Hong Kong Government
Civil Engineering Department
香港政府土木工程署

Pak Shek Kok Reclamation - Public Dump Environmental Impact Assessment Study

白石角填海工程 － 公衆卸泥 環境影響評估研究

Executive Summary

摘要

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1.0 BACKGROUND

The proposed Pak Shek Kok (PSK) reclamation project forms part of the Public Dumping Strategy developed by the Fill Management Committee in 1992 which identifies short and long term reclamation sites to meet the Territorial requirement for the disposal of surplus construction material which is suitable for reclamation.

The PSK site was chosen following a detailed site search conducted by Planning Department in the area because it fully met the requirements of the Public Dumping Strategy and also appeared to be the least environmentally objectionable. In September 1993, the Civil Engineering Department appointed Mouchel Asia Limited to undertake an Environmental Impact Assessment (EIA) Study to quantify the potential impacts of the project and propose measures for their control.

The issues evaluated under this study include:

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

The EIA provides information on the nature and extent of potential environmental impacts associated with the reclamation allowing decisions to be made 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
- need to review the extent of the reclamation if it is found that the project will cause significant environmental impacts.

2.0 THE PROPOSED DEVELOPMENT

2.1 Project Description

The proposed PSK reclamation site covers an area of approximately 67 hectares of 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 dredging of the marine mud underneath the site would not take place. 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 2003 and once completed the finished level of the PSK site would

be +5.5 mPD which is about the same level as the Tolo Highway.

Unless mitigation measures are implemented the construction and operation of the PSK reclamation are likely to create noise, air quality, marine water quality and visual impacts on the local environment (sensitive receivers). These sensitive receivers include:

- Hong Kong Institute of Biotechnology (HKIB) Building, a research institute with requirements for high indoor air quality. The building is sound insulated and centrally air-conditioned, with glazing over a large portion of the external walls.
- Staff Accommodation of HKIB. Window-type air conditioners are provided for all flats. However, the balconies are exposed.
- Marine Science Laboratory, (MSL). The office and the research laboratory are air-conditioned, the water laboratory is open. The laboratory abstracts seawater from Tolo Harbour for marine organism culture and requires good quality water.
- University Water Sports Centre, a recreational centre adjacent to the MSL.
- Chinese University of Hong Kong (CUHK), a tertiary educational institute with staff and student accommodation across the Tolo Highway. Class rooms are all air-conditioned but the accommodation buildings generally are not.
- Village houses such as Cheung Shue Tan, Wong Nai Fai and Tsiu Hang which are located to the north of CUHK.
- St Christopher's Home (SCH) which will be redeveloped into a low density residential area (Tai Po Town Lot No. 135).
- Cyclists along the bicycle track of Tolo Highway.
- Residences at Ma On Shan.
- Mariculture Zones in Tolo Harbour.
- Tai Po and Shatin proposed sea water intakes at which Water Supplies Department require low suspended solids and ammonia.

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

The PSK site would operate between 0800 - 1800 hrs, Monday to Saturday, and be closed on all Sundays and Public Holidays. Once operating, licensed contractors would be able to dispose of suitable construction waste and surplus

fill material to the site, provided the material complies with dumping licences issued by Civil Engineering Department under the Crown Lands Ordinance. Acceptable materials include:

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

Material containing marine mud, household refuse, plastic, metal, industrial and chemical waste, animal and vegetable matter and other material considered unsuitable by the reclamation supervisor would not be permitted on the site.

2.2 Road Access Option

To establish access to the site, three road access options (see Figure 1) were evaluated with respect to engineering feasibility, impact on surrounding traffic and safety aspects:

- Option 1 - This road access would be gained from the Tolo Highway via the interchange south of CUHK, then north passing through the edge of Ma Liu Shui ferry piers, the Water Sports Centre of CUHK, MSL and the HKIB grounds.
- Option 2 - This road access would be from the Tai Po Road via Yau King Lane serving the new residential development at Villa Castell passing over the Kowloon Canton Railway (KCR) line and the Tolo Highway into the northern area of the site.
- Option 3 - This road access would involve access from within the CUHK campus and 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.

Of the three road options assessed, it was found that Option 1 is the most feasible option and the detailed environmental impact assessment was based on this access route. The assessment showed that with Option 1 noise levels at the HKIB staff accommodation exceeded the recommended standard. This was mitigated by realignment of the road away from the staff accommodation; shown as Option 1A on Figure 2.

2.3 Proposed Filling Sequence

As road access Option 1 would be adopted, it is recommended that the southern part of the first phase of reclamation should be filled up to finished level (+5.5 mPD) as quickly as possible in order that a landscape mound can be created in this area to mitigate noise, dust and visual impacts when the reclamation work is being carried out further north of the HKIB and its staff accommodation.

2.4 Activities during Construction

The activities during the construction of the project primarily include:

- construction of the seawall and associated dredging
- provision of an access road.

Dredging is likely to be required to remove the soft marine deposits or mud along the line of the seawall. It may be possible to construct seawalls on foundations which do not require dredging. If this technique is found to be applicable at the PSK site, dredging can be avoided for the later stages of the seawall construction. Avoiding dredging is the top priority. In this EIA, dredging the whole length of seawalls is considered as the worst case scenario.

2.5 Activities during Operation

The activities during operational phase consist of:

- transporting of infill material to the site
- unloading of material
- infilling the reclamation site
- spreading and temporarily stockpiling of material on site
- transferring of stockpiling material to the active working face
- material compaction
- hydroseeding and planting

3.0 EXISTING ENVIRONMENTAL CONDITIONS

To assess the significance of environmental impacts of the reclamation project it is necessary to establish the existing environmental conditions for particular parameters against which to measure the predicted changes. The existing conditions also show the condition of the environment with reference to established environmental standards, guidelines and objectives.

Available data for the study area have been reviewed and additional environmental monitoring was conducted for those parameters where the existing data were insufficient to establish the background conditions.

The findings are summarised as follows:

- **Noise**

  24-hour noise levels were monitored at five locations near the reclamation site in January 1994. A minimum daytime (0700 - 1900 hr) noise level of 52 dB(A) and a maximum daytime noise level of 73 dB(A) were measured at the Cheung Shue Tan Village and the staff accommodation adjacent to HKIB respectively. It was found that the present noise climate in the vicinity of the PSK area is dominated by traffic noise, predominantly from the Tolo Highway, and the KCR is also an important contributor.

