

Planning Division,
Geotechnical Engineering
Office

**Agreement No. CE
31/2004 (GE) Natural
Terrain Hazard
Mitigation Works in Kwai
Chung, Victoria Road
and Luk Keng Village -
Design and Construction**

Natural Terrain Hazard
Mitigation Works in Luk
Keng Wong Uk
(Project Profile)

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Works in Kwai Chung, Victoria Road and Luk Keng Village - Design
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Natural Terrain Hazard Mitigation Works in Luk Keng Wong Uk
(Project Profile)

June 2006

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PROJECT PROFILE

1. BASIC INFORMATION

1.1 Project Title

1.1.1 The project title is Natural Terrain Hazard Mitigation Works in Luk Keng Wong Uk (hereafter called "the Project")

1.2 Purpose and Nature of the Project

1.2.1 This project aims to construct natural terrain landside risk mitigation measures to protect Luk Keng Wong Uk from landslide hazards from the natural hillside overlooking the village. The hillside has a history of landslides and the landslide risk requires mitigation.

1.2.2 The proposed works in Luk Keng Wong Uk is partly within the boundaries of Pat Sin Leng Country Park and a "Conservation Area" under Outline Zoning Plan (OZP S/NE-LK/9 – Luk Keng & Wo Hang). According to the Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO), the Project is classified as a Designated Project (DP) under Item Q.1, Part 1 of Schedule 2. Therefore an Environmental Permit (EP) is required prior to the commencement of the construction works. According to Section 5(11) of the EIAO, the Project Proponent would apply for permission to apply directly for an EP. The extents of the hillsides concerned in Luk Keng Wong Uk are illustrated in **Figure 1-1**.

1.2.3 The construction period of the Project would require approximately 22 months, with a tentative commencement date in the 4th quarter of year 2006 and the completion date in the 3rd quarter of year 2008 (see **Section 2.2**).

1.3 Name of Project Proponent

The Project Proponent is the Geotechnical Engineering Office, Civil Engineering and Development Department, Government of the Hong Kong Special Administrative Region.

1.4 Location and Scale of the Project and History of Site

- 1.4.1 Luk Keng Wong Uk has been established long time ago. Agriculture and fishpond culture were the dominant activities by the villagers. Despite of the urban development in Hong Kong in the previous decades, the general environmental setting in Luk Keng remains intact.
- 1.4.2 Two natural terrain landslides occurred on the hillsides behind Luk Keng Wong Uk in year 1997 and 1998. The landslide debris were channelised and some of the debris were deposited in the village area at the toe of the hillside. A detailed natural terrain hazard study was carried out after the landslides and the study found that the hillsides concerned have a history of landslides. The study concluded that the natural terrain landslide risk requires mitigation.
- 1.4.3 The proposed natural terrain hazard mitigation works and the associated worksites in Luk Keng Wong Uk are presented in **Figures 1-2 to 1-4**. The proposed natural terrain hazard mitigation scheme can be summarized as follows:
- (i) Flexible barriers (tensioned steel mesh fences) to retain landslide debris;
 - (ii) Baffles to slow down landslide debris;
 - (iii) Soil nailing works at previous landslide scars to stabilise the hillside (outside woodland);
 - (iv) Drainage improvement works for an existing gully;
 - (v) Soil nailing and concrete retaining wall for registered man-made slope feature 3NE-C/C135, and soil nailing for registered man-made slope feature 3NE-C/C13; and
 - (vi) Surface drainage channels with access paths / stairways to ensure proper control and discharge of surface water.
- 1.4.4 Operational phase of the proposed natural terrain hazard mitigation works would be limited to routine maintenance of the mitigation measures only (e.g. periodic clearance of accumulated debris at the barriers).

1.5 Number and Types of Designated Projects to be Covered

- 1.5.1 In accordance with Item Q.1, Part 1 of Schedule 2 of the TM-EIAO, the Project would be regarded as a Designated Project (DP), and an EP is required prior to the commencement of the construction works.
- 1.5.2 Other than this Project, no other designated projects are covered in this project profile.

1.6 Name and Telephone Number of Contact Person(s)

1.6.1 All queries regarding the Project can be addressed to the following:

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2. OUTLINE OF PLANNING AND IMPLEMENTATION PROGRAMME

2.1 Project Proponent, Engineer and Contractor

2.1.1 The Geotechnical Engineering Office (GEO) of the Civil Engineering and Development Department (CEDD) is the Project Proponent with overall responsibility for the planning, design and construction. Ove Arup & Partners Hong Kong Ltd. (Arup) was commissioned as the engineering and environmental consultant. The proposed works will be implemented by the Contractor(s) to be appointed by CEDD at a later stage.

2.2 Tentative Implementation Programme

2.2.1 According to the current design and planning, the construction period of the Project would last for approximately 18 months as illustrated in the following table. The tentative construction commencement date is in the 2nd quarter of 2007 and the completion date is targeted at the end of 3rd quarter of 2008.

Table 2-1: Construction Programme (Tentatively only)

Item	Works	Month																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
1	Soil nailing at previous landslide scars in hillside	■	■	■															
2	Baffles				■	■	■												
3	Flexible barriers		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
4	Drainage improvement works (Trapezoidal channel)		■	■	■	■	■												
5	Pumping concrete	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
6	Slope upgrading works on man-made slopes							■	■	■	■	■	■						

2.2.2 As shown in **Table 2-1**, soil nailing would need about 3 months and would be followed by constructing baffles for another 3 months.

2.2.3 There are a total of 10 sections of flexible barriers and would need approximately 17 months for their construction. Each section of the flexible barriers would be constructed in sequence, with each takes approximately 2 months. The trapezoidal channel is about 10m long and would take approximately up to 5 months for construction. Slope upgrading works for each man-made slopes (slope number 3NE-C/C135 and 3NE-C/C13) would take about 6 months and would be constructed sequentially.

2.3 Construction Methodology

2.3.1 According to the current design, the envisaged construction methods and plant involved are summarized in the table below:

Table 2-2: Tentative Construction Methods for Various Works

Type of Works	Construction Method
Flexible barrier	<ul style="list-style-type: none"> Flexible barrier involves erection of tensioned steel mesh fence across posts supported on anchor foundation. Anchor foundation involves drilling within soil and rock using portable drilling tools, followed by installation of anchor and grouting. The approximate size of the drillhole is 0.1m in diameter.
Soil nail at previous landslide scars in hillside	<ul style="list-style-type: none"> Soil nail involves drilling within soil and rock using portable drilling tools, followed by installation of steel bar and grouting. The approximate size of the drillhole is 0.1m in diameter.
Baffles	<ul style="list-style-type: none"> Baffles involve erection of a composite mass of about 1m high comprising steel tube filled with concrete, supported on mini-pile and soil nail foundation. Mini-pile involves drilling within soil and rock using small piling rig, followed by steel bars installation and grouting. The approximate diameter of the drillhole is less than 0.3m in diameter. Construction of soil nails is similar to that for soil nailing at previous landslide scars in hillside.
Soil nail for man-made slopes	<ul style="list-style-type: none"> Soil nail involves drilling within soil and rock using portable drilling tools, followed by installation of steel bar and grouting. The approximate size of the drillhole is 0.1m in diameter.
Concrete retaining wall for man-made slopes	<ul style="list-style-type: none"> Minor excavation and concreting for a structure of about 1.5m high near the toe of the slope 3NE-C/C135.

- 2.3.2 The current construction methodology does not require haul roads. Construction plant will be transported by labour to the works areas up in the hillside.

2.4 Environmental Considerations

Soil Nailing at Previous Landslide Scars in Hillside

- 2.4.1 The majority of the soil nailing work on the hillside has been purposefully designed to be at the previous landslide scars only to avoid encroaching into the woodland on the hillslope behind Luk Keng Wong Uk (see **Figure 1-2**). This would avoid the impacts on those trees within the woodland to the maximum practicable extent.

Baffles for Hillside

- 2.4.2 Similar to soil nailing, most of the baffles (ie impediments to landslide debris) are located outside the woodland to avoid impacts on those trees within the woodland to the maximum practicable extent.

Avoid Placing Noisy Plant Close to Receiver

- 2.4.3 A concrete pump would be required to pump concrete for the foundation of the flexible barriers and other natural terrain hazard mitigation measures (see **Section 5**). Concrete pump is a relatively noisy plant item. Instead of moving the concrete pump as the work front (which would inevitably get close to the receivers and increase the noise impacts), the concrete pump would be strategically located at the western temporary works area (currently the open playground). The site hoarding would also provide attenuation to protect the neighbouring receivers.

Minimising Impacts on Country Park and Conservation Area

- 2.4.4 Due to the vicinity of the country park and the conservative area, it is not possible for the proposed works to totally avoid the country park and the conservation area. In order to reduce the impacts, environmental friendly methods including soil nail, baffles and flexible barriers, which have the flexibility to avoid local constraints (eg trees), have been adopted.

Minimizing Impacts by Refining the Design Layout

- 2.4.5 The length of the trapezoidal channel has also been minimised from over 30m to about 10m to avoid the impacts on the fern species *Cibotium barometz* (the Lamb of Tartary) (see **Section 4**).

2.5 Interaction with Other Projects

- 2.5.1 There are no other projects in the vicinity. Hence there are no interactions with other projects.

3. MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT

3.1 Existing and Planned Sensitive Receivers

Ecological Sensitive Receivers

3.1.1 In accordance with No. 2 and 9 of Note 1, Appendix A, Annex 16 of TM-EIAO, there are 3 sites of conservation importance which would overlap with the project area (see **Figure 3-1**):

- Pat Sin Leng Country Park - The previous landslide scars behind Luk Keng Wong Uk requiring soil nailing works fall within the country park boundary;
- Conservation Area under OZP S/NE-LK/9 Luk Keng & Wo Hang - Some of the works areas for the Project are located within Conservation Area; and
- Luk Keng Wong Uk Fung Shui Wood – This wood was one of the fung shui woods recorded and surveyed by AFCD. The boundary of this fung shui wood is unrecognisable, but the woodland behind Luk Keng Wong Uk within the Conservation Area is believed a mixture of it with other secondary woodland. Part of the proposed mitigation (in particular trapezoidal channel and U-channels) is located within this woodland mixture.

3.1.2 Outside the project area, there are also another three sites of conservation importance in accordance with No. 6 and 9 of Note 1, Appendix A, Annex 16 of EIAO TM, which also would not be directly affected by the project.

- Luk Keng Chan Uk Fung Shui Wood (This wood was one of the fung shui woods recorded and surveyed by AFCD.);
- A Chau SSSI; And
- Luk Keng Marsh (It is one of the 12 priority sites under the New Conservation Policy. The boundary of Luk Keng Marsh as illustrated in EPD website would have minimal overlap with the Project Area. The overlapped area however is only existing road and hill slope rather than marsh area. No marsh area would be encroached by the project, and thus the Luk Keng Marsh is not considered overlapping with the project area.)

Noise Sensitive Receivers

3.1.3 The nearest Noise Sensitive Receivers (NSRs) are the village houses in Luk Keng Wong Uk near the toe of the hillside. These NSRs are isolated village houses with 1 to 3 storeys. There is one school building for Luk Keng Primary School in the vicinity but it has been abandoned. **Figure 1-2** illustrates the locations of the typical NSRs. The buildings near to the 2 man-made slopes are stores which are not considered as NSRs. According to the TM-EIAO, the daytime construction noise criterion for these NSRs is 75dB(A) for residential premises.

Air Sensitive Receivers

3.1.4 The Air Sensitive Receivers (ASRs) would include those NSRs as illustrated in **Figure 1-2** and other recreational uses (eg playground, basketball court etc).

Water Sensitive Receivers

3.1.5 The nearest water receiving body in the vicinity of the project site is the Sha Tau Lok region of the Mirs Bay WCZ. There is also an existing gully within the study area. The upper part of the

gully is not paved with concrete while the lower portion has been paved with concrete. For the upper part, drainage improvement / protection work is required which would involve some limited clearance and minimal trimming. Excavation / training / channelization / concreting are not required. For the lower portion of the gully which is already paved with concrete, a new trapezoidal channel would be formed. The alignment of the trapezoidal channel is illustrated in **Figure 1-2** and the section is given in **Figure 1-3**. According to site observations, the gully is relatively dry during winter. During summer, it is anticipated that it would have some limited water flow.

- 3.1.6 The Luk Keng Marsh (highlighted in the “List of Priority Sites for Enhanced Conservation” under the New Natural Conservation Policy issued by AFCD) is located to the east of the proposed work, is also a Water Sensitive Receiver (WSR). There are also some fish ponds in the vicinity which are also considered as WSRs. **Figures 3-1 & 3-9** illustrate the locations of these WSRs.

Landscape and Visual Sensitive Receivers

- 3.1.7 The landscape character comprises 3 distinct landscape character areas (LCAs), namely: villages, lowlands and hillsides. The location of these is illustrated on **Figure 3-2**, while **Figure 3-3** encloses photographs illustrating the nature of each LCA.
- 3.1.8 Village houses have variations in architectural form, height and finishes and tend to be 2 or 3 stories high with flat roofs. Streetscapes are rather bare with little vegetation. Overall, the villages have characteristics that are quite typical in the wider region and will accommodate minor changes without affecting the overall character. Lowlands are occupied with active and abandoned agricultural fields, fishponds, streams and patches of natural vegetation. Landforms are even with very little profile variation. Overall, the sensitivity to character change is medium. Hillsides are characterised by woodlands, scrubland-grassland and some rocky outcrops. Compared with lowlands, the hillsides are mostly untouched and vary in profile. The varying landform profiles allow for opportunities to screen minor works. Overall, the sensitivity to change of hillsides is medium-high.
- 3.1.9 Landscape resources (LRs) within the Landscape Impact Assessment (LIA) study boundary comprise 8 types, namely: streams, fishponds, woodlands, scrublands and grasslands, active and abandoned agricultural fields, mangroves and rocky shores, ocean and village houses and roads. These are illustrated on **Figure 3-4** with representative photographs on **Figures 3-5 and 3-6**.
- 3.1.10 The sensitivity to change of the aquatic resources varies as the sea and rivers are natural features that are rather untouched and would appear artificial if developed, while the fishponds could accommodate some changes. The rivers are narrow with mudflats providing interesting landscape areas. Sea areas within the LIA study boundaries area characterised by still waters having only small waves. Fishponds have a less peaceful appearance being cluttered with artificial banks, shelters, railings etc. Photo No. 2 on **Figure 3-5** illustrates this cluttered appearance. Notwithstanding the above, the fishponds set an interesting rural appearance in the lowland LCAs. In a similar way give the other two artificial resources, agricultural fields and village houses and roads, a rural character to the overall landscape environment. Many agricultural fields are abandoned and only a few were recorded with both dry and wet crop types. A few have small orchards. These types of fields are not considered particularly sensitive to change. As landscape resources, the village houses and roads are also not very sensitive to change. Most village houses are two or three storeys high with flat roofs and balconies, which could be altered without dramatic changes in appearance. Facades are mostly finished with white paint or bare concrete. Some roofs are pitched with clay tiles.
- 3.1.11 Rocky shores and mangroves are considered sensitive to change. The mangroves provide unique local landscape settings, which are rare. Scrubland and grassland areas occur higher up on hillsides and comprise a variety of species, including *Rhodomlytrus tomentosa* and

Listsea rotundifolia. Though these species are common, they are character-forming with a medium to high sensitivity to change. Woodlands occur mostly at slope toes of hillsides and comprise a variety of tree species, including *Schefflera heptaphylla*, *Machilus breviflora* and *Canthium dicoccum*. Parts of the woodland have fung shui characteristics, which are very sensitive to change. Approximate 900 trees were recorded within the works boundaries. The dominant species are *Sterculia lanceolata*, *Aporosa dioica*, *Schefflera heptaphylla* and *Aquilaria sinensis*. A total number of 42 *Aquilaria sinensis* trees were also recorded within the works boundaries. These are rare and precious trees in South China but rather common in Hong Kong, especially in Country Parks¹. Overall, the woodland and its trees have a high sensitivity to change.

- 3.1.12 The nearest group of Visually Sensitive Receivers (VSRs) is the mini-bus terminus at Luk Keng Wong Uk. Viewing distances from this VSR will be less than 20m to the nearest works, namely the construction of the long retaining wall (approximately 30m long and 1.5m high) at the toe of the registered man-made slope No. 3NE-C/C135. Since it is a meeting point in the Village, which is frequently visited with good views to the hillsides behind the slope, its sensitivity to change is considered medium to high. Other VSRs groups are the Kai Kuk Shue Ha Village, Luk Keng Wong Uk Village, users of the Luk Keng road and the Nam Chong Lei Uk Village. The locations of these VSRs are illustrated on **Figure 3-7**. Viewing distances from these other VSRs to the nearest works areas varies from approximately 110m to 300m and a wide range of alternative high quality views are available. Therefore their sensitivity to change is considered medium (**Figure 3-8**).

Archaeological Sites and Cultural Heritage Elements

- 3.1.13 The relevant literature in the Monument Records Office has been reviewed. There is no records indicating that there are any known archaeological sites in the vicinity. However, there are some war relics away from the project boundary (see also **Section 3.2**).

Other Planned Environmental Sensitive Receivers

- 3.1.14 The latest Outline Zoning Plan (OZP) for Luk Keng has been reviewed (S/NE - LK/9 - Luk Keng and Wo Hang, gazetted on April 2005). It indicates that the landuses in the vicinity of the Project would remain unchanged. Hence, it is not anticipated that there are new planned environmental sensitive receivers as compared what have been identified in this Project Profile.

3.2 Major Elements of the Existing Environment

Landuses

- 3.2.1 The Project site is located near the Luk Keng Wong Uk along Luk Keng Road. Pat Sin Leng Country Park is in the close proximity. The terrain to the immediate west of Luk Keng Wong Uk is also classified as "Conservation Area" and the coastline is classified as "Coastal Protection Zone" (see **Figure 1-1**). According to the OZP S/NE - LK/9 - Luk Keng and Wo Hang, there is a general presumption against development in Conservation Area and Coastal Protection Zone. Other than village uses, other dominant landuses in the vicinity include agriculture land and fishponds.

¹ HU, Q. et al (2003) *Rare and Precious Plants of Hong Kong*. AFCD, Hong Kong.

Potentially Hazardous Installation

- 3.2.2 According to EPD's information², there is no Potentially Hazardous Installation (PHI) within 500m from the Project. The nearest PHI is located at Ta Kwu Ling which is more than 1km away.

Archaeological Site and Cultural Heritage Elements

- 3.2.3 According to the literature available, there are no known archaeological site and declared monument within the 500m zone of the Project. The nearest built heritage is Kang Yung Study Hall at Sheung Wo Hang located at about 2km away and screened by the intervening terrain.
- 3.2.4 In addition, there are some military structures up the hill slope at Luk Keng, which are built during the Japanese occupation period³. These structures include trenches, pillboxes and observation post etc. The path leading to these structures is not well-defined and hence the access is difficult. All these structures are beyond the proposed work boundary with a minimum separation distance of 50m. The approximate locations of these structures are illustrated in **Appendix 3-1**.

Ecology

- 3.2.5 An ecological study was conducted to collect information to establish ecological characters of the work sites and its 500m boundary by both literature review and field surveys. Field surveys were conducted in September 2005 (wet season) and March 2006 (dry season) covering habitat, vegetation, mammal, bird, herpetofauna, dragonfly, butterfly and aquatic fauna. The details of the methodology of the field surveys, and the detailed findings from literature review and the ecological surveys are presented in **Appendix 3-2**.
- 3.2.6 As discussed in **Section 3.1**, there are 3 recognised sites of conservation importance which would overlap with the works site boundary of the Project, i.e. Pat Sin Leng Country Park, Conservation Area under OZP and Luk Keng Wong Uk Fung Shui Wood.
- 3.2.7 Besides these 3 sites, there are also another 3 areas of conservation importance in the vicinity of Luk Keng Wong Uk, including Luk Keng Marsh, Chan Uk Fung Shui Wood, and A Chau SSSI. Luk Keng marsh is to the east and southeast of Luk Keng Wong Uk and outside the works site boundary for the Project, while Luk Keng Chan Uk and A Chau SSSI is about 400m and 500m away from the project site respectively. All these areas would not be affected by the Project.
- 3.2.8 The Project Area itself is located on a hill slope immediate to the west of Luk Keng Wong Uk Village, covering an area of about 1.93 ha. The upper part of the Project Area is within the boundary of Pat Sin Leng Country Park while the lower part within the Conservation Area under OZP. There was also a fringe of Village Zone at the lowest part of the Project Area.
- 3.2.9 Only 3 habitats were recorded within the Project Area, i.e. woodland, grassland and urbanized/disturbed. But the urbanized/disturbed habitat was only a fringe of village at the bottom of the hillslope (**Figure 3-9**). There is no aquatic habitat (e.g. streams or ponds) within the Project Area. As reported in the **Appendix 3-2**, there were also other habitats recorded within the 500m distance but outside the Project Area, such as fishponds, streams, marshes and mangroves. These other habitats would not be encroached by the project.

² http://www.epd.gov.hk/epd/english/environmentinhk/air/data/risk_mgt.html

³ "War Relics in the Green", by Ko Tim Keung

- 3.2.10 The grassland within the Project Area covered the upper part of the hillslope which is also within the Pat Sin Leng Country Park boundary. Both floral and faunal diversity was low in the grassland, with no species of conservation importance found.
- 3.2.11 The woodland within the Project Area has an area of about 1 ha. It is a mixture of the original Luk Keng Wong Uk fung shui wood and secondary woodland and mainly located within the Conservation Area (also the lower part of the hillslope). In spite of the relatively high plant diversity and good structure (i.e. with presence of mature trees) in this woodland habitat, the plant species found were dominated by typical and common species. Limited diversity of fauna was recorded and all fauna species were common in Hong Kong. Although no fauna of special ecological importance was recorded inside, the woodland is still considered an ecological concern given its age and size (mature native woodland over 1 ha in size is considered as important habitat type in Hong Kong as stipulated in TM-EIAO).
- 3.2.12 Two plant species considered of conservation importance were recorded during the ecological field survey within the woodland in the Project Area, i.e. *Aquilaria sinensis* (Incense Tree) and a fern species *Cibotium barometz* (the Lamb of Tartary).
- 3.2.13 Incense Tree is not protected in Hong Kong and is rather common in lowland forest and fung shui woods. However, it is a Category III nationally protected species in China and is listed as vulnerable in the China Plant Red Data Book and by IUCN (2002). There were at least 3 mature trees and up to 20 seedlings encountered during the ecological field survey. During the later tree survey for the present study, 42 individuals of Incense Trees were recorded and mapped within the works site boundary (shown in **Figure 4-1a & b**). All of them were seen inside woodland habitat within the Conservation Area. It was therefore not uncommon in the woodland within the Project Area.
- 3.2.14 *Cibotium barometz* is a large tree-like fern native to China including Hong Kong. It is widely distributed and commonly found in Hong Kong, mainly along shrubby and forested valleys and forest margins. Its rhizomes could be used in herbal formulas. It is listed in Appendix 2 of CITES, which is applied for species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled, for control of trade of species for medicinal purposes. Within the Project Area, this fern species was mainly found in two areas near the upper section of the gully (on both sides on the banks, but not inside the gully channel) (shown in **Figure 4-1a & b**). In addition to these two areas, some scattered individuals were also found at the foothill within the Project Area.
- 3.2.15 In addition to the above two plant species, individuals of one tree species of conservation importance, *Artocarpus styracifolius* (Two-coloured artocarpus), were found and mapped within the Project Area during the tree survey (shown in **Figure 4-1a & b**). *Artocarpus styracifolius* is a native Fung Shui wood tree species of restricted distribution in Hong Kong (Xing et al. 2000). It is not protected under the local regulations or in China. 33 individuals of this tree species were scattered within the whole Project Area.
- 3.2.16 Another species of plant, *Phrynium placentarium* which is also considered of conservation importance, was reported in previous Biodiversity Studies conducted by University of Hong Kong to occur about 200m to the southwest of the Project Area, but was not recorded during the present study. *Phrynium placentarium* is a locally rare herb found in lowland forest and streamsides in Hong Kong (Xing et al. 2000). It is not protected under local regulations or in China. Though not found within the Project Area, the potential of the occurrence of this plant would be taken into account in the assessment.

