



Civil Engineering Department
Geotechnical Engineering Office

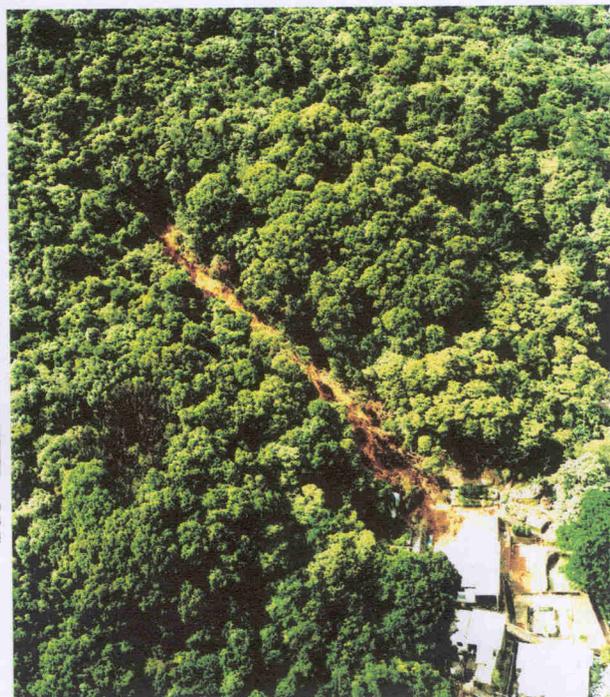
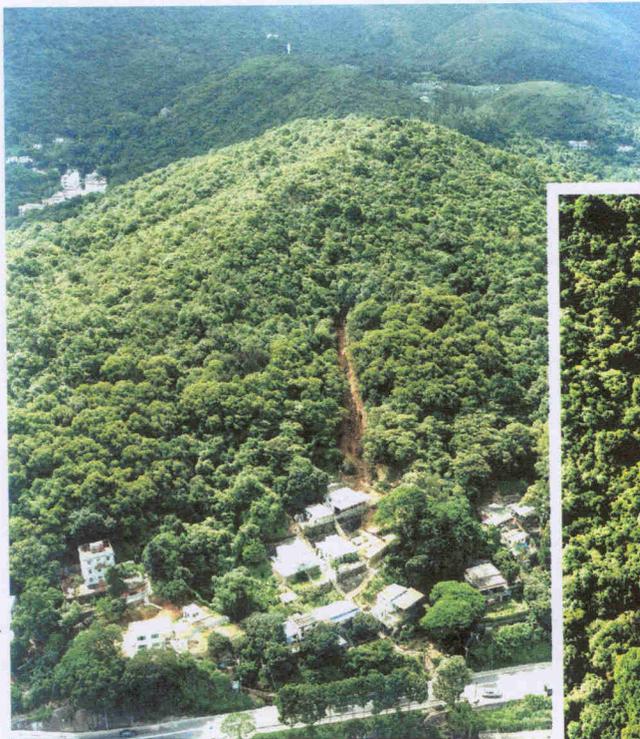


Agreement No. CE 93/2001 (GE)

Landslide Mitigation Works
at Pak Sha Wan and Tsing Shan Trail above Area 19 -
Design and Construction

PROJECT PROFILE FOR PAK SHA WAN LANDSLIDE MITIGATION WORKS

NOVEMBER 2003



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Tsing Shan Trail above Area 19 -
Design and Construction

Project Profile for Pak Sha Wan Landslide Mitigation Works

PROJECT PROFILE

November 2003

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1 BASIC INFORMATION

1.1 Project Title

Agreement No. CE 93/2001 (GE) Landslide Mitigation Works at Pak Sha Wan and Tsing Shan Trail above Area 19 - Design and Construction (Landslide Mitigation Works at Pak Sha Wan Site).

1.2 Purpose and Nature of the Project

The objective of this Project is to design and construct landslide mitigation works at Pak Sha Wan in Sai Kung and Tsing Shan Trail, where natural terrain landslides pose a major hazard to the nearby residents at the toe of the natural hillsides.

The proposed landslide mitigation works at Pak Sha Wan fall within the Boundary of Conservation Area and will consist of constructing rainwater surface drainage channel which discharges into Hebe Haven, which is less than 300 m from the boundary of the Conservation Area. As such, under the Environmental Impact Assessment Ordinance the works is regarded as a Designated Project. This report will focus on the scope of environmental issues and detail the necessary mitigation measures to safeguard the intrinsic landscape quality of the Conservation Area in Pak Sha Wan and ensure its existing natural character is retained. The proposed works at Tsing Shan Trail will not be addressed in this report.

A natural terrain hazard study (Fugro, 2003) comprising desk study, API, geological mapping, ground investigation and hazard assessment was carried out by Fugro (HK) Limited. The results concluded that above the Pak Sha Wan Village, channelised debris flow is considered to constitute a hazard by travelling downslope along the well-defined ephemeral drainage line to Pak Sha Wan Village. Mitigation measures are proposed under the Landslip Preventive Measures (LPM) Programme to protect the residents at the village.

The location of the Project Site and proposed landslide mitigation works are provided in Figure 1 and Figure 2 respectively.

1.3 Name of Project Proponent

The Project Proponent is the Planning Division of the Geotechnical Engineering Office, Civil Engineering Department, Government of the Hong Kong Special Administrative Region (HKSAR).

1.4 Location and Scale of Project and History of Site

A natural terrain landslide occurred on the natural hillside above Pak Sha Wan village on 9th June 1998 and the landslide debris affected village houses No. 27 and 30. A detailed investigation of the landslide was carried out by Fugro Scott Wilson Joint Venture under the Landslide Investigation Consultancy Agreement. The landslide was a high mobility channelised debris flow along an ephemeral drainage line (FSWJV, 1999). The results showed that the natural hillside is posing a significant risk to the village houses and other existing developments at the toe.