- **Air Quality**

  The PSK area lies between the industrial areas at Tai Po and Shatin and is crossed by the Tolo Highway. Air quality can be considered in terms of dust (both coarse dust, Total Suspended Particulate (TSP), and fine dust, Respirable Suspended Particulate (RSP)) and NO_2.

  EPD routinely monitor air quality at Tai Po and Shatin. The monitoring results for 1992 showed that NO_2 levels were well within Air Quality Objectives (AQO). However, the TSP levels at Tai Po exceeded the annual AQO limit as well as the daily limit on 2 occasions. Two exceedances of the daily TSP limit were also monitored at Shatin. The RSP AQOs were met at both stations in the same year.

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

- **Marine Water Quality**

  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 Water Quality Objectives (WQO) are met by most of the parameters. Dissolved oxygen concentrations in the bottom water layer is the least compliant parameter.

- **Marine Sediment Quality**

  The quality of the sediments along the line of the proposed retaining seawall has been determined. Chemical analysis of the sediments down to the hard sea bed indicates that increased concentrations of lead occur along most of the line at the surface and also at other depths. The levels are such that some of the sediment falls into the EPD Class C, seriously contaminated, category.

4.0 POTENTIAL ENVIRONMENTAL IMPACTS

4.1 Noise Impact

4.1.1 Potential Causes and Effects

Noise is expected to be caused by construction of the seawall and access road, operations at the reclamation, and traffic on the access road.

Nineteen noise sensitive receivers (NSRs) representative of the area surrounding the PSK reclamation site were selected for assessment. The HKIB building was not included as a NSR since it is not an educational or residential receiver.

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

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

Construction of the seawall alone would create minimum impacts at all selected NSRs. Also the unmitigated levels due to the construction of access road Option 1 are expected to be within recommended standard at all NSRs except at the staff accommodation of HKIB. 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 HKIB staff accommodation building.

Operational activities on the site during Phases 1, 2 and 3 are predicted to give rise to noise levels below the recommended maxima. However, the combined impact of the traffic noise from access road Option 1 and the on-site operations of Phase 1 reclamation are predicted to exceed the standard at the HKIB staff accommodation if unmitigated. Mitigation measures are therefore required to limit the operational noise.

4.1.2 Mitigation Measures

Noise levels at the staff accommodation building can be reduced by the use of a noise barrier or realignment of the access road further away from the building.

Although a noise barrier 6 m high 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 to increase the distance between the staff accommodation building and the access road from 5 to 80 m 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). At the same time this would reduce the need for acquisition of University land and visual intrusion of the noise barrier to the residents of the staff accommodation building. The realigned access road (Option 1A) is shown in Figure 2.

It is therefore recommended that the access road be realigned further seaward. The construction noise can be further reduced by the implementation of additional mitigation measures.

To mitigate construction noise along the access road and at the reclamation site 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 would be reduced further through implementation of the following measures:

- Noisy equipment and activities sited as far from sensitive receivers as is practical.
- Noisy plant or processes replaced by quieter alternatives where possible.
- Noisy activities scheduled to minimise exposure of nearby NSRs to high levels of construction noise.
- Idle equipment turned off or throttled down. Potentially noisy equipment properly maintained and used no more often than is necessary.
- Power units of non-electric stationary plant and earth-moving plant quietened by vibration isolation and partial or full acoustic enclosures.
- Construction activities planned so that parallel operation of several sets of equipment close to a given receiver is avoided.
- Reduction of the numbers of powered mechanical equipment.

4.2 Air Quality Impact

4.2.1 Potential Causes and Effects

As the increase in the amount of traffic on the Tolo Highway generated by the reclamation will be small compared to that already using the Highway, the increase of vehicle exhaust (NO_2) and fine dust (RSP) due to the construction and operation of the reclamation is expected to be minimal.

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. Sewage loadings presently in the surface waters flowing into the Harbour to the reclamation area will be reduced during the operation phase of the site as the villages in the PSK area are progressively sewered. The extension of the nullah can be designed in such a way as to maximise its flushing and it is considered, therefore, that odour will not be a problem for the reclamation project.

An increase in ambient dust concentrations during construction of the access road and operation of the reclamation site would have impacts on residential and institutional uses in the study area. The assessment of air quality used the same set of representative sensitive receivers as noise impact assessment, with the addition of the HKIB which intends to establish a pilot "clean room" facility meeting US Food and Drug Administration (FDA).

Dust concentrations during construction of the access road were predicted, based on the assumption that no dust suppression measures would be 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, coarse dust (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.

4.2.2 Mitigation Measures

The key on-site mitigation measures for site working include:

- Damping down of dust on the haul roads, particularly any unpaved sections.
- Covering of exposed surfaces.
- Provision of a sophisticated wheel and under body washing facility for all vehicles leaving the site.
- Progressive restoration of completed areas.
- Restriction of vehicle speed on site.
- Twice daily cleaning of the paved access road by vacuuming.

In addition, the access road will maintain a buffer of 80 m between HKIB and the CUHK staff accommodation (i.e. sensitive receiver CUHK-6 in the report). These mitigation measures would bring dust concentrations at sensitive receivers to an acceptable level with respect to the AQO.

Since the site will be closed on Sundays and Public Holidays, dust will not be generated from site activities on the days the cycle track is most heavily utilised. The installation of the site boundary hoarding along the cycle track, which is recommended as a visual mitigation measure, will also have the benefit of acting as a dust barrier. This will reduce the exposure of the cyclists to dust during the working day. Therefore the site will produce minimal impact on these users.

To minimise the level of exposure to dust of the external sea water tanks at the Marine Science Laboratory a dust barrier is recommended and this should be installed on the section of the access road in front of the laboratory. This, together with other mitigation measures identified above would be sufficient to prevent dust accumulation on the water surfaces.

With the present air filtration system more dusty conditions are 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 air handling plants serving the second and third floors will require more frequent maintenance. It is considered that the efficiency of the present system is adequate to maintain the environment within the building allowing for the increased external dust levels which are predicted.

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 appropriately designed and maintained. Fresh air required for the system should be filtered to a similar standard as for the second and third floors of the existing building. Further filtration of fresh and recirculated air is expected to be required before being supplied to the clean spaces. The HEPA type filter media would be able to control the microbial count to within the FDA standards.

4.3 Water Quality and Sediment Impact

4.3.1 Potential Causes and Effects

Within Tolo harbour there are a number of sensitive receivers which have been identified. These are :

- Mariculture zones at Yim Tin Tsai, Lo Fu Wat and Three Fathoms Cove,
- The proposed 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 Marine Science Laboratory,
- Non gazetted bathing beaches at Lung Mei, Hoi Ha, Sha Lan, Yim Tin Tsai and Lok Wo Sha.