4. POSSIBLE IMPACTS ON THE ENVIRONMENT

4.1 Ecology

4.1.1 As discussed in **Section 1.4**, the proposed natural terrain hazard mitigation works include soil nailing, baffles, flexible barrier, trapezoidal channel, U-channels, and concrete retaining wall. Some of these works might produce ecological impacts. **Section 3.1 & 3.2** above have shown that the ecological resources of concern would be the woodland habitat and 2 plant species of conservation concern. Potential ecological impacts anticipated from the proposed works would be:

- Loss or disturbance of woodland habitat; and
- Loss or disturbance of individuals of the 4 concerned plant species.

Details of each construction elements

4.1.2 As shown in **Figure 1-2**, 6 major types of works involved in the present project as listed in **Table 4-1** below, while the boundary of woodland habitat and the locations of the three concerned plant species recorded in the present study (the 42 individuals of Incense Trees and the 33 individuals of Two-coloured *Artocarpus* recorded during tree survey and the Lamb of Tartary recorded during the ecological field survey) in relation to the works sites are shown in **Figure 4.1a & b**.

Table 4-1: Construction Elements and Locations

Construction Elements	Within woodland	Outside woodland
Flexible barriers (tensioned steel mesh fences)	✓ (FW 3 – FW 10)	✓ (FW 1 & FW 2)
Soil nailing	✓ (for the two man-made slopes)	✓ (in grassland)
Baffles		✓ (in grassland)
Drainage improvement (trapezoidal channel)	✓ (near FW 6 & FW 7)	
Surface drainage channels (U-channel)	✓ (along FWs)	✓ (along FWs)
Concrete retaining wall	✓ (for one man-made slope)	

4.1.3 Brief descriptions of the construction methods of each element are given below. Their locations and potential of causing impacts are also discussed.

4.1.4 **Flexible barrier** (tensioned steel mesh fence), which would be supported on anchor foundation, would be provided at several locations to retain landslide debris. There would be a total of 10 flexible barriers (see **Figure 1-2**), mainly along the toe of the hillside, uphill to an existing gully, and below the baffles. Except the 2 barriers below the baffles, others would fall within the woodland (**Figure 4-1a & b**).

- 4.1.5 The flexible barrier is a much less disturbing construction method than the traditional concrete debris-resisting barrier which would require site formation and slope works. The barriers themselves would not be directly installed on the ground but would only be supported by isolated anchor foundations at certain intervals. Anchor foundation for flexible barrier only involves drilling within soil and rock using portable drilling tools, followed by installation of anchor and grouting. The approximate size of the drillhole is also small (0.1m in diameter). As there would be flexibility for the locations of the anchor foundations, and the footprints of the flexible barriers could also be adjusted in accordance with the topography or the needs, if it is carefully planned, it should be feasible to avoid most of the trees for both the barriers and the anchor foundations. Tree loss could therefore be minimized and woodland loss could then be prevented.
- 4.1.6 In the present project, although the alignments of a few flexible barriers would be very close to the locations of some Incense Trees and Two-coloured Artocarpus (FW5, FW8 & FW9) and the Lamb of Tartary (FW8 & FW9) as shown in **Figure 4-1a & b**, the engineer for the Project had confirmed that no Incense Tree, Two-coloured Artocarpus or the Lamb of Tartary would be felled or damaged. When the barrier is constructed, the exact locations of the anchor foundations would be adjusted on site to avoid trees (including Incense Tree and Two-coloured Artocarpus), the Lamb of Tartary and, if any, *Phrynium placentarium*. The footprint of the barriers would also be adjusted to avoid the plants of conservation importance. All these siting and adjustment process would be supervised by an appointed Ecologist/Plant Specialist (see **Section 5** for more details).
- 4.1.7 Subject to the final alignments of the flexible barriers, along the footprint of some flexible barriers, some individuals of trees are potentially required felling, but they are all common species (see **Table 4-6** and below sections on tree loss).
- 4.1.8 Regarding the disturbance impacts from constructing flexible barriers, the exact locations of the anchor foundations would be adjusted (under supervision of an appointed Ecologist/Plant Specialist) to maintain a minimum 1m distance to young trees and a longer distance to mature trees (those including Incense Tree and Two-coloured Artocarpus). As the anchor foundations would be scattered, the potential impacts on the root systems of trees are also avoided.
- 4.1.9 Soil nails would be installed at previous landslide scars to stabilise hillside. The majority of them would be located in uphill area outside the woodland and would affect grassland habitat only. Some of them however would be needed on the two man-made slopes which are however located within the woodland (**Figure 4-1a**). One individual of Incense Tree and three individuals of Two-coloured Artocarpus were within one of the man-made slope. Similar with the anchor foundations for flexible barriers, soil nailing would only involve drilling within soil and rock using portable drilling tools with drillhole about 0.1m in diameter, followed by installation of steel bar and grouting. There would be some flexibility allowed for the exact locations of the soil nailing. The planned locations of the soil nailing on the man-made slope had been adjusted to avoid these four trees, as shown in the close-up insert in **Figure 4-1a**.
- 4.1.10 As in the case of the anchor foundations of flexible barriers, in the present project the exact locations of soil nailing on the two man-made slopes would be adjusted on site to prevent loss of trees and plant species of conservation importance, in particular the one Incense Tree and three Artocarpus on the man-made slope, and therefore woodland loss. There would be also a minimum 1 m distance to any trees.
- 4.1.11 **Baffles** (Impediments to landslide debris) would be constructed on mini-piles and soil nails, just downhill to the soil nailing areas, to slow down landslide debris. Construction of baffles is similar to that for soil nailing in the previous landslide scars in hillside. Baffles involve erection of a composite mass comprising steel tube of 1m high filled with concrete, supported on mini-pile and soil nail foundation. Mini-pile involves drilling within soil and rock using small piling rig, followed by steel bars installation and grouting. The approximate diameter of the drillhole is less than 0.3m in diameter.

- 4.1.12 In the present project, all these baffles would be located outside the woodland, and therefore would not cause any tree loss or woodland loss. The only affected habitat would be grassland habitat (**Figure 4-1a & b**).
- 4.1.13 **Trapezoidal channel** (drainage improvement) would be formed for an existing gully within the woodland, near FW 6 & FW 7. The gully will be partially re-shaped and engineered with reinforced concrete. The extent of improvements would be limited to the lowest 10m of the gully, which had already been concreted previously. This could prevent the disturbance or damage to the individuals of *Cibotium barometz* (the Lamb of Tartary) recorded near the banks of the upper section of the gully. There should also be flexibility on the alignment of the re-shaped gully. Although the boundary of the trapezoidal channel would be close to the location of one Incense Tree as shown in **Figure 4-1b**, it should be feasible to avoid this Incense Tree. The engineer for the Project had confirmed that no Incense Tree would be felled or damaged in the Project.
- 4.1.14 In the vicinity of the trapezoidal channel, there would be some individuals of trees requiring felling, but they are all common species (see **Table 4-6** and below sections on tree loss).
- 4.1.15 For **U channels**, some minor excavations and concreting will also be carried out in other smaller gullies within the works areas (both within and outside the Woodland) to provide surface drainage, which could ensure proper control and discharge of surface water. There would be no need to conduct the excavations at any specific locations. Although the proposed location of one of the U- channels would be close to the location of two individuals of Incense Tree as shown in **Figure 4-1a** (the U-channel between FW2 and FW3), while another U-channel would be just uphill to one individuals of Two-coloured Artocarpus and the two areas with the Lamb of Tartary as shown in **Figure 4-1b**, avoidance of these plants would be feasible. The engineer for the Project had confirmed that no Incense Tree, Two-coloured Artocarpus or the Lamb of Tartary would be felled or damaged in the Project.
- 4.1.16 **Concrete retaining structure** will be provided for the Project at the toe of a registered man-made slope 3NE-C/C135. It would involve minor excavation and concreting for a structure of about 1.5m high near the toe of the slope. There should also be flexibility on the alignment of the concrete retaining structure, and it should be feasible to avoid all trees in accordance with the locations of trees recorded during tree survey (**Figure 4-1a & b**).

Habitat loss impact

- 4.1.17 Woodland loss is prevented through the avoidance of trees, even though some elements are inevitably located within the woodland. Among the above construction elements, baffles would be completely outside woodland. While the other elements within woodland would not require site formation, as they would use portable instruments. The only tree felling required would be in the vicinity of the trapezoidal channel, and potentially on the footprint of some flexible barriers, but the number is small (less than 20) and the trees were scattered on the channels and the barriers, and would not constitute a woodland loss. Loss of plant species of conservation importance would be avoided and the disturbance would be minimal given the scale of the proposed works.
- 4.1.18 Habitat loss would be limited to grassland habitat occupied by the soil nails and baffles. The severity of the limited and scattered grassland habitat loss is thus considered minimal.

Tree loss

- 4.1.19 As confirmed by the Engineer that in-situ avoidance is feasible for all types of works involved in the project, it would be possible to prevent any loss of the plant species of conservation importance, and to minimize the number of trees affected. No loss of plant species of conservation importance would be caused.

- 4.1.20 Out of the 900 trees within the Project Area, as stated in Table 4-6 under landscape sections, only less than 20 individuals of trees needed to be felled. These are the only trees to be affected in the present project. These affected trees are all common species, including *Schefflera heptaphylla* and *Sterculia lanceolata*. These 20 lost trees are scattered among the trapezoidal channel and a few flexible barriers. Loss of scattered individuals of trees, especially when the lost trees are all of common species, is considered a landscape impact rather than an ecological impact. The compensation of the lost trees is also provided as a landscape mitigation measure (see **Section 5.5**).

Disturbance impact

- 4.1.21 Besides the above works sites, there would also be works areas to accommodate the equipments such as generator and concrete pump, and the access path. These works areas and the alignments of the access path could be placed on locations with the least impacts, or be fine-tuned to avoid trees. Woodland loss is not anticipated (**Figure 4-1a & b**). The potential disturbance impacts would be minimal given the scale of the proposed works.
- 4.1.22 Although the works sites fell within country park and Conservation Area which harbours a woodland partially contributed by Wong Uk Fung Shui Wood, no flora and fauna of special ecological importance were found inside the particular areas within the two conservation sites and their vicinity. Given the nature and the scale of the proposed works, other ecological resources such as the other three recognised sites of conservation importance (Luk Keng Marsh, A Chau SSSI & Chan Uk Fung Shui Wood), fishponds, streams, and mangroves are unlikely to be affected.
- 4.1.23 For the 2 potential ecological impacts anticipated from the proposed works, i.e. loss or disturbance of woodland habitat & loss or disturbance on individuals of concerned plants, woodland loss is prevented and no loss or disturbance to plant species of conservation importance would be caused. The only impacts would be minimal grassland loss and minimal disturbance caused by equipments and workers. Given the above, there should be no adverse ecological impacts caused by the project.

4.2 Noise

- 4.2.1 A schedule of the construction works is indicated in **Appendix 4-1**. It is currently not envisaged that there would be construction activities undertaken outside 7am - 7pm. However, if the Contractor finds that there is a need to carry out night-time work, he must apply a Construction Noise Permit (CNP) and ensure full compliance with the NCO requirements.
- 4.2.2 The construction methodology has been described in **Section 2.3** in details. Potential impacts on Noise Sensitive Receivers (NSRs) during the construction stage will arise mainly from the use of Powered Mechanical Equipment (PME). The PMEs to be employed in this project include hand-held drilling tool, mini excavator, compressor, generator, concrete pumps etc. It is anticipated that the following construction plant inventory would be required for various works.

Table 4-2: Construction Plant Inventory and Sound Power Levels

Item	Item of Works	Construction Plant Inventory	SWL ^[1] , dB(A)
1	Flexible barrier	<ul style="list-style-type: none"> • 1 x hand-held drilling tool for anchor foundation construction • Mini Robot excavator 	96
2	Soil nails	<ul style="list-style-type: none"> • 1 x compressor 	99

Item	Item of Works	Construction Plant Inventory	SWL ^[1] , dB(A)
		<ul style="list-style-type: none"> 2 x hand-held drilling tool 1 x generator 	
3	Baffles at hill side	<ul style="list-style-type: none"> 1 x compressor 1 x hand-held drilling tool 1 x generator 	98
4	Pumping concrete	<ul style="list-style-type: none"> Concrete pump 	96
5	Concrete retaining wall	<ul style="list-style-type: none"> Concrete pump Excavator 	101

[1] SWL – Sound Power Levels, taking into account typical utilisation rates and good site practices in **Table 4-2**.

4.2.3 The above table also shows the Sound Power Level (SWLs) of the construction plant inventory. It should be noted that the above SWLs have assumed some good site practices and typical utilisation rates (NB, practically, these PME's will not be operating for all times within a work site) for the various construction plant. The following table summarises these assumptions.

Table 4-3: Summary on Utilisation Rates and Good Site Practices

PME	Utilisation Rate ^[1]	Good Site Practices
Compressor	100%	Use of quiet plant
Concrete pump	100%	Use of quiet plant With hoarding / barriers (approx 5-10dB(A) attenuation)
Drill	50%	
Excavator	50%	
Generator	100%	Use of quiet plant

[1] The utilization rates are considered realistic and practicable in achieving the construction programme by the Engineering Team and were agreed with the Project Proponent.

4.2.4 In addition to the above utilisation rates, the assessment has taken into account the screening effect of site hoarding for some of the works. For example, the hoarding near the flexible barrier FW5 would be able to provide 5-10dB(A) attenuations for the NSRs. For conservative assessment, only a 5dB(A) attenuation has been adopted. Similar hoarding attenuation however would not be adopted for other work sites located up on the hillside (eg baffles, U-Channels).

4.2.5 With the above assumptions, the predicted construction noise impacts on the NSRs would comply with the stipulated day-time noise criterion of 75dB(A). Hence, there is no residual construction noise impact. The table below summarises the predicted noise impacts. All the construction noise calculations are given in **Appendix 4-2**. Also shown in **Appendix 4-2** are the SWLs of the quiet plant, the screening effect assumed, separation distance from the work sites to the NSRs etc.

Table 4-4: Summary of Predicted Construction Noise Impacts

NSR	Predicted Noise Impacts dB(A)	Day-time Criterion dB(A)	Compliance (Y/N)
NSR 1	68	75	Y
NSR 2	67	75	Y
NSR 3	72	75	Y
NSR 4	73	75	Y
NSR 5	72	75	Y

4.2.6 Once the natural terrain hazard mitigation works are completed, there will not be any noise sources and hence there is no noise impact during the operational phase.

4.3 Air Quality

4.3.1 As discussed in **Section 2.3**, extensive open excavation is not required for all the proposed natural terrain hazard mitigation works. Some minor open excavation and concrete casting is however required for soil nailing and the concrete retaining wall in slope 3NE-C/C135. For drainage improvement work in the lower part of the existing gully (already paved with concrete), some minor concreting work is also anticipated to re-shape the gully.

4.3.2 Given the small amount of spoil, the workers would carry the spoil along the existing foot path down the terrain. It is not required to have haul roads or conveyor system. Since there are no major open excavation works, it is anticipated that the dust emission from the proposed works area would be relatively insignificant.

4.3.3 Once the natural terrain hazard mitigation works are completed, there will not be any air quality pollution sources and hence there is no air quality impact during the operational phase.

4.4 Water Quality

4.4.1 According to the latest design, all the works would be land-based and there will not be any marine works for the terrain hazard mitigation works. Potential water pollution sources during construction phases include:

- Construction runoff; and
- Sewage effluent due to workforce on site.

4.4.2 Construction runoff may cause physical, biological and chemical effects. The physical effects include potential blockage of drainage channels and increase of Suspended Solid (SS) levels in the Mirs Bay WCZ.

4.4.3 Local flooding may also occur in heavy rainfall situations. The chemical and biological effects caused by the construction runoff are highly dependent upon its chemical and nutrient content.

4.4.4 Runoff containing significant amounts of concrete and cement-derived material may cause primary chemical effects such as elevated turbidity and discoloration, pH, and accretion of solids. A number of secondary effects may also result in toxic effects to water biota due to elevated pH values, and reduced decay rates of faecal micro-organisms and photosynthetic rate due to the decreased light penetration.

- 4.4.5 Sewage effluents will arise from the sanitary facilities provided for the on-site construction workforce. The characteristics of sewage would include high levels of BOD₅, Ammonia and E. Coli counts.
- 4.4.6 However, given the relatively small scale of excavation and the implementation of good site practices, adverse water quality impacts during the construction are not anticipated.
- 4.4.7 Once the natural terrain hazard mitigation works are completed, there will not be any water pollution sources and hence there is no water quality impact during the operational phase.

4.5 Landscape and Visual Impacts

Landscape Character Areas

- 4.5.1 The landscape character of villages is typical and can accommodate minor changes without affecting the overall character. Most impacts on this character will be from the retaining wall structure at the toe of slope No. 3NE-C/C135 and the new u-channel. The overall impact on this character is slight adverse. The site clearance area for the construction of baffles is limited to less than 16 m² per baffle. No tree will be affected by this work and only grass and shrubs will be removed. Given the total number of baffles to be constructed on hillside (LC2) is less than 100 units and total site clearance area is less than 0.2 ha. The impact by the baffles to the overall character is considered moderate adverse.
- 4.5.2 Most of the construction activities will be carried out on the hillside. Given the variation of hillside landforms, impacts on this LCA could be secluded. As a result the change of character due to the landform variation and the limited extent of works will be small, with the overall impact being moderate. Since no construction activities will be carried out in lowlands, impacts on this character are considered to be negligible.
- 4.5.3 A summary of the impacts on LCAs is given below:

Table 4-5: Summary of Impacts on LCAs Before Mitigation

LCA	Description of Construction Phase Impact	Description of Operation Phase Impact	Definition of Impact
Village (LCA1)	Source: <ul style="list-style-type: none"> • Minor construction works at the edge of Luk Keng Wong Uk • Movement and storage of plant and equipments in the village. Magnitude: Small.	Source: <ul style="list-style-type: none"> • Retaining wall structure at toe of slope No. 3NE-C/C135 and new u-channels. Magnitude: Small.	Construction: Slight Adverse Operation: Slight Adverse
Lowlands (LC2)	No impact expected.	No impact expected.	Negligible
Hillside (LC3)	Source: <ul style="list-style-type: none"> • Construction of trapezoidal channel, footprint of flexible barriers, soil nails, U-channels, staircases and baffles 	Source: <ul style="list-style-type: none"> • Erected flexible barriers • Trapezoidal channel, soil nails, U-channels, staircases and baffles • No vegetation on 	Construction: Moderate Adverse Operation: Moderate

LCA	Description of Construction Phase Impact	Description of Operation Phase Impact	Definition of Impact
	<ul style="list-style-type: none"> Loss of vegetation is less than 1 ha. Existing LCA size is 33 ha. Magnitude: Small.	construction disturbed area Magnitude: Small.	Adverse

Landscape Resources

4.5.4 Since no construction activities will be carried out in stream, fishponds, active/ abandoned agricultural fields, mangrove/rocky shore and ocean, impacts on these resources are considered to be negligible.

4.5.5 Most of the construction activities will be in the woodlands and in the scrubland/grasslands. Since the location of soil nails, baffles, foundation of flexible barriers and u-channels will cover limited extents of areas and can be modified locally to avoid impact on trees, the impacts will be negligible. Drill holes of each soil nail and baffle will be limited to less than 0.3m in diameter and vegetation clearance is therefore limited. Only less than 20 out of the total 900 trees within the works boundary will require felling. The species included are common species such as *Schefflera heptaphylla* and *Sterculia lanceolata* and no *Aquilaria sinensis* will be felled. As a result, the loss of woodland in term of area is zero.

4.5.6 Most village houses are two or three storeys high and will not be changed.

4.5.7 A summary of the impacts on LRs is given below:

Table 4-6: Summary of Impacts on LRs Before Mitigation

LR	Description of Construction Phase Impact	Description of Operation Phase Impact	Definition of Impact
Stream	No impact expected.	No impact expected.	Negligible.
Fishponds	No impact expected.	No impact expected.	Negligible.
Woodlands	Source: <ul style="list-style-type: none"> Construction of trapezoidal channel, footprint of flexible barriers. Baseline vegetation cover is 21 ha. Loss of woodland is zero in terms of area. The loss of individual trees within close proximities of the works will be less than 20. Magnitude: Negligible.	Source: <ul style="list-style-type: none"> Erected flexible barriers Trapezoidal channel No vegetation on construction disturbed area Magnitude: Negligible.	Construction: Negligible Operation: Negligible

LR	Description of Construction Phase Impact	Description of Operation Phase Impact	Definition of Impact
Scrubland / Grassland	Source: <ul style="list-style-type: none"> • Construction of soil nails, U-channels, access paths / stairways and baffles • Baseline vegetation cover is 19 ha. • Loss of vegetation is 2 ha. Magnitude: Small.	Source: <ul style="list-style-type: none"> • Soil nails, U-channels, access paths / stairways and baffles • No vegetation on construction disturbed area Magnitude: Small.	Construction: Moderate Adverse Operation: Moderate Adverse
Active / Abandoned Agricultural fields	No impact expected.	No impact expected.	Negligible.
Mangrove / Rocky Shore	No impact expected.	No impact expected.	Negligible.
Ocean	No impact expected.	No impact expected.	Negligible.
Village Houses and Roads	Source: <ul style="list-style-type: none"> • Minor construction works at the edge of Luk Keng Wong Uk • Movement and storage of plant and equipment in the village. Magnitude: Small.	Source: <ul style="list-style-type: none"> • Retaining wall structure at toe of slope No. 3NE-C/C135 and new u-channels. Magnitude: Small.	Construction: Slight Adverse Operation: Slight Adverse

Visual Sensitive Receivers

4.5.8 The only VSR that will receive noteworthy changes during the construction phase is the viewers from Luk Keng Wong Uk. Works associated with the construction of a low retaining wall would be visible as well as limited views to other features. Other VSRs will hardly receive any impacts, as the works will not be very noticeable from other locations.

