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Agreement No. CE 55/2006 (EP) Inter-reservoirs Transfer Scheme (IRTS) - Water Tunnel between Kowloon Byewash Reservoir & Lower Shing Mun Reservoir - Environmental Impact Assessment - Investigation

Environmental Impact Assessment Report (Final)

(Volume 1 of 2)

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in association with

ADI Limited
Archaeological Assessments

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1. INTRODUCTION

1.1 Background

1.1.1 This Project is named as "West Kowloon Drainage Improvement – Lai Chi Kok Transfer Scheme - Inter-Reservoirs Transfer Scheme ("IRTS") – Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir".

1.1.2 The main objective of the Project is to serve the dual purpose to substantially reduce stormwater discharge into the drainage system in the Lai Chi Kok area and, at the same time, to channel the overflow into the Lower Shing Mun Reservoir via the proposed IRTS tunnel to generate an average annual raw water yield at about 2.5 million m^3.

1.1.3 This Project partly falls within the Kam Shan Country Park and is a designated project ("DP") under Item Q.1 of Part I, Schedule 2 of the EIAO which specifically encompasses "*All projects including new access roads, railways, sewers, sewage treatment facilities, earthworks, dredging works and other building works partly or wholly in an existing or gazetted proposed country park or special area, a conservation area, an existing or gazetted proposed marine park or marine reserve, a site of cultural heritage, and a site of special scientific interest*".

1.1.4 An application (No. ESB-154/2006) for an Environmental Impact Assessment ("EIA") study brief under section 5(1) of the Environmental Impact Assessment Ordinance ("EIAO") was submitted by the Water Supplies Department ("WSD") on 29 September 2006 with a Project Profile (No. PP-298/2006). An EIA Study Brief (No.: ESB-154/2006) was issued by EPD on 9 Nov 2006 for carrying out the EIA which is shown in Appendix A.

1.1.5 Figure 1-1 shows this Project and the general EIA Study Area within 500m of the proposed tunnel alignment and both portals, and Figures 1-2 to 1-6 shows the cross-sections of the project.

1.1.6 Mott MacDonald Hong Kong Limited (formerly Mott Connell Limited) was commissioned by WSD to conduct this EIA under Agreement No. CE 55/2006 (EP). Another engineering consultancy on the same Project was awarded to Black & Veatch Hong Kong Limited under Agreement No. CE54/2006 (WS) to carry out investigation, design and construction ("IDC") for the Project.

1.2 Purpose and Approach of the EIA Study

1.2.1 The purpose of this EIA study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the project and related activities taking place concurrently. This information will contribute to decisions by the Director of Environmental Protection on: -

- The overall acceptability of any adverse environmental consequences that are likely to arise as a result of the Project;
- The conditions and requirements for the detailed design, construction and operation of the Project to mitigate against adverse environmental consequences wherever practicable; and
- The acceptability of residual impacts after the proposed mitigation measures is

implemented.

1.2.2 This EIA Study has been conducted to achieve a number of more specific objectives listed in Clause 2.1 of the EIA Study Brief. These specific objectives are:

1. to describe the Project and associated works together with the requirements for carrying out the Project;
2. to identify and describe the elements of the community and environment likely to be affected by the Project and/or likely to cause adverse impacts to the Project, including both the natural and man-made environment;
3. to provide information on the consideration of alternatives to avoid and minimise the potential adverse environmental impacts on the sensitive uses that may be subject to the adverse environmental impacts of the proposed developments and associated works; to compare the environmental benefits and dis-benefits of each of the different options; to provide reasons for selecting the preferred option(s) and to describe the part of environmental factors played in the selection of the preferred option(s);
4. to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;
5. to identify and quantify any potential losses or damages and other potential impacts on flora, fauna and natural habitats and to propose measures to mitigated these impacts;
6. to identify any potential landscape and visual impacts and to propose measures to mitigate these impacts;
7. to identify and assess any adverse impacts on historical buildings/structures and archaeological sites and to propose measures to mitigate these impacts;
8. to propose the provision of infrastructure or mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the Project;
9. to investigate the feasibility, practicability, effectiveness and implications of the proposed mitigation measures;
10. to identify, predict and evaluate the residual environmental impacts (i.e. after practicable mitigation) and the cumulative effects expected to arise during the construction and operation phases of the Project in relation to the sensitive receivers and potential affected uses;
11. to identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the Project which are necessary to mitigate these environmental impacts and cumulative effects and reduce them to acceptable levels;
12. to investigate the extent of the secondary environmental impacts that may arise from the proposed mitigation measures and to identify constraints associated with the mitigation measures recommended in the EIA study, as well as the provision of any necessary modification; and
13. to design and specify the environmental monitoring and audit requirements to ensure the effective implementation of the recommended environmental protection and pollution control measures.

