

**Chapter 8**

**ECOLOGICAL IMPACT  
ASSESSMENT**

## 8. ECOLOGICAL IMPACT ASSESSMENT

### Introduction

- 8.1 The following section presents the results of an ecological assessment of impacts resulting from proposed works associated with the Project. Two areas were included in the assessment: Cheoy Lee Shipyard (CLS) and To Kau Wan (TKW) (Figs. 8.1 & 8.2). Additionally, possible impacts to areas within 500m of these sites, and the impacts arising from the upgrading of a temporary road between the two sites were assessed. Reference was made to previous ecological surveys in the area. Field checks, and further detailed field surveys were undertaken to supplement and assess the validity of data in these reports. General measures required to mitigate identified impacts are recommended, in addition to more detailed measures to mitigate impacts to key ecological sensitive receivers.
- 8.2 The objectives of the ecological assessment are as follows:
- to identify ecological sensitive receivers;
  - to establish the ecological importance of habitats affected by proposed works;
  - to assess the scale of possible ecological impacts from the proposed works;
  - to identify any necessary mitigation measures and evaluate residual impacts; and
  - to assess the need for an ecological monitoring and audit programme.

### Environmental Legislation, Standards and Guidelines

- 8.3 This section makes reference to the following guidelines, standards, documents and HKSAR Government ordinances and regulations when identifying habitats and species of ecological importance, and assessing potential impacts of the proposed project on the ecological resources in the assessment area:

*Country Parks Ordinance* (Cap 208) and associated Subsidiary Legislation;  
*Forests and Countryside Ordinance* (Cap 96) and its subsidiary legislation, Forestry Regulations;  
*Wild Animals Protection Ordinance* (Cap 170);  
*Town Planning Ordinance* (Cap 131);  
*Hong Kong Planning Standards and Guidelines* Chapter 10 (HKPSG);  
*Environmental Impact Assessment Ordinance* (Cap 499) and the associated *Technical Memorandum for the Environmental Impact Assessment Ordinance (EIAO TM) Annex 8 and Annex 16*.  
*Study Brief ESB-062/2000*

- 8.4 The *Country Parks Ordinance* (Cap. 208) provides for the designation and management of country parks and special areas. Country parks are designated for the purpose of nature conservation, countryside recreation and outdoor education. Special Areas are created mainly for the purpose of nature conservation.
- 8.5 The *Forests and Countryside Ordinance* prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on Government land. Related subsidiary Regulations prohibit the selling or possession of listed restricted and protected plant species. The list of protected species in Hong Kong which comes under the Forestry Regulations was

last amended on 11 June 1993 under the *Forestry (Amendment) Regulation 1993* made under *Section 3* of the *Forests and Countryside Ordinance*.

- 8.6 Under the *Wild Animals Protection Ordinance*, designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals are protected under this Ordinance. The Second Schedule of the Ordinance which lists all the animals protected was last revised in June 1992.
- 8.7 The amended *Town Planning Ordinance* provides for the designation of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Conservation Area, Country Park, Green Belt or other specified uses that promote conservation or protection of the environment. The authority responsible for administering the *Town Planning Ordinance* is the Town Planning Board.
- 8.8 *Chapter 10* of the *HKPSG* covers planning considerations relevant to conservation. This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also describes enforcement issues. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.
- 8.9 *Annex 16* of the *EIAO TM* sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. *Annex 8* recommends the criteria that can be used for evaluating habitat and ecological impact.
- 8.10 *Study Brief ESB-062/2000* details the scope of the initial ecological assessment of impacts associated with the decommissioning of Cheoy Lee Shipyards.
- 8.11 The report also makes reference to the following international conventions where appropriate:

*Convention on the Conservation of Migratory Species of Wild Animals* (the "Bonn Convention")

*United Nations Conventions on Biodiversity* (1992);

*The PRC National Protection List of Important Wild Animals*;

*Agreement between the Government of Australia and the Government of PRC for the Protection of Migratory Birds and their Environment*;

*Agreement on the protection of Migratory Birds and Their Habitats by the Governments of Japan and the PRC*; and

*IUCN Red Data Books*

## **Assessment Methodology**

### ***Baseline Information***

- 8.12 Baseline information was collated via a review of previous surveys of the assessment area and adjacent regions. Particular attention was given to *Environmental Impact Assessment: Construction of an International Theme Park in Penny's Bay of North Lantau and its Essential Associated Infrastructures* (Hereafter referred to as the *Theme Park EIA Report*), as this report details the ecology of much the North Lantau Area affected by the current project.

Other documents reviewed included: *Northshore Lantau Development Feasibility Study: Environmental Impact Assessment Volume 1 (NLDFS EIA Report)*; *Penny's Bay Reclamation Stage 1: Detailed Vegetation Survey, Final Report (Oct. 2001)*.

- 8.13 Consultations with local ecologists were undertaken where appropriate. Habitat and ecological communities within the Assessment Area were identified with reference to habitat types listed in the Hong Kong Vegetation Map (WWF-HK, 1994).
- 8.14 The reports referred to in section 8.12 contain extensive baseline ecological data for the whole North Lantau area. Site visits were undertaken from August-November, 2001 to confirm the validity of data presented in existing reports. The following data were collected during the field checks:
- Recording of habitat types within assessment areas;
  - Record of dominant/notable vegetation in assessment areas,
  - General surveys of wildlife including avifauna, herpetofauna, mammals, stream invertebrates and terrestrial invertebrates.
- 8.15 Previous reports identified a population of Rice Fish in Mong Tung Hang Stream (MTHS), along with several restricted/protected wetland plant species in and around CLS, as key ecologically sensitive receivers in the assessment areas. Accordingly, detailed surveys of freshwater fish populations and wetland plant species in and around CLS were conducted in October/November.
- 8.16 Potential ecological impacts arising from the development of the Assessment Areas were assessed following *EIAO TM Annex 16* guidelines and the impacts evaluated based on the criteria in *EIAO TM Annex 8*.

## Description of Existing Ecological Baseline Conditions

### Habitat Type and Vegetation

- 8.17 Northeast Lantau within the assessment areas is dominated by grassland/shrubland mosaic habitat. Other habitats recorded included: tall shrubland, secondary woodland, wetlands, plantation, wasteland, backshore vegetation and freshwater streams. Habitat maps of both assessment areas are given in Figs. 8.1 & 8.2. Representative photographs of each habitat type are given in Fig. 8.3. Photographs of notable species/ habitats are given in Figure 8.4.
- 8.18 The following sections describe each habitat in more detail. Descriptions are based mainly on data presented in the *Theme Park EIA Report*, as recent field checks confirmed most of the findings in this report are still valid. Supplementary information from other Reports, and recent field surveys/checks are referred to where appropriate.

### Grassland/lowland Shrub Mosaic

- 8.19 The grassland/shrubland mosaic is the dominant habitat type across much of North Lantau, covering the hillsides and ridges surrounding both Assessment Areas. The species composition of this habitat is mainly herbaceous or woody plant species with an average height of less than 1.5m. 68 plant species, but no rare or protected species were recorded in this habitat type in the *Theme Park EIA Report*. Major/dominant plant species include the common shrubs *Baekkea frutescens*, *Arundinella setosa*, *Cymbopogon goeringii*, *Eulalia*

*quadrinervis*, *Isachaemum barbartum* and the fern *Dicranopteris pedata*. The dominant species present indicated that this habitat had been frequently disturbed by hill-fires. Species and structural diversity were considered low to moderate. No major changes in this habitat type were observed during recent field checks.

### Tall Shrubland

- 8.20 Tall shrubland is a transitional stage in ecological succession between shrubland and woodland. The tall shrubland recorded comprised woody vegetation with average heights ranging from 2-4m. A total of 53 plant species were recorded in previous surveys of Tall Shrubland in Northeast Lantau in *Theme Park EIA Report*. This habitat has low species and structural diversity. In the assessment area, such habitats were mostly found in small patches along streams that have been less affected by hill-fires. Tall shrubland habitats were dominated by the shrub *Cratogeomys cochinchinense*, *Litsea rotundifolia*, *Litsea glutinosa*, *Microcos paniculata* and *Rhus succedanea*.
- 8.21 Recent field checks recorded few new additional species in this habitat type. However, protected or restricted plants species were recorded in two patches of tall shrubland within the assessment areas. The locally common but protected insectivorous plant *Nepenthes mirabilis* was found growing in shrubland adjacent to MTHS (Fig 8.1). Additionally, *Lilium brownii* was recently recorded growing in Tall Shrub near the North Lantau Highway toll plaza (Fig. 8.2). *L. brownii* is protected by law, and has a restricted distribution in Hong Kong.

### Woodland

- 8.22 Several small patches of secondary woodland were located in the Assessment Areas (Fig. 8.1 & 8.2). In North East Lantau, the plant species diversity of this habitat type is considered moderate, with a total of 55 species recorded in the *Theme Park EIA Report*. Plant species recorded are typical of secondary woodlands in Hong Kong and dominant tree species recorded included the common species *Cratogeomys cochinchinense*, *Aporosa dioica*, *Litsea glutinosa*, *Mallotus paniculatus*, *Microcos paniculata* and *Schefflera octophylla*.
- 8.23 Secondary woodland at Ngong Shuen Au, near CLS, has been affected by recent road works, and is now much reduced in size. Only a small patch to the northwest of the shipyard remains intact (Figure 8.1). Works proposed in this project will not directly affect the remaining woodland.

### Marshes

- 8.24 A brackish wetland (approximately 0.8ha) was found next to CLP Penny's Bay Gas Turbine Plant. This habitat type is low in habitat heterogeneity and floristic diversity. The wetland was dominated by *Zoysia* sp., which are tolerant of high salinity.
- 8.25 It was suspected this habitat may have been affected by nearby reclamation works. However, a recent detailed field survey confirmed that the wetland remains largely unchanged. The recent survey recorded 11 new plant species at the site, most of which are associated with brackish habitats. All new records were of common and widespread species in Hong Kong.
- 8.26 Several small areas of freshwater wetland were located near CLS, including a narrow strip of wetland located adjacent to the north-east boundary of the shipyard on the eastern side of Penny's Bay, at least part of which is permanently flooded. Vegetation in this habitat was

predominantly herbaceous, and less than 1.5 m tall. Dominant species included *Fuirena ciliaris*, *Fimbristylis complanata*, *Fimbristylis acuminata* and *Eragrostic sp.*

- 8.27 Most of these habitats were probably formed as a result of natural drainage from the hillsides behind the shipyard being obstructed by the shipyard reclamation. Naturalness is, therefore, only moderate and recreatability is high. This habitat was found to be poor in floristic diversity and also simple in structure.
- 8.28 Initial surveys of these marshes listed only 14 plant species in these habitats, three of which were considered restricted or protected. However, subsequent detailed vegetation surveys, and recent field surveys have revealed the presence of more restricted/protected species. The identity, distribution and status of these plants is given in Table 8.1.

**Table 8.1 Restricted/protected Wetland Plants Identified in the Assessment area**

Family Species	Author	IUCN global status	Hong Kong status*	Previous Hong Kong collections	Legal Protection
Cyperaceae <i>Eleocharis acutangula</i>	(Roxb.) Schult.	Not threatened	Restricted	Shui Hau, Cheung Sheung	-
Eriocaulaceae <i>Eriocaulon merrillii</i>	R.Br.	None	Common/ Restricted	Tung Chung, Sai Kung and Lai Chi Wo	-
Cyperaceae <i>Fimbristylis acuminata</i>	Vahl	Data deficient	Rare/ Restricted	Kai Sha, Hoi Ha, Lai Chi Chong, Grass Island, Shui Hau.	-
Cyperaceae <i>Fimbristylis complanata</i>	(Retz.) Link	None	Restricted	San Tau, Lantau, Kap Lung – Tai Mo Shan	-
Cyperaceae <i>Fuirena ciliaris</i>	(L.) Roxb.	Data deficient	Restricted	Tai Wan – Sai Kung, Sha Tin, Castle Peak, Kwungtung.	-
Nepenthaceae <i>Nepenthes mirabilis</i>	(Lour.) Druce	Not threatened	Common	S. Lantau, Sai Kung, So Kwun Wat, Tai Lam Chung, Tsing Yi	Protected by law in HK and included in CITES App.II
Xyridaceae <i>Xyris pauciflora</i>	R.Br.	Data deficient	Restricted	Tung Chung, Lantau, Near Fanling, Sheung Shui, Shek- O, Beacon Hill	-

\* Reference: Detailed Vegetation Survey, October 2001; and Corlett *et al.* (2000)

- 8.29 Recent detailed field surveys noted several clumps of *Fuirena ciliaris* and *Eriocaulon merrillii* (both species with restricted distributions in Hong Kong) were found near wetland area *b*.

### Plantation

- 8.30 This habitat type is dominated by woody species planted for landscape purposes. Plantations comprise mainly *Acacia confusa* and *Leucaena leucocephala*, and were found around the CLP Penny's Bay Gas Turbine Plant and adjacent excavated hillside. Only five tree species were found with heights of trees ranging from 5-15 m. All tree species were exotics, and therefore of relatively low ecological importance. Recent field surveys confirmed that this habitat has been largely unaffected by nearby reclamation works and other developments in the Assessment Area.

### Wasteland

- 8.31 Wasteland refers to the open, flat areas formed from reclamation next to CLS and the CLP Penny's Bay Gas Turbine Plant, along with the reclaimed site at TKW. Additionally small patches of wasteland were encountered along the verges of the proposed temporary road. Dominant species included *Neyraudia reyaudiana* and exotic weeds including *Mikania*

*micrantha* and *Lantana camara*. This habitat is very open and low in floristic diversity (23 species in total), habitat heterogeneity and naturalness.

### Backshore Vegetation

- 8.32 A total of 70 plant species have been recorded in Theme Park EIA surveys of backshore vegetation. In the current Assessment Areas, backshore vegetation was limited because of the rocky nature of the intertidal zone. The backshore vegetation of these shores is continuous with shrubland or secondary woodlands further inland. Dominant plants found included *Cladium marisus*, *Heteropogon contortus*, *Scaevola*, *Scolopia chinensis* and *Neyraudia arundinacea* (*N. reyaudiana*). Floristic diversity is moderate but habitat heterogeneity is very low as a result of sparse vegetation. One rare species, *Schoenus falcatus*, was found in the assessment area, along the western side of Penny's Bay. Recent field checks confirmed that this habitat type has not changed significantly since previous surveys.
- 8.33 The Detailed Vegetation Survey (Oct. 2001) also reports *Schoenus falcatus* and *Eriocaulon merrillii* growing in backshore vegetation at Chok Ko Wan Tsui. These plants will not be affected by works proposed for this project, and will therefore not be considered further in this report.