4.5.9 A summary of the impacts on VSRs is given below:

Table 4-7: Summary of Impacts on VSRs Before Mitigation

VSR	Description of Construction Phase Impact	Description of Operation Phase Impact	Definition of Impact
Kai Kuk Shue Ha Village (VSR1)	<p>Source:</p> <ul style="list-style-type: none"> Loss of vegetation on hillside Construction machines/ vehicles movements <p>Magnitude: Small.</p>	<p>Source:</p> <ul style="list-style-type: none"> Erected flexible barriers Trapezoidal channel No vegetation on construction disturbed area <p>Magnitude: Small.</p>	<p>Construction: Slight Adverse</p> <p>Operation: Slight Adverse</p>
Mini-bus terminus (VSR2)	<p>Source:</p> <ul style="list-style-type: none"> Loss of vegetation of hillside Construction machines/ vehicles movements <p>Magnitude: Moderate</p>	<p>Source:</p> <ul style="list-style-type: none"> Retaining wall structure at toe of slope No. 3NE-C/C135 and new u-channels. <p>Magnitude: Moderate</p>	<p>Construction: Moderate Adverse</p> <p>Operation: Moderate Adverse</p>
Luk Keng Wong Uk Village (VSR3)	<p>Source:</p> <ul style="list-style-type: none"> Loss of vegetation of hillside Construction machines/ vehicles movements <p>Magnitude: Small.</p>	<p>Source:</p> <ul style="list-style-type: none"> Trapezoidal channel and flexible barrier. <p>Magnitude: Small.</p>	<p>Construction: Slight Adverse</p> <p>Operation: Slight Adverse</p>
Luk Keng road (VSR4)	<p>Source:</p> <ul style="list-style-type: none"> Loss of vegetation of hillside Construction machines/ vehicles movements <p>Magnitude: Small.</p>	<p>Source:</p> <ul style="list-style-type: none"> Retaining wall structure at toe of slope No. 3NE-C/C135 and new u-channels. Soil nails, U-channels, access paths / stairways and baffles <p>Magnitude: Small.</p>	<p>Construction: Slight Adverse</p> <p>Operation: Slight Adverse</p>
Nam Chong Lei Uk Village (VSR5)	No impact expected.	No impact expected.	Negligible.

4.6 Waste Management

4.6.1 Since there will be some minor excavation works, it is inevitable to have some C&D materials that need to be disposed off-site. Where practicable, the excavated C&D materials would be re-used in-situ to minimize the amount of C&D materials that need to be disposed. The following table summarises the estimated breakdown of waste generation.

Table 4-8: Estimated of C&D Waste Generated

Item	Item of Works	Estimated Waste Quantity, m ³
1	Soil Nailing	200
2	Tensioned Steel Mesh Fence	[1]
3	Proposed Drainage Improvement Works	[1]
4	Construction of Baffles	450
5	Concrete Retaining Wall	50
Total		700

[1] Insignificant quantity

4.6.2 Given the small amount of C&D material (approx 700m³) that needs to be disposed off-site, it is considered that the impacts are insignificant. Further opportunities for reusing would need to be considered at a later stage.

4.6.3 The quantities of other types of waste arising from the construction phase of the Project should be minimal. Provided that the wastes generated from the project are properly handled, stored, recycled as far as possible, and disposed of in accordance with good waste management practices and relevant regulations and requirements under the Waste Disposal Ordinance, no significant waste impact arising from the construction stage of the Project would be envisaged.

4.6.4 During the operational phase, there is no generation of wastes arising from the Project. No adverse waste impact is anticipated.

4.7 Archaeology and Cultural Heritage

4.7.1 As discussed in **Section 3.2**, all the existing war relics are beyond the proposed works boundary with a minimum separation of about 50m. In addition, topographic survey and site inspections did not reveal any signs of above-ground military structures within the proposed work boundary. Hence, there is no adverse impact during both the construction and operational phases.

5. ENVIRONMENTAL PROTECTION AND MITIGATION MEASURES

5.1 Ecology

5.1.1 As discussed in **Section 4.1**, the potential ecological impacts arising from the present project would not likely to be adverse. This section would stipulate how the environmental protection and mitigation measures of the project could meet the requirements of the TM-EIAO.

5.1.2 It is stipulated in the TM-EIAO that when dealing with impacts the “Avoid, Minimize and Compensate” approach should be followed. The feasibility to avoid impacts is thus at the highest priority and will be first examined. If impacts are not feasible to completely be avoided, efforts will be made to minimise the impacts. Only after all possibilities of the first two approaches are exhausted, compensation will be formulated for inevitable impacts. Potential mitigation measures will be then provided to address the potential impacts. The following paragraphs identify feasible and practicable mitigation measures to reduce the severity of any negative impacts identified in the previous sections.

Avoidance

5.1.3 The Pat Sin Leng Country Park and the Conservation Area which also includes the woodlands, are the sites of conservation importance would be affected by the project. As described in **Section 2.4** above, consideration has been given to avoid the country park and the conservation area. However, due to the requirement to mitigate the natural terrain landslide hazard, part of the works would inevitably need to be within the country park and conservation area.

5.1.4 Woodland habitat is the major habitat of concern in the present project. The majority of works areas involving earth works, however, would be outside the woodland but inside the grassland habitat which is of lower ecological value. Hence, the current design has avoided the woodland habitat to the maximum practicable extent.

5.1.5 While no fauna might be impacted as illustrated by the field survey results, potential impacts on plants would be the concern. Four plant species of conservation value, i.e. Incense Tree, Two-coloured Artocarpus, the Lamb of Tartary and *Phrynium placentarium*, are the species that have been considered.

5.1.6 All baffles would be located outside the woodland, and the impacts on woodland are avoided. The only affected habitat would be grassland habitat where there would be no tree loss.

5.1.7 The exact locations for flexible barriers and soil nailing could be adjusted on site according to the site conditions. Therefore it is feasible to avoid plant individuals of protected species.

5.1.8 The length of the trapezoidal channel was reduced from 30m to 10m and would be limited to the lowest disturbed section of the gully, and therefore impacts on the Lamb of Tartary near the upper reach of the gully were avoided.

Minimization

5.1.9 Most soil nailing locations would be outside woodland, except those on the two man-made slopes. The potential impacts on woodland habitat are reduced as far as possible.

5.1.10 Two of the flexible barriers would also be outside woodland habitat. Other flexible barriers would be set on rather flat areas with fewer trees, therefore the impacts on trees were

reduced (only less than 20 no. of common trees will be impacted), and the extent of site formation and excavation would also be reduced and so is the associated disturbance.

- 5.1.11 Most of the construction of the trapezoidal channel would be limited to within dry season only. Although the stream and marsh habitats within the 500m boundary were physically separated from the Project Area by the village and therefore they would not be subject to sedimentation impacts caused by site runoff if any, the potential risk of sedimentation impact is further reduced by this work programme. Moreover all disturbed areas would be hydroseeded to prevent soil erosion after construction and prior to planting of landscape vegetation.
- 5.1.12 An Ecologist/Plant Specialist will be appointed by the contractor, who would be approved by AFCD in prior, and will station on site and supervise the selection of the excavation locations (including anchor foundations, soil nailings and baffles) and the avoidance of trees and concerned plants. The Ecologist / Plant Specialist will ensure that a minimum 1m distance is maintained from all excavation locations to any young trees, and a longer and sufficient distance from mature trees so as to protect the root systems of mature trees. The Ecologist / Plant Specialist would also ensure the four plant species of conservation importance (Incense Tree, Two-coloured Artocarpus, the Lamb of Tartary and *Phrynium placentarium*) are avoided during the constructions.
- 5.1.13 The construction of the 10 flexible barriers and the works on the two man-made slopes would be carried out in sequence. The potential disturbance impact is thus reduced.

Compensation

- 5.1.14 As no woodland loss would be caused by the Project and the direct impacts on individuals of the 4 concerned plant species could be avoided, there would be no adverse ecological impacts from the present project and no compensation plan is required.

Mitigation Plan

- 5.1.15 Although no specific ecological compensation plan would be needed for the Project, some site practices and construction phase mitigation measures should be adopted to further protect the ecology:
- The individuals or patches of the 4 concerned plant species should be fenced off.
 - Trees would be planted to compensate the loss of common tree species. The loss to compensation ratio shall be at least 1:1;
 - Site runoff should be collected and desilted before discharged into existing drainage system. No discharge into any streams or marsh areas should be allowed.
 - To ensure the structures to be provided in the site would be compatible with the surrounding natural environment, the soil nailings, flexible barriers, baffles, trapezoidal channel and concrete retaining structures would be painted in subdue colour.
 - The structures to be constructed on site would be painted in subdue colour so as to be compatible with the surrounding natural environment
 - The on-site ecologist / plant specialist (to be appointed by the Contractor) will ensure that the works (including foundations) would not adversely affect the roots of the trees
- 5.1.16 No operation phase measure is required. Implementation of the above mitigation measures will further protect the ecology in the area.

5.2 Noise

5.2.1 Construction noise can be controlled to acceptable level by implementing good site practices. The following summarises good site practices and measures that should be followed during the construction period in order to ensure compliance with the noise criterion.

- Well maintained plant should be operated on-site and plant should be checked regularly;
- Plant (such as trucks, cranes) that may be in intermittent use should be shut down between work periods;
- Plant known to emit noise strongly in one direction, where possible, be orientated so that the noise is directed away from nearby NSRs;
- Silencers on construction equipment should be properly fitted and maintained during the construction works;
- Mobile plant should be sited as far away from NSRs as possible and practicable;
- Quiet plants described in Section 4.1 should be used; and
- Hoarding near to the flexible barrier FW5 and the temporary work area should be provided (see **Figure 5-1**). The surface density of the site hoarding (approx 2m high) should be at least 10kg/m^2 , and with no openings or gaps.

5.3 Air Quality

5.3.1 Although adverse dust impacts are not anticipated, appropriate dust mitigation measures stipulated in the Air Pollution Control (Construction Dust) Regulation should be implemented to control fugitive dust emission. The key following dust suppression measures are recommended:

- Regular watering to reduce dust emissions from all exposed site surface, particularly during dry weather;
- Frequent watering for particularly dusty construction areas and areas close to air sensitive receivers;
- Cover all excavated or stockpile of dusty material by impervious sheeting or sprayed with water to maintain the entire surface wet;
- Provision of vehicle washing facilities at the exit points of the site;
- Tarpaulin covering of any dusty materials on a vehicle leaving the site.

5.4 Water Quality

5.4.1 In order to control surface runoff satisfactorily without adverse impact during the construction stage, the Contractor should comply with the Water Pollution Control Ordinance (WPCO) and its subsidiary regulation. The key control measures are as follows:

- The Contractor should design and implement all the mitigation measures and practices specified in the ProPECC PN 1/94 "Construction Site Drainage" and "Recommended Pollution Control Clauses for Construction Contracts" issued by EPD.
- All runoffs arising from the construction site should be properly collected and treated to ensure the discharge standards as stipulated in WPCO are met. Silt trap and oil interceptor should be provided to remove the oil, lubricants, grease, silt, grit and debris from the wastewater before being pumped to the public stormwater drainage system. The silt traps and oil interceptors should be cleaned and maintained regularly. All the effluent arising from construction activities and surface run-off should be diverted away

from natural stream. Stockpiling should be properly covered to avoid loss of materials into natural stream.

- Any foul effluent should not be discharged into any public sewer and stormwater drain, unless an effluent discharge permit is obtained under the WPCO by the Contractor.
- Site toilet facilities, if needed, should be chemical toilets or should have the foul water effluent directed to a foul sewer.

5.5 Landscape & Visual

5.5.1 As there would be flexibility in the locations of the anchor foundations and footprints of the flexible barriers as well as the location of soil nailing, felling of precious tree, such as *Aquilaria sinensis* and other vegetation clearance can be avoided. In case of any disturbance to landscape and visual receivers, the following mitigation measures shall be adopted:

Construction Phase:

- MC1: All retain trees shall be properly protected and fenced off with a 1.2m high fence around the dripline of trees;
- MC2: Excess materials and waste shall be removed from site as soon as practical;
- MC3: All disturbed areas shall be hydroseeded to prevent soil erosion prior to planting;
- MC4: Compensatory trees shall be planted in groups on both sides of the trapezoidal channel to compensate the loss of trees. Native species including *Sterculia lanceolata*, *Schefflera octophylla* and *Reevesia thyroidea* shall be used for compensatory tree planting. With respect to the number of trees, the loss to compensation ratio shall be not less than 1:1;
- MC5: Shade tolerant native climber and native tree whips, such as *Uvaria macrophylla* and *Machilus breviflora*, shall be planted along the flexible barrier;
- MC6: Drought tolerant tree and shrub mix vegetation shall be planted near sun exposed areas affected by the access paths / stairways, baffles and soil nails;
- MC7: The retaining wall at slope feature 3NE-C/C135 shall be finished with granite stone pitching;
- MC8: Creeping plants, such as *Ficus pumila*, shall be planted along the top of the retaining wall at slope feature 3NE-C/C135;
- MC9: Flexible barriers, baffles shall be painted in olive green colour; and
- MC10: Trapezoidal channel will be finished with granite stone pitching.
- MC11: Soil nail heads will be of recessed type and covered with planting.

Operation Phase:

MO1: All new vegetation planted during construction shall be maintained for at least one year.

5.5.2 Implementation of the above mitigation measures (**Figure 5-2**) will render landscape and visual impacts acceptable during both the construction and operation phases.

5.6 Waste Management

5.6.1 Proper waste management in the way of avoiding, minimising, reusing and recycling should be adopted in order to minimise the generation of various wastes and associated environmental impacts during the construction stage. The Contractor shall comply with the Waste Disposal Ordinance and its subsidiary regulations, and implement the necessary waste management measures. The following control measures are recommended:

- Excavated material should be reused on site as far as possible to minimise off-site disposal. Scrap metals or abandoned equipment should be recycled if possible.
- Waste arising should be kept to a minimum and be handled, transported and disposed of in a suitable manner.
- The Contractor should adopt a trip ticket system for the disposal of C&D materials to any designated public filling facility and/or landfill. Independent audits of the Contractor and resident site staff will be undertaken to ensure that the correct procedures are being followed.
- Chemical waste shall be handled in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Wastes.
- All general refuse should be segregated and stored in enclosed bins or compaction units and waste separation facilities for paper, aluminium cans, plastic bottles etc. should be provided to facilitate reuse or recycling of materials and their proper disposal.

5.7 Archaeology and Cultural Heritage

5.7.1 Whilst there are neither direct nor indirect impacts on any known military structures, it is recommended that a watching brief be included in the construction contract for the Contractor employ an archaeologist during excavation up in the hillside. He will provide advice to identify any objects / structures with archaeological and heritage values. The details of the watching brief should be submitted by the archaeologist to AMO for agreement before any excavation up in the hillside commences.

6. USE OF PREVIOUSLY APPROVED EIA REPORTS

6.1.1 A summary of the previously approved EIA Reports that have been made reference to is given below.

Table 6-1: Summary of previously Approved EIA Reports Referenced

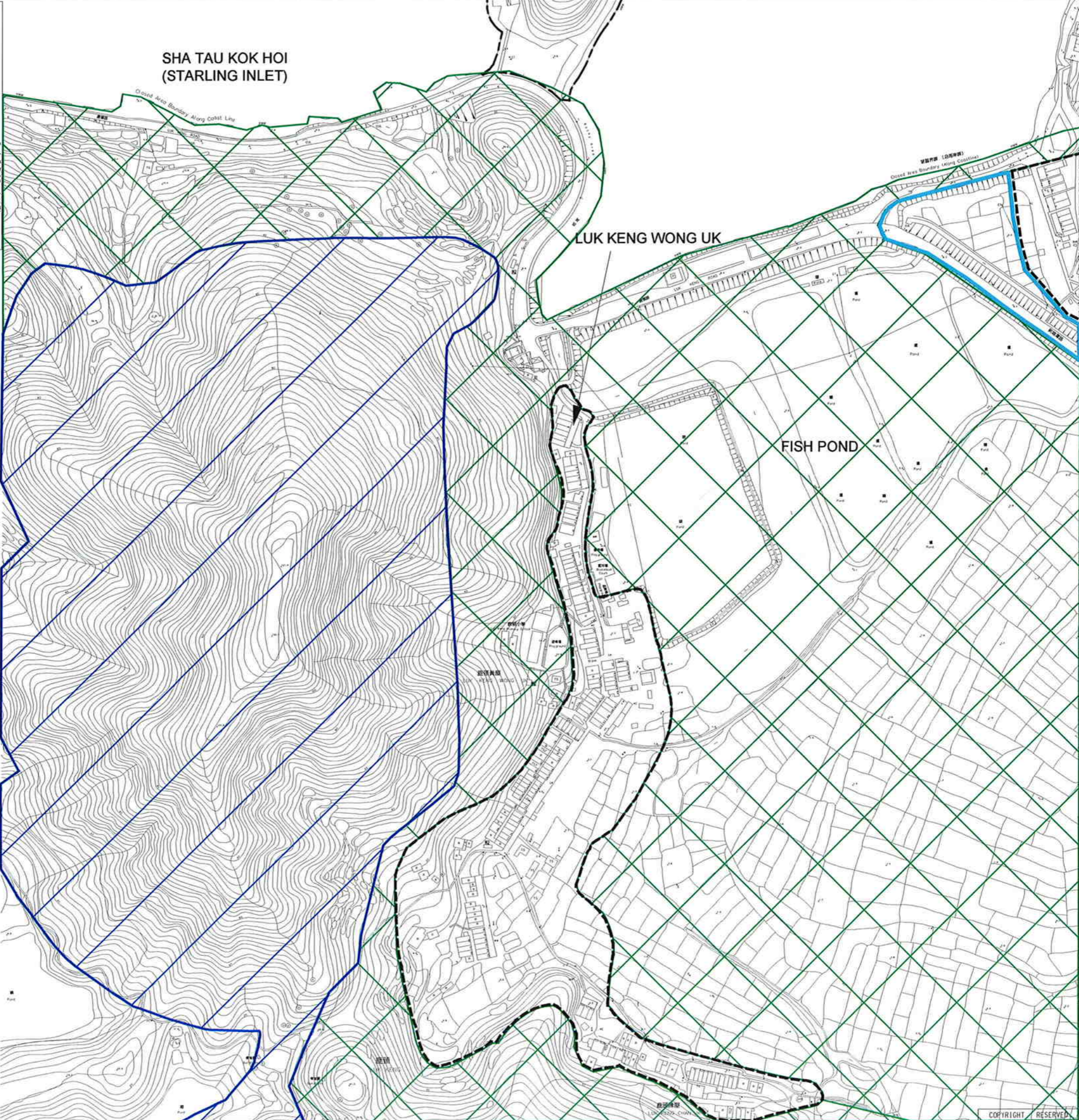
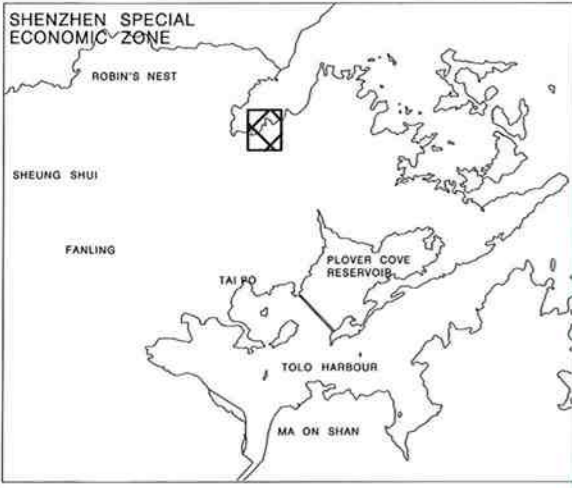
Approved Report	EIA	EPD Reference	Remark
Kowloon Link	Southern	EIA-098/2004	Sound power levels of quiet plant and the utilisation rates for construction noise assessment.

7. CONCLUSIONS






7.1.1 Natural terrain hazard mitigation works are proposed to protect Luk Keng Wong Uk from landslide hazard from the natural hillside overlooking the village. The proposed works would include construction of soil nails, baffles, flexible barriers etc, and upgrading works to two man-made cut slopes within the immediate vicinity of the village.

7.1.2 This Project Profile is submitted under Section 5(11) of the EIAO to provide sufficient information for application for permission to apply directly for an Environmental Permit

7.1.3 Potential environmental impacts in terms of air, noise, water, ecology, landscape and visual impacts, waste management associated with this project have been examined. Since most of the works for this Project are of very small scale and there are no pollution sources during the operational phase, adverse environmental impacts are not anticipated during both construction and operational stages, given that good site practices are properly implemented.



LEGEND

-  PAT SIN LENG COUNTRY PARK
-  CONSERVATION AREA
-  COASTAL PROTECTION AREA
-  AGRICULTURE
-  VILLAGE TYPE DEVELOPMENT

No.	Date	Description	Checked
Revision			
		Name	Date
Surveyed	-	-	-
Designed	-	-	-
Drawn	Fai		03/06
Reviewer	FC		03/06
Checked	HS		03/06
Approved	DL		03/06

Agreement no. CE 31/2004 (GE)
 Arup project no. 24364

Contract
 NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK

Location
 LUK KENG WONG UK

Drawing Title
 LUK KENG WONG UK LOCATION PLAN

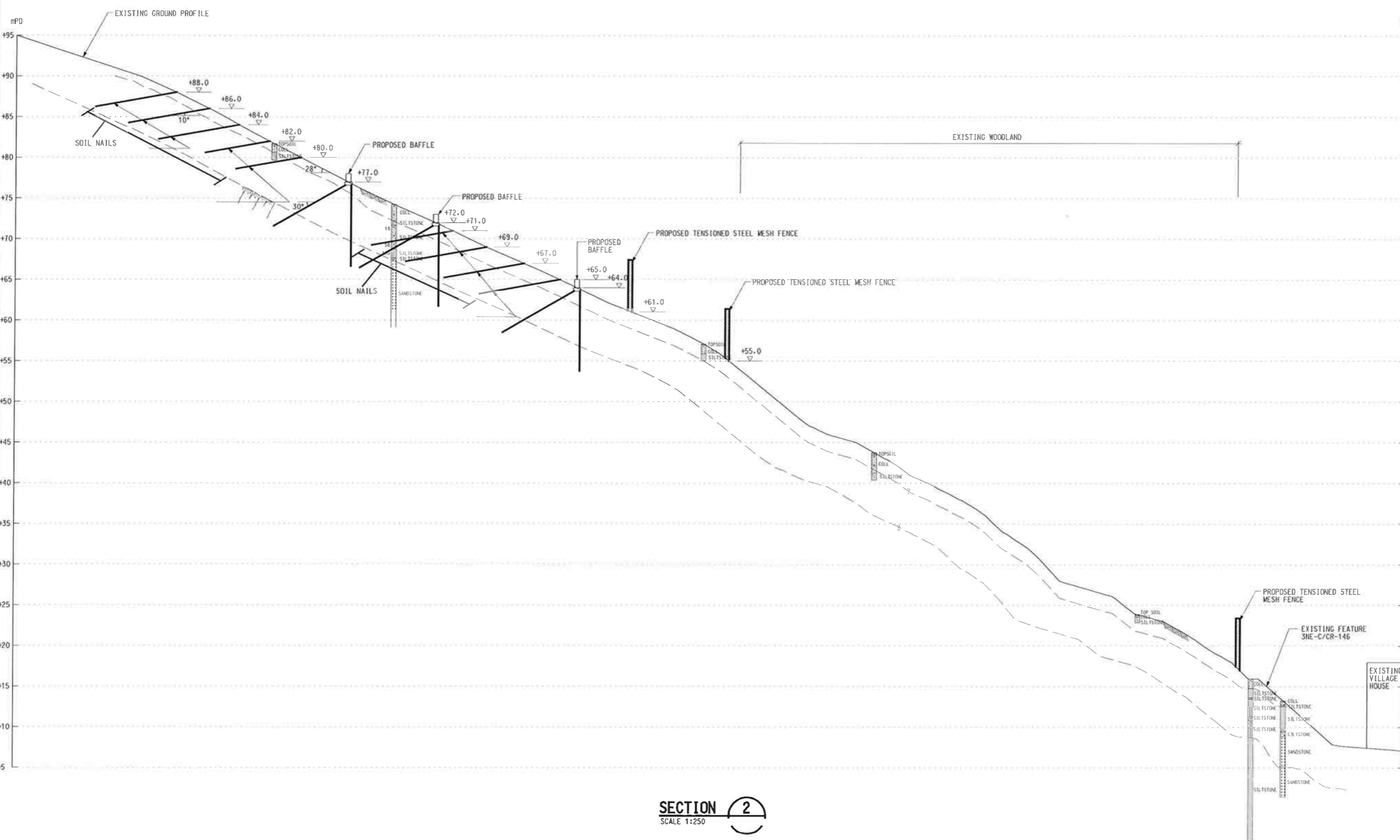
Drawing no.	Rev	Scale
FIGURE 1-1	-	AS

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SECTION 2
 SCALE 1:250

- NOTES :
- FOR GENERAL NOTES REFER TO DRAWING NO. 24364/LK/G/201 & 202.
 - FOR SOIL NAIL AND MINIPILE DETAILS REFER TO DRAWING NO. 24364/LK/G/241 & 242.
 - FOR TENSIONED WIRED MESH FENCE DETAILS REFER TO DRAWING NO. 24364/LK/G/243.
 - FOR TYPICAL BAFFLE & TRAPEZOIDAL CHANNEL DETAILS REFER TO DRAWING NO. 24364/LK/G/244.

