Annex M

Penny's Bay Rail Link Environmental Impact Assessment Report

FINAL REPORT

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

Mass Transit Railway Corporation

Penny's Bay Rail Link:
Environmental Impact Assessment

February 2000

Environmental Resources Management
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Mass Transit Railway Corporation

Penny's Bay Rail Link:
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February 2000

Reference C1937

For and on behalf of
Environmental Resources Management

Approved by: STEVE LAISTER

Signed:

Position: EXECUTIVE DIRECTOR

Date: 25 February 2000

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1 INTRODUCTION

1.1 BACKGROUND

ERM-Hong Kong has been commissioned to undertake an Environmental Impact Assessment (EIA) of the *Penny's Bay Rail Link* (PBRL) for the Mass Transit Railway Corporation (MTRC) in accordance with the requirements of the *Environmental Impact Assessment Study Brief No. ESB - 043/1999 for Construction of An International Theme Park in Penny's Bay of North Lantau and Its Essential Associated Infrastructures.*

The PBRL EIA forms part of a wider EIA for the Theme Park, essential infrastructures including road works, water supplies, stormwater drains, a multi-purpose lake and various other utilities being developed by Civil Engineering Department (CED). The assessment of PBRL is part of this wider study but, as required by the EIA applicant, CED, is provided by MTRC as a standalone EIA to be included as an Appendix to CED's submission under the EIA Study Brief.

After approval of the EIA and at a suitable point within MTRC's detailed design, it is the Corporation's intention to apply for an Environmental Permit to construct and operate the Penny's Bay Rail Link.

1.2 OVERVIEW OF PENNY'S BAY RAIL LINK

Following agreement between Walt Disney and the SAR Government, the MTR Corporation has been invited by Government to build and operate a new rail link from Yam O to the Penny's Bay reclamation. The new rail link, the "Penny's Bay Rail Link", will be integrated with the existing MTR Tung Chung Line at a new station to be constructed at Yam O. From Yam O, the train will travel to Disneyland Station in Penny's Bay as the basis of the direct rail service to the Disney Theme Park.

The PBRL will be a shuttle service between the Tung Chung Line at a new Yam O Station and a new Disneyland Station at Penny's Bay. The link will be operated by MTR and will form an integral part of the MTR network.

Yam O Station would be constructed at the rail junction with the Tung Chung Line. The Station would have two platform faces for the main MTR Tung Chung Line services between Hong Kong and Tung Chung and an additional, third, platform dedicated to the PBRL service.

The related development to the PBRL being undertaken by others on the Penny's Bay reclamation and other associated transport infrastructure is described in Section 2, Project Description of the Theme Park EIA. A description of the Northshore Lantau Development is provided in *Annex A*.

1.3 *PURPOSE AND OBJECTIVES OF THE EIA STUDY*

As required by the Study Brief, the purpose of the EIA Study and associated preliminary designs are to provide information on the nature and extent of environmental impacts arising from the construction and operation of the proposed designated projects and related activities taking place concurrently. While the PBRL is one of eleven infrastructures to be assessed under the Study Brief, the PBRL EIA presents a standalone assessment of the construction and operation of the railway. Cumulative impact assessment will be undertaken within the EIA Study provided by CED with full details of all construction works and infrastructure operation. The EIA presented for PBRL will provide information to allow the following decisions by the Director of Environmental Protection :

(i) the overall acceptability of any adverse environmental consequences that are likely to arise as result of the project;
(ii) the conditions and requirements for the detailed design, construction and operation of the proposed project to mitigate against adverse environmental consequences wherever practicable; and,
(iii) the acceptability of residual impacts after the proposed mitigation measures are implemented.

The objectives of the EIA study and associated preliminary designs are as follows for the PBRL:

(i) to describe the proposed project and associated works together with the requirements for carrying out the proposed project;
(ii) to identify and describe the elements of the community and environment likely to be affected by the proposed project and/or likely to cause adverse impacts to the proposed project, including both the natural and man-made environment;
(iii) to identify and quantify all environmental sensitive receivers, emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;
(iv) to identify and quantify any potential losses or damage to flora, fauna and natural habitats;
(v) to identify any negative impacts on sites of cultural heritage and to propose measures to mitigate these impacts;
(vi) to identify and quantify any potential landscape and visual impacts and to propose measures to mitigate these impacts;
(vii) to propose the provision of infrastructure or mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the project;
(viii) to identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and the cumulative effects expects to arise during the construction and operation phases of the project in relation to the sensitive receivers and potential affected uses;

(ix) to identify, assess and specify methods, measures and standards, to be included in the details design, construction and operation of the project which are necessary to mitigate these environmental impacts and reducing them to acceptable levels;

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

(xi) to identify constraints associated with the mitigation measures recommended in the EIA study;

(xii) to identify, within the study area, any individual project(s) that fall under Schedule 2 of the EIA Ordinance; to ascertain whether the findings of this EIA study have adequately addressed the environmental impacts of those projects; and where necessary. To identify the outstanding issues that need to be addressed in any further detailed EIA study; and

(xiii) to design and specify the environmental monitoring and audit requirements, if required, to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted.

The Study Brief, attached in *Annex A*, sets out collectively the technical requirements of the EIA for all the proposed infrastructure works. Of these requirements, the following are seen to apply to PBRL EIA based upon the scope of the project and prior liaison with EPD through the Environmental Working Group for the Northshore Lantau Development and Penny's Bay Rail Link:

- Air quality impact;
- Noise Impact;
- Water Quality Impact;
- Waste Impact; and,
- Landscape and Visual Impact.

Potential ecological impact in association with the proposed rail link includes the loss of low-value shrub habitat, grass habitat and secondary woodland at the railway tunnel portal areas. Known archaeological sites within the Project boundary of PBRL include Wan Tuk and high archaeological potential has also been identified within Cheoy Lee Shipyard. These ecological and archaeological impacts are addressed in the Theme Park EIA and Northshore Lantau Development Feasibility Study.

The Study Brief also requires assessment of aquatic ecology, fisheries, dredging, filling and dumping. However, all marine construction activities are to be undertaken by CED and reclaimed land will be made available to MTRC with 1.5m of MTRC's required invert level for the PBRL alignment. Consequently, the MTRC's construction PBRL will not impact upon the marine environment. Reference should be made to CED's marine construction activities as assessed in the Theme Park EIA and Northshore Lantau Development Feasibility Study.

It should also be noted that while the PBRL alignment will pass through the site of Choey Lee Shipyard, CED will conduct the decommissioning EIA for this land. According, demolition and site preparation within the Choey Lee Shipyard boundary are not assessed in the PBRL EIA.

Hazard assessment of explosives stored on site is also required by the Study Brief. While the MTRC will be using explosives in the construction of a tunnel between Yam O and Penny's Bay, no overnight storage is planned and therefore Hazard Assessment is not required under the Study Brief. Should the MTRC's requirements for storage change or the use of barging points for explosive delivery be required at a later stage, then approval will be sought via a Variation Application to EPD with appropriate Hazard Assessment.

This EIA Report has been produced in accordance with the requirements of the Study Brief and the guidelines of the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO TM). This report will provide essential information to ultimately enable the MTRC to apply for an Environmental Permit.

1.4 THE EIA ORDINANCE

On 1st April 1998, the *Environmental Impact Assessment (EIA) Ordinance* was implemented by the Hong Kong Government. Under the requirements of the Ordinance, all designated projects require an Environmental Permit before they can commence. The types of projects which are considered as being designated, and thus requiring an Environmental Permit are listed in Schedules 1 and 2 of the Ordinance. Schedule 2, Part 1A of the Ordinance relates to 'Roads, Railways and Depots'. It defines both 'a railway and its associated stations' and 'a railway siding, depot, maintenance workshop, marshalling yard or goods yard' as being designated projects. Therefore, the PBRL is a *designated project* governed by the requirements of the Ordinance and requiring an Environmental Permit. Consequently, construction works cannot start until an Environmental Permit is issued.

The current programme for the PBRL envisages that construction will commence in the second quarter of 2002. In order to meet this target date, the EIA must be completed and approved, and an environmental permit application lodged 30 days prior to commencement of construction.

Upon completion of this EIA, the applicant can apply for an environmental permit. Given that the form of the application and supporting information is acceptable, the following are the statutory time periods which are allowed for the review of the application and the issue of the Environmental Permit. The overall determination period for the application is a maximum of 150 days, during which the following procedures will be undertaken:

- Upon receipt of the completed EIA Study, the EPD is required to review the EIA Report within ***sixty (60) days***, to determine whether it meets the requirements of the Study Brief and the Technical memorandum. If the

EIA Report meets the requirements, the EPD shall advise the applicant regarding the requirements for public inspection of the Report, and also whether a submission to the Advisory Council on the Environment (ACE) or its subcommittee is required.

- The EIA Report is then presented for public inspection (with comments required within thirty (30) days) and, if required, is forwarded to the ACE (with comments required within ***sixty (60) days***). These consultations may be undertaken concurrently. (As required by the Study Brief, the EIA Report and Executive Summary Report must be up-loaded onto the EPD's EIAO Internet Website to aid public inspection of the Report).

- Within ***thirty (30) days*** of the expiry of the public inspection period, or the receipt of comments from the ACE, (or from the receipt of further information, which must be requested by the EPD within 14 days of the inspection period or the receipt of comments from ACE). The EPD must determine the approval of the EIA Report. If no response is received within the 30-day period, the EIA Report is taken to be approved without conditions.

1.5 *STRUCTURE OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT*

This EIA Report is presented as two documents:

- Penny's Bay Rail Link EIA: *EIA Main Report*; and,
- Penny's Bay Rail Link EIA: *EIA Executive Summary.*

After this introductory section, the remainder of this volume of the EIA, is arranged as follows:

- *Section 2* provides an up-to-date description of the project;
- *Section 3* presents the findings of the *Air Quality Assessment;*
- *Section 4* presents the findings of the *Noise Assessment;*
- *Section 5* presents the findings of the *Water Quality Assessment;*
- *Section 6* presents the findings of the *Waste Assessment;*
- *Section 7* presents the findings of *the Landscape and Visual Assessment;*
- *Section 8* presents the *Conclusions and Recommendations of the EIA Study.*

The following annexes are referred to in the *Main Report*:

Annex A - EIA Study Brief, Description of Northshore Lantau Development & Relevant Communication

Annex B - Construction & Operational Noise Assessment

Annex C - Construction Dust Emission Factors Evaluations

Annex D - Environmental Monitoring and Audit Manual

Annex E - Implementation Schedule

2.1 ALIGNMENT DESCRIPTION

The proposed Penny's Bay Rail Link comprises a new 3.6 km link from the existing Tung Chung Line at Yam O to the Penny's Bay site of the proposed new Disney Theme Park as shown by *Figure 2.1a.*

A new Yam O Station will be constructed along the existing Tung Chung Line and will have two platforms, for the Tung Chung Line services between Hong Kong and Tung Chung, and an additional, third platform dedicated to the PBRL service. Concourses will be constructed above the three platforms and connected by overhead link bridges.

The PBRL will comprise a single track which departs from the Up Tung Chung line track west of Yam O before passing under the existing North Lantau Highway and into a 100 m length of cut and cover tunnel. The PBRL then enters the 750 m single cell horse-shoe tunnel to pass below the central hills of Lantau to emerge to the north of Penny's Bay. A passing loop will be constructed to the south of the portal before the PBRL enters the new Disneyland Station. The Disneyland Station will be built on Penny's Bay Reclamation and will comprise a single platform with cleaning facilities and a light workshop area.

Much of the PBRL is to be constructed at grade. However, portions of the track will be in cutting in the vicinity of Disneyland Station and will be for the shielded from the Theme Park by earth bunding along side the railway alignment. At Yam O, the alignment is at-grade, situated on the existing reclamation level as it passes under the roads of the North Lantau Highway.

2.2 IDENTIFICATION OF ALIGNMENT CONSTRAINTS AND "DO NOTHING" SCENARIO

Within the Yam O site, the alignment is constrained by the existing and proposed highways, the existing Lantau Airport Railway (LAR), an existing MTR traction substation and the close proximity of the sea wall. Together with the need for the PBRL platform to be parallel with the existing LAR lines, the alignment is essentially predetermined to fit the existing infrastructure. Other options have been examined but these involve only minor deviation in the vicinity of Yam O Station according to platform and connection details.