A detailed natural terrain hazard study (NTHS) was then carried out by Fugro (HK) Limited, which concluded that protective works should be carried out to

mitigate the landslide hazard in the interest of public safety (Fugro, 2003).

The following mitigation measures have been proposed for Pak Sha Wan site:-

- i) Construct a containment structure at the toe of the natural hillside to contain possible channelised debris flow about 300 m³ in order to protect the existing developments within or downslope of the study area;
- ii) Install a series of 15 m long soil nail of 32 mm diameter at the base of the containment structure;
- iii) Carry out improvement works to the existing surface drainage system;
- iv) Construct maintenance stairway to the proposed containment structure;
- v) Provide landscape treatment to the site area; and
- vi) Provide chain link fences with lockable gate to fence off the containment structure.

1.5 Number and Types of Designated Projects Covered by the Project Profile

The proposed landslide mitigation works at Pak Sha Wan lie within the Boundary of a Conservation Area and consist of works on a drainage channel that discharges within 300 m of the Conservation Area. Boundaries of the Conservation Area and Work Area are detailed in Figures 1 & 2.

Thus in accordance with Category Q.1 & I.1 (b) of Part 1, Schedule 2 of the Environmental Impact Assessment Ordinance (EIAO), the proposed landslide mitigation works is considered a Designated Project.

Therefore, an Environmental Permit under the EIA Ordinance must be obtained prior to the commencement of the construction of landslide mitigation measures.

1.6 Name and Telephone Number of Contact Person(s)

All queries regarding the project can be addressed to the project proponent (Dr. Ng Kwok Choi / GEO) or their consultants (Mr. Sum Yat Hei Stellan / Fugro (HK) Ltd.):-

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2 OUTLINE OF PLANNING AND IMPLEMENTATION

2.1 Responsibilities of Parties

The Agreement was awarded by the Civil Engineering Department (CED) to Fugro (HK) Limited (FHK) as the engineering consultant in March 2002. FHK is responsible for preparing a NTHS report, design and supervision of the landslide mitigation works. The proposed works will be implemented by Contractor(s) to be appointed by the Project Proponent at a subsequent stage.

2.2 Tentative Project Timetable

The contract for the landslide mitigation works is scheduled for tendering in December 2003 and is likely to commence in March 2004 with a duration of 12 months. The preliminary works timetable for the Project is summarised in Table 2.1.

Table 2.1 Preliminary schedule of works

| ITEM | 2004 | | | | | | | | | | | | 2005 | | |
|---|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|--|
| | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | | |
| 1. Site establishment | | | | | | | | | | | | | | | |
| 1.1 Hoarding erection | | ■ | | | | | | | | | | | | | |
| 1.2 Site clearance | | ■ | ■ | | | | | | | | | | | | |
| 1.3 Temporary access road formation | | | ■ | ■ | | | | | | | | | | | |
| 2. Concrete Containment Structure | | | | | | | | | | | | | | | |
| 2.1 Excavation | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| 2.2 Concrete Containment Structure construction | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | |
| 2.3 Soil nail and Dowel bars installation | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | |
| 3. Surface drainage | | | | | | | | | | | | | | | |
| 3. Surface drainage | | | | | | | | | | ■ | ■ | ■ | ■ | | |
| 4. Landscaping Works | | | | | | | | | | | | | | | |
| 4. Landscaping Works | | | | | | | | | | | ■ | ■ | ■ | | |
| 5. Site clearance and demobilisation | | | | | | | | | | | | | | | |
| 5. Site clearance and demobilisation | | | | | | | | | | | | ■ | ■ | | |

2.3 Interactions with Other Projects

There are no known interactions with other definitive projects on-going during the same period which need to be considered.

3 POSSIBLE IMPACT ON THE ENVIRONMENT

3.1 General

The potential environmental impacts of the Landslide Mitigation Works at Pak Sha Wan are reviewed in this section.

3.2 Construction Phase

3.2.1 Air Quality

Dust nuisance and gaseous emissions from the construction plant and vehicles pertinent to the Project are potential construction phase air quality impacts. Fugitive dust emissions arising from site excavations, drilling operation, truck movement, material handling and wind erosion would be the main sources of air pollution.

As the site area would be small in scale and the quantity of plant located on site would be limited, vehicle and plant exhaust emissions from the site would not be considered to be a significant source of air pollution. Adverse dust impacts at the identified Air Sensitive Receivers (ASRs) (Refer to Table 4.1 and Figure 4) would not be anticipated with the implementation of mitigation measures stipulated in the Air Pollution Control (Construction Dust) Regulation.

3.2.2 Noise

The proposed powered mechanical equipment (PME) to be used are provided in Table 3.1.

Table 3.1 The proposed Powered Mechanical Equipment (PME) to be used

| PME Description | Quantity |
|---------------------------------|----------|
| Breaker | 1 |
| Pneumatic breaker | 1 |
| Generator | 1 |
| Loader (e.g. Skid Steer Loader) | 1 |
| Dump truck | 1 |
| Pump truck | 1 |
| Air compressor | 1 |
| Drilling rig (Air drilling) | 1 |
| Mobile concrete lorry mixer | 1 |
| Vibrator poker | 1 |
| Grout mixer and pump | 1 |
| Winch system | 1 |

The PME for various construction works are provided in Table 3.2 and Appendix 1. Noise impact arising from the construction phase of the Project would be generated from the use of PME for construction works. Locations of Area A to G in the Project Site are provided in Figure 3.