No.	Date	Description	Checked

Revision	Name	Date

Agreement no.	CE 31/2004 (GE)
Arup project no.	24364
Contract	NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK
Location	LUK KENG WONG UK

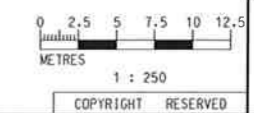
Drawing Title
 PROPOSED NATURAL TERRAIN HAZARD MITIGATION WORKS - SECTIONS

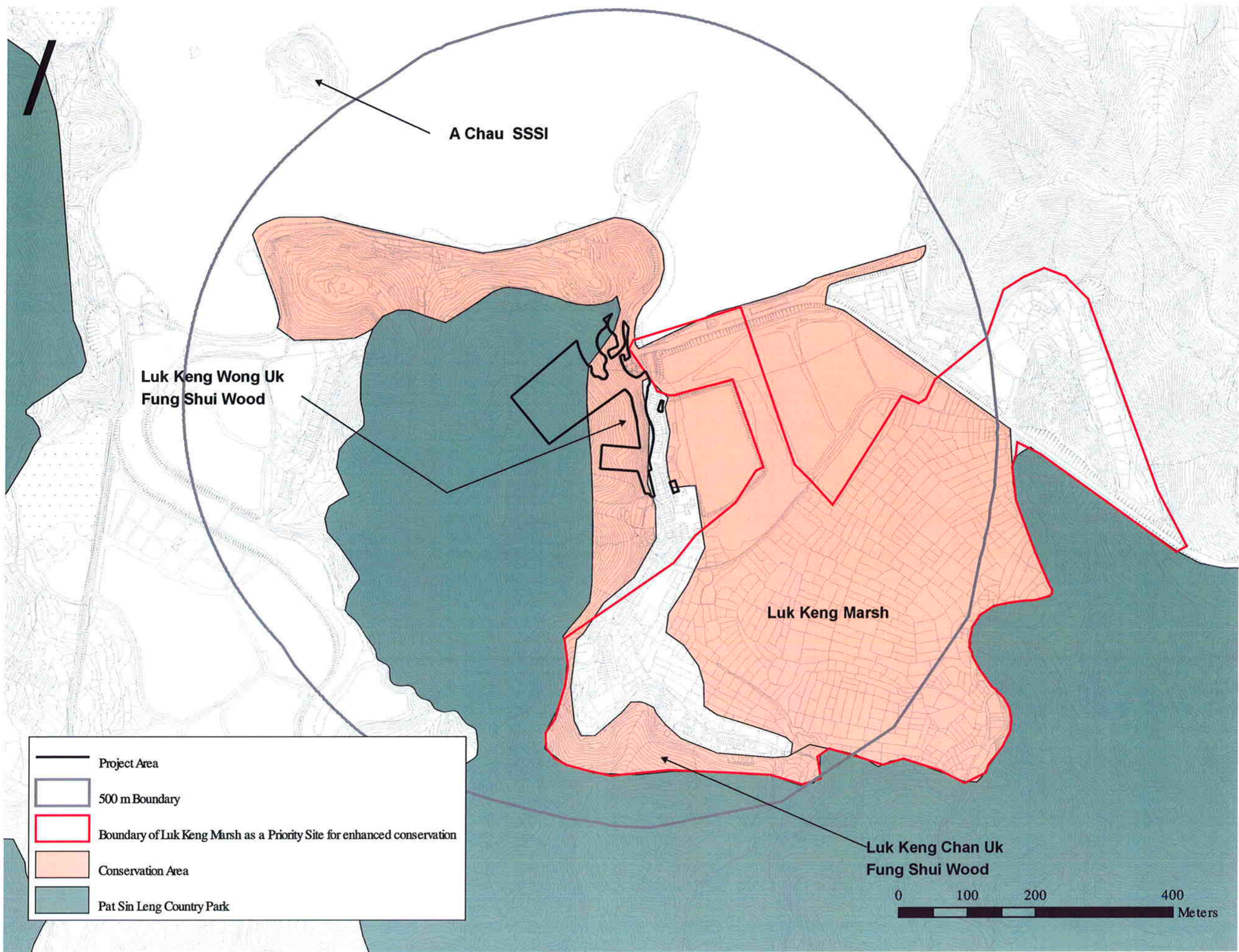
Drawing no.	Rev	Scale
FIGURE 1-4	-	AS

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	Project Area
	500 m Boundary
	Boundary of Luk Keng Marsh as a Priority Site for enhanced conservation
	Conservation Area
	Pat Sin Leng Country Park

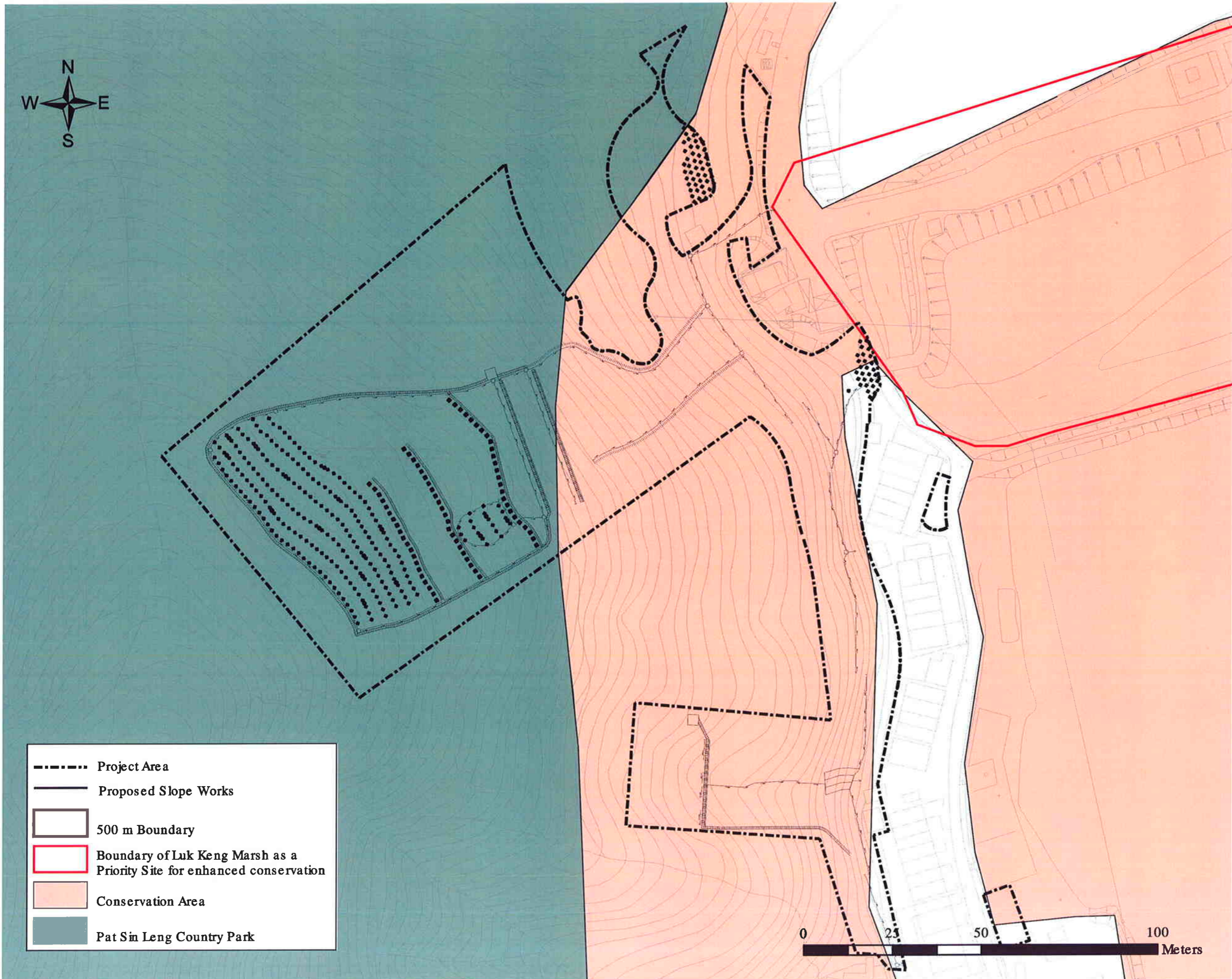
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Revision			
		None	Date
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Checked			
Approved			

Agreement no. CE 31/2004 (GE)
 Arup project no. 24364
 Contract
 NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK
 Location
 LUK KENG WONG UK

Project Area and Recognised Sites of Conservation Importance
 Drawing no. Figure 3.1A
 Scale AS

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	Project Area
	Proposed Slope Works
	500 m Boundary
	Boundary of Luk Keng Marsh as a Priority Site for enhanced conservation
	Conservation Area
	Pat Sin Leng Country Park

No.	Date	Description	Checked

Agreement no. CE 31/2004 (GE)

Arup project no. 24364

Contract

NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK

Location

LUK KENG WONG UK

Proposed slope works and Recognised Sites of Conservation Importance

Drawing no.	Rev	Scale
Figure 3.1B	-	AS

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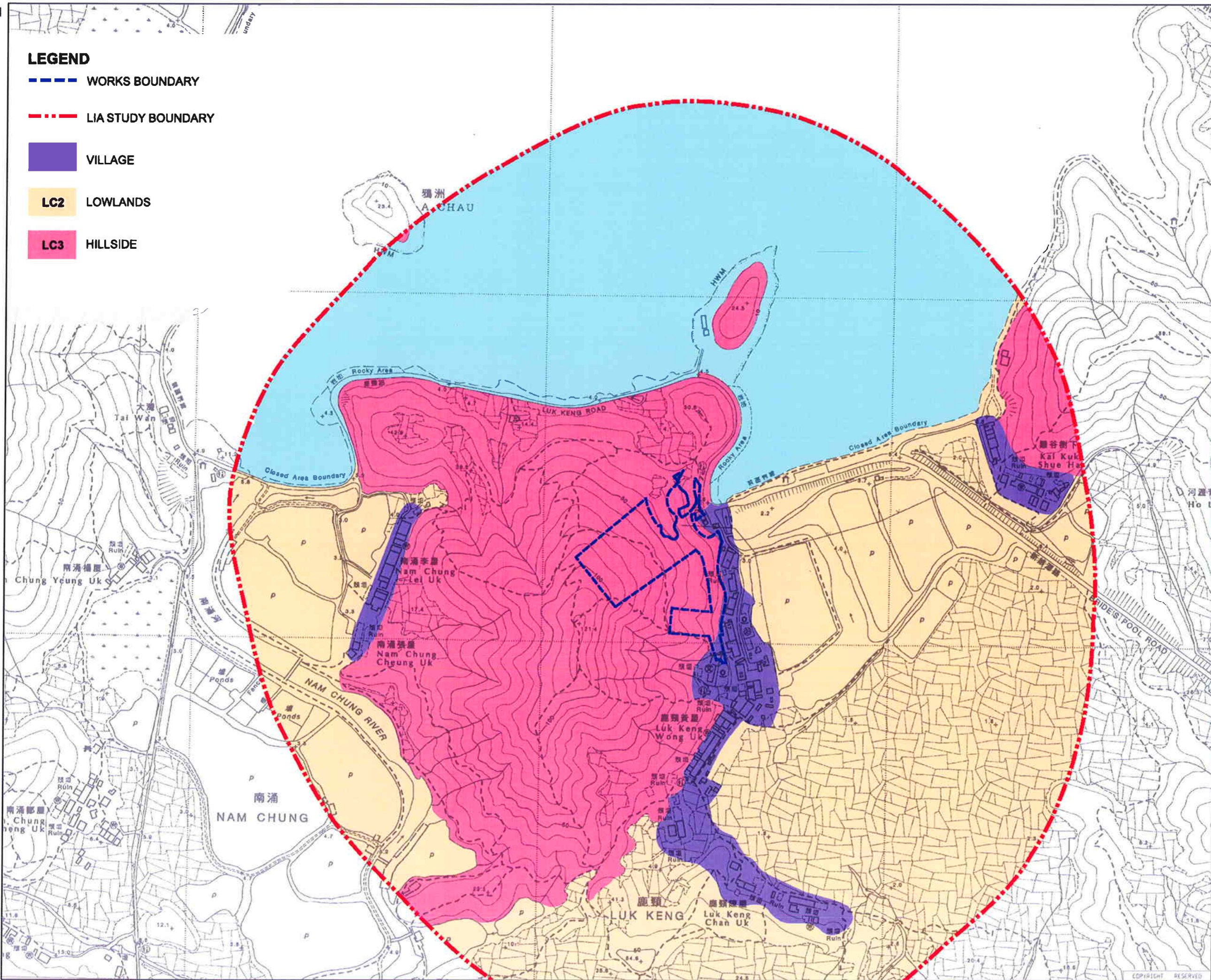
Office

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LEGEND

- WORKS BOUNDARY
- LIA STUDY BOUNDARY
- VILLAGE
- LC2 LOWLANDS
- LC3 HILLSIDE



No.	Date	Description	Checked
A	05/06	Revised Works Boundary	JSP
Revision		None	Date
Surveyed			
Designed	MWL	MAR 06	
Drawn	RAB	MAR 06	
Reviewer	MWL	MAR 06	
Checked	MWL	MAR 06	
Approved	JSP	MAR 06	

Agreement no. CE 31/2004 (GE)
 Arup project no. 24364

Contract
 NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK

Location
 LUK KENG WONG UK

Drawing Title
Landscape Character Plan

Drawing no. **Figure 3 - 2** Rev. **A** Scale **1:5000**

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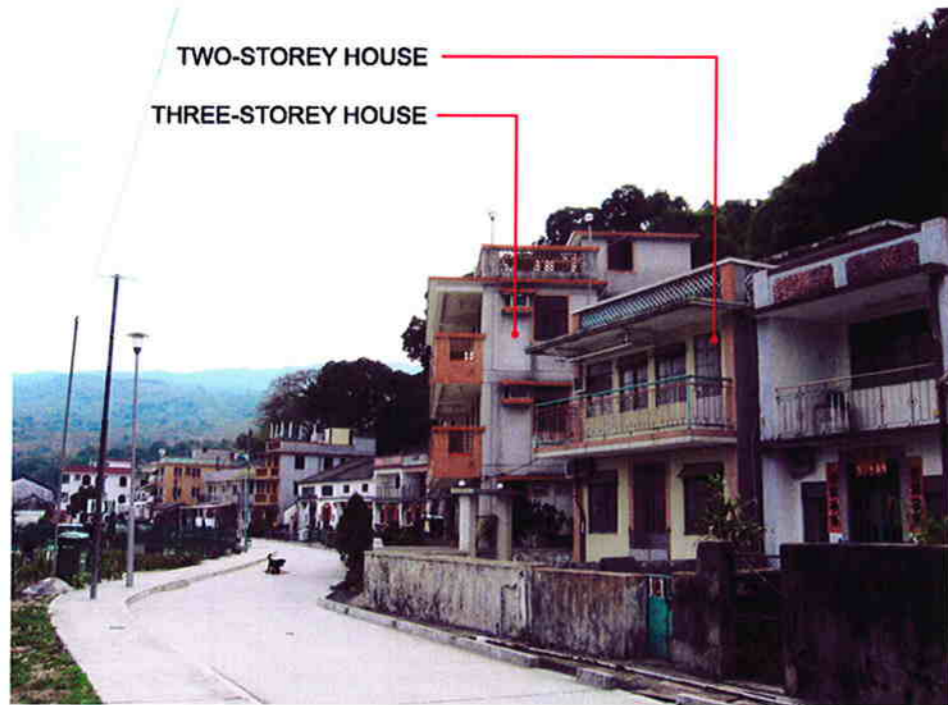


Photo 1: Village. The village is characterised by the different styles of village houses.



Photo 2: Lowlands. The character of this LCA is defined by the flat plain composed of ponds and abandoned fields.

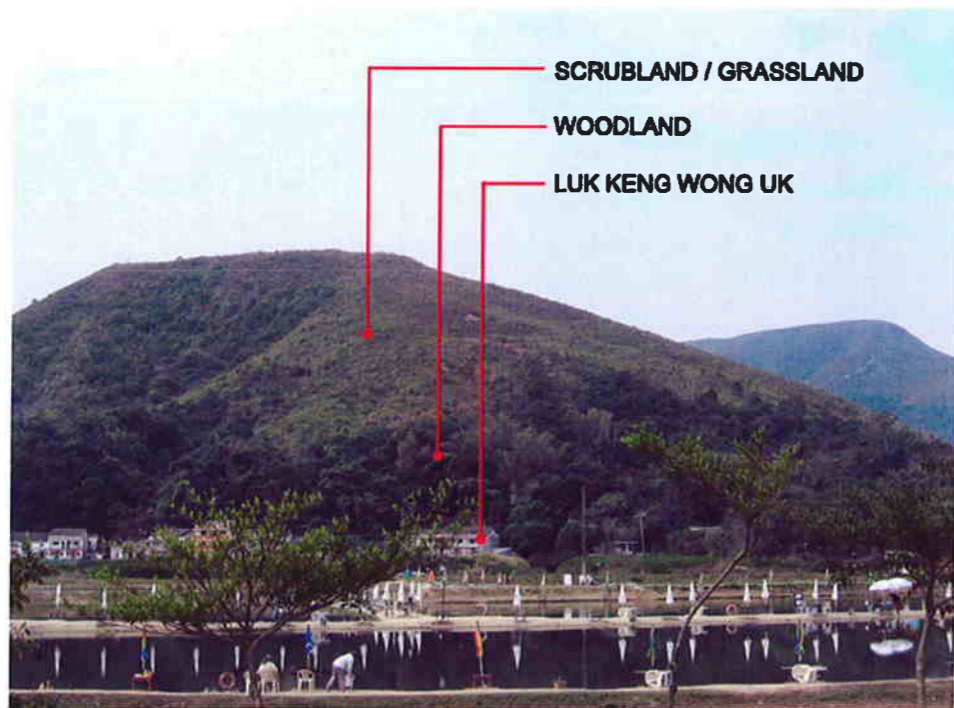


Photo 3: Hillside. This LCA is characterised by the dense woodland at slope toe and scrubland from mid-hill to the ridge.

No.	Date	Description	Checked
Revision			
		Name	Date
Surveyed			
Designed		MWL	MAR06
Drawn		RAB	MAR06
Reviewer		MWL	MAR06
Checked		MWL	MAR06
Approved		JSP	MAR06

Agreement no.	CE 31/2004 (GE)
Arup project no.	24364
Contract	NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK
Location	LUK KENG WONG UK

Drawing Title		
Typical Photos of Landscape Character		
Drawing no.	Rev	Scale
Figure 3 - 3	-	NTS

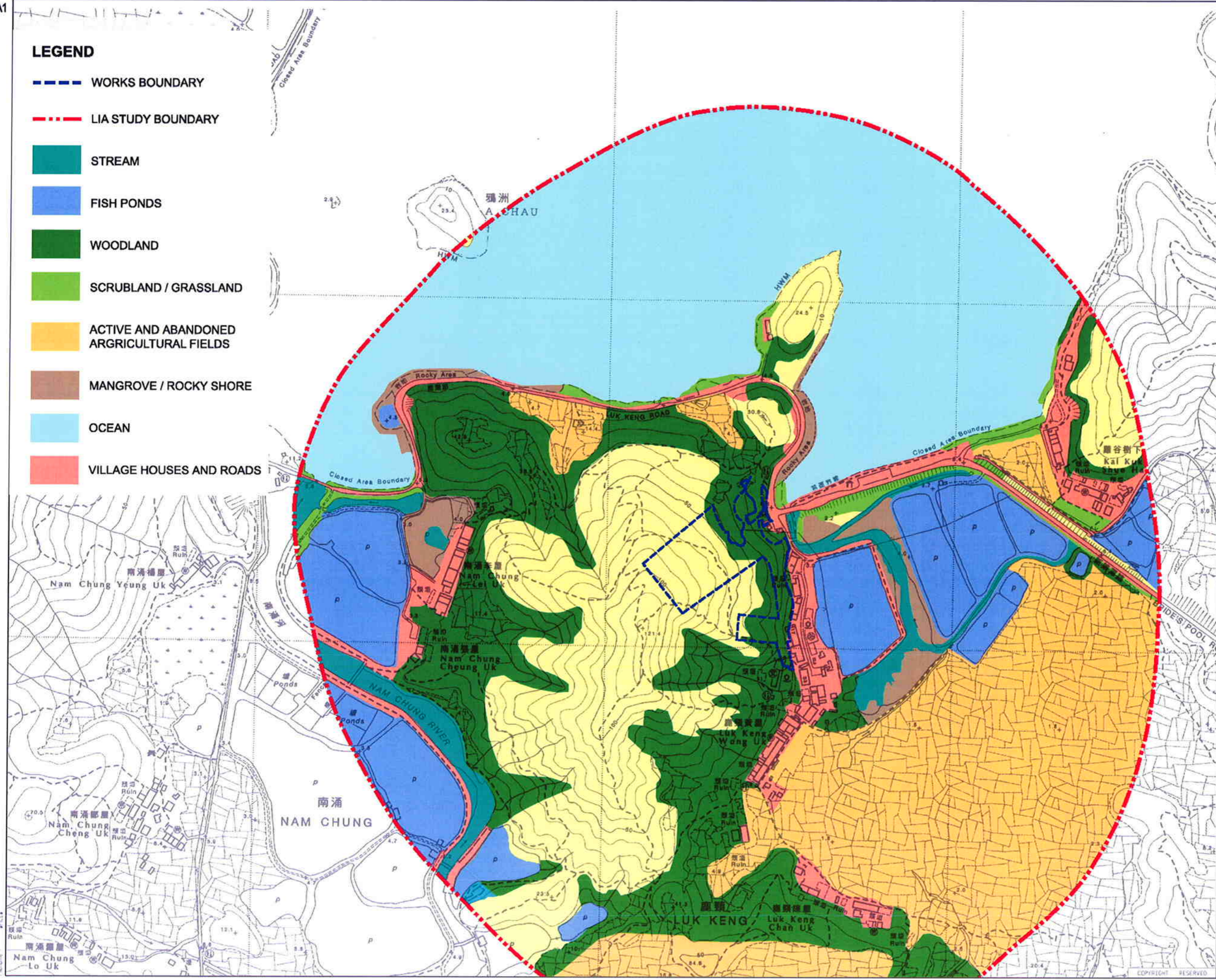
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LEGEND

- WORKS BOUNDARY
- LIA STUDY BOUNDARY
- STREAM
- FISH PONDS
- WOODLAND
- SCRUBLAND / GRASSLAND
- ACTIVE AND ABANDONED AGRICULTURAL FIELDS
- MANGROVE / ROCKY SHORE
- OCEAN
- VILLAGE HOUSES AND ROADS



Rev. No.	Date	Description	Checked
A	05/06	Revised Works Boundary	JSP
Revision			
		Name	Date
Surveyed			
		Designed	MWL MAR06
		Drawn	RAB MAR06
		Reviewer	MWL MAR06
		Checked	MWL MAR06
		Approved	JSP MAR06

Agreement no.	CE 31/2004 (GE)
Asp project no.	24364
Contract	NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK
Location	LUK KENG WONG UK

Landscape Resources Plan		
Drawing no.	Rev.	Scale
Figure 3 - 4	A	1:5000

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Photo 5: Abandoned Field. Abandoned fields are covered by grass and herbaceous plants.