1.3 Structure of this EIA Study Report

1.3.1 The EIA Report is divided into a total of 13 sections, viz.:

- Section 1 - Introduction
- Section 2 - Project Description
- Section 3 - Air Quality Impact
- Section 4 - Noise Impact
- Section 5 - Water Quality Impact
- Section 6 - Waste Management
- Section 7 - Hazard to Life
- Section 8 - Ecological Impact
- Section 9 - Landscape & Visual Impact
- Section 10 - Cultural Heritage Impact
- Section 11 - Implementation Schedule of Mitigation Measures
- Section 12 - Summary of Findings, Conclusion & Recommendations

2. PROJECT DESCRIPTION

2.1 Project Requirements & Programme

2.1.1 The proposed Project, which this EIA concerns, is shown on Figure 2-1 and comprises the following principal works elements:

1. Construction of a new water tunnel, approximately 2.8 km in length and 3m in diameter, from Kowloon Byewash Reservoir to Lower Shing Mun Reservoir;
2. Construction of an intake structure at Kowloon Byewash Reservoir and an isolation system;
3. Construction of an outfall structure at Lower Shing Mun Reservoir with an energy dissipater; and
4. All associated civil, structural, geotechnical, electrical and mechanical works, including landscaping, permanent and temporary accesses as may be necessary for the completion of the works elements listed above.

2.1.2 The project will only involve underground tunnelling works beneath the Kam Shan Country Park. No access shafts along the tunnel alignment would be necessary.

2.1.3 According to the latest estimate, the Project (reference scheme) is scheduled to commence construction in late 2009 for completion by mid 2012 as shown in Appendix B. However, as a result of adopting an alternative IRTS scheme, the program can be shortened and realise an early completion by early 2012.

2.1.4 The operation activity of this project is mainly transferring water from the Kowloon Byewash Reservoirs into Lower Shing Mun Reservoir via the water tunnel.

2.2 The Study Area and Constraints

2.2.1 Depending on specific requirements of various disciplines, the EIA Study area is generally defined within 500m of the Project alignment and both portals. The Project falls within the Kam Shan Country Park and the lower direct water gathering grounds ("WGG") of both reservoirs as shown in Figure 2-1.

2.2.2 All uses and development within the country park and the WGG require prior consent from the Country and Marine Parks Authority and the Water Supplies Department respectively.

2.2.3 Main environmental constraints of the Project are shown in Figure 2-1 and encompass the following key elements: -

1. Outline Zoning Plan ("OZP") which shows the environmentally sensitive uses falling within the 500m envelop of the Project;
2. Lower direct water gathering grounds (WGG) where both portals situate;
3. Kam Shan Country Park;
4. Location of the proposed Intake (work site) within Consultation Zone of the Shek Lei Pui Water Treatment Works – a potentially hazardous installation (PHI).

2.2.4 The associated impacts have been addressed in the Chapters 3-10 of this EIA Report.

2.3 Need for the Project and Consequences of not Proceeding with the Project

2.3.1 The Project is part of the LCKTS and forms an integral part of the overall flood control strategy for West Kowloon. The main benefit of the IRTS is that the general standard of flood protection in the Sham Shui Po, Cheung Sha Wan and Lai Chi Kok districts can be raised to withstand a rainstorm with a return period of one in 50 years without extensive pipe laying works in these heavily trafficked areas.

2.3.2 The Project would help to reduce the scale of the LCKTS and the disturbance caused by the original works in the affected areas. It also contributes to an overall capital cost saving and generates an average additional raw water yield of about 2.5 million m^3 a year and promotes sustainability in water conservation.

2.3.3 Without this Project these benefits cannot be realised.

2.4 Consideration of Different Alignment Options

Reference Tunnel Portals and Alignment

2.4.1 The reference tunnel alignment (A-C) as shown in Figure 2-2 was identified during the feasibility study stage and is a rather straight route connecting the two reservoirs. It was selected to avoid running directly underneath the existing reservoirs and measures approximately 2.8km long. The reference tunnel would cross the existing High Island Water Tunnel, which is at a lower level.

2.4.2 The reference intake location (Intake A) is located at the south-western part of the Kowloon Byewash Reservoirs, which is the lowest member of the Kowloon Group of Reservoirs. The reference outfall location (Outfall C) is located at the southern side of the Lower Shing Mun Reservoir along the Lower Shing Mun Reservoir Road.

2.4.3 The reference outfall portal has been intended as the launching site for tunnelling works as the direction of drive from outfall to intake allows the tunnel to drain naturally during construction and to reduce the chances of tunnel inundation.

Alternative Tunnel Portals and Alignment

2.4.4 As part of the associated consultancy under Agreement No. CE54/2006 (WS), the IDC consultant has prepared Working Paper No. 1 [1] to evaluate alternative portal locations and tunnel alignments in August 2007. The study involved a comprehensive evaluation of various key factors including: -

- Environmental benefits;
- Geology, hydrogeology and geotechnical engineering;
- Hydraulic performance, cost and programme;
- Tunnel constructability, site formation and landslip preventive works; and
- Operation and maintenance, traffic, utilities, land matter and interface with other

[1] Working Paper No. 1 – Evaluation of Alternative Portal Locations/ Tunnel Alignments under Agreement No. CE 54/2006 (WS) – Inter-reservoirs Transfer Scheme (IRTS) Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir – August 2007 by Black & Veatch Hong Kong Limited.

planned concurrent projects.

