


 土木工程署  
 Civil Engineering Department



**Environmental Impact Assessment**  
*Construction of an International  
 Theme Park in Penny's Bay of  
 North Lantau and its  
 Essential Associated  
 Infrastructures*

29 February 2000

Scott Wilson (Hong Kong) Ltd,  
 in association with  
**Environmental Resources Management**  
 Shuckland Cox  
 Wilbur-Smith Associates



# 1 INTRODUCTION

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1.1.1 Under a contract between the Civil Engineering Department (CED) and Scott Wilson (Hong Kong) Limited, Environmental Resources Management - Hong Kong, Limited (ERM) was commissioned to undertake an Environmental Impact Assessment (EIA) and Shankland Cox Asia Limited was commissioned to undertake a Landscape and Visual Impact Assessment (LVIA), for the proposed Theme Park in Penny Bay, Lantau and its essential associated infrastructures. In accordance with the Environmental Impact Assessment Study Brief No. ESB-043/1999 this Executive Summary Report summarises the findings of the EIA Study.

## 1.2 STUDY AREA HISTORY

1.2.1 In 1989, the Port and Airport Development Strategy Study identified North-East Lantau as the primary area for expanding the port facilities in Hong Kong. Subsequently, the Project Area was earmarked for container terminals (CT10 and CT11) and port related uses under the 1993 Lantau Port and Western Harbour Development Studies (LAPH). Since then, a number of EIA Studies which demonstrated the environmental feasibility of the port development have been conducted and endorsed by the ACE in 1995. Based on the LAPH and subsequent studies, the Outline Zoning Plan (OZP) for North-East Lantau Port was gazetted in March 1995, with the main development theme evolving around the port development. The 1995 Visitor and Tourism Study (Hong Kong Tourist Association/ Planning Department) identified the potential for a tourism corridor along the north shore of Lantau Island and the 1997/98 Port Cargo Forecast indicated a general slowdown of the growth rate of cargo throughput in Hong Kong. On the basis of these findings, the planned development programme for port facilities has subsequently been reviewed. The 1998 Territorial Development Strategy Review (TDSR) identified North-East Lantau as having potential for a range of other land uses, such as tourism/recreation, housing, business estate and major transport interchange. As a follow up to the TDSR, an integrated planning and engineering feasibility study (the Northshore Lantau Development Feasibility Study (NLDFS)) was initiated by the CED in June 1998.

1.2.2 In March 1999, the Financial Secretary announced that the Administration was in the process of negotiation with The Walt Disney Company with a view to determining whether a Disney theme park project could be brought to fruition in Hong Kong. The Committee on Planning and Land Development, after considering initial findings of the NLDFS, agreed that the land use proposals for North-East Lantau should be drawn up on the basis of the tourism/recreation development theme, with an intention to translate North-East Lantau into a "Tourist Paradise" comprising a world-class theme park and a range of other compatible tourist attractions. The findings of the NLDFS and a Preliminary Outline Development Plan (PODP) were presented to the Town Planning Board in July 1999 and it was agreed that the PODP was a suitable basis for the revision of the previous North-East Lantau Port OZP. The land use of the proposed Project site was thus revised to incorporate a theme park and related resort hotel development, a water recreation centre and supporting government, institutional and community facilities and transport network in August 1999. In addition, two future container terminals to the southeast of the Theme Park are retained under the draft OZP to cater for long term port expansion in Hong Kong. The location of such new facilities is pending review in further studies.

1.2.3 In parallel with these developments, in 1998 Disney was looking for a suitable site for the potential development of a Disney project in Hong Kong. A number of potential sites were identified, including Penny Bay and Yam O on North Lantau. In 1999, the Government and Disney agreed that Penny Bay was the most promising option and following this decision the two sides started serious negotiation. Following the consideration of different Project settings and the selection of the preferred site, CED is proposing to construct land and essential associated infrastructures for an international Theme Park in Penny Bay, Lantau. Hongkong International Theme Parks Limited (HKITP) will construct and operate the Theme Park and related resort development of hotels and retail, dining and entertainment (RD&E) areas. The proposed Theme Park is expected to become a core tourist attraction in the Hong Kong SAR.

### 1.3 THE PROPOSED PROJECT

#### ELEMENTS

1.3.1 The proposed Project has the following characteristics which includes 9 *EIA Ordinance (EIAO)* Schedule 2 Designated Projects (DPs):

- Reclamation of about 280 ha of land within Penny Bay (a DP) and 10 ha of land at Yam O (a DP), using marine sand and public filling materials and the construction of associated seawalls;
- Phased development of an international Theme Park (of about 180 ha) together with RD&E complexes, hotels (with a final capacity of up to 7,000 rooms) and supporting infrastructure and services. The Theme Park is anticipated to have an opening annual capacity of 7.5 million visitors, rising to 20 million visitors with the completion of Phase II. The Theme Park comprises an EIA Ordinance DP;
- Construction of an approximately 32 ha Water Recreation Centre (WRC) with a 12 ha artificial lake (a DP);
- Construction of the following: a 1.5 km section of Chok Ko Wan Link Road (CKWLR) from the existing Yam O Interchange extending over the proposed Penny Bay roundabout, a 4 km primary distributor, Road P2, a 3.5 km district distributor, Resort Road, around the Theme Park (all DPs) plus an 800 m central pedestrian walkway between Phases I and II of the Theme Park;
- Construction of a 3.6 km long rail line, the Penny Bay Rail Link (PBRL), including an 850m tunnel and stations at Penny Bay and Yam O, linking the Tung Chung Line at Yam O to the Theme Park (a DP);
- Construction of a Public Transport Interchange (PTI) for the Theme Park close to the Penny Bay Rail Station and a temporary PTI at the Yam O rail station;
- Construction of two public ferry piers and a service quay on the southern waterfront;
- Construction of general service infrastructure and associated works, including the stormwater drainage system, the eastern culvert (a DP), sewerage facilities, irrigation, water supply and utility services; and
- Proposed slope formation and stabilisation, screening and landscaping works.