Photo 6: Mangrove / Rocky Shore. Patches of mangrove are located in the rocky shore.



Photo 7: Ocean. Ocean view from elevated location. Buildings in Shenzhen can be seen.



Photo 8: Village. The village is characterised by the different styles of houses.

No.	Date	Description	Checked
Revision			
		Name	Date
Surveyed			
Designed		MWL	MAR06
Drawn		RAB	MAR06
Reviewer		MWL	MAR06
Checked		MWL	MAR06
Approved		JSP	MAR06

Agreement no. CE 31/2004 (GE)
 Arup project no. 24364

Contract
 NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK

Location
 LUK KENG WONG UK

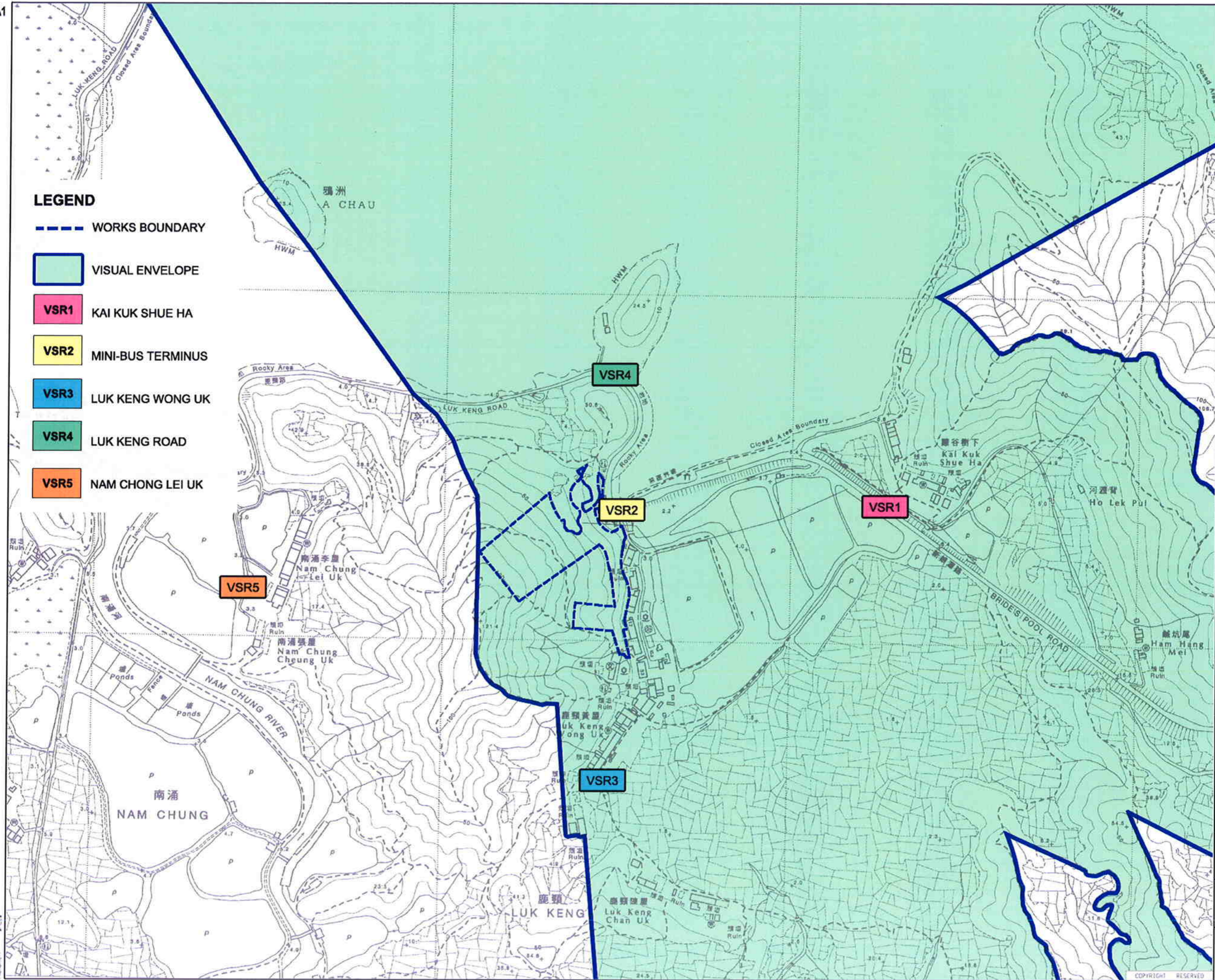
Drawing Title
Typical Photos of Landscape Resources (Sheet 2 of 2)

Drawing no.	Rev	Scale
Figure 3 - 6	-	NTS

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LEGEND

- WORKS BOUNDARY
- VISUAL ENVELOPE
- VSR1 KAI KUK SHUE HA
- VSR2 MINI-BUS TERMINUS
- VSR3 LUK KENG WONG UK
- VSR4 LUK KENG ROAD
- VSR5 NAM CHONG LEI UK

No.	Date	Description	Checked
Revision		None	Date
Surveyed			
Designed	MWL	MAR06	
Drawn	RAB	MAR06	
Reviewed	MWL	MAR06	
Checked	MWL	MAR06	
Approved	JSP	MAR06	

Agreement no. CE 31/2004 (GE)
 Arup project no. 24364

Contract
 NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK

Location
 LUK KENG WONG UK

Drawing Title
Locations of Visually Sensitive Receivers

Drawing no. Figure 3 - 7
 Rev. -
 Scale 1:5000

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Existing



FLEXIBLE BARRIERS

BASE SOIL AFTER CONSTRUCTION OF SOIL NAILS

CONCRETE WALL

Without Mitigation



CLIMBERS *Uvaria macrophylla* PLANTED AT THE BASE OF FLEXIBLE BARRIER

HYDROSEEDING AND NATIVE SHRUB PLANTING TO COVER BASE SOIL

CREeping PLANT *Ficus pumila* PLANTED AT THE TOP OF THE WALL

GRANITE FACADE TO MATCH EXISTING ENVIRONMENT

With Mitigation



CLIMBERS AFTER 10 YEARS

LARGE SHRUBS AFTER 10 YEARS

WALL COVERED WITH *Ficus pumila*

After 10 Years

No.	Date	Description	Checked
Revision			
		Name	Date
Surveyed			
Designed		MWL	MAR06
Drawn		RAB	MAR06
Reviewer		MWL	MAR06
Checked		MWL	MAR06
Approved		JSP	MAR06

Agreement no.	CE 31/2004 (GE)
Arup project no.	24364
Contract	NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK
Location	LUK KENG WONG UK

Drawing Title		
Photomontage of VSR2		
Drawing no.	Rev	Scale
Figure 3 - 8	-	NTS

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- Project Area
- Abandoned Agriculture
- Fish Pond (abandoned)
- Fish Pond (active)
- Mangrove
- Stream Channel/Open Water
- Marsh
- Plantation
- Woodland
- Grassland/shrubland
- Urbanised/Disturbed/Wasteland
- Rock
- 500m boundary

No.	Date	Description	Checked

Agreement no.	CE 31/2004 (GE)
Arup project no.	24364
Contract	NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK
Location	LUK KENG WONG UK

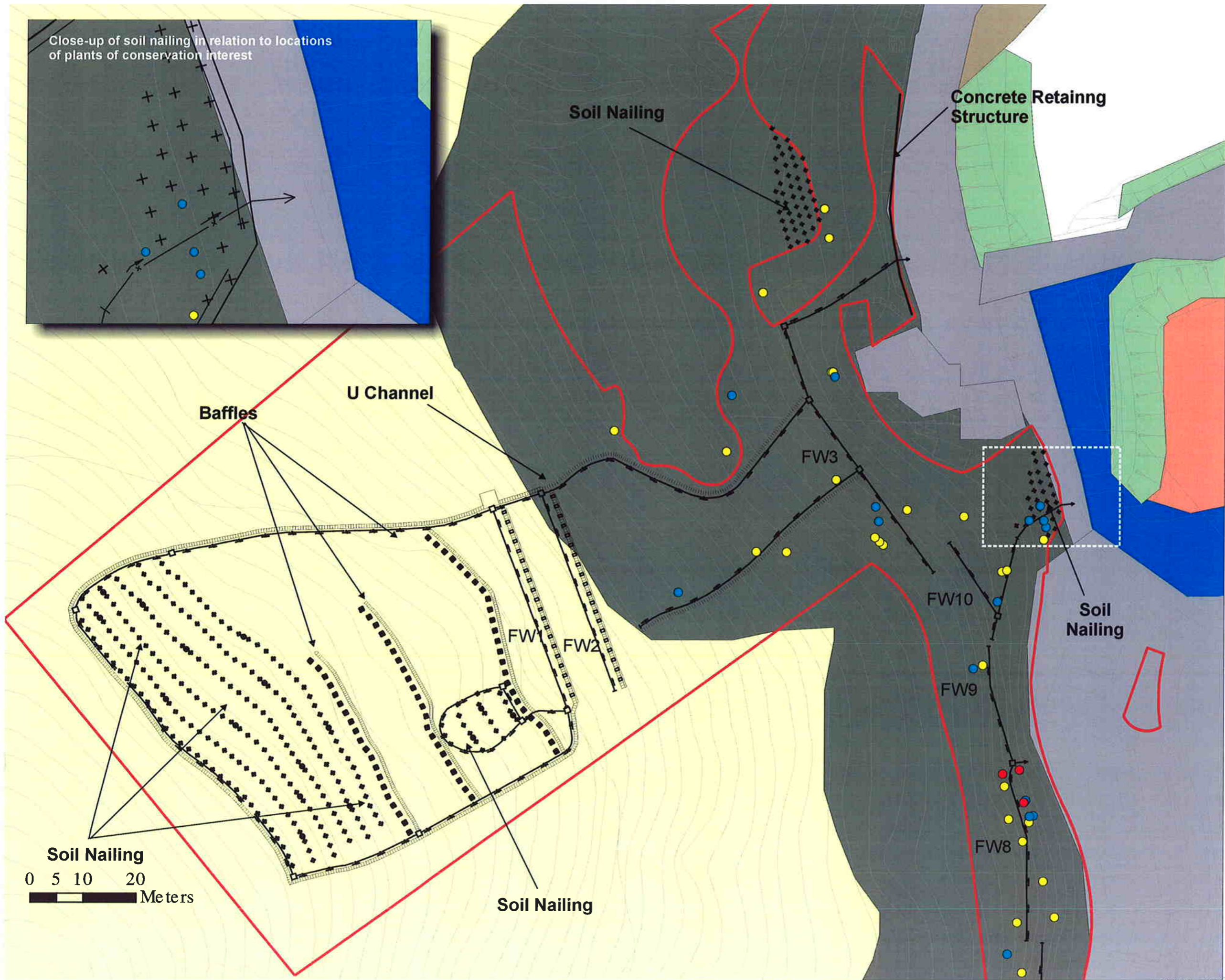
Habitat map

Drawing no.	Rev.	Scale
Figure 3.9	-	AS

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- Mangrove
- Stream Channel/Open Water
- Plantation
- Woodland
- Grassland/shrubland
- Urbanised/Disturbed/Wasteland
- Rock
- Aquilaria sinensis*
- Artocarpus strachinifolius*
- Cibotium barometz* (individual)
- Cibotium barometz* (colony)
- Project Area
- FW** Flexible Barrier (U-channel will be provided along Flexible Barrier)

No.	Date	Description	Checked
Revision:			
		Name	Date
Surveys			
Designed			
Drawn			
Reviewed			
Checked			
Approved			

Agreement no. CE 31/2004 (GE)

Arup project no. 24364

Contract

NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK

Location

LUK KENG WONG UK

Drawing title

Locations of species of conservation importance in relation to the Project Area

Drawing no. Figure 4.1A

Rev. -

Scale AS

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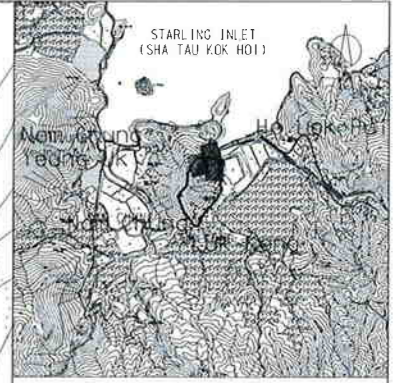
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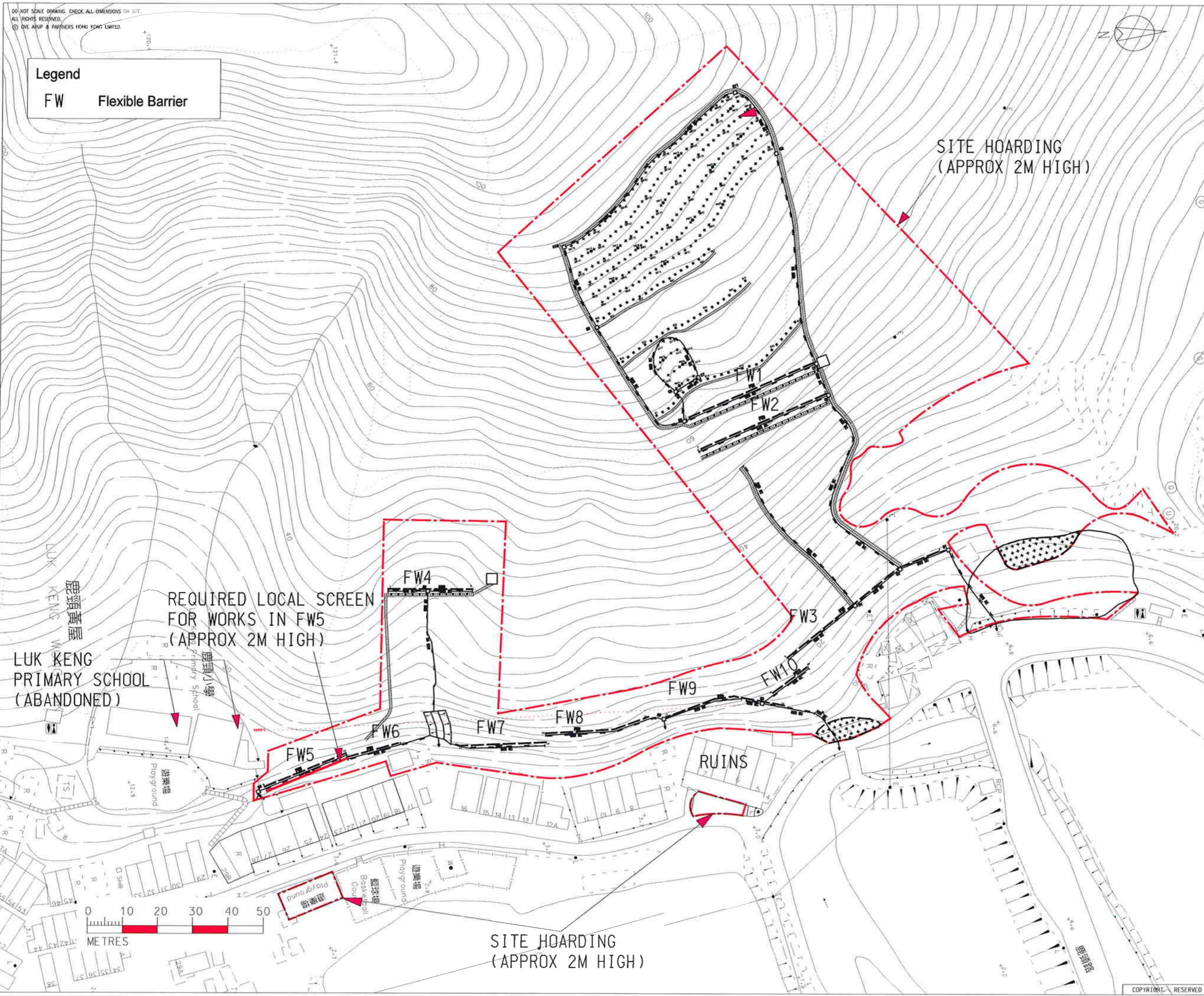
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Legend
FW Flexible Barrier



KEY PLAN



No.	Date	Description	Checked
Revision			
		Name	Date
Surveyed	-	-	-
Designed	-	-	-
Drawn	Fai		03/06
Reviewer	FC		03/06
Checked	HS		03/06
Approved	DL		03/06

Agreement no. CE 31/2004 (GE)
 Arup project no. 24364
 Contract
 NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK

Location
 LUK KENG WONG UK

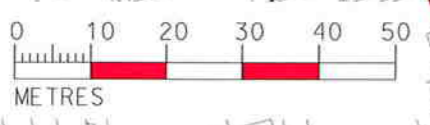
Drawing Title
 LAYOUT OF SITE HOARDING

Drawing no.	Rev	Scale
FIGURE 5-1	-	AS

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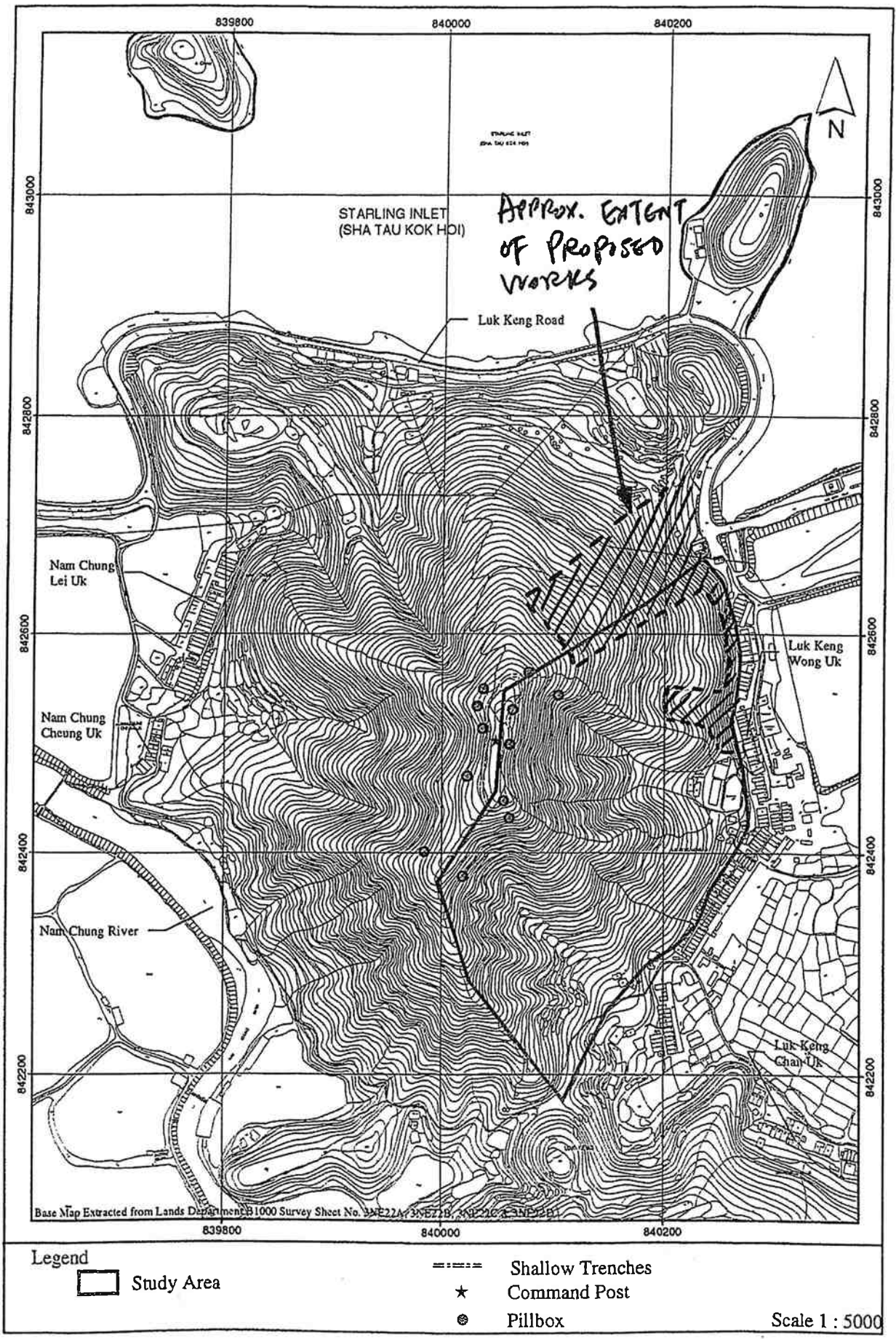
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SITE HOARDING (APPROX 2M HIGH)

APPENDIX 3-1

Wartime Relics



Plan Showing Location of War Relics (Ko, 2001)

APPENDIX 3-2

**Ecological Baseline of
Luk Keng Wong Uk**



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ECOSYSTEMS LTD.

Appendix 3-2

Ecological Baseline of Luk Keng Wong Uk



List of Figures

- Figure A3-2.1 Habitat map with sampling locations for fauna and sightings of species of conservation importance.
- Figure A3-2.2 Sites of conservation importance
- Figure A3-2.3 Photos of habitats and species of conservation interest

List of Annexes

- Annex A3-2.1 Plant species recorded within the Project Area
- Annex A3-2.2 Bird species recorded during field surveys
- Annex A3-2.3 Butterfly and Dragonfly species and their abundance recorded during field surveys.
- Annex A3-2.4 Amphibian, Reptile and Mammal species recorded from literatures and during field surveys.
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1. Introduction

The present attachment covers the scope, the methodology and the results of the ecological study conducted for the Project (the natural terrain hazard mitigation work) at Luk Keng Wong Uk.

