Hong Kong Government
Civil Engineering Department

Pak Shek Kok Reclamation - Public Dump Environmental Impact Assessment Study

Final Report

Mouchel Asia Limited

in association with

HWR • Enpac • Urbis • RWG

April 1994

Hong Kong Government
Civil Engineering Department

Agreement No. CE 13/93

Pak Shek Kok Reclamation - Public Dump Environmental Impact Assessment Study

Final Report

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Mouchel Asia Limited
Sub-consultants
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1.0 INTRODUCTION

1.1 Background

The proposed Pak Shek Kok (PSK) reclamation project is a result of the "Public Dumping Strategy" formulated by the Fill Management Committee in 1992 which identifies short and long term reclamation sites to meet the Territorial demand for the disposal of surplus construction material suitable for reclamation. This Strategy was endorsed by the Land Development Policy Committee at its meeting on 27 March 1992 and identified the need for a reclamation area in the North East New Territories, for the purpose of receiving public dump material as soon as possible after the completion of the Ma On Shan (MOS) Public Dump Reclamation area in 1993. The location of the site is shown in Figure 1.1.

To find a new public dump site, a search was conducted by the Planning Department of the Hong Kong Government to identify an area of seabed specifically for the purpose of reclamation by public dumping. The project site, referred to as the PSK reclamation area, was chosen on the basis that the site appeared to be the least disruptive environmentally of the sites evaluated. Subsequent investigation determined that the project may have significant environmental impacts and therefore, in September 1993, the Civil Engineering Department of the Hong Kong Government (CED) appointed Mouchel Asia Limited (Mouchel), under Agreement No. CE 13/93, to undertake an Environmental Impact Assessment (EIA) Study. The issues to be evaluated under this study include;

- noise;
- air quality;
- marine water quality;
- sediment;
- road access;
- land use impacts.

The environmental impact assessment was divided into two phases. The Phase I Study was to provide an initial assessment to identify the key issues of the environmental impacts that may arise from the development of the facility and define the environmental monitoring and audit programmes necessary to ensure that the reclamation site will be developed in an environmentally acceptable manner. The findings and recommendations of the Phase I study are presented in the Initial Assessment Report (Ref. 1)

As part of the initial assessment, the three road access alternatives proposed by Government were assessed and findings and recommendations were presented in the Working Paper on Road Access Assessment (Ref. 2). The paper concluded that Option 1 (see Figure 1.2) is the most feasible option with respect to engineering constraints, land resumption, future widening of Tolo Highway and the development programme of the reclamation site. The paper was discussed in the Road Access Working Group meeting on 3rd December 1993. The Access Road Working Group supported the conclusion that the only viable option was Option 1 and agreed that the Consultants should carry out the detailed environmental impact assessment based on this road access option.

Phase II of this Study provides a detailed assessment of the potential impacts identified in the Phase I study. Practical and cost-effective mitigation measures are proposed for significant impacts. An environmental management plan and post-project audit requirements, necessary to ensure the effectiveness of the mitigation measures, are also discussed in this Report.

1.2 Objectives of the EIA

The EIA is intended to provide information on the nature and extent of potential environmental impacts associated with the reclamation which will lead to decisions on:

- the acceptability of any environmental impacts that are identified in the study,
- conditions to be considered during the detailed design, construction and operation of the facility,
- the need to review the extent of the reclamation if it is found that the project as proposed will cause significant environmental impacts.

In order to fulfil the objectives of the EIA; the scope of study as described in the Brief, are as follows:

- to minimize pollution, nuisance and environmental disturbance arising from the Project;
- to identify and evaluate the net environmental impacts and cumulative effects expected to arise during the execution of the Project in relation to the existing and planned community and neighbouring land uses;
- to recommend cost-effective methods and measures, and to identify standards, which may be necessary to mitigate these impacts and reduce them to acceptable levels;
- to recommend environmental monitoring and audit requirements necessary to ensure the effectiveness of the environmental protection measures adopted;
- to examine the limits of a reduced Project which would be acceptable, in the case where the whole Project as currently defined would be found unacceptable on environmental grounds.

1.3 Report Structure

The report is intended to form an environmental assessment which can be used for public consultation. To comply with the general requirements for such documents, a separate bilingual (English and Chinese) Executive Summary will be produced which outlines the findings in layman's terms.

Following this Introduction, Section 2 describes the proposed development including the access to the project site and the anticipated filling sequence. The finished form of the reclamation is also outlined. The predicted traffic generated from the project which affects the extent of various environmental impacts is also presented.

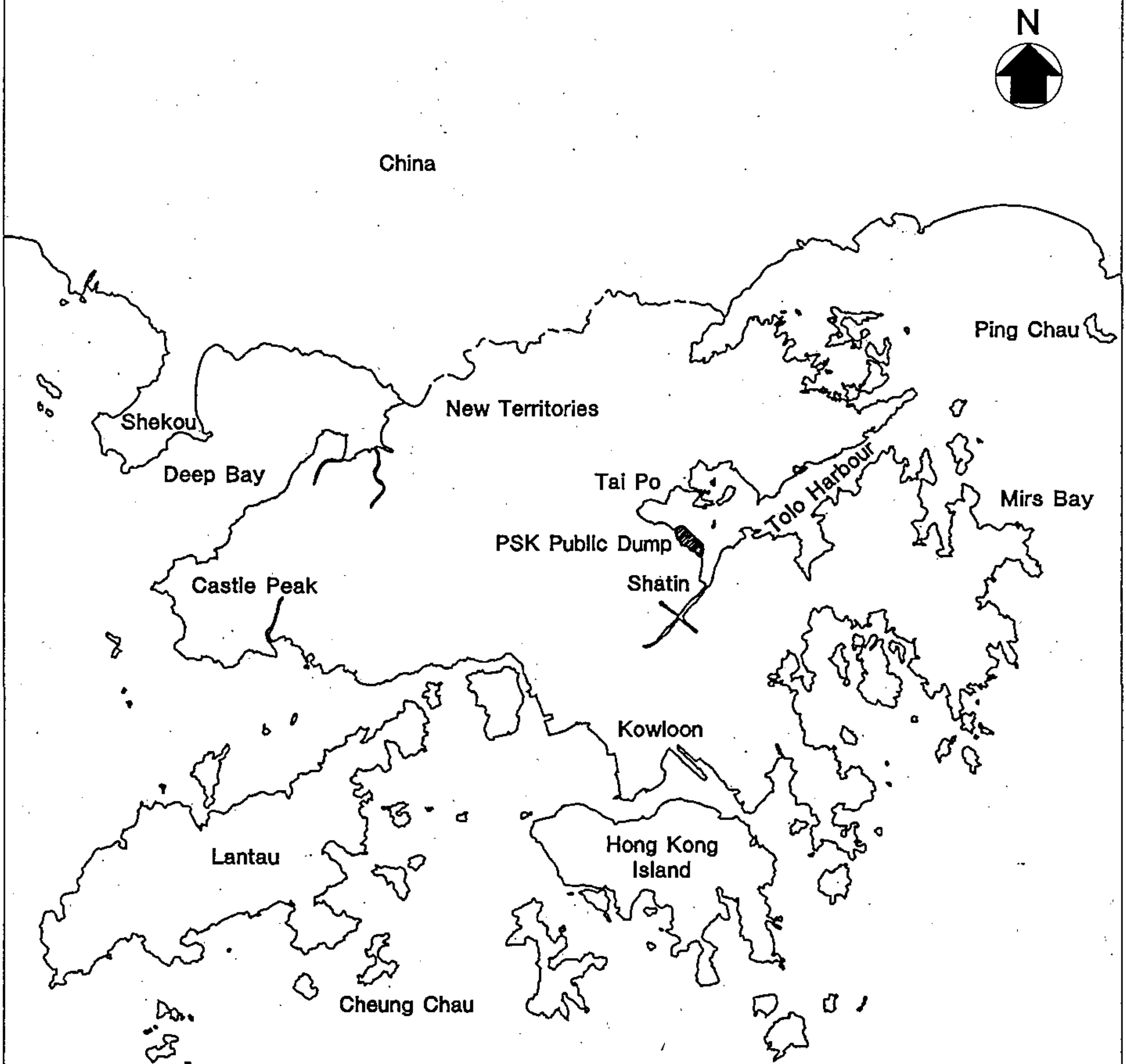
CED's intended contract strategy for the reclamation project is discussed. The construction and operation activities associated with the reclamation are described which form the basis of the impact assessment.

Section 3 describes the existing environmental conditions of the project area. The additional environmental monitoring data obtained under this study is presented and discussed which assists the determination of the significance of the impacts resulting from the project and the definition of future environmental and audit monitoring requirements.

Sections 4,5,6,7,8 and 9 respectively present the assessments of the likely extent and significance of noise, air quality, water quality, marine sediment, visual impact and land use and utility impacts related to the construction and operation of the reclamation. For each category of impact the environmental standards and the guidelines used for the assessment are presented and sensitive receivers are identified. Mitigation measures for identified impacts are recommended. Likely residual impacts after implementing the possible measures are also discussed.

Section 10 presents the environmental management plan including the environmental monitoring and audit programmes to be carried out during the development of the project. The management plan will be used to verify the predictions of environmental impact developed during the design stage and to ensure unforeseen impacts are detected at an early stage. Specification clauses for environmental performance of the contract are recommended.

Section 11 summarises the finding and provides a conclusion for the EIA.



Site Location Plan

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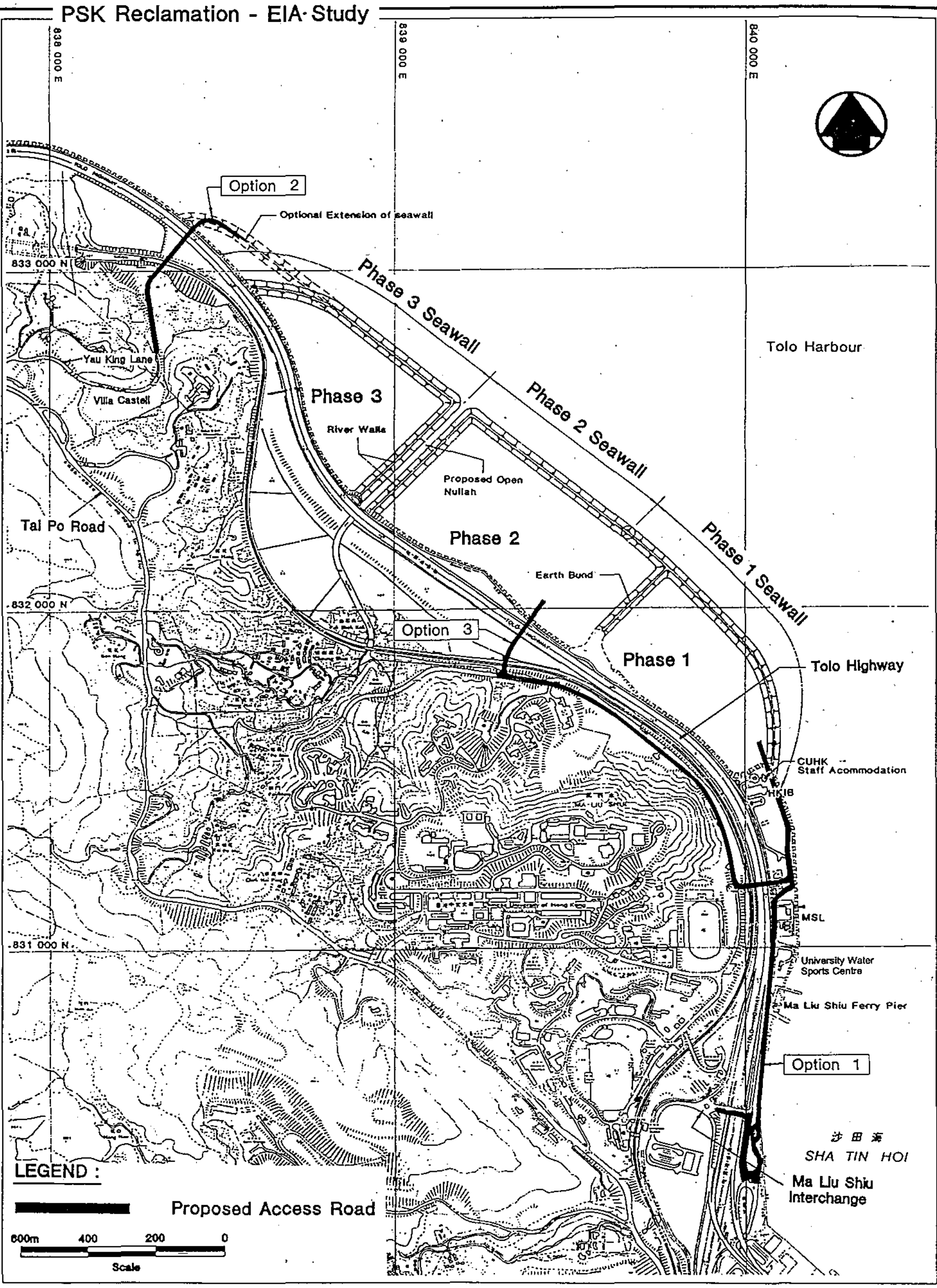
Figure No. 1.1

PSK Reclamation - EIA Study



Access Road Options

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Figure No. 1.2

2.0 THE PROPOSED DEVELOPMENT

2.1 Project Programme

2.1.1 General Overview

The proposed PSK reclamation site covers an area of approximately 67 hectares of area marine water. The project site has the capacity to receive a volume of approximately 6 million m^3 of material, based on the assumption that no dredging of the marine mud underneath the site would occur. The site is expected to have a lifespan of 7 - 8 years and is scheduled to commence in late 1995. The site will cater for the disposal of suitable surplus construction waste until the year of 2003. Once completed the finished level of the PSK site would be +5.5 mPD.

Construction and operation of the PSK reclamation is likely to create noise, air quality, marine water quality and visual impacts on the sensitive receivers in proximity to the site if unmitigated. These receivers include:

- Hong Kong Institute of Biotechnology (HKIB) Building, a research institute with plans to commercialize their products. Requirements on indoor air quality for the clean areas are extremely high. The building is sound insulated and centrally air-conditioned, with glazing over a large portion of the external wall.

- Staff Accommodation of HKIB which houses about 20 families immediately adjacent to the HKIB building. Residences are known to be extremely sensitive to the environment, particularly noise and air quality. Special windows and window-type air conditioners are provided for all flats. However, the balconies facing the Tolo Harbour are exposed.

- Marine Science Laboratory, (MSL) a teaching and research facility of the Chinese University of Hong Kong (CUHK) Department of Biology. The facility contains offices and research facilities for 3 academic and 7 technical and support staff. Additional research space is provided for 5 post graduate students and between 5 and 7 senior seminar students. Apart from the office and the testing laboratory which are air-conditioned, the water laboratory is open. The laboratory extracts seawater from Tolo Harbour for marine organisms culture and requires good water quality.

- University Water Sports Centre, a recreational centre adjacent to the MSL.

- CUHK, a tertiary educational institute with staff and student accommodations across the Tolo Highway. Class rooms are all air-conditioned but the accommodation buildings generally are not.

- Village Developments, (VD) e.g. Cheung Shue Tan and Wong Nai Fai, Tsiu Hang which are located to the north of CUHK. Generally with no special treatment to the building envelopes.

- St Christopher's Home (SCH) which will be redeveloped into a low density residential area. No special treatment to building envelope.

- Cyclists along the bicycle track of Tolo Highway.

- Residences on Ma On Shan.

- Mariculture Zones in Tolo Harbour. They are of some distance from the reclamation area and are unlikely to be affected by the project. However, they should be addressed in the study.

- Sea water intakes. There are two proposed intakes in the study area, one in Tai Po and one in Shatin. Water quality standards require low suspended solids and ammonia.

The potential impacts on these sensitive receivers must be addressed in order that practical mitigation measures could be recommended to ensure the project is carried out in an environmentally acceptable manner.

The proposed hours of operation at the PSK site are 0800 - 1800 hrs, Monday to Saturday, with the exception of public holidays (approximately 295 days per year). Once operating, licensed contractors or individuals would be able to dispose of suitable construction waste and surplus fill material to the project site which would be controlled under the dumping licence contained in Appendix I of the Works Branch Technical Circular No. 2/93, Public Dumps. Reinforcement bars will not be accepted for disposal at the public dump site. Acceptable materials listed in Appendix I include the following:

- earth (soil)
- inert building debris
- broken rock and concrete
- the above listed materials mixed with small quantities of timber

The accepted rock and broken concrete up to 250 mm could be disposed of anywhere in the reclamation area, however, hard material above 250 mm in size (referred to as oversized material) and reinforcement bars will be required to be placed in special designated areas. The likely quantity of oversized material that will be received at PSK is estimated to be about 10% of the total quantity of material received. It is expected that the construction material received at the site would be delivered in trucks with an average capacity of 6.73 m^3 of material and possibly by barge with a capacity of about 800 m^3 per load.

CED have confirmed that crushing of rock and mechanical sorting of waste will not be allowed at the PSK site. However, in order to facilitate site operation, small scale manual sorting of unsuitable material occasionally delivered to site will be expected.

In view of the contaminated nature of the marine deposits in the reclamation area, the suitability of constructing the seawall using the no-dredging methods is being investigated by the Geotechnical Engineering Office (GEO). Results will not be available during the study period. Due to the time constraint of the development programme, part of the seawalls will have to be built using the conventional dredging method. If it is found that the no-dredging method is applicable to PSK site, the remainder of the seawalls will be built using the no-dredging method. If not, dredging of marine deposit for the whole length of the seawalls will be necessary. In this EIA, dredging the whole length of seawalls is considered as the worst case scenario.

2.1.2 Implementation Programme

The implementation programme of the development of the project is presented in Figure 2.1. Failure to proceed with the project on time would result in a reliance on other public dumps in the Territory. However, this may overload other public dumps sites and some construction waste will have to be disposed of at landfills. The valuable and expensive landfill capacity will therefore be wasted by receiving the inert construction waste. In NENT, the lifespan of Shuen Wan Landfill will be shortened which is detrimental to the municipal solid management operations in the NENT area.

CED have closely examined the implementation programme of the project and established a preliminary list of action plans to ensure that the PSK site will be available to accept construction material in late 1995. As part of the action plans, the completed MOS public dump site in Area 77 will be used as a stockpiling area for surplus construction material before the opening of the PSK public dump. It is estimated that 0.9 million m^3 of material can be stockpiled at the MOS site. The stockpiled material will eventually be disposed of at the PSK site.

2.2 Access to the Project Site

2.2.1 Local Road Network

The site location and surrounding road network are shown in Figure 1.2. The site is bounded by the Tolo Harbour to the East and the Tolo Highway to the West with the KCR line just beyond the Tolo Highway. The Tolo Highway in this area is a main arterial route (Route 1) connecting Shatin with Fanling and is designated an Expressway. The highway is 3 lanes in each direction and carries approximately 87,500 vehicles/day with a peak of 7,000 vehicles/hour south of Ma Liu Shiu Interchange and 110,000 vehicles/day giving a peak/hr flow of 8,800 vehicles/hr north of the interchange. In accordance with the Transport Planning & Design Manual (Ref.3), its classification as an expressway prohibits direct frontage access being gained and also prohibits grade separated junctions providing access to specific developments. The close proximity of the Tolo Highway therefore forms a barrier for access to the site.

Further to the west lies the 7.5 - 8.0 m wide single carriageway Tai Po Road. This serves as a feeder distributer road for the Tolo Highway and in this area locally serves the CUHK at Ma Liu Shui and the village settlements of Tai Po Kau San Wai, Tsiu Hang, Kon Hang, Pak Shek Kok, Cheung Shue Tan, Wong Nai Fai, Po Min Pai Mun, Tai Po Mei, and Chek Nai Ping. The Tai Po Road currently carries approximately 10,000 vehicles/day south of the CUHK and approximately 6,000 vehicles/day north of the CUHK.

2.2.2 Adjacent Private Access

There is currently no public access to the foreshore in the area of the proposed site, however, there are various private access roads that run close to the site. The HKIB gains access from the main campus via a single lane bridge crossing the Tolo Highway. This access also serves CUHK staff accommodation adjacent to the HKIB, the MSL and University Water Sports Centre. The 6.0 to 7.3 m wide internal ring road of the CUHK runs adjacent to the KCR line and Tolo Highway for much of its length.

North of the CUHK in the area between Tai Po Kau San Wai and Tsiu Hang lies a new development known as Villa Castell which is served by Yau King Lane, a steeply inclined (10% gradient) 7.3 m wide access road from the Tai Po road. This provides the nearest access to the northern end of the proposed site.

2.2.3 Adjacent Public Access

Just south of the CUHK is a grade separated interchange that serves the CUHK rail station and also provides access to east of the Tolo Highway via a bridge. A roundabout junction just south of the bridge connects with an access road approximately 5.5 m wide running in a north/south direction adjacent to the Tolo Highway. This access serves the two public ferry piers next to the Water Sports Centre although there is no connection from the Water Sports Centre to this access road.

To establish access to the site, three road access options as shown in Figure 1.2, were evaluated:

Option 1 - This road access would be gained from the Tolo Highway via the grade separated interchange south of the CUHK, then north adjacent to the highway passing through the edge of the Ma Liu Shui ferry piers, the Water Sports Centre of the CUHK and the HKIB grounds.

Option 2 - This road access would be from the Tai Po Road, Yau King Lane serving the new residential development at Villa Castell passing over the KCR line and the Tolo Highway on a new bridge leading into the northern area of the site.

Option 3 - This road access would involve access from within the CUHK campus, this would be a combination of the first part of Option 1 using the CUHK bridge to gain access to the campus and a new bridge to cross the Tolo Highway into the site.

These road access options were assessed with respect to engineering feasibility, impact on surrounding traffic and safety aspects. The findings and recommendation were presented in the Working Paper on Road Access Assessment (Ref.2). The paper was discussed among various interested Government departments. The following summarizes the principle elements of the working paper.

2.2.4 Route Appraisal

The working paper appraised the three routes taking into consideration the following:

- Route Alignment - Horizontal Curves
  - Vertical Gradients
- Traffic Capacity
- Safety aspects - sightline, pedestrian conflicts
- Impact to existing adjacent users
- Construction content/cost

The general benefits and disbenefits of each option were outlined as follows:

Option 1 -

- Provides the most direct access
- Little conflict with existing adjacent users.
- Requires land from CUHK and MSL to provide minimum design standard
- May have delays in later years gaining access to and from Tolo Highway as Tolo Highway has attained its design flow
- Disruption to CUHK's segregated internal layout caused by opening up a direct access to the University from Tolo Highway

Option 2 -

- Last route to be effected by traffic congestion in general area.
- Few other impacts from junctions or accesses apart from Villa Castell.
- Provides good access to district distributor (Tai Po Road), although has a short length of steep gradient on Yau King Lane.
- Probably the least safest route as steep gradients produce higher down hill speeds and visibility requirements increase with speed are constrained.

- Right turning movements to and from Tai Po Road not as satisfactory as other route connections.

Option 3 -

- Has the worst alignment due to junctions and steep gradients over existing bridge.
- Longest route with impacts on CUHK.
- Disruption to MSL and CUHK internal segregated layouts.
- Traffic safety compromised by junctions and steep gradients from existing bridge.

After considering the benefits and disbenefits of each option the routes were assessed by cost/benefit analysis to establish the preferred option.

Whilst it is not possible to accurately cost individual access options without carrying out the conceptual design, the options were able to be ranked in order of cost, this allowed a rough cost/benefit analysis to be undertaken.

Access construction costs were ranked in the following manner:

- Options 2 and 3 would be the most expensive due to structural costs, the structural content is very similar for each option, however, Option 2 would have more roadworks and earthworks content and therefore was considered to cost more.
- Option 1 had very little structural content other than a subway for the cycle track and the roadwork construction costs of this route were considered minimal compared to the structural costs of other options.

The preferred option (Option 1) was therefore presented to the Access Road Working Group.

2.2.5 Comments on Working Paper

The main comments received were from Transport Department (TD) and Highways Department (HyD). Their concern was with Options 2 and 3 which would need to cross the Tolo Highway on new structures.

Both departments were unable to agree to the two options as the recent updating of the Second Comprehensive Transport Study (CTS2) (Ref.4) indicated the need and recommended the provision of additional road capacity between Shatin and Tai Po by the widening of Tolo Highway or by other means parallel to Tolo Highway. TD and HyD are concerned that the two options would compromise the future widening scheme.

Construction works associated with the proposed widening of Tolo Highway is estimated to start in early 1997 with completion some time between 1998 and 2001. There is a choice of widening to 4 or 5 lanes in each direction. TD are recommending 5 lanes in each direction due to the forecast traffic figures.

The scope of works is to be established on completion of the current Territory Development Strategy Review Study. The study is programmed to be completed in mid 1994 and would establish the need and extent of widening works.

As the feasibility study for the widening of Tolo Highway would be unable to start until mid 1994 firm details of alignment would not be available until 1995-96. Because of this TD and HyD considered that it was not possible to locate supporting columns and abutments for the structures of Options 2 and 3.

Irrespective of the Tolo Highway widening, the time scale for Option 2 is dependent on land acquisition and resolving problems associated with the use of the Yau King Lane which is private. The start of construction is unlikely before at least 1997, with completion possibly by end of 1998.

Option 3 has also been ruled out by CUHK as it would be too disruptive to campus operations if used for a prolonged period.

The currently proposed widening option (5 lane in each direction) of Tolo Highway is shown on the attached Drawing No. 90406/001. The proposed widening will affect the internal access road to the HKIB and MSL and reprovisioning works would be required to accommodate this proposal. The access bridge would need to be demolished, however it is not clear whether it is proposed to reconstruct an alternative bridge or not. The proposed road access Option 1 would take account of the possible widening requirements for Tolo Highway.

In view of the above, the Access Road Working Group concluded that the only viable option was Option 1. The proposed route is shown on Drawing No. 90406/001 and is described in more detail in the following section.

2.2.6 Preferred Route to PSK (Option 1)

Access Option 1 would be accessed via the Tolo Highway at the Ma Liu Shui interchange. From the existing roundabout it would head north along the existing ferry pier access road. Due to the increase in traffic, modification to the existing refuse collection point is necessary; it is proposed to remove this facility from the main alignment and relocate it in the layby section created near the roundabout. The alignment would follow the existing access road although some widening would be necessary to maintain a minimum 6.75 m width. On reaching the ferry piers it would be necessary to slightly raise the alignment to pass over the cycle track which would be in a slightly depressed subway. The route would diverge from the existing alignment to allow for the future widening of Tolo Highway, however, the route will avoid encroachment into the Water Sports Centre. The slight realignment, if necessary, can be undertaken when the Tolo Highway is widened. A short section of new road construction would be required in the area in order to connect with the existing access road running adjacent to the Water Sports Centre and MSL. The route would then turn east and north, generally following the existing access road. However, bend improvements are recommended at this location to bring the access road up to an acceptable standard. The proposed bend improvements may necessitate resuming land from the MSL, but this will be avoided if possible. The route will rise above existing levels in this area to improve the junction with the access bridge and assist with bend improvements.

On passing the end of the existing bridge ramp the proposed route would diverge from the existing access road on to new road construction, and generally follow the coast line, passing on the seaward side of the HKIB staff accommodation block, and entering the site at the southern tip.

There is currently no direct access from Tolo Highway to the CUHK. If the ferry pier access road and the internal access to MSL and HKIB are connected, it will create a direct link from Tolo Highway to CUHK. It is understood this would be welcomed by the University, although concern with security at MSL was highlighted. As shown in Drawing No. 90406/001, it is proposed to operate a security type check point at the gate just north of the Ma Liu Shui Ferry Piers. This would ensure only CUHK personnel, Government and public dumping licences holders could use the access road, this would also aid security. Placing the check point adjacent to the ferry pier turning area allows vehicles to be turned away without passing the gate.

The vertical alignment of access Option 1 would be generally level except when passing over the cycle track, maximum gradients of 4% could be achieved.

2.3 Proposed Filling Sequence (Stages)

As road access Option 1 will be adopted, the sequence of filling will be Phase 1, Phase 2 and followed by Phase 3 (See Figure 1.2). As discussed in Section 2.5 the reclamation may be let in two contracts only, Phases 2 and 3 reclamation may therefore be combined into one contract. However, in the detailed assessment, Phases 2 and 3 are assessed separately in order to show the potential impacts of the reclamation in different areas.

The 0.9 million m^3 of construction material stockpiled at the MOS public dump site will be transferred and disposed of at the PSK site. In order to extend the life of Phase 1 to about 2.5 years and to dispose of all the stockpiled material in this area, CED will revise the limit of Phase 1 reclamation.

It is recommended that the southern part of the Phase 1 reclamation should be filled up to finished level (+5.5 mPD) as quickly as possible in order that a landscape mound could be constructed in this area to mitigate noise, dust and visual impacts from the reclamation work further north of HKIB and its staff accommodation. The height of the mound with respect to noise attenuation level and visual impact will be discussed in later sections.

2.4 Waste Arisings and Truck Arrivals

As the site will be reclaimed using suitable construction waste, and the rate of supply of the waste may vary significantly throughout the year, it is difficult to prepare a precise programme of delivery of materials.

The CED's anticipated forecast of annual waste arisings for PSK are given in Table 2.1.

Table 2.1 : Predicted Annual Construction Waste Arisings at PSK

Year	Waste Arisings (m^3)
(Oct-Dec) 1995[1]	137,000[2]
1996	530,000[2]
1997	530,000[2]
1998	530,000
1999	530,000

Note: (1) assume PSK site will operate in October 1995;

(2) in additional to this volume, 2 barge loads (800 m^3/load) of stockpiled material will be transferred from the MOS Public Dump site to PSK each day until all the stockpiled material (900,000 m^3) has been cleared.

This estimate was based on the Fill Management Committee (FMC) Forecast of surplus material in the North-East New Territories (Ref.5). During the first two years of operation PSK would receive two barge loads per day of material that has been stockpiled at the MOS Public Dump in addition to waste generated from construction activities.

To determine the daily truck arrivals anticipated at the proposed PSK site during operations, it is estimated that each truck arriving at the site would contain approximately 6.73 m^3 of material and that the site would operate 295 days per year for 10 hours a day. Applying this to FMC's anticipated forecasts of waste arisings given in Table 2.1 there would be an average of 267 vehicles arriving at the site per day, or an average of 27 trucks per hour.

However, due to the variations in the generation of construction waste, it is difficult to precisely determine the daily and hourly truck arrivals for the proposed project. An estimate of the typical daily arrival of waste vehicles at a public dump site has been obtained from MOS Public Dump. The number of vehicles arriving at this site between January and August 1993 is depicted in Table 2.2.

As shown in Table 2.2, the daily number of truck loads arriving at the MOS Public Dump fluctuates significantly. This information is based on data contained in Contract No ST 59/90 provide by CED Solid Waste Division (Ref.6). Table 2.3 depicts the average daily truck trips to the MOS Public Dump for each operational day.

Table 2.2 : Ma On Shan Public Dump, Daily Number of Trucks Arriving; 1993 (- = site closed)

Day	January	February	March	April	May	June	July	August
1	-	235	-	-	-	201	171	-
2	272	225	-	-	-	50	206	417
3	-	240	-	-	-	57	198	324
4	248	232	-	-	-	75	-	347
5	221	227	-	-	-	122	282	447
6	255	206	-	-	-	-	275	387
7	277	-	-	-	-	137	239	420
8	338	224	-	-	-	223	201	-
9	267	-	-	-	-	122	205	389
10	-	-	-	-	-	104	167	248
11	283	-	-	-	-	146	-	333
12	212	-	-	-	-	48	78	485
13	204	-	-	-	-	-	144	488
14	255	-	-	-	-	143	95	534
15	294	-	-	-	20	370	187	-
16	200	-	-	-	-	142	237	147
17	-	-	-	-	127	290	276	371
18	170	-	-	-	101	357	-	474
19	173	-	-	-	96	251	325	405
20	155	-	-	-	128	-	264	211
21	31	-	-	-	124	242	328	299
22	-	-	-	-	119	274	173	-
23	-	-	-	-	-	141	175	247
24	-	-	-	-	56	-	294	255
25	-	-	-	-	23	330	-	280
26	1	-	-	-	35	400	347	159
27	65	-	-	-	57	18	347	78
28	152	-	-	-	120	144	424	-
29	170	-	-	-	158	155	480	-
30	207	-	-	-	-	176	439	-
31	-	-	-	-	101	-	174	148
Total	4450	1589	-	-	1265	4718	6731	7893

Table 2.3 : Ma On Shan Public Dump - Average Daily Truck Trip Per Month (per Working Day)

Month	Jan.	Feb.	March	April	May	June	July	Aug.
Truck Arrivals/ Month	4450	1589	-	-	1265	4718	6731	7893
Delivery Days/ Month	22	7	-	-	14	26	27	24
Average Trips/ day	203	227	-	-	90	182	250	329

As shown in Table 2.3 the average number vehicle arrivals per delivery day varies from 89 in May to 329 in August. The maximum likely number of truck arrivals per day can be determined from the maximum daily truck arrivals for each month (Table 2.2) divided by the average daily number of trucks given in Table 2.3. This is depicted in Table 2.4.

Table 2.4 : Difference between Maximum Daily Truck Arrival and Average Truck Arrival at Ma On Shan Public Dump

Month	Jan.	Feb.	March	April	May	June	July	Aug.
Maximum Truck Arrivals/Day	338	240	-	-	158	400	480	534
Average Truck Arrival/Day	203	227	-	-	90	182	250	329
Maximum Truck Arrivals/day divided by Average Truck Arrivals/day	1.66	1.06	-	-	1.76	2.19	1.92	1.62

As shown in Table 2.4, the peak number of trucks arriving for the 6 months ranged from a factor of 1.06 to 2.19, which can be averaged to 1.7 This average factor of 1.7 and the highest factor of 2.19 have been used to calculate the maximum daily truck arrivals projected for the PSK project. These are shown in Table 2.5.

Table 2.5 : Estimated Peak Hour Truck Trips to Pak Shek Kok

Year	Anticipated Material Volume (m^3/year)	Average Number of Vehicles			Peak Truck Trips Per Day (1.7)	Maximum Peak Truck Trips Per Day (2.19)
		Per Year	Per Day	Per Hour		
1995(1)	137,000(2)	20,357	267(2)	27	454	585
1996-1999	530,000	78,752	267	27	454	585

Notes: (1) Assume the site will operate in October 1995
(2) Based on 76 working days from October - December 1995

As shown in Table 2.5, the peak truck trips per day is expected to range from 454 to 585. The origin of the material to be received at the proposed PSK project site is difficult to estimate because it is dependent upon the location of the proposed sorting centres and constructions sites. To give an idea of where construction waste is currently being received from at MOS Public Dump, Table 2.6 shows the origin of materials for public dumping disposal for October 12th-14th, 1993.

Table 2.6 : Origin Survey of Material Arriving at Public Dumps (Contract No. ST 59/90)

Date	Origin of Material	No. of Trucks	Total No. of Trucks
12/10/93	Wong Tai Sin	120	
	Lion Rock Tunnel Road	82	
	Tai Wai	10	
	Shek Mum Quarry	50	
	Jat Min Chuen	8	
	City One Shatin	40	
	Fo Tan	30	
	Tsuen Wan	15	
	Ma On Shan	30	385
13/10/93	Shek Mum Quarry	55	
	City One Shatin	30	
	Fo Tan	28	
	Tsuen Wan	10	
	Ma On Shan	45	
	Kowloon Bay	28	
	Sha Tin	76	272
14/10/93	Lion Rock Tunnel Road	30	
	Tai Wai	8	
	Shek Mum Quarry	19	
	City One Shatin	7	
	Sha Tin	5	69

It is likely that construction material will continue to be generated from these areas, however, they will be dependent upon the construction projects planned during the PSK project life.

2.5 Contract Arrangement

CED advise that the reclamation will be implemented through three consecutive contracts in which Design and Build element for constructing seawall foundation may be included. The first contract will include the construction of the Phase 1 seawall and access road and dumping operation. The contractor will be responsible for removing all the stockpiled materials at the MOS site and disposing them at the PSK site. If the access road to PSK site is not ready before October 1995, the MOS site may be re-opened temporarily to accept dumping material. The material will then be transported together with the stockpiled material to PSK by barge. This option should only be considered as the last resort for transporting construction material to PSK site as it involves double handling of the material which is not beneficial in terms of environmental pollution and cost-effectiveness. It is anticipated that the first contract will last for about 2.5 years. The second and third contracts will cover the remaining part of the reclamation.

2.6 Activities during Construction

The activities during the construction of the project primarily include construction of the seawall and associated dredging and provision of an access road.

The first part of the construction activities will be the construction of the seawall behind which the material will be dumped. The proposed marine seawall is expected to be of the conventional sloping or breakwater type, with vertical or blockwork seawalls where barging activities are to take place. Dredging is likely to be required, in the area that the wall will be constructed, to remove the soft marine deposits or mud which would be inappropriate as a foundation material and these would be replaced by suitable backfill material which offers higher strength characteristics. A number of dredging methods are available and will be discussed in Section 7.0. It may be possible to construct seawalls on foundations which do not depend on the removal of soft marine muds from the sea bed prior to their construction. New seawall construction methods using in-depth cement mixing or piling with sand displacement are being considered by the Geotechnical Engineering Office (GEO). If it is found to be applicable at the PSK site, dredging can be avoided for the later stages of the seawall construction.

It is anticipated that the applicability of the no dredging method cannot be determined in the short term, the first 200-300 m of the Phase 1 seawall will therefore be constructed using the conventional dredging method. It is expected that this section of seawall will be completed within 6 months. Most of the material for seawall construction will be come from the stockpiles at MOS (including rocks). Transportation of material will be by barge. There will be a limited number of construction vehicles for seawall construction.

For the actual reclamation area, excluding the seawall area, it is assumed that there will be no dredging activities.

For sediment impact assessment, it is assumed that the whole length of seawall will be constructed using the dredging method and the dredged marine deposits will require disposal. The estimated volume of material that will require disposal for each stage of the project is shown in Table 2.7.

Table 2.7 : Volume of Material to be Dredged (assuming no-dredge methods are not used)

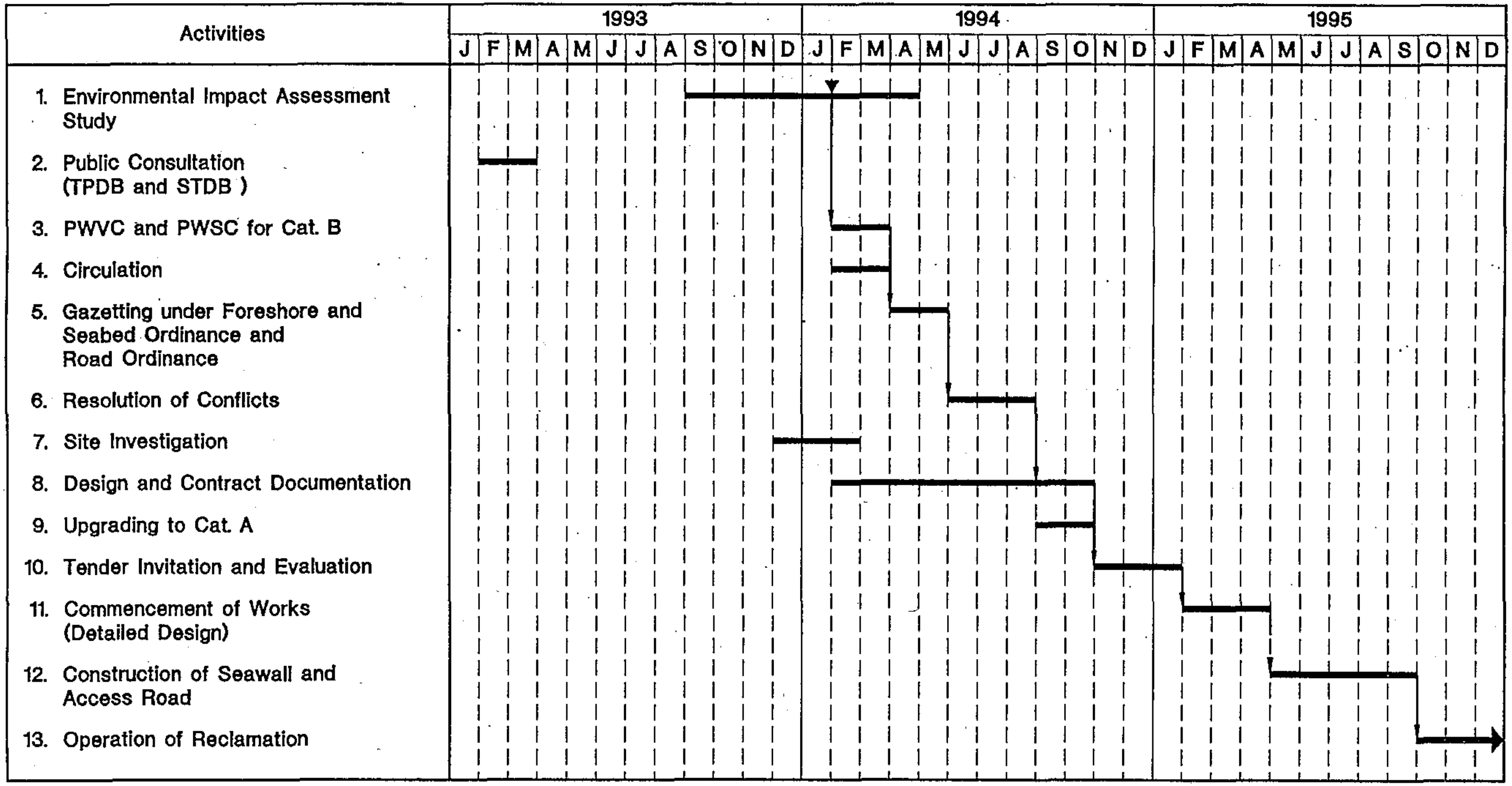
Phase	Volume of Material (m^3)
1	218,850
2	166,900
3	141,750
Total	527,500

The activities related to the construction of access road will include earthwork, drainage, concrete construction, kerbing and paving. Blasting and piling are not expected to be required.

2.7 Activities during Operation

The activities during operational phase consists of infilling the reclamation site; transporting of infill material to the site; unloading of material; spreading and temporarily stockpiling of material on site; transferring of stockpiling material to the active working face and material compaction; hydroseeding and planting.

In order to suppress wind blown dust on haul routes and active working face, spraying of water using water bowsers is likely to be required. All trucks leaving the dumping site should be washed to remove dirt attached to underchassis and wheels. These mitigation measures are further discussed in Section 5. Equipment maintenance will also be expected on this site.



Project Implementation Programme

May 1994

Mouchel

Figure No. 2.1

3.0 EXISTING ENVIRONMENTAL CONDITIONS

3.1 Introduction

In order to assess the significance of environmental impacts of the reclamation project it is necessary to establish the existing environmental conditions for particular parameters which could act as yardstick to measure the predicted changes. The existing conditions can also be used to show the state of the environment with reference to established environmental standards, guidelines and objectives. The existing environmental conditions can be established by reviewing the available data in the study area and if data is insufficient or is not available, it is necessary to carry out a monitoring programme to obtain more data. Available data for the study area has been reviewed and additional environmental monitoring was conducted for those parameters which existing data is inadequate to establish the background conditions. The findings of the assessment are presented in this section.

3.2 Noise

24-hour noise levels were monitored at five locations in the study area in January 1994 (see Figure 3.1). Hourly results of the monitoring programme are found in Appendix A. Daytime (0700 to 1900 hrs) results are summarised in Table 3.1.

Table 3.1 : Results of Background Noise Monitoring

Noise Sensitive Receiver		Location of Noise Meter	L_{90} (1 hour) Daytime Facade Noise Level (dB(A))	
	Location as shown in Figure 3.1		minimum	maximum
CUHK: Staff Accommodation adjacent to HKIB	A	roof	70	73
CUHK: Xuesi Hall	B	roof	63	65
CHUK: Residence No. 7	C	roof	62	66
CUHK: Residence No. 10	D	roof	71	73
Cheung Shue Tan Village	E	roof	52	56

The area monitored is dominated by traffic noise, particularly from traffic on Tolo Highway, a dual three-lane rural trunk road with a posted speed of 100 km/hr. Tolo Highway leads to the principle border crossings, and thus carries a large proportion of heavy vehicles. The section of Tolo Highway that runs by the proposed reclamation is built mostly on reclaimed land, and is predominantly level. Over this section, the highway is paved with friction course.

Noise from KCR rail traffic (both electric and diesel powered) running parallel to Tolo Highway also contributes to the overall noise environment.

3.3 Air Quality

The proposed reclamation is situated between Shatin and Tai Po, adjacent to the Tolo Highway. Tai Po and Shatin both have industrial areas; in particular, Tai Po is the site of a large industrial estate that houses potentially polluting industries. Tolo Highway is a source of motor vehicle emissions, including significant levels of RSP.

1992 ambient pollution concentrations have been monitored at EPD's Tai Po and Shatin Stations. The results of EPD's monitoring for NO_2, TSP and RSP have been obtained and are shown in Table 3.2 below:

Table 3.2 : Average 1992 Pollution Concentrations at EPD's Tai Po and Shatin Monitoring Stations

Monitoring Station	1992 Monitored Pollution Concentrations ($\mu g/m^3$): 90th Percentile Values			
	NO_2 (1)		TSP (2)	RSP (2)
	1-hr	24-hr	24-hour	24-hour
Tai Po	70	97	137	83
Shatin	-	-	125	82

Notes (1) NO_2 concentrations were not sampled at the Shatin Monitoring Station. The table shows the maximum 24-hour concentration in 1992 at Tai Po Station, since the corresponding 90th-percentile 24-hour value was not available.

(2) The particulate concentrations are based on samples taken once every six days (i.e., five samples per month).

3.3.1 Existing NO_2 Concentrations

Table 3.2 above shows that the maximum NO_2 concentrations recorded at the Tai Po Monitoring Station in 1992 were well below the relevant AQO maxima of 300 $\mu g/m^3$ (hourly) and 150 $\mu g/m^3$ (24-hourly). In the same year, the average yearly NO_2 concentration was recorded as 40 $\mu g/m^3$, also well below the AQO maximum of 80 $\mu g/m^3$. Thus, no exceedance of the hourly, 24-hourly, or yearly NO_2 objective was recorded at the Tai Po Station in 1992.

3.3.2 Existing TSP Concentrations

TSP concentrations at both Shatin and Tai Po exceeded the AQO's daily objective of 260 $\mu g/m^3$ in 1992. At both monitoring stations, this exceedance occurred in two samples (one in April and one in December). The annual TSP objective of 80 $\mu g/m^3$ was exceeded at both stations in 1992.

In the same year, TSP concentrations throughout the Territory exceeded the daily AQO maximum at least once at 10 out of 11 EPD monitoring stations, and exceeded the annual AQO maximum at 9 out of 11 stations. The exceedance of the annual AQO were slight at both Shatin and Tai Po.

3.3.3 Existing RSP Concentrations

The RSP concentration at Tai Po Monitoring Station exceeded the AQO's daily objective of 180 $\mu g/m^3$ in a single sample obtained in 1992 (in April). At Shatin Monitoring Station, the daily AQO standard was met in all samples during the same year. Both stations met the annual AQO standard of 55 $\mu g/m^3$ RSP in 1992.

In the same year, RSP concentrations throughout the Territory exceeded the daily AQO maximum at least once at 8 out of 11 EPD monitoring stations, and exceeded the annual AQO maximum at 5 out of 11 stations.

3.3.4 Meteorological Data

The most recent year's sequential data recorded at the Tai Po Kau Station has been obtained from the Royal Observatory, and has been used in the air quality assessment for this Report.

In general, winds in Hong Kong prevail from the east with an average wind speed of 6.3 m/s (over the years 1961 - 1990). Mean air temperature is 23°C and average relative humidity is 77 percent. From October to March, dry conditions prevail in which mean monthly evaporation exceeds mean monthly rainfall. These characteristics lead to entrainment of dust from exposed surfaces.

3.3.5 Background Dust Quality in the Study Area

From 25th January to 9th February 1994, dust levels were measured at following three sites surrounding the proposed PSK reclamation:

- open area next to a temple in Cheung Shue Tan village
- rooftop of Grace Tien Hall at CUHK
- rooftop of HKIB Building

The following parameters were measured:

- 24-hour TSP concentration
- 24-hour RSP concentration
- 1-hour TSP concentration
- 1-hour RSP concentration
- wind speed
- wind direction

Wind speed and wind direction were measured at half-hour intervals over 2.5 hours at each location.

The results of monitoring are presented in Tables 3.3 to 3.6 below:

Table 3.3 : Background Dust Levels: 24-hour TSP

Location	Number of Samples	Mean ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Number of AQO Exceedance
Cheung Shue Tan	15	83	124	0
CUHK Campus	14	95	147	0
HKIB Building	15	98	152	0

Table 3.4 : Background Dust Levels: 24-hour RSP

Location	Number of Samples	Mean ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Number of AQO Exceedance
Cheung Shue Tan	15	67	105	0
CUHK Campus	14	69	104	0
HKIB Building	15	72	109	0

Table 3.5 : Background Dust Levels: 1-hour TSP

Location	Number of Samples	Mean ($\mu g/m^3$)	Maximum ($\mu g/m^3$)
Cheung Shue Tan	42	113	238
CUHK Campus	42	116	256
HKIB Building	42	107	337

Table 3.6 : Background Dust Levels: 1-hour RSP

Location	Number of Samples	Mean ($\mu g/m^3$)	Maximum ($\mu g/m^3$)
Cheung Shue Tan	42	163	659
CUHK Campus	42	149	319
HKIB Building	42	99	212

During the time of measurements, several specific dust sources were identified which may have contributed to atypical elevated particulate levels. In Cheung Shue Tan, refuse was burned near the monitoring point on one occasion. Also in Cheung Shue Tan, burning incense at the temple appears to have contributed to high particulate levels on two occasions. However, the maximum concentrations provided in the Tables above were not associated with any specific causes identified by the monitoring team.

Meteorological data was also obtained during the two-week monitoring period at all three locations. A total of 83 samples each of wind direction and wind speed were obtained at each monitoring station. The monitoring results are summarized below:

Table 3.7 : Wind Direction During Dust Monitoring

Location	Proportion of samples in which wind was from the:						Calm Condition
	N	NE	NW	SE	SW	E	
Cheung Shue Tan	-	42%	-	14%	4%	1%	39%
CUHK Campus	23%	25%	6%	16%	17%	-	12%
HKIB Building	11%	31%	4%	18%	4%	-	33%

Table 3.8 : Wind Speed During Dust Monitoring

Location	Proportion of samples in which wind speed was:							
	< 1 m/s	< 2 m/s	1-2 m/s	1-3 m/s	2-3 m/s	2-4 m/s	3-4 m/s	4-5 m/s
Cheung Shue Tan	88%	5%	4%	2%	-	1%	-	-
CUHK Campus	45%	8%	10%	6%	24%	1%	6%	-
HKIB Building	81%	4%	6%	2%	5%	-	1%	1%

3.4 Marine Water Quality Data

3.4.1 EPD Routine Marine Water Quality Monitoring

As part of its role in monitoring and protecting the marine environment EPD carries out routine water quality surveys throughout the Territory's waters.

A summary of the water quality in the three sub-zones of Tolo harbour for the years 1990 and 1991 are shown in Tables 3.9 and 3.10 and are based on figures given in the EPD annual reports on marine water quality (Ref. 8,9). The values shown are annual means and ranges and are the result of an aggregation of data from a number of sampling locations within each sub-zone.

For 1992 and 1993 a more detailed breakdown of water quality in the Harbour sub-zone (closest to the reclamation site) has been carried out using data from the EPD marine water quality data base. The annual mean values and ranges are given in Table 3.11 and 3.12 for the individual stations within the sub-zone. The positions of the stations TM2 to TM4 relevant to the project area are shown in Figure 3.2.

3.4.2 Water Quality Monitoring at the Shuen Wan Landfill

In order to monitor the impact of the Shuen Wan landfill additional monitoring has been carried out by EPD in the immediate vicinity of the landfill site. Marine water quality data at two stations, TM21 and TM24 (Figure. 3.2) have been provided by EPD for the year 1991. The annual means for selected water quality parameters are compared with those of the two closest stations, TM3 and TM4, for which long term data are available, in Table 3.13.

Table 3.9 : Summary of Water Quality for 1990 in Tolo Harbour Sub-zones.

		Harbour Sub-zone	Buffer Sub-zone	Channel Sub-zone
Temperature (°C)	Surface	23.6 15.7 - 31.2	23.8 15.7 - 31.1	23.5 16.0 - 29.5
	Bottom	22.9 16.6 - 29.7	22.5 15.8 - 29.3	21.8 15.7 - 28.2
Salinity (ppt)	Surface	29.4 23.5 - 33.1	30.0 25.1 - 33.3	30.7 28.7 - 33.0
	Bottom	31.0 28.5 - 34.8	31.5 29.0 - 34.5	32.3 30.9 - 34.4
Dissolved Oxygen (% sat.)	Surface	99.1 48.8 - 161.3	108.8 62.2 - 162.3	108.7 70.8 - 151.2
	Bottom	68.3 15.4 - 134.0	71.3 20.2 - 126.5	63.2 16.5 - 136.7
pH		8.31 7.43 - 8.81	8.42 7.79 - 8.92	8.40 7.71 - 8.91
Secchi disc (m)		1.83 0.4 - 4.0	2.16 1.0 - 5.0	2.68 0.2 - 7.0
Turbidity (NTU)		4.5 1.2 - 19.5	3.6 1.5 - 7.7	3.3 1.2 - 7.0
Suspended Solids (mg/l)		3.5 0.5 - 22.0	2.8 0.5 - 16.0	3.5 0.5 - 27.7
BOD (mg/l)		2.4 0.23 - 6.6	2.2 0.4 - 6.6	1.7 0.1 - 6.0
Inorganic N (mg/l)		0.278 0.034 - 0.87	0.143 0.025 - 0.414	0.104 0.020 - 0.442
Total N (mg/l)		0.899 0.366 - 2.485	0.720 0.311 - 2.737	0.638 0.272 - 1.779
PO_4-P (mg/l)		0.056 0.004 - 0.165	0.027 0.005 - 0.075	0.017 0.002- 0.040
Total P (mg/l)		0.139 0.025 - 0.870	0.094 0.02 - 0.395	0.083 0.027 - 0.340
Chlorophyll (ug/l)		9.6 0.2 - 57.5	6.1 0.25 - 29.0	4.5 0.2 - 33.6
E coli (no./100ml)		176 0 - 53605	9 0 - 383	2 0 - 95

Table 3.10 : Summary of Water Quality for 1991 in Tolo Harbour Sub-zones.

		Harbour Sub-zone	Buffer Sub-zone	Channel Sub-zone
Temperature (°C)	Surface	23.0 16.1 - 29.8	23.2 16.1 - 21.9	22.9 16.3 - 28.9
	Bottom	22.1 16.1 - 27.9	21.8 15.9 - 29.6	20.7 15.8 - 25.0
Salinity (ppt)	Surface	30.2 18.5 - 31.8	30.9 19.9 - 32.5	31.4 20.7 - 32.7
	Bottom	31.9 20.3 - 37.1	32.5 30.7 - 34.7	33.0 31.0 - 34.7
Dissolved Oxygen (% sat.)	Surface	120 55 - 208	123 61 - 201	115 74 - 177
	Bottom	57 4 - 118	79 11 - 143	74 8 - 192
pH		8.2 7.7 - 8.8	8.3 8.0 - 8.8	8.2 8.0 - 8.8
Secchi disc (m)		1.6 0.8 - 4.0	2.2 1.1 - 5.0	3.1 1.2 - 7.0
Turbidity (NTU)		4.3 1.1 - 22.8	3.6 1.1 - 11.9	2.8 0.8 - 15.0
Suspended Solids (mg/l)		5.5 0.7 - 29.3	4.7 0.8 - 32	3.1 0.7 - 11.2
BOD (mg/l)		2 1 - 5	2 < 1 - 3	1 < 1 - 2
Inorganic N (mg/l)		0.26 0.05 - 0.63	0.16 0.1 - 0.61	0.13 0.02 - 0.59
Total N (mg/l)		0.80 0.31 - 2.15	0.62 0.22 - 1.59	0.49 0.22 - 1.41
PO_4-P (mg/l)		0.07 0.02 - 0.13	0.035 0.01 - 0.06	0.03 0.01- 0.05
Total P (mg/l)		0.16 0.06 - 0.35	0.12 0.06 - 0.24	0.10 0.04 - 0.21
Chlorophyll (ug/l)		5.1 0.2 - 30.5	2.33 0.2 - 7.6	1.0 0.2 - 3.6
E coli (no./100ml)		225 3 - 5000	4 0 - 41	1 0 - 19

Table 3.11 : Summary of Water Quality for 1992 in Tolo Harbour; Harbour Sub-zone.

		TM2	TM3	TM4
Temperature (°C)	Surface	22.0 12.1 - 29.8	22.0 11.7 - 29.7	22.0 12.4 - 29.9
	Bottom	21.7 12.1 - 29.1	21.3 11.9 - 29.3	21.3 12.7 - 29.2
Salinity (ppt)	Surface	28.7 23.0 - 30.8	29.3 24.4 - 32.3	28.8 23.3 - 31.7
	Bottom	30.9 29.1 - 32.1	31.3 26.1 - 33.0	31.1 23.8 - 32.6
Dissolved Oxygen (% sat.)	Surface	97 30 - 185	110 58 - 149	119 64 - 165
	Bottom	54 5 - 116	48 12 - 106	42 4 - 85
pH		8.1 7.8 - 8.4	8.1 7.8 - 8.3	8.1 7.9 - 8.3
Secchi disc (m)		1.8 0.8 - 2.5	2.1 0.9 - 3.5	1.8 0.9 - 2.5
Turbidity (NTU)		2.8 1.6 - 4.0	2.0 1.0 - 4.3	2.4 0.9 - 6.8
Suspended Solids (mg/l)		3.3 1.0 - 9.5	1.9 0.5 - 4.3	3.0 0.8 - 9.0
BOD (mg/l)		3 1 - 4	2 1 - 4	3 1 - 4
Inorganic N (mg/l)		0.34 0.05 - 0.73	0.27 0.06 - 0.60	0.24 0.05 - 0.59
Total N (mg/l)		0.80 0.29 - 1.4	0.72 0.26 - 1.23	0.70 0.32 - 1.12
PO_4-P (mg/l)		0.09 0.04 - 0.14	0.06 0.03 - 0.11	0.06 0.03 - 0.18
Total P (mg/l)		0.18 0.10 - 0.35	0.14 0.07 - 0.32	0.14 0.06 - 0.24
Chlorophyll (ug/l)		6.6 0.2 - 33.5	2.9 0.4 - 5.2	5.7 0.3 - 28.6
E coli (no./100ml)		524 190 - 2500	128 23 - 1277	55 7 - 271

Table 3.12: Summary of Water Quality for 1993 in Tolo Harbour, Harbour Sub-zone.

		TM2	TM3	TM4
Temperature (°C)	Surface	23.4 17.5 - 29.6	23.6 17.3 - 30.1	23.3 17.2 - 29.4
	Bottom	22.8 15.8 - 29.5	22.4 15.7 - 28.5	22.1 15.6 - 28.0
Salinity (ppt)	Surface	30.0 28.2 - 32.3	30.0 26.7 - 32.2	30.3 27.7 - 32.1
	Bottom	30.8 29.8 - 33.9	32.2 30.4 - 33.0	32.2 30.5 - 33.4
Dissolved Oxygen (% sat)	Surface	94 51 - 145	114 64 - 191	108 65 - 153
	Bottom	73 15 - 121	60 13 - 99	56 15 - 118
pH		8.1 7.7 - 8.5	8.3 8.0 - 8.5	8.3 8.0 - 8.5
Secchi disc (m)		2.0 1.3 - 2.8	2.1 1.4 - 3.5	2.3 1.1 - 3.2
Turbidity (NTU)		3.0 1.8 - 6.6	2.3 1.6 - 4.2	2.5 1.6 - 5.2
Suspended Solids (mg/l)		3.5 1.0 - 8.8	2.4 1.0 - 7.2	3.4 1.0 - 10.5
BOD (mg/l)		2.7 0.7 - 8.9	2.2 0.7 - 4.1	2.5 1.4 - 4.5
Inorganic N (mg/l)		0.37 0.19 - 0.58	0.29 0.10 - 0.40	0.34 0.11 - 0.52
Total N (mg/l)		0.73 0.43 - 1.1	0.64 0.34 - 1.0	0.66 0.37 - 0.99
PO_4-P (mg/l)		0.09 0.06 - 0.14	0.06 0.03 - 0.10	0.07 0.04 - 0.10
Total P (mg/l)		0.15 0.07 - 0.18	0.11 0.07 - 0.14	0.12 0.07 - 0.19
Chlorophyll (μg/l)		1.2 0.3 - 36.5	2.6 0.3 - 8.7	2.2 0.3 - 7.5
E. coli (no/100ml)		1948 105 - 9350	102 3 - 323	221 4 - 947

Table 3.13: Comparison of Annual Mean Water Quality at Stations TM21, TM24, TM3 and TM4.

Parameter	Station			
	TM21	TM24	TM3	TM4
Suspended Solids	3.5	3.7	2.8	4.0
Ammoniacal-Nitrogen	0.22	0.22	0.18	0.16
BOD	3.0	3.6	2.0	2.0
TKN	0.89	0.70	0.83	0.67
Dissolved Oxygen	7.3	7.9	6.7	7.5

These data suggest that the water quality in the region of the landfill is broadly similar to that in the remainder of the centre part of the Harbour sub-zone. Comparison of the mean values at Stations TM21 and TM24 with those at TM3 shows no significant difference ($p<0.05$). This is further supported by the report of the Consultants (Ref.10) that acute effects on water quality have not been unambiguously observed and that water quality impact of the landfill arises mostly from the release of nitrogen.

3.4.3 Ma On Shan Reclamation Water Quality Monitoring Data

As part of the Ma On Shan Development, which is situated close to the proposed project area and is being operated as a public dump, water quality has been monitored in the vicinity of the project area. The data for parameters temperature, salinity, dissolved oxygen (DO), turbidity and suspended solids (SS) have been measured during the month of May 1993 on both flood and ebb tides (Ref.11). The parameters of greatest interest are dissolved oxygen and suspended solids, over the whole month 52 sets of observations were taken for suspended solids and 18 for dissolved oxygen. The locations of Stations A-D are shown in Figure 3.2; the routine EPD monitoring station closest to these is TM2 which is in the middle of the Shatin Hoi Channel.

Table 3.14 : DO and SS Concentrations at Four Locations off Ma On Shan.

Location	A		B		C		D	
Parameter	**DO**	**SS**	**DO**	**SS**	**DO**	**SS**	**DO**	**SS**
DAv Maximum	7.4	22.2	8.5	23.3	7.5	21.8	7.5	22.2
DAv Mean	6.1	17.4	6.1	17.3	5.8	17.7	5.9	17.5
DAv Minimum	3.9	10.7	3.0	11.2	3.3	11.2	3.3	10.5
Upper Minimum	4.3		3.3		3.7		4.0	
Bottom Minimum	2.6		2.5		2.3		1.8	

Note: (1) DAv = Depth Averaged value;
(2) All values are given as mg/l.

3.4.4 Nullah Water Quality

The nullah which will ultimately pass through the reclamation is fed by the Tai Po Mei and Cheung Shue Tan rivers. These receive storm water and septic tank drainage from the villages of:

- Cheung Shue Tan
- Wong Nai Fai
- Po Min
- Po Mun
- Tai Po Mei
- Chek Nai Ping
- Kon Hang

The river was inspected in March 1989 as part of the Tolo Harbour Catchment Study on Unsewered Developments (Ref.12) when water quality was reported as good.

The same study carried out two water quality surveys in the nullah at Cheung Shue Tan when the flows differed by approximately 3 orders of magnitude. The results of the two surveys are given in Table 3.15 and indicate significant differences in BOD and Ammonia concentrations between the two sampling occasions while oxidised nitrogen concentrations were similar.

Table 3.15 : Water Quality in the Nullah below Cheung Shue Tan Village

	Flow (m3/d)	TON (mg/l)	BOD (mg/l)	NH4-N (mg/l)	DO (mg/l)	WQI
Occasion 1	7833	0.64	1.2	0.02	7.0	4 Excellent
Occasion 2	8	0.63	28	3.75	5.0	13 Bad

Although the concentrations of BOD and ammoniacal nitrogen were high during the time of low flow the actual loads were low. The low concentrations during high flow and the high dilution which will occur during low freshwater flows are unlikely to give rise to deterioration in water quality in the extension to the nullah if good tidal flushing is maintained.

A further survey of the water quality in the nullah was carried out for this study in January 1994 in which quality was determined of 2 hour intervals over a 24 hour period. The results, presented in Table 3.16 indicate that the water quality is good and unlikely to give rise to problems.

Table 3.16: Nullah Water Quality Monitoring Results

Date	Time (hrs)	pH (units)	Salinity (‰)	BOD (mg/l)	NH_4-N (mgN/l)	TKN (mgN/l)
28th Jan 1994	1030	7.7	< 1	2	< 0.05	0.9
	1230	7.9	< 1	< 1	< 0.05	0.9
	1430	7.8	< 1	2	< 0.05	0.8
	1630	7.6	< 1	1	< 0.05	0.8
	1830	7.3	< 1	1	< 0.05	1.0
	2030	7.3	< 1	3	< 0.05	0.9
	2230	7.2	< 1	2	< 0.05	0.9
29th Jan. 1994	0030	7.3	< 1	1	< 0.05	1.0
	0230	7.4	< 1	1	< 0.05	1.0
	0430	7.3	< 1	2	< 0.05	1.0
	0630	7.4	< 1	2	< 0.05	1.0
	0830	7.5	< 1	2	< 0.05	1.0
	Mean	7.5	< 1	1.6	< 0.05	0.9

3.4.5 Marine Water Quality Relative to Standards and Guidelines

The Water Quality Objectives (WQO) (see Section 6.2) and the quality targets of the sensitive receivers are compared with the present quality of the marine waters as summarised in Tables 3.9 to 3.12 and the original data for locations TM2 to TM4.

This comparison is given below for those WQO for which monitoring data are available. Data are not readily available for the aesthetic parameters and these are therefore not included. In addition comparisons are made with any particular requirements of the identified sensitive receivers.

The annual geometric mean values of *E. coli* at all locations is less than WQO value of 610/100ml but the minimum value at TM2 currently exceeds the most stringent maximum proposed (100/100ml) by the MSL.

The dissolved oxygen values reported by the EPD annual summaries are given as %-saturation rather than the absolute concentration specified in the WQO. Percentage compliance of concentrations of dissolved oxygen (mg/l) for the years 1990 to 1992 for locations TM2,3 and 4 have been calculated using data from the EPD data base and are given in Table 3.17.

Table 3.17 : Percentage Compliance for Dissolved Oxygen at Stations TM2 - TM4

	Depth Average (not less than 4mg/l)			Bottom 2m (not less than 2mg/l)		
	TM2	TM3	TM4	TM2	TM3	TM4
1990	88	92	92	100	88	88
1991	90	100	95	95	80	65
1992	75	75	92	67	75	58

During the monitoring at MOS the concentration at the bottom at location D fell to below the WQO value on one occasion, while the concentration in the remainder of the water column was maintained above the limit value. On all other occasions the WQO was met. The lower limit for % saturation specified by the MSL was not met in the bottom water on all occasions.

For all the Tolo sub-zones the specification for the pH WQO relates to a relative change which might result from a discharge. For marine waters in other gazetted Water Control Zone (WCZ) a range of 6.5 to 8.5 pH units is defined. This range can be used as an additional guide to the marine water quality. All sub-zones comply with the lower range limit of 6.5 but in all three sub-zones the upper values of the annual ranges extend beyond the upper range limit of 8.5 with the exception of those for 1992. These high values frequently coincide with times of high phytoplankton biomass, expressed as concentration of chlorophyll-a, which would indicate that the exceedance may be due to temporary disturbances of the carbonate-bicarbonate equilibrium in the sea water resulting from rapid consumption of carbon dioxide during intense photosynthetic activity. The reported pH values were within the range required by the MSL.

No absolute values are set for the WQO for salinity. The WQO relates to changes relative to the ambient salinity. However, in order to maintain the quality for the MSL a minimum salinity of 25 ppt is required; the minimum at TM2 fell below this value.

No absolute values are set for temperature, the WQO relates to changes relative to the ambient temperature.

No absolute values are set for the suspended solids WQO which specifies an absence of settleable solids which would adversely affect benthic communities or bottom geometry and a limit on the reduction of the depth of light penetration. The use of the water from Tolo Harbour for flushing water requires concentrations of suspended solids less than 150-200 mg/l in order to reduce wear of the intake pumps but a more stringent < 10 mg/l is the target value set by Water Supply Department (WSD). Within the Tolo Harbour sub-zone the mean value lies below the WSD limit but the maximum values reported for the years 1990-1991 are in excess of this value. In 1992 maximum values at the three individual sites in the sub-zone were less than the limit.