Table 3.2 The proposed Powered Mechanical Equipment (PME) for various Construction works

| Item | PME | Area | | | | | | |
|--|-------------------------------|------|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G |
| 1. Site Establishment | | | | | | | | |
| 1.1 Hoarding erection | - Generator | | | √ | | | | |
| 1.2 Site clearance | - Winch system | √ | | | | | √ | |
| 1.3 Access and stairway construction | - Dump truck | | | | | | | √ |
| 2. Concrete Containment Structure | | | | | | | | |
| 2.1 Excavation | - Air compressor | | | √ | | | | |
| | - Pneumatic breaker | √ | | | √ | | | |
| | - Winch system | √ | | | | | √ | |
| | - Dump truck | | | | | | | √ |
| | - Loader | √ | | | | | | |
| | - Generator | | | √ | | | | |
| 2.2 Concrete containment structure construction and minor concrete works | - Pump truck | √ | | | √ | | √ | √ |
| | - Vibrator poker | | | | √ | | | √ |
| | - Mobile concrete lorry mixer | | | | | | | √ |
| | - Generator | | | √ | | | | |
| | - Air Compressor | | | √ | | | | |
| 2.3 Soil nail and dowel bars installation | - Drilling rig (Air Drilling) | √ | | | | | √ | |
| | - Grout mixer and pump | | | | | | √ | |
| | - Generator | | | √ | | | | |
| | - Air compressor | | | √ | | | | |
| 3. Surface Drainage | | | | | | | | |
| | - Breaker | √ | | √ | √ | | √ | |
| | - Generator | | | √ | | | | |
| | - Winch system | √ | | | | | √ | |
| | - Dump truck | | | | | | | √ |
| | - Air Compressor | | | √ | | | | |
| 4. Landscaping Works | - No PME | | | | | | | |
| 5. Site Clearance and Demobilisation | | | | | | | | |
| | - Winch system | √ | | | | | √ | |
| | - Dump truck | | | | | | | √ |

According to the construction programme for the Project, the construction works will commence in March 2004 and be completed by March 2005. The construction tasks undertaken for the Project will include the following:-

1. Hoarding Erection & Site Clearance;
2. Access and stairway construction;
3. Excavation;
4. Concrete Containment Structure Construction;
5. Soil Nail and Dowel Bars Installation;
6. Rainwater Surface Drainage Works;
7. Landscaping Works; and
8. Site Clearance and demobilisation.

Due to the close proximity of Noise Sensitive Receivers (NSRs) (Refer to Table 4.2 and Figure 5) to the proposed work sites, adverse noise impacts would be anticipated during the construction phase if no mitigation measures are implemented. To minimise such impacts, the construction activities detailed above will be scheduled to ensure

that only a single activity is in operation at any point in time. The noise assessment calculations and results are presented in Appendices 1 to 4.

The cumulative noise levels at the NSRs are predicted to range from 80 dB(A) to 92 dB(A). Mitigation measures (as presented in Section 5) would be required to reduce the construction noise impacts significantly (refer to Appendices 3 and 4). When mitigation measures as stated in Section 5 are implemented, the predicted cumulative noise levels are ranged from 68 dB(A) to 75 dB(A).

The corrections for the effect of barriers as suggested in the Technical Memorandum on Noise From Construction Work Other Than Percussive Piling was insufficient to reduce the noise level to an acceptable limit even when other mitigation measures was implemented. In order to reduce the noise level further, better noise insulated barriers were required. Table 2.2.1 of the Guidelines on Design of Noise Barriers published by Environmental Protection Department and Highways Department provides examples of different types of noise barriers and was referenced for the selection of the appropriate noise barriers.

In order to reduce the secondary noise impact generated from the installation and removal of noise barriers, prefabricated noise barriers would only be considered.

Various local noise barriers supplier was contacted with aim to confirm the availability of selected product. The proposed prefabricated noise barriers are easily installed and have a high noise absorbing performance. The noise reduction it can achieve ranged from 14 - 46dB(A), the lowest range was used in the noise assessment. The predicted noise level at the worst case scenario would comply with the 75dB(A) criteria.

In addition to the noise mitigation mentioned in section 5, regular noise audit shall be conducted at the NSRs to monitor the situation during construction works.

3.2.3 Water Quality

Water-bodies may experience impacts due to surface runoff from the drainage-line, and which discharges directly into the coastal waters of Hebe Haven (see Plate Nos. 23, 24 & 25 in Appendix 5). Runoff and drainage from construction activities may contain increased loads of suspended solids, contaminants and untreated sewage. These are identified as the main sources of impact during the construction phase.

3.2.4 Waste

Waste generated from the construction activities of the proposed works would be mainly composed of excavated materials and construction materials. It is estimated that about 580 m³ excavated materials would be generated. By implementing the approved methods and the recommended control measures described in Section 5 on handling,

transporting and disposing of wastes, no adverse environmental impacts and nuisance are anticipated.

3.2.5 Ecology

Minor vegetation clearance in the Works Area is expected. No tree felling / lopping is required. Disturbance to wildlife is considered low due to the existing village housing in the immediate vicinity and the associated human activities. There will be no direct impacts by the proposed works to these areas. Refer to Section 4.4 for survey methodology.

3.2.6 Cultural Heritage

Two graves are located directly outside the boundary of the Works Area (Refer to Figure 6). Hoarding encompassing the entire Works Area will be erected to ensure the graves will not be affected by the proposed works. Christian Nationals Evangelism Commission (CNEC) Pak Sha Wan Church and a temple are located 50m and 100m from the Works Area and are not expected to experience any adverse impacts from the works.

3.2.7 Landscape Impact

The following construction activities would impact upon the landscape. They include:-

- the construction works of hoarding;
- the construction works of containment structure (Figure 2); and
- the construction works of stepped channel (Figure 2).