These constraints determine the alignment to the east and then south, in tunnel through the hill to Penny's Bay, continuing towards the Theme Park site on land to be reclaimed by CED. The layout within the Penny's Bay reclamation is determined by the planning layout of the intended landuses for the platform. Given the proposed arrangement of the landuse in Penny's Bay, there are no other conceivable and practical alignments between Yam O

Station and Disneyland Station that would ameliorate environmental impacts, including noise and those to landscape and visual resources.

The existing LAR tracks at Yam O are at approximately +6.2 mPD and the PBRL will be at the same level with a horizontal profile extending from the LAR tracks to the tunnel portal. Throughout the tunnel section, the vertical alignment follows a slight up gradient towards the Penny's Bay reclamation, designed to match with the Government's highway proposals at that portal, then trending downwards to Disneyland Station, where it is at a level of approximately +2.0mPD, which in conjunction with earth bunds, serves to mask train operations from the Theme Park.

While the above constraints allow no alternative alignment, a "Do Nothing" scenario is considered briefly here. The PBRL is proposed in order to improve transport communications for the users of the Theme Park and other new sites proposed on the Penny's Bay reclamation and Northshore Lantau Development. In environmental terms, the projected ridership levels indicate that the proposed railway will carry up to 30,000 passengers per hour. If the PBRL was not constructed, the travellers to the proposed new land uses would need to find alternative means of transport. It is most likely that the alternative transport options would comprise car and bus journeys. As a consequence, there would be an increased level of vehicles on the road networks in the surrounding areas which would give rise to increased levels of vehicular air pollutants and noise.

2.3 *OPERATING CONCEPT*

The PBRL will be fully integrated with the MTRC's existing Tung Chung Line through a new interchange station at Yam O. From Yam O Station, the train will travel to a new station in Penny's Bay, with direct pedestrian access to the Disney site.

The new rail link will have the following operating characteristics:

- A shuttle service between the new Yam O Station on the Tung Chung Line and a new Disneyland Station at Penny's Bay to be operated by the MTRC.
- Fully integrated with the wider MTR network in terms of ticketing and service connections.
- Upon commissioning in 2005, urban line type train with at least three cars would operate a shuttle service from Yam O to the Theme Park. Train service interval would be subject to discussion and demand estimates, but are currently assumed to be between five and 10 minute headway in each direction.
- In the longer term, eight-car trains may be employed to meet increased demand.

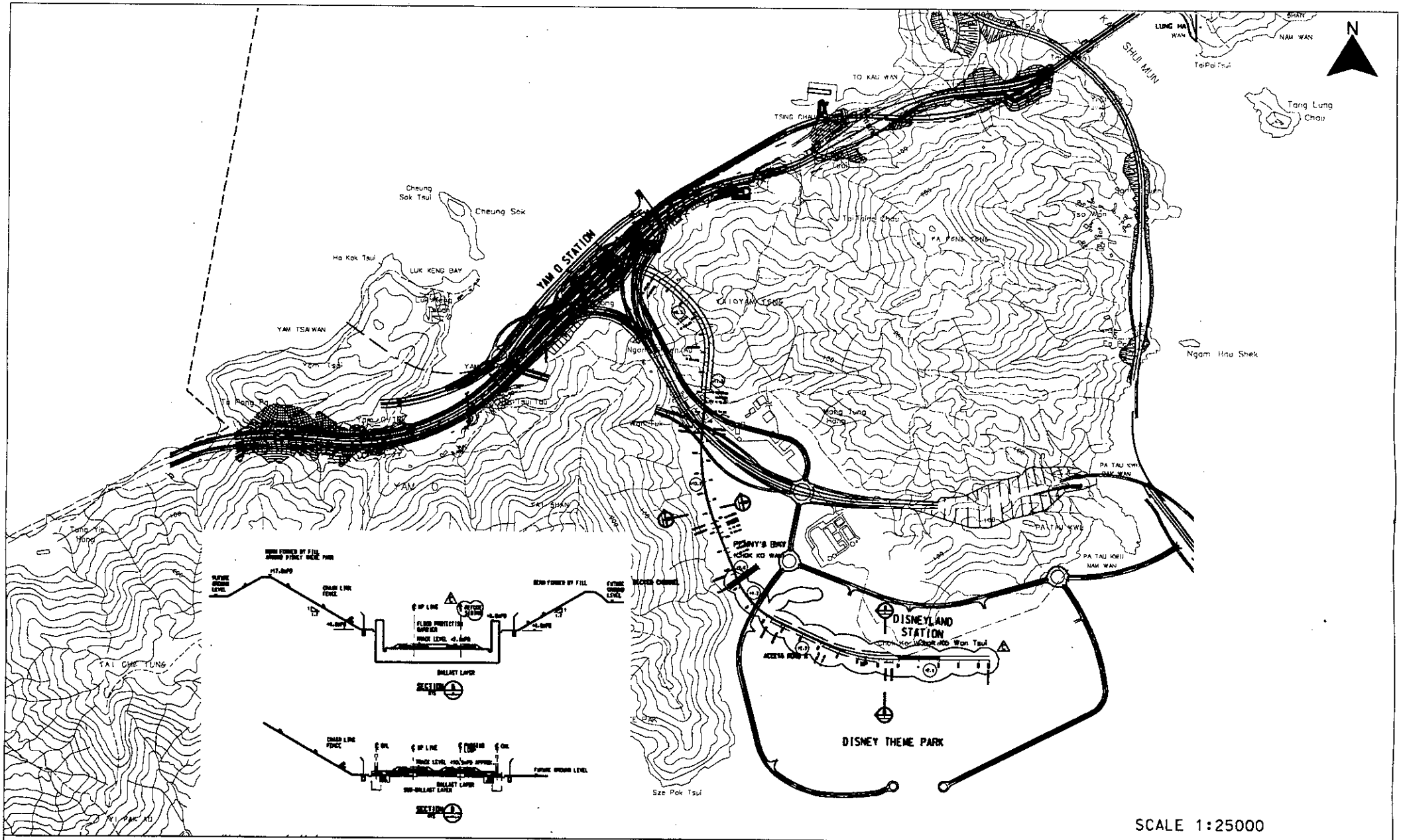

FIGURE 2.1a

PENNY'S BAY RAIL LINK

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- The train journey time from Yam O Station to Disneyland Station would be about 3.5 minutes.

- Cross platform interchange, without ticket barriers and similar to the existing MTR network, would be provided at Yam O Station for visitors travelling to Disneyland Station from the main urban areas. These include visitors from the Tung Chung Line rail interchanges at Lai King and Nam Cheong. Their return journeys would be via convenient overhead passenger connections from the PBRL platform to the Hong Kong bound platform, also without ticket barriers.

- Customers originating in Tung Chung would interchange with the Penny's Bay Rail Link service by using the overhead pedestrian connections at Yam O Station. Travellers returning to Tung Chung would take the mainline Tung Chung Line service, by cross-platform interchange, from Yam O Station to Tung Chung.

- The Theme Park would have one station with a single platform. All trains would terminate and reverse at Disneyland Station.

- The shuttle service would be integrated with the existing MTR lines and stabling, maintenance, etc. would be provided at the MTRC's existing facilities at nearby Siu Ho Wan Depot. This depot would also provide support and train substitution in the event of equipment failure.

- Light train cleaning at Disneyland Station.

2.4 METHOD OF CONSTRUCTION

Both station sites will be principal areas of construction, as shown by *Figure 2.4a*, supplemented by a temporary depot near Disneyland Station and sites at the tunnel portals.

The required works for the construction of PBRL include the use of heavy plant for excavation, filling, concreting, tunnelling and station construction. The key construction stages and activities of the Project are outlined below:

- *Yam O Station Construction* comprising excavation and foundation works, station construction and sheet piling for the protection of existing tracks and platforms. The station structure will be constructed on pad footings and will be of reinforced concrete construction with simple beam & slab foundations. At the station site excavation will be required for the removal of an earthen bank near the existing sub-station.

- *Tunnel Portal Works* will comprise mainly start-up works including initial excavation, sheet piling, soil nail installation, re-construction of roads and mechanical rock excavation. In addition, 100 m long sections of cut-and-

cover may be constructed at the northern portal.

- *Tunnel Works* include construction activities in the vicinity of the tunnel portal for material transfer, ventilation and the removal of spoil. Tunnel excavation, using blasting and hydraulic breaking, will be undertaken primarily from the southern portal. No explosives will be stored on site overnight. However, should further detailed planning reveal that overnight storage and/ or use of barging points for explosives delivery will be required, the MTRC will make appropriate application for approval by EPD. MTRC will ensure their contractors fully comply with the requirements of the Mines and Quarries Division of CED in the transportation, handling and use of explosives

- *Track Construction* including track bed setting, track drainage construction and track laying, which will involve the use of diesel locomotives and formation and use of a temporary depot area adjacent to the Disneyland Station Site. Two temporary barging points will be required; one at Yam O and another at the southern boundary of the Penny's Bay reclamation to receive overhead line steel work and components.

- *Disneyland Station Construction* comprising excavation and foundation works within the Penny's Bay reclamation. The station structure will be of steel frame construction on concrete raft footings.

Site traffic generated from the works is anticipated to be limited and Government's new highway infrastructure will be required to access Penny's Bay. Restricted hours working may be applied for by the MTRC's contractor for tunnel construction at the southern end and will be subject to the requirements of a Construction Noise Permit.

2.5 *PENNY'S BAY RAIL COMMISSIONING*

Yam O Station and the Penny's Bay Rail Link would be opened for passenger service approximately 36 months from the date of construction commencement. The presently envisaged programme milestones are as follows and assume Government land at Penny's Bay will be available in January 2003:

- Yam O Station and adjacent works commence, following completion of Advance Works, in the third quarter of 2002;
- The rock tunnel commences in the third quarter of 2002 and is completed by the second quarter of 2004;
- Disneyland Station and the open cut section of alignment commenced and completed between the first quarter of 2003 and the second quarter of 2004;
- The track turn out (from the LAR) and related works are started in the third quarter of 2003 and completed in the second quarter of 2004;
- Trackwork and overhead line are installed in the first to third quarters of 2004;

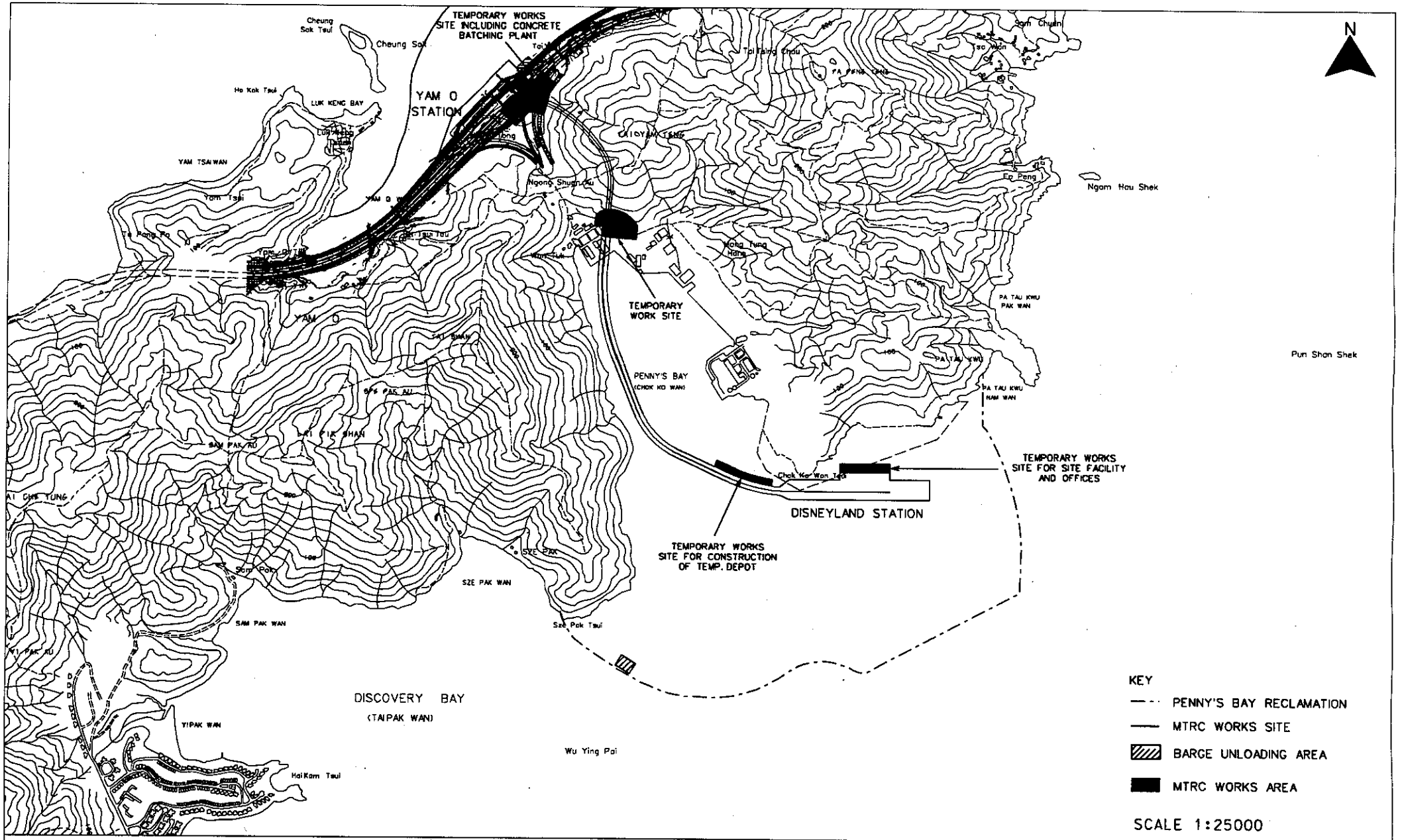

FIGURE 2.4a

LOCATIONS OF MTRC WORKS AREA

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- Station fitting out works, commissioning and test and trial running are completed in the fourth quarter of 2004; and then enabling,
- The Penny's Bay Rail Link to open to the public in February 2005.