The upper levels of suspended solids are also below the concentrations which are likely to impact on marine filter feeders and below the concentrations at which mariculture is successfully being carried out in Hong Kong waters.

The MSL require suspended solids to be less than 5 mg/l at the intake. The mean concentration for station TM2 lies below the limit but the maximum exceeds this by a factor of approximately 2. Concentrations measured at MOS Station A exceeded the limit value by a factor of over three.

Compliance with the light penetration is determined by the use of the Secchi disc which determines the depth to which approximately 10% of the surface light penetrates the water column. The depth of penetration is controlled by a number of factors including the concentration of suspended solids but examination of the EPD data indicate that there is not a consistent relationship between the two determinants. The measurement of the depth of extinction is influenced by a number of factors which must be controlled in order to minimise random variation, due to observation techniques such as water surface reflectance. The present Secchi depth measured at TM2 is frequently less than the depth required by the MSL.

No data for toxicants are presented in the EPD annual reports nor held on the standard marine water quality data base. The presence of active mariculture zones in the Harbour and the siting of the CUHK MSL indicate that the water quality is sufficient to support a marine ecosystem.

Over the period 1990-1993 the level of compliance of surface water with the marine WQO has varied and rarely has it achieved 100% compliance in all three sub-zones (Ref.13). However the data presented by EPD show a steady improvement.

Although not a prescribed WQO for Tolo Harbour marine waters ammoniacal nitrogen is a good indicator of the general water quality. The concentration of the toxic un-ionised form of ammonia in the water for any given total ammonia concentration is a function of both temperature and pH. Data for 1992 have been extracted from the EPD data base for locations TM2, TM3 and TM4 and the concentrations of un-ionised ammonia calculated to provide guidance on the un-ionised ammonia concentrations which are given in Table 3.18.

Table 3.18: Concentrations of Total and Un-ionised Ammonia at Locations TM2 - TM4

	TM2	TM3	TM4
Total Ammonia (mgN/l)	0.195	0.169	0.147
Temperature (°C)	22	22	22
pH	8.1	8.1	8.1
Un-ionised Ammonia (%)	4.4	4.4	4.4
Un-ionised Ammonia (mgN/l)	0.009	0.007	0.006

At all three stations the calculated annual mean concentration of un-ionised ammonia is below the WQO value of 0.021 mgN/l which is prescribed for other WCZ.

At all locations for which data were examined the annual average inorganic nitrogen concentration exceeds the WQO value which are giving rise to the high concentrations of algal growth indicated by the high chlorophyll-a concentrations. The MSL have a target value for total nitrogen of 1 mg/l which is currently exceeded by the maximum concentration reported at TM2.

The total phosphate concentrations specified by the MSL as 0.1 mg/l is consistently exceeded at the closest EPD monitoring station TM2.

The MSL specify a range of 10-50 µg/l for the upper target limit for chlorophyll-a at the intake. The annual average concentration reported by EPD for Station TM2 is below the lower limit and the reported maximum is below the upper range limit provided.

3.5 Marine Sediment Quality

3.5.1 Routine Sediment Quality Monitoring

As part of their routine marine monitoring programme EPD carry out analysis of surface sediments collected from a number of points in Tolo Harbour. The two locations which are in the region of the project area are TS2 and TS3, their positions are indicated in Figure 3.3. Mean values for the year 1992 and 1993 for six heavy metals and two anthropogenic trace organic groups are given in Table 3.19.

Table 3.19: Annual Mean Surface Concentrations of Contaminants at the Two EPD Monitoring Stations in the Tolo Harbour; Harbour Sub-zone for the years 1992 and 1993

Year	Station	Determinant (mg/kg)								
		Cu	Cd	Cr	Pb	Ni	Zn	Hg	PAH	PCB
1992	TS2	70	-	51	100	23	160	0.05	0.056	0.008
	TS3	49	-	34	102	17	157	0.05	0.044	0.007
1993	TS2	35	0.05	31	93	21	145	0.05	-	-
	TS3	44	0.06	33	94	20	170	0.05	-	-

3.5.2 Effluent Transport Scheme Sediment Quality

Additional and more comprehensive data have been taken from the Tolo Harbour Effluent Export Scheme (Ref.14) for which sediment cores were collected from the installation line for the effluent pipe from Tai Po to Shatin. This line follows closely, but slightly off-shore of, the alignment of the seawall which will form the boundary of the reclamation. The location of those sampling stations, S6 to S10, close to the seawall position are shown in Figure 3.3. The cores were cut into depth sections and analysed for a range of heavy metals; the results of those analyses are given in Table 3.20.

Table 3.20: Sediment Quality Along the Line of the Effluent Pipeline

Station	Determinant (mg/kg)						
	Cu	Cd	Cr	Pb	Ni	Zn	Hg
S6							
0m	17.0	0.83	28.9	80.1	33.1	130	0.073
1m	13.1	0.78	35.2	68.0	25.1	132	0.051
1.5m	10.0	0.75	26.9	48.9	26.0	115	0.076
2m	10.6	0.86	28.9	69.4	19.1	161	0.077
3m	16.4	1.10	27.9	54.8	28.5	144	0.061
S7							
0m	56.5	0.89	13.0	91.8	16.4	182	0.070
1m	9.4	0.53	22.8	47.9	19.8	97	0.076
1.5m	10.6	0.89	28.0	67.1	19.5	119	0.068
2m	13.0	0.95	20.6	65.8	24.7	109	0.048
3m	17.6	0.95	26.5	82.3	27.6	152	0.042
3.5m	18.5	0.97	25.4	62.6	23.0	126	0.048
S8							
0m	14.3	0.70	17.2	71.8	20.6	88	0.060
1m	10.7	0.85	23.2	59.7	15.8	107	0.049
1.5m	11.9	0.65	27.2	72.5	19.8	128	0.059
2m	12.0	0.88	26.4	73.3	16.0	132	0.082
3m	16.1	0.87	30.0	95.7	27.5	169	0.034
S9							
0m	23.1	0.93	27.1	106.7	31.0	154	0.084
1m	12.6	0.74	31.0	76.1	20.7	141	0.048
1.5m	11.4	0.65	26.8	72.1	18.8	133	0.065
2m	13.4	0.91	17.1	51.4	19.2	119	0.027
3m	15.3	0.76	21.9	72.7	26.4	147	0.032
S10							
0m	15.4	0.72	21.3	89.7	19.5	105	0.066
1m	12.1	0.81	26.7	75.4	16.3	131	0.084
1.5m	10.5	1.11	21.9	64.7	13.8	132	0.052
2m	10.6	0.67	24.3	80.2	15.2	117	0.065
3m	15.1	0.56	28.0	108.0	17.8	149	0.069

Comparison of the metal concentrations measured in the sediments with the EPD Sediment Quality Class ranges (Table 7.1) at each site allows the sediment to be allocated to a class type. There is no allowance for averaging of class across metals in EPD Technical Circular 1/1/92 (Ref.15), the exceedance of the limit concentration by only one metal determines to which class the sediment is assigned. All Stations are assigned to Class C as a result of the concentrations of lead at some point in the sediment column. Averaging of concentrations of lead allocated to Class B or C with depths above and below tends to result in bulked concentrations of one class lower with the exception of Stations S10. Such an approach would enable the majority of the sediment to be assigned to Class B rather than Class C.

EPD Technical Circular 1/1/92 gives no limit figures for PCB and PAH concentrations for the different sediment classifications but a concentration of 0.05 mg/kg is regarded as an upper limit for PCB in clean marine sediments (Ref.16). The provisional environmental quality objective for PAH in Dutch sediments is 0.6 mg/kg (Ref.17). The values for Stations TS2 and TS3 given in Table 3.19 indicate that the sediments are not therefore significantly contaminated with anthropogenic trace organic compounds when compared with other standards.

3.5.3 Sediment Sampling and Analysis under this Study

The sediment quality data obtained from EPD routine sediment monitoring programme and the site investigation of the Tolo Harbour Effluent Export Scheme indicate that the surface sediments (up to 4 m below seabed) are contaminated to a degree which places them in EPD Class C sediment. However, there are insufficient data to determine the contamination status of the sediment for the whole depth of marine deposit to be dredged along the proposed seawalls. Further sediment sampling and analysis were therefore carried out under this study to estimate the volume of the dredged mud that needs to be disposed of as contaminated mud.

The sampling requirements and procedures are in accordance with the Work Branch Technical Circular (WBTC) No. 22/92, Marine Disposal of Dredged Mud. The field sampling work was carried out by Lam Geotechnic Limited and the laboratory analysis for heavy metals was carried out by Materialab Limited.

(a) Sampling locations

A total of eleven locations were chosen along the proposed alignment of the seawall which are shown in Figure 3.3. Field sampling was conducted on 1st and 2nd February 1994. The coordinates of the sampling locations were identified by the differential global positioning system (DGPS). The actual sampling locations were within 5 m of the proposed coordinates.

(b) Field sampling

The sampling was carried out using a standard rotary drilling rig mounted on a jack-up barge. The samples were recovered by means of a 75 mm diameter 4 m long PVC tube advanced into the seabed using vibrocoring technique. The sampling hole was terminated at the underside of the marine deposits. 100 mm long vibrocore sub-samples were cut out longitudinally from the 4 m vibrocore tube at depths in accordance with WBTC No. 22/92. Samples were stored in a freezer on the barge after sampling and during transportation of samples to laboratory. In order to avoid cross-contamination of samples with depth, only the centre 50 mm of the cores was taken for analysis. Analysis was carried out as shown below:

Table 3.21: Analytical Methods for Heavy Metals

Parameter	Methodology
Total Copper	Direct acid digestion followed by AA analysis
Total Chomium	as above
Total Cadmium	as above
Total Lead	as above
Total Nickel	as above
Total Zinc	as above
Total Mercury	Cold vapour generation
Dry Weight	Constaint weight at 103-105°C

The details of the analysis results are given in Table 3.22.

Table 3.22 : Sediment Quality in the Line of the Proposed Seawall

Station	Determinant (mg/kg)						
	Cu	Cd	Cr	Pb	Ni	Zn	Hg
SM1							
0.0-0.1m	23	0.26	14	81	6.4	139	0.09
0.9-1.0m	12	0.02	21	66	12	116	0.12
1.9-2.0m	9	0.11	24	58	14	128	0.07
2.9-3.0m	9	0.03	22	68	12	117	0.06
5.9-6.0m	11	<0.02	25	81	13	142	0.06
8.9-9.0m	11	<0.02	20	67	11	97	0.07
SM2							
0.0-0.1m	16	0.11	22	94	12	129	0.21
0.9-1.0m	8.8	<0.02	21	55	13	114	0.06
1.9-2.0m	10	<0.02	25	64	15	143	0.05
2.9-3.0m	10	<0.02	26	78	14	152	0.06
5.9-6.0m	12	0.04	27	79	13	133	0.06
SM3							
0.0-0.1m	13	<0.02	23	77	12	112	0.21
0.9-1.0m	9.7	0.04	26	57	15	132	0.08
1.9-2.0m	9.7	<0.02	24	64	14	131	0.08
2.9-3.0m	11	<0.02	27	78	15	150	0.07
5.9-6.0m	10	<0.02	23	75	11	111	0.10
SM4							
0.0-0.1m	19	0.08	19	79	9.6	172	0.11
0.9-1.0m	8.7	<0.02	21	53	13	113	0.07
1.9-2.0m	8.9	<0.02	21	61	12	117	0.07
2.9-3.0m	8.1	0.06	18	60	9.5	101	0.05
SM5							
0.0-0.1m	9.4	0.41	20	55	8.7	101	0.05
0.9-1.0m	8.6	0.12	22	66	13	129	0.03
1.9-2.0m	9.8	0.13	22	70	12	129	0.02
2.9-3.0m	8.0	0.10	16	58	8.4	91	0.02
SM6							
0.0-0.1m	25	0.37	20	99	8.1	156	0.03
0.9-1.0m	9.0	0.05	20	64	13	124	0.03
1.9-2.0m	7.7	0.12	18	60	11	106	0.02
2.9-3.0m	8.7	0.16	18	65	11	115	0.02
SM7							
0.0-0.1m	13	0.06	17	71	10	99	0.08
0.9-1.0m	8.0	0.05	18	57	12	115	0.02
1.9-2.0m	9.4	0.14	20	63	13	128	0.03
2.9-3.0m	10	0.12	24	77	14	144	0.02
SM8							
0.0-0.1m	9.1	0.05	17	73	9.8	102	0.02
0.9-1.0m	10	<0.02	20	21	5.0	37	0.05
1.9-2.0m	9.6	<0.02	20	76	12	140	0.02
2.9-3.0m	8.0	0.08	19	63	12	124	0.01
5.9-6.0m	11	<0.02	20	83	11	123	0.01
SM9							
0.0-0.1m	15	<0.02	21	87	9.1	118	0.20
0.9-1.0m	8.4	0.05	18	53	9.3	108	0.10
1.9-2.0m	8.6	0.05	18	58	9.9	111	0.07
2.9-3.0m	9.9	0.02	20	76	10	133	0.09
5.9-6.0m	10	0.05	18	73	8.5	110	0.08
SM10							
0.0-0.1m	16	0.05	22	89	8.9	119	0.18
0.9-1.0m	8.3	0.02	16	56	8.9	102	0.07
1.9-2.0m	10	0.06	22	76	11	136	0.05
2.9-3.0m	12	<0.02	20	76	8.3	119	0.06
5.9-6.0m	12	0.04	20	78	9.7	114	0.06
8.9-9.0m	7.6	<0.02	9.5	44	3.8	50	0.06
SM11							
0.0-0.1m	8.0	0.04	15	56	7.4	102	0.07
0.9-1.0m	20	<0.02	23	83	9.0	116	0.20
1.9-2.0m	9.0	0.07	21	56	12	129	0.07
2.9-3.0m	10	0.09	20	61	11	112	0.10
5.9-6.0m	12	0.05	20	71	10	111	0.05

The results of the survey carried out along the line of the proposed seawall confirm the presence of Class C sediments on the area as initially indicated by the survey of effluent pipeline. With respect to Cadmium, Chromium, Copper, Nickel and Mercury the sediments fall within Class A. At four locations SM2, 3, 4 and 6 the sediments are Class B with respect to Zinc at same depth in the column. At all locations there are concentrations of Lead at one or more depths in the column causing the sediments to be classified as Class C. With this information the quantities of different classes of sediment to be dredged can be estimated and the results are given in Section 7.

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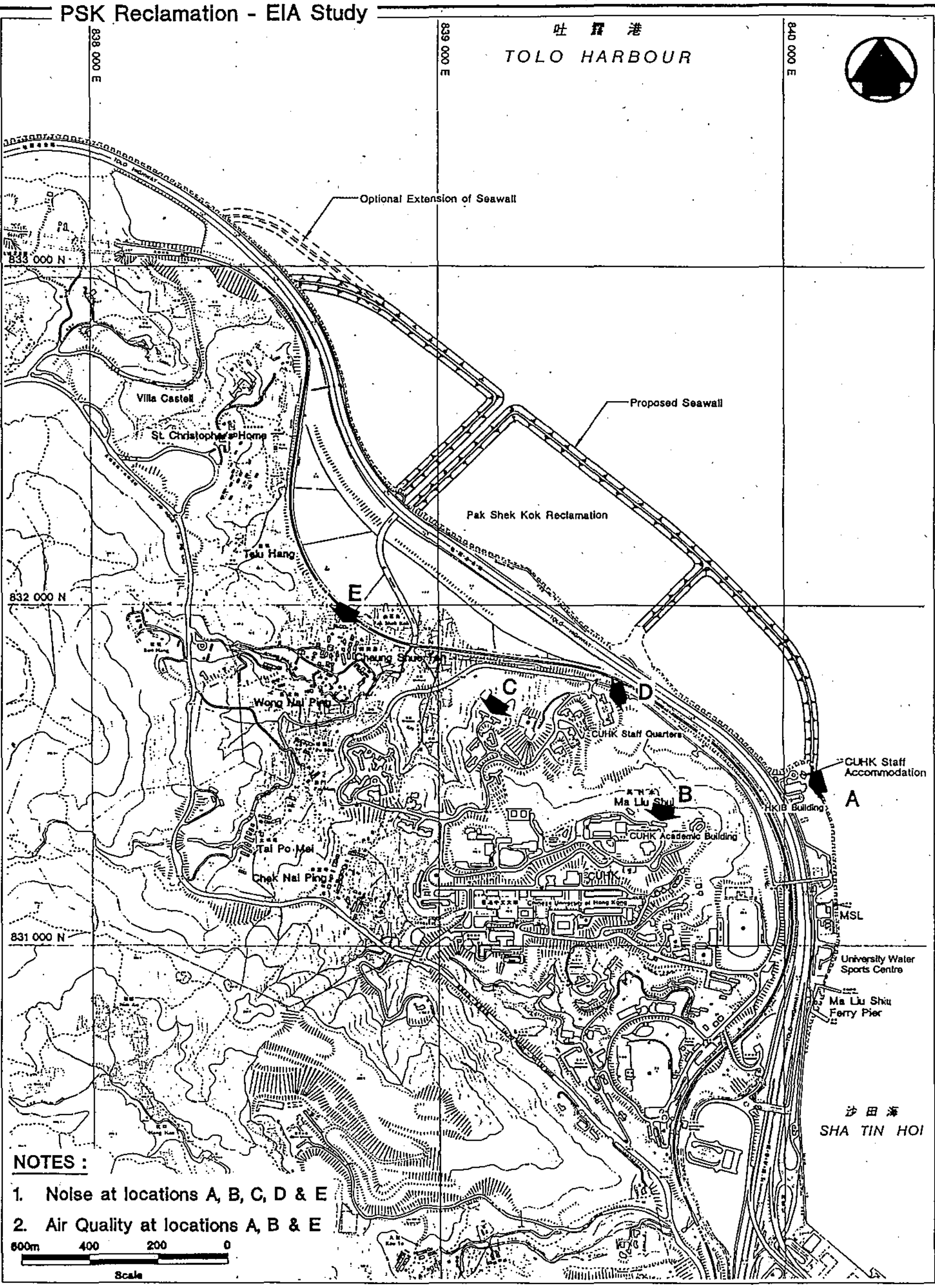
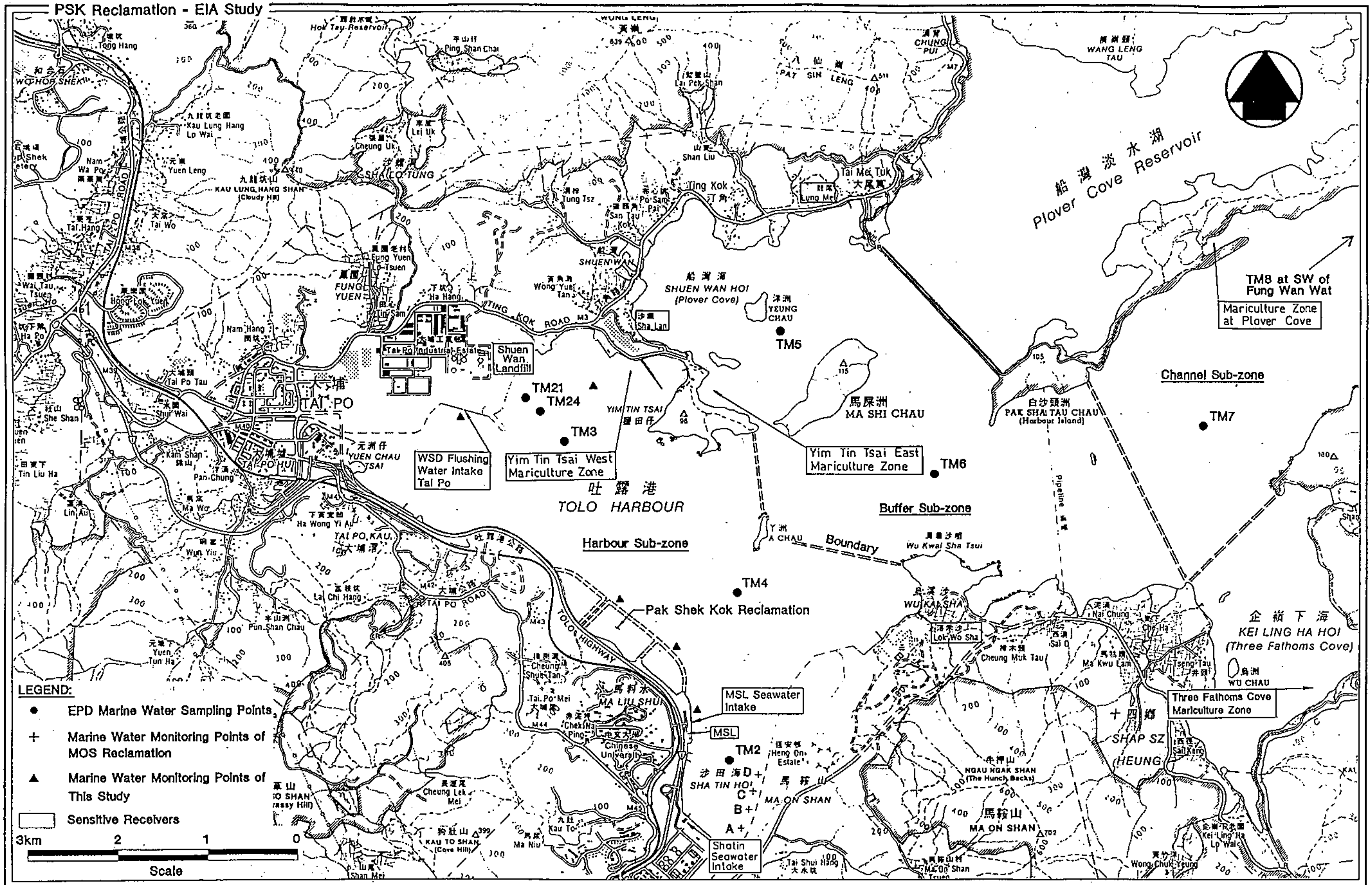


Noise and Dust Monitoring Locations

May 1994

Mouchel

Figure No. 3.1



Tolo Harbour WCZ and Marine Water Quality Monitoring Locations

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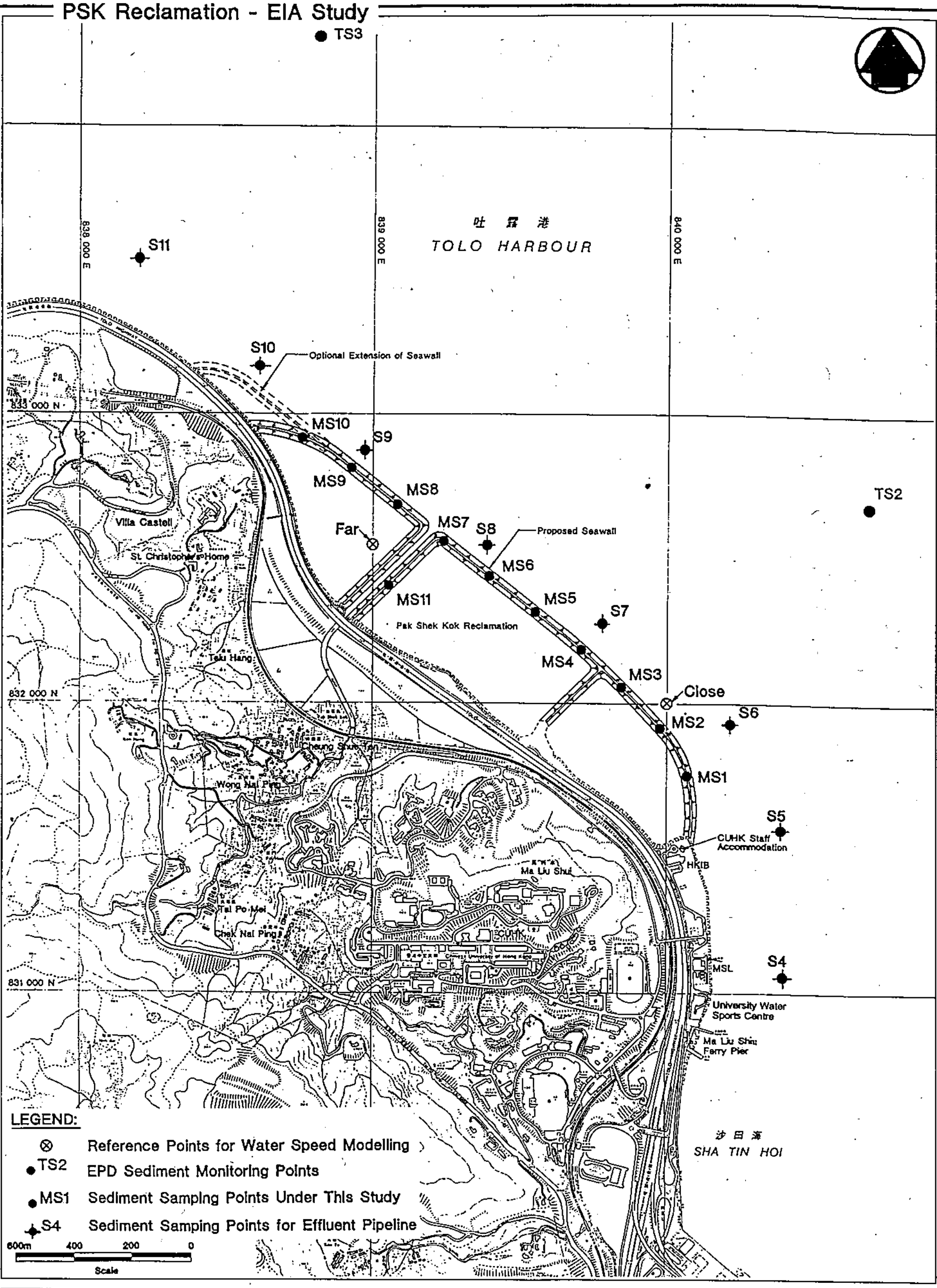
May 1994

Figure No. 3.2



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Marine Sediment Monitoring Locations

May 1994

Figure No. 3.3

4.0 NOISE

4.1 Introduction

This section deals with the noise levels expected from construction of the seawall and access road, operations at the public dump, and traffic on the access road. In the following sections, assessment criteria are discussed, and input assumptions and assessment methodology are described. The impacts during construction and operation of the reclamation are separately assessed, and cumulative impacts considered.

4.2 Environmental Standards and Guidelines

4.2.1 Construction Noise Impacts

The noise generated by construction of the reclamation site in the non-restricted hours (0700-1900 hrs) is assessed with reference to the criterion of 75 dB(A) (L_{eq} 30 mins), or 10 dB(A) above the prevailing background noise level whichever is lower in order to avoid nuisance to surrounding residential and academic NSRs. Works at the site are expected to cease at 1800 hrs, so evening and night-time NCO criteria are not relevant.

This criterion is applied to the noise arising from operation of construction equipment at the site, along with haul road traffic once it has left the public road.

Using these criteria and the results of background noise monitoring, allowable construction noise levels at individual NSRs (see Figure 4.1) are shown below in Table 4.1.

Table 4.1 : Representative NSRs

Receiver Identification		Noise Assessment Criterion	Applicable Noise Monitoring Location
TPK1	Residence, Tai Po Kau San Wai	62 dB(A)	Cheung Shue Tan
TPK2	Residence, Tai Po Kau San Wai	62 dB(A)	Cheung Shue Tan
LL1	Residence, Lookout Link	62 dB(A)	Cheung Shue Tan
LL2	Residence, Lookout Link	62 dB(A)	Cheung Shue Tan
VC	Residence, Villa Castell	62 dB(A)	Cheung Shue Tan
SCH	New residential development at St Christopher's Home	72 dB(A)	Residence No. 7
TPR	Residence, Tai Po Rd	62 dB(A)	Cheung Shue Tan
WNF	Residence, Wong Nai Fai Village	62 dB(A)	Cheung Shue Tan
CST1	Residence, Che Cheung Shue	62 dB(A)	Cheung Shue Tan
CST2	Residence, Cheung Shue Tan Village	62 dB(A)	Cheung Shue Tan
PM	No 96, Po Min Village	62 dB(A)	Cheung Shue Tan
TPM	No 58, Tai Po Mei Village	62 dB(A)	Cheung Shue Tan
CUHK1	CUHK: Xuesi Hall	73 dB(A)	Xuesi Hall
CUHK2	CUHK: Residence No. 10	75 dB(A)	Residence No. 10
CUHK3	CUHK: Residence No. 7	72 dB(A)	Residence No. 7
CUHK4	CUHK	73 dB(A)	Xuesi Hall
CUHK5	CUHK	73 dB(A)	Xuesi Hall
CUHK6	CUHK: Staff Accommodation	75 dB(A)	HKIB
CUHK7	CUHK: Residence	62 dB(A)	Cheung Shue Tan

The need for conventional piling is not anticipated. Piling with sand displacement is being considered by GEO as a method of constructing the seawall without dredging but this assessment will assume conventional seawall construction using dredgers.

4.2.2 Operational Noise Impacts

(a) Site Activities

According to the NCO, works in connection with, or for the reclamation of, any foreshore and seabed are considered to be construction works. CED have confirmed that the PSK Reclamation-Public Dump should be considered as a reclamation project for the purpose of applying the NCO. Thus, the impact of operations at the dump site itself is assessed with reference to the same criteria as that outlined in Section 4.2.1 above. As during construction, operational hours are expected to be from 0800 to 1800 hrs.

(b) Site Traffic on Public Roads

The impact of dump-related traffic travelling on public roads is assessed with reference to the HKPSG, which stipulate that L_{10} noise levels from road traffic should not exceed 70 dB(A) (1 hour) at sensitive residential facades, and 65 dB(A) at sensitive educational facades. These criteria have a clear application for NSRs currently exposed to low traffic noise levels (e.g., Villa Castell), but fail to address deterioration at facades already exposed to traffic noise levels exceeding the HKPSG criteria. For these receivers, the need for mitigation may be determined with reference to criteria that address deterioration in the noise environment. In this assessment, mitigation will be considered where, for a single prediction year, the predicted noise level with dump-related traffic is at least 1.0 dB(A) more than that without dump-related traffic.

4.3 Sensitive Receivers

A set of representative NSRs have been selected and are shown in Figure 4.1. These NSRs, and the relevant allowable construction and operation noise levels assigned to them (see Section 4.2.1 above), are listed in Table 4.1. The HKIB building has not been included as a NSR since it is not an educational or residential receiver. It has a central ventilation system, thus does not rely on open windows for ventilation. The construction and operation of the reclamation is expected to cause some noise nuisance to users of the cycle track. No formal assessment is made in this report because the users are non-stationary and therefore any nuisances caused are expected to be transient.

4.4 Impact during Construction Phase

Construction can generally be expected to entail dredging for and construction of a sloping seawall, construction of land access routes, and placement of fill.

4.4.1 Seawall Construction

For the first 200 to 300 m of seawall in Phase 1, a conventional sloping seawall (permeable) will be built. Grab dredgers will be used to excavate the wall trenches, and sand will be placed in the trenches using bottom dumping barges as far as practical. Core fill, secondary and primary armour rocks will be placed using a derrick lighter.

The Phase 1 seawall and dividing wall will be built using construction material stockpiled at the MOS Public Dump site and placed by derrick lighter. Phase 1 seawall construction is expected to be completed within six months. Equipment requirements are summarised below.

Table 4.2 : Construction Phase Activities and Equipment: Seawall Construction

Activity Description	Equipment	Sound Power Level (dB(A))
Dredging	• Grab dredger	@ 112
Sand fill	• Bottom-dumping barge • Tugboat	- @ 110
Sloping seawall (core fill and armour rock)	• Derrick lighter • Tugboat	@ 104 @ 110
Dividing bund (Phase 1 only)	• Derrick lighter • Tugboat	@ 104 @ 110

The method for Phases 2 and 3 seawall construction is not yet certain. Conventional construction methods, such as those indicated above for the Phase 1 construction, may be used. Alternatively, in-depth cement mixing and piling with sand displacement are being considered. The following assessment is based on a worst-case scenario in which conventional construction methods are used.

Assuming conventional seawall construction, the construction period of Phases 2 and 3 will be twelve months. Due to the compressed construction schedule required for completion of the Phase 1 seawalls, greater numbers of equipment are expected to be operating at a given moment during the first six months of the reclamation than during the remainder of the reclamation formation and dump operation. The following worst-case scenarios are evaluated in the construction noise impact assessment:

Table 4.3 : Seawall Construction Scenarios: Equipment Requirements

PME on site	Phase 1						Phase 2	Phase 3
	Months						Twelve Months	Twelve Months
	1	2	3	4	5	6		
Dredgers	2	2	2	0	0	0	1	1
Derrick Lighters	0	3	5	7	8	4	4	4
Tugboats	2	5	4	4	3	2	4	4

The need for dredging is not anticipated along the nullah extension. The invert level of the nullah will be between 0 and +1 mPD, and the trapezoidal nullah channel will be formed using rubble. The formation of the nullah is thus similar to that of the remainder of the reclamation, and will not be assessed separately.

4.4.2 Access Road Construction

As discussed in Section 2.2, the environmental assessment has been based on road access Option 1. The following construction tasks and equipment form the basis of the impact assessment. The works are assumed to occur sequentially, though some tasks (e.g., earthworks and drainage) may be carried out concurrently at some stage in the construction programme.

The Option 1 road alignment requires no blasting.

Table 4.4 : Construction Phase Activities and Equipment: Access Road Construction

Activity Description	Equipment and Quantity		SWL (dB(A)) per piece
Preliminary works and mobilization	Truck with crane	1	109
	Drilling rig (diesel)	1	114
Earthworks	Pneumatic breaker	2	110
	Air compressor	2	100
	JCB excavator	1	112
	Dump trucks	2	117
	Grader	1	113
	Roller (vibratory)	1	108
Drainage	Dump trucks	2	109
	Backhoes	2	112
	Truck with crane	1	109
	Concrete mixer truck	1	109
Kerbing and concrete construction	Concrete mixer truck	1	109
	Vibratory pokers	1	113
	Dump truck	1	109
Paving	Trucks (sub-base)	2	109
	Asphalt trucks	2	109
	Paver	1	109
	Roller (pneumatic)	1	108
	Roller (vibratory)	1	108

(a) Assessment Methodology

Construction and operational noise have been assessed with reference to the Plant Sound Power Method in BS 5228: Part 1: 1984 (Noise Control on Construction and Open Sites) (Ref.18). No allowances have been made for ground attenuation or air absorption, both of which will decrease reclamation noise levels at distant receivers.

Traffic noise with and without dump-related vehicles has been assessed with reference to the UK Department of Transport (DOT) procedure outlined in Calculation of Road Traffic Noise (CRTN) (1988) (Ref.19).

(b) Assessment Results

During construction of the Phase 1 seawall, the equipment requirements are expected to be greater than during construction of Phases 2 and 3. Monthly Phase 1 noise levels have been predicted and are shown in Table 4.5

Table 4.5 : Facade Noise Levels at Representative NSRs: Construction of Seawall During Phase 1

Receiver Identification and Noise Criterion (dB(A))		Facade Noise Level (dB(A)) due to Phase 1 Seawall Construction during Month					
		1	2	3	4	5	6
TPK1	62	46	48	48	46	46	44
TPK2	62	46	49	48	47	46	44
LL1	62	47	49	49	47	47	45
LL2	62	48	50	50	48	48	46
VC	62	49	51	51	49	49	46
SCH	72	50	52	52	50	49	47
TPR	62	50	53	52	51	50	48
WNF	62	51	54	54	52	51	49
CST1	62	52	54	54	52	52	50
CST2	62	50	53	53	51	50	48
PM	62	54	56	56	54	54	51
TPM	62	54	56	56	54	54	52
CUHK1	73	58	60	60	58	58	56
CUHK2	75	65	67	67	65	65	62
CUHK3	72	58	60	60	58	58	55
CUHK4	73	56	58	58	56	56	53
CUHK5	73	57	59	59	57	57	54
CUHK6	75	67	69	69	68	67	65
CUHK7	62	54	56	56	54	53	51

Table 4.5 shows that noise levels due to construction of the Phase 1 seawall is expected to be well within acceptable limits at all selected NSRs.

During construction of the seawall for Phases 2 and 3, equipment requirements are less than those expected during construction of Phase 1. Anticipated noise levels have been predicted assuming conventional construction techniques, and are shown in Table 4.6.

Table 4.6 : Facade Noise Levels at Representative NSRs: Construction of Seawall During Phases 2 and 3

Receiver Identification and Noise Criterion (dB(A))		Facade Noise Level (dB(A)) due to Seawall Construction during	
		Phase 2	Phase 3
TPK1	62	50	54
TPK2	62	50	55
LL1	62	51	57
LL2	62	53	60
VC	62	54	60
SCH	72	55	62
TPR	62	52	52
WNF	62	53	53
CST1	62	52	52
CST2	62	50	50
PM	62	54	54
TPM	62	55	55
CUHK1	73	55	50
CUHK2	75	59	53
CUHK3	72	55	53
CUHK4	73	53	51
CUHK5	73	53	49
CUHK6	75	51	45
CUHK7	62	53	52

Table 4.6 shows that noise levels due to conventional construction of the seawall during Phases 2 and 3 is expected to be well within acceptable limits at all selected NSRs.

Construction of the Option 1 access road will result in noise from the use of Powered Mechanical Equipment (PME) as predicted in Table 4.7. The figures shown assume that PME is located at the nearest point of the alignment to each NSR, and that the access road extends through all three reclamation phases. Noise levels associated with preliminary works and earthworks for section of the alignment on reclaimed land are included, though the need for these works is not anticipated at the present time.

Table 4.7 : Facade Noise Levels at Representative NSRs: Construction of Access Road

Receiver Identification and Noise Criterion (dB(A))		Facade Noise Level (dB(A)) due to Construction of the Option 1 Access Road				
		Preliminary Works	Earthworks	Drainage	Kerbing	Paving
TPK1	62	50	57	53	50	52
TPK2	62	50	57	53	51	52
LL1	62	52	59	55	52	54
LL2	62	54	61	57	55	56
VC	62	55	62	58	56	57
SCH	72	57	64	60	57	59
TPR	62	49	56	52	50	51
WNF	62	50	57	53	50	52
CST1	62	52	59	54	52	54
CST2	62	52	59	55	52	54
PM	62	49	56	52	50	51
TPM	62	47	54	50	47	49
CUHK1	73	57	64	60	57	59
CUHK2	75	56	63	59	57	58
CUHK3	72	53	60	53	53	55
CUHK4	73	51	58	59	51	53
CUHK5	73	55	62	58	55	57
CUHK6	75	96	103	99	97	98
CUHK7	62	50	57	53	51	52

Table 4.7 shows that noise levels due to construction of the Option 1 access road is expected to be within acceptable limits at all selected NSRs except CUHK6 (staff accommodation adjacent to the HKIB). Due to the extremely close proximity of this receiver to the road alignment (approximately 5 m), noise levels from construction of the access road will exceed the recommended maximum when construction works are in progress closely.

In order to indicate the approximate noise levels from combined construction activities, Table 4.8 shows facade noise levels that would be expected during concurrent construction of the seawall and access road:

Table 4.8 : Facade Noise Levels at Representative NSRs: Combined Construction of Seawall and Access Road

Receiver Identification and Noise Criterion (dB(A))		Facade Noise Level (dB(A)) due to Construction of		
		Seawall	Access Road	Combined
TPK1	62	54	53	57
TPK2	62	55	53	57
LL1	62	57	55	59
LL2	62	60	57	62
VC	62	60	58	62
SCH	72	62	60	64
TPR	62	53	52	56
WNF	62	54	53	57
CST1	62	54	54	67
CST2	62	53	55	67
PM	62	56	52	58
TPM	62	56	50	57
CUHK1	73	60	60	63
CUHK2	75	67	63	69
CUHK3	72	60	60	63
CUHK4	73	58	58	61
CUHK5	73	59	62	64
CUHK6	75	69	103	103
CUHK7	62	56	57	60

As shown in Table 4.8, construction of the seawall and access road are expected to result in noise levels that are within acceptable limits at all selected NSRs except CUHK6 (the staff accommodation building near HKIB) which will be exposed to high noise levels from earthworks associated with the access road at the closest point in its alignment. If concurrent construction of the Phase 3 seawall and the access road occurs, NSRs LLZ and VC (representing exposed facades along Lookout Link and Villa Castell) may also be exposed to construction noise levels that approach, but not exceed, the maximum desirable levels. For these reasons, measures to minimise construction noise should be adopted by the Contractor. Such measures are discussed in Section 4.6.

4.5 Impacts during Operational Phase

4.5.1 Operational Activities

The need for dredging of the reclamation and placement of a sand blanket prior to filling is not anticipated, since there are no immediate development plans for the reclamation.

During filling of the reclamation, material will be delivered by both land and sea, according to the assumptions in Table 4.9 below. No material stockpiles are expected during Phase 1 operations, but stockpiles are anticipated during Phases 2 and 3. Although the locations of the stockpiles are not determined at this stage, they are assumed to be in the southeast corners of the Phase 2 and Phase 3 reclamation areas.

Table 4.9 : Operation Phase Activities and Equipment: Delivery of Materials

Period	Delivery Mode and Frequency (all years)	
	by sea	by land
Hourly	--	46 truck trips
Daily	2 derrick barge trips (with tugboat)	454 truck trips

The barge reception area (at which barge-transported material is transferred to dump trucks) will be located at the northernmost corner of the Phase 1 reclamation (see Figure 1.2).

As the reclamation rises above the water level, site formation activities will take place. The assessment is based on the following activities and equipment requirements during this phase of the reclamation:

Table 4.10: Operation Phase Activities and Equipment: Land Formation

Operation	Assumed Maximum Equipment Requirements	
	Equipment Type	Number
Unloading barge-transported fill	Derrick lighter Dump trucks	1 4
Unloading road-transported fill	Dump trucks	4
Sorting fill	Backhoe	1
Spreading fill	Bulldozer	1
Transferring stockpiled fill to active face (Phases 2 and 3 only)	Loader Dump trucks	1 2
Compacting fill	Vibratory Roller	1

Other noise may be generated by on-site maintenance of equipment and plant. Such activities are not included in this assessment due to their infrequent occurrence.

No rock crushing or mechanical screening of waste will be carried out at the site.

The equipment sound power levels (SWL) used in the assessment have been obtained, where possible, from monitoring identical operations at the MOS Public Dump. The site was visited in November 1993, and the sound of various site activities and equipment was monitored. However, not all equipment could be monitored at the time of the site visit. Where no measured sound levels are available, SWL values from Table 3 of the Technical Memorandum on Noise from Construction Work other than Percussive Piling (Ref.20) are used. The SWL values obtained from these sources and used in the assessment are shown in Table 4.11.

Table 4.11: Operation Phase Activities and Equipment: Sound Power Levels

Equipment	SWL (dB(A))	Source
Derrick lighter	104	Table 3, Technical Memorandum on Noise from Construction Work other than Percussive Piling
Dump trucks unloading fill	111.4	Monitored noise level from MOS operation: Hino KF 24-tonne dump truck unloading soil and rocks
Backhoe	112	Table 3, Technical Memorandum on Noise from Construction Work other than Percussive Piling
Bulldozer spreading fill	109.3	Monitored noise level from Ma On Shan operation: Caterpillar tracked bulldozer
Loader	112	Table 3, Technical Memorandum on Noise from Construction Work other than Percussive Piling
Vibratory roller	108	Table 3, Technical Memorandum on Noise from Construction Work other than Percussive Piling

As road access Option 1 has been adopted as the preferred option, the filling sequence will be Phase 1, then Phase 2, followed by Phase 3. It is expected that the southern end of Phase 1 will be filled up to the finished level (+5.5 mPD) as soon as possible.

4.5.2 Traffic on the Public Road during Operation Phase

Independent of the dump, traffic on Tolo Highway is expected to increase significantly from current levels. The current traffic flow is approximately 110,000 vehicles per day in both directions, of which 8,800 vehicles comprise the peak hour. The Working Paper on Road Access Assessment (Ref.2) predicted a daily flow (AADT) in 2003 of about 150,000 vehicles, representing saturation flow. Assuming that the proportion of vehicles during the peak hour remains unaltered, this predicted AADT implies a peak hour flow of about 12,000 vehicles. The general traffic split during the morning peak hour is 55 percent southbound and 45 percent northbound.

In year 2011, CTS-2 predicts that the proportion of heavy vehicles along Tolo Highway will be about 43 percent; the comparable 1990 proportion is about 47 percent. The decrease in proportion of heavy vehicles may reflect the commissioning of Route 3 as an alternative route to the border. In order to represent a future scenario in which a large proportion of heavy vehicle traffic uses Route 3, the lower heavy-vehicle proportion of 43 percent (exclusive of dump-related vehicles) is used in this assessment.

Superimposed on this future flow will be the dump-related traffic. The peak period for dump related traffic (0900-1000 hrs) does not coincide with the Tolo Highway peak (0800-0900 hrs). However, to assess a worst case scenario it is assumed that the two peak hours do coincide. Expected peak-hour flow is 46 in-coming heavy vehicles. Equal numbers are assumed to approach the reclamation site from the north and south.

The flows on which the traffic noise impact assessment is based are shown in Table 4.12.

Table 4.12 : Assumed 2003 Traffic Flows on Tolo Highway

Parameter	Value used in this assessment	
	Exclusive of Dump-related Traffic	Inclusive of Dump-related Traffic
Peak Flow (vehicles/hr)	6600 (South bound) 5400 (North bound)	6623 (South bound) 5423 (North bound)
Percent Heavy Vehicles	43.0%	43.4%
Speed (km/hr)	80	80

4.5.3 Access Road Traffic

(a) Assessment Methodology

Noise from traffic along the access road has been assessed with reference to Section A.3.4.2 of BS 5228: Part 1: 1984 (Noise Control on Construction and Open Sites, Part 1: Code of Practice for Basic Information and Procedures for Noise Control). The assumptions used in the assessment are shown in Table 4.13. The SWL of 105.2 dB for dump trucks was obtained from Table 12 of BS 5228, and shows the average of six measured SWLs for 20- and 24-tonne dump trucks. All observed dump trucks at the MOS public dump site had gross vehicle weight of 24 tonnes. Traffic flow was obtained from the Working Paper of Access Road Assessment.

Table 4.13: Input Assumptions for Access Road Traffic Noise Impact Assessment

Parameter		Assumed Value
L_{WA}	sound power level of the plant	105.2 dB
Q	number of vehicles per hour	46 trucks (1 way)
V	average vehicle speed	20 km/hr
d	distance of NSR from centre of haul road	(varies)

(b) Assessment Results

Operation of the Phase 1 reclamation will result in noise from the use of PME as predicted in Table 4.14. The delivery of materials from barges is assumed to be carried out at the barge loading platform between Phases 1 and 2. "Land-based delivery" refers to dumping of land-transported materials; the noise from traffic on the access road is separately assessed in Table 4.17.

Table 4.14 : Facade Noise Levels at Representative NSRs: Operation of the Reclamation (Phase 1)

Receiver Identification and Noise Criterion (dB(A))		Facade Noise Level (dB(A)) due to Operation of the Phase 1 Reclamation		
		Delivery of Materials from Barge	Land-based Delivery and Land Formation	Combined
TPK1	62	40	49	49
TPK2	62	41	49	50
LL1	62	41	50	50
LL2	62	42	51	51
VC	62	43	52	52
SCH	72	44	52	53
TPR	62	43	53	53
WNF	62	44	54	55
CST11	62	44	54	55
CST2	62	43	53	54
PM	62	46	56	56
TPM	62	46	56	57
CUHK1	73	44	63	63
CUHK2	75	52	67	68
CUHK3	72	48	60	60
CUHK4	73	47	59	59
CUHK5	73	46	59	59
CUHK6	75	44	71	71
CUHK7	62	46	56	56

Table 4.14 shows that noise levels due to operation of the Phase 1 reclamation is expected to be within acceptable limits at all selected NSRs, though NSR CUHK6 (staff accommodation adjacent to the HKIB) will be subject to noise levels approaching the recommended maximum.

Operation of the Phases 2 and 3 reclamation will result in noise from the use of PME as predicted in Tables 4.15 and 4.16. As in the above assessment for Phase 1, the delivery of materials from barges is assumed to be carried out at the barge loading platform between Phases 1 and 2, and "land-based delivery" refers to dumping of land-transported materials.

Table 4.15 : Facade Noise Levels at Representative NSRs: Operation of the Reclamation (Phase 2)

Receiver Identification and Noise Criterion (dB(A))		Facade Noise Level (dB(A)) due to Operation of the Phase 2 Reclamation:		
		Delivery of Materials from Barge	Land-based Delivery and Land Formation	Combined
TPK1	62	40	52	53
TPK2	62	41	53	53
LL1	62	41	54	54
LL2	62	42	56	56
VC	62	43	57	57
SCH	72	44	58	58
TPR	62	43	56	56
WNF	62	44	57	57
CST1	62	44	57	57
CST2	62	43	55	55
PM	62	46	60	60
TPM	62	46	61	61
CUHK1	73	44	59	59
CUHK2	75	52	66	67
CUHK3	72	48	62	62
CUHK4	73	47	58	58
CUHK5	73	46	56	57
CUHK6	75	44	53	54
CUHK7	62	46	58	58

Table 4.16 : Facade Noise Levels at Representative NSRs: Operation of the Reclamation (Phase 3)

Receiver Identification and Noise Criterion (dB(A))		Facade Noise Level (dB(A)) due to Operation of the Phase 3 Reclamation		
		Delivery of Materials from Barge	Land-based Delivery and Land Formation	Combined
TPK1	62	40	55	55
TPK2	62	41	56	56
LL1	62	41	57	57
LL2	62	42	60	60
VC	62	43	62	62
SCH	72	44	64	64
TPR	62	43	57	57
WNF	62	44	58	58
CST1	62	44	56	57
CST2	62	43	54	54
PM	62	46	60	60
TPM	62	46	61	61
CUHK1	73	44	53	53
CUHK2	75	52	56	57
CUHK3	72	48	57	58
CUHK4	73	47	54	55
CUHK5	73	46	53	53
CUHK6	75	44	47	49
CUHK7	62	46	57	57

Noise from operations at the reclamation site during Phases 1, 2, and 3 is not expected to exceed recommended maxima. This is due to two factors:

(i) The distances between the reclamation site and sensitive residential and educational facades, which contribute to high levels of distance noise attenuation.

(ii) The existing noise environment, which is dominated by traffic on Tolo Highway.

Noise from access road traffic has been predicted, and is shown below in Table 4.17 in combination with concurrent noise from operations at the reclamation site.

Table 4.17: Facade Noise Levels at Representative NSRs: Access Road Traffic and Operations of the Reclamation

Receiver Identification and Noise Criterion (dB(A))		Facade Noise Level (dB(A)) due to		
		Access Road Traffic	Operations of the Reclamation	Combined
TPK1	62	52	55	57
TPK2	62	52	56	58
LL1	62	53	58	58
LL2	62	54	60	62
VC	62	54	62	63
SCH	72	55	64	65
TPR	62	51	57	58
WNF	62	52	58	59
CST1	62	53	57	59
CST2	62	53	55	57
PM	62	51	60	61
TPM	62	50	61	61
CUHK1	73	55	63	64
CUHK2	75	55	68	68
CUHK3	72	52	62	62
CUHK4	73	53	59	60
CUHK5	73	55	59	60
CUHK6	75	75	71	77
CUHK7	62	52	58	59

As shown in the above tables, operation of the reclamation is expected to result in noise levels that are within acceptable limits at all selected NSR except at NSRs CUHK6 (the staff accommodation building near HKIB). Noise levels at NSRs TPM (Tai Po Mei Village) and PM (Po Min Village) can be expected to approach the maximum acceptable levels, but are not expected to exceed them.

Throughout the site, reasonable measures to minimize construction noise should be adopted by the Contractors. Such measures are discussed in the next section.

Using the CRTN calculation method, the small increase in total traffic flow and proportion of heavy vehicles on Tolo Highway due to the inclusion of reclamation traffic (see Table 4.12 above) is expected to have no noticeable effect on traffic noise. Thus, the need for mitigation measures at Tolo Highway is not anticipated.

4.6 Mitigation Measures

4.6.1 In order to reduce noise at the exterior facade of NSR CUHK-6, a solid noise barrier along the western side of the access road may be considered. However, an inwardly curved sound barrier at a total height of 6 m and a surface mass of 7 kg/m^2 would only reduce the noise by 10 to 15 dB(A) at the staff accommodation building. In view of the anticipated high noise level at this location, it is considered that sound barriers are not adequate to protect this NSR.

To reduce both construction and operation phase noise, the access road may be moved to a greater distance from the staff accommodation (see Figure 8.14). It is proposed to realign the access road onto new reclaimed land further south, which would have benefits in terms of noise, visual impact, and air quality. The proposed alignment would increase the distance between the staff accommodation and the access road from about 5 m to 80 m, while at the same time decreasing the need for University land. If the access road alignment is removed to a distance of 80 m from the staff accommodation, the resulting operational facade noise level during the peak hour is expected to be reduced to 62 dB(A), well within the assessment criterion of 75 dB(A) for this receiver. Such a move would also reduce worst-case construction noise levels from 103 dB(A) to about 74 dB(A); cumulative road and seawall construction noise would then reach about 75 dB(A), the recommended limit at NSR CUHK-6.

For mitigation of construction noise along the access road and at the reclamation itself, the most effective mitigation measure is to control noise at its source. In the case of powered mechanical equipment, this involves either selecting silenced equipment, or reducing the transmission of noise using mufflers, silencers, or acoustic enclosures.

Construction noise may be mitigated through several measures:

(a) Noisy equipment and activities should be sited by the Contractor as far from sensitive receivers as is practical.

(b) Noisy plant or processes should be replaced by quieter alternatives where possible. For example, pneumatic concrete breakers can be silenced with mufflers and bit dampers. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained. The use of this equipment should be required by the specification.

(c) Noisy activities can be scheduled to minimise exposure of nearby NSRs to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours). Prolonged operation of noisy equipment close to dwellings should be avoided.

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

(e) The power units of non-electric stationary plant and earth-moving plant can be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.

(f) Construction activities can be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.

(g) If possible, reduce the numbers of operating items of powered mechanical equipment.

(h) Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g., bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.

Though not effective in reducing noise levels, the establishment of good community relations can be of great assistance to both the contractors and NSRs. Residents and the University administration should be notified in advance of planned operations, and informed of progress. In addition, residents and the University administration may be provided with a telephone number for the Resident Engineer's office, where they may register complaints concerning excessive noise. If justified, the Resident Engineer may authorise noisy operations to cease or to be conducted at more restricted hours.

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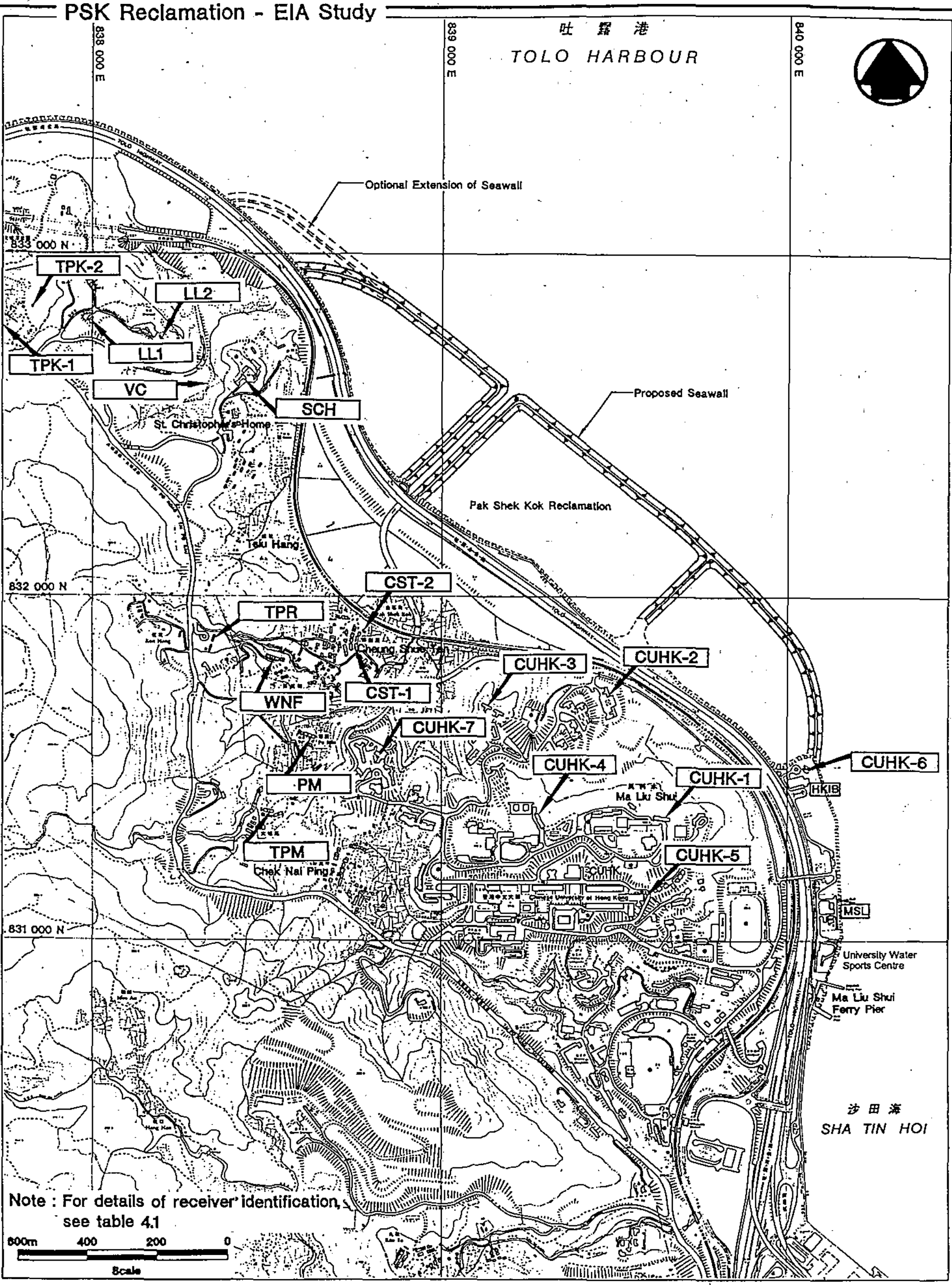


Noise and Air Quality Sensitive Receivers

Mouchel

May 1994

Figure No. 4.1

5.0 AIR QUALITY IMPACT

5.1 Introduction

This section deals with the air quality changes expected from construction of the access road, operations at the reclamation, and traffic on the access road. In the following sections, assessment criteria are discussed, and input assumptions and assessment methodology are described. The impacts during construction and operation are separately assessed, and cumulative impacts considered. The expected effectiveness of mitigation measures implemented during the operational phase of the reclamation is evaluated.

The potential impact of the construction and operation of the reclamation site on the indoor air quality of HKIB is discussed with respect to the predicted ambient dust levels and the US Federal Drug Administration (FDA) Standards.

Odour from the discharge of untreated sewage (essentially septic tank overflow) into the nullah was initially anticipated. However, more in-depth review shows that the reclamation will not cause significant odour problem.

The water quality impact assessment discussed in Section 6 concluded that no significant change to the hydrodynamics of the harbour resulting in alterations of the flushing characteristics were to be expected (see Section 6.7.2).

Within the nullah, the increase in the length by 450 m is not expected to result in any deterioration in water quality in either the existing section or the extension (see Section 9.2). Tolo Highway drainage, which currently discharges directly into Tolo Harbour, will be re-routed into the nullah as existing outfalls are blocked by reclamation. It is not expected that the diversion of surface water from outfalls into the nullah will have any adverse effect on local water quality (see Section 9.3).

In the absence of any significant changes in the harbour hydrodynamics and to water quality in the nullah, conditions leading to a deterioration in odour are not anticipated. The introduction of a sewerage system in the area can be expected to reduce sewage loadings in the nullah and harbour, and thus odour. Currently, village septic tanks discharge into the Tai Po Mei Hang and Cheung Shue Tan Hang streams, which in turn discharge into the nullah and Tolo Harbour. Sewage improvement works for Wong Nai Shai and Pak Shek Kok will be carried out between 1996 and 2000, and further villages will be sewered between 1997 and 2002. Thus, this source of odour will be progressively removed.

In light of the decreased sewage loadings and flushing characteristics of the nullah, no increase in odour is expected, and no quantitative odour assessment is required.

5.2 Environmental Standards and Guidelines

5.2.1 Construction Phase

(a) Hong Kong Planning Standards and Guidelines (HKPSG)

The HKPSG identify construction and reclamation sites as major sources of dust and suspended particulates, and recommend that a buffer distance of at least 100 m be provided between the reclamation site and the nearest sensitive receivers (including residences, educational institutions, and active recreational facilities). In addition, the Guidelines state that transportation routes to and from the reclamation site should be designed, and necessary protective measures taken, to minimise dust nuisance.

(b) Air Pollution Control Ordinance

Dust emissions from construction sites come under the control of the Air Pollution Control Ordinance, which calls for compliance with a set of health-related air quality objectives (AQOs) for seven pollutants, of which NO_2, TSP and RSP are relevant. Compliance with the concentration levels shown in Table 5.1 is required.

The AQOs contain no hourly criteria for concentrations of TSP and RSP. However, EPD has a Dust Suppression Guideline to indicate the maximum acceptable concentration of TSP during construction works. This Guideline, which is 500 $\mu g/m^3$ (hourly average), is used in the present assessment.

Table 5.1 : Air Quality Objectives

Parameter	Maximum Permitted Average Concentration ($\mu g/m^3$)		
	1 hour	24 hours	Yearly
TSP	500	260	80
RSP	--	180	55
NO_2	300	150	80

Notes: (1) All criteria are Hong Kong Air Quality Objectives except hourly TSP concentration, which is an EPD Dust Suppression Guideline.
(2) Hourly criterion for NO_2 not to be exceeded more than three times per year.
(3) 24-hour criteria not to be exceeded more than once per year.

5.2.2 Operational Phase

Operational phase criteria are identical to those listed in Sections 5.2.1.

5.3 Sensitive Receivers

An increase in ambient dust concentrations during construction of the haul road and operation of the reclamation site will have impacts on residential and institutional uses in the study area. This assessment has used the same set of representative sensitive receivers as was used in the noise impact assessment (Section 4.2.1 above), with the addition of the HKIB. Air quality impacts are expected to be particularly significant at HKIB, which intends to establish a pilot "clean room" facility meeting US FDA standards. The indoor air quality requirements of this facility are described in Section 5.7. While the HKIB will have its own filtration system, dust and airborne microbes must be controlled at source to avoid overburdening of that system.

The construction and operation of the reclamation is expected to cause some air quality nuisance to users of the cycle track. No formal assessment is made in this report because the users are non-stationary and therefore any nuisances caused are expected to be transient.

5.4 Impact during Construction Phase

5.4.1 Methodology

A description of construction phase activities is provided in Section 4.4 above.

One year's sequential meteorological data (from 1992) has been obtained from the Royal

Observatory for the Tai Po Kau Station. The data from Tai Po Kau is preferred to that of the Shatin Station due to the seaside location of the former station.

One-hour and 24-hour TSP concentrations have been examined, using the Fugitive Dust Model (FDM) to predict worst dust concentrations assuming the following input parameters:

- Mixing height: 500 m
- Surface Roughness: 0.04 m
- Height of Emissions: ground level

Dredging and underwater placement of fill are not dust-generating activities, and thus are not modelled. However, dust levels generated by construction of the haul road have been modelled as area sources using the US EPA's AP-42 emission factor for heavy construction operations ($1.10x10^{-7}$ $kg/m^2 \bullet sec$).

5.4.2 Assessment Results

Dust emissions during construction of the access road have been predicted, based on the assumption that no dust suppression measures are adopted. However, due to the limited construction area involved and the large source-to-receiver distances, predicted dust concentrations at all evaluated sensitive receivers, including HKIB, are negligible.

5.5 Impact during Operation Phase

5.5.1 Methodology

A description of operation phase activities is provided in Section 4.5 above.

As for the construction phase impact assessment, one year's meteorological data (from 1992) from the Royal Observatory's Tai Po Kau Station has been used. One-hour, 24-hour and annual average TSP concentrations have been examined, using the FDM to predict worst dust concentrations.

The paved access road has been modelled as a line source during its operation, using a TSP emission factor (E_{AR}) of 1.306 kg per vehicle-kilometre travelled. This emission factor was obtained from US EPA's AP-42 publication, and has assumed a silt content of 7.1 percent and a total surface dust loading of 380 kg/km. Average vehicles weight has been assessed at 22.4 tonnes, and two lanes of traffic have been assumed.

Operations on the reclamation itself have been modelled as area sources using the AP-42 emission factor (E_R) for heavy construction operations ($1.10x10^{-7}$ $kg/m^2 \bullet sec$). This is considered the most appropriate emission factor available, since it deals with such operations as land clearance, ground excavation, and cut and fill operations, which were observed during a November 1993 visit to the MOS Public Dump.

Stockpiles have been modelled as area sources using an emission factor (E_S) of $6.56x10^{-5}xf$ $kg/day/m^2$, where "f" is the percentage of time that the unobstructed wind speed exceeds 5.4 m/s at mean pile height. This is based in part on the average silt value for overburden in AP-42's Table 11.2.3-1. The emission factor is that for wind erosion of aggregate stockpiles (AP-42, Section 11.2.3).

Rock crushing is not anticipated on the site.

The FDM does not permit emission factors (which are input in units of quantity per second) to change over time. As a result, it is not possible to combine use of one year's sequential meteorological data with appropriate reductions in the 24-hour emission factors for traffic on the access road and for activities on the reclamation, which are dust emitters for only 8 to 9 hours per day. For this reason, an alternative methodology to estimate 24-hour TSP concentrations has been utilised.

The FDM permits 1, 3, 8 and 24 hour averages to be obtained. Working within this limit, the 8-hour average (A_8) based on emission factors E_{AR} and E_R and on an excised set of 8 hours meteorological data per day, has been obtained, along with a 24-hour average (A_{24}) based on emission factor E_S. The combined 24-hour average has been calculated using the following formula:

$$(A_8 \bullet (8/24)) + A_{24}$$

A similar methodology has been used to obtain the annual averages.

A background TSP concentration of 137 µg/m³ has been added to predicted 24-hour results to obtain a cumulative concentration. This figure represents the 90th percentile value obtained during 1992 at EPD's Tai Po monitoring station. The maximum 24-hour value was not used since it exceed the AQO criterion. EPD's results have been used in preference to results obtained during the two-week monitoring programme at PSK, since the Tai Po monitoring results are obtained over an entire year.

A background TSP concentration of 165 µg/m³, 248 µg/m³, or 175 µg/m³ has been added to predicted 1-hour model results to obtain a cumulative concentration. These figures represent 90th percentile values obtained at the HKIB building, the CUHK campus, and Cheung Shue Tan Village respectively in the two week monitoring programme carried out as part of this study in January and February 1994.

No background TSP levels have been assumed for the annual averages, since the presence of the reclamation and its associated facilities can be expected to dominate the annual average TSP concentrations.

The air quality impacts of road traffic generated by the dump have been assessed using the CALINE4 Model. Dump-related traffic is added to projected 2003 traffic flows on Tolo Highway (see Table 4.12) to determine the cumulative impacts of traffic pollutants NO_2 and RSP.

5.5.2 Assessment Results

Dust concentrations based on the absence of any dust mitigation measures have first been calculated, assuming land formation over Phase 1, with concurrent operation of the paved access road. Modelling results are shown below in Table 5.2. It should be noted that the table is based on the absence of any dust suppression measures. It also assumes a road alignment that moves the access road to a distance of 80 m from the HKIB building, onto land reclaimed for the purpose of providing an adequate buffer distance between the access road and sensitive receivers. Exceedances of the maximum AQO daily TSP concentration are highlighted in boldface.

Table 5.2 : Predicted TSP Concentrations at Selected Sensitive Receivers under Unmitigated Condition: Operations in Phase 1 and Realigned Access Road

Sensitive Receiver	TSP Concentration ($\mu g/m^3$)		Sensitive Receiver	TSP Concentration ($\mu g/m^3$)	
	1-hour	24-hour		1-hour	24-hour
TPK1	342	160	CST-1	**530**	198
TPK2	357	160	CST-2	**536**	200
LL1	259	150	CUHK-1	337	154
LL2	259	151	CUHK-2	**602**	211
VC	345	165	CUHK-3	368	166
SCH	279	156	CUHK-4	311	152
TPR	367	155	CUHK-5	387	167
WNF	377	177	CUHK-6	**4689**	**726**
PM	430	188	CUHK-7	349	157
TPM	324	166	HKIB	**3368**	**502**
			MSL	**4421**	**635**

Although the access road is realigned to a greater distance, the 24-hour dust concentrations at receivers CUHK-6, HKIB, and MSL still exceed the relevant AQO criterion.