The construction phase would include impacts upon landscape resources and landscape character. They include:-

- negative impact upon the existing landscape character of the Works Area due to the construction of hoarding;
- negative impact upon the existing landscape character of the Works Area due to the construction of containment and stepped channel; and
- negative impact upon the existing landscape resources due to the loss of existing vegetation. The negative impact would be minor as the Works Area is generally developed and dominated by weedy herbs. Furthermore, the ground vegetation to be removed is non-woody herbs.

The existing landscape character around the site boundary and at the locations of proposed containment and stepped channel are shown in Plate Nos. 2 to 6 and Plate Nos. 9 to 18 in Appendix 5.

3.2.8 Visual Impact

The potential visual impacts during the construction phase would be

loss of views of the existing green slope within the Works Area. The sources of visual impacts during the construction phase would include the following:-

- the construction works of hoarding;
- the construction works of containment structure;
- the construction works of stepped channel;
- the construction traffic; and
- site access areas and powered mechanical equipment.

Negative visual impacts during the construction phase would include the following:-

- views of the construction works of the hoarding;
- views of the construction works of containment and stepped channel;
- loss of views to green cover from Visual Sensitive Receivers (VSRs) (Refer to Table 4.4);
- construction traffic in the vicinity of the Works Area; and
- scaffolding and emergent structures.

It is considered that VSRs located in proximity to the construction works would receive the most substantial negative visual impacts. The VSRs that would be most affected during the construction phase include:-

- Residents of Location No. 1 (No. 30 Pak Sha Wan Village);
- Residents of Location No. 4 (No. 27 Pak Sha Wan Village); and
- Residents of Location No. 5 (No. 32 Pak Sha Wan Village).

Locations of major VSRs are provided in Figure 7 and Plate Nos. 2, 5 and 6 in Appendix 5.

Minor negative visual impact would be experienced by VSRs in the following locations:-

- Residents in Pak Sha Wan Village; and
- Passengers and crew of the boats within Hebe Haven moored or travelling between Pak Sha Wan Pier and Marina Cove.

3.3 Operation Phase

Under normal operating condition, no adverse environmental impacts are expected from the proposed mitigation works.

In the event of a landslide occurring, the landslide debris will be contained within the proposed containment structure and the debris will be removed manually by labourer through the maintenance stairway to a dump truck on Hiram's Highway and deposited to a proper public landfill area.

3.3.1 Air Quality

Fugitive dust emissions arising from landslide debris removal, truck movement, material handling and wind erosion would be the main sources of air pollution.

3.3.2 Noise

As any debris generated from a landslide will only be removed manually. As such, no adverse noise impact arising from the Project would be anticipated.

3.3.3 Water Quality

As with the construction phase, the water-bodies may experience impacts due to surface runoff from the drainage-line, and which discharges directly into the coastal waters of Hebe Haven (see Plate Nos. 23, 24 & 25 in Appendix 5). Runoff and drainage from landslide debris removal activities may contain increased loads of suspended solids, contaminants and untreated sewage.

3.3.4 Waste

All debris generated from any landslide will be transported to a public landfill for deposition. No adverse impact would be anticipated during the operation phase.

3.3.5 Ecology

No adverse ecological impact is expected during the operation phase.

3.3.6 Cultural Heritage

No adverse cultural heritage impact is expected during the operation phase.

3.3.7 Landscape Impact

The construction of the containment structure and stepped channel would result in minor impacts to the landscape character. The results of the ecological survey (refer to section 4.4) indicates the vegetation within the site boundary contains no ecological conservation value. It is anticipated that landscape impacts resulting from the project would be minimised to an acceptable level by establishing tree planters at the toe of the existing slope and the restoration of the terrace area with planted low trees and native shrubs (Section 5.7).

3.3.8 Visual Impact

The primary sources of visual impacts during the operation phase would include the following:-

- The existence of the containment structure; and
- The existence of the stepped channel.

Visual impacts associated with the existence of the containment structure and stepped channel would tend to be negative. However, the resulting negative visual impacts would be slight as there would only be limited glimpse views of the new containment structure and stepped channel at VSRs. The establishment of tree planters and the restoration of the terrace area should maintain the general visual appearance of the area.

The VSRs identified (Figure 7) include:-

- Residents in Pak Sha Wan Village; and
- Passengers and crew of the boats within Hebe Haven moored or travelling between Pak Sha Wan Pier and Marina Cove.

Provided mitigation measures proposed in Section 5.8 are implemented, visual impacts resulting from the project are considered to be acceptable. The anticipated layout and sections of the Works Area during the operation phase are presented in Appendix 6.

4 MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT

4.1 Air Quality

Vehicles travelling on Hiram's Highway (see Plate No. 21 in Appendix 5) are identified as the major source of air pollution in the vicinity of the Works Area. As air monitoring data for Sai Kung is not available, the air monitoring data gathered at stations in Sha Tin and Tai Po are considered for this assessment. The annual mean SO₂ and NO₂ concentrations measured at station in Sha Tin are 14 µg/m³ and 51 µg/m³ respectively, while the annual mean SO₂ and NO₂ concentrations measured at station in Tai Po are 13 µg/m³ and 50 µg/m³ respectively (*Air Quality in Hong Kong* (EPD, 2001)). The results are well below the 1-year Air Quality Objectives (AQOs) for both SO₂ and NO₂ (80 µg/m³) established under the Air Pollution Control Ordinance. The emissions from the construction vehicles, equipment and plant are not expected to contribute significantly to the levels of SO₂ and NO₂ in the area. It is anticipated that the Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) would remain well below the respective AQOs.

Air sensitive receivers (ASRs) have been identified (Figure 4) and are detailed in Table 4.1.