During the initial stages of seawall construction the most significant effects on water quality will result from the dredging of sediment for the formation of the seawalls.

For the purpose of this assessment it has been assumed that dredging techniques will 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 from the north or north west a 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.

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

Predicted changes in other water quality parameters assessed in relation to construction and operational activities are considered insignificant in relation to the existing water quality. All other identified sensitive receivers will not be affected by the project.

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 stage of construction for the seawalls sand will be placed in the dredged trench. The first stage will be completed using bottom dumping barges, the coarse nature of the sands, the shallow depth and low current speed will result in small losses of fines. The second stage of core fill and placement of secondary and primary armour rock will be even more coarse material which will settle rapidly. The impact on local water quality will therefore be minimal.

4.3.2 Mitigation Measures

The identification of some the sediment as Class C requires that these 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 and will reduce the increase of suspended solid concentration at the MSL's seawater intake to 2.5 mg/l. 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. A silt curtain should also be installed around the seawater intake of MSL in order to further reduce the influence of the sediment plume on MSL during dredging.

During the transportation of sediment to the disposal sites 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.

Compliance monitoring should be carried out at two locations between the end of the seawall and the shoreline. Dumping and tipping works should cease in the event that the water quality action limit is breached and should not continue until a silt curtain is placed around the tipping face. If shown to be necessary, the length of seawall should be extended beyond the 100 m buffer distance to retain the suspended solids.

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.

As permeable seawalls will be constructed, there will be a movement of water through the reclamation due to precipitation and the effect of tides. This will result in leaching from the fill material. However, as the fill materials are relatively inert, there will be no significant impact on water quality.

4.4 Visual Impact and Land Use

4.4.1 Potential Causes and Effects

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 while 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 building;

- Resident students, lecturers and workers at the CUHK main campus site, in particular those who live in buildings at the eastern side and who 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 University Water Sports Centre;
- 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 as shown in Figure 2.

4.4.2 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 building 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 between road access alignment Options 1 and 1A when experienced at ground level. In visual terms, road alignment Option 1A is preferable to Option 1 for the residents of the HKIB staff accommodation building 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 changed due to the loss of a waterfront. Its replacement by a green buffer may be considered only as a partial compensation for this loss.

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

The landscape mitigation measures will screen the access road and the landscape mitigation planting will form a green buffer. There will be a change in the visual experience of 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 two floors of the buildings.

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

5.0 ENVIRONMENTAL MONITORING AND AUDIT

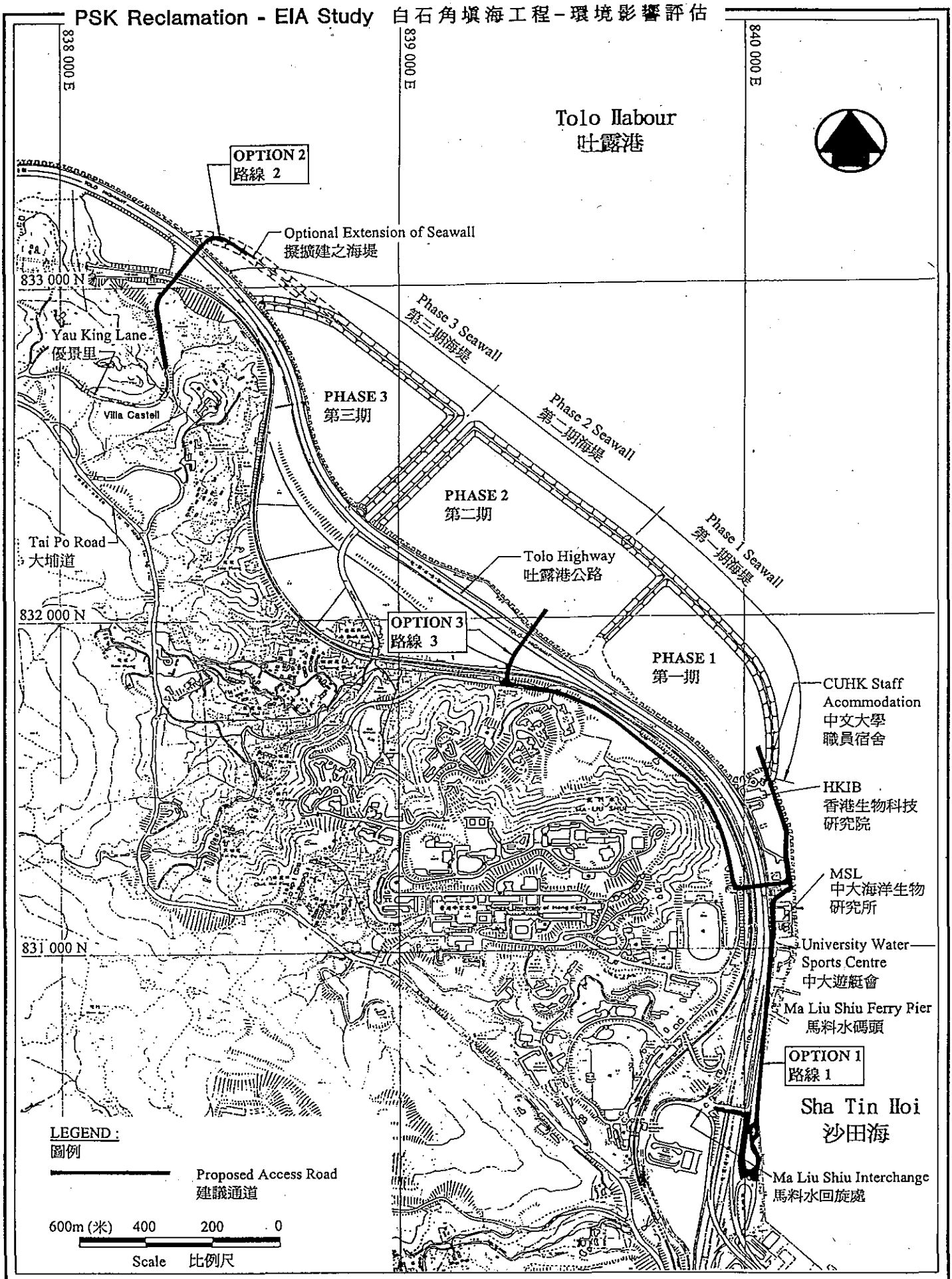
Environmental monitoring and audit requirements for dust, noise and marine water quality are defined for the reclamation project, enabling performance compliance to be ensured and environmental nuisance minimised. It is recommended that the supervision of the monitoring and audit process be carried out by an independent consultant.