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3 NOISE

3.1 INTRODUCTION

This section provides an evaluation of the noise impacts arising from the construction and operational phases of the Project. The potential for noise impacts is assessed and appropriate mitigation measures are recommended in order to address any adverse impacts.

During the construction phase, plant used on site for the construction of stations, tunnel and at-grade track will be the primary source of noise affecting the surrounding environment. During the operational phase, noise from trains operating along the proposed PBRL and associated ventilation facilities will be sources of noise. These will be addressed in the following sub-sections.

3.2 ENVIRONMENTAL LEGISLATION AND STANDARDS

3.2.1 *Construction Noise*

General

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

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

The *Environmental Impact Assessment Ordinance* (EIAO) and the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO TM) also provide guidelines for the assessment of noise impacts associated with construction activities.

Despite any description or assessment made in this report on construction noise aspects, there is no guarantee that a Construction Noise Permit (CNP) will be issued for the project construction. The Noise Control Authority will consider a well-justified CNP application, once filed, for construction works within restricted hours as guided by the relevant TMs issued under the NCO. The Noise Control Authority will take into account of contemporary situations or conditions of adjoining land uses and any previous complaints against construction activities at the site before making a decision in granting a CNP. The EPD require that nothing in this report shall bind the Noise

Control Authority in making a decision on the success of a CNP application; and, that if a CNP is to be issued, the Noise Control Authority shall include any condition they consider appropriate. Failure to comply with any such conditions will lead to cancellation of the CNP and prosecution action under the NCO.

Percussive Piling

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

When assessing a CNP application for the carrying out of percussive piling, the EPD will be guided by the PP-TM. The EPD will look at the difference between the Acceptable Noise Levels (ANLs), as promulgated in the PP-TM, and the Corrected Noise Levels (CNLs) that are associated with the proposed piling activities. Depending on the level of noise impact on nearby Noise Sensitive Receivers (NSRs), the Noise Control Authority would determine the time periods for percussive piling operation, as presented in *Table 3.2a.*

Table 3.2a ***Permitted Hours of Operation for Percussive Piling (Not Involving the Use of Diesel, Pneumatic and/or Steam Hammers)***

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

The use of diesel, pneumatic and steam hammer pile drivers has been prohibited since 1 October 1999.

As the issuance of a CNP by the Noise Control Authority would depend on the application submitted by the Contractor, noise assessment of percussive piling activities has been excluded in this study.

General Construction Works - Statutory

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

In addition to the general controls on the use of PME during the restricted hours, the EPD has implemented a more stringent scheme via the DA-TM. The DA-TM regulates the use of five types of Specified Powered Mechanical

Equipment (SPME) and three types of Prescribed Construction Work (PCW), which are non-PME activities, in primarily densely populated neighbourhoods called Designated Areas (DAs). The SPME and PCW are:

SPME:

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

PCW:

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

In the interest of offering additional protection to the population, the carrying out of PCW is generally banned inside a DA. As for the use of SPME, it would be necessary to comply with DA-TM noise level requirements that are 15 dB(A) more stringent than those listed in the GW-TM before a CNP would be issued.

When assessing an application for the use of PME or SPME, the Noise Control Authority will compare the ANLs, as promulgated in the GW-TM and DA-TM, and the CNLs (after accounting for factors such as barrier effects and reflections) associated with the proposed PME operations. A CNP may be issued if the Contractor can reasonably demonstrate that the CNL will be equal to or less than the ANL. The ANLs are related to the noise sensitivity of the area in question and different Area Sensitivity Ratings (A, B or C) have been drawn up to reflect the background characteristics of different areas. The relevant ANLs are shown in *Table 3.2b*.

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

Time Period	Area Sensitivity Rating		
	A	B	C
• All days during the evening (1900-2300 hours) and general holidays (including Sundays) during the day and evening (0700-2300 hours)	60(1)/45(2)	65/50	70/55
• All days during the night-time (2300-0700 hours)	45/30	50/35	55/30

Note:
(1) ANLs stipulated in Technical Memorandum on Noise from Construction Work other than Percussive Piling.
(2) ANLs stipulated in Technical Memorandum on Noise from Construction Work in Designated Areas.

There are some factors affecting the assessment results of a CNP application, such as the assigning of Area Sensitivity Rating, ANLs, and other relevant factors such as received complaints etc. The Noise Control Authority would determine the ANLs at the time of assessment of such an application based on the contemporary situations/conditions. It should be noted that the situations/conditions around the sites may change from time to time. The Area Sensitivity Rating assumed for the NSRs identified in this study is presented in *Section 3.2.2*. The Area Sensitivity Rating assumed in this report are for indicative assessment only.

General Construction Works - Non-statutory

Although the NCO does not provide for the control of construction activities during normal working hours, a limit of $L_{eq,\,30\,min}$ 75 dB(A) is stipulated in *Annex 5* of EIAO TM for all domestic premises, hotels and hostels. The construction noise limits for educational institutions during normal school hours and examination periods are 70 dB(A) and 65 dB(A) respectively. The stated noise limits are applicable to uses which rely on opened windows for ventilation and are assessed at a position 1 m from the external facade.

The existing Lantau North Country Park and the proposed Country Park Extension Area have been included in this study to evaluate the construction noise arising from the proposed works. However, Country Parks themselves are not considered identical to other NSRs identified in this study and furthermore, no established noise assessment criteria are available. A semi-quantitative approach will be adopted for the assessment of construction noise at Country Parks.

3.2.2 *Railway Noise*

Railway noise is controlled by the *Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites* (IND-TM) published under the NCO. This IND-TM establishes ANLs for railway noise depending on the sensitivity of the area where the NSR is located.

While the Northshore Lantau Development will substantially alter the character of the area, as shown by *Figure 3.2a*, Luk Keng Tsuen has been assigned a "present day" and "future" Area Sensitivity Rating of "B" according to the "Village" type of area containing the NSR and the presence of the North Lantau Highway as a direct Influencing Factor.

The relevant criteria are presented in *Table 3.2c* and are to be met at a position of 1 m from the window facade of receiver.

Table 3.2c ***NCO Railway Noise Assessment Criteria ($L_{Aeq,30min}$ dB)***

Time Period	Acceptable Noise Level for NSR with an Area Sensitivity Rating of "B"
Daytime & Evening (0700 to 2300)	65

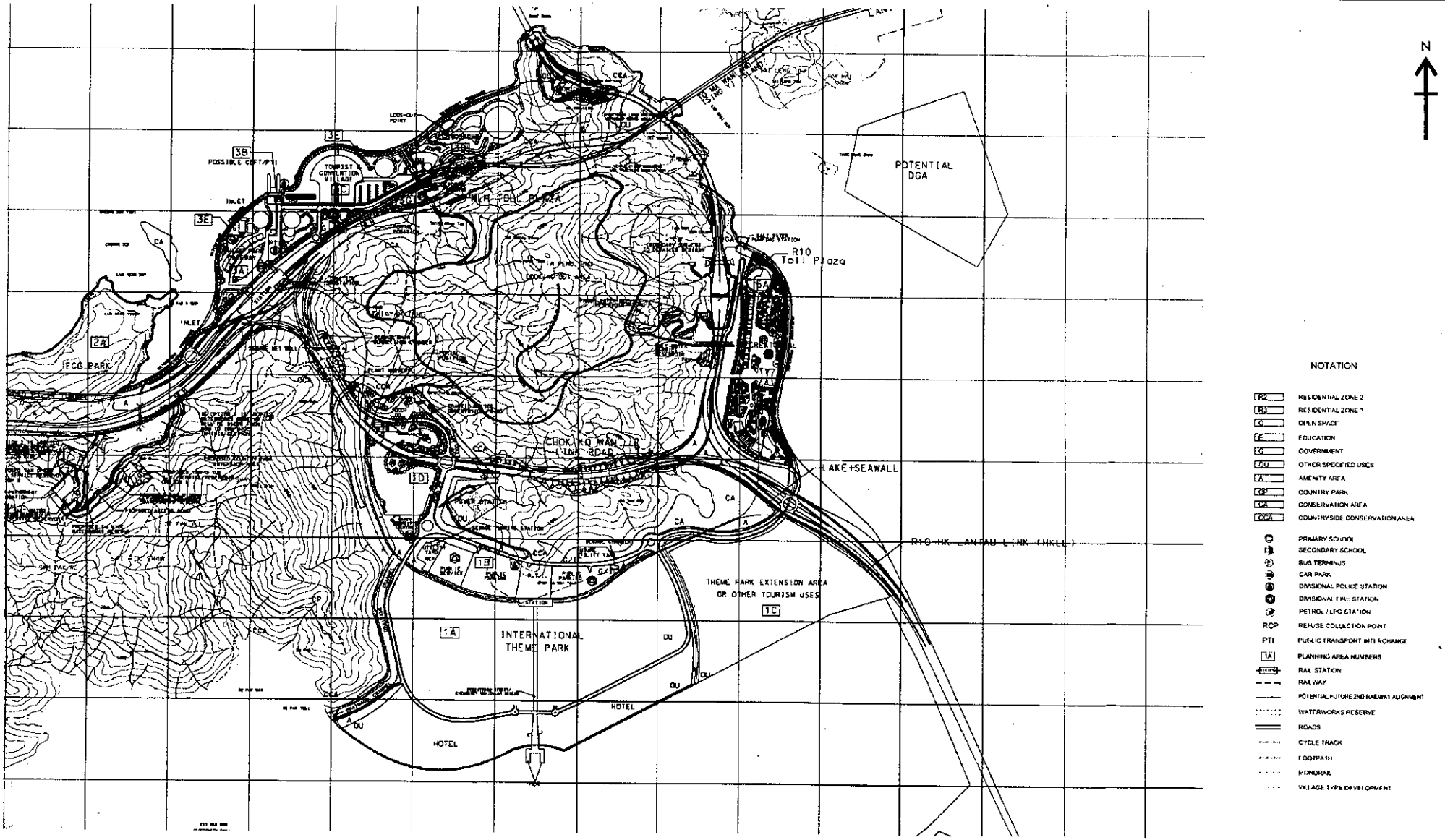

FIGURE 3.2a

DRAFT RECOMMENDED OUTLINE DEVELOPMENT PLAN

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Time Period	Acceptable Noise Level for NSR with an Area Sensitivity Rating of "B"
Night-time (2300 to 0700)	55

The *Hong Kong Planning Standards and Guidelines* (HKPSG) also provides further criteria for assessing railway noise. These criteria are specified in terms of A-weighted maximum noise level and daily railway noise exposure, as given in *Table 3.2d* below.

Table 3.2d ***HKPSG Railway Noise Guidelines***

Parameter	Acceptable Noise Level (dB(A))
Maximum A-weighted sound pressure level, L_{max} (2300-0700)	85
Daily Equivalent continuous sound level, $L_{eq\ 24\ hours}$	65

Country Parks are not specifically identified as NSRs in the IND-TM and are assigned no quantitative railway noise limit under the EIAO TM. Therefore, within this EIA, railway noise levels are predicted at the Proposed Country Park Extension Area and addressed only in qualitative terms.