Table 4.1 Representative Air Sensitive Receivers (ASRs)

| ASR | Description | Nearest Distance between ASR and Site Boundary (m) | Plate no. |
|------|----------------|--|-----------|
| ASR1 | Location No. 1 | 2.2 | 2 |
| ASR2 | Location No. 2 | 6.0 | 3 |
| ASR3 | Location No. 3 | 6.0 | 4 |
| ASR4 | Location No. 4 | 1.4 | 5 |
| ASR5 | Location No. 5 | 5.8 | 6 |

4.2 Noise

The Works Area is rural in nature and there are some residential buildings. Rural traffic from Hiram's Highway is the main contributor to background noise level, which is anticipated to be low during the weekdays. However, a higher background noise level is expected during weekends and holidays due to the volume of recreational visitors in Sai Kung.

Noise sensitive receivers (NSRs) were identified on the site survey (Figure 5). The representative NSRs are presented in Table 4.2.

Table 4.2 Representative Noise Sensitive Receivers (NSRs)

| NSR | Description | Nearest Distance between NSR and Site Boundary (m) | EIAO-TM ⁽¹⁾ Construction Noise Criteria, dB(A) |
|------|----------------|--|---|
| NSR1 | Location No. 1 | 2.2 | 75 |
| NSR2 | Location No. 2 | 6.0 | 75 |
| NSR3 | Location No. 3 | 6.0 | 75 |
| NSR4 | Location No. 4 | 1.4 | 75 |
| NSR5 | Location No. 5 | 5.8 | 75 |

⁽¹⁾ Environmental Impact Assessment Ordinance – Technical Memorandum

4.3 Water Quality

The proposed containment structure and rainwater surface drainage channel will be constructed within the existing natural drainage line. According to the 1:1000 Survey Sheet No. 7SE-25B issued by the Lands Department, the Works Area does not contain a stream. Water accumulates and flows through it only during periods of heavy rain. In other conditions it generally remains dry.

Runoff from the immediate surrounding, including potential discharge from residential dwellings, enters the drainage line and flows away from the conservation area and into an existing drainage channel that runs under Hiram's Highway and discharges into the sea (see Plate No. 25 in Appendix 5).

Shipyards and residential dwellings are found near the discharge point (see Plate No. 22 in Appendix 5) and some untreated wastewater may be discharged by them into the surrounding coastal waters.

Based on the conditions described the works are not anticipated to have a significant impact on the existing quality of the water of the drainage line. It is recognised that minor impacts may be experienced by the adjacent coastal waters during the construction phase if mitigation measures are not employed.

4.4 Ecology

A baseline ecological profile of the Works Area and its surroundings has been prepared based on a site inspection conducted on 14th May 2003, supplemented with ecological information for the broader area available in an approved EIA Study Report for CLP Power (1999). The site inspection focused on the vegetation community within and at the fringes of the site, and included incidental observations of bird, butterfly and reptile activity. A habitat

map showing the existing habitats of the Works Area and its immediate surroundings is provided in Figure 9.

The Works Area

Past village activities are evident in the Works Area. At the back (west) of the village are remnants of past cultivation set in a concrete terrace. The terrace is separated into two halves: the southern part being largely intact, is dominated by common weedy herbs of the family *Compositae*; the northern part having been covered in earth by the landslip, has a few woody shrub species present where the soil is deep enough. There are no trees present within this part of the Site.

At the north / northwest corner of the Site, along from the concrete terrace, the toe of an otherwise vegetated slope was also affected by the landslide, and is now also dominated by a range of common weedy herbs of the family *Compositae*. Part of the slope toe has been concreted and there are two specimens of the orchard tree species the Lychee *Litchi chinensis* set in concrete planters. The trees are of no ecological conservation value, having been planted and maintained within a developed area.

The Surrounding Habitat

From a general vegetation survey around other parts of the Site locally co-dominant species are *Alocasia macrorhizza*, *Ipomoea cairica*, *Mikania micrantha*, and *Lantana camara*. The ferns *Dryopteris varia* and *Blechnum orientale*, and a number of naturalized garden escapees are locally abundant around the wall of the drainage culvert.

There were generally few trees within other areas of the Site, although mature specimens of *Cinnamomum camphora* and *Delonix regia* at over 10m high were conspicuous. There were also several individuals of papaya *Carica papaya* and banana *Musa paradisiaca* and various ornamental species around the north and east parts of the Site, such as the bamboo *Phyllostachys* sp. A tree survey was conducted by Helen Chan Professional Land Survey Limited. The results of the survey are summarised in Figure 8.

Sightings of bird and butterfly activity adjacent to the Works Area was limited, although there was some activity around the fringes of the Site. Birds observed were all common in developed area: Magpie robin *Copsychus saularis*, Japanese White Eye *Zosterops japonica*, Chinese bulbul *Pycnonotus sinensis*, Crested bulbul *P. jocosus*, Feral pigeon *Columba livia*, Spotted dove *Streptopelia chinensis* and Masked laughing thrush *Garrulax perspicillatus*. A total of nine butterfly species were observed – all being common species – with *Artogeia candida*, *Euploea core* and *Ideopsis similis* being the most abundant.

One incidental observation of a colour-changeable lizard *Calotes versicolor* was made in leaf litter at the western fringe of the Site, behind the intact concrete terrace.

The land immediately upslope and outside the Site is semi-mature / immature native secondary woodland habitat that comprises various tree and shrub species. Representative species include *Schefflera octophylla*, *Cinnamomum*

camphora, *Sterculia lanceolata*, *Persea chinensis*, *Acronychia pedunculata*, *Rhodomyrtus tomentosa*, *Eurya nitida*, *Baeckea frutescens* and *Cratoxylum cochinchinense* (CLP, 1999).

The woodland canopy is typically in the range 3 m to 7 m high. Light penetration through the canopy is limited and subsequently there is generally little ground flora.