Linked to the monitoring activities, an action plan is described to ensure that if any significant impact (either accidental or through inadequate implementation of mitigation measures on the part of the contractor) does occur, then the cause of this is quickly identified and remedied, and that the risk of a similar event re-occurring is minimised.

An Environmental Monitoring and Audit Manual which includes the monitoring programme and the action plan included in the main report will be prepared as a stand-alone document.

6.0 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 within 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.



Access Road Options
通道路線圖

May 1994
一九九四年五月

Mouchel 萬碩

Figure No.
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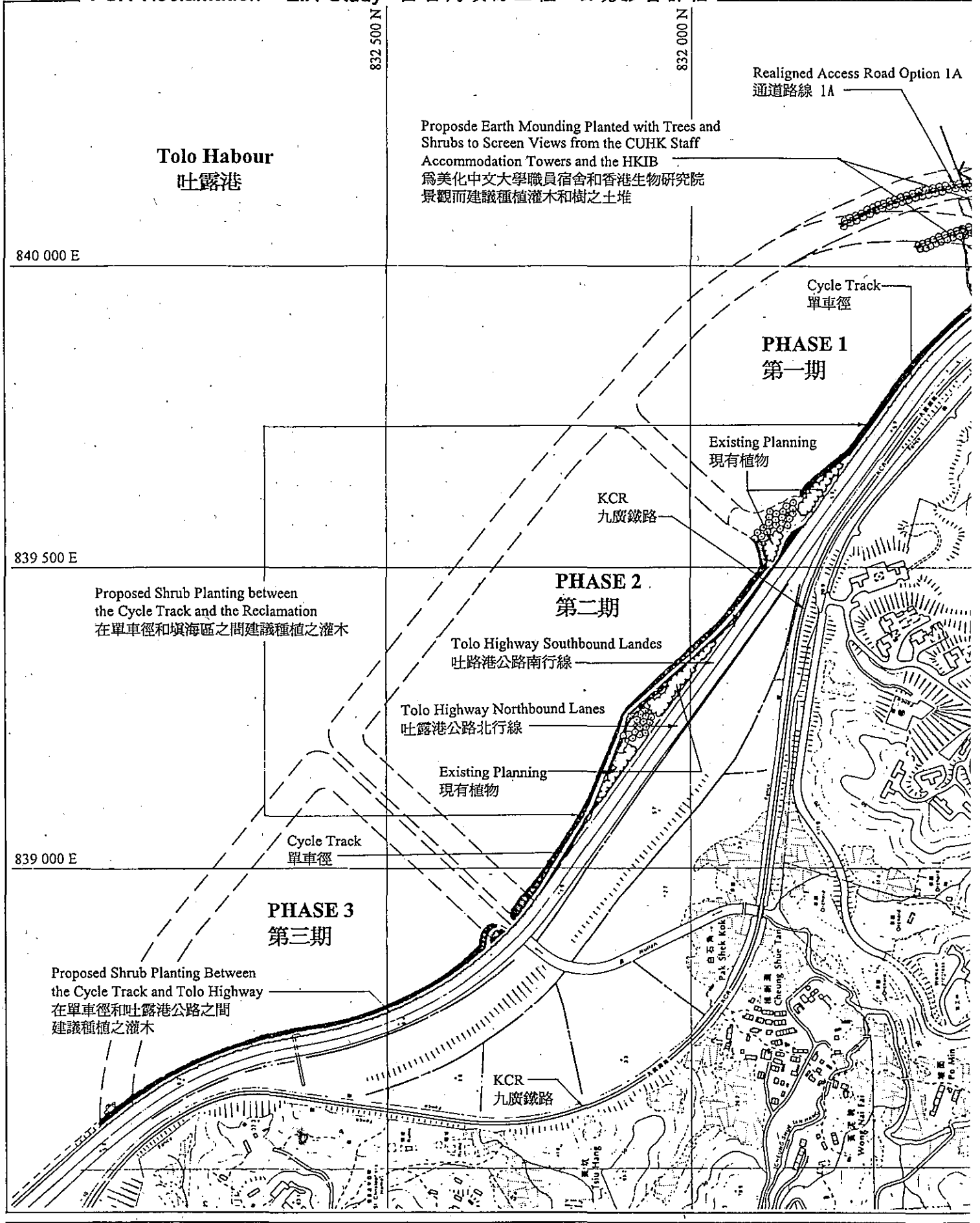

Landscape Mitigation P

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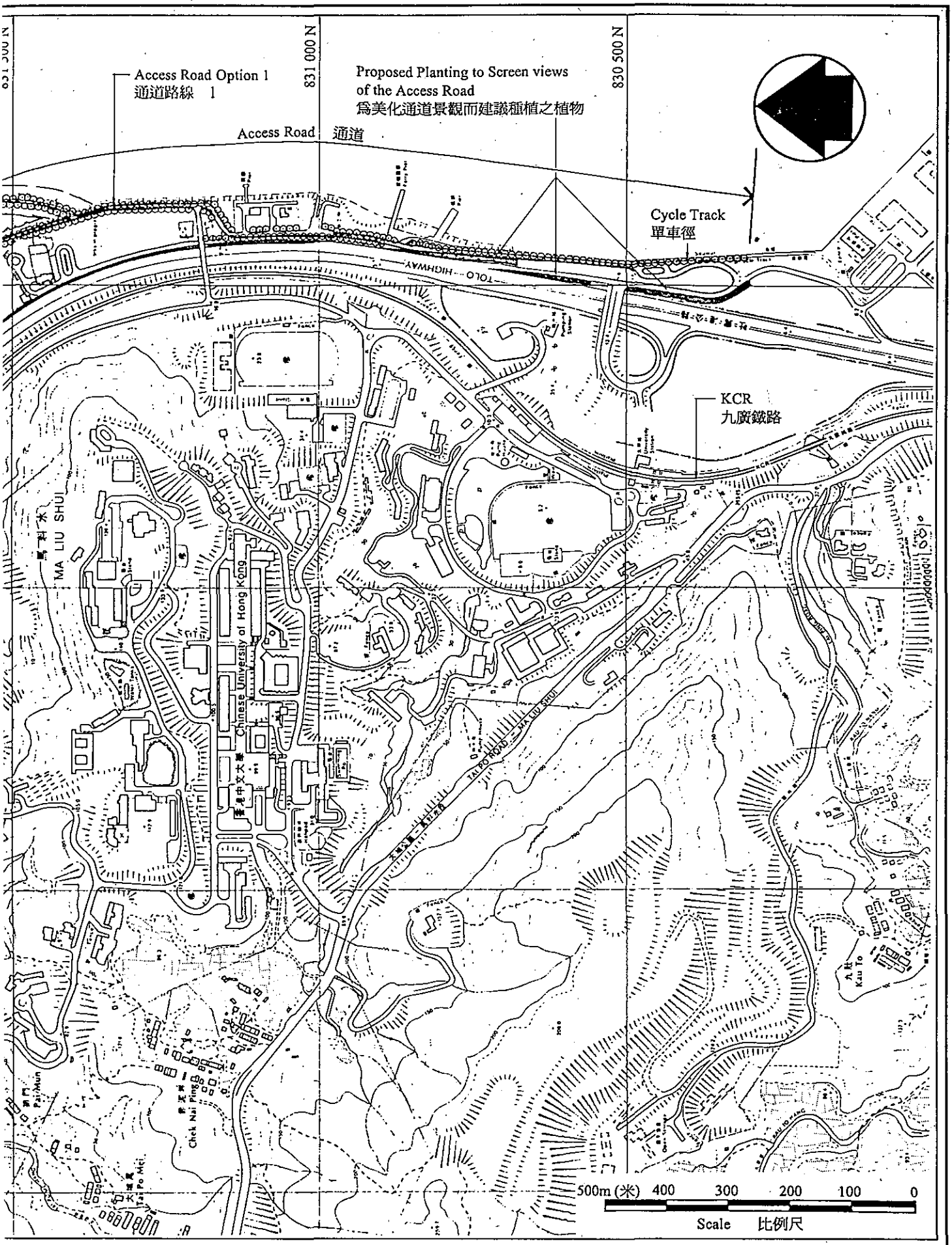