3.2.3 *Fixed Plant Noise*

Noise from fixed sources such as station air conditioning facilities, traction substations and vent shafts for tunnel ventilation are required to comply with EIAO TM. The assessment of impacts from fixed noise sources will normally be conducted with reference to IND-TM. All fixed noise sources should be so located and designed such that the noise level at the facade of the nearest NSRs is at least 5 dB(A) lower than the appropriate ANL as stated in IND-TM, or the prevailing background noise levels for areas with ambient noise level 5 dB(A) below the relevant ANL. In addition, the cumulative noise from train operations and fixed plant noise should not exceed the ANL.

3.2.4 *Additional Requirement for Disney Theme Park*

Based on the planned land uses and the layout of the proposed Theme Park, the Theme Park operator has confirmed that none of the types of potential noise sensitive uses identified in EIAO TM will be located within the proposed Theme Park. It is therefore considered that the Theme Park would not be on NSRs under the EIAO and will not be assessed.

Apart from the legal requirements of NCO and EIAO, an additional condition from the Government of HKSAR on the operation of railway, is required for the proposed Theme Park. According to this requirement, the noise generated from PBRL should not exceed a limit of $L_{Aeq\ (10\ mins)}$ 69 dB at the nearest boundary of guest areas within the Theme Park and hotels. Railway noise levels at the boundary of Theme Park will be predicted and checked against this requirement in the following section.

3.3 BASELINE CONDITIONS AND SENSITIVE RECEIVERS

The existing ambient noise level is mainly affected by the traffic on North Lantau Highway and railway noise from Airport Express Line and Tung Chung Line. Noise emission from the nearby Penny's Bay Power Station also contributes to the background noise level of the area. In the future, the planned Chok Ko Wan Link Road and Route 10 will be new noise sources of the area.

The nearest potential sensitive receivers are village type developments located in Luk Keng Tsuen, while the nearest densely populated areas are Discovery Bay and Peng Chau which are more distant from the site. *Table 3.3a* presents the identified NSR and its relative location is given in *Figure 3.3a.*

Table 3.3a ***Nearest Noise Sensitive Receivers & Areas***

NSR	Distance from Project Boundary (m)	Remark
Luk Keng Tsuen (NSR A)	380	Area Sensitivity Rating of "B" has been assumed
Proposed Country Park Extension Area (NSRs B, C & D)	400-1200	

With reference to the Study Brief (ESB-043/1999) for *Construction of An International Theme Park in Penny's Bay of North Lantau and its Essential Associated Infrastructures,* an assessment area has been clearly defined for noise impact assessment (an area within 300 m from the boundary of the Project). One NSR at a larger distance from the Project, Luk Keng Tsuen, is, however, included for assessment purpose in this study at the request of Director of Environmental Protection Department (see *Annex A1*). The proposed Country Park Extension Area has also been included in this study to evaluate the noise arising from the Project. Discovery Bay, Peng Chau and the nearest existing country park which are over 2 km away from the Project, have been excluded in the subsequent noise assessment sections as adverse impacts at these NSRs are not anticipated.

According to the Theme Park operator, based on the land uses associated with their other operational Theme Parks, none of the types of potential noise sensitive receivers identified in *Annex 13* of the EIAO TM will be located within either phase of the Theme Park. The Theme Park will therefore not be considered a potential NSR to be assessed under the EIAO. However, it has been included in this study to evaluate the rail noise level and check against the additional noise requirement imposed by the Government of HKSAR.

3.4 CONSTRUCTION PHASE

3.4.1 *Potential Source of Impacts*

The source of noise during each construction stage of the Project is mainly

from the use of PME on site. The works will generate a number of noisy activities including the use of heavy plant for excavation, filling, concreting, tunnelling, ventilation building and station construction. The key construction stages and activities of the Project are outlined below:

- *Station Construction* - foundation works, excavation works, station construction and sheet piling for the protection of existing tracks and platforms;

- *Works at Tunnel Portal* - mainly start-up works including initial excavation, sheet piling, soil nail installation, re-construction of roads and mechanical rock excavation;

- *Tunnel Works* - include construction activities at tunnel portal for material transfer, ventilation and removal of spoil, concrete lining and track laying within tunnel;

- *At-grade Track Construction* - construction of surface drainage and flood protection barrier, track laying for the at-grade sections involving the use of diesel locomotives; and

- *Ventilation Building* - foundation works and superstructure construction.

The tentative project implementation programme for the construction of Yam O Station and the adjacent at-grade section is from September 2002 to April 2004 (20 months). Rock tunnelling will last for about 21 months from August 2002 to April 2004. The construction of Disneyland Station and open cut section will last for about 16 months according to the tentative implementation programme (January 2003 to April 2004). Track work and the installation of overhead lines will take about nine months from August 2003 to April 2004.

Site traffic generated from the works is anticipated to be limited given a small volume of spoil to be generated from the works. Night-time working may be necessary for tunnel construction. The Contractor shall follow the requirements and procedures stipulated in GW-TM for any construction works required during the restricted hours (1900 - 0700). As previously mentioned, a CNP is required for such night-time construction activities.

3.4.2 *Assessment Methodology*

The assessment of noise impacts from the construction of the railway extension has been undertaken based on the procedure outlined in GW-TM. For this EIA Study, only daytime construction noise associated with the railway extension is addressed. Any works within the restricted hours period will be assessed in accordance with the requirement in GW-TM undertaken by the Noise Control Authority, when the contractor applies for a CNP for the works. In general, the methodology is as follows:

- identify representative NSRs that may be affected by construction works;

- determine plant items for corresponding construction activities, based on an agreed plant inventory;
- assign sound power levels (SWLs) to construction plant based on the information in GW-TM and other appropriate sources;
- calculate the correction factors based on the distance between the NSRs and the notional noise source point at the work sites and facade reflection; and
- calculate the predicted noise levels at NSRs in the absence of any mitigation measures.

Annex B presents the plant inventory used for the construction of Penny's Bay Rail Link and *Tables 3.4a* to *3.4f* summarise the SWLs evaluated for each construction activity. The plant inventory and quantity of PME for different construction activities have been confirmed and agreed with MTRC.

Table 3.4a ***Sound Power Levels of Activity for Yam O Station Construction***

Activity	Sound Power Level (dB(A))
Foundation (Concreting)	122
Foundation (Formwork & Reinforcement)	114
Excavation	124
Station Construction	123
Sheet Piling for Protection on Existing Tracks/ Platforms	118

Table 3.4b ***Sound Power Levels of Construction Activity at Tunnel Portal (Start-up Works)***

Activity	Sound Power Level (dB(A))
Excavation	122
Sheet Piling	118
Soil Nail Installation and Initial Tunnel Excavation	120
Re-construction of Roads	116
Mechanical Rock Excavation	125

Table 3.4c ***Sound Power Levels for Tunnelling Works***

Activity	Sound Power Level (dB(A))
Works at Tunnel Portal (Tunnel Ventilation and Material Transfer)	123
Removal of Spoil at Tunnel Portal	118
Concrete Lining and Track Laying	120

Table 3.4d ***Sound Power Levels of Activity for At-grade Track Construction***

Activity	Sound Power Level (dB(A))
Surface Drainage Construction (including pumps to control water influx and the construction of flood protection barrier)	125

Activity	Sound Power Level (dB(A))
Track Laying	122

Table 3.4e ***Sound Power Levels of Activity for Disneyland Station Construction***

Activity	Sound Power Level (dB(A))
Excavation	123
Foundation (Concreting)	122
Foundation (Formwork & Reinforcement)	115
Station Construction	124

Table 3.4f ***Sound Power Levels of Activity for Ventilation Building***

Activity	Sound Power Level (dB(A))
Building Foundation	125
Building Superstructure	121

3.4.3 Prediction and Evaluation of Impacts

Details of construction noise calculations are given in *Annex B*. *Table 3.4g* below presents the maximum predicted noise levels at representative NSRs during the key construction stages of the railway extension. Noise levels at Luk Keng Tsuen and the proposed Country Park Extension Areas were calculated based on the SWLs evaluated in the preceding section and the corrections for distance as given in GW-TM. Facade correction has also been made for Luk Keng Tsuen to obtain the facade noise levels.

Table 3.4g ***Predicted Maximum Construction Noise Level ($L_{eq\ 30min}$, dB(A))***

Activity	NSR			
	Luk Keng Tsuen	Country Park Extension Area		
	A	B	C	D
Yam O Station Construction	65	60	53	50
Tunnel Portal (Start-up Works)	62	60	59	53
Tunnel Works	60	58	57	52
At-grade Track Construction	64	61	64	49
Disney Station Construction	50	49	52	54
Ventilation Building Construction	61	61	58	53

The construction period for the whole Penny's Bay Rail Link will be about 36 months. Within this period, noisy activities identified include concreting for station foundation, station construction, mechanical rock excavation, works at tunnel portals, surface drainage construction, foundation works for ventilation building, laying of track and excavation works in various construction stages. The maximum sound power level of construction plant during this period is 125 dB(A) and arising from mechanical rock excavation at tunnel portal, surface drainage construction for the at-grade alignment (including pumps to control water influx and the construction of flood protection barrier) and during foundation construction for ventilation building.

According to the prediction results, all the noise levels are within the daytime construction noise standard stipulated in EIAO TM for Luk Keng Tsuen (NSR A). The noise levels predicted at the proposed Country Park Extension Areas (NSRs B, C and D) range from 49 dB(A) to a maximum of 64 dB(A). For planning consideration, any future trails or footpaths proposed within the Country Park Extension Areas during the construction phase of PBRL could be located on the other side of the ridge, any noise nuisance would therefore be minimal given the topographical screening effect of the ridge.

In view of the noise emission sources of the construction activities and the buffer distance between the works and NSRs, noise impacts during daytime are not expected. Any works within the restricted hours period will be assessed in accordance with the requirement in GW-TM undertaken by the Noise Control Authority, when the Contractor applies for a CNP for the works.

3.4.4 *Environmental Control Measures*

The construction activities being undertaken in the Project are unlikely to give rise to adverse daytime noise impacts to the surrounding environment as concluded in the preceding section. Specific mitigation measures are therefore not required. However, the Contractor will be required to adopt good site practice and maintain proper on-site management in order to minimise noise emissions from the works. The following measures are recommended:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction works;
- machines and plant that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum; and
- silencers or mufflers on construction equipment should be utilised and be properly maintained during the construction works.

Although it is difficult to quantify the level of noise reduction achieved from incorporation of these elements, the environmental performance of the works would be improved with these control measures.

3.4.5 *Environmental Monitoring and Audit*

Environmental monitoring is considered not necessary as the identified NSRs are remote from the works and noise impacts associated with the construction activities are not envisaged.

3.5 OPERATIONAL PHASE

3.5.1 *Potential Sources of Impact*

The main source of noise in operational phase of the Project includes:

- railway noise from the operational trains;
- fixed plant noise from ventilation building proposed at the northern and southern tunnel portals, and the noise from train washing plant at Disneyland Station.

These emissions are addressed in the following sections.

3.5.2 *Railway Noise*

Operational Details

In the operational phase of Penny's Bay Rail Link, a maximum of fifteen return services per hour are possible assuming travel time between stations of 3.5 minutes and a thirty second dwelling time at each station (Yam O and Disneyland). Two Electric Multiple Unit (EMU) trains will operate simultaneously utilising a passing loop in Penny's Bay. This results in 30 train movements per hour at each point on the track. Although 4-car trains will be operated in the short to medium term, longer term capacity may require the employment of 8-car trains; this 8-car scenario has been used as the basis of the operational noise assessment presented in this report as this represents the "worse-case" operating conditions. The other acoustic features of the railway are presented below. These details have been checked and confirmed by MTRC during the preparation of this EIA:

- train length of 184 metres (eight cars, each of 23 m long);
- the maximum A-weighted noise level (L_{max}) of the rolling stock will be maintained by MTRC to within a reference noise level at 25 m of 89 dB(A) at 130 kph on ballasted track supporting continuously welded rail;
- maximum operating speed on the link is 80 kilometres per hour;
- design acceleration profiles of 1 and -1 ms^{-2};
- the reference L_{max} noise level for a train air-conditioning unit will be 68 dB(A) at 7.5 m; and
- two air-conditioning units per car.

