.8	31.7	39.9	38.6	29.9	9.9	**43.3**
Facaded corrected Noise Levels	30.9	32.3	34.2	42.4	41.1	32.4	12.4	**45.8**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked **Primary School, 6th Floor**								**A-weighted levels**
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	140.0	140.0	140.0	140.0	140.0	140.0	140.0	
Slant distance, d' (m)	142.0	142.0	142.0	142.0	142.0	142.0	142.0	
distance correction (dB)	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	126.0	126.0	126.0	126.0	126.0	126.0	126.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	126.9	126.9	126.9	126.9	126.9	126.9	126.9	
Path difference, delta (m)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.8	1.6	3.3	6.6	13.1	26.3	52.5	
PL(N) (3)	2.0	3.0	4.0	4.5	5.0	3.5	2.0	
Attenuation (dB)	10.1	12.1	14.1	16.7	19.2	23.7	28.2	
Corrected Noise Levels	29.9	31.4	32.8	41.5	41.2	32.5	12.0	**45.2**
Facaded corrected Noise Levels	32.4	33.9	35.3	44.0	43.7	35.0	14.5	**47.7**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
Primary School, 1st Floor								
Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	140.0	140.0	140.0	140.0	140.0	140.0	140.0	
Slant distance, d' (m)	140.1	140.1	140.1	140.1	140.1	140.1	140.1	
distance correction (dB)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	126.0	126.0	126.0	126.0	126.0	126.0	126.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	126.0	126.0	126.0	126.0	126.0	126.0	126.0	
Path difference, delta (m)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.5	2.9	5.9	11.8	23.5	47.1	94.1	
PL(N) (3)	3.0	4.0	4.5	5.0	3.5	2.0	1.0	
Attenuation (dB)	11.7	13.7	16.2	18.7	23.2	27.7	31.7	
Corrected Noise Levels	30.4	24.8	28.7	30.4	23.1	12.4	-1.6	**35.4**
Facaded corrected Noise Levels	32.9	27.3	31.2	32.9	25.6	14.9	0.9	**37.9**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
Primary School, 3rd Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	140.0	140.0	140.0	140.0	140.0	140.0	140.0	
Slant distance, d' (m)	140.6	140.6	140.6	140.6	140.6	140.6	140.6	
distance correction (dB)	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	126.0	126.0	126.0	126.0	126.0	126.0	126.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	126.1	126.1	126.1	126.1	126.1	126.1	126.1	
Path difference, delta (m)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.2	2.4	4.8	9.5	19.1	38.2	76.3	
PL(N) (3)	2.0	3.0	4.5	4.5	4.0	2.5	1.5	
Attenuation (dB)	11.7	13.8	15.3	18.3	21.8	26.3	30.3	
Corrected Noise Levels	30.3	24.7	29.6	30.8	24.5	13.8	-0.2	**35.8**
Facaded corrected Noise Levels	32.8	27.2	32.1	33.3	27.0	16.3	2.3	**38.3**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
Primary School, 6th Floor								
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Shortest horizontal distance, d (m)	140.0	140.0	140.0	140.0	140.0	140.0	140.0	
Slant distance, d' (m)	142.0	142.0	142.0	142.0	142.0	142.0	142.0	
distance correction (dB)	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	
Source to Barrier distance, SB (m)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
Barrier to Receiver distance, BR (m)	126.0	126.0	126.0	126.0	126.0	126.0	126.0	
slope SB	16.1	16.1	16.1	16.1	16.1	16.1	16.1	
slope BR	126.9	126.9	126.9	126.9	126.9	126.9	126.9	
Path difference, delta (m)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.8	1.6	3.3	6.6	13.1	26.3	52.5	
PL(N) (3)	2.0	3.0	4.0	4.5	5.0	3.5	2.0	
Attenuation (dB)	10.1	12.1	14.1	16.7	19.2	23.7	28.2	
Corrected Noise Levels	31.8	26.3	30.7	32.4	27.1	16.4	1.9	**37.3**
Facaded corrected Noise Levels	34.3	28.8	33.2	34.9	29.6	18.9	4.4	**39.8**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

Tertiary Education Institution, 1st Floor

Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	50.4	50.4	50.4	50.4	50.4	50.4	50.4	
distance correction (dB)	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	50.4	50.4	50.4	50.4	50.4	50.4	50.4	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	44.6	48.1	51.5	62.7	64.9	60.7	44.7	**68.0**
Facaded corrected Noise Levels	47.1	50.6	54.0	65.2	67.4	63.2	47.2	**70.5**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

Tertiary Education Institution, 3rd Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	51.7	51.7	51.7	51.7	51.7	51.7	51.7	
distance correction (dB)	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	51.7	51.7	51.7	51.7	51.7	51.7	51.7	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	44.4	47.9	51.3	62.5	64.7	60.5	44.5	**67.9**
Facaded corrected Noise Levels	46.9	50.4	53.8	65.0	67.2	63.0	47.0	**70.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked **Tertiary Education Institution, 6th Floor**								
							A-weighted levels	
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	55.2	55.2	55.2	55.2	55.2	55.2	55.2	
distance correction (dB)	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	55.2	55.2	55.2	55.2	55.2	55.2	55.2	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	44.2	47.7	51.1	62.3	64.5	60.3	44.3	**67.6**
Facaded corrected Noise Levels	46.7	50.2	53.6	64.8	67.0	62.8	46.8	**70.1**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
Tertiary Education Institution, 1st Floor								
Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	50.4	50.4	50.4	50.4	50.4	50.4	50.4	
distance correction (dB)	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	50.4	50.4	50.4	50.4	50.4	50.4	50.4	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	46.5	43.0	49.4	53.6	50.8	44.6	34.6	**57.2**
Facaded corrected Noise Levels	49.0	45.5	51.9	56.1	53.3	47.1	37.1	**59.7**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains								
Tertiary Education Institution, 3rd Floor								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	51.7	51.7	51.7	51.7	51.7	51.7	51.7	
distance correction (dB)	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	51.7	51.7	51.7	51.7	51.7	51.7	51.7	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	46.3	42.8	49.2	53.4	50.6	44.4	34.4	**57.1**
Facaded corrected Noise Levels	48.8	45.3	51.7	55.9	53.1	46.9	36.9	**59.6**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains **Tertiary Education Institution, 6th Floor**								
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	55.2	55.2	55.2	55.2	55.2	55.2	55.2	
distance correction (dB)	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	
Source to Barrier distance, SB (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier to Receiver distance, BR (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
slope SB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
slope BR	55.2	55.2	55.2	55.2	55.2	55.2	55.2	
Path difference, delta (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PL(N) (3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Attenuation (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Corrected Noise Levels	46.1	42.6	49.0	53.2	50.4	44.2	34.2	**56.8**
Facaded corrected Noise Levels	48.6	45.1	51.5	55.7	52.9	46.7	36.7	**59.3**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked								
Tertiary Education Institution, 1st Floor								**A-weighted levels**
Frequency (Hz)	125	250	500	1000	2000	4000	8000	
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	50.4	50.4	50.4	50.4	50.4	50.4	50.4	
distance correction (dB)	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	
Source to Barrier distance, SB (m)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	
Barrier to Receiver distance, BR (m)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
slope SB	35.1	35.1	35.1	35.1	35.1	35.1	35.1	
slope BR	15.3	15.3	15.3	15.3	15.3	15.3	15.3	
Path difference, delta (m)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.1	0.1	0.2	0.5	1.0	2.0	3.9	
PL(N) (3)	1.0	1.0	1.0	1.5	2.5	3.5	4.0	
Attenuation (dB)	4.2	4.8	6.3	8.4	10.4	12.4	14.9	
Corrected Noise Levels	40.4	43.3	45.2	54.3	54.5	48.3	29.8	**58.3**
Facaded corrected Noise Levels	42.9	45.8	47.7	56.8	57.0	50.8	32.3	**60.8**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

Tertiary Education Institution, 3rd Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	51.7	51.7	51.7	51.7	51.7	51.7	51.7	
distance correction (dB)	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	
Source to Barrier distance, SB (m)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	
Barrier to Receiver distance, BR (m)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
slope SB	35.1	35.1	35.1	35.1	35.1	35.1	35.1	
slope BR	18.0	18.0	18.0	18.0	18.0	18.0	18.0	
Path difference, delta (m)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.1	2.2	4.4	8.8	17.6	35.1	70.3	
PL(N) (3)	2.5	3.5	4.0	4.5	4.0	2.5	1.5	
Attenuation (dB)	10.9	12.9	15.4	17.9	21.4	25.9	30.0	
Corrected Noise Levels	33.6	35.0	35.9	44.6	43.3	34.6	14.6	**48.0**
Facaded corrected Noise Levels	36.1	37.5	38.4	47.1	45.8	37.1	17.1	**50.5**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC EMU, disc braked

Tertiary Education Institution, 6th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	70.7	70.7	70.7	70.7	70.7	70.7	70.7	
Octave band corrections (1)	-7.0	-11.0	-13.0	-5.0	-4.0	-8.0	-22.0	
Octave band levels (dB (A))	63.7	59.7	57.7	65.7	66.7	62.7	48.7	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	47.6	51.1	54.5	65.7	67.9	63.7	47.7	**71.1**
Receiver height, Z_r (m)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	55.2	55.2	55.2	55.2	55.2	55.2	55.2	
distance correction (dB)	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	
Source to Barrier distance, SB (m)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	
Barrier to Receiver distance, BR (m)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
slope SB	35.1	35.1	35.1	35.1	35.1	35.1	35.1	
slope BR	25.4	25.4	25.4	25.4	25.4	25.4	25.4	
Path difference, delta (m)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	3.9	7.8	15.5	31.1	62.2	124.3	248.6	
PL(N) (3)	4.0	4.5	4.5	2.5	1.5	1.5	1.5	
Attenuation (dB)	14.9	17.4	20.4	25.4	29.4	32.4	35.4	
Corrected Noise Levels	29.3	30.3	30.7	36.9	35.0	27.8	8.8	**40.7**
Facaded corrected Noise Levels	31.8	32.8	33.2	39.4	37.5	30.3	11.3	**43.2**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains

Tertiary Education Institution, 1st Floor

Frequency (Hz)	125	250	500	1000	2000	4000	8000	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	50.4	50.4	50.4	50.4	50.4	50.4	50.4	
distance correction (dB)	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	
Source to Barrier distance, SB (m)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	
Barrier to Receiver distance, BR (m)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
slope SB	35.1	35.1	35.1	35.1	35.1	35.1	35.1	
slope BR	15.3	15.3	15.3	15.3	15.3	15.3	15.3	
Path difference, delta (m)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	0.1	0.1	0.2	0.5	1.0	2.0	3.9	
PL(N) (3)	1.0	1.0	1.0	1.5	2.5	3.5	4.0	
Attenuation (dB)	4.2	4.8	6.3	8.4	10.4	12.4	14.9	
Corrected Noise Levels	42.3	38.2	43.1	45.2	40.4	32.2	19.7	**49.5**
Facaded corrected Noise Levels	44.8	40.7	45.6	47.7	42.9	34.7	22.2	**52.0**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains **Tertiary Education Institution, 3rd Floor**								
								A-weighted levels
Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	51.7	51.7	51.7	51.7	51.7	51.7	51.7	
distance correction (dB)	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	*3.2*	
Source to Barrier distance, SB (m)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	
Barrier to Receiver distance, BR (m)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
slope SB	35.1	35.1	35.1	35.1	35.1	35.1	35.1	
slope BR	18.0	18.0	18.0	18.0	18.0	18.0	18.0	
Path difference, delta (m)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	1.1	2.2	4.4	8.8	17.6	35.1	70.3	
PL(N) (3)	2.5	3.5	4.0	4.5	4.0	2.5	1.5	
Attenuation (dB)	10.9	12.9	15.4	17.9	21.4	25.9	30.0	
Corrected Noise Levels	35.5	29.9	33.8	35.5	29.2	18.5	4.5	**40.6**
Facaded corrected Noise Levels	38.0	32.4	36.3	38.0	31.7	21.0	7.0	**43.1**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book
(2): N = 2*path length difference / wavelength
(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

KCRC PRC Passenger trains

Tertiary Education Institution, 6th Floor

Frequency (Hz)	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	**A-weighted levels**
A-weighted dB levels	60.6	60.6	60.6	60.6	60.6	60.6	60.6	
Octave band corrections (1)	5.0	-6.0	-5.0	-4.0	-8.0	-14.0	-22.0	
Octave band levels (dB (A))	65.6	54.6	55.6	56.6	52.6	46.6	38.6	
A-weighted corrections	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.0	
dB levels	49.5	46.0	52.4	56.6	53.8	47.6	37.6	**60.3**
Receiver height, Z_r (m)	23.5	23.5	23.5	23.5	23.5	23.5	23.5	
Source height, Z_s (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barrier height, Z_b (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Shortest horizontal distance, d (m)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	
Slant distance, d' (m)	55.2	55.2	55.2	55.2	55.2	55.2	55.2	
distance correction (dB)	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	*3.4*	
Source to Barrier distance, SB (m)	35.0	35.0	35.0	35.0	35.0	35.0	35.0	
Barrier to Receiver distance, BR (m)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	
slope SB	35.1	35.1	35.1	35.1	35.1	35.1	35.1	
slope BR	25.4	25.4	25.4	25.4	25.4	25.4	25.4	
Path difference, delta (m)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	
speed of sound	340.0	340.0	340.0	340.0	340.0	340.0	340.0	
wavelength	2.7	1.4	0.7	0.3	0.2	0.1	0.0	
Fresnel no. N (2)	3.9	7.8	15.5	31.1	62.2	124.3	248.6	
PL(N) (3)	4.0	4.5	4.5	2.5	1.5	1.5	1.5	
Attenuation (dB)	14.9	17.4	20.4	25.4	29.4	32.4	35.4	
Corrected Noise Levels	31.2	25.2	28.6	27.8	20.9	11.7	-1.3	**34.9**
Facaded corrected Noise Levels	33.7	27.7	31.1	30.3	23.4	14.2	1.2	**37.4**

(1): Octave band level correction taken from Figure 15.4 of Transportation Noise Reference Book

(2): N = 2*path length difference / wavelength

(3): PL(N) correction taken from Figure 7.9 of Noise and Vibration Control

Prediction of Lmax		
NSR 10D, 1st floor		
	Equation	
Slant distance, ds' (m)		175.40
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.46
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		84.90
Barrier correction (dB)	(refer to Leq, 30min calc)	-21.50
Critical Lmax =		57.44
NSR 10D, 10th floor		
	Equation	
Slant distance, ds' (m)		179.00
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.55
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		84.90
Barrier correction (dB)	(refer to Leq, 30min calc)	-17.30
Critical Lmax =		61.55
NSR 10D, 20th floor		
	Equation	
Slant distance, ds' (m)		186.90
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.74
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		84.90
Barrier correction (dB)	(refer to Leq, 30min calc)	-10.50
Critical Lmax =		68.16

Prediction of Lmax		
NSR 10D, 1st floor		
	Equation	
Slant distance, ds' (m)		175.40
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.46
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		93.20
Barrier correction (dB)	(refer to Leq, 30min calc)	-17.40
Critical Lmax =		69.84
NSR 10D, 10th floor		
	Equation	
Slant distance, ds' (m)		179.00
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.55
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		93.20
Barrier correction (dB)	(refer to Leq, 30min calc)	-14.60
Critical Lmax =		72.55
NSR 10D, 20th floor		
	Equation	
Slant distance, ds' (m)		186.90
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.74
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		93.20
Barrier correction (dB)	(refer to Leq, 30min calc)	-10.70
Critical Lmax =		76.26

Prediction of Lmax		
NSR 10D, 1st floor		
	Equation	
Slant distance, ds' (m)		175.40
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.46
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		81.30
Barrier correction (dB)	(refer to Leq, 30min calc)	-17.40
Critical Lmax =		57.94
NSR 10D, 10th floor		
	Equation	
Slant distance, ds' (m)		179.00
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.55
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		81.30
Barrier correction (dB)	(refer to Leq, 30min calc)	-14.60
Critical Lmax =		60.65
NSR 10D, 20th floor		
	Equation	
Slant distance, ds' (m)		186.90
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.74
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		81.30
Barrier correction (dB)	(refer to Leq, 30min calc)	-10.70
Critical Lmax =		64.36

Prediction of Lmax		
NSR 13E, 1st floor		
	Equation	
Slant distance, ds' (m)		180.40
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.58
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		84.90
Barrier correction (dB)	(refer to Leq, 30min calc)	-21.10
Critical Lmax =		57.72
NSR 13E, 10th floor		
	Equation	
Slant distance, ds' (m)		183.90
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.67
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		84.90
Barrier correction (dB)	(refer to Leq, 30min calc)	-17.40
Critical Lmax =		61.33
NSR 13E, 20th floor		
	Equation	
Slant distance, ds' (m)		191.60
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.84
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		84.90
Barrier correction (dB)	(refer to Leq, 30min calc)	-13.50
Critical Lmax =		65.06

Prediction of Lmax		
NSR 13E, 1st floor		
	Equation	
Slant distance, ds' (m)		180.40
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.58
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		93.20
Barrier correction (dB)	(refer to Leq, 30min calc)	-17.30
Critical Lmax =		69.82
NSR 13E, 10th floor		
	Equation	
Slant distance, ds' (m)		183.90
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.67
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		93.20
Barrier correction (dB)	(refer to Leq, 30min calc)	-14.70
Critical Lmax =		72.33
NSR 13E, 20th floor		
	Equation	
Slant distance, ds' (m)		191.60
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.84
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		93.20
Barrier correction (dB)	(refer to Leq, 30min calc)	-11.10
Critical Lmax =		75.76

Prediction of Lmax		
NSR 13E, 1st floor		
	Equation	
Slant distance, ds' (m)		180.40
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.58
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		81.30
Barrier correction (dB)	(refer to Leq, 30min calc)	-17.30
Critical Lmax =		57.92
NSR 13E, 10th floor		
	Equation	
Slant distance, ds' (m)		183.90
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.67
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		81.30
Barrier correction (dB)	(refer to Leq, 30min calc)	-14.70
Critical Lmax =		60.43
NSR 13E, 20th floor		
	Equation	
Slant distance, ds' (m)		191.60
Distance correction (dB)	Correction = 10log(ds'/dref)	-8.84
Facade correction (dB)	Correction = +2.5	2.50
Lmax (v)		81.30
Barrier correction (dB)	(refer to Leq, 30min calc)	-11.10
Critical Lmax =		63.86

Annex F

WQO's

Table F1 *Water Quality Objectives for Tolo Harbour and Channel Water Control Zone*

	Water Quality Objective	Part or parts of Zone
A.	AESTHETIC APPEARANCE	
	(a) There should be no objectionable odours or discolouration of the water	Whole zone
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c) Mineral oil should not be visible on the surface.	Whole zone
	(d) There should be no recognisable sewage-derived debris.	Whole zone
	(e) Floating, submerged and semi=submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	(f) The water should not contain substances which settle to form objectionable deposits.	Whole zone
B.	BACTERIA	
	The level of Escherichia coli should be less than 1 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Whole zone
C.	COLOUR	
	Human activity should not cause the colour of water to exceed 30 Hazen units.	Whole zone
D.	DISSOLVED OXYGEN	
	The level of dissolved oxygen should not be less than 4 mg per litre.	Whole zone
E.	pH	
	Human activity should not cause the pH of the water to exceed the range of 6.5-8.5 units.	Whole zone
F.	TEMPERATURE	
	Human activity should not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
G.	SALINITY	
	Human activity should not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H.	SUSPENDED SOLIDS	
	(b) Human activity should not cause the annual median of suspended solids to exceed 20 mg per litre.	Whole zone
I.	AMMONIA	
	The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J.	5-DAY BIOCHEMICAL OXYGEN DEMAND	
	The 5-day biochemical oxygen demand should not exceed 3 mg per litre	Whole zone

	Water Quality Objective	Part or parts of Zone
K.	CHEMICAL OXYGEN DEMAND	
	The chemical oxygen demand should not exceed 15 mg per litre.	Whole zone
L.	TOXIC SUBSTANCES	
	(a) Toxic substances in the water should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other.	Whole zone
	(b) Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Table F2 *Standards for Effluents Discharged into the Marine Waters of Tolo Harbour and Channel Water Control Zone*

Flow rate (m^3/day)	≤10	>10 & ≤200	>200 & ≤400	>400 & ≤600	>600 & ≤800	>800 & ≤1000	>1000 & ≤1500	>1500 & ≤2000	>2000 & ≤3000	>3000 & ≤4000	>4000 & ≤5000	>5000 & ≤6000
Determinand												
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)	45	45	45	45	45	45	45	45	45	45	45	45
Colour (lovibond units) 25 mm cell length	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	30	30	30	30	30	30	15	15	15	15	15	15
BOD	20	20	20	20	20	20	10	10	10	10	10	10
COD	80	80	80	80	80	80	50	50	50	50	50	50
Oil & Grease	20	20	20	20	20	20	10	10	10	10	10	10
Iron	10	10	10	7	5	4	2.7	2	1.3	1	0.8	0.6
Boron	5	4	3	2.5	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2.5	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	0.5	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1	1	0.8	0.2	0.2	0.2	0.2	0.14	0.1
Cyanide	0.1	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	0.25	0.25	0.25	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	20	20	20	15	15	15	15	15	10	10	10	10
Total phosphorus	8	8	5	5	5	5	5	5	5	5	5	5
Surfactants (total)	15	15	15	15	15	15	10	10	10	10	10	10
E. coli (count/100 ml)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Annex G

Summary of Sewage Disposal

15. Sewerage

15.1 Sewage Disposal

15.1.1 Working Paper ET/08 - 'Sewage Disposal' issued under this Study in September 1997 indicated that disposal of sewage flow generated from the Pak Shek Kok Development to the existing Sha Tin Sewage Treatment Works (STW) was the preferable option. The following paragraphs will describe in detail of the sewerage layout and requirements for adopting the preferred option.

15.1.2 Based on the Recommended Outline Development Plan (RODP) (Report PL/14) issued in February 1998, the total residential population (R1 and R2) in Pak Shek Kok is estimated to be 12,130 and the estimated employment in the Science Park is 16,500. The predicted flows and loads are summarised in **Table 15.1** which are based on the population predictions presented in **Table 15.2**. The sewage flows generated from Pak Shek Kok Development are estimated to be 416m^3/d in 2001 (solely from Science Park Phase 1) and 3945m^3/d in 2003 respectively.

15.1.3 The ultimate sewage discharge from Pak Shek Kok to Sha Tin STW will be taken into consideration by DSD during the design of the Stage 3 extension of Sha Tin STW. Further information regarding the industrial, institutional and recreational developments in Pak Shek Kok should be sent to DSD to update the preliminary flow and wasteload estimates in **Table 15.1**.

15.1.4 The Science Park Phase 1 is currently planned for commissioning in later half of 2001. However, the Stage 3 extension work is scheduled to be commissioned at the end of 2003. It is unlikely that the programme for the upgrade work can be accelerated to match with the Science Park Phase 1 requirement.

15.1.5 The estimated sewage flows are estimated to be 416m^3/d in 2001 and increase to be 3945m^3/d in 2003, after which the Stage 3 extension will be commissioned. These additional sewage flows are small when compared with the existing capacity of Sha Tin STW. Since the Sha Tin STW is currently overloaded, the existing process configuration should be modified to maximise the treatment capacity associated with the less stringent nitrogen control requirements. The options for modification work will be evaluated by EPD and DSD.

15.1.6 In order to further reduce the impact of the flows conveyed to Sha Tin STW from Pak Shek Kok, it is recommended that an interim storage facility should be provided in the proposed works. This would provide flow attenuation to allow the flows from the Pak Shek Kok Development to be temporarily stored. These flows could then be pumped to Sha Tin STW during off-peak hours when sufficient capacity should become available to accommodate these flows.

Table 15.1
Estimation of Sewage Flow for Pak Shek Kok Development Area

Sewage Flow	Year						
	2001	2002 - 2003		2006 - 2007		2015	
1) Residential		R1	R2	R1	R2	R1	R2
Population	0	6000	2,044	6,000	6,130	6,000	6,130
Unit Sewerage Flow, L/h/d	0	240	300	240	300	240	300
Sutotal, m^3/d	0	1440	613	1440	1839	1440	1839
Total, m^3/d	0	2053		3279		3279	
2) Science Park Residential							
Population	0	100		200		300	
Unit Sewerage Flow, L/h/d	300	300		300		300	
Total, m^3/d	0	30		60		90	
3) Industrial/Commerical/Institutional							
Hotel (head)							
Population	0	0		1000		1000	
Unit Sewerage Flow, L/h/d	370	370		370		370	
Total, m^3/d	0	0		370		370	
Science Park (head)							
Employment Population	0	3300		7700		16500	
Unit Sewerage Flow, L/h/d	60	60		60		60	
Total, m^3/d	0	198		462		990	
Hi-Tech Industrial (ha)	1.6	4.8		8		22	
Unit Sewage Flow, $m^3/ha/d$	400	400		400		400	
Net/Gross Ratio	0.65	0.65		0.65		0.65	
Net Unit Sewage Flow, $m^3/ha/d$	260	260		260		260	
Total, m^3/d	416	1248		2080		5720	
Visitors to Ecology Centres (head)							
Population	0	3000		6000		10000	
Unit Sewerage Flow, L/h/d	60	60		60		60	
Total, m^3/d	0	180		360		600	
Other Employment (head)	0	600		1200		1900	
Unit Sewerage Flow, L/h/d	60	60		60		60	
Total, m^3/d	0	36		72		114	
4) Miscellaneous, m^3/d	0	200		600		1000	
TOTAL FLOW, m^3/d	**416**	**3945**		**7283**		**12163**	

Notes:
Unit sewage flow is based on the DSD Sewerage Manual Part 1

Table 15.2
Development Projection for Pak Shek Kok Development Area

	2001	2002-2003	2006-2007	2015
Residential				
Population R1 + R2	-	8,044	12,130	12,130
Hotel	-	-	1,000	1,000
Science Park Residential	-	100	200	300
Industrial / Commerical				
Science Park Employment	-	3,300	7,700	16,500
Hi-Tech Industrial, ha[1]	-	-	8	22
Other Employment	-	600	1,200	1,900
Visitors to Ecology Centers	-	3,000	6,000	10,000

[1] Assumed developed area

Table 15.3 - Sewage Flow Calculations

Planning Area	Population (h)	Unit Flow	Equivalent	Peak	Flow Discharge
	Area (ha)	m^3/h/d or m^3/ha/d	Population	Factor	m^3/s
R1	6000	0.240	-	4	0.0667
R2	6130	0.300	-	4	0.0851
Primary School 1	1300	0.025	-	6	0.0023
Primary School 2	1300	0.025	-	6	0.0023
Secondary School	1300	0.025	-	6	0.0023
Unsewer Village	200	0.150	-	8	0.0028
Science Park	22.0	429	37786	3	0.3277
REC	10.0	429	17160	3.5	0.1738
Education Institution	6.2	429	10639	3.5	0.1077
G/IC	2.0	429	3432	4	0.0397

Table 15.4
Comparison of Sewerage Options

	Option 1	Option 2	Option 3
Length of Pipe Jacking (1800mm diameter steel pipe)	100-120m	100-120m	100-120m
No. of Pumping Stations Required	2	3	2
Length and Location of Deep Gravity Sewer (cover depth > 6m)	210m (A to B) 350m (C to E)	210m (A to B)	500m (A to B) 630m (C to E)
Length of Rising Main	200m (B to C)	200m (B to C) 770m (D to E)	200m (B to C)
Crossing of the Proposed 5-cell box culvert	Travel at the top of the box by rising main	Travel at the top of the box by rising main	Travel at the top of the box by rising main
Crossing of the Proposed Single cell box culvert	Travel beneath the box by gravity sewer	Travel at the top of the box by rising main	Travel beneath the box by gravity sewer

15.1.7 The storage facility should be incorporated into the proposed sewerage network at the Pak Shek Kok Development by increasing the size of the wet wells of the proposed sewage pumping stations. For the purpose of this Study, a retention period of 8 hours has been assumed in order to estimate the areas required for the proposed sewage pumping stations.

15.2 Sewerage Layout

15.2.1 As mentioned in the revised Draft Final DIA Report (Report ET/11) for this study which was issued in February 1998, there are two trunk drainage systems proposed for Pak Shek Kok Development. A 5-cell box culvert (3.0m (W) by 2.5m (H)) was proposed for extension of the existing Pak Shek Kok nullah. Running in north east direction, the box culvert will pass through the proposed R2 site and outfall at the new reclamation limit. The invert levels of the box culvert are +1.35 mPD and +1.00 mPD at upstream and downstream ends respectively. Another single cell box culvert (4.3m (W) by 3.5m (H)) was proposed running through the middle of the Science Park. The invert levels of this box culvert are +0.98 mPD and +0.40 mPD at upstream and downstream ends respectively. It is indicated that the cover depths of these two box culverts are between 1 to 2 metres based on the assumption that the finished ground levels of Pak Shek Kok area is in the range of +5.5 mPD to +6.5 mPD.

15.2.2 Although it would be preferable for the sewerage network to drain by gravity to the proposed Sewage Pumping Station as indicated on the RODP, it can be seen that the pipes would need to have considerable cover in order to pass below the proposed culverts. This would result in high construction and maintenance costs, and also an increased pumping head at the Sewage Pumping Station.

15.2.3 It is therefore recommended that in addition to the sewage pumping station mentioned in the RODP, additional pumping stations will be required (ie. two or three pumping stations in total). These will pump the flows generated from the Development and Area 12/39 for onward transfer to Sha Tin STW for treatment.

15.2.4 Three options are proposed for the sewerage layout in Pak Shek Kok area. Option 1 as shown in **Figure 15.1** indicates the proposed sewerage network starting at point A for receiving the sewage from Area 12/39. In order to facilitate the sewage discharged from the E and G/IC sites at south west of Tolo Highway, a gravity sewer is also proposed starting at point X and eventually to be connected to the point A. This gravity sewer will also serve for the provisional connection from the unsewered village areas at south west of Pak Shek Kok. The gravity pipe will then travel in the north-east, running under the KCRC rail track and Tolo Highway and eventually discharge into the proposed pumping station no. 1. The method of pipe jacking of approximately 100m to 120m long by using a 1800mm diameter steel pipe will be proposed for the installation of gravity pipe crossing the rail track and

Tolo Highway. The gravity pipe will be installed inside the steel pipe such that maintenance work can be carried out for the gravity pipe under the rail track and Tolo Highway without any traffic disruption. A 300mm diameter rising main will be proposed from point B to point C running at the top of the proposed 5-cell box culvert. Finally, a gravity pipe of size ranging from 675mm to 800mm diameter is proposed from travelling point C to point E. This pipe will run beneath the proposed single cell box culvert and eventually discharge to the proposed pumping station no.3 for onward transfer to the Sha Tin STW. The longitudinal profile of the sewerage network is shown in **Figures 15.2** and **15.3**.

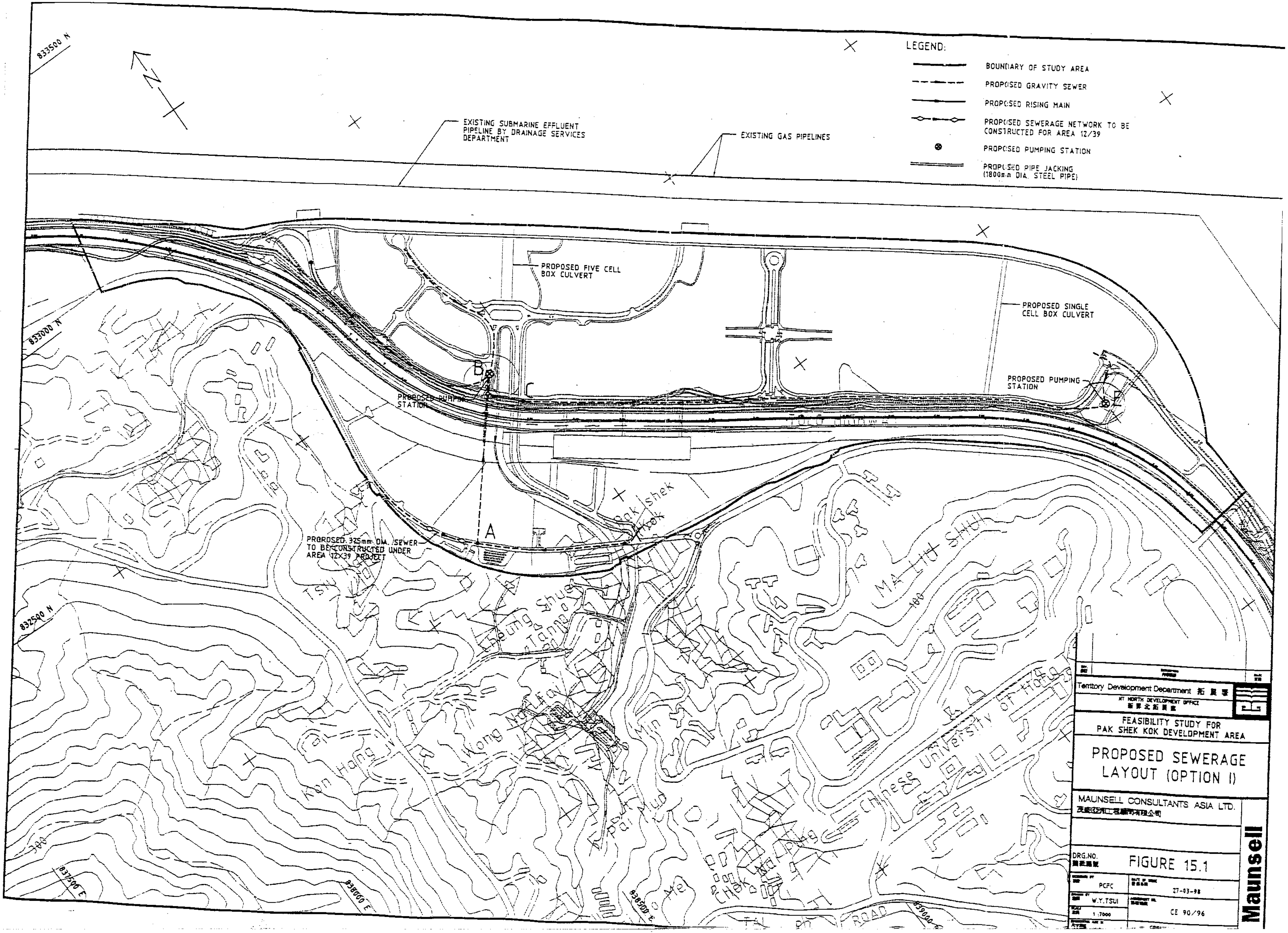
15.2.5 **Figure 15.4** indicates the sewerage layout under Option 2 in which the routing from point A to point C is exactly the same as Option 1. In order to avoid the deep gravity sewer along the road from point C to point E, an additional pumping station is proposed at point D. A 350mm diameter rising main will also be proposed running at the top of the proposed single cell box culvert and eventually discharged to the proposed pumping station no. 3. The longitudinal profile of the sewerage network is shown in **Figures 15.5** and **15.6**.

15.2.6 **Figure 15.7** indicates the sewerage layout under Option 3 in which the details of the pipe jacking is the same as Option 1. However, the proposed pumping station no. 1 is located near the reclamation limit as shown in **Figure 15.9**. A 300mm diameter rising main will be proposed from point B to point C running at the top of the proposed 5-cell box culvert. A gravity pipe of size ranging from 675mm to 800mm diameter is proposed travelling from point C to point E. This pipe will run beneath the proposed single cell box culvert and eventually discharge to the proposed pumping station no.3. The longitudinal profile of the sewerage network is shown in **Figures 15.8** and **15.9**.

15.2.7 The major items of works to be carried out under the three options are summarised in **Table 15.4**. It is recommended that Option 1 should be adopted due to the following reasons:

- Minimum number of pumping stations are proposed which can enhance the ease of maintenance.
- The length of deep gravity sewer is small when compared with that of Option 3.

15.2.8 **Figure 15.10** indicates the schematic flow diagram for the sewerage network in Pak Shek Kok under Option 1. A 800mm diameter gravity main will be required for collection of sewage from Pak Shek Kok and discharged to the pumping station no. 3. It is also estimated that a 350mm diameter pumping main will be required to pump the flows off-site and the preferred treatment location would be Sha Tin STW. The design of the sewerage system should be undertaken in accordance with the Sewerage Manual issued by Drainage Services Department. It is recommended that this preliminary sewerage design be updated once the planning development and the population figures of Pak Shek Kok area are finalised.