### Streams

- 8.34 Many small, seasonal streams of limited value to wildlife were noted in the assessment areas. Only two permanent streams were found in the assessment areas, both near CLS.
- 8.35 Mong Tung Hang Stream (MTHS) drains the area to the North of the shipyard. The upper section of this stream has a natural substrate composed of boulders and cobbles, and a well-defined pool-riffle sequence. Extensive riparian vegetation can be found on the banks of the stream, including the protected plant species *Nepenthes mirabilis*. The water of this stream appeared to be free from pollution. The lower section of MTHS has been extensively channelised, and is routed under the shipyard.
- 8.36 A second stream flows in an Easterly direction, discharging into Penny's Bay between the CLP Penny's Bay Gas Turbine and the Shipyard (hereafter referred to as CLPS). This too is a natural watercourse and appears free from pollution, with shrubland dominating the riparian zone along the upper section. Close to its discharge point, the stream becomes tidal and brackish.

### Fauna

#### Mammals

- 8.37 No direct or indirect sightings of mammals were recorded in the *Theme Park EIA Report* or recent field checks in the assessment areas.

#### Herpetofauna

- 8.38 Previous surveys conducted for the *Theme Park EIA Report* recorded three amphibian species in the wetlands behind Cheoy Lee Shipyard, *Rana limnocharis*, *Polypedates megacephalus*, *Microhyla ornata*.

- 8.39 Recent field surveys recorded several *Rana macrodactyla* tadpoles close to the brackish wetland at CLPS. This species is common and widespread across Lantau (Karsen *et al.*, 1998).

### Invertebrates

- 8.40 Nine species of dragonfly and damselfly common to Hong Kong were recorded around North Lantau during the *Theme Park EIA Report*. Most of recorded species were encountered close to areas with fresh water. Field surveys recorded thirty-four species of butterfly. Most of the butterflies were encountered at the edge of woodlands and nearby shrubland. No rare or ecological significant species of terrestrial insects were recorded.
- 8.41 Recent field checks had similar findings, with common and widespread species recorded at the two sites. Two damselflies (*Euphaea decorata*, *Copera marginipes*) and one butterfly (*Papilio polytes*) not previously recorded in the assessment area were noted. All three species are common and widespread in Hong Kong.
- 8.42 According to the *Theme Park EIA Report*, no rare, endangered, or endemic stream invertebrates were recorded in large streams during previous surveys; identified species were all common and typical of unimpacted freshwater streams in Hong Kong. Recent field checks found the communities largely unchanged, with only a few new species recorded. All new records were of common and widespread species.

### Fish

- 8.43 The *Theme Park EIA Report* recorded five fish species were found in the streams around CLS, including the locally rare Rice Fish (*Oryzias curvinotus*) in MTHS. Mosquito Fish (*Gambusia affinis*) were identified in seepage pools and artificial ditches in the shipyard, as well as Grey Mullet (*Mugil cephalus*), Mudskipper (*Periophthalmus cantonensis*) and *Therapon jarbua* in the stream behind the CLP Penny's Bay Gas Turbine Plant. Except the Rice Fish, which is locally rare, the other species were common and widespread in Hong Kong. No fish were found in upper stream-courses.
- 8.44 *Oryzias curvinotus* is still common in Mainland China, but is becoming increasingly rare in Hong Kong. Its distribution is limited to a few slow-flowing, lowland streams and a number of lentic habitats such as marshes (e.g., Sam A Tsuen Marsh) and reservoirs (e.g., Chi Ma Wan Peninsula)
- 8.45 There are two related factors contributing to the local decline in *O. curvinotus* populations. Firstly, many of the species' preferred habitats in Hong Kong have been polluted, channelised or otherwise altered by man (Dudgeon & Corlett, 1994). Such impacts can lead directly to the elimination of native fish communities (e.g., Dudgeon, 1996; Chan, 2001). Secondly, in degraded environments, circumstantial evidence suggests exotic poeciliids such as *Gambusia affinis* eliminate *O. curvinotus* populations. *G. affinis* and other poeciliids occupy a similar ecological niche to *O. curvinotus*, and therefore compete for resources with the latter species. Additionally, *G. affinis* is believed to predate the eggs and young of *O. curvinotus* (Chong & Dudgeon, 1992. See also Dudgeon & Corlett, 1994). According to Chong and Dudgeon (1992), the distribution of the Rice Fish *Oryzias curvinotus* in Hong Kong has reduced dramatically, and is now restricted to a few isolated sites across Hong Kong, including: Chi Ma Wan on Lantau, Sam A Tsuen in Northeast New territories, eastern Sai



Kung and Tung Chung area. It can be considered as endangered in Hong Kong due to the fragmented distribution of generally small populations.

- 8.46 Due to the possible high value of stream habitats to *Oryzias curvinotus*, further detailed surveys of both MTHS and the CLPS were conducted in October 2001. Nine species of fish were recorded during these surveys, most of which were found in the estuarine area of CLPS. In total six of the fish species noted in recent surveys had not been recorded previously at MTHS or CLPS. All species recorded in recent surveys are common and widespread across Hong Kong.
- 8.47 Recent surveys of MTHS failed to detect any Rice Fish in the stream; it is probable that the small population previously found in the stream is no longer present.

### Avifauna

- 8.48 Almost all the 32 species of avifauna recorded in the *Theme Park EIA Report* are common in Hong Kong. Typical species included: Black-eared Kite (*Milvus milgrans*), Common Sandpiper (*Actitis hypoleucos*), Spotted Dove (*Streptopelia chinensis*), Chinese Bulbul (*Pycnonotus sinensis*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Japanese White-eye (*Zosterops japonica*), Long-tailed Shrike (*Lanius schach*) and Yellow-bellied Prinia (*Prinia flaviventris*). A rare migrant Sparrowhawk (*Accipiter* sp.) was observed flying passed. The one notable species identified in previous surveys around Penny's Bay was the locally rare White-bellied Sea Eagle (*Haliaeetus leucogaster*). A breeding pair of Eagles, together with a juvenile bird, were observed nesting in woodlands near Pa Tau Kwu. Recent monitoring of these birds suggests the female adult has paired with another male, although no record of breeding behaviour has been made. Possible impacts to this species will not be considered in this assessment, as the nest site is a considerable distance from the nearest assessment area boundary (over 800m), and as such, will not be affected by the proposed works.
- 8.49 Recent field checks recorded only one new species in the assessment area, the common and widespread Jungle Crow (*Corvus macrorhynchos*). One interesting record was a number of Little Egrets (*Egretta garzetta*) roosting in secondary woodland east of TKW. It is possible that this site is used for breeding by Little Egrets and other Ardeid species. However, during subsequent visits, only a few egrets were seen at the site, and there was no sign of breeding activity. As there were no previous record of such in the area, the sighting could be an occasional one. Egrets and herons are considered to be of regional and global conservation significance as the birds, although still common in Hong Kong, maybe declining in numbers locally, largely as a result of the loss of suitable foraging habitats (e.g. through the in-filling of fishponds). Additionally, populations in Hong Kong are significant in the context of the southeast China region.

### Ecological Value

- 8.50 In accordance with the EIAO TM *Annex 8* criteria, the ecological importance of the recorded habitats have been evaluated in the tables below.

**Table 8.2a Ecological Value of Grassland/Low Shrub Mosaic and Tall Shrubland Habitats in the Assessment area**

Criteria	Grassland/Low Shrub Mosaic	Tall Shrubland
Naturalness	Habitat maintained by frequent hill fires	Habitat maintained by frequent hill fires
Size	The grassland low shrub mosaic is the dominant habitat type in the Assessment Area	Small patches scattered throughout the Assessment Area
Diversity	Low to moderate	Low to moderate
Rarity	No rare or protected species recorded	Two protected species were found in Tall shrub habitats: <i>Nepenthes mirabilis</i> recorded in Tall Shrub adjacent to MTHS <i>Lilium brownii</i> recorded near North Lantau Highway
Recreatability	Habitat regenerates naturally after fire disturbance	Habitat regenerates naturally after fire disturbance
Fragmentation	The grassland/shrubland mosaic is not fragmented.	Small patches scattered throughout the assessment area
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	The potential value is low.	The potential value is low
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground were found in the survey.
Age	The habitats are frequently disturbed and therefore are secondary in nature.	The habitats are disturbed and therefore are secondary in nature.
Abundance/Richness of Wildlife	Low to moderate species diversity	Low to moderate species diversity
Ecological value	Low	Low Moderate (where restricted/protected species occur)

**Table 8.2b Ecological Value of secondary woodland habitats in the Assessment area**

Criteria	Secondary woodland
Naturalness	The secondary woodlands have been modified and subjected to human disturbance.
Size	Small patches (approximately 0.1-0.5ha.) found adjacent to CLS and TKW sites
Diversity	The species diversity is moderate.
Rarity	No rare or protected species were found in the habitat, though TKW has a record of Ardeids.
Re-creatability	Habitat will regenerate in 10-40 yrs.
Fragmentation	The woodlands are not fragmented.
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	The potential value is considered moderate.
Nursery ground	Woodland at TKW may offer potential nesting site for Ardeids
Age	The habitats are relatively mature.
Abundance/Richness of Wildlife	Moderate
Ecological value	Moderate

**Table 8.2c Ecological Value of Brackish and Freshwater Wetland Habitats in the Assessment area**

Criteria	Brackish Wetland	Freshwater Wetland
Naturalness	Natural habitat	Naturalness is only moderate and partially man-made habitat.
Size	Small in size.(app. 0.8ha)	Small in size (app. 0.5ha)
Diversity	The species diversity is low.	The species diversity is low
Rarity	No rare nor protected species were found in this habitat type.	Several restricted or protected plant species ( <i>Eleocharis acutangula</i> , <i>Eriocaulon merrillii</i> , <i>Fimbristylis acuminata</i> , <i>Fimbristylis complanata</i> , <i>Fuirena ciliaris</i> , <i>Nepenthes mirabilis</i> , <i>Xyris pauciflora</i> ) recorded in wetlands close to CLS
Re-creatability	Re-creatability is moderate.	Re-creatability is moderate to high.
Fragmentation	This habitat type is not fragmented.	The wetlands are not fragmented, but small in size.
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	The potential value is considered moderate.	The potential value is considered moderate.
Nursery ground	Tadpoles of the frog <i>Rana macrodactyla</i> were found in freshwater pools adjacent to the wetland.	No record of significant nursery or breeding ground was found in the survey.
Age	Not applicable.	The habitats probably formed recently by seepage from hillsides behind after reclamation.
Abundance/Richness of Wildlife	Low-moderate	Low
Ecological value	Low-Moderate	Moderate-high

**Table 8.2d Ecological Value of Plantation and Wasteland Habitats in the Assessment area**

Criteria	Plantation	Wasteland
Naturalness	Created habitat	Created habitat
Size	Small in size.	Moderate in size (in total, app. 25ha)
Diversity	The species diversity is low.	The species diversity is low.
Rarity	No rare or protected species were found in this habitat.	No rare or protected species were found in this habitat.
Re-creatability	Habitat can be re-created easily.	The habitat can be re-created easily.
Fragmentation	Habitat is not fragmented.	The habitat is not fragmented.
Ecological linkage	The plantation is not functionally linked to any highly valued habitat in close proximity in a significant way.	Habitat is not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	Low value.	Low value
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground was found in the survey.
Age	Not applicable.	Not applicable.
Abundance/Richness of Wildlife	Low	Low
Ecological value	Low	Low

**Table 8.2e Ecological Value of Backshore Vegetation and Stream Habitats in the Assessment area**

Criteria	Backshore vegetation	Streams
Naturalness	Natural habitat with limited human disturbance.	The streams are largely natural and free of pollution.
Size	Moderate in size	The length of the natural streams is approximately 1400-1800m.
Diversity	The species diversity is moderate.	The species diversity is moderate to low.
Rarity	One rare plant species, <i>Schonenus falcatus</i> found in back shore vegetation at Penny's Bay.	No rare species recorded in recent detailed surveys, although the locally rare Rice Fish previously known from MTHS
Re-creatability	It has moderate re-creatability.	Re-creatability of streams is low-moderate.
Fragmentation	The habitats are not fragmented but always have a linear shape.	Not applicable.
Ecological linkage	The present habitats are not functionally linked to any highly valued habitat in close proximity in a significant way.	It is probable that water from Mong Tung Hang Stream and other smaller streams supply the wetlands to the NE of the shipyard
Potential value	The potential value is low.	The potential value is moderate to low.
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground was found in the survey.
Age	Relative mature and stable.	Not applicable
Abundance/Richness of Wildlife	Low	Low
Ecological value	Moderate	Moderate (Moderate-High if Rice Fish are present)

- 8.51 Based on the ecological conditions presented in the above sections, it is considered that grassland/ low shrub habitats within the Assessment Area have generally low value because of their poor diversity; and also because most of the species identified are common, widespread and typical to such habitats in Hong Kong.
- 8.52 Tall Shrubland habitat generally has low ecological value, because of poor diversity and common, widespread species. Where restricted/protected species occur, the habitat is considered to have moderate value.
- 8.53 Given their small size, secondary woodlands are regarded as having only moderate ecological value.
- 8.54 The brackish wetlands have low-moderate value, given the relatively species poor vegetation community found in the habitat. The only notable feature of the wetlands was the use of the habitat as a breeding ground by the frog *Rana macrodactyla*. Freshwater wetlands are considered to have moderate-high value, for although species diversity is generally low, the habitat supports a number of restricted/protected plant species.
- 8.55 The ecological value of the wasteland and plantation habitats is limited given the frequent human disturbance and low species diversity in these habitat types.
- 8.56 Although small in area, Backshore vegetation in the Assessment area was found to support one rare plant species, and is considered to be of moderate ecological value.
- 8.57 The larger freshwater streams in the Assessment areas are generally free from human impacts, and are considered to be of moderate ecological value. The lower stream course at

MTHS is relatively more important, given the previous records of Rice Fish in this habitat. Upper stream courses, which are small with bedrock as substratum support less diverse communities.