Three further scenarios have been evaluated:

(a) land formation over Phase 2, with concurrent operation of the paved access road (extending along the Phase 1 seawall) and stockpiling;

(b) land formation over Phase 3, with concurrent operation of the paved access road (extending along Phases 1 and 2 seawalls) and stockpiling; and

(c) annual average for land formation over a single phase, with concurrent operation of the paved access road (realigned further seaward).

As above, these scenarios have assumed that the Option 1 access road will be realigned approximately 80 m from CUHK-6 and HKIB. Modelling results are shown below in Tables 5.3 to 5.5. It should be noted that the tables are based on the absence of any dust suppression measures. Exceedance of the maximum AQO daily or EPD hourly TSP concentrations are highlighted in boldface.

Table 5.3 : Predicted TSP Concentrations at Selected Sensitive Receivers Under Unmitigated Condition: Operationss in Phase 2 and Realigned Access Road (Includes Stockpile Emissions)

Sensitive Receiver	TSP Concentration ($\mu g/m^3$)		Sensitive Receiver	TSP Concentration ($\mu g/m^3$)	
	1-hour	24-hour		1-hour	24-hour
TPK1	395	174	CST-1	728	221
TPK2	432	172	CST-2	658	223
LL1	284	160	CUHK-1	338	163
LL2	290	164	CUHK-2	902	297
VC	405	177	CUHK-3	399	194
SCH	325	171	CUHK-4	322	161
TPR	284	162	CUHK-5	387	173
WNF	417	185	CUHK-6	4689	733
PM	462	197	CUHK-7	360	175
TPM	332	175	HKIB	3368	507
			MSL	4710	644

Table 5.4 : Predicted TSP Concentrations at Selected Sensitive Receivers Under Unmitigated Condition: Operations in Phase 3 and Realigned Access Road (Includes Stockpile Emissions)

Sensitive Receiver	TSP Concentration ($\mu g/m^3$)		Sensitive Receiver	TSP Concentration ($\mu g/m^3$)	
	1-hour	24-hour		1-hour	24-hour
TPK1	672	216	CST-1	664	239
TPK2	624	222	CST-2	674	248
LL1	422	204	CUHK-1	338	159
LL2	460	223	CUHK-2	602	220
VC	728	272	CUHK-3	463	193
SCH	688	316	CUHK-4	369	164
TPR	416	194	CUHK-5	387	174
WNF	432	205	CUHK-6	4689	732
PM	472	214	CUHK-7	421	173
TPM	328	182	HKIB	3368	510
			MSL	4710	643

Table 5.5: Predicted Annual TSP Concentrations at Selected Sensitive Receivers Under Unmitigated Condition: Operations at Reclamation and Realigned Access Road (Include Stockpiling Emissions)

Sensitive Receiver	TSP Concentration ($\mu g/m^3$)	Sensitive Receiver	TSP Concentration ($\mu g/m^3$)
TPK1	18	CST-1	26
TPK2	18	CST-2	28
LL1	17	CUHK-1	3
LL2	24	CUHK-2	37
VC	41	CUHK-3	15
SCH	50	CUHK-4	6
TPR	12	CUHK-5	9
WNF	18	CUHK-6	268
PM	19	CUHK-7	11
TPM	13	HKIB	146
		MSL	34

If unmitigated, the hourly TSP concentrations are expected to exceed the maximum acceptable level of 500 $\mu g/m^3$ at HKIB, MSL, and CUHK-6 (the nearby staff accommodation) due to their proximity to the access road and Phase 1 reclamation. Dust concentrations in Cheung Shue Tan village and at CUHK-2 (Residence No. 10) are also expected to be significantly over the criterion, particularly during Phases 2 and 3. During Phase 3 reclamation, dust levels at Villa Castell, at the site of St Christopher's Home, and Tai Po Kau will be expected to exceed 500 $\mu g/m^3$. Excessive dust levels are also indicated over large areas shown in the contours (Figures B.1 to B.8 of Appendix B). At the worst-affected receivers, exceedance is due almost entirely to the paved access road, which in this unmitigated scenario is assumed to contribute dust spilled and tracked onto the paved surface, and entrained by vehicles travelling on both the paved road and unpaved shoulders.

Daily TSP concentrations are expected to be exceeded during all three Phases of the reclamation at receivers CUHK-6, HKIB and MSL. In addition, dust levels will exceed the maximum AQO level of 260 $\mu g/m^3$ at receivers Villa Castell (VC) and the site of St. Christophers Home (SCH) during Phase 3 reclamation, and at CUHK-2 during Phase 2 reclamation.

Exceedance of the annual TSP average could be expected at CUHK-6 and HKIB in the absence of any mitigation measures.

These results indicate that dust suppression measures are required to keep dust concentrations to acceptable levels. Mitigation measures and their anticipated effectiveness are addressed in the following section.

The marginal increase in traffic along Tolo Highway due to addition of the dump-related vehicles (from 12,000 peak-hour vehicles to 12,046 vehicles) produces no discernible change in RSP and NO_2 levels at sensitive facades (see Table 5.6).

Table 5.6: Predicted NO_2 and RSP Concentrations at Selected Sensitive Receivers due to Road Traffic Generated by Reclamation

Sensitive Receiver	Concentration ($\mu g/m^3$)		Sensitive Receiver	Concentration ($\mu g/m^3$)	
	NO_2	RSP		NO_2	RSP
TPK1	0.4	0.3	CST-1	0.8	0.4
TPK2	0.4	0.3	CST-2	0.8	0.4
LL1	0.4	0.1	CUHK-1	0.0	0.0
LL2	0.4	0.2	CUHK-2	0.8	0.5
VC	0.8	0.4	CUHK-3	0.4	0.1
SCH	0.4	0.2	CUHK-4	0.0	0.0
TPR	0.0	0.1	CUHK-5	0.0	0.1
WNF	0.4	0.2	CUHK-6	1.9	1.1
PM	0.4	0.2	CUHK-7	0.0	0.1
TPM	0.4	0.1	HKIB	2.3	1.2

5.6 Mitigation Measures

Dust may be suppressed by several means, including wetting, covering of exposed surfaces to prevent wind erosion, and minimization of mechanical disturbance.

(a) Paved Access Road

In order to protect those receivers near the access road, particularly HKIB and CUHK-6, travel on unpaved or untreated shoulders should be prevented, and effective wheel washing facilities provided. On the access road, wide lanes and paved shoulders are recommended, to restrict dump trucks to travelling only on the paved surface. Kerbs or barriers are a further measure to prevent dump trucks from travelling over unpaved or untreated areas beside the road. A sophisticated wheel washing facility with high pressure water jets for vehicles exiting the site is recommended, to remove dust and grit from not only the tyres, but also the undercarriage and body of the vehicle.

Implementing a highly effective wheel washing system, combined with measures to prevent vehicles from travelling over unpaved areas beside the access road, could reduce dust emissions from the paved haul road by a factor of 7, according to the US EPA AP-42 publication.

(b) Operations at the Site

Twice-daily watering can reduce dust emissions by about 50 percent, but this reduction is very dependent upon other conditions such as wind speed and precipitation. In this assessment, a more conservative reduction factor of 25 percent has been used to represent the mitigation situation, in light of the large exposed areas expected (which would be difficult to water) and high wind and temperature conditions prevalent at the site.

(c) Stockpiles

Watering of both the stockpile and its access points, combined with continuous chemical treatment with a wetting agent (to more effectively wet fines and retain moisture), can reduce total particulate emissions by up to 90 percent. However, the effectiveness of this measure is dependent upon wind, temperature and precipitation. In the exposed areas on the reclamation, a more conservative reduction factor of 25 percent has been assumed for storage piles.

(d) Progressive Restoration

The size of the active working area above sea level should be limited as far as practical. Areas reaching the final level should be progressively restored with hydroseeding and surface water drainage system in order to control dust generation and surface water runoff.

Applying the above reduction factors, the mitigated scenario has been evaluated. Predictions are presented in Tables 5.7 to 5.10, and in pollution isopleths shown in Figures B.9 to B.16 of Appendix B.

Table 5.7 : Mitigated TSP Concentrations at Selected Sensitive Receivers: Operations in Phase 1 and Realigned Access Road

Sensitive Receiver	TSP Concentration ($\mu g/m^3$)		Sensitive Receiver	TSP Concentration ($\mu g/m^3$)	
	1-hour	24-hour		1-hour	24-hour
TPK1	199	140	CST-1	226	146
TPK2	201	140	CST-2	226	146
LL1	187	139	CUHK-1	261	140
LL2	187	139	CUHK-2	299	148
VC	199	141	CUHK-3	265	141
SCH	190	140	CUHK-4	257	139
TPR	188	140	CUHK-5	268	141
WNF	204	143	CUHK-6	**810**	223
PM	201	144	CUHK-7	262	140
TPM	196	141	HKIB	**621**	191
			MSL	**772**	208

NOTE: Mitigation measures are described above, and are assumed to reduce haul road emissions by 86%, reclamation emissions by 25%, and stockpile emissions by 25%.

Table 5.8 : Mitigated TSP Concentrations at Selected Sensitive Receivers: Operations in Phase 2 and Realigned Access Road (Includes Stockpile Emissions)

Sensitive Receiver	TSP Concentration (μg/m³)		Sensitive Receiver	TSP Concentration (μg/m³)	
	1-hour	24-hour		1-hour	24-hour
TPK1	214	144	CST-1	322	156
TPK2	221	144	CST-2	270	156
LL1	200	143	CUHK-1	300	146
LL2	209	145	CUHK-2	458	212
VC	222	147	CUHK-3	349	159
SCH	221	148	CUHK-4	303	145
TPR	202	144	CUHK-5	319	146
WNF	237	148	CUHK-6	**810**	228
PM	260	150	CUHK-7	331	150
TPM	223	146	HKIB	**621**	194
			MSL	**813**	213

NOTE: Mitigation measures are described above, and are assumed to reduce haul road emissions by 86%, reclamation emissions by 25%, and stockpile emissions by 25%.

Table 5.9 : Mitigated TSP Concentrations at Selected Sensitive Receivers: Operations in Phase 3 and Realigned Access Road (Includes Stockpile Emissions)

Sensitive Receiver	TSP Concentration (μg/m³)		Sensitive Receiver	TSP Concentration (μg/m³)	
	1-hour	24-hour		1-hour	24-hour
TPK1	344	158	CST-1	321	163
TPK2	280	167	CST-2	307	167
LL1	334	170	CUHK-1	279	143
LL2	340	182	CUHK-2	359	154
VC	382	199	CUHK-3	409	158
SCH	476	246	CUHK-4	338	148
TPR	356	164	CUHK-5	321	146
WNF	284	156	CUHK-6	**810**	228
PM	275	155	CUHK-7	378	149
TPM	241	150	HKIB	**621**	196
			MSL	**813**	210

NOTE: Mitigation measures are described above, and are assumed to reduce haul road emissions by 86%, reclamation emissions by 25%, and stockpile emissions by 25%.

Table 5.10 : Mitigated Annual TSP Concentrations at Selected Sensitive Receivers: Operations at Reclamation and Realigned Access Road (Includes Stockpile Emissions)

Sensitive Receiver	TSP Concentration ($\mu g/m^3$)	Sensitive Receiver	TSP Concentration ($\mu g/m^3$)
TPK1	5	CST-1	4
TPK2	6	CST-2	4
LL1	7	CUHK-1	1
LL2	11	CUHK-2	6
VC	18	CUHK-3	3
SCH	28	CUHK-4	1
TPR	2	CUHK-5	1
WNF	3	CUHK-6	38
PM	3	CUHK-7	2
TPM	2	HKIB	21
		MSL	5

NOTE: Mitigation measures are described above, and are assumed to reduce haul road emissions by 86%, reclamation emissions by 25%, and stockpile emissions by 25%.

The results in the tables and figures indicate that, if carefully applied and maintained, mitigation measures aimed at suppressing dust at its source will reduce TSP emissions from the reclamation and its access road to acceptable levels over most of the study area. Daily and annual average remain within AQO bounds. However, high dust concentrations could still be experienced along the realigned access route (at receivers CUHK-6, HKIB and MSL) which during periods of high background dust levels, may exceed maximum guideline of 500 $\mu g/m^3$. This indicates the need for additional mitigation measures along the access road.

It is recommended that a dust barrier of 2 m high should be installed on the section of the access road in front of the MSL. As is discussed in Section 5.7 the air filtration system should provide additional protection for the occupants inside the building.

The sophisticated washing system with high pressure water jets should be supplemented with road cleaning at least twice a day. This is because of typical rapid build-up of surface dust on the roadway from spillage and tracking of material. The road should be cleaned by vacuuming, since sweeping may serve only to re-entrain dust, and flushing may increase the concentration of suspended solids in water emptying into Tolo Harbour. It is recommended that the road be cleaned at the close of the working day, in order to remove dust that would otherwise lay on the road surface overnight. Twice-daily cleaning can achieve dust control efficiencies on the order of 50 percent, which would bring dust concentration to an acceptable level (see Table 5.11). Furthermore, incoming dump trucks should not be loaded to a level higher than the side and tail boards, and their loads should be dampened and securely covered before transport. This will help to minimize spillage onto the road surface. However, it will be difficult to control incoming trucks.

Table 5.11 : Mitigated 1-hour TSP Concentrations at Selected Sensitive Receivers: Operations in Phases 1, 2 and 3, and Realigned Access Road - Residual Impacts

Sensitive Receiver	TSP Concentration ($\mu g/m^3$)		
	Phase 1	Phase 2	Phase 3
TPK1	178	194	243
TPK2	177	190	316
LL1	171	185	324
LL2	171	199	330
VC	177	198	354
SCH	173	211	463
TPR	172	187	346
WNF	180	222	274
PM	183	236	265
TPM	176	213	231
CST-1	191	282	311
CST-2	191	233	297
CUHK-1	171	217	196
CUHK-2	191	375	276
CUHK-3	174	265	326
CUHK-4	170	220	255
CUHK-5	175	236	238
CUHK-6	493	493	493
CUHK-7	172	248	295
HKIB	397	397	397
MSL	474	494	494

NOTE: Mitigation measures are described above, and are assumed to reduce access road emissions by 86% and further 50% by regular wetting reclamation emissions by 25%, and stockpile emissions by 25%.

Although the mitigation measures indicated above are expected to reduce dust emissions to acceptable levels, the hourly maximum is approached at the site of St. Christopher's Home during Phase 3 reclamation. Particularly during periods of high background dust concentrations, additional dust suppression measures may have to be undertaken, or those that have been adopted may have to be more conscientiously applied. At this advanced stage of the reclamation, it may be desirable to proceed by reclaiming and consolidating smaller areas, so that they can be hydroseeded or otherwise finished and thus removed as a dust source.

The use of fast-growing vegetation to reduce dust emissions is possible, and particularly desirable where it may replace chemical stabilizers that could contribute to water pollution. However, the effectiveness of vegetation in reducing wind erosion is a function of its density and its root structure and strength. Even fast-growing vegetation will require at least one to two weeks to develop the necessary strength and density. If weather conditions during this time are conducive to wind erosion (e.g., windy and dry), dust concentration levels could be undesirably high. The use of synthetic fabric gauze that disintegrates with outdoor exposure is now widespread in Hong Kong. This material is used to cover and protect seeded soil while grass seed sprouts. One or more layers of this gauze, placed over hydroseeded areas, may be sufficient to reduce windborne dust to acceptable levels until the grass has grown sufficiently to prevent wind erosion.

At stockpiles, windbreaks should be provided on three sides to prevent wind erosion.

5.7 Impact on HKIB Indoor Air Quality

This section will review and discuss the potential impact of the construction and operation of the reclamation on the indoor air quality of HKIB. The aim of the section is to propose mitigation measures to maintain the indoor air quality of the building at current standards and to consider the impact on the likely adoption of US FDA standards for the working environment in some areas of the building.

5.7.1 Airconditioning/Mechanical Ventilation Systems of HKIB Building

The HKIB building is located to the east side of the Tolo highway on an exposed seafront site. The building is 3-4 storeys in height and it is of rectangular plan, the longer sides aligned east/west. The north and south facing facades of the building are extensively glazed from first to third floors with openable windows.

The building has provision for airconditioning to all occupied spaces and mechanical ventilation is provided for plantrooms. The ground and mezzanine floors are used as administration offices, main entrance and are airconditioned by a fan-coil system with treated fresh air supplied from a central airhandling unit.

Of the first to third floors, only the second floor has been fully fitted-out for laboratory use and a small portion of the third floor is fitted out for animal holding. All three floors have been designed for the application of central airhandling system. Each floor has a large airhandling plantroom at the west end, but only the second floor has an airhandling unit installed in this room.

The animal holding rooms at the third floor are airconditioned by means of an all-air system with the airhandling equipment sited on the roof, supplying 100% treated fresh air. The adjacent office and specimen preparation room are airconditioned by fan-coil units, but the fresh air supplied to the units appears to be untreated.

Figure 5.1 demonstrates in a simple schematic form the airflow regime for the airconditioning systems within the building. Air intakes are located on the west and north sides of the building and at the roof.

The design of the airconditioning systems includes for filtration of the air supplied to the accommodation, all the fresh air drawn into the building should pass through a filter media. The air filtration provisions are described in more detail in the next section.

The airconditioning systems are designed to maintain a positive pressure within the building relative to outside conditions. This pressurisation minimises the likelihood of infiltration of outdoor air and the consequent ingress of dirt and dust, since the building cannot be hermetically constructed. The use of openable windows will increase the amount of dust entering the building, even with the airconditioning in operation, since the building/room pressurisation will diminish and prevailing wind conditions may force untreated, outdoor air into the room.

5.7.2 Air Filtration Equipment

Virtually all the airconditioning and some of the supply ventilation systems serving the building are provided with a filtration media to remove a certain level of airborne particulates. The standard of the filter media is selected with regard to the function of the accommodation served by the airconditioning system.

The laboratories and animal holding rooms have a relatively higher efficiency filtration, with pre and final filters installed in the airhandling units. Pre-filter efficiency is 25% (ASHRAE 52-76) and the final filter media is 90% (ASHRAE 52-76).

The primary air units (serving fan coil systems) are provided with a cleanable metal mesh media which has a very low filtration efficiency. A secondary filter media will also be located at each fan coil unit, but this would be a washable nylon or metal mesh type, of low efficiency.

The airconditioning filtration systems are already subjected to high airborne particulate concentrations resulting from the close proximity of the building to the Tolo highway and the fresh air intakes for the laboratory airhandling plantrooms face directly toward the highway. As the road becomes more heavily utilised, ambient dust/particulate concentrations will tend to increase. Similarly, construction and use of the reclamation site will increase ambient dust levels as the Fugitive Dust Model detailed in previous section predicts.

The air filtration equipment will continue to operate at the rated efficiency, although the likely distribution of the particulate size in the ambient air cannot be readily determined. The air passing into the building through the primary air/fan-coil airconditioning system will tend to be higher in particulate content than now, due to the very low arrestance capability of the system filter media. Therefore an increase in dust settlement within the administration areas and building entrance lobby is likely to occur.

It is not anticipated that significantly increased passage of particulate through the airconditioning systems serving the second and third floors, since the arrestance and dust holding capabilities of the filtration media are adequate to handle the anticipated increase in load.

The filter media in all air systems through the building will be subjected to increased dust loads and consequently filter maintenance should be more frequent. The filters on the primary air/fan coil systems can be removed for cleaning unless they are to be replaced with a more efficient media to reduce dust ingress. Increased efficiency implies the use of a disposable type media being employed similar to that installed for the second and third floor airconditioning systems.

The filter replacement frequency for the second floor airconditioning system is not only a function of the dust concentrations in the ambient air, but will also depend upon the volume of fresh air handled, since the design of the system appears to allow the fresh air volume to vary. The assessment indicates a decrease of approximately 30% in the time between filter replacement.

The third floor system operates with 100% fresh air supply and therefore it may be anticipated from the predicted dust levels that the time between filter replacement is likely to decrease by approximately 40%.

5.7.3 FDA Standards of Air Cleanliness

It is understood that HKIB research facilities conforming to standards required by the US FDA are to be provided within the building at some time in the near future and these facilities will be purpose constructed at the first or third floor levels in space currently unoccupied.

The standards required by the FDA for clean production facilities are detailed in the document " Guideline On Sterile Drug Products Produced By Aseptic Processing " issued by the FDA (Ref.21). These guidelines stipulate minimum criteria for particulate and microbial air quality within what are termed 'Critical' and 'Controlled' rooms of the facility. To achieve the criteria will entail the treatment of the air supplied to the room(s), the control of air movement from the clean room(s) to the peripheral rooms/zones, the control of entry/exit by personnel and the careful choice of surface materials within the clean room(s).

The presence of airborne microorganisms will not only be attributable to the outdoor air drawn into the airconditioning system, the primary source will be internal and originate from personnel or organic materials within the facility. Organic contaminants present in the outdoor air will take the form of viruses, bacteria, fungus spores and pollen grains and are commonly referred to as bioaerosols. Viruses and bacteria are generally attached to larger particles when airborne and a large proportion will be removed at the first stage filtration.

The reclamation site is primarily intended for the disposal of construction materials which are, on the whole, organically inert; construction timber or other putrescible material should be minimised by the conditions of the dumping licence. Nevertheless, the likely increase of bioaerosols cannot be ruled out, considering the fact that the completed reclamation site will be landscaped and planted, therefore an increase of airborne pollen and spores is possible, but the concentrations of these at any one time in the environment surrounding the HKIB is likely to be seasonal, though unpredictable.

The current filtration standards applied to the airconditioning system at the second floor will provide sufficient protection from the external sources of microorganisms, both at present and also with the future reclamation construction and operation.

The class 100 standard (Critical) stipulated in the FDA guidelines, may not, in the case of HKIB, be a requirement for an entire room. Laminar flow cabinets of class 100 standard located within a 'Controlled' room may suffice for the scale of work being required. The laminar flow cabinets can attain microbial air quality at the work surface of better than the 3.5 colony forming units (CFU) per m^3 required by the FDA.

The adherence to the FDA standards in the accommodation to be constructed for the purpose within the building, will be readily achieved by adherence in the design to recommended planning forms, internal finish materials and an airconditioning/ventilation system which maintains the correct airflow / room pressurisation regime and air filtration. Diagrammatic airflow / filtration schemes are indicated in Figure 5.2 and include the alternative of the use of class 100 laminar flow cabinets. The use of HEPA filtration media is a necessity to achieve the FDA standards and consequently the fluctuation in external air microbial content will not prove to be of any consequence.

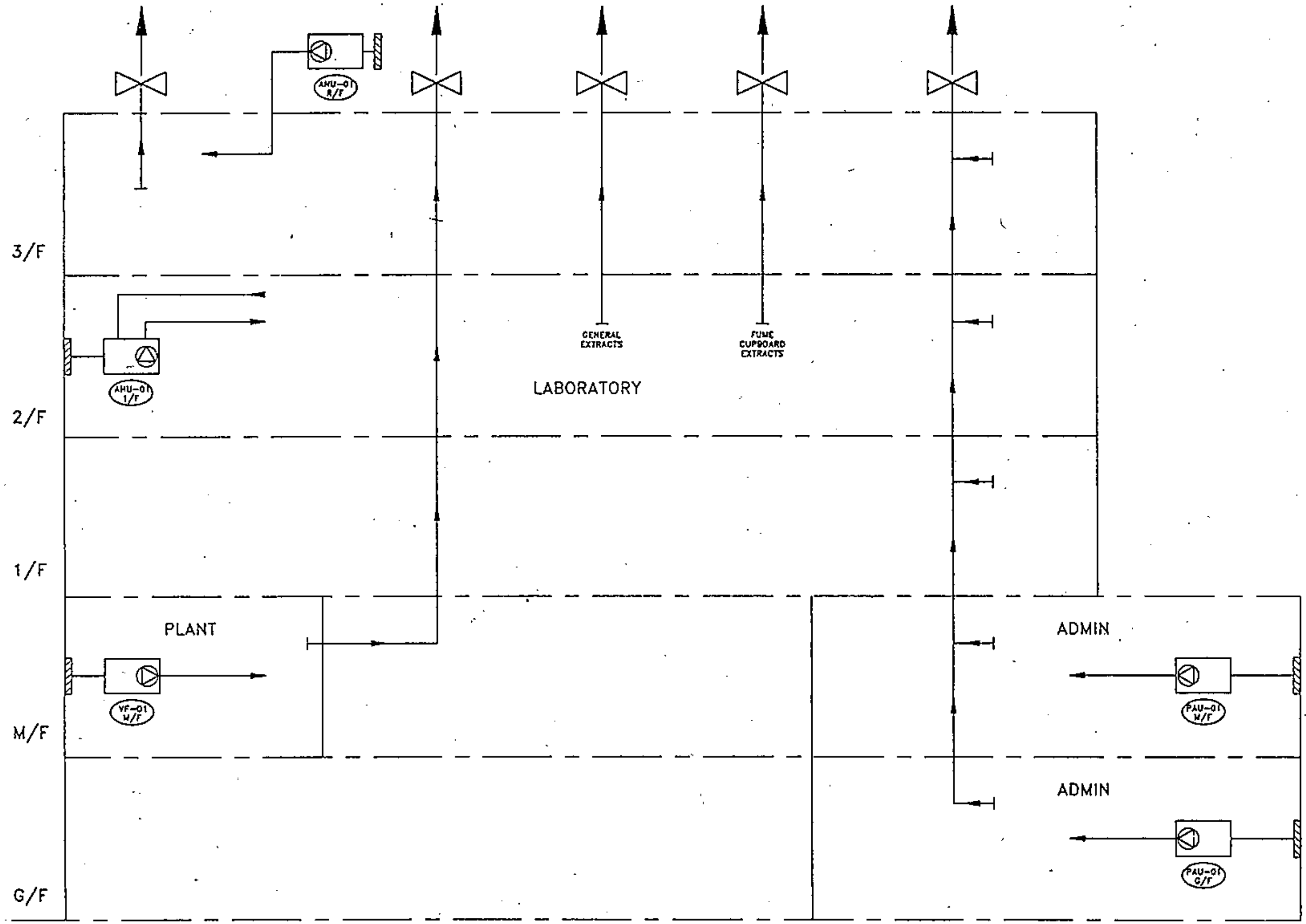
5.7.4 Summary

The Fugitive Dust Model has projected dust levels around the reclamation site. It is predicted that the quantities of airborne particulates in the environment around HKIB will increase above the background although complying with the AQO.

With the present filtration system a greater incidence of the ingress of dust is likely to be experienced within the ground/mezzanine floor office and reception areas. The present dust levels could be maintained by increasing the filter retention capacity, however maintenance of the media will be more frequent.

Similarly, the filter media within the airhandling plants serving the second and third floors will require more frequent maintenance, however it is considered that the level of efficiency of the media is adequate to maintain an acceptable environment within the laboratories for the increased particulate levels anticipated, including any additional bioaerosol loads.

In relation to the introduction of facilities complying with FDA standards, it is considered that there is no reason why the external environment should pose an operational problem if the accommodation of the facility and the airconditioning/ventilation system are correctly designed and properly maintained. Fresh air required for the system should be filtered to a similar standard as the existing laboratory space. Further filtration of fresh and recirculated air is likely to be required before supply to the clean spaces. The extent of the final filtration is primarily dependent on the bioaerosol contamination that may be generated within the space, and will most certainly be HEPA type media to maintain the CFU count to within the FDA standards.



Air Flow Schematic Diagram for The HKIB Building

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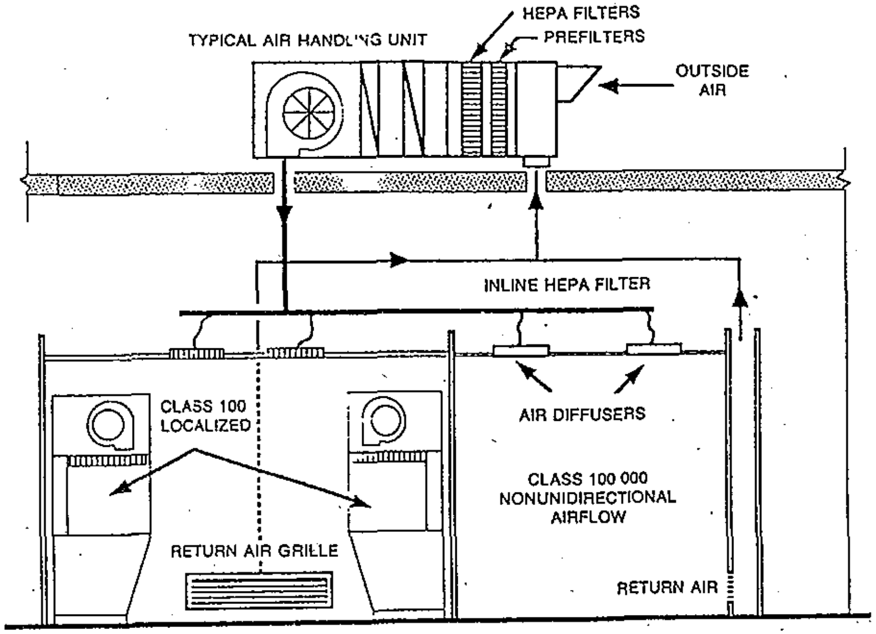
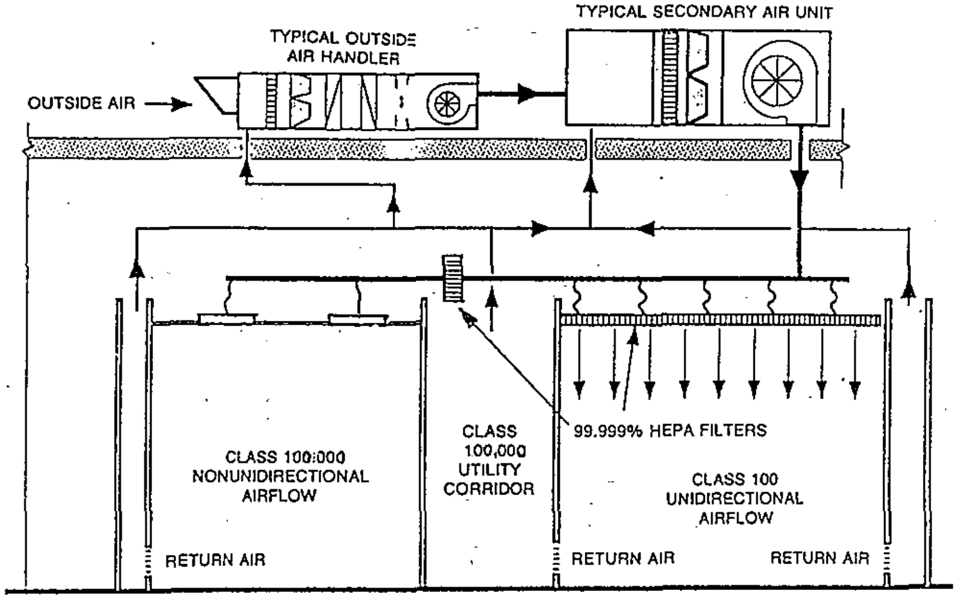
Mouchel

Figure No. 5.1



Non-unidirectional Cleanroom with HEPA Filters Located at Air Handler



Non-unidirectional Cleanrooms with Ducted HEPA Filter Supply Elements

ALTERNATIVE FOR CRITICAL AREA USING LAMINAR FLOW CABINETS

ALTERNATIVE FOR CONTROLLED AREA

STANDARD FOR CONTROLLED AREAS

STANDARD FOR CRITICAL AREAS WHERE WHOLE ROOM MUST COMPLY WITH CLASS 100

Typical Air Handling Arrangements for Clean Areas to Comply with FDA Standards

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Figure No. 5.2

6.0 WATER QUALITY IMPACT

6.1 Introduction

Marine water quality in Hong Kong is managed through the process of assignment of Beneficial Uses (BU) to the WCZ. Associated with the BU are a series of water quality parameters, WQO which are defined numerical values or permissable changes in magnitude. Tolo Harbour was gazetted as a Water Control Zone in April 1987.

The project area lies within the Tolo Harbour WCZ which is itself divided into three sub-zones, Harbour, Buffer and Channel and it is within the Harbour sub-zone that the area is situated. The boundaries between the three sub-zone are shown in Figure 3.2.

The complete range of BU which have been identified (Ref.22) as applicable for Hong Kong marine waters are shown in Table 6.1.

Table 6.1 : Beneficial Uses Applicable to Hong Kong Marine Waters

BU number	Description of BU
BU-1	As a source of food for human consumption.
BU-2	As a resource for commercial fin and shell fisheries.
BU-3	As a habitat for marine life and a resource for human exploitation.
BU-4	For bathing.
BU-5	For secondary contact recreation - diving, sail-board and dinghy sailing.
BU-6	For domestic and industrial purposes.
BU-7	For navigation and shipping including the use of officially approved and endorsed sheltered harbours and typhoon shelters.
BU-8	For aesthetic enjoyment.

Not all BU are applicable to all the presently gazetted Hong Kong WCZ; those which apply to the three marine sub-zones of Tolo Harbour WCZ are given in Table 6.2.

Table 6.2 : Beneficial Uses Applicable to the Marine Waters of the Tolo Harbour WCZ

Beneficial Use	Harbour Sub-zone	Buffer Sub-zone	Channel Sub-zone
BU-1	+	+	+
BU-2	+	+	+
BU-3	+	+	+
BU-4	-	+	+
BU-5	+	+	+
BU-6	+	+	-
BU-7	+	+	+
BU-8	+	+	+

Note: + indicates BU applicable to WCZ and,
- indicates not applicable.

In order to establish standards for the water quality in any zone appropriate to the assigned BU WQO expressed in terms of numerical values have been derived for particular quality parameters. The water quality parameters which are required to be controlled in order to maintain the prescribed BU (Ref. 22) are given in Table 6.3.

Table 6.3 : Marine Water Quality Parameters to be Controlled for Marine Related Beneficial Uses

Parameter	BU-1	BU-2	BU-3	BU-4	BU-5	BU-6	BU-7	BU-8
Aesthetic	-	+	+	+	+	+	+	+
Bacterial	-	-	-	+	+	+	-	-
Dissolved Oxygen	-	+	+	-	_	+	-	-
pH	-	+	+	+	+	+	-	-
Ammonia	-	+	+	-	-	+	-	-
Temperature	-	+	+	-	-	-	-	-
Colour	-	+	+	+	+	+	-	-
Suspended Solids	-	+	+	-	-	+	-	-
Salinity	-	+	+	-	-	-	-	-
Dangerous Substances	-	+	+	+	+	+	-	-

BU-1 is maintained by the application of the quality objective directly to the food substance and not the water from which the food was taken, consequently there are no defined parameters in the marine environment which are controlled.

The proposed construction and operation of the reclamation at PSK which lies at the western end of Tolo Harbour has the potential to bring about changes in water quality during the seawall construction phase, the placement of the waste and following its completion. The changes in water quality which could occur may be sufficiently large as to result in the water quality breaching the Government's prescribed WQO and/or affecting specific users (sensitive receivers) of the marine environment.

Activities which may, to a greater or lesser degree, result in changes in water quality are identified as:

- Dredging existing sediments in preparation of the foundations of the seawalls,
- Placement of material for the construction of the retaining seawalls,
- Disturbance of the existing sediments within the fill areas,
- Placement of the construction waste,
- Modification of the existing hydrodynamic regime along the shoreline modifying the dispersion and dilution of surface, storm water and discharges from the nullah.

The extent of the transport of sediment during the construction phase has been considered by use of a simplified sediment plume model. Specific mitigation measures required to ensure that the environmental impact is minimised and are based on the assessment of the sediment plume study.

Data reported by the EPD (Ref.7,8) together with data from the EPD marine water quality data base and other studies carried out in the area were used to establish the present water and sediment quality.

Where it is indicated that there may be changes in marine water quality these changes are compared with the marine WQO which have been defined by the EPD in the gazetting of the Tolo Harbour WCZ. When there is potential for the objectives to be breached, mitigation measures, either in the form of changes in working practice, phasing of activities or design specification will be required.

6.2 Environmental Standards and Guidelines

6.2.1 Marine Water Quality Objectives

The marine waters of the Tolo Harbour WCZ have been divided into three sub-zones and different WQO have been prescribed for each sub-zone, these are defined in Table 6.4. The WQO prescribed for dissolved oxygen, light penetration and chlorophyll-a become more stringent towards the seaward end of the zone as a whole. This reflects to a large extent the need to control the development of phytoplankton blooms, and in particular the red tides which increased significantly in frequency of occurrence between 1977 and 1988 and has shown a marked decrease over the period 1989-92 (Ref. 12).

Table 6.4 : WQO for the Marine Waters of the Tolo Harbour WCZ (Ref. 9)

Water Quality Parameter	Objective		
	Harbour Sub-zone	**Buffer Sub-zone**	**Channel Sub-zone**
Offensive odour, tints and colours	not to be present	not to be present	not to be present
Visible foam, oil, grease, scum, litter	not to be present	not to be present	not to be present
E.coli (no/100ml;annual geometric mean)	not to exceed 610	not to exceed 610	not to exceed 610
Dissolved Oxygen within 2 m of the bottom	not less than 2 mg/l	not less than 3 mg/l	not less than 4 mg/l
Dissolved Oxygen in remainder of water column	not less than 4 mg/l	not less than 4 mg/l	not less than 4 mg/l
pH change	not to exceed 0.5	not to exceed 0.3	not to exceed 0.1
Salinity change	not to exceed 3 mg/l	not to exceed 3 mg/l	change not to exceed 0.3 mg/l
Temperature Change	absolute change not to exceed 1°C	absolute change not to exceed 1°C	absolute change not to exceed 1°C
Settleable Solids adversely affecting benthic communities or bottom geometry	not to be present	not to be present	not to be present
Light Penetration	not to be reduced by more than 20%	not to be reduced by more than 15%	not to be reduced by more than 10%
Toxicants	not to be present at levels producing significant effects	not to be present at levels producing significant effects	not to be present at levels producing significant effects
Chlorophyll-a (running mean of 5 samples)	not to exceed 20 mg/m^3	not to exceed 10 mg/m^3	not to exceed 6 mg/m^3

The WQO values are generally defined as depth averaged values, unless otherwise specified, annual means or percentiles. However there may be short term, large magnitude concentration differences which may have an impact on sensitive receivers but have little influence on the annual values. The annual range values provided by the EPD give an indication of the extreme values which currently occur.

6.2.2 Quality Objectives for Mariculture

There are mariculture zones located within the Tolo Harbour WCZ (see Figure 3.2). The WQO prescribed for all three sub-zones of the Tolo Harbour WCZ do not include either an absolute or relative value for suspended solids. Suspended solids are controlled by the application of the settleable solids and light penetration parameters. It is appropriate to consider the concentrations of suspended solids which can be tolerated by different marine shell and fin fish. The feeding behaviour of marine filter feeders, such as mussels, are not significantly affected by suspended solids concentrations up to 100 mg/l and good to moderate freshwater fisheries are found in waters with concentrations in the range 25-80 mg/l. In Hong Kong marine waters mariculture is carried out in areas where concentrations are as high as 26 mg/l (Ref.23).

Other parameters which have the potential to affect the quality of the marine water with respect to its use for mariculture, for example dissolved oxygen and ammonia, are taken into account with specific values for the WQO.

6.2.3 Marine Aquarium Use

The MSL of CUHK has a marine water intake which is used to supply its fish and invertebrate stock holding, culture and experimental facilities. The rate of abstraction is variable depending on the level of requirement. Target quality standards for the water at the station's intake have been provided by the laboratory and these are listed in Table 6.5.

Table 6.5 : Quality Objectives for Sea Water to be used by MSL and for Flushing by WSD

Parameter	MSL Target Limit	WSD Flushing Target Limit
Colour (HU)	-	< 20
Secchi Depth (m)	> 2	-
Salinity (ppt)	> 25	-
pH	> 7.5	-
Turbidity (NTU)	-	< 10
Threshold Odour Number	-	< 100
Ammoniacal Nitrogen (mgN/l)	-	< 1
Total Nitrogen (mgN/l)	< 1	-
Total Phosphate (mgP/l)	< 0.1	-
Suspended Solids (mg/l)	< 5	< 10
Dissolved Oxygen (mg/l)	-	> 2
Dissolved Oxygen (% sat)	> 10-30	-
Biochemical Oxygen Demand (mg/l)	< 5	< 10
Synthetic Detergents (mg/l)	-	< 5
Chlorophyll-a (μg/l)	< 10 - 50	-
E. coli (no./100ml)	< 100 - 1000	< 20,000

The MSL has a number of seawater tanks which are open to the atmosphere. Air borne dust generated by the use of the access road may accumulate on the surface of the water in static tanks. Tanks operated in a flow-through mode will not be susceptible.

6.2.4 Water Taken for Flushing

Large parts of Hong Kong are supplied by the Water Supplies Department (WSD) with sea water for toilet flushing. For such water WSD have defined target quality objectives at the point of abstraction; these are also given in Table 6.5.

6.3 Sensitive Receivers

Sensitive receivers are defined as those users of the marine environment whose use of the environment could be impaired as a result of a reduction in quality of the environment. Within Tolo harbour there are a number of sensitive receivers which have been identified (see Figure 3.2). These are :

- Mariculture zones at Yim Tin Tsai, Lo Fu Wat and Three Fathoms Cove,
- The proposed WSD sea water intakes for flushing water at Shatin and Tai Po seafronts due to be commissioned in 1994 and 1995 respectively,
- Sea water intake for the MSL of CUHK,
- Non gazetted bathing beaches at Lung Mei, Hoi Ha, Sha Lan, Yim Tin Tsai and Lok Wo Sha.

6.4 Impact during Construction Phase

Two techniques may be employed during the construction of the seawalls; conventional dredging of compressible sediments followed by backfilling with sand to form the seawall foundations and no dredging methods using in-situ in-depth cement mixing or sand displacement. The latter techniques have not yet been employed in Hong Kong and are still being investigated by GEO to determine the feasibility of such methods. Of the two methods the former has the greater potential for giving rise to deterioration in water quality locally. It is planned that the construction of the Phase 1 seawall will be constructed using dredge techniques due to the lengthy lead time required for the dredge method.

During the initial stages of construction the most significant effects on water quality will result from the dredging of sediment for the formation of the foundations of the seawalls. The impact of these activities are considered in Section 7, Marine Sediment Impact.

During the stage of construction of the foundations for the seawalls sand will be placed in the dredged trench. The first stage will be completed using bottom dumping barges to place sand in the trench, the coarse nature of the sands, the shallow depth and low current speed will result in small losses of fines as a sediment plume. The second stage of core fill and placement of secondary and primary armour rock will also be coarse material which will settle rapidly under the prevailing hydrodynamic conditions.

6.5 Impact during Operation Phase

It has been proposed by CED that the filling of the area bounded by the Phase I seawall be started before the completion of the full length of the Phase I seawall and the construction of the dividing earth bund to -2 mPD which will be constructed between the end of the seawall and the land. The dumping of waste into an open embayment has the potential for loss of both suspended solids and floating debris. It is probable that a similar strategy will be adopted for the subsequent stages of the reclamation which will result in similar potential impacts. It is unlikely that the surface currents over the submerged seawall and the earth bund will be significantly different to those in the absence of the walls and the sediment plume will behave in a similar way to that during dredging.

In order to comply with the present restrictions contained in the CED Dumping Licence the material should be free from marine mud, household refuse, plastic, metal, industrial and chemical waste, animal and vegetable matter and any other material considered unsuitable. Limited amounts of timber may be included mixed with otherwise acceptable material. The material which should be placed in the area behind the seawall creating the reclamation is therefore construction waste which will comprise materials including:

- earth
- building debris, and
- broken rock.

This mixture, while relatively chemically inert, will give rise to a localised area of increased suspended solids while being placed. The absence of the earth bund at the end of Phase 1 and the incomplete closure by seawalls during Phases 2 and 3 will not provide the quiescent conditions which would encourage settling within the walled areas.

It is not the intention to remove the sediments from within the body of the reclamation area, install wick drains or cover the existing sediments with a sand blanket. During the dumping operation the *in situ* sediments will be put into suspension and mixed with the fines contained in the dumped material which will dilute them. However since the area will not be closed there may be loss through the open end of the embayment.

The material placed in the reclamation will contain small amount of discarded construction timber and may also, contain timber removed during site clearance together with other buoyant materials such at packing and thermal insulation materials. All of these will float to the surface following dumping and would under conditions of winds from the second and third quadrants be carried by induced currents and wind effects into the body of Tolo Harbour.

The accidental or otherwise inclusion of contaminated construction waste or quantities of putrescible material in the reclamation may give rise to leachate which could give rise to local deterioration in water quality. Monitoring of water quality adjacent to the Shuen Wan Landfill site (see Section 3.4.2) which receives refuse shows no evidence of adverse effects. It is unlikely therefore that occasional quantities of refuse included in the reclamation will result in deterioration in water quality.

A mitigation measure to reduce dust emissions is proposed by the installation of wheel and under body washing facilities at the exit from the site. Such a procedure will produce an effluent high in suspended solids which may also contain fuel and lubricant hydrocarbons. If allowed to run into the Harbour this would produce a visible sediment plume and possible surface oil film.

On-site plant will be required for handling barged material and for site levelling. This will necessitate on site maintenance and re-fuelling areas giving rise to risk of oil and fuel spillages.

Site facilities will be required for staff managing the site, inspecting loads and directing operations. Toilet and washing facilities will be required which if uncontrolled may discharge or be discharged into the Harbour.

6.6 Post Completion Impacts

As permeable seawalls will be constructed, there will be a movement of water through the reclamation due to precipitation and the effect of tidal rise and fall. This will result in leaching from the fill material. However if the present licensing policy is maintained then the material will be relatively inert and should not give rise to any polluting leachate. A similar site is currently being operated at Ma On Shan and water quality monitoring data for suspended solids and dissolved oxygen relating to its operation have been examined. Dissolved oxygen concentrations on all but one occasion met the WQO. Suspended solids concentrations were consistently high when compared with the historic concentrations at an adjacent EPD monitoring station.

The report of the Restoration of the Shuen Wan Landfill Study (Ref.9) indicates that acute effects on water quality have not been unambiguously observed and that water quality impact of the landfill arises mostly from the release of nitrogen. Analysis of the available monitoring data in Section 3.4.2, indicate no significant effects on water quality. Refuse will not be permitted in the dump and hence it is unlikely that even if small quantities putrescible waste are included there will be no significant leaching of nitrogen compounds into the surrounding waters.

6.7 Mitigation Measures

6.7.1 Construction Phase

The use of bottom dumping barges to place the sand to form the foundations for the seawall under the relatively low tidal velocities in the harbour will limit the formation of a sediment turbidity plume. Placement of seawall core and primary and secondary rock armour by grab from a derrick lighter will not result in a significant sediment plume due to the low proportion of fines contained compared with the dredged sediment. However to minimise the scope for resuspension of the existing sediments the placing of the foundation and fill material must be closely controlled spatially.

6.7.2 Operation Phase

Mitigation measures required during this stage will be required predominantly to minimise the losses of suspended solids and floating debris. The incomplete construction of the seawall, ie. forming a sill below water level, should be avoided since suspended solids will be lost to the harbour over the submerged sill.

The option exists to begin placing of public dump material in the site before completion of the full length of each phase seawall. Placement of the fill will be predominantly by end face tipping from trucks. For the Green Island study modelling of the plume resulting from the fill material assumed that the fines made up 22.5% by volume of the construction waste and that losses from the bottom opening door barges are 3%. Using the same fines content, a loss rate of 5% as provided by EPD, with a dumping rate of 180 m^3/hr (530,000 m^3/yr) in the simple box model used for the dredging plume gives the following figures for a face width of 20 m and a plume width of 100 m.

Table 6.6: Suspended Solids Concentration Increases Downcurrent of the Filling Activities.

Width Averaged Concentration (mg/l)					
Current Speed (m/s)	Plume Average	Face	50 m	75 m	100 m
0.02	28	141	28	14	0
0.05	11	56	18	16	14
0.08	7	35	12	11	11

The current velocities in the region of the face will be low because of the short fetch of the wind and consequently will be less than 0.05 m/s. Concentrations at the end of a 100 m seawall would be expected to be no more than 14 mg/l. The use of a silt screen around the dumping face would be expected to reduce the losses to the surrounding water by a factor of 2.5. This measure would result in a reduction to approximately 5.5 mg/l above background at the end of the wall.

Compliance monitoring carried out at two locations between the end of the seawall and a line perpendicular to the existing shoreline will indicate any increases in concentration; in the event that the water quality Action limit is breached the silt screen should be installed around the tipping face. If shown to be necessary the length of the seawall extended further to retain the plume.

Advection and dispersion and settlement of the suspended solids over the distance between the end of the seawall and the MSL would result in concentrations which were not detectable with respect to the background.

During periods of winds in the second quadrant which occur mostly during the wet season floating debris could be carried out of the area into the harbour. The placement of a suitably protected surface boom supporting a hanging net or skirt around the tipping front would serve to contain any floating material. The area contained by the boom should be cleared on a continuous basis by sampans whenever tipping is in progress and the timber together with any other material, expanded polystyrene, plastics, fibre glass, empty containers etc. disposed of to the closest conventional landfill.

It is recommended that when built the dividing earth bund should be constructed up to +2 mPD in order to control the suspended solid plume during placing of waste and to minimize the escape of floatable materials in this area. In order to allow barge to move in and out of the reclamation area (for bottom dumping) a narrow opening should be allowed between the dividing bund and the seawall, this should be closed with a silt screen when not required for barge access.

Strict application of dumping licences and monitoring of the material placed in the dump should be implemented to control unauthorised material being placed in the dump.

In order to reduce suspended solids and oil discharges from the vehicle washing facility, and also reduce water usage, it is recommended that a recirculation system be used. Settled solids should be disposed of to above ground areas of the reclamation and arrangements made for treatment of oil contaminated wash water or off site disposal.

Fuel tanks on the site should be housed within drainable trays which should be regularly drained of rain water. Vehicle maintenance should be carried out on paved areas, spillages controlled by absorbants 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.

It is not expected that the presence of the reclamation will have any significant effect on the hydrodynamics of Tolo Harbour resulting in alternations of the flushing characteristics. Flushing of the nullah and surface water run-off from Tolo Highway are considered in Section 9 of this report.

Dust accumulation on the water surfaces of exposed seawater tanks at the MSL can be controlled by the general dust mitigation measures applied to the access road, see Section 5.6, together with a specific dust barrier between the MSL and access road.

7.0 MARINE SEDIMENT IMPACT

7.1 Introduction

The construction of seawall for the reclamation may require either removal or stabilisation of marine sediment which is unsuitable as the foundation for the seawall. The latter is being considered by GEO, however it is anticipated that at least part of the seawalls will be built using the dredging method. Dredged sediment need to be disposed of at designated marine dumping grounds. The removal and disposal of sediment may cause impacts on water column which require careful consideration.

This section discuss the environmental impact associated with the dredging and disposal of marine mud. The amount of mud to be dredged has been estimated based on the assumptions that the whole length of seawall will be dredged and a typical sloping seawall will be built. With reference to the sediment quality monitoring results obtained under this study, the proportion of contaminated mud is calculated. Suitable handling and disposal measures for any contaminated sediment are recommended.

7.2 Environmental Standards and Guidelines

Criteria for the classification of sediments based on their degree of contamination have been defined by EPD (Ref. 14). These criteria are given in Table 7.1 together with values typical of background sediments (Ref. 15)

Table 7.1 : Concentrations of Heavy Metals and PCB in Marine Sediments and Boundary Values for EPD Class A,B and C sediments.

		Determinant (mg/kg)						
	Cu	Cd	Cr	Pb	Ni	Zn	Hg	PCB
Background	7	0.05	7	19	10	40	0.07	<0.005
Class A	<55	<1	<50	<65	<35	<150	<0.8	-
Class B	55-64	1.0-1.4	50-79	65-74	35-39	150-190	0.8-0.9	-
Class C	>=65	>=1.5	>=80	>=75	>=40	>=200	>=1.0	-

Class A - Uncontaminated material for which no special dredging, transport or disposal are required.

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.

7.3 Sensitive Receivers

The sensitive receivers within Tolo harbour who may be affected by the release of dredged sediment into the water column are the same as those to be affected by changes in water quality (see Figure 3.2), namely:

- Mariculture zones at Yim Tin Tsai, Lo Fu Wat and Three Fathoms Cover
- The proposed WSD sea water intakes for flushing water at Shatin and Tai Po seafronts due to be commissioned in 1994 and 1995 respectively
- Sea water intake for MSL
- Non Gazetted bathing Beaches at Lung Mei, Hoi Ha, Sha Lan, Yim Tin Tsai and Lok Wo Sha

7.4 Impact during Dredging

7.4.1 Requirement for Dredging

The EPD has concluded from a recently carried out study that a possible solution to the problems posed by the need for removal and disposal of contaminated sediment is to leave them in place and carry out reclamation work on top of them. Consequently the possibility of seawall construction by the use of *in situ* stabilisation techniques, counterfill and drainage is to be investigated as an option to minimise the quantity of contaminated sediment which need to be removed and disposed of from Hong Kong projects as a whole. In which case, if the loading is carried out in a controlled way the sediment is retained *in situ* and is overlain by clean sediments. Such techniques may allow pore water to be retained within the loading medium even further reducing releases to the overlying waters. However such techniques may not be appropriate for this project for technical reasons or reasons of time scale and the more traditional technique of dredging and backfill have been assumed as a worst case situation.

Therefore during the construction of the seawalls it has been considered that the existing sediments will be removed in order to create the foundations for the seawall. Based on an assessment of the quality of the sediment which may need to be removed it is clear that the sediments are contaminated, in particular with lead, to such an extent that they are in Class C. Class C are described as seriously contaminated which must be dredged 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. Class C contaminated sediment can only be disposal of at the contaminated mud dump pit at East Sha Chau.

Dredging of the sediments has the potential release into suspension large quantities of contaminated sediment which will may subsequently impact on the MSL and the marine biotic community in general.

7.4.2 Dredging Method

Various types of dredgers have been used for dredging soft marine sediment which include:

- Cutter suction dredger
- Trailing suction hopper dredger
- Bucket dredger
- Backhoe dredger
- Grab dredger

The following criteria or constraints have been considered in the selection of the appropriate dredging plant for the PSK reclamation project:

- shallow depth of water in the reclamation area
- the close proximity (100m away) of submarine effluent and gas pipelines
- quality of sediment to be dredged
- maximum depth to be dredged

Seabed levels along the line of seawall vary between 4.7 and 7.1 m below the principle datum. These water depths will restrict the use of trailing suction hopper dredgers which are relatively big and require a minimum draught of 7 m. Suction dredgers are considered not appropriate for the PSK reclamation as the sediment to be dredged has to be loosened before it can be drawn into the suction pipe. Contaminants will more easily be released into water column and give rise to deterioration of local water quality. As the sediment is being drawn by pumps, it ends up with sediments with high water content. The discharge of decantrate or overflow containing pollutants in solution and in suspension will have an adverse effect on water quality and should not be permitted with Class C sediments.

Bucket and backhoe dredgers are not close dredging methods and consequently are not appropriate for dredging Class C sediment. Backhoe dredgers are normally restricted for dredging in shallow water. Barge equipped with the biggest backhoe can only dredge up to 5 to 7 m below sea level. As the maximum depth of sediment at PSK is 17.5 m below water, backhoe dredgers are therefore not suitable.

The grab dredger is one of the most common types of mechanical dredger in Hong Kong. Open and close grabs are available for working in different site conditions. Grab can be either pontoon-mounted or fitted to self-propelled hopper vessels but the former is more common. The removed sediments are discharged into barges moored alongside. Grab dredgers are ideally suited to work in confined areas.

Grab dredgers can operate at the required depths at PSK site. The release of pollutants can be minimised by using a close grab. Dredging of sediment with grab results in a very small degree of dilution and therefore avoids the problems of decantrate or overflow. This is also an important consideration in term of transportation cost. Dilution of the sediment will increase the number of barges required and therefore increase the construction cost. Grab dredged sediment tends to cohere better. When the sediment is bottom dumped at the disposal ground, it is less likely to break and therefore can settle more rapidly to the bottom. This is beneficial with respect to reducing environmental impacts at the dumping ground.

With respect to the site constraints at the PSK site and sediment contamination levels, it is considered that the most appropriate method of removing the marine sediment at PSK is by using close grab dredgers loading into bottom dumping barges.

Grab dredgers in Hong Kong are most commonly fitted with 3-18 m^3 grabs. Considering the shallow water depths at the PSK area, it is recommended to use grab dredgers with bucket size of 3 m^3. Grab dredgers of this size will normally have a production rate of about 102 m^3/hr. The size of the barge for transporting sediment to disposal ground should be about 800-1000 m^3 so that there will be sufficient keel clearance when the fully ladened barge is travelling in the area near the effluent and gas pipelines.

7.4.3 Quantity of Different Classes of Sediment to be Removed

The total amount of sediment to be dredged has been estimated and results are presented in Table 2.7. The vertical profile of sediment quality at eleven locations along the alignment of seawall are tabulated in Table 3.22 and also shown in Figure 7.1. With this information and a typical design of the rubble mound seawall, the quantity of different classes of sediment to be removed is calculated.

Table 7.2: Quantity of Class A, B and C Sediment to be Removed (assuming dredging the whole length of seawall)

Category	Volume of Material (m^3)
Class A + B	288,000
Class C	240,000

7.4.4 Sediment Plume Dispersion

The location of the proposed reclamation lies in an area where water depths are of the order of 5 m or less at the landward end of Tolo Harbour. Being at the landward end of a large enclosed bay, it must be expected that tidal water speeds in the area to be reclaimed and in the immediate vicinity will be small with little movement of the water body and thus flushing of the area. At such a distance from the bay/open-sea interface the water movements only provide the local change in tidal volume rather than any major through flow as might be found in an open coastal area

Figures C.2 to C.5 of Appendix C show the simulated water speeds at two points just offshore in the proposed reclamation area taken from a previous 250 m WAHMO model simulation of wet and dry season spring and neap tides. The position of the points, close and far with respect to the MSL, are shown in Figure 3.3. Current speeds are low, in the order of 0.02 m/s or less for each of the different tide types. The flow vectors show that the tidal flow does not reverse through 180° during the tidal cycle as demonstrated in open coastal areas but is almost unidirectional with the flow approximately parallel to the coast in an eastward direction - the exact direction varies according to the tide type. The flow patterns are consistent with the formation of a large, slowly moving circulation in this corner of Tolo Harbour which would tend to carry suspended sediment in the direction of the MSL and the planned Shatin seawater pumping station and away from the mariculture zones as Yim Tin Tsai and the seawater intake at Tai Po.

To examine the water movements in more detail, a float release was simulated just offshore of the area to be reclaimed and tracked for a complete tidal cycle. Figures C.6 to C.9 of Appendix C show the results for the four simulated tide types which show the extent of the small tidally driven water currents. The excursions from the release points, which are in the vicinity of the Phase 1 seawall, during full tidal excursions for dry season spring and neap tides and wet season spring and neap tides are 0.7, 0.6, 0.9 and 1.3 km respectively. The tracks indicate that although the currents are predominantly south of easterly the tracks are not directed southward towards the intake of the MSL or the planned Shatin seawater intake.

For the low water speeds in the area in which dredging will take place, any sediment which is put into suspension should settle unhindered by upwelling of the water body or vertical turbulent exchange which will be very small. The settling velocity for sediment disturbed at the dredging site is expected to be of the order of 1 mm/s as found appropriate in other WAHMO sediment transport model studies. In water depths of approximately 5 m assuming the worst case where sediment is input to the water column at the water surface, the sediment lost would take around 5,000 seconds or 1.4 hours to settle to the sea bed. Assuming that 0.02 m/s is representative of the horizontal tidal currents, sediment lost to suspension could travel up to approximately 100 m before settling to the sea bed.

At the head of Tolo Harbour, it is very likely that wind driven currents will be more important than tidal currents in determining net water movements. It has been found that wind driven currents are typically of the order of 1%-1.5% of the wind speed. Based on an analysis of wind data from Cheung Chau Table 7.3 shows the distribution of wind speeds estimated for wind directions which would drive currents in the same approximate direction as the tidal flows.

Table 7.3: Return Periods of Different Wind Speeds Likely to Enhance Tidal Current Speeds

Wind Direction (°N)	Return Period (years)	Wind Speed (m/s)
270	0.1	6
300	0.1	5
330	0.1	12
270	1	13
300	1	15
330	1	17

The wind data from Cheung Chau may not be fully representative of the inner Tolo harbour area where the local topography may modify wind speeds and directions. The figures given in the table above, however, should be representative of the general magnitude of the wind speeds which could be expected at the site. Assuming a wind driven current equivalent to 1.5% of the wind speed and a settling velocity of 1 mm/s, as for the calculation of tidally driven sediment transport, it could be expected that 10 times per year, wind driven currents could cause sediment losses to travel distances of 500 m to 1 km. During the stronger once per year wind speeds, it is unlikely that dredging operations would continue but, under these wind speeds, wind driven currents could carry sediment in suspension almost 1.5 km. Therefore during the construction of the Phase I seawall the sensitive receivers within the 1 km radius of the site are the MSL and Shatin seawater intakes. During Phase 2 and Phase 3 seawall construction all are outside the radius of travel.

Wind driven currents at the head of a bay, depending on the wind direction, will generally generate water currents in the same direction as the wind near the surface with a return flow near the bed moving in a different direction. The direction of the return flow will depend on the wind direction relative to the coast and it is not a simple matter to predict the net water movements which will result for a given wind. However, the calculations above indicate that, depending on the location of the dredger, the wind driven currents may carry suspended material as far the MSL.

It has been assumed that a grab dredger will be used and that dredging rates will be in the region of 100 m^3/hr. Assuming the dry density of the natural sea bed to be approximately 500 kg/m^3 and sediment losses of the order of 5%, a value which has been used in previous studies, dredging losses would be equivalent to 0.7 kg/s. If under tidal currents alone sediment losses can remain in suspension for approximately 1.5 hours reaching up to a distance of 100 m from the dredging site and assuming the plume is 50 m wide, suspended sediment concentrations averaged over the whole plume area could reach approximately 140 mg/l; concentrations would be higher in the immediate vicinity of the dredger decreasing with distance to fall to zero at the limit of travel of the plume. If a silt screen is used, the sediment losses to the area outwith the screen will be reduced and the concentration of 140 mg/l over the area impacted will be an overestimate. If tidal currents are larger than assumed, or in the presence of wind driven currents, sediment losses would impact a correspondingly larger area but at a reduced averaged concentration. Under the effect of higher wind speeds and consequently higher water currents, concentrations could reduce considerably except if wave action inhibited settling to the sea bed.

Depth and width averaged concentrations for different wind speeds and distances down current of the dredging are given in Table 7.4. The MSL intake lies approximately 400 m from the closest point of the Phase 1 seawall. In conditions of wind speed less than 6 m/s from the fourth quadrant the down current limit of the sediment plume is unlikely to give rise to measurable increases in suspended solids concentrations.

Table 7.4: Suspended Solids Concentration Increases Downstream of Dredging Activities

Wind Speed (m/s)	Width Average Concentration (mg/l)					
	Plume Average	Dredger	50 m	100 m	550 m	1000 m
0	140	350	70	0	0	0
6	25	64	56	50	0	0
12	14	35	27	25	13	0

The elevation of suspended sediment concentrations of 140 mg/l above the current background over the local area is significant. It is not possible to predict wind driven currents in advance and the rate of settling of sediment losses will also depend on any wave activity especially in shallow water which would reduce the effective settling velocity of the sediment losses allowing them to remain is suspension for a longer period of time and hence travel further. It should be expected, however, that for the low speed water currents expected in the area to be dredged, the relatively high suspended sediment concentrations generated will be confined to a limited area.

Average ammoniacal nitrogen concentrations associated with the sediments at TS2 and 3 are 3.3 and 5.6 mg/kg respectively. Assuming instantaneous dilution into a 'depth averaged box' of 10 m width and length directly proportional to current speed, the worst case concentration increase is 0.004 mgN/l. This is not significant when compared with the current background average concentration range of 0.15 - 0.2 mgN/l.

Sulphides in the sediments will be predominantly in the form of the insoluble iron sulphide at the typical pH (> 7.4) and Eh (range -200 to -300 mv) at TS2 and TS3. The worst case instantaneous dilution would give rise to an increase of 91 μgS/l. At the pH, temperature and salinity values in the receiving water the proportion of the sulphide which would be in the undissociated form would be 0.038 giving a concentration in the immediate dilution zone of 3.5 μg/l. Twenty-four hour average maximum concentration limits of un-dissociated hydrogen sulphide of 10 μg/l have been proposed (Ref. 24) for protection of marine life and a value of 40 μg/l for aesthetic considerations. Consequently there is no risk of toxic effects on fish or to sulphurous odours from the water.

Concentrations of the anthropogenic trace organic compounds, PCBs, at stations TS2 and 3 are 0.007 and 0.008 mg/kg which are approximately an order of magnitude lower than the concentrations regarded as characteristic of clean marine sediments (Ref.15). Concentrations of PAH 0.04-0.06 mg/kg are below the value of 0.6 mg/kg described as acceptable (Ref.16) by a similar factor. As such these concentrations adsorbed onto the dispersed sediments are unlikely to give rise to adverse effects on water quality.

Heavy metals in the sediments will be predominantly bound to the finer sediment particles, concentrations in the water mass will therefore be related to the suspended solids concentration and their concentration in the sediment. For the sediment plume modelling it was assumed that all of the sediment dredged and that lost was fine. Using the typical concentrations of metals in the sediments along the line of the seawall (Table 3.12) metal concentrations in the water due to the suspended solids can be calculated. Table 7.5 gives concentrations which would be associated with a 140 mg/l increase in suspended solids.

Table 7.5: Suspended Solids Bound Heavy Metal Concentrations

	Heavy Metal (μg/l)						
	Cu	**Cd**	**Cr**	**Pb**	**Ni**	**Zn**	**Hg**
Concentration at 140 mg/l suspended solids	2.1	0.01	3.5	10.5	2.1	18.2	0.01
UK Marine EQS	5	-	15	25	30	40	-

The concentrations predicted are total (particulate and dissolved) concentrations while the proposed UK Environmental Quality Standard (EQS) values are for the dissolved phase annual average. For all the metals the concentrations in the dissolved phase will be less than the total and will therefore be well below the EQS and will cause no adverse effects on the marine biota.

The sediment released water into the water column during grab dredging and will impose both a biological and chemical oxygen demand within the plume. Oxygen demand of the sediment is determined analytically as COD which can be used as an estimator of the environmental oxygen demand of the disturbed sediment by applying a factor of 0.5 (Ref. 25).

The oxygen demand imposed on the water column is countered by transfer of oxygen across the atmosphere- water interface at a rate which is controlled by the difference between the saturation concentration and the actual concentration in the surface layer of the water column. A suitable model for the rate of transfer is:

$$\frac{dM}{dt} = k\,(Cs - Cw)$$

where:
- M = mass of oxygen (g/m^2)
- t = time (days)
- k = transfer coefficient (m/d)
- Cs = oxygen saturation value (g/m^3)
- Cw = concentration in water (g/m^3)

The value of the k typically used in the WAHMO tidal water quality model is 1.5. Assuming a saturation concentration of 7.1 mg/l and that the upper layer water column dissolved oxygen concentration falls to the WQO value of 4mg/l the maximum transfer capacity is 4.7 g/m^2/d.

Values for COD of 20 g/kg are given in the EPD sediment quality data base for the two locations in inner Tolo Harbour TS2 and TS3 which will give rise to an environmental demand of 10 g/kg. Plume average sediment concentrations under static wind conditions are 140 mg/l equivalent to a surface loading of 700 g/m^2/d which represents an oxygen demand of 7 g/m^2/d which together with the existing background demand rate of 3.9 g/m^2/d exceeds the rate of transfer (4.7 g/m^2/d) at the WQO limit and will give rise to values below the WQO limit of 4 mg/l. With the enlarged plume area during wind speeds of 6 m/s the demand due to the sediments falls to 1.25 g/m^2/d but when added to the existing background gives a total demand of 5.2 g/m^2/d which will result in the concentration falling to 3.7 mg/l, still below the WQO. The use of a sealed grab within a silt screen will reduce the suspended solids oxygen demand by a factor of 5 and so reduce the areal demand to 4.2 g/m^2/d. Consequently the oxygen concentration will reach 4.3 mg/l which meets the WQO of 4 mg/l and the targets for the MSL and WSD given in Table 6.5.

7.5 Transport and Disposal of Marine Sediment

7.5.1 Transport of Sediment to Disposal Ground

Care should be taken during transportation in order not to lose any material during transit. Sediment could be lost from barges due to:

- Leakage through bottom doors
- Slopping overboard in the case of overloading
- Material washed off the deck
- Short dumping where the sediment is dumped prior to the designated dumping ground in order to save time and costs.