Territory Development Department 拓展署
NT NORTH DEVELOPMENT OFFICE
新界北拓展處

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

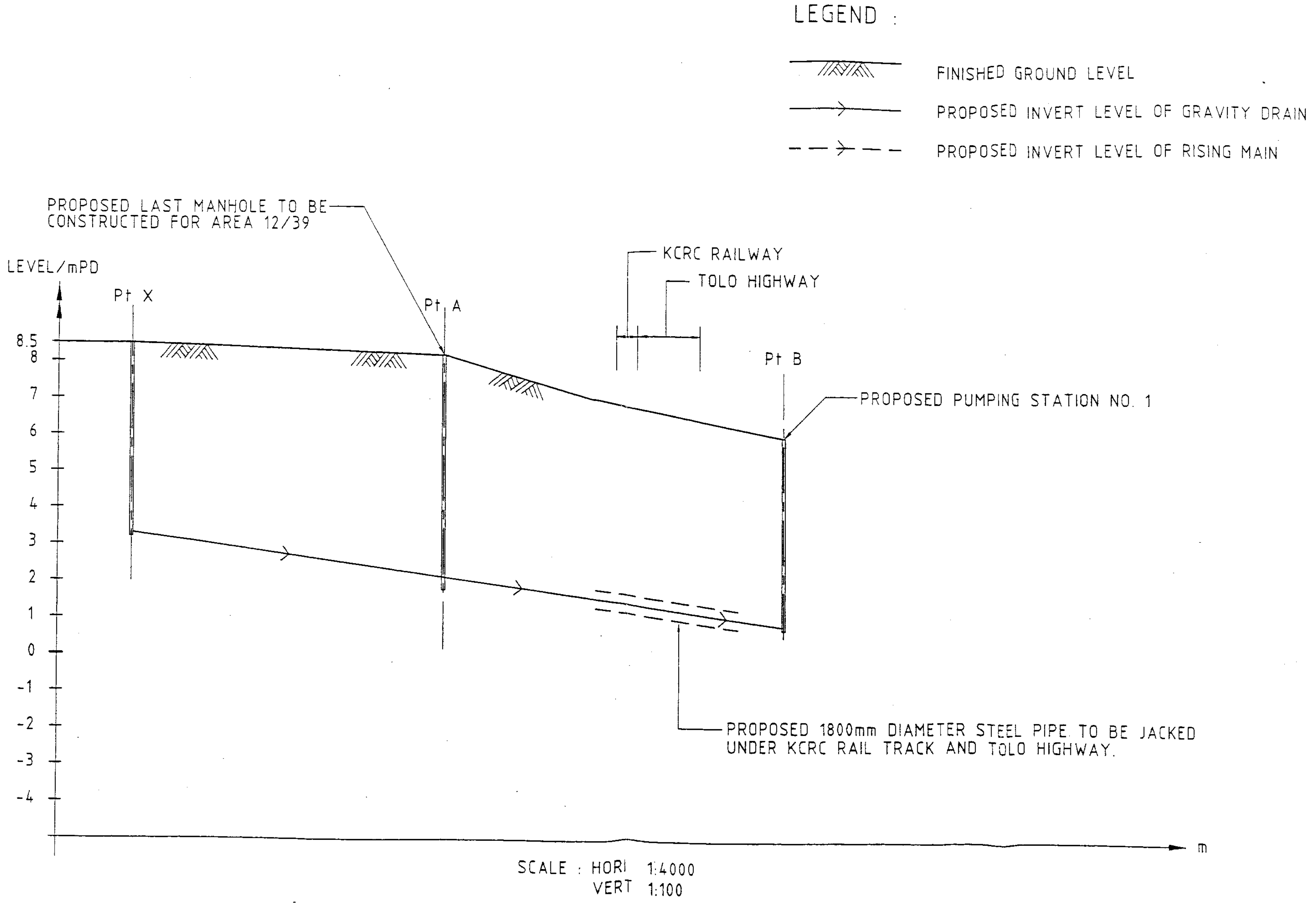
PROPOSED SEWERAGE
LAYOUT (OPTION I)

MAUNSELL CONSULTANTS ASIA LTD.
茂盛(亞洲)工程顧問有限公司

DRG.NO.
圖紙編號 FIGURE 15.1

PCFC
27-03-98
W.Y.TSUI
1:7000
CE 90/96

Maunsell



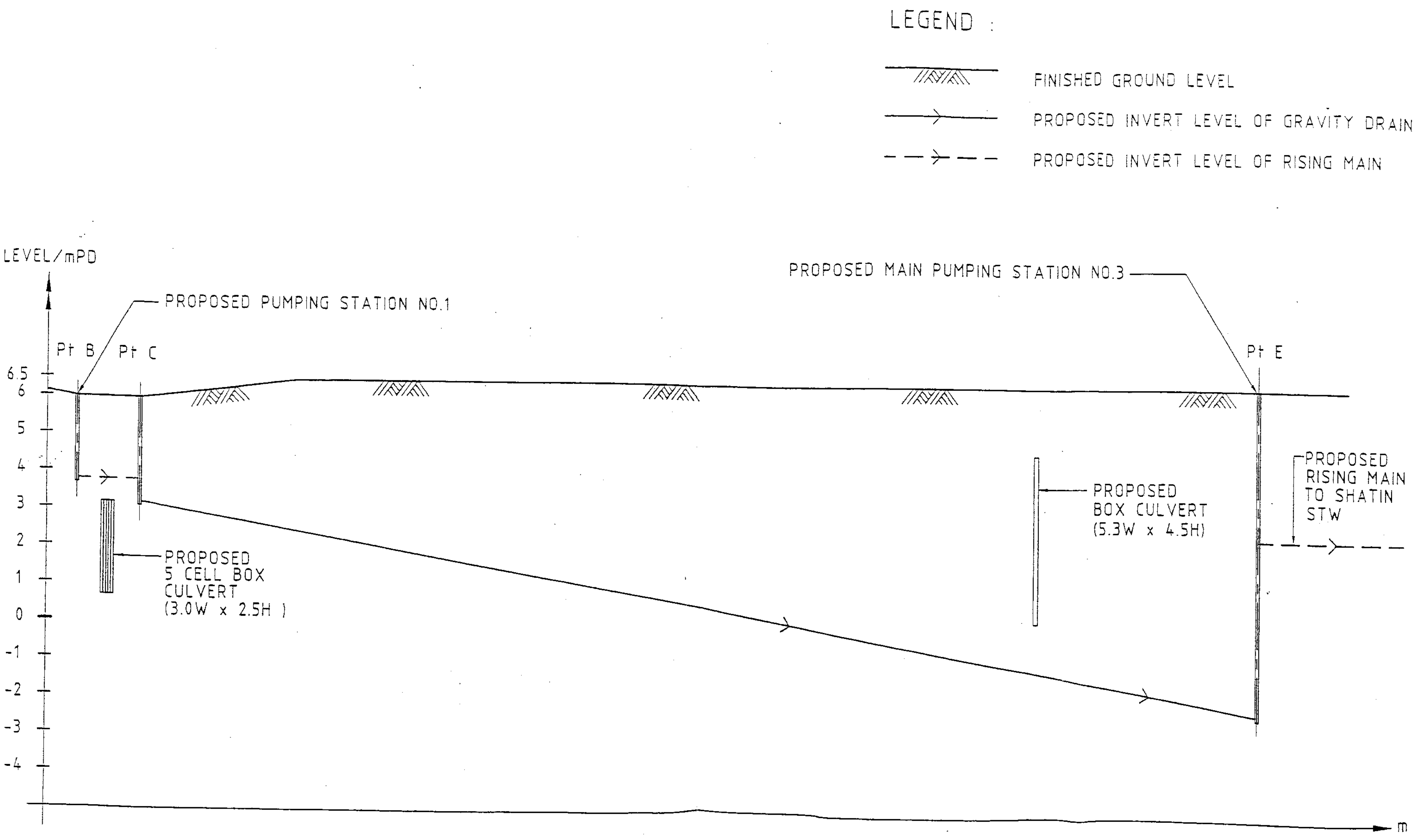
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

LONGITUDINAL PROFILE OF PROPOSED MAIN SEWERAGE NETWORK (OPTION1)

SHEET 1 OF 2

Maunsell
茂盛(亞洲)工程顧問有限公司

JOB NO.:	FIGURE:
91997	15.2



SCALE : HORI 1:4000
VERT 1:100

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

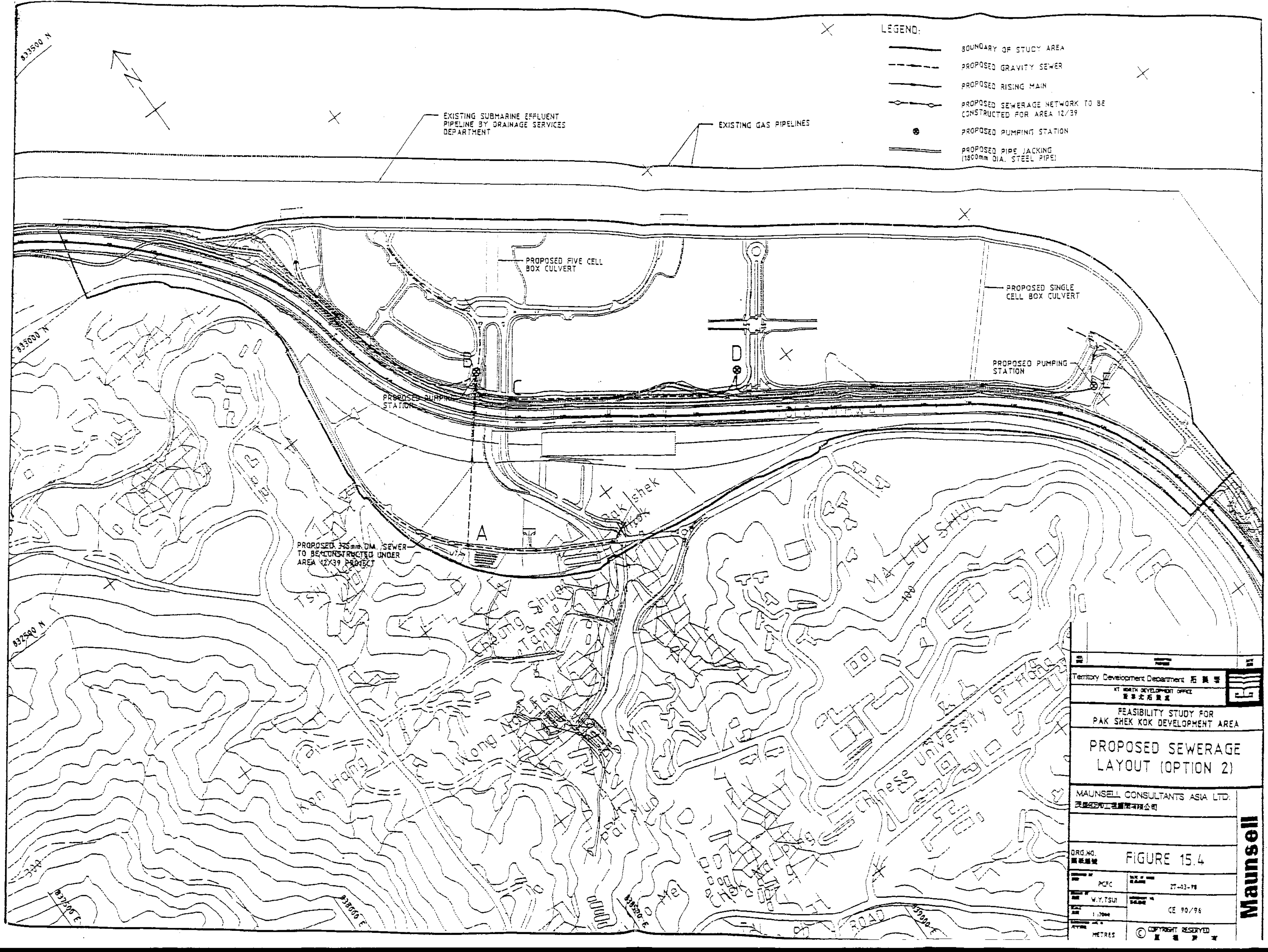
LONGITUDINAL PROFILE OF PROPOSED MAIN SEWERAGE NETWORK (OPTION1)

SHEET 2 OF 2

Maunsell
茂盛(亞洲)工程顧問有限公司

JOB NO.: 91997

FIGURE: 15.3



Territory Development Department 拓展署
NT NORTH DEVELOPMENT OFFICE
新界北拓展處

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

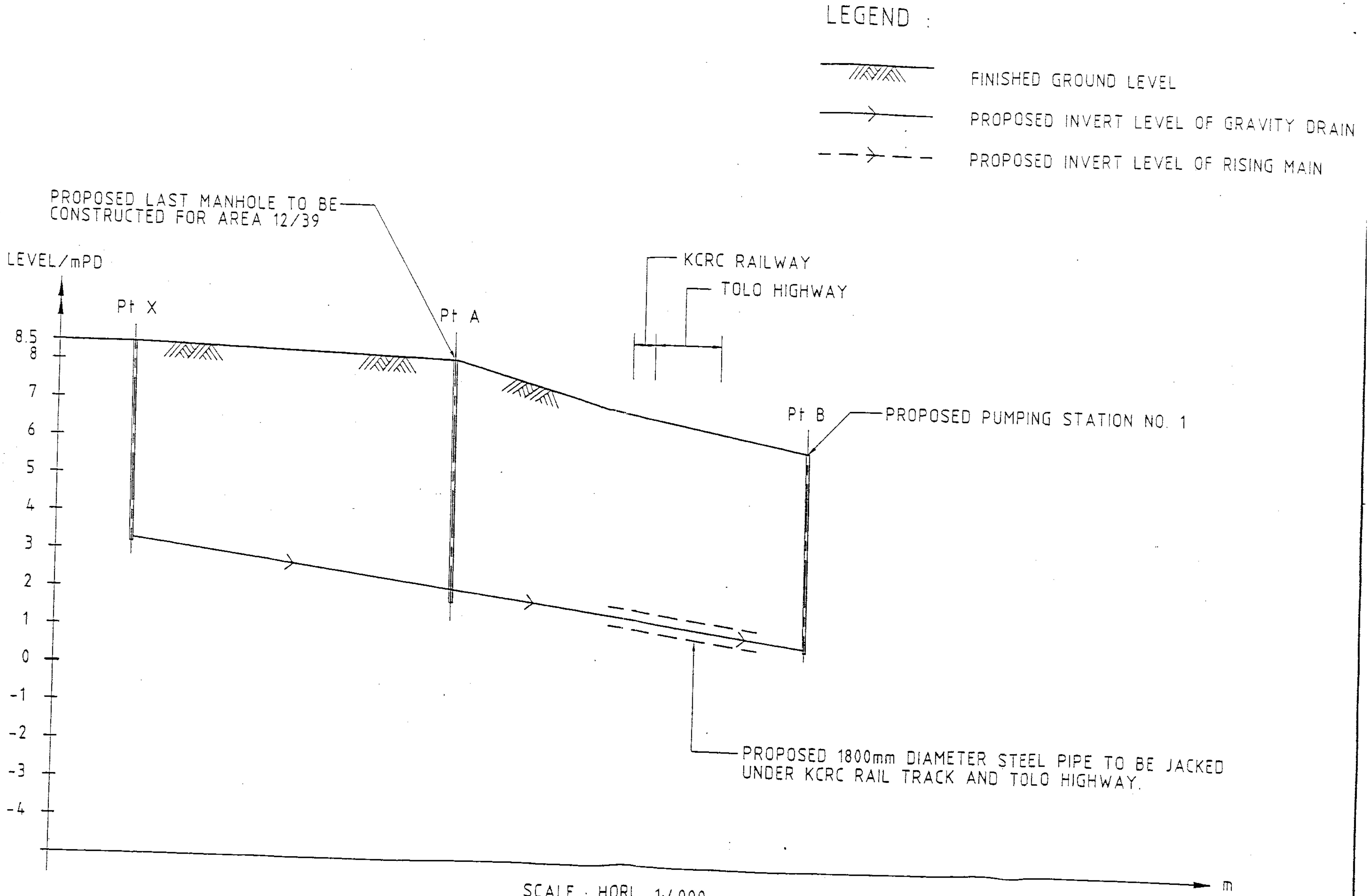
PROPOSED SEWERAGE
LAYOUT (OPTION 2)

MAUNSELL CONSULTANTS ASIA LTD.

DRG.NO.
FIGURE 15.4

PCFC
27-03-98
W.Y.TSUI
CE 90/96
1:7000
METRES

Maunsell



SCALE : HORI 1:4000
VERT 1:100

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

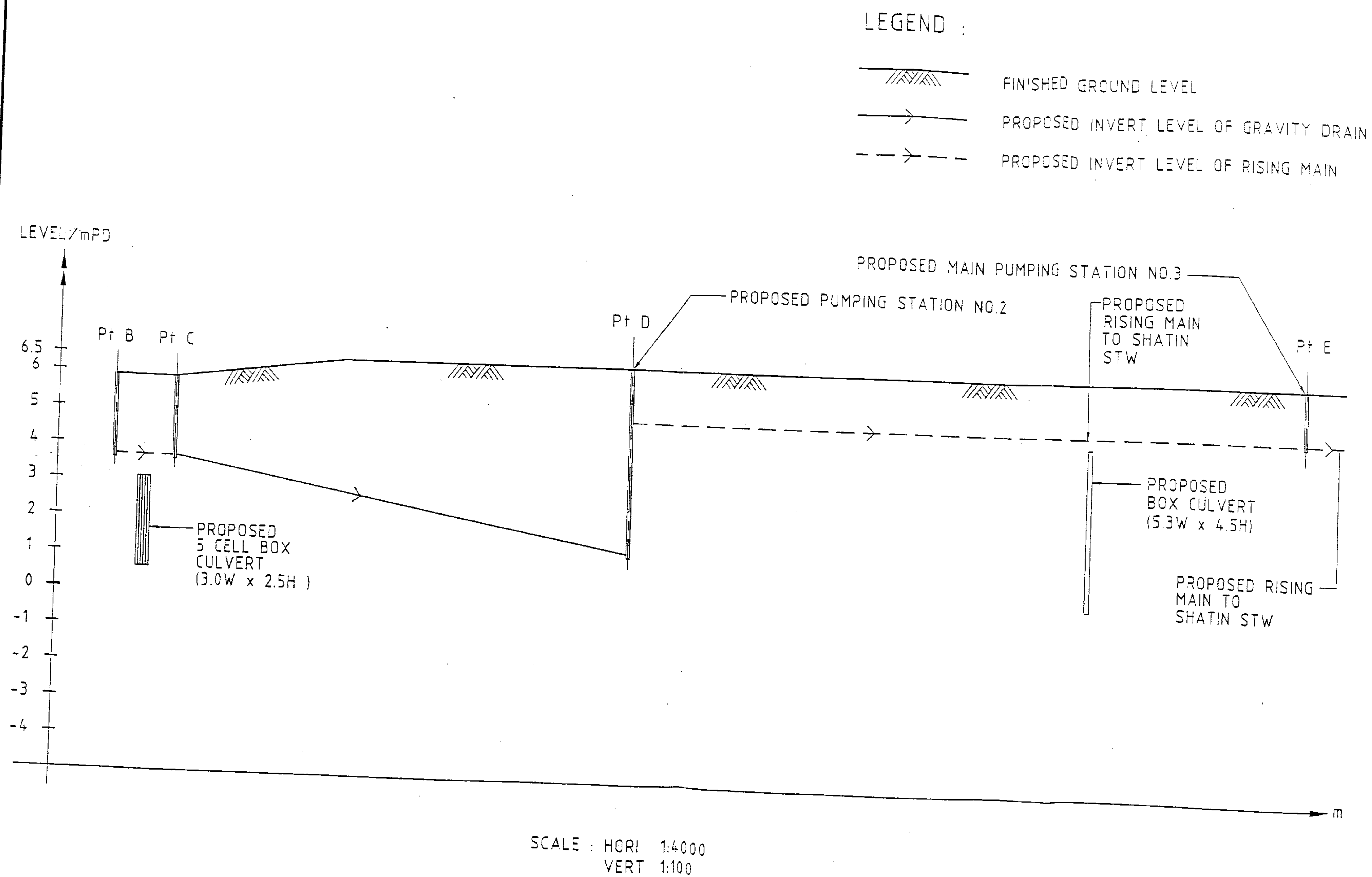
LONGITUDINAL PROFILE OF PROPOSED MAIN SEWERAGE NETWORK (OPTION2)

SHEET 1 OF 2

Maunsell
茂盛(亞洲)工程顧問有限公司

JOB NO.: 91997

FIGURE: 15.5



FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

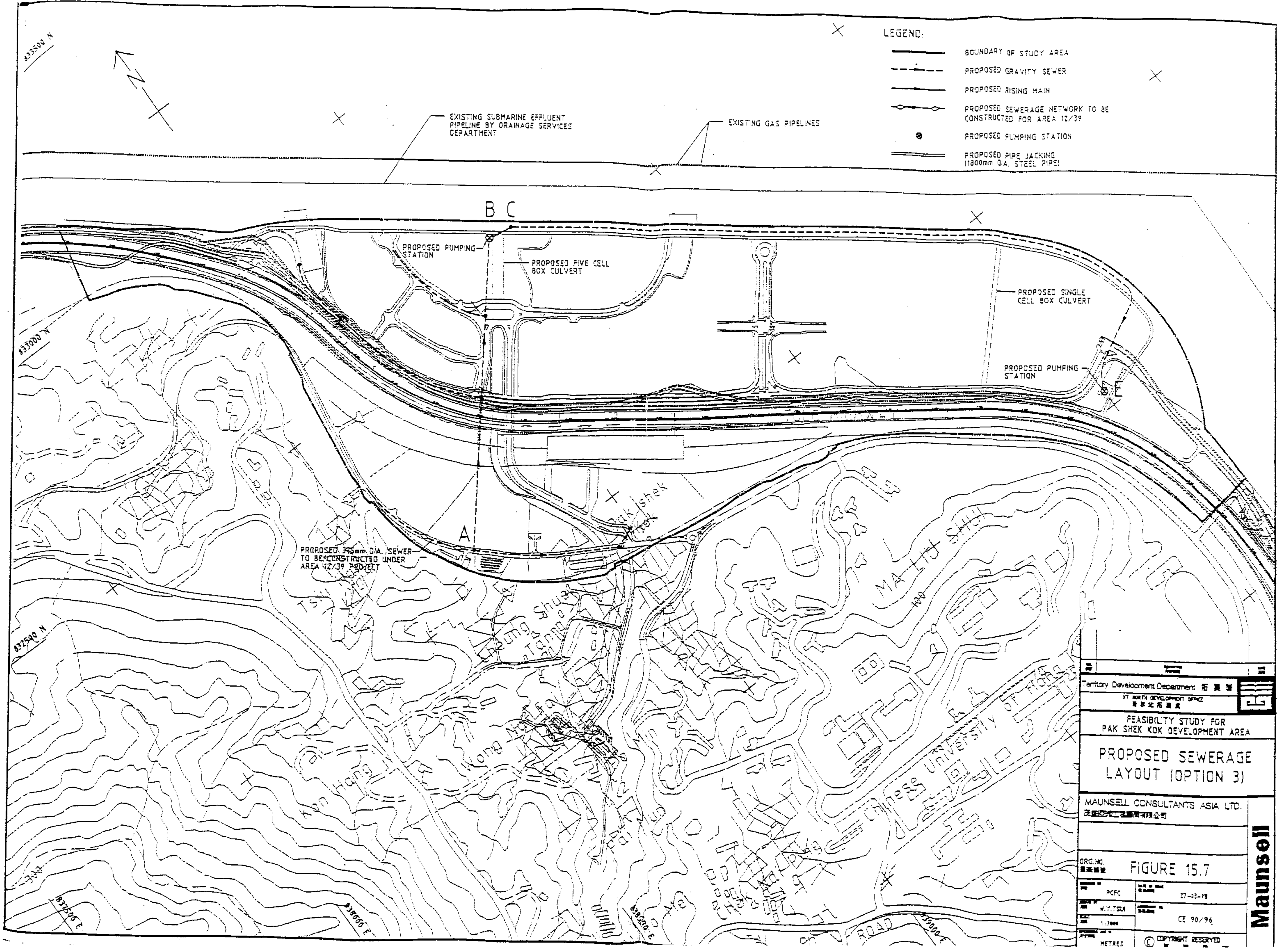
LONGITUDINAL PROFILE OF PROPOSED MAIN SEWERAGE NETWORK (OPTION2)

SHEET 2 OF 2

Maunsell

JOB NO.: 91997

FIGURE: 15.6



Territory Development Department 拓展署
NT NORTH DEVELOPMENT OFFICE
新界北拓展處

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

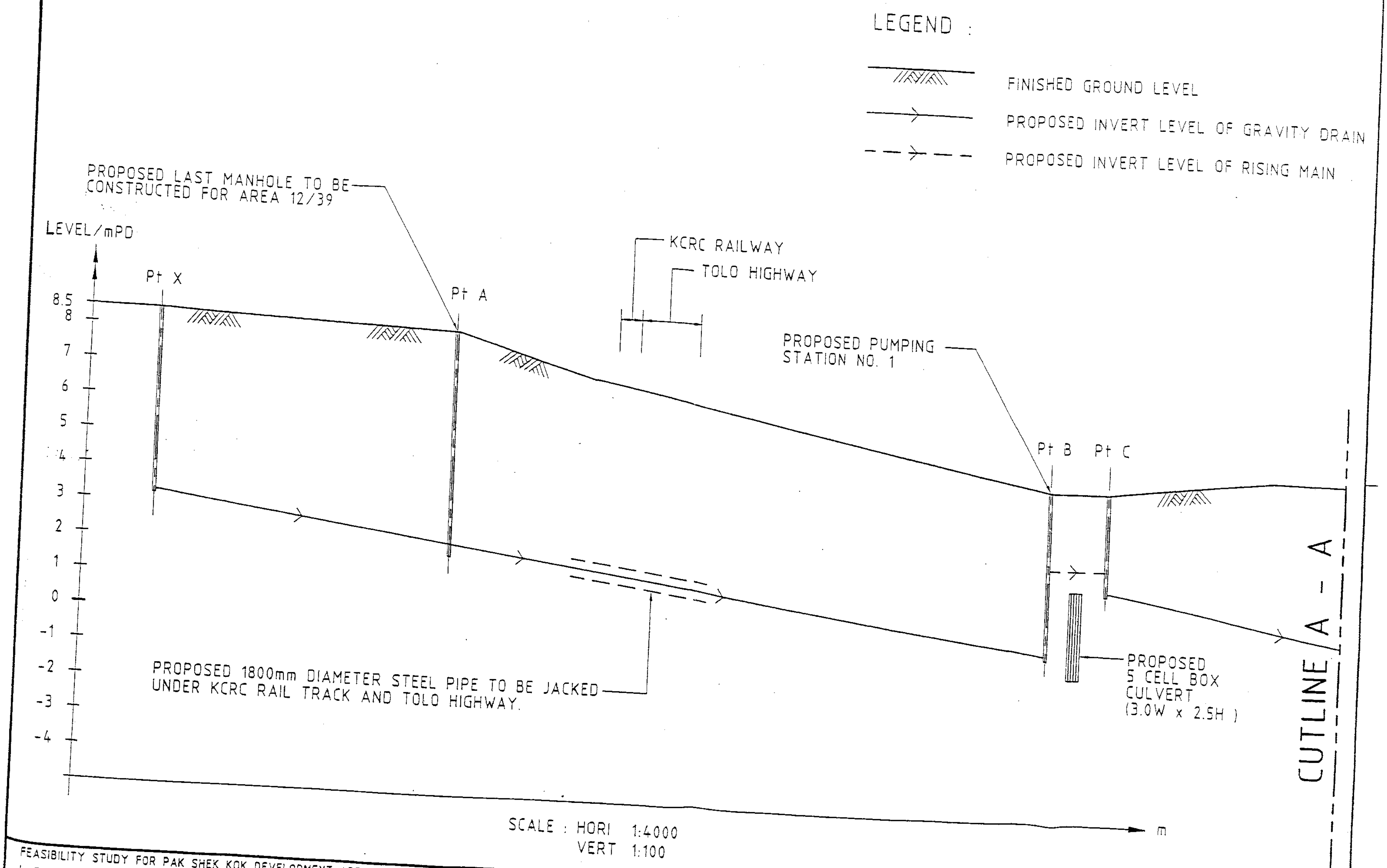
PROPOSED SEWERAGE
LAYOUT (OPTION 3)

MAUNSELL CONSULTANTS ASIA LTD.

Maunsell

ORG.NO.
FIGURE 15.7

PCFC
27-03-98
W.Y.TSUI
1:7000
CE 90/96
METRES



FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

LONGITUDINAL PROFILE OF PROPOSED MAIN SEWERAGE NETWORK (OPTION3)

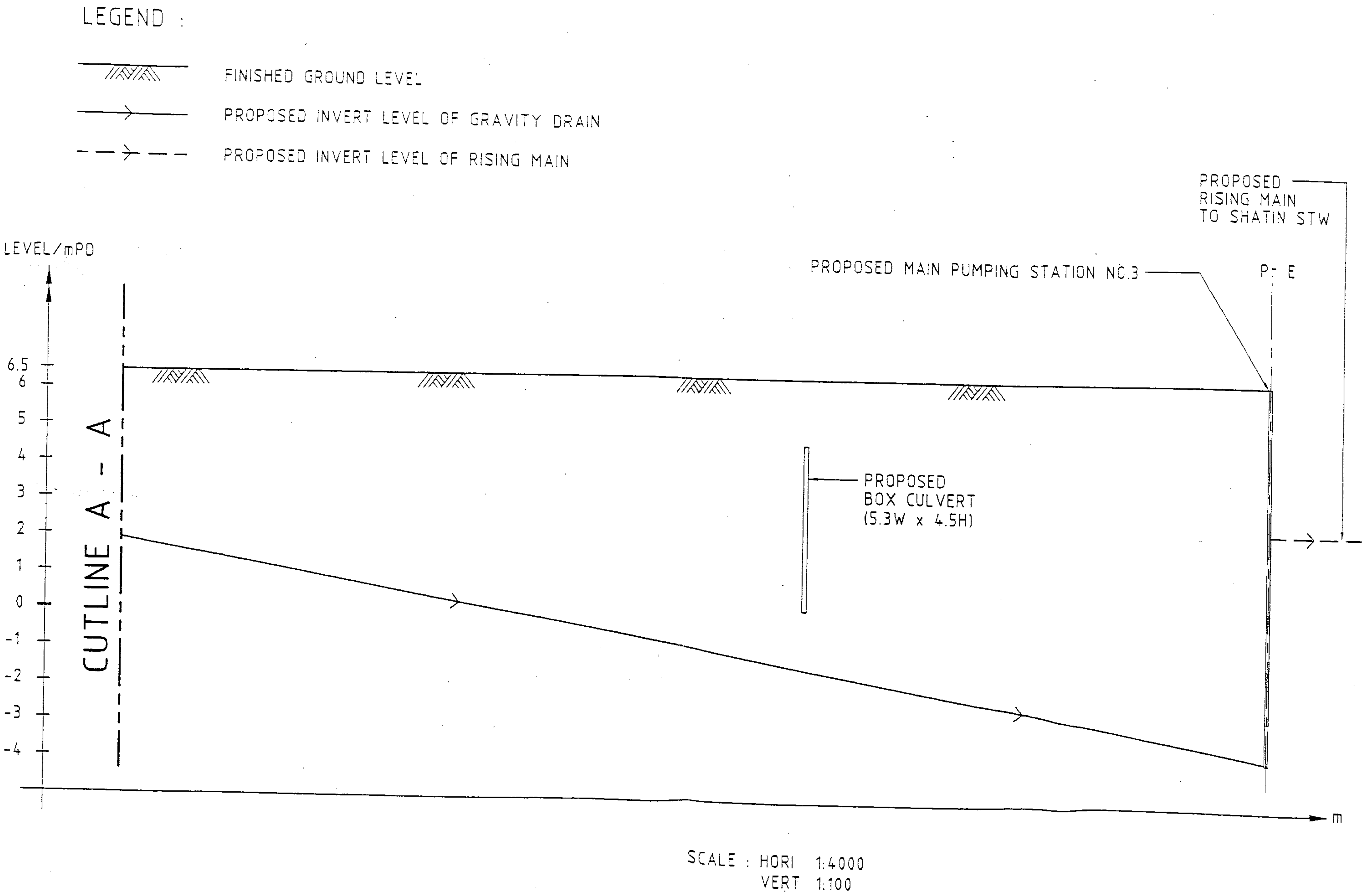
SHEET 1 OF 2

Maunsell

茂盛(亞洲)工程顧問有限公司

JOB NO.: 91997

FIGURE: 15.8



FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

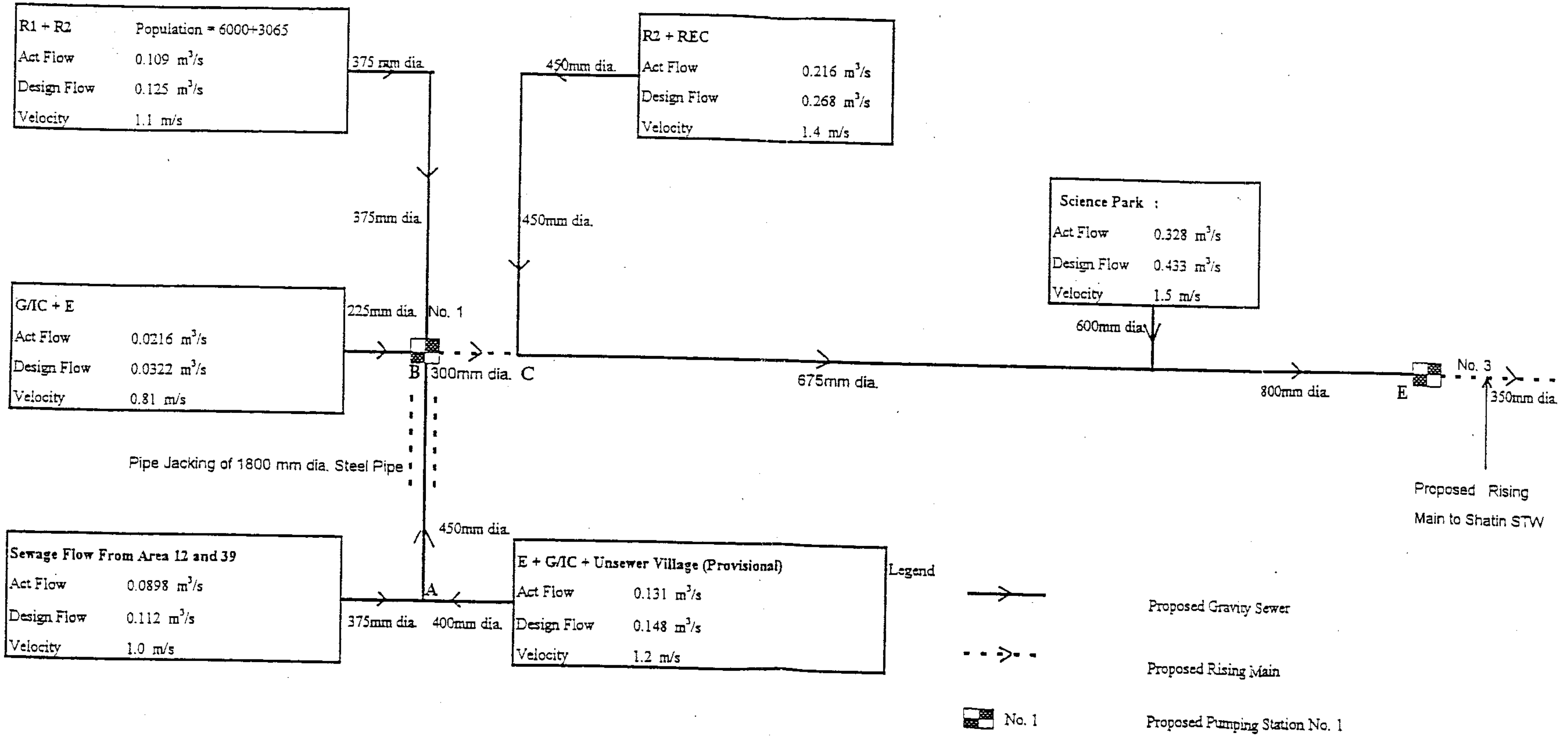
LONGITUDINAL PROFILE OF PROPOSED MAIN SEWERAGE NETWORK (OPTION3)

SHEET 2 OF 2

Maunsell
茂盛(亞洲)工程顧問有限公司

JOB NO.: 91997

FIGURE: 15.9



AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT

SCHEMATIC FLOW DIAGRAM

Maunsell

JOB NO.:	FIGURE:
91997	15.10

Annex H

List of Vegetation

Table H1 *Plant Species Recorded in the Study Area for PSKDA*

Growth Form	Species	Relative Abundance					
		Waste	Orch/Agr	Waste (Flood)	SW	P W	G
Tree	*Acacia confusa*	*	**		***	***	
	Alangium chinsnse				**		
	Aporusa dioica				**		
	Bridelia monoica				*		
	Bridelia tomentosa				**	*	*
	Castanopsis fissa				*		
	Casuarina equisetifolia	*				****	*
	Cinnamomum camphora				*		
	Citrus maxima		**				
	Clausena lansium		***				
	Cratoxylum ligustrinum				*		*
	Dimocarpus longan	*	***				
	Litchi chinensis		***				
	Lophostemon confertus				***		
	Erythrina variegata		*		*		
	Ficus hirta				*		
	Ficus hispida	*			**		**
	Ficus variegata				*		
	Hibiscus tiliaceous	*				*	
	Homalium cochinchinensis						*
	Leucanea leucocephala	*				**	
	Litsea cubeba				*		
	Litsea glutinosa				*		*
	Macaranga tanarius	*					**
	Machilus breviflora				*		
	Machilus oreophila				*		
	Mallotus paniculata						**
	Microcos paniculata						*
	Musa paradisiaca		****		***		
	Pavetta hongkongensis				*		
	Pinus massoniana						**
	Psidium guajava		**				
	Rhus succedanea				*		**
	Sapium discolor				***		*
	Schefflera octophylla				***		*
	Sterculia lanceolata				*		*
	Symplocos glauca				*		
	Syzygium hancei				*		
	Trema orientalis				*		
	Turpinia cochinchinensis				*		
	Zanthoxylum avicennae				*		
Shrub	*Antirrhea chinensis*				*		
	Clerodendrum cyrtophyllum				*		
	Desmodium heterocarpon	**					
	Desmos cochinchinensis				***		

Growth Form	Species	Relative Abundance					
		Waste	Orch/Agr	Waste (Flood)	SW	P W	G
	Euphorbia hirta	**					
	Eurya japonica						**
	Ficus varioiosa						*
	Helicteres angustifolia						***
	Ilex asprella						**
	Ilex pubescens						*
	Lantana camara	***	**		***	***	*
	Ligustrum sinense		**		*		*
	Litsea rotundifolia				*		*
	Ludwigia adscendens			**			
	Melastoma sanguineum				**		**
	Murraya exotica		*				
	Phoenix hanceana						
	Phyllanthus cochinchinensis				*		**
	Phyllanthus urinaria	**	**				
	Psychotria rubra				***		*
	Rhaphiolepis indica						**
	Rhodomyrtus tomentosa						**
	Sesbenia cochinchinensis	****		**		**	
	Suaeda australis,						
	Urena lobata				*		
Herb	*Ageratum conyzoides*	***	***			**	
	Alchornea trewioides		*			**	
	Alocasia macrorrhiza		**				
	Amaranthus viridis		*				
	Apluda mutica						*
	Arundinella setosa						***
	Bidens pilosa	**	*			**	
	Chloris barbata	**	**			**	
	Clerodendrum fortunatum						
	Coix lachryma-jobi			**			
	Colocasia esculens		**				
	Conyza canadensis	**				*	
	Cymbopogon spp.						**
	Cyperus spp.			**			
	Dianella ensifolia				*		**
	Dicranopteris linearis	**		*			****
	Digitaria cruciata	**			***	**	
	Echinochloa crus-galli	*	**				
	Eclipta prostrata			**			
	Elephantopus tomentosa		***			**	**
	Eleusine indica	*				**	
	Emilia sonchifolia		**				
	Eragrostis atrovirens			***			
	Eremochloa ciliaris						
	Erigeron floribundus	**					

Growth Form	Species	Relative Abundance					
		Waste	Orch/Agr	Waste (Flood)	SW	P W	G
	Eriocaulon spp.			*			
	Gynura bicolor	*	*				
	Frimbristylis spp.			**			
	Hedyotis corymbosa						*
	Imperata cylindrica	***				*	***
	Innula cappa						**
	Ischaemum spp.						***
	Juncus spp.			*			
	Marsilea quadrifolia			**			
	Mikania micrantha	***	**	**		**	*
	Mimosa pudica	**			**	*	
	Miscanthus floridulus	**		*			**
	Neyraudia reynaudiana	**		*			**
	Oxalis corniculata		***				
	Oxalis repens		**				
	Panicum maxima						*
	Panicum repens	*		***			*
	Paspalum notatum	***					**
	Paspalum districhum			**			
	Rhynchelytrum repens	**				*	*
	Pogonatherum critinum	**					*
	Polygonum chinense		**				
	Pteroloma triquetrum				*	*	*
	Rhynoscopa rubra	**		**			*
	Setaria glauca						**
	Sida acuta	**					
	Solanum nigrum		**				
	Solanum torvum		*				
	Sonchus oleraceus		**				*
	Synedrella nodiflora	**	**				
	Triumfetta bartramia	**					
	Utricularia spp.			**			
	Vernonia cinerea		***				
	Wedelia chinensis	**	**	**		****	
	Spiranthes sinensis			*			
	Eulophia sinensis			*			
Climber	*Buettnera aspera*				**		
	Cocculus orbiculatus				*		*
	Embelia laeta						*
	Ficus pandurata				*		
	Gnetum montanum				**		
	Ipomoea carica	***	**			*	**
	Lygodium japonica	*			**		***
	Millettia nitida						*
	Morinda umbellata					*	**
	Mussendanea pubescens						*

Growth Form	Species	Relative Abundance					
		Waste	Orch/Agr	Waste (Flood)	SW	P W	G
	Paederia scandens		***			**	**
	Pueraria lobata	**	**	**	***		
	Pueraria phaseoloides	**		**	***		
	Rourea microphylla						
	Rubus parvifolius				*		
	Smilax china				*		*
	Smilax glabra						**
	Strophanthus divariculatus						**
	Tetracera asiatica						*
	Uvaria microcarpa				*		

Key:

Waste :	Wasteland
Orcd/Agr:	Agricultural field and Orchard
Waste (Flood):	Scattered wasteland areas flooded in wet season
SW:	Secondary Woodland
PW:	Plantation Woodland
G:	Grassland

Annex I

EM&A Manual

TERRITORIAL DEVELOPMENT DEPARTMENT

AGREEMENT NO. CE 90\96

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

ENVIRONMENTAL IMPACT ASSESSMENT STUDY:

ENVIRONMENTAL MONITORING AND AUDIT MANUAL

MAY 1998

FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA
ENVIRONMENTAL IMPACT ASSESSMENT STUDY:
Environmental Monitoring and Audit Manual

CONTENT **Page**

FIGURES :

TABLES :

ANNEX A Proforma for construction phase EM&A programme

Sample Template for Interim Notifications of Environmental Quality Limits Exceedances
Data Sheet for TSP Monitoring
Noise Monitoring Field Record Sheet
Water Quality Monitoring Data Record Sheet
Data format for water quality monitoring
Implementation Schedule
Implementation Status Proforma
Data Recovery Schedule
Site Inspection Proforma
Proactive Environmental Protection Proforma
Regulatory Compliance Proforma
Complaint Log

1 INTRODUCTION

1.1 Purpose of the Manual

1.1.1 The purpose of this Environmental Monitoring and Audit (EM&A) Manual, hereafter referred to as the Manual, is to guide the setup of an EM&A programme to ensure compliance with the Environmental Impact Assessment (EIA) study recommendations, to assess the effectiveness of the recommended mitigation measures and to identify any further need for additional mitigation measures or remedial action. This Manual outlines the monitoring and audit programme to be undertaken for the construction of Pak Shek Kok Development Area (PSKDA). It aims to provide systematic procedures for monitoring, auditing and minimising of the environmental impacts associated with the construction works.