1.3.2 The Project Area and elements are shown in *Figure 1*.

## PROJECT CONSTRUCTION

- 1.3.3 CED will be the overall Project proponent and will oversee the Project reclamation works and the provision of the Theme Park essential infrastructure. However, the construction and operation of the PBRL will be undertaken by the intended railway operator, MTRC. The design and construction of the Theme Park, hotels and, RD&E elements will be carried out by HKITP. The currently proposed, worst case, programme for construction assumed in the EIA is summarised below.
- 1.3.4 The proposed Theme Park and associated developments will be constructed on land reclaimed by CED in phases between the second quarter (Q2) 2000 and Q4 2008. Once the reclamation and basic infrastructure works are completed, the sites will be handed over to the HKITP to allow construction of the Theme Park superstructures, hotels, RD&E elements and infrastructure. Between Q2 2002 and Q2 2005, the Theme Park Opening Day, Phase I will be constructed to occupy the western portion of the site and will also include related hotel and RD&E elements. The Phase I Theme Park will then be expanded over a ten year period to achieve the final Phase I Theme Park. Phase II of the Theme Park will be built between 2008 and 2024. The WRC construction will commence in Q2 2001 and will be completed in Q4 2004. The section of CKWLR from Yam O to the Penny Bay Interchange is envisaged to be built between Q4 2001 and Q1 2005, Road P2 between Q3 2003 and Q1 2005, the Resort Road Q1 2003 to Q1 2005 and PBRL and stations from Q4 2002 with opening for passenger service in Q1 2005. Tentative dates for utilities and services installation are between Q3 2000 and Q1 2005.

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## 2 STUDY APPROACH

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- 2.1.1 As required by the *EIA Study Brief (No. ESB 043/1999)* the purpose of this EIA Study was to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project, and related concurrent activities.
- 2.1.2 This EIA Study has been prepared in accordance with the requirements of the Study Brief and the general principles and guidelines of the *Technical Memorandum on Environmental Impact Assessment Process (EIAO TM)*.

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## 3 SUMMARY OF ENVIRONMENTAL OUTCOMES

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- 3.1.1 The following sections summarise the nature and extent of the key environmental impacts and outcomes arising from the construction and operation of the Project and related activities taking place concurrently. The EIA Report provides further details. The sections summarise the key environmental impacts avoided and protection and benefits afforded to sensitive environmental resources and populations. Environmentally sensitive designs and mitigation measures (compensation areas) are recommended:

## 3.2 AIR QUALITY

### BASELINE CONDITIONS

- 3.2.1 The air quality within the Study Area is currently rural affected by local emissions from the North Lantau Highway and, to a lesser extent, the Penny's Bay Gas Turbine Plant (GTP) and emissions from the SAR and beyond. The existing air quality for the Study Area is comparable with the monitoring results collected from the Tung Chung air quality monitoring station. In future, local vehicular emissions are expected to contribute more significantly to the air quality in the Study Area.

### CONSTRUCTION PHASE

- 3.2.2 Impacts primarily relate to dust nuisance and gaseous emissions from the construction plant and vehicles. Dust generation is considered the major concern. Construction activities include site formation, construction of the Theme Park and associated facilities including hotels and WRC; roads and a railway, including track and station construction. With the incorporation of the recommended mitigation measures, it has been predicted that there will be no exceedances of the statutory Air Quality Objectives (AQOs) for cumulative hourly and daily total suspended particulate (TSP) levels at any of the identified Air Sensitive Receivers (ASRs). The assessment takes full account of impacts from the construction concurrent projects. However, to ensure no exceedance of the TSP standard at the receivers, Environmental Monitoring and Audit (EM&A) is recommended, as prescribed in the Project EM&A Manual.

### OPERATIONAL PHASE

- 3.2.3 Vehicular emissions from the adjacent road networks, including CKWLR, Route 10 and Road P2, and the emissions from the GTP are the major air quality concerns. In addition, the emissions from the vehicle parking areas and emissions from fireworks displays, on-site fuel combustion equipment and sewage pumping station are also of concern. Potential air quality impacts during the operation of PBRL will be limited since electric passenger trains will be used and hence no local air emissions will be produced.
- 3.2.4 All statutory AQOs will be satisfied at all ASRs at both the low level (ground level and 10 m above ground) and high level (20 to 40 m above the ground). Height restrictions have been incorporated into the OZP and RODP to avoid any potential air quality impact from the GTP emissions. It has been determined that the dispersion of the stack emissions will not be adversely affected by the Theme Park and associated developments.
- 3.2.5 Possible impacts from the fireworks displays have been assessed through scientific literature review and dispersion modelling. Based on the available literature, fireworks displays will not be a significant source of atmospheric emissions of dioxins and furans. The modelling results indicated emissions from fireworks would only slightly increase the predicted daily and annual RSP concentrations by  $8.88 \mu\text{g m}^{-3}$  and  $0.58 \mu\text{g m}^{-3}$  respectively at the worst affected ASR. Based on the modelling results and the low percentage of heavy metals in the fireworks compositions, adverse impacts from heavy metals are not predicted. Potential odour impacts from hydrogen sulphide generated by the fireworks displays have also been modelled and the results are within the acceptable nuisance criterion at ASRs. The

assessment predicts that fireworks would only contribute to marginal increases in pollutant levels in the atmosphere. Operational monitoring is proposed for verification purposes.

- 3.2.6 Potential odour impacts from the proposed sewage pumping station would not affect the adjacent ASRs with the adoption of the recommended odour control measures in the detailed design. Measures include the enclosure of odour sources and the provision of odour scrubbing systems.