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Figure No.
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目錄

1.0 背景資料

建議中的白石角填海工程是填料管理委員會於一九九二年製訂的公眾卸泥策略一部分。此委員會專責確定各短期及長期填海地點，以符合本港有關棄置適合作填海用途的剩餘建築材料的要求。

經過規劃署對該區進行了詳細的選址研究後，白石角被視爲最能符合公眾卸泥策略的規定，同時所引起的環境問題亦會最小。一九九三年九月，土木工程署委託了萬碩組合顧問工程師進行一項環境影響評估研究，確定建議填海工程的潛在影響，以及就有關影響提供控制措施。

本報告的研究範圍包括：

- 噪音
- 空氣質素
- 海水質素
- 沉積物
- 通道
- 土地用途的影響

本評估報告爲有關填海工程的潛在環境影響的性質及範圍提供資料，以便決定：

- 評估報告指出的環境影響的接受程度，
- 在詳細設計、施工及運作期間需要考慮的情況；
- 在工程未造成嚴重環境影響前對填海範圍作出檢討的需要。

2.0 建議的發展計劃

2.1 工程內容

建議中的白石角填海區約佔六十七公頃的海洋面積，假設無需挖掘填海區海底的海泥，整個填海區可容納約六百萬立方米的填料。預期整項工程需時七至八年，計劃於一九九五年年底展開，由九五年起至二零零三年，此填海區將供棄置合適剩餘建築材料之用。在整項工程完成後，白石角填海區的地面高度將爲海拔五點五米，與吐露港公路大致相同。

除非實施適當的控制措施，否則白石角填海工程的施工及運作將對該區的環境（敏感接收者）構成噪音、空氣質素、海洋水質與視覺上的影響，此等敏感接收者包括：

- 香港生物科技研究院大樓。此研究院對室內空氣質素的要求十分嚴格，大樓裝有隔音設備及中央冷氣系統，大部分外牆爲玻璃幕牆。
- 香港生物科技研究院的職員宿舍。所有宿舍均提供有窗口式冷氣機。但露台部分則沒有屏蔽。
- 中大海洋生物研究所。研究所的辦公室與實驗室均裝有冷氣設備，而海洋實驗室則屬露天，此實驗室負責抽取吐露港的海水用以培殖海洋生物，因此需要良好的水質。
- 中大水上活動中心。一個鄰近中大海洋生物研究所的康樂中心。
- 香港中文大學。一間座落於吐露港公路對面的專上學院，建有職員及學生宿舍。所有教室均裝有冷氣設備，但大部分宿舍則沒有裝設冷氣裝置。
- 位於香港中文大學北面的村屋，如樟樹灘、黃泥塊與蕉坑。
- 將重建爲低密度住宅區的聖雅各福群會兒童院〔大埔新市鎮135地段〕。
- 使用吐露港單車徑的騎單車人士。
- 馬鞍山的住宅區。
- 吐露港的養魚區。
- 計劃中的大埔及沙田海水抽取入口。水務署要求此處海水只可含低量懸浮固體及氨。

本研究報告提出了工程將對敏感接收者構成的潛在影響，以便可提供實際的控制措施，確保填海工程能在可接受的環境情況下展開。
白石角填海區的工程將在星期一至六，早上八時至下午六時間進行，星期日及公眾假期則不會開放。填海工程一旦展開，持有執照的承建商可將適當的建築廢料與剩餘填料傾卸在填海地區內，但有關物料必須符合按官地條例由土木工程署簽發的傾卸泥土執照規定。可接受的填料包括：

- 泥土（土壤），
- 建築碎料，
- 碎石及混凝土，
- 混有少量木材的以上各項物料，

含有海泥、住宅廢料、塑膠、金屬、工業與化學廢物、動物與植物廢料，以及填海工程主管認爲不適合的其他物料均不得傾卸在填海區內。

2.2 通道的選擇

有關修築通往填海區的通道，本報告已就策劃的可行性，對附近交通的影響及安全問題，爲三個不同路線的通道選擇作出了評估：

- 路線 1 - 此通道可取道吐露港公路，經香港中文大學南面的交匯處，然後向北穿過馬料水碼頭、香港中文大學的水上活動中心、中大海洋生物研究所及香港生物科技研究所等地方。
- 路線 2 - 此通道將取道大埔道，經優景里及新近發展的住宅 Villa Castell，再經一條新築天橋跨越九廣鐵路及吐露港公路，最後轉入填海區北面。
- 路線 3 - 此通道需取道香港中文大學校舍內的道路，首部分路線與路線 1 通道相同，然後利用中文大學的天橋進入校園外圍道路，再經一條新築天橋跨越吐露港公路，進入填海區。