1.1.2 Hong Kong environmental regulations for air and water quality, noise and waste, the Hong Kong Planning Standards and Guidelines, and recommendations in the EIA study final report on Feasibility Study for PSKDA have served as environmental standards and guidelines in the preparation of this Manual.

1.1.3 This Manual contains the following:

(a) responsibilities of the Contractor, the Engineer or Engineer's Representative (ER) and Environmental Team (ET) with respect to the environmental monitoring and audit requirements during the course of the project;

(b) information on project organisation and programming of construction activities for the project;

(c) the hypotheses of potential impacts, the basis for and description of the broad approach underlying the environmental monitoring and audit programme;

(d) requirements with respect to the construction schedule and the necessary environmental monitoring and audit programme to track the varying environmental impact;

(e) the specific questions and testable hypotheses that the monitoring programme is designed to answer;

(f) full details of the methodologies to be adopted, including all field, laboratory and analytical procedures, and details on quality assurance and quality control programme;

(g) the rationale on which the environmental monitoring data will be evaluated and interpreted and the details of the statistical procedures that will be used to interpret the data;

(h) definition of Action and Limit levels (AL Levels);

(i) establishment of Event and Action Plans;

(j) requirements of reviewing pollution sources and working procedures required in the event of non-compliance of the environmental criteria and complaints;

(k) requirements of presentation of environmental monitoring and audit data and appropriate reporting procedures; and

(l) requirements for review of EIA predictions and effectiveness of the environmental monitoring and audit programme.

1.1.4 For the purpose of this Manual, the "Engineer" shall refer to the Engineer as defined in the Contract and the Engineer's Representative (ER), in cases where the Engineer's powers have been delegated to the ER, in accordance with the Contract. The ET leader, who shall be responsible for and in charge of the ET, shall refer to the person delegated the role of executing the environmental monitoring and audit requirements.

1.2 Background

1.2.1 On 10 April 1997, the Territory Development Department (TDD) of the Hong Kong Government commissioned Maunsell Consultants Asia Ltd (hereafter known as Maunsell) as the lead consultant for the Feasibility Study on the PSKDA (hereafter referred to as the Study) under Agreement No. CE 90/96. The purpose of this Study is to identify the alternative concept options for the PSKDA and then recommend the preferred development option for which Preliminary Design will be developed.

1.2.2 The project site and boundary is shown in *Figure 1.2a*.

1.2.3 The purpose of the EIA was to provide information on the nature and extent of environmental impacts arising from the construction and operation of the PSKDA and related activities which includes the dredging and public filling taking place concurrently for the Pak Shek Kok Reclamation - Public Dump (PSKRPD). The EIA will contribute to decisions on:

- the overall acceptability of any adverse environmental impacts arising from the proposed PSKDA;
- any conditions and requirements to be included into the detailed design, construction and operation of the PSKDA; and
- the acceptability of any residual impacts after the implementation of mitigation measures.

The EIA has produced various deliverables during the Assignment for consideration by the Environmental Study Management Group which include the following:

- **Environmental Demonstration Paper** The purpose of this Demonstration Paper was to comparatively assess the previous PSKRPD EIA and only assess the changes made in the reclamation phasing to determine that the impacts are no greater than that previously assessed;
- **EIA - Initial Assessment Report (EIA - IAR)** The purpose of this report was to review existing data and highlight key issues and constraints of the PSKDA proposals. The findings of this report have been used to provide input into the selection of a preferred development option;
- **EIA Report** The purpose of this report was to consolidate all the findings of the environmental impact assessment based on the preferred PSKDA option. The findings and recommendations of this report will be incorporated into the Preliminary Design of the PSKDA;
- **Environmental Monitoring and Audit (EM&A Manual)** The purpose of this Manual is to design and specify the EM&A requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures recommended in the EIA Report; and
- **Executive Summary** The purpose of the Executive Summary is to provide a non technical summary of all the findings in the EIA Study.

1.3 Environmental Monitoring and Audit Requirements

Noise

1.3.1 It was recommended that noise monitoring be carried out as part of the EM&A programme during the construction period of the PSKDA at the following locations:

- NSRs N1 (Chinese University Hong Kong (CUHK) Staff Accommodation);
- N2 (CUHK);
- N3 (Cheung Shue Tan Village);
- N4 (Tsiu Hang Village); and
- N8 (Tertiary Education Institution in Area 39).

1.3.2 Monitoring is required to ensure compliance with the Environmental Impact Assessment Ordinance (EIAO) in providing feedback to the Contractors for the management of their operations.

Air Quality

1.3.3 The cumulative construction work is likely to cause exceedance of the Total Suspended Particulates (TSP) dust criterion at ASRs A1 and A2 in 2001. Dust control measures are recommended to be incorporated in the Contract Specification of the PSKDA and PSK Reclamation to minimise dust nuisance arising from the works. It is expected that with the above measures, dust emission from infrastructure and development construction, materials handling and bulldozing could be reduced by 50%.

Water Quality

1.3.4 Based on the EIA Report of water quality impacts, it is recommended that during the construction of PSKDA, a water quality monitoring and auditing programme should be conducted before and during reclamation works to proactively detect any deterioration of water quality.

Waste Management

1.3.5 Auditing of different waste generation, storage, recycling, treatment, transport and disposal arrangements/procedures should be carried out periodically to determine if waste is being managed in accordance with approved procedures and the site water management plan and see if waste reduction targets are being achieved or could be improved.

1.3.6 Representative air, noise and water sensitive receivers, as defined in Environmental Impact Assessment Ordinance-Technical Memorandum, have been identified based on the EIA Report are listed in *Tables 1.2a-c*. The locations of these sensitive receivers are shown in *Figures 1.3a-c*.

Table 1.3a ***Air Sensitive Receivers***

ASR	Description
A1	Hong Kong Institute of Biotechnology (HKIB)
A2	HKIB Staff Accommodation
A3	CUHK Playing Fields
A4	CUHK: Residence No. 10
A5	Cheung Shue Tan Village
A6	Wong Nai Fai Village
A7	Tsiu Hang Village
A8	Deerhill Bay
A9	Villa Castell
A10	Hong Kong Institute of Education Playing Fields
A11	Education Facility
A12	Education Facility
A13	Open Space in Stage III Reclamation
A14	Residential Development (High Density)-R2 (1)
A15, A16	Residential Development-Site A (Medium Density)
A17	Residential Area in Stage III Reclamation
A18	Science Park
A19	CUHK Marine Science Laboratory (MSL)

Table 1.3b Noise Sensitive Receivers

NSR	Description
N1	HKIB Staff Accommodation
N2	CUHK: Residence No. 10
N3	Cheung Shue Tan Village
N4	Tsiu Hang Village
N5	Deerhill Bay
N6	Villa Castell
N7	Educational Uses in Area 12
N8	Possible Tertiary Education Institution in Area 39
N9	Residential Development-Site A (Medium Density)
N10	Residential Development (High Density)-R2

Table 1.3c Water Sensitive Receivers

WSR	Description
W1	CUHK Marine Science Laboratory (existing)
W2	Shatin WSD Seawater Pumping Station
W3	Tai Po WSD Seawater pumping Station
W4	Yim Tin Tsai Mariculture Zone
W5	CUHK Marine Science Laboratory (reprovisioned)

1.4 Project Organisation

1.4.1 The project organisation and lines of communication with respect to environmental protection works is shown in *Figure 1.4a*.

1.4.2 The Environmental Team (ET) shall not be in any way an associated body of the Contractor. The ET leader shall have relevant professional qualifications, or have sufficient relevant EM&A experience subject to approval of the Engineer's Representative (ER) and the Environmental Protection Department (EPD).

1.4.3 Appropriate staff shall be included in the ET, under the supervision of the ET Leader, to fulfil the EM&A duties of the ET Leader specified in this manual. Basically, the duties comprise the following:

(a) To monitor the various environmental parameters as required in EIA study final report;

(b) To investigate and audit the Contractors' equipment and work methodologies with respect to pollution control and environmental mitigation, and anticipate environmental issues for proactive action before problems arise;

(c) To audit and prepare audit reports on the environmental monitoring data and the site environmental conditions; and

(d) To report on the environmental monitoring and audit results to the Contractor, the ER, and the EPD or its delegate.

1.4.4 Appropriate resources shall also be allocated under the Contractor and the ER to fulfil their duties specified in this manual.

1.4.5 The Independent Checker (Environmental), IC(E), shall be an independent person or company with a minimum of 5 years EIA experience and proven track record in EM&A similar to the scope proposed in this Manual.

1.5 Construction Programme

PSKDA Construction Sequence

1.5.1 The formation of the sites and provision of infrastructure to be undertaken will in accordance with the construction programme as shown in *Figure 1.5a*. The construction programme forecasts the availability of land for various types of developments. The programme also incorporates other Government engineering and construction projects including roads and other infrastructure constructions, the provision of public housing estates and other government and community facilities. As shown in *Figure 1.5a*, the PSKDA will be implemented in stages, broadly following the completion of the reclamation which will be progressively completed from first commencement (late 1996) to 2004.

1.5.2 The construction of the proposed PSKDA is expected to proceed in three stages, with the development of the Science Park proceeding in the southern section first by the year 2001, followed by the development of residential development in the north in 2003 and recreation in the central area by the year 2006. A preliminary construction programme is shown in *Figure 1.5a*. At present, it is not known how the development on the existing Area 12 (Part) and 39 reclamation will proceed, apart from the area reserved for HKIE playing fields should be completed by the year 2000. Key programme dates can be summarised as follows:

- Civil Engineering Department (CED) reclamation programme is essentially fixed, with land for the Science Park Phase 1 being produced first (in portions from February 1998 to June 1999), followed by the northern portion (December 2000), then the remaining central section of land (July 2004).
- Substantial additional sewerage disposal capacity, beyond that needed for the Science Park Phase 1, is not expected to be available until 2003.

1.5.3 It should, however, be noted that the construction programme will be subject to ongoing change and refinement due to design development and Government review, as well as change and refinement as the design progresses. Any subsequent significant changes to the programme will necessitate an environmental review to confirm that impacts, including cumulative impacts, are no greater than those predicted in this PSKDA EIA.

Infrastructural Works

1.5.4 Infrastructural works to be conducted on the reclamation will include construction of the Science Park, residential development and recreational uses and the associated road works, infrastructural services and pipe laying.

1.5.5 The HKIE Sports Centre, as a committed use, can commence construction once the extension of Yau King Lane is completed, which is the only access to that site during its construction time.

1.5.6 The first phase of the Science Park is intended to open in mid 2001 on land nearest the Hong Kong Institute of Biotechnology. The advanced works which will include the Southern Access Road and will supply the necessary infrastructure to allow the Science Park to operate is expected to be open by mid 2001.

1.5.7 The residential areas north of the nullah will commence in 2001 and should be completed by mid 2003. The residential area south of the nullah will commence in 2004 and should be completed by the 2007.

Southern and Northern Access Roads

1.5.8 The Southern and Northern access roads have been proposed in the PSKDA Study *Access Road Options Working Paper (ET/03)*, *Working Paper (ET/07)* and *PPFS*. Access options to the north and south have been proposed due to the implementation of the proposed developments and potential connections with the Tolo Highway. *Figures 1.5b-c* show the alignments of the proposed access roads. There will also be small reclamation requirements associated with these access roads as shown in *Figures 1.5d-e*.

KCRC Station

1.5.9 The options for rail access have been proposed in the PSKDA Study *Access Road Options Working Paper (ET/03)* and *KCRC Provisions Report (ET/06)* which would involve the option of the provision of a station along a straight section of rail in the middle of the site as shown in *Figure 1.5f*.

Other Projects

1.5.10 A summary of concurrent projects within the PSKDA is given in *Table 1.5a* and described in the following sections:

Table 1.5a Concurrent Projects

Development	**Proposed/Likely Programme**
Tolo Highway Widening	December 1998 - December 2001
Tai Po Development - Formation and Servicing of Area 12 (part) and 39, Phase I	March 1998 - March 2000
Tai Po Development - Formation and Servicing of Area 12 (part) and 39, Phase II	mid 1999 - end 2001

Tai Po Areas 12 (part) and 39

The proposed formation and servicing works have been divided into two phases. Phase I will include the following works:

- Site formation in the northern part of Area 39 (filling to approximately +6.0 m PD and associated drains);
- Widening of the existing Yau King Lane and construction and construction of Road L39/1 (north) to link Area 39 to Tai Po Road. Part of Road L39/1 will be constructed on the existing Kowloon Canton Railway embankment and track;
- Provision of pedestrian footways; and
- Provision of associated drains.

(i) Phase II Works will include completion of the site formation and servicing in the southern part of Area 39, completion of Road L39/1 and construction of Roads L39/2, L12/1, L12/2, culverting of the existing nullah, training of stream channels and other associated works. The duration of Phase II works is expected to be from mid 1999 until mid 2001.

PSK Reclamation

1.5.11 The construction of the Pak Shek Kok Reclamation is to be undertaken under a CED Public Dump Contract and has been environmentally assessed previously in the Pak Shek Kok Reclamation-Public Dump, EIA Study undertaken by Mouchel (April 1994). The proposed construction programme was expected to commence in the south and proceeding in three stages (Stages I to III) to the north.

1.5.12 Subsequent to the findings of the previous PSKRPD EIA, a revised staging programme was proposed in the PSKDA Study Reclamation Options Working Paper ET/02, Addendum No.1 in order to cater for the housing demand identified. An environmental Demonstration Paper was undertaken, as part of the PSKDA EIA Study, and submitted on 27 August 1997 to comparatively assess the proposed changes with previous PSKRPD EIA to determine that the impacts were no greater than that previously assessed.

1.5.13 *Figure 1.5a* is the tentative works programme for the project. This programme is for information of the ET Leader to get an initial idea of the projection of the works. The ET Leader shall make reference to the actual works progress and programme during the construction stage to schedule the EM&A works, and the Contractor shall provide the respective information to the ET Leader for formulating the EM&A schedule.

1.5.14 Due to the concurrent ongoing projects highlighted in this section, it is considered effective to have an integrated EM&A programme, if contractual arrangements allows. This integrated approach will facilitate the interaction of the various projects and thus avoid the potential duplication of environmental monitoring requirements.

2 AIR QUALITY

2.1 Introduction

2.1.1 In this section, the methodology, equipment, monitoring locations, criteria and protocols for the monitoring and audit of air quality impacts during the construction stage of PSKDA are explained. Dust is expected to be the key pollutant during construction of the PSKDA.

2.1.2 The impact of fugitive dust on ambient air pollution depends on the quantity, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and particles that are 30 - 100 μm in diameter are likely to undergo impended settling. These particles, depending on the extent of atmospheric turbulence, would settle within a distance of 100 m from the source. The main dust impact will arise from the fine particles of a diameter less than 30 μm, measured as TSP, dispersed over great distance from the sources. TSP levels shall, therefore, be monitored to evaluate the dust impact during impact during the construction. The objectives of TSP monitoring shall be:

- to identify the extent of construction dust impacts on sensitive receiver;
- to determine the effectiveness of mitigation measures to control dust from construction activities;
- to recommend further mitigation measures if found to be necessary; and
- to comply with AL Levels for air quality as defined in this Manual.

2.2 Air Quality Parameters

2.2.1 Monitoring and audit of the TSP levels shall be carried out by the ET to ensure that any deteriorating air quality could be readily detected and timely action taken to rectify the situation.

2.2.2 1-hour and 24-hour TSP levels should be measured to indicate the impacts of construction dust on air quality. The TSP levels shall be measured by following the standard high volume sampling method as set out in the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B. Upon approval of the ER, 1-hour TSP levels can be measured by direct reading methods which are capable of producing comparable results as that by the high volume sampling method, to indicate short event impacts.

2.2.3 All relevant data including temperature, pressure, weather conditions, elapsed-time meter reading for the start and stop of the sampler, identification and weight of the filter paper, and other special phenomena and work progress of the concerned site etc. shall be recorded down in details. A sample data sheet is shown in *Annex A*.

2.3 Monitoring Equipment

2.3.1 High volume sampler (HVS) in compliance with the following specifications shall be used for carrying out the 1-hr and 24-hr TSP monitoring:

(a) 0.6-1.7 m^3/min (20-60 SCFM) adjustable flow range;
(b) equipped with a timing/control device with +/- 5 minutes accuracy for 24 hours operation;
(c) installed with elapsed-time meter with +/- 2 minutes accuracy for 24 hours operation;
(d) capable of providing a minimum exposed area of 406 cm^2 (63 in^2);
(e) flow control accuracy: +/- 2.5% deviation over 24-hr sampling period;
(f) equipped with a shelter to protect the filter and sampler;
(g) incorporated with an electronic mass flow rate controller or other equivalent devices;
(h) equipped with a flow recorder for continuous monitoring;
(i) provided with a peaked roof inlet;
(j) incorporated with a manometer;
(k) able to hold and seal the filter paper to the sampler housing at horizontal position;
(l) easy to change the filter; and
(m) capable of operating continuously for 24-hr period.

2.3.2 The ET Leader is responsible for provision of the monitoring equipment. He shall ensure that sufficient number of HVSs with an appropriate calibration kit are available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. The HVSs shall be equipped with an electronic mass flow controller and be calibrated against a traceable standard at regular intervals. All the equipment, calibration kit, filter papers, etc. shall be clearly labelled.

2.3.3 Initial calibration of dust monitoring equipment shall be conducted upon installation and thereafter at bi-monthly intervals. The transfer standard shall be traceable to the internationally recognised primary standard and be calibrated annually. The calibration data shall be properly documented for future reference by the concerned parties such as the IC(E). All the data should be converted into standard temperature and pressure condition.

2.3.4 The flow-rate of the sampler before and after the sampling exercise with the filter in position shall be verified to be constant and be recorded down in the data sheet as mentioned in *Annex A*.

2.3.5 If the ET Leader proposes to use a direct reading dust meter to measure 1-hr TSP levels, he shall submit sufficient information to the IC(E) to prove that the instrument is capable of achieving a comparable result as that the HVS and may be used for the 1-hr sampling. The instrument should also be calibrated regularly, and the 1-hr sampling shall be determined periodically by HVS to check the validity and accuracy of the results measured by direct reading method.

2.3.6 Wind data monitoring equipment shall also be provided and set up at conspicuous locations for logging wind speed and wind direction near to the dust monitoring locations. The equipment installation location shall be proposed by the ET Leader and agreed with the ER in consultation with IC(E). For installation and operation of wind data monitoring equipment, the following points shall be observed:

(a) the wind sensors should be installed on masts at an elevated level 10m above ground so that they are clear of obstructions or turbulence caused by the buildings;
(b) the wind data should be captured by a data logger and to be downloaded for processing at least once a month;
(c) the wind data monitoring equipment should be re-calibrated at least once every six months; and
(d) wind direction should be divided into 16 sectors of 22.5 degrees each.

2.3.7 In exceptional situations, the ET Leader may propose alternative methods to obtain representative wind data upon approval from the ER and agreement from IC(E).

2.4 Laboratory Measurement / Analysis

2.4.1 A clean laboratory with constant temperature and humidity control, and equipped with necessary measuring and conditioning instruments, to handle the dust samples collected, shall be available for sample analysis, and equipment calibration and maintenance. The laboratory shall be HOKLAS accredited or other internationally accredited laboratory.

2.4.2 If a site laboratory is set up or a non-HOKLAS accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment shall be approved by the ER in consultation with the IC(E). Measurement performed by the laboratory shall be demonstrated to the satisfaction of the ER and the IC(E). IC(E) shall conduct regular audit to the measurement performed by the laboratory to ensure the accuracy of measurement results. The ET Leader shall provide the ER with one copy of the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B for his reference.

2.4.3 Filter paper of size 8"x 10" shall be labelled before sampling. It shall be a clean filter paper with no pin holes, and shall be conditioned in a humidity controlled chamber for over 24-hr and be pre-weighed before use for the sampling.

2.4.4 After sampling, the filter paper loaded with dust shall be kept in a clean and tightly sealed plastic bag. The filter paper is then returned to the laboratory for reconditioning in the humidity controlled chamber followed by accurate weighing by an electronic balance with a readout down to 0.1 mg. The balance shall be regularly calibrated against a traceable standard.

2.4.5 All the collected samples shall be kept in a good condition for 6 months before disposal.

2.5 Monitoring Locations

2.5.1 The dust monitoring locations are shown in *Figure 2.5a* and summarised in *Table 2.5a*. The status and locations of dust sensitive receivers may change after issuing this manual. If such cases exist, the ET Leader shall propose updated monitoring locations and seek approval from ER and agreement from the IC(E).

Table 2.5a ***Air Quality Monitoring Stations***

Air Quality Monitoring Stations	Monitoring Location
AM1	HKIB Staff Accommodation
AM2	Cheung She Tan Village
AM3	Villa Castell
AM4*	SW edge of Stage II reclamation

Note: * AM4 monitoring will not commence until the formation of nullah is finished.

2.5.2 When alternative monitoring locations are proposed, the following criteria, as far as practicable, should be followed:

(a) at the site boundary or such locations close to the major dust emission source;

(b) close to the sensitive receptors; and

(c) take into account the prevailing meteorological conditions.

2.5.3 The ET Leader shall agree with the ER in consultation with the IC(E) the position of the HVS for installation of the monitoring equipment. When positioning the samplers, the following points shall be noted:

(a) a horizontal platform with appropriate support to secure the samplers against gusty wind should be provided;

(b) no two samplers should be placed less than 2 meter apart;

(c) the distance between the sampler and an obstacle, such as buildings, must be at least twice the height that the obstacle protrudes above the sampler;

(d) a minimum of 2 metres of separation from walls, parapets and penthouses is required for rooftop samplers;

(e) a minimum of 2 metre separation from any supporting structure, measured horizontally is required;

(f) no furnace or incinerator flue is nearby;

(g) airflow around the sampler is unrestricted;

(h) the sampler is more than 20 metres from the dripline;

(i) any wire fence and gate, to protect the sampler, should not cause any obstruction during monitoring;

(j) permission must be obtained to set up the samplers and to obtain access to the monitoring stations; and

(k) a secured supply of electricity is needed to operate the samplers.

2.6 Baseline Monitoring

2.6.1 The ET Leader shall carry out baseline monitoring at all of the designated monitoring locations for at least 14 consecutive days prior to the commissioning of the construction works to obtain daily 24-hr TSP samples. 1-hr sampling shall also be done at least 3 times per day while the highest dust impact is expected. Before commencing the baseline monitoring, the ET leader shall inform the IC(E) of the baseline monitoring programme such that the IC(E) can conduct on-site audit to ensure accuracy of the baseline monitoring results.

2.6.2 During the baseline monitoring, there should not be any construction or dust generation activities in the vicinity of the monitoring stations.

2.6.3 In case the baseline monitoring cannot be carried out at the designated monitoring locations during the baseline monitoring period, the ET Leader shall carry out the monitoring at alternative locations which can effectively represent the baseline conditions at the impact monitoring locations. The alternative baseline monitoring locations shall be approved by the ER and agreed with the IC(E).

2.6.4 In exceptional case, when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall liaise with the IC(E) and EPD to agree on an appropriate set of data to be used as a baseline reference and submit to ER for approval.

2.6.5 Ambient conditions may vary seasonally and shall be reviewed at three monthly intervals. If the ET Leader considers that the ambient conditions have been changed and a repeat of the baseline monitoring is required to be carried out for obtaining the updated baseline levels, the monitoring shall be at times when the contractor's activities are not generating dust, at least in the proximity of the monitoring stations. Should change in ambient conditions be determined, the baseline levels and, in turn, the air quality criteria, shall be revised. The revised baseline levels and air quality criteria shall be agreed with the IC(E) and EPD.

2.7 Impact Monitoring

2.7.1 The ET Leader shall carry out impact monitoring during the course of the Works. For regular impact monitoring, the sampling frequency of at least once in every six-days, shall be strictly observed at all the monitoring stations for 24-hr TSP monitoring. For 1-hr TSP monitoring, the sampling frequency of at least three times in every six-days shall be undertaken when the highest dust impact occurs. Before commencing the baseline monitoring, the ET leader shall inform the IC(E) of the impact monitoring programme such that the IC(E) can conduct on-site audit to ensure accuracy of the impact monitoring results.

2.7.2 The specific time to start and stop the 24-hr TSP monitoring shall be clearly defined for each location and be strictly followed by the operator.

2.7.3 In case of non-compliance with the air quality criteria, more frequent monitoring exercise, as specified in the Action Plan in *Section 2.8*, shall be conducted within 24 hours after the result is obtained. This additional monitoring shall be continued until the excessive dust emission or the deterioration in air quality is rectified.

2.8 Event and Action Plan for Air Quality

2.8.1 The baseline monitoring results form the basis for determining the air quality criteria for the impact monitoring. The ET Leader shall compare the impact monitoring results with air quality criteria set up for 24-hour TSP and 1-hour TSP. *Table 2.8a* shows the air quality criteria, namely Action and Limit (AL) Levels to be used. Should non-compliance of the air quality criteria occurs, actions in accordance with the Action Plan in *Table 2.8b* shall be carried out.

Table 2.8a *Action and Limit Levels for Air Quality*

Parameters	Action	Limit
24 Hour TSP Level in μg/m^3	For baseline level ≤ 200 μg/m^3, Action level = (Baseline level * 1.3 + Limit level)/2; For baseline level > 200 μg/m^3, Action level = Limit level	260
1 Hour TSP Level in μg/m^3	For baseline level ≤ 384 μg/m^3, Action level = (Baseline level *1.3 + Limit level)/2 For baseline level > 384 μg/m^3, Action level = Limit level	500

Table 2.8b Event/Action Plan for Air Quality

EVENT	ACTION			
	ET Leader	IC(E)	ER	CONTRACTOR
ACTION LEVEL				
1. Exceedance for one sample	1. Identify source 2. Inform IC(E) and ER 3. Repeat measurement to confirm finding 4. Increase monitoring frequency to daily	1. Check monitoring data submitted by ET 2. Check Contractor's working method	1. Notify Contractor	1. Rectify any unacceptable practice 2. Amend working methods if appropriate
2. Exceedance for two or more consecutive samples	1. Identify source 2. Inform IC(E) and ER 3. Repeat measurements to confirm findings 4. Increase monitoring frequency to daily 5. Discuss with IC(E) and Contractor on remedial actions required 6. If exceedance continues, arrange meeting with IC(E) and ER 7. If exceedance stops, cease additional monitoring	1. Checking monitoring data submitted by ET 2. Check Contractor's working method 3. Discuss with ET and Contractor on possible remedial measures 4. Advise the ER on the effectiveness of the proposed remedial measures 5. Supervisor implementation of remedial measures	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Ensure remedial measures properly implemented	1. Submit proposals for remedial actions to IC(E) within 3 working days of notification 2. Implement the agreed proposals 3. Amend proposal if appropriate
LIMIT LEVEL				
1. Exceedance for one sample	1. Identify source 2. Inform ER and EPD 3. Repeat measurement to confirm finding 4. Increase monitoring frequency to daily 5. Assess effectiveness of Contractor's remedial actions and keep IC(E), EPD and ER informed of the results	1. Checking monitoring data submitted by ET 2. Check Contractor's working method 3. Discuss with ET and Contractor on possible remedial measures 4. Advise the ER on the effectiveness of the proposed remedial measures 5. Supervisor implementation of remedial measures	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Ensure remedial measures properly implemented	1. Take immediate action to avoid further exceedance 2. Submit proposals for remedial actions to IC(E) within 3 working days of notification 3. Implement the agreed proposals 4. Amend proposal if appropriate
2. Exceedance for two or more consecutive samples	1. Notify IC(E), ER, Contractor and EPD 2. Identify source 3. Repeat measurement to confirm findings 4. Increase monitoring frequency to daily 5. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented 6. Arrange meeting with IC(E) and ER to discuss the remedial actions to be taken 7. Assess effectiveness of Contractor's remedial actions and keep IC(E), EPD and ER informed of the results 8. If exceedance stops, cease additional monitoring	1. Discuss amongst ER, ET, and Contractor on the potential remedial actions 2. Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly 3. Supervise the implementation of remedial measures	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. In consultation with the IC(E), agree with the Contractor on the remedial measures to be implemented 4. Ensure remedial measures properly implemented 5. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated	1. Take immediate action to avoid further exceedance 2. Submit proposals for remedial actions to IC(E) within 3 working days of notification 3. Implement the agreed proposals 4. Resubmit proposals if problem still not under control 5. Stop the relevant portion of works as determined by the ER until the exceedance is abated

2.9 Dust Mitigation Measures

2.9.1 The EIA report has recommended dust control and mitigation measures. The Contractor shall be responsible for the design and implementation of these measures.

2.9.2 The cumulative construction work is likely to cause exceedance of the TSP dust criterion at ASRs A1 and A2 in 2001. The following dust control measures are recommended to be incorporated in the Contract Specification of the PSKDA and PSK Reclamation to minimise dust nuisance arising from the works:

- the heights from which fill materials are dropped should be controlled to a practical height to minimize the fugitive dust arising from unloading;
- during transportation by truck, materials should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport;
- all stockpiles of aggregate or spoil should be enclosed or covered and water applied in dry or windy condition;
- effective water sprays should be used on the site at potential dust emission sources such as unpaved area;
- the haul road should be paved and vehicle speed should be limited to 20 kph;
- the haul road should be located away from the sensitive receivers, regular watering is recommended; and
- wheel washing facilities should be provided at the exit of work site.

2.9.3 If the above measures are not sufficient to restore the air quality to acceptable levels upon the advice of ET Leader, the Contractor shall liaise with the ET Leader on some other mitigation measures, propose to ER for approval, and implement the mitigation measures.

3 NOISE

3.1 Introduction

3.1.1 As the noise sensitive receivers (NSR)s near the PSKDA working area will be subjected to daytime, and possibly restricted-hour construction noise, a noise monitoring programme shall be developed by the ER to include daytime and restricted-hour (if necessary) noise measurement at the sensitive receivers. The programme shall be carried out by the ET to ensure that the noise level of construction works complies with the criteria of the Noise Control Ordinance (NCO) and other adopted noise criteria.

3.2 Noise Parameters

3.2.1 The construction noise level shall be measured in terms of the A-weighted equivalent continuous sound pressure level (L_{eq}). $L_{eq(30\ min)}$ shall be used as the monitoring parameter for the time period between 0700-1900 hours on normal weekdays. For all other time periods, $L_{eq(3 \times 5\ min)}$ shall be employed for comparison with the NCO criteria.

3.2.2 As supplementary information for data auditing, statistical results such as L_{10} and L_{90} shall also be obtained for reference. A sample data record sheet is shown in *Annex A* for reference.

3.3 Monitoring Equipment

3.3.1 As referred to in the Technical Memorandum (TM) issued under the Noise Control Ordinance (NCO), sound level metres in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications shall be used for carrying out the noise monitoring. Immediately prior to and following each noise measurement the accuracy of the sound level metre shall be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements may be accepted as valid only if the calibration level from before and after the noise measurement agree to within 1.0 dBA.

3.3.2 Noise measurements should not be made in accordance with standard acoustical principles and practices in relation to weather conditions.

3.3.3 The ET Leader is responsible for the provision and maintenance of the monitoring equipment. He shall ensure that sufficient noise measuring equipment and associated instrumentation are available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. All the equipment and associated instrumentation shall be clearly labelled.

3.4 Monitoring Locations

3.4.1 The noise monitoring locations are shown in *Figure 3.4a* and summarised in *Table 3.4a*. The status and locations of noise sensitive receivers may change after issuing this manual. If such cases exist, the ET Leader shall propose updated monitoring locations and seek approval from ER, and agreement from the IC(E) and EPD of the proposal.

Table 3.4a *Noise Monitoring Stations*

Noise Monitoring Station	Noise Monitoring Location
NM1	CUHK Staff Accommodation
NM2	CUHK Residence No. 10
NM3	Cheung Shue Tan Village
NM4	Tsiu Hang Village
NM5	Deerhill Bay Development
NM6	Possible Tertiary Education Institution in Area 39
NM7	Residential Development (High Density) - R2

3.4.2 When alternative monitoring locations are proposed, the monitoring locations shall be chosen based on the following criteria:

(a) at locations close to the major site activities which are likely to have noise impacts;

(b) close to the noise sensitive receivers (N.B. For the purposes of this section, any domestic premises, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing art centre shall be considered as a noise sensitive receiver); and

(c) for monitoring locations located in the vicinity of the sensitive receivers, care shall be taken to cause minimal disturbance to the occupants during monitoring.