### 3.3 NOISE

#### BASELINE CONDITIONS

- 3.3.1 The noise environment within the Study Area is currently rural in nature with the operation of Cheoy Lee Shipyard and the occasional operation of the GTP in Penny's Bay being the only noise sources. In future, noise emitted from the PBRL, proposed road networks and the Theme Park operation are expected to contribute to the noise environment in the Study Area. The EIAO-TM does not provide a specific noise limit for Country Parks. Therefore, while this EIA has evaluated noise levels at the Country Park and the proposed Country Park Extension Area, the resulting noise impacts are interpreted qualitatively.

#### CONSTRUCTION NOISE

- 3.3.2 Powered Mechanical Equipment (PME) will be the primary source of construction noise. Noise exceedances at Noise Sensitive Receivers (NSRs) have been predicted only for the evening time period. Mitigation measures including the use of quiet plant and the erection of movable noise barriers have been recommended for evening construction works. With the implementation of the recommended mitigation measures, noise impacts at the identified NSRs will comply with the statutory *Noise Control Ordinance* evening criterion. Regular monitoring of construction noise at adjacent NSRs is recommended, in order to ensure that the NSRs are not subject to adverse construction noise.

#### OPERATIONAL NOISE

- 3.3.3 No adverse noise impact on NSRs such as Peng Chau, Discovery Bay and Luk Keng Tsuen was predicted for the operation of the Theme Park. Noise created by the fireworks displays at the Theme Park is predicted to comply with the  $L_{eq, 15min}$  55 dB(A) limit, defined based on the timing, duration, irregular and impulsive character of fireworks noise. For other fixed plant noise sources, including the GTP, the proposed sewage pumping station at Penny Bay, the public transport interchanges and the possible future container terminal developments, it is anticipated that their impacts on NSRs are likely to be minimal and within the relevant criteria.
- 3.3.4 For railway noise from the PBRL, the predicted  $L_{Aeq,30min}$  level at Luk Keng Tsuen was 45 dB, with  $L_{max}$  55 dB(A) and the  $L_{eq, 24 hour}$  noise level would be at least 1 dB(A) lower. The cumulative impact from Airport Express Line and Tung Chung Line was estimated to be 55 dB(A). The results indicated that the proposed PBRL 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.

- 3.3.5 Adverse road traffic noise impacts at Peng Chau, Discovery Bay, Luk Keng Tsuen and the existing Lantau North Country Park were not anticipated due to the large separation distances and the very substantial terrain screening the proposed road network from the sensitive receivers. The predicted road traffic noise levels along the boundary of the Proposed Country Park Extension Area fall within the range of 40-70 dB(A).
- 3.3.6 There are no established noise criteria associated with Country Parks. The operational noise of the Theme Park and associated developments was predicted not to be perceptible at the existing North Lantau Country Park boundary. At the boundary of the Proposed Country Park Extension Area, a noise level of up to 67 dB(A) has been predicted. The existing North Lantau Country Park is located more than 7 km from the Theme Park. Adverse noise impacts from the operation of the Theme Park are not anticipated.
- 3.3.7 It is concluded that adverse noise impacts due to the operation of the Theme Park and associated developments are not anticipated.
- 3.3.8 Noise monitoring is recommended during the operational phase to ensure compliance with the operational noise criteria. For the monitoring of operational noise, mainly from fixed plant, it is suggested that this should be carried out at the Theme Park perimeter to ensure compliance with the  $L_{eq, 30min}$  75 dB(A) criterion. In addition, it is recommended that noise monitoring should be undertaken during the fireworks displays to ensure compliance with the  $L_{eq, 15min}$  55 dB(A) criterion at the nearest NSRs at Discovery Bay and Peng Chau.

## 3.4 WATER QUALITY

### BASELINE CONDITIONS

- 3.4.1 A review of EPD routine water quality monitoring data determined that the water quality in the vicinity of the proposed Theme Park was generally good. There were, however, existing exceedences of the *Water Pollution Control Ordinance (WPCO)* Water Quality Objectives (WQOs) for total inorganic nitrogen to the south of Penny Bay and of dissolved oxygen to the south and east of Penny Bay and to the north of Yam O. The exceedence for the total inorganic nitrogen has been recorded for the last 10 years and was thought to be strongly influenced by the outflows from the Pearl Estuary. The exceedence of the dissolved oxygen WQO had not been recorded in earlier years and would be expected to recover in the future. *E. coli* levels were in compliance with the WQOs for Secondary Contact Recreation Sub-zones to the south of Penny Bay.

### CONSTRUCTION IMPACTS

- 3.4.2 The assessment considered the potential impacts due to the formation of reclamations at Penny Bay and Yam O, plus several other concurrent projects and land based construction activities, including those for the Theme Park and the associated road and rail links. The worst case construction impact assessment determined that there could be an exceedence of the WQO for suspended sediment at the Ma Wan Fish Culture Zone. The exceedence was predicted to occur due to cumulative impacts of the Theme Park reclamation construction combined with all potentially concurrent projects and was not predicted to occur due to the construction of the Theme Park in isolation. The contribution of the Theme Park reclamation construction to the cumulative impacts would be minimised through the application of mitigation measures, which consisted of advanced construction of seawalls to

confine sediment plumes and restrictions on the maximum dredging and filling rates. It was determined that the predicted cumulative increases in suspended sediment concentrations, whilst exceeding the WQO, would not cause adverse effects to the cultured fish and could not therefore be considered to be an adverse impact. A robust water quality monitoring and audit programme has been formulated to trigger further mitigation on the Theme Park and other projects in the area, if found necessary. The potential impacts to water quality from land based construction activities will be readily controlled through a series of 'best practice' methods to control wastewater discharges from the construction sites. Audits of the mitigation measures for the land based construction activities should be carried out.