### Identification of Ecological Impacts

- 8.58 Several potential impacts associated with this project have been identified. Direct impacts to habitats/vegetation resulting from the Project are summarised in Table 8.3a. Table 8.3b provides a summary of indirect impacts:

**Table 8.3a Direct impacts to habitats/vegetation resulting from the Project**

Habitat	Shipyard Decommissioning	Slope Works	Fill works
Grass/ low shrub mosaic	-	2.5ha***	0.5ha
Tall Shrub	-	-	Approx. 0.5ha
Secondary woodland	-	-	-
Freshwater wetland	Approx. 0.25ha	Approx. 0.2ha	Approx. 0.1ha
Brackish wetland	-	-	-
Plantation	-	-	-
Wasteland	0.2ha	-	17.5ha
Backshore vegetation	-	-	-
Freshwater streams	-	-	Approx. 200m
Rice-fish habitat	-	-	All of Rice-fish habitat
Restricted/protected plant species	<i>Fuirena ciliaris</i> and <i>Eriocaulon merrilli</i> near wetland area b	<i>Eleocharis acutangula</i> , <i>Eriocaulon merrillii</i> , <i>Fimbristylis acuminata</i> , <i>Fimbristylis complanata</i> , <i>Fuirena ciliaris</i> , <i>Nepenthes mirabilis</i> , <i>Xyris pauciflora</i>	<i>Eleocharis acutangula</i> , <i>Eriocaulon merrillii</i> , <i>Fimbristylis acuminata</i> , <i>Fimbristylis complanata</i> , <i>Fuirena ciliaris</i> , <i>Nepenthes mirabilis</i> , <i>Xyris pauciflora</i>

\*\*\*Details of the proposed slope works have yet to be finalised. This estimate is based on the latest available plans

**Table 8.3b A summary of indirect impacts resulting from works associated with the Project**

Works	Indirect impacts
Shipyard Decommissioning Demolition Phase	Indirect impact to fauna associated with directly impacted habitats (i.e., loss of foraging grounds)  See Note (1)
Shipyard Decommissioning Remediation Phase	Indirect impact to fauna associated with directly impacted habitats (i.e., loss of foraging grounds)  Potential spill of contaminated materials resulting from road accident  See Note (1)

Fill/Slope Works: Construction Phase	Indirect impact to fauna associated with directly impacted habitats (i.e., loss of foraging grounds)  See note (1)
Fill/Slope Works Operation Phase	-

(1) - Disturbance to wildlife and habitats surrounding assessment areas through increased noise, dust, human activities, uncontrolled storage/dumping of construction material, potential hillfires/other accidents may be associated with these works.

### Prediction of Ecological Impacts

8.59 Potential ecological impacts arising from the project, evaluated according to *Table 1 of Annex 8* of the *EIAO TM*, are discussed below, and summarised in Tables 8.5a-8.5f.

#### Shipyard Decommissioning: Demolition Phase

- 8.60 Direct impacts of the demolition phase works would be limited to the loss of wasteland habitat, and several clumps of the restricted plant species *Furiana ciliaris* and *Eriocaulon merrillii* on the eastern boundary of the shipyard.
- 8.61 Indirect impacts may affect ecologically sensitive habitats (freshwater and brackish wetlands, streams, woodland, scrub/grassland mosaic, tall shrub) in the regions surrounding the assessment area, especially to the North and East of Cheoy Lee Shipyard.
- 8.62 Indirect impacts may arise from increased human activities associated with the works, such as material storage and project site run-off, if uncontrolled. This may disturb habitats and associated flora and fauna, particularly the restricted/protected plant species found in the wetland areas behind the Shipyard. Impacts to the wetland habitats in the assessment area will be limited by the presence of fences surrounding the largest stands of restricted/protected wetland plants. The fences were erected to mitigate the potential impacts brought about by human activities associated with other projects in the area.
- 8.63 Noise and dust resulting from demolition may also impact on fauna and flora close to the shipyard, although these impacts will be of a temporary nature.
- 8.64 Backshore vegetation and other habitats to the west of the Shipyard are not expected to be affected by demolition phase works. This area is now shielded from the shipyard by a large seawall associated with reclamation works in Penny's Bay.

#### Shipyard Decommissioning: Remedial Phase

- 8.65 Direct impacts resulting from remediation works would be limited to the loss of a small area of wasteland as a result of road upgrading works, and the temporary loss of a small area of wasteland habitat at TKW.
- 8.66 There is a small risk of the accidental release of contaminated material being transported from CLS to TKW, or TKW to Tsing Yi on land.

- 8.67 Indirect impacts may arise from increased human activities, and construction works such as material storage and project site run-off, if uncontrolled. This may disturb habitats and associated flora and fauna in areas adjacent to the two works sites.

*Slope/Fill Works: Construction and Operational Phases*

- 8.68 Detailed geotechnical surveys of the slopes surrounding CLS have determined several of the slopes are unstable and in need of remedial works to ensure their safety (see fig. 8.1). Ecological impacts arising from slope stabilisation/reprofiling works were not addressed in the *Theme Park EIA Report*, as the results of slope surveys were not available when the report was being prepared.
- 8.69 The extensive fill works required to form a new level after decommissioning were not addressed in the *Theme Park EIA Report*. These works are an essential part of infrastructure developments associated with the Theme Park, and as such, ecological impacts arising from the works are unavoidable.
- 8.70 Direct impacts resulting from slope and fill works are expected to include the loss of several areas of moderate-high value habitats that support restricted/protected species. These include freshwater wetlands on or near slopes to the east of the shipyard, tall shrubland around MTHS, and Rice Fish habitats at MTHS.
- 8.71 Other direct impacts are expected to affect low/low-moderate value habitats including: grassland/low shrub mosaic, brackish wetlands, wasteland, and the tidal reach of CLPS.
- 8.72 Indirect impacts may arise from increased human activities, and construction works such as material storage and project site run-off, if uncontrolled. Other impacts may include increased dust, sedimentation and noise. These impacts may disturb moderate-high value habitats close to CLS, including secondary woodland and freshwater wetland.

**Cumulative Ecological Impacts**

- 8.73 Direct impacts to freshwater wetland and disturbance to restricted/protected species resulting from proposed slope and fill works were not addressed in the *Theme Park EIA Report* or the *NSLDFS EIA Report*. (see sections 8.68 and 8.69). As such, these impacts will add significantly to the overall ecological impact resulting from current and proposed works in the Penny's Bay Area. Impacts to other habitat types resulting from the current project are small in scale, and will not add significantly to impacts identified in previous EIA Reports. The cumulative loss of vegetation/habitats resulting from the Theme Park Development and other projects in and around Penny's Bay are summarised in Table 8.4.

**Assessment of Ecological Impacts**

- 8.74 Potential ecological impacts to habitats in the Assessment Area resulting from the current Project have been evaluated according to *Table 1 of Annex 8 of the EIAO TM*, and are summarised in Tables 8.5a-8.5f below.
- 8.75 The risk to ecological sensitive receivers from the transport of potentially harmful contaminants by road is very low, as all trucks carrying wastes will be escorted, and subject to stringent speed restrictions. Further measures to ensure the safe transport of materials are detailed in Section 6.

**Table 8.4 A summary of cumulative habitat/vegetation loss and impacts to restricted/protected species resulting from the Theme Park Development and other Projects in Northeast Lantau**

Habitat	Theme Park (Phase I & II)*	CKWLR**		Other NSLD**	Route 10***	Additional impacts resulting from Shipyard Decommissioning and associated works			Cumulative impact
		Yam O Interchange to Penny's Bay Roundabout	Penny's Bay Roundabout to Route 10 Toll Plaza			Shipyard Decommissioning	Slope Works	Fill works	
Grass/ low shrub mosaic	2.3ha	2.5ha	13ha	25.8ha	9ha	-	2.5ha***	0.5ha	55.6ha
Tall Shrub	-	2ha	2.6ha	8ha	8ha	-	-	Approx. 0.5ha	21.1ha
Secondary woodland	0.4ha	1.4ha	-	1ha	0.8ha	-	-	-	3.6ha
Freshwater wetland	-	-	-	-	-	Approx. 0.25ha	Approx. 0.2ha	Approx. 0.1ha	0.55ha
Brackish wetland	0.7ha	-	0.3ha	-	-	-	-	-	1ha
Plantation	0.1ha	-	-	-	-	-	-	-	Approx. 0.1ha
Wasteland	-	-	-	-	-	Approx. 0.2ha	-	Approx. 17ha	Approx. 17.2ha
Backshore vegetation	Approx. 2ha	-	-	-	-	-	-	-	Approx 2ha
Freshwater streams	-	-	550m	250m	-	-	-	Approx. 200m	Approx. 1km

\* As described in the *Theme Park EIA Report*

\*\* As described in the *NSLDFS EIA Report*

\*\*\* Details of the proposed slope works have yet to be finalised. This estimate is based on the latest available plans



**Table 8.5a Overall Impact Evaluation of Grassland/lowland Shrub Mosaic and Tall Shrubland**

Evaluation Criteria	Grassland/Low Shrub Mosaic	Tall Shrubland
Habitat quality	The habitat quality of grassland/shrubland mosaic is low.	CLS: Overall low, except for patch near MTHS supporting <i>N.mirabilis</i>  TKW: Overall, low, except for patch near NLE supporting <i>Lilium Brownii</i>
Species	No loss of restricted or protected species, although there may be potential indirect impact to the wildlife.	CLS: Direct impact to <i>N.mirabilis</i>  TKW: No direct impact to <i>Lilium brownii</i> or other species, although vegetation/wildlife may be indirectly affected.
Size/Abundance	CLS: small area of grassland/low shrub mosaic on slopes above CLS to be reprofiled/filled will be directly impacted  TKW: No permanent habitat loss	CLS: loss of approximately 0.5ha near MTHS  TKW: No permanent loss
Duration	CLS: loss of habitat on reprofiled/filled slopes above CLS will be permanent  TKW: The duration of impact will persist during the remediation phase.	CLS: loss of habitat near Mong Tung Hang Stream will be permanent.  TKW: The duration of impact will persist during the decommissioning remediation phase.
Reversibility	CLS: loss of habitat will be permanent  TKW: The effects of indirect impacts on grassland/shrubland mosaic are reversible. The habitat is readily re-created and will recover easily.	CLS: loss of habitat near Mong Tung Hang Stream will be permanent  TKW: The effects of indirect impact on tall shrubland are reversible. The habitat is readily re-created and will recover easily.
Magnitude	The scale of the impacts is considered low	CLS: The scale of the impact is considered moderate TKW: The scale of the impacts is considered low
Overall impact conclusion	Low	CLS: Moderate TKW: Low

**Table 8.5b Overall Impact Evaluation of Secondary Woodland**

Evaluation Criteria	Secondary Woodland
Habitat quality	The habitat quality of the woodland is moderate
Species	CLS: There may be potential indirect impact to the wildlife inhabiting woodland near assessment areas  TKW: There may be potential indirect impact to the wildlife inhabiting woodland near assessment areas, including Ardies.
Size/Abundance	No permanent loss of habitat
Duration	CLS: The duration of impact will persist during the demolition phase of decommissioning works and the construction phase of slope and fill works.  TKW: The duration of impact will persist during the remediation phase of decommissioning works.
Reversibility	The impacts on woodland are temporary and reversible.
Magnitude	CLS: The scale of the impacts is considered low  TKW: The scale of the impacts is considered low
Overall impact conclusion	CLS: Low  TKW: Low-Moderate

**Table 8.5c Overall Impact Evaluation of Brackish and Freshwater Wetlands**

Evaluation Criteria	Brackish wetland	Freshwater wetland
Habitat quality	The habitat quality of brackish wetland is low-moderate	The habitat quality of freshwater marshland is moderate-high
Species	There will be direct impacts to the wildlife inhabiting the areas, although no rare/protected species would be affected.	There will be direct impacts to restricted/protected wetland plants in these habitats
Size/Abundance	Loss of all brackish water habitat, although the affected area is small (approx. 0.8ha)	Loss most of the freshwater wetland at CLS (approx. 0.4ha)
Duration	Habitat loss will be permanent	Habitat loss will be permanent
Reversibility	Loss of habitats is irreversible	Loss of habitats is irreversible
Magnitude	The scale of impact is moderate.	The scale of impact is high.
Overall impact conclusion	Low	High

**Table 8.5d Overall Impact Evaluation of Wasteland and Plantations**

Evaluation Criteria	Wasteland	Plantation
Habitat quality	The habitat quality of wasteland is very low.	The habitat quality of the plantation is low.
Species	CLS: There will be a permanent impact on wildlife inhabiting the area.  TKW: There will be temporary direct impact to the wildlife inhabiting the areas.	There may be potential indirect impact to the wildlife inhabiting the areas
Size/Abundance	CLS: All wasteland habitat within the project boundary will be lost (App. 17ha)  TKW: No permanent loss of habitat	No permanent loss of habitat
Duration	CLS: Permanent loss of habitat  TKW: The duration of impact will persist during the remediation phase of shipyard decommissioning.	The duration of impact will persist during the demolition phase of decommissioning, and the construction phase of slope/fill works.
Reversibility	CLS: direct loss of wasteland is irreversible.  TKW: The habitat is readily re-created and will recover quickly and easily.	Indirect impacts to the plantation is reversible. The habitat is readily re-created and will recover easily.
Magnitude	CLS: The scale of impact considered low.  TKW: The scale of the impact is considered low	The scale of impact is considered low.
Overall impact conclusion	Low	Low

**Table 8.5e Overall Impact Evaluation of Backshore Vegetation**

Evaluation Criteria	Backshore vegetation
Habitat quality	The habitat quality of backshore vegetation is moderate.
Species	CLS: No impacts are anticipated to the wildlife inhabiting the areas or individuals of the rare plant species <i>Schoenus falcatus</i> TKW: There will be temporary indirect impact to the backshore vegetation.
Size/Abundance	No direct loss of habitat
Duration	TKW: The duration of impact will persist during the remediation phase of shipyard decommissioning.
Reversibility	TKW: The habitat is will recover quickly and easily from indirect impacts
Magnitude	CLS: no impact anticipated TKW: The scale of the impacts is considered low
Overall impact conclusion	CLS: no impact anticipated TKW: low

**Table 8.5f Overall Impact Evaluation of Mong Tung Hang and CLP Penny's Bay Gas Turbine Streams**

Evaluation Criteria	MTHS	CLPS
Habitat quality	The habitat quality is moderate-high.	The habitat quality is moderate
Species	Locally rare Rice Fish ( <i>Oryzias curvinotus</i> ) was previously found at the lower section of the stream. Restricted/protected plant species were found in the riparian zone of the stream	Loss of tidal section
Size/Abundance	App. 75m of natural stream-course will be lost	The tidal section of the stream would be directly affected
Duration	Habitat loss will be permanent	Habitat loss will be permanent
Reversibility	Direct loss of stream habitat is irreversible.	Direct loss of stream habitat is irreversible.
Magnitude	The scale of direct impacts to Rice Fish (if present) is high	The scale of potential impacts is moderate.
Overall impact conclusion	High	Low-Moderate

### Mitigation of Ecological Impacts

8.76 The main potential ecological impacts resulting from the project have been identified as:

- Direct impacts to tall shrub/freshwater wetland habitats and associated restricted/protected plant species near CLS
- Direct impacts to Rice Fish habitats

8.77 Specific measures to mitigate these impacts are discussed in the following sections. In accordance with the *EIAO TM*, measures to first avoid, then minimise, and finally compensate for each impact are discussed in both cases.