Protected plant species have been found in the Ho Chung Valley, approximately 1 km southwest of the subject site, although no protected plant species have been recorded in the immediate vicinity of the site (reference to the above species). Furthermore, no protected plant species were recorded around the fringes of the site during site inspection.

The secondary woodland habitat upslope of the Site forms a continuum with similar habitat over the lower slopes and sheltered upland ravines of the Ma On Shan Country Park. As such, the size and linkage of this habitat likely affords shelter for a diverse wildlife community, with evidence of the Barking Deer *Muntiacus reevesi* and Wild Boar *Sus scrofa* having been recorded (CLP, 1999).

The woodland habitat immediately adjacent to the Site primarily comprises immature and semi-mature trees, with very few mature individuals observed. Representative species in the tree community just outside the Site boundary fence included *Mallotus paniculatus*, *Schefflera octophylla*, *Macaranga tanarius*, *Celtis sinensis*, *Machilus sp.*, *Bridelia monoica*, *Sterculia lanceolata*, *Exbucklandia populnea*, *Ficus hispida*, *F. variegata*, *Litsea glutinosa*, *Sapium sebiferum* and *Rhus chinensis*. These tree species are all common and widespread in the HKSAR.

Associated flora just beyond the Site boundary included a range of common species such as *Miscanthus floridulus*, *Lantana camara*, *Ipomoea cairica* and *Mikania micrantha* that are indicators of disturbed land.

Ecological Evaluation

A comparative evaluation of the ecological value of the Site with the surrounding shrub / secondary woodland habitat is presented in Table 4.3.

Table 4.3 Comparative Ecological Evaluation of the Site and Surroundings

| Evaluation Criteria Subject Site Surrounding Habitat | | |
|---|--------------|---|
| Criteria | Location | Habitat |
| Age / Naturalness | Works Area | Generally of young age and very low naturalness due to human development and disturbance. Few mature trees within the Site, with various ornamental shrubs. |
| | Surroundings | Natural immature / semi-mature secondary woodland habitat. Likely <10 years old at the immediate site fringes (i.e., only shrubs / immature trees). |

| | | |
|--------------------------------|--------------|---|
| Diversity | Works Area | Very low diversity, being dominated by common herbs and climbing species. |
| | Surroundings | Increasing diversity with increasing distance from the Site boundary and areas of disturbance. |
| Rarity | Works Area | No rare species present. All vegetation species present are common and widespread. |
| | Surroundings | No rare species in the immediate surroundings, but the broader environs are known to support a number of rare plants. |
| Linkage / Fragmentation | Works Area | Has poor linkage as the site is part of a developed village area, and is bound on the east by a main road. No fragmentation issues due to Site context. |
| | Surroundings | Good linkage with heavily vegetated slopes and large undisturbed areas of Country Park. |
| Recreatability | Works Area | The habitat affected by the landslip can be partly but not fully recreated due to the need for stabilisation works. Rehabilitation will establish a low vegetation cover of similar ecological value to the habitat lost. |
| | Surroundings | Generally difficult to recreate due to age, community structure, and species diversity. |
| Wildlife Abundance | Works Area | Generally low due to a high existing level of development and human disturbance, although the site fringes support an increasingly diverse and abundant bird and butterfly community. |
| | Surroundings | Likely high given the ecological linkage with large undisturbed areas of Country Park. |
| Ecological Value | Works Area | Very low in the developed areas. Low value at the fringes of the disturbed, former cultivation area. |
| | Surroundings | Moderate in immediate surroundings. Moderate to high value in more remote environs far from the Site. |

Based on the ecological baseline profile and the evaluation presented above, no adverse ecological impacts are anticipated from the works. Furthermore, there is potential for ecological enhancement of the Site through the works (Refer to Section 5).

4.5 Cultural Heritage

There are two graves located near to the western boundary of the proposed site area. Photos of the two graves are not provided in the report due to cultural consideration. Also, CNEC Pak Sha Wan Church and a temple are located approximately 50 m and 100 m from the Works Area (see Plate Nos. 7 & 8 in Appendix 5 and Figure 1).

4.6 Landscape and Visual Impact

Visual sensitive receivers in the vicinity of the Works Area are summarised in Table 4.4 below.

Table 4.4 Visual Impact Sensitive Receivers

| <i>Visual</i> | | |
|--------------------|---|---|
| Sensitive Receiver | Description | Approximate Distance from Site Boundary (m) |
| VSR1 | Residents in Pak Sha Wan Village | 10 - 40 |
| VSR2 | Passengers and crew of the boats within Hebe Haven moored or travelling between Pak Sha Wan Pier and Marina Cove. | 200-900 |

5 ENVIRONMENTAL PROTECTION MEASURES TO BE INCORPORATED IN THE DESIGN AND ANY FURTHER ENVIRONMENTAL IMPLICATIONS

5.1 Air Quality

Dust mitigation measures stipulated in the Air Pollution Control (Construction Dust) Regulation will be implemented to control fugitive dust emission from the project site during construction phase or in the event of a landslide. Relevant control measures are listed below:-

- Regular watering to reduce dust emissions from exposed site surfaces and unpaved road, with complete coverage, particularly during dry weather;
- Frequent watering for particularly static dusty construction areas and areas close to air sensitive receivers;
- Establishment and use of vehicle wheel and body washing facilities at the exit points of the site;
- Tarpaulin covering of all dusty vehicle loads transported to, from and between site location; and
- Routing of vehicles and positioning of construction plant should be at the maximum possible distance from air sensitive receivers when feasible.

With the implementation of the above dust mitigation measures, the dust impacts experienced during the construction phase or removal of debris from a landslide would be minimised to an acceptable level.