### **OPERATIONAL IMPACTS**

- 3.4.3 The assessment determined that the operation of the Theme Park would have no adverse impacts on tidal current patterns and marine water quality. A number of operational measures were devised to ensure that water quality in the artificial lake would be maintained and thus its beneficial uses protected. It was determined that at the opening of the Theme Park in 2005, the Siu Ho Wan Sewage Treatment Works (STW) would have adequate capacity to cater for the increased flows due to the Theme Park. However, as flows increased up to 2011 and beyond, it was determined that additional treatment capacity would be required.

## **3.5 WASTE MANAGEMENT**

### **CONSTRUCTION**

- 3.5.1 The following quantities of waste were predicted to arise during the construction of the Theme Park and associated developments: dredged materials (approximately  $46.3 \text{ M m}^3$  or a maximum rate of  $90,600 \text{ m}^3 \text{ d}^{-1}$ ), construction and demolition material (a peak generation rate of approximately  $45 \text{ m}^3 \text{ d}^{-1}$ ); chemical waste (a few cubic metres per month); and general refuse (2.8 tpd during peak construction period). No surplus of excavated materials is envisaged.
- 3.5.2 The Theme Park and associated development reclamations offer a very good opportunity to utilise the public fill generated in the HK SAR. The use of public fill will not only alleviate the demand for virgin fill material but also reduce the pressure of disposing inert construction and demolition materials at the strategic landfills. The Penny Bay Reclamation Stage I will utilise about 2 million  $\text{m}^3$  of public fill. Stage II of the Penny Bay Reclamation will make the maximum use (53 %) of public fill, given the geometry of the reclamation. For the Yam O reclamation about 58 % of the fill requirement will be public fill. In all cases the balance will be sand fill.
- 3.5.3 Based on the assessment, adverse waste management impacts are not anticipated during the construction phase.

### **OPERATION**

- 3.5.4 Based on the operating experience of other international theme parks, the amount of Municipal Solid Waste (MSW) to be generated from the operation of the Theme Park at Penny Bay will increase from about 38 tpd in 2005, to 73.5 tpd in 2014, and then to 175 tpd in 2024.



- 3.5.5 The quantity of recyclable materials expected to be recovered by local recyclers under the current market driven conditions is estimated to be about 23 to 26% of the total quantity of waste generated. Analyses show that a market for the major recyclables exists, especially when source separation programmes are in place to enhance the market value of the recovered materials. It is recommended that the Theme Park should institute a source separation programme to recover recyclables from the waste stream with an additional recycling target of 10% for remaining recyclable materials and a further 10% for compostable materials. Attaining the latter target is dependent upon the availability of a composting facility in the HK SAR. These targets should be adopted in the Waste Management Plan for the Theme Park. A waste avoidance and recycling programme, which forms a major part of the HKITP Waste Management Plan, should be implemented and monitored annually to determine the practical recycling rate that can be achieved, based the market for recycled materials at that time.
- 3.5.6 The assessment demonstrates that the North Lantau Transfer Station will be able to handle the quantity of waste arisings from the Theme Park and associated developments until, at least, 2016. This assessment makes the conservative assumption that the material recovery measures are not in place. With regard to waste transfer and disposal, HKITP should closely liaise with the EPD regarding waste transfer and disposal arrangements when the handling capacity of the NLTS and strategic landfills are close to their maxima.

## 3.6 TERRESTRIAL ECOLOGY

### BASELINE CONDITIONS

- 3.6.1 The major habitat types within the Assessment Area comprise secondary woodland, tall shrubland, grassland/shrubland mosaic, brackish/freshwater wetland, village/orchard, wasteland, plantation, freshwater streams, as well as backshore vegetation. The field surveys indicated that the grassland/shrubland mosaic, which is typical of similar habitats elsewhere in Hong Kong, is the main habitat type. The identified secondary woodland, backshore vegetation, freshwater wetland and freshwater stream habitats are considered to have moderate to high ecological value, and all the other habitats a low value. The plant species with ecological interest which may be affected by the Project are *Schoenus falcatus* and *Eriocaulon merrilli*. Two locally rare faunal species have been recorded in the Assessment Area: the Rice Fish (*Oryzias latipes*) in the lower Mong Tung Hang Stream and the White-bellied Sea Eagle (*Haliaeetus leucogaster*).

### CONSTRUCTION PHASE

- 3.6.2 The proposed developments associated with the Project will generally lead to a loss of low ecological value terrestrial habitats and hence to a low ecological impact. Mitigation measures are recommended to avoid or reduce the potential impacts on habitats of moderate to high ecological value. For example, woodland compensation planting is proposed at Ngong Shuen Au.
- 3.6.3 During project construction and operation, the potential disturbance to a pair of White-bellied Sea Eagles in the Assessment Area was considered moderate. Although construction disturbance effects (e.g. noise) could potentially be controlled such that disturbance to the eagles would be minimised, and the Theme Park fireworks displays would be located about 800 m from the nesting site thereby reducing potential disturbance, abandonment of the nest

site as a result of disturbances could not be ruled out. However, the closest point from the Theme Park to the nest site would be about 500 m and in the worst case scenario of nest abandonment, the White-bellied Sea Eagles should be able to find suitable alternative nesting sites. Hence, no significant residual impacts are expected, though construction and operation EM&A was recommended to provide feedback into construction and operation to minimise any disturbance.