All precautionary measure must be taken when transporting contaminated sediment which will include:

- Good housekeeping to ensure barges are not overloaded and to avoid wash-off and slopping.
- The use of purpose built bottom dumping barge fitted with water tight doors to prevent leakage.
- An automatic self monitoring system should be installed on board the barges able to monitor and record the identity and position of the barge and specific parameters such as date, time and duration of any dump operation to prevent short dumping.

7.5.2 Disposal of Sediment

For Classes A and B sediment, the sediment can be disposed of at the gazetted marine dumping ground at Ninepins Islands. Class C contaminated sediment should be disposed of at East Sha Chau or other area approved by EPD.

It is recommended that the discharge of sediment at the designated dumping grounds should be by bottom dumping. This method allows a large volume of mud to be released in a short-time and reach the seabed without collapsing minimising the loss of pollutants from the descending sediment cloud.

7.6 Mitigation Measures

Silt screens should be used to contain the sediment losses during dredging which will serve to reduce the concentrations of suspended solids and the oxygen sag down current of the dredger. Monitoring of the dredging operation should be carried out to ensure that local sensitive receivers are not adversely affected by the sediment losses.

Since the sediments overlying the base deposits fall into the EPD Classes B and C at various depths through the sediment column there is a requirement for special dredging, transport and disposal methods over and above those which would normally be applied for the purpose of ensuring compliance with the EPD WQO. In the event that dredging is required the works should be carried out using a sealed grab and a silt curtain as shown in Figure 7.2 to retain the fine sediments disturbed and released to the water column during the raising of the grab. The receiving barges must not be allowed to overflow. The use of a silt screen around the immediate grabbing area extending downwards to the sediment will confine the losses allowing settling back to the sediment surface over a relatively small area. If necessary, the dredging rate may have to reduce in order to further limit the impact of sediment plume on adjacent sensitive users.

The MSL currently has the facility to operate water treatment processes prior to the use of the water in the laboratory. The processes which have been described by the officer-in-charge of the laboratory as being available are:

- Physical sedimentation in a settling tank;
- Biological Filtration containing *Nitrosomonas* spp.;
- Sand filtration;
- Disinfection by ultra violet irradiation and ozone.

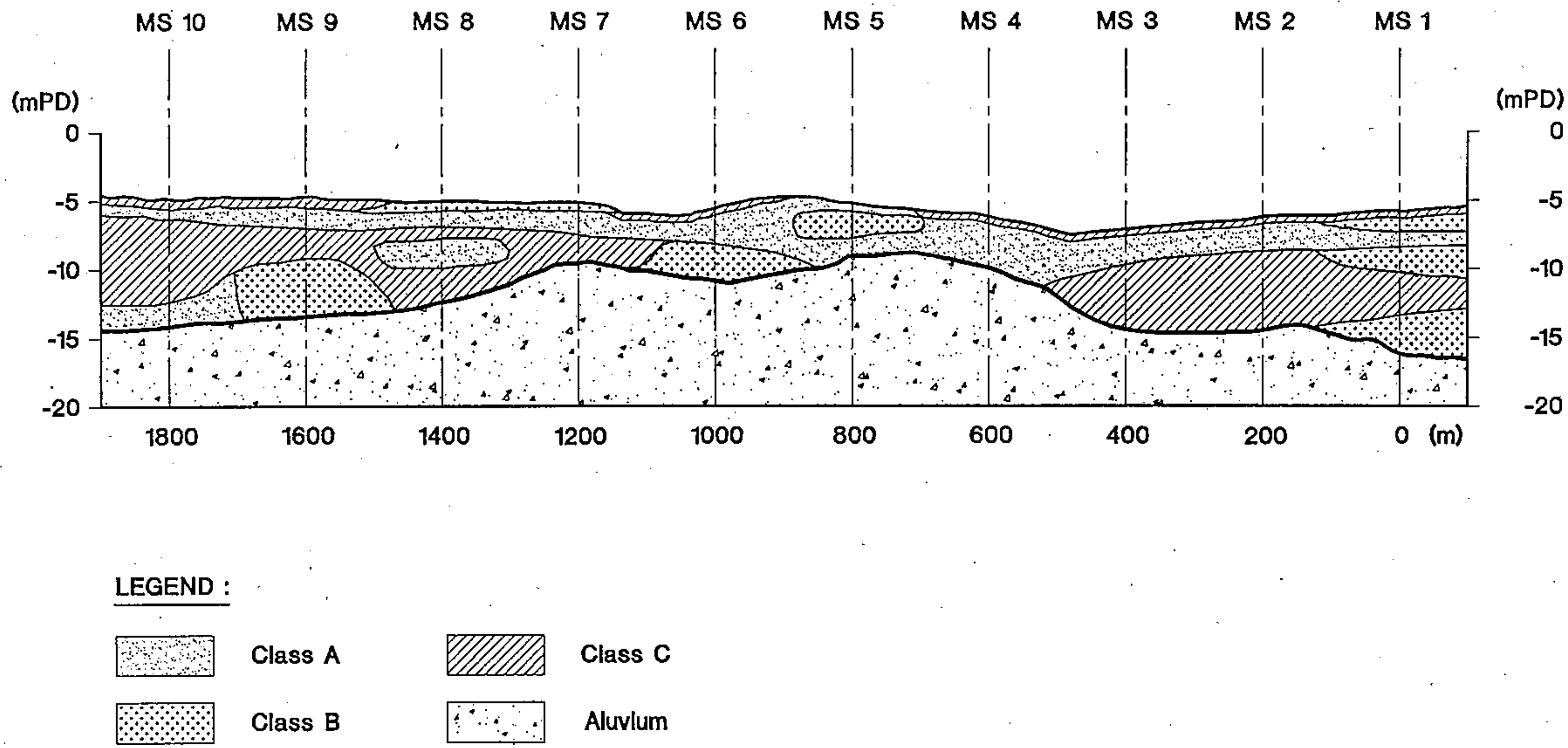
The presence of *Nitrosomonas* spp in the biological filtration matrix will mediate oxidation of dissolved ammonia to nitrite. *Nitrobacter* spp. will also be present in the filters naturally and will convert nitrite to nitrate.

The sediment plume modelling indicates that even without suitable containment there will not be elevated levels of suspended solids in the area of the MSL intake. The use of a compliance monitoring station adjacent to the intake will provide suitable monitoring for deterioration in quality.

The disposal of sediments to the marine environment by surface dumping creates a large plume of fine sediments which may be carried away from the dump site in the direction of the prevailing current. In this case the sediments in the project area have been identified as Class C with respect to lead and consequently can only be disposed of at the Sha Chau containment site. The spoil should be bottom dumped in the prepared trench and covered evenly with clean sand by sprinkling to prevent instabilities resulting from uneven loading and finally capped with a layer of clean mud. Full compliance with the licence terms in particular those controlling short dumping bearing in mind the distance between the project area and Sha Chau must be monitored and audited.

Strict observance of the operating procedures prescribed for the placement of contaminated sediments will minimise possible losses of sediment both during and following placement of the contaminated material.

The possibility for construction of the retaining seawalls following stabilisation techniques, counterfill and drainage would reduce the quantity of contaminated sediment which would need to be disposed of.

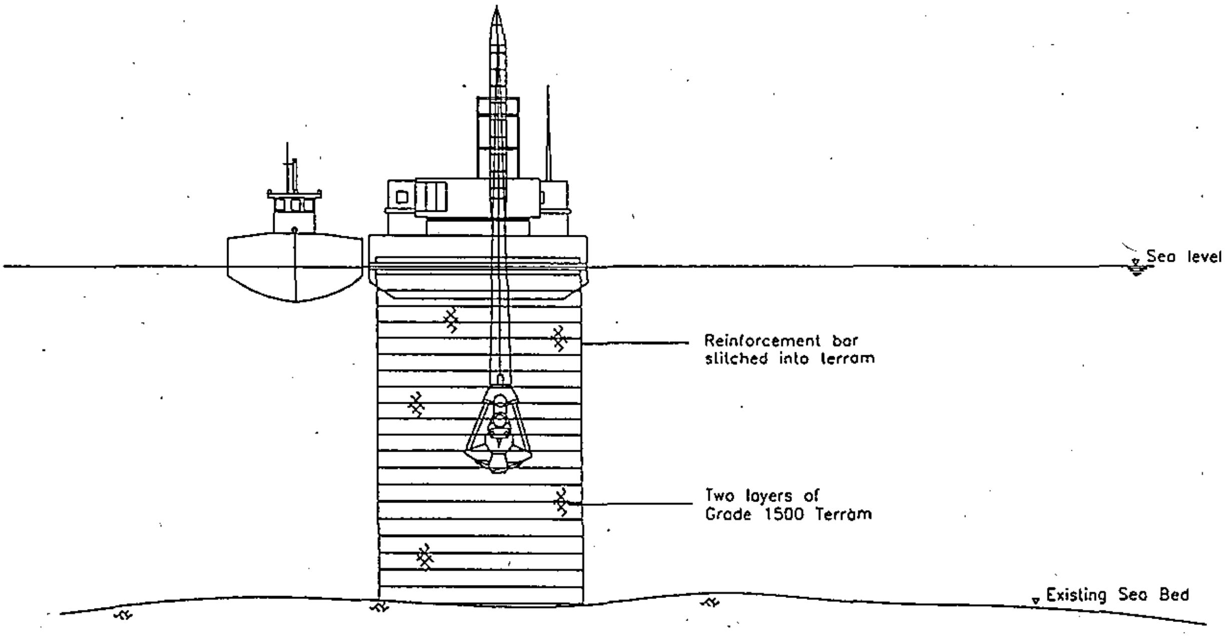


Marine Sediment Classification along the Line of Seawall

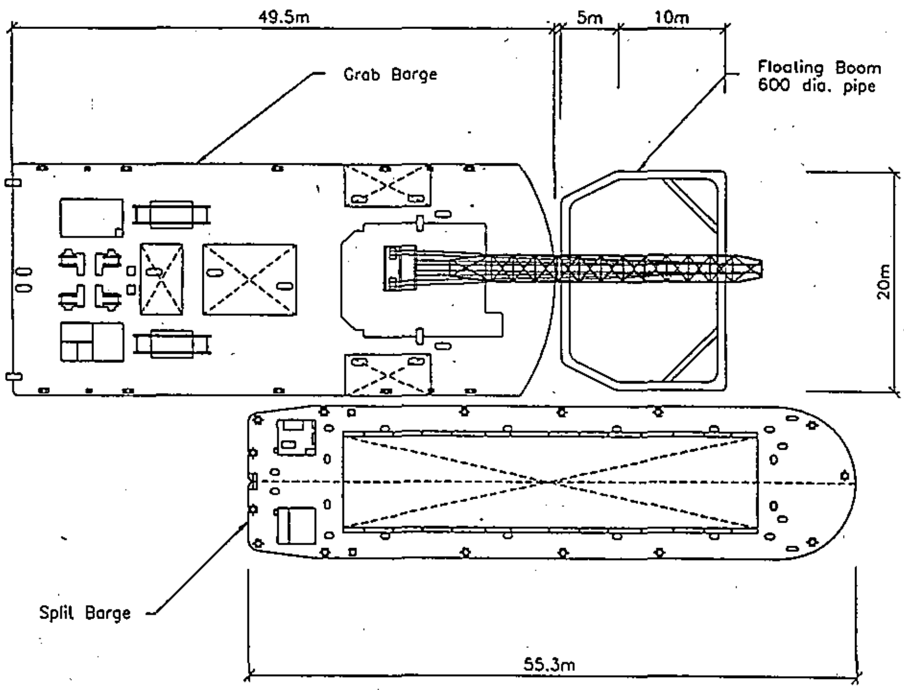
May 1994

Mouchel

Figure No. 7.1



Front Elevation



Plan

Grab Dredging with Silt Curtain

May 1994

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Figure No 7.2

8.0 VISUAL IMPACT AND LAND USE

8.1 Visual Impact

8.1.1 Introduction

This section of the report identifies:

(a) Potential visual impacts which will be experienced during the construction and operational phases of the reclamation;

(b) Landscape mitigation measures;

(c) Residual visual impacts after implementation of the mitigation measures.

8.1.2 Assessment Methodology

The visual impact of the proposed reclamation is assessed by :

(a) Investigation of the landscape context of the reclamation site in terms of the surrounding topography, vegetation, land use and landscape character;

(b) Identification of the major zones of visual influence of the site;

(c) Identification of the potential visual receptors who will be affected by the reclamation;

(d) Synthesis of the above information leading to a comparative evaluation of the visual impacts.

(a) Landscape Context

(i) Topography

The reclamation site is located on the southern side of Tolo Harbour midway between Tai Po and Shatin new town developments. The landscape of the study area can be described as a large natural harbour almost entirely surrounded by a dramatic back drop of mountains (see Figure 8.1)

Pat Sin Leng and Plover Cove Country Park in the north, Tai Mo Shan and Shing Mun Country Park in the west and Ma On Shan and Sai Kung in the east each have summits rising above 600 m.

The coastline between Tai Po in the north and Wu Kai Sha in the east is man made, resulting from extensive land reclamation in the area.

(ii) Vegetation

Figure 8.2 illustrates the major areas of vegetation types. The hillslopes directly south-west of the reclamation are predominantly covered in woodland and tall shrub. A small area of low shrubland is located adjacent to the northern end of the site. A few clumps of trees are located at intervals between Tolo Highway and the cycle track. Grass and low scrub covers the adjacent reclaimed land which has not been developed yet.

There are no areas of ecological interest adjacent to the site, however several "proposed and existing SSSI's" and also "other areas of ecological interest" are located within the Tolo Harbour area (see Figure 8.3).

(iii) Land Use

The existing land use in the vicinity of the site is illustrated in Figures 8.3 and 8.4. The land use is described in greater detail in Section 8.2. Most of the surrounding area comprises Country Park and grass and scrubland/woodland.

Adjacent areas are designated as Government, Institution and Community facilities (GI/C), Vacant Development Land and areas where construction is in progress.

(iv) Landscape Character

The local landscape is dominated by natural features such as the mountains and the natural harbour. Man's impact is restricted to narrow areas around the periphery of the harbour. The most predominant man made features are the residential and industrial estate at Tai Po and Ma On Shan reclamation areas, and to a lesser extent, the CUHK and adjacent traditional village settlements.

(b) Zone of Visual Influence

Figure 8.5 illustrates the zone of visual influence of the reclamation site. This zone has been identified through a mixture of site investigation and desktop analysis of local and regional topographical and vegetation patterns.

In line with other visual impact studies in Hong Kong, a 3 km radius has been taken as the maximum extent of the primary zone of visual influence. Beyond this distance it is considered that visual impact becomes secondary and relatively insignificant. Within the 3 km radius, the area of visibility is further restricted by existing landform, vegetation and buildings of the surrounding landscape.

Having identified the zone of visual influence, it is possible to identify the potential visual receptors or groups of visual receptors within this zone.

The principle potential vantage points within the primary zone of visual influence can be summarised as follows :

(i) Views experienced from the North

- From Sha Lan Village on Yim Tin Tsai peninsula
- From Tai Po Industrial Estate
- From Pat Sin Leng Country Park

(ii) Views experienced from the North West

- From Tai Po New Town
- From the KCR
- From Tolo Highway northbound and southbound lanes
- From Tai Po to Shatin Cycle Track

(iii) Views experienced from the West

- From the proposed residential development on Tai Po Town Lot No. 135 (previous St. Christopher's Home) and the Villa Castell residential area
- From Cheung Shue Tan traditional village
- From the KCR
- From Tolo Highway northbound and southbound lanes
- From Tai Po to Sha Tin Cycle Track
- From Tai Po Kau Country Park

(iv) Views experienced from the South

- From CUHK main campus
- From the KCR
- From Tolo Highway northbound and southbound lanes
- From Tai Po to Shatin Cycle Track

(v) Views experienced from the South East

- From the CUHK campus (Staff accommodation, the HKIB and MSL)
- From the Water Sports Centre (CUHK)
- From Ma Liu Shiu Ferry Pier

(vi) Views from the East

- From Ma On Shan residential area
- From Wu Kai Sha residential area
- From Ma On Shan Country Park
- From Tolo Harbour

(c) Sensitive Visual Receptors

For the purposes of this study, the potential visual receptors may be grouped into four main categories which are listed below. The relative sensitivity of these receptors and the context of potential visual intrusion associated with the reclamation is assessed in Sections 8.1.3 and 8.1.4.

(i) Those who view the reclamation from their homes;

This category of visual receptors is considered to be the most affected by any visual intrusion associated with the reclamation. This is because the attractiveness, or otherwise, of the outlook from the home will have a very significant affect on the home dwellers' perception of the quality and acceptability of their home environment and their general quality of life.

(ii) Those who view the reclamation from their workplace;

This category of visual receptors is considered to be relatively less affected by potential visual intrusion than those in the first category. This is because they are employed in activities where visual outlook plays a less important, although still significant, role in the perception of the quality of the working environment.

(iii) Those who view the reclamation whilst taking part in an outdoor leisure activity;

This category of visual receptors is considered more or less sensitive according to the type of activity being enjoyed. Football players, for example, are usually less concerned with the quality of their surrounding environment than hill walkers.

(iv) Those who view the reclamation whilst travelling along a public thoroughfare.

The degree of sensitivity of these receptors depends to a large extent on the speed of travel and whether the view is continuous or occasionally glimpsed. Generally, the slower the speed of travel and the more continuous the viewing experience becomes then the greater the degree of sensitivity.

The significance of the visual influence on the visual receptors may vary greatly and is considered to be dependent on the complex inter-relationship of a number of factors including :

- Nature of the development and its compatibility with the surrounding landscape;
- Number of visual receptors;
- Category or type of visual receptors;
- Distance of the visual receptor from the reclamation site;
- Length of time the reclamation is in view;
- Landscape context of the reclamation;
- Particular visual backdrop to the reclamation site from specific important view points;
- Whether the reclamation blocks attractive views or screens unattractive ones.

8.1.3 Potential Visual Impacts During the Construction Phase

The visible components within the site area during the construction phase will comprise :

- Proposed realigned road Option 1A
- Seawall
- Associated construction vehicles, machinery and temporary site buildings.

The visible components outwith the site area during the construction phase will comprise suspended sediments in the water seen as a discolouration and clouding of the sea water. As dredging will be carried out within a silt curtain, the sediment plume should be restricted within the dredging area. This impact is considered insignificant.

Construction activity within the site will be concentrated in some areas while other parts of the site may remain visually undisturbed for a longer period of time.

The visual impacts experienced within the study area during the construction phase are summarised in Table 8.1. Figures 8.6 to 8.12 compare the existing views with sketches of the proposed views of the reclamation site.

Negative visual impacts during the construction phase will be experienced by:

- HKIB building and its staff accommodation tower;
- Students lectures and workers at the CUHK main campus in particular where taller buildings emerge above the tree canopy at the main campus site area;
- Residents at the proposed 12 and 6 storey residential apartment blocks at Tai Po Town Lot No. 135 (previous St. Christopher's Home) in the west;
- Cyclists using the cycle track in both directions adjacent to the site;
- People using the Water Sports Centre;
- People using Ma Liu Shiu Ferry Pier and the Tap Mun Ferry;
- Motorists and passengers travelling in the southbound lane of Tolo Highway towards Shatin adjacent to the site;
- Passengers on the KCR travelling in both directions where the line runs adjacent to the site boundary.

Negative visual impacts will also be experienced by the following receptors but to a lesser degree:

- residents at the 2 storey houses of the proposed residential development at Tai Po Town Lot No. 135;
- residents at Cheung Shue Tan and Wong Nai Fai traditional villages.

The woodland context of each of these latter two groups of visual receptors restricts views out towards the reclamation area.

Views from the western facing apartments at the edge of Ma On Shan residential area will also experience a negative visual impact. However, because of the distance from the site and the relatively small scale of the works within the larger landscape context, the impact will not be so great.

Visual impacts experienced from other areas are relatively minor.

8.1.4 Potential Visual Impacts During the Operational Phase

The visible components within the site area during the operational phase will comprise :

- Proposed realigned access road Option 1A
- Seawall
- Reclaimed land
- Associated construction vehicles, machinery and temporary site building
- Dust particles

Beyond the site area, the visible components during the operational phase will comprise areas affected by airborne dust particles. With the mitigation measures implemented, this impact should be relatively small.

The potential visual impacts experienced within the study area during the operational phase are also summarised in Table 8.1 and Figures 8.6 to 8.12.

Table 8.1: Summary of Potential Visual Impact Assessment, during Construction and Operational Phases

Location and Context of Potential Visual Receptor	Ref. Figure	Type of visual Receptor	No. of Receptors	Comment	Potential Visibility		Significance of Potential	
					Construction Phase	Operational Phase	Construction Phase	Operational Phase
i) Views from the North								
a. Sha Lan Village, Yim Tin Tsai Peninisula	Fig. 8.6	Residents	Few, constant	Stationary	OO,DV,LL	OO,DV,LL	1	1
b. Tai Po Industrial Estate	-	Workers	Few, constant	Stationary	OO,DV,IL	OO,DV,IL	1	1
c. Pat Sin Leng Country Park	-	Recreators on foot	Very few, occasionally	In slow motion	OO,DV,HL	OO,DV,HL	1	2
ii) Views from the North-West								
a. Tai Po New Town	Fig. 8.7	Residents and workers	Many, constant	Stationary	OO,DV,IL	OO,DV,IL	1	2
b. KCR	Fig. 8.7	Passengers	Many, often	In fast motion	PO,IV,LL	MO,IV,LL	2 (M1)	3 (M2)
c. Tolo Highway Northbound	-	Motorists and passengers	Many, often	In fast motion	PO,NV,LL	PO,NV,LL	2 (M1)	2 (M1)
d. Tolo Highway Southbound	-	Motorists and passengers	Many, often	In fast motion	OO,NV,LL	OO,NV,LL	3 (M2)	4 (M2)
e. Cycle Track	-	Recreators on bicycle	Moderate, occasionally	In motion	OO,NV,LL	OO,NV,LL	4	5 (M4)
iii) Views from the West								
a. Proposed Residential at Lot No. 135	Fig. 8.8	Residents	Moderate	Stationary	MO,IV,IL	MO,IV,IL	4	4
b. Cheung Shue Tan Traditional Village	Fig. 8.8	Residents	Few	Stationary	MO,IV,IL	MO,IV,IL	2	3
c. KCR	Fig. 8.9	Passengers	Many, often	In fast motion	MO,IV,LL	MO,IV,LL	1 (M1)	1 (M1)
d. Tolo Highway Northbound	-	Motorists and passengers	Many, often	In fast motion	MO,NV,LL	MO,NV,LL	2 (M1)	2 (M1)
e. Tolo Highway Southbound	-	Motorists and passengers	Many, often	In fast motion	PO,NV,LL	PO,NV,LL	4 (M2)	4 (M2)
f. Cycle Track	-	Recreators on bicycle	Few, occasionally	In motion	OO,NV,LL	OO,NV,LL	4	5 (M4)
g. Tai Po Kau Country Park	-	Recreators on foot	Few, occasionally	In slow motion	OO,DV,HL	OO,DV,HL	1	2
iv) Views from the South								
a. Chinese University Campus	Fig 8.10,8.11	Students and lecturers	Many, often	Stationary	PO,IV,IL	PO,IV,IL	4	4
b. KCR	-	Passengers	Many, often	In fast motion	OO,NV,LL	OO,NV,LL	3 (M2)	3 (M2)
c. Tolo Highway Northbound	-	Motorists and passengers	Many, often	In fast motion	MO,NV,LL	MO,NV,LL	2 (M1)	2 (M1)
d. Tolo Highway Southbound	-	Motorists and passengers	Many, often	In fast motion	OO,NV,LL	OO,NV,LL	4 (M2)	4 (M2)
e. Cycle Track	-	Recreators on bicycle	Few, occasionally	In motion	OO,NV,LL	OO,NV,LL	5	5 (M4)
v) Views from the South-East								
a. Chinese University Campus	-	Students, lecturers, workers	Many, constant	Stationary	OO,NV,LL	OO,NV,LL	4	4
b. Water Sports Centre	-	Recreators on land	Moderate, occasionally	Stationary	OO,NV,LL	OO,NV,LL	4 (M2)	4 (M2)
c. Ma Liu Shui Ferry Pier	-	Recreators on land	Moderate, occasionally	Stationary	OO,NV,LL	OO,NV,LL	4 (M2)	4 (M2)
vi) Views from the East								
a. Ma On Shan Residential Area	Fig. 8.12	Residents	Many, constant	Stationary	OO,IV,IL	CO,IV,IL	2 (M1)	3 (M2)
b. Wu Kai Sha Residential Area	-	Residents	Many, constant	Stationary	OO,DV,IL	OO,DV,IL	1	1
c. Ma On Shan Country Park	-	Recreators on foot	Few, occasionally	In slow motion	OO,DV,HL	OO,DV,HL	1	1
d. Tolo Harbour	-	Recreators on boat/ferry	Moderate, often	Stationary	OO,NV,HL	OO,NV,HL	2(M1)	3 (M2)

Notes: 1. Significance of Impact: 1 Very Minor Impact; 2 Minor Impact; 3 Moderate Impact; 4 High Impact; 5 Very High Impact

2. OO Full View; PO Partially Obscured; MO Mostly Obscured; DV Distant View; IV Intermediate; NV Near View; HL High Level; IL Intermediate Level; LL Low Level

The potential visual impacts during the operational phase will be experienced by the same receptors as the construction phase.

Negative visual impacts will be experienced to a lesser degree by :

- residents of the proposed 2 storey houses and lower floors of the towers at Tai Po Town Lot No. 135 (previous St. Christopher's Home), and Cheung Shue Tan traditional village;
- residents from the western facing apartments at the outer edge of Ma On Shan residential area.

Visual impacts experienced from other areas are relatively minor.

8.1.5 Assessment Results

The findings of the visual impact assessment demonstrate that the site will be visible from many areas of the study area during both the construction phase and the operational phase. However, the significance of many of these views will be relatively minor from the North, North-west, East because :

(a) Tolo Harbour creates a large physical divide between many of the groups of receptors and the proposed reclamation. This in turn reduces the visual significance of the site within the larger landscape context. Furthermore the frequent atmospheric haze reduces visibility, in particular over long stretches of water.

(b) From low lying viewing points the visible portion of the reclamation will be seen as a thin strip which will be no greater in thickness than the visible portion of the existing seawall.

The significant visual degradation will be experienced from locations in the intermediate and near distances at the North-west, West, South and South-east. In particular, views experienced from :

(i) the CUHK campus including the HKIB, MSL and the staff accommodation

(ii) the proposed 6 and 12 storey residential blocks on Tai Po Town Lot No. 135 (previous St. Christopher's Home);

(iii) the cycle track

(iv) the southbound lane of Tolo Highway

(v) the Water Sports Centre, Ma Liu Shiu Ferry Pier and the Tap Mun Ferry

The visual impacts during the operational phase are broadly similar to the impacts experienced during the construction phase, but will be slightly greater. The visible component during the operational phase will increase in size as the land is reclaimed. This will have more significance to receptors who view the site from above. Progressive restoration of the completed areas will reduce the degree of visual intrusion of the site.

In the short term, the realigned road access Option 1A will have a greater visual impact than Option 1 when experienced from the CUHK staff accommodation towers and HKIB because of the increased extent of the reclamation. The visual impact will decrease once the proposed planting matures in height. In the long term the realigned Option 1A access road will have less visual impact compared with the original Option 1 alignment.

Cyclists using the Tai Po to Shatin cycle track are considered very sensitive visual receptors. This is partly because they are participating in a leisure activity and therefore have much higher visual and experiential expectations compared with the motorists and passengers using the KCR and Tolo Highway; and also because the cyclists are travelling more slowly and will suffer the negative impact for a longer time period compared with those using the KCR and Tolo Highway.

Similarly, HKIB and its staff accommodation directly adjacent to the reclamation are considered very sensitive receptors. The students and lecturers who live in the Campus overlooking the reclamation will also be affected.

8.1.6 Landscape Mitigation Measures

The visual degradation has been considered above and several key groups of receptors identified. The landscape mitigation proposal is based on the findings of this assessment and aims to mitigate the visual degradation experienced by these groups of visual receptors wherever practicable.

The proposal is shown in Figures 8.13 and 8.14 and described below:

(a) Landscape Mitigation Measures Implemented During the Construction Phase

(i) A continuous 2 m wide belt of shrub and tree planting along both sides of the realigned access road (Option 1A) in order to screen the access road from views from the east (from Ma On Shan residential area, boats and ferries in the vicinity) and views from the west (from the Water Sports Centre, Ma Liu Shiu Ferry Pier, the MSL, the HKIB and its staff accommodation towers, the cycle track, Tolo Highway and the KCR)

(ii) A visual buffer comprising a 3 metre high earth mound planted with trees and shrubs between realigned access road (Option 1A) and the HKIB staff accommodation towers

(iii) A continuous temporary hoarding painted a sympathetic colour to the surrounding environment, along the western edge of the reclamation and along the access road, in order to screen views from the cycle track, Tolo Highway and the KCR. This will provide a temporary visual screen from the outset until the planting buffer grows in height

(iv) a continuous belt of ornamental shrub planting along the full length of the proposed reclamation and access road, in between Tolo Highway and the cycle track, in order to visually mitigate the increased awareness of Tolo Highway experienced by bicyclists on the Shatin to Tai Po cycle track.

(b) Landscape Mitigation Measures Implemented During the Operational Phase

(i) A 3 metre high earth mound planted with trees and shrubs, at the southern boundary to help mitigate views from the HKIB and its staff accommodation tower

(ii) A continuous belt of shrub planting at the western edge of the reclamation between the hoarding and the cycle track in order to create a green buffer which will eventually grow taller than the hoarding.

The principal landscape element drawing cyclists along the cycle track is the waterfront. The removal of the waterfront will be an acute loss and will be exaggerated by the increased awareness of the proximity of Tolo Highway.

The landscape mitigation proposal therefore states that a strip of ornamental shrub planting should be provided along the full length of the proposed reclamation and access road, in between Tolo Highway and the cycle track.

The residual impacts during both construction and operational phases which will also be experienced after the mitigation measures are in place, however, it is expected to be minimal. The residue impacts are summarised below :

(i) From the cycle track along entire length adjacent to the site;

(ii) From the CUHK Campus and in particular the associated HKIB at its staff accommodation tower in the south-east;

(iii) From the proposed residential 6 and 12 storey apartment blocks on Tai Po Town Lot No. 135 in the west;

(iv) From recreation boats, yachts and passenger ferries in the vicinity.

8.2 Land Use

8.2.1 Introduction

This section assesses the impact of the reclamation on the existing and likely future land uses in proximity to the proposed reclamation which may be affected during the construction and operation phases.

8.2.2 Statutory and Non-Statutory Planning Proposals Affecting the Site

The proposed reclamation site adjoins Tai Po Outline Zoning Plan (OZP) No. S/TP/6 (See Figure 8.14), Shatin OZP No. S/ST/5 and Shatin New Town Areas 47B and 68 (Ma Liu Shui) Layout Plan No. L/ST 68/4. The site is located next to the Tolo Highway, a portion of the KCR and a large vacant land reserve known as Planning Area No. 39. The reserve is currently designated "Undetermined" and Government proposes to designate the land for Government/Institutional Community (G/IC) and recreation. Residential use for vacant land has been ruled out because of unacceptable traffic implications. The reclamation site itself is not demarcated on the OZPs and no planning intention for the area has been specified. According to Shatin OZP No. S/ST/5, Ma Liu Shui area is mainly occupied by the CUHK currently zoned for G/IC development. Land use along the coast of Ma Liu Shui comprises G/IC facilities, including the CUHK staff quarters, the HKIB, the Water Sports Centre and the Ma Liu Shui Ferry Pier.

Other uses in close proximity to the subject site include low density residential (R(C)), village development (V), green belt (GB), recreation priority area (RPA) and the Tai Po Kau Nature Reserve is located to the south of the planning area where urban development is not permitted. A Section 16 application for comprehensive recreation and residential development comprising 464 residential units within the RPA was approved in 1990. Completion of the development is currently anticipated by 1997/98.

There are two sites adjacent to the proposed reclamation zoned as Comprehensive Redevelopment Areas (CRA). The intention of the CRA zoning is to discourage fragmentation and piece-meal development which may conflict with the overall low density and rural character for the area. A Section 16 planning application for each area has been approved for residential group C (R(C)). The proposal incorporates 12, 6 and 2 storey residential blocks and various recreational facilities. Implementation is currently expected to be completed by 1997/98.

The reclamation area is separated from the PSK area by Tolo Highway. This separation of land uses may provide opportunities for a range of uses other than those currently zoned in the adjoining areas.

The Tai Po New Town Outline Development Plan (ODP) No. D/TP/A is a non-statutory planning document covering the same area as the OZP. The general zoning for the ODP is comparable to the OZP.

In the north-western part of Planning Area 12, two small sites zoned G/IC in the ODP are zoned R(C) in the OZP. Within the same Planning Area in Tsiu Hang, some sites zoned R(3) and G/IC in the ODP are designated as Comprehensive Redevelopment Areas. Zoning in other areas near PSK is largely the same. On the whole, the differences of zoning between the two town plans are not significant.

The PSK area west of the Tolo Highway has no land use designation while the area west of the Highway is zoned "Undetermined". Planning Department have advised that the current planning intention for the area west of the highway is to reserve the area for G/IC or recreation uses. About 8 to 10 hectares of land was required by CUHK for long term physical expansion. Architectural Services Department are currently contemplating use of 5 hectares of this site for the provision of sporting facilities for teaching purposes associated with Hong Kong Institute of Education. The majority of the area to the west of the railway alignment is zoned as a Country Conservation Area (CCA) reflecting Government's planning intention to conserve the area's natural environment. Village Development Areas (VDA) have been designated to maintain the rural character of the area. These include the existing villages of Po Min and Cheung Shue Tan. The purpose of the designation is to restructure the random village layout to include some community facilities and provide better access. Growing demand for low density residential property in the area is expected relating to the upgrading of Tai Po Road. This is reflected in the number of applications for residential development which have been submitted. Current planning intentions, however, are to retain the low density and rural character of areas in proximity to the reclamation site.

Several low density residential zones (R3) have been designated in Planning Area 12. This again reflects the growing demand for residential property in the area and has been made possible by the recent improvements to the road network. This will be enhanced by the future improvement of Tai Po road which links Tai Po New Town with the CUHK.

A G/IC site has also been designated to provide community facilities for the forecast increase in population for the area. No specific facilities have been specified for the site.

Planning Department has appointed consultants to review and update the NENT Development Strategy and the Interim Development Strategy was completed in mid 1993. The main emphasis of the Interim Strategy was the containment of urban growth and the conservation and enhancement of recreational areas and areas of natural beauty. This planning intention should be reflected where practicable in the appreciation of land use impacts resulting from the implementation and after-use of the reclamation site.

8.2.3 Potential Impact on Land Use During the Construction Phase

After the review of statutory and non-statutory planning framework for the land uses in the study area, a number of existing and planned land uses in the vicinity of the reclamation have been identified which may be affected by the construction of the reclamation.

The existing land uses are:

(a) CUHK campus and its associated staff quarters;

(b) HKIB and the MSL;

(c) St Christopher's Home;

(d) Water Sports Centre (CUHK) of Hong Kong;

(e) Ma Liu Shui Ferry Pier;

(f) segment of cycle track and footpath which is located adjacent to the proposed reclamation site;

(g) existing and proposed low density residential development and village clusters which adjoin the proposed reclamation site.

The planned land uses are:

(a) proposed residential development on the current site of St. Christopher's Home;

(b) intended G/IC or recreational development and the expansion of CUHK to PSK Bay which will be sandwiched between the Tolo Highway and KCR. It is doubtful whether the proposed residential developments were made with cognisance of the proposed reclamation.

The construction of the proposed reclamation will have a negative impact upon the existing and planned land uses in the vicinity of the reclamation site. However, the extend of impact will depend on the implementation programme of these projects or development.

Should the development of anticipated recreational provision of Area 38 be undertaken promptly this may conflict with the enjoyment of the area. At the moment no timetable exists for the development of the site for G/IC and recreational facilities although Government has expressed a clear planning intention in this regard.

The existing cycle track and footpath adjacent to the Tolo Highway will be affected by the reclamation in term of visual impacts. After the implementation of landscape proposal, the extent of impact will be reduced.

During the construction of Phases 2 and 3 seawalls minor visual and noise impacts may be suffered by proposed residential development at St. Christopher's Home which is anticipated to be completion by 1997/98 and which are to be constructed on CRA sites located to the west of the reclamation. Impacts are not anticipated to be substantial. Only the high rise blocks will have direct line of sight to the reclamation.

Importation of fill material by road would spread impacts to the south of the site. Large haulage vehicles would produce noise and dust impacts to buildings associated with the University which include staff accommodation, MSL the Water Sports Centre. Delivery of fill material by barge would impose fairly nominal impacts.

The construction of Phases 2 and 3 seawalls will likely be occurred subsequent to the implementation of residential and recreational development anticipated to the west of the site. However, the anticipated noise levels should be within acceptable noise standards. Greater impacts are more likely to be experienced by residents of CUHK staff quarters located south of Phase 1 of the reclamation. Staff quarters and HKIB will be exposed to visual impacts related to dredging operations. HKIB is not considered to be sensitive to noise impact.

The construction of the seawall is unlikely to have substantial impacts to amenity other than transient impacts on visual amenity. No piling is anticipated in connection with seawall construction. At present implementation is envisaged in stages, which will have the effect of spreading possible impacts over a longer period than would be the case if the project were implemented as a single phase. The phasing of development away from the CUHK staff quarters will, however, have the benefit of ensuring that site works become progressively district from this sensitive receiver.

8.2.4 Potential Impacts on Land Use During the Operation Phase

Reclamation material will consist of graded building rubble. Nor organic material is anticipated. Odour impacts will be virtually absent. Conversely, more significant impacts are likely to arise from the delivery and grading of fill delivered to site. Delivery will be via a combination of barge and vehicular transport. Review of present statutory planning proposals and current approved plans indicates the following identifiable impacts to present and likely future land use in the vicinity of the proposed reclamation.

(a) The deposit and grading of reclamation material will create adverse noise impacts and effects during times of operation staff quarters of HKIB. With the realignment of access road (Option 1A) further seaward, the impact will reduce significant and should be within the acceptable noise standard.

(b) During the operation of the reclamation, dust will be generated by the transport and placing of fill material. The HKIB and CUHK staff quarters are likely to be affected. However, if the recommended mitigation measures are strictly implemented, the impacts will be reduced to acceptable level except for exceptionally high background dust.

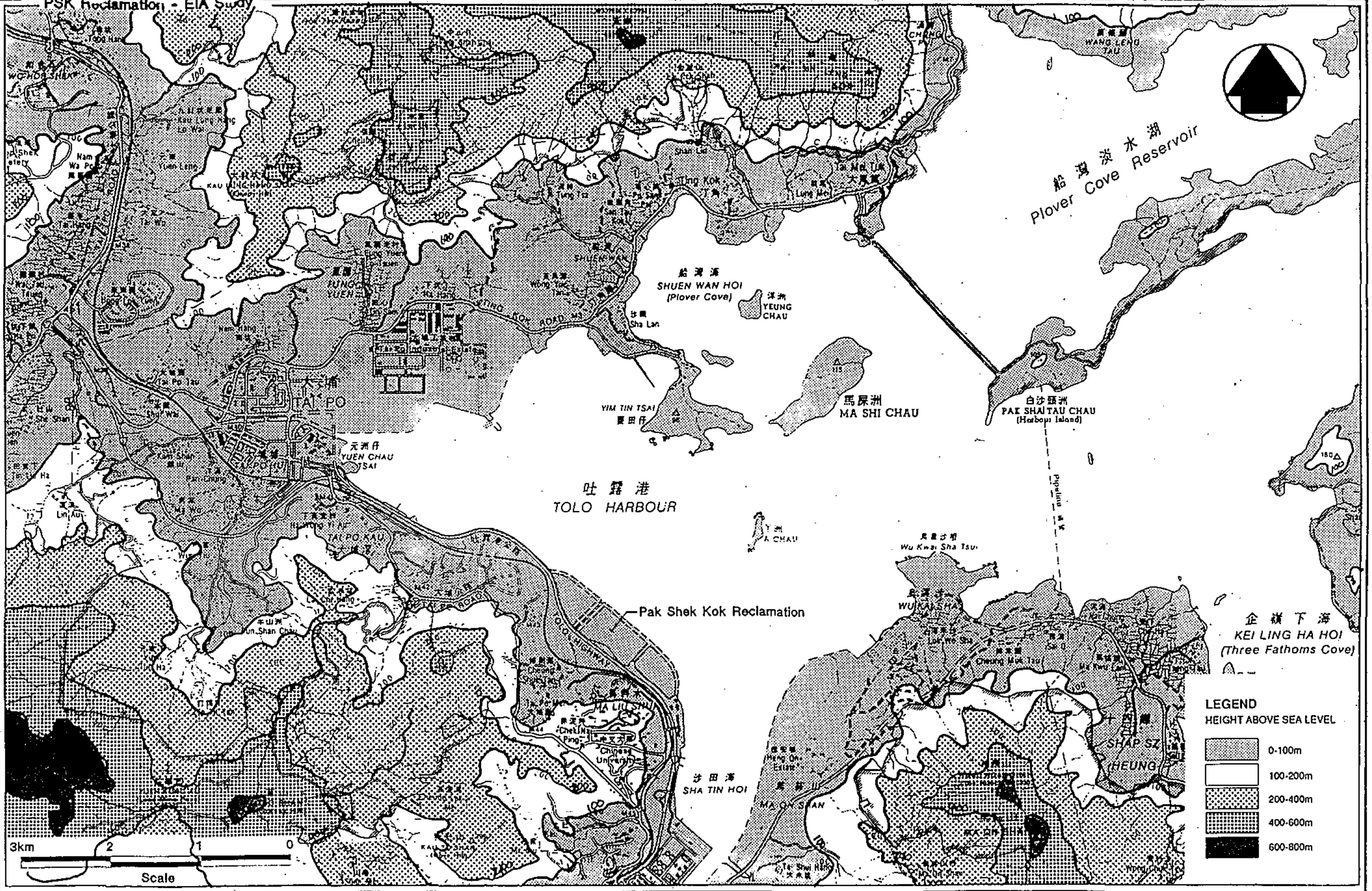
The spread of impacts will inevitably be linked to degree and intensity of operations linked to the implementation of the reclamation. Impacts to existing village development and to residential and recreational development proposed for completion in 1997/98 are likely to be confined to visual impacts.

The timescale currently envisaged for proposed future development within proximity to the reclamation may mean broader, impacts are avoided if the reclamation is implemented early. By and large the scale of development anticipated on adjacent sites and the advantages of distance attenuation are likely to confine the effects of the reclamation to visual impacts. Overall, it is present sensitive uses adjacent to the reclamation rather than future planned are envisaged land use which will be adversely affected by implementation of the reclamation.

8.2.5 Summary and Conclusion

Land use impacts from the deposit and grading of fill material will have direct impacts to the amenity and function of land uses adjacent to the reclamation. These include the CUHK staff quarters, research and lecture facilities. The spread of impacts will inevitably be linked to degree and intensity of operations associated with the reclamation. Impacts to existing village development and to residential and recreational development proposed for completion in 1997/98 are likely to be confined to visual impacts and possible dust impacts.

The timescale currently envisaged for proposed future development in proximity to the proposed reclamation may mean broader impacts are avoided if the reclamation is completed early. By and large the scale of development anticipated on adjacent sites and the advantages of distance attenuation are likely to confine the effects of the reclamation to visual impacts. Overall, it is present sensitive uses adjacent to the reclamation rather than future planned land use which will be adversely affected by implementation of the reclamation.



Topography

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Figure No. 8.1

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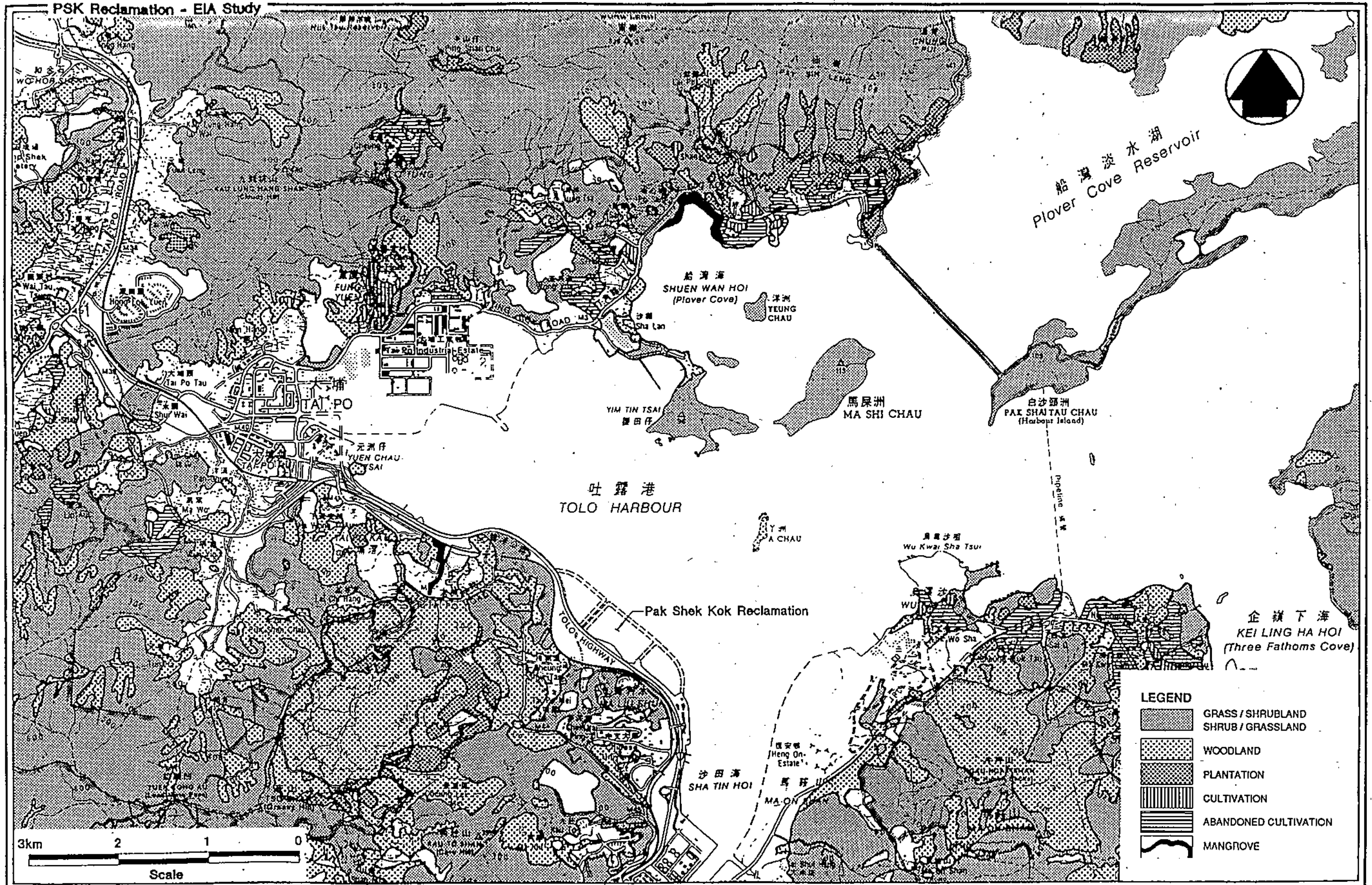

Vegetation

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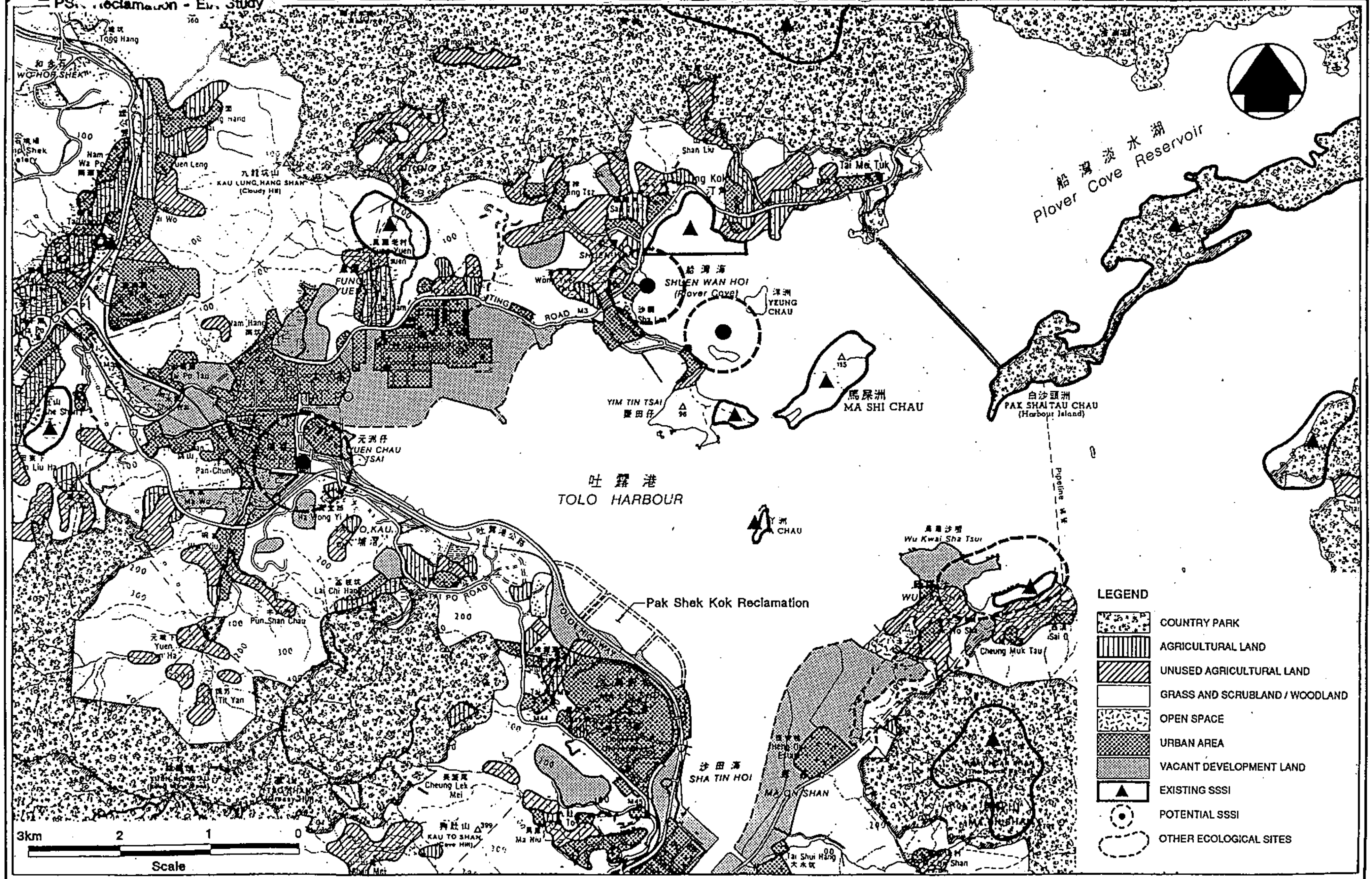
May 1994

Figure No. 8.2



Land Use

May 1994

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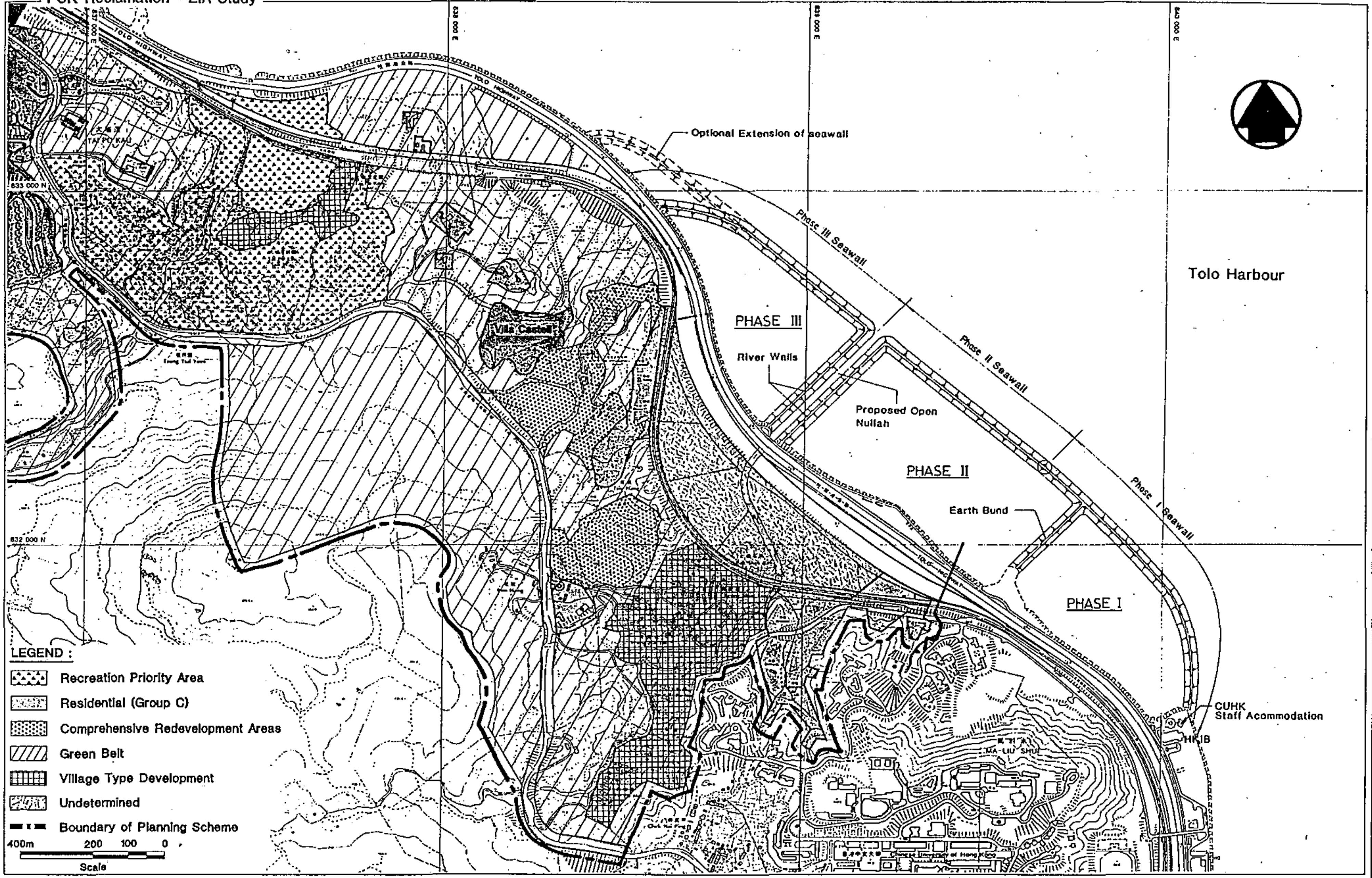
Figure No. 8.3



Tai Po - Outline Zoning Plan

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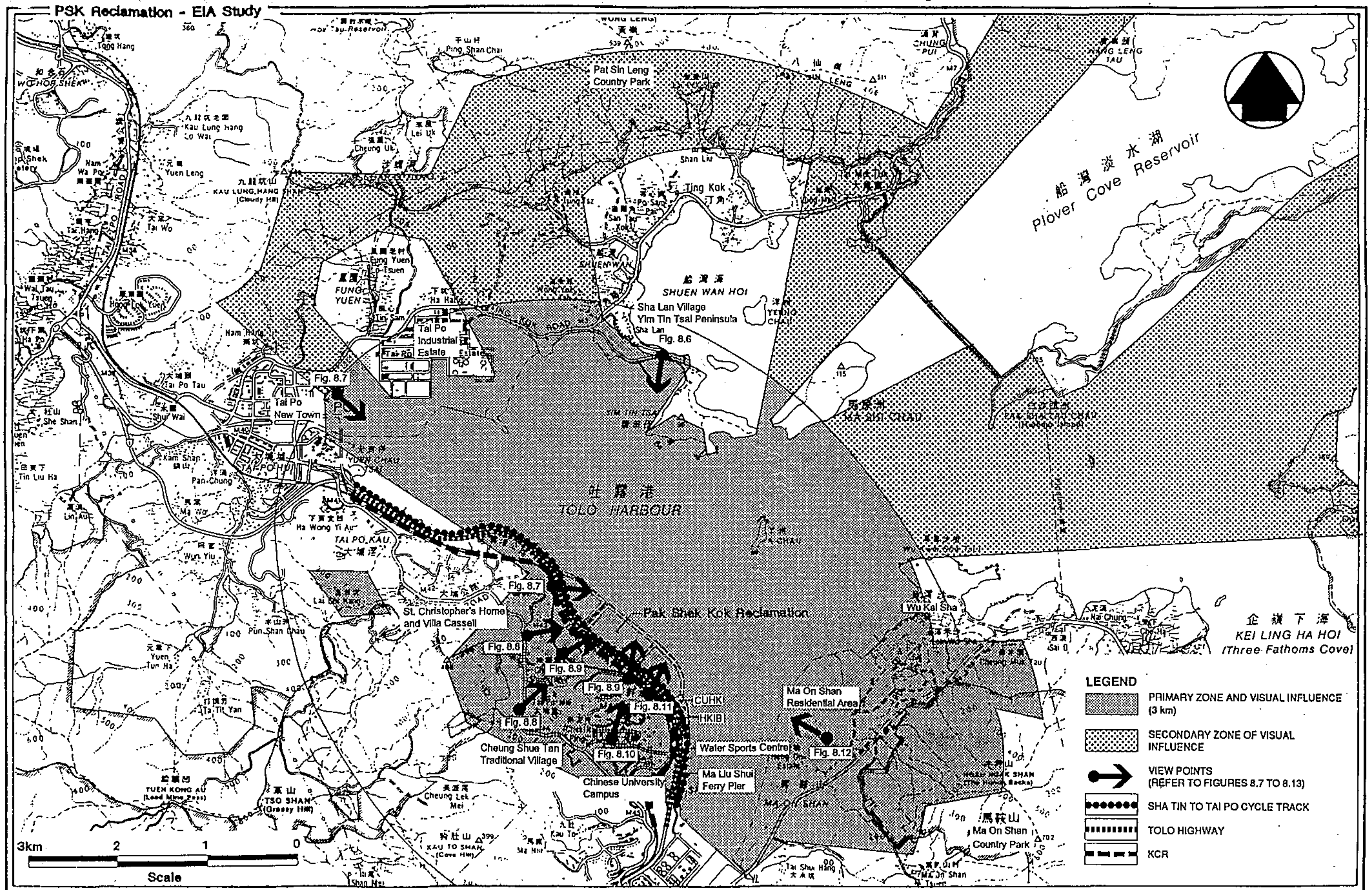
Figure No. 8.4



Zone of Visual Influence

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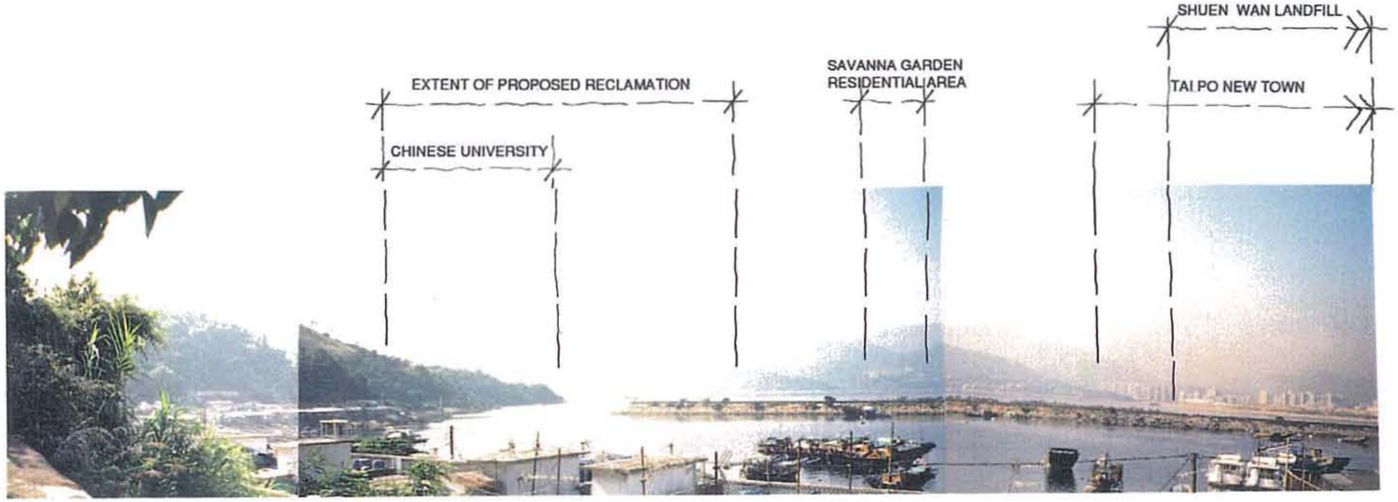
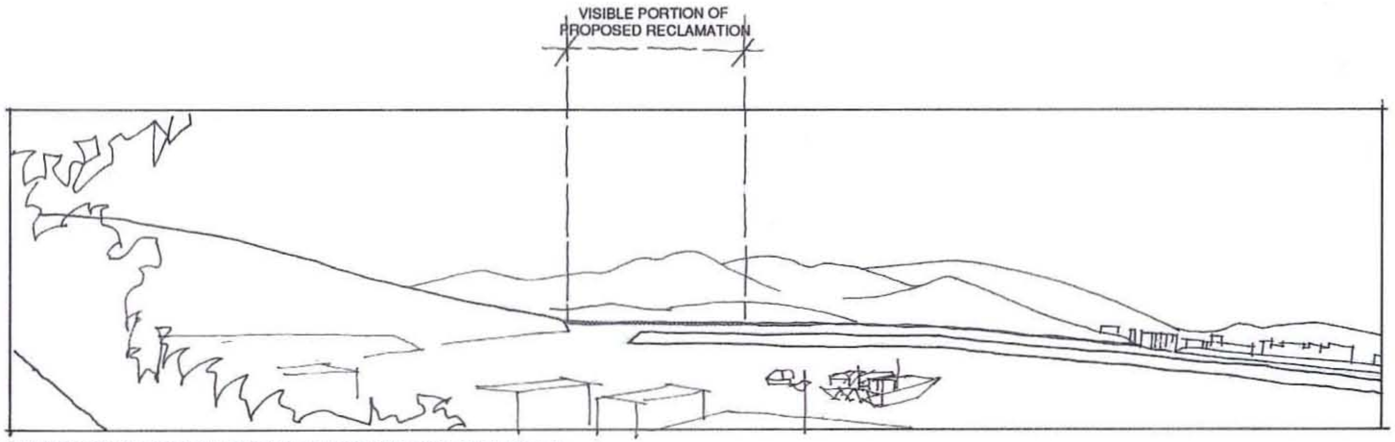
May 1994

Figure No. 8.5



EXISTING VIEW FROM YIM TIN TSAI PENINSULA



SKETCH OF PROPOSED VIEW FROM YIM TIN TSAI PENINSULA

Existing and Proposed Views from the North : Sha Lan Village (Yim Tin Tsai Peninsula)

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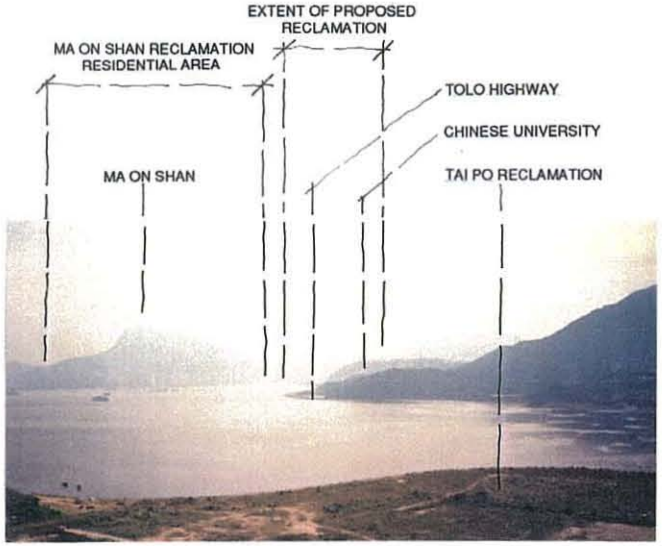
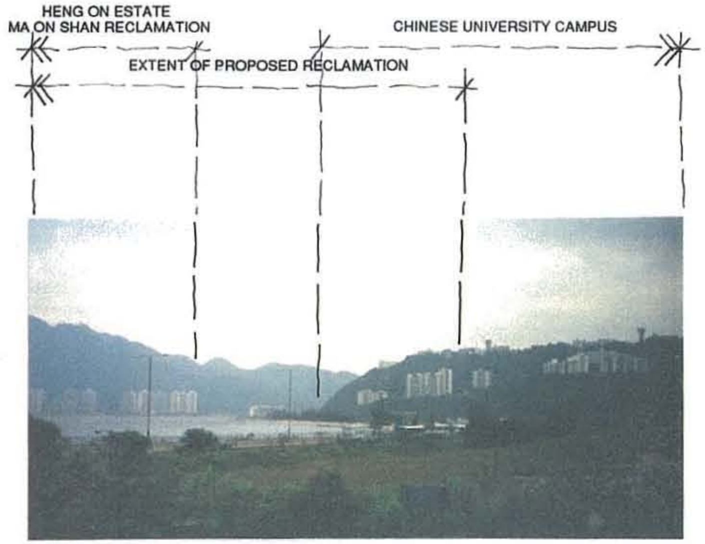
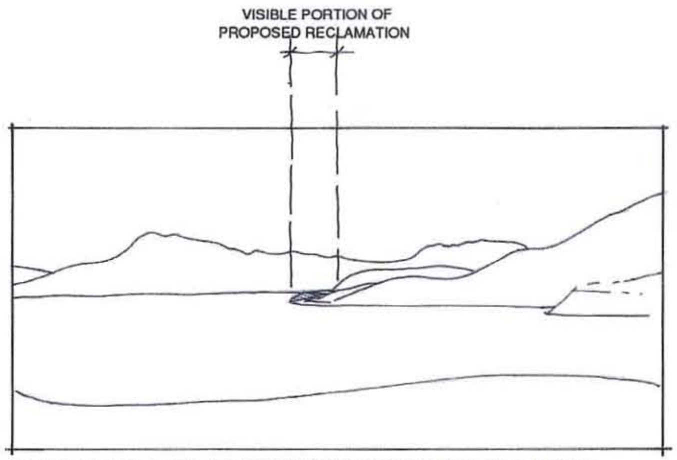
Figure No. 8.6



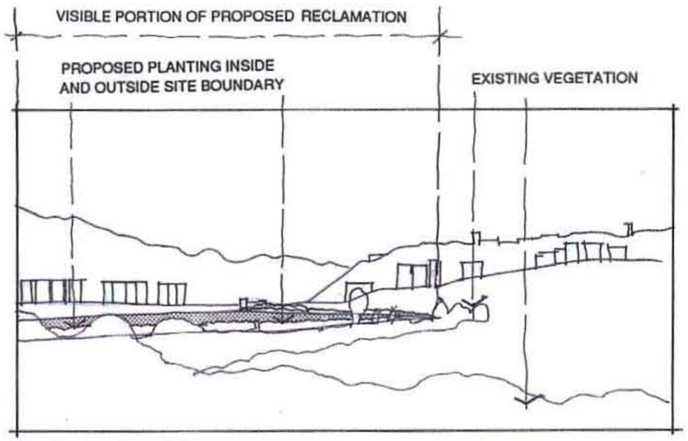
EXISTING VIEW FROM TAI PO RESIDENTIAL TOWER



EXISTING VIEW FROM KCR SOUTHBOUND



SKETCH OF PROPOSED VIEW FROM TAI PO RESIDENTIAL TOWER



SKETCH OF PROPOSED VIEW FROM SOUTHBOUND

Existing and Proposed Views from the North West :
Tai Po New Town / KCR Southbound