5.2 Noise

Utilisation of Quiet Powered Mechanical Equipment (PME)

- The utilisation of quiet PME will reduce the excessive construction noise levels arising from various construction activities at all of the NSRs. The quiet PME is detailed in Appendix 3. Quiet PME considered in the assessment are commercially available on the market and they have been employed in Fugro's present Landslip Preventive Works contracts.

The proposed equipment is the minimum numbers that are required to conduct the works. Hence reducing the number of PME is not an option.

Temporary Noise Barrier

- A 5m high noise barrier with at least 100 mm thick acoustic panels with wool or glass fiber backed by galvanized mild steel sheet with a surface density of 34 kg/m² or equivalent material will be erected along the southern works site boundary of Area A and partially at Area B and C during the construction phase. Although noise generated at Area B does not exceed the allowable limits, noise barriers are still required to be erected to screen the noise generated from Area A. Movable noise barriers should be used at Area C, D and F where PME are used, details of the noise barrier type and locations are shown in Figure 5. All barriers should ensure the line of sight between the construction and NSRs is blocked. All noise barriers will be prefabricated and install on-site to reduce the noise impacts caused during the installation of noise barriers.

Enclosure

- If enclosure is used, it will consist of minimum 50 mm thick absorptive panels with polyester film backed by metal sheet with a surface density of 20 kg/m² or equivalent materials to ensure the noise generated from PME such as compressor pneumatic breaker, electric breaker, vibrator poker, grout mixer and pump and drilling rig are sufficiently mitigated.

Restriction in Percentage On-time

- As the PME would not be fully operated, the total SWLs for various construction activities would be reduced through restricting the PME percentage on-time. The on-time percentages are presented in Appendix 3.

Good Site Practice

The following good site practices will be implemented during construction phase:

- Silencers and mufflers on construction equipment should be utilised and properly maintained during the construction program;
- Only well-maintained plant should be operated on-site;
- Plant should be serviced regularly;
- Machines and plant in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- Plant potentially emit noise strongly in one direction should be orientated if possible, so that the noise is directed away from the nearby NSRs; and
- Material stockpiles and other structures should be utilised, wherever possible, in screening noise from on-site construction activities.

Residual Noise Impacts

With implementation of the above noise mitigation measures, the cumulative construction noise levels anticipated at all NSRs would not exceed their respective noise criteria, i.e. 75dB(A) for residential premises and offices. Table 5.1 summarised the mitigation measures in each works area.

Table 5.1 Summary of Noise Mitigation Measures in Each Works Area

| Area | Mitigation Measures |
|------|--|
| A | Erect 5 m high temporary noise barrier at the southern works area boundary during construction phase. |
| B | Erect 5 m high temporary noise barrier at the east and south-eastern works area boundary during construction phase. |
| C | Erect 5 m high temporary noise barrier at the west and southern works area boundary during construction phase. All PME should be enclosed or screened by movable noise barrier. |
| D | Use enclosures or movable noise barrier for breakers and vibrator poker. |
| E | No mitigation measures are required. |
| F | Use enclosures or movable noise barrier for vibrator poker, drilling rig, grout mixer and pump, and breaker. |
| G | On-time percentage for pump truck (CA3) will be reduced to 50%. During soil nail and dowel bars installation (CA5), the dump truck will be reduced to 80% on time. |

Note: All noise barriers to be erected are using 100 mm thick acoustic panels with wool or glass fiber backed by galvanized mild steel sheet with a surface density of 34 kg/m² or equivalent materials and enclosures or movable noise barrier to be erected are using at least 50 mm thick absorptive panels with polyster film backed by metal sheet with a surface density of 20 kg/m² or equivalent materials.

5.3 Water Quality

- All runoffs arising from the works site will be properly treated with the utilisation of sedimentation tanks or silt traps so that the discharge standards stipulated in Water Pollution Control Ordinance (WPCO) are met.
- If temporary toilet facilities are established, foul water effluent will be directed to a foul sewer or sewage treatment and disposal facility.
- Any foul, contaminated, cooling or hot water will not be discharged into any public sewer, storm-water drain, channel or the sea.
- All contaminated or waste water generated from the works site will be collected on a regular basis and transported by licensed waste collector for treatment or proper disposal. Portable chemical toilets will be provided within the works site and the waste will be collected regularly. This contract has adopted the "Pay for Safety and Environment Scheme" under which the Contractor shall comply with ETWB TCW No. 15/2003, which includes provisions of "Pay for Waste Management",

“Waste Management Plan”, and “Waste Flow Table”.

- The Contractor will be responsible for the design, construction, operation and maintenance of all the mitigation measures and practices specified in the Professional Persons Environmental Consultative Committee Practice Note (ProPECC PN) 1/94 “ Construction Site Drainage” issued by the Director of Environmental Protection.
- A temporary site drainage system consisting of intercepting channels or sand traps will be provided to prevent storm runoff from washing across exposed soil surfaces.
- Adequate temporary covers (e.g. tarpaulin) would be also provide to protect soil surface from erosion.
- The quality of water discharging into the coastal waters of Hebe Haven will be monitored by conducting regular environmental site audits on the construction site practices to ensure all the mitigation measures stipulated have been employed and operating successfully.

5.4 Waste Management Implications

- The Contractor will comply with the Waste Disposal (Chemical Waste) (General) Regulation, the Waste Disposal Ordinance and its subsidiary regulations and the Dumping at Sea Ordinance.
- The Contractor will prepare and carry out a Waste Management Plan so that the waste arising from the construction activities could be kept to a minimum and the waste is handled, transported and disposed of in an appropriate manner.
- No sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material should be allowed to flow from site onto adjoining land.
- The construction waste generated on site will be transported to the designated public filling facility and/or landfill by the trip ticket system. Regular independent audits of the Contractor and resident site staff would be implemented to ensure that the correct procedures are being followed.
- Inert C&D material would be generated from the excavation for constructing the containment structure. Excavated material will be disposed in accordance with ETWB TCW No. 15/2003.
- Before commencing the construction works, the contractors shall adopt good site management practice in order to minimise over-ordering of construction materials and avoid cross contamination to reusable/recyclable materials collected.