#### **OPERATION PHASE**

- 3.6.4 During operation of the Theme Park and associated developments, an identified impact comprises the possibility of the White-bellied Sea Eagles abandoning the existing nesting site due to noise from the remote (more than 2 km and 800 m from Phases I and II, respectively), nightly laser show and short duration fireworks displays. Direct human interference is a concern which may be mitigated by the continued prohibition of human access during Project operation by secure fencing of the nesting area. It is, thus, considered necessary to extend the EM&A programme during Theme Park operation to monitor the reaction of the White-bellied Sea Eagles to the fireworks displays. In the worst case of abandonment of the pair from their nest during operation, possible suitable habitat and nesting sites are available in the vicinity of the Assessment Area and thus no residual impact is predicted.

### **3.7 MARINE ECOLOGY**

#### **BASELINE CONDITIONS**

- 3.7.1 Literature reviews of existing information supplemented with the results of field surveys of marine ecological resources indicate that the intertidal rocky shores within the Study Area are of medium ecological value, whereas for the sandy habitats, a low ecological value was assigned. Soft bottom habitats identified in the assessment were regarded as being of low ecological value. A small area containing high ecological value assemblages of hard corals will be lost as a result of the reclamation activities. Information on baseline conditions suggests that no species of conservation importance have been recorded from the marine areas close to the reclamation sites, with the exception of the Chinese White Dolphin. The findings of work conducted by Dr Tom Jefferson of the Ocean Park Conservation Foundation indicate that the abundance of the Chinese White Dolphin is low in East Lantau and that they use the area seasonally in winter. East Lantau and thus the waters near the proposed reclamation sites do not appear to be highly utilised by the Chinese White Dolphin and are not considered as critical areas. These waters do not comprise Finless Porpoise habitat.

#### **CONSTRUCTION PHASE**

- 3.7.2 Potential impacts to marine ecological resources from the proposed construction works may arise either indirectly, e.g. through perturbations of the surrounding water quality, or directly as a result of habitat loss. The natural intertidal and subtidal assemblages within the Penny Bay and Yam O reclamations will be lost permanently due to the proposed reclamation works. However, it is anticipated that given an appropriate seawall design, assemblages typical of those lost will recolonise after reclamation. Indirect impacts during the reclamation process, such as an increase in suspended solids levels and decrease in dissolved oxygen levels in the water column may impact intertidal and subtidal filter feeders and other

marine organisms. However, any effects are not expected to be severe and no unacceptable impacts are predicted to occur.

- 3.7.3 The impacts occurring as a result of the construction of the Theme Park and associated developments are the direct loss of 290 ha of the low ecological value soft benthic assemblages, 3.08 km of medium and low ecological value natural intertidal shores, 1.27 km of sloping artificial seawalls, and 0.298 ha of high ecological value coral habitat. The loss of the habitat within the areas to be reclaimed will be mitigated through the provision of 3.9 km of sloping armour rock/concrete seawalls, of which 4.3 ha would be suitable for corals to colonise and grow. This mitigation measure reduces the magnitude of the residual impacts to an acceptable level.
- 3.7.4 An ecological monitoring and audit programme involving the use of dive surveys will be conducted to report on the progress of colonisation of the seawalls once construction works have ceased. As an additional habitat enhancement measure, CED has undertaken to deploy Artificial Reefs in Hong Kong waters at a site (or sites) to be decided following consultation with the Director of Agriculture, Fisheries and Conservation. Construction and operation phase dolphin/porpoise monitoring should be conducted to evaluate whether there have been any effects on these animals.

#### **OPERATION PHASE**

- 3.7.5 Operational impacts to marine ecological resources may occur through disturbances to water quality due to changes in the hydrodynamic regime of the area or due to effluent discharges into the marine environment. It is expected that all discharges will have to comply with the *WPCO* discharge standards and consequently marine ecological resources will be protected from impacts. Minor changes in the local hydrodynamic regime are predicted, although these are not expected to alter water quality to an extent that marine ecological resources are affected. An increase in the number of vessels travelling to and from Victoria Harbour and the Theme Park is predicted to occur. However, as these vessels will not be high speed and as this area is not regarded as critical habitat for the Chinese White Dolphin, unacceptable impacts are not predicted to occur.

### **3.8 FISHERIES**

- 3.8.1 A review of existing information on capture fisheries indicates that the adult fisheries resources in the marine areas close to the Assessment Area are in general of low value. Hence, adult capture fisheries resources are unlikely to be adversely impacted by the Project. Although impacts to fish fry may occur through the permanent loss of habitat and/or elevated suspended sediment levels as a result of the proposed reclamation works, these impacts have been deemed acceptable as these waters are not an important nursery area for commercial fisheries species. Any impacts which are predicted can be mitigated through the Project design. Any measures which are required to reduce impacts to water quality will also serve to protect against unacceptable impacts to capture fisheries resources. In terms of residual impacts to capture fisheries, the small loss of fishing grounds from the Hong Kong fishery is expected to be compensated for by the potential environmental benefits of the proposed sloping armour rock/concrete seawalls. Artificial Reefs have been recommended for deployment as an additional marine ecology and fisheries habitat enhancement measure. As a result, the residual impacts to capture fisheries through the construction and operation of the Theme Park and associated developments have been deemed acceptable.

3.8.2 In terms of impacts to culture fisheries, the Ma Wan Fish Culture Zone (FCZ) is not predicted to be impacted by either suspended solids elevations, dissolved oxygen depletions or nutrient elevations, as a result of either the construction or operation of the Theme Park. Projected changes to the hydrodynamic regime are not expected to impact the water quality of the FCZ as current speeds are expected to be only minimally affected. Discharges will comply with *WPCO* standards. Mitigation measures have been recommended to minimise impacts from the construction of the Penny Bay reclamation to the Ma Wan FCZ. Mitigation and monitoring measures will serve to protect the Ma Wan FCZ from cumulative impacts.