3.4.3 The monitoring station shall normally be at a point 1m from the exterior of the sensitive receivers building facade and be at a position 1.2m above the ground. If there is a problem with access to the normal monitoring position, an alternative position may be chosen, and a correction to the measurements shall be made. For reference, a correction of +3dB(A) shall be made to the free field measurements. The ET Leader shall agree with the IC(E) on the monitoring position and the corrections adopted. Once the positions for the monitoring stations are chosen, the baseline monitoring and the impact monitoring shall be carried out at the same positions.

3.5 Baseline Monitoring

3.5.1 The ET Leader shall carry out baseline noise monitoring prior to the commencement of the construction works. The baseline monitoring shall be carried out daily for a period of at least two weeks. A schedule on the baseline monitoring shall be submitted to the ER for approval before the monitoring starts.

3.5.2 There shall not be any construction activities in the vicinity of the stations during the baseline monitoring. Baseline monitoring measurements shall be evenly spread throughout the assessment period to be conducted at the some frequency and duration throughout all periods of the day for which works are anticipated to be constructed (eg. daytime, evening and nighttime).

3.5.3 In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall liaise with EPD to agree on an appropriate set of data to be used as a baseline reference and submit to the ER for approval.

3.6 Impact Monitoring

3.6.1 Noise monitoring shall be carried out at all the designated monitoring station. The monitoring frequency shall depend on the scale of the construction activities. The following is an initial guide on the regular monitoring frequency for each station on a per week basis when noise generating activities are underway:

(a) one set of measurements between 0700-1900 hours on normal weekdays;

(b) one set of measurements between 1900-2300 hours;

(c) one set of measurements between 2300-0700 hours of next day; and

(d) one set of measurements between 0700-1900 hours on holidays.

General construction work carrying out during restricted hours is controlled by CNP system under the NCO.

3.6.2 For the measurements (b), (c) and (d) above, one set of measurements shall at least include 3 consecutive $L_{eq(5\ min)}$ results.

3.6.3 If a school exists near the construction activity, noise monitoring shall be carried out at the monitoring stations for the schools during the school examination periods. The ET Leader shall liaise with the school's personnel and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.

3.6.4 In case of non-compliance with the construction noise criteria, more frequent monitoring as specified in the Action Plan in *Section 3.7* shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the construction activities.

3.7 Event and Action Plan for Noise

3.7.1 The AL Levels for construction noise are defined in *Table 3.7a*. Should non-compliance of the criteria occurs, action in accordance with the Action Plan in *Table 3.7b*, shall be carried out.

Table 3.7a *Action and Limit Levels for Construction Noise*

Time Period	Action	Limit
0700-1900 hrs on normal weekdays	When one documented complaint is received	75* dB(A)
0700-2300 hrs on holidays; and 1900-2300 hrs on all other days		60/65/70** dB(A)
2300-0700 hrs of next day		45/50/55** dB(A)

* Reduce to 70 dB(A) for schools and 65 dB(A) during school examination periods.
** To be selected based on Area Sensitivity Rating.

Table 3.7b *Event/Action Plan for Construction Noise*

EVENT	ACTION			
	ET Leader	IC(E)	ER	Contractor
Action Level	1. Notify IC(E) and Contractor 2. Carry out investigation 3. Report the results of investigation to the IC(E) and Contractor 4. Discuss with the Contractor and formulate remedial measures 5. Increase monitoring frequency to check mitigation effectiveness	1. Review the analysed results submitted by the ET 2. Review the proposed remedial measures by the Contractor and advise the ER accordingly 4. Supervise the implementation of remedial measures	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Require Contractor to propose remedial measures for the analysed noise problem 4. Ensure remedial measures are properly implemented	1. Submit noise mitigation proposals to IC(E) 2. Implement noise mitigation proposals
Limit Level	1. Notify IC(E), ER, EPD and Contractor 2. Identify source 3. Repeat measurement to confirm findings 4. Increase monitoring frequency 5. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented 6. Inform IC(E), ER and EPD the causes & actions taken for the exceedances 7. Assess effectiveness of Contractor's remedial actions and keep IC(E), EPD and ER informed of the results 8. If exceedance stops, cease additional monitoring	1. Discuss amongst ER, ET, and Contractor on the potential remedial actions 2. Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly 3. Supervise the implementation of remedial measures	1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Require Contractor to propose remedial measures for the analysed noise problem 4. Ensure remedial measures are properly implemented 5. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated	1. Take immediate action to avoid further exceedance 2. Submit proposals for remedial actions to IC(E) within 3 working days of notification 3. Implement the agreed proposals 4. Resubmit proposals if problem still not under control 5. Stop the relevant portion of works as determined by the ER until the exceedance is abated

3.8 Noise Mitigation Measures

3.8.1 The EIA Report has recommended construction noise control and mitigation measures. The Contractor shall be responsible for the design and implementation of these measures.

Recommended Mitigation Measures

3.8.2 Mitigation measures are detailed below, and the following forms of mitigation measures are recommended and should be incorporated into the Contract Specification:

- good site practice to limit noise emissions at source;
- selection of quieter plant and working methods; and
- reduction in number of plant operating in critical areas close to NSRs.

3.8.3 The Contractor may develop a different package of mitigation measures to meet the required noise standards, but the following illustrates suitable measures to demonstrate a feasible mitigation approach.

Good Site Practice

3.8.4 Good site practice and noise management can considerably reduce the impact of the construction sites' activities on nearby NSRs. The following package of measures should be followed during each phase of construction:

- only well maintained plant should be operated on-site and plant should be serviced regularly during the construction works;
- machines and plants (such as trucks, excavators) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction, should, where possible, be orientated so that the noise is directed away from nearby NSRs;
- silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction works; and
- mobile plant should be sited as far away from NSRs as possible.

Selecting Quieter Plant and Working Methods

3.8.5 The Contractor may be able to obtain particular models of plant that are quieter than standard types given in *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (GW-TM). The benefits achievable in this way will depend on the details of the Contractor's chosen methods of working, and it is considered too restrictive to specify that a Contractor has to use specific items of plant for the construction operations. It is therefore both preferable and practical to specify an overall plant noise performance specification to apply to the total sound power level of all plant on the site so that the Contractor is allowed some flexibility to select plant to suit his needs.

3.8.6 Quiet plant is defined as Power Mechanical Equipment (PME) whose actual Sound Power Level (SWL) is less than the value specified in GW-TM for the same piece of equipment. Examples of SWLs for specific silenced PME, which are known to be available in Hong Kong, are given below:

Bulldozer:	110 dB(A) max;
Breaker (Hand Held):	110 dB(A) max;
Compressors:	100 dB(A) max;
Concrete Pumps:	105 dB(A) max;
Dump Truck:	109 dB(A) max;
Excavator:	105 dB(A) max;
Generator:	100 dB(A) max;
Lorry:	105 dB(A) max;
Loader:	105 dB(A) max; and
Poker Vibrator:	110 dB(A) max.

Reducing the Number of Plant Operating in Critical Areas Close to NSRs

3.8.7 In general, the number of plant should be left to the choice of the Contractor. However, in cases of exceedances being identified by the noise monitoring, it may be appropriate to restrict the number of particularly noisy plant within certain parts of the site that are very close to the NSRs.

Constructing Temporary and Movable Noise Barriers

3.8.8 Movable barriers could be very effective in providing noise screening from a particular plant. It is anticipated that a 3 m high movable noise barrier with a skid footing and a small cantilevered upper portion can be located within a few metres of plant. It is estimated that movable noise barrier of this type, if carefully located, can produce at least 10 dB(A) screening for stationary plant and 5 dB(A) for mobile plant.

3.8.9 If there is any construction work during the restricted hours, it is the responsibility of the contractors to comply with the NCO and relevant TMs. The contractor should submit CNPs application and will be assessed by the Noise Control Authority, EPD. Conditions stipulated in CNPs might be strictly followed.

3.8.10 If the above measures are not sufficient to restore the construction noise quality to an acceptable levels upon the advice of ET Leader, the Contractor shall liaise with the ET Leader on some other mitigation measures, propose to ER for approval, and carry out the mitigation measures.

4 WATER QUALITY

4.1 Water Quality Parameters

4.1.1 During the PSKDA construction, operation of the seawater intakes could be directly impacted by Suspended Solids (SS), turbidity and pH values of seawater. SS concentration and turbidity should, therefore, be monitored to assess the background (ambient levels) and the extent of dredging impact during the construction. The pH value indicates the corrosive impact of seawater. The total hardness of water reflects the extent of the formation of insoluble precipitates that accumulate as adhering deposits on the surface of intake pipes and restrict the intake of seawater. Thus, these parameters are the most sensitive parameters of the seawater intakes that require close monitoring. Dissolved Oxygen (DO) concentration and % saturation will also be closely monitored as it is sensitive to reclamation activities.

4.1.2 Water quality monitoring shall be carried out by the ET to ensure that any deteriorating water quality could be readily detected and timely action taken to rectify the situation. Water quality monitoring parameters shall include:

- Dissolved oxygen (DO) (in mg l^{-1} and % saturation)
- Temperature (°C)
- pH value
- Turbidity (NTU)
- Water depth (m)
- Salinity (mg l^{-1})

In situ measurement

- Suspended Solids (SS) (mg l^{-1})
- Ash-free dry weight of SS (mg l^{-1})
- Chlorophyll a (μg l^{-1})
- Total Lead (μg l^{-1})
- Ammoniacal nitrogen (mg l^{-1})
- Total phosphate (mg l^{-1})

Laboratory analysis

These parameters are selected for monitoring on the following basis:

- to reflect the background marine water quality near and within the working area; and
- the nature of the construction activities (dredging and filling).

4.1.3 As described in the EIA Report, the layout and construction phasing of the PSKDA has been designed to optimise tidal flushing of the temporary water body and avoid the formation of embayed water body.

4.1.4 The selection of water quality monitoring parameters shall be based on the recommendation in the EIA/EA report. The monitoring shall be carried out by the ET to ensure that any deteriorating water quality could be readily detected and action be taken in time to rectify the situation.

4.1.5 In association with the water quality parameters, some relevant data shall also be measured, such as monitoring location/position, time, water depth, water temperature, salinity, DO % saturation, weather conditions, sea conditions, tidal stage, and any special phenomena and work underway at the construction site etc.

4.1.6 A sample monitoring record sheet and data format are shown in *Annex A* for reference.

4.2 Monitoring Equipment

4.2.1 Water quality monitoring equipment with the following specifications shall be supplied by the ET Leader.

Dissolved Oxygen and Temperature Measuring Equipment

4.2.2 Dissolved oxygen and temperature measuring equipment

(a) The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and use a DC power source. It shall be capable of measuring:-

- a dissolved oxygen level in the range of 0-20 mg/l and 0-200% saturation; and
- a temperature of 0-45 degree Celsius.

(b) It shall have a membrane electrode with automatic temperature compensation complete with a cable. Sufficient stocks of spare electrodes and cables shall be available for replacement where necessary. (e.g. YSI model 59 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or an approved similar instrument).

(c) Should salinity compensation not be built-in in the DO equipment, in-situ salinity shall be measured to calibrate the DO equipment prior to each DO measurement.

Turbidity Measurement Instrument

4.2.3 The instrument should be a portable, weatherproof turbidity-measuring instrument complete with comprehensive operation manual. The equipment should use a DC power source. It should have a photoelectric sensor capable of measuring turbidity between 0-1000 NTU and be complete with a cable (e.g. Hach model 2100P or an approved similar instrument).

4.2.4 The turbidity metre shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of SS (in mg l^{-1}). After calibration, turbidity measurements shall be taken as a true representation of levels of SS only before laboratory test results for SS are known.

Suspended Solids

4.2.5 A water sampler comprises a transparent PVC cylinder, with a capacity of not less than 2 litres, and can be effectively sealed with latex cups at both ends. The sampler should have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (e.g. Kahlsico Water Sampler or an approved similar instrument).

4.2.6 Water samples for suspended solids measurement should be collected in high density polythene bottles, packed in ice (cooled to 4°C without being frozen), and delivered to the laboratory as soon as possible after collection.

Water Depth Detector

4.2.7 A portable, battery-operated echo sounder should be used for the determination of water depth at each designated monitoring station. This unit can either be handheld or affixed to the bottom of the work boat, if the same vessel is to be used throughout the monitoring programme.

Salinity

4.2.8 A portable salinometer capable of measuring salinity in the range of 0-40 mg l^{-1} shall be provided for measuring salinity of the water at each monitoring location.

Water Sampling Equipment

4.2.9 A water sampler, consisting of a transparent PVC or glass cylinder of not less than two litres which can be effectively sealed with cups at both ends, shall be used. The water sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (e.g. Kahlsico Water Sampler 13SWB203 or an approved similar instrument).

Location of the Monitoring Stations

4.2.10 A hand-held or boat-fixed type digital Global Positioning System (GPS) or other equivalent instrument of similar accuracy shall be provided and used during monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

4.2.11 All in-situ monitoring instrument shall be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use, and subsequently re-calibrated at 3 monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use. Wet bulb calibration for a DO metre shall be carried out before measurement at each monitoring location.

4.2.12 For the on site calibration of field equipment, the BS 127:1993, "Guide to field and on-site test methods for the analysis of waters" should be observed.

4.2.13 Sufficient stocks of spare parts should be maintained for replacements when necessary. Backup monitoring equipment shall also be made available so that monitoring can proceed uninterrupted even when some equipment some equipment is under maintenance, calibration, etc.

4.3 Laboratory Measurement / Analysis

4.3.1 Analysis of suspended solids shall be carried out in a HOKLAS or other international accredited laboratory. Water samples of about 1000 ml shall be collected at the monitoring stations for carrying out the laboratory SS determination. The detection limit shall be 1 mg l^{-1} or better. The SS determination work shall start within 24 hours after collection of the water samples. The SS determination shall follow APHA 17ed 2540D or equivalent methods subject to approval of EPD.

4.3.2 If a site laboratory is set up or a non-HOKLAS and non-international accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment, analytical procedures, and quality control shall be approved by the EPD. The ET Leader shall provide the ER with one copy of the relevant chapters of the "Standard Methods for the Examination of Water and Wastewater" updated edition and any other relevant document for his reference.

4.3.3 For the testing methods of other parameters as recommended by EIA or required by EPD, detailed testing methods, pre-treatment procedures, instrument use, Quality Assurance/Quality Control (QA/QC) details (such as blank, spike recovery, number of duplicate samples per batch, etc.), detection limits and accuracy shall be submitted to EPD for approval prior to the commencement of monitoring programme. The QA/QC shall be in accordance with the requirement of HOKLAS or international accredited scheme. The QA/QC results shall be reported. EPD may also request the laboratory to carry out analysis of known standards provided by EPD for quality assurance. Additional duplicate samples may be required by EPD for inter laboratory calibration. Remaining samples after analysis shall be kept by the laboratory for 3 months in case repeat analysis is required. If in-house or non-standard methods are proposed, details of the method verification may also be required to submit to EPD. In any circumstance, the sample testing shall have comprehensive quality assurance and quality control programmes. The laboratory shall prepare to demonstrate the programmes to EPD or his representatives when requested.

4.4 Monitoring Locations

4.4.1 The water quality monitoring locations are shown in *Figure 4.4a* (refer to *Table 4.4a*). The status and locations of water quality sensitive receivers and the marine activities may change after issuing this manual. If such cases exist, the ET Leader shall propose updated monitoring locations to IC (E) and seek approval from EPD.

Table 4.4a *Water Quality Monitoring Stations*

Station Description	HK Metric Grid E	HK Metric Grid N	Code
Southern Access Reclamation	831725	840250	WM1
Southern Access Reclamation	831350	840150	WM2
Sha Tin WSD Seawater Pumping Station	830300	840200	WM3
MSL (existing)	831120	840200	WM4
MSL (reprovisioned)	831413	840270	WM5
Control Station within Tolo Harbour	840700	833800	C2

4.4.2 When alternative monitoring locations are proposed, they should be selected based on the following guidelines:

(a) at the boundary of the mixing zone of the major site activities as indicated in the EIA final report, which are likely to cause water quality impacts;

(b) close to the sensitive receptors which are likely to be affected;

(c) for monitoring locations located in the vicinity of the sensitive receptors, care should be taken to cause minimal disturbance during monitoring;

(d) two or more control stations which shall be at locations representative of the project site in its undisturbed condition. Control stations should be located, as far as is practicable, both upstream and down stream of the works area.

4.4.3 Control station C2 is necessary to compare the water quality from potentially impacted sites with the ambient water quality. Control stations shall be located within the same body of water as the impact monitoring stations but should be outside the area of influence of the works and, as far as practicable, not affected by any other works. The control station will thus serve as a means to check whether or not the marine water quality is impacted by other major adjacent development during PSKDA construction and in certain circumstances, may be of significant benefit for off-site impact attribution purposes.

4.4.4 Measurements shall be taken at 3 water depths, namely, 1 m below water surface, mid-depth and 1 m above sea bed, except where the water depth less than 6 m, the mid-depth station may be omitted. Should the water depth be less than 3 m, only the mid-depth station will be monitored. The ET Leader shall seek approval from IC(E) and EPD on all the monitoring stations.

4.5 Baseline Monitoring

4.5.1 Baseline conditions for water quality shall be established and agreed with EPD prior to the commencement of works. The purposes of the baseline monitoring are to establish ambient conditions prior to the commencement of the works and to demonstrate the suitability of the proposed impact, control and reference monitoring stations. The baseline conditions shall normally be established by measuring the water quality parameters specified in *Section 4.1*. The measurements shall be taken at all designated monitoring stations including control stations, 3 days per week, at mid-flood and mid-ebb tides, for four weeks prior to the commencement of marine works.

4.5.2 There shall not be any marine construction activities in the vicinity of the stations during the baseline monitoring.

4.5.3 In exceptional cases when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall seek approval from the IC(E) and EPD on an appropriate set of data to be used as baseline reference.

4.5.4 Baseline monitoring schedule shall be faxed to EPD 1 week prior to the commencement of baseline monitoring. The interval between 2 sets of monitoring shall not be less than 36 hours.

4.6 Impact Monitoring

4.6.1 During the course of the marine works for the Southern Access Road Reclamation, monitoring shall be undertaken three days per week, at mid-flood and mid-ebb tides, with sampling/measurement at the designated monitoring stations. The interval between two sets of monitoring shall not be less than 36 hours except where there are exceedances of Action and/or Limit levels, in which case the monitoring frequency will be increased.

4.6.2 Samples shall be taken at 1 m below the surface, mid-water depth and 1 m above the seabed at both mid-flood and mid-ebb tide. If the water depth is less than 6 m, the mid-depth measurement may be omitted subject to the approval of the Engineer. If the depth is less than 3 m, only the mid-depth measurement need to be taken subject to the approval of the Engineer.

4.6.3 Upon completion of all marine activities, a post project monitoring exercise on water quality shall be carried out for four weeks in the same manner as the impact monitoring.

4.6.4 Proposed water quality monitoring schedule shall be faxed to EPD on or before the first day of the monitoring month. EPD shall also be notified immediately for any changes in schedule by fax.

4.7 Event and Action Plan for Water Quality

4.7.1 Monitoring data collected during the period of the construction works shall be assessed for SS and DO with regard to the AL Levels criteria as shown in *Table 4.7a*. Should the monitoring results of the water quality parameters at any designated monitoring stations indicate that the water quality criteria are exceeded, the actions in accordance with the Action Plan in *Table 4.7b* shall be carried out.

4.7.2 There are two established ways to set the water quality assessment criteria for a monitoring programme. The consultants shall seek advice from the Director of Environmental Protection on setting the assessment criteria and the design of the project specific Action Plan.

4.7.3 Approach One:

The water quality assessment criteria, namely Action and Limit levels are based on the results of baseline monitoring and WQO of the relevant water control zone (Table 3.1). Should the monitoring results of the water quality parameters at any designated monitoring stations indicate that the water quality assessment criteria are exceeded, the actions in accordance with the Action Plan in Table 3.2 shall be carried out.

4.7.4 Approach Two:

The water quality assessment criteria shall be based on the results of statistical analysis on the different between impact monitoring results and 30% above control, and/or specific levels defined during the EIA stage for the sensitive receivers. Project specific Action Plan shall be designed according to the monitoring programme and seek approval from the Director of Environmental Protection.

Table 4.7a ***Action and Limit Levels for Water Quality***

Parameters	*Action*	*Limit*
DO in mg/l (Surface, Middle & Bottom)	*Surface & Middle* *5%-ile of baseline data for surface and middle layer.* *Bottom* *5%-ile of baseline data for bottom layer.*	*Surface & Middle* *4 mg/l except 5 mg/l for FCZ* *or* *1%-ile of baseline data for surface and middle layer* *Bottom* *2 mg/l or* *1%-ile of baseline data for bottom layer*
SS in mg/l (depth-averaged)	*95%-ile of baseline data or120% of upstream control station's SS at the same tide of the same day*	*99%-ile of baseline or 130% of upstream control station's SS at the same tide of the same day and specific sensitive receiver water quality requirements (e.g. required suspended solids level for concerned sea water intakes)*
Turbidity (Tby) in NTU (depth-averaged)	*95%-ile of baseline data or 120% of upstream control station's Tby at the same tide of the same day*	*99%-ile of baseline or 130% of upstream control station's Tby at the same tide of the same day*

Table 4.7b *Event and Action Plan for Water Quality*

Event	*ET Leader*	*IC(E)*	*ER*	Contractor
Action level being exceeded by one sampling day	*Repeat in-situ measurement to confirm findings;* *Identify source(s) of impact;* *Inform IC(E) and Contractor;* *Check monitoring data, all plant, equipment and Contractor's working methods;* *Discuss mitigation measures with IC(E) and Contractor;* *Repeat measurement on next day of exceedance.*	*Discuss with ET and Contractor on the mitigation measures* *Review proposals on mitigation measures submitted by Contractor and advise the ER accordingly* *Assess the effectiveness of the implemented mitigation measures.*	*Discuss with IC(E) on the proposed mitigation measures;* *Make agreement on the mitigation measures to be implemented;*	*Inform the ER and confirm notification of the non-compliance in writing;* *Rectify unacceptable practice;* *Check all plant and equipment;* *consider changes of working methods;* *Discuss with ET and IC(E) and propose mitigation measures to IC(E) and ER;* *Implement the agreed mitigation measures.*
Action level being exceeded by more than one consecutive sampling days	*Repeat in-situ measurement to confirm findings;* *Identify source(s) of impact;* *Inform IC(E) and Contractor;* *Check monitoring data, all plant, equipment and Contractor's working methods;* *Discuss mitigation measures with IC(E) and Contractor;* *Ensure mitigation measures are implemented;* *Prepare to increase the monitoring frequency to daily;* *Repeat measurement on next day of exceedance.*	*Discuss with ET and Contractor on the mitigation measures* *Review proposals on mitigation measures submitted by Contractor and advise the ER accordingly* *Assess the effectiveness of the implemented mitigation measures.*	*Discuss with IC(E) on the proposed mitigation measures;* *Make agreement on the mitigation measures to be implemented;* *Assess the effectiveness of the implemented mitigation measures.*	*Inform the Engineer and confirm notification of the non-compliance in writing;* *Rectify unacceptable practice;* *Check all plant and equipment;* *consider changes of working methods;* *Discuss with ET and IC(E) and propose mitigation measures to IC(E) and ER within 3 working days;* *Implement the agreed mitigation measures.*
Limit level being exceeded by one sampling day	*Repeat in-situ measurement to confirm findings;* *Identify source(s) of impact;* *Inform IC(E), contractor and EPD;* *Check monitoring data, all plant, equipment and Contractor's working methods;* *Discuss mitigation measures with IC(E), ER and Contractor;* *Ensure mitigation measures are implemented;* *Increase the monitoring frequency to daily until no exceedance of Limit level.*	*Discuss with ET and Contractor on the mitigation measures* *Review proposals on mitigation measures submitted by Contractor and advise the ER accordingly* *Assess the effectiveness of the implemented mitigation measures.*	*Discuss with IC(E), ET and Contractor on the proposed mitigation measures;* *Request Contractor to critically review the working methods;* *Make agreement on the mitigation measures to be implemented;* *Assess the effectiveness of the implemented mitigation measures.*	*Inform the Engineer and confirm notification of the non-compliance in writing;* *Rectify unacceptable practice;* *Check all plant and equipment;* *consider changes of working methods;* *Discuss with ET, IC(E) and ER and propose mitigation measures to IC(E) and ER within 3 working days;* *Implement the agreed mitigation measures.*
Limit level being exceeded by more than one consecutive sampling days	*Repeat in-situ measurement to confirm findings;* *Identify source(s) of impact;* *Inform IC(E), contractor and EPD;* *Check monitoring data, all plant, equipment and Contractor's working methods;* *Discuss mitigation measures with IC(E), ER and Contractor;* *Ensure mitigation measures are implemented;* *Increase the monitoring frequency to daily until no exceedance of Limit level for two consecutive days.*	*Discuss with ET and Contractor on the mitigation measures* *Review proposals on mitigation measures submitted by Contractor and advise the ER accordingly* *Assess the effectiveness of the implemented mitigation measures.*	*Discuss with IC(E), ET and Contractor on the proposed mitigation measures;* *Request Contractor to critically review the working methods;* *Make agreement on the mitigation measures to be implemented;* *Assess the effectiveness of the implemented mitigation measures;* *Consider and instruct, if necessary, the Contractor to slow down or to stop all or part of the marine work until no exceedance of Limit level.*	*Inform the ER and confirm notification of the non-compliance in writing;* *Rectify unacceptable practice;* *Check all plant and equipment;* *Consider changes of working methods;* *Discuss with ET, IC(E) and ER and propose mitigation measures to IC(E) and ER within 3 working days;* *Implement the agreed mitigation measures;* *As directed by the Engineer, to slow down or to stop all or part of the marine work or construction activities..*

4.8 Water Quality Mitigation Measures

4.8.1 The EIA report has recommended water quality control and mitigation measures. The Contractor shall be responsible for the design and implementation of these measures.

4.8.2 The results of the comparative assessment of the revised PSK Reclamation staging proposals, based on the same assumptions and methodology used in the previous PSKRPD EIA demonstrate that the potential water quality impacts will not be greater than previously assessed. Therefore, assumed that the mitigation measures proposed in the previous PSKRPD EIA will be adequate for the PSK Reclamation to be undertaken by the CED contractor (including Northern Access Road Reclamation to be undertaken by TDD contractor) mitigation measures are described below:

Southern Access Road Reclamation

Dredging Activities

- use of sealed grab and silt screen to contain sediment losses during dredging;
- the receiving barges must not be allowed to overflow; and
- in the event of an exceedance, the dredging rate could be reduced to further limit the impact on adjacent receivers.

Owing to the potential adverse water quality impact caused by the dredging of Southern Access Road Reclamation, in addition to the above mentioned mitigation measures, the following extra measures are also recommended:

- deploy silt screen at the at the Southern Access Road Reclamation face and at the Sha Tin WSD intake during the dredging of Southern Access Road Reclamation;
- the silt screens deployed will have efficient reduction in the SS concentration (a factor of 2.5 according the previous PSKRPD EIA). In addition the silt screen should be durable and easily maintainable. Regular surveillance and maintenance are also required;
- deploy silt screen at the reprovisioned MSL intake during the dredging of Southern Access Road reclamation; and
- reduction of the level of SS at reprovisioned MSL intake to comply with the 5 mg l^{-1} standard can be achieved by reduction of dredging rates of the Southern Access Road Reclamation, via extension of the Southern Access Road Reclamation dredging duration from 3 to 7.5 months.

Provided that the above two mitigation measures are implemented properly, the mitigated SS concentration at the Sha Tin WSD intake will comply with the WSD standards.

Filling Activities

- construction of a leading seawall of 100 m from the active dumping face;
- use of refuse boom around the public filling area to contain any floating refuses within the site area and the motorised sampans would be deployed to collect floating refuses if required;.
- use of silt screen around the public filling face would be expected to reduce the losses to the surrounding water;
- placement of a suitably protected surface boom supporting a hanging net or skirt around the tipping front to contain any floating debris;
- strict application of public filling licences and monitoring of material placed in the public fills should be implemented to control unauthorised material being placed in the public fills;
- use of a recirculation system to reduce SS and oil discharges from the vehicle wheel washing facility;
- fuel tanks on site should be housed within drainable trays and regularly drained of rain water. Vehicle maintenance should be carried out on paved areas, spillages controlled by absorbents and waste oils collected in designated tanks prior to disposal off site;
- permanent site offices and facilities should be connected to the most convenient sewer. Temporary chemical toilet facilities at distant locations on the reclamations should be serviced daily and the contents disposed of to the sewer; and
- at least a 200 m gap between seawalls will be maintained to assist adequate flushing during the filling of the Stage II Phase 2 formation period.

Contaminated Sediment

As it is anticipated that some of the dredged sediment is seriously contaminated. It should be noted that further additional mitigation measures may be needed in this instance and, therefore, the following mitigation measures may be appropriate.

Dredging Activities

- the prohibition of stockpiling of any moderately or seriously contaminated (Class B and C) material, and careful control of stockpiling of any uncontaminated (Class A) material to prevent run-off, resuspension and odour nuisance.
- all vessels should be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;

- all dredgers should be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

- the construction works should cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the site or public filling grounds;

- additional provisions will be required where sediments are contaminated. The locations and depths of any areas of contaminated sediments should be indicated int he construction contract following the completion of a detailed sediment quality survey which has been recommended by Full Management Committee (FMC), prior to construction. The Contractor should be required to ensure that contaminated sediments are dredged, transported and placed in approved special dumping grounds in accordance with the EPDTC 1-1-92, WBTC 22/92 and WBTC 6/92. Typical mitigation measures are list below:

- transport of contaminated mud to the marine disposal site should, wherever possible, be by split barge of not less than 750 m^3 capacity, well maintained and capable of rapid opening and discharge at the disposal site;

- the material should be placed in the pit by bottom dumping, at a location within the pit specified by the FMC;

- discharge should be undertaken rapidly and the hoppers should then immediately be closed, material adhering to the sides of the hopper should not be washed out of the hopper and the hopper should remain closed until the barge next returns to the disposal site;

- the dumping vessel should be stationary throughout the dumping operation;

- the Contractor must be able to position the dumping vessel to an accuracy of +/- 10 m;

- inspection of the barge loading to ensure that loss of material does not take place during transportation;

- transport barges or vessels shall be equipped with automatic self-monitoring devices; and

- on site audit of the equipment and plant is essential to ensure it is used in the correct manner.

Filling Activities

- all vessels should be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;

- all grabs should be fitted with tight fitting seals to their bottom openings to prevent leakage of filling material;

- loading of barges should be controlled to prevent splashing of filling material to the surrounding water, and barges or hoppers should not be filled to a level which will cause the overflow of materials of polluted water during loading or transportation;

- the works should cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds; and

- a maximum 5% fines contents of marine fill sand arriving at site is recommended as the upper limit of the fines content to minimize the SS impact upon the Sha Tin WSD intake located 200-300 m from the construction site.

General Construction Activities

All site construction run-off should be controlled and treated to prevent high levels of SS entering surrounding waters in accordance with ProPECC PN 1/94. The following measures, which constitute good site practices, may be considered where applicable:

- temporary ditches should be provided to facilitate run-off discharge into the appropriate watercourses, via a sediment trap/sediment retention basin, prior to discharge;

- permanent drainage channels should also incorporate sediment basins or traps, and baffles to enhance deposition rates;

- all traps (temporary or permanent) should also incorporate oil and grease removal facilities;

- sediment traps must be regularly cleaned and maintained by the contractor. Daily inspections of such facilities should be required of the contractor;

- concrete batching plants should be bunded to contain the surface water run-off;

- water from concrete batching plants must also pass through sediment traps and settlement tanks prior to run-off into watercourses. These must be regularly cleaned and maintained by the contractor;

- collection of spent bentonite/other grouts in a separate slurry collection system for either cleaning and reuse/disposal to landfill;

- maintenance and plant areas should be bunded and constructed on a hard standing with the provision of sediment traps and petrol interceptors;

- all drainage facilities must be adequate for the controlled release of storm flows;

- minimising of exposed soil areas to reduce the potential for increased siltation and contamination of run-off;

- all chemical stores shall be contained (bunded) such that spills are not allowed to gain access to water bodies; and
- chemical toilets will be required to handle the sewage from the on-site construction workforce.

4.8.3 If the above measures are not sufficient to restore the water quality to an acceptable levels upon the advice of the ET Leader, the Contractor shall liaise with the ET Leader on some other mitigation measures, propose to IC(E) and ER for approval, and carry out the mitigation measures.

5 WASTE MANAGEMENT

5.1 Introduction

5.1.1 The Contractor is responsible for waste control within the construction site, removal of waste material produced by the site and the implementation of any mitigation measures to minimise waste or redress problems arising from site waste. The waste material may include any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material flowing from the site into any storm sewer, sanitary sewer, or any waste matter or refuse deposited anywhere within the site or onto any adjoining land.

5.1.2 When handling the waste material, the following measures shall be undertaken:

5.1.3 The proposed re-use, recycling, storage, collection, transport and disposal methods for various wastes which are recommended to avoid or minimise potential adverse impacts of the PSKDA are detailed below. Specifically, it is recommended that during the construction phase, the Contractor incorporate the recommendations into an on-site waste management plan.

5.1.4 The Contractor shall also pay attention to the Waste Disposal Ordinance, the Dumping at Sea Ordinance, the Public Health and Municipal Services Ordinance and the Water Pollution Control Ordinance, and carry out the appropriate waste management work. The relevant licence/permit, such as the effluent discharge licence, the chemical waste producer registration, etc. shall be obtained. The Contractor shall refer to the relevant booklets issued by EPD when applying for the licence/permit.

5.1.5 During the site inspections and the document review procedures as mentioned in Sections 6.1 and 6.2 of this manual, the ET Leader shall pay special attention to the issues relating to waste management, and check whether the Contractor has followed the relevant contract specifications and the procedures specified under the laws of Hong Kong.

5.2 Waste Mitigation Measures

The various waste management options can be categorised in terms of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in the long term. Hence, the hierarchy is as follows:

- Avoidance and minimisation, ie not generating waste through changing or improving practices and design;
- Re-use of materials, thus avoiding disposal (generally with only limited reprocessing);
- Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and

- Treatment and disposal, according to relevant laws, guidelines and good practice.

The contractor should consult the Waste Disposal Authority, the EPD, on the final disposal of wastes.

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

Training and instruction of construction staff should be given at the site to increase awareness and draw attention to waste management issues and the need to minimise waste generation. The training requirements should be included in the site waste management plan.

5.2.1 Storage, Collection and Transport of Waste

Permitted waste hauliers should be used to collect and transport the wastes to the appropriate disposal points. The following measures to minimise adverse impacts including windblown litter and dust from the transportation of these wastes should be implemented:

- Handle and store wastes in a manner which ensures that they are held securely without loss or leakage, thereby minimising the potential for pollution;

- Use waste hauliers authorised or licensed to collect the specific category of waste;

- Remove wastes in a timely manner;

- Maintain and clean the waste storage areas regularly;

- Minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;

- Obtain the necessary waste disposal permits from the appropriate authorities, if they are required, in accordance with the *Waste Disposal Ordinance)(Cap 354)*, *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)*, the *Crown Land Ordinance (Cap 28)*, *Dumping At Sea Ordinance (Cap 466)* and *Works Branch Technical Circular No. 22/92, Marine Disposal of Dredged Mud*;

- Dispose of waste at licensed sites;

- Develop procedures such as a ticketing system to facilitate tracking of loads, particularly for chemical waste, and to ensure that illegal disposal of wastes does not occur; and

- Maintain records of the quantities of wastes generated, recycled and disposed.

5.2.2 Dredged Material

The volume of material dredged should be minimised by limiting dredging during reclamation to seawall formation. Suitable mitigation measures for handling of dredged material were dealt with, in *Section 4*.

5.2.3 Excavated Materials

Excavated materials are not considered likely to cause adverse impacts with respect to their disposal, since they will be reused on-site at the PSK Reclamation.

5.2.4 Construction and Demolition Waste

The likely generation rates of construction and demolition wastes from the CUHK facilities and Pak Shek Kok Public Pier is estimated to be approximately 2,800 m^3. In order to minimise waste arisings, the mitigation measures described below should be adopted.

Careful design, planning and good site management can minimise over ordering and generation of waste materials such as concrete, mortars and cement grouts. If feasible, the temporary noise barrier or enclosures should be designed in such a way that they could be reused, after they have been dismantled and removed, thereby not generating construction waste. The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing should be considered to increase the potential for reuse.

The Contractor should recycle as much as possible of the construction waste on-site or the nearby Pak Shek Kok Public Filling Area. Proper segregation of wastes on site will increase the feasibility that certain components of the waste stream can be recycled by specialised contractors. Concrete and masonry, for example can be crushed and used as fill and steel reinforcing bar can be used by scrap steel mills. Different areas of the work sites can be designated for such segregation and storage depending on site specific conditions.

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

In accordance with the *New Disposal Arrangements for Construction Waste, Environmental Protection Department and Civil Engineering Department, 1992*, disposal of construction waste can either be at a specified landfill, or at a public filling area, with the latter being the preferred option. Waste with inert material > 20% should be directed to the Pak Shek Kok Public Filling Area, where they have the added benefit of offsetting the need for removal of materials from terrestrial borrow areas for reclamation purposes. If landfill disposal has to be used, the wastes will most likely be delivered to the NENT Landfill.

At present, Government is developing a charging policy for the disposal of waste to landfill. When it is implemented, this will provide additional incentive to reduce the volume of waste generated and to ensure proper segregation to allow free disposal of inert material to public filling areas.

5.2.5 Chemical Waste

For those processes which generate chemical waste, it may be possible to find alternatives which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste. Chemical waste that is produced, as defined by *Schedule 1* of the *Waste Disposal (Chemical Waste) (General) Regulation,* should be handled in accordance with the *Code of Practice on the Packaging, Handling and Storage of Chemical Wastes* as follows.