#### Impacts to restricted/protected plant species

8.78 An area containing approximately 1000 *N.mirabilis* (Fig. 8.5a, area P3) will not be affected by proposed slope/fill works. These plants will be retained *in-situ*.

- 8.79 The design of slope works north of the shipyard have been modified, allowing a patch of approximately 200 *Nepenthes mirabilis* plants to be retained *in-situ* (Fig. 8.5a, Area P1). To prevent tipping, vehicle movement and encroachment of personnel into this area, it is recommended the plants, along with a 10m buffer zone, are fenced off.
- 8.80 There is little scope to avoid direct impacts to other restricted/protected plant species affected by the project. Slope and fill works (which will directly impact the plants) are integral and necessary components of the project: with slope works required to stabilise currently dangerous slopes to the north and east of CLS, and fill works required to allow infrastructure developments associated with the Theme Park to be constructed. Therefore, *ex-situ* techniques are the only option available to conserve affected restricted/protected plant species. The transplanting of affected plants to a receptor site at Tai Tam Country Park is recommended as the primary measure to conserve restricted/protected plant species. Specific measures to maximise the success of transplanting are given in sections 8.81-8.90.
- 8.81 For most of the species associated with wetland areas *a* and *b*, an effort should be made to transplant small areas of habitat rather than focussing on individual plants. This will minimise stress to wetland associated plant species, thereby increasing the probability of successful transplantation.
- 8.82 The habitats/individual plants included in the transplanting programme are given in Fig 8.5a-8.5c The habitats to be transplanted consist of:

Wetland Area *a*

Wetland Area *b*

Individual plants or clumps of plants to be transplanted consist of:

*Fuirena ciliaris* (851, 852)

*Nepenthes mirabilis* (840, 841, 843, 844-847, P2a, P2b, P2c)

Patches of *F.ciliaris* and *E.merrillii* close to wetland area *b*.

*Identification of Receptor Sites*

- 8.83 The *Theme Park EIA Report* suggest receptor sites at Sze Pak Wan and the South East Chi Ma Wan Peninsular (both on Lantau Island) for affected plant species. Surveys undertaken during the preparation of the *DVS* found few sites in these areas suitable for freshwater plant species due to unsuitable abiotic conditions.

A wider search for receptor sites was conducted using a comprehensive database of wetland sites in HK prepared by Binnie, Black and Veatch, AFCD's consultant for the Wetland Compensation Study. The database was searched to identify sites with the following criteria:

- Freshwater rather than saltwater/brackish wetland
- Wetland on Government administered land
- Conservation status (preference given to sites with protected status such as country parks)
- Close to the affected site – the search restricted site selection to wetlands on Lantau Island.

Potential sites identified in the database included Tai Long Wan, Cheung Sha Wan and Pui O. Unfortunately, these potential sites were not considered to be suitably protected (i.e., on privately owned land) or to have similar plant diversity to the habitats of Penny's Bay.

A final survey of potential receptor sites conducted during the preparation of the *DVS* identified several potential receptor sites in Tai Tam Country Park (Hong Kong Island). Recent site visits conducted during the preparation of this report found these sites unsuitable because of variable and unreliable water regimes.

Field surveys undertaken during the preparation of this report have identified a suitable receptor site in Tai Tam Country Park (Fig. 8.6). The site consists of an area suitable for transplanting part of the wetland habitats and clumps of *F.ciliaris* and *E.merrillii*, in addition to three nearby exposed rock faces suitable for *N.mirabilis*. Although the site is relatively distant from the donor site, it is considered more suitable than potential receptor sites closer to CLS for the following reasons:

- The site is well protected (situated in a country park)
- Nearby wetlands are known to have similar species composition to transplanted wetlands.
- No restricted/protected species found close to the receptor site will be disturbed by the transplanting measures.

Further monitoring will be required to confirm the suitability of this area as a receptor site.

- 8.84 At the time of writing, Tin Shui Wai recreated wetland has been identified a potential 'back-up' receptor site.

#### *Preparation of Donor Sites*

- 8.85 Preparation of donor sites should include:

- The repositioning of fencing around extant wetlands, especially wetland area *a*. Existing fencing in some areas is too close to the existing wetlands and needs to be removed and reconstructed outside the wetland boundaries, in order to protect species until they are transplanted. Positioning of the new fencing should take place under the supervision of a plant biologist familiar with the restricted/protected plant species of the habitats.
- The watering of wetland habitats/plants species prior to transplanting, to minimise stress to plants (especially plants found on drier land close to wetland area *b*) during transplanting.

#### *Preparation of Receptor site*

- 8.86 Early preparation of the receptor site is required, and should include the following:

- At the Tai Tam Receptor site, a permanent low dam (app. 1m high) should be constructed at the southern boundary of the site. The dam will slow the flow of seepage water across the receptor site, enlarging the area suitable for wetland plant species. The dam should be built using natural rocks and cobbles set in concrete, to minimise visual impact, and constructed at least 1 month before transplantation. To enhance the receptor site habitat

for *N.mirabilis*, netting or chicken wire should be installed along the exposed rock-faces to train the plants.

#### *General Guidelines for Transplantation*

- 8.87 When transplanting plants, it is important that the root tips of plants are not damaged and neither dry out, nor drown. To minimise root damage to the plants, it is important that:
- prior to transportation, habitats are well watered;
  - plants are either dug out either with a buffer area of substrate, or for large roots, a buffer area of substrate is loosed (with a spade, or flat trowel) and the extent of the roots are sourced and further loosed quickly by hand, before digging out;
  - the roots and buffer area of substrate are packed by tightly wrapping with hessian or jute, and watered heavily to avoid air locks and desiccation (wrapping with plastic can drown the roots and encourage the roots to rot);
  - the package of jute is well watered;
  - the time between uprooting and transplanting is minimised
  - plants are kept in the shade if not in the ground, and transported in air-con with plenty of water;
  - the roots are packed well into the same or similar substance at the receptor site and well watered to prevent root balls forming and to encourage roots to grow deep to ensure stability of the plant.

#### *Transplanting wetland habitats*

- 8.88 The following protocol should be followed when transplanting wetland habitats and clumps of *F.ciliaris*/*E.merrillii*:
- The wetlands should be dug out in squares approximately 50cm by 50cm. Before each small area is removed, it should be clearly tagged with a unique number for future reference.
  - The species composition, percentage coverage and general condition of vegetation on each tagged area of wetland should be recorded prior to transplantation.
  - Wetlands should be dug out to a depth of at least 20cm.
  - At least three people are needed when digging, to shift the wetland to the transplanting container.
  - The container should be a wooden crate, with one side that can be opened, covered inside with well watered hessian. In this way, the container allows the wetland to keep its shape with minimal disturbance to the plants and the hessian minimises desiccation.

- The plants should then be transported directly to the receptor site. Once on site, the hessian should be removed and the plants/wetland placed on site.
- Newly transplanted plants should be well watered.
- The approach to transplanting clumps of *F.ciliaris*/*E.merrillii* (clumps 851 and 852, and clumps found near wetland area *b*) should be similar to methods used to transplant wetlands. The plants themselves, along with an area of adjacent vegetation and soil, will be transplanted together.

*Transplanting of N.mirabilis plants*

8.89 For *N.mirabilis*, the following approach to transplanting should be used:

- Before transplantation, individual plants should be tagged with a unique number for future reference.
- The soil around the roots of each plant should be carefully loosened with a spade, and the roots quickly sourced and loosened by hand before digging out, with as much soil as possible.
- Additional substrate should be taken from the donor site for the receptor site.
- The soil is packed tightly by wrapping in hessian and well watered before transporting the plants directly to the receptor site.

The hessian should be carefully removed from the roots and attached soil, and the plants planted at the base of the rock face. Additional substrate from the donor site should be added around the base of the plants. The stems/leaves of the plants should then be arranged on the prepositioned netting or chicken wire.

8.90 A preliminary schedule of transplanting works is given in Table 8.6 below:

**Table 8.6 Preliminary schedule of works for *ex-situ* conservation measures for restricted/protected plant species**

Task	Time Required	Date	Personnel	Details
<b>Transplanting</b>				
Preparation of receptor site	4-5 days	February 2002	Engineer, Plant biologist & 2 Construction workers	Construction of small dam to retain water on site Positioning of chicken wire on <i>N. mirabilis</i> receptor sites
Preparation of donor and receptor site	2 days	April 2002:	Plant biologist and Gardener	Adequate watering of plants at donor site Addition watering of receptor sites
Translocate 50% wetland habitats	2 days	May 2002: week 1	Plant biologist & 3 gardeners	Ensure additional bags of donor site substrate, hessian, spades, trowels. Ensure appropriate transport and clean containers. Avoid delays between uprooting and transplanting.
Translocate 50% <i>Nepenthes</i> plants: phase 1	2 days	May 2002: week 1	Plant biologist & 3 gardeners	As above, plus knife & root powder.
Translocate 50% wetland habitats: phase 2	2 days	Late June/Early July	Plant biologist & 3 gardeners	Ensure additional bags of donor site substrate, hessian, spades, trowels. Ensure appropriate transport and clean containers. Avoid delays between uprooting and transplanting.
Translocate 50% <i>N. mirabilis</i> plants: phase 2	2 days	Late June/Early July	Plant biologist & 3 gardeners	As above, plus knife & root powder

### Contingency Plans

- 8.91 As little information is available concerning many of the affected restricted/protected plant species, a contingency against unsuccessful transplantation is proposed. Seeds and a small number of plants from each species should be stored at specialist facilities until the success of transplanting can be established. Should transplanting prove unsuccessful, remedial measures including the reintroduction of germinated seeds/stored plants to receptor sites are suggested. Details of these measures are given in section 8.92 (seed storage) and section 8.93 (plant storage), and summarised in Table 8.7.

#### *Seed Collection/Storage*

- 8.92 The seed should be held in the Kew Garden seed bank until other *ex-situ* conservation measures are considered to be successful (i.e., a maximum of three years). Specialists at the seed bank will store the seed under the conditions considered most appropriate for the species, and will test the seed for viability and germination success. Details of seed collection and storage are given below.

#### Seed collection

- The successful collection of seeds is dependent on the fruiting times of the affected species. Details of known fruiting times are given in Table 8.8
- It is recommended that the site be visited at least three times (in December, February, and April) prior to transplanting to collect seeds. Note, given the limited time available, it may not be possible to collect seeds from all species affected by the proposed works. For such species stored plants will be used in any necessary remedial actions.



- As many seeds available from each species should be collected. Where possible, mature seeds should be taken.
- Seeds should be appropriately labeled (Bridson and Forman 1992) with reference to the relevant herbarium specimen; placed in air-mail envelopes, and stored in cool, dry conditions until they are sent to the seed bank.

#### Seed Storage

Prior to sending material to the seed storage bank at Kew Gardens, the following measures should be undertaken:

- Agreement regarding the holding of seed on deposit, the required subsequent treatment of seed, (e.g., sub-sample screening to identify proportion of empty or infested seeds; or a sub-sample used for germination and viability testing) should be confirmed;
- Confirmation is also required regarding the return of plant materials in the event of transplantation failure; and
- The appropriate paperwork (seed dispatch form, MSB seed consignment cover note Donation of materials form), should be completed.

Following confirmation of the agreement with Kew Gardens;

- The seeds should be dispatched in air-mail envelopes by courier;
- the appropriate paperwork should be faxed or emailed of to the specific seed bank for notice of arrival;
- If other *ex-situ* conservation measures are successful, an appropriate decision will be needed on where to return the viable seed on deposit. The seed can then be reintroduced into the field in Hong Kong, once appropriate reintroduction issues have been considered.
- The estimated cost for the holding of seed on deposit, the required subsequent treatment of seeds (e.g., viability testing) is 200 pounds sterling per species.

#### *Storage of Plants & Cuttings Collection*

8.93 Further mitigation measures should involve close co-operation with horticultural and botanical experts at KFBG. These measures consist of:

- The collection and storage of:
  - 3 clumps of *Eleocharis acutangula*
  - 5 clumps of *Eriocaulon merrillii*
  - 5 clumps of *Fimbristylis acuminata*
  - 5 clumps of *Fimbristylis complanata*
  - 5 clumps of *Fuirena ciliaris*
  - 5 individuals of *Xyris pauciflora*

- The collection of 50 cuttings from *N.mirabilis* and subsequent cultivation and storage. Standard techniques for cuttings involve cutting the plant diagonally just above a leaf or shoot node, and dipping the cut end in rooting powder to encourage root growth. Cultivation methods should be determined by horticultural experts at KFBG.
- The stored and cultivated plants will be held by KFBG for a maximum of three years. KFBG have agreed in principle to carry out this work. Details concerning both these measures should be discussed and specified with KFBG staff.
- After the three-year monitoring period, any remaining stored plants/cuttings should be transplanted to the receptor sites. If no room is available at the sites, relocation to other wetlands (such as newly created compensatory wetlands) should be considered.

**Table 8.7 Summary of the collection and storage of seeds, plants and cuttings**

Task	Time Required	Date	Personnel	Details
<b>Seed Collection</b>				
Collect seed from donor site.	6 days	2 days in February March, and April	Plant biologist	<ul style="list-style-type: none"> <li>• Confirmation of seed deposit to RBG Kew and KFBG.</li> <li>• Most species are expected to produce seed Oct.-Nov. or in March.</li> <li>• Seed to be kept cool &amp; dry.</li> </ul>
Dispatch seed with appropriate paperwork & herbarium references	3 days	1 day in February March, and April	Plant biologist	Seed collection: courier seed immediately to seed bank with appropriate herbarium reference, paperwork required by seed bank including fax to confirm, and instructions to test seed viability if facility available.
<b>Plant Storage/ Cutting Collection</b>				
Collection of 50 cuttings from <i>N.mirabilis</i>	1 day	February 2002	Plant biologist	Cuttings taken directly to KFBG
Collection of small number of rare plants for storage at KFBG	1 day	February 2002	Plant biologist and assistant	General guidelines for transplanting given in section 4.6/4.7 should be followed. Plants to be taken directly to KFBG.

8.94 A summary of *ex-situ* mitigation measures for restricted/protected plant species directly affected by the proposed works is given in table 8.8.