### **3.9 RISK TO LIFE ASSESSMENT**

3.9.1 As part of the EIA, a hazard assessment of dangerous goods (fireworks and sodium hypochlorite) incidents resulting in loss of life was undertaken to evaluate the risks associated with storage, transport and use of dangerous goods at the Theme Park. With the incorporation of the design and operating safety measures considered in the analysis, the risks due to fireworks and sodium hypochlorite storage, transport and use were found to be in the 'acceptable' region of the Hong Kong Risk Guidelines. Further risk mitigation measures have been suggested for the Theme Park operator to consider for their implementation on a good practice basis.

### **3.10 CULTURAL HERITAGE**

#### **BASELINE CONDITIONS**

3.10.1 The baseline study on cultural heritage resources indicate that there are no standing heritage or marine archaeological deposits within the Theme Park and associated developments Study Area. However, concerns have been raised regarding the potential impact to some archaeological sites identified.

#### **CONSTRUCTION AND OPERATION PHASE IMPACTS**

3.10.2 Preservation in totality and avoidance of impact as far as possible has been taken as the first priority for the cultural heritage impact assessment. However, the potential damage to or loss of archaeological resources including temporary or permanent landtake, ground compaction, topsoil or subsoil disturbance during construction, change in watertable and a limitation on accessibility for future investigation still exist. Mitigation measures to heritage resources include the use of plastic sheets to cover any impacted area at the Wan Tuk archaeological site before the temporary access road construction and/or fill up work required at the site, and the avoidance of waterlogged site conditions through detailed design of runoff diversion. The associated residual impact could be mitigated by the removal of the filled material and the plastic sheet covers when necessary for future investigation and design to allow the diversion of surface runoff to avoid the development of waterlogged site conditions.

3.10.3 Preservation by record in totality (full rescue programme) prior to the construction on Chok Ko Wan archaeological site has been recommended to mitigate the impact to this site.

3.10.4 The detailed design of the CKWLR and Road P2 support column locations to reduce the impact to the potential coastal archaeological deposit could minimise the impact to potential

archaeological deposits at the Cheoy Lee Shipyard (CLS) site. The development of the area will provide an opportunity for an archaeological field evaluation to be undertaken at the original coastal area within the existing CLS site, which will be considered under a separate Schedule 2 EIA of CLS site decommissioning and provide appropriate mitigation measures for identified archaeological deposits. The associated residual impact could be mitigated by rescue excavation if necessary in the last resort if the impact is unavoidable.

- 3.10.5 In order to ensure that the heritage sites at Pa Tau Kwu archaeological site and the 2 grave sites are not impacted by construction work, these sites should be indicated on all construction plans as “temporary protection area” and the physical site boundaries, with the inclusion of 5 m buffer zone, should be fenced off on sites and drawn to construction workers’ attention to prevent entry. Access to the grave sites should be retained during construction, and grave owners informed of specific access arrangements, when necessary. Operational access should also be retained to the grave sites for future visitors after Project completion.
- 3.10.6 Having implemented the recommended mitigation measures on impacted heritage resources, the impacts to the cultural heritage resources are considered acceptable. The subsequent CLS site decommissioning EIA will further assess any cultural heritage resources within the CLS site, when access is available, and will formulate appropriate mitigation measures.

### **3.11 LANDSCAPE AND VISUAL**

#### **BASELINE CONDITIONS**

- 3.11.1 The Penny Bay area is predominately undulating hillsides forming a well-enclosed valley between two high points, Fa Peng Teng to the northeast, and Tai Shan to the northwest. Areas of shrub and woodland exist on the lower slopes of the two hill areas, while the upper slopes are dominated by grassland. There is some man-made intrusion in the form of the Penny Bay Gas Turbine Plant and the CLS site along the east coast of the bay.

#### **IMPACTS AND MITIGATION**

- 3.11.2 Grassland, shrub and woodland are affected primarily by the proposed transport infrastructure and in particular woodland will be adversely affected by CKWLR and Road P2 proposals at Ngong Shuen Au. The Theme Park reclamation will remove sections of natural coastline and is therefore a significant impact, although the proposal of an open channel along the western edge of the Penny Bay reclamation has allowed the retention of an extensive length of natural coastline. There will be a high level of a more suburban, tourism, recreation oriented landscape character of the Project Area from a predominately rural type, whereas the upland character zones are largely unaffected by development proposals. An expected high level of change to the local visual system of the Project Area is also predicted. The higher levels of adverse impact will result from a loss of a large area of bay and coastal waters, the temporary low visual quality associated with the relocation works area and slope cutting associated with the CKWLR and Road P2.
- 3.11.3 A range of mitigation measures have been proposed including reclamation mitigation measures such as temporary hydroseeding along the edge to improve its visual characteristics. The construction impacts of the Theme Park will be mitigated by the proposed advancement of construction and landscaping of the permanent soil berms. The

operation phase is considered to be of an acceptable visual value and not requiring mitigation. The mitigation for the slope cutting associated with CKWLR and Road P2 will include slope landscaping and minimisation of the areas affected by slope cutting. The primary residual impacts that have been identified are the loss of bay and coastal waters and the adverse impact of CKWLR on local topography and landscape character. In accordance with *Annex 10* of the *EIAO TM*, the landscape and visual impact is considered acceptable with mitigation.

### **3.12 LAND CONTAMINATION**

3.12.1 To allow the Theme Park and associated developments EIA Study to be a 'stand alone' assessment, the relevant land contamination section of the NLDFS EIA was included within this EIA, although it is not strictly a requirement of the Study Brief. In order to provide quantitative information to the limited extent possible, a preliminary sampling programme was conducted along a stream bed discharging from the southeastern boundary of the CLS site. The results of five soil samples indicated that, whilst low concentrations of total petroleum hydrocarbons (as gasoline) and 11 heavy metal compounds were detected in some samples, the concentrations were not a major concern. Almost all of the detected metal compounds were noted to be below the respective Dutch "Value concentrations, which would imply clean, uncontaminated soil. As appropriate remediation will be performed for the CLS site before construction of the Theme Park road and rail elements, future potential negative land contamination impacts are judged to be minimal. Remediation works will be required to meet the EPD standards. The NLDFS assessment will be verified by CED in a separate *EIAO* Schedule 2 EIA for the CLS site. Thus, it is considered that there will be no potential residual negative impacts and no insurmountable constraints associated with the future use of the site for the Theme Park and associated developments.