As advised by MTRC, rolling stock of the existing MTR Urban Lines would be used for PBRL. The reference noise level of the rolling stock would be 2-3 dB(A) higher than LAR trains, which has a reference L_{max} level of 86 dB(A) under the same operating condition. A reference noise level at of 89 dB(A) was therefore used in this assessment as a worst case.

Assessment Methodology

The acoustic modelling of the alignment including the air-conditioning units of the trains has been undertaken using ERM's in-house software, ERM *Rail Noise Model* (ERMRNM). This software employs the methodology described

by the Noise Advisory Council's *A Guide To The Measurement and Prediction of the Equivalent Noise Level (Leq)*. As an example, $L_{Aeq,30min}$ noise levels have been calculated as follows from a reference L_{max} source term for the rolling stock:

- localised variation in L_{max} noise due to train speed:

$$\Delta_v = 30 \cdot \text{Log}_{10} (v_1/v_2) \text{ dB};$$

- integration of theoretical time history for train rolling noise with dipole directivity (1) : SEL (sound exposure level) = $L_{max} + 10 \cdot \text{Log}_{10}(l/v) + 10.5 - 10 \cdot \text{Log}_{10}((4D/4D^2 + 1) + 2 \tan^{-1}(1/2D))$ dB, where :

l = train length (m)
v = train speed (kph)
d = distance from track (m)
$D = d/l$

- 30-minute equivalent continuous energy level (L_{eq}) = SEL + $10 \cdot \text{Log}_{10}$ ($n_i/1800$) dB, where :

n_i = number of trains with identical noise characteristics

- correction for distance:

$\Delta_d = 10 \times \text{Log}_{10}(25/d)$ dB, where

d = distance between a line source and NSR in m

Additional relevant procedures are incorporated for the following:

- calculation of noise levels from point sources moving along the alignment (air-conditioning units);
- user definable source term in third octaves;
- a 2.5 dB(A) reflection correction at the facade of the receiver except Theme Park and Country Park;
- calculation of atmospheric absorption of noise for NSRs located over 300 m away from the alignment;
- barrier shielding calculation in third octaves based on the methodology developed by Maekawa as follows:

$$\Delta L_{\text{absorptive barrier}} = 7 \text{ dB} + 20 \log[(2\pi N)^{1/2}/(\tanh(2\pi N)^{1/2})] \text{ dB} - PL(N)$$

where PL is the difference in barrier attenuation between an infinite line source and a point source as a function of the maximum Fresnel Number, N.

(1) A Guide to the Measurement and Prediction of the Equivalent Noise Level (Leq), The Noise Advisory Council, HMSO, London, 1978.

$$N = 2 (P.L.D.)/ \lambda$$

where P.L.D. is the Path Length Difference between the direct and diffracted sound paths; and λ is the wavelength of sound.

- Attenuation given by reflective barriers is 2 dB(A) less than absorptive barriers [1].

Topographical features between the railway and the NSRs have been included as ridge lines. Consideration of atmospheric absorption has been given taking account of the most conservative weather condition (i.e. ambient temperature of 30 °C and relative humidity of 70%) to ensure the assessment of the worst case scenario. The calculation algorithm in the model for atmospheric absorption is based on *Method for Calculating the Absorption of Sound by the Atmosphere* [2].

Prediction and Evaluation of Impacts

Table 3.5a presents the predicted facade railway noise levels at the identified NSRs. An $L_{eq,30min}$ of 45 dB(A) has been calculated for the nearest NSR at Luk Keng Tsuen as a result of 30 train movements per hour assuming that 8-car trains will be used as a worst case. During the initial operation (but assuming the same worst case number of movements), the predicted noise level $L_{eq,30min}$ will be 42 dB(A) with 4-car trains upon commencement of operations. The $L_{eq,24hour}$ noise level would be at least 1 dB(A) lower assuming a similar peak headway for a total of 18 hours on any one day. The calculated L_{max} level at Luk Keng Tsuen is 55 dB(A). All the predicted values comply with the NCO and EIAO TM noise limit and adverse noise impact at Luk Keng Tsuen is not expected.

From the Lantau and Airport Railway Environmental Impact Study [3], the maximum predicted facade $L_{eq,30min}$ level at Luk Keng Tsuen in Year 2012 due to the operational trains on Airport Express Line and Tung Chung Line was 55 dB(A), in the presence of noise mitigation measures which will be deployed as and when necessary by agreement between EPD and MTRC based on the requirements of the Lantau and Airport Railway Environmental Impact Study. It should be noted that reference to the predicted train noise levels in the Environmental Impact Study [3] presents a worst case for the PBRL noise assessment since Tung Chung Line trains will stop at Yam O Station in the future whereas the predicted noise levels assume a through service at maximum speed of 135 kph. The lower train speeds will reduce noise levels from the Tung Chung Line and the Yam O Station platforms and station building will reduce noise levels from all Lantau and Airport Railway trains. The noise attenuation effect of these factors has not been considered in

(1) Crockett, A.R. and Pyke, J.R., Viaduct Design for Minimisation of Direct and Structure Radiated Train Noise, presented at the International Workshop on Railway Noise (IWRN), November 1998, and to be published in Journal of Sound and Vibration in 2000.

(2) American National Standard: Method for Calculating the Absorption of Sound by the Atmosphere, ANSI S1.26-1995 (Revision of ANSI S1.26-1978 (R1989)).

(3) Lantau and Airport Railway: Environmental Impact Study Final Report. Prepared by ERM-Hong Kong Ltd for Mass Transit Railway Corporation, January 1994.

the PBRL EIA. The cumulative noise level at Luk Keng Tsuen in the future is 55 dB(A) from both the Lantau and Airport Railway and PBRL and this noise level will comply with the NCO and EIAO TM requirements.

Predicted $L_{eq,30min}$ level at the proposed Country Park Extension Area is in the range of 49 to 56 dB(A), with L_{max} level ranges between 57 to 65 dB(A).

With the 9 m high earth berm (see *Figures 3.5a* and *3.5b*) and the separation from the rail link, noise impact on Theme Park from PBRL is not anticipated. The noise level predicted at the boundary of Theme Park is in the range of 43 to 46 dB(A) which complies with the 69 dB(A) $L_{eq\ (10\ mins)}$ noise limit at the nearest boundary of guest areas within the Theme Park.

Table 3.5a ***Predicted Facade Railway Noise Levels from PBRL (Worst Case)***

NSR		$L_{eq,30min}$	L_{max}	Remark
A	Luk Keng Tsuen	45	55	Night-time noise limits of $L_{eq,30min}$ 55 dB(A) (Area Sensitivity Rating of "B") and L_{max} 85 dB(A)
B	Country Park Extension Area	50	60	
C	Country Park Extension Area	56	65	
D	Country Park Extension Area	49	57	
E	Theme Park	45*	57	Noise limit of $L_{eq,10min}$ 69 dB(A) at boundary of Theme Park
F	Theme Park	46*	58	Noise limit of $L_{eq,10min}$ 69 dB(A) at boundary of Theme Park
G	Theme Park	43*	53	Noise limit of $L_{eq,10min}$ 69 dB(A) at boundary of Theme Park

* Note: $L_{eq,10min}$ level predicted at the boundary of Theme Park.

The results show that the proposed railway will not impact upon the existing NSRs and will comply with the statutory requirements of the NCO and EIAO TM in all assessment time periods (daytime and evening, night time and all day (24 hour)). No specific noise mitigation measures are required in the operational phase. Output noise prediction results from the ERM Rail Noise Model are provided in *Annex B* for reference.

3.5.3 *Fixed Plant Noise*

Sources of fixed plant noise for the proposed Penny's Bay Rail Link include:

- transformers and substations for power supply to the railway;
- ventilation buildings located at the northern and southern tunnel portal for tunnel ventilation; and
- washing facilities located close to the Disneyland Station (see *Figure 3.5c*).

In order to ensure the environmental performance of these fixed plant, it is recommended that the sound pressure level measured at a distance 1 m from the noise sources should be controlled to within 80 dB(A), as a good engineering practice to reduce the potential noise nuisance to the surrounding environment.