2. Study Area and Survey Period

The Study Area for the present ecological study is defined as the area within 500m distance from the boundary of the Project Area (the works site boundary) at Luk Keng Wong Uk (see **Figure A3-2.1**). The field surveys were conducted in September 2005 and March 2006 to cover wet and dry seasons.

3 Methodology

Ecological study included both literature review and field surveys. A review on relevant legislations, literatures, and aerial photos was performed initially. Field surveys were then conducted to verify and update the information gathered from the review and collect field ecological data. Evaluation of the ecological baseline conditions followed the criteria and guidelines stated in the EIAO TM.

The ecological baseline condition for the Project covered all aquatic and terrestrial sites, habitats and species of conservation within the Study Area. All the survey methodologies made reference to the EIAO Guidance Note 10/2004, namely “Methodologies for Terrestrial and Freshwater Ecological Baseline Surveys”, and the sampling techniques included transect count, point count, active searching and direct observation. The surveys included the following items.

- Habitat survey
- Vegetation survey
- Bird survey
- Dragonfly and Butterfly survey
- Amphibian and Reptile survey
- Mammal survey
- Aquatic fauna survey

4 Results

4.1 Project Area and Study Area

The Study Area is located at the northeast New Territories, on the southeast coast of Starling Inlet, covering 109.87 ha of area. The northern part of the Study Area (about one fourth of the Study Area) is marine area (**Figure A3-2.1**). The western part of the Study Area is a north-south



bound elongated hill, while the eastern part of the Study Area is mainly marsh (i.e. Luk Keng Marsh) and fishponds.

The Project Area is located on a hill slope immediate to the west of Luk Keng Wong Uk Village, covering an area of about 1.93 ha.

The major ecological resources within and near the Study Area (see **Figure A3-2.2**) included:

- **Pat Sin Leng Country Park:** Luk Keng Wong Uk is located immediately east to its boundary at Luk Keng.
- **Conservation Area under OZP S/NE-LK/9 – Luk Keng & Wo Hang:** The area of and around Luk Keng Wong Uk is covered by the OZP S/NE-LK/9 – Luk Keng & Wo Hang. Part of the Project Area is located within the Conservation Area under this OZP.
- **Luk Keng Wong Uk fung shui wood, Luk Keng Chan Uk fung shui wood** (Chu 1998; Yip *et al.* 2004): Luk Keng Wong Uk and Chan Uk fung shui woods (**Figure A3.2-2**) had an area of 0.3 ha and 0.5 ha respectively, and had little human disturbance. Some of the proposed hazard mitigations (trapezoidal channel, flexible barriers and associated U-channels) are located within Luk Keng Wong Uk fung shui wood. Luk Keng Chan Uk is about 400m away from the Project Area.
- **Luk Keng Marsh:** Luk Keng marsh is an important freshwater/brackish wetland immediately east of Luk Keng Wong Uk (Dudgeon & Chan 1996) (**Figure A3-2.2**). It was listed as one of the 12 pilot sites for the Private-Public Partnership Scheme under the Conservation Policy of government (EPD 2004).
- **Starling Inlet and A Chau SSSI:** Just over the 500m Study Area and on the south-west part of the Starling Inlet, A Chau (**Figure A3-2.2**) is a wooded island and was designated as SSSI in 1986.

For the Project Area, only Pat Sin Leng Country Park and the Conservation Area were covered by its boundary. The boundary of Luk Keng Marsh as illustrated in EPD website has minimal overlap with the Project Area. The overlapped area however is only existing road and hill slope rather than marsh area. The Luk Keng Marsh is thus not considered overlapping with the Project Area.

4.2 Habitats and vegetation

Project Area

Only three habitats were recorded within the Project Area, i.e. woodland, grassland/shrubland and urbanized/disturbed/wasteland (**Figures A3-2.1 & A3-2.3**) Other than gullies and existing



drainage channels, there is no water course (including natural stream courses) or aquatic habitat within the Project Area.

The woodland within the Project Area was mainly located within the Conservation Area (**Figure A3-2.1**) and distributed in a belt form extending both northward and southward along the foothill right behind Luk Keng Wong Uk Village. It has an area of about 1 ha and is a mixture of the original Luk Keng Wong Uk fung shui wood and secondary woodland which blended together without a clear boundary between each other. It had moderate to high diversity. Major canopy tree species were dominated by typical secondary woodland species, while trees commonly found in fung shui wood were not uncommon.

One tree species recorded of conservation concern is *Aquilaria sinensis* (Incense Tree). It is not protected in Hong Kong and is rather common in lowland forest and fung shui woods in Hong Kong. However, it is a Category III nationally protected species in China and is listed as vulnerable in the China Plant Red Data Book and by IUCN (2002). A total of 3 mature trees and up to 20 seedlings were encountered inside the woodland during the field survey. It was not uncommon in this woodland habitat.

A second plant of conservation concern is a fern species *Cibotium barometz* (the Lamb of Tartary). It is a large tree-like native fern, and is widely distributed and common in Hong Kong, mainly along shrubby and forested valleys and forest margins. Its rhizome could be used in herbal formulas and it is thus listed in Appendix 2 of CITES (for species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled). Within the Project Area, this fern species was mainly found near the upper section of the gully (on the two sides, but not inside the gully). In addition, some scattered individuals were also found at the foothill within the Project Area.

The upslope area of the Project Area is occupied by grassland/shrubland which was probably maintained by hillfires starting at grave sites outside the Project Area. No species of conservation importance was found in this habitat within the Project Area.

There is only a fringe of urbanized/disturbed habitat along the edge of the Project Area. Due to its limited area size, this habitat type is not evaluated in the present study.

Study Area

In additions to woodland and grassland found in the Project Area, more habitats were recorded in the Study Area:



- **Woodland:** More woodlands along foothills behind villages at Chan Uk and Nam Chung.
- **Grassland/shrubland:** Dominated the upper slopes, with more frequent disturbance by fire.
- **Abandoned agriculture:** All agricultural fields within the study area were abandoned.
- **Fish ponds:** Fish ponds were mostly active and operated for recreational fishing.
- **Marsh, mangrove, streams and open water:** To the east and southeast of Wong Uk Village.
- **Urbanized/disturbed/wasteland:** Mainly composed of Luk Keng Wong Uk Village, Chan Uk Village, Nam Chung Village and Luk Keng Road.

Plant species encountered were typical of those recorded in these habitats. No further species of conservation importance were observed.

4.3 Fauna

The findings on the fauna within the Project Area as well as the Study Area are summarized below in **Table A3-2.1** below. Fauna which is locally rare or listed under WAPO (except birds) or regional/global convention or of restricted distribution are considered of conservation concern.

Table 3-2.1 Key Findings on Fauna from Ecological Field Surveys

Fauna groups	Key Findings
Birds	All bird species recorded within and near the Project Area are common and widespread in Hong Kong (Annex A3-2.2), and of low conservation concern. A Chau SSSI is the biggest egretty in Hong Kong and is also a winter roost of Great Cormorant <i>Phalacrocorax carbo</i> since winter 1996/97 (Carey <i>et al.</i> 2001). But this site is over 500m away from the Project Area.
Butterflies	No rare butterfly species were recorded within and near the Project Area during the field surveys (Annex A3-2.3). Among the 64 species previously recorded in Luk Keng area (Yiu 2004), butterflies of conservation concern included Orange Awlet <i>Bibasis oedipodea</i> , Indian Awl King <i>Choaspes benjaminii</i> , and Centaur Oak Blue <i>Arthropala pseudocentaurus</i> . As no larval foodplant of these species were found within the Project Area, these species would not be affected and are not relevant to the assessment.
Dragonflies	All dragonfly species recorded during field surveys within (2 species) and near (3 species) the Project Area are common and widespread in Hong Kong

Fauna groups	Key Findings
	<p>(Annex A3-2.3).</p> <p>The nearby Luk Keng Marsh supports 58 species of dragonfly (Wilson 2004), including the endemic Spangled Shadow-emerald <i>Macromidia ellenae</i>. This species is not relevant to the assessment as the marsh is outside the Project Area.</p>
Amphibians	<p>No amphibian species of conservation concern was recorded within and near the Project Area during field surveys or literature review (Annex A3-2.4).</p>
Reptiles	<p>Among the reptiles found during field surveys (Annex A3-2.4), Chinese Cobra <i>Naja atra</i> sighted on the grassland was listed in Appendix 2 of CITES (Zhao 1998). But this species is not considered a potential ecological concern for the Project due to: a) the woodland within the Project Area is not considered preferred habitat of this species (Karsen <i>et al.</i> 1998); b) affected area will be small and will not threaten the survivorship of Chinese Cobra; and c) alternative habitats are available in nearby area.</p>
Mammals	<p>The only mammal recorded was Japanese Pipistrelles <i>Pipistrellus abramus</i> (Annex A3-2.4), which is protected under WAPO and were seen flying above the marshes during night surveys. This species is common in Hong Kong (Shek 2004) and not considered relevant to the assessment.</p>
Aquatic fauna	<p>No aquatic fauna was found within the Project Area as there is no streams or other aquatic habitats inside.</p> <p>Outside the Project Area, aquatic habitats included marsh and streams. Aquatic fauna recorded from previous studies and the present filed surveys are all common and of no special conservation importance (Annex A3-2.5).</p>

5 Evaluation of Habitats and Species

The ecological importance of the habitats within the Project Area was evaluated below in accordance with the criteria stipulated in Annex 8 of EIAO TM.

Table A3-2.2 Evaluation of habitats within the Project Area

Criterion	Woodland	Grassland
Naturalness	Semi-natural, mixture of fung shui wood and naturally colonized woodland.	Basically natural, but probably frequently disturbed by hillfires.



Criterion	Woodland	Grassland
Size	1.05 ha	1.23 ha
Diversity	113 plant species recorded, diversity of fauna is low	21 plant species, diversity of fauna is very low
Rarity	No rare species recorded	No rare species recorded
Re-creatability	Re-creatable but take time to mature and restore function	Re-creatable
Fragmentation	Not fragmented, continuous patch.	Not fragmented, continuous patch.
Ecological linkage	Potentially a roosting site for the egrets utilizing wetlands in the vicinity, but not recorded in literature nor the field survey.	Not functionally linked to any highly valued habitat in close proximity
Potential value	Minor, close to climax	Moderate if disturbance could be avoided.
Nursery/breeding ground	No significant record, but can provide breeding habitats for birds, butterflies and reptiles	No significant record, limited as breeding habitat of terrestrial fauna due to low vegetation cover
Age	Oldest part about 60 years. Secondary woodland younger of age.	Young due to disturbance
Abundance/richness of wildlife	Low fauna abundance	Very low fauna abundance
Overall ecological value	Moderate to High	Low

The conservation status of the rare/endangered/protected flora and fauna species is evaluated below based on Table 3 of Annex 8 of the EIAO TM.

Table A3-2.3 Evaluation of species of conservation importance

Common name	Scientific name	Locations	Protection status	Distribution	Rarity
Incense Tree	<i>Aquilaria sinensis</i>	In woodland within the Project Area	Not protected locally but Category III nationally protected species in China and is listed as vulnerable in the China Plant Red Data Book and by IUCN (2002).	In secondary woodland and fung shui woods	Locally common
The lamb	<i>Cibotium</i>	Near the	Not protected locally but	Mainly along	Locally common



Common name	Scientific name	Locations	Protection status	Distribution	Rarity
of Tartary	<i>barometz</i>	gully within the Project Area	listed in Appendix 2 of CITES	shrubby and forested valleys and forest margins	
Chinese Cobra	<i>Naja atra</i>	In grassland within the Project Area	Not protected locally but listed in Appendix 2 of CITES	Can be found in a great variety of habitats, generally uncommon in shaded woodland	Common & widespread in Hong Kong,

6 Conclusions

The only potential ecological concern identified within the Project Area was the woodland which might potentially be directly impacted, in particular the two plant species of conservation concern inside, i.e. *Aquilaria sinensis* (Incense Tree) and *Cibotium barometz* (the Lamb of Tartary). They are both common and widespread in Hong Kong.

Chinese Cobra, a species listed in CITES Appendix 2, however is not considered relevant to the assessment as there is no preferred habitats for this species present, and thus is not a ecological concern.

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ANNEXES

Annex A3-2.1 Plant species recorded within the Project Area

Species	Habit	Exotic	Relative Abundance	
			Woodland	Shrubland/Grassland
<i>Acacia confusa</i>	T	Exotic	+	
<i>Acronychia pedunculata</i>	T		++	+
<i>Adiantum malaccensis</i>	F		+++	
<i>Alangium chinense</i>	T		+++	
<i>Albizia lebbek</i>	T		+	
<i>Alocasia macrorrhiza</i>	H		++	
<i>Alpinia</i> sp.	H		++	
<i>Aporosa dioica</i>	T		+++	
<i>Aquilaria sinensis</i>	T		++	
<i>Aralia chinensis</i>	T			+
<i>Archidendron lucidum</i>	T		+	
<i>Ardisia punctata</i>	S		+	
<i>Ardisia quinqueгона</i>	S		+++	
<i>Bamboo</i>	H		++	
<i>Bauhinia glauca</i>	C		+	
<i>Blechnum orientale</i>	F		+	++
<i>Boehmeria nivea</i>	S		++	
<i>Bowringia callicarpa</i>	C		+	
<i>Breynia fruticosa</i>	S		++	
<i>Bridelia tomentosa</i>	T		++	
<i>Byttneria aspera</i>	C		++	
<i>Canthium dicoccum</i>	T		++	+
<i>Carallia brachiata</i>	T		+	
<i>Caryopteris incana</i>	H		+	
<i>Cassytha filiformis</i>	C			+
<i>Castanopsis fissa</i>	T		+++	
<i>Choerospondias axillaris</i>	T		+	
<i>Christella parasitica</i>	F		++	
<i>Cibotium barometz</i>	F		+++	
<i>Cinnamomum burmanii</i>	T		++	
<i>Cinnamomum camphora</i>	T		++	
<i>Cratoxylum cochinchinensis</i>	T		+++	++
<i>Daphniphyllum calycinum</i>	T		+++	



Species	Habit	Exotic	Relative Abundance	
			Woodland	Shrubland/Grassland
<i>Desmos chinensis</i>	S		+++	
<i>Dianella ensifolia</i>	H		+	
<i>Dicranopteris pedata</i>	F		++	+++
<i>Dimocarpus longan</i>	T	Exotic	++	
<i>Elaeocarpus chinensis</i>	T		++	
<i>Ficus sp.</i>	T		+	
<i>Ficus fistulosa</i>	T		+	
<i>Ficus hirta</i>	S		++	
<i>Ficus hispida</i>	T		++	
<i>Ficus superba</i>	T		+	
<i>Ficus variegata</i>	T		+++	
<i>Ficus variolosa</i>	S		++	
<i>Gahnia tristis</i>	H		+	
<i>Garcinia oblongifolia</i>	T		+	
<i>Gardenia jasminoides</i>	S		+	
<i>Glochidion eriocarpum</i>	S		+++	
<i>Gnetum montanum</i>	C		+	
<i>Gordonia axillaris</i>	S		++	
<i>Hedyotis hedyotideia</i>	H		+	
<i>Homalium cochinchinensis</i>	T		+	
<i>Ilex asprella</i>	S		+	++
<i>Itea chinensis</i>	T		+	
<i>Kyllinga sp.</i>	H		++	
<i>Lantana camara</i>	S	Exotic	++	
<i>Lasianthus chinensis</i>	T		+++	
<i>Litchi chinensis</i>	T	Exotic	+	
<i>Litsea cubeba</i>	T		++	+++
<i>Litsea glutinosa</i>	T		+	
<i>Litsea rotundifolia</i>	S		+++	++
<i>Lophatherum gracile</i>	G		++	
<i>Lygodium japonicum</i>	F		++	
<i>Lygodium microphyllum</i>	F		++	+
<i>Machilus breviflora</i>	T		+++	
<i>Machilus velutina</i>	T		+	
<i>Melastoma candidum</i>	S			++



Species	Habit	Exotic	Relative Abundance	
			Woodland	Shrubland/Grassland
<i>Mallotus paniculatus</i>	T		++	++
<i>Maesa perlarius</i>	S		++	
<i>Melastoma sanguineum</i>	S			++
<i>Metasequoia glyptostroboides</i>	T	Exotic	+	
<i>Microcos paniculata</i>	T		++	
<i>Microstegium ciliatum</i>	G		++	
<i>Miscanthus sinensis</i>	G		+	++
<i>Ormosia</i> sp.	T		+	
<i>Pandanus</i> sp.	S		+	
<i>Psychotria rubra</i>	S		+++	
<i>Psychotria serpens</i>	C		++	
<i>Pteris ensiformis</i>	F		+	
<i>Pteris semipinnata</i>	F		++	
<i>Pueraria lobata</i>	C		+	
<i>Pygeum topengii</i>	T		++	
<i>Reevesia thyrsoidea</i>	T		+	
<i>Rhaphiolepis indica</i>	S		+	
<i>Rhodomyrtus tomentosa</i>	S		+	+
<i>Rhus hypoleuca</i>	T			++
<i>Rubus reflexus</i>	C		+	
<i>Sarcosperma laurinum</i>	T		++	
<i>Sapium discolor</i>	T		++	++
<i>Sapium sebiferum</i>	T		+	+
<i>Sarcandra glaber</i>	S		++	
<i>Schefflera heptaphylla</i>	T		+++	
<i>Schima superba</i>	T		++	
<i>Scleria</i> sp.	H		+	
<i>Scolopia saeva</i>	T		+	
<i>Smilax china</i>	C			+
<i>Smilax corbularia</i>	C		+	
<i>Smilax glabra</i>	C		+	
<i>Solanum torvum</i>	S		+	
<i>Sterculia lanceolata</i>	T		+++	
<i>Strophanthus divaricatus</i>	C			+
<i>Symplocos glauca</i>	T		+	



Species	Habit	Exotic	Relative Abundance	
			Woodland	Shrubland/Grassland
<i>Symplocos lancifolia</i>	T		+++	
<i>Syzygium hancei</i>	T		++	
<i>Syzygium jambos</i>	T		++	
<i>Syzygium levinei</i>	T		++	
<i>Tectaria subtriphylla</i>	F		+	
<i>Tetracera asiatica</i>	C		+	
<i>Tricalysia dubia</i>	S		+	
<i>Tylophora ovata</i>	C		+	
<i>Uvaria grandiflora</i>	S		++	
<i>Uvaria macrophylla</i>	S		+++	

Habit: T = tree, S = shrub, H = herb, G = grass, C = climber

+++ = common, ++ = occasional, + = scarce



Annex A3-2.2 Bird species recorded during field surveys (CW = common and widespread)

Common names	Latin names	Project Area		Study Area	Commonness
		Grassland	Woodland		
Chinese Bulbul	<i>Pycnonotus sinensis</i>		++		CW
Crested Bulbul	<i>Pycnonotus jocosus</i>		++		CW
Oriental Magpie Robin	<i>Copsychus saularis</i>		+		CW
Common Tailorbird	<i>Orthotomus sutorius</i>		++		CW
Great Tit	<i>Parus major</i>		+		CW
Japanese white-eye	<i>Zosterops japonica</i>		+		CW
Arctic Warbler	<i>Phylloscopus borealis</i>		+		CW
Little Egrets	<i>Egretta garzetta,</i>			++	CW
Great Egrets	<i>Casmerodius albus,</i>			+	CW
Grey Heron	<i>Ardea cinerea,</i>			++	CW
Black-crowned Night Heron	<i>Nycticorax nycticorax,</i>			+++	CW
Common Sandpiper	<i>Actitis hypoleucos,</i>			+	CW
White-breasted Waterhen	<i>Amaurornis phoenicurus,</i>			+	CW
Pied Kingfishers	<i>Ceryle rudis</i>			+	CW
Common Kingfishers	<i>Alcedo atthi</i>			+	CW
Total species			7	8	



Annex A3-2.3 Butterfly and Dragonfly species and their abundance recorded during field surveys.

Common names	Latin names	Project Area		Study Area	Commonness
		Grassland	Woodland		
Chestnut Angle	<i>Odontoptilum augulatum</i>		+		C
Contiguous Swift	<i>Polytrems lubricans</i>		+		C
Tailed Jay	<i>Graphium agamemnon</i>		+		VC
Great Mormon	<i>Papilio memnon</i>		+		C
Common Mormon	<i>Papilio polytes</i>		+		VC
Mottled Emigrant	<i>Catopsilia pyranthe</i>	+			C
Pale Grass Blue	<i>Zizeeria maha</i>		+		VC
Punchinello	<i>Zemeros fleygas</i>	+			C
Common Palmfly	<i>Elymnias hypermnestra</i>		+		C
Banded Tree Brown	<i>Lethe confusa</i>		+		VC
Shan Nawab	<i>Polyura nepenthes</i>		+		UC
Angled Castor	<i>Ariadne ariadne</i>		+		C
Rustic	<i>Cupha erymanthis</i>		+		VC
Peacock Pansy	<i>Junonia almana</i>		+		C
Blue-spotted Crow	<i>Euploea midamus</i>		+		VC



Common names	Latin names	Project Area		Study Area	Commonness
		Grassland	Woodland		
Ceylon Blue Tiger	<i>Ideopsis similis</i>		+		VC
Common Grass Yellow	<i>Eurema hecabe</i> ,	+		+	C
Red Helen	<i>Papilio helenus</i> ,			+	C
Paris Peacock	<i>P. paris</i> ,			+	C
Common Mormon	<i>P. polytes</i> .			+	C
Total species		3	14	4	
Common names	Latin names	Project Area		Study Area	Commonness
Green Skimmer	<i>Orthetrum sabina</i>		+	+	C
Lesser Blue Skimmer	<i>O. triangulare</i>		+		C
Wandering Glider	<i>Pantala flavescens</i> ,			+	C
Crimson Dropwing	<i>Trithemis aurora</i>			+	C
Total species		2		3	

C = common, VC = very common, UC = uncommon (following Wilson 2004 on dragonflies and Yiu 2004 on butterflies)



Annex A3-2.4 Amphibian, Reptile and Mammal species recorded from literatures and during field surveys.

Fauna	Field surveys		Literatures
	Project Area	Study Area	Dudgeon and Chan 1996 & Lau and Dudgeon 1999;
Amphibians			
Gunther's Frog <i>Rana guentheri</i> ,			✓
Paddy Frog <i>Fejervarya limnocharis</i> ,			✓
Brown Tree Frog <i>Polypedates megacephalus</i>			✓
Spotted Narrow-mouthed Frog <i>Kalophrynus interlineatus</i>			✓
Reptiles			
Reeves's Smooth Skink <i>Scincella reevesii</i>	+		
Chinese Cobra <i>Naja atra</i> .	+		
Changeable Lizard <i>Calotes versicolor</i>		+	
Mammals			
Japanese Pipistrelles <i>Pipistrellus abramus</i>		++	

+++ = Abundant, ++ = Common, + = Occasional



Annex A3-2.5 Aquatic fauna recorded from literatures and during field surveys.