### **3.13 TERRITORY-WIDE ENVIRONMENTAL IMPLICATIONS**

3.13.1 The territory-wide environmental implications of the additional visitors to the Theme Park were addressed in broad terms. The air quality assessment concluded that the territory-wide air quality impact due to Theme Park (Phases I and II) related traffic is not significant. Operational water quality modelling predicted that there would be no breaches of the Water Quality Objectives due to the treated sewage effluent and stormwater discharges from the Theme Park and therefore concluded that there would be no associated adverse territory-wide or local impacts to water quality. The quantity of solid waste arising from the Theme Park (Phases I and II) operation can be handled by the North Lantau Transfer Station up to 2016. This evaluation assumes that no waste reduction measures are in place; however, HKITP will introduce source separation schemes to reduce the quantity of waste to be disposed.

### **3.14 ENVIRONMENTAL MONITORING AND AUDIT (EM&A)**

3.14.1 As summarised above, and detailed in the Project EM&A Manual, the EIA Study has recommended a comprehensive EM&A programme comprising monitoring before construction and monitoring and audit during both construction and operation of the Project for: air quality (baseline, construction and operation), noise (baseline, construction and operation), water quality (baseline and construction), waste management (construction and operation), terrestrial ecology (baseline, construction and operation), and marine ecology (baseline, construction and operation). As there will be multiple contracts underway in the

Project Area, an Environmental Project Office (ENPO) has been recommended in the EM&A Manual. This will be funded and set up by the Project proponent (CED) to monitor and audit the cumulative impacts.

### 3.15 ENVIRONMENTAL BENEFITS, DESIGNS, KEY PROTECTION MEASURES AND ENHANCEMENTS

3.15.1 The key benefits associated with the Project are expected to be primarily of an economic nature. Additional environmental benefits, designs, key protection measures (summarised in *Sections 3.2 to 3.14*) and enhancements arising from the Project include the following.

- HKITP has committed to exclude the purchase of any fireworks that contain Chromium, Lead, Mercury, Arsenic, Manganese, Nickel or Zinc in their formulation. This minimises the use of products containing potentially harmful heavy metals and reduces possible impacts to the surrounding environment.
- Noise created by the evening fireworks displays at the Theme Park is restricted to comply with the  $L_{eq, 15min}$  55 dB(A) limit at the relevant NSRs.
- Water quality mitigation measures for the construction of the Theme Park reclamations were specified in terms of operational constraints (eg limiting the rate of working, defining the construction sequence for the reclamations and recommending certain methods of construction) and 'best practice' working methods.
- The Project reclamations will require a large amount of fill material and therefore offer a very good opportunity to utilise the public fill generated in the SAR. The use of public fill will not only alleviate the demand for virgin fill material but also reduce the pressure of disposing inert Construction and Demolition Material (C&DM) at the strategic landfills.
- HKITP will implement waste reduction initiatives intended to divert material away from disposal at the strategic landfills. The initiatives will centre around the introduction of waste segregation and materials recovery measures.
- The use of fabric (plastic) fenders instead of tropical hardwood fenders has been recommended for the proposed Theme Park Ferry Pier and service quay construction.
- The use of wooden hoardings in the Project construction period will not be allowed and metal (aluminium, alloy, etc.) has been recommended to help reduce the quantity of construction and demolition (C&D) wastes.
- Secondary woodland planting will be undertaken to compensate for the loss of approximately 1.8 ha of the woodland at Ngong Shuen Au. As considerable areas, of not less than 6 ha, of woodland planting are proposed as landscape and visual impact mitigation on the adjacent hillside to the east of Ngong Shuen Au, sufficient compensatory woodland will be provided. Species used for planting should be similar to the species identified in the Tree Survey and be native to the Hong Kong or South China regions. The trees should bear fruit preferred by birds, and/or larval and/or adult butterfly food plants to maintain the ecological function of the existing secondary woodland.
- Laser effects used in the shows are expected to utilise lasers in the 20 to 30 Watt power range. All laser effects will also be "terminated" against fixed, non-reflective, objects within the Theme Park to prevent any impact to guests or staff inside the Theme Park, or to terrestrial faunal resources outside the Theme Park.
- Conservation of the natural coastline of western Penny Bay by the recommendation of an open channel form rather than a box culvert in this area.
- Protection of pitcher plants by restricting access during construction works, even though the works area will not encroach upon their current habitat.
- As an additional habitat enhancement measure, the Project proponent, CED, has undertaken to deploy 4,350 m<sup>3</sup> Artificial Reefs (ARs) in Hong Kong waters at a site (or sites) to be decided upon in consultation with the DAFC. ARs act as habitat enhancement devices and provide hard bottom, high profile habitat in areas without natural cover. The ARs subsequently will provide food, shelter and a nursery ground for commercial fish and, over the long term, enhance fishery stocks. Enhanced fish stocks in the area will not only benefit local fisheries resources but will also increase the availability of prey items for the seasonal population of marine mammals that uses the area.