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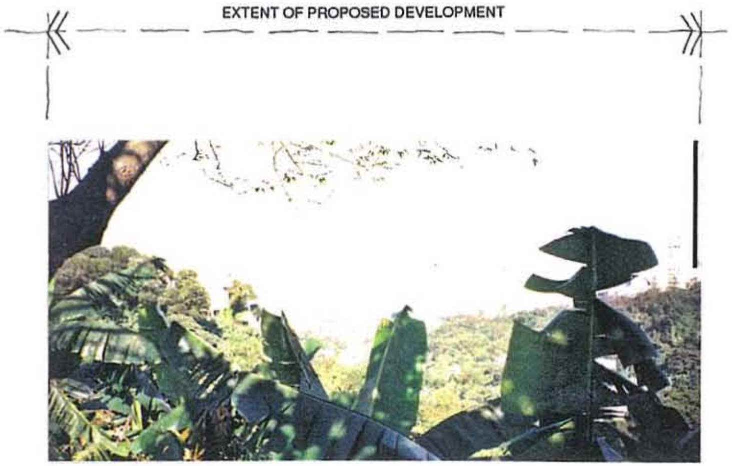
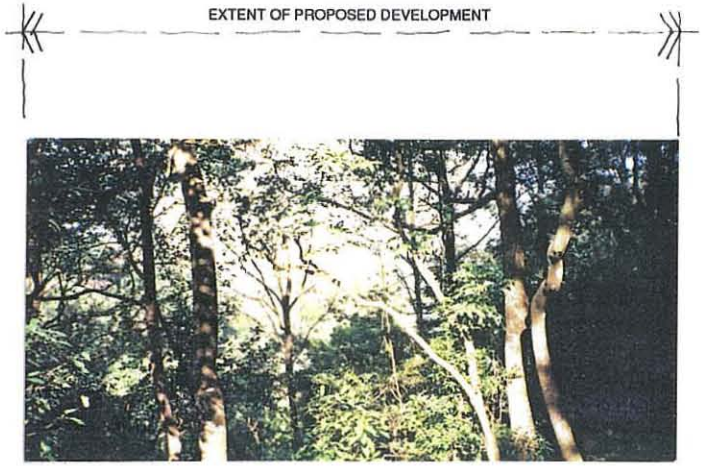
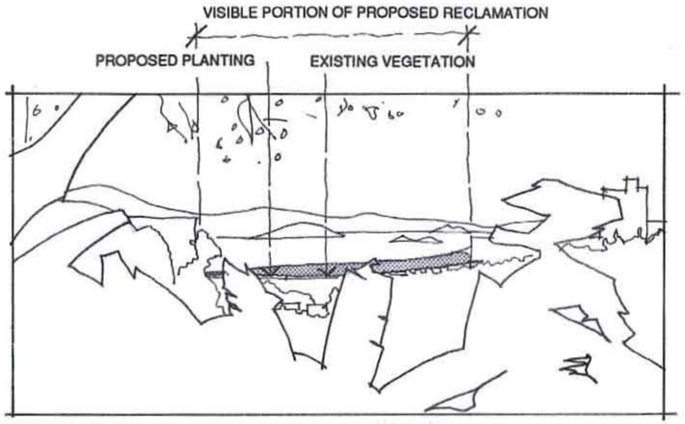
Figure No. 8.7



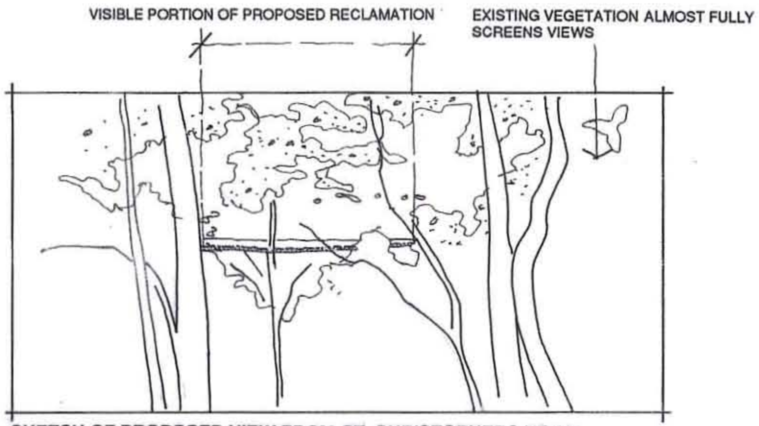
EXISTING VIEW FROM CHEUNG SHUE TAN



EXISTING VIEW FROM ST. CHRISTOPHERS HOME



SKETCH OF PROPOSED VIEW FROM CHEUNG SHUE TAN



SKETCH OF PROPOSED VIEW FROM ST. CHRISTOPHERS HOME

Existing and Proposed Views from the West :
Cheung Shue Tan Traditional Village / St. Christophers Home

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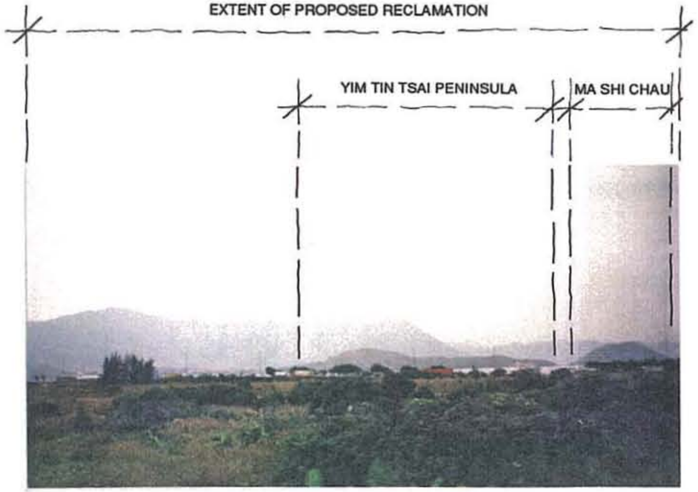
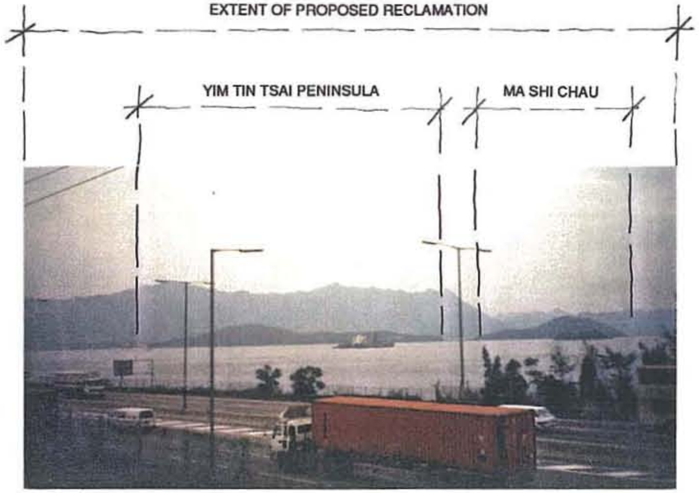
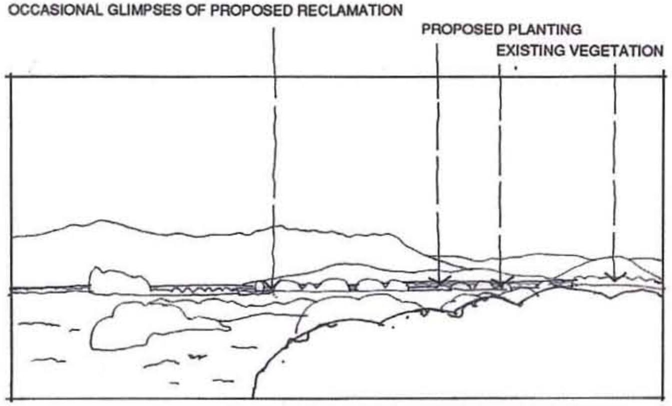
Figure No. 8.8



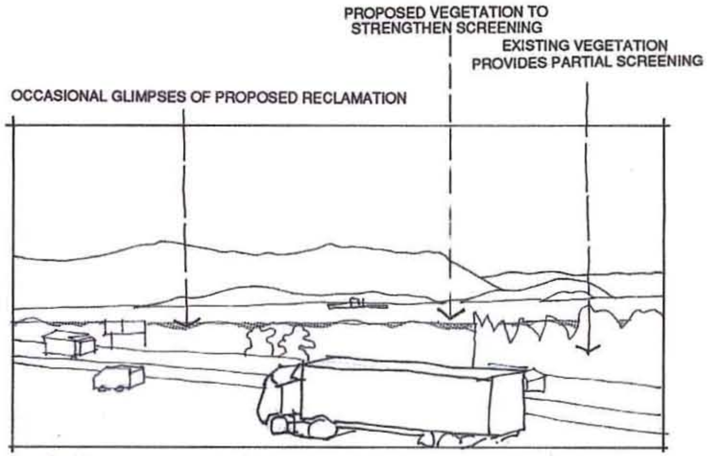
EXISTING VIEW FROM KCR BETWEEN TSIU HANG AND CHEUNG SHUE TAN



EXISTING VIEW FROM KCR AT MA LIU SHUI



SKETCH OF PROPOSED VIEW FROM KCR BETWEEN TSIU HANG AND CHEUNG SHUE TAN



SKETCH OF PROPOSED VIEW FROM KCR AT MA LIU SHUI

Existing and Proposed Views from the West :
From the KCR Between Tsiu Hang and Cheung Shue Tan / From The KCR at Ma Liu Shui

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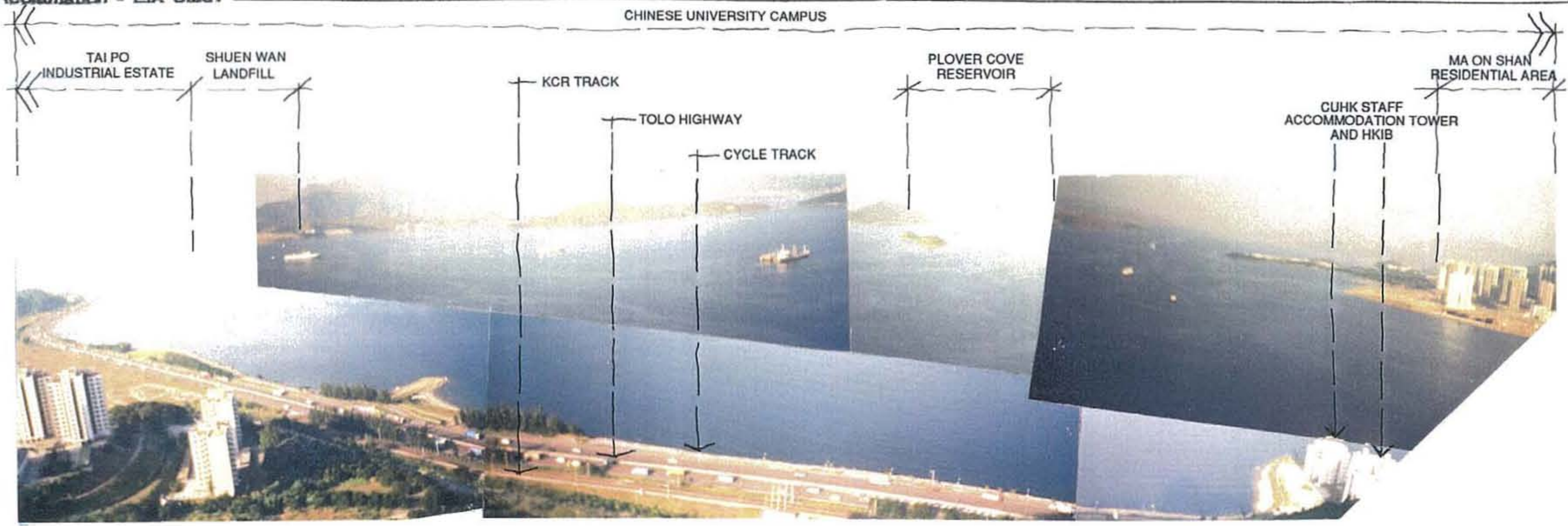
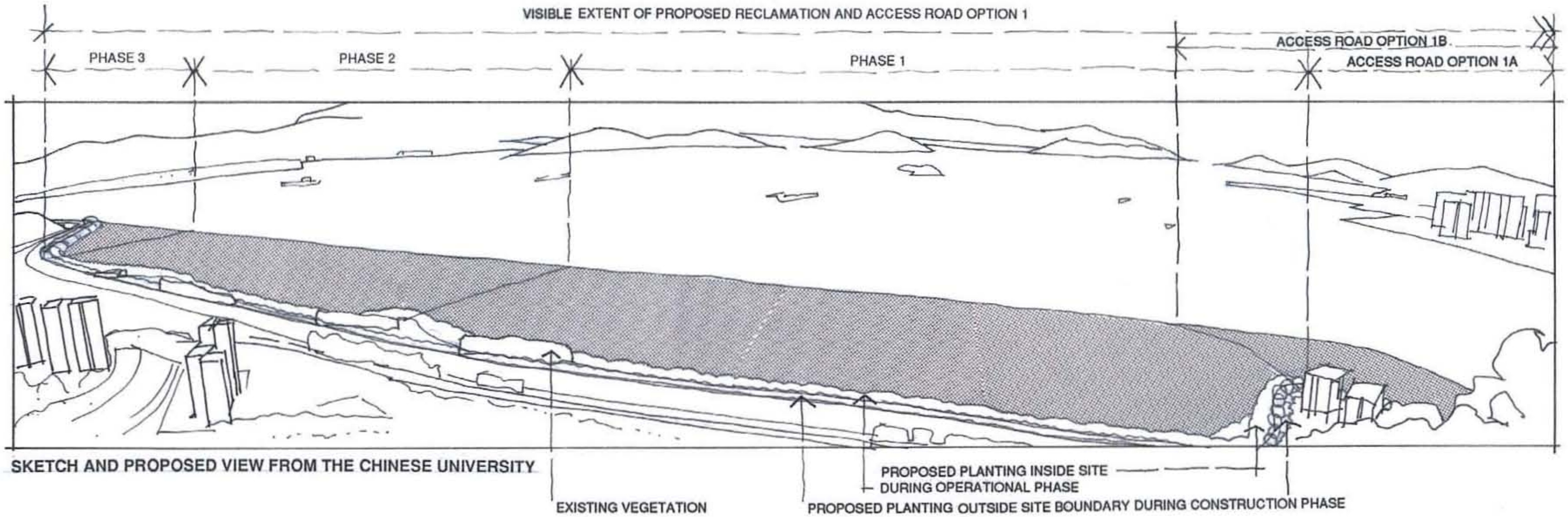
Figure No. 8.9



EXISTING VIEW FROM THE CHINESE UNIVERSITY



SKETCH AND PROPOSED VIEW FROM THE CHINESE UNIVERSITY

Existing and Proposed Views from the South : Chinese University, Residential Tower (Roof Top Outlook)

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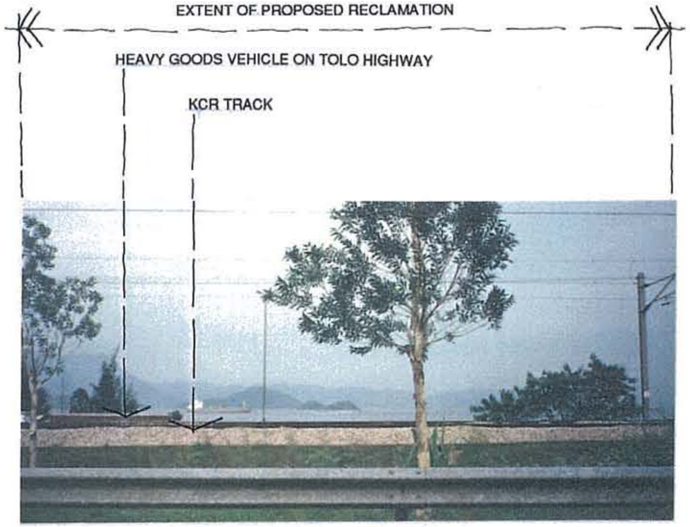
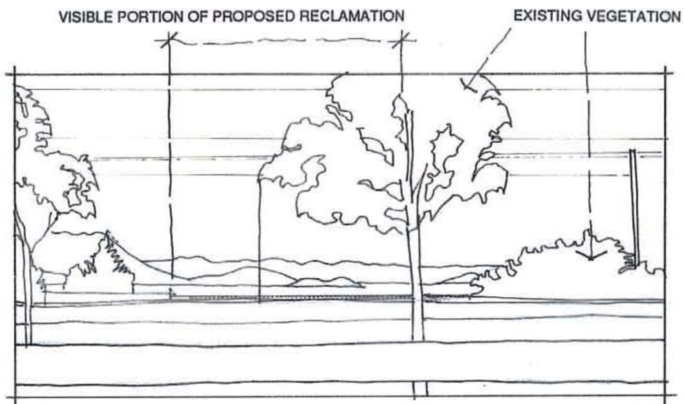
Figure No. 8.10



EXISTING VIEW FROM CHINESE UNIVERSITY CAMPUS



SKETCH OF PROPOSED VIEW FROM CHINESE UNIVERSITY CAMPUS

Existing and Proposed Views from the South :
Chinese University Campus Low Road Adjacent to KCR

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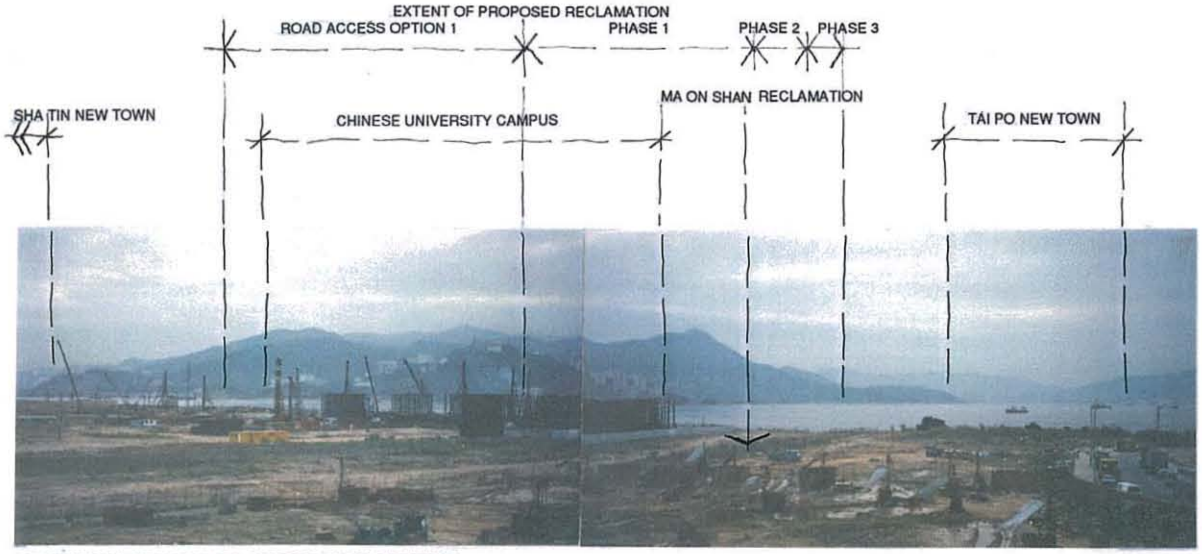
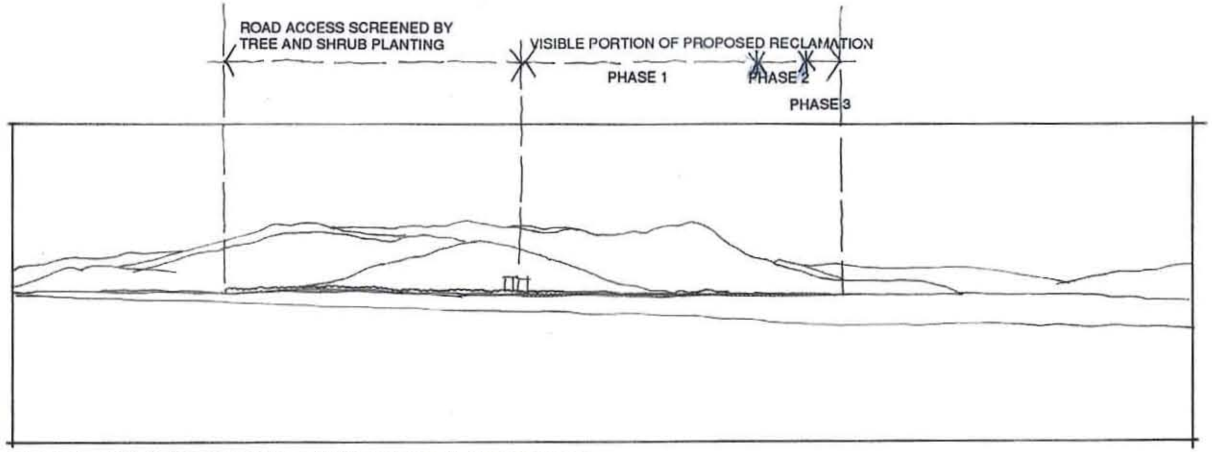
Figure No. 8.11



EXISTING VIEW FROM MA ON SHA RECLAMATION



SKETCH OF PROPOSED VIEW FROM MA ON SHAN RECLAMATION

Existing and Proposed Views from the East :
Residential Area at Ma On Shan Reclamation

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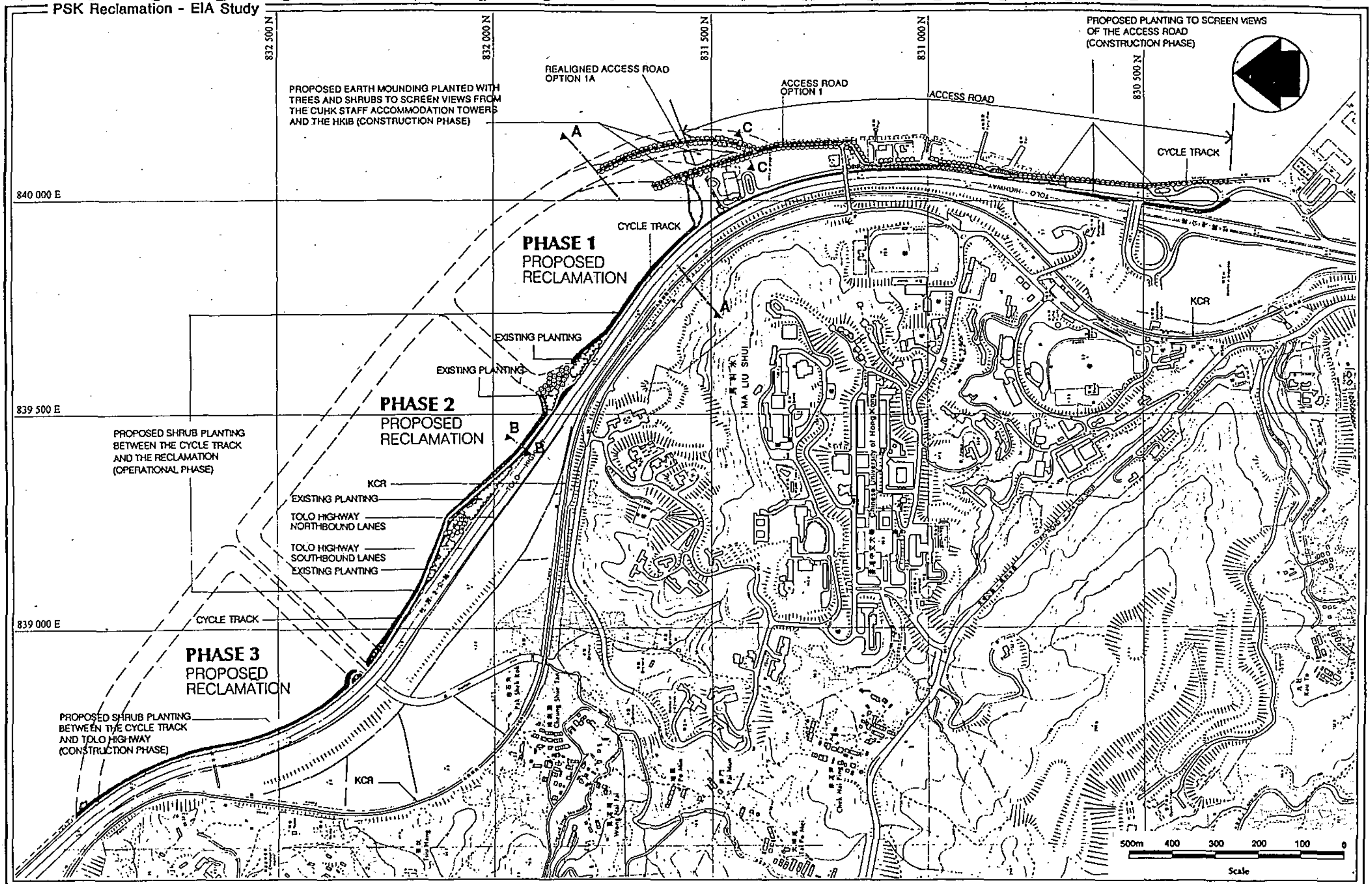
Figure No. 8.12



Landscape Mitigation Proposals

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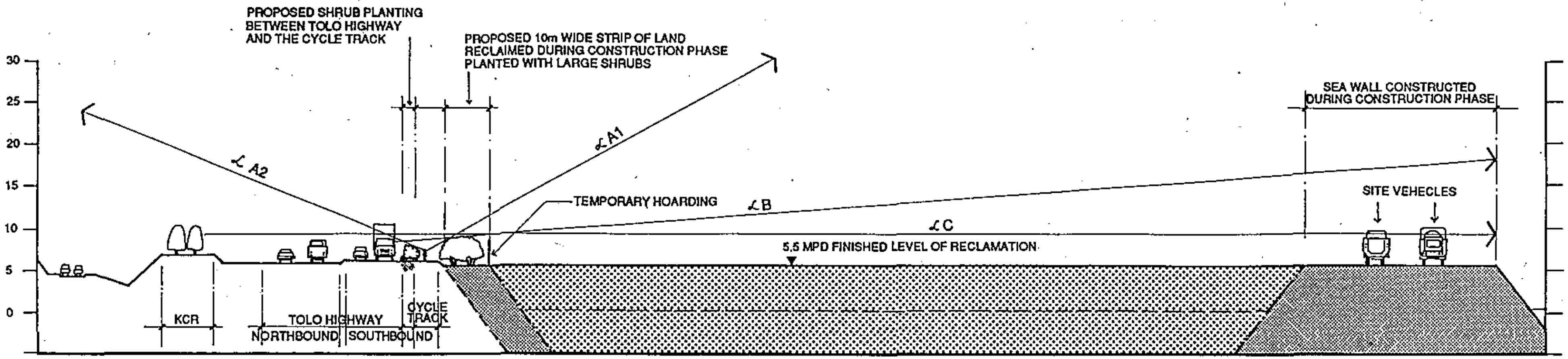
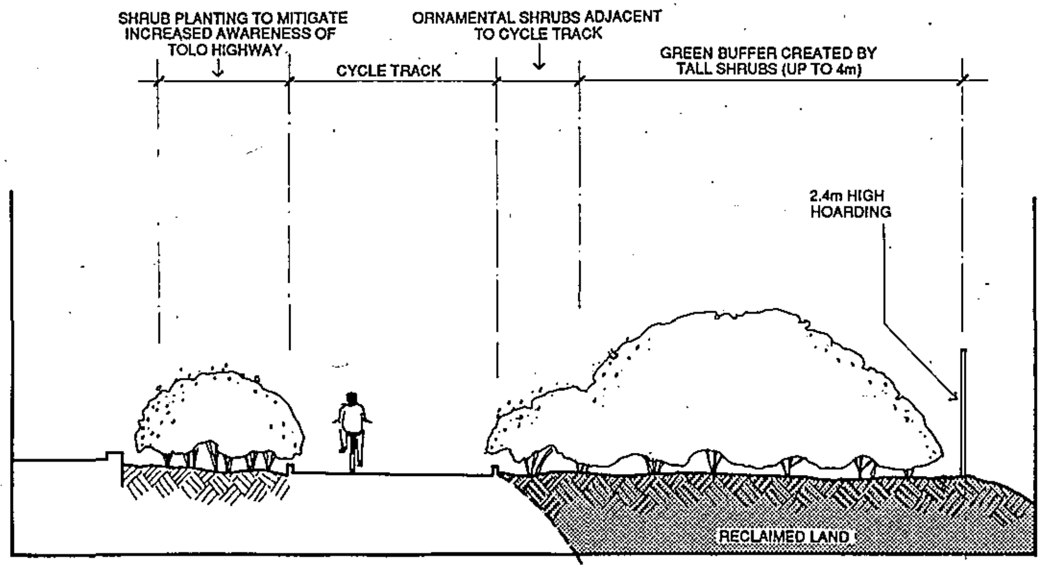
Figure No. 8.13



CROSS SECTION AA

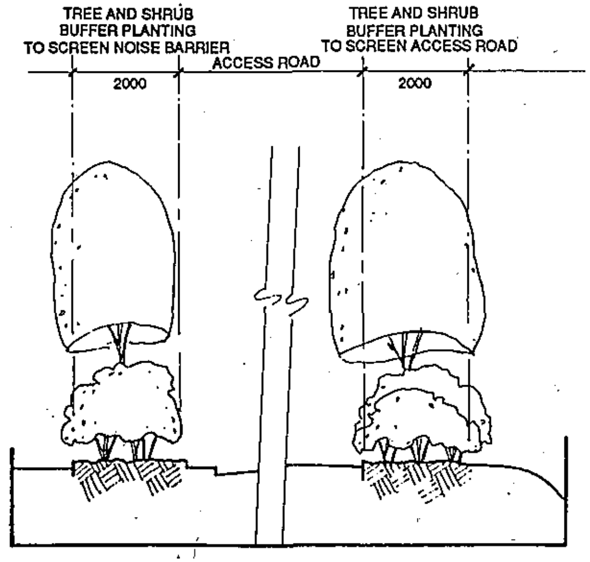
SCALE : HORIZONTAL 1 : 1000
VERTICAL 1 : 500

NOTES : ∡ A ANGLE OF VISIBILITY FROM THE CYCLE TRACK
∡ B ANGLE OF VISIBILITY FROM TOLO HIGHWAY
∡ C ANGLE OF VISIBILITY FROM THE KCR



SECTION BB

SCALE 1 : 100



SECTION CC

SCALE 1 : 100

Cross Sections

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Figure No. 8.14

9.0 UTILITY IMPACT

9.1 Introduction

This section discusses the impacts of the construction and operation of the reclamation on the utilities within and adjacent to the reclamation site which include road drainage outfalls, effluent and gas pipelines. There are several drainage outfalls in the proposed reclamation area which would need to be diverted or extended. The impact of the diversion and extension of drainage outfalls on the local water quality are discussed. Measures need to be taken to prevent the damage of the effluent and gas pipelines during the construction and operation of the reclamation are recommended.

9.2 Hinterland Drainage

At present there are discharges from village septic tanks into the Tai Po Mei Hang and Cheung Shue Tan Hang streams discharging into the nullah which in turn flows into Tolo Harbour under the Tolo Highway. Phases 2 and 3 of the project will involve the creation of seawalls which will extend the length of the nullah by approximately 450 m. Water quality in the stream is variable (see Section 3.4.4), concentrations of BOD and ammoniacal nitrogen being highest at low flows. Extended retention times at low freshwater flows within the nullah could give rise to conditions suitable for the initiation of phytoplankton growth.

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 being completed by 2002. Thus the input of nutrients into the Tolo will be further reduced. It is not expected however that the increase in length of the nullah will give rise to any deterioration in water quality in the existing section or the extension.

The residual volume of the channel post completion of the Phases 2 and 3 wall should be minimised in order to maximise flushing and hence encourage rapid dilution in the open water of the harbour. The lining and levelling of the nullah to provide a toe at the seawater end levelled to low low-water will result in a retention time of one tide cycle.

9.3 Surface Water Drainage from Tolo Highway

At present the surface water drainage from the Tolo Highway discharges via a number of outfalls through the present seawall directly into Tolo Harbour. These outfalls which currently discharge between the end points of the proposed reclamation will progressively lose access to the open water. Interception and re-routing of the surface water will be required. It is suggested that they be routed to discharge into the nullah which will be retained between Phases 2 and 3. It is anticipated that the diversion of surface water from outfalls will not have an adverse effect on local water quality as the water is from road drainage.

9.4 Gas and Effluent Pipelines

The proposed reclamation and the base of the seawall will not extend as far as the gas and effluent pipeline routes, and as such will not directly affect the pipelines. The activities during the constructions have potential to cause damage to the pipelines by work barge anchors, incorrect positioning during dredging or placement of rock armour. Accurate positioning and marking of the pipeline with surface marker buoys will minimise the risk of accidental damage. The maximum draught clearance of barges and dredgers should also be restricted to 5 m.

10.0 ENVIRONMENTAL MANAGEMENT PLAN

10.1 Introduction

Environmental monitoring, audit and performance requirements for noise, air quality and marine water quality are recommended for the development of the reclamation in this section. The requirements specify the parameters to be measured, the location, frequency and duration of the measurements. These requirements and recommendations will be incorporated into the tender document for the development of the reclamation.

10.2 Environmental Monitoring Programme

10.2.1 Introduction

As part of the compliance and post project audit it is essential that an appropriate baseline monitoring plan is established to determine the impacts on the physical, chemical, biological and human environment. Monitoring programmes for each of the major environmental components have been identified and are defined in the following sections.

The monitoring programme will also be used to verify the predictions of environmental impact developed during the design stage and to ensure that unforeseen impacts are detected at an early stage. This will allow corrective measures to be implemented before irrecoverable damage can occur.

Environmental monitoring will be carried out starting from the construction and operation to the after care stages of the reclamation. The objectives of environmental monitoring are;

- To provide a database of environmental parameters against which to determine any short term or long term environmental impacts as a result of the construction or operation of the project;
- To confirm the assumptions made in the design of the project and particularly the effectiveness of the mitigation measures;
- To provide an indication whether the environmental control measures are effective in maintaining the required standards;
- To provide data to enable the environmental audits to be carried out.

To achieve these aims it is recommended that environmental monitoring be carried out in three stages;

(i) Preconstruction (Baseline)

(ii) During construction and operation of the site

(iii) After the project is completed

Table 10.1 summarises the specified baseline and compliance monitoring requirements which forms the basic framework of the monitoring plan. Details of the specific monitoring parameters and the required frequency of sampling are given in the following sections.

Environmental monitoring during construction and operation of the site is generally the responsibility of the contractor. The contractor should prepare a checklist relating to each of the environmental issues that will, in conjunction with the environmental control clauses of the Contract document, form the basis of a proforma for the environmental monitoring programme.

Table 10.1 : Framework for Environmental Monitoring Plan

Monitoring Requirement	Period	Location	Parameters	Monitoring Frequency/ Duration
Noise	Baseline	5 Sensitive receivers Villa Castell, Cheung Shue Tan Village, CUHK Campus, HKIB	L_{30} L_{eq} L_{90}	24 hour periods on weekdays for a period of 14 days immediately before construction commences
	Impact and Compliance	"	"	3 time per week for 30 minutes
Dust	Baseline	3 locations HKIB, Campus of CUHK and Cheung Shui Tan Village	TSP RSP wind speed / direction	daily for 24hr sampling and 3 times per day for 1 hour sampling for 2 consecutive weeks
	Impact and Compliance	3 permanent locations plus temporary monitoring points when required	"	24 hr every 6 days for both TSP and RSP; 3 times every 6 days for 1-hr TSP monitoring
Marine Water Quality	Baseline	8 locations as shown in Table 10.2	Group A: Temperature, Salinity, DO, Turbidity, SS, Total Lead, Total Zinc Group B: NH_4-N, Nitrate, TKN, Total PO_4, Total Copper, Chlorophyll-a, E.coli, BOD	Group A: 4 days/week at mid flood and mid ebb for a period of 4 consecutive weeks, within 6 weeks prior to construction Group B: 2 days/week at mid flood and mid ebb for a period of 3 consecutive months within 14 weeks prior to construction
	Impact and Compliance	Same as baseline monitoring	Same as baseline monitoring (Total Zinc, Lead and Copper to be monitored only when dredging is being carried out	Group A: 3 days/week at mid flood and mid ebb throughout the construction and operation period. Group B: 1 day/week at mid flood and mid ebb throughout the construction and operation period.
	Post Project	Same as baseline monitoring	Same as baseline monitoring	As for impact and compliance for a period of 6 weeks

10.2.2 Baseline Monitoring

(a) Noise

Noise monitoring should be carried out daily over at least, a two-week period prior to the commencement of works to enable L_{10}, L_{eq}, and L_{90} noise levels to be assessed over 24 hours on a typical weekday at five representative NSRs around the site.

Proposed monitoring sites are:

- Villa Castell, overlooking Tolo Highway and the proposed reclamation;
- village house in Cheung Shue Tan, facing Tolo Highway and the proposed reclamation;
- staff quarters at the CUHK, overlooking Tolo Highway and the proposed reclamation;
- residence building at the CUHK, overlooking the reclamation and Tolo Highway;
- the HKIB building, at a facade facing Tolo Harbour.

(b) Air Quality

Baseline monitoring of particulates (TSP and RSP) should be carried out at HKIB, Campus of CUHK and Cheung Shue Tan Village for two consecutive weeks prior to the commissioning of the construction work according to the following frequency:

- daily for 24-hour sampling,
- at least 3 times per day for 1-hr sampling.

There should be no construction or dust-generating activities in the vicinity of the dust monitoring stations during baseline monitoring.

(c) Marine Water Quality

In order to establish the water quality in the immediate area adjacent to the works and in the locations of the identified sensitive receivers it is recommended that a programme of water quality monitoring be carried out to the following specification. The detailed monitoring programme, equipment and facilities should be approved by EPD before the commencement of works and work should not begin until the programme has been approved by EPD.

(i) Monitoring Locations

Eight monitoring stations identified as (also refer to Figure 10.1):

Table 10.2 : Marine Water Quality Monitoring Stations

Station Description	HK Metric Grid E	HK Metric Grid N
50m seaward of the centre of the Phase 1 Seawall	840000	832000
50m seaward of the centre of the Phase 2 Seawall	839540	832420
50m seaward of the centre of the Phase 3 Seawall	839000	832850
Two locations spaced between the end of the seawall and the shoreline	Moveable as the wall is extended	Moveable as the wall is extended
Sensitive Receiver Tai Po Seawater Pumping Station	837660	834540
Sensitive Receiver Shatin Seawater Pumping Station	840200	830300
Sensitive Receiver Yim Tin Tsai Mariculture Zone	839300	834800
Sensitive Receiver MSL	840200	831120
Reference Control Station within Tolo Harbour	840700	833800

(ii) Sampling Depths:

- 1 m below water surface
- mid depth
- 1 m above seabed

If the total depth is less than 6 m the mid depth sample should be omitted. If the total depth is less than 3 m then the bottom sample may also be omitted.

(iii) Parameters to be monitored:

Table 10.3 : Marine Water Monitoring Parameters

Group A	Group B
Temperature	Ammoniacal N
Salinity	Nitrite N
Dissolved Oxygen	Nitrate N
Turbidity	Total Kjeldal N
Suspended Solids	Total PO_4
Total Lead	Total Copper
Total Zinc	Chlorophyll-a
	E. coli
	BOD

(iv) Sampling Frequency:

For Group A parameters, on four days each week at mid flood and mid ebb for a period of 4 consecutive weeks within a period commencing not more than six weeks prior to commencement of construction.

For Group B parameters, on two days each week at mid flood and mid ebb for a period of three consecutive months commencing not more than fourteen weeks prior to the start of construction.

When sampling for both parameter groups is being carried out sampling for both groups should be carried out at the same time.

Baseline monitoring will be used to establish the water quality in terms of the measured parameters immediately prior to the commencement of works.

10.2.3 Impact and Compliance Monitoring

The monitoring plan during the construction and operational phases must be compatible with and an extension of the baseline monitoring which has been reviewed in Section 10.2.2. These recommendations will be incorporated into the tender document for the construction and operation of the public dump.

(a) Noise

Noise monitoring is required to verify compliance with the requirements of any Construction Noise Permit and criteria contained in the Contract document. The requirements are the same as detailed in Section 10.2.2 to enable comparison.

Daytime compliance monitoring should be undertaken at least three times per week, involving measurement over a 30-minute period of typical activity. Measurement should be carried out 1 m from the worst-affected external facades of the designated NSRs. Noise measurements should not be made during periods of high background noise (such as during peak traffic hours), or in the presence of fog, rain, or excessive steady or gusty winds).

In addition to noise monitoring the effectiveness of mitigation measures should be checked by ensuring that any silenced construction equipment is properly used and maintained, any noise barriers are properly positioned and maintained, and good site practice is maintained.

Environmental monitoring during construction and operation is generally the responsibility of the contractor. The contractor should prepare a checklist relating to each of the environmental issues that will, in conjunction with the environmental control clauses of the Contract document, form the basis of a proforma for the environmental monitoring programme.

(b) Air Quality

A programme of particulate monitoring should be developed to ensure compliance with appropriate air quality standards, the effectiveness of dust control measures, and to identify any deterioration of air quality during the construction and operational phases.

Guidelines for dust monitoring are provided in Appendix B of this Report.

In addition to TSP and RSP monitoring, the effectiveness of mitigation measures should be assessed by observing their maintenance and use. This would apply to measures such as wheel washing facilities, water sprays, tarpaulins and other covers, barriers, enclosures and hydroseeded areas. Regular checks should be made to ensure that site road speed limits are observed, that appropriate construction methods are being used, and the site maintains good housekeeping practices.

(c) Marine Water Quality

(i) Monitoring Location

Impact and compliance monitoring sampling locations and parameters will be the same as those used for the determination of the baseline conditions. Two additional locations will be monitored between the end of the seawall and the shoreline.

(ii) Sampling Frequency:

Group A Parameters: Three days each week at mid flood and mid ebb tide throughout the construction and operation period.

Group B Parameters: One day each week at mid flood and mid ebb tide throughout the construction and operation period.

When sampling for both parameter Groups is being carried out sampling for both groups should be carried out on at the same time. Monitoring for zinc, lead and copper is only required during dredging activities.

10.2.4 Post Project Monitoring

Post project monitoring will be required for group A and B parameters on completion of the project, particularly with respect to the marine environment. Frequency will be as for impact and compliance monitoring for a period of 6 weeks. There is no requirement for post project monitoring of noise or air quality.

10.3 Environmental Audit Programme

10.3.1 Introduction

This section of the report defines the requirements to enable environmental auditing of the proposed development to be carried out. Environmental audits will be undertaken at two stages of the project development;

(i) Compliance Auditing during the project construction and operation; and

(ii) Post Project Audit, ie. once the project has been completed.

The aim of these audits is to ensure satisfactory compliance with the legislative requirements and to ensure that no nuisance is caused to sensitive receivers. This will require information on;

(i) the statutory requirements for parameters of concern; and

(ii) monitoring data.

Each audit will then comprise a review of the available monitoring data and comparison with the relevant legislative requirements and environmental performance standards specified in the contract document to ensure compliance.

(a) Statutory Requirements

The contractor must establish a construction compliance monitoring schedule which will involve the establishment of trigger, action and target limits for air, noise and water pollution with action plans. Target levels for noise will be based on regulatory and statutory limits or the prevailing baseline noise levels; the target levels for air will be developed based on the AQO; the target levels for water quality will be established based on the WQO of the Tolo Harbour Water Control Zone where applicable and in consultation with the EPD. The guidelines for setting the target levels for water quality are given in Table 10.6.

Trigger levels relating to the environmental parameters to be monitored will be established. Whenever monitoring indicates that a particular parameter has exceeded its trigger level a programme of action will be indicated to determine the likely cause of non-compliance; any alterations to the construction or operation programme which will reduce the likelihood of any such breached occurring again and the predicted outcome of any corrective action programme. Increased monitoring frequencies may be implemented in the event of any trigger levels being exceeded.

Action Plans will be devised for each parameter which will indicate any alteration to the monitoring programme, the response to results and instigating corrective action programmes.

(b) Monitoring Data

As discussed in Section 10.2, the monitoring requirements are for continued monitoring of key indicators;

(i) before construction commences (baseline monitoring);

(ii) during the construction and operation of the project; and

(iii) after project completion.

Comparison of data collected under stages (i) and (ii) provides information for the compliance audit whilst comparison of data from stage (i) and (iii) provide information for the post project audit.

10.4 Compliance Audit Requirements

Details of indicators to be measured; where and at what frequency have been defined and discussed in Section 10.2. The frequency and parameters to be measured for monitoring construction noise, dust emissions and water quality will be recommended to ensure that the contractor complies with applicable regulations and standards.

(a) Noise

Noise monitoring will ensure compliance with relevant noise standards. As operation of the dump is considered a construction activity under the NCO, the noise criterion during both construction and operation of the dump is the same.

In addition to these monitoring requirements, it will be necessary to monitor work practices, plant efficiency and operation, and site cleanliness to ensure that mitigation measures are in place and are effective.

As part of the monitoring schedules and audit, three levels have been devised to monitor compliance with environmental objectives and to provide early warning of potential problem areas as the project proceeds. The three levels are:

- *Trigger Level:* This level acts as an "early warning" of deterioration, so that closer monitoring of noise levels may be initiated, possible sources of the noise may be identified, and early mitigation measures enacted to prevent further deterioration. This level may be defined as receipt of one independent complaint (directed either to EPD or the site office).

- *Action Level*: Achievement of this level indicates that noise levels have increased from the Trigger Level, and that corrective action is required before conditions further deteriorate and relevant standards are not met. This level may be defined as receipt of more than one independent complaint in a four-week period.

- *Target Level:* This is the upper limit, or maximum permissible level that will still comply with the appropriate regulation. In the absence of statutory controls to limit daytime (0700-1900 hrs) construction noise, a limit of 75 dB(A) (L_{eq} 30 min) or 10 dB(A) over the prevailing background noise level (whichever is lower), may be adopted as the Target Level. Exceedance of the Target Level is generally not permitted.

When complaints are received or the Target Level is exceeded, the Action Plan shown in Table 10.4 is recommended.

Table 10.4 : Action Plan for Noise Exceedance

Event	Action by Engineer
One independent complaint received	• Investigate complaint.
More than one independent complaint received in a four-week period	• Investigate complaint. • Increase frequency of monitoring.
Target Level exceeded	• Review noise source and working method. • Implement noise mitigation measures. • Perform noise monitoring after implementation of noise mitigation measures.

(b) Air Quality

To assess the air quality impacts of the dump operation, it is necessary to monitor air quality for the duration of operations. In addition to these monitoring requirements, it will be necessary to monitor work practices, plant efficiency and operation, and site cleanliness to ensure that mitigation measures are in place and are effective.

As part of the monitoring schedules and audit, three levels have been devised to monitor compliance with environmental objectives and to provide early warning of potential problem areas. The three levels are:

- *Trigger Level:* This level acts as an "early warning" of deterioration, so that closer monitoring of dust levels may be initiated, possible sources of the excessive dust may be identified, and early mitigation measures enacted to prevent further deterioration. For this project, the Trigger Level is defined as 130% of the baseline dust concentration at a given location.

- *Action Level*: Achievement of this level indicates that dust levels have increased from the Trigger Level, and that corrective action is required before conditions further deteriorate and relevant standards are not met. For this project, the Action Level is defined by averaging the Trigger and Target (see below) Levels.

- *Target Level:* This Level is the upper limit permitted and, for 24-hour dust concentrations, is identical to the AQO standards. For TSP, the Target Level is 500 $\mu g/m^3$ (1 hour average) and 260 $\mu g/m^3$ (24 hour average). For RSP, the Target Level is 180 $\mu g/m^3$ (24 hour average). Exceedance of the Target Level is generally not permitted.

In the event of exceedance of the Trigger, Action, and Target Levels, the Action Plan detailed in Table 10.5 is recommended.

Table 10.5 : Action Plan for Dust Exceedance

Event	Action by Engineer	Action by Contractor
Trigger Level exceeded (one sample)	• Repeat measurement as soon as possible. • Notify contractor.	• Identify source.
Trigger Level exceeded (more than one consecutive sample)	• Repeat measurement as soon as possible. • Notify contractor and EPD immediately.	• Identify source and impose necessary mitigation measures.
Action Level exceeded (one sample)	• Repeat measurement as soon as possible. • Notify contractor and EPD immediately.	• Identify source and impose necessary mitigation measures.
Action Level exceeded (more than one consecutive sample)	• Daily monitoring is to be imposed. • Notify contractor and EPD immediately. • Require contractor to make additional proposals for dust suppression.	• Identify source. • Review plant, equipment and working procedures. • Submit proposals for reducing dust to Engineer. • Implement remedial action to reduce dust emissions immediately. • Notify Engineer of the action taken.
Target Level exceeded (one sample)	• Daily monitoring is to be imposed. • Notify contractor and EPD immediately. • Require contractor to make additional proposals for dust suppression. • Provide investigation report to EPD as soon as possible.	• Identify source. • Review plant, equipment and working procedures. • Submit proposals for reducing dust to Engineer. • Implement remedial action to reduce dust emissions immediately. • Notify Engineer of the action taken. • Provide investigation report.
Target Level exceeded (more than one consecutive sample)	• Daily monitoring is to be imposed. • Notify contractor and EPD immediately. • Require contractor to make additional proposals for dust suppression, and take immediate steps to reduce dust. • Provide investigation report to EPD as soon as possible.	• Identify source. • Review plant, equipment and working procedures. • Submit proposals for reducing dust to Engineer. • Implement remedial action to reduce dust emissions immediately. • Notify Engineer of the action taken. • Provide investigation report, which should include findings and suggestions to prevent such exceedance happening again. • Stop the relevant portion of work as necessary, as determined by the Engineer.

(c) Marine Water Quality

In order to assess the water quality impacts of the construction and operation of the dump a monitoring programme as outlined in Section 10.2.3 must be implemented. In addition attention should be paid to the day to day operation of the site to monitor the implementation of good working practice and application of mitigation measures.

The audit programme is designed to assess the results of the monitoring programme and report changes in water quality which are indicated by reference to the Trigger, Action and Target parameter values and to initiate any actions which are required to confirm the non-compliant result and subsequent mitigation measure.

The results of the compliance monitoring will be compared with the following defined values.

Trigger level: Level beyond which there is an indication that a deterioration in water quality is occurring at which more frequent monitoring may be initiated and mitigation measures implemented.

Action level: Level at which significant changes in water quality have occurred beyond which remedial actions are required to prevent the water quality exceeding the Target Limit.

Target level: Level which is defined by reference to the appropriate WQO set by EPD for that location.

Table 10.6 : Water Quality Standards

Water Quality Parameter	Trigger Level	Action Level	Target Level
Offensive odours, tints and colours	The contractor and engineer should ensure that these are always absent at the site as a result of site activities		
Visible foam, oil, grease, scum and litter			
E coli (CFU/100ml)	Determined from baseline monitoring	Running geometric mean of 5 most recent samples <610	Annual geometric mean < 610
Dissolved Oxygen within 2m of the bottom	Determined from baseline monitoring		not less than 2mg/l
Dissolved oxygen in the rest of the column	Determined from baseline monitoring		not less than 4mg/l
BOD_5 (mg/l)	Determined from baseline monitoring		
Turbidity (NTU)	Determined from baseline monitoring		1.3 x Control at Stations along seawall
Suspended solids (mg/l)	Determined from baseline monitoring		1.3 x Control at Stations along sea wall; 20 mg/l at MSL; 50 mg/l at Yim Tin Tsai Mariculture zone.
Ammoniacal N (mgN/l)	Determined from baseline monitoring		0.021 as un-ionised ammonia
Total Inorganic Nitrogen (mgN/l)	Determined from baseline monitoring		
Total Kjeldahl N (mg/l)	Based on significant trend from baseline values		
Total PO4 (mgP/l)			
Total lead (μg/l)	Determined from baseline monitoring		
Total copper (μg/l)			
Total zinc (μg/l)			
Chlorophyll-a (μg/l)		Determined from baseline monitoring	Running mean of 5 most recent samples <15 μg/l

Where the results of the compliance monitoring indicate that there is a significant change in water quality the contractor will be required to examine his method of working and should it be shown that the deterioration results from his activities modify the method of working in such a way as to ensure that he is not contributing to the deterioration. An outline of the actions to be taken are given below:

Table 10.7: Action Plan for Marine Water Quality Exceedance

Event	Action by Engineer	Action by Contractor
One isolated non compliant trigger value	• Investigate non-compliant result • Inform Contractor	• Identify cause of non-compliance
Two or more consecutive non-compliant trigger values or one non compliant action value	• Investigate non- compliant results • Inform contractor and EPD • Increase frequency of monitoring	• Identify cause of non-compliance • Review plant and working practice • Implement mitigation measures immediately
Two or more consecutive non-compliant action values	• Investigate non- compliant results • Inform contractor and EPD • Maintain increased frequency of monitoring until values below trigger value	• Identify cause of non-compliance • Review plant and working practices • Report to Engineer cause and form of mitigation measures to be implemented • Implement measures immediately • Inform Engineer of actions
One Target value non compliance	• Investigate non- compliant result • Inform contractor and EPD immediately • Maintain increased frequency of monitoring until results below trigger value • Supply investigation report to EPD as soon as possible	• Identify cause of non-compliance • Review plant and working practices • Report to Engineer cause and mitigation measures to be implemented • Implement measures • Inform Engineer of actions • Supply Engineer with investigation report
Two or more consecutive non-compliant Target values	• Investigate non- compliant result • Inform contractor and EPD immediately • Maintain increased frequency of monitoring until results below trigger value • Supply investigation report to EPD as soon as possible	• Identify cause of non-compliance • Review plant and working practices • Report to Engineer cause and mitigation measures to be implemented • Implement measures immediately • Inform Engineer of actions • Supply Engineer with investigation report • Cease causative work as necessary if required by the Engineer

When the working methods are to be investigated this will include, as a minimum:

- checking of all dredging or dumping plant and equipment
- maintenance or replacement of any plant or equipment shown to be giving rise to the deterioration in quality
- review of working methods
- maintenance of any silt screens required by the dredging licence.

Prior to commencement of works a silt screen shall be installed around the MSL water pumping intake. This screen shall be designed in such as way as ensure that the concentration of suspended solids in the water taken in shall be less than 20 mg/l.

10.4.1 Compliance Audits

The compliance audit will be carried out during the construction and operation of the project. The achievement of environmental compliance will be evaluated by monitoring the key indicators established. The results of monitoring and comparison with regulatory requirements (auditing) will indicate whether new or additional remedial measures are necessary during implementation.

These compliance audits will ensure effective compliance and it is recommended that these audits are undertaken at monthly intervals during the construction and filling of the PSK Public Dump site.

The monitoring data should be analysed so that the actual impacts of the project construction and implementation can be determined and compared with the predictions made in the EIA.

Each audit will be accompanied by an evaluation report detailing the findings of the audit and these will be made available for all interested parties. As part of the audit process it will be important to establish the requirements for complaint channels in the audit reports so that local organisations and individuals have recourse to make complaints.

The audit reports will

(i) present, review and summarise the environmental monitoring data;

(ii) establish from the baseline data monitoring, any exceedance of the trigger, action and target limits for compliance monitoring and the performance and acceptability of the project in environmental terms;

(iii) recommend the event/action plans to reduce any impacts for both compliance monitoring if required

(iv) recommend any remedial works required or redress unacceptable environmental impacts.

10.4.2 Post Project Audit Requirements

It is important that the indicators and parameters to be monitored and the method of analysis, sampling sites etc are the same for post project monitoring as well as the compliance monitoring process to ensure scientific rigour and statistical acceptability.

The impact of the project, the accuracy of the predictions, the effectiveness of any mitigation measures and the satisfactory operation of monitoring networks should be determined and assessed by a post project audit after the project is completed.

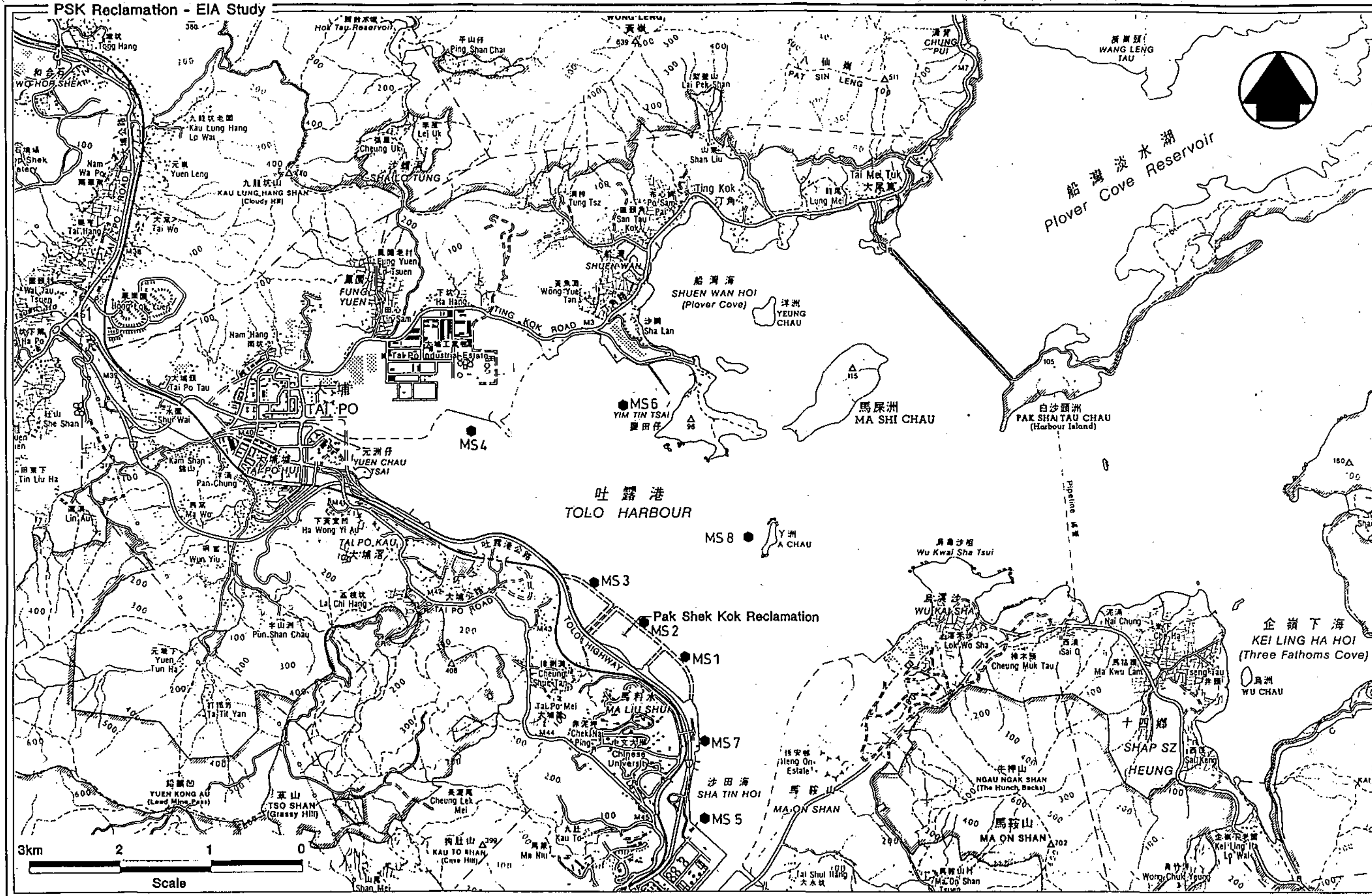
This post project audit will require;

(i) collection, organisation and analysis of monitoring data for key indicators to establish the record of change associated with the project, and

(ii) comparison of actual impact against the impact predicted as part of the EIA. This will enable assessment of the accuracy of the predictions and the effectiveness of the impact assessment, management practices and procedures.

The post project audits will ensure effective compliance with the legislative requirements and it is recommended that these audits are undertaken at weekly intervals for a period of three months once the filling of the reclamation site has been completed to ensure the effectiveness of the environmental protection measures adopted.

The importance of effective post project monitoring and auditing cannot be overemphasised since these operations provide a benchmark for improving the quality and accuracy and effectiveness of EIA predictions.



Water Quality Monitoring Stations

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Figure No. 10.1

11.0 SUMMARY AND CONCLUSION

11.1 Noise

The present noise climate in the vicinity of the PSK area is dominated by traffic noise, predominantly from the Tolo Highway; the KCR is also an important contributor.

Noise levels have been predicted for the 19 representative sensitive receiver sites during the different phases of the project based on the different activities which will be taking place.

Construction of the seawall alone would create minimum impacts at all selected NSRs. Also, the noise levels due to the construction of the Option 1 access road are expected to be within acceptable limits at all NSRs except at the staff accommodation of HKIB if unmitigated. However, due to the close proximity of this receiver to the road alignment, noise levels from road construction would exceed the recommended standard when construction works are being carried out close to the building. Mitigation measures are therefore required to control construction noise affecting the staff accommodation building.

Operational activities on the site during Phases 1, 2 and 3 are predicted to result in noise levels within the recommended maxima. However, the combined impact of the traffic noise from Option 1 access road and the on-site operations of Phase 1 reclamation are predicted to exceed the maximum at the HKIB staff accommodation if unmitigated. Mitigation measures are therefore required to limit the operational noise. Noise levels at the staff accommodation can be reduced by the use of a noise barrier or realignment of the access road further away from the building.

Although a 6 m high noise barrier with a mass of 7 kg/m^2 would be capable of reducing noise by 10 to 15 dB(A) at the staff accommodation building, the noise standard is unlikely to be met when construction works are carried out close to the building. This measure is therefore not satisfactory.

Realignment of access road (Option 1A) would increase the distance between the staff accommodation and the access road from 5 to 80 m. Such a move would reduce the worst-case access road construction noise levels from 103 dB(A) to 74 dB(A); the combined road and seawall construction noise would therefore be within the recommended noise limit of 75 dB(A). The operational facade noise level during peak hour would also be reduced to 62 dB(A) which is well within the recommended limit of 75 dB(A). At the same time this would reduce the need for acquisition of University land and the visual intrusion of the noise barrier to the residents of the staff accommodation.

It is therefore recommended that the access road should be realigned further seaward as shown in Figure 8.14 (Option 1A). The construction noise can be further reduced by the implementation of additional mitigation measures as proposed under Section 4.6.

No formal assessment has been made of the impact of noise and dust on users of the cycle track because these users are considered as non-stationary; any nuisances are therefore considered to be transient. Since the public dump will be closed on Sundays and Public Holidays, noise and dust will not be generated on the days the cycle track is most heavily utilised and therefore the site will produce minimal impact on the users.

11.2 Air Quality

The PSK area lies between the industrial areas at Tai Po and Shatin and is crossed by the Tolo Highway. Air quality has been considered in terms of TSP, RSP and NO_2, .

EPD routinely monitor the air quality at Tai Po and Shatin. Results for 1992 show that NO_2 levels were well within AQO values. Annual TSP levels exceeded the AQO and on 2 occasions the daily AQO was exceeded. RSP levels were within the AQO but the daily value was exceeded on one occasion.

Daily measurements of TSP and RSP at three locations in the PSK area carried out in early 1994 show that the AQO was met on all 15 sampling occasions.

Dust concentrations during construction of the access road have been predicted, based on the assumption that no dust suppression measures are adopted. Due to the limited construction area involved and the large source-to-receiver distances, increases in dust concentrations at all evaluated sensitive receivers, including HKIB, are negligible.

During all operational phases it is predicted that, if unmitigated, TSP levels would exceed the AQO at one or more locations. At the worst affected receivers the exceedance is due almost entirely to the use of the access road. Mitigation measures have been proposed and are described in Section 5.6. This measures would reduce TSP concentrations to below the AQO level.

The key on-site mitigation measures for site working include damping down and covering of exposed surfaces, wheel and under body washing of vehicles before crossing from site to access road and progressive restoration of completed areas.

Mitigation measures will also be required for the access road. Twice daily cleaning of the road should be carried out in order to bring dust concentrations to an acceptable level with respect to the AQO.

The installation of the hoarding along the cycle track, as recommended as a visual mitigation measure, will also have the benefit of acting as a dust barrier. Thus reducing the exposure of the cyclists to dust during the working day.

In order to minimise the level of exposure to dust of the external seawater tanks at the MSL a dust barrier is recommended which should be installed on the section of the access road in front of the MSL. This, together with other mitigation measures identified above would be sufficient to prevent dust accumulation on the water surfaces.

It is predicted that the airborne particulate level in the environment around HKIB would increase above the prevailing background while complying with the AQO.

With the present filtration system a greater incidence of the ingress of dust is likely to be experienced within the ground floor office and reception areas. The present dust levels could be maintained by increasing the filter retention capacity, however more frequent maintenance of the media will be required.

Similarly, the filter media within the airhandling plants serving the second and third floors will require more frequent maintenance. However it is considered that the level of efficiency of the media is adequate to maintain an acceptable environment within the building for the increased particulate levels anticipated.

In relation to the introduction of facilities complying with FDA standards, it is considered that there is no reason why the external environment should pose an operational problem if the clean rooms and the airconditioning/ventilation system are correctly designed and properly maintained. Fresh air required for the system should be filtered to a similar standard as the existing building. Further filtration of fresh and recirculated air is likely to be required before supply to the clean spaces. The HEPA type filter media should be able to control the CFU count to within the FDA standards.

As the increase in the amount of traffic on the Tolo Highway generated from the reclamation is small compared to that already using Tolo Highway, the increase of NO_2 and RSP due to the construction and operation of the reclamation is expected to be minimal.

The input of sewage loadings to the reclamation area will be reduced during the operation phase of the site as the villages in the PSK area will progressively be sewered. Chemical conditions within the sediments to be dredged indicate that sulphide will be predominantly in the insoluble form and will not give rise to hydrogen sulphide odours. It is considered therefor that odour will not be a problem for the reclamation project.

11.3 Water Quality and Sediments

Over the period 1988-1993 measurements of water quality in Tolo Harbour carried out by EPD indicate a steady improvement to the extent that for most of the time the WQO are met by most of the parameters. Dissolved oxygen concentrations in the bottom layer is the least compliant parameter. However Chlorophyll concentrations, a measure of algal abundance, have fallen and now comply with the WQO.

The quality of the sediments along the line of the proposed retaining seawall has been determined. Chemical analysis indicate that elevated concentrations of lead occur along most of the line at least one depth. The levels are such that the sediment falls into the EPD Class C, seriously contaminated, category.

For the purpose of this assessment it was assumed that dredging techniques would be used to prepare for the placement of the seawall. An assessment of the creation of a sediment plume within the water column during the dredging operation has indicated that under the condition of a high wind 12 m/s from the north or north west the sediment plume could extend as far as the intake of the MSL where suspended solids concentrations could increase by upto 13 mg/l above the background. In order to reduce this increase we will recommend the use of a sealed grab within an enclosing silt screen. Such measures will reduce the sediment losses to the surrounding water by a factor of 5 and result of a maximum increase of only 2.5 mg/l.

Under static air conditions the oxygen demand of the resuspended sediments could give rise to an oxygen sag within the plume but this would not extend as far as the MSL.

Other water quality parameters have been assessed in relation to construction and operational activities. Predicted changes are considered insignificant in relation to the existing water quality.

The identification of the sediment as Class C requires that they must be dredged and transported with great care. This will require the use of close sealed grabs and a silt curtain around the dredging area to minimise the extent of the plume. This will result in the subsequent sediment plume being smaller than predicted. It is recommended that the silt curtain should be used throughout the whole of the dredging period irrespective of the classification of the sediments being removed. This will further limit the oxygen sag to within the silt curtain.

If the whole length of seawall is to be dredged, the volume of sediment to be removed will be about 527,500 m^3 of which 240,000 m^3 will require special disposal and containment at East Sha Chau or other suitably designated site. During the transportation of sediment to the disposal site it is essential that the sediments is not allowed to overflow or leak from the barge and that the sediment is bottom dumped only in the designated area.

During filling of the area behind the seawall it is expected that part of the filling will be carried out by bottom dumping barge and part by end tipping by lorries delivering to the site. It is recommended that the seawall be maintained to above sea level for a distance of at least 100 m from the active end face or barge bottom dumping area to minimise loss of suspended fines into the Harbour Sub-Zone.

The construction waste delivered to the site will contain small quantities of floatable material. The use of a floating refuse boom extending to 1 m below the surface should be used to retain this material which should be removed daily or more frequently should the need arise.

The water quality in the nullah which will cross the reclamation is generally good despite receiving discharges from septic tanks associated with dwellings on the hill slopes above. The water depth in the nullah is shallow and the nullah is well-flushed. The channel across the reclamation should be designed in such a way as to retain the well flushed characteristics.

Surface drainage water from the Tolo Highway intercepted and diverted as recommended will improve flushing of the extended nullah and will not cause any deterioration in water quality.

11.4 Environmental Monitoring and Audit

A comprehensive monitoring programme for dust, noise and marine water quality is specified which will enable the pre-construction environmental conditions to be determined. A similar programme is specified which will collect data during the construction and operation phase. Trigger and Action levels are given at which specific responses are required to initiate additional monitoring or mitigation measures. The comparison of the monitoring data with the Trigger and Action values is defined in the Audit programme which will ensure that the project is carried out in an environmentally acceptable manner. It is recommended that the supervision of the monitoring and the audit process are carried out by an independent consultant.