**Table 8.8 Summary of mitigation measures for restricted/protected plant species**

Species	Location at Penny's Bay*	Tag no.**	Habitat at Penny's Bay***	HK seed times	Mitigation measures
<i>Eleocharis acutangula</i>	Wetland area a	850	SW facing, wetland vegetation to 60 cm, flat land, sand over rock, 0-1 cm water.	March-April, July-Oct.	<ol style="list-style-type: none"> <li>1. Dispatch seed to seed bank**</li> <li>2. Relocate 3 clumps to KFBG</li> <li>3. Transplant individuals to wetland receptor site.</li> </ol>
<i>Eriocaulon merrillii</i>	Near Wetland area b	None	Open, sheltered, SW facing, 2-4 m altitude, flat land, sand over rock, 0-5 mm water.	May-Sept.	<ol style="list-style-type: none"> <li>1. Dispatch seed to seed bank.</li> <li>2. Relocate 5 clumps to KFBG</li> <li>3. Translocate individuals to wetland receptor site.</li> </ol>
<i>Fimbristylis acuminata</i>	Wetland area b Small clumps located on slope behind shipyard	842, 848	Open, sheltered, S-SW facing, low altitude, flat land, relatively poor drainage	Feb., May, Sept. Nov.	<ol style="list-style-type: none"> <li>1. Dispatch seed to seed bank</li> <li>2. Relocate 5 clumps to KFBG</li> <li>3. Translocate individuals to wetland receptor site.</li> </ol>
<i>Fimbristylis complanata</i>	Wetland area b	835, 836, 842	Open, S-SW facing, 0-4 m altitude, flat land, sand substrate, over rock.	July - Nov.	<ol style="list-style-type: none"> <li>1. Dispatch seed to seed bank</li> <li>2. Relocate 5 clumps to KFBG</li> <li>3. Translocate individuals to wetland receptor site.</li> </ol>

<i>Fuirena ciliaris</i>	Wetland area b, small clumps located on slope behind shipyard, and close to wetland area b	842, 849, 851-853	Open, SW facing, 2-4 m altitude, flat land, sand over rock.	Oct. Nov.	<ol style="list-style-type: none"> <li>1. Dispatch seed to seed bank.</li> <li>2. Relocate 5 clumps to KFBG</li> <li>3. Translocate individuals to wetland receptor site.</li> </ol>
<i>Nepenthes mirabilis</i>	Areas P2a, P2b, and P2c  Wetland areas a and b	837-841, 843-847, P2a, P2b, P2c.	Stream courses of south facing shrubland, on 30 – 90% gradients of granite or fencing, sand-mud substrate over rock, associated with <i>Rhodomyrtus tomentosa</i> (rose myrtle)	July – Sept.	<ol style="list-style-type: none"> <li>1. Dispatch seed to seed bank.</li> <li>2. Dispatch 50 cuttings to KFBG for cultivation and storage.</li> <li>3. Translocate individuals to wetland receptor site.</li> </ol>
<i>Xyris pauciflora</i>	Wetland area a Less than 10 individuals.	None	Open, sheltered, SW facing, 2-4 m altitude, flat land, sand over rock, 0-5 mm water.	Oct. – Mar.	<ol style="list-style-type: none"> <li>1. Dispatch seed to seed bank</li> <li>2. Dispatch 5 individuals to KFBG for storage</li> <li>3. Translocate individuals to wetland receptor site</li> </ol>

\* For locations, please refer to Figures 8.5a-8.5c

\*\* tag numbers refer to on-site tagging of some affected individuals by Millicich & Co.

\*\*\* As many seeds as possible from each species should be collected, to maximise the success rate of this mitigation measure.

### Impacts to MTHS and Rice Fish population

- 8.95 In addition to affecting restricted/protected plant species, the lower course of MTHS (approx 75m) will be extensively and unavoidably modified by proposed fill-works at CLS. As such, mitigation measures focus on compensating for the loss of Rice Fish habitat by the recreation of a suitable habitat above the proposed area of works. Details of these mitigation measures are given in sections 8.98-8.115.
- 8.96 The specifics of mitigation measures will depend largely on the result of future surveys. It is recommended that at least two more detailed fish surveys of the stream are conducted prior to the commencement of slope/fill works. If *O.curvinotus* are found in the stream, they will be temporarily relocated to aquaria, where they will be held until a suitable habitat has been recreated (see sections 8.98-8.112) If no *O.curvinotus* are found in the stream, the possibility of stocking the recreated habitat with fish from another source should be investigated (see sections 8.113-8.115).
- 8.97 To ensure the suitability of holding aquaria and the re-created habitat, recording of abiotic factors (water quality parameters: including dissolved oxygen, conductivity, pH and nutrient levels; other measures of habitats to include water flow rate, depth, substrate composition) should be conducted during detailed fish surveys.

### Habitat Recreation

- 8.98 Measures to mitigate adverse impacts to the *O.curvinotus* population will focus on re-creating a suitable habitat for the species upstream of MTHS where impact arise from construction works to the re-created habitat is minimal. A small dam will be constructed and such dam creating a pool of slow flowing water will provide a suitable habitat for *O.curvinotus*. Boulders and other substrate taken from downstream areas affected by channelisation works will be used to construct the dam. The general design of the recreated habitat is illustrated in Fig. 8.7
- 8.99 In addition to the proposed recreated habitat, other measures to increase the ecological value of the drainage channel at MTHS should be considered. The channel should be designed to

mimic natural streams to compensate for the unavoidable loss of stream habitat. Small weirs (10-20cm above the substrate level) should be provided along the course of the drainage channel, to create a pool/riffle sequence similar to natural stream habitats. Cobbles and boulders from the existing stream course should be added to the pool sections, to provide a suitable habitat for benthic macroinvertebrates and other stream wildlife.

- 8.100 Following the establishment of suitable environmental conditions, the fish will be relocated to the recreated habitat.

#### *Collecting fish*

- 8.101 Two methods should be used to collect any *O.curvinotus* currently populating MTHS. Firstly, the fish should be collected with fish traps. It is expected that this method will result in the majority of *O.curvinotus* being captured with minimal stress. A hand-net should be used to catch any remaining fish in the stream.
- 8.102 Fish should be transported immediately to holding aquaria in plastic containers filled with water from MTHS, and oxygenated with portable air pumps.
- 8.103 It is suggested that this operation be carried out in the dry season for the following reasons:
- Lower flow rates in the dry season will facilitate the collection of fish
  - Lower temperatures in the dry season will minimise the risk of heat stress to the fish while being transported to holding aquaria.
- 8.104 The collection and transport of fish to holding aquaria should be carried out by an experienced ecologist/biologist specialising in local freshwater fish.

#### *Holding Aquaria*

- 8.105 Holding aquaria should be housed in a suitable indoor location with stable ambient conditions (especially temperature). To minimise the time taken to transport fish to and from MTHS, the aquaria should be housed close to MTHS if practicable.
- 8.106 Holding aquaria need to be established well in advance of the fish being collected and relocated. Initially, the tanks should be filled with water from MTHS. Cobbles and small stones from the stream should also be added to the tanks, to provide cover and hiding places for the fish.
- 8.107 Regular monitoring of water chemistry (i.e., pH, DO, nutrient levels) should be conducted and compared to baseline data collected during detailed surveys (see section 8.97). Remedial measures (e.g., increased filtration/water changes to reduce nutrient levels; increasing/decreasing aeration to maintain DO) should be implemented where necessary to ensure suitable conditions are maintained.
- 8.108 Once stable and suitable conditions have been established, the relocation of *O.curvinotus* from MTHS to the holding aquaria can proceed.
- 8.109 Following the relocation of fish to the aquaria, monitoring of water quality should be continued, as should the implementation of any measures necessary to maintain water quality.

- 8.110 The maintenance of fish tanks and care of captive fish should be overseen by an experienced ecologist/biologist specialising in local freshwater fish.

*Relocation of O.curvinotus to recreated habitat*

- 8.111 It is important that *O.curvinotus* are moved to the recreated habitat following the completion of slope/fill works, and the construction of the channelised section of MTHS. Additionally, surveys of fauna (e.g., macroinvertebrates) in the recreated habitat should be conducted before the fish are re-located. The Rice-fish should only be relocated after the habitat has become established, and has been colonised by aquatic invertebrates and other organisms.

- 8.112 Fish should be transported to the re-created habitat in plastic containers oxygenated with portable air pumps.

*Alternative sources of O.curvinotus*

- 8.113 If no *O.curvinotus* are found at MTHS in future surveys, it may be possible to stock the re-created habitat with fish from other sources. Local freshwater ecology specialists or research institutes should be contacted to determine if they maintain populations of this species in captivity.

- 8.114 Re-locating any population from aquaria to the recreated habitat should follow guidelines detailed in sections 8.111-8.112.

- 8.115 If Rice Fish are found in future surveys, they should be temporarily relocated to holding aquaria. A recreated habitat suitable for the fish should then be constructed at MTHS, and the fish returned to the habitat.

*Other Mitigation Measures*

- 8.116 The following measures are suggested to avoid, minimise and compensate for other impacts arising from various phases of the Project:

*Shipyard Decommissioning*

- 8.117 All potentially harmful contaminants from CLS should be handled, treated and disposed of in an appropriate manner; to avoid and minimise risks to human health and flora and fauna. For further details, please refer to other Sections 4,5 & 7 of this Report, which discuss Land Contamination and Air/Water Quality issues.

- 8.118 Several measures can be implemented to avoid and minimise disturbance to habitats at TKW, including potential Ardeid nesting sites:

- The construction of of biopiles (where high levels of activity may disturb the birds) should take place from October-February, outside of the Ardeid breeding season;
- Thermal Desorbers should be placed at the west of the site, as far from potential nesting sites as possible

*Fill/Slope works*

- 8.119 Shotcrete should not be used for the slope works. The design of slope works should make reference to the GEO Publication No. 1/2000 "Technical Guidelines on Landscape Treatment and Bioengineering for Man-made Slopes and Retaining Walls"
- 8.120 Works on slopes supporting natural vegetation should be minimised as far as slope safety standards allow.
- 8.121 Newly created slopes should be hydro-seeded, and, planted with tree and shrub species. If conditions prove suitable, native plants should be used in preference to exotic species.

#### General Mitigation Measures

- 8.122 The following mitigation measures are applicable to all works associated with the project
- 8.123 Before commencement of works, staff should be informed by the Site Engineer of the conservation significance of restricted/protected plant species directly impacted by the development.
- 8.124 Placement of equipment or stockpile in designated works areas and access routes should be selected on existing disturbed land to minimise disturbance to natural habitats.
- 8.125 Construction activities should be restricted to the work areas that should be clearly demarcated.
- 8.126 The work areas should be reinstated immediately after completion of the works.
- 8.127 Waste skips should be provided to collect general refuse and construction wastes. The wastes should be disposed of timely and properly off-site.
- 8.128 Drainage arrangements should include sediment traps to collect and control construction run-off.
- 8.129 Open burning on works sites is illegal, and should be strictly prohibited.
- 8.130 The Site Engineer should audit the proper implementation of the above mitigation measures.

#### **Residual Ecological Impacts**

- 8.131 The transplantation and storage of restricted plant species, along with Rice fish habitat and pool/riffle recreation, will mitigate for the loss of restricted wetland plant habitats and MTHS respectively.
- 8.132 With the proposed mitigation measures in place, there will still be residual impacts arising from the project.
- 8.133 Loss of grassland/low shrub, brackish wetland, wasteland habitats and CLPS is considered acceptable, given the relatively low ecological value of these habitat types. Furthermore, loss of tall shrub and freshwater wetlands (where no rare or protected species occur) is also considered acceptable, given the relatively low ecological value of these habitat types.

### Ecological Monitoring and Audit (EM&A) Requirement

8.134 The implementation of the transplanting of rare/protected plant species and rice fish habitats will require monitoring and auditing. Details of EM&A requirements are given in sections 8.135-8.140 below.

#### *Restricted/Protected plant species*

8.135 To maximise success rate of relocation, the plants and their environment need to be carefully monitored after transplantation. The monitoring team should include suitably qualified plant biologist, with at least 3 years experience with wetland plants, transplanting projects and vegetation monitoring. Additionally, the team should include a qualified horticulturist with at least 3 years practical experience, available to provide information on seed preservation and cultivation.

#### Monitoring

8.136 Details of the recommended monitoring programme are given below.

- An initial comparison of abiotic parameters at the donor and receptor sites should be made. To confirm the suitability of receptor sites. This data should be reported to EPD/IEC prior to transplantation works, and include a description of habitat conditions (substrate conditions, exposure, altitude, aspect, exposure to sunlight, drainage and water conditions, and seasonal availability of water).
- The receptor sites should be visited over a period of 3 years. Monitoring should be carried out twice weekly for first 4 months after transplanting, and once a month for the remainder of the programme.
- Monitoring should include:
  - A check of the species composition, percentage coverage and condition of vegetation on each of the tagged areas of transplanted wetland and *N.mirabilis* plants.
  - The condition of the wetland/plants should be considered in terms of the presence of flowers/seeds, leaf colour, signs of disease/pests, signs of stress (e.g., resulting from lack of water/too much sunlight); and evidence of self regeneration
  - Abiotic factors to be monitored should include water quality parameters (water depth, dissolved oxygen, pH, salinity, temperature) and soil condition
- Any signs of plant stress should be recorded together with actions taken.
- During monitoring, routine maintenance of the receptor site should be implemented. The most important maintenance tasks should include:
  - Ensuring the wetlands/plants are receiving sufficient water.
  - Controlling invasive plant species such as exotic climbers, which may smother the transplanted species.

- Short reports containing results of field investigation and measurements should be prepared after each monthly survey. Submitted by the contractors monitoring team for review by the IEC and EPD within 15 days of the end of the reporting month. Reports should contain details of:
  - Monitoring work undertaken during the reporting period;
  - Plant survival;
  - Signs of plant stress; and
  - Any management actions undertaken.

#### Remedial measures

8.137 Routine monitoring and maintenance should ensure the wetland plants become successfully established at the receptor site. However, if large numbers of plants die back and do not re-grow, remedial strategies must be implemented. These strategies should include the germination of stored seeds, and the transplanting of stored plants and *N.mirabilis* cuttings from KFBG.