- The sloping armour rock/concrete seawalls proposed for the Penny Bay and Yam O reclamations have been demonstrated to become colonised by subtidal hard surface assemblages, such as soft corals, gorgonians and hard corals. Thus the potential habitat provided by the greater than 4.3 ha total surface is expected to mitigate for the loss of approximately 0.298 ha of high ecological value assemblages of hard corals within the reclamation sites.
- Environmental benefits arising from the conversion of land uses from port developments to tourism recreation purposes as the change from the originally planned port uses provides an opportunity to reduce the potential environmental impacts associated with port operation, including more heavy good vehicles in the Study Area causing noise and air pollution, hydrodynamic and water quality impacts, visual and glare impacts from 24 hour port operations.
- The public modes of transport to and from the Theme Park are expected to dominate the travel market, accounting for about 95% of all travel. Of the public modes, the rail mode will be dominant and will be complemented by other transport modes and the provision of integrated transport facilities (ie the PTIs at Yam O and the Theme Park) to improve accessibility by rail.

### **3.16 OVERALL CONCLUSIONS**

- 3.16.1 The EIA has, based on the latest worst case information available, critically assessed the overall acceptability of any adverse environmental consequences that are likely to arise as a result of the Project and, where necessary, has specified the conditions and requirements for the detailed design, construction and operation of the Project to mitigate against adverse environmental consequences, wherever practicable.
- 3.16.2 Overall, the EIA Final Report for the Theme Park and associated developments has predicted that the Project will comply with all environmental standards and legislation after the proposed construction and operational stage mitigation measures are implemented. The EIA has thus demonstrated the acceptability of any residual impacts from the Project and the protection of the population and environmentally sensitive resources. Environmental monitoring and audit mechanisms have been recommended before and during construction and during operation to verify the accuracy of the EIA predictions and the effectiveness of recommended mitigation measures.
- 3.16.3 In conclusion, it is considered that the EIA provides a suitable basis for the Director of Environmental Protection to consider granting Environmental Permits to allow the construction or operation of the Theme Park and associated developments covered by the EIA Study.



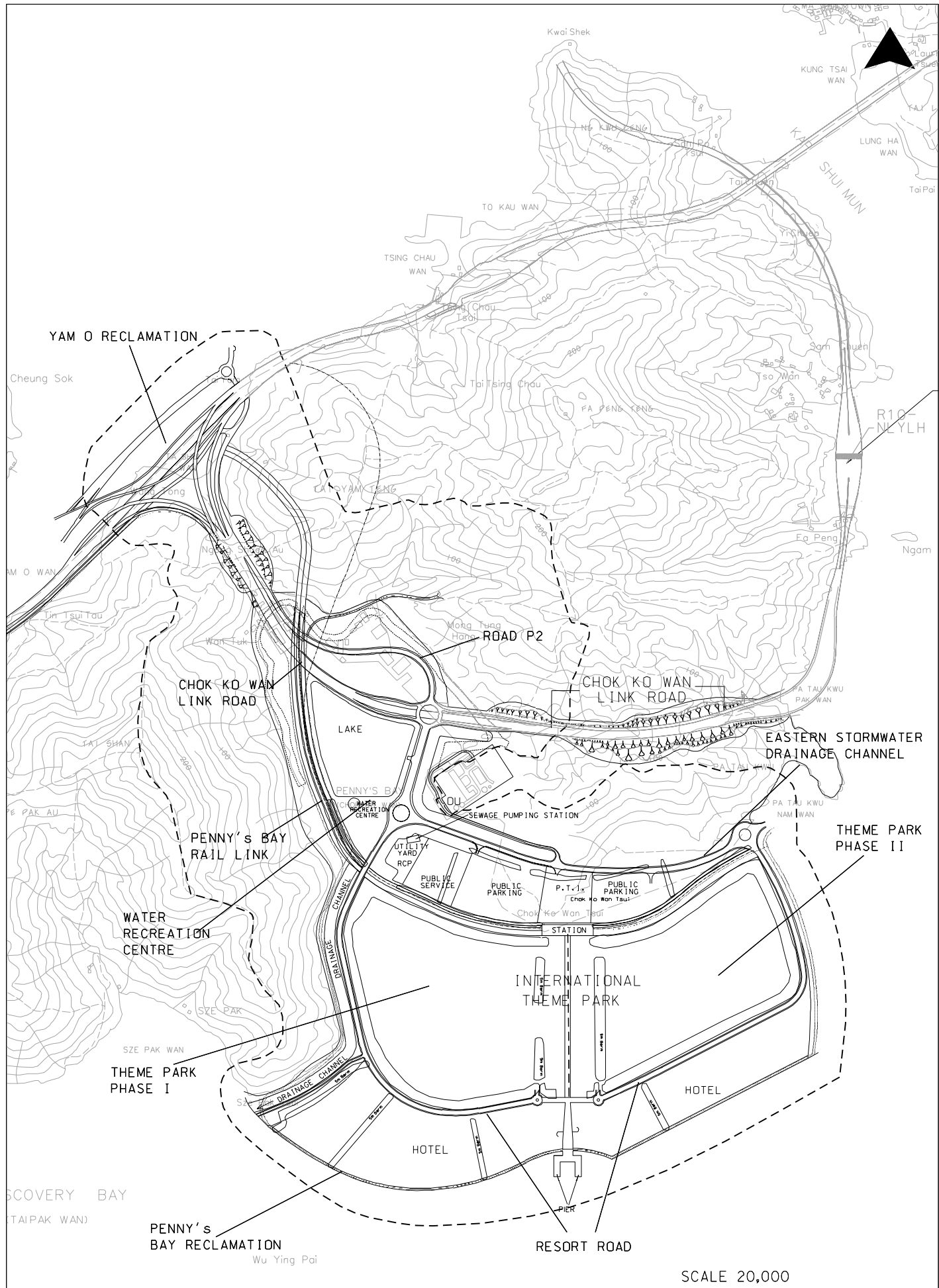


FIGURE 1 DESIGNATED PROJECTS IN THE STUDY AREA

SCALE 20,000

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