11.5 Visual Impact and Land Use

The findings of the visual impact assessment demonstrate that the proposed reclamation will be visible from all of the vantage points identified in the zone of visual influence. Some of the visual impacts will be negligible whereas some will be significant according to a number of factors such as the context of the receptor, the number and location of the receptors, the duration of exposure and compatibility with the surrounding area.

Degradations in visual quality will be experienced by the following groups of receptors :

- HKIB and its staff accommodation tower
- Resident students, lecturers and workers at the CUHK main campus site, in particular those who live in buildings at the eastern side and can see the reclamation site from above
- Residents of the proposed 6 and 12 storey apartment blocks at Tai Po Town Lot No. 135 in the west
- Users of the Shatin to Tai Po cycle track;
- Motorists and passengers in vehicles using the southbound lanes of Tolo Highway;
- Passengers travelling on the KCR in either direction where the track is aligned next to Tolo Highway;
- People using the Water Sports Centre (CUHK);
- People using Ma Liu Shui Ferry Pier and Tap Mun Ferry.

Some of the visual degradations unless mitigated by other non-intrusive methods can be partially or fully mitigated by landscape mitigation measures.

During the construction phase, road access alignment(Option 1A) will create a greater visual degradation than the original Option 1 due to the increased extent of the reclamation experienced from the CUHK staff accommodation towers and the HKIB. The area will be visible until the proposed planting matures and will be particularly noticeable from elevated viewpoints. However there will be a negligible difference in impact when experienced at ground level between road access alignment Options 1 and 1A. In visual terms, road alignment Option 1A is preferable to Option 1 for the residents of the HKIB staff accommodation giving greater separation between it and the access road.

It must be recognised that while landscaped visual buffers can screen undesirable views, the visual quality experienced by receptors will be changed. For receptors using the transport corridor in the west the visual quality will be degraded resulting from the loss of a waterfront. The replacement green buffer can only be considered as partial compensation for this loss.

Cyclist are amongst the most sensitive receptors along this corridor. Therefore, in the final land use planning of the reclamation, it is recommended that the cycle track is realigned with the new waterfront.

Similarly the landscape mitigation measures will screen the access road and the landscape mitigation planting will form a green buffer. However there will be change in net visual content experienced by residents of the HKIB staff accommodation towers and the staff of the HKIB during both the construction and operational phases through a change of a sea view for that of a green area by those in the lower 2 floors of the buildings.

The final land use should be visually compatible with the surrounding land character to mitigate the visual degration experienced from the receptors.

11.6 Conclusion

With the implementation of the recommended mitigation measures and monitoring of the environmental conditions at sensitive receivers in accordance with the proposed environmental management plan, the impact of noise, air quality and water quality will be brought down to the established environmental guidelines and standards. This will result in the construction and operation of the reclamation being carried out in an environmentally acceptable manner.

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Comments	Response to Comments
The Chinese University of Hong Kong Buildings Office Ref. (45) in 102/46 XIV dated 24 March 1994.	
(1) Access to the Project Site (2.2)	
Many aspects of the environmental impact assessment have been based on access Option 1 being adopted, making use of some sections of Campus Roads, which the University has not acceded to yet, are there actually other options apart from the three, including any that may become available in a few years, for instance? When Option 2 was said to cost more with a time scale dependent on various problems to be resolved, is the cost not prohibitive and the timing just wide of the mid-nineties such that it could become a suitable alternative to replace Option 1 after few years?	Direct access to the site from Tolo Highway has been considered at the planning stage of the project. However, this access option was rejected by the Transport Department for safety reasons. Taking the current programme of the Tolo Highway widening into account, access option 2 would not be available until 1998 or later. As the lifespan of the PSK Public Dump is about 8 to 10 years (i.e. reaching its final capacity by about 2003), it is difficult to justify to adopt access option 2 at that stage which the access bridge (clear span for 8 lanes with a central column) could only be used for a few years. The cost will become prohibitive.
It is most distressing to think that the University has to put up with the disturbance and impact of over 500 truck trips right under her nose each day over a protracted time span of up to perhaps ten years. The proposal would seem a less tough morsel to swallow if relief could be found in three or four years, either by converting to Option 2 or planning another access from the North in association with the Tolo Highway widening proposal or any other means. Indeed, an alternative access route from the North in a few years appears compatible with the layout and operating programme of your Phases 2 and 3 sites.	It is understood that Highways Department would be requested to examine the feasibility of an access from Tolo Highway widening works and from the completed widened highway as part of their feasibility study.
Your indication under general benefits and disbenefits for Option 1 that there is "little conflict with existing adjacent users" apparently is an understatement. There is definitely going to be substantial conflict with existing users of the Hong Kong Institute of Biotechnology (HKIB), Marine Science Laboratory (MSL) and Water Sports Centre (WSC), pedestrians and motorists alike, trying to filter through an incessant flow of heavy trucks. Also, there will be an increasing number of University members requiring to access the facilities on the seaward side of the KCRC tracks. This particular route of access actually was suggested by the DLO/ST to the University when she requested	It is recommended that pedestrians using the ferry piers be routed under the cycle subway to avoid any crossing conflicts with the access road. Students using the access bridge on foot, visiting the HKIB, MSL and the yacht club, can be routed over the access road to avoid any conflicts.

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for a more direct vehicular linkage from her main Campus to two major sites east of the University Station likely to be developed soon.	
(2) Proposed Filling Sequences (Stages) (2.3/5.6)	
It is advocated strongly that the filling operation should be separated into more phases. Alternatively, each of your three phases should be divided into as many sub-phases as practical in like sequence you put them. The idea is to facilitate progressive but prompt restoration of each working site with hydroseeding if not minimum landscaping and surface drainage to control dust generation and reduce visual impacts.	Mitigation measures for dust control given in 5.6(d) involve progressive restoration with surface drainage & hydroseeding.
The whole of the 0.9 million m^3 of construction waste stockpiled at MOS public dump site should be transferred and disposed of at the southern part of the Phase 1 reclamation up to finished level as quickly as possible to complete the landscape mound and an extended buffer for HKIB and her staff accommodations to mitigate noise, dust and visual impacts from further works to the north. It is requested therefore that the operations suggested in Note (2) of Table 2.1 should be accelerated.	Noted.
Indeed, if the cost of double handling part volume of the construction waste is not prohibitive and MOS public dump site could continue to entertain some stockpiling, keeping it open for dumping for a longer while and then transferring the material by barge to PSK site would reduce greatly the frequency of trucks accessing through the Campus and associated impacts on the University.	The MOS public dump site will only be available until mid 1996.
(3) Activities During Construction (2.6/5.6)	
Blasting, preferably piling as well, should be prohibited. Haul roads should be surfaced at least up to beyond the mound and buffer north of HKIB.	Neither blasting nor piling are anticipated during the construction phase. It is proposed that the haul roads are lengthened as the reclamation proceeds.

Comments

(4) Noise Impact - Environmental Standards and Guidelines (4.2)

The University residences and hostels bearing receiver identification CUHK 1, 2, 3, 4, 5 and 7 had been in existence long before the formation of the Tolo Highway. The latter was incorporated without due consultation with the University or consideration on aspects of noise and other impacts meeting the EPD standards. Whilst it is felt that the Government should supplement mitigating measures to alleviate the adverse impacts on those domestic accommodations, to allege that any other new noise source capable of being masked under the prevailing exorbitant background noise would be acceptable is rather unfair to the Institution. It is unthinkable that 73dB(A) or 75dB(A) could be taken as noise assessment criterion for any domestic NSR in today's standard, such as being applied to CUHK 1-6.

As a result, suitable noise mitigating measures have not been specified for the MSL and University Residences 10/11 and 7/8, which is considered unsatisfactory.

Response to Comments

As stated in the Initial Assessment Report (February 1994), works in connection with or for the reclamation of any foreshore and sea-bed are considered by the NCO to be construction works. Accordingly, there is no statutory noise limit in connection with the works during daytime hours (07.00 to 19.00). In the Initial Assessment Report, a criterion of 75 dB(A) for day time construction noise was put forward; this was subsequently tightened to the lesser of two values (10 dB(A) over the prevailing background noise, or 75 dB(A)).

It is stressed that reclamation-related noise is not expected to reach these criteria levels. In fact, as indicated in the summary table below, reclamation-related noise levels are not expected to exceed the existing background levels except at CUHK-6 (where exceedance is anticipated for a limited time during construction of the access road) :

NSR	Range of Monitored Background Noise Levels (Table 3.1)	Maximum Predicted Construction Phase Noise Levels (Table 4.5 - 4.8) dB(A)		Maximum Predicted Operation Phase Noise Levels (Table 4.14 - 4.17) dB(A)	
CUHK1	63 - 65 dB(A)	64	earthworks for access road	64	access rd traffic and reclamation activity (combined)
CUHK2	71 - 73 dB(A)	69	seawall and access road (combined)	68	"
CUHK3	62 - 66 dB(A)	63	"	62	"
CUHK4	63 - 65 dB(A)	61	"	60	"
CUHK5	63 - 65 dB(A)	64	"	60	"
CUHK6[1]	71 - 73 dB(A)	75	"	62	"

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	It is appreciated that the University is unwillingly subjected to high background noise levels as a result of traffic on Tolo Highway. However, it would be of little use to ignore the presence of the highway and to set noise criteria based on low background noise levels that would prevail in its absence.
	Regarding the MSL, a 2-m noise/dust barrier has been proposed along the boundary between the laboratory grounds and the access road.
(5) Air Quality Impact (5.7)	
It is apprehended that the HKIB and MSL might become a maintenance burden to the University in this respect on account of the dumping operations. The project should provide for consequential costs of repair/replacement for equipment/spares owing to premature deterioration.	The report indicated the likely increase in frequency for filter maintenance and proposed the replacement of filters for the Primary air systems serving the ground and mezzanine floors, with a media type of higher efficiency in order to offset the increase in airborne particulates around the HKIB.
	The capital cost of upgrading of the primary air supply filters is likely to be in the order of HK$24,000.00. The additional cost of filter maintenance for the existing installations we consider could be in the order of HK$4,000.00 - 5,000.00 per annum. CED have indicated that they would be prepared to pay for these costs during the period of operation of the site.
(6) Visual Impact and Landscape Mitigation Measures (8.1.6)	
It is suggested to sub-divide the sites in all phases into smaller areas each to be filled up to the final level and restored with hydroseeding or suitable landscape and surface water drainage in succession as mentioned earlier in the paper to minimise dust and visual impacts.	The consultants brief does not include addressing the landscape treatment of the reclamation itself. However it is obviously agreed that any temporary landscape treatment, including hydroseeding on the reclamation will mitigate dirt and visual impacts and phased implementation of such work immediately following completion of filling is recommended.
(7) Land Use (8.2)	
The University is very concerned about future land disposal of the Pak Shek Kok area and new reclamation. She has been requesting for land areas of between 8-10 hectares at Pak Shek Kok to be alienated to the University for	The consultants brief only requires the consideration of existing land use and resultant impacts during the construction and operational phases of the public dump. Nevertheless, in due consideration of your comments Government

Comments	Response to Comments
her expanding programmes of development. It is hoped that they could be effected as soon as the KCRC tracks are realigned or at least earmarked for the University as reserve. These should be distinguished from areas of the public dump which probably would not be made available or suitable for construction in another 10-12 years. Likewise, the proposed haul road of Option 1 on the University Eastern Campus would sterilize or compromise her prospective developments there.	should perhaps give due cognisance of the University's land use requirements in future land zoning.
Some tracts of land areas at the public dump immediately adjacent to the University's boundaries should be zoned as green belt or non-building zone at least temporarily.	Beyond the scope of the consultancy brief.
The University would want more concrete assurance by the Government that her views will be sought and comments taken into account when future land disposal at Pak Shek Kok takes place. Where any proposal is made in respect of Crown Land or private agriculture land involving a modification of the lease term at the area, the matter should be considered carefully with a view to the University's requirements before any permission to develop the land concerned is given.	Beyond the scope of the consultancy brief.
(8) Impact and Compliance Monitoring (10.4)	
The various mitigating measures outlined are observed to be quite comprehensive, but their adequacy and effectiveness remain to be demonstrated. The Government should provide assurance that contingencies are there to enable any proven inadequacy in future to be supplemented as appropriate. It is necessary therefore to establish an appropriate procedure/ authority for channelling complaints and halting aggressive operations pending effective mitigating measures to be applied. The Government should provide assurance for an efficient and effective action plan for environmental audit exceedance.	In order to ensure the adequacy and effectiveness of the proposed mitigation measures, a comprehensive environmental management plan has been proposed. This comprises, among others, compliance monitoring to check for compliance of noise, air quality, marine water quality with relevant environmental legislation and regulations. In particular, two warning levels (with required reporting to EPD as the control authority) have been designated so that any proven inadequacies may be rectified before maximum pollutant levels are reached.

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In the event access Option 1 is adopted, the section of Campus Road along its route must not be deprivatised. The University should continue to have control over that length of road and a right to close it against any dumping operations if matters worsen and get out of hand. Suitable procedures should be established and agreed upon to enable the University to exercise that right.	Noted.
Minor Corrigendum	
The following discrepancies are noticed, which have been indicated to you in previous comments:	
- The MSL is a research laboratory for staff and students as well as a teaching facility (not merely for student projects)	Additional Research Applications noted - Final Text will be amended to show broader use.
- The facility adjacent the MSL is the University's Water Sports Centre (not just a Yacht Club)	Your comment concerning the university water sports centre and the MSL are noted.
- The (5 lanes) widening option of Tolo Highway apparently is not shown in Dwg No. 90406/001.	The line is shown as -1-1- but is not indicated in the legend. The legend will be updated.
The Chinese University of Hong Kong Department of Biology dated 6 April 1994	
As one of the sensitive receivers of the proposed Pak Shek Kok Reclamation - Public Dump Project, I am writing to convey our concern about its impact on our activities and to point out some inadequacies in your Draft Final Report on the project.	
(a) The Marine Science Laboratory (MSL) is a teaching and research unit of the Department of Biology, the Chinese University of Hong Kong (CUHK). At the present time, the Laboratory contains office and research facilities for 3 academic and 7 technical and supporting staff members. The laboratory offers specialized undergraduate courses in Marine Biology (student enrolment	Broader research use noted. Final text will be modified to include additional research use.

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about 70) and Fish Biology and Mariculture (student enrolment about 45). The laboratory also is the working place for 5 postgraduate (M, Phil. and Ph.D.) students and about 5-7 Senior Seminar students. A considerable proportion of the research activities of the laboratory is now funded by competitive grants from the University and Polytechnic Grants Committee (UPGC) and Croucher Foundation. Your reference to the "MSL as a research laboratory for student projects" is not correct (p.2-1 and 2-3).	
(b) On page 2-6, you mentioned that the creation of a direct link from Tolo Highway to CUHK (route Option 1) would be welcomed by the University. Since the proposed project would create disturbance to the university community for at least 10 years, such a general statement is difficult to comprehend. You also mentioned that concern with security at MSL was highlighted but this fact has never been further dealt with in your report. I might add that the whole operation would affect the security to the whole university campus and not just the MSL.	As shown in Drawing No. 90406/001, it is proposed to operate a security type check point at the gate just north of the Ma Liu Shui Ferry Piers. This would ensure only CUHK personnel, Government and public dumping licences holders could use the access road, this would also aid security. Placing the check point adjacent to the ferry pier turning area allows vehicles to be turned away without passing the gate. This requirement will be incorporated into the Final Report.
(c) On page 2-6, you mentioned that bend improvement may necessitate resuming land from the MSL. We would like to stress that this is not acceptable to the MSL as this would bring the disturbance nearer to our working site.	Land resumption will be avoided if at all possible.
(d) The noise impact on MSL during construction of the access road and operation is never addressed in 4.0 (yet is mentioned briefly on p. 8-12). The noise impact on MSL would be about the same as that on the staff accommodation next to HKIB and should have been included in the noise monitoring program. The use of a noise barrier suggested for the staff accommodation would also be appropriate for MSL.	The MSL was originally understood to be purely a laboratory, in which case its status as a Noise Sensitive Receiver was equivocal. Considered as an educational institution, in line with comment (a) above, it is explicitly a Noise Sensitive Receiver. Thus we agree with Professor Chang's concern that the MSL be included in the noise assessment. Peak hour traffic along the access road would be expected to generate a L_{eq} facade noise level of about 68 dB(A) at the nearest facade of the MSL. This basic noise level will be abated by the presence of the dust barrier. According to EPD's *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, a barrier high enough to totally screen construction vehicles

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	from the NSR offers a noise reduction of about 10 dB(A). In light of the fact that the MSL is exposed to traffic noise from the nearby Tolo Highway, we have assumed that the assessment criterion for the MSL is the same as that for NSR CUHK6 (the HKIB staff accommodation building), which is 75dB(A). Using this criterion, the access road noise level is within acceptable limits.
(e) I cannot see the logic behind recommending the erection of a dust barrier and yet saying on page 11-2 that "dust concentrations at all evaluated sensitive receivers are negligible. You recommended that a 2 m high dust barrier be erected in front of the MSL (p. 5-11). How is a 2 m high barrier justified to be sufficient to prevent dust settling on the tanks and other parts of the MSL in view of the lack of any supporting data? Besides, the barrier has to be incomplete since vacant spaces must be left for entry into the MSL. Besides, what is the negative visual impact of the dust barrier? Also, the creation of a dust barrier would create hazardous road conditions for both vehicular and pedestrian traffic as the barrier would make the trucks visible only at close range (see subsequent paragraph on road safety). These points should be addressed in your report.	In general, most of the larger particles tend to settle out within short distances and so the dust concentrations at elevated receivers should be negligible. In addition to being a dust barrier, the 2m high wall could serve as a noise barrier as explained below. We consider that a 2m high wall is sufficient to reduce noise and dust levels at MSL. Increasing the dust barrier to 4m high will cause significant visual impact. Transparent panels can be included at strategic points to aid visibility.
(f) However, I still see a dust barrier is essential for the MSL to survive. The Laboratory, besides contains seawater tanks for the culture of marine organisms, has a number of analytical, bacterial and physiological equipment housed in research and 2 teaching laboratories. These equipment are expensive and would certainly deteriorate in a dusty environment. <u>I would request therefore that the dust barrier be elevated to 4 m.</u>	See response to (e) above.
(g) On page 11-3, you mentioned that "a high wind from the north or north west the sediment plume could extend as far as the intake of the MSL where suspended solid concentrations could increase by upto 13 mg/l above the background". How "high" is the wind? May I stress that for several months of a year, we would be expecting northerly winds. Furthermore, you seem to be contradicting yourself by saying on page 7-9 that "The sediment plume modelling indicates that even without suitable containment there will not be	The wind speed which results in the plume extending to the MSL is 12 m/s (Table 7.4) which have a frequency of 10 times per year. The assumptions made for the sediment plume modelling are outlined in section 7.4.4 and assume a width and depth average concentration. Sediment losses are based on a $3m^3$ open grab with no silt screen surround. The use of a silt screen would be expected to reduce the loss from 5% to 2% and a sealed

Comments	Response to Comments
elevated levels of suspended solids in the area of the MSL intake". By the way, a full evaluation of the validity of your claims cannot be made since not enough details of your modelling methods have been given in your report. In this connection, I requested that you consider building an extension pipe for our seawater intake so that we can obtain reasonably good quality water from the central areas of the harbour.	grab within the screen to 1%. Therefore with mitigating measures, increased concentrations would be one fifth of those predicted and give rises to values of up to 2.5 mg/l above the present background, an extension of the outfall is not considered necessary.
(h) On page 6-7, you mentioned "A mitigation measure to reduce dust emissions is proposed by the installation of wheel and under body washing facilities at the exit from the site. Such a procedure will produce an effluent high in suspended solids which may also contain fuel and lubricant hydrocarbons. If allowed to run into the Harbour this would produce a visible sediment plume and possible surface oil film". It is statements such as these that the MSL is deeply concerned. The site exit is very close to our seawater intake and presumably the washing effluent (freshwater?) has to go into the harbour. Your report has not considered any mitigation measures regarding this point.	Section 6.7.2 para 6 recognised the need for recirculation, settling of suspended solids and aqueous phase treatment. Concern over the disposal of the washing facility's wastewater is understood. As mentioned above in responses to CED's comments, the wastewater can be expected to contain a high concentration of suspended solids and some oil and grease. Therefore, a multi-chamber sedimentation tank of adequate capacity must be provided, along with an oil/water separator. Flocculation using alum may be required to achieve adequate removal of suspended solids. The treated wastewater should be redirected to the vehicle washing facility for reuse.
(i) I should point out that many areas of your report do not seem to be done scientifically. For example, on page 6-2 table 6.3, you mentioned "dangerous substances", what are these substances? On page 6-4 table 6.4, "toxicants", settleable solids adversely affecting benthic communities", what are these?	The phrase 'dangerous substances' is that used in the WP2 - Water Quality Objectives for the Sewage Strategy Study. 'Toxicants' and 'settleable solids ...' are used in the Water Quality Objectives for the Gazetted Water Control Zones. Both were used to be consistent with the source documents. Substances which qualify as 'dangerous' are those which require controlling on grounds of their toxicity, persistence and bio accumulation. The original Lists I and II of the Paris and Oslo commissions have been incorporated into the European Community Dangerous Substances Directive. Included in List I are Mercury and Cadmium compounds, PCBs, HCH, DDT, Aldrin, Endrin, Dieldrin. Included in List II are the heavy metals, Hydrogen Sulphide, Ammonia, organo tins and Chloroform. Settleable solids adversely affecting benthic communities' refers to concentrations of suspended solids settling from the water column which will

Comments	Response to Comments
	compromise the survival of the benthic community in terms of blocking of borrows, impairment of feeding and accumulation rates which exceed the rate and which the community can re-establish itself.
(j) Finally, I should point out that we deeply regret that the Pak Shek Kok Reclamation has to be imposed upon us. We note that the whole project would last for about 10 years (including the time for building the access road) and would have an operation time of 0800 - 1800 Mondays to Saturdays. Trucks are estimated to pass directly in front of the MSL at a frequency of about 1 per minute and at peak times at about 3 - 4 per minute. Even with all the noise, dust and sea water quality factors discarded, we would still be faced with the problem of road safety. Including students and staff, we have about 100 people frequenting the MSL for classes and work. With trucks running at this frequency (and often high speed), I am deeply worried about the safety of our students and staff travelling to the MSL (both vehicular and pedestrian traffic). Furthermore, difficulty in launching our boat in the middle of a huge pile of truck traffic is envisaged. We have to move our boat from the MSL to the slipway via the proposed truck access road. May I suggest that you seriously consider the possibility of building an access bridge (flyover) for pedestrian and vehicular traffic from the present bridge to the MSL. The bridge would also serve any traffic going to the Water Sports Centre.	Vehicle numbers visiting the Ma On Shan Public Dump Site show a strong positive skewed distribution due to the relatively few days during which high numbers visit the site. 1% and 4% of the traffic is represented by the >500 and 450-500 vehicles/day classes. At PSK this would amount to 788 and 3150 vehicles annually giving return periods of 0.005 and 0.02 years (1.5 and 6.6 days/year) respectively. At the peak numbers predicted for PSK, 585 vehicles/day, equivalent to 1170 movements/day, this represent an hourly average of 117 movements per hour. Analysis of movements of vehicles delivering construction waste to the Shuen Wan Landfill site, and confirmed by observation at Ma On Shan, shows a bimodal distribution through the day with peaks mid morning (1000-1100 hrs) and mid afternoon (1400-1500 hrs). The morning peak is 1.3 x daily average, therefore the maximum traffic flow pass the MSL is likely to be 2.5 movements/minute and this is only likely to occur an average 1.5 days/year. A flyover for vehicular traffic from the present bridge is not considered necessary. Students and lecturers using the access bridge on foot, visiting the HKIB, MSL and the yacht club can be routed over the access road by way of the rampway footbridge shown in Drawing No. 90406/001 to avoid any conflicts.
Civil Engineering Department Reg. (9) in SW 3612 IV dated 7 April 1994	
2.2.5 Comments on Working Paper Para. 9 The drawing no. 90406/001 is mis-quoted.	The line of the Highway widening is shown as -1-1- but is not indicated in the legend. The legend will be updated.
2.3 Proposed Filling Sequence (Stages) Para. 2 Please revise the life span of Phase 1 reclamation to be about 2 1/2 years.	Life span will be revised in Final Text.

Comments		Response to Comments
2.5	Contract Arrangement	
	It is anticipated that the reclamation will be implemented through 3 consecutive contracts in which Design and Build element for constructing seawall foundation may be included. Please delete the second sentence of this paragraph. The duration of the first contract is anticipated to be 2 1/2 years, while the second and third contracts will cover the remaining part of the reclamation.	Text will be modified in line with the comment.
5.6	Mitigation Measures for Air Quality Impact	
(a)	Paved Access Road	
	Please provide further details and suggested model of the wheel and underbody washing facility recommended to be deployed from which the claimed mitigation effect can be achieved. Please also indicate the suggested location for the installation of this facility.	A sophisticated vehicle washing system uses high pressure water streams to access the entire undercarriage of the vehicle (including tyres) as well as the body. Such a system is currently in use at transfer stations in Chai Wan and Kowloon Bay. A dusty vehicle drives into a structure that houses an array of water nozzles capable of washing down the vehicle from the top, sides and bottom. The vehicle washing system generates wastewater that must be collected for treatment. The wastewater can be expected to contain a high concentration of suspended solids and some oil and grease. Therefore, a multi-chamber sedimentation tank of adequate capacity must be provided, along with an oil/water separator. Flocculation using alum may be required to achieve adequate removal. of suspended solids. The treated wastewater will be redirected to the vehicle washing facility for reuse. The washing facility should be located at the point where vehicles exit the reclamation site onto the paved road surface. As the reclamation progresses past Phase I, we would recommend that the access road along the reclamation be progressively paved, so this point may move over time.

Comments	Response to Comments
(c) Stockpiles	
Please elaborate further the chemical treatment mentioned.	Chemicals used to reduce dust emissions act by reducing interfacial surface tension to agglomerate micron sized dust particles. They also lower the surface tension of water to create a more effective spray. The chemical is normally obtained in a concentrated liquid form, then diluted with water and sprayed. Dilution may be either in-line, using a metering pump, or in a dilution tank. The diluted suppressant is sprayed onto the exposed dust-generating surface, where it contacts, confines, and agglomerates dust particles. Once applied, the agent retains its dust suppression characteristics, so that little or no further treatment is required unless a fresh surface is exposed. The product is generally non-toxic for inhalation when sufficiently diluted. Undiluted, the chemical may cause contact irritation.
Para. 1, page 5-11 — Please provide further details on the "2m high specific dust barrier" to be erected between MSL and the proposed access road, on which the assessment is based.	The purpose of erecting the 2m high dust barrier is to prevent the advection of dust-laden air towards MSL. As the dust is expected to arise from the re-entrainment of the dust particles by vehicles moving on the access road, it is considered that a 2m high wall would serve the purpose. This would also serve as a noise barrier for MSL.
11.1 Noise	
Para. 8 The second sentence should read "Since the public dump will be closed ... ". The public dump of this site will close on Public Holidays and Sundays, not the whole site. Nevertheless, the construction activities carried out on those days are still under various statutory controls, e.g. the provisions of the Noise Control Ordinance.	The text will be changed accordingly.
11.2 Air Quality	
Para. 4 The meaning of the second sentence, "... combined with large source ....". is unclear.	The text will be changed to "Due to the limited construction area involved and the large source-to-receiver distances, increases in dust..."

Comments	Response to Comments
11.3 Water Quality and Sediments	
para. 2 The last sentence should read "... EPD Class C, seriously contaminated, category".	'Seriously' will be inserted in Final Text.
General	
Pursuant to Clause 6.2.1, of the Brief, you are required to prepare cost estimate for the proposed mitigation measures. Please submit the estimate as soon as possible.	Cost for mitigation measures will be calculated for inclusion in the Final Report.
Royal Hong Kong Police - Traffic Wing Ref (28) in CP/T/TMB 151/30 Pt. 41 dated 28 March 1994	
I have no comments.	Noted.
Civil Engineering Department Port Works Division Ref (55) in PWO 24/1201/93 dated 29 March 1994	
I refer to Chief Engineer/Solid Waste, CEO, CED's memo ref: (41) in SW 3612 III dated 18.3.1994 forwarded to me among others, and wish to inform you that I have no comment on the captioned draft report.	Noted.
Marine Department, Ref (18) in PA/S 909/100/7 (2) dated 8 April 1994	
Please be advised that I have no comment to offer on the Draft Final Report.	Noted.
New Territories North Development Office, Ref (58) in NTN TPF 1/1/25 dated 28 March 1994	
I refer to CE/Solid Waste's memo ref. (41) in SW 3612 III dated	Noted.

Comments	Response to Comments
18.3.94 and have no comment to offer on the Draft Final Report.	
Sha Tin District Office, Ref (2) in ST 4/73 III dated 7 April 1994	
I have no comment on the Draft Final Report.	Noted.
Tai Po District Office, ref (69) in TP 88/61/77 A II dated 9 April 1994	
Please be informed that this office has no particular comment on the captioned report.	Noted.
Environmental Protection Department, Ref (27) in EP 2/N5/13 III dated 8 April 1994	
Air Quality	
General Comments	
Board on the findings of the captioned DPD, it is revealed that task the hourly and daily TSP concentrations are in exceedance at several of the ASRs even dust mitigation measures were implemented. Therefore, it is concluded that the captioned public dump is unacceptable from air point of view. However, should CED wish to proceed with this project, then you should assess any further dust suppression measures necessary to improve the dust impact to acceptable levels. This should be demonstrated by means of modelling.	Further dust suppression measures have been mentioned in the text on p.5-11 but, as EPD has pointed out, their effectiveness has not been modelled. We have performed an additional FDM run to determine predicted TSP concentrations with the adoption of further dust suppression measures which greatly reduce the dust levels at those sensitive receivers (CUHK-6, HKIB, and MSL) near the access road. US EPA's AP-42 states (in Section 11.2.6.4) that "control efficiencies on the order of 50% on a paved road with moderate traffic (500 vehicles per day) requires cleaning of the surface at least twice per week". We have adopted this reduction factor, although we recommend a more frequent cleaning schedule of twice per day. Resulting hourly and daily TSP averages at CUHK-6, HKIB and MSL (the ASRs subject to excessive TSP concentration in Tables 5.7 to 5.10) are given in the following table.

Comments

Response to Comments

Predicted Daily and Hourly TSP Concentrations at Selected Sensitive Receivers with Further Dust Suppression Measures

SR Identification	TSP concentration ($\mu g/m^3$ during use of realigned access road and operations at Phases 1, 2 or 3
24-hour concentration (exclusive/inclusive of background TSP)	
CUHK-6	49/186
HKIB	33/170
MSL	40/177
1-hour concentration (exclusive/inclusive of background TSP)	
CUHK-6	308/493
HKIB	237/402
MSL	329/494

TSP concentrations at the other ASRs decrease or remain the same; they are therefore not included here as they do not exceed AQO or EPD criteria in Tables 5.7 to 5.10.

Modelling results indicate that with further dust suppression measures, the dust concentrations at the worst affected ASRs will be within the AQO.

Comments	Response to Comments
Specific Comments	
(a) Section 5.1, 3rd Para. Pg. 5-1	
You should confirm that there will be no odour problem arising due to embayment of stormwater and foul drainage outfalls by the dumping site;	The water quality impact assessment in the DFR (Chapter 6) concluded that no significant change to the hydrodynamics of the harbour resulting in alterations of the flushing characteristics were to be expected (ref Section 6.7.2). Within the nullah, the increase in the length by 450m is not expected to result in any deterioration in water quality in either the existing section or the extension (ref Section 9.2). Tolo Highway drainage, which currently discharges directly into Tolo Harbour, will be rerouted into the nullah as existing outfalls are blocked by reclamation. It is not expected that the diversion of surface water from outfalls into the nullah will have any adverse effect on local water quality (ref Section 9.3). In the absence of any significant changes in the harbour hydrodynamics and to water quality in the nullah, conditions leading to a deterioration in odour are not anticipated. In fact, the introduction of a sewerage system in the area can be expected to reduce sewage loadings in the nullah and harbour, and thus odour. Currently, village septic tanks discharge into the Tai Po Mei Hang and Cheung Shue Tan Hang streams, which in turn discharge into the nullah and Tolo Harbour. Sewage improvement works for Wong Nai Shai and Pak Shek Kok will be carried out between 1996 and 2000, and further villages will be sewered between 1997 and 2002. Thus, this source of odour will be progressively removed.
(b) Foot Note to Table 5.7, Pg. 5-9	
You should provide assumptions and explain how the haul road emissions could be reduced by 86%,	The assumptions behind the 86% reduction in haul road emissions are contained in Section 5.6(a). The reduction in emissions by a factor of 7 is related to the use (in the AP-42 emissions equation) of an "industrial road augmentation factor" (I), which is 7.0 for an industrial roadway which traffic enters from an unpaved area, and 1.0 for an industrial roadway in which traffic

Comments	Response to Comments
	does not travel on unpaved areas. AP-42 recommends that a value between 1.0 and 7.0 be estimated to best represent the extent to which vehicles track dust from unpaved areas and unpaved shoulders. The unmitigated scenario shown in Tables 5.2 to 5.6 assumed I=7.0 to reflect direct transit of dump trucks from the unpaved reclamation surface to the access road, and uncontrolled travel along unpaved shoulders. The mitigated scenario (Table 5.7 to 5.10) assumed I=1.0 to reflect use of a very efficient vehicle washing system (as described on p. 5-8) to remove dust from wheels and undercarriages, combined with measures such as roadside kerbs and barriers to prevent travel on unpaved shoulders. In either case, spillage from entering vehicles is assumed to be minimal after the length and speed of their journey to the dump site, during which loose materials can be expected to have already spilled.
(c) Finally, it is suggested that you should also present the annual TSP impact for comparison with the TSP annual AQO value.	The annual TSP impact has been modelled using the one-year sequential data obtained from the RO. Modelling results are presented in the following tables: Under unmitigated condition, the annual TSP concentrations at CUHK-6 and HKIB exceed the TSP annual AQO concentration of 80 $\mu g/m^3$. With the implementation of the recommended mitigation measures, the dust concentrations at all ASRs are well within the TSP annual AQO value.

Predicted Annual TSP Concentrations at Selected Sensitive Receivers under Unmitigated Condition: Operations at Reclamation and Access Road (includes Stockpile Emissions)

SR	TSP Concentration ($\mu g/m^3$)	SR	TSP Concentration ($\mu g/m^3$)
	Annual		Annual
TPK1	18	CST-1	26
TPK2	18	CST-2	28
LL1	17	CUHK-1	3
LL2	24	CUHK-2	37
VC	41	CUHK-3	15
SCH	50	CUHK-4	6
TPR	12	CUHK-5	9
WNF	18	CUHK-6	268
PM	19	CUHK-7	11
TPM	13	HKIB	146
		MSL	34

Mitigated Annual TSP Concentrations at Selected Sensitive Receivers: Operations in Reclamation and Access Road (included Stockpile Emissions)

SR	TSP Concentration ($\mu g/m^3$)	SR	TSP Concentration ($\mu g/m^3$)
	Annual		Annual
TPK1	5	CST-1	4
TPK2	6	CST-2	4
LL1	7	CUHK-1	1
LL2	11	CUHK-2	6
VC	18	CUHK-3	3
SCH	28	CUHK-4	1
TPR	2	CUHK-5	1
WNF	3	CUHK-6	38
PM	3	CUHK-7	2
TPM	2	HKIB	21
		MSL	5

NOTE: Mitigation measures are described above, and are assumed to reduce access road emissions by 86%, reclamation emissions by 25%, and stockpile emissions by 25%.

Comments	Response to Comments
Water Quality	
Section 3.4.3, Pg. 3-10	
Concentrations of suspended solids appear to be significantly greater at the four monitoring stations off Ma On Shan than at the EPD station, TM2, further offshore. Can you provide the probable explanation?	Trucks were delivering to Ma On Shan only during the latter half of the month of May following a period of over three months during which time no deliveries were made by truck. The concentrations of suspended solids shows no significant time trend over the month and is clearly not related to the increase of truck arrivals. The positions of the sampling stations A to D are within 50 m of the seawall while the EPD monitoring station, for which the reported suspended solids concentrations measurement for May is lower than those for stations A to D, lies approximately 400 m offshore. There are no data to indicate the concentration gradient perpendicular to the seawall and hence the extent of the increase in concentration. It is not possible to determine the origin of the suspended solids which gave rise to the increase.
Section 3.5.3, Pg. 3-19	
From the data presented in Table 3.22, the surface layer at station SM1 appears to be Class C with respect to nickel.	Value checked. Correct concentration is 6.4 mg/kg giving Class A classification.
Section 6.6, Pg. 6-7	
Related to the earlier comment - does the experience of elevated SS concentrations at Ma On Shan imply that similar post completion impacts could be expected at Pak Shek Kok?	(Refer to response to Section 3.4.3, Pg.3-10 above.)
Section 6.7.2, Pg. 6-8	
The proposed 'mitigatory measure' to dump at least 100m from the end of the seawall does not look to be adequate given that the majority of suspended solid material is expected to be carried an equivalent distance even under calm, low wind conditions. I do not support the proposal to begin	Table 7.4 gives concentrations of suspended solids resulting from dredging using a non sealed grab and without the use of a silt screen. Placement of the fill will be by end face tipping from trucks. For the Green Island study modelling of the plume resulting from the fill material assumed that fines made up 22.5% by

Comments	Response to Comments
dumping operations before completion of the full length of the seawall for each phase - particularly for Phase 1, which is closest to the MSL and Sha Tin seawater intakes.	volume of the construction waste and that losses from bottom opening door barges are 3%. Using same fines content, a loss rate of 5% as provided by EPD, with a dumping rate of $180m^3$/hour ($530,000m^3$/year) in the simple box model used for the dredging plume gives the following figures, for a face width of 20m and plume width of 100m.

Width Average Concentration (mg/l)					
Current Speed (m/s)	Plume Average•	Face	50m	75m	100m
0.02	28	141	28	14	0
0.05	11	56	18	16	14
0.08	7	35	12	11	11

The current velocities in the region of the face will be low because of the short fetch of the wind and consequently will be less than 0.05 m/s. Concentration at the end of the seawall would be expected to be no more than 14 mg/l. The use of a silt screen around the dumping face would be expected to reduce the losses to the surrounding water by a factor of 2.5, this would result is a reduction to approximately 5.5 mg/l above background at the end of the seawall..

Advection, dispersion and settlement of the suspended solids over the distance between the end of the wall and the MSL would result in concentrations which were not detectable with respect to the background. Therefore a wall length of 100m in considered sufficient to protect the sensitive receivers.

Comments	Response to Comments
Surface booms to trap floating debris should support underhung nets.	Boom design would include hanging net or skirt as used at Aldrich Bay.

Comments	Response to Comments
In addition, scavenging sampans should be employed whenever tipping is in progress.	Continuous removal of floating debris will be proposed.
Section 7.4.4, Pg. 7-4	
Float release simulation: The findings of the simulations (Figs. 7.6 to 7.9) are inconclusive because :-	The findings of the report did not depend on the float tracks and, therefore, the assumed sediment plume paths, being directed away from the MSL and WSD intakes. The report assessed the likely elevations in suspended sediment concentrations which could occur as a result of the sediment plumes being transported towards the intakes according to the transport directions indicated by the float tracks.
(a) Only the wet season neap tide simulation (Fig. 7.7) indicates a track directed away from the MSL or WSD intakes.	
(b) The effect of the stream flow on circulation pattern should be less in dry season, and cannot be concluded from the one tidal cycle float tracks.	The expected flows in both wet and dry seasons were inferred from the results of a previous model of wet and dry season tidal flows. This model had a limited resolution (250m) but was considered to illustrate the main features of the near coastal flows in the area of interest. In generating the float tracks, only one tidal cycle was considered because, assuming the sediment has a settling velocity of the order of 1mm/s and that the water depth is of the order of 5m, all sediment losses should settle to the sea bed in approximately 1.5 hours as given in Section 7.4.4 of the draft final report. While some small percentage of the sediment losses might remain in suspension longer than 1.5 hours, to consider the fate of suspended sediment after more than one tidal cycle (25 hours) would not be useful because the concentrations should be vanishingly small.
(c) The tidal circulation (~0.02 m/s) has a relatively minor role in the transport fate on pollutants (especially for settling sediment) in comparison with the more dominant wind driven currents (~ 0.09 m/s).	The relative importance of wind and tidally driven currents was considered in the report and is summarised in Table 7.4 which give distances travelled by the plume under 0, 6 & 12 m/s winds. With a wind of 6 m/s (= current 0.09 m/s) the depth averaged concentration at 440m down current of the point of the seawall nearest to the MSL would be 10-15 mg/l above background. With mitigation measures this would be 2-3 mg/l. As works progress the dredging will more further away from the MSL and hence concentration increases would decline during the dredging programme.

Comments	Response to Comments
Hence the simulation cannot conclude if the proposed reclamation will or will not affect the MSL or WSD intakes.	The above shows that the MSL and proposed WSD intakes should not be affected.
Oxygen demand : The claimed compliance with WQO (and possibly targets for MSL and WSD) is incorrect because :- (a) The claim only considered the dredging induced COD of 1.25 $g/m^2/d$ under a wind speed of 6 m/s. (b) All other OD contributing factors (including the background) were ignored.	The background oxygen demand figure provided by EPD in their comment and the additional load imposed by the dredging together give a demand of 5.2 $g/m^2/d$. This would cause the depth average Dissolved Oxygen concentration to fall to 3.7 mg/l which is below the WQO. The use of a sealed grab within a silt screen will reduce the suspended solids oxygen demand by a factor of 5, this will in turn reduce the area demand to 4.2 $g/m^2/d$ and consequently only reduce the dissolved oxygen to 4.3 mg/l which meets the WQO value of >4 mg/l.
According to EPD's Marine Water Quality Report 91, the inner Tolo Harbour BOD, is 2.3 mg/L Ultimate BOD ~ 3.4 mg/L). This is equivalent to an OD rate of 3.9 $g/m^2/d$ (@ assumed deoxygenation rate of 0.23 /d).	
The total OD rate (dredging + background) is thus 5.2 $g/m^2/d$ which exceeds the WQO of 4.7 $g/m^2/d$. However, as the targets for MSL/WSD are not indicated in the report, we are unable to ascertain if these are met.	DO requirements for MSL and WSD are given in Table 6.5 being > 10-30% saturation and > 2 mg/l respectively.
A minor note that the oxygen demand under static and 6 m/s wind conditions should read 7 $g/m^2/\underline{d}$ and 1.25 $g/m^2/\underline{d}$, respectively, instead of 7 g/m^2 and 1.25 g/m^2 in the last paragraph of the Section.	Units will be corrected.
Table 10.3	
Zn should be included as a 'Group A' water quality parameter. Consideration should also be given to adding BOD to 'Group B'.	Table will be amended to include Zn and BOD.

Comments	Response to Comments
Section 10.4(c), Pg. 10-10	
The marine quality 'Target Levels' need some revision. The Target Levels should be based on the gazetted WQO where this is appropriate for the parameter in question. However, the purpose of the Target Level goes beyond the need to ensure compliance with the WQOs. The primary function is to provide adequate protection for those sensitive receivers that may be adversely affected by the project. Target levels are therefore required for other key parameters for which no appropriate WQO exists (e.g.S S). For some parameters, the Target Level adopted may need to be more stringent than the gazetted WQO to ensure adequate protection of particularly sensitive receivers (e.g. MSL water intake).	Responses are given in the expanded comments from EPD dated 11 April 1994 below.
Facilities Planning	
Para. 2.1.1	
You are required to clarify or confirm whether reinforcement bars are accepted by this public dump.	Under the dumping licence reinforcement bars will not be accepted.
Para. 2.1.2	
Based on the proposed implementation programme, the PSK-PD would not be commissioned until Oct. 95. By then, the SWL should have been exhausted and NENT Landfill should have been commissioned and would not accept inert construction waste (more than 20% inert materials).	This highlights the need for the PSK dump to be commissioned.
Para. 2.5	
The proposed contract option (DBO contract) should be further addressed under separate study.	Noted.

Comments	Response to Comments
Environmental Protection Department Ref (28) in EP 2/N5/13 III dated 11 April 1994	
Water Quality	
Re. Table 10.1, the monitoring of parameters : total lead and total copper during "Impact and Compliance" stage is applicable to period when there are dredging activities on-going at the site. Once the dredging work has been fully completed, the monitoring for these two parameters can cease.	Table 10.1 will be modified to show monitoring period for dredging period only.
Re. Table 10.2, and para. 10.2.4, the parameters to be monitored during "post Project" stage should be the same as those for the "Impact and Compliance" stage and "Baseline" stage rather than simply monitor for turbidity and DO. Meanwhile, the duration for the Post Project monitoring can be reduced to 6 weeks.	Table and text will be changed to show modified monitoring.
Re. para 10.2.2(c)(i) and Table 10.2, the report does not contain any map or drawing showing the locations of the eight proposed water quality monitoring stations.	Figure showing stations will be included in Final Report.
Re. para. 10.3.1(a), the target levels for water quality will be set based on the Water Quality Objectives (WQO) of the Tolo Water Control Zone when applicable and EPD should be consulted on this matter. Besides, I cannot understand why the report say that "the target levels .... based on the guidelines given in Table 10.1" whereas this table is merely related to what to be monitored at what frequency at which stage.	For Table 10.1 read Table 10.6.
Re. Table 10.6, the setting of TAT levels on parameters such as odour, colour, visible foam, oil and etc. are not appropriate. The contractor and engineer should always ensure that offensive odour, tints, colours, visible foam, oil and grease, scum and litter are always absent at the site and as a result of the site's activities.	Reference to TAT will be removed.

Comments	Response to Comments
Re. Table 10.6, trigger level for E.coli should not be set at this stage but rather after the baseline monitoring has been performed when the relevant baseline data are available. The "Action Level" for E.coli should be "running geometric mean of latest 5 monitoring days not to exceed 610 CFU/100ml". The "Target level" proposed is acceptable.	Table will be modified in line with comment.
Re. Table 10.6, similarly trigger and action levels for Dissolved Oxygen should not be set at this stage and should rather be established when the baseline monitoring has been completed. The target levels proposed for DO at bottom and at surface and middle are in line with the WQO and hence are acceptable.	Table will be modified in line with comment.
Re. Table 10.6 TAT levels for turbidity and SS, normally the WQO will be applied to assign the target levels. Hence the target levels for both turbidity and SS shall most likely be 130% of value of control station. Whether "mean difference" will be added on top of this "130%" will depend on whether the baseline data review that there are statistically significant differences between the control stations and the impact stations. If such differences really exist, "mean difference" will be added as a compensating or correction factor. Once again, trigger and action levels are too early to be consolidated at the EIA stage.	Mean difference corrected was included to indicate method of correcting for differences between control and impact stations. Text and table will be modified in line with the comment.
Re. Table 10.6 TAT levels for turbidity and SS, the target level in form of "130% of control station value" shall only apply to the three stations at Phase 1 - 3 seawall. Target level for SS and turbidity at Taipo and Shatin Pumping stations shall be set at a level agreed with and accepted by the operation authority (probably the WSD) of the two pumping plants. The Target level for SS for Yim Tin Tsai Mariculture Zone should be 50 mg/l according to the recommendation from AFD. Also based on the last para. of 10.4(c), before the setting up of silt screen around MSL's seawater intake, the target level of SS at the MSL station shall be set as 20 mg/l.	Table and text will be modified in line with Comments.

Comments	Response to Comments
Re. Table 10.6 TAT level for ammoniacal N, the running mean for trigger and action should be calculated based on the 5 latest monitoring results of the same stations. Although at first glance, the trigger and action level proposed by you agreed pretty well the data from EPD's own routine marine monitoring stations nearby, this set of TAT level should still be regarded as "tentative" one which is subject to revision upon availability of baseline data.	Table will be modified in line with comment.
Re. Table 10.6, setting of TAT levels for Nitrate and Nitrite is not required but instead Nitrate N, Nitrate N and Ammonical N shall be summed up to give the "Total Inorganic Nitrogen" and a set of TAT levels shall be set on this parameter. The TAT level for "Total Inorganic Nitrogen" can hardly be set at this stage without having some solid baseline data on hand. Anyway, this set of TAT can be consolidated upon completion of baseline monitoring.	Table will modified to combine separate to inorganic nitrogen forms into one combined parameter.
Re. Table 10.6, setting of TAT levels for TKN and total PO4 may not be essential. It may be advisable to analysis and interrupt the two parameters in somewhat long-term basis rather than day-to-day TAT compliance checking to see if there is any clear trend of water quality deterioration in these two aspects.	Table and text will be modified in line with comment.
Re. Table 10.6 Trigger and Action levels for Pb and Cu, I cannot understand the rationale nor can I find any supporting data in this EIA report based on which they come up with such proposed figures. In this regard, I am not convinced by the trigger and action level proposed by you at this stage. Trigger and Action level shall better be set after the baseline data are available.	Trigger values taken from Table 7.5 which contains UK marine water quality standards for Pb & Cu given as dissolved phase annual means. Action level taken as 2 x trigger value. Table will be modified in line with comments.
Re. Table 10.6, according to the WQO of Tolo WCZ the target level for chlorophyll-a should be less than 20 $\mu g/l$ in terms of the running mean of the 5 latest monitoring results being less than 15 $\mu g/l$. It seems acceptable to skip trigger level for this parameter.	Table will be modified in line with comment.

Comments	**Response to Comments**
Re. Table 10.7, the format of the "Action Plan for Marine Water Quality Exceedance" is not quite appropriate. It should contain another column which stipulates the "Action by Contractor" as well. Table 10.5 in the same report is a good example of the format of a typical Action Plan. It is alright that the Action Plan divides TAT exceedance cases into 3 or 5 events or categories. However, the Table 10.7 did not cover the event for one or more consecutive exceedance of Target value(s).	Table 10.7 will be extended to include additional column for contractor's action and additional rows for exceedences of Target Value(s).
Re. 10.4(c) last para., it should be mentioned that the target level for suspended solids (SS) for monitoring stations at Taipo Seawater Pumping Station and Shatin Seawater Pumping station should be established in consultation with the operation authority (probably the WSD) of the two plants. In case the SS level exceed the agreed target values, provision and installation of silt screens should be made by the contractor to protect the intakes.	Target levels for flushing water quality have been provided by WSD and are given in table 6.5. The value for SS is 10 mg/l the value should be confirmed with the Operating Authority before the plants become operational.
Re. App. C para. 1.4(b), the turbidimeter does not necessarily have to contain a cable but must be capable of measuring turbidity between 0-200 NTU. The "Partech Model 700 3RP Mark 2" quoted is a somewhat obsolete model, "Hach 2100P Turbidimeter or similar approved" seems more appropriate.	Text will be modified in line with comment.
Re. App. C para. 1.4(d), the Seafarer 700 model thereby quoted is also an obsolete model while "Seafarer 701 or similar approved" seems to be better.	Text will be modified in line with comment.
Re. App. C 1.5(b) 6th para., the first sentence should be amended as "Should the monitoring ...., in the opinion of the Engineer based on the established TAT levels, be indicative of a deteriorating situation ....".	Text will be modified in line with comment.
Re. App. C 1.5(b) 7th para., delete the phase "AWWA Standard Methods for Analysis for Water and Wastewater".	Noted. Reference to AWWA method will be deleted.
Re. App. C para 1.8, it should be mentioned in this para. that the Contractor must react and implement mitigations as according to the agreed Action Plan in case of exceedance of TAT levels. Also at the end of the	Text will be modified in line with the comment.

Comments	Response to Comments
paragraph, it should be mentioned that in case the Contractor fail to implement to essential mitigating measures or the water quality deterioration persist despite these mitigating measures, the Engineer can instruct the Contractor to suspend the marine work temporarily until the Engineer is convinced that proper mitigations have been implemented and the water quality is restored to acceptable level.	
District Lands Office Shatin Ref (10) in LND/ST 8/164 II dated 8 April 1994	
I refer to your above Draft Final Report and would like to advise you that the layout of Kowloon-Canton Railway Corporation's proposed temporary access and cycle track diversion at Ma Liu Shui Pier has been revised as shown in Figure 3 of the attached Traffic Impact Assessment Report prepared by MVA Asia Limited. The layout plan showing the work to be done by Kowloon-Canton Railway Corporation on your drawing no. 90406/001 should be amended accordingly.	The layout shown in Drawing 90406/001 sent to KCRC on 9 March 1994 shows the most recent layout.
Highways N.T. Region Ref. ( ) in HNT 713/TP/26 dated 29 March 1994	
Referring to the above, please note that there is a nil return from this Region.	Noted.
Agriculture and Fisheries Department Ref. (13) in AF DVL 07/8X. Dated 15 April 1994	
Please be advised that we have no comment on the captioned report.	Noted.
Transport Department Traffic Engineering (NT/E) DIV. Ref. NR 182/200-26 Dated 12 April 1994	
I have the following comments on the access road design (Drawing No. 90406/001 refers) :-	

Comments	**Response to Comments**
(i) Parking facilities for existing ferry piers	
The current proposed parking bays will be located right next to the main access and are to be immediately in front of the gate check point. To avoid causing any unnecessary disruption or hazard to the through road traffic as well as vehicles using the car park, I suggest that the parking stalls should be relocated reasonably off from the main carriageway with separated exit and ingress points to ensure safe manoeuvring and minimise the possible road side idling/waiting by vehicles using the facilities. In order to incorporate the above amendment, the check point location as currently proposed should also be adjusted to suit. A copy of part plan showing my suggested layout is attached for your reference.	Drawing will be amended to include suggested layout.
(ii) Open area in front of pier concourse	
The existing open area in front of the pier concourse is a convenient and popular place where cyclists/picnickers tend to assemble or take rest. In view of the situation that the proposed replacement cycle track across the area will bear a significant level difference from the adjoining area, consideration should therefore be given to providing replacement footpath, railing, directional signs etc to direct pedestrian in a safety manner to the existing walkway opposite the proposed road.	Replacement of footpath will be incorporated into the drawing. Other details such as railing, directional sign etc. should be provided during the detailed design stage.
It is further noticed that the proposed replacement cycle track will encroach upon part of the existing pier concourse. Presumably comments from Port Works of ASD should be sought before finalising the scheme.	Noted.

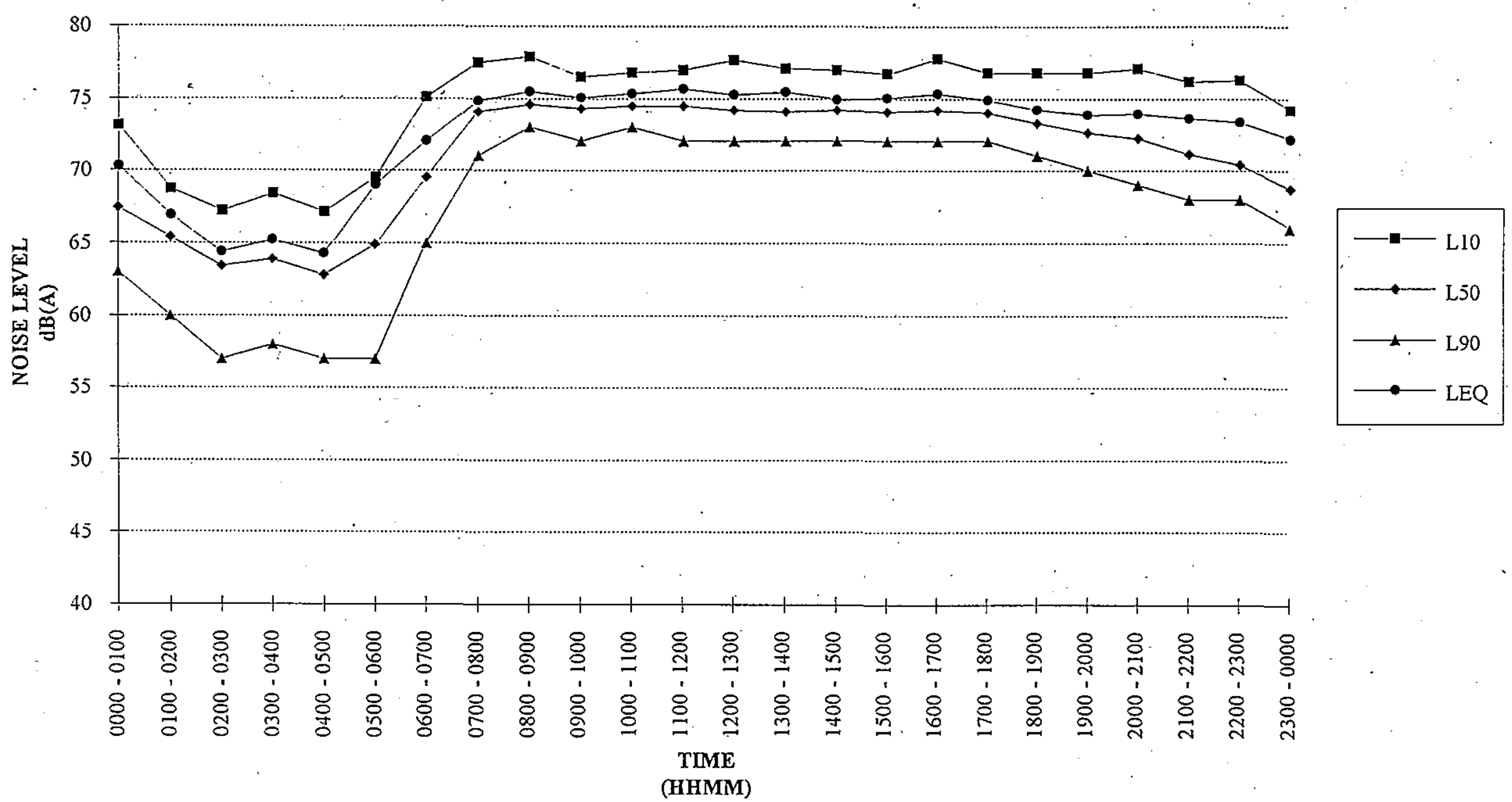
Comments	Response to Comments
District Planning Office, Shatin and North East, Planning Department Ref (10) in PD/TP 3/14/2 (II). Dated 14 April 1994	
This Office has the following comments on the captioned Report :	
(a) Section 8.1.2 (a)(iii), second paragraph	
'Government Institution and Community facilities (GI/C)' should read 'Government, Institution and Community facilities (G/IC)'.	Text will be amended accordingly.
(b) Section 8.1.2 (b)(iii)	
'A/TP/58' is only the section 16 planning application number for the proposed residential development at ST. Christopher's Home. According to DLO/TP, the development site should be 1Tai Po Town Lot No. 135' (TPTL No. 135). Reference of 'A/TP/58' for the proposed residential development at St. Christopher's Home in the Report should be amended accordingly.	Text will be amended accordingly.
(c) Section 8.2.2, 7th paragraph, 5th line	
The 5 hectares of land is for the provision of sporting facilities for teaching purpose associated with the Hong Kong Institute of Education.	Text will be amended accordingly.
(d) Section 8.2.2, 8th paragraph, last sentence	
It is not clear which road is actually referred to.	
This road is referred to the Tai Po road in OZPS/TP/6 which connects to Tai Po and CUHK.	

Comments	Response to Comments
Environmental Protection Department (Verbal comment) Dated 26 April 1994	
In relation to Section 7.4.4, what mitigation measures will be taken for the WQO greater than 4 mg/l being not complied with.	
The use of the close grab and silt screen reduces the oxygen demand due to dredging by a factor of 5. This will result in plume concentration of Dissolved Oxygen of 4.3 mg/l which meets the WQO.	
Environmental Protection Department, ref (7) in EP2/N5/13IV dated 16th May 1994 (Further comments to responses to comments)	
Water Quality	
Section 6.7.2, p.6-8	
For the most probable current speed of 0.05 m/s, the S.S. concentration of 14 mg/l at 100 m from the tipping face is excessive considering that the average background S.S. in the vicinity is only about 3 mg/l. Stringent compliance monitoring has to be carried out during dumping operation. There should be at least 2 monitoring stations between the end of the seawall and the shoreline. If WQOs are breached, tipping should not continue until the mitigatory measures are implemented.	The value of 14 mg/l at 100 m from the tipping face occurs in the absence of a silt screen, the use of a silt screen would reduce the value to 5.5 mg/l. The recommendation will be for compliance monitoring to be at two locations between the end of the seawall and the shore line. The action plan will provide for cessation of works in the event of WQO exceedance.
Section 7.44, p.7-4	
Mitigation measures to reduce the influence of the sediment plume, including the use of silt screens at the MSL intake and at the sediment source should always be taken, together with the water quality monitoring program mentioned. In the event of the Action Limit still being breached, further mitigation measures, e.g. by reducing the dredging rate, have to be taken.	Additional mitigation measure of reducing dredging rate will be included in the list of measures to be applied.

Comments	Response to Comments
Please clarify why the target values for DO for MSL and WSD are set at 10-30% saturation and >2 mg/l respectively. The target level should be set at least to the WQO which is >4 mg/l. Non-achievement of the WQO should not be allowed.	Dissolved Oxygen requirement for MSL and WSD of > 10-30% sat. and >2 mg/l respectively are values provided by MSL and WSD and are given in Table 6.5 of the DFR and are generally less stringent than the WQO. However, the target limit for DO for the reclamation should be set in accordance with the WQO as given in Table 10.6.
Environmental Protection Department, ref (13) in EP2/N5/13IV dated 27th May 1994 (Further comments to responses to comments)	
A) Additional comments on the consultants' responses Section 7.4.4, p.7.4	
a) As mentioned in our memo of 16.5.94 in the same series, mitigation measures to reduce the influence of the sediment plume, including the use of silt screen at the MSL's intake and at the sediment source, should always be taken together with the water quality monitoring program because MSL's intake is about 100 m away from the closest point of the Phase I seawall. Table 7.4 of the Draft Final Report (DFR) indicates that under a probable wind speed of 12 m/s, increase of ss at 550 m downstream is 13 mg/l in the Tolo Harbour Subzone (Table C1, Marine Water Quality in Hong Kong for 1992, EPD), ss at the intakes of MSL and WSD caused by dredging will be much greater than the target levels (< 50 mg/l)	As stated in the first paragraph of Section 7.6 (p7-8) of the DFR, it is recommended that silt curtain and closed grab should be used during dredging of marine sediment in order to control sediment looses. Monitoring of water quality should also be carried out during dredging operation to ensure that local sensitive receivers are not adversely affected. The quantative analysis of the effectiveness of the recommended mitigation measures has been provided in our response to item (g) of CUHK's comments dated 16th April 1994 (refer to page 8 of our consolidated responses to comments).
b) Perhaps, it may be true that MSL and WSD only require DO levels <10-30% saturation and <2 mg/l, I want to re-emphasize that EPD has the statutory duty to achieve, enforce and maintain the Water Quality Objectives (WQO) of a Water Control Zone. In other words, WQO is the minimum requirement from EPD.	The target limits for DO at different depths specified in Table 10.6 of the DFR agreed with EPD's requirements.

Comments	Response to Comments
There may be different requirement from different users or sensitive receivers, but the Target Limits must be set such that the most stringent water quality requirements can be met. In this case, it is the WQO. The WQO for DO within the Tolo Harbour Subzone are: (i) DO within 2 m of bottom : not less than 2 mg/l and (ii)DO in the rest of water column : not less than 4 mg/l.	