8.138 Remedial measures to be implemented at specific action levels are detailed below:

- Less than 50% survival
  - Instigate germination of a portion of seed for the species in question, and arrange for the planting of stored plants/cultivated cuttings
  - Review of the conditions at the receptor site to ensure it is still considered suitable for the species prior to replanting.
- Less than 30% survival

Very low survival levels may indicate that the receptor site is not suitable for the species in question. Therefore, other sites where the species of concern are known to occur should be identified and monitored, in order to:

  - document additional information on species preferences, flowering time and seed production;
  - collect seeds in a controlled manner to ensure that there is a genetic resource of this species;
  - undertake trials to grow seedlings of these restricted/protected species;
  - cultivate seedlings and replant species in alternative receptor sites (an alternative site has been suggested in Tin Shui Wai Recreated Wetland, a review of this and other potential sites should be conducted, where sites are visited and suitability of biotic and abiotic conditions assessed);
  - ensure that plants of these target species at existing sites are adequately protected.

8.139 A summary of the monitoring of transplanted plants and suggested remedial measures is given in Table 8.9 below:



**Table 8.9 Summary of monitoring of transplanted restricted/protected plant species and suggested remedial measures**

Task	Time Required	Date	Personnel	Details
<b>Monitoring</b>				
Monitoring of Donor and Receptor site prior to transplanting	2 days	March 2002 (1 day) April 2002 (1 day)	Plant biologist	Measurements to include: substrate conditions, exposure, altitude, aspect, exposure to sunlight, drainage and water conditions, and determination of seasonality of water.
Monitoring at donor and receptor site	2 days	May 2002: Week 2	Plant biologist	Measurement of baseline data on plants and abiotic variables. Some initial die back is expected in the first week.
Monitoring, data comparison and reporting	Monitoring, 38 days  Data analysis and Report writing, app. 30 days	May 2002 & June 2002 (weeks 2 & 4), July 2002-April 2004	Monitoring team (inc. plant biologist)	Monthly Reports submitted by the monitoring team for review by an independent environmental checker and EPD  Final Report submitted after completion of monitoring period
<b>Remedial Strategies</b>				
Monitoring team report less than 50% survival of a particular species	-	After consultation between IEC/EPD, remedial measures to be implemented by team including plant biologist and horticulturist	Team including plant biologist and horticulturist	Monitoring team to initiate remedial programme:  1) Review conditions at receptor site, and after consultation with IEC/EPD, make any necessary changes to enhance sites conditions.  2) Contact: Kew seed bank to arrange for shipment of seeds to Hong Kong)  3) Contact: AFCD arrange for germination of stored seeds  4) Arrange for germinated seeds to be reintroduced into the receptor site  5) Contact KFBG to prepare plant material for transplanting. Arrange transplanting of stored plants/cultivated cuttings
Monitoring team report less than 30% survival of a particular species	-	After consultation between IEC/EPD, remedial measures to be implemented by team including plant biologist and horticulturist	Team including plant biologist and horticulturist	Further studies of restricted/protected species to include: <ul style="list-style-type: none"> <li>• Identify sites where species already occur</li> <li>• Document additional information on species preferences, flowering time and seed production;</li> <li>• Collect seeds in a controlled manner to ensure that there is a genetic resource of this species;</li> <li>• Undertake trials to grow seedlings of these restricted species;</li> <li>• Identify new receptor sites (i.e., Tin Shui Wai)</li> <li>• Cultivate seedlings and replant species in alternative receptor sites</li> <li>• Ensure that plants of these target species at existing sites are adequately protected.</li> </ul>

*Monitoring of relocated O. curvinotus population*

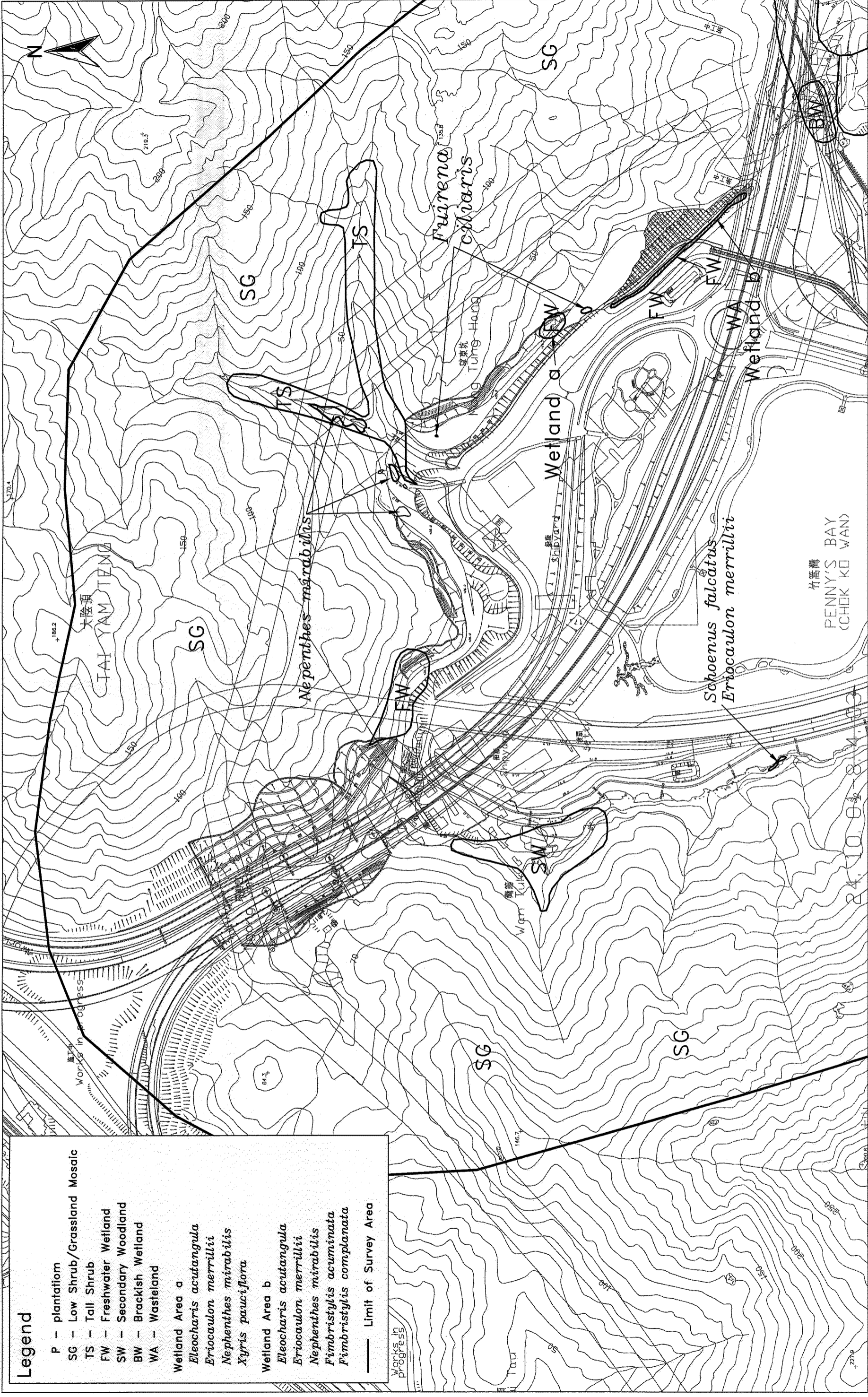
8.140 After relocation, the *O. curvinotus* population should be regularly monitored over a period of 1 year by a suitably qualified ecologist/biologist. The ecologist/biologist monitoring fish populations should have at least three years relevant experience in local freshwater fish ecology/biology. Monitoring should be carried out every two weeks for the first three months after relocation, and monthly for the remainder of the monitoring period.

## Conclusions

- 8.141 The major habitat types within the areas assessed comprised grass/low shrub mosaic, tall shrubland, secondary woodland, brackish and freshwater marshes, wasteland, plantation, freshwater streams and backshore vegetation. Based on the assessment, most habitats within the assessment area were considered to be of low or low/moderate ecological value.
- 8.142 Unavoidable impacts resulting from slope/fill works are expected to affect Rice-fish habitats at Mong Tung Hang Stream, and several restricted/protected plant species in wetlands and tall shrub habitats around Cheoy Lee Shipyard.
- 8.143 To compensate for the adverse impacts on restricted/protected plant species, transplanting of affected individuals to suitable receptor sites is recommended. The reintroduction of plant material stored at specialist storage facilities is recommended as a contingency plan, if transplanting should prove unsuccessful.
- 8.144 To compensate for the loss of Rice Fish habitats, the recreation of a suitable habitat at MTHS is recommended.
- 8.145 The risk to ecological sensitive receivers from the transport of potentially harmful contaminants is found to be very low and therefore acceptable.
- 8.146 With the implementation of the suggested mitigation measures, the ecological impacts arising from this project were found to be acceptable.

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Legend	
P	plantation
SG	Low Shrub/Grassland Mosaic
TS	Tall Shrub
FW	Freshwater Wetland
SW	Secondary Woodland
BW	Brackish Wetland
WA	Wasteland
Wetland Area a	
	<i>Eleocharis acutangula</i>
	<i>Eriocaulon merrillii</i>
	<i>Nephenthes mirabilis</i>
	<i>Xyris pauciflora</i>
Wetland Area b	
	<i>Eleocharis acutangula</i>
	<i>Eriocaulon merrillii</i>
	<i>Nephenthes mirabilis</i>
	<i>Fimbristylis acuminata</i>
	<i>Fimbristylis complanata</i>
—	Limit of Survey Area

Title		Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Constuction Decommissioning of Cheoy Lee Shipyard	
Scale		1:5000	Project No. R06100
Date		Feb 2002	Figure No. 8.1
<b>Maunsell</b> MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD			

Habitat Map - Cheoy Lee Shipyard ( Sheet 1 of 2 )

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**Legend**

- P - plantation
- SG - Low Shrub/Grassland Mosaic
- TS - Tall Shrub
- FW - Freshwater Wetland
- SW - Secondary Wetland
- BW - Brackish Wetland
- WA - Wasteland

**Wetland Area a**

- Eleocharis acutangula*
- Eriocaulon merrillii*
- Nepenthes mirabilis*
- Xyris pauciflora*

**Wetland Area b**

- Eleocharis acutangula*
- Eriocaulon merrillii*
- Nepenthes mirabilis*
- Fimbristylis acuminata*
- Fimbristylis complanata*

— Limit of Survey Area

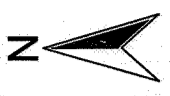
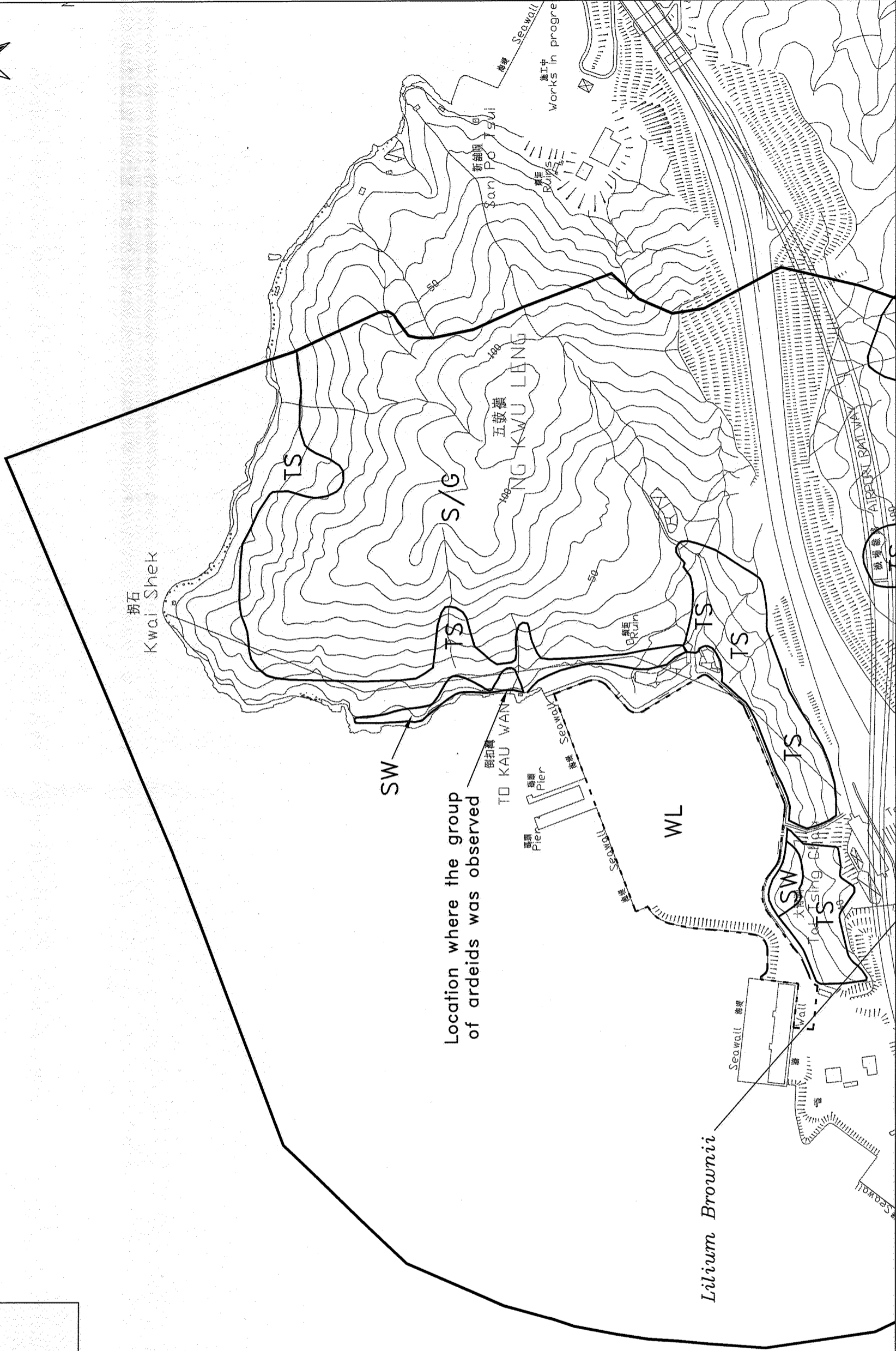
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Date	Feb 2002	Figure No.	8.1
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Habitat Map - Cheoy Lee Shipyard ( Sheet 2 of 2 )

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**Legend**

- S/G - Low Shrub/Grassland Mosaic
- TS - Tall Shrub
- WL - Waste Land
- SW - Secondary Woodland
- Limit of Works Area
- Limit of Survey Area



Title

Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction  
Decommissioning of Cheoy Lee Shipyard