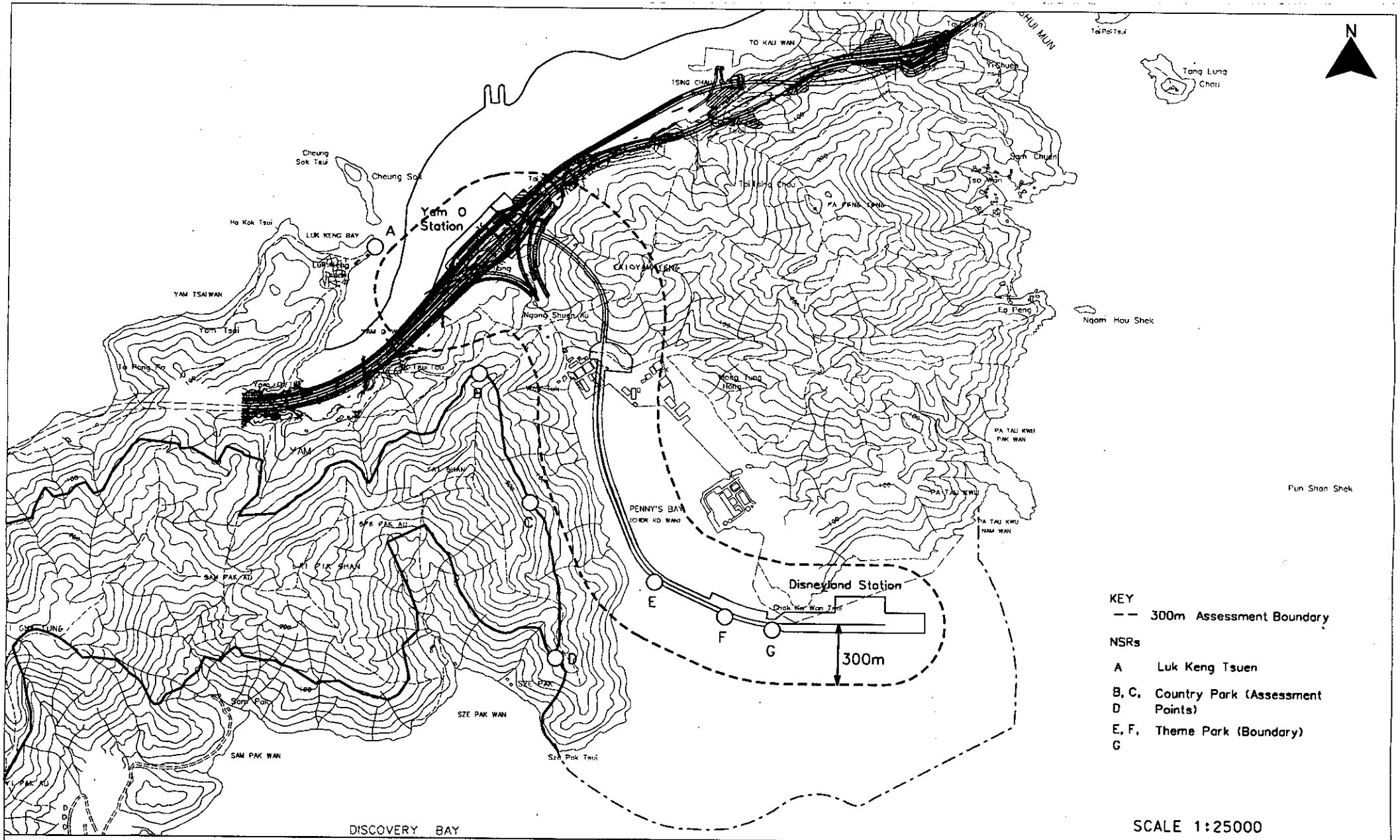


FIGURE 3.3a

LOCATIONS OF NSRs

USTN FILE: C1937_7
DATE: 12/01/00

Environmental Resources Management

ERM

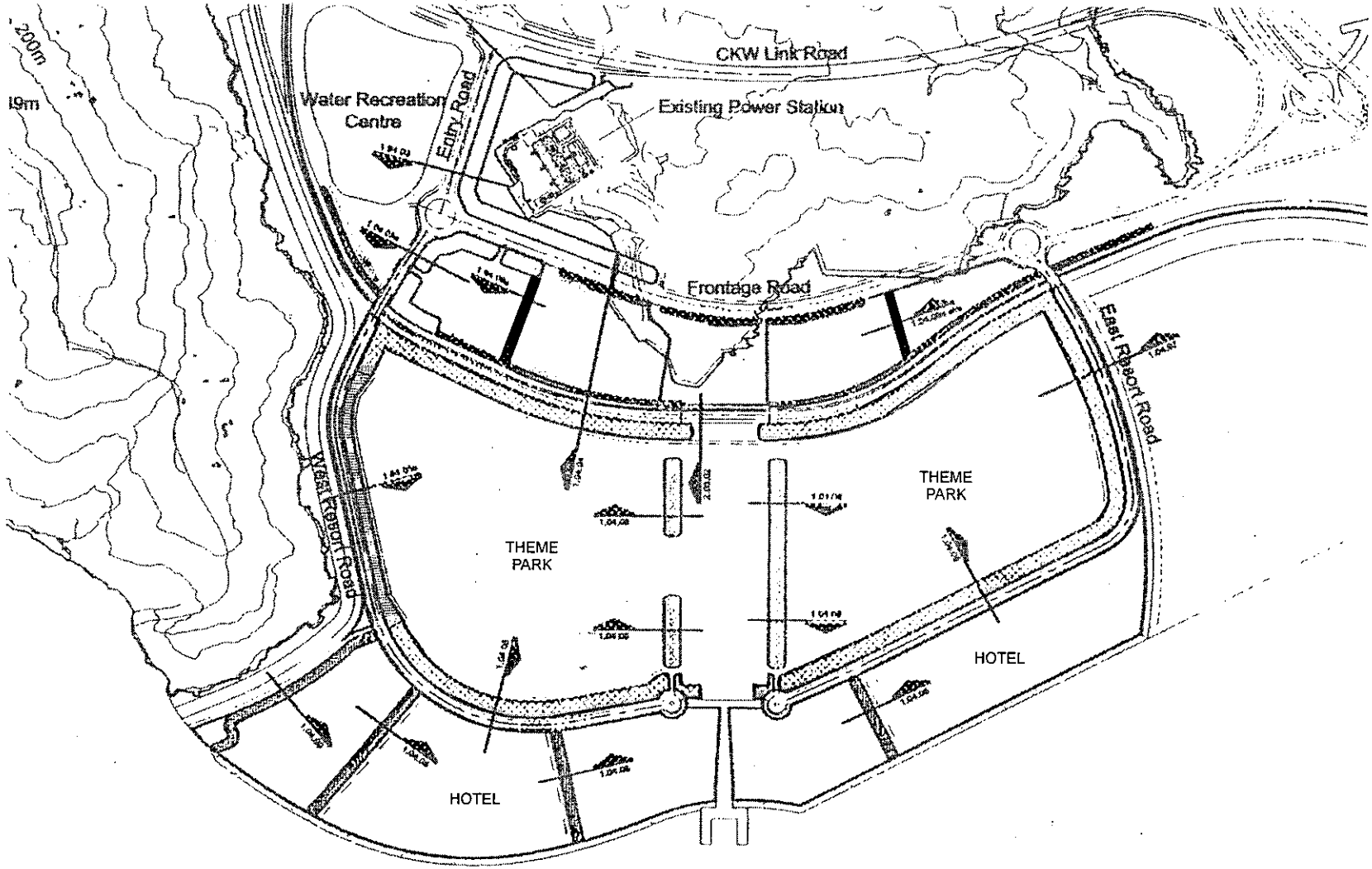


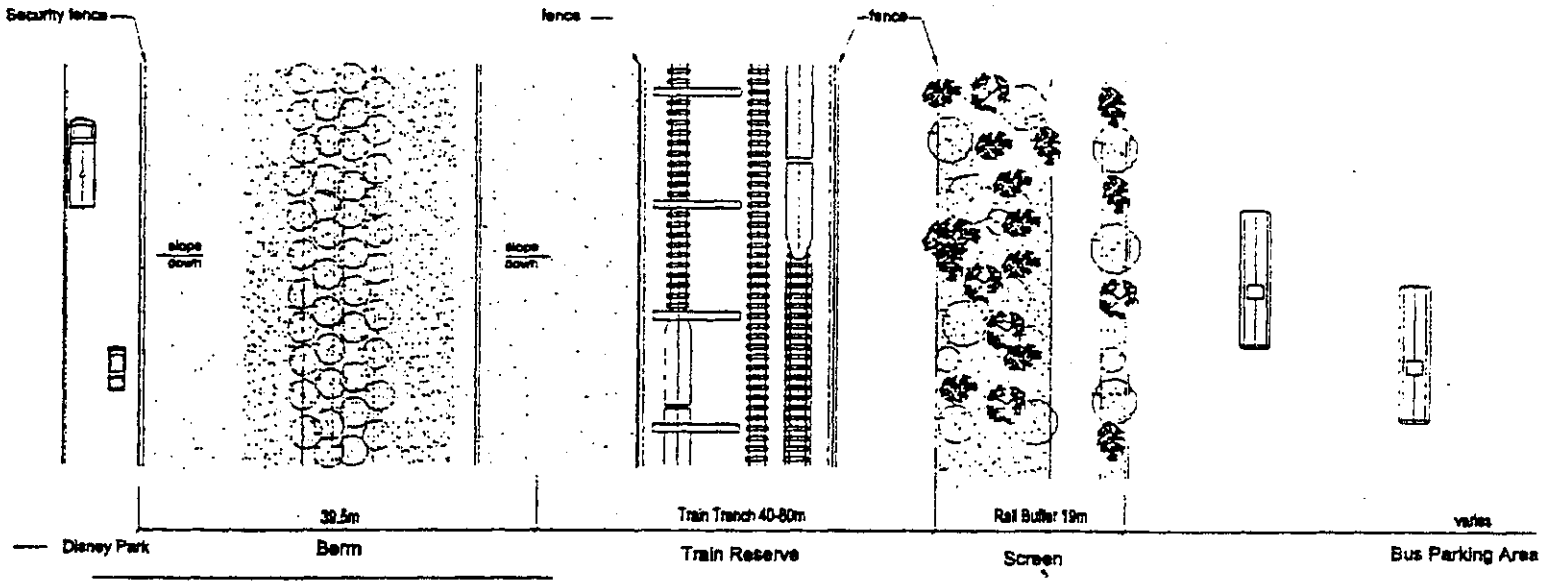
FIGURE 3.5a

LOCATION OF BERMS

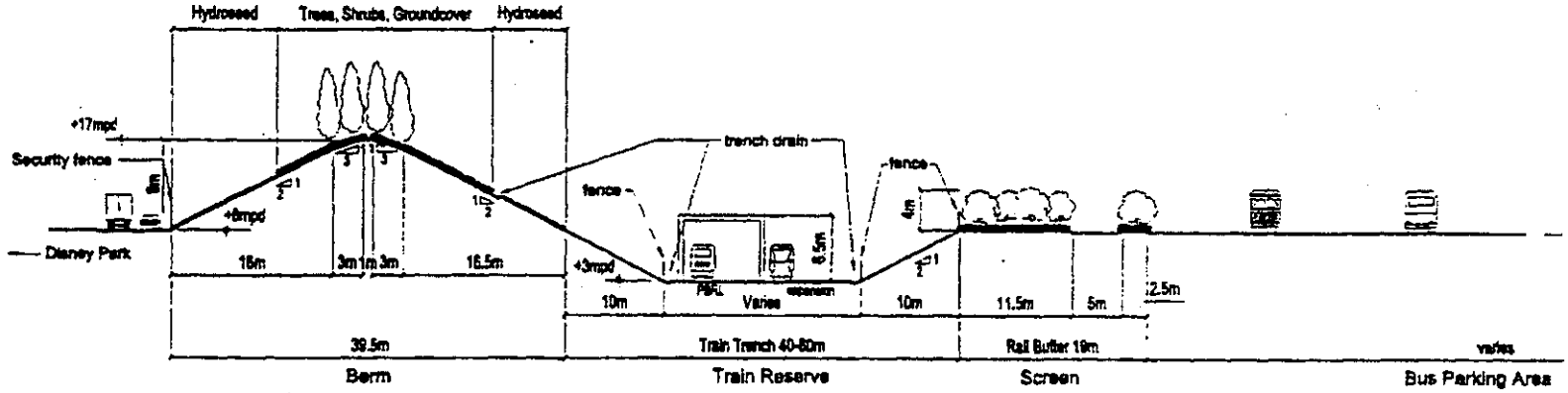
FILE: C1937h3
DATE: 07/01/2000

Environmental Resources Management

ERM



Typical plan at Public Berm / Rail / Frontage Road



Typical section at Public Berm / Rail / Frontage Road

(looking west)

FIGURE 3.5b

TYPICAL PLAN AND SECTION AT PUBLIC BERM / RAIL / FRONTAGE ROAD

FILE: C1937h
DATE: 07/01/2000

Environmental Resources Management

ERM

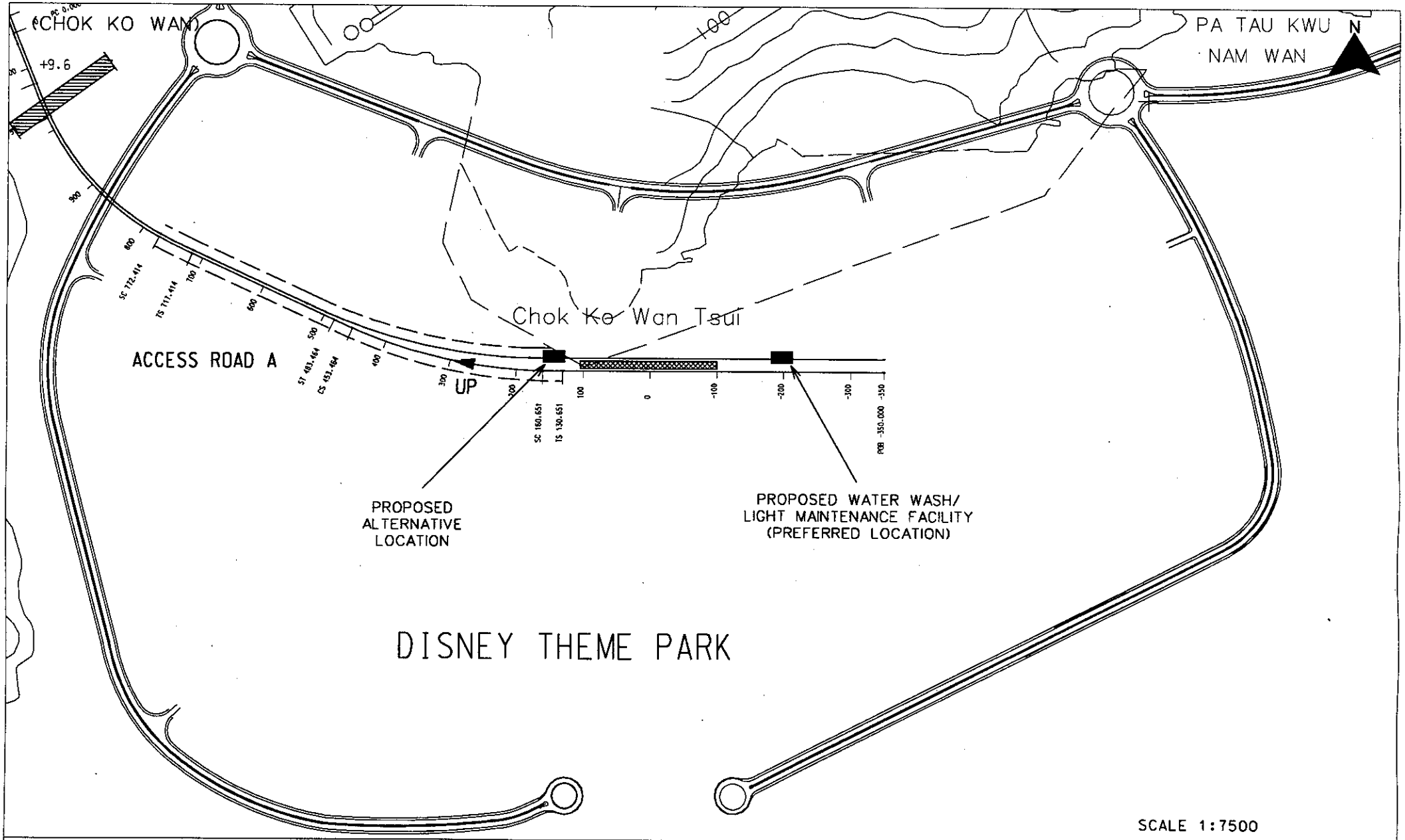


FIGURE 3.5c

LOCATION OF WATER WASH/LIGHT MAINTENANCE FACILITY

USTN FILE: C1937_14
DATE: 14/01/00

Environmental
Resources
Management

ERM

These plant and tunnel ventilation equipment will be designed by MTRC to ensure that the noise levels at any NSR will be 5 dB lower than the NCO criteria as mentioned in *Section 3.2.3*. Given the large distance separation between the alignment and the nearest NSRs, and the provision of 9 m earth berm next to the proposed railway, this will be easily achieved by adoption of the good engineering practice (80 dB(A) at 1 m noise limit).