Appendix A: Noise Monitoring Results

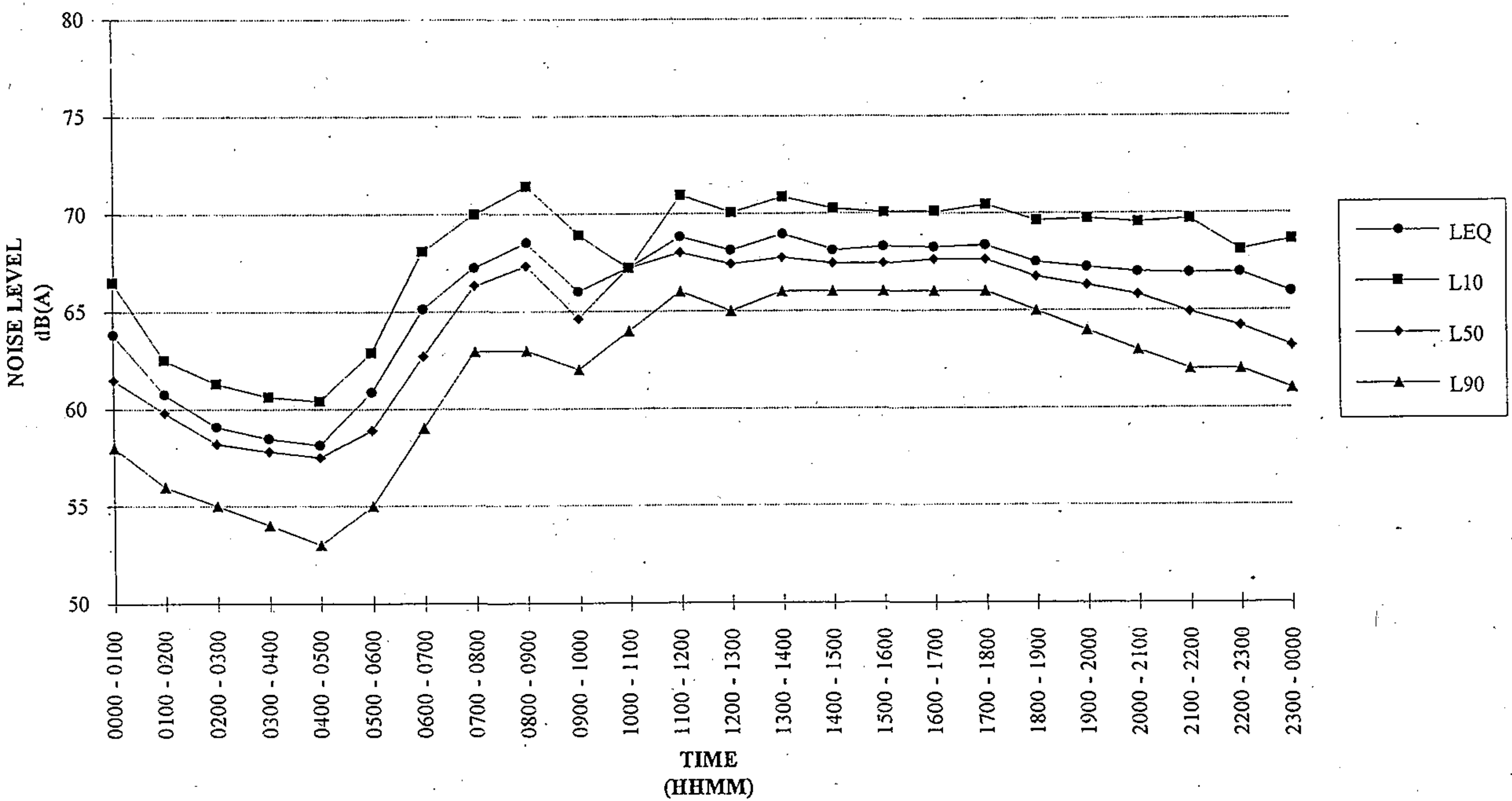


Noise Measurement at R/F, Residence No. 10

May 1994

Mouchel

Figure No. A1

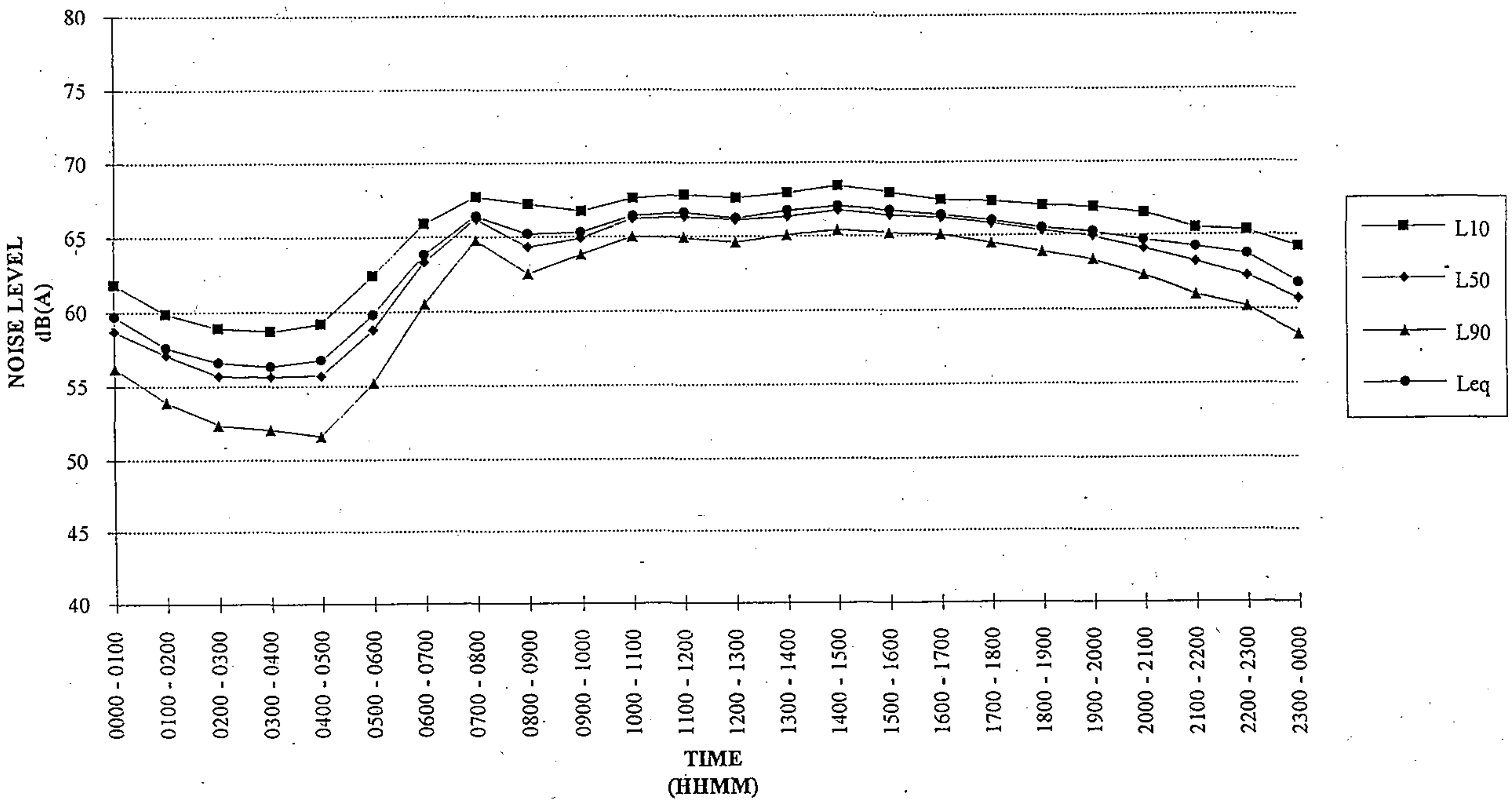


Noise Measurement at R/F, Residence No. 7

May 1994

Mouchel

Figure No. A2

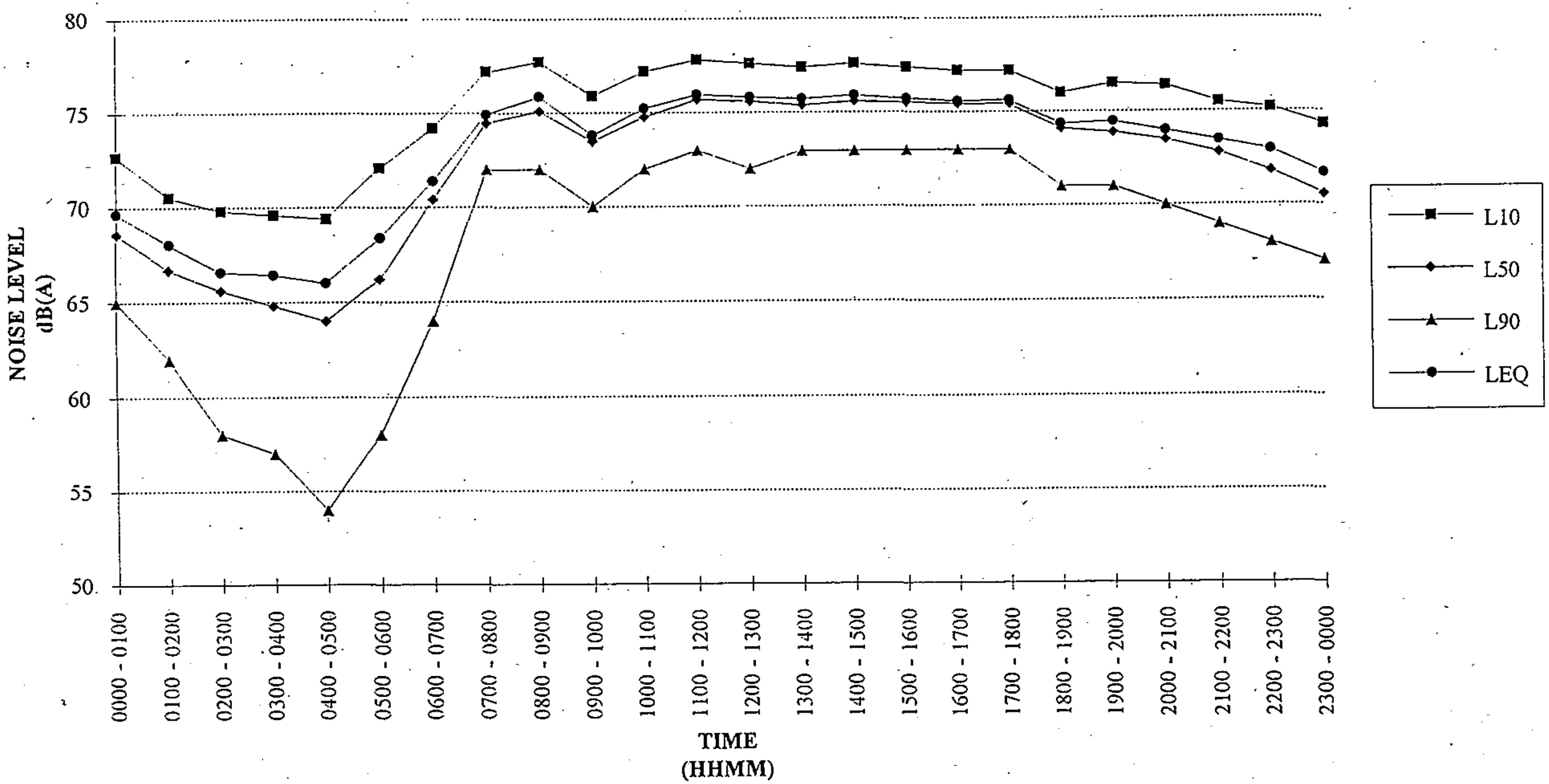


Noise Measurement at R/F, Xuesi Hall

May 1994

Mouchel

Figure No. A3

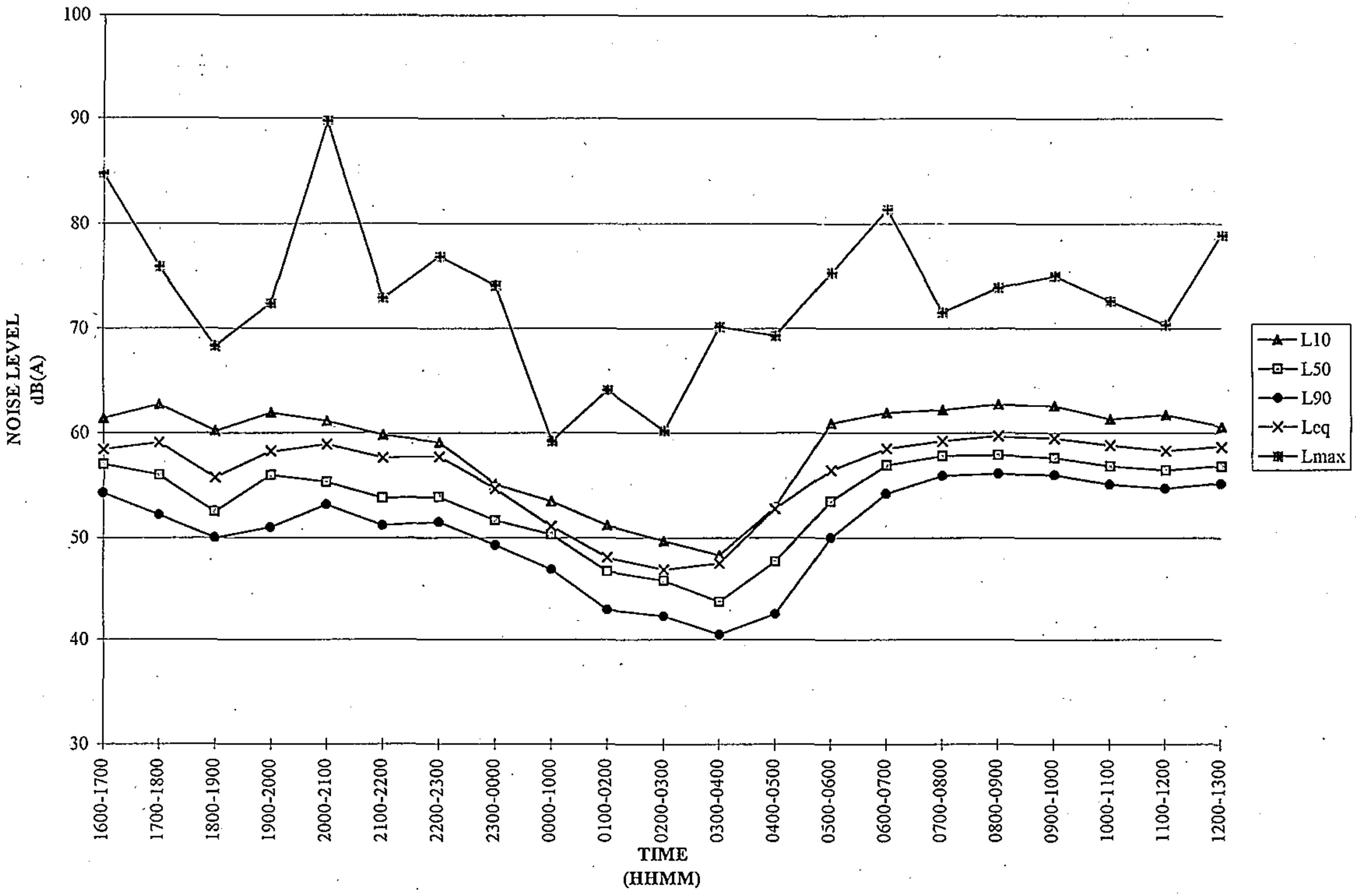


Noise Measurement at R/F, HKIB

May 1994

Mouchel

Figure No. A4



Hourly Noise Results at Cheung Shue Tan

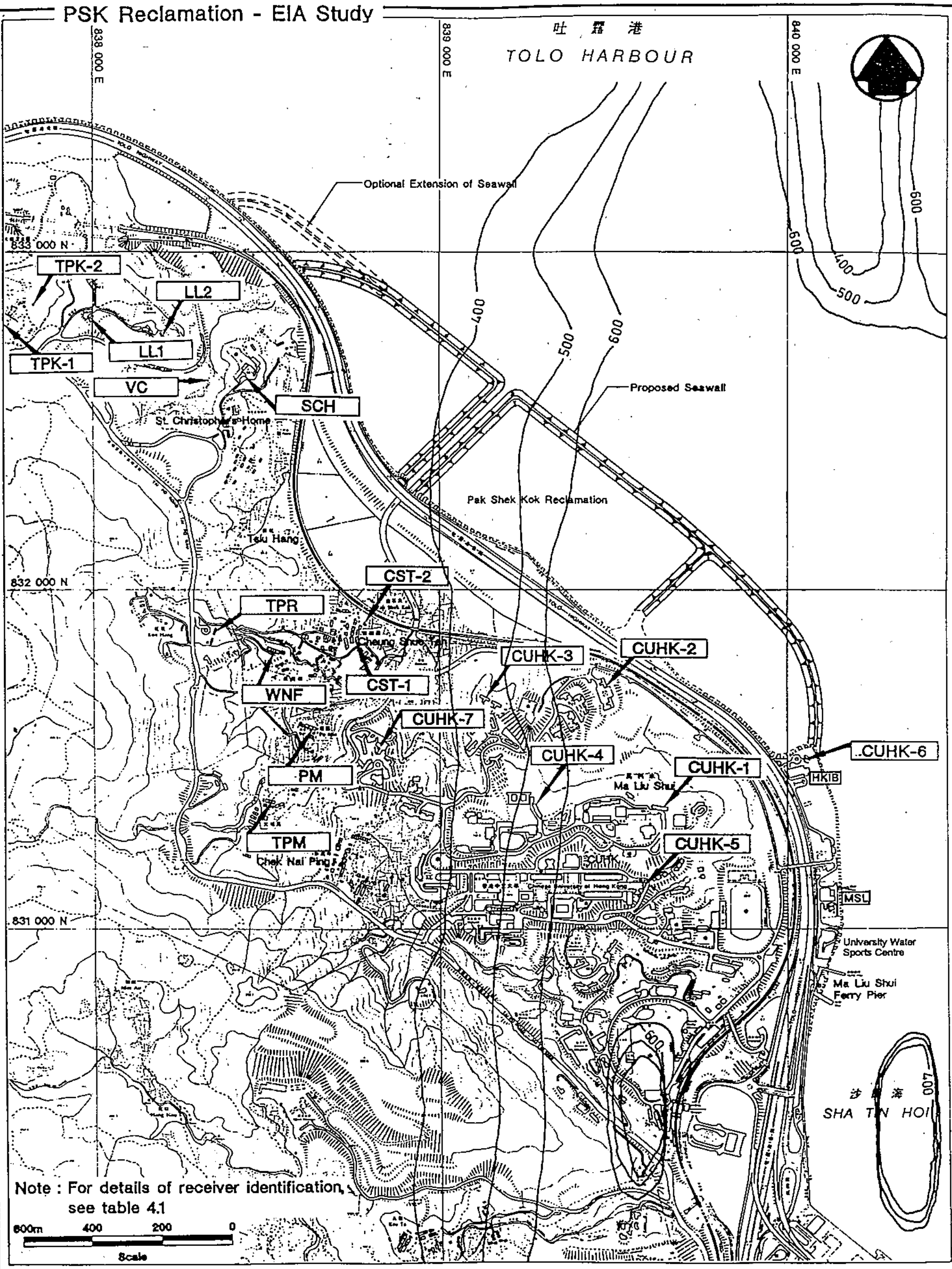
May 1994

Mouchel

Figure No. A5

Appendix B: Dust Modelling Contours

PSK Reclamation - EIA Study

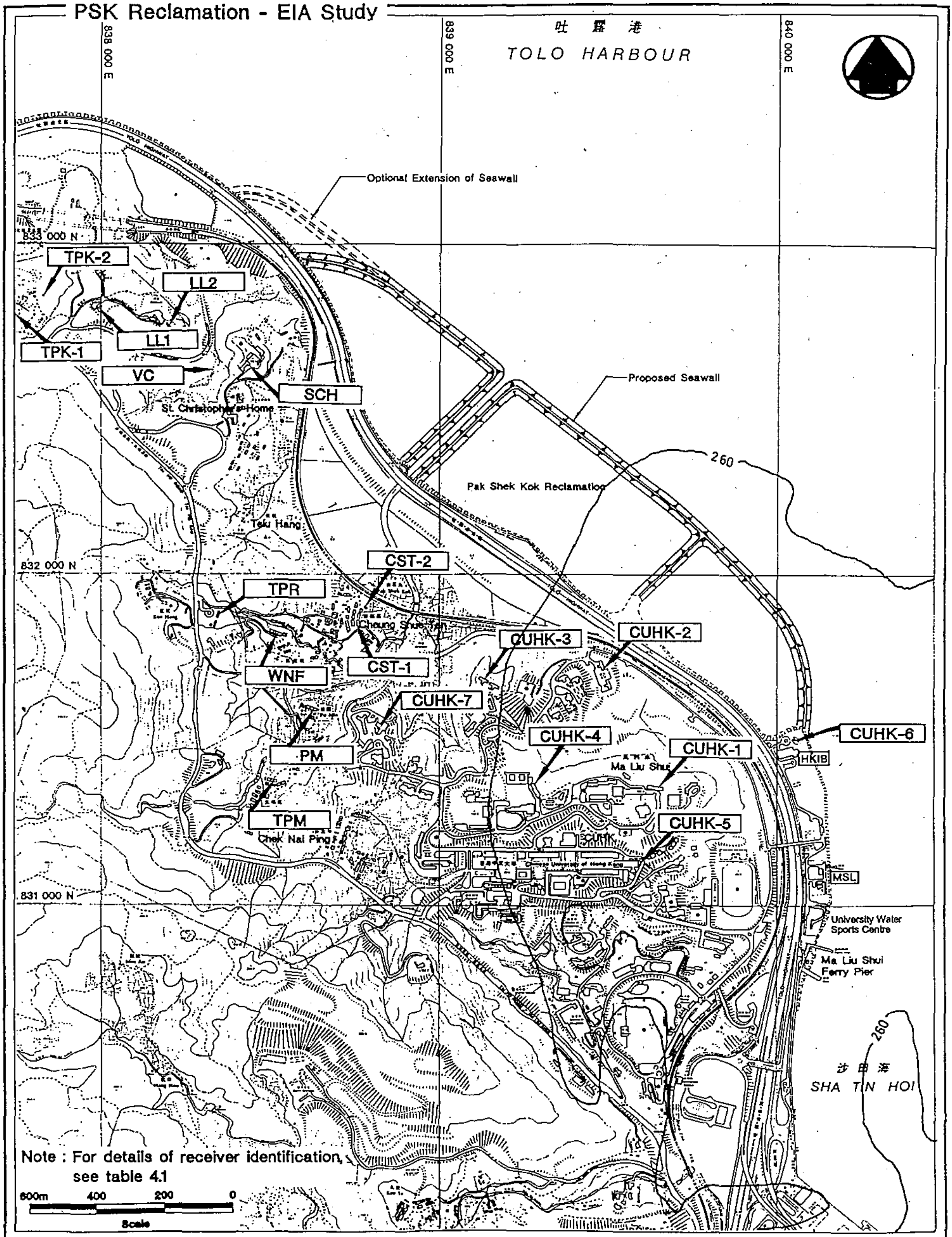


Hourly Average TSP Concentrations ($\mu g/m^3$) During Phase 1 Reclamation (Unmitigated)

May 1994

Mouchel

Figure No. B1

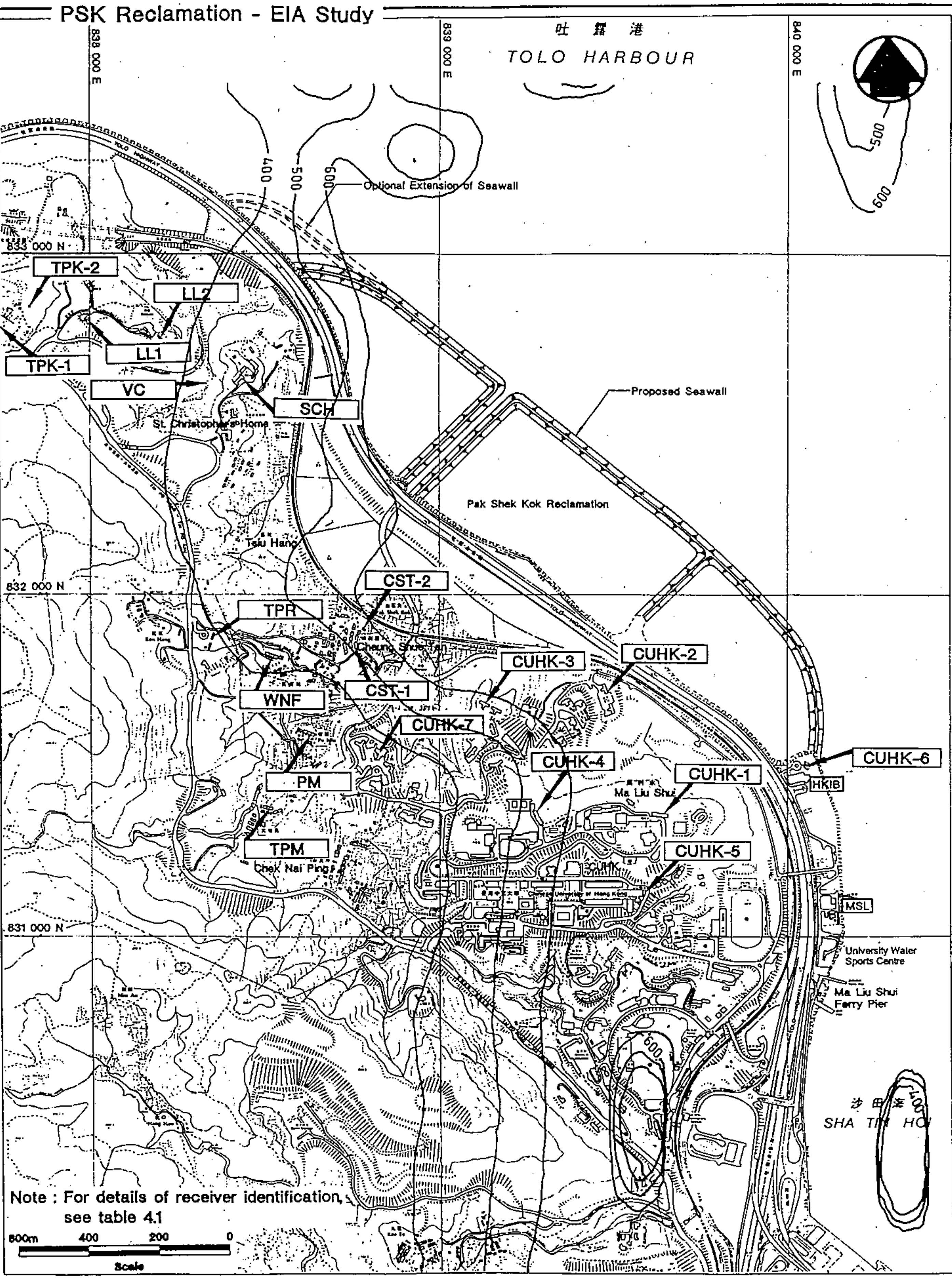


Daily Average TSP Concentrations ($\mu g/m^3$) During Phase 1 Reclamation (Unmitigated)

May 1994

Mouchel

Figure No. B2

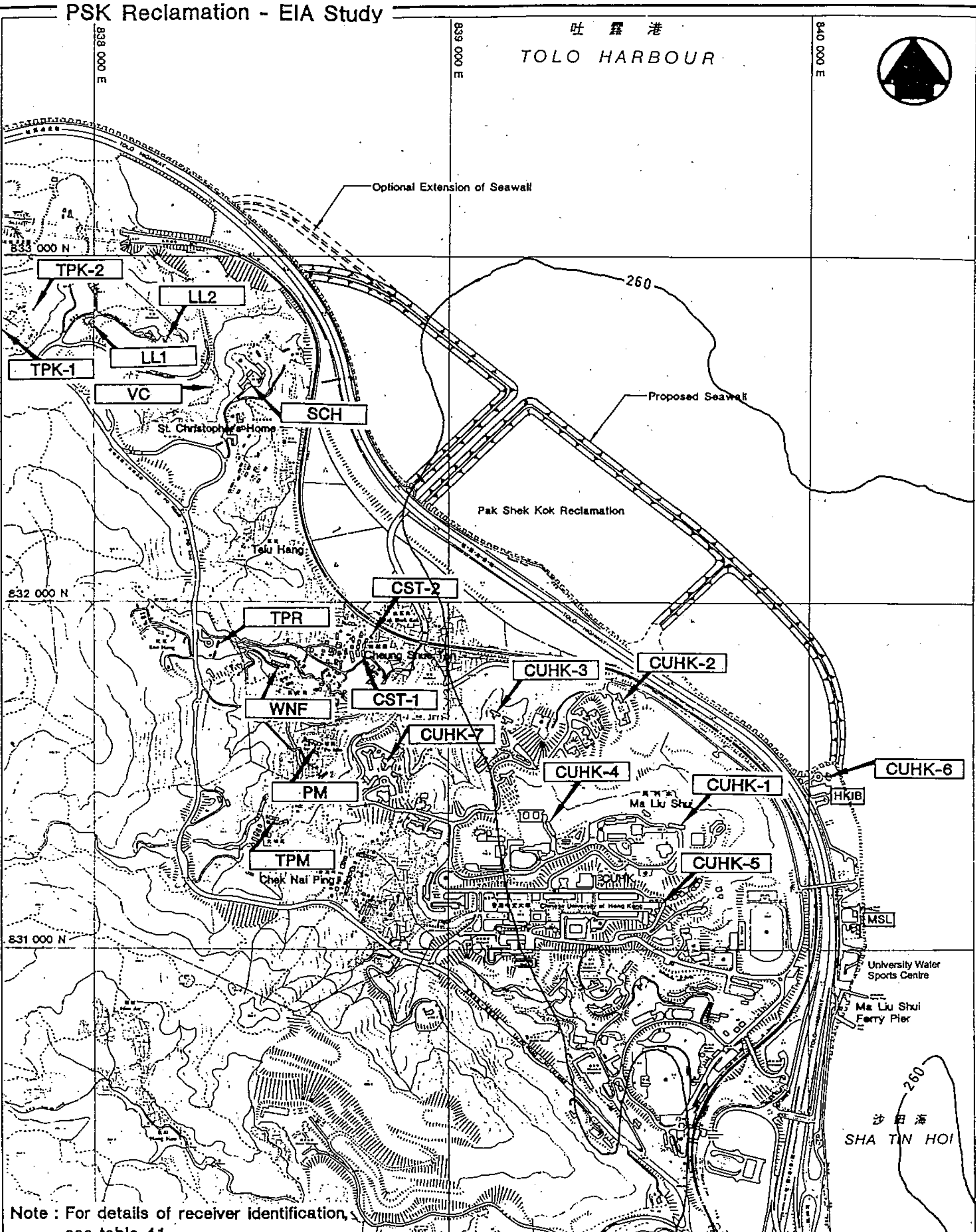


Hourly Average TSP Concentrations ($\mu g/m^3$) During Phase 2 Reclamation (Unmitigated)

May 1994

Mouchel

Figure No. B3

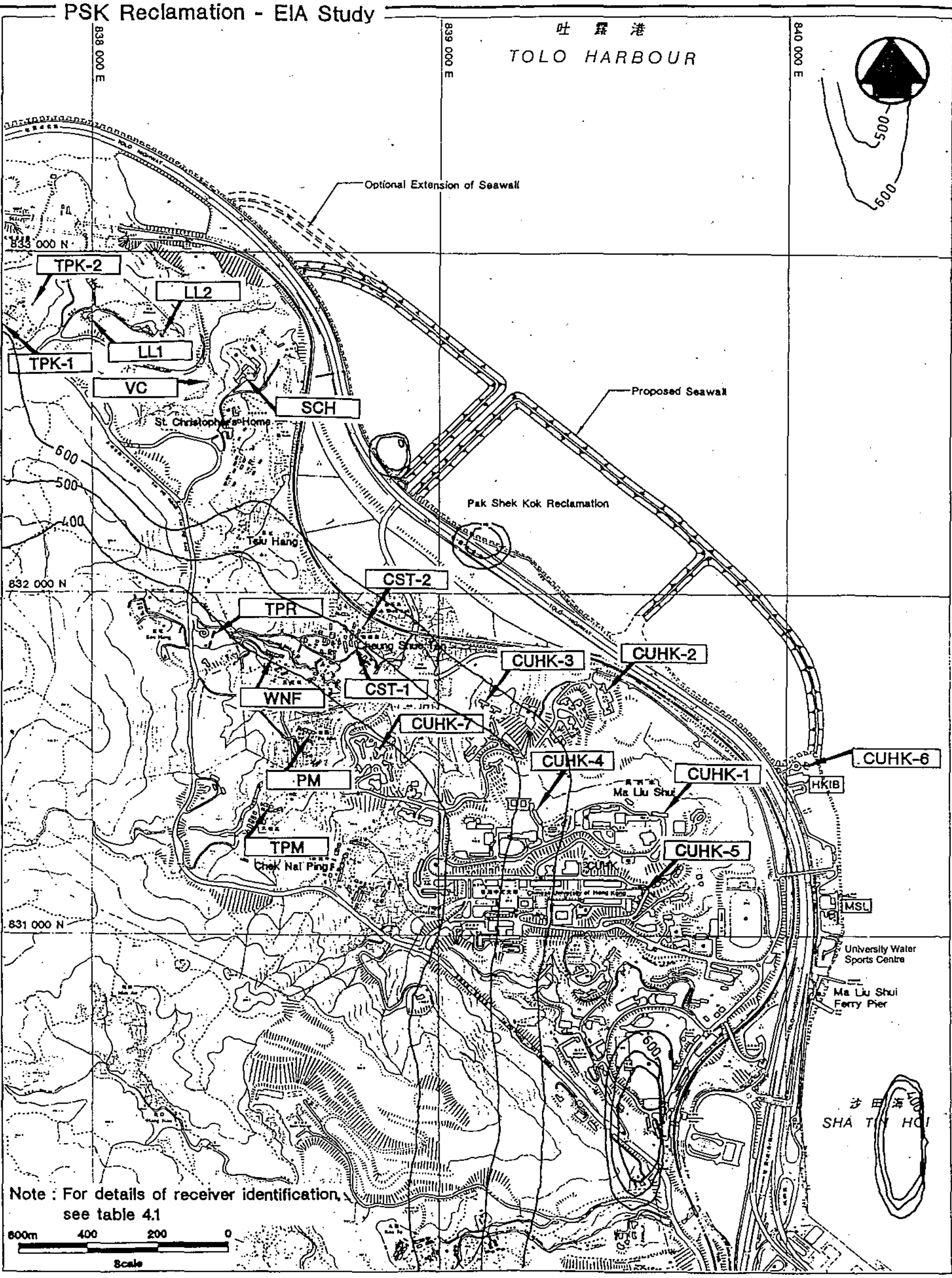


Daily Average TSP Concentrations ($\mu g/m^3$) During Phase 2 Reclamation (Unmitigated)

May 1994

Mouchel

Figure No. B4



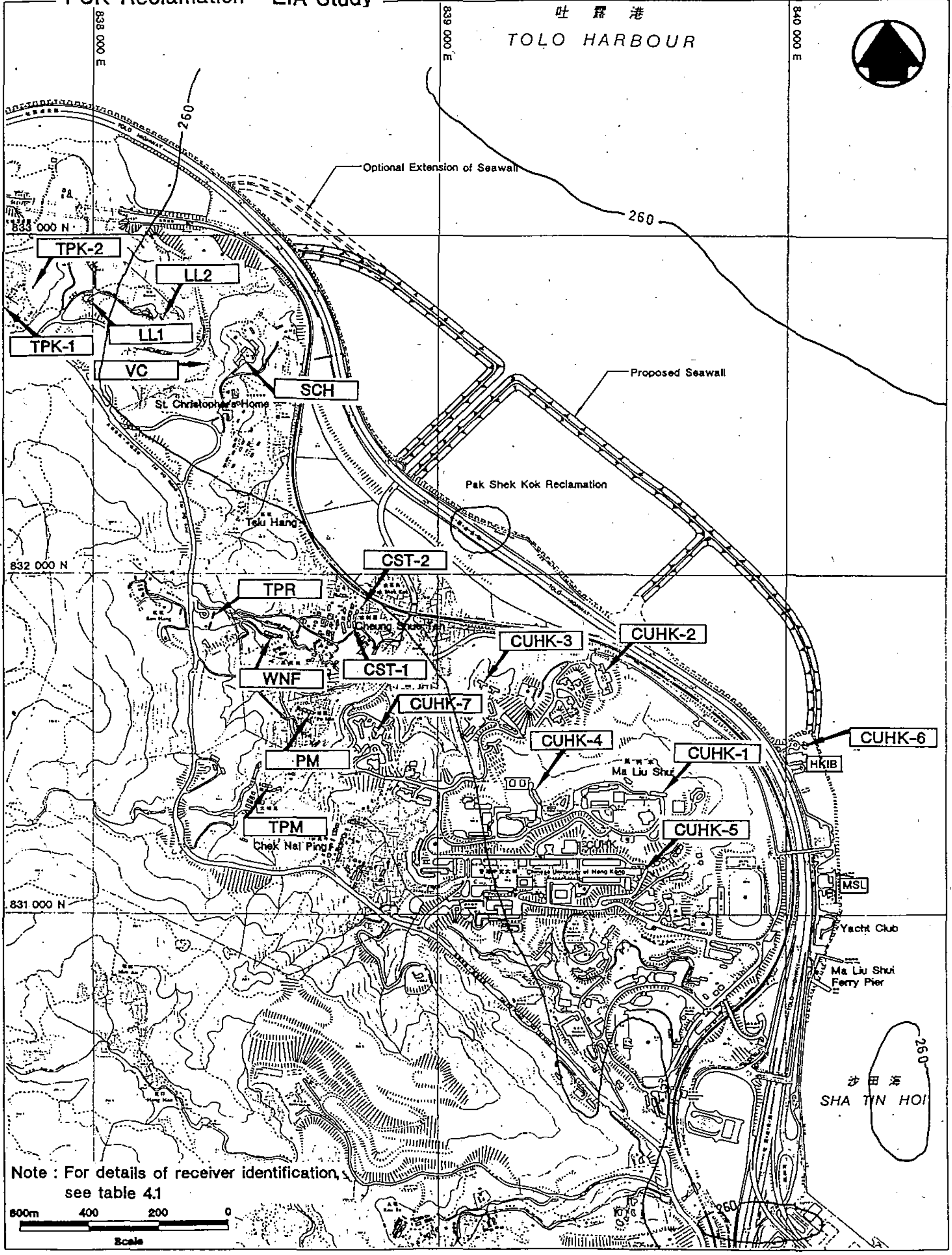
Hourly Average TSP Concentrations ($\mu g/m^3$) During Phase 3 Reclamation (Unmitigated)

May 1994

Mouchel

Figure No. B5

PSK Reclamation - EIA Study



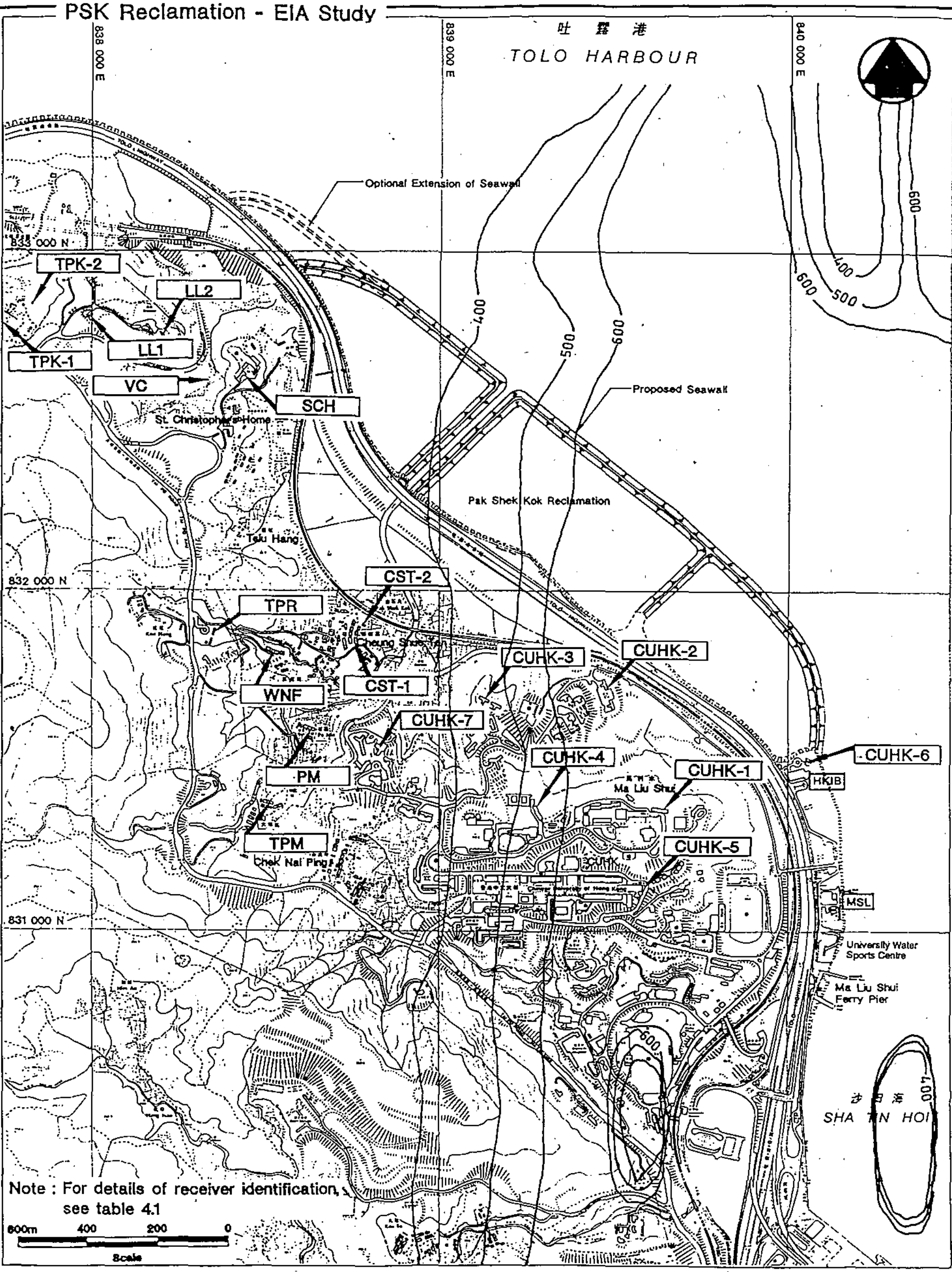
Daily Average TSP Concentrations ($\mu g/m^3$) During Phase 3 Reclamation (Unmitigated)

May 1994

Mouchel

Figure No. B6

PSK Reclamation - EIA Study



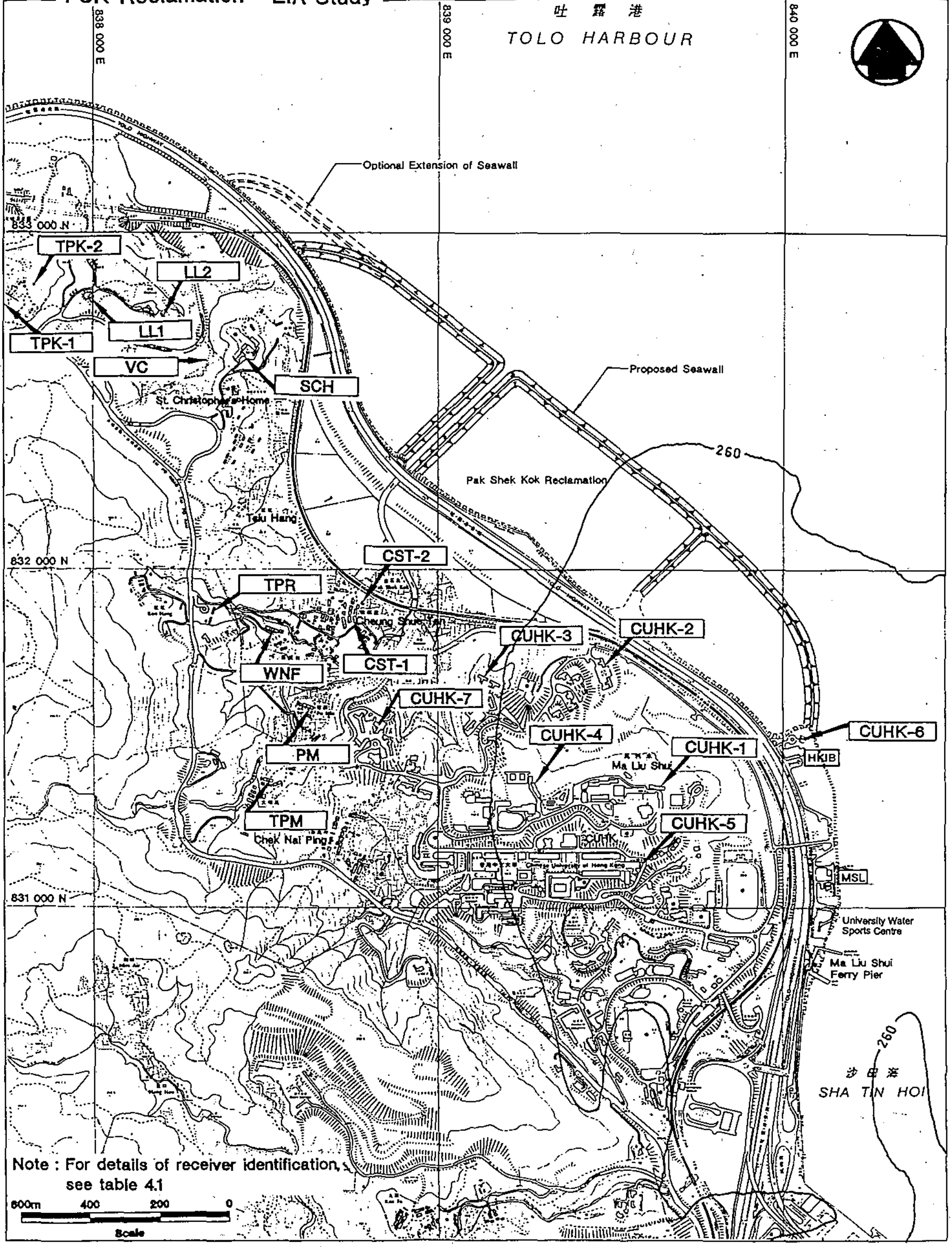
Hourly Average TSP Concentrations ($\mu g/m^3$) During Phase 1 Reclamation (Southern Half) (Unmitigated)

May 1994

Mouchel

Figure No B7

PSK Reclamation - EIA Study



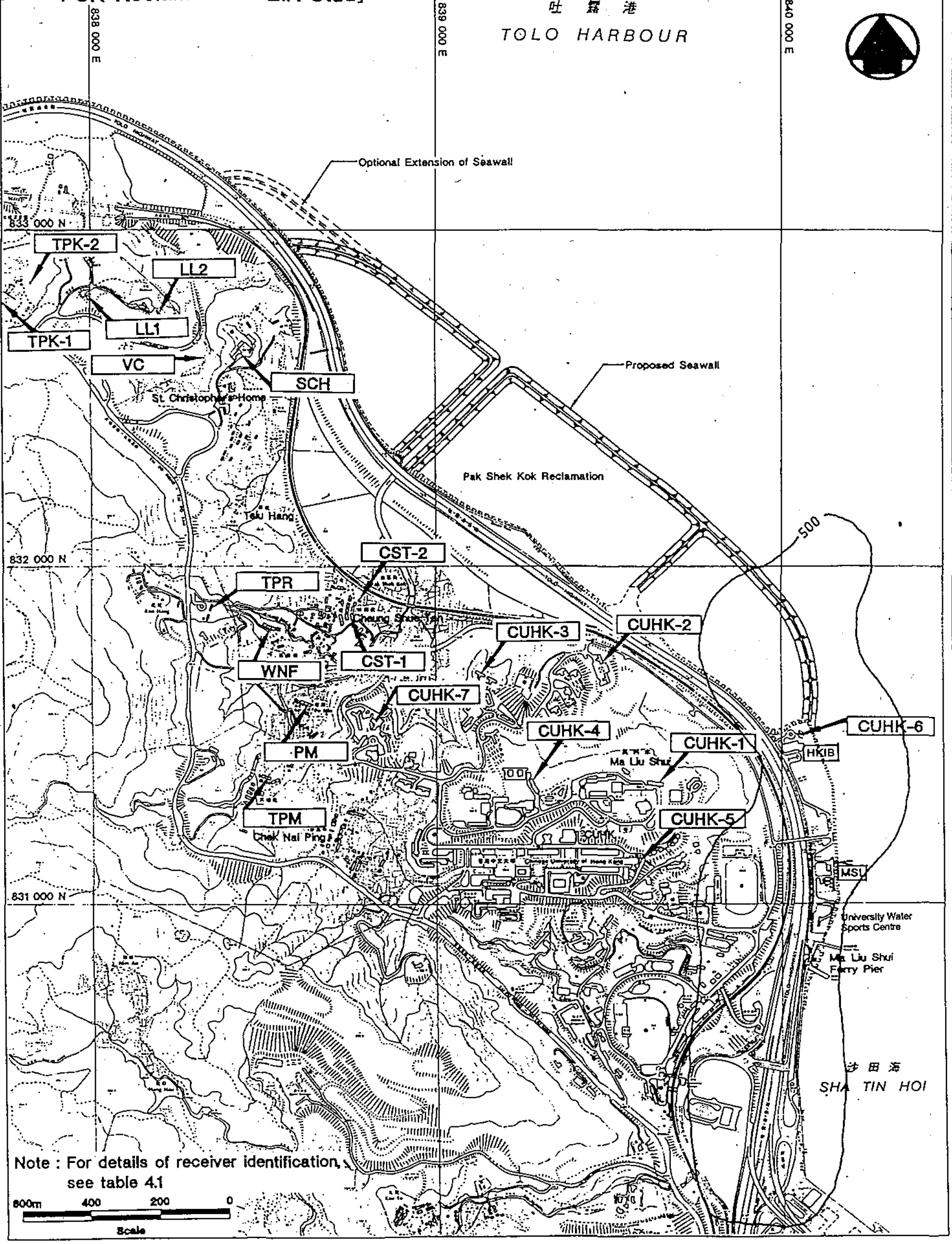
Daily Average TSP Concentrations ($\mu g/m^3$) During Phase 1 Reclamation (Southern Half) (Unmitigated)

May 1994

Mouchel

Figure No. B8

PSK Reclamation - EIA Study



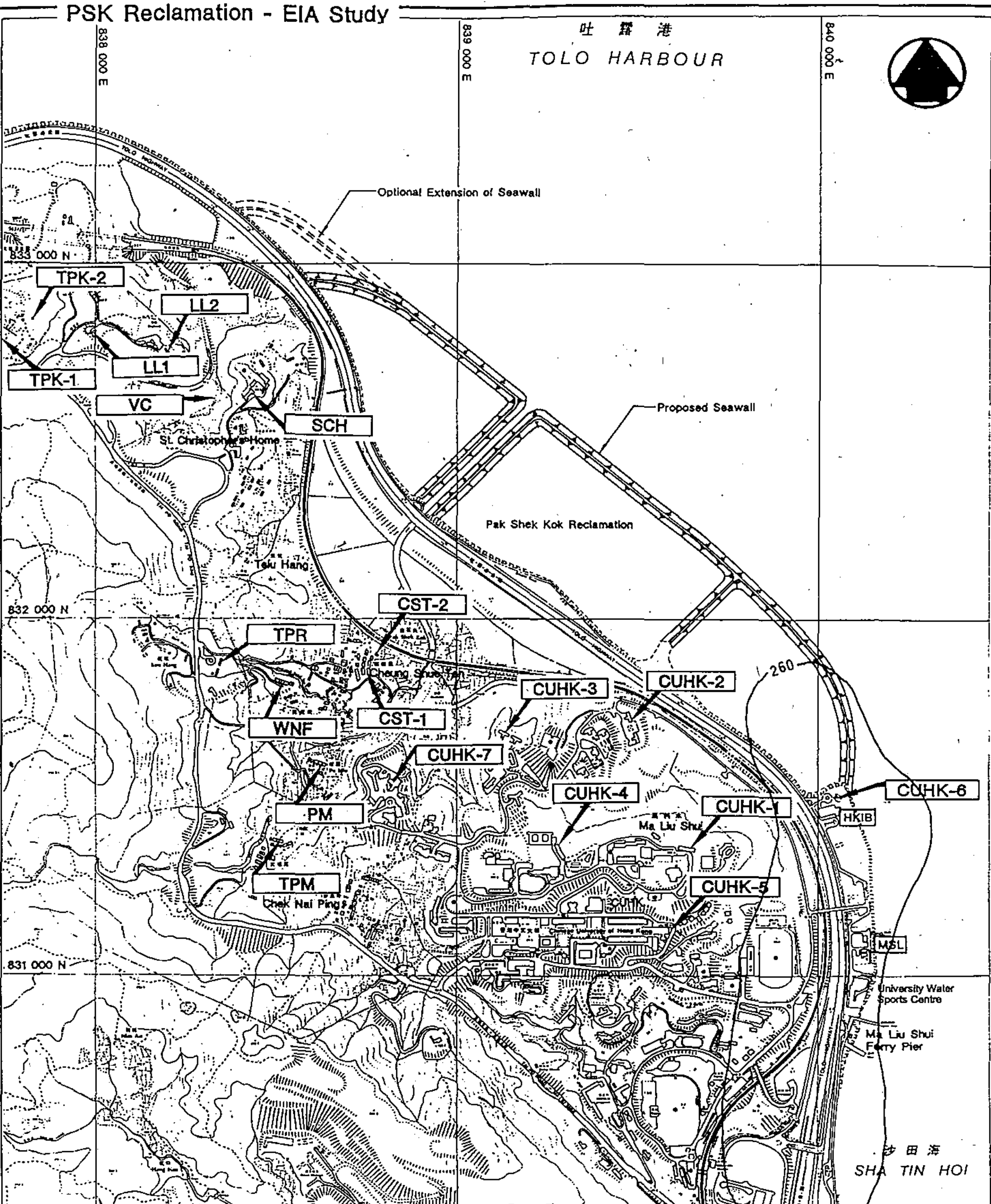
Hourly Average TSP Concentrations ($\mu g/m^3$) During Phase 1 Reclamation (Mitigated)

May 1994

Mouchel

Figure No. B9

PSK Reclamation - EIA Study



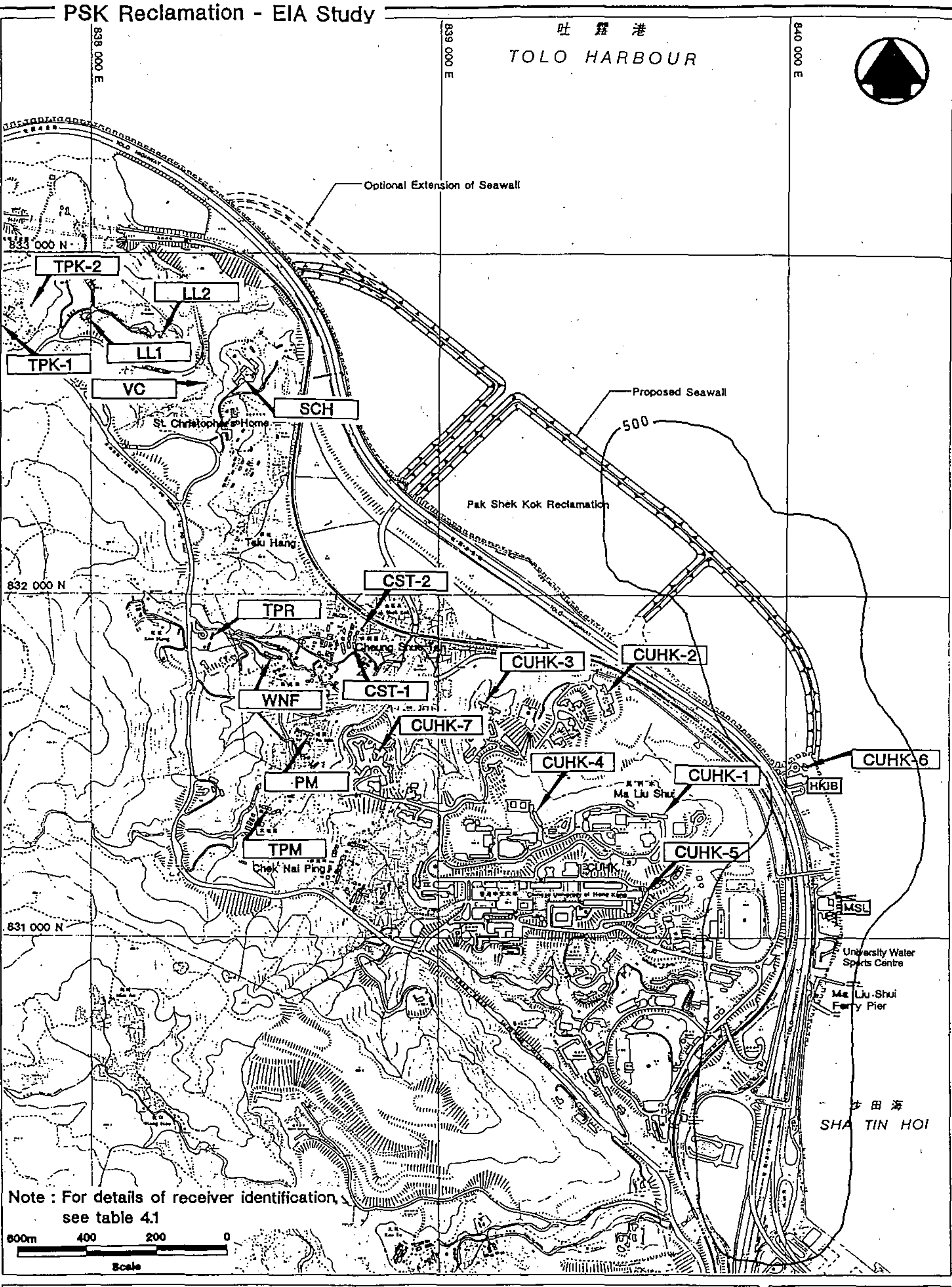
Daily Average TSP Concentrations ($\mu g/m^3$) During Phase 1 Reclamation (Mitigated)

May 1994

Mouchel

Figure No. B10

PSK Reclamation - EIA Study

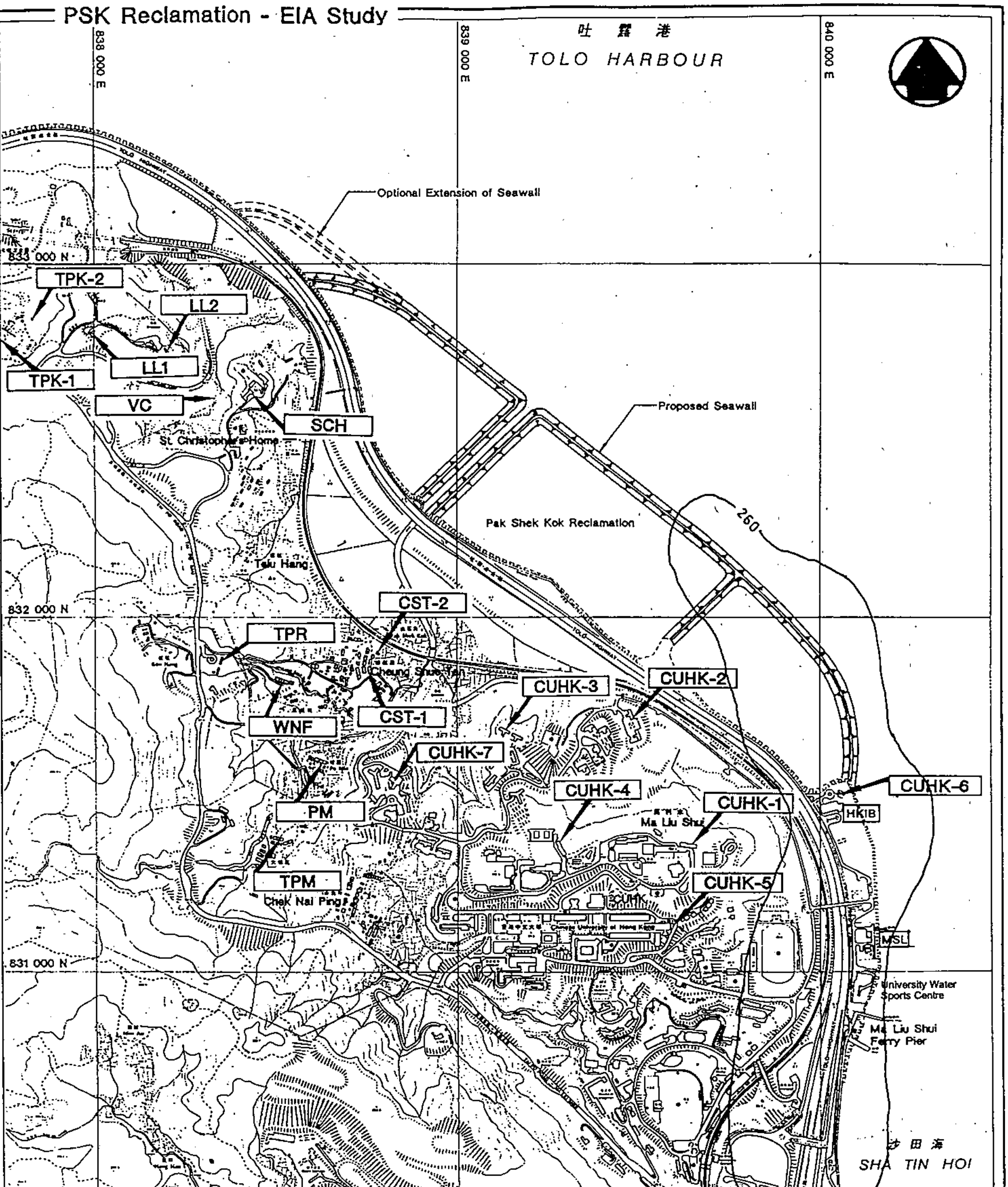


Hourly Average TSP Concentrations ($\mu g/m^3$) During Phase 2 Reclamation (Mitigated)

May 1994

Mouchel

Figure No B11



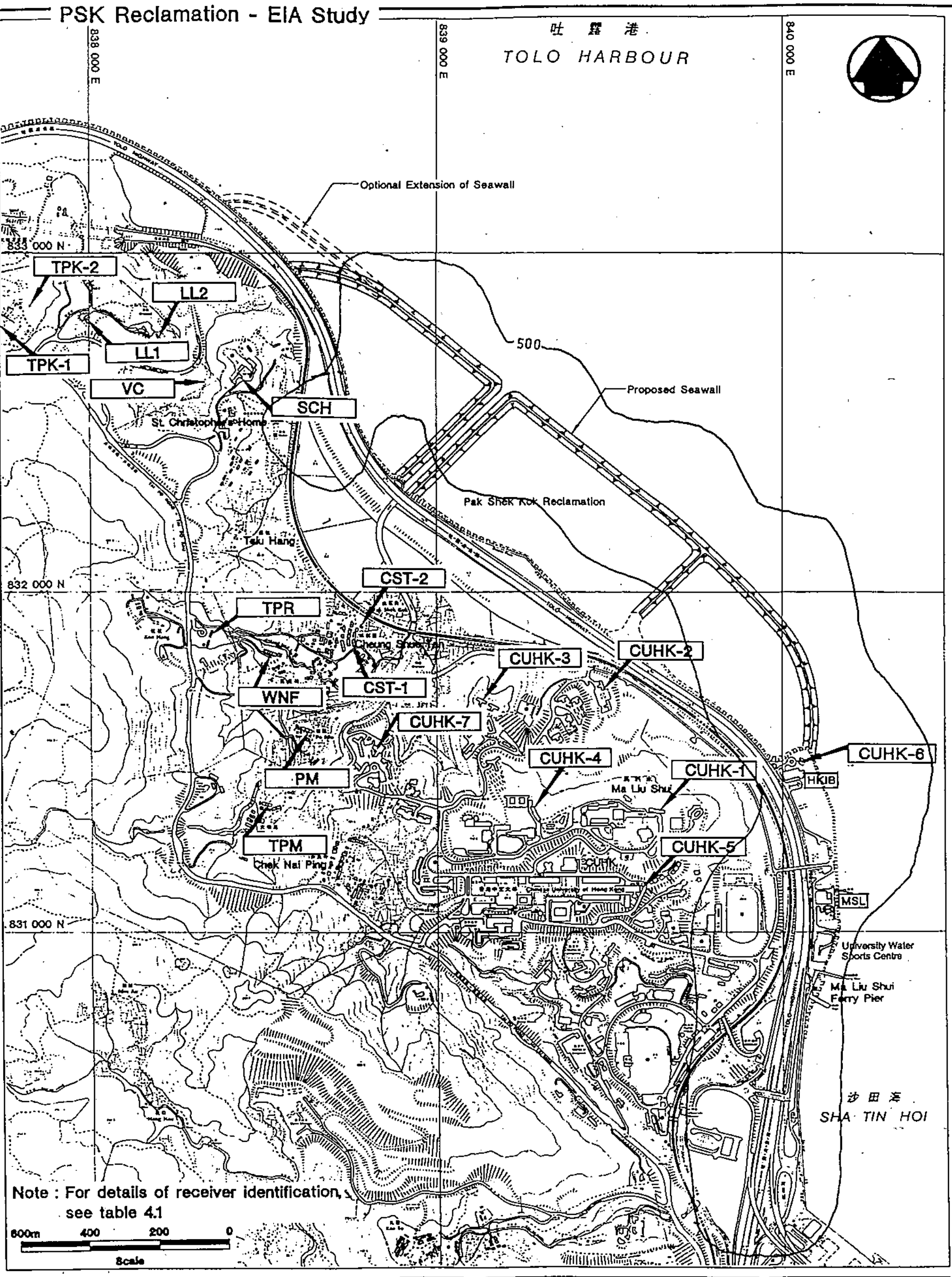
Daily Average TSP Concentrations ($\mu g/m^3$)
During Phase 2 Reclamation (Mitigated)

May 1994

Mouchel

Figure No. B12

PSK Reclamation - EIA Study

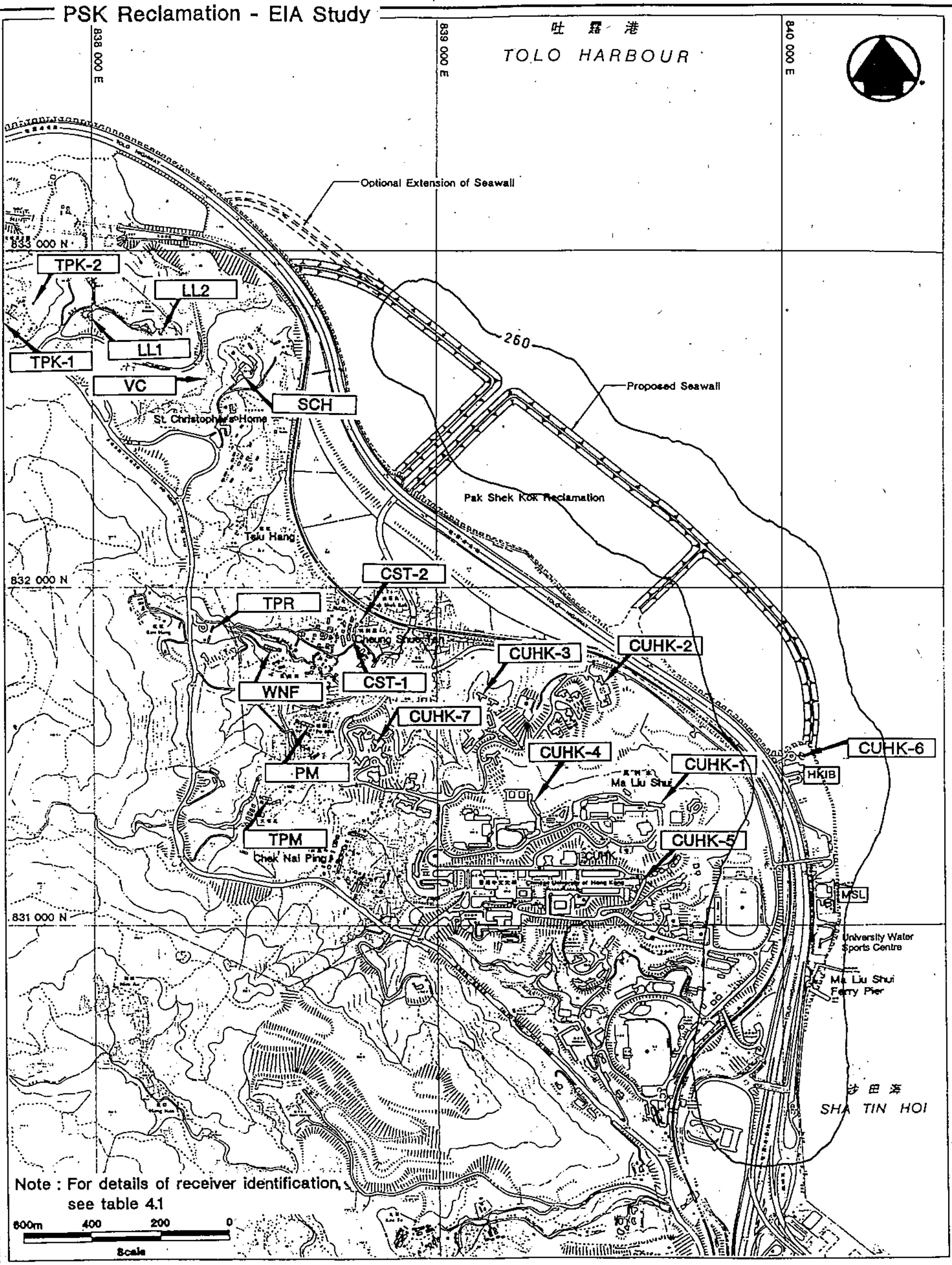


Hourly Average TSP Concentrations ($\mu g/m^3$) During Phase 3 Reclamation (Mitigated)

May 1994

Mouchel

Figure No. B13



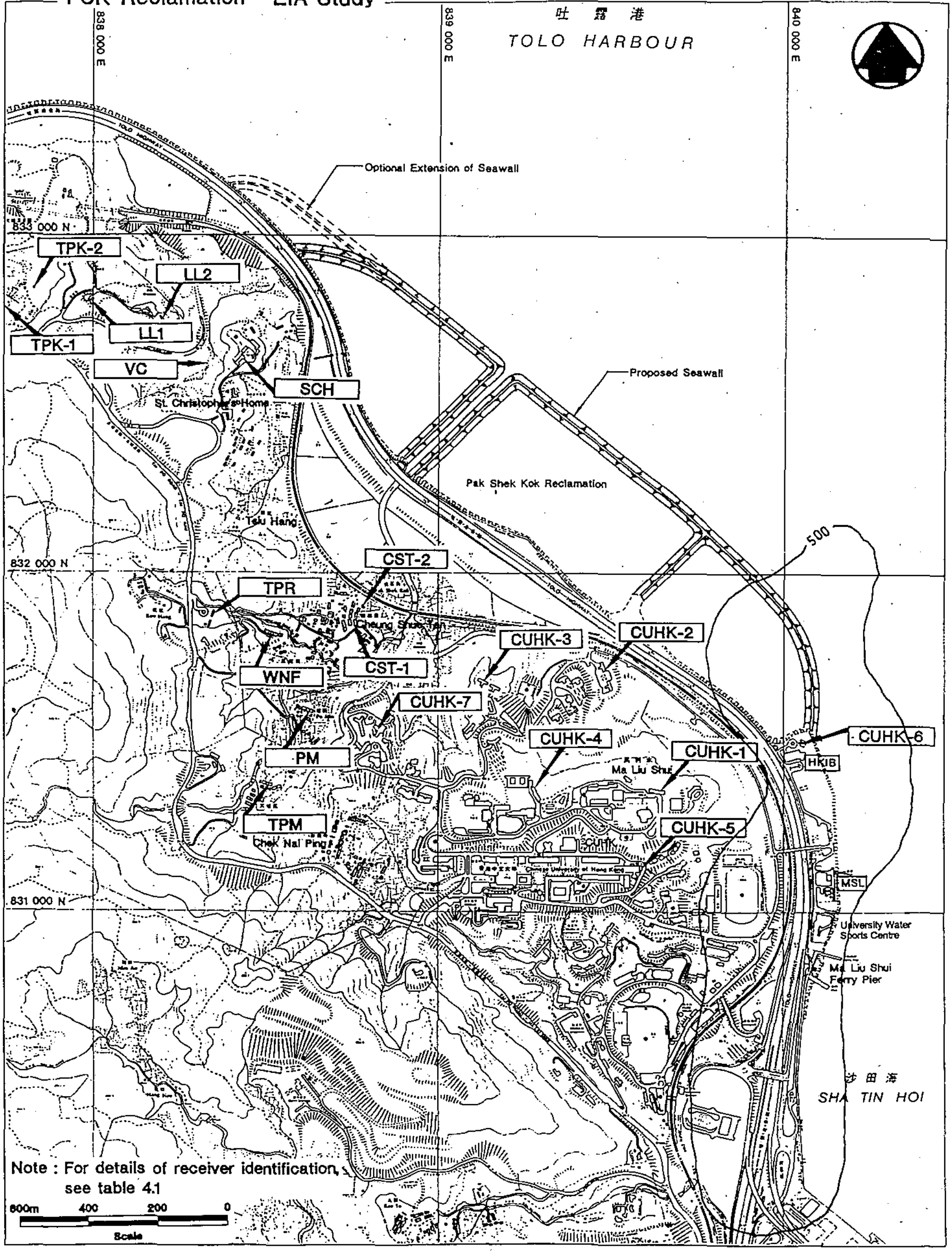
Daily Average TSP Concentrations ($\mu g/m^3$) During Phase 3 Reclamation (Mitigated)