Containers used for the storage of chemical wastes should:

- be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- have a capacity of less than 450 l unless the specifications have been approved by the EPD; and
- display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Chemical Waste (General) Regulations and Codes of Practise.

The storage area for chemical wastes should:

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

Disposal of chemical waste should:

- be via a licensed waste collector; and
- be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers; or
- be to a reuser of the waste, under approval from the EPD.

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

5.2.6 General Refuse

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

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

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

6 SITE ENVIRONMENTAL AUDIT

6.1 Site Inspections

6.1.1 Site Inspections provide a direct means to trigger and enforce the specified environmental protection and pollution control measures. They shall be undertaken routinely by the ET Leader to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control mitigation measures are properly implemented. With well defined pollution control and mitigation specifications and a well established site inspection, deficiency and action reporting system, the site inspection is one of the most effective tools to enforce the environmental protection requirements on the construction site.

6.1.2 The ET Leader is responsible for formulation of the environmental site inspection, deficiency and action reporting system, and for carrying out the site inspection works. He shall submit a proposal on the site inspection, deficiency and action reporting procedures within 21 days of the construction contract commencement to the Contractor for agreement and to the ER for approval.

6.1.3 Regular site inspections shall be carried out at least once per week. The areas of inspection shall not be limited to the pollution control and mitigation measures within the site; it should also review the environmental situation outside the site area which is likely to be affected, directly or indirectly, by the site activities. The ET Leader shall make reference to the following information in conducting the inspection:

(a) the EIA recommendations on environmental protection and pollution control mitigation measures;

(b) works progress and programme;

(c) individual works methodology proposals (which shall include proposal on associated pollution control measures);

(d) the contract specifications on environmental protection;

(e) the relevant environmental protection and pollution control laws; and

(f) previous site inspection results.

6.1.4 The Contractor shall update the ET Leader with all relevant information of the construction contract for him to carry out the site inspections. The inspection results and its associated recommendations on improvements to the environmental protection and pollution control works shall be submitted to the IC(E) and the Contractor within 24 hours, for reference and for taking immediate action. The Contractor shall follow the procedures and time-frame as stipulated in the environmental site inspection, deficiency and action reporting system formulated by the ET Leader to report on any remedial measures subsequent to the site inspections.

6.1.5 Ad hoc site inspections shall also be carried out if significant environmer problems are identified. Inspections may also be required subsequent to receipt of an environmental complaint, or as part of the investigation work, as specifie in the Action Plan for environmental monitoring and audit.

6.2 Compliance with Legal and Contractual Requirements

6.2.1 There are contractual environmental protection and pollution control requirements as well as environmental protection and pollution control laws in Hong Kong which the construction activities shall comply with.

6.2.2 In order that the works are in compliance with the contractual requirements, all the works method statements submitted by the Contractor to the ER for approval shall also be sent to the ET Leader for vetting to see whether sufficient environmental protection and pollution control measures have been included.

6.2.3 The ET Leader shall also review the progress and programme of the works to check that relevant environmental laws have not been violated, and that the any foreseeable potential for violating the laws can be prevented.

6.2.4 The Contractor shall regularly copy relevant documents to the ET Leader so that the checking work can be carried out. The document shall at least include the updated Work Progress Reports, the updated Works Programme, the application letters for different licence/permits under the environmental protection laws, and all the valid licence/permit. The site diary shall also be available for the ET Leader's inspection upon his request.

6.2.5 After reviewing the document, the ET Leader shall advise the ER and the Contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the ET Leader's review concludes that the current status on licence/permit application and any environmental protection and pollution control preparation works may not cope with the works programme or may result in potential violation of environmental protection and pollution control requirements by the works in due course, he shall advise the Contractor and the ER accordingly.

6.2.6 Upon receipt of the advice, the Contractor shall undertake immediate action to remedy the situation. The ER shall follow up to ensure that appropriate action has been taken by the Contractor in order that the environmental protection and pollution control requirements are fulfilled.

6.3 Environmental Complaints

6.3.1 Receipt of a complaint shall activate the actions required in the Event and Action Plans for air, noise and water quality by ET, Engineer, Contractor and IC(E). A flow chart of the formal procedure for handling complaints is given in *Figure 6.3a*. Complaints shall be referred to the ET Leader for carrying out complaint investigation procedures. The ET Leader shall liaise with the Contractor on the complaint investigation and undertake the following procedure:

(a) log complaint and date of receipt onto the complaint database and inform the IC(E) immediately;

(b) investigate the complaint to determine its validity, and to assess whether the source of the problem is due to works activities;

(c) if a complaint is valid and due to works, identify mitigation measures;

(d) if mitigation measures are required, advise the Contractor accordingly;

(e) review the Contractor's response on the identified mitigation measures, and the updated situation;

(f) if the complaint is transferred from EPD, submit interim report to EPD on status of the complaint investigation and follow-up action within the time frame assigned by EPD;

(g) review relevant environmental monitoring results and undertake additional monitoring if necessary to verify the situation;

(h) report the investigation results and the subsequent actions to the complainant; and

(i) record the complaint, investigation, the subsequent actions and the results in the monthly EM&A reports (refer to *Section 7*).

6.3.2 During the complaint investigation work, the Contractor and ER shall cooperate with the ET Leader in providing all the necessary information and assistance for completion of the investigation. If mitigation measures are identified in the investigation, the Contractor shall promptly carry out the mitigation. The ER shall ensure that the measures have been carried out by the Contractor.

6.3.3 Details of all complaints shall form a part of the regular monthly reports (refer to *Section 7*) and shall be accompanied by a review of the circumstances including any recommendations necessary to avoid future repetitions of complaints of a similar nature. The findings of all complaints shall be sent to the complainant in writing as soon as possible.

7 REPORTING

7.1 General

7.1.1 The reporting guidelines referred to in this section are based upon a paper based system, however, the same information can be provided by an electronic medium upon agreeing the format with the ER and EPD. All the monitoring data (baseline and impact) shall also be submitted in diskettes in a format shown in *Annex A*.

7.2 Baseline Monitoring Report

7.2.1 The ET Leader shall prepare and submit a Baseline Environmental Monitoring Report within 10 working days of completion of the baseline monitoring. Copies of the Baseline Environmental Monitoring Report shall be submitted to all parties; the Contractor, the IC(E), the ER and the EPD. The format and content of the report, and the representation of the baseline monitoring data shall be in a format to the satisfaction of EPD and include, but not be limited to the following:

(a) up to half a page executive summary;

(b) brief project background information;

(c) drawings showing locations of the baseline monitoring stations;

(d) monitoring results (in both hard and diskette copies) together with the following information:

- monitoring methodology;
- name of laboratory and types of equipment used and calibration details;
- parameters monitored;
- monitoring locations (and depth);
- monitoring date, time, frequency and duration;
- QA/QC results and detection limits;

(e) details on influencing factors, including:

- major activities, if any, being carried out on the site during the period;
- weather conditions during the period;
- other factors which might affect the results;

(f) determination of the AL Levels for each monitoring parameter and statistical analysis of the baseline data; the analysis shall conclude if there is any significant difference between control and impact stations for the parameters monitored, and the following information should be recorded:

- graphical plots of monitored parameters in the month annotated against;

- the major activities being carried out on site during the period;

(g) revisions for inclusion in the EM&A Manual; and

(h) comments and conclusions, includes:

- submission of implementation status proforma, proactive environmental protection proforma, regulatory compliance proforma, site inspection proforma, data recovery schedule and complaint log summarising the EM&A period (see *Annex A*).

7.3 EM&A Reports

7.3.1 The results and findings of all EM&A work required in the Manual shall be recorded in the monthly EM&A reports prepared by the ET Leader. The EM&A report shall be prepared, endorsed by IC(E) and submitted within 10 working days of the end of each reporting month, with the first report due in the month after construction commences. Before submission of the first EM&A report, the ET Leader shall liaise with the parties on the exact number of copies and format of the monthly reports in both hard copy and electronic medium requirement. The ET Leader shall review the number and location of monitoring stations and parameters to monitor every 6 months or on as needed basis in order to cater for the changes in surrounding environment and nature of works in progress.

7.3.2 The report shall contain an executive summary of the project dumping activities including daily quantity and locations, exceedance of AL Levels, causes of exceedance and mitigation measures being taken; all monitoring data with the information indicating the sampling / measurement locations, and other factors which might affect the results and detailed description of the findings from auditing of monitoring data.

7.3.3 The raw data sheets of the monitoring data shall be maintained properly and readily and easily accessible upon request by other parties. The monitoring data shall be stored floppy disk with the format agreed with EPD. The disk shall be submitted to EPD together with the monthly report.

7.3.4 A report shall be made to EPD immediately by fax following exceedance of the Action Level by any parameter giving details of raw monitoring data, mitigation measures implemented and the proposed actions to ensure the reoccurrence shall be prevented.

7.3.5 First Monthly EM&A Report

The First Monthly EM&A Report shall include at least the following :

(a) 1-2 pages executive summary;

- Breaches of AL levels;
- Complaints Log;
- Notifications of any summons and successful prosecutions;
- Reporting Changes;
- Future key issues.

(b) Basic Project Information

- Project organisations including key personnel contact names and telephone numbers;
- Programme
- Management structure; and
- Works undertaken during the month;

(c) Environmental Status

- Work undertaken during the month with illustrations (such as location of works daily dredging/filling rates percentage fines in the fill material used);and

- Drawing showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations.

(d) Summary of EM&A requirements

- All monitoring parameters;
- AL Levels;
- Event-Action Plans;
- Environmental mitigation measures, as recommended in the project EIA Report;
- Environmental requirements in contract documents;

(e) Implementation Status

Advice on the implementation status of environmental protection and pollution control/mitigation measures, as recommended in the project EIA Report, summarised in the updated implementation schedule (in *Annex A*);

(f) Monitoring Results

To provide monitoring results (in both hard and diskette copies) together with the following information:

- Monitoring methodology
- Name of laboratory and types of equipment used and calibration details
- Parameters monitored
- Monitoring locations (and depth)
- Monitoring date, time, frequency, and duration;
- Weather conditions during the period;. and
- Any other factors which might affect the monitoring results;
- QA/QC results and detection limits

(g) Report on Non-compliance, Complaints, Notifications of Summons and Successful Prosecutions

- Record of all noncompliance (exceedances) of the AL Levels;

- Record of all complaints received (written or verbal) for each media, including locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary;

- Record of all notifications of summons and successful prosecutions for breaches of the current environmental protection/pollution control legislations, including locations and nature of the breaches, investigation, follow-up actions taken, results and summary;

- Review of the reasons for and the implications of non-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures; and

- Description of the actions taken in the event of noncompliance and deficiency reporting and any follow-up procedures related to earlier noncompliance;

(h) Others

- An account of the future key issues as reviewed from the works programme and work method statements; and

- Advice on the solid and liquid waste management status.

7.3.6 Subsequent Monthly EM&A Reports

The subsequent Monthly EM&A Reports shall include the following :

(a) Executive Summary (1-2 pages)

- Breaches of AL levels
- Complaint Log
- Notifications of any summons and successful prosecutions;
- Reporting Changes
- Future key issues

(b) Environmental Status

- Construction programme with fine tuning of construction activities showing the inter-relationship with environmental protection/mitigation measures for the month;

- Works undertaken during the month with illustrations including key personnel contact names and telephone number; and

- Drawing showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations

(c) Implementation Status

Advice on the implementation status of environmental protection and pollution control/mitigation measures including measures for ecological and visual impacts, as recommended in the EIA Report, summarised in the updated implementation schedule (see *Annex A*).

(d) Monitoring Results

To provide monitoring results (in both hard and diskette copies) together with the following information:

- Graphical plots of the monitored parameters in the month annotated against;
- The major activities being carried out on site during the period;
- Monitoring methodology
- Name of laboratory and types of equipment used and calibration details
- Parameters monitored
- Monitoring locations (and depth);
- Monitoring date, time, frequency, and duration;
- Weather conditions during the period; and
- Any other factors which might affect the monitoring results;
- QA/QC results and detection limits

(e) Report on Non-compliance, Complaints, Notifications of Summons and Successful Prosecutions

- Record of all noncompliance (exceedances) of the AL Levels;

- Record of all complaints received (written or verbal) for each media, including locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary;

- Record of all notifications of summons and successful prosecutions for breaches of the current environmental protection/pollution control legislations, including locations and nature of the breaches, investigation, follow-up actions taken, results and summary;

- Review of the reasons for and the implications of non-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures; and

- a description of the actions taken in the event of noncompliance and deficiency reporting and any follow-up procedures related to earlier noncompliance;

(f) Others

- An account of the future key issues as reviewed from the works programme and work method statements; and

- Advice on the solid and liquid waste management status.

(g) Appendix

- AL levels

- Graphical plots of trends of monitored parameters at key stations over the past four reporting periods for representative monitoring stations annotated against the following:

  i) major activities being carried out on site during the period;
  ii) weather conditions during the period; and
  iii) any other factors which might affect the monitoring results

- Monitoring schedule for the present and next reporting period
- Cumulative statistics on complaints, notifications of summons and successful prosecutions
- Outstanding issues and deficiencies

7.3.7 Quarterly EM&A Summary Reports

The Quarterly EM&A Summary Report which should generally be around 5 pages (including about 3 of text and tables and 2 of figures) should contain at least the following information. Apart from these, the first quarterly summary report should also confirm that the necessary statistical power to categorically identify or confirm the absence of impact attributable to the works.

(a) up to half a page executive summary;

(b) basic project information including a synopsis of the project organisation, programme, contacts of key management, and a synopsis of work undertaken during the quarter;

(c) a brief summary of EM&A requirements including:

- monitoring parameters;
- AL Levels; and
- environmental mitigation measures, as recommended in the EIA Report;

(d) advice on the implementation status of environmental protection and pollution control/mitigation measures, as recommended in the project EIA study report, summarised in the updated implementation schedule;

(e) drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;

(f) graphical plots of the trends of monitored parameters over the past 4 months (the last month of the previous quarter and the present quarter) for representative monitoring stations annotated against;

- the major activities being carried out on site during the period;
- weather conditions during the period; and
- any other factors which might affect the monitoring results;

(g) advice on the solid and liquid waste management status;

(h) a summary of noncompliance (exceedances) of the AL Levels;

(i) an quarterly assessment of constructional impacts on water quality at the project site including but not limited to comparison of the difference between the quarterly mean and 1.3 times of the ambientment which is defined as 30% increase of the baseline data or EPD data of the related parameters by using appropriate statistical procedures. Suggestion of appropriate mitigation measures if the quarterly assessment analytical results demonstrate that the quarterly mean is significantly higher than the liaison water quality times of the ambient mean ($p < 0.05$);

(j) a brief review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures;

(k) a summary description of the actions taken in the event of non-compliance and any follow-up procedures related to earlier non-compliance;

(l) a summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, actions and follow-up procedures taken;

(m) comments (e.g. effectiveness and efficiency of the mitigation measures), recommendations (e.g. any improvement in the EM&A programme) and conclusions for the quarter; and

(n) proponents' contacts and any hotline telephone number for the public to make enquiries.

7.3.8 Annual/Final EM&A Review Reports

The Annual/Final EM&A Report should contain at least the following information:

(a) Executive Summary (1-2 pages);

(b) drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations:

(c) basic project information including a synopsis of the project organization contacts of key management, and a synopsis of work undertaken during the course of the project or past twelve months;

(d) a brief summary of EM&A requirements including:

  (i) environmental mitigation measures, as recommended in the project EIA Report;
  (ii) environmental impact hypotheses tested;
  (iii) AL Levels;
  (iv) all monitoring parameters
  (v) Event-Action Plans;

(e) a summary of the implementation status of environmental protection and pollution control/mitigation measures as recommended in the project EIA study report summarized in the updated implementation schedule;

(f) graphical plots and the statistical analysis of the trends of monitored parameters over the course of the project, including the post project monitoring (for the past twelve months for annual report) for all monitoring stations against:

- the major activities being carried out on site during the period;
- weather conditions during the period; and
- any other factors which might affect the monitoring results

(g) a summary of noncompliance (exceedances) of the AL Levels;

(h) a review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures as appropriate;

(i) a description of the actions taken in the event of non-compliance;

(j) a summary record of all complaints received (written or verbal) for each media liaison and consultation undertaken, action and follow-up procedures taken;

(k) a summary record of notifications of summons and successful prosecutions for breaches of the current environmental protection pollution control legislations locations and nature of the breaches, investigation, follow-up actions taken and results;

(l) a review of the validity of EIA Report predictions and identification of shortcomings in EIA Report recommendations; and

(m) a review of the effectiveness and efficiency of the mitigation measures;

(n) a review of success of the EM&A programme to cost effectively identify deterioration and to initiate prompt effective mitigatory action when necessary.

7.4 Data Keeping

7.4.1 The site document such as the monitoring field records, laboratory analysis records, site inspection forms, etc. are not required to be included in the monthly EM&A reports for submission. However, the document shall be well kept by the ET Leader and be ready for inspection upon request. All relevant information shall be clearly and systematically recorded in the document. The monitoring data shall also be recorded in magnetic media form, and the software copy can be available upon request. The water quality data software format shall be agreed with EPD. All the documents and data shall be kept for at least one year after completion of the construction contract.

7.5 Interim Notifications of Environmental Quality Limit Exceedances

7.5.1 With reference to Event/Action Plans in *Tables 2.8b*, *3.7b* and *4.7b*, when the environmental quality limits are exceeded, the ET Leader shall immediately notify the ER and EPD, as appropriate. The notification shall be followed up with advice to EPD on the results of the investigation, proposed action and success of the action taken, with any necessary follow-up proposals. A sample template for the interim notifications is shown in *Annex A*.

8 OPERATION PHASE EM&A

8.1 Introduction

According to the findings of EIA Report, only waste monitoring and audit are required during the operation phase (see *Section 1.3)*. The methodology, equipment, monitoring locations, criteria and protocols for the monitoring and audit of waste is explained below.

8.2 Waste Management

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

8.2.2 Waste Management Hierarchy

The waste management strategy for the PSKDA operation should follow the waste management hierarchy as discussed below.

- *Waste Avoidance and Minimisation* To mitigate the potential adverse impacts due to the generation of solid waste, waste reduction measures should be used where feasible, particularly if this will lead to reduced costs.

- *Recycling and Reuse* For the remaining solid waste, recyclable and reusable portions should be separated out where practical. Recyclable wastes (eg paper and aluminium cans) should be separated and stored until collected by a recycling contractor or individual collectors. Segregated materials should be stored in tidy, dry conditions to prevent intermingling and contamination of materials.

- *Treatment and Disposal* All wastes which cannot feasibly be recycled or reused, should be disposed of to landfill, or if chemical or other dangerous wastes, to the Chemical Waste Treatment Facility (CWTF), as follows:

- general refuse should be transported by a reputable private waste collector and disposed of at the NENT Landfill; and

- chemical waste as defined by *Schedule 1* of the *Waste Disposal (Chemical Waste) (General) Regulation*, should be stored in accordance with approved methods defined in the Regulations and the chemical waste, transported by a party licensed to transport chemical wastes by the EPD and disposed of at a facility licensed to receive chemical wastes by EPD.

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

General Refuse

Considerable scope exists to take waste reduction and management into account at the detailed design stage of the PSKDA, particularly at individual building and refuse collection points, by providing spaces or facilities for the segregation and storage of recyclable materials.

Public areas should be provided with bins and emptied frequently during each day, as necessary to prevent overspilling. The arisings of general refuse at the PSKDA may contain recyclable elements. Recycling bins for paper, bottles and aluminium cans may also be provided in public areas.

Waste collected from public areas should be taken to central refuse collection points. Hotels, retail areas and residential blocks should be provided with refuse collection points. Aluminium, paper and paperboard may be present in quantities large enough to warrant the provision of separate bins at the refuse collection points, the contents of which could be collected by, or sold to, recycling contractors. It may also be feasible to segregate organic materials, in particular food waste, for use as a composting medium. Organic materials have a high water content and may generate leachates and strong odours and therefore should be stored in sealed containers and collected daily.

Guidelines for the design of refuse collection points are given in the HKPSG. Drainage, storage and treatment facilities should be incorporated within the design of the refuse collection points for the collection of contaminated water and leachate arising from the compaction units.

General refuse from the PSKDA would most likely be taken directly to the NENT landfill by Regional Services Department (RSD) or by private contractors.

Chemical Waste

Under the Waste Disposal (Chemical Waste) (General) Regulation, chemical waste producers should register with EPD. Chemical wastes should be transported by a registered chemical waste collector to a facility licensed to receive chemical wastes.

Chemical waste should be stored in safe and suitably resistant containers, labelled, and in an appropriate storage area, in accordance with the Waste Disposal (Chemical Waste)(General) Regulation. Enviropace, the operator of the CWTF, supplies approved containers for chemical waste which can be replaced with each collection.

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

Annex A

Proforma for Construction Phase EM&A Programme

IMPLEMENTATION SCHEDULE

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
Air Quality									
1	4.5.26-27	2.9	• the heights from which fill materials are dropped should be controlled to a practical height to minimize the fugitive dust arising from unloading; • during transportation by truck, materials should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport; • all stockpiles of aggregate or spoil should be enclosed or covered and water applied in dry or windy condition; • effective water sprays should be used on the site at potential dust emission sources such as unpaved area; • the haul road should be paved and vehicle speed should be limited to 20 kph; • the haul road should be located away from the sensitive receivers, regular watering is recommended; and • wheel washing facilities should be provided at the exit of work site.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		
Noise									
2	3.5.16-34	3.8	**Good Site Practice** Good site practice and noise management can considerably reduce the impact of the construction sites' activities on nearby NSRs. The following package of measures should be followed during each phase of construction: • only well maintained plant should be operated on-site and plant should be serviced regularly during the construction works; • machines and plants (such as trucks, excavators) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum; • plant known to emit noise strongly in one direction, should, where possible, be orientated so that the noise is directed away from nearby NSRs; • silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction works; and • mobile plant should be sited as far away from NSRs as possible.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
3	3.5.16-34	3.8	**Selecting Quieter Plant and Working Methods** The Contractor may be able to obtain particular models of plant that are quieter than standard types given in *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (GW-TM). The benefits achievable in this way will depend on the details of the Contractor's chosen methods of working, and it is considered too restrictive to specify that a Contractor has to use specific items of plant for the construction operations. It is therefore both preferable and practical to specify an overall plant noise performance specification to apply to the total sound power level of all plant on the site so that the Contractor is allowed some flexibility to select plant to suit his needs. Quiet plant is defined as Power Mechanical Equipment (PME) whose actual Sound Power Level (SWL) is less than the value specified in GW-TM for the same piece of equipment. Examples of SWLs for specific silenced PME, which are known to be available in Hong Kong, are given below: Bulldozer: 110 dB(A) max; Breaker (Hand Held): 110 dB(A) max; Compressors: 100 dB(A) max; Concrete Pumps: 105 dB(A) max; Dump Truck: 109 dB(A) max; Excavator: 105 dB(A) max; Generator: 100 dB(A) max; Lorry: 105 dB(A) max; Loader: 105 dB(A) max; and Poker Vibrator: 110 dB(A) max.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
4	3.5.16-34	3.8	**Reducing the Number of Plant Operating in Critical Areas Close to NSRs** In general, the number of plant should be left to the choice of the Contractor. However, in cases of exceedances being identified by the noise monitoring, it may be appropriate to restrict the number of particularly noisy plant within certain parts of the site that are very close to the NSRs.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		
5	3.5.16-34	3.8	**Constructing Temporary and Movable Noise Barriers** Movable barriers could be very effective in providing noise screening from a particular plant. It is anticipated that a 3 m high movable noise barrier with a skid footing and a small cantilevered upper portion can be located within a few metres of plant. It is estimated that movable noise barrier of this type, if carefully located, can produce at least 10 dB(A) screening for stationary plant and 5 dB(A) for mobile plant. If there is any construction work during the restricted hours, it is the responsibility of the contractors to comply with the NCO and relevant TMs. The contractor should submit CNPs application and will be assessed by the Noise Control Authority, EPD. Conditions stipulated in CNPs might be strictly followed.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
Water Quality									
6	5.5.40-45	4.8	*Dredging Activities* • use of sealed grab and silt screen to contain sediment losses during dredging; • the receiving barges must not be allowed to overflow; and • in the event of an exceedance, the dredging rate could be reduced to further limit the impact on adjacent receivers. Owing to the potential adverse water quality impact caused by the dredging of Southern Access Road Reclamation, in addition to the above mentioned mitigation measures, the following extra measures are also recommended: • deploy silt screen at the at the Southern Access Road Reclamation face and at the Sha Tin WSD intake during the dredging of Southern Access Road Reclamation; • the silt screens deployed will have efficient reduction in the SS concentration (a factor of 2.5 according the previous PSKRPD EIA). In addition the silt screen should be durable and easily maintainable. Regular surveillance and maintenance are also required; • deploy silt screen at the reprovisioned MSL intake during the dredging of Southern Access Road reclamation; • reduction of the level of SS at reprovisioned MSL intake to comply with the $5 \text{ mg } l^{-1}$ standard can be achieved by reduction of dredging rates of the Southern Access Road Reclamation, via extension of the Southern Access Road Reclamation dredging duration from 3 to 7.5 months; and • maximum dredging rate shall be limited to 86 m^3/hr. Provided that the above two mitigation measures are implemented properly, the mitigated SS concentration at the Sha Tin WSD intake will comply with the WSD standards.	Southern and Northern Access Road Reclamation	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
7	5.5.40-45	4.8	*Filling Activities* • construction of a leading seawall of 100 m from the active dumping face; • use of refuse boom around the public filling area to contain any floating refuses within the site area and the motorised sampans would be deployed to collect floating refuses if required;. • use of silt screen around the public filling face would be expected to reduce the losses to the surrounding water; • placement of a suitably protected surface boom supporting a hanging net or skirt around the tipping front to contain any floating debris; • strict application of public filling licences and monitoring of material placed in the public fills should be implemented to control unauthorised material being placed in the public fills; • use of a recirculation system to reduce SS and oil discharges from the vehicle wheel washing facility; • fuel tanks on site should be housed within drainable trays and regularly drained of rain water. Vehicle maintenance should be carried out on paved areas, spillages controlled by absorbents and waste oils collected in designated tanks prior to disposal off site; • permanent site offices and facilities should be connected to the most convenient sewer. Temporary chemical toilet facilities at distant locations on the reclamations should be serviced daily and the contents disposed of to the sewer; • at least a 200 m gap between seawalls will be maintained to assist adequate flushing during the filling of the Stage II Phase 2 formation period; and • grab filling method shall be employed and maximum filling rate shall be limited to 138 m^3/hr.	Southern and Northern Access Road Reclamation	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
8	5.5.40-45	4.8	*Contaminated Sediment* As it is anticipated that some of the dredged sediment is seriously contaminated. It should be noted that further additional mitigation measures may be needed in this instance and, therefore, the following mitigation measures may be appropriate. *Dredging Activities* • the prohibition of stockpiling of any moderately or seriously contaminated (Class B and C) material, and careful control of stockpiling of any uncontaminated (Class A) material to prevent run-off, resuspension and odour nuisance. • all vessels should be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash; • all dredgers should be fitted with tight fitting seals to their bottom openings to prevent leakage of material; • the construction works should cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the site or public filling grounds; • additional provisions will be required where sediments are contaminated. The locations and depths of any areas of contaminated sediments should be indicated int he construction contract following the completion of a detailed sediment quality survey which has been recommended by Full Management Committee (FMC), prior to construction. The Contractor should be required to ensure that contaminated sediments are dredged, transported and placed in approved special dumping grounds in accordance with the EPDTC 1-1-92, WBTC 22/92 and WBTC 6/92. Typical mitigation measures are list below:	Southern and Northern Access Road Reclamation	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
			• transport of contaminated mud to the marine disposal site should, wherever possible, be by split barge of not less than 750 m^3 capacity, well maintained and capable of rapid opening and discharge at the disposal site; • the material should be placed in the pit by bottom dumping, at a location within the pit specified by the FMC; • discharge should be undertaken rapidly and the hoppers should then immediately be closed, material adhering to the sides of the hopper should not be washed out of the hopper and the hopper should remain closed until the barge next returns to the disposal site; • the dumping vessel should be stationary throughout the dumping operation; • the Contractor must be able to position the dumping vessel to an accuracy of +/- 10 m; • inspection of the barge loading to ensure that loss of material does not take place during transportation; • transport barges or vessels shall be equipped with automatic self-monitoring devices; • on site audit of the equipment and plant is essential to ensure it is used in the correct manner; and • maximum dredging rate shall be limited to 86 m^3/hr.						

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
9	5.5.40-45	4.8	*Contaminated Sediment* As it is anticipated that some of the dredged sediment is seriously contaminated. It should be noted that further additional mitigation measures may be needed in this instance and, therefore, the following mitigation measures may be appropriate. *Filling Activities* • all vessels should be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash; • all grabs should be fitted with tight fitting seals to their bottom openings to prevent leakage of filling material; • loading of barges should be controlled to prevent splashing of filling material to the surrounding water, and barges or hoppers should not be filled to a level which will cause the overflow of materials of polluted water during loading or transportation; • the works should cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds; • a maximum 5% fines contents of marine fill sand arriving at site is recommended as the upper limit of the fines content to minimize the SS impact upon the Sha Tin WSD intake located 200-300 m from the construction site; and • grab filling method shall be employed and maximum filling rate shall be limited to 138 m^3/hr.	Southern and Northern Access Road Reclamation	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
10	5.5.40-45	4.8	*General Construction Activities* All site construction run-off should be controlled and treated to prevent high levels of SS entering surrounding waters in accordance with ProPECC PN 1/94. The following measures, which constitute good site practices, may be considered where applicable: • temporary ditches should be provided to facilitate run-off discharge into the appropriate watercourses, via a sediment trap/sediment retention basin, prior to discharge; • permanent drainage channels should also incorporate sediment basins or traps, and baffles to enhance deposition rates; • all traps (temporary or permanent) should also incorporate oil and grease removal facilities; • sediment traps must be regularly cleaned and maintained by the contractor. Daily inspections of such facilities should be required of the contractor; • concrete batching plants should be bunded to contain the surface water run-off; • water from concrete batching plants must also pass through sediment traps and settlement tanks prior to run-off into watercourses. These must be regularly cleaned and maintained by the contractor; • collection of spent bentonite/other grouts in a separate slurry collection system for either cleaning and reuse/disposal to landfill; • maintenance and plant areas should be bunded and constructed on a hard standing with the provision of sediment traps and petrol interceptors; • all drainage facilities must be adequate for the controlled release of storm flows; • minimising of exposed soil areas to reduce the potential for increased siltation and contamination of run-off; • all chemical stores shall be contained (bunded) such that spills are not allowed to gain access to water bodies; and • chemical toilets will be required to handle the sewage from the on-site construction workforce.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
Waste									
11	6.4	5.2	• Avoidance and minimisation, ie not generating waste through changing or improving practices and design; • Re-use of materials, thus avoiding disposal (generally with only limited reprocessing); • Recovery and recycling, thus avoiding disposal (although reprocessing may be required); and • Treatment and disposal, according to relevant laws, guidelines and good practice. The contractor should consult the Waste Disposal Authority, the EPD, on the final disposal of wastes. The hierarchy should be used to evaluate waste management options, thus allowing maximum waste reduction and often reduction of disposal costs. Waste reduction measures should be introduced at the design stage and carried through the construction activities, wherever possible, by careful purchasing control, re-use of formwork and good site management. By reducing or eliminating over-ordering of construction materials, waste is avoided and costs are reduced both in terms of purchasing and in disposing of wastes. Training and instruction of construction staff should be given at the site to increase awareness and draw attention to waste management issues and the need to minimise waste generation. The training requirements should be included in the site waste management plan. Storage, Collection and Transport of Waste Permitted waste hauliers should be used to collect and transport the wastes to the appropriate disposal points. The following measures to minimise adverse impacts including windblown litter and dust from the transportation of these wastes should be implemented: • Handle and store wastes in a manner which ensures that they are held securely without loss or leakage, thereby minimising the potential for pollution; • Use waste hauliers authorised or licensed to collect the specific category of waste; • Remove wastes in a timely manner;	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
			• Maintain and clean the waste storage areas regularly; • Minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers; • Obtain the necessary waste disposal permits from the appropriate authorities, if they are required, in accordance with the *Waste Disposal Ordinance)(Cap 354)*, *Waste Disposal (Chemical Waste) (General) Regulation (Cap 354)*, the *Crown Land Ordinance (Cap 28)*, *Dumping At Sea Ordinance (Cap 466)* and *Works Branch Technical Circular No. 22/92, Marine Disposal of Dredged Mud*; • Dispose of waste at licensed sites; • Develop procedures such as a ticketing system to facilitate tracking of loads, particularly for chemical waste, and to ensure that illegal disposal of wastes does not occur; and • Maintain records of the quantities of wastes generated, recycled and disposed.						

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
12	6.4	5.2	Construction and Demolition Waste In order to minimise waste arisings, the mitigation measures described below should be adopted. Careful design, planning and good site management can minimise over ordering and generation of waste materials such as concrete, mortars and cement grouts. If feasible, the temporary noise barrier or enclosures should be designed in such a way that they could be reused, after they have been dismantled and removed, thereby not generating construction waste. The design of formwork should maximise the use of standard wooden panels so that high reuse levels can be achieved. Alternatives such as steel formwork or plastic facing should be considered to increase the potential for reuse. The Contractor should recycle as much as possible of the construction waste on-site or the nearby Pak Shek Kok Public Filling Area. Proper segregation of wastes on site will increase the feasibility that certain components of the waste stream can be recycled by specialised contractors. Concrete and masonry, for example can be crushed and used as fill and steel reinforcing bar can be used by scrap steel mills. Different areas of the work sites can be designated for such segregation and storage depending on site specific conditions. The handling and disposal of bentonite slurries should follow the *Practice Note For Professional Persons, Construction Site Drainage, Professional Persons Consultative Committee, 1994 (ProPECC PN 1/94).* In accordance with the *New Disposal Arrangements for Construction Waste, Environmental Protection Department and Civil Engineering Department, 1992,* disposal of construction waste can either be at a specified landfill, or at a public filling area, with the latter being the preferred option. Waste with inert material > 20% should be directed to the Pak Shek Kok Public Filling Area, where they have the added benefit of offsetting the need for removal of materials from terrestrial borrow areas for reclamation purposes. If landfill disposal has to be used, the wastes will most likely be delivered to the NENT Landfill. At present, Government is developing a charging policy for the disposal of waste to landfill. When it is implemented, this will provide additional incentive to reduce the volume of waste generated and to ensure proper segregation to allow free disposal of inert material to public filling areas.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
13	6.4	5.2	Chemical Waste For those processes which generate chemical waste, it may be possible to find alternatives which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste. Chemical waste that is produced, as defined by *Schedule 1* of the *Waste Disposal (Chemical Waste) (General) Regulation*, should be handled in accordance with the *Code of Practice on the Packaging, Handling and Storage of Chemical Wastes* as follows. Containers used for the storage of chemical wastes should: • be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed; • have a capacity of less than 450 l unless the specifications have been approved by the EPD; and • display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Chemical Waste (General) Regulations and Codes of Practise. The storage area for chemical wastes should: • be clearly labelled and used solely for the storage of chemical waste; • be enclosed on at least 3 sides; • have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest; • have adequate ventilation; • be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste if necessary); and • be arranged so that incompatible materials are adequately separated.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
			Disposal of chemical waste should: • be via a licensed waste collector; and • be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Facility which also offers a chemical waste collection service and can supply the necessary storage containers; or • be to a reuser of the waste, under approval from the EPD. The Centre for Environmental Technology operates a Waste Exchange Scheme which can assist in finding receivers or buyers.						
14	6.4	5.2	General Refuse General refuse generated on-site should be stored in enclosed bins or compaction units separate from construction and chemical wastes. A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily or every second day basis to minimise odour, pest and litter impacts. The burning of refuse on construction sites is prohibited by law. General refuse is generated largely by food service activities on site, so reusable rather than disposable dishware should be used if feasible. Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated or easily accessible, so separate, labelled bins for their deposit should be provided if feasible. Office wastes can be reduced through recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered if one is available.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
15	6.6	8.2	*General Refuse* Considerable scope exists to take waste reduction and management into account at the detailed design stage of the PSKDA, particularly at individual building and refuse collection points, by providing spaces or facilities for the segregation and storage of recyclable materials. Public areas should be provided with bins and emptied frequently during each day, as necessary to prevent overspilling. The arisings of general refuse at the PSKDA may contain recyclable elements. Recycling bins for paper, bottles and aluminium cans may also be provided in public areas. Waste collected from public areas should be taken to central refuse collection points. Hotels, retail areas and residential blocks should be provided with refuse collection points. Aluminium, paper and paperboard may be present in quantities large enough to warrant the provision of separate bins at the refuse collection points, the contents of which could be collected by, or sold to, recycling contractors. It may also be feasible to segregate organic materials, in particular food waste, for use as a composting medium. Organic materials have a high water content and may generate leachates and strong odours and therefore should be stored in sealed containers and collected daily. Guidelines for the design of refuse collection points are given in the HKPSG. Drainage, storage and treatment facilities should be incorporated within the design of the refuse collection points for the collection of contaminated water and leachate arising from the compaction units. General refuse from the PSKDA would most likely be taken directly to the NENT landfill by Regional Services Department (RSD) or by private contractors.	All Operational Activities within the PSKDA	Individual Developer responsible for implementation			✓	

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
16	6.6	8.2	*Chemical Waste* Under the Waste Disposal (Chemical Waste) (General) Regulation, chemical waste producers should register with EPD. Chemical wastes should be transported by a registered chemical waste collector to a facility licensed to receive chemical wastes. Chemical waste should be stored in safe and suitably resistant containers, labelled, and in an appropriate storage area, in accordance with the Waste Disposal (Chemical Waste)(General) Regulation. Enviropace, the operator of the CWTF, supplies approved containers for chemical waste which can be replaced with each collection. Oils and solvents can be recycled, or reused as fuel, depending upon their chemical nature and level of contamination. Transportation of used oils and other chemicals for reuse, recycling or disposal requires a chemical waste licence from the EPD. Other recycling options may be arranged, for instance through the Waste Exchange Scheme operated by the Centre for Environmental Technology.	All Operational Activities within the PSKDA	Individual Developer responsible for implementation			✓	

Item No.	EIA* Ref	EM&A Log Ref	Environmental Protection Measures*	Location/Timing	Implementation Agent	Implementation Stages**			
						Des	C	O	Dec
Ecology									
17	7.10	6.1	Tthe following mitigation measures in relation to protecting the two important plant species and good construction practice to minimise disturbance to the surrounding environment are recommended: • survey and collect individuals of the protected plant species *Spiranthes sinensis* and *Eulophia sinensis* prior to work commencement for transplanting to adjacent planting areas within the Open Space zone. • erect fences along the boundary of construction sites before the commencement of works to prevent tipping, vehicle movements, and encroachment of personnel into adjacent wooded areas; • regular checks to ensure that the work site boundaries are not exceeded and that no damage to surrounding areas; • avoid burning during construction, or such use if unavoidable should be carried out under close supervision; and • prohibit wild and uncontrolled open fires within the work site boundary, and install fire fighting equipment in the work area.	All Construction Activities within the PSKDA	The Contractor responsible for implementation Contractor to discuss the work methods with the ET and IC(E) and the proposed work methods should be agreed with ER		✓		

* All recommendations and requirements resulted during the course of EIA/EA Process, including ACE and/or accepted public comment to the proposed project.