以上三個通道路線中，以路線 1 最爲可行，而以下的詳細環境影響評估亦將會根據此通道路線進行。評估報告顯示，選擇路線 1，在生物科技研究院職員宿舍的噪音預計將超出建議標準。但假如將路線如圖2 中路線 1A 般移離宿舍，情況將可改善。

2.3 建議的堆填程序

基於採用通道路線 1，我們建議在第一期填海工程進行時，應盡快將第一期填海區的南部堆填至完成高度(海拔五點五米)，以便在此處形成一個小山丘，當工程在香港生物科技研究院及其職員宿舍較北面的地區展開時，可以減低對該區造成的噪音、塵埃及視覺影響。

2.4 施工期間的活動

填海工程施工期間的活動主要包括：

- 興建海堤及進行有關挖泥工作，
- 修築通道。

興建海堤很可能需要進行挖泥工程，以清除海堤下較軟的海洋沉積物或海泥，也可能將海堤修築在鞏固後的地基上，而無需進行挖泥工程。假如此種建築技術適用於白石角填海區，則較後期的海堤建築工程亦可避免進行挖泥。這填海工程應盡量避免挖泥。本評估報告以整條海堤需要進行挖泥工程作爲最壞的情況。

2.5 運作期間的活動

運作期間的有關活動包括：

- 將填料運往填海區，
- 卸下填料，
- 將填料傾卸入填海區，
- 分佈填料及將填料暫時堆放在填海區內，
- 將堆放的物料移往工作地點，
- 壓實物料，
- 進行噴草及種植工作。

3.0 現時的環境情況

要評估填海工程對環境造成的影響，必須就現時的環境情況製訂若干標準，以便與工程進行時預期出現的變動作出比較。同時，參照既定環保標準、指引及指標，可了解現時四周環境的情況。

本報告已評估了研究範圍內的有關資料，同時亦在現有資料不足以製訂參考標準的情況下，進行了額外的環境監察工作，以製訂所需標準。

所得資料簡述如下：

- 噪音

在九四年一月分別於填海區鄰近五個地點進行了二十四小時的噪音水平監察。最低日間(上午七時至下午七時)噪音爲 52 分貝(A)，是在樟樹灘村錄得，而在生物科技研究所的職員宿舍則錄得最高的 73 分貝(A)。結果顯示白石角地區附近的噪音主要來自路面交通，其中尤以吐露港公路爲甚。此外，九廣鐵路亦製造了不少噪音。

- 空氣質素

白石角位於大埔及沙田的工業區之間，吐露港公路橫貫其中。空氣質素可按空氣中的灰塵類別(包括粗粒灰塵，總懸浮粒子(TSP)、微細粉塵，可吸入懸浮粒子(RSP)) 和二氧化氮的含量界定。

目前，環境保護署定期監察大埔及沙田兩區的空氣質素。根據九二年的調查結果顯示，區內的二氧化氮含量遠低於空氣質素指標(AQO)。至於在大埔區的總懸浮粒子水平曾在兩次監察中錄得超過全年空氣質素指標及每日空氣質素指標的情況。在沙田區也出現過兩次超出每日總懸浮粒子指標的情況。同期在這兩區所量度的可吸入懸浮粒子仍保持在全年空氣質素指標內。

根據九四年初在白石角區內三個地點每天進行的空氣灰塵含量監察顯示，在全部十五次測量中，灰塵含量均合乎空氣質素指標。

- 海水質素

根據環境保護署於八八年至九三年間在吐露港進行的水質監察顯示，該區水域的水質正逐步改善，大部分測量樣品均很多時能合乎海水質素指標(WQO)的標準，其中以海水底層的溶解氧氣濃度偏低。

- 海床沉積物質素

海堤沿線的海床沉積物的質素已經過測定。根據海床沉積物的化學分析顯示，無論是在表面或在不同的海深中，海堤沿線大部分區域的沉積物含鉛量均偏高。其中部分沉積物的質素甚至可被列入環境保護署的海泥污染指標中的丙級，即嚴重污染類別。

4.0 潛在的環境影響

4.1 噪音影響

4.1.1 潛在成因及影響

預料噪音將來自海堤及通道的建築工程、填海工程以及通道上的往來交通。

爲了評估工程所產生的噪音水平，在白石角填海區的周圍選擇了十九個噪音敏感接收者進行研究。由於香港生物科技研究院大樓並非爲教學及居住用途，因此不當作噪音敏感接收者。

至於工程所產生的噪音對區內單車徑使用者所造成的影響，本報告則並無進行正式評估工作。這是因爲單車徑使用者一般屬非靜止狀態，噪音所構成的滋擾只屬暫時性質，同時，單車徑的使用率以周日及假期最高，而白角石填海工程則會在這些日期停工，不會產生噪音，所以工程只對單車徑使用者造成極輕微的影響。

本報告已根據將會進行的各種施工活動，評估了工程在不同施工階段對噪音敏感接收者所產生的噪音水平。

單就海堤建造工程而言，其對所有選定噪音敏感接收者只會造成極輕微的影響。而修建通道(路線 1)對所有噪音敏感接收者造成的未經消減噪音水平亦預計在建議的噪音標準內，但香港生物科技研究院的職員宿舍則除外。該宿舍大樓由於極接近通路沿線，在大樓附近進行道路工程所造成的噪音將會超出建議標準水平，因此，必須進行噪音消減措施，以控制建路工程對宿舍大樓造成的噪音影響。

填海工程在進行第一、二、三期運作時，預計噪音水平將會提高，但仍能維持在建議標準水平內。然而，如不實施合適的噪音消減措施，則通道(路線 1)上的往來交通，加上第一期填海工程進行時的噪音，預計將會超過香港生物科技研究院職員宿舍大樓可接受的最高噪音水平。因此，實有必要實施噪音消減措施，以減低工程進行時的噪音影響。

4.1.2 噪音消減措施

建立隔音牆及將通道遷移至遠離職員宿舍的路線，可有助減少噪音對住客的影響。

然而，假如建築工程在職員宿舍附近進行，則即使六米高的隔音牆可

以將職員宿舍接收到的噪音水平減低十至十五分貝，噪音水平仍難符合標準。因此，建造隔音牆不是理想的噪音消減方法。

將通道移離職員宿舍，使兩者的距離由原來的五米增至八十米，可將通道建造工程所產生的噪音水平由最嚴重的一百零三分貝降至七十四分貝，亦使通道和海堤建造工程所造成的噪音總量降至七十五分貝的建議噪音標準內。同時，此舉亦可減少收回大學土地及避免隔音牆對宿舍住客造成視覺干擾。新的通道路線(路線1A)可參照圖2。