5.5 Ecology

5.5.1 WBTC No. 14/2002, Management & Maintenance of Natural Vegetation and Landscape Works, and Tree Preservation.

- There shall be no felling / cutting of any trees within or immediately surrounding the Site.

Only two trees have potential to be directly affected by the

proposed works – Lychee trees at the northwest (top) of the Site. Despite having no ecological conservation value, these two trees are to be retained in-situ during the works and shall be clearly demarcated with a protective shield around their base.

- The removal of ground vegetation will be minimal.

There is a need to clear ground vegetation to facilitate the works, although the volume of plant matter and the species are all common and widespread in the HKSAR.

The ground vegetation to be removed is non-woody herbs and creeping / climbing vines. The disposal of this type of vegetation onto the land adjacent to the Site (south, west and / or north) for natural decomposition is recommended. This disposal method would not generate any odour or visual impacts, and is a sustainable waste management option for a small volume of plant matter.

5.5.2 GEO Publication No. 1/2000, Technical Guidelines on Landscape Treatment and Bio-engineering for Man-made Slopes and Retaining Walls

- The containment structure at the north / northwest of the Site can accommodate climbing vegetation and groundcover plants for a screening effect. Suitable climbers include the native *Ipomoea cairica* that is widespread at the Site, and *Ficus pumila*.
- The tree planters at the toe of the existing slope will ensure that the visual appearance of the area is retained.
- The disturbed terrace can be reinstated through the removal of earth deposits, which should be retained where feasible.
- If desirable, the restored terrace area can be planted with low trees / shrubs (native) such as *Celtis sinensis*, *Mallotus paniculatus* and / or *Macaranga tanarius* that are present in the adjacent woodland habitat. Provided the soil conditions are suitable, natural colonization of the terrace by native groundcover flora will occur rapidly.

5.5.3 General Good Practice Measures

- No open fires shall be permitted on site for burning of leaf litter and cleared vegetation. Vegetation management should follow *WBTC No. 14/2002*.
- Works equipment and material stockpiles should not affect any vegetation outside the Site boundary.
- The Site fencing should be maintained to clearly demarcate the works area.

5.6 Cultural Heritage

Hoarding will be erected around the site area to ensure the graves will not be disturbed by the construction works.

5.7 Landscape

The following mitigation measures shall be adopted:

- Top soil in the works area should be conserved as far as possible.
- Construction access and works area should be minimised.
- Temporary works areas should be designed to minimise disturbance to existing woodland.

5.8 Visual

The following visual mitigation measures shall be employed:-

- Hoarding should be erected along the works site to screen the proposed works.
- There shall be no felling / cutting of any trees within or immediately surrounding the Site.
- The removal of ground vegetation will be minimal.

5.9 Severity, Distribution and Duration of Environmental Effects

The possible severity, distribution and duration of environmental effects and further implications are summarised below:-

| | Effects | Severity | Distribution | Duration |
|---------------------------------|---|----------|---|-----------------------------------|
| Ecology | Minor vegetation clearance in the Works Area | Minimal | Local – within the Works Area | 12 months |
| Water Quality | Surface runoff containing suspended solids | Minimal | Drainage line and coastal waters of Hebe Haven | 12 months |
| Air Quality | Dust and vehicle emissions from construction activities | Minimal | Local – near the Works Area | 12 months |
| Solid Waste | Handling and disposal of about 580m ³ of excavated materials | Minimal | Local – within the Works Area | 12 months |
| Visual and Landscape Appearance | Construction works of containment structure, stepped channel | Minimal | Views from Pak Sha Wan Village and coastal waters of Hebe Haven | Long term (containment operation) |
| | Erection of hoarding and usage of powered mechanical equipment | Minimal | coastal waters of Hebe Haven | 12 months |
| Noise | Noise generated from usage of powered mechanical equipment | Minimal | Local – near the Works Area | 12 months |

Transboundary, cumulative, secondary and induced effects are not anticipated for this project.

5.10 Further Implications

5.10.1 History of Similar Projects

Agreement No. CE 67/2001 (GE), Landslide Mitigation Works against Natural Terrain Hazards in Tung Wan and Shatin Heights – Design and Construction, Tung Wan Landslide Mitigation Works.

5.10.2 Public Consultation to Date

Notices showing details and extent of the proposed works have been posted in the vicinity of the site by DLO/SK from 9 April 2003 to 22 April 2003 for public consultation. DO/SK has also consulted the Village Representative of Pak Sha Wan Village. No objection on the project has been raised by the public.

5.10.3 Public Interest and Political Sensitivity

The objective of the proposed landslide mitigation works are to protect the existing housing development at the toe of the previous landslide area, and therefore they are beneficial to the public.

6 USE OF PREVIOUSLY APPROVED EIA REPORTS

CLP Power Hong Kong Limited (1999). 132 kV Overhead Pole Line & Underground Cable from the Existing Po Lam Substation to the Existing Tui Min Hoi Substation – Circuit No. 2: Final EIA Study Report. October 1999.

Reference was made in the referred EIA report to information on the ecological baseline profile for the general area upslope of the subject site, and in particular information on vegetation/habitat character and wildlife usage. The area of interest has not been affected by any human disturbance since approval of the CLP (1999) EIA Report, and hence the ecological baseline remains valid. No reference was made to the impact assessment or any other aspect of this approved report.