3.6 CONCLUSIONS

Construction noise has been identified arising from the Project during its construction phase. The use of powered mechanical equipment on site is the primary source of noise. However, in view of the distance between the sensitive uses and the works, no noise impacts are expected.

In view of the setback distance and the operational characteristics of the trains, no noise impacts are anticipated during the operational phase. The 9 m high earth berm located along the proposed alignment also provides noise screening for the proposed Theme Park. Accordingly, no mitigation measures will be required and no cumulative impacts with existing sources of railway noise will arise. Fixed plant noise is also not an issue and can satisfy the NCO and EIAO TM noise limit provided that the recommended good engineering practice noise limit is implemented.

Environmental monitoring for noise is not necessary during the construction and operational phases.

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4 AIR QUALITY

4.1 INTRODUCTION

This section addresses the potential air quality impacts associated with the construction and operation of Penny's Bay Rail Link. The potential for air quality impacts is assessed, particularly during the construction phase of the railway alignment and stations.

During the construction phase, dust emissions will be likely from site preparation activities, tunnelling works, excavation, concrete batching truck haulage and the construction of station structure. Exhaust emissions from trucks and powered mechanical equipment may also affect the surrounding environment. The extent of impacts depends on the buffer distance between the works and the sensitive receivers and is assessed semi-quantitatively in this EIA Study. Practical mitigation measures will also be recommended, where necessary, to reduce identified air quality impacts.

Full quantitative assessment of the Theme Park and Northshore Lantau Development and associated supporting infrastructure is undertaken in the main Theme Park EIA with source emission data provided by this assessment.

4.2 ENVIRONMENTAL LEGISLATION AND STANDARDS

The principal legislation for the management of air quality is the *Air Pollution Control Ordinance, Cap. 311* (APCO). The whole of the Hong Kong Special Administrative Region is covered by the *Hong Kong Air Quality Objectives* (AQOs) which stipulates the statutory limits of typical air pollutants and the maximum allowable exceedance values over specific periods. The AQOs are shown in *Table 4.2a.*

The EIAO TM also stipulates an hourly TSP limit of 500 $\mu g\ m^{-3}$ (measured at 25°C and 1 atmosphere) should not be exceeded in construction dust impact assessment at all Air Sensitive Receivers (ASRs).

Table 4.2a *Hong Kong Air Quality Objective (μgm^{-3})(i)*

Pollutant	Averaging Time			
	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	1 Year (iv)
Total Suspended Particulates (TSP)	-	-	260	80
Respirable Suspended Particulates(v) (RSP)	-	-	180	55
Sulphur Dioxide (SO_2)	800	-	350	80
Nitrogen Dioxide (NO_2)	300	-	150	80
Carbon Monoxide (CO)	30,000	10,000	-	-
Ozone (O_3)	240			

Note:
(i) Measured at 298K (25°C) and 101.325 kPa (one atmosphere).
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Arithmetic means.
(v) Respirable suspended particulates are defined as particles suspended in the air with a nominal aerodynamic diameter of 10 μm and smaller.

4.3 BASELINE CONDITIONS AND SENSITIVE RECEIVERS

The background air quality is primarily influenced by road vehicles travelling on the North Lantau Highway and air emissions from the Penny's Bay Gas Turbine Power Station. The proposed alignment runs between Yam O and Penny's Bay; work sites for the construction of the Project will be located in the Bay areas and the valley between Tai Shan and Tai Yam Teng. Atmospheric mixing of the area is therefore dependent on the local topography and oceanic weather condition. The planned Chok Ko Wan Link Road and Route 10 will be additional sources of air emissions during the operational phase of the Project.

The air quality of the Penny's Bay area has been monitored by China Light & Power Co. Ltd. (CLP). In 1998, the annual average levels of SO_2 and NO_2 were recorded as 4 $\mu g\ m^{-3}$ and 32 $\mu g\ m^{-3}$ respectively, indicating that the background pollutant levels of the Penny's Bay area are low. However, dust level was not monitored at CLP's Penny's Bay monitoring station.

The background air pollutant level provided in *Draft Guidelines for Local-scale Air Quality Assessment Using Models*, prepared by the Environmental Protection Department (EPD) can then be used to reflect the ambient dust level of the study area. The whole study area is classified as rural according to this guideline. Background air quality for rural areas has been calculated based on the annual average pollutant level of the EPD's fixed monitoring stations for the past five years (i.e. 1992 - 1996) and are detailed in *Table 4.3a* below for reference. It is concluded that the ambient air quality of the study area is generally good with low pollutant levels.

Table 4.3a ***Background Air Pollutant Level***

Pollutant	Concentration in μg m^{-3}	
	Penny's Bay Monitoring Station (1)	*EPD Guideline*
NO_2	32	39
SO_2	4	13
TSP	-	87
RSP	-	51

Note: (1) Extracted from *Air Quality in Hong Kong 1998*

The nearest potential sensitive receivers are village type developments located at Luk Keng Tsuen. Although Penny's Bay Power Station itself is a pollution source, offices and accommodations within the station are potential sensitive receivers. Country park to the west of the proposed railway is also an ASR according to APCO. In the operational phase, numerous air sensitive uses will be located in the surrounding of the proposed railway. These include the Theme Park, the southern hotel and resort areas, police and fire stations, water recreational centre, the northern Theme Park Gateway, Technodrome, Tourist and Convention Village.

Representative ASRs have been identified according to APCO and *Annex 12* of *Technical Memorandum on Environmental Impact Assessment Process* (EIAO TM). *Table 4.3b* below presents the representative ASRs identified for both construction and operational phases and their distance from the Project. *Figure 4.3a* shows the relative location of ASRs.

Table 4.3b ***Identified Air Sensitive Receivers***

ASR	Description	Construction Phase ASR	Operational Phase ASR	Distance from the Project (m)
A1	Penny's Bay Power Station	✓	✓	455
A2	Proposed Country Park Extension Area	✓	✓	670
A3	Proposed Country Park Extension Area	✓	✓	380
A4	Proposed Country Park Extension Area	✓	✓	600
A5	Luk Keng Tsuen	✓	✓	670
A6	Theme Park		✓	125
A7	Hotel and Resort in Theme Park		✓	850
A8	Theme Park Extension (Phase 3)		✓	810
A9	Fire Station (West of Disneyland Station)		✓	215
A10	Police Station		✓	165
A11	Fire Station (East of Disneyland Station)		✓	175
A12	Water Recreational Centre		✓	120
A13	Eco Park		✓	970
A14	Theme Park Gateway		✓	160
A15	Tourist and Convention Village		✓	570
A16	Technodrome		✓	1100

With reference to the Study Brief (ESB-043/1999) for *Construction of An International Theme Park in Penny's Bay of North Lantau and its Essential Associated Infrastructures*, an assessment area has been clearly defined for air quality impact assessment. Cumulative air quality impact will be addressed in this Theme Park EIA and therefore, this Penny's Bay Rail Link EIA will focus on the likely impact from the railway construction to the nearest ASRs only.

4.4 CONSTRUCTION PHASE

4.4.1 *Potential Impacts*

The potential air quality impacts arising from the construction of Penny's Bay Rail Link and its associated facilities are likely to relate to fugitive dust emissions and gaseous emissions from construction plant. The major construction works involved for the railway extension are site clearance, foundation works, tunnelling works, at-grade alignment construction and station construction. Potential sources of dust from the works include material handling, transfer of spoil, concrete batching, tunnel blasting, wind erosion of stockpiles and earth bunds and vehicular movement within the site.

Emissions of SO_2 and NO_2 will be generated by diesel-powered mechanical equipment used on-site. However, the number of such plant required on-site will be limited and gaseous emissions will be minor. It is therefore, not expected to cause an exceedance of the AQOs for these gases due to the limited construction plant on site. Specific dusty activities associated with the Project are outlined below.

Yam O Station

The construction of Yam O Station may give rise to dust from a range of activities including the excavation for site formation, earthworks for removal of the earth bank near the existing sub-station and concreting activities. There will be a concrete batching plant located at the work site close to the northern tunnel portal, concrete will be delivered to the work sites and other sites in Penny's Bay by concrete mixer lorries. Tentative project implementation programme for the construction of Yam O Station and the adjacent at-grade section is from the third quarter of 2002 to second quarter 2004 (approximately 20 months).

Tunnel Construction

Excavation works for the 100 metre long cut and cover sections will be undertaken at the southern and northern portal areas. There will be shotcreting works for soil nail installation. Re-construction of roads for site access close to the portal areas will also be carried out and export of spoil material by trucks is expected. The construction of approximately 750 m long tunnel will be carried out by means of drill and blast method. Hydraulic

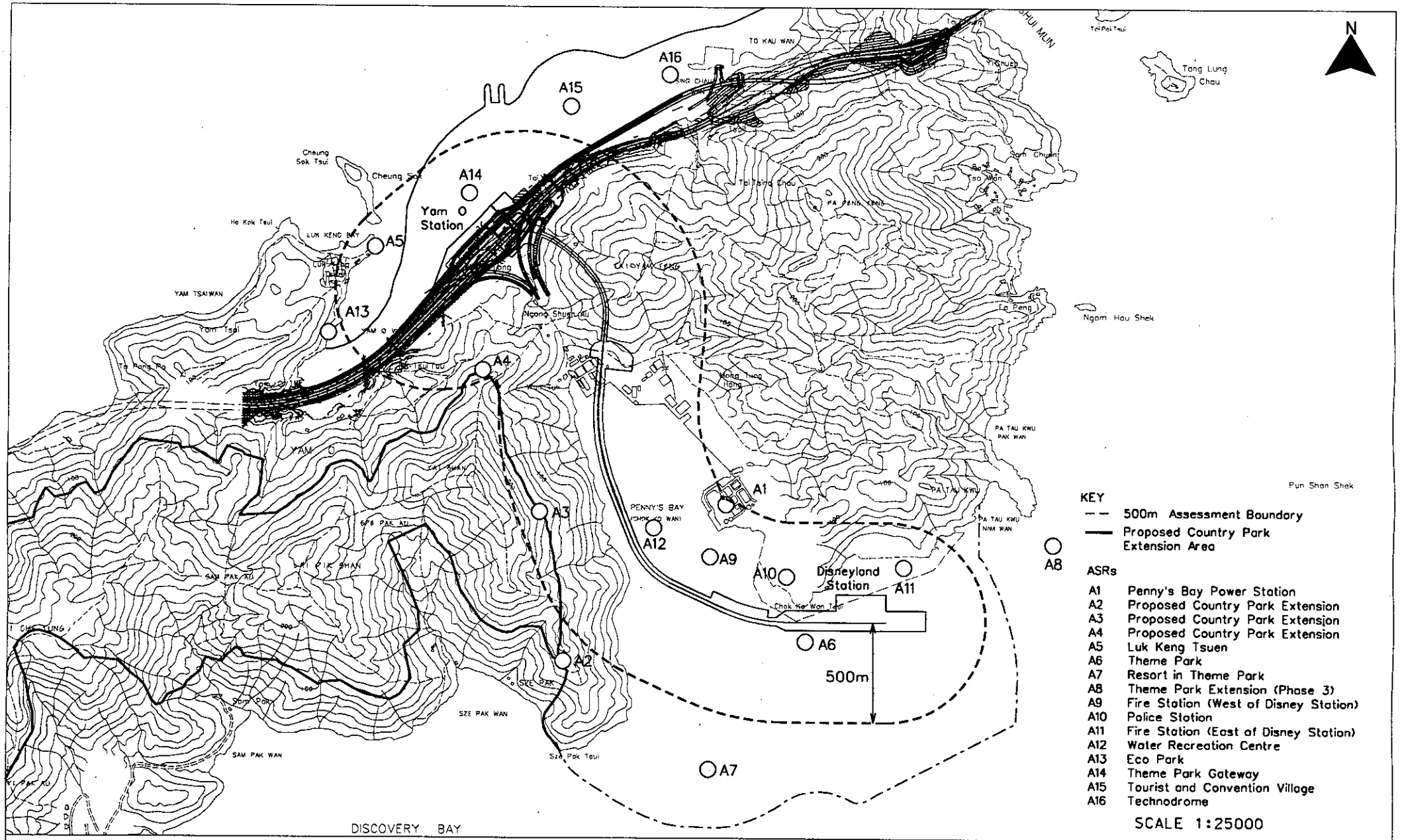

FIGURE 4.3a

LOCATIONS OF ASRs

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Environmental Resources Management

ERM

breaking is required inside the cut and cover tunnel sections and at the tunnel portals. Disposal of spoil will be undertaken using lorries over site roads. There will also be stockpiles for shotcrete material. Concrete will be supplied by the in-situ concrete batching plant located at the northern portal area. The construction of rock tunnel will last for about 21 months according to the tentative implementation programme (third quarter of 2002 to second quarter of 2004).