Scientific name	Common name	Project Area	Study Area	Dudgeon and Chan 1996
<i>Macropodus opercularis,</i>				✓
<i>Gambusia affinis,</i>				✓
<i>Puntius (= Capoeta) semifasciolatus</i>			+++	✓
<i>Misgurnus sp.</i>				✓
<i>Periophthalmus cantonensis,</i>	Mudskipper			
<i>Uca arcuata,</i>	Fiddler crab			
<i>Perisesarma bidens,</i>	Sesarmine crab			
<i>Parasesarma affinis.</i>				
<i>Radix plicatulus</i>	freshwater snail			
<i>Oreochromes spp.</i>	Tilapia		+++	

+++ = Abundant, ++ = Common, + = Occasional

Figure A3-1.1 Habitat map with sampling locations for fauna and sightings of species of conservation importance.

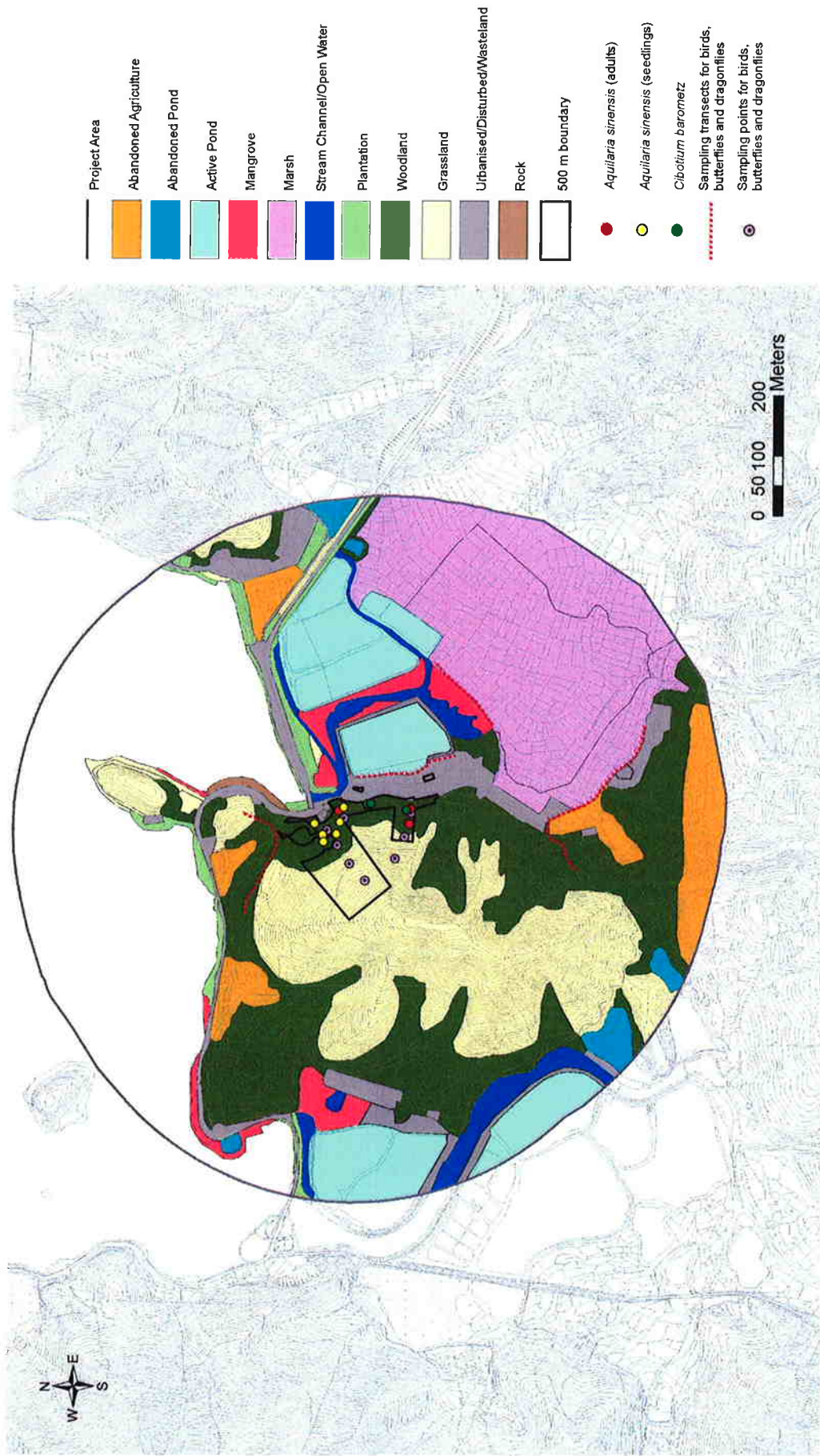


Figure A3-1.2 Sites of conservation importance

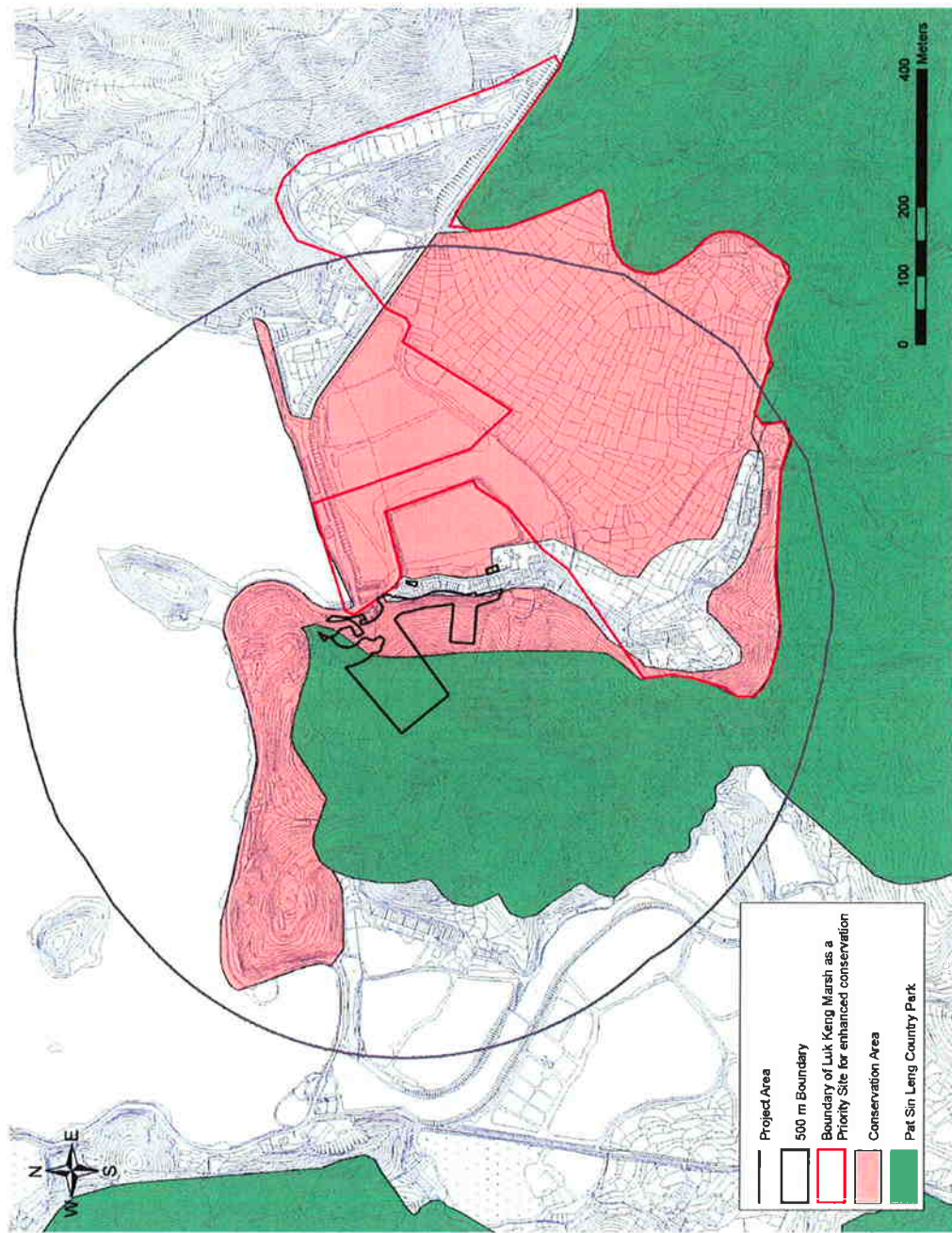
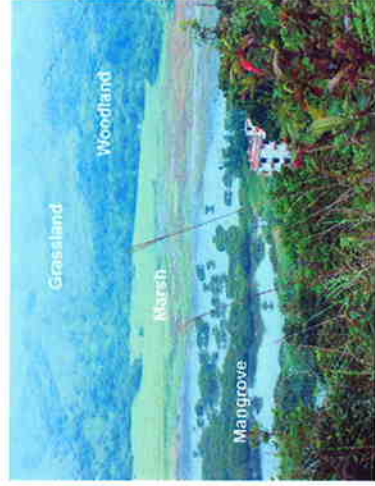


Figure A3-1.3 Photos of habitats and species of conservation interest

Study Area



Project Area



Appendix 4-1

**Construction Plant
Inventory**

Project : Luk Keng
 Title : SWLs of PMEs

PME	SWLs to TM-NCO		Quiet Plant (BS5228)				W/ Other Good Practices									
	% Operation	Corr. dB(A)	ID	Description	Power rating Size, weight	PME SWL, dB(A)	Unmitigated SWL, dB(A)	ID	Power rating Size, weight	PME SWL, dB(A)	Quiet Plant SWL, dB(A)	Enclosure, dB(A)	Barrier, dB(A)	Acoustic Mat, dB(A)	Total Reduction, dB(A)	Mitigated SWL, dB(A)
Compressor	100	0	CNP002	Air compressor, air flow > 10m ³ /min and =< 30 m ³ /min	-	102	102			102	102				0	102
Concrete pump	100	0	CNP047	Concrete pump, stationary / lorry mounted	-	109	109	C6-36	100KW	106	106				-5	101
Drill	50	-3	CNP064	Drill, percussive, hand held (electric)	-	103	100	C6-52	4kg	98	95				0	95
Excavator	50	-3	CNP081	Excavator / loader, wheeled / tracked	-	112	109	CNP082		94	91				0	91
Generator	100	0	CNP102	Generator, silenced, 75dB(A) at 7m	-	100	100				100				0	100

Job Title : Luk Keng

Heading : Plant Inventory

Soil Nailing		SWL of Single PME			Total SWL		
Worksite Area 1							
Activity	Months	PME	Units	[1]	[2]	[3]	
Soil Nailing	M1 to M3	Compressor	1	102	102	102	[3]
		Drill	2	100	95	103	102
		Generator	1	100	100	100	98
				106	105	107	100
							105

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Activity	Months	PME	Units	SWL of Single PME			Total SWL		
				[1]	[2]	[3]	[1]	[2]	[3]
Baffle	M4 - M6	Compressor	1	102	102	102	102	102	102
		Drill	1	100	95	100	100	95	95
		Generator	1	100	100	100	100	100	100
				106	105	105	106	105	105

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Flexible Barrier - FW1				SWL of Single PME			Total SWL		
Worksite Area 3									
Activity	Months	PME	Units	[1]	[2]	[3]	[1]	[2]	[3]
Installing Flexible Barrier & associated channels	M2 - M4	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110	95 91 96	95 91 96

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Flexible Barrier - FW2		SWL of Single PME			Total SWL		
Worksite Area 4							
Activity	Months	PME	Units	[1]	[2]	[3]	
Installing Flexible Barrier & associated channels	M5 - M6	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110
							[2] 95 91 96
							[3] 95 91 96

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Flexible Barrier - FW3				SWL of Single PME			Total SWL		
Worksite Area 5									
Activity	Months	PME	Units	[1]	[2]	[3]	[1]	[2]	[3]
Installing Flexible Barrier & associated channels	M7 - M8	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110	95 91 96	95 91 96

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Flexible Barrier - FW4		SWL of Single PME			Total SWL		
Workspace Area 6							
Activity	Months	PME	Units	[1]	[2]	[3]	
Installing Flexible Barrier & associated channels	M9 - M10	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Flexible Barrier - FW5				SWL of Single PME			Total SWL		
Worksite Area 7				[1]	[2]	[3]	[1]	[2]	[3]
Activity	Months	PME	Units						
Installing Flexible Barrier & associated channels	M11-M12	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110	95 91 96	95 91 96

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Flexible Barrier - FW6				SWL of Single PME			Total SWL		
Worksite Area 8				[1]	[2]	[3]	[1]	[2]	[3]
Activity	Months	PME	Units						
Installing Flexible Barrier & associated channels	M13-M14	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110	95 91 96	95 91 96

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Flexible Barrier - FW7				SWL of Single PME			Total SWL		
Workspace Area 9				[1]	[2]	[3]	[1]	[2]	[3]
Activity	Months	PME	Units						
Installing Flexible Barrier & associated channels	M15-M16	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110	95 91 96	95 91 96

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng
Heading : Plant Inventory

Flexible Barrier - FW8				SWL of Single PME			Total SWL		
Worksite Area 10									
Activity	Months	PME	Units	[1]	[2]	[3]	[1]	[2]	[3]
Installing Flexible Barrier & associated channels	M17 - M 18	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110	95 91 96	95 91 96

[1] Assume SWLs in TM-NCO
[2] Assume quiet plant as good practices (ref BS5228)
[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Flexible Barrier - FW9				SWL of Single PME			Total SWL		
Worksite Area 11									
Activity	Months	PME	Units	[1]	[2]	[3]	[1]	[2]	[3]
Installing Flexible Barrier & associated channels	M19 - M20	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110	95 91 96	95 91 96

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng
Heading : Plant Inventory

Flexible Barrier - FW10				SWL of Single PME			Total SWL		
Worksite Area 12									
Activity	Months	PME	Units	[1]	[2]	[3]	[1]	[2]	[3]
Installing Flexible Barrier & associated channels	M21-M22	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110	95 91 96	95 91 96

[1] Assume SWLs in TM-NCO
[2] Assume quiet plant as good practices (ref BS5228)
[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Trapezoidal channel		SWL of Single PME			Total SWL		
Worksite Area 13							
Activity	Months	PME	Units	[1]	[2]	[3]	
Forming trapezoidal channel	M1 - M6	Concrete pump Excavator	1 1	109 109 112	106 91 106	101 91 101	109 109 112
							[3] 101 91 101

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

U-Channel downhill of FW2		SWL of Single PME			Total SWL		
Worksite Area 15							
Activity	Months	PME	Units	[1]	[2]	[3]	
Installing channels downhill of FW2	M17- M18	Drill Excavator	1 1	100 109 110	95 91 96	95 91 96	100 109 110

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Channels		SWL of Single PME		Total SWL		
Worksite Area 16						
Activity	Months	PME	Units	[1]	[2]	[3]
Installing channels downhill of baffles	M17- M18	Drill Excavator	1 1	100 109 110	95 91 96	100 109 110
					95 91 96	95 91 96

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng
Heading : Plant Inventory

Western Temporary Works Area				SWL of Single PME			Total SWL		
Activity	Months	PME	Units	[1]	[2]	[3]	[1]	[2]	[3]
				Pumping Concrete	M1 - M22	Concrete pump	1	109	106

[1] Assume SWLs in TM-NCO
 [2] Assume quiet plant as good practices (ref BS5228)
 [3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Artificial Slope 3NE-C/C135		Worksite Area 18		SWL of Single PME			Total SWL		
Activity	Months	PME	Units	[1]	[2]	[3]	[1]	[2]	[3]
Forming concrete retaining wall	M7 - M9	Concrete pump Excavator	1 1	109 109 112	106 91 106	101 91 101	109 109 112	106 91 106	101 91 101

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Soil Nailing		SWL of Single PME			Total SWL		
Worksite Area 19							
Activity	Months	PME	Units	[1]	[2]	[3]	
Soil Nailing (at slope 3NE-C/C135)	M7 to M9	Compressor	1	102	102	102	102
		Drill	2	100	95	103	98
		Generator	1	100	100	100	100
				106	105	105	107
							105

[1] Assume SWLs in TM-NCO

[2] Assume quiet plant as good practices (ref BS5228)

[3] Assume other good site practices

Job Title : Luk Keng
Heading : Plant Inventory

Soil Nailing				SWL of Single PME			Total SWL		
Worksite Area 20				[1]	[2]	[3]	[1]	[2]	[3]
Activity	Months	PME	Units						
Soil Nailing (at slope 3NE-C/C13)	M10 to M12	Compressor	1	102	102	102	102	102	102
		Drill	2	100	95	103	98	100	98
		Generator	1	100	100	100	100	100	100
				106	105	105	107	105	105

[1] Assume SWLs in TM-NCO
 [2] Assume quiet plant as good practices (ref BS5228)
 [3] Assume other good site practices

Job Title : Luk Keng

Heading : Plant Inventory

Channels		SWL of Single PME			Total SWL		
Activity	Months	PME	Units				
			[1]	[2]	[3]		
Worksite Area 21							
Installing channels downhill near FW4	M9 - M10	Drill Excavator	100 109 110	95 91 96	95 91 96	100 109 110	
						[3] 95 91 96	

[1] Assume SWLs in TM-NCO

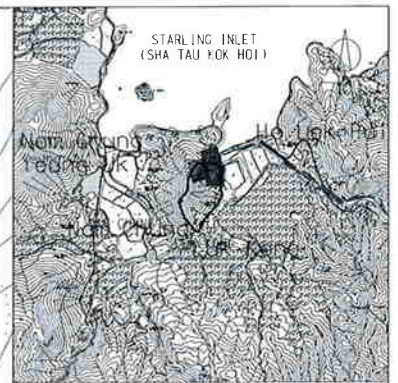
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[3] Assume other good site practices

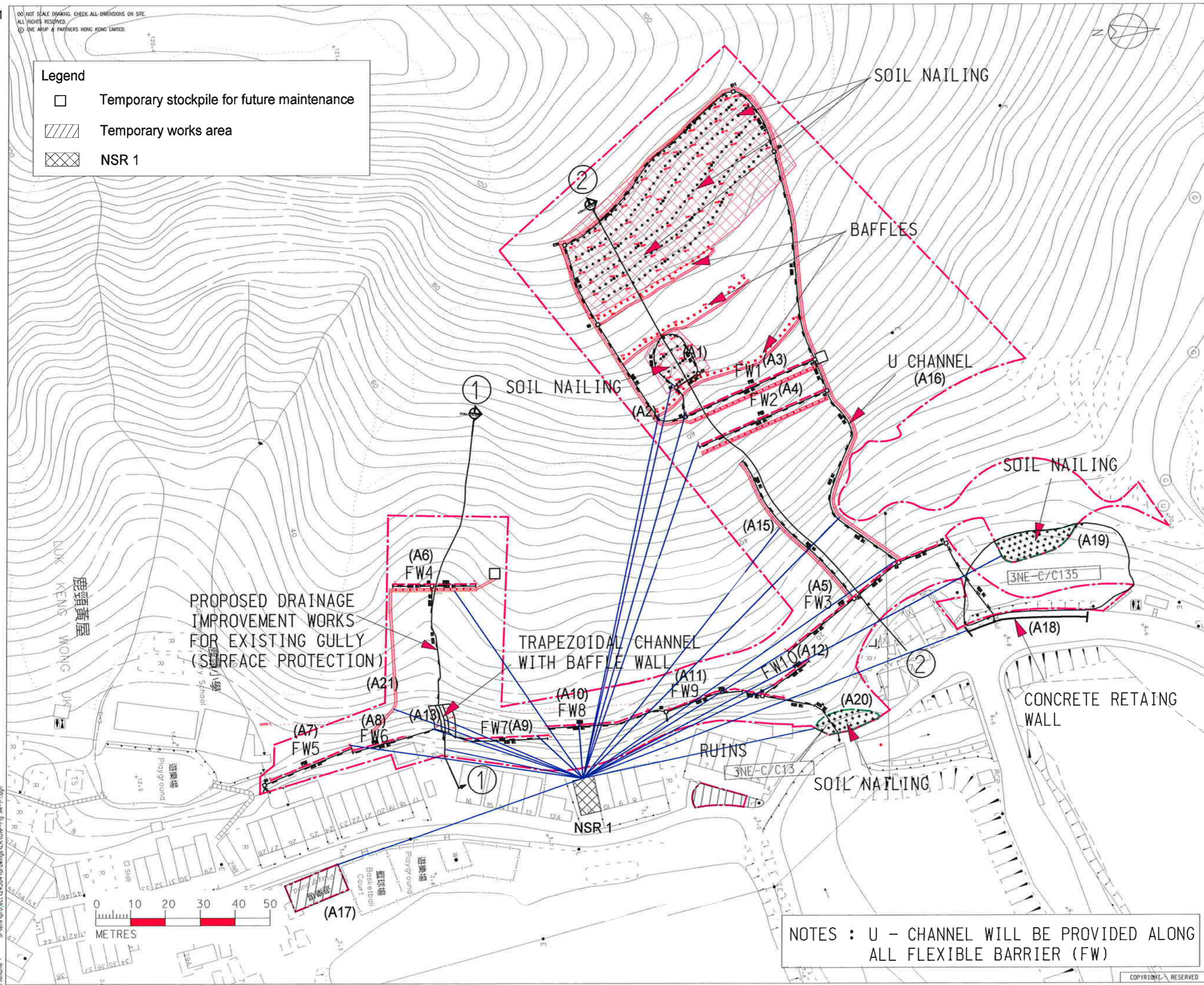
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Legend

- Temporary stockpile for future maintenance
- ▨ Temporary works area
- ▩ NSR 1



KEY PLAN



No.	Date	Description	Checked

Agreement no.	CE 31/2004 (GE)
Arup project no.	24364
Contract	NATURAL TERRAIN HAZARD MITIGATION WORKS IN LUK KENG WONG UK
Location	LUK KENG WONG UK

Drawing Title	DISTANCE FROM WORK SITES TO NSR 1	
Drawing no.	Rev	Scale
FIGURE A4-1-1	-	AS

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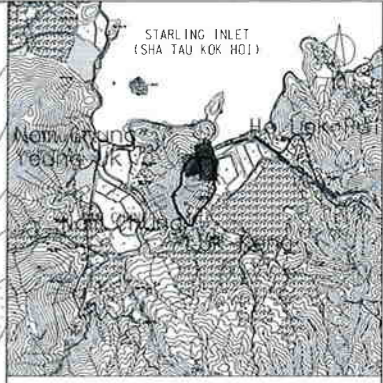


NOTES : U - CHANNEL WILL BE PROVIDED ALONG ALL FLEXIBLE BARRIER (FW)