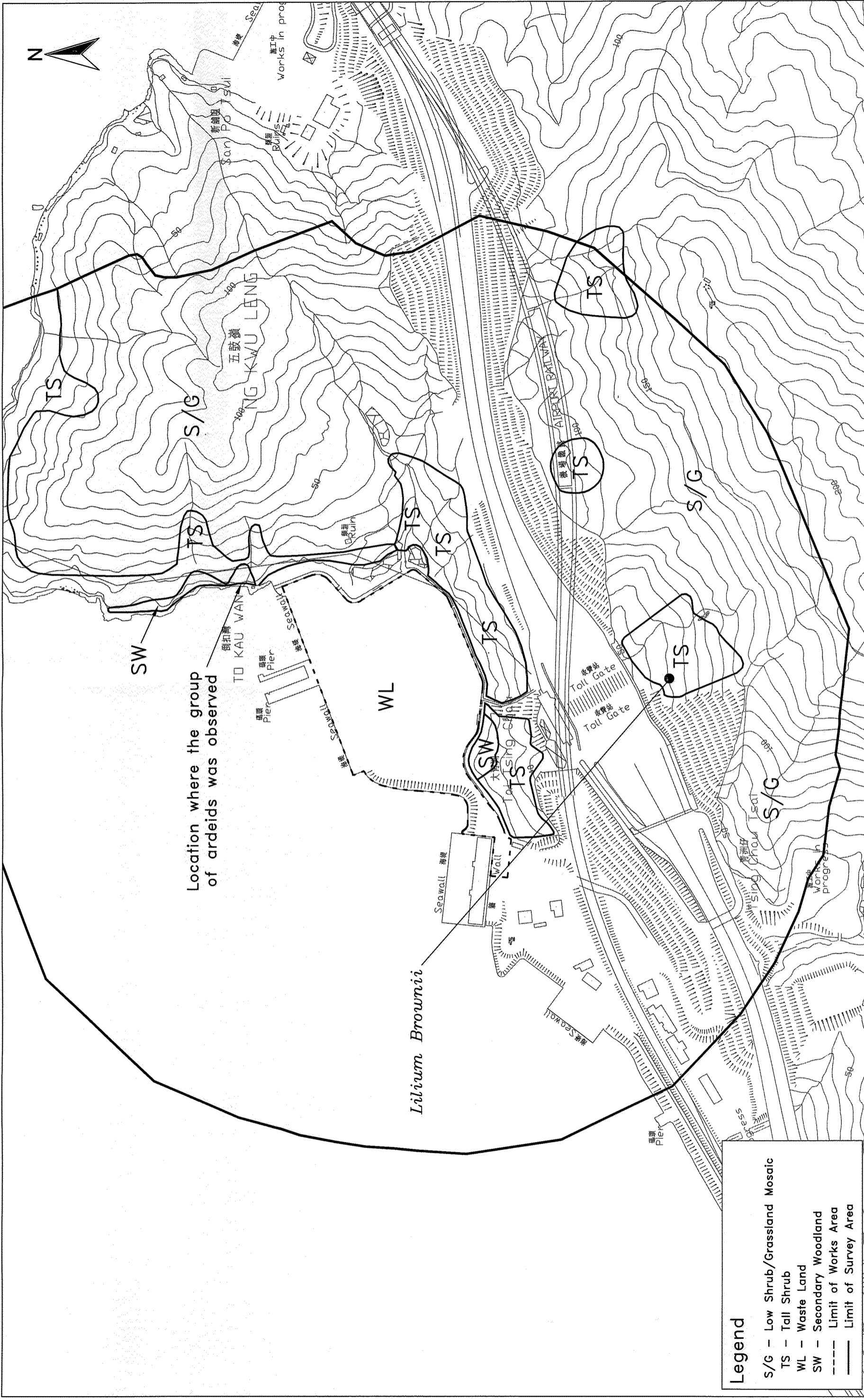
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Date Feb 2002

Project No. R06100

Figure No. 8.2





**Legend**

- S/G - Low Shrub/Grassland Mosaic
- TS - Tall Shrub
- WL - Waste Land
- SW - Secondary Woodland
- Limit of Works Area
- Limit of Survey Area

Location where the group of ardeids was observed

*Lilium Brownii*

Title	Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard	
	Scale	1:5000
Project No.	R06100	
	Date	Feb 2002
Figure No.	8.2	





Wasteland



Small Stand of Backshore Vegetation Fenced to Protect *Scoenus Falcatus* and *Eriocaulon merrillii*. Behind can be Seen the Dominant Shrub/Grassland Mosaic Habitat



Area of Brackish Wetland at the Mouth of the CLP Gas Turbine Stream. Note the Tall Shrub Habitat in the Background.

Title Agreement No. CE 68/99 Infrastructure for Penny's Bay Development Engineering Design and Construction: Decommissioning of Cheoy Lee Shipyard Photographic Records of Representative Habitats in the Project Area	Scale	N.T.S.	Project No.	R06100	
	Date	Feb-02	Figure No.	8.3a	





Secondary Woodland



Area of Fresh Water Wetland Fenced to Protect *Nepenthes mirabilis* and Other Wetland Plants



Plantation

Title Agreement No. CE 68/99 Infrastructure for Penny's Bay Development Engineering Design and Construction: Decommissioning of Cheoy Lee Shipyard <b>Photographic Records of Representative Habitats          in the Project Area</b>	Scale	N.T.S.	Project No.	R06100	
	Date	Feb-02	Figure No.	8.3b	



Patches of low scrub/grass growing on exposed slope north of the shipyard due for reprofiling work

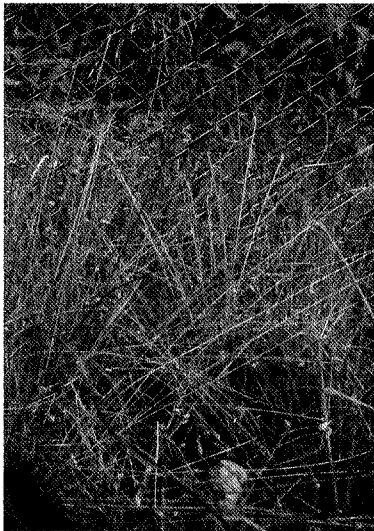
Title	Agreement No. CE 68/99 Infrastructure for Penny's Bay Development Engineering Design and Construction: Decommissioning of Cheoy Lee Shipyard	Scale	N.T.S.	Project No.	R06100	<b>Maunsell</b> <small>MAUNSELL ENVIRONMENTAL  MANAGEMENT CONSULTANTS LTD</small>
	Photographic Records of Representative Habitats in the Project Area	Date	Feb-02	Figure No.	8.3c	



Wetland Area a: Detail of *Fuirena ciliaris*.  
*Fimbristylis* sp. can be noted in the background



*Eriocaulon merrillii*



Wetland Area a: *Eliocharis acutangula*, *Fimbristylis acuminata*,  
*Nepenthes mirabilis* and *Xyris pauciflora*

Title	Agreement No. CE 68/99 Infrastructure for Penny's Bay Development Engineering Design and Construction: Decommissioning of Cheoy Lee Shipyard  Photographic Records of Restricted or Protected Species/ Habitats Directly Affected by the Project	Scale	N.T.S.	Project No.	R06100	
		Date	Feb-02	Figure No.	8.4a	



*Nepenthes mirabilis*



Mong Tung Hang Stream

Title Agreement No. CE 68/99 Infrastructure for Penny's Bay Development Engineering Design and Construction: Decommissioning of Cheoy Lee Shipyard Photographic Records of Restricted or Protected Species/ Habitats Directly Affected by the Project	Scale	N.T.S.	Project No.	R06100	
	Date	Feb-02	Figure No.	8.4b	

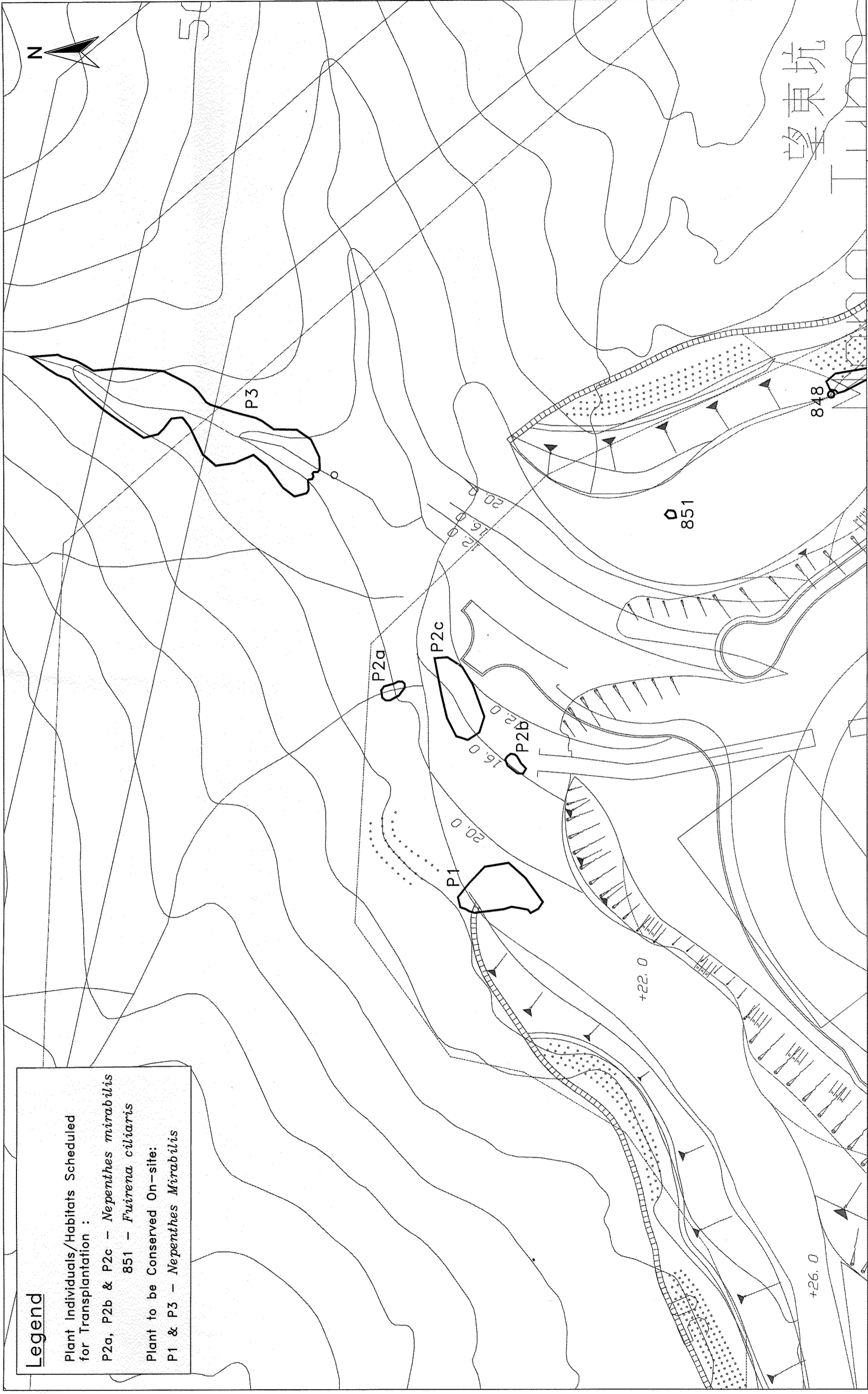
**Legend**

Plant Individuals/Habitats Scheduled for Transplantation :

P2a, P2b & P2c - *Nepenthes mirabilis*  
 851 - *Fuirena ciliaris*

Plant to be Conserved On-site:

P1 & P3 - *Nepenthes Mirabilis*



Title

Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction  
 Decommissioning of Chey Lee Shipyard

Scale 1:1000

Date Jan 2002

Project No. R06100

Figure No. 8.5a

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**Legend**

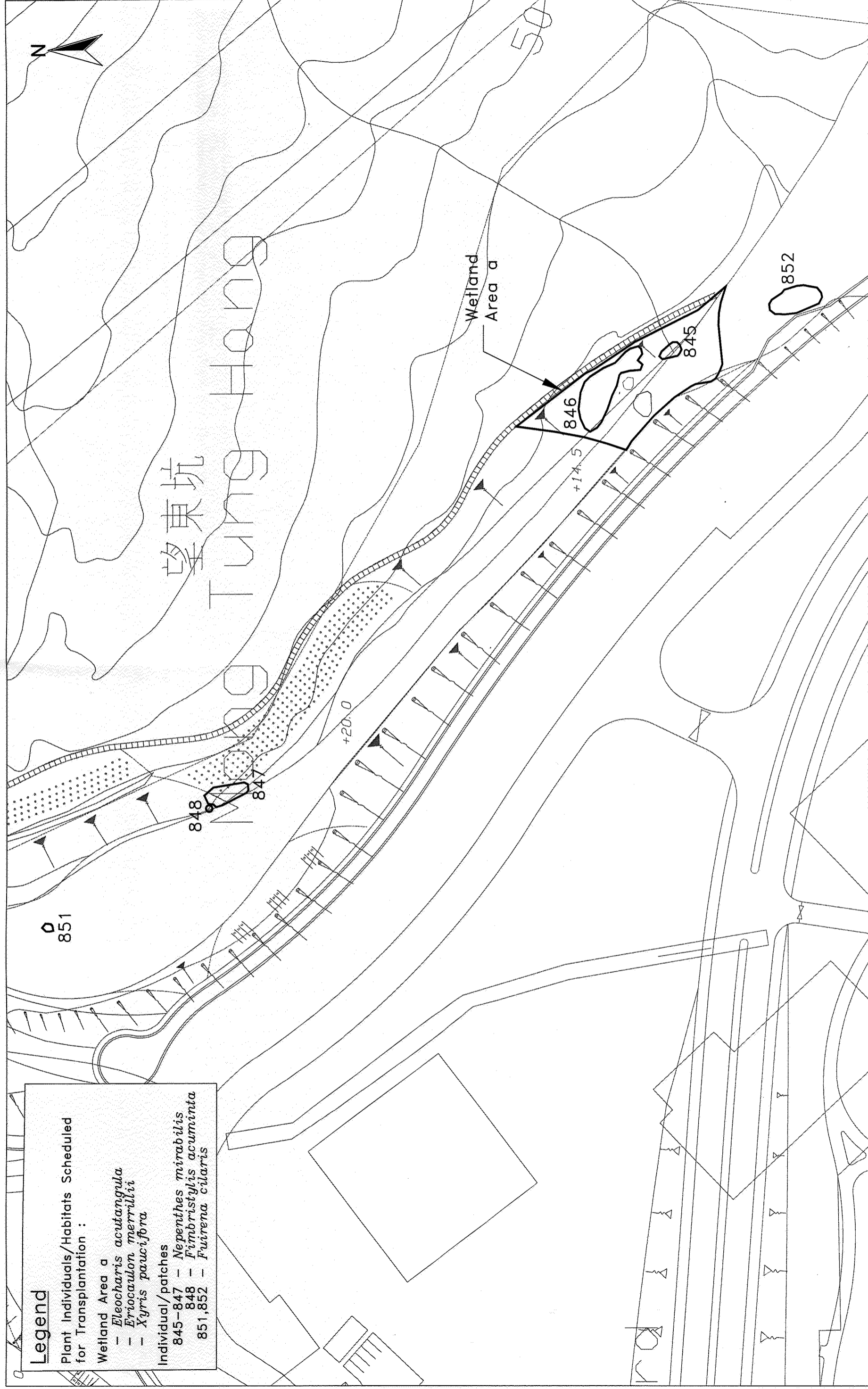
Plant Individuals/Habitats Scheduled for Transplantation :