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

Signed by Project Proponent: ________________ Date: ________________

IMPLEMENTATION STATUS PROFORMA

Ref:________________

Ref**	Environmental Protection Measures*	Implementation Status

* All recommendations and requirements resulted during the Course of EIA/EA Process, including ACE and /or accepted public comment to the proposed project

** EIA Ref/EM&A Log Ref/Design Document Ref

Signed by Environmental Team Leader: ____________________ Date: ________________

Audited by Independent Checker (Environment): ____________________ Date: ________________

DATA RECOVERY SCHEDULE

Ref:__________

Date	Air Quality Monitoring					Noise Monitoring									
	Monitoring Station*					Monitoring Location*					Monitoring Location*				
	A1	A2	A3	A4	A5	N1	N2	N3	N4	N5	W1	W2	W3	W4	W5
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															
26															
27															
28															
29															
30															
31															
% of R															

* *Remark type of parameters*

% of R *The percentage of Data Recovery is the actual monitoring over the scheduled monitoring*

Signed by Environmental Team Leader: ____________________ Date: ______________

Copy to Independent Checker (Environment)

SITE INSPECTION PROFORMA

Ref:__________

Date	Location	Req't Ref.*	Observation/Deficiency	Mitigation Action** (Responsible Agency)	Date*** of Confirmation

* *EIA Ref/EM&A Log Ref/Design Document Ref/Environmental Protection Contract Clause*

** *Specific Environmental Mitigation Measures should be stated, such as, equipment, processes, systems, practices or technologies.*

*** *The required completion date to confirm the specified Environmental Protection Action*

This Proforma is an Environmental Protection Instruction for: ____________________ on ________________

Signed by Environmental Team Leader: ____________________ Date: ________________

Copy to Independent Checker (Environment)

PROACTIVE ENVIRONMENTAL PROTECTION PROFORMA

Ref:__________

Ref*	Proposed Construction Method**	Location/ Working Period	Anticipated Impacts	Recommended Mitigation Measures

* *EIA Ref/EM&A Log Ref/Design Document Ref*

** *Details of equipment, vehicles, plants, processes, technologies for the option of construction method*

Reviewed by Environmental Team Leader: ____________________ Date: ______________

Approved by Independent Checker (Environment): ____________________ Date: ______________

REGULATORY COMPLIANCE PROFORMA

Ref:__________

Ref**	Environmental License/Permit*	Control Area/Facility/Location	Effective Date

* *Name of Applicant, Business Corporation, relevant regulation and remark of license/permit conditions*

** *File reference of the licensee/permittee*

Recorded by Environmental Team Leader: ____________________ Date: _______________

Signed by Independent Checker (Environment): ____________________ Date: _______________

COMPLAINT LOG

Ref:________

Log Ref	Date/Location	Complainant/ Date of Contact	Details of Complaint	Investigation/Mitigation Action	File Closed

Filed by Environmental Team Leader: ________________________ Date: ________________

Sample Template for Interim Notifications of Environmental Quality Limits Exceedances

Incident Report on Action Level or Limit Level Non-compliance

Project	
Date	
Time	
Monitoring Location	
Parameter	
Action & Limit Levels	
Measured Level	
Possible reason for Action or Limit Level Non-compliance	
Actions taken / to be taken	
Remarks	

Location Plan

Prepared by : ____________________

Designation : ____________________

Signature : ____________________

Date : ____________________

Data Sheet for TSP Monitoring

Monitoring Location		
Details of Location		
Sampler Identification		
Date & Time of Sampling		
Elapsed-time Meter Reading	Start (min.)	
	Stop (min.)	
Total Sampling Time (min.)		
Weather Conditions		
Site Conditions		
Initial Flow Rate, Qsi	Pi (mmHg)	
	Ti (°C)	
	Hi (in.)	
	Qsi (Std. m^3)	
Final Flow Rate, Qsf	Pf (mmHg)	
	Tf (°C)	
	Hf (in.)	
	Qsf (Std. m^3)	
Average Flow Rate (Std. m^3)		
Total Volume (Std. m^3)		
Filter Identification No.		
Initial Wt. of Filter (g)		
Final Wt. of Filter (g)		
Measured TSP Level ($\mu g/m^3$)		

	Name & Designation	Signature	Date
Field Operator :			
Laboratory Staff :			
Checked by :			

Noise Monitoring Field Record Sheet

Monitoring Location		
Description of Location		
Date of Monitoring		
Measurement Start Time (hh:mm)		
Measurement Time Length (min.)		
Noise Meter Model/Identification		
Calibrator Model/Identification		
Measurement Results	L_{90} (dB(A))	
	L_{10} (dB(A))	
	LEQ (dB(A))	
Major Construction Noise Source(s) During Monitoring		
Other Noise Source(s) During Monitoring		
Remarks		

	Name & Designation	Signature	Date
Recorded By :			
Checked By :			

Water Quality Monitoring Data Record Sheet

Location				
Date				
Start Time (hh:mm)				
Weather				
Sea Conditions				
Tidal Mode				
Water Depth (m)				
Monitoring Depth		Surface	Middle	Bottom
Salinity				
Temperature (°C)				
DO Saturation (%)				
DO (mg/l)				
Turbidity (NTU)				
SS Sample Identification				
SS (mg/l)				
Observed Construction Activities	<100m from location			
	>100m from location			
Other Observations				

	Name & Designation	Signature	Date
Recorded By :			
Checked By :			

Note: The SS results are to be filled up once they are available from the laboratory.

Data format for water quality monitoring

A. The data base structure for water quality monitoring is listed below. The ET shall select the related field names to create their own data recording sheet.

Field Name	Type	Width	Dec	Remark
Project/contract ID	C	3		Given by EPD
WorkArea ID	C	2		Given by EPD
SamStn	C	3		Sampling Station
Latitude	C	10		Latitude of Sampling Station
Longitude	C	10		Longitude of Sampling Station
Easting	C	6		HK Grid (Easting) of Sampling Station
Northing	C	6		HK Grid (Northing) of Sampling Station
Date	D	8		Sampling Date
Time	C	5		Sampling Time
Replicate	C	1		1 = first sample; 2 = duplicated sample; etc
StnPurpose	C	1		Purpose of Sampling Station (C = control; I = Impact; S = Sensitive receiver; etc)
SamPurpose	C	1		Purpose of Sample (B = baseline; I = Impact)
Weather	C	20		(sunshine, precipitation, humidity, air temperature)
TideStatus	C	10		Tidal Status (e.g mid_ebb; mid-flood)
WaterDepth	N	4	1	Depth of water column in meter
SamDepthM	N	4	1	Depth of sample taken in meter
SamDepth	C	1		Depth of sample taken (S=surface; M=middle; B=bottom)
WaterTemp	N	4	1	Water Temperature
Salinity	N	6	2	
DO	N	6	2	Dissolved Oxygen
DOS	N	6	2	Dissolved Oxygen in % saturation
Turbidity	N	6	2	
SS	N	6	2	Suspended solids
Metals_T ...	N	6	2	Total metals (approx. 7 parameters, and can be more)
Metals_D ...	N	6	2	Dissolved metals (approx. 7 parameters, and can be more)
Trace organic ...	N	6	2	Trace organic (e.g PAHs, PCBs etc.. can be a lot)
Nutrients	N	6	2	Nutrients (include several parameters such as NO_2_N, NO_3_N, NH_4_N, TP, OP etc)
BOD	N	6	2	
COD	N	6	2	
Chlorophyll_a	N	6	2	
Ecoli	N	10	0	
Fcoliform	N	10	0	Faecal coliform
PARA ...				Other parameters not listed above. (Confirm with EPD individually

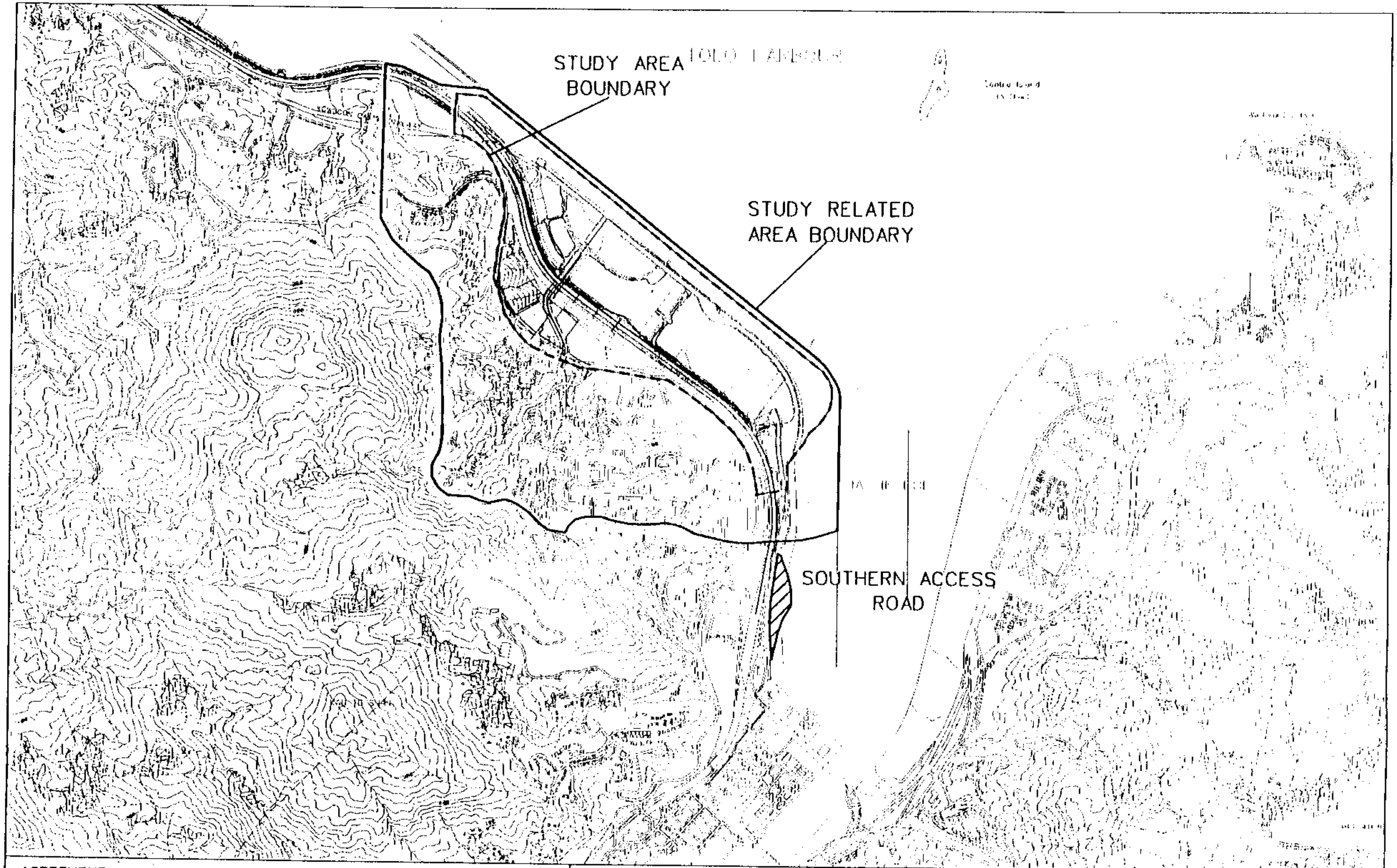
(Remark: enter 999.99 to any numeric field that have no reading. Please note that "zero" is also a valid data)

B. Details of water analytical methods and detection limits for different parameters.

Parameter	Limits of detection for WQ parameters	Units of measurement for WQ parameters	Analytical methods
e.g. DO			
e.g. Cd_T			
etc ...			

C. Apart from A and B, the following information shall also be provided:

1. Project name, contract number, consultant name and telephone, contractor name, contact person and telephone number, site staffs and telephone.
2. Project commencement date and the proposed completion date, frequency of sampling and project work nature, e.g. dumping, dredging or reclamation.
3. List of site instrument for water quality monitoring.



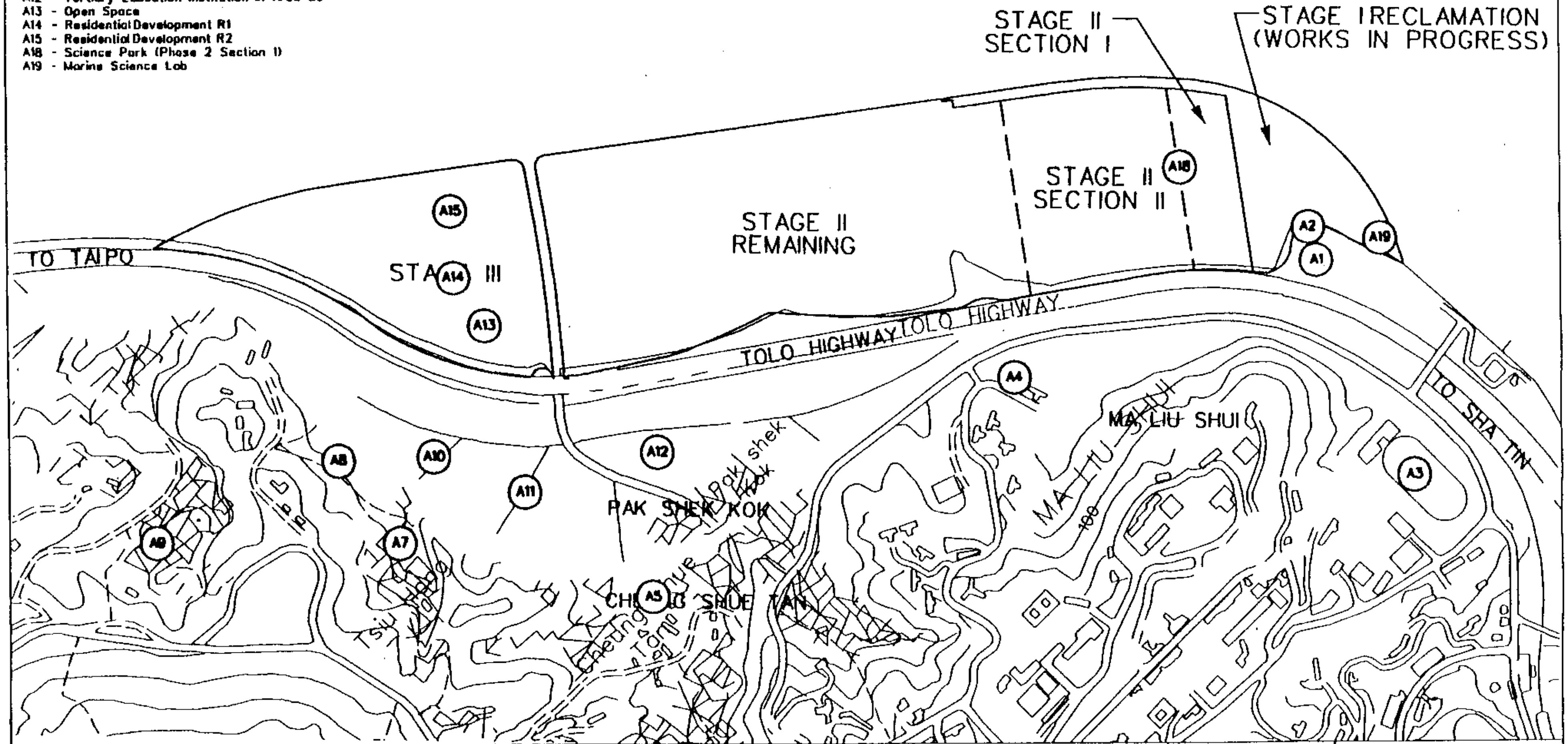
AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

PAK SHEK KOK STUDY AREA & RELATED AREA

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 07/05/98
FIGURE NO. : 1.2a

AIR SENSITIVE RECEIVERS
Key
A1 - Hong Kong Institute of Biotechnology (HKIB)
A2 - HKIB Staff Accommodation
A3 - CUHK Playing Fields
A4 - CUHK Residence No10
A5 - Cheung Shue Tan Village
A6 - Wong Nai Fai Village
A7 - Tsiu Hong Village
A8 - Deerhill Bay
A9 - Villa Castell
A10 - Hong Kong Institute of Education (HKIE) Playing Fields
A11 - Education Uses in Area 12
A12 - Tertiary Education Institution in Area 39
A13 - Open Space
A14 - Residential Development R1
A15 - Residential Development R2
A18 - Science Park (Phase 2 Section I)
A19 - Marine Science Lab



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

LOCATION OF ASRs DURING CONSTRUCTION

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

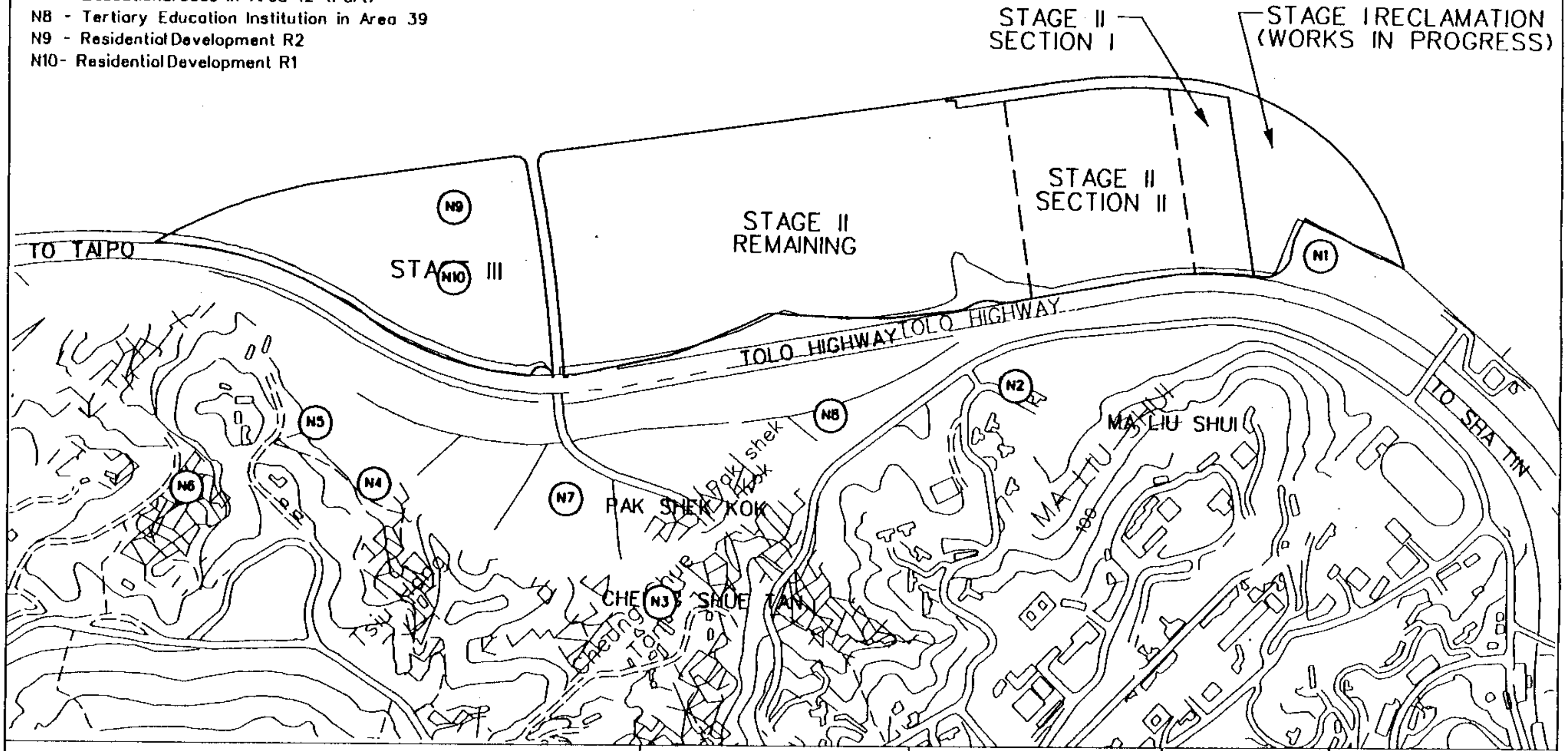
DATE : 11/05/98

FIGURE NO. : 1.3a

NOISE SENSITIVE RECEIVERS

Key

N1 - HKIB Staff Accommodation
N2 - CUHK: Residence No.10
N3 - Cheung Shue Tan Village
N4 - Tsiu Hang Village
N5 - Deerhill Bay
N6 - Villa Costell
N7 - Educational Uses in Area 12 (Part)
N8 - Tertiary Education Institution in Area 39
N9 - Residential Development R2
N10 - Residential Development R1



AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

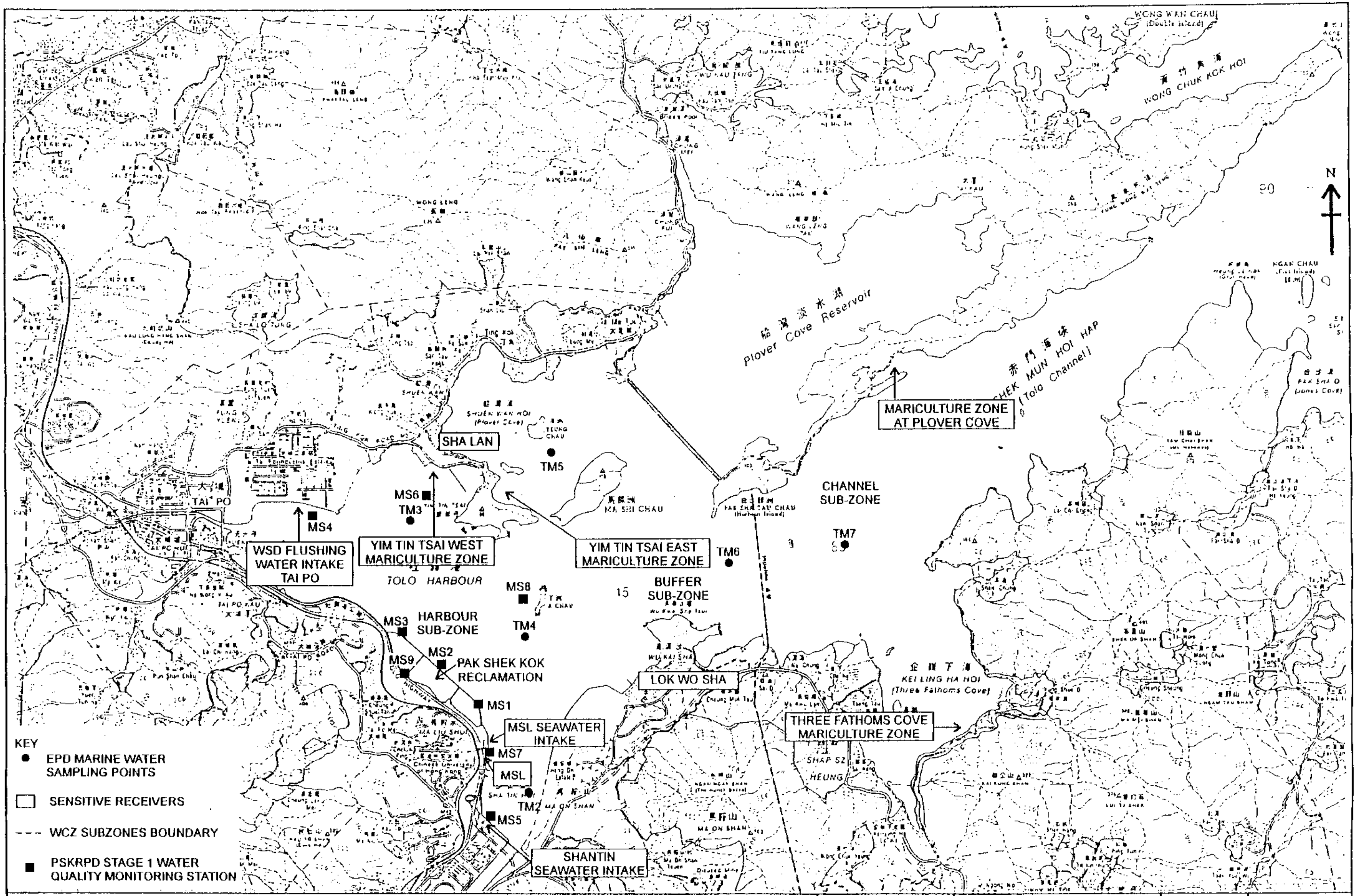
LOCATION OF NSRs DURING CONSTRUCTION

Maunsell
茂盛(亞洲)工程顧問有限公司

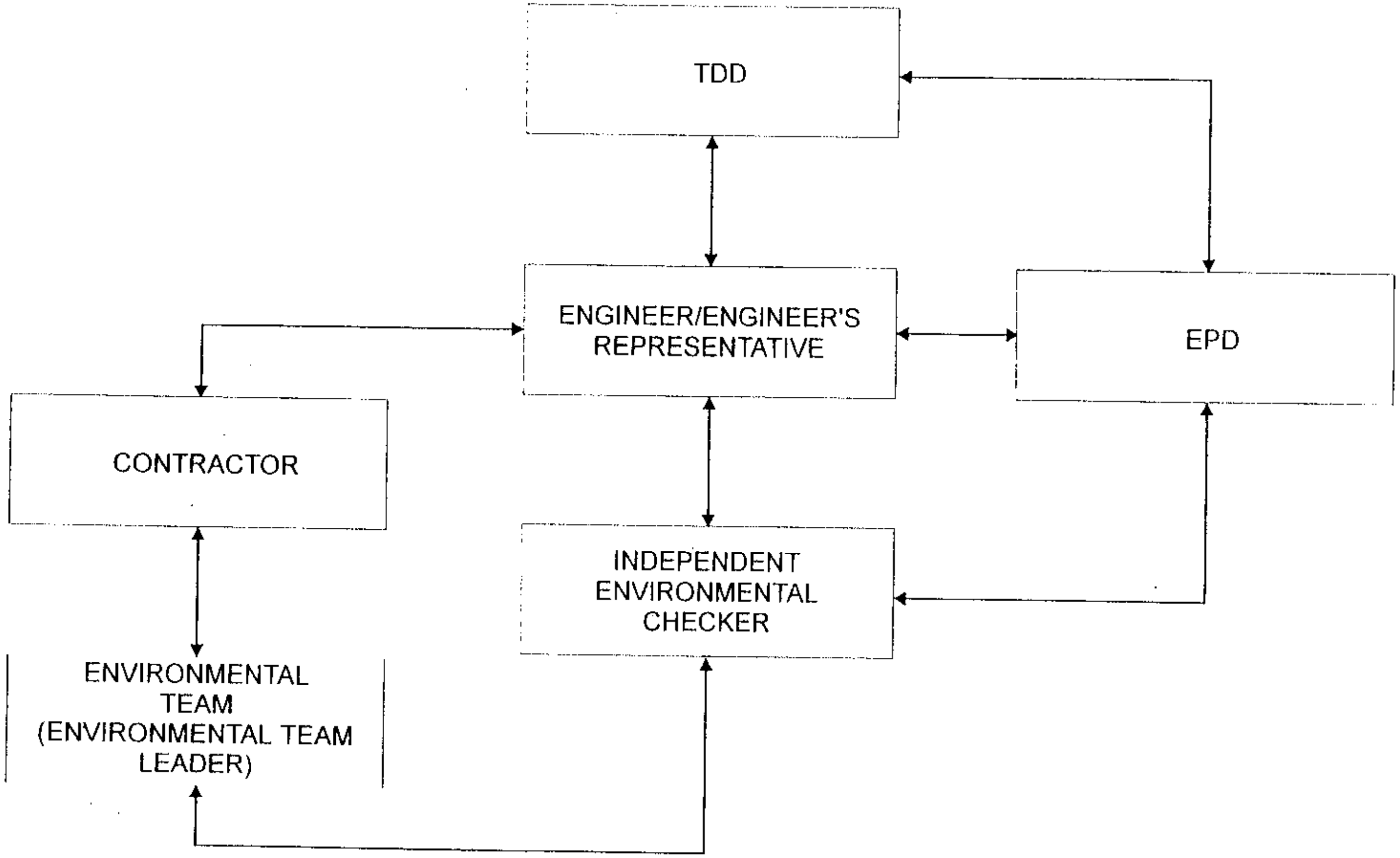
SCALE : N.T.S.

DATE : 11/05/98

FIGURE NO. : 1.3b



TOLO HARBOUR WCZ AND MARINE WATER QUALITY MONITORING LOCATIONS	Maunsell 茂盛(亞洲)工程顧問有限公司	NOT TO SCALE	DATE :	FIGURE NO. 1.3c



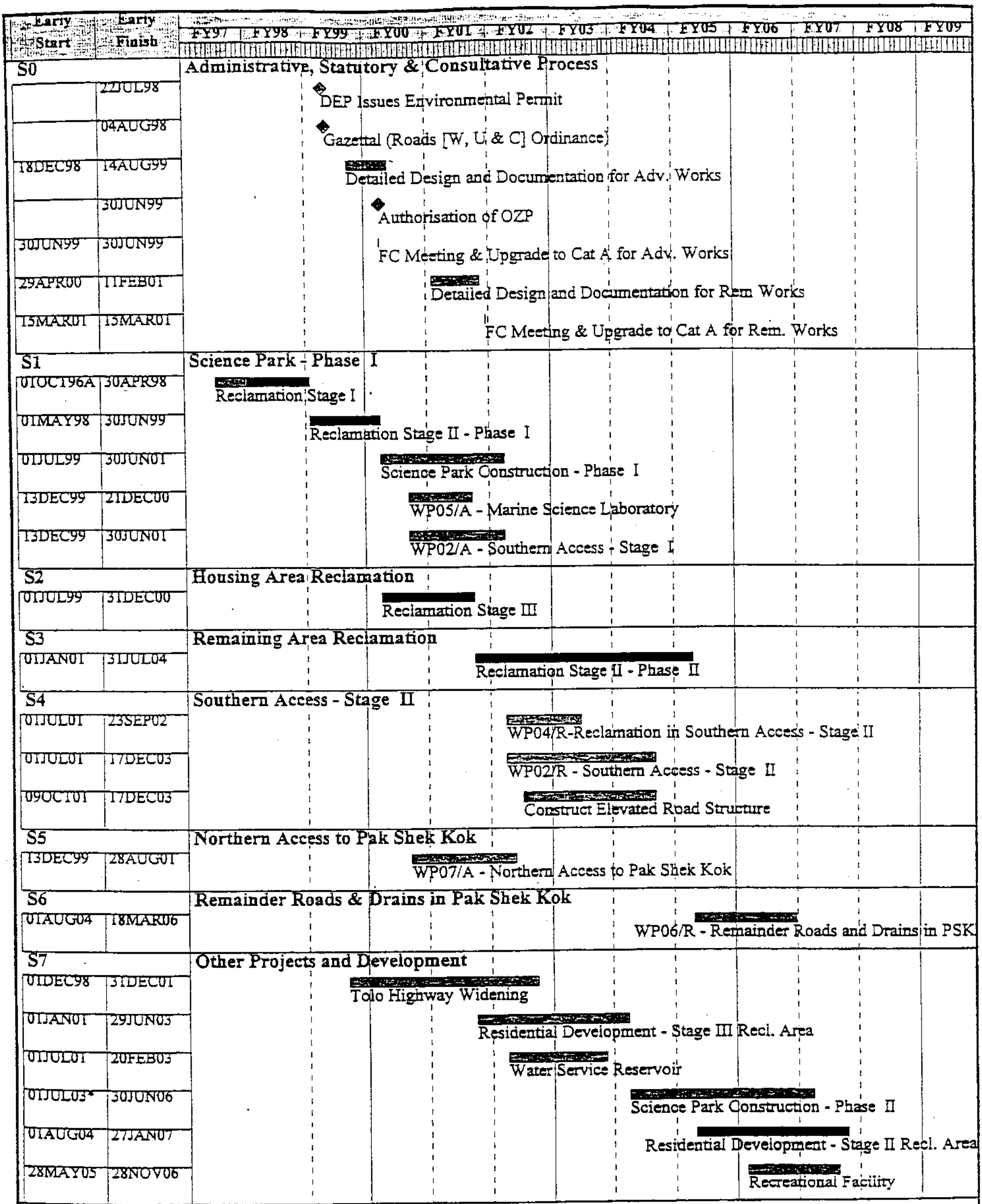
PROJECT ORAGANISATION AND LINES OF COMMUNICATION WITH RESPECT TO THE EM&A PROGRAMME

NOT TO SCALE

DATE :

FIGURE NO

1.4a



Early Start	Early Finish	
S0		**Administrative, Statutory & Consultative Process**
	22JUL98	DEP Issues Environmental Permit
	04AUG98	Gazettal (Roads [W, U & C] Ordinance)
18DEC98	14AUG99	Detailed Design and Documentation for Adv. Works
	30JUN99	Authorisation of OZP
30JUN99	30JUN99	FC Meeting & Upgrade to Cat A for Adv. Works
29APR00	11FEB01	Detailed Design and Documentation for Rem Works
15MAR01	15MAR01	FC Meeting & Upgrade to Cat A for Rem. Works
S1		**Science Park - Phase I**
01OCT96A	30APR98	Reclamation Stage I
01MAY98	30JUN99	Reclamation Stage II - Phase I
01JUL99	30JUN01	Science Park Construction - Phase I
13DEC99	21DEC00	WP05/A - Marine Science Laboratory
13DEC99	30JUN01	WP02/A - Southern Access - Stage I
S2		**Housing Area Reclamation**
01JUL99	31DEC00	Reclamation Stage III
S3		**Remaining Area Reclamation**
01JAN01	31JUL04	Reclamation Stage II - Phase II
S4		**Southern Access - Stage II**
01JUL01	23SEP02	WP04/R-Reclamation in Southern Access - Stage II
01JUL01	17DEC03	WP02/R - Southern Access - Stage II
09OCT01	17DEC03	Construct Elevated Road Structure
S5		**Northern Access to Pak Shek Kok**
13DEC99	28AUG01	WP07/A - Northern Access to Pak Shek Kok
S6		**Remainder Roads & Drains in Pak Shek Kok**
01AUG04	18MAR06	WP06/R - Remainder Roads and Drains in PSK
S7		**Other Projects and Development**
01DEC98	31DEC01	Tolo Highway Widening
01JAN01	29JUN03	Residential Development - Stage III Recl. Area
01JUL01	20FEB03	Water Service Reservoir
01JUL03*	30JUN06	Science Park Construction - Phase II
01AUG04	27JAN07	Residential Development - Stage II Recl. Area
28MAY05	28NOV06	Recreational Facility