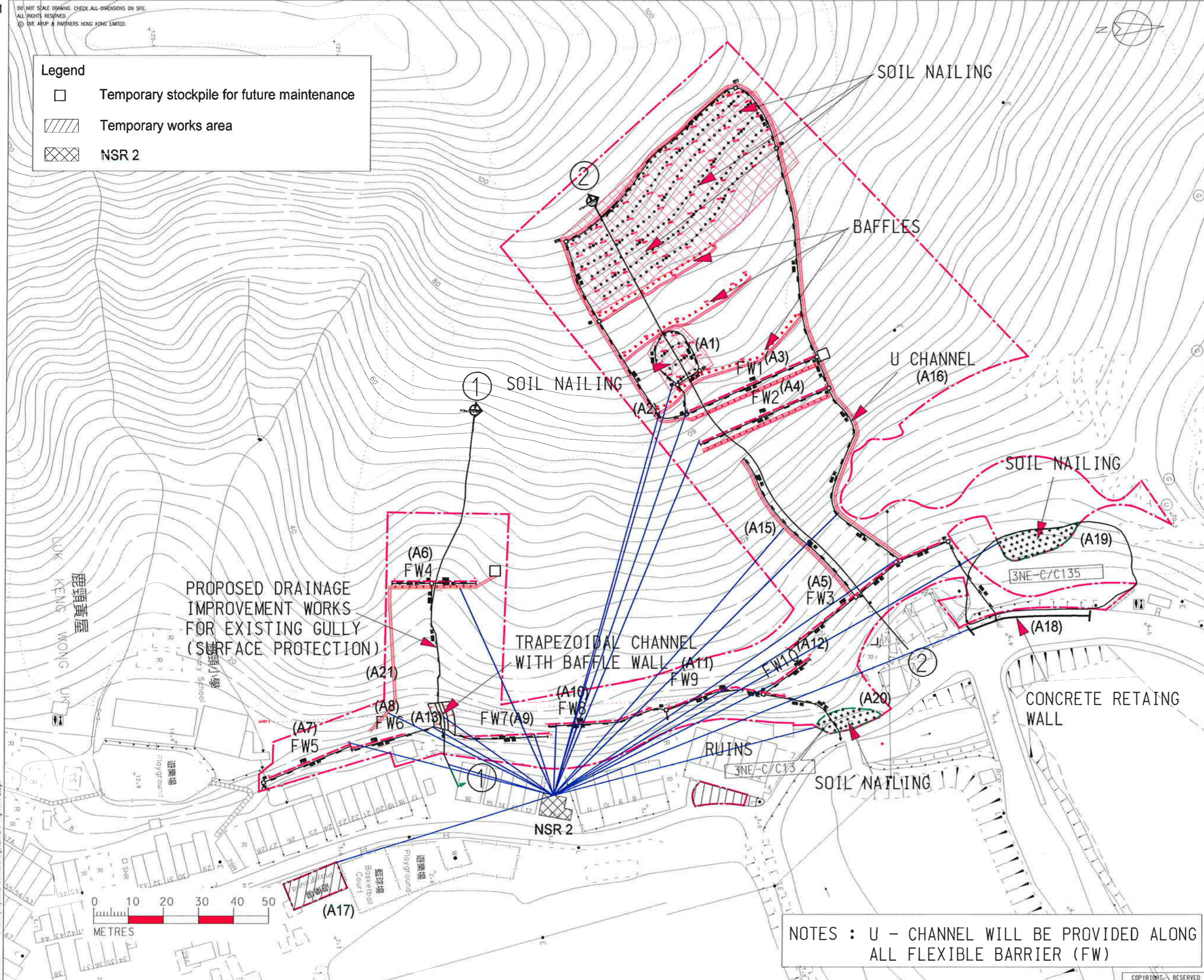
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- Temporary stockpile for future maintenance
- ▨ Temporary works area
- ▩ NSR 2



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No.	Date	Description	Checked
Revision			
		Name	Date
Surveyed	-	-	-
Designed	-	-	-
Drawn	Fai		03/06
Reviewer	FC		03/06
Checked	HS		03/06
Approved	DL		03/06

Agreement no. CE 31/2004 (GE)
Arup project no. 24364
Contract
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Location
LUK KENG WONG UK

Drawing Title
DISTANCE FROM WORK SITES TO NSR 2

Drawing no. FIGURE A4-1-2
Rev -
Scale AS

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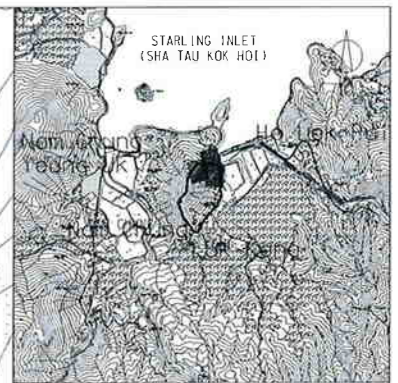
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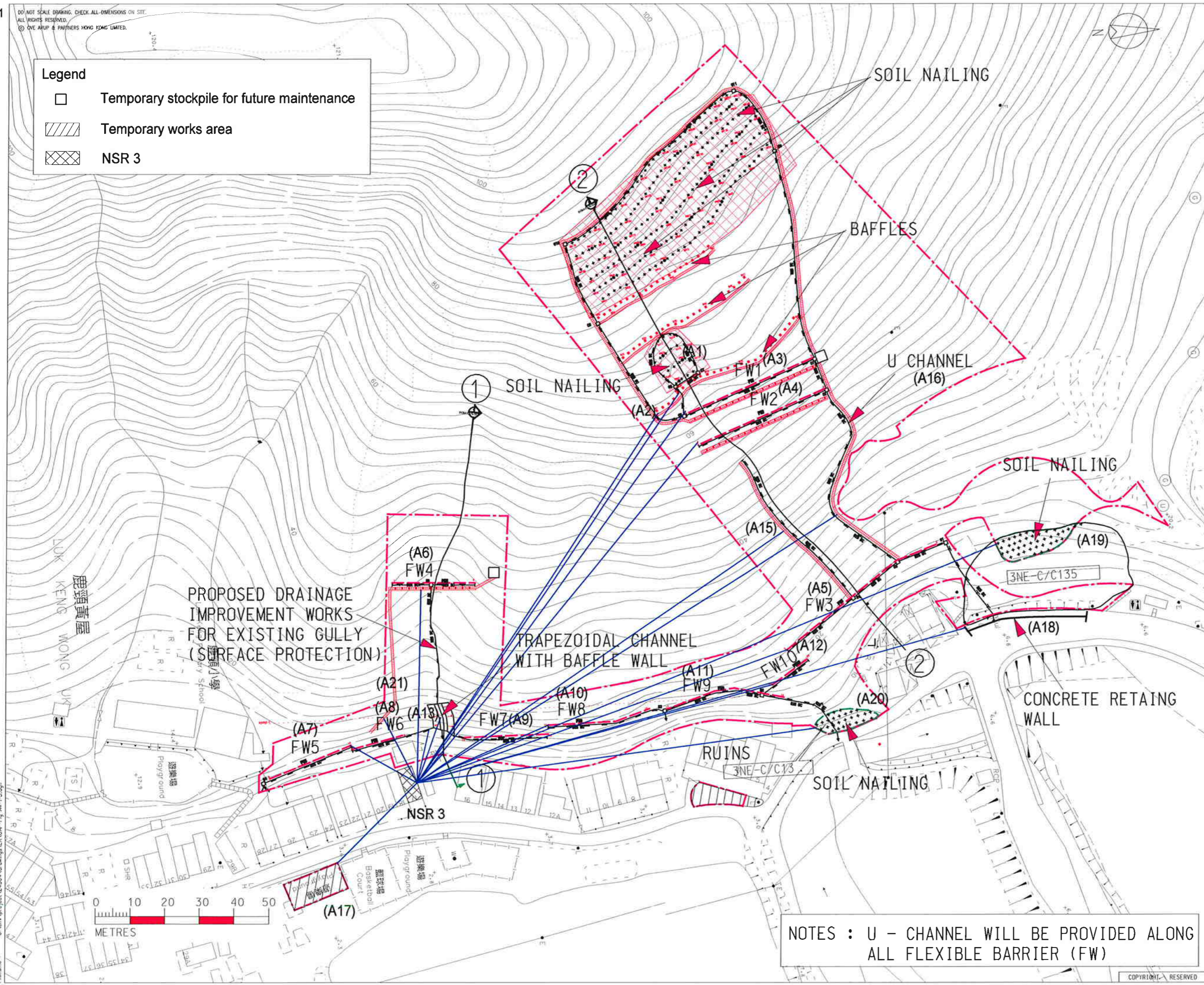
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Legend

-  Temporary stockpile for future maintenance
-  Temporary works area
-  NSR 3



KEY PLAN



No.	Date	Description	Checked
Revision		None	Date
Surveyed	-	-	-
Designed	-	-	-
Drawn	Fai		03/06
Reviewed	FC		03/06
Checked	HS		03/06
Approved	DL		03/06

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Location
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Drawing Title
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FIGURE A4-1-3	-	AS

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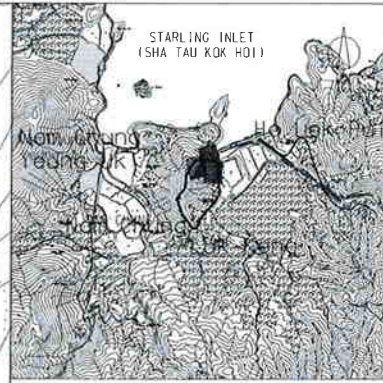


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-  Temporary stockpile for future maintenance
-  Temporary works area
-  NSR 4



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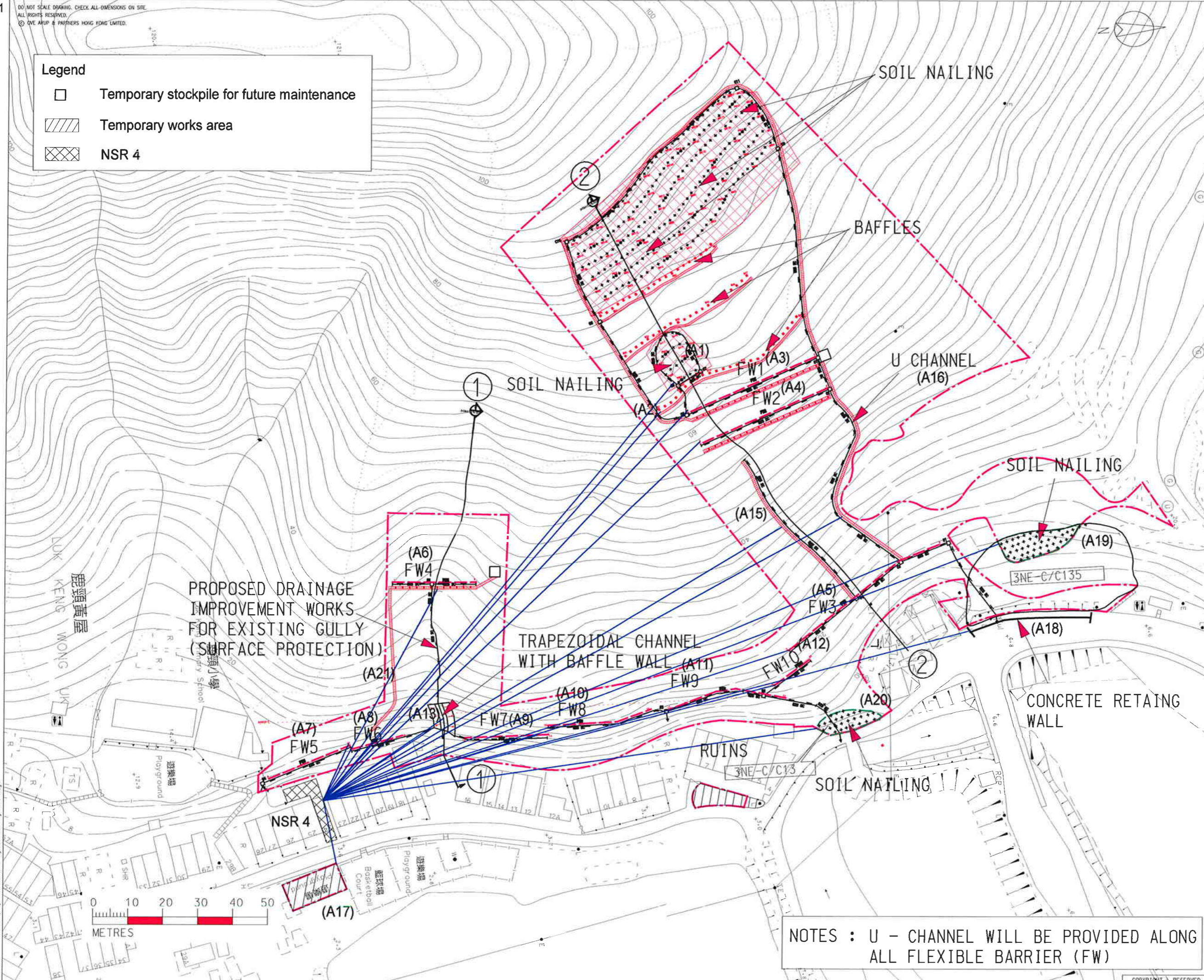
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Drawn	Fai		03/06
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Checked	HS		03/06
Approved	DL		03/06

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 Drawing no. FIGURE A4-1-4
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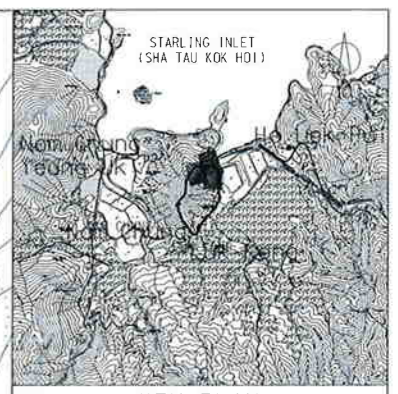
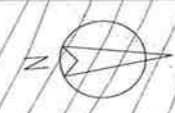
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Legend

- Temporary stockpile for future maintenance
- Temporary works area
- NSR 5



KEY PLAN

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Revision			
		Name	Date
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Checked	HS		03/06
Approved	DL		03/06

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Location
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Drawing Title
DISTANCE FROM WORK SITES TO NSR 5

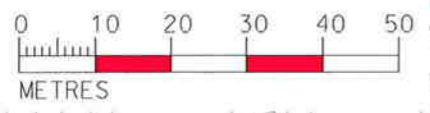
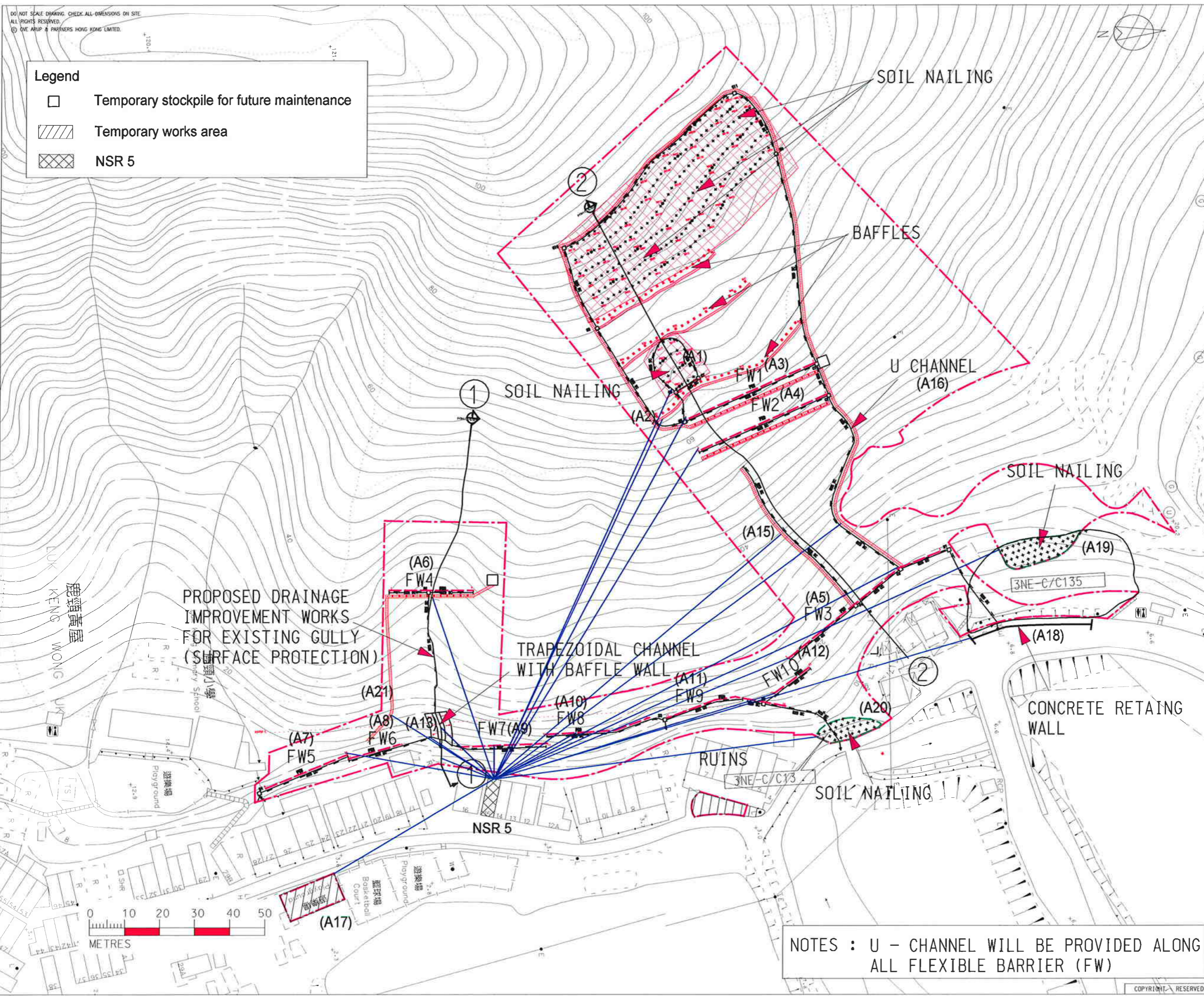
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FIGURE A4-1-5	-	AS

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APPENDIX 4-2

**Construction Noise
Assessment**

Project : Luk Keng
 Title : Construction Noise Calculation

Table 1 - Notional Distance from Construction Sites to NSRs, m

NSRs	Work Site																							
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24
N1	115	106	110	102	70	65	68	46	16	16	32	57	45		92	103	75	119	135	70	59			
N2	124	115	118	110	79	66	60	40	19	22	40	68	40		102	113	65	128	145	79	52			
N3	135	127	132	127	103	56	23	16	19	43	74	105	20		133	143	33	183	180	115	21			
N4	152	143	150	146	139	67	6	15	42	70	100	130	40		157	168	25	190	205	145	21			
N5	123	114	117	111	91	55	43	22	10	27	52	84	21		117	123	53	142	159	93	35			

Table 2 - Distance Attenuation and Facade Correction, dB(A)

NSRs	Work Site																							
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24
N1	-46	-46	-46	-45	-42	-41	-42	-38	-29	-29	-35	-40	-38		-44	-45	-43	-47	-48	-42	-40			
N2	-47	-46	-46	-46	-43	-41	-41	-37	-31	-32	-37	-42	-37		-45	-46	-41	-47	-48	-43	-39			
N3	-48	-47	-47	-47	-45	-40	-32	-29	-31	-38	-42	-45	-31		-47	-48	-35	-49	-50	-46	-31			
N4	-49	-48	-49	-48	-48	-42	-21	-29	-37	-42	-45	-47	-37		-49	-50	-33	-51	-51	-48	-31			
N5	-47	-46	-46	-46	-44	-40	-38	-32	-25	-34	-39	-43	-31		-46	-47	-39	-48	-49					
0																								
0																								
0																								
0																								
0																								

Table 3 - Screening Between Construction Sites and NSRs, dB(A)

NSRs	Work Site																							
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24
N1	0	0	0	0	0	0	-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N2	0	0	0	0	0	0	-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N3	0	0	0	0	0	0	-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N4	0	0	0	0	0	0	-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N5	0	0	0	0	0	0	-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4 - Sum of Distance Attenuation and Screening, dB(A)

NSRs	Work Site																							
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24
N1	-46	-46	-46	-45	-42	-41	-47	-38	-29	-29	-35	-40	-38	0	-44	-45	-43	-47	-48	-42	-40	0	0	0
N2	-47	-46	-46	-46	-43	-41	-46	-37	-31	-32	-37	-42	-37	0	-45	-46	-41	-47	-48	-43	-39	0	0	0
N3	-48	-47	-47	-47	-45	-40	-37	-29	-31	-38	-42	-45	-31	0	-47	-48	-35	-49	-50	-46	-31	0	0	0
N4	-49	-48	-49	-48	-48	-42	-26	-29	-37	-42	-45	-47	-37	0	-49	-50	-33	-51	-51	-48	-31	0	0	0
N5	-47	-46	-46	-46	-44	-40	-43	-32	-25	-34	-39	-43	-31	0	-46	-47	-39	-48	-49	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Project : Luk Keng
Title : Construction Noise Calculation
Scenario : With all good site practices

Activities	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	
Area 1 Soil Nailing - up hill	106	105	105																				
Area 2 Baffles				105	105	105																	
Area 3 FW1		96	96	96																			
Area 4 FW2				96	96																		
Area 5 FW3						96	96	96															
Area 6 FW4								96	96														
Area 7 FW5										96	96												
Area 8 FW6											96	96											
Area 9 FW7													96	96									
Area 10 FW8																96	96						
Area 11 FW9																		96	96				
Area 12 FW10																				96	96		
Area 13 Trapezoidal Channel	101	101	101	101	101	101																	
Area 14 Not used																							
Area 15 Channels																		96	96				
Area 16 Channels																			96	96			
Area 17 Pumping concrete	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101
Area 18 Concrete Retaining Wall							101	101	101														
Area 19 Soil Nailing (3NE-C/C13s)								105	105														
Area 20 Soil Nailing (3NE-C/C13)										105	105	105											
Area 21 U - Channel											96	96											
Area 22																							

Project : Luk Keng
Title : Construction Noise Calculation
Scenario : With all good site practices

Activities	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	
Not used																							
Area 23 Not used																							
Area 24 Not used																							

Summary of SWLs

Area 1	105	105	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 2	0	0	0	105	105	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 3	0	96	96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 4	0	0	0	0	96	96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 5	0	0	0	0	0	0	96	96	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 6	0	0	0	0	0	0	0	0	96	96	0	0	0	0	0	0	0	0	0	0	0	0
Area 7	0	0	0	0	0	0	0	0	0	0	96	96	0	0	0	0	0	0	0	0	0	0
Area 8	0	0	0	0	0	0	0	0	0	0	0	0	96	96	0	0	0	0	0	0	0	0
Area 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	96	0	0	0	0	0	0
Area 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	96	0	0	0	0
Area 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	96	0	0
Area 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	96	0
Area 13	101	101	101	101	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
Area 14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 17	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101
Area 18	0	0	0	0	0	0	101	101	101	101	0	0	0	0	0	0	0	0	0	0	0	0
Area 19	0	0	0	0	0	0	0	105	105	105	0	0	0	0	0	0	0	0	0	0	0	0
Area 20	0	0	0	0	0	0	0	0	0	105	105	105	0	0	0	0	0	0	0	0	0	0
Area 21	0	0	0	0	0	0	0	0	0	0	96	96	0	0	0	0	0	0	0	0	0	0
Area 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Update Construction Noise

Predicted Construction Noise, dB(A)	Max	Update Construction Noise																					
N1	66	66	66	66	66	66	63	63	64	65	65	65	65	61	61	66	68	68	63	63	61	61	
N2	66	66	66	67	67	67	63	63	64	65	64	64	63	63	63	67	66	66	63	63	61	61	
N3	72	72	72	72	72	72	66	66	69	69	67	67	70	70	69	69	67	67	66	66	66	66	
N4	73	70	70	70	70	70	68	68	70	70	73	73	71	71	69	69	68	68	68	68	68	68	
N5	72	71	71	71	71	71	63	63	64	63	62	62	66	66	72	65	65	63	63	62	62	62	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	