Wetland Area a

- *Eleocharis acutangula*
- *Eriocaulon merrillii*
- *Xyris pauciflora*

Individual/patches

- 845-847 - *Nepenthes mirabilis*
- 848 - *Fimbristylis acuminata*
- 851,852 - *Fuirena ciliaris*



Title

Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction  
Decommissioning of Cheoy Lee Shipyard

Scale 1:1000

Project No. R06100

Location of Species Scheduled for Transplantation

Date Jan 2002

Figure No. 8.5b

**Legend**

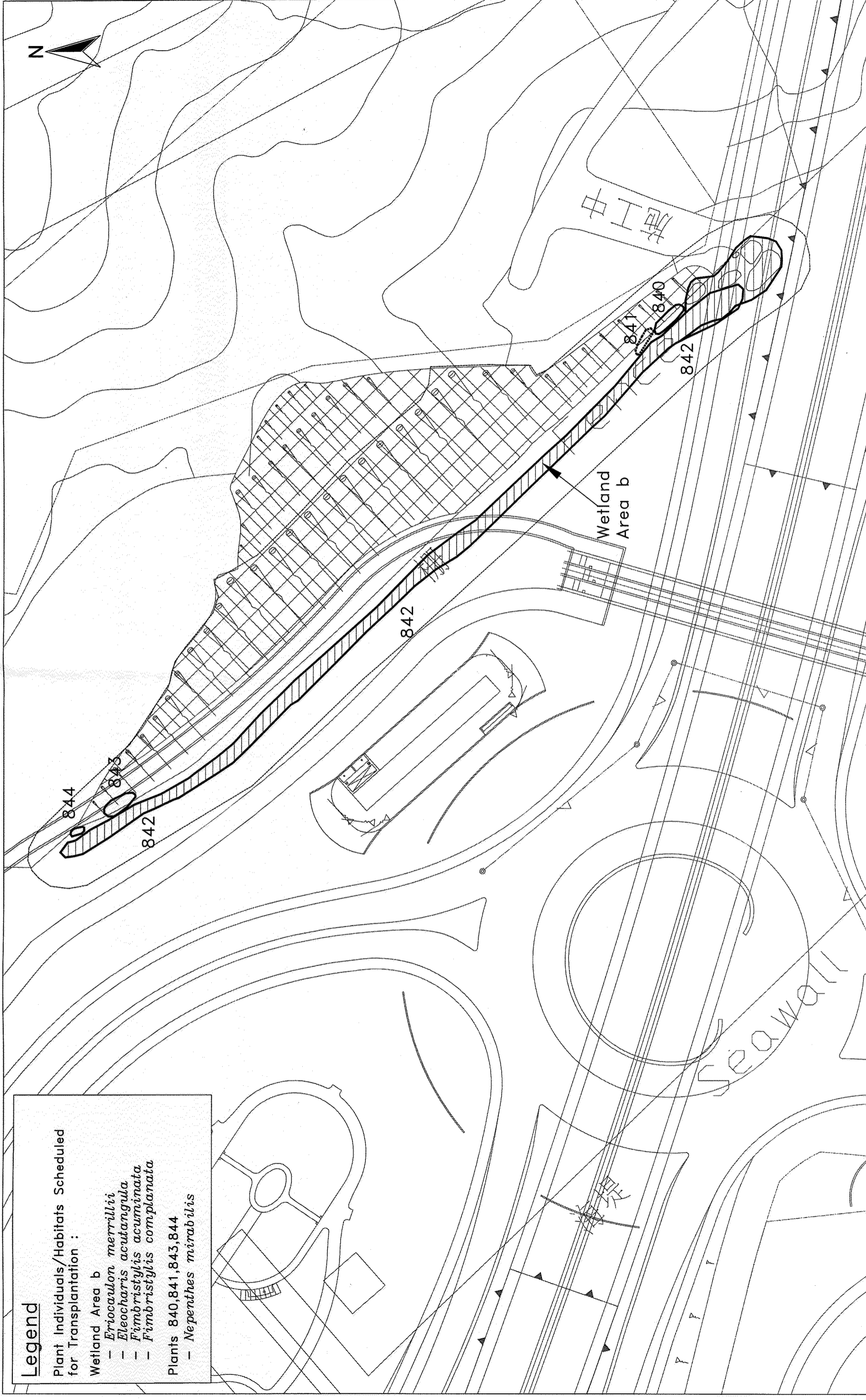
Plant Individuals/Habitats Scheduled for Transplantation :

Wetland Area b

- *Eriocaulon merrillii*
- *Eleocharis acutangula*
- *Fimbristylis acuminata*
- *Fimbristylis complanata*

Plants 840,841,843,844

- *Nepenthes mirabilis*



Title

Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction  
Decommissioning of Chey Lee Shipyard

Scale  
1:1000

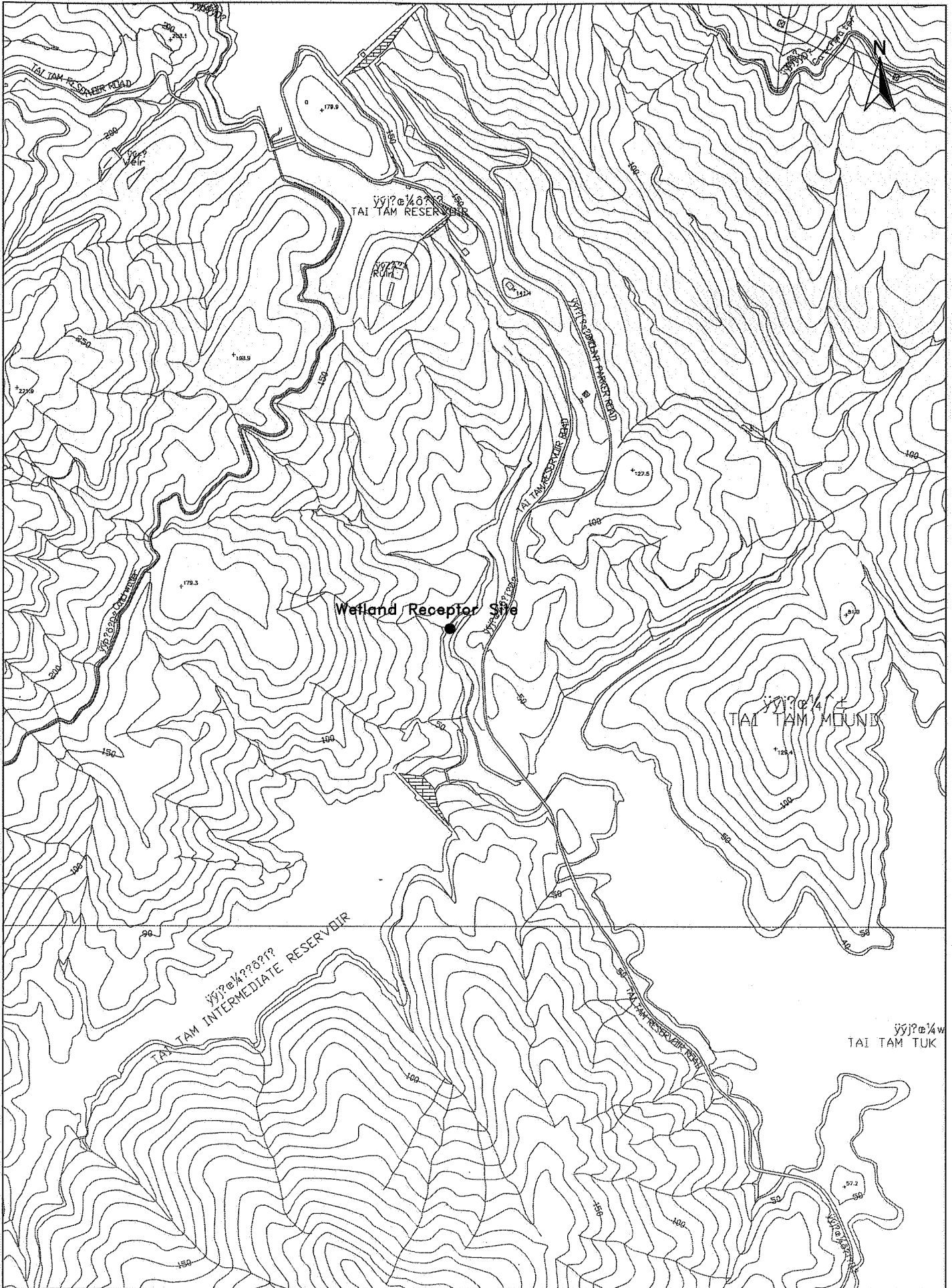
Project No.  
R06100

**Location of Species Scheduled for Transplantation**

Date  
Feb 2002

Figure No.  
8.5c

**Maunsell**  
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MANAGEMENT CONSULTANTS LTD



Title      Agreement No. CE 68/99 Infrastructure for Penny's Bay Development -  
 Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard

**General Location of Wetland Receptor Site,  
 Tai Tam Country Park**

Scale  
**1 : 5000**

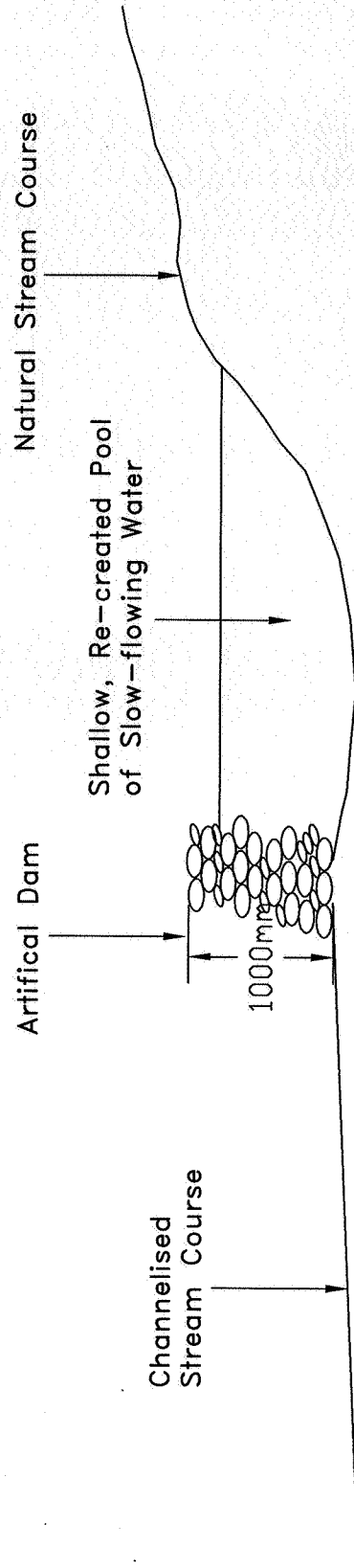
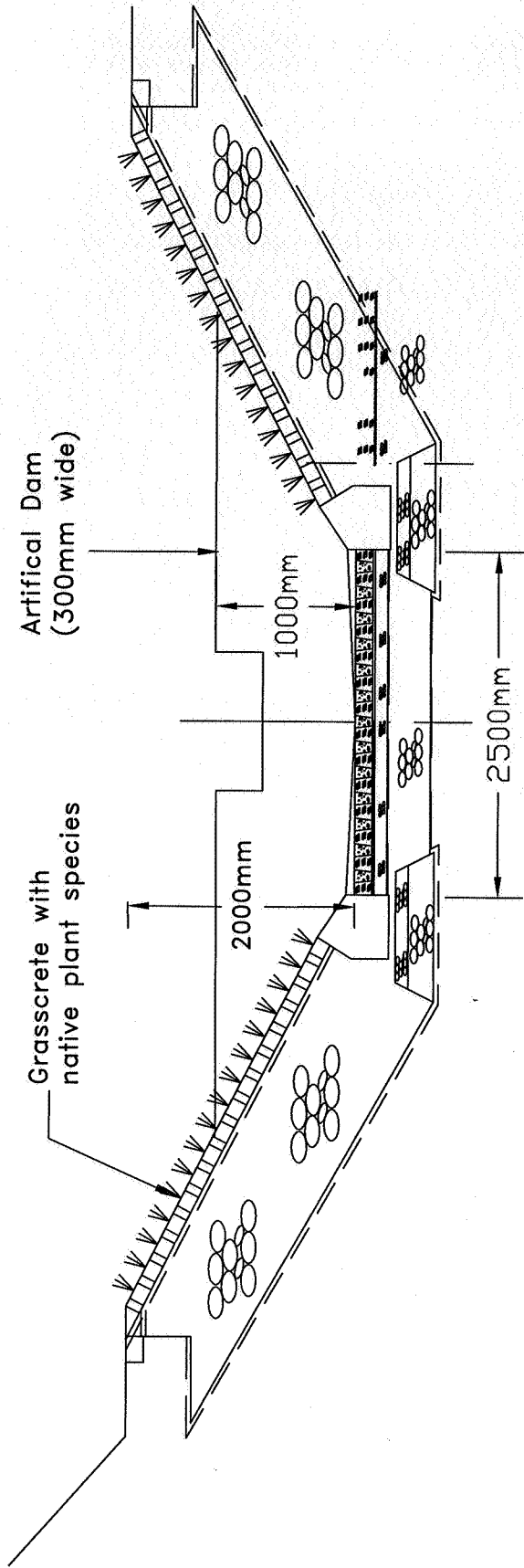
Date  
**Feb 2002**

Project  
 No.      **R06100**

Figure  
 No.      **8.6**

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 MANAGEMENT CONSULTANTS LTD





Longitudinal Section Through Recreated Rice Fish Habitat

Title Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard General Design of Recreated <i>Oryzias curvinitus</i> Habitat above Channelised Stream	Scale 1:500	Project No. R06100
	Date Feb 2002	Figure No. 8.7