因此，本報告建議修築的通道應盡量向海傍方向遷移。此外，實施額外的噪音消減措施亦有助減低建造工程所產生的噪音影響。

要消減通道沿線及填海工程範圍的建造工程噪音影響，最有效的方法是從噪音來源著手。以動力機械設備而言，消減噪音方法是改用操作較寧靜的設備，或使用消音器或隔音裝置來減低噪音的傳輸。
下列方法可進一步降低建造工程所產生的噪音：

- 產生大量噪音的機器及作業項目，應盡可能在遠離噪音敏感接收者的範圍裝設或進行。
- 在可能情況下，以操作較寧靜的設備或工序替代會產生大量噪音的設備或工序。
- 適當安排產生大量噪音的作業項目的工作時間，藉此將其對附近噪音敏感接收者所造成的影響減至最低。
- 機器不使用時，應關掉電源或將運作速度減慢。爲可能發出噪音的設備提供適當保養服務，而且不可過份耗損。
- 對於非電動固定設備及運土設備的發電機件，可以使用減震方法及安裝部分或完全隔音設備降低噪音水平。
- 小心策劃建造工程各個項目，以避免多部機器同時在個別接收者附近開動。
- 減少動力機械的數目。

4.2 空氣質素的影響

4.2.1 潛在成因及影響

與吐露港公路現時的交通流量相比，填海工程爲公路帶來的交通量增幅只屬少量，因此填海工程施工及運作所引起的汽車廢氣(二氧化氮)及微粒粉塵(可吸入懸浮粒子)的增幅將預計十分輕微。

在將會挖走的海泥所含的化學元素中，絕大多數的硫化物都是以不易溶形態出現的，故此不會散發二氧化硫的臭味。由於白石角一帶的鄉村會逐步敷設完善的污水收集系統，所以現時聚積在地面水經吐露港流入填海區的污物，數量將於施工期間減少。溝渠的伸延部分可作出特別設計，盡量加強沖洗能力。因此，填海工程不會產生散發臭味的問題。

通道興建工程及填海工程進行時，空氣中的灰塵含量將會提高，對研究範圍內的住宅及教學設施構成影響。空氣素質評估工作將使用噪音影響評估的相同敏感接收者，另外加上香港生物科技研究院。香港生物科技研究院正擬開設一所符合美國食物及藥物管理 (FDA) 標準的「淨室」設施。

至於通道建造工程在沒有實施任何灰塵消減措施的情況下所產生的灰塵含量，本報告已作出了預測。由於涉及的工程範圍有限，加上工程與接收者相距很遠，所產生的灰塵含量對所有接受評估的敏感接收者(包括香港生物科技研究院)構成的影響實微不足道。

預計在各運作階段期間，如不實施任何有效減低灰塵污染的措施，則將有一個或多個地點的空氣中粗粒灰塵(TSP)含量超出空氣質素指標。其中受影響最嚴重的接收者，其粗粒灰塵的超量主要是因爲通道的運作。

4.2.2 灰塵消減措施

填海區內的主要灰塵消減措施包括：

- 濕潤通道(特別是未鋪路面部分)以減少灰塵飛揚。
- 遮蓋外露表面。
- 裝設先進的輪軌及車底清洗設施，清洗所有駛離填海區的車輛底部。
- 逐步修復已完成填海工程的部分。

- 限制填海區內的行車速度。

- 每天清洗已鋪面通道兩次。

此外，將通道移離生物科技研究院職員宿舍（在最終報告所指的敏感接收者 CUHK-6）更可形成一段八十米闊的緩沖區，減低灰塵對職員宿舍的影響。這些灰塵消減措施可將灰塵含量對敏感接收者的影響降至空氣質素指標內可接受的水平。

由於填海區在週日及公眾假期休息，因此不會在單車徑使用率最高的日子產生灰塵。此外，擬爲改善工程外觀而在單車徑與填海區交界沿途裝設的圍板，亦可作爲一種隔塵設施，以減少在施工期間灰塵對騎單車人士的影響，令填海區只會對往來單車徑的人士構成輕微影響。

本報告建議在中大海洋生物研究所對開的一段通道加設一道隔塵屏障，以盡量減少灰塵飄散至研究所的室外海水儲水缸。這道屏障加上上述各種灰塵消減措施，能有效防止灰塵積聚在儲水缸的水面。

以現時香港生物科技研究院的空氣隔濾系統來說，地面辦公室及接待處會有較多灰塵。如要保持現時的灰塵水平，可更頻密更換有關介質，以加強系統的濾塵能力。
同樣，二樓及三樓空氣處理機內的隔濾介質亦需要更頻密更換。本報告認爲即使室外灰塵含量預期上升，現有系統的效能亦足夠保持室內環境質素不變。

如果淨室及空調／通風系統設計得宜，並且妥加保養，相信室外的環境不會影響設置符合美國食物及藥物管理條例的設施。進入系統的新鮮空氣必須加以過濾，務求過濾後的空氣質素與大廈二、三樓的接近。新鮮空氣及迴環流動的空氣在流進大廈內潔淨的地方前，均須進一步過濾。HEPA 類型的隔濾介質可以將空氣中的微生物數目控制在美國食物及藥物管理條例的標準內。

4.3 水質及沉積物的影響

4.3.1 潛在成因及影響

吐露港內有不少敏感接收者，包括：

- 位於鹽田仔、老虎凹及三杯酒的養魚區，

- 即將於九四年在沙田海傍，以及於九五年在大埔海傍爲沖廁用海水而設置的海水抽取入口；

- 中大海洋生物研究所的海水抽取入口；

- 龍尾、海下、沙瀾、鹽田仔及落禾沙等未經憲報公布的海灘。

在建造海堤的最初階段，影響海水水質最嚴重的是挖掘堤床沉積物的工序。

這次評估假定了承建商會先挖走堤床沉積物，以便建築海堤。評估結果顯示，在刮北或西北強風之下，挖泥期間在水柱內產生的沉積物卷流，範圍最遠可伸展到中大海洋生物研究所的海水入口，令海水入口的懸浮沉積物含量最多可較四周水域的高出13 mg/l。

在無風的情況下，重新懸浮在海水的沉積物會消耗水中的氧氣，令卷流內溶解氧的含量下降，但這個情況不會影響到中大海洋生物研究所附近的海水。

按評估結果所示，預計由建造工程及有關運作所引致海水水質變化的幅度，只會對現時的水質構成輕微的影響。此外，工程亦不會影響其他既定的敏感接收者。

如果需要沿著整道海堤的堤床挖走沉積物，挖走的沉積物將約爲527,500 立方米，其中 240,000 立方米的沉積物需要運往沙州東面或其他合適的地點加以特別處理及密封。