Figure 1.5 a

Project Start	01OCT96
Project Finish	29JUL07
Data Date	10APR97
Run Date	24MAR98

▬ Current Bar
▬ Progress Bar
▬ Critical Activity

F106

Sheet 1 of 1

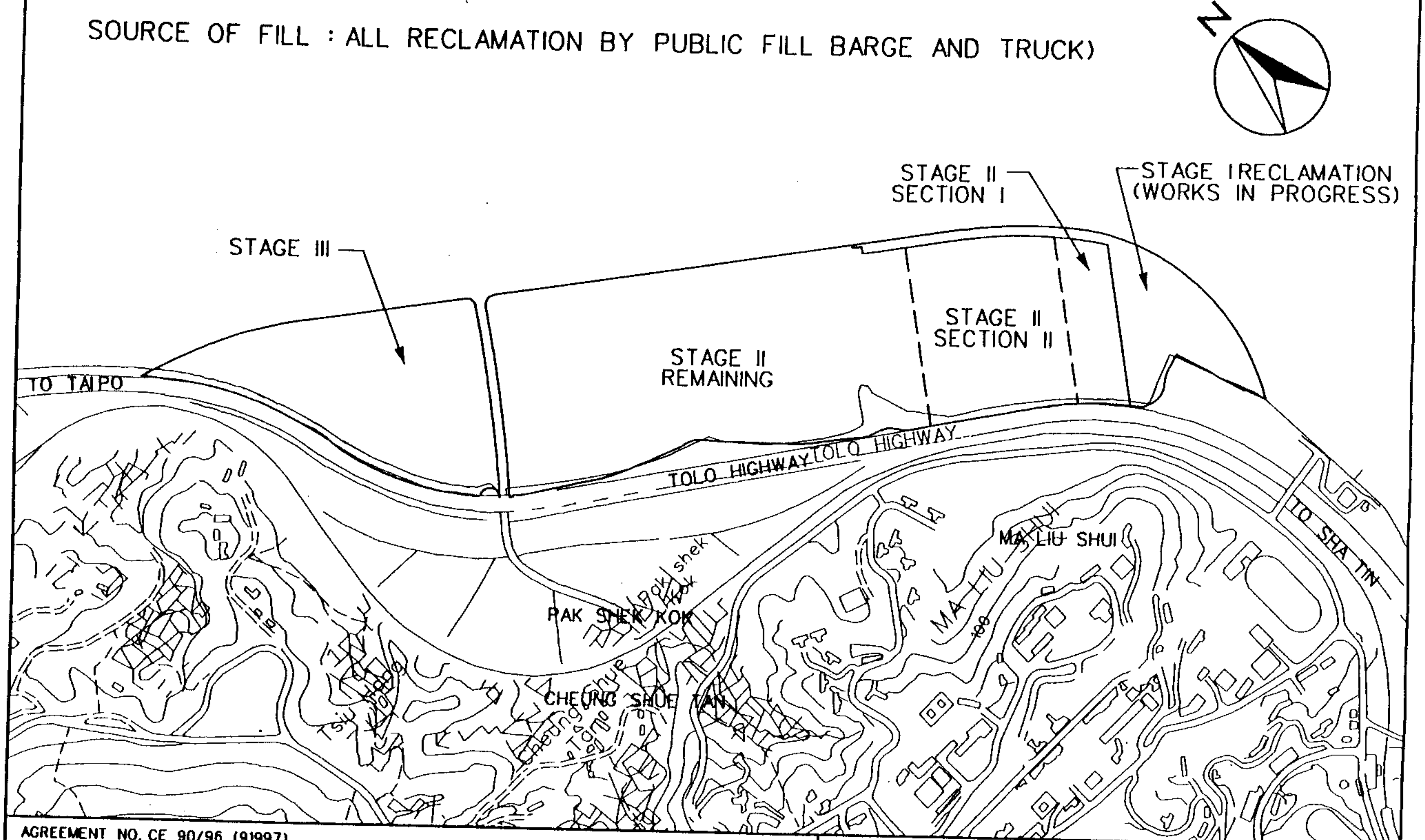
Territory Development Department

Pak Shek Kok Development

Summary Development Programme

FY03 Means
1 April 02 -
31 March 03

SOURCE OF FILL : ALL RECLAMATION BY PUBLIC FILL BARGE AND TRUCK)



AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

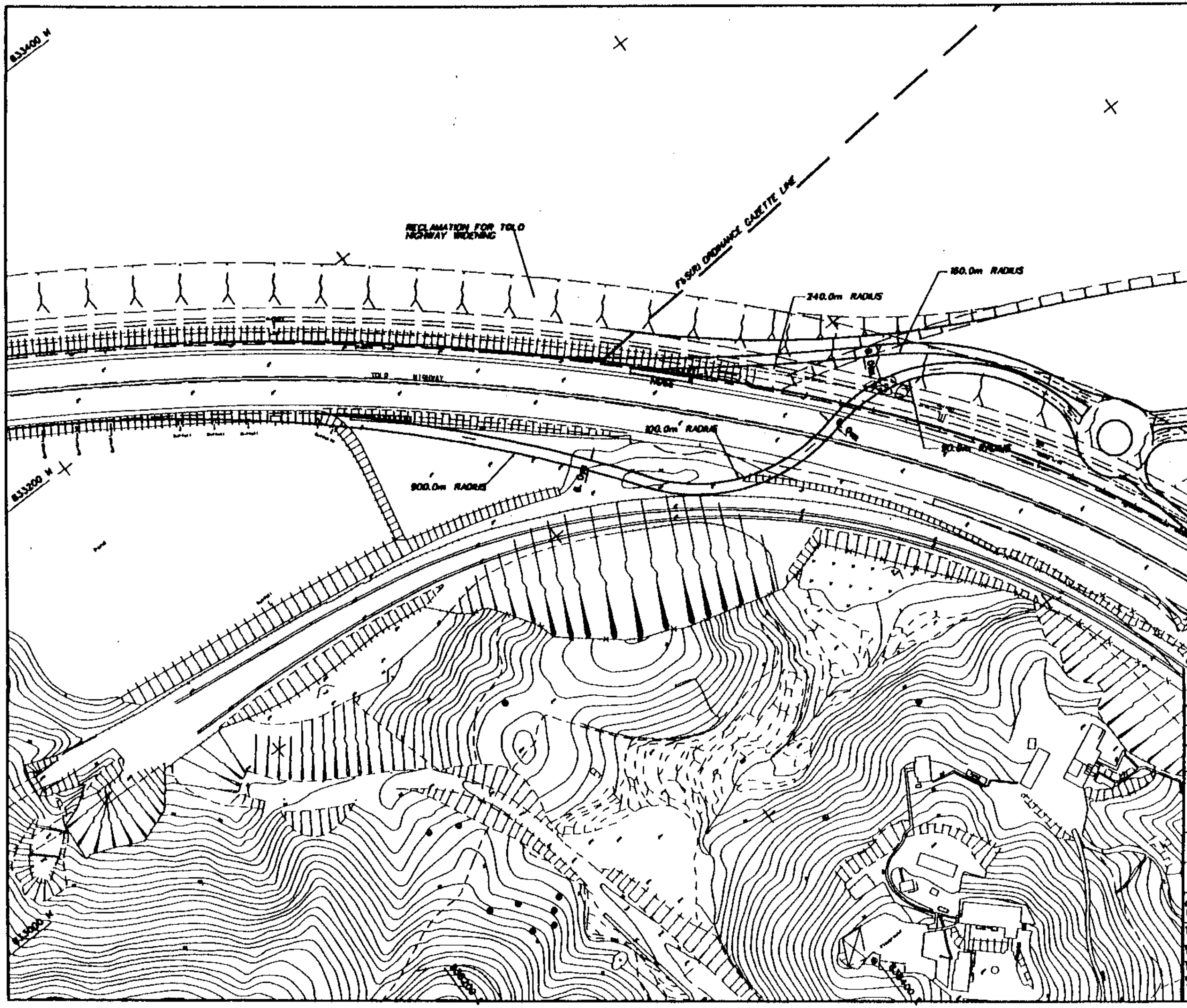
RECLAMATION - OPTION 2

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.

REVISED : 12/05/98

FIGURE NO. : 1.5b



Territory Development Department

NT NORTH DEVELOPMENT OFFICE

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA
PRELIMINARY LAYOUT

NORTHERN ACCESS
OPTION IIIE LAYOUT

MAUNSELL CONSULTANTS ASIA LTD.

DRG.NO. 1.5c

J S CROMAR

25-9-97

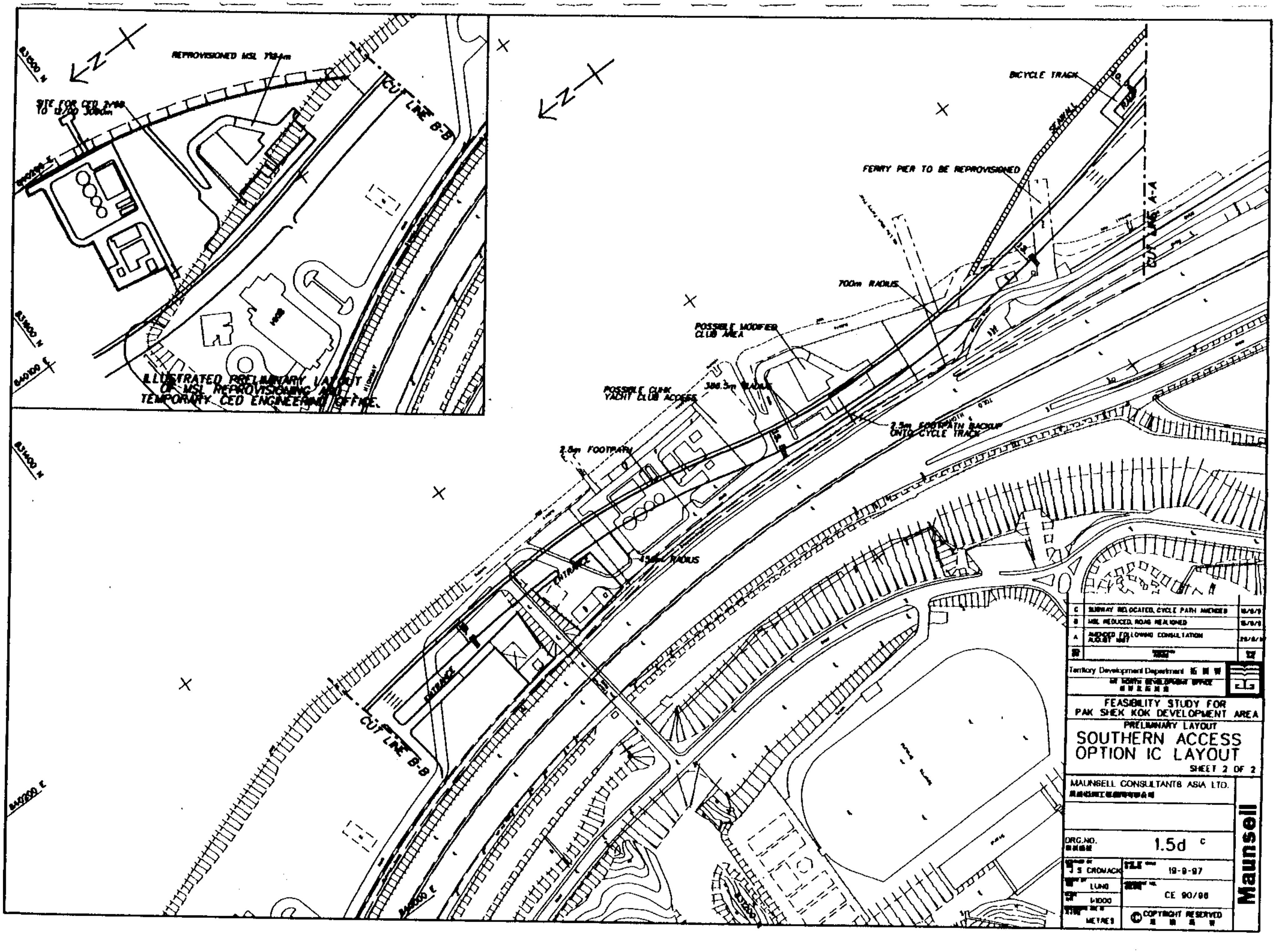
LUNG

CE 90/96

1:1000

METRES

Maunsell



C	SUBWAY RELOCATED, CYCLE PATH AMENDED	15/9/97
B	MSL REDUCED, ROAD REALIGNED	15/9/97
A	AMENDED FOLLOWING CONSULTATION AUGUST 1997	29/8/97

Territory Development Department
NT NORTH DEVELOPMENT OFFICE

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

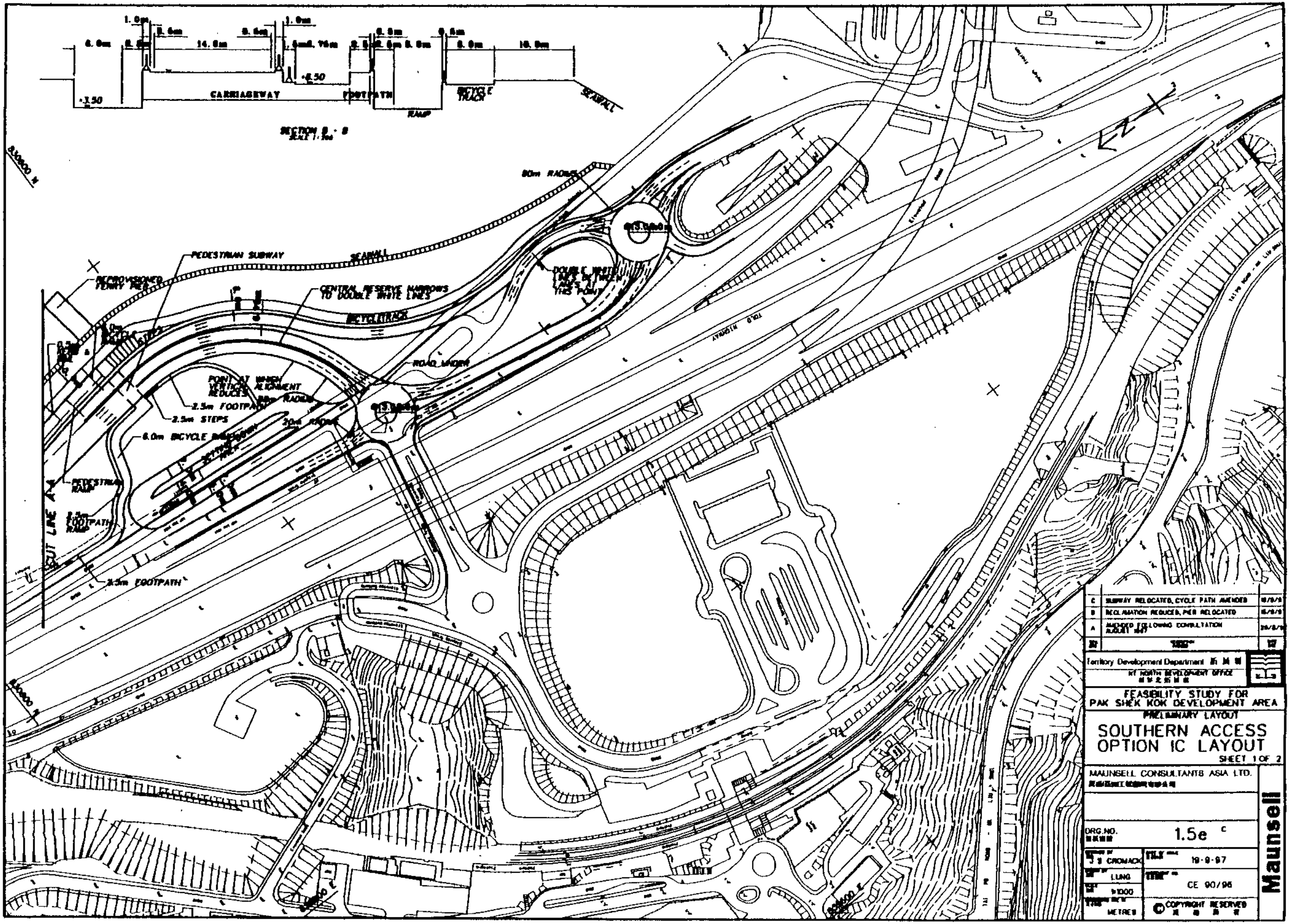
PRELIMINARY LAYOUT
SOUTHERN ACCESS
OPTION IC LAYOUT
SHEET 2 OF 2

MAUNSELL CONSULTANTS ASIA LTD.

DRG.NO. 1.5d C

J S CROMACK
DATE 19-9-97
LUNG
CE 90/96
1:1000
METRES
© COPYRIGHT RESERVED

Maunsell



C	SUBWAY RELOCATED, CYCLE PATH AMENDED	18/9/9
B	RECLAMATION REDUCED, PIER RELOCATED	15/9/9
A	AMENDED FOLLOWING CONSULTATION AUGUST 1997	20/8/9

Territory Development Department 拓展署
NT NORTH DEVELOPMENT OFFICE
新界北拓展處

FEASIBILITY STUDY FOR
PAK SHEK KOK DEVELOPMENT AREA

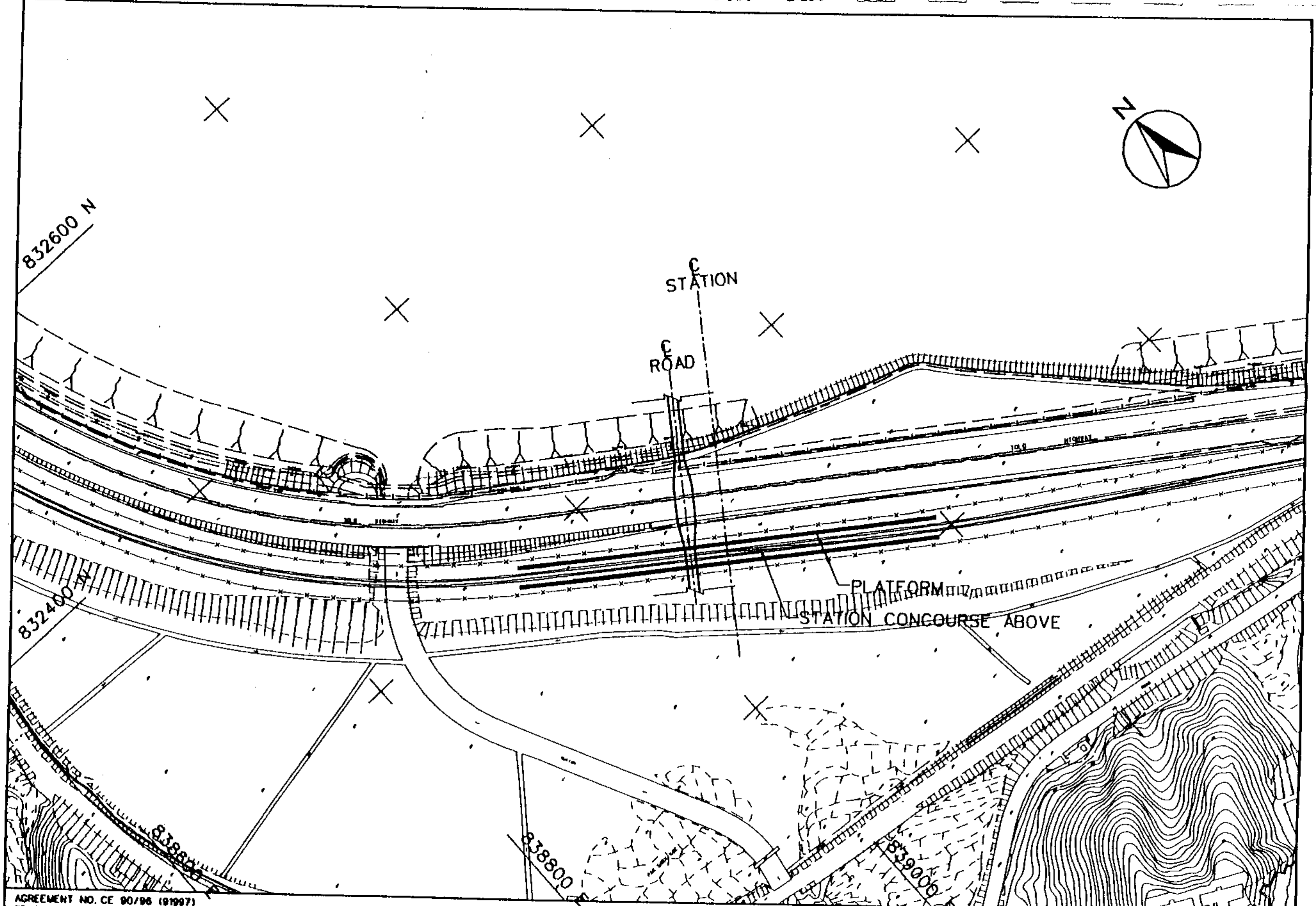
PRELIMINARY LAYOUT
SOUTHERN ACCESS
OPTION IC LAYOUT
SHEET 1 OF 2

MAUNSELL CONSULTANTS ASIA LTD.

DRG.NO. 1.5e C

J S CROMACK
19-9-97
LUNG
CE 90/96
1:1000
METRES
© COPYRIGHT RESERVED

Maunsell



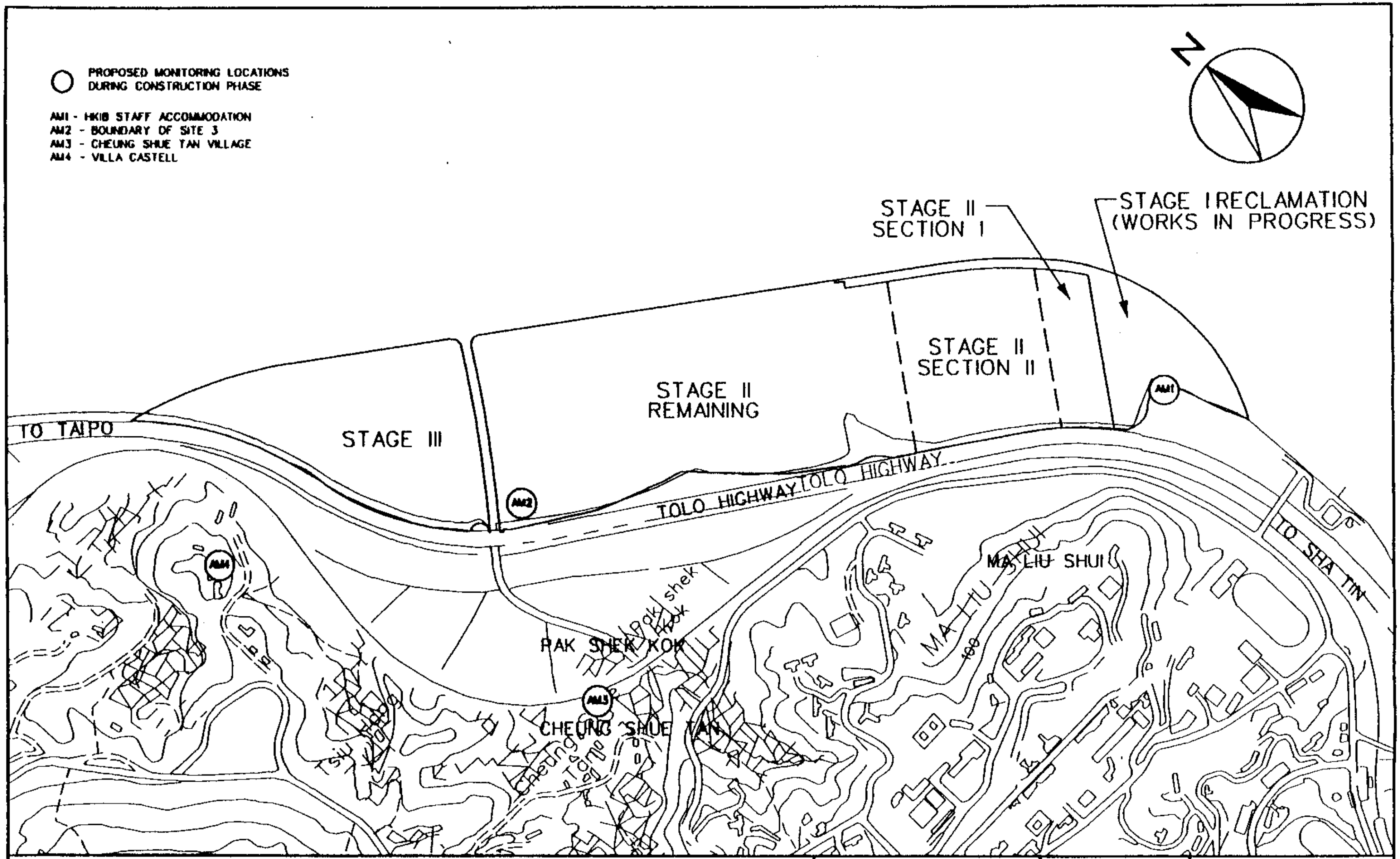
AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

STATION LOCATION

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : 1 : 2500
DATE : 18/9/97

FIGURE NO. : 1.5f



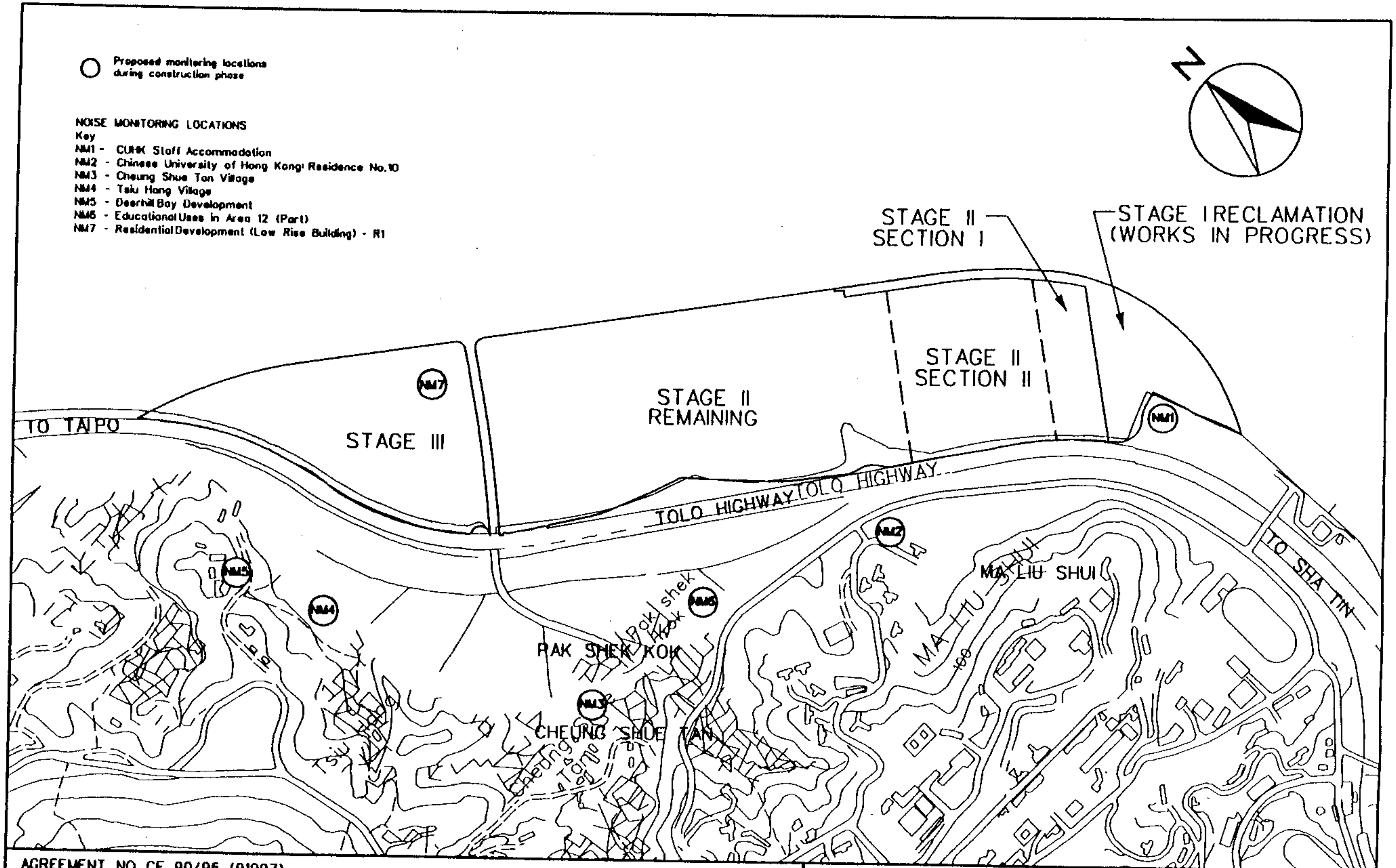
AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

LOCATION OF PROPOSED MONITORING LOCATIONS

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
REVISED : 07/05/98

FIGURE NO. : 2.5a

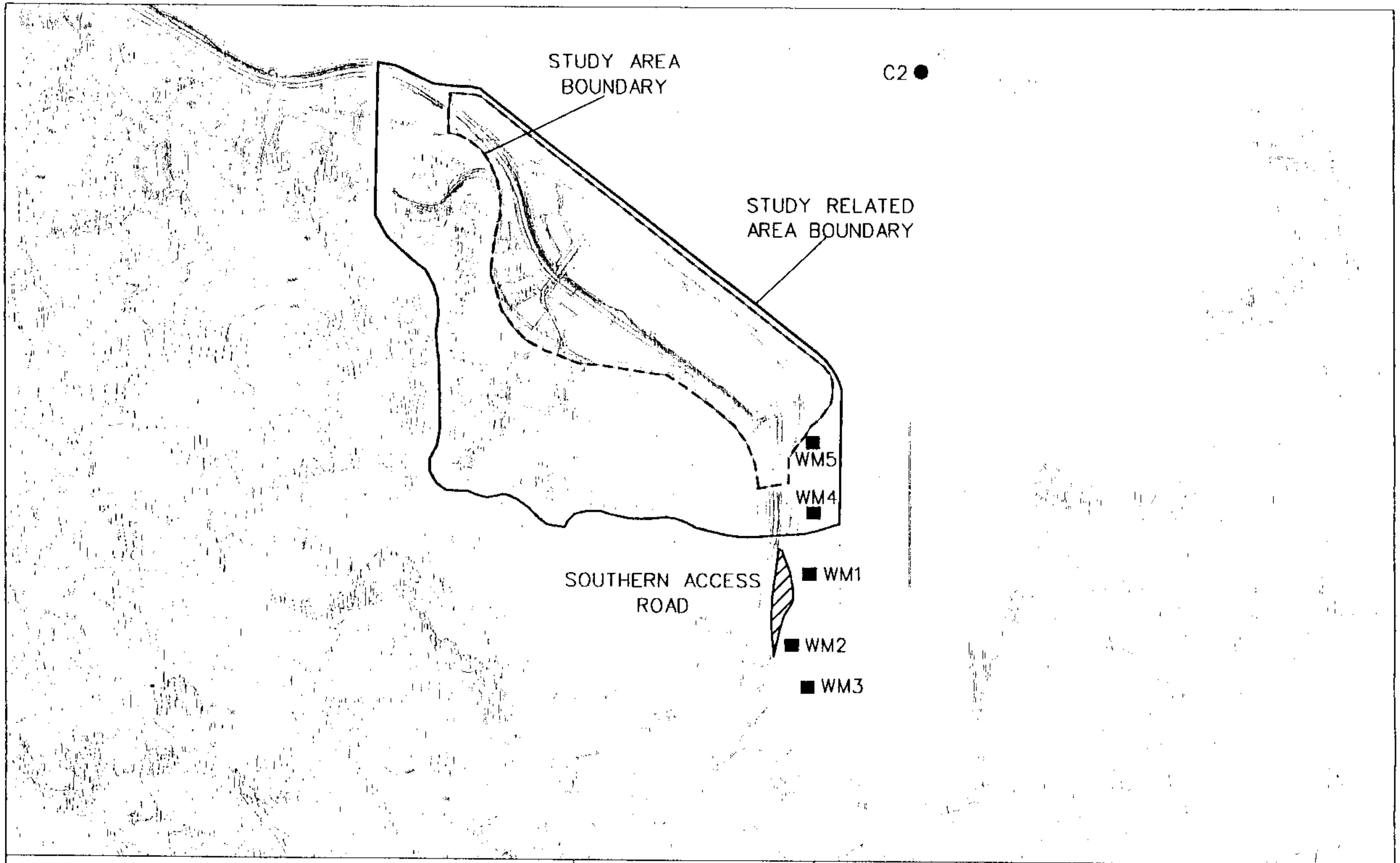


AGREEMENT NO. CE 90/96 (91997)
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

LOCATION OF PROPOSED MONITORING LOCATIONS

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
REVISED : 26/03/98
FIGURE NO. : 3.4a

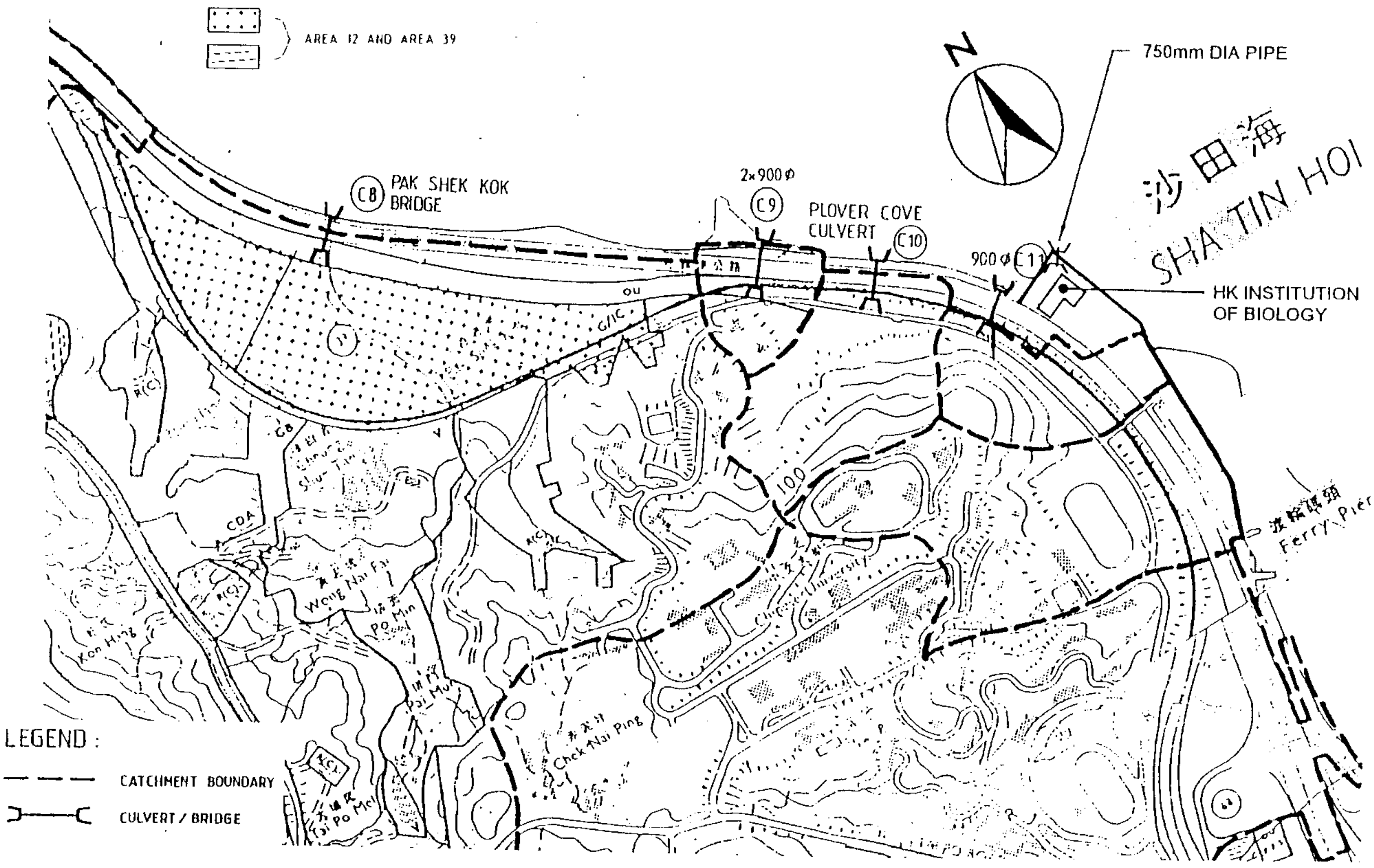


AGREEMENT NO. CE 90/96
FEASIBILITY STUDY FOR PAK SHEK KOK DEVELOPMENT AREA

WATER QUALITY MONITORING LOCATIONS

Maunsell
茂盛(亞洲)工程顧問有限公司

SCALE : N.T.S.
DATE : 07/05/98
FIGURE NO. : 4.4a

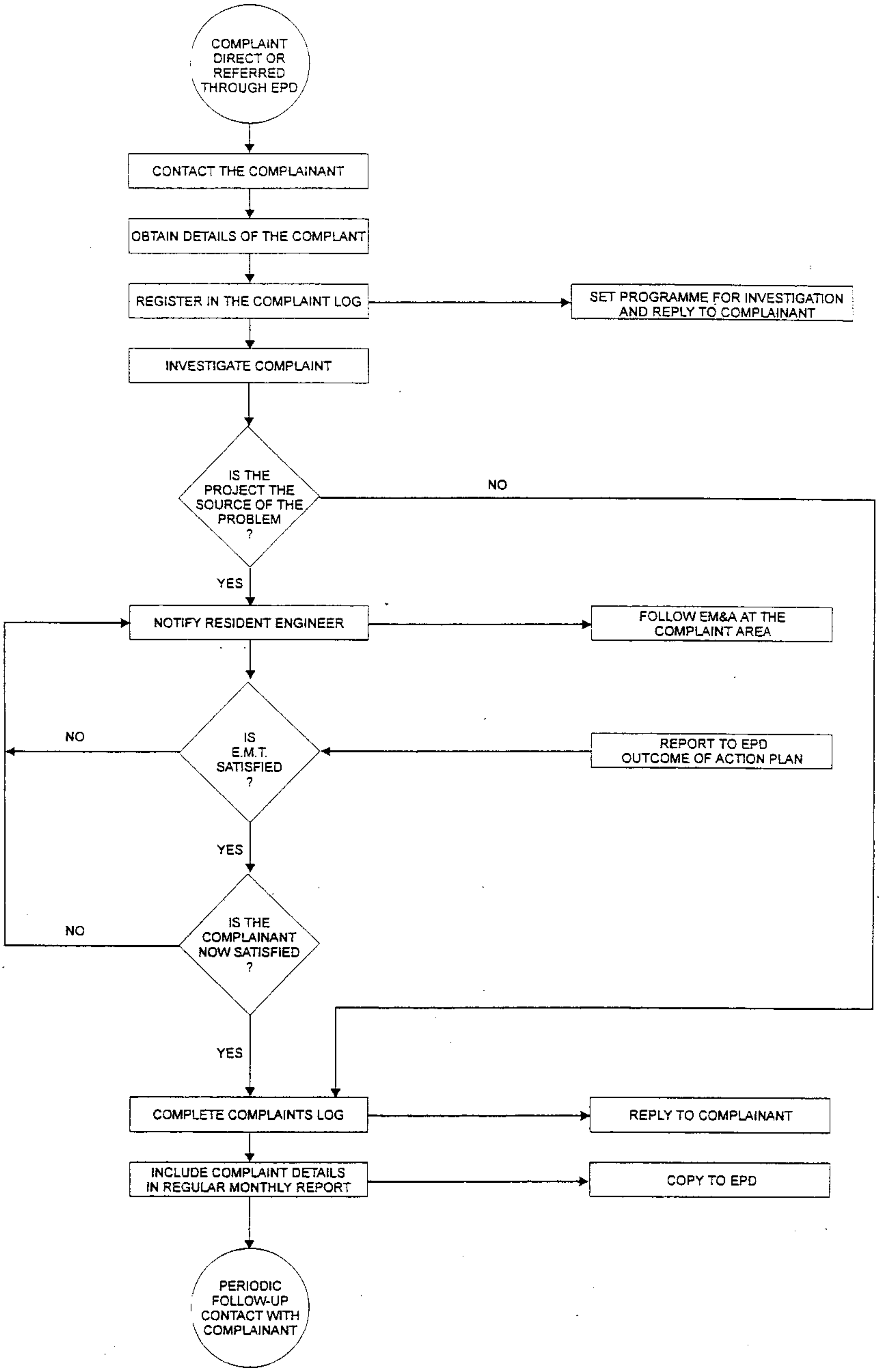


LOCATION OF MAJOR EXISTING OUTFALLS

Maunsell
茂盛(亞洲)工程顧問有限公司

DATE :