At-Grade Track Construction

Dusty activities associated with the at-grade track construction include surface drainage construction and the stockpiling of ballast. Excavation works will be kept to a minimum for the alignment construction. Track work and the installation of overhead lines will last for about nine months from third quarter of 2003 to the end of the first quarter of 2004.

Disneyland Station

The construction of the Disneyland Station will involve excavation works for raft foundations and the disposal of spoil by surface transport. Concrete will be delivered from concrete mixer lorries. No other dusty works are identified as the station will be largely made of structural steel with cladding and pre-cast concrete floors. The construction of Disneyland Station and open cut section will last for about 16 months according to the tentative implementation programme (first quarter of 2003 to second quarter of 2004).

4.4.2 *Evaluation of Impacts*

The construction period for the whole Penny's Bay Rail Link will be about 36 months. It is estimated that approximately 16,500 m^3 and 27,000 m^3 of excavated materials will be generated from the construction of cut and cover tunnel and the drill and blast tunnel respectively. About 25,000 m^3 of excavated materials will be generated from other minor excavation works. These give a total of approximately 68,500 m^3 of excavated material and these works will be undertaken for approximately 21 months between 2002 and 2004. The average daily spoil generation rate (the average volume of material need to be handled per day) is estimated to be 110 m^3/day. The traffic associated with off-site disposal of excavated material, based on the total volume of spoil generated, is estimated to be 20 truck-trips per day (assuming each truck has a carrying capacity of 6.7 m^3).

To evaluate the potential dust impact from the construction of the Project, dust emission factors have been calculated based on *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition* (AP-42) published by the Environmental Protection Agency of United States (USEPA). The calculations have taken account of the particle size distributions and the empirical formulae developed in AP-42. *Table 4.4a* presents the calculated dust emission factors and details of the evaluations are enclosed in *Annex C*.

Table 4.4a *Dust Emission Factors for Construction Activities*

Activity	Emission Rate (1)	Remarks
• Material Handling	1.85 g Mg^{-1} (1.04×10^{-2} g s^{-1})	• calculated based on an estimated daily material handling rate of 110 m^3/day and a material density of 1.94 Mg/m^3
• Haul Road	250 g (vehicle-km travelled)$^{-1}$ (1.16×10^{-4} g m^{-1} s^{-1})	• based on an estimated site traffic of 20 truck-trips/day • vehicle speed limited at 10 kph • 85% dust reduction by paved road
• Wind Erosion	0.85 Mg hectare^{-1} year^{-1}	• dust emission dependent on the exposed surface area
• Concrete Batching Plant	0.164 kg Mg^{-1}	• dust emission dependent on the concrete production rate
• Blasting	$0.00022A^{1.5}$ kg blast^{-1}	• dust emission dependent on the horizontal area with blasting depth less than or equal to 21 m and the duration of blasting

Note:
(1) From Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition.

In view of the volume of spoil generated from the construction of Yam O Station, Disneyland Station and tunnel construction within the construction period, the material handling rate is very low (i.e. 110 m^3/day). Site traffic generated from the construction activities would also be low (i.e. 20 vehicles/day) taking account of the amount of spoil to be transferred. It is therefore envisaged that the amount of dust generated from material handling and haulage of trucks would be minimal as presented in *Table 4.4a*. Given the fact that the nearest ASR is over 350 m away from the works, exceedance of AQOs due to construction dust from material handling and site traffic would be highly unlikely.

Shotcreting for soil nail installation and other concreting works would be undertaken within specific areas such as within tunnel and at the station site. The moisture content of material to be handled during these activities would be high and therefore emission of dust would be limited. Stockpiling of shotcrete material and ballast for at-grade track construction is expected to be kept to the minimal. In addition, it is envisaged that the measures detailed in *Air Pollution Control (Construction Dust) Regulations* will be strictly followed by the Contractor in order to minimise the emission of dust from stockpiling. Dust impacts on the identified ASRs located remote from areas of stockpiling are unlikely. Re-construction of access roads again would not cause any exceedances of AQOs given the buffer distance from the ASRs and the scale of road works proposed.

A preliminary blasting schedule from MTRC indicated that there would be a tunnel and surface blast in late morning and a tunnel blast early evening. There would be approximately a total of 250 tunnel blasts and 10 surface blasts at each portal. The Contractor will be required to adopt the best practical means and measures in undertaking these works, such as the measures required by the Mines & Quarries Division of the Civil Engineering Department, the outbreak of dust from these activities would be carefully

controlled and without causing dust impacts on the ASRs.

Concrete batching plant proposed at the tunnel portal area is another source of dust in the construction phase. Preliminary estimation from MTRC indicated that the silo capacity would exceed 50 tonnes. According to APCO, concrete batching plant with a total silo capacity exceeding 50 tonnes is classified as a specified process which requires a license to operate. The Contractor responsible for the operation of concrete batching plant is required to assess the potential dust impact, to develop practical mitigation measures as per the best practicable means requirements for cement works and to monitor the dust level at specific locations in agreement with the EPD before the license is granted. Under this mechanism, it is envisaged that dust impact from the proposed concrete batching plant would be unlikely and would comply with the AQOs.

Although the works for the PBRL development are unlikely to give rise to air quality impact, the cumulative impact from the works and the activities for the construction of Theme Park and the development in North Lantau is addressed quantitatively in the EIA Study for Theme Park and Northshore Lantau Development.

In order to maintain the environmental performance of the works, environmental control measures stipulated in *Air Pollution Control (Construction Dust) Regulation* are recommended to limit the dust emission from the site. The recommended control measures are described in the subsequent section. These measures shall be strictly followed by the Contractor in order to minimise dust emissions from the works.

4.4.3 *Environmental Control Measures for Construction Dust*

Dust suppression measures specified in the *Air Pollution Control (Construction Dust) Regulations* will be followed in order to limit dust emissions associated with the works. The requirements of these mitigation measures, as outlined below, will be incorporated into the contract specification to ensure the environmental performance of construction activities.

Site Clearance

- water or dust suppression chemical shall be sprayed immediately before, during and immediately after the operation so as to maintain the entire surface of working area wet for the uprooting of trees, shrubs, or vegetation or for the removal of boulders, poles, pillars; and

- all demolished items (including trees, shrubs, vegetation, boulders, poles, pillars, structures, debris, rubbish and other items arising from site clearance) that may dislodge dust particles shall be covered entirely by impervious sheeting or placed in an area sheltered on the top and the three sides.

Site Boundary and Entrance

- high pressure water jet shall be provided at every discernible or designated vehicle exit point for vehicle washing facilities;

- the area where vehicle washing takes place and the section of the road between the washing facilities and the exit point shall be paved with concrete, bituminous materials or hardcores; and

- where a site boundary adjoins a road, street, service lane or other area accessible to the public, hoarding of not less than 2.4 m high from ground level shall be provided along the entire length of that portion of the site boundary except for a site entrance or exit.

Excavation Works

- the working area of any excavation or earth moving operation shall be sprayed with water or a dust suppression chemical immediately before, during and immediately after the operation so as to maintain the entire surface wet.

Pneumatic or Power-driven Drilling, Cutting and Polishing

- water or a dust suppression chemical shall be continuously sprayed on the surface where any pneumatic or power-driven drilling, cutting, polishing or other mechanical breaking operation that causes dust emission is carried out, unless the process is accompanied by the operation of an effective dust extraction and filtering device.

Exposed Earth and Stockpiling of Dusty Materials

- exposed earth shall be properly treated by suitable measures including compaction, turfing, hydroseeding, vegetation planting or other appropriate stabiliser within 6 months after the last construction activity on the construction site where the exposed earth lies; and

- any stockpile of dusty material shall be:
  (i) covered entirely by impervious sheeting;
  (ii) placed in an area sheltered on the top and the three sides; or
  (iii) sprayed with water or a dust suppression chemical so as to maintain the entire surface wet.

Handling and Transfer of Dusty Materials and Debris

- any debris shall be covered entirely by impervious sheeting or stored in a debris collection area sheltered on the top and the three sides; and

- all dusty materials shall be sprayed with water or a dust suppression chemical immediately prior to any loading, unloading or transfer

operation so as to maintain the dusty materials wet.

Use of Vehicles and Access Road

- every vehicle shall be washed to remove any dusty materials from its body and wheels immediately before leaving a construction site;

- where a vehicle leaving a construction site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle;

- vehicle speed limited at 10 kph;

- every main haul road shall be:
  (i) paved with concrete, bituminous materials, hardcores or metal plates, and kept clear of dusty materials; or
  (ii) sprayed with water or a dust suppression chemical so as to maintain the entire road surface wet; and

- the portion of any road leading only to a construction site that is within 30 m of a discernible or designated vehicle entrance or exit shall be kept clear of dusty materials.

For tunnel blasting works, the requirements of the Mines & Quarries Division of the Civil Engineering Department shall be followed.

According to the EPD's *Best Practicable Means Requirements for Cement Works (Concrete Batching Plant)*, the following mitigation measures are required:

- the loading, unloading, handling, transfer or storage of cement, pulverised fuel ash or other equally dusty materials should be carried out in an enclosed system;

- all dust-laden air or waste gas generated by the process operations should be properly extracted and vented to fabric filtering system;

- cement, pulverised fuel ash or other equally dusty materials should be stored in storage silo fitted with audible high-level alarms to warn of over-filling, the high-level alarm indicators should be interlocked with the material filling line;

- vents of all silos and weighing scale should be fitted with fabric filtering system; and

- seating of pressure relief valves of all silos should be checked, and the valves reseated if necessary, before each delivery.

The MTRC established construction management systems actively seek to ensure the compliance of relevant legislation through the establishment, implementation and maintenance of Corporate housekeeping measures.

These have been employed to good effect on the construction phases of the Lantau Airport Railway, the Quarry Bay relief works and the Tseung Kwan O Extension.

4.4.4 *Environmental Monitoring and Audit*

Environmental monitoring and audit is considered unnecessary as the identified ASRs are remote from the works and air quality impacts associated with the construction activities are not envisaged given the case that all the measures specified in the *Air Pollution Control (Construction Dust) Regulations* will be strictly followed by the Contractor.

4.5 *OPERATIONAL PHASE*

Potential air quality impacts during the operation of Penny's Bay Rail Link will be limited since electric trains will be used and no air emissions will be produced. However, low levels of dust may be generated by the abrasion and wear of track, electrical pick-up gear and rolling stock during normal operation and from maintenance activities. Ozone will also be generated due to arcing between the power rail and train pick-ups. The amount of air pollutant generated from such activities will be limited and will have a negligible impact on the ASRs.

Air quality impacts during the operation phase are not considered further in this Study.

4.6 *CONCLUSIONS*

Construction dust has been identified as the main air quality issue arising from the Project during its construction phase. Handling of excavated materials and vehicle movements on haul roads are the main sources of dust. However, in view of the buffer distance between the sensitive uses and the works, no air quality impacts are expected. To ensure the environmental performance of the works, environmental control measures stated in the *Air Pollution Control (Construction Dust) Regulation* shall be followed to limit the dust emissions from the site. Other measures to suppress the emission of dust during tunnelling, blasting works and concrete batching have been recommended. Environmental Monitoring & Audit of air quality impacts is not necessary for the Project.

Air quality impacts during the operational phase are not considered to be of concern as limited potential sources have been identified.