海堤建造期間，挖走沉積物後的壕溝會填入沙泥。首期工程會使用躉船由艙底將沙泥傾卸入海；由於沙泥的體積較大，而且海床又淺，加上水流的速度緩慢，所以只會流失少量細屑。主要部分的填土及放置主次海堤石的第二期工程會使用體積更大的物料，這些物料能夠快速沉澱下來，因此對當地水質的影響不大。

4.3.2 緩解措施

部分被界定爲丙級的沉積物必須挖走，運送時亦要倍加小心。因此，有需要使用密封的抓斗，以及圍繞挖泥區設置沉積物屏幕，以盡量減低卷流的範圍。採取這些措施後，沉積物卷流的範圍會較預期中的狹少，並且能把海洋生物研究所海水抽取口四周海水的懸浮沉積物含量控制在 2.5 mg/l 的水平以下。本報告建議，無論挖走的沉積物屬何等級，在整個挖泥工程進行期間應使用沉積物屏幕。在海洋生物研究所的抽水口亦應設置沉積物屏幕，以進一步減低在挖泥工程進行時沉積物卷流對研究所的影響。
躉船運送沉積物往卸泥區時，最重要的是勿讓沉積物從躉船溢出或漏走，以及只可在指定卸泥區才可從艙底傾卸沉積物。

海堤旁邊範圍的填土工程部分會採用躉船從艙底傾卸部分沙泥，其餘沙泥則會由泥頭車運送至填海區，然後再傾倒落海。本報告建議，海堤應保持高出水面，並與進行大量堆填工作的地區或躉船卸泥區相距至少 100 米，以盡量減少懸浮沙屑進入吐露港的附屬區。

在海堤末端及海岸線之間兩處地方，並須進行符合標準的監察行動。假如傾卸沙泥對水質的影響超過標準限制，則須停止躉船及泥頭車將沙泥傾倒落海，直至在填海區前設置沉積物屏幕。如有需要，海堤的長度可延長至 100 米緩沖區以外，以阻止懸浮沙屑流出填海區。

運往填海區的建築廢料可能含有少量漂浮物質，所以應該在海面設置 1 米深的浮泡欄柵，用以欄阻這些漂浮物質，並且每天清理，有需要時，須更頻密清理此等物質。

雖然填海區對上山坡民居的化糞池排放物會流入橫越填海區的明渠，但明渠內的水質仍然普遍良好。明渠的河床淺，去水能力強。伸延填海區的明渠在設計上應保留去水力強的特點。
本報告建議將來自吐露港公路的表流收集，堵截及引導分流到明渠，這樣可以改善明渠延長部分的去水力，而不會令水質變壞。

由於建造的海堤可讓流水滲透，雨水滲入填海區及潮汐的變化可能導致海水滲過填海區，繼而令填料流走。然而，填料的墮性較大，因此水質所受的影響不大。

4.4　景觀及土地用途的影響

4.4.1　潛在成因及影響

景觀影響評估結果顯示，從景觀受影響一帶所有較高的地點，均可看見建議中的填海區。由於受影響目標的類型、數目及座落點、受影響的時間及跟四周能否相容等因素不一，所以影響程度亦各有不同。

受景觀影響的目標包括：

- 香港生物科技研究院及研究院的職員宿舍，
- 在中大校園主要範圍留宿的學生、講師及職工，尤其是東面宿舍及可以從宿舍俯瞰到填海區的住客，
- 西面大埔新市鎮135地段擬建的 6 至12 層住宅大廈的住客，
- 沙田至大埔單車徑的使用者，

- 使用吐露港公路南行線的車輛司機及乘客，
- 使用與吐露港公路並行的九廣鐵路南北行線的乘客，
- 使用中大水上活動中心的人士，
- 使用馬料水碼頭及乘搭塔門渡輪的人士。

除非利用其他不會構成滋擾的緩解措施改善受影響的景觀，否則可依照圖 2 所示的方法，全面或局部改善景觀影響。

4.4.2 緩解措施

在通道建造工程進行期間，由於中大職員宿舍及香港生物科技研究院會見到更大面積的填海區，因此路線 1A 通道路線構成的景觀影響會較原先路線 1 的嚴重。在計劃中擬種植的樹木成長前，填海區可從四周看見，尤其是從高處俯瞰。然而，從地面上看，通道路線 1及路線 1A 所構成的影響分別不大。就景觀的優劣來說，由於路線 1A 的通道行車線與香港生物科技研究院職員宿舍距離較遠，所以較路線1爲佳。
雖然以樹木作爲景觀屏障可以遮蔽令人討厭的景觀，但受影響目標視野內的實際景觀將會有變。使用西面吐露港公路及單車徑的人士再看不到海景，作屏障用的綠化物，只可算是局部補償。

騎單車人士或許是最受影響的敏感接收者，因此，本報告建議在填海區土地用途的最終設計上，將單車徑改與填海後的新海傍並行。

綠化景物的緩解措施可以遮擋從行車通道望向填海區的視線，而種植的樹木亦會築成一堵綠化的屏障。建造工程展開及運作期間，香港生物科技研究院的職員及研究院職員宿舍的住客將受到視野景觀上的改變，兩幢大廈最低兩層的住客將看不到海景，轉而看到一個綠化地帶。

土地用途的最終設計應能配合周圍土地景觀的特性，以盡量減低受影響目標的視野景觀影響。

5.0 環境監測及審核

本報告已爲填海工程訂定了灰塵、噪音和海水水質的環境監測及審核標準，以確保達到所需水平，同時亦將對環境構成的滋擾減至最低。本報告建議委託獨立的顧問公司，負責督導環境監測及審核工作。

在環境監測程序方面，現已訂定一系列的行動，以確保一旦因意外或承建商未有採取足夠緩解措施而導致嚴重影響時，有關方面能盡快找出成因，並立即作出補救，務求盡量減低同類意外再次發生的可能。

此外，亦會獨立編製一份環境監測及審核手册，其中包括總報告書內的監察方案及行動計劃。

6.0 結論

假如能依照建議的環境管理計劃，實施建議中的緩解措施，以及監測敏感接收者的四周環境，則噪音、空氣質素及水質的影響將可減低至符合目前的環保守則及標準，令填海工程的施工及運作可在可接受的環境影響下展開。

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