FIGURE NO.
5.5a



COMPLAINTS PROCEDURE - ACTION FLOW CHART	Maunsell 茂盛(亞洲)工程顧問有限公司	DATE :	FIGURE NO. 6.3a

Annex J

Detailed Road Traffic Noise Result for NSR 10D

```
HFANOISE v1.10 RESULTS FILE : FULL OUTPUT

File : 2011.DAT
Time : 16:50:28
Date : Tuesday, 02 June  1998

Receiver no    82:
X=838931.5  Y=832423.4  Z=     17.0  Height=     26.6

Road      Road    Sub     Flow     Speed %Heavy Gradient Basic <------------------------------ Corrections ------------------------------>
Name    Segment  Segment                                 Noise  Speed Gradient Surface Distance Angle Barrier Ground Facade Refle Segment
                                                         Level                                  of View        Cover         ction  Total

TH-SB  1013 1014   1        5740.0  100.0  45.00   0.8   79.80   7.6     0.2    -3.5     -9.4   -12.1  -17.7   0.0    2.5    0.0   47.4
       1013 1014   2        5740.0  100.0  45.00   0.8   79.80   7.6     0.2    -3.5     -9.4   -13.5  -17.5   0.0    2.5    0.0   46.2
       1013 1014   3        5740.0  100.0  45.00   0.8   79.80   7.6     0.2    -3.5     -9.4   -15.1  -17.3   0.0    2.5    0.0   44.8
       1013 1014   4        5740.0  100.0  45.00   0.8   79.80   7.6     0.2    -3.5     -9.4   -10.4  -17.1   0.0    2.5    1.5   51.2
       1013 1014      Category: A  Noise Level:  54.1
TH-SB  1012 1013   1        5740.0  100.0  45.00   0.9   79.80   7.6     0.3    -3.5     -9.4   -10.2  -17.6   0.0    2.5    1.5   51.0
       1012 1013   2        5740.0  100.0  45.00   0.9   79.80   7.6     0.3    -3.5     -9.4   -15.1  -17.3   0.0    2.5    1.5   46.4
       1012 1013   3        5740.0  100.0  45.00   0.9   79.80   7.6     0.3    -3.5     -9.4   -11.2  -17.0   0.0    2.5    1.5   50.6
       1012 1013   4        5740.0  100.0  45.00   0.9   79.80   7.6     0.3    -3.5     -9.4   -17.9  -16.7   0.0    2.5    1.5   44.2
       1012 1013      Category: A  Noise Level:  54.9
TH-NB  1031 1032   1        5320.0  100.0  50.00   0.7   79.50   8.0     0.0    -3.5    -10.0   -13.8   -6.0   0.0    2.5    0.0   56.7
       1031 1032   2        5320.0  100.0  50.00   0.7   79.50   8.0     0.0    -3.5    -10.0   -13.5   -5.3   0.0    2.5    0.0   57.7
       1031 1032   3        5320.0  100.0  50.00   0.7   79.50   8.0     0.0    -3.5    -10.0   -15.1   -5.3   0.0    2.5    0.0   56.1
       1031 1032   4        5320.0  100.0  50.00   0.7   79.50   8.0     0.0    -3.5    -10.0   -10.3  -15.1   0.0    2.5    0.0   51.1
       1031 1032      Category: A  Noise Level:  62.0
TH-NB  1030 1031   1        5320.0  100.0  50.00   0.8   79.50   8.0     0.0    -3.5    -10.0   -10.2  -16.5   0.0    2.5    0.0   49.8
       1030 1031   2        5320.0  100.0  50.00   0.8   79.50   8.0     0.0    -3.5    -10.0   -15.1  -16.2   0.0    2.5    0.0   45.2
       1030 1031   3        5320.0  100.0  50.00   0.8   79.50   8.0     0.0    -3.5    -10.0   -11.4  -15.9   0.0    2.5    0.0   49.2
       1030 1031      Category: A  Noise Level:  53.3
TH-NB  1032 1033   1        5320.0  100.0  50.00   2.1   79.50   8.0     0.6    -3.5    -10.4   -12.8  -15.4   0.0    2.5    0.0   48.5
       1032 1033   2        5320.0  100.0  50.00   2.1   79.50   8.0     0.6    -3.5    -10.4   -12.7  -16.5   0.0    2.5    0.0   47.5
       1032 1033   3        5320.0  100.0  50.00   2.1   79.50   8.0     0.6    -3.5    -10.4   -17.4   -9.0   0.0    2.5    0.0   50.3
       1032 1033   4        5320.0  100.0  50.00   2.1   79.50   8.0     0.6    -3.5    -10.4   -18.0   -8.2   0.0    2.5    0.0   50.5
       1032 1033      Category: A  Noise Level:  55.4
TH-SB  1014 1015   1        5740.0  100.0  45.00   1.6   79.80   7.6     0.0    -3.5     -9.9   -18.0  -16.9   0.0    2.5    1.5   43.1
       1014 1015   2        5740.0  100.0  45.00   1.6   79.80   7.6     0.0    -3.5     -9.9   -12.4  -17.6   0.0    2.5    1.5   48.0
       1014 1015   3        5740.0  100.0  45.00   1.6   79.80   7.6     0.0    -3.5     -9.9   -12.7  -18.4   0.0    2.5    1.5   46.9
       1014 1015   4        5740.0  100.0  45.00   1.6   79.80   7.6     0.0    -3.5     -9.9   -18.5  -18.8   0.0    2.5    0.0   39.2
       1014 1015      Category: A  Noise Level:  51.5
TH-SB  1015 1016   1        5740.0  100.0  45.00   0.0   79.80   7.6     0.0    -3.5    -10.1   -18.1    0.0   0.0    2.5    1.5   59.7
       1015 1016   2        5740.0  100.0  45.00   0.0   79.80   7.6     0.0    -3.5    -10.1   -18.3  -17.9   0.0    2.5    1.5   41.6
       1015 1016   3        5740.0  100.0  45.00   0.0   79.80   7.6     0.0    -3.5    -10.1   -19.0  -17.9   0.0    2.5    1.5   40.9
       1015 1016   4        5740.0  100.0  45.00   0.0   79.80   7.6     0.0    -3.5    -10.1   -15.9  -17.9   0.0    2.5    1.5   44.0
```

Road Name	Road Segment	Sub Segment	Flow	Speed	%Heavy	Gradient	Basic Noise Level	Corrections									Segment Total
								Speed	Gradient	Surface	Distance	Angle of View	Barrier	Ground Cover	Facade	Reflection	
TH-SB	1015 1016	5	5740.0	100.0	45.00	0.0	79.80	7.6	0.0	-3.5	-10.1	-16.4	-17.9	0.0	2.5	1.5	43.5
	1015 1016	6	5740.0	100.0	45.00	0.0	79.80	7.6	0.0	-3.5	-10.1	-15.0	-17.9	0.0	2.5	1.5	44.9
	1015 1016	7	5740.0	100.0	45.00	0.0	79.80	7.6	0.0	-3.5	-10.1	-15.7	-17.9	0.0	2.5	1.5	44.2
	1015 1016		Category: A	Noise Level:		60.3											
TH-NB	1033 1034	1	5320.0	100.0	50.00	0.0	79.50	8.0	0.0	-3.5	-10.7	-19.2	-1.5	0.0	2.5	0.0	55.1
	1033 1034	2	5320.0	100.0	50.00	0.0	79.50	8.0	0.0	-3.5	-10.7	-16.4	-16.3	0.0	2.5	0.0	43.1
	1033 1034	3	5320.0	100.0	50.00	0.0	79.50	8.0	0.0	-3.5	-10.7	-15.9	-16.7	0.0	2.5	0.0	43.2
	1033 1034	4	5320.0	100.0	50.00	0.0	79.50	8.0	0.0	-3.5	-10.7	-16.4	-16.9	0.0	2.5	0.0	42.5
	1033 1034	5	5320.0	100.0	50.00	0.0	79.50	8.0	0.0	-3.5	-10.7	-15.0	-16.5	0.0	2.5	0.0	44.3
	1033 1034	6	5320.0	100.0	50.00	0.0	79.50	8.0	0.0	-3.5	-10.7	-16.8	-16.3	0.0	2.5	0.0	42.7
	1033 1034	7	5320.0	100.0	50.00	0.0	79.50	8.0	0.0	-3.5	-10.7	-15.8	-16.6	0.0	2.5	0.0	43.4
	1033 1034		Category: A	Noise Level:		56.5											
Rd L2	1116 1120	1	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-13.2	-31.1	0.0	2.5	0.0	26.4
	1116 1120	2	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-8.5	-31.4	0.0	2.5	0.0	30.8
	1116 1120	3	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-9.6	-30.3	0.0	2.5	0.0	30.8
	1116 1120	4	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-14.2	-30.2	0.0	2.5	0.0	26.3
	1116 1120	5	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-15.4	0.0	0.0	2.5	0.0	55.3
	1116 1120	6	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-12.6	0.0	0.0	2.5	0.0	58.1
	1116 1120	7	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-12.5	0.0	0.0	2.5	0.0	58.2
	1116 1120		Category: N	Noise Level:		62.2											
TH-SB	1011 1012	1	5740.0	100.0	45.00	0.2	79.80	7.6	0.1	-3.5	-9.7	-16.3	-17.5	0.0	2.5	1.5	44.5
	1011 1012	2	5740.0	100.0	45.00	0.2	79.80	7.6	0.1	-3.5	-9.7	-12.7	-17.4	0.0	2.5	1.5	48.2
	1011 1012	3	5740.0	100.0	45.00	0.2	79.80	7.6	0.1	-3.5	-9.7	-16.8	-17.4	0.0	2.5	1.5	44.1
	1011 1012	4	5740.0	100.0	45.00	0.2	79.80	7.6	0.1	-3.5	-9.7	-17.8	-17.4	0.0	2.5	1.5	43.1
	1011 1012		Category: A	Noise Level:		51.5											
TH-SB	1009 1010	1	5740.0	100.0	45.00	0.2	79.80	7.6	0.0	-3.5	-10.4	-13.5	-17.9	0.0	2.5	1.5	46.1
	1009 1010	2	5740.0	100.0	45.00	0.2	79.80	7.6	0.0	-3.5	-10.4	-17.3	-17.9	0.0	2.5	1.5	42.3
	1009 1010	3	5740.0	100.0	45.00	0.2	79.80	7.6	0.0	-3.5	-10.4	-16.8	-17.9	0.0	2.5	1.5	42.8
	1009 1010	4	5740.0	100.0	45.00	0.2	79.80	7.6	0.0	-3.5	-10.4	-18.7	-17.8	0.0	2.5	1.5	41.0
	1009 1010	5	5740.0	100.0	45.00	0.2	79.80	7.6	0.0	-3.5	-10.4	-16.6	-30.2	0.0	2.5	1.5	30.7
	1009 1010	6	5740.0	100.0	45.00	0.2	79.80	7.6	0.0	-3.5	-10.4	-19.4	-30.1	0.0	2.5	1.5	28.0
	1009 1010		Category: A	Noise Level:		49.6											
TH-NB	1027 1028	1	5320.0	100.0	50.00	0.4	79.50	8.0	0.0	-3.5	-10.9	-18.2	-17.5	0.0	2.5	0.0	39.9
	1027 1028	2	5320.0	100.0	50.00	0.4	79.50	8.0	0.0	-3.5	-10.9	-13.1	-17.4	0.0	2.5	0.0	45.1
	1027 1028	3	5320.0	100.0	50.00	0.4	79.50	8.0	0.0	-3.5	-10.9	-17.3	-17.2	0.0	2.5	0.0	41.1
	1027 1028	4	5320.0	100.0	50.00	0.4	79.50	8.0	0.0	-3.5	-10.9	-16.8	-17.0	0.0	2.5	0.0	41.8
	1027 1028	5	5320.0	100.0	50.00	0.4	79.50	8.0	0.0	-3.5	-10.9	-18.7	-16.8	0.0	2.5	0.0	40.1
	1027 1028	6	5320.0	100.0	50.00	0.4	79.50	8.0	0.0	-3.5	-10.9	-17.5	-30.2	0.0	2.5	0.0	27.9
	1027 1028		Category: A	Noise Level:		49.1											
TH-NB	1029 1030	1	5320.0	100.0	50.00	0.2	79.50	8.0	0.0	-3.5	-10.3	-17.8	-16.6	0.0	2.5	0.0	41.8
	1029 1030	2	5320.0	100.0	50.00	0.2	79.50	8.0	0.0	-3.5	-10.3	-15.6	-16.6	0.0	2.5	0.0	44.0
	1029 1030	3	5320.0	100.0	50.00	0.2	79.50	8.0	0.0	-3.5	-10.3	-12.7	-16.6	0.0	2.5	0.0	46.9

Road Name	Road Segment	Sub Segment	Flow	Speed	%Heavy	Gradient	Basic Noise Level	<—	—	—	—	Corrections	—	—	—	—	—>
								Speed	Gradient	Surface	Distance	Angle of View	Barrier	Ground Cover	Facade	Reflection	Segment Total
TH-NB	1029 1030	4	5320.0	100.0	50.00	0.2	79.50	8.0	0.0	-3.5	-10.3	-18.0	-16.5	0.0	2.5	0.0	41.7
	1029 1030		Category: A	Noise Level:		50.2											
Rd L3	1117 1118	1	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-8.1	-14.3	-30.4	0.0	2.5	0.0	24.1
	1117 1118	2	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-8.1	-9.4	-30.1	0.0	2.5	0.0	29.3
	1117 1118	3	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-8.1	-13.9	-30.1	0.0	2.5	0.0	24.8
	1117 1118	4	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-8.1	-15.1	0.0	0.0	2.5	0.0	53.7
	1117 1118	5	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-8.1	-12.3	0.0	0.0	2.5	0.0	56.5
	1117 1118	6	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-8.1	-12.9	0.0	0.0	2.5	0.0	55.9
	1117 1118	7	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-8.1	-11.7	0.0	0.0	2.5	0.0	57.1
	1117 1118	8	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-8.1	-10.9	0.0	0.0	2.5	1.5	59.4
	1117 1118		Category: N	Noise Level:		63.9											
Rd L2	1120 1121	1	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-7.1	0.0	0.0	2.5	0.0	63.6
	1120 1121	2	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-11.4	0.0	0.0	2.5	1.5	60.8
	1120 1121	3	970.0	20.0	19.10	0.0	72.10	2.5	0.0	-1.0	-5.4	-17.4	0.0	0.0	2.5	1.5	54.8
	1120 1121		Category: N	Noise Level:		65.8											
TH-SB	1010 1011	1	5740.0	100.0	45.00	0.4	79.80	7.6	0.1	-3.5	-10.0	-13.6	-17.8	0.0	2.5	1.5	46.6
	1010 1011	2	5740.0	100.0	45.00	0.4	79.80	7.6	0.1	-3.5	-10.0	-17.7	-17.7	0.0	2.5	1.5	42.6
	1010 1011		Category: A	Noise Level:		48.1											
TH-NB	1028 1029	1	5320.0	100.0	50.00	0.3	79.50	8.0	0.0	-3.5	-10.5	-17.7	-16.9	0.0	2.5	0.0	41.4
	1028 1029	2	5320.0	100.0	50.00	0.3	79.50	8.0	0.0	-3.5	-10.5	-19.4	-16.8	0.0	2.5	0.0	39.8
	1028 1029	3	5320.0	100.0	50.00	0.3	79.50	8.0	0.0	-3.5	-10.5	-14.6	-16.6	0.0	2.5	0.0	44.8
	1028 1029		Category: A	Noise Level:		47.3											
Rd D1	1121 1250	1	1500.0	50.0	23.50	0.0	74.00	2.5	0.0	-1.0	-8.5	-13.0	0.0	0.0	2.5	1.5	58.0
	1121 1250	2	1500.0	50.0	23.50	0.0	74.00	2.5	0.0	-1.0	-8.5	-10.9	0.0	0.0	2.5	1.5	60.1
	1121 1250		Category: N	Noise Level:		62.2											
Rd D1	1143 1144	1	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-8.6	-14.7	0.0	0.0	2.5	1.5	52.9
	1143 1144	2	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-8.6	-10.4	0.0	0.0	2.5	1.5	57.2
	1143 1144	3	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-8.6	-10.1	0.0	0.0	2.5	1.5	57.5
	1143 1144	4	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-8.6	-14.8	0.0	0.0	2.5	1.5	52.8
	1143 1144		Category: N	Noise Level:		61.7											
Rd L7	1118 1119	1	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-7.9	-12.9	0.0	0.0	2.5	0.0	56.1
	1118 1119	2	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-7.9	-17.3	0.0	0.0	2.5	0.0	51.7
	1118 1119	3	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-7.9	-17.1	0.0	0.0	2.5	0.0	51.9
	1118 1119	4	560.0	50.0	30.30	8.0	69.70	3.3	2.4	-1.0	-7.9	-15.1	0.0	0.0	2.5	0.0	53.9
	1118 1119		Category: N	Noise Level:		59.8											
Rd L6	1133 1134	1	80.0	50.0	50.00	0.0	61.20	5.0	0.0	-1.0	-4.6	-3.8	0.0	0.0	2.5	0.0	59.3
	1133 1134		Category: N	Noise Level:		59.3											
Rd D1	1251 1252	1	1500.0	50.0	23.50	0.0	74.00	2.5	0.0	-1.0	-9.2	-14.7	0.0	0.0	2.5	1.5	55.6
	1251 1252	2	1500.0	50.0	23.50	0.0	74.00	2.5	0.0	-1.0	-9.2	-10.9	0.0	0.0	2.5	1.5	59.4
	1251 1252		Category: N	Noise Level:		60.9											
Rd D1	1142 1143	1	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-8.8	-11.2	0.0	0.0	2.5	1.5	56.2
	1142 1143	2	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-8.8	-16.6	0.0	0.0	2.5	1.5	50.8

Road Name	Road Segment	Sub Segment	Flow	Speed	%Heavy	Gradient	Basic Noise Level	<—— Corrections								——>	
								Speed	Gradient	Surface	Distance	Angle of View	Barrier	Ground Cover	Facade	Reflection	Segment Total
Rd D1	1142 1143	3	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-8.8	-17.7	0.0	0.0	2.5	1.5	49.7
	1142 1143	4	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-8.8	-12.4	0.0	0.0	2.5	1.5	55.0
	1142 1143		Category: N	Noise Level:		59.8											
TH-NB	1034 1035	1	5320.0	100.0	50.00	0.1	79.50	8.0	0.0	-3.5	-10.2	-17.9	-10.3	0.0	2.5	0.0	48.1
	1034 1035		Category: A	Noise Level:		48.1											
TH-SB	1016 1017	1	5740.0	100.0	45.00	0.0	79.80	7.6	0.0	-3.5	-9.8	-18.3	0.0	0.0	2.5	0.0	58.3
	1016 1017		Category: A	Noise Level:		58.3											
Rd D1	1250 1251	1	1500.0	50.0	23.50	0.0	74.00	2.5	0.0	-1.0	-9.0	-11.4	0.0	0.0	2.5	1.5	59.1
	1250 1251		Category: N	Noise Level:		59.1											
Rd L6	1134 1120	1	80.0	50.0	50.00	0.0	61.20	5.0	0.0	-1.0	-4.7	-5.6	0.0	0.0	2.5	0.0	57.4
	1134 1120		Category: N	Noise Level:		57.4											
Rd L6	1132 1133	1	80.0	50.0	50.00	0.0	61.20	5.0	0.0	-1.0	-4.6	-9.9	0.0	0.0	2.5	0.0	53.2
	1132 1133	2	80.0	50.0	50.00	0.0	61.20	5.0	0.0	-1.0	-4.6	-8.7	0.0	0.0	2.5	0.0	54.4
	1132 1133		Category: N	Noise Level:		56.9											
Rd D1	1141 1142	1	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-9.2	-17.2	0.0	0.0	2.5	1.5	49.8
	1141 1142	2	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-9.2	-16.4	0.0	0.0	2.5	1.5	50.6
	1141 1142	3	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-9.2	-14.0	0.0	0.0	2.5	1.5	53.0
	1141 1142		Category: N	Noise Level:		56.1											
Rd D1	1252 1253	1	1500.0	50.0	23.50	0.0	74.00	2.5	0.0	-1.0	-9.5	-16.6	0.0	0.0	2.5	0.0	51.9
	1252 1253	2	1500.0	50.0	23.50	0.0	74.00	2.5	0.0	-1.0	-9.5	-17.1	0.0	0.0	2.5	0.0	51.4
	1252 1253		Category: N	Noise Level:		54.7											
Rd D1	1140 1141	1	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-9.2	-16.8	0.0	0.0	2.5	1.5	50.2
	1140 1141	2	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-9.2	-14.0	0.0	0.0	2.5	1.5	53.0
	1140 1141		Category: N	Noise Level:		54.8											
Rd D1	1139 1130	1	740.0	50.0	30.00	0.0	70.90	3.2	0.0	-1.0	-9.9	-19.1	0.0	0.0	2.5	1.5	48.1
	1139 1130	2	740.0	50.0	30.00	0.0	70.90	3.2	0.0	-1.0	-9.9	-18.7	0.0	0.0	2.5	1.5	48.5
	1139 1130	3	740.0	50.0	30.00	0.0	70.90	3.2	0.0	-1.0	-9.9	-15.0	-30.0	0.0	2.5	1.5	22.2
	1139 1130		Category: N	Noise Level:		51.3											
Rd D1	1253 1254	1	2170.0	50.0	15.00	0.0	75.60	1.2	0.0	-1.0	-9.0	-17.4	0.0	0.0	2.5	0.0	51.9
	1253 1254		Category: N	Noise Level:		51.9											
Rd D1	1144 1121	1	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-9.0	-14.5	0.0	0.0	2.5	1.5	52.7
	1144 1121		Category: N	Noise Level:		52.7											
Rd L1	1129 1130	1	240.0	50.0	36.00	0.0	66.00	3.8	0.0	-1.0	-11.5	-18.1	0.0	0.0	2.5	1.5	43.2
	1129 1130	2	240.0	50.0	36.00	0.0	66.00	3.8	0.0	-1.0	-11.5	-18.8	0.0	0.0	2.5	1.5	42.5
	1129 1130	3	240.0	50.0	36.00	0.0	66.00	3.8	0.0	-1.0	-11.5	-16.7	-30.0	0.0	2.5	0.0	13.1
	1129 1130	4	240.0	50.0	36.00	0.0	66.00	3.8	0.0	-1.0	-11.5	-19.1	-30.0	0.0	2.5	0.0	10.7
	1129 1130	5	240.0	50.0	36.00	0.0	66.00	3.8	0.0	-1.0	-11.5	-19.0	-30.0	0.0	2.5	0.0	10.8
	1129 1130	6	240.0	50.0	36.00	0.0	66.00	3.8	0.0	-1.0	-11.5	-15.8	-30.1	0.0	2.5	0.0	13.9
	1129 1130		Category: N	Noise Level:		45.9											
Rd D1	1130 1140	1	540.0	50.0	35.00	0.0	69.50	3.7	0.0	-1.0	-9.6	-16.2	0.0	0.0	2.5	1.5	50.4
	1130 1140		Category: N	Noise Level:		50.4											

```
Road      Road      Sub       Flow    Speed %Heavy Gradient Basic  <------------------------------- Corrections -------------------------------> 
Name     Segment  Segment                                   Noise  Speed Gradient Surface Distance Angle  Barrier Ground  Facade Refle  Segment
                                                            Level                                  of View         Cover          ction  Total

YKL      1221 1222   1       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -17.9    0.0     0.0    2.5    0.0    35.4
         1221 1222   2       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -17.6    0.0     0.0    2.5    0.0    35.7
         1221 1222   3       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -12.6    0.0     0.0    2.5    0.0    40.7
         1221 1222   4       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -19.4    0.0     0.0    2.5    0.0    33.9
         1221 1222   5       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -16.8    0.0     0.0    2.5    0.0    36.5
         1221 1222   6       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -19.4    0.0     0.0    2.5    0.0    33.9
         1221 1222   7       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -15.2    0.0     0.0    2.5    0.0    38.1
         1221 1222   8       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -17.2   -0.1     0.0    2.5    0.0    36.0
         1221 1222   9       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.0   -14.1   -0.2     0.0    2.5    0.0    39.0
         1221 1222     Category: N  Noise Level:  46.7
Rd L7    1204 1205   1       250.0    50.0  15.00     3.7   66.20    1.2    1.1     -1.0   -11.6   -19.3    0.0     0.0    2.5    0.0    39.1
         1204 1205   2       250.0    50.0  15.00     3.7   66.20    1.2    1.1     -1.0   -11.6   -17.3    0.0     0.0    2.5    0.0    41.1
         1204 1205   3       250.0    50.0  15.00     3.7   66.20    1.2    1.1     -1.0   -11.6   -16.8    0.0     0.0    2.5    0.0    41.6
         1204 1205     Category: N  Noise Level:  45.5
Rd L7    1203 1204   1       250.0    50.0  15.00     5.4   66.20    1.2    1.6     -1.0   -11.1   -16.6    0.0     0.0    2.5    0.0    42.8
         1203 1204     Category: N  Noise Level:  42.8
Rd D1    1259 1260   1      2170.0    50.0  15.00     0.0   75.60    1.2    0.0     -1.0   -19.5   -16.6    0.0     0.0    2.5    0.0    42.2
         1259 1260     Category: N  Noise Level:  42.2
TH-NB    1024 1025   1      5320.0   100.0  50.00     0.1   35.10    8.0    0.0     -3.5     0.0     0.0    0.0     0.0    2.5    0.0    42.1
         1024 1025     Category: A  Noise Level:  42.1    Warning: Source line passes close to receiver.
YKL      1211 1212   1       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.1   -18.1    0.0     0.0    2.5    0.0    34.1
         1211 1212   2       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.1   -19.4   -4.0     0.0    2.5    0.0    28.8
         1211 1212   3       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.1   -17.5   -4.3     0.0    2.5    0.0    30.4
         1211 1212   4       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.1   -19.4   -4.0     0.0    2.5    0.0    28.8
         1211 1212   5       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.1   -16.2   -3.7     0.0    2.5    0.0    32.3
         1211 1212     Category: N  Noise Level:  38.4
YKL      1212 1213   1       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.0   -17.0   -3.8     0.0    2.5    0.0    31.5
         1212 1213   2       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.0   -19.3    0.0    -2.1    2.5    0.0    30.9
         1212 1213   3       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.0   -19.5    0.0    -2.1    2.5    0.0    30.7
         1212 1213   4       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.0   -17.8  -18.2     0.0    2.5    0.0    16.3
         1212 1213   5       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -15.0   -16.9  -19.7     0.0    2.5    0.0    15.7
         1212 1213     Category: N  Noise Level:  35.9
YKL      1220 1221   1       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.1   -14.5    0.0     0.0    2.5    0.0    38.7
         1220 1221   2       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.1   -18.5    0.0     0.0    2.5    0.0    34.7
         1220 1221     Category: N  Noise Level:  40.2
Rd D1    1262 1263   1      2170.0    50.0  15.00     0.0   75.60    1.2    0.0     -1.0   -19.2   -19.3    0.0     0.0    2.5    0.0    39.8
         1262 1263     Category: N  Noise Level:  39.8
Rd L7    1205 1206   1       250.0    50.0  15.00     5.8   66.20    1.2    1.7     -1.0   -11.6   -19.4    0.0     0.0    2.5    0.0    39.6
         1205 1206     Category: N  Noise Level:  39.6
YKL      1218 1219   1       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.4   -17.8    0.0     0.0    2.5    0.0    35.1
         1218 1219   2       260.0    50.0   7.00     0.0   66.30   -0.5    0.0     -1.0   -14.4   -15.4    0.0     0.0    2.5    0.0    37.5
```

```
Road    Road      Sub       Flow     Speed %Heavy Gradient Basic <--------------------------- Corrections --------------------------->
Name    Segment   Segment                                  Noise  Speed Gradient Surface Distance Angle  Barrier Ground Facade Refle Segment
                                                           Level                                  of View        Cover         ction Total
-----------------------------------------------------------------

YKL    1218 1219      Category: N   Noise Level:  39.5
YKL    1214 1215   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -14.8   -15.3    0.0   -2.0    2.5    0.0   35.2
       1214 1215   2      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -14.8   -17.3    0.0    0.0    2.5    0.0   35.2
       1214 1215      Category: N   Noise Level:  38.2
YKL    1210 1211   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -15.2   -14.6    0.0   -2.1    2.5    0.0   35.4
       1210 1211   2      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -15.2   -17.8    0.0   -2.1    2.5    0.0   32.2
       1210 1211      Category: N   Noise Level:  37.1
YKL    1219 1220   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -14.2   -14.3    0.0    0.0    2.5    0.0   38.8
       1219 1220      Category: N   Noise Level:  38.8
YKL    1215 1216   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -14.7   -18.1    0.0    0.0    2.5    0.0   34.5
       1215 1216   2      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -14.7   -17.0    0.0    0.0    2.5    0.0   35.6
       1215 1216      Category: N   Noise Level:  38.1
YKL    1217 1218   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -14.5   -14.7    0.0    0.0    2.5    0.0   38.1
       1217 1218      Category: N   Noise Level:  38.1
YKL    1216 1217   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -14.6   -15.2    0.0    0.0    2.5    0.0   37.5
       1216 1217      Category: N   Noise Level:  37.5
YKL    1222 1223   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -13.7   -16.2   -0.3    0.0    2.5    0.0   37.1
       1222 1223      Category: N   Noise Level:  37.1
YKL    1223 1224   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -12.6   -18.2   -0.2    0.0    2.5    0.0   36.3
       1223 1224      Category: N   Noise Level:  36.3
YKL    1229 1230   1      260.0   50.0    7.00    0.0   66.30  -0.5    0.0    -1.0   -15.0   -19.4    0.0    0.0    2.5    0.0   32.9
       1229 1230      Category: N   Noise Level:  32.9
Rd L7  1119 1200   1      250.0   50.0   15.00   20.1   66.20   1.2    6.0    -1.0    -7.6   -22.3    0.0    0.0    2.5    0.0   45.0
       1119 1200      Category: N   Noise Level:  45.0   Warning: Segment angle less than 2°.
TH-NB  1035 1307   1     5320.0  100.0   50.00    0.8   79.50   8.0    0.2    -3.5    -8.4   -28.5   -9.5    0.0    2.5    0.0   40.3
       1035 1307      Category: A   Noise Level:  40.3   Warning: Segment angle less than 2°.
Rd L7  1200 1201   1      250.0   50.0   15.00   12.1   66.20   1.2    3.6    -1.0    -2.7   -27.8    0.0    0.0    2.5    0.0   42.0
       1200 1201      Category: N   Noise Level:  42.0   Warning: Segment angle less than 2°.
Rd L7  1201 1202   1      250.0   50.0   15.00   12.2   66.20   1.2    3.7    -1.0    -5.2   -25.1   -9.5    0.0    2.5    0.0   32.8
       1201 1202      Category: N   Noise Level:  32.8   Warning: Segment angle less than 2°.
TH-SB  1303 1304   1     5740.0  100.0   45.00    0.0   79.80   7.6    0.0    -3.5    -9.5   -28.0    0.0    0.0    2.5    1.5   50.4
       1303 1304      Category: A   Noise Level:  50.4   Warning: Segment angle less than 2°.
TH-SB  1302 1303   1     5740.0  100.0   45.00    0.0   79.80   7.6    0.0    -3.5    -7.4   -30.6    0.0    0.0    2.5    0.0   48.4
       1302 1303      Category: A   Noise Level:  48.4   Warning: Segment angle less than 2°.
Rd L7  1202 1203   1      250.0   50.0   15.00   10.3   66.20   1.2    3.1    -1.0    -9.2   -20.6    0.0    0.0    2.5    0.0   42.2
       1202 1203      Category: N   Noise Level:  42.2   Warning: Segment angle less than 2°.
TH-NB  1307 1308   1     5320.0  100.0   50.00    0.0   79.50   8.0    0.0    -3.5    -6.1   -33.6   -7.2    0.0    2.5    0.0   39.6
       1307 1308      Category: A   Noise Level:  39.6   Warning: Segment angle less than 2°.
TH-NB  1308 1309   1     5320.0  100.0   50.00    0.0   79.50   8.0    0.0    -3.5    -6.0   -33.6   -0.5    0.0    2.5    0.0   46.4
```

```
Road    Road      Sub       Flow      Speed %Heavy Gradient Basic <------------------------ Corrections ------------------------>
Name    Segment   Segment                                   Noise  Speed Gradient Surface Distance Angle  Barrier Ground Facade Refle Segment
                                                            Level                                  of View        Cover         ction Total

TH-NB   1308 1309     Category: A  Noise Level:   46.4       Warning: Segment angle less than 2°.
TH-SB   1301 1302   1        5740.0  100.0  45.00      0.0   79.80    7.6    0.0    -3.5    -5.1   -36.2    0.0    0.0    2.5    0.0   45.1
        1301 1302     Category: A  Noise Level:   45.1       Warning: Segment angle less than 2°.
TH-SB   1304 1305   1        5740.0  100.0  45.00      0.0   79.80    7.6    0.0    -3.5   -13.2   -25.5   -0.8    0.0    2.5    1.5   48.4
        1304 1305     Category: A  Noise Level:   48.4       Warning: Segment angle less than 2°.
TH-NB   1309 1310   1        5320.0  100.0  50.00      0.0   79.50    8.0    0.0    -3.5   -11.3   -27.7   -0.3    0.0    2.5    0.0   47.2
        1309 1310     Category: A  Noise Level:   47.2       Warning: Segment angle less than 2°.
TH-NB   1310 1311   1        5320.0  100.0  50.00      0.0   79.50    8.0    0.0    -3.5   -12.8   -26.1   -0.2    0.0    2.5    0.0   47.4
        1310 1311     Category: A  Noise Level:   47.4       Warning: Segment angle less than 2°.
TH-SB   1300 1301   1        5740.0  100.0  45.00      0.0   79.80    7.6    0.0    -3.5    -5.4   -36.9    0.0    0.0    2.5    0.0   44.1
        1300 1301     Category: A  Noise Level:   44.1       Warning: Segment angle less than 2°.
Rd D1   1254 1255   1        2170.0   50.0  15.00      0.0   75.60    1.2    0.0    -1.0    -8.4   -25.3    0.0    0.0    2.5    0.0   44.6
        1254 1255     Category: N  Noise Level:   44.6       Warning: Segment angle less than 2°.
TH-NB   1311 1312   1        5320.0  100.0  50.00      0.0   79.50    8.0    0.0    -3.5   -14.0   -26.7   -0.1    0.0    2.5    0.0   45.7
        1311 1312     Category: A  Noise Level:   45.7       Warning: Segment angle less than 2°.
TH-SB   1305 1306   1        5740.0  100.0  45.00      0.0   79.80    7.6    0.0    -3.5   -14.6   -26.1   -1.7    0.0    2.5    0.0   44.0
        1305 1306     Category: A  Noise Level:   44.0       Warning: Segment angle less than 2°.
TH-SB   1017 1300   1        5740.0  100.0  45.00      0.0   79.80    7.6    0.0    -3.5   -11.4   -31.6    0.0    0.0    2.5    0.0   43.4
        1017 1300     Category: A  Noise Level:   43.4       Warning: Segment angle less than 2°.
Rd D1   1255 1256   1        2170.0   50.0  15.00      0.0   75.60    1.2    0.0    -1.0    -4.8   -33.5    0.0    0.0    2.5    0.0   40.0
        1255 1256     Category: N  Noise Level:   40.0       Warning: Segment angle less than 2°.
Rd L7   1206 1207   1         250.0   50.0  15.00      7.0   66.20    1.2    2.1    -1.0   -11.0   -21.3    0.0    0.0    2.5    0.0   38.7
        1206 1207     Category: N  Noise Level:   38.7       Warning: Segment angle less than 2°.

        Total contribution from :
        Unaltered                 0.0
        Altered                  67.9
        New                      72.8
        OVERALL                  74.0          No angle of view selected: 360° used


        TH-SB:Tolo Highway - Southbound
        TH-NB:Tolo Highway - Northbound
        YKL:  Yau King Lane
```