May 1994

Mouchel

Figure No. B14

PSK Reclamation - EIA Study



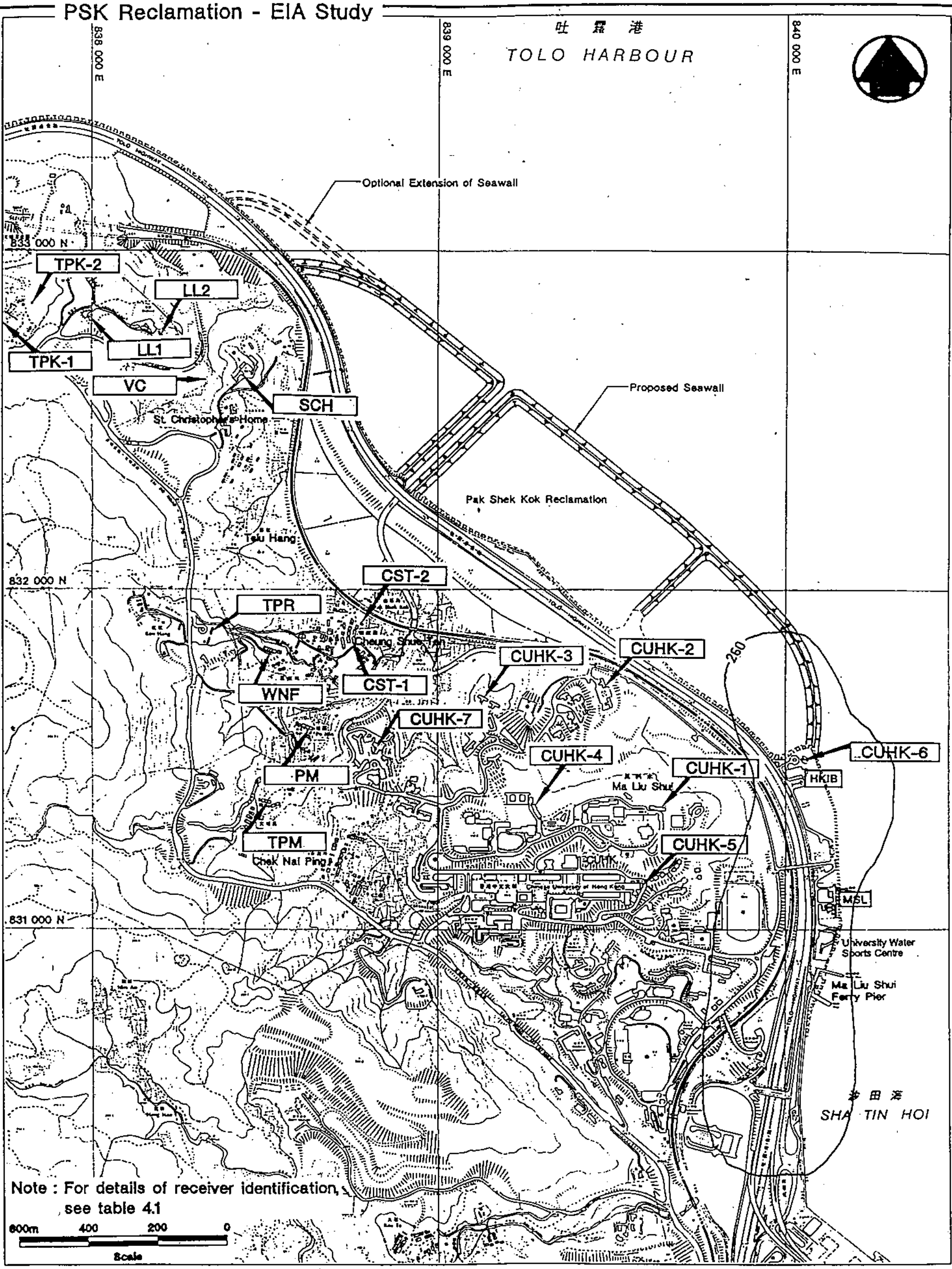
Hourly Average TSP Concentrations ($\mu g/m^3$) During Phase 1 Reclamation (Southern Half) (Mitigated)

May 1994

Mouchel

Figure No. B15

PSK Reclamation - EIA Study



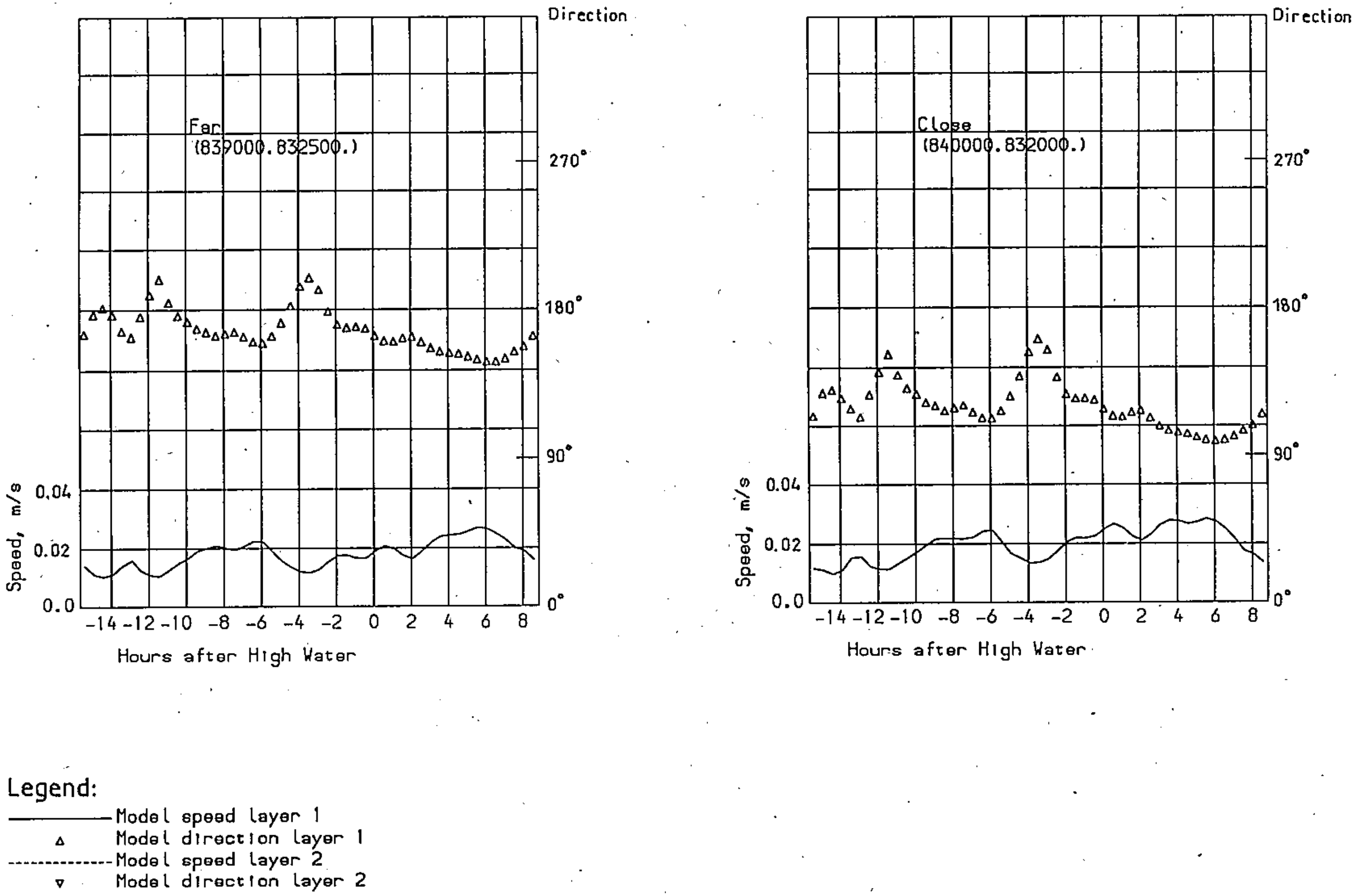
Daily Average TSP Concentrations (ug/m³)
During Phase 1 Reclamation
(Southern Half) (Mitigated)

May 1994

Mouchel

Figure No. B16

Appendix C: Water Quality Modelling Results



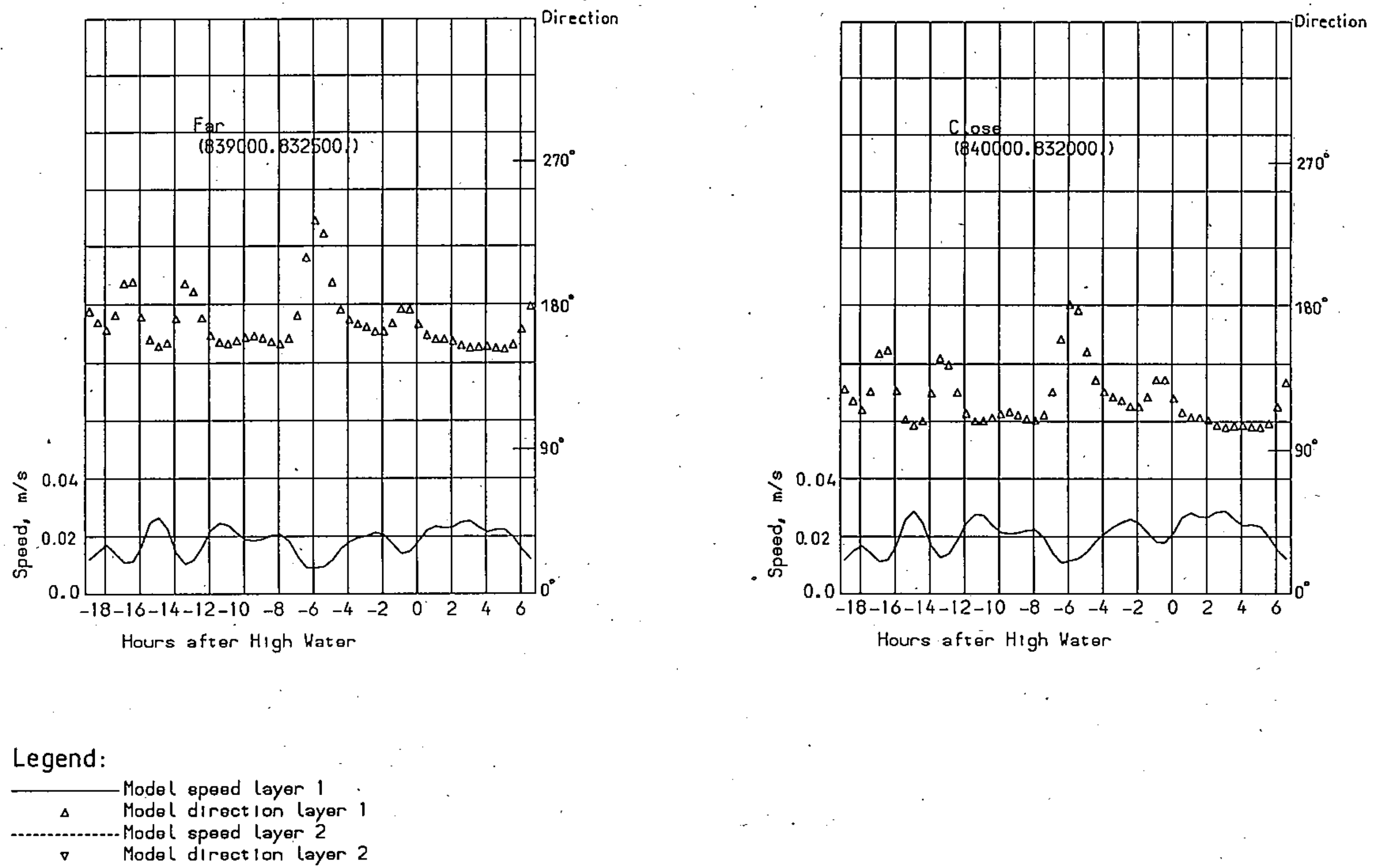
Simulated Water Speed in the Reclamation Area - Wet Season Spring Tide

May 1994

Mouchel

Figure No. C1

PSK Reclamation - EIA Study

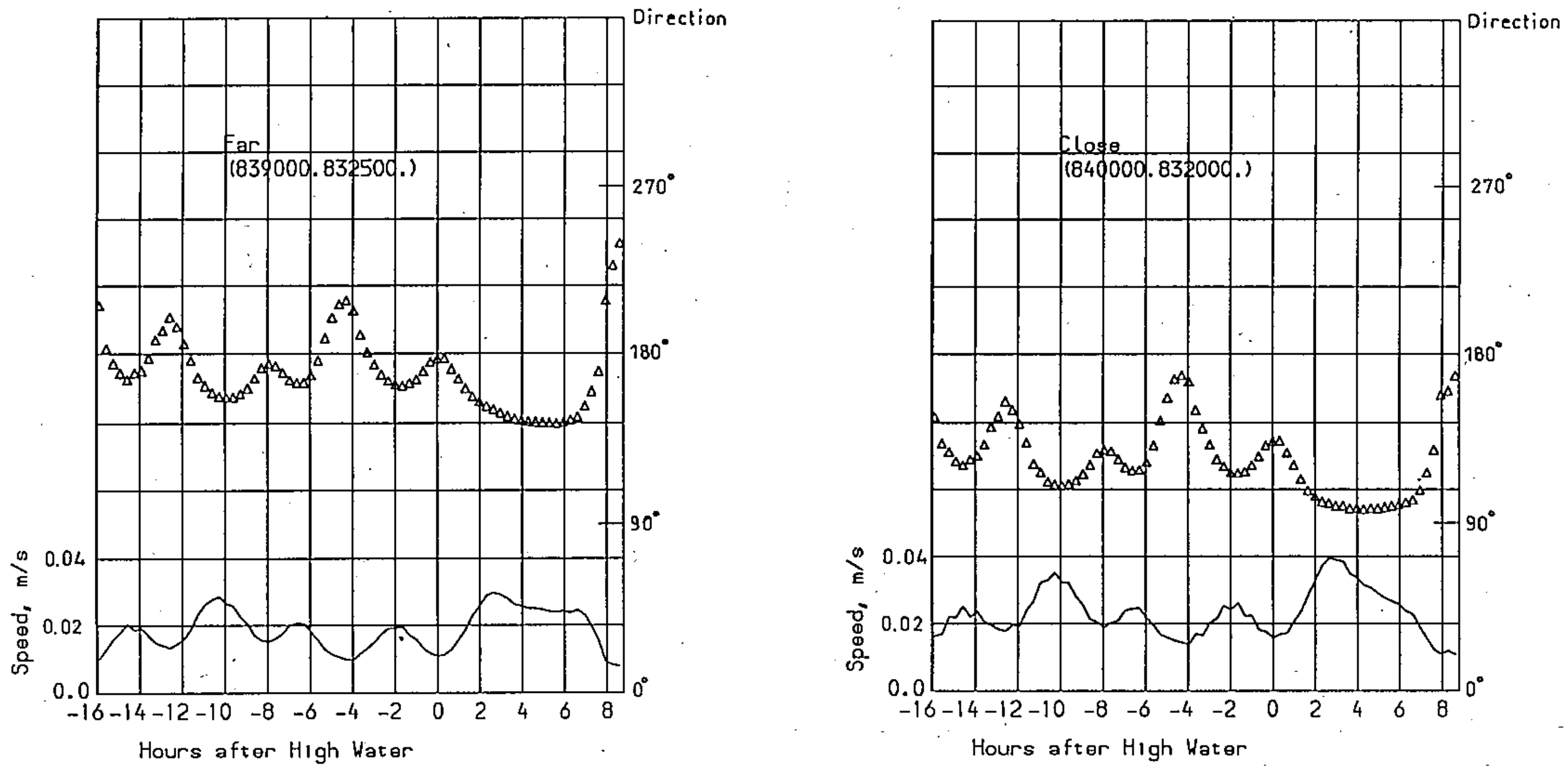


Simulated Water Speed in the Reclamation Area - Wet Season Neap Tide

May 1994

Mouchel

Figure No. C2



Legend:

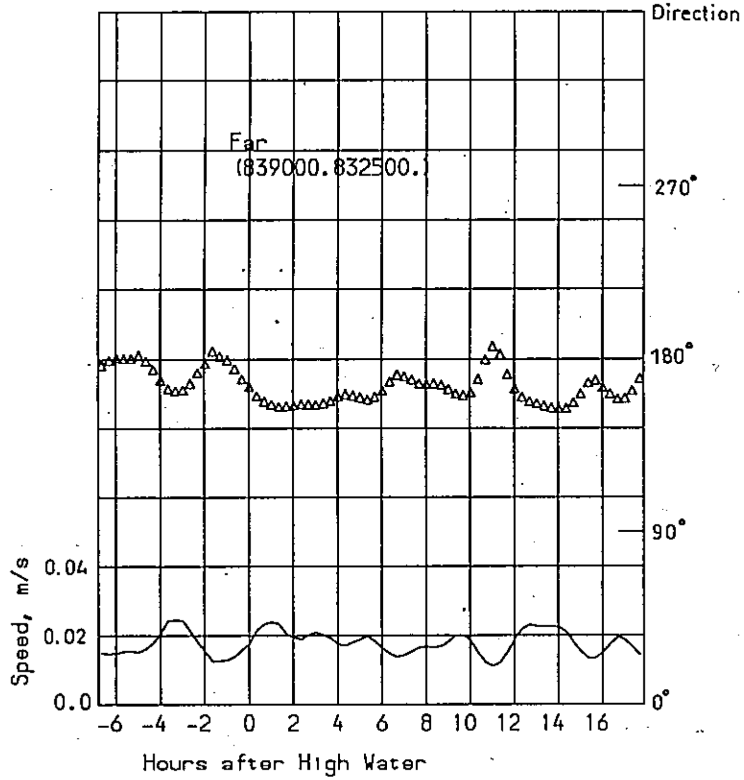
- —— Model speed layer 1
- △ Model direction layer 1
- ------ Model speed layer 2
- ▽ Model direction layer 2

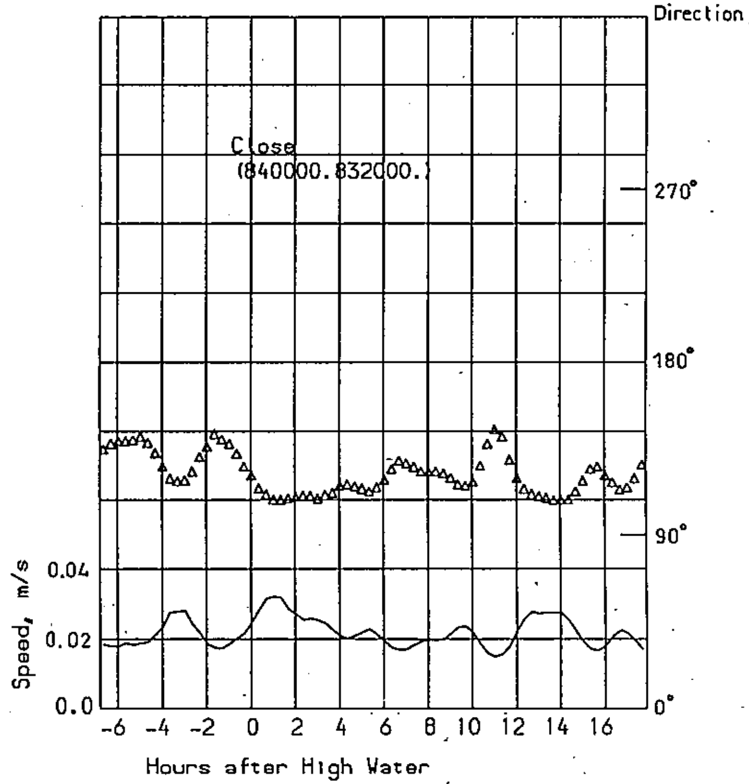
Simulated Water Speed in the Reclamation Area - Dry Season Spring Tide

May 1994

Mouchel

Figure No. C3





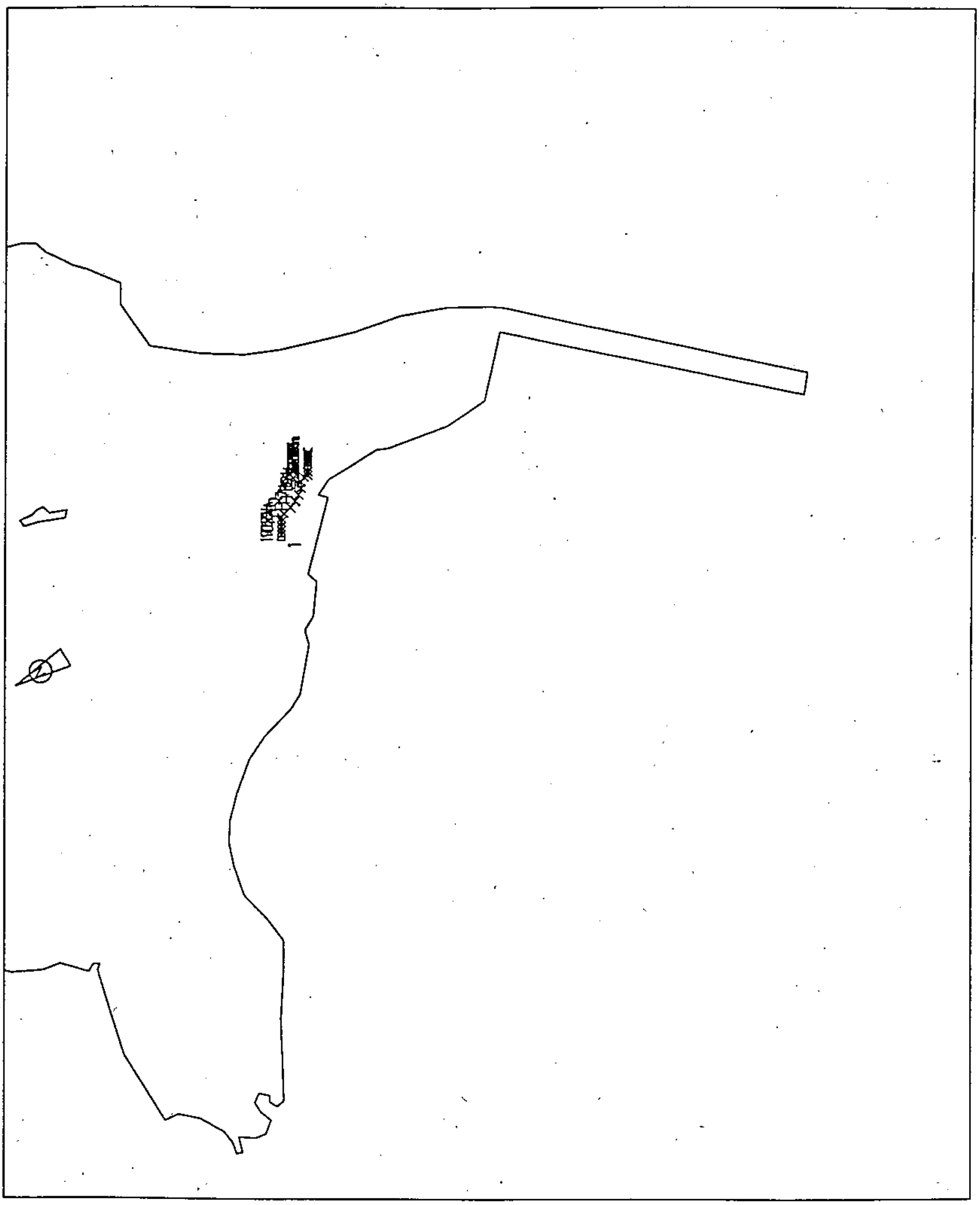
Legend:
- ———— Model speed layer 1
- △ Model direction layer 1
- ------------ Model speed layer 2
- ▽ Model direction layer 2

Simulated Water Speed in the Reclamation Area - Dry Season Neap Tide

May 1994

Mouchel

Figure No. C4

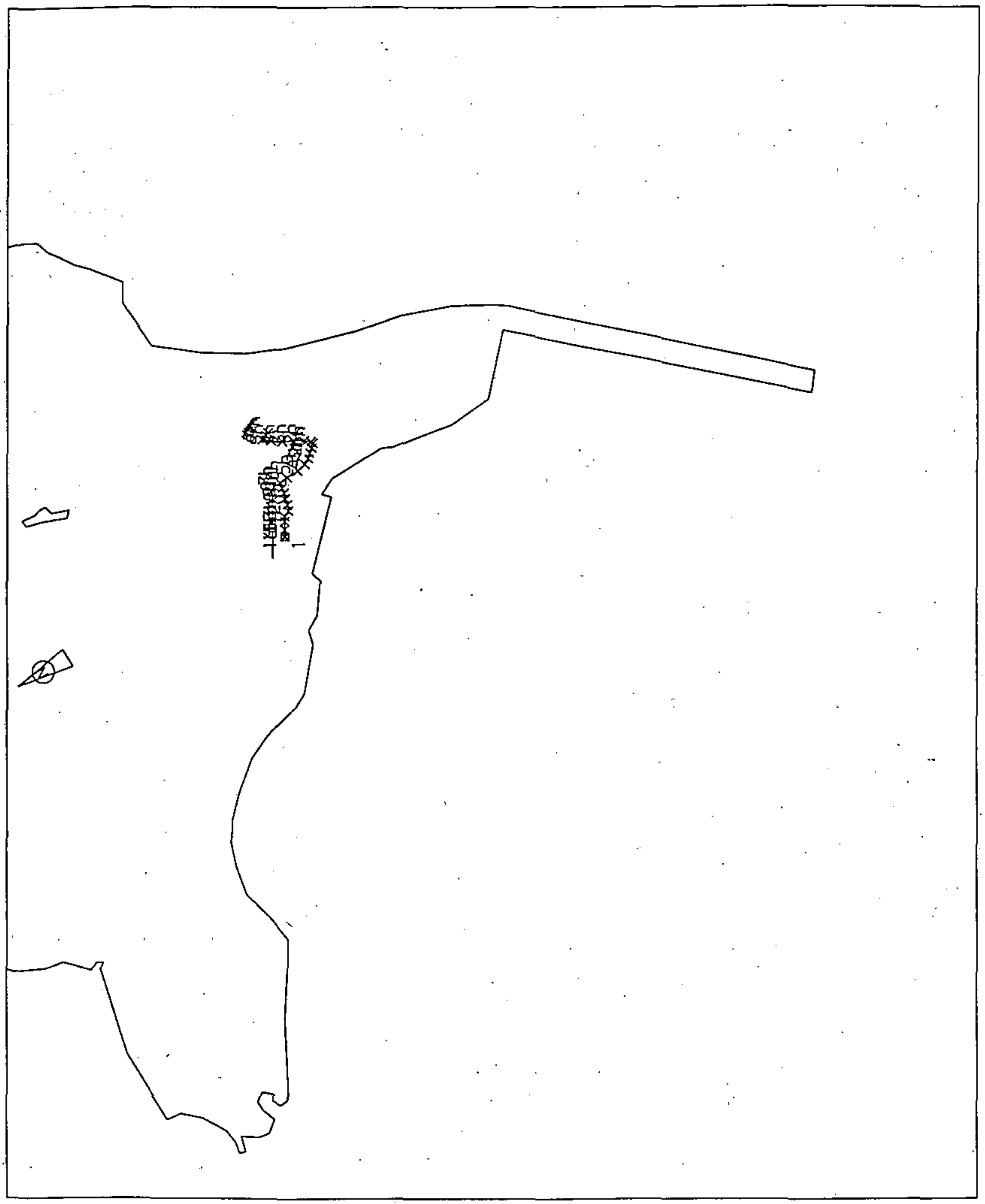


Simulated Water Current
for Wet Season Spring Tide

May 1994

Mouchel

Figure No. C5

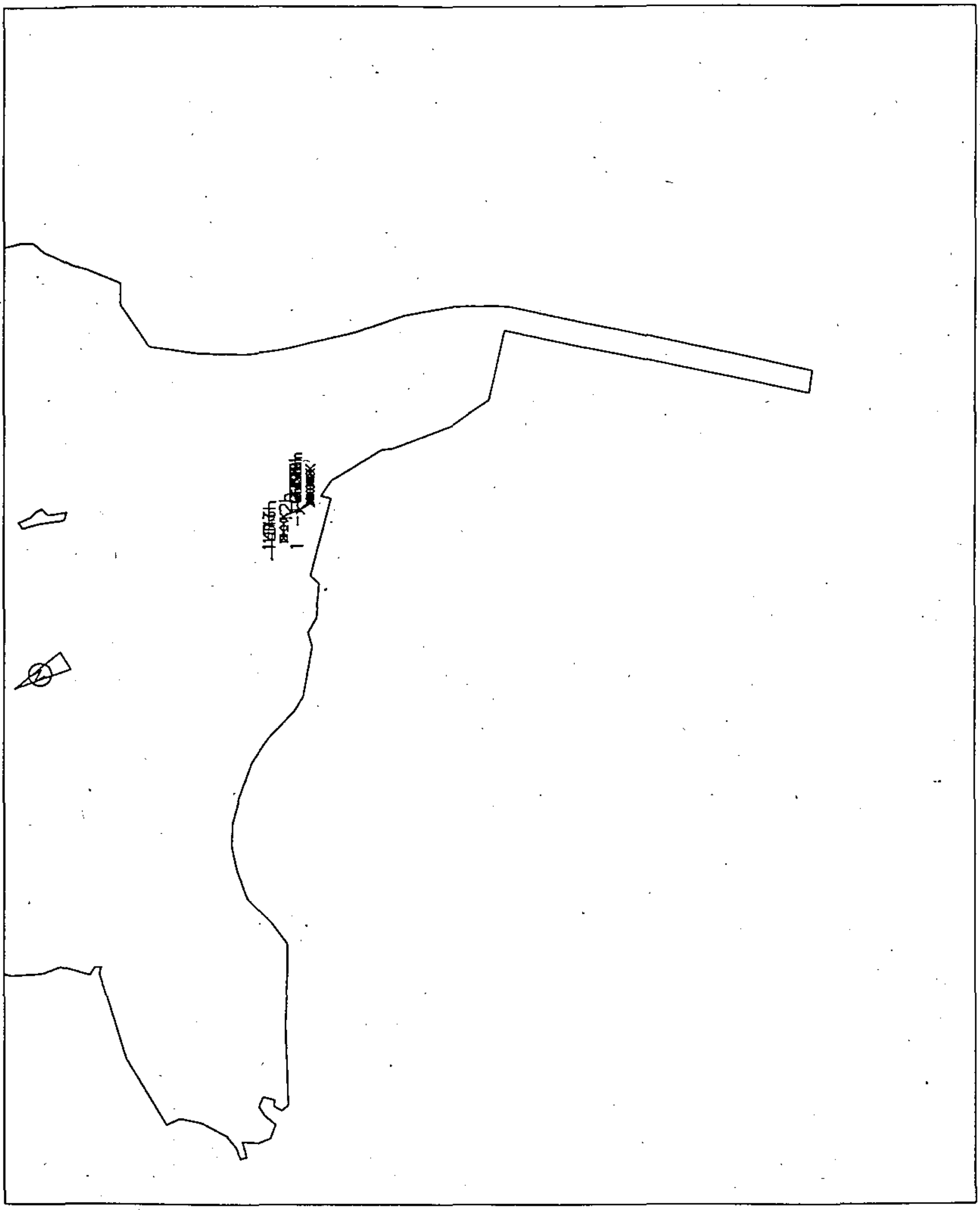


Simulated Water Current
for Wet Season Neap Tide

May 1994

Mouchel

Figure No. C6



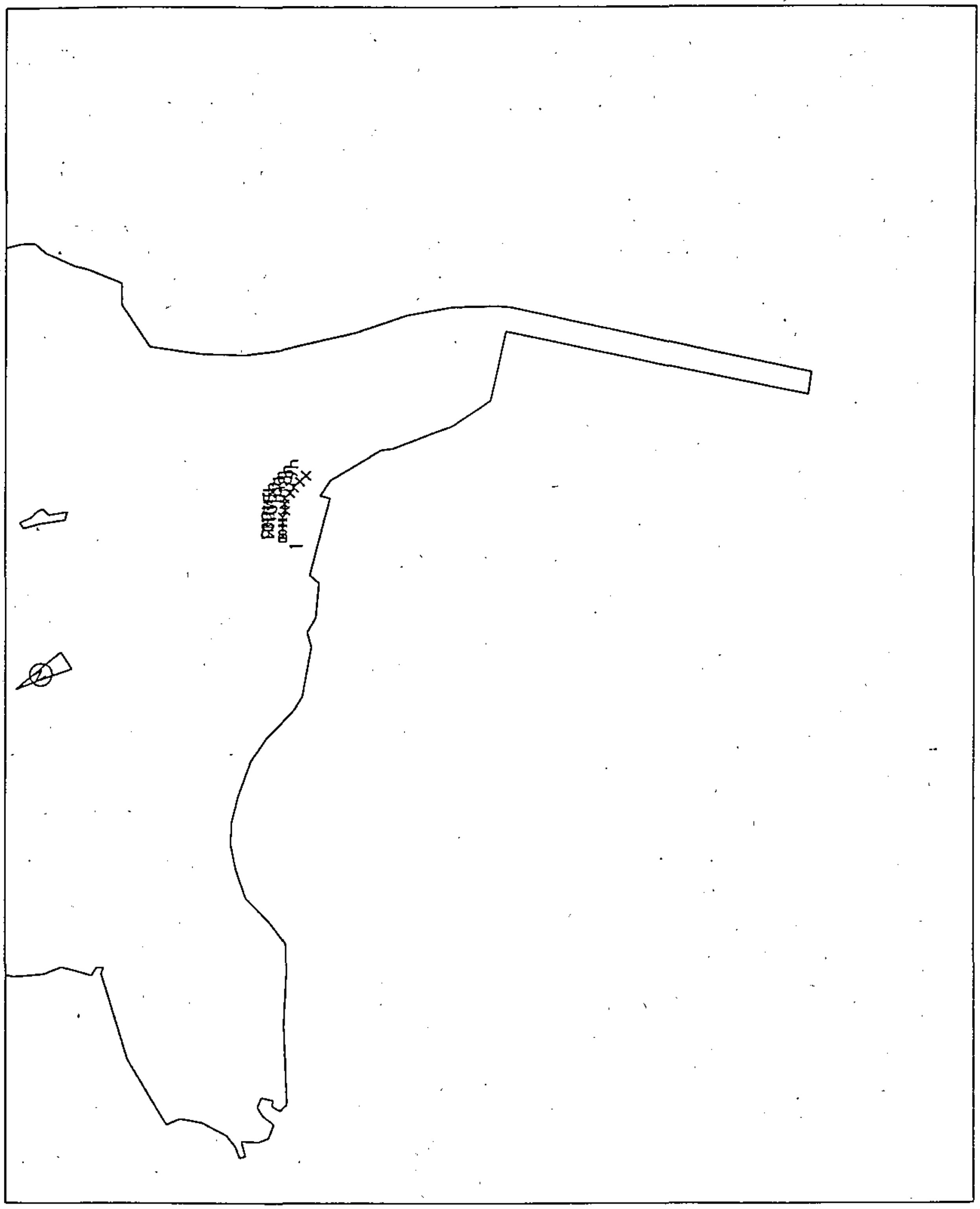
Simulated Water Current
for Dry Season Spring Tide

May 1994

Mouchel

Figure No. C7

PSK Reclamation - EIA Study



Simulated Water Current
for Dry Season Neap Tide

May 1994

Mouchel

Figure No. C8

Appendix D: Guidelines for Dust Monitoring

1 EPD has devised a set of dust monitoring and audit guidelines to ensure that its dust monitoring requirements are understood and met. EPD's guidelines are summarised below.

2 *Monitoring Methodology*

Standard high volume sampling method should be used to obtain the mass concentration of TSP (total suspended particulates) in ambient air.

3 *Monitoring Equipment*

3.1 High Volume Sampler (HVS): The HVS should be equipped with an electronic mass flow controller and calibrated against a traceable standard at regular intervals.

3.2 A direct reading dust meter capable of achieving a comparable results as that obtained by HVS may be used for the 1-hour sampling. The dust meter should be regularly calibrated against a primary standard.

3.3 Wind Data Monitoring Equipment: Equipment should be set up in a non-sheltered location near dust monitoring locations to obtain wind speed and wind direction. The wind sensor should be installed on a mast 10 m above ground. Data should be stored in a data logger, and processed at least once a month. Wind direction should be divided into 16 sectors of 22.5 degrees each. Equipment should be calibrated at least every six months.

4 *Selection of Monitoring Site*

Locations should be agreed upon with the Engineer in consultation with EPD as necessary during the EIA stage. In selecting sites, the following criteria should be considered:

- location should be at the site boundary or close to major dust emitters;
- location should be close to sensitive receivers;
- prevailing meteorological conditions should be considered.

5 *Positioning of Sampler*

When positioning the sampler, the following points should be noted:

- Samplers should be placed at least 2 m apart.
- There must be an unrestricted airflow around the sampler:
    - If a sampler is placed near an obstruction, the height of the obstruction above the sampler must be determined. The sampler should then be placed at a distance of at least twice this height from the obstruction.
    - A minimum of 2 m separation is required between a rooftop sampler and a wall, parapet, or other rooftop structure.
- Sampler should not be placed near an incinerator or furnace flue.

6 *Data Collection*

6.1 A comprehensive set of field details should be recorded on the field data sheet, including temperature, pressure, weather conditions, elapsed-time meter reading for the starting and finishing times of the sampler, identification and weight of the filter paper, site activities, and any other relevant information.

6.2 The flow rate of the sampler before and after the sampling exercise with the filter in position should be verified to be constant. The flow rates should be recorded in the data sheet.

7 *Laboratory Measurement and Analysis of Filter Paper*

8" by 10" filter paper should be used, and labelled prior to sampling. The paper should be conditioned in a humidity-controlled chamber for over 24 hours and weighed prior to use. After sampling, the laden filter should be kept in a sealed plastic bag for transport to the laboratory. In the lab, the filter paper should be reconditioned in the humidity-controlled chamber, and weighed using a regularly-calibrated electronic balance accurate to 0.1 mg.

8 *Reporting and Responsibilities*

8.1 The monitoring team should report directly to the Engineer.

8.2 An Environmental Monitoring and Audit (EM&A) Manual should be prepared and submitted to EPD within the month that the contract is offered.

8.3 Monthly monitoring reports should be prepared and submitted to EPD before the 10th day of the following month.

8.4 All exceedance of air quality standards, along with information on remediation measures, should be included in the monthly monitoring report.

9 *Monitoring Requirements*

Requirements for Baseline, Impact, and Non-compliance monitoring are provided in the main text.

10 *Quality Control*

10.1 "Custody Transfer Documents" should be used to ensure that a chain of custody exists from the point of sampling to the final disposal of samples. At each point in the chain, one person is responsible for the sample until the custody transfer document is signed by someone else, who then assumes responsibility. In this way, the integrity of the samples can be ensured.

10.2 All equipment calibration and recalibration exercises should be documented.

10.3 Each measurement report should be checked and signed by the operator, a second staff member, and a senior before it is issued.

10.4 Data input into the database should be checked against field records prior to being sent to the Officer responsible for the audit. In case of unresolved discrepancies, the data should be flagged to indicate that it may be unreliable.

11 *Action Plans*

Action plans are provided in the main text.

12 *Contingency Plans*

Contingency plans for the following kinds of problems should be worked out in advance, and included in the contract. An allowance for operating additional monitoring sites or increasing the numbers of equipment should be included in budget calculations.

- Delay in setting up monitoring sites or equipment, obtaining power supply, or laboratory facilities
- Failure or theft of equipment
- Adverse weather conditions
- Prolonged absence of key personnel

Appendix E: Recommended Specification Clauses for Pollution Control

1.0 WATER POLLUTION CONTROL AND WATER QUALITY MONITORING

1.1 General Requirements

(a) The Contractor shall carry out the Works in such a manner as to minimise adverse impacts on the water quality during execution of the Works. In particular he shall arrange his method of working to minimise the effects on the water quality within the Site, adjacent to the Site, on the transport routes and at the loading, dredging and dumping areas.

(b) Before marine plant is used on the Works, it shall be inspected by the Engineer to ensure that the plant is suitable for the project and can be operated to achieve the Water Quality Objectives (WQO) as detailed in PS clause 1.3. The Contractor shall provide all necessary facilities to the Engineer for inspecting or checking such vessels and shall not use such vessels or plant for the Works without the agreement of the Engineer. The Engineer may require the Contractor to carry out trials of any plant or vessels to prove their suitability.

(c) The Contractor shall design methods of working to minimise water pollution and to meet the WQO, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(d) Before the commencement of the Works, the Contractor shall submit to the Engineer the proposed methods of working.

(e) After commencement of the Works if the Plant or work method are believed by the Engineer, to be causing unacceptable levels of pollution, the Plant or work methods shall be inspected and remedial proposals drawn up, approved and implemented, as detailed in PS clause 1.9(b). Where such remedial measures include the use of additional or alternative plant such plant shall not be used on the Works until agreed by the Engineer. Where remedial measures include maintenance or modification of previously approved plant such plant shall not be used on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the Engineer.

1.2 Definitions

For use in this Section of the Particular Specification only, the following definitions are used:-

a) Dredged material - all dredged material.

b) Marine mud - dredged material to be removed from the project area.

c) Contaminated marine mud - designated dredged material to be removed from the seawall areas containing sufficient micro-pollutants to require particular handling and disposal procedures.

d) Fill material - dredged or land originated material to be used in the sea wall or placed in the reclamation. Material placed in the reclamation should be controlled under the dumping licence contained in Appendix I of the Works Branch Tedmical Circular No. 2/93, Public Dump.

e) Unsuitable material - material which is unsuitable for placing in the reclamation. The material shall be disposed of at designated landfill sites.

1.3 **Water Quality Objective**

The objective is to minimise adverse impacts resulting from the Contractors operation on the water quality within Tolo Harbour. To achieve this objective the Contractor is to design and implement methods of working that:-

(a) Minimise disturbance to the seabed while dredging;

(b) Minimise leakage of dredged material during lifting;

(c) Minimise loss of material during transport of fill or dredged material;

(d) Prevent discharge of public dump material or dredged material except at approved locations;

(e) Prevent the unacceptable reduction, due to the Works, of the dissolved oxygen content of the water adjacent to the Works; and

(f) Prevent excess suspended solids from being present in the intake waters of the MSL and WSD proposed seawater intakes.

1.4 **Water Quality Monitoring Equipment**

The Contractor shall provide within one week of the commencement of the Contract, the following equipment:-

(a) Dissolved oxygen (DO) and temperature measuring equipment

The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and be operable from a DC power source. It shall be capable of measuring:-

i) a dissolved oxygen level in the range of 0-15 mg/l and 0-200% saturation; and

ii) a temperature of 0-45 degree Celsius.

It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 25 m in length. Sufficient stocks of spare electrodes and cable shall be maintained for replacement where necessary. (YSI model 58 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or similar approved)

(b) Turbidity Measurement Instrument

Turbidity within the water shall be measured *in situ* by the nephelometric method. The instrument shall be a portable, weatherproof turbidity-measuring instrument complete with sensor and comprehensive operation manuals. The equipment shall be operable from a DC power source. It shall have a photoelectric sensor capable of measuring turbidity between 0-200 NTU. Hach 2100P Turbidimeter or similar approved).

(c) Thermometer

A laboratory standard certified mercury thermometer with an accuracy of at least 0.5 degree Celsius.

(d) Water Depth Detector

A portable, battery-operated Echo Sounder shall 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. (Seafarer 701 or similar approved).

(e) Water Sampling

Water sampling shall be taken by a water sampler consisting of a 3 litre PVC cylinder that can be effectively sealed with latex cups at both ends. The sampler shall have a positive latching system to prevent premature closure until released by a messenger at the selected water depth (Kalisco water sampler no. 135WB203 or similar approved).

(f) Hydrowire

Equipment shall be lowered over the side of the boat using a weighted hydrowire calibrated at at least 0.5 m intervals.

All monitoring instruments shall be checked, calibrated and certified by an approved accredited laboratory before use on the Works and subsequently re-calibrated at 3-month intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes shall be checked with certified standard solutions before each use. The turbidity meter shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of suspended solids (in mg/l).

1.5 Water Quality Monitoring

The Contractor shall provide approved qualified technicians, capable of operating the monitoring equipment, together with a suitable work boat for carrying out the monitoring. Monitoring shall be commenced by the Contractor under the supervision of the Engineer within 7 days of the commencement of the Works.

Monitoring shall be carried out *in situ* and in accordance with the following:-

(a) Baseline Monitoring

'Baseline' conditions for the various water quality parameters are to be established prior to the commencement of the marine works under the Contract. The Contractor shall establish the 'Baseline' conditions by measuring the water quality parameters, given in Table 1.1 at all Designated Monitoring Stations. For Group A parameters, measurements are to be made on four days each week at mid flood and mid ebb for a period of 4 consecutive weeks within a period commencing not more than six weeks prior to commencement of construction.

For Group B parameters, measurements are to be made on two days each week at mid flood and mid ebb for a period of three consecutive months commencing not more than fourteen weeks prior to the start of construction.

When measurements for both parameter groups is being carried out sampling for both groups should be carried out at the same time.

For dissolved oxygen, temperature and turbidity measurements shall be taken *in situ* and at 3 water depths, namely, 1 m below water surface, mid-water depth, and 1 m above sea bed, water samples will be taken at the same depths.

Table 1.1 : Marine Water Monitoring Parameters

Group A	Group B
Temperature	Ammoniacal N
Salinity	Nitrite N
Dissolved Oxygen	Nitrate N
Turbidity	Total Kjeldal N
Suspended Solids	Total PO_4
Total Lead	Total Copper
Total Zinc	Chlorophyll-a
	E. coli
	BOD

(b) Impact and Compliance Monitoring

During the course of the Works, monitoring shall be undertaken for groups A & B parameters as follows:

Group A Parameters: Three days each week at mid flood and mid ebb tide throughout the construction and operation period.

Group B Parameters: One day each week at mid flood and mid ebb tide throughout the construction and operation period.

When sampling for both parameter Groups is being carried out sampling for both groups should be carried out on at the same time. Measurements for Zinc, Lead and Copper are only carried out during dredging operations.

Monitoring at each Designated Monitoring Station shall be undertaken on a working day. The interval between each series (mid-ebb and mid-flood) of samplings shall not be less than 36 hours. The values of turbidity, DO and Dissolved Oxygen Saturation (DOS) shall be determined in accordance with Clause 1.4 and Clause 1.5(a). Two measurements at each depth of each Station shall be taken. Where the difference in value between the first and second reading of each set is more than 25% of the value of the first reading the readings shall be discarded and further readings shall be taken. For the purpose of evaluating the water quality, all values shall be depth averaged.

Should the monitoring programme record levels of Group A or B parameters, in the opinion of the Engineer based on the established Trigger, Action and Target levels, be indicative of a deteriorating situation such that, in the opinion of the Engineer, closer monitoring is required, then the Engineer may direct that further monitoring shall be undertaken daily at each Designated Monitoring Station until the recorded depth averaged values of these parameters indicate to the satisfaction of the Engineer an improving and acceptable level of Water Quality.

Analysis for Group A and B parameters shall be carried out in accordance with the Technical Memorandum on standards for Effluent Discharged into Drainage and Sewerage Systems, Inland and Coastal waters, or other method approved by EPD.

1.6 Positions of Designated Monitoring Stations

Table 1.2 : Marine Water Monitoring Stations

Station Description	HK Metric Grid E	HK Metric Grid N
50m seaward of the centre of the Phase 1 Seawall	840000	832000
50m seaward of the centre of the Phase 2 Seawall	839540	832420
50m seaward of the centre of the Phase 3 Seawall	839000	832850
Two locations spaced between the end of the seawall and the shoreline	Moveable as the wall is extended	Moveable as the wall is extended
Sensitive Receiver Tai Po Seawater Pumping Station	837660	834540
Sensitive Receiver Shatin Seawater Pumping Station	840200	830300
Sensitive Receiver Yim Tin Tsai Mariculture Zone	839300	834800
Sensitive Receiver MSL	840200	831120
Reference Control Station within Tolo Harbour	840700	833800

1.7 Reporting of Monitoring Data

The results of all *in situ* Water Quality Monitoring shall be provided by the Contractor to the Engineer, in an agreed format, no later than 24 hours after the sampling. All other parameters shall be reported no later than 2 weeks after sampling.

At monthly intervals at times to be agreed with the Engineer, the Contractor shall provide to the Engineer a summary report, in both printed and magnetic media form, to an agreed format, details of all water quality data obtained in that month. This will include a summary report of any repeat monitoring or remedial measures taken to maintain the water quality.

1.8 Action on Detection of a Deteriorating Water Quality

Where monitoring of the water quality shows, an exceedance of action level, the Contractor shall review the mitigation measures in accordance with the agreed Action Plan. The review of the mitigation measures shall include but not be limited to the following:-

(a) Checking of all marine plant and equipment;

(b) Maintenance or replacement of any marine plant or equipment contributing to the deterioration;

(c) Checking and maintenance of all silt screens; and

(d) Review of all working methods.

The Contractor shall, as a result of the review, implement further mitigation measures such that the water quality is below the trigger level.

The Engineer shall be kept informed of all steps taken, and written reports and proposals for action shall be passed to the Engineer by the Contractor whenever monitoring shows non-compliance with the WQO.

In the case that the Contractor fails to implement the necessary mitigation measures or the water quality deterioration persists despite the mitigation measures then the Engineer can instruct the Contractor to temporarily suspend the causative works until the Engineer is assured that proper mitigation measures have been implemented and the water quality has returned to acceptable levels.

1.9 General Procedures for the Avoidance of Pollution During Dredging, Transporting, and Dumping of Marine Mud

(a) All Construction Plant shall be designed and maintained to minimise the risk of silt and other contaminants being released into the water column or deposited in other than designated locations.

(b) Pollution avoidance measures shall include but are not limited to the following:-

(i) mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted;

(ii) all vessels shall be sized such that adequate clearance is maintained between vessels and the sea bed and under water pipelines at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash or pipelines damaged;

(iii) the Works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds;

(iv) all barges shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

(v) excess material shall be cleaned from the decks and exposed fittings of barges before the vessels are moved; and

(vi) loading of barges shall be controlled to prevent splashing of dredged material to the surrounding water and barges shall not be filled to a level which will cause overflowing of material or polluted water during loading or transportation.

(c) The Engineer may monitor any or all vessels transporting material to ensure that no dumping outside the approved location takes place. The Contractor shall provide all reasonable assistance to the Engineer for this purpose.

(d) The Contractor shall ensure that all marine mud, contaminated marine mud at the approved locations. He will be required to ensure accurate positioning of vessels before discharge and will be required to submit and agree proposals with the Engineer for accurate position control at disposal sites before commencing dumping.

(e) The Engineer may monitor any or all vessels transporting material to ensure that loss of material does not take place during transportation. The Contractor is to provide all reasonable assistance to the Engineer for this purpose.

(f) The Contractor shall ensure that all unsuitable material is disposed of at the approved landfill or other designated location.

1.10 Designated Contaminated Marine Mud

Where quantities of the material to be dredged is contaminated with micro-pollutants, the locations and depths of the designated contaminated marine mud will be indicated on the drawings or directed by the Engineer on site. The Contractor is to ensure that the designated contaminated marine mud is dredged, transported and placed in approved special dumping grounds in accordance with the provisions of P.S. clause 1.11 and in such a manner to minimise the loss of material to the water column.

1.11 Special Procedures for the Avoidance of Pollution During Dredging, Transportation and Disposal of Designated Contaminated Marine Mud

When dredging, transporting and disposing of designated contaminated marine mud, the Contractor shall implement additional special procedures for the avoidance of pollution which shall include but are not limited to the following:-

(a) Dredging of designated contaminated marine mud shall only be undertaken by a suitable grab dredger using a close grab;

(b) Transport of designated contaminated marine mud shall 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;

(c) Discharge from split barges shall take place within a radius of 100 metres of centre of the area allocated for the disposal of designated contaminated marine mud; and

(d) Discharge shall be undertaken rapidly and the hoppers shall then immediately be closed; any material adhering to the sides of the hopper shall not be washed out of the hopper and the hopper shall remain closed until the barge next returns to the disposal site.

1.12 Audit Measurements

At the completion of all dredging and filling works, the Contractor shall continue the monitoring of water quality for weekly for a period of three months for dissolved oxygen and turbidity. At the end of this period the Contractor shall provide a summary report to the Engineer in the agreed format.

1.13 Protection of Water Quality at Water Intakes

When dredging or placing fill the Contractor shall surround the water intakes indicated on the Drawings with suitable silt curtain systems to prevent excess silt contaminating the water drawn into the intakes. The silt curtain system shall be designed to ensure that the indrawn water shall contain less than 20 mg/l of suspended solids at the MSL intake.

1.14 Silt Curtains

The Contractor will be responsible for designing, agreeing with the Engineer and installing silt curtains, where required, to achieve the Water Quality Objective and the protection of water quality at water intakes as described in PS Clause 1.13.

Silt curtains shall be formed from tough, abrasion resistant, permeable membranes, suitable for the purpose, supported on floating booms in such a way as to ensure that the ingress of turbid waters to the enclosed waters shall be restricted.

The bottom of the curtain shall be formed and installed in such a way that tidal rise and fall are accommodated, and that the ingress of turbid waters is limited. The removal and reinstallation of such curtains during typhoon conditions shall be as agreed with the Director of Marine.

The Contractor shall regularly inspect the silt curtains and shall ensure that they are adequately moored and marked to avoid danger to marine traffic.

2.0 NOISE POLLUTION CONTROL

2.1 The Contractor shall comply with and observe the Noise Control Ordinance and its subsidiary regulations in force in Hong Kong.

In order to demonstrate compliance with the Specification clauses limiting the disturbance to the general public caused by site activities noise the Contractor shall carry out, to the satisfaction of the Engineer, the following construction noise monitoring procedures:

i) all measurements shall be carried out by suitably experienced staff, who have been approved by the Engineer.

ii) sound level readings shall be recorded on forms provided by the Contractor, and approved by the Engineer.

iii) the measurements taken are for the information of the Engineer, Employer and the Contractor and shall not form a basis for prosecution under the Noise Control Ordinance.

2.2 The Contractor shall provide an approved integrating sound level meter to IEC 651 : 1979 (Type 1) and 804 : 1985 (Type 1) and the manufacturer's recommended sound level calibrator for the exclusive use of the Engineer at all times. The Contractor shall maintain the equipment in proper working order and provide substitute when the equipment is out of order or otherwise not available.

The sound level meter including the sound level calibrator shall be verified by the manufacturers every two years to ensure they perform the same levels of accuracies as stated in the manufacturer's specifications. That is to say at the time of measurements, the equipment shall have been verified within the last two years.

2.3 In addition to the requirements imposed by the Noise Control Ordinance to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the period from 0700 to 1900 hours on any day not being a general holiday including Sundays, the following requirements shall also be complied with:

i) The noise level measured at 1 m from the external facade of the following noise sensitive receivers resulting from the site activities alone during any 30 minute period shall not exceed an equivalent sound level (Leq) as given below:

Identified Sensitive Receiver	**Noise Standard (dB(A))**
Villa Castell, overlooking Tolo Highway and the proposed reclamation	62
Village house in Cheung Shue Tan, facing Tolo Highway and the proposed reclamation	62
Staff quarters (Residence No.10) of the CUHK, overlooking Tolo Highway and the proposed reclamation	75
Residence building No.7 of the CUHK overlooking the reclamation and Tolo Highway	72
The HKIB building, at a facade facing Tolo Harbour	75

Alternative locations may be agreed or directed by the Engineer if difficulties arise in obtaining access, or if the locations become unsuitable. The exact location and direction of the noise monitoring is to be agreed with the Engineer on site and recorded for use in all subsequent monitoring.

Where the Contractor has been granted a permit to work during restricted hours, additional measurements shall be taken during the restricted hours.

ii) The noise level measured at 1 m from the most affected external facade of the nearby Chinese University of Hong Kong from the site activities alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 70 dB(A). During examination periods the sound level shall not exceed 65 dB(A).

The Contractor shall liaise with the Chinese University of Hong Kong to ascertain the exact dates and times of all examination periods during the course of the contract.

Should the limits stated in the above sub-clauses (i) and (ii) be exceeded, the construction shall stop and shall not recommence until appropriate measures acceptable to the Engineer that are necessary for compliance have been implemented.

Any stoppage or reduction in output resulting from compliance with this clause shall not entitle the Contractor to any extension of time for completion or to any additional costs whatsoever.

2.4 The Contractor shall prior to the commencement of the construction works carry out baseline monitoring to determine and agree ambient sound levels. The baseline monitoring shall be carried out for a period of at least two weeks, with measurements to be taken every day at each location and to a schedule agreed with the Engineer. From the baseline measurements an agreed ambient noise level shall be calculated. Where the Contractor intends to apply for a permit for working during restricted hours he shall carry out further baseline monitoring to determine and agree ambient noise levels during such hours.

The Contractor shall submit to the Engineer, no later than the 10th day of the month following the monthly reporting period, three copies of a report giving the dates and times of each series of measurements. The actual measurements of each recording, together with comments on any discarded measurements shall also be provided.

2.5 Before the commencement of any work, the Engineer may require the methods of working, equipment and sound-reducing measures intended to be used on the site to be made available for inspection and approval to ensure that they are suitable for the project.

2.6 The Contractor shall schedule the works, site the facilities, select quiet equipment and use purpose-built acoustic panels and enclosures so as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

2.7 The Contractor shall ensure that all plant and equipment to be used on site are properly maintained in good operating condition and noisy construction activities shall be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers.

2.8 Notwithstanding the requirements and limitations set out in clause 2.3 above and subject to compliance with clauses 2.6 and 2.7 above, the Engineer may upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any duration provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the Noise Control Ordinance in any respect.

2.9 No excavator mounted breaker shall be used within 125 m from any nearby noise sensitive receivers.

2.10 For the purpose of the above clauses, any domestic premises, hostel, temporary housing accommodation, medical clinic, educational institution, place of public worship, library, performing arts centre or office building shall be considered a noise sensitive receiver.

2.11 The Contractor shall, when necessary, apply as soon as possible for a construction noise permit in accordance with the Noise Control (General) Regulations, display the permit as required and copy to the Engineer. The Contractor is to note that neither the Authority nor its employees can influence the issue or terms of a construction noise permit.

3.0 AIR POLLUTION CONTROL

3.1 The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities.

In order to demonstrate compliance with the Specification clauses limiting the disturbance to the general public caused by construction and operational dust, (measured as total suspended particulates and herein referred to as "dust (TSP)"), the Contractor shall carry out, to the satisfaction of the Engineer, the following dust (TSP) monitoring procedures:-

i) all measurements shall be carried out by suitably experienced staff, who have been approved by the Engineer.

ii) dust (TSP) level readings shall be recorded on forms provided by the Contractor, and approved by the Engineer.

iii) the measurements taken are for the information of the Engineer, Employer and the Contractor and shall be used to evaluate the Contractors performance in undertaking the requirements for controlling dust (TSP) levels generated from the reclamation.

3.2 The Contractor shall install and operate three high volume air samplers and associated equipment and shelters in accordance with the USA standard *Title 40, Code of Federal Regulations, Chapter 1 (part 50), Appendix B* for the measurement of dust (TSP). The Contractor shall maintain the equipment in proper working order and provide replacement when the equipment are out of order or otherwise not available.

Monitoring shall be carried out 1 day in every 6 days at each locations during the construction and operation of the site and in a manner as instructed by the Engineer. The Contractor shall provide all necessary protection fences and the like at each monitoring location. Testing and analysis of sampled materials shall be carried out by a laboratory approved by the Engineer.

3.3 Dust (TSP) level monitoring shall be carried out at the following locations, and the Contractor shall be responsible for arranging any access. Alternative locations may be agreed or directed by the Engineer if difficulties arise in obtaining access, or if the locations become unsuitable.

i) Hong Kong Institute of Biotechnology

ii) Campus of the Chinese University of Hong Kong

iii) Cheung Shue Tan Village

The exact location of the dust (TSP) monitoring is to be agreed with the Engineer on site and recorded for future compliance. The agreed locations shall not be located at the site of major roads and shall be free from local obstructions or sheltering.

The Contractor shall prior to the commencement of the construction works carry out baseline monitoring to determine and agree ambient dust (TSP) levels. The baseline monitoring shall be carried out for a period of at least two weeks, with measurements to be taken every day at each location and to a schedule agreed with the Engineer. From the baseline measurements an agreed ambient dust (TSP) level shall be calculated.

The Contractor shall submit to the Engineer, no later than the 10th day of the month following the monthly reporting period, three copies of a report giving the dates and times of each series of measurements. The actual measurements of each recording, together with comments on any discarded measurements shall also be provided.

3.4 The Contractor shall at his own cost and to the satisfaction of the Engineer install effective dust suppression equipment and take such other measures as may be necessary to ensure that at the Site boundary and any nearby sensitive receiver the concentration of airborne dust shall not exceed 0.5 milligrams per cubic meter, at standard temperature (25°C) and pressure (1.0 bar) averaged over one hour, and 0.26 milligrams per cubic metre, at standard temperature (25°C) and pressure (1.0 bar) averaged over 24 hours.

3.5 In the process of material handling, any material which has the potential to create dust shall be treated with water or wetting agent sprays, especially when dusty materials are being discharged to a vehicle from a barge at a fixed transfer point.

3.6 Any vehicle with an open load-carrying area used for moving materials, and having the potential to create dust, shall have properly fitting side and tail boards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin. The tarpaulin shall be properly secured and shall extend at least 300 mm over the edges of the side and tail boards.

3.7 Stockpiles of fill material greater than 20 m^3 shall be enclosed on three sides, with walls extending above the pile and 2 metres beyond the front of the pile. In addition, water sprays shall be provided and used, both to dampen stored materials and when receiving fill material.

3.8 The Contractor shall frequently clean and water the site access road to minimize the fugitive dust emissions.

3.9 The Contractor shall restrict all vehicles to a maximum speed of 8 km per hour and confine haulage and delivery vehicles to designated roadways inside the site.

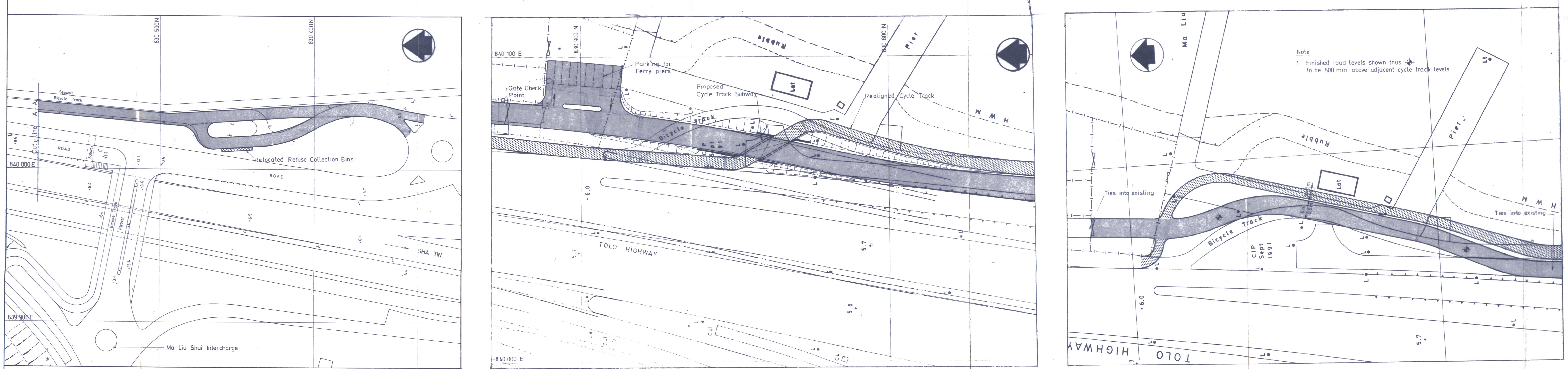
3.10 The Contractor shall provide and maintain wheel washing facilities at location approved the Engineer. The design of the wheel washing facility shall be approved by the Engineer before installation in order to ensure that it is suitable for the project. All vehicles leaving the site shall be cleaned to the satisfaction of the Engineer. No earth, mud, debris, dust and the like shall be deposited on access and public roads. Water in the wheel cleaning facility shall be recirculated through a settling facility. Water shall be changed when the recirculated water become muddy. The wheel washing facility shall be usable prior to the construction works. The Contractor shall also provide a hard-surfaced road between the washing facility and the public road.

3.11 Conveyor belts shall be fitted with windboards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimize emission of dust. All conveyors carrying materials which have the potential to create dust shall be totally enclosed and fitted with belt cleaners.

Appendix F: Cost Estimate of Recommended Mitigation Measures (Estimate at May 1994)

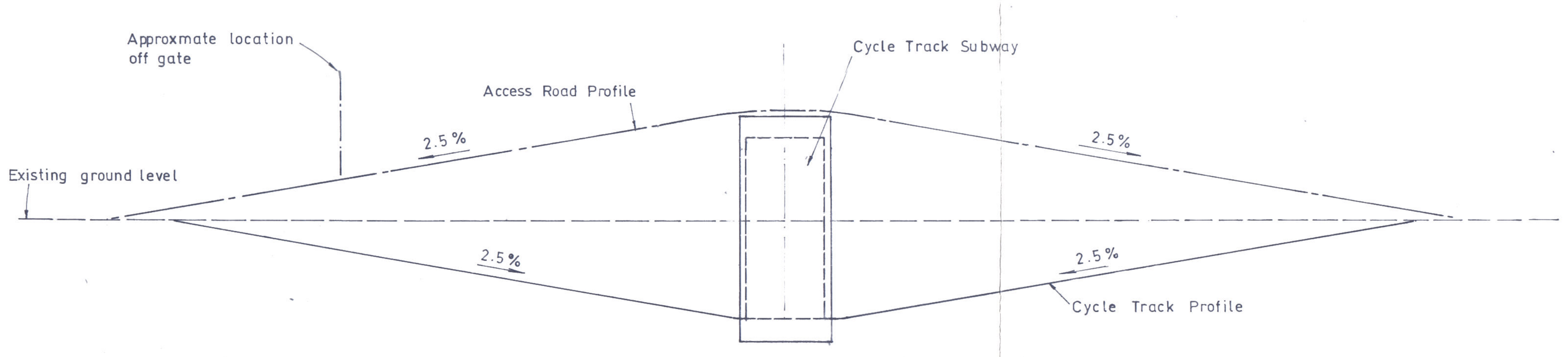
Item	Description	Quantity	Rate (HK$)	Amount (HK$)
1.0	Noise Mitigation Measure			
1.1	Noise barrier (Dust barrier) outside MSL (2m high steel post concrete planks)	185m	$3,500	$647,500
2.0	Dust Mitigation Measures			
2.1	Dust barrier outside MSL (included in item 1.1)	-	-	-
2.2	Vehicle washing facility (including water recycling system	-	Item	$576,000
2.3	Hydroseeding of completed area	670,000m^2	$15	$10,050,000
2.4	Upgrading primary air supply filters for HKIB	-	Item	$24,000
2.5	Water bowser	-	Item	$225,000
3.0	Mitigation Measures for Water Quality Control			
3.1	Dredging of classes A and B sediment with silt curtain and closed grab (including disposal of sediment at East of Ninepins Islands)	288,000m^3	$42	$12,096,000
3.2	Dredging of class C sediment with silt curtain and closed grab (including disposal of sediment at East Sha Chau)	240,000m^3	$56	$13,440,000
3.3	Silt screen around MSL seawater intake	-	Item	$50,000
4.0	Landscape Mitigation Measures (rates include one year maintenance cost and based on Figure No. 8.13.) All irrigation would be by bowser during the maintenance period. After this period, planting would be dependent on natural water			
4.1	Tree planting (light standard trees at 4m c/c) at edge of the reclamation; between cycle path and reclamation; earth mound between access road and HKIB.	17,350m^2	$12	$208,200
4.2	Roadside planting (light standard trees at 8m c/c)	263 nos.	$150	$39,450
4.3	Shrub planting (2m wide, 2 plants/m^2) at the edge of the reclamation; between cycle path and Tolo Highway and at the earth mound between the access road and the HKIB	16,650m^2	$113	$1,881,450
			Total	$39,237,600.00

Note: No preliminary has been allowed



INSERT PLAN
1:500

WORK DONE BY OTHERS 1:500
(TEMPORARY VEHICLE ACCESS & CYCLE TRACK DIVERSION)



LONGITUDINAL SECTION OF CYCLE TRACK ADJACENT TO FERRY PIER
N.T.S.

Rev.	Description	By	Date
A	Final report issued	FY	9.6.94

Client: Hong Kong Government, Civil Engineering Department

Project: Pak Shek Kok Reclamation EIA Study

Drawing Title: CONCEPTUAL DESIGN OF ACCESS ROAD

Mouchel
Mouchel Asia Limited
Consulting Engineers

Drawn	FY	17.1.94
Checked	GT	9.6.94
Approved	NKM	9.6.94
Scale	1:1000 or as shown	

Date Issued	Drg. No.	Rev.
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