2.4.5 In summary, the evaluation has generated 4 combinations of tunnel alignment viz., tunnel Alignment A-C, B-C, B-D, and A-D as shown in Figure 2-2 with alternative intake and outfall locations shown in Figure 2-3 and Figure 2-4.

2.5 Selection of Preferred Scenario

Preferred Tunnel Portals and Alignment

2.5.1 Amongst the various combinations of options, it was concluded in Working Paper No. 1 that **Alignment A-D** should be the preferred one after consideration of the programme, constructability, and maintenance, environmental and social impacts to the public and this preferred alignment is shown in Figure 2-5. The work site areas of the Outfall and Intake structure are shown in Figure 2-6 and Figure 2-7.

2.5.2 The preferred alignment concluded in this WP No. 1 is agreeable under this EIA based on the review given in Table 2-1. As the various tunnel alignments are all underground and hence would not make a lot of difference in the environmental impacts. The comparison below has therefore focussed on both portals.

Table 2-1 Comparison of Environmental Impacts of Various Alternative Portal Locations

Environmental Impacts	Intake A	Intake B	Outfall C	Outfall D
Air quality – fugitive dust	Though Intake A is closer to air sensitive receivers (ASRs), an adequate separation of 145m can still be maintained and hence will not cause any unacceptable impact/ nuisances	Intake B is further away from the ASRs and hence will cause the least impact/ nuisance	Outfall C is further away from the ASRs and hence will cause the least impact/ nuisance	Though Outfall D is closer to ASRs, an adequate separation of 200m can still be maintained and hence will not cause any unacceptable impact/ nuisances
Construction Noise (air-borne)	Same comment as above in terms of airborne construction noise impact. Detailed assessment in Chapter 4 has demonstrated full compliance for Alignment A-D			
Construction Noise (ground-borne)	Same comment as above in terms of ground-borne construction noise impact. Detailed assessment for AD in Chapter 4 has demonstrated full compliance for Alignment A-D			
Water quality	Same for any of the 4 combinations			
Waste generation	Length of tunnel is rank in ascending order as BD (2.6km) < BC (2.7km) < AC (2.8km) < AD (2.9km). Difference is insignificant			
Hazard to life	Worksite of Intake A is within 400m of the Shek Lei Pui WTW	Worksite of Intake B is further away from the Shek Lei Pui WTW and hence should be subject to a lower hazard level	N.A.	N.A.
Ecological Impact	Impact on vegetation could be minimised as most of the worksite area is proposed on one existing barbecue site.	Comparing with Intake A, potentially larger area of vegetation would be affected.	Disturbance to wildlife and habitats would be comparatively significant as this outfall is proposed at the core of the woodland.	Disturbance to wildlife and surrounding habitats could be reduced as the outfall is proposed away from the core area of the woodland.
Landscape Resources	LR1: (Moderate adverse) Loss of small number of trees and existing vegetation surrounding the proposed work site.	LR1: (Moderate adverse) Potential loss of a relatively larger number of trees and existing vegetation surrounding	LR1: (Moderate adverse) Potential loss of large number of trees and existing vegetation surrounding the proposed work	LR1: (Moderate adverse) Loss of small number of trees and existing vegetation surrounding the proposed work site.

Environmental Impacts	Intake A	Intake B	Outfall C	Outfall D
	LR2: (Moderate Adverse) Appearance of new intake structure with permanent access road. LR3: (Insubstantial impact)	the proposed work site. LR2: (Moderate Adverse) Receive similar impact as intake A option LR3: (Insubstantial impact)	site due to the location of core woodland LR2: (Moderate Adverse) Appearance of new outfall structure LR3: (Insubstantial impact)	LR2: (Moderate Adverse) Receive similar impact as outfall C option LR3: (Insubstantial impact)
Landscape Character Area	LCA1: (Moderate Adverse) Loss of existing trees, alternation of a part of existing picnic site to permanent access road, alternation of existing topography and appearance of new intake structure LCA4: (Insubstantial Impact) No activity in LCA4.	LCA1: (Moderate Adverse) Loss of potentially larger number of existing trees compared with Intake A option, alternation of existing woodland into permanent access road, alternation of existing topography and appearance of new intake structure LCA4: (Insubstantial Impact) Similar to Intake A option	LCA2: (Moderate Adverse) Loss of existing trees, alternation of existing topography and appearance of new outfall structure LCA3: (Insubstantial Impact) No activity in LCA3.	LCA2: (Moderate Adverse) Similar impact received as Outfall C option LCA3: (Insubstantial Impact) Similar to Outfall Option C
Visual Impact	Moderate Adverse Impact: residents of No. 8 Caldecott Road former government apartment R2 (R2) and visitors in Kam Shan Country Park (T1) due to the appearance of new intake structure	Moderate Adverse Impact: Visitors in Kam Shan Country Park (T1) due to the appearance of new intake structure Insubstantial Impact for other VSRs as proposed structure is further is more distant and not visible to Residents of No. 8 Caldecott Road former	Moderate Adverse Impact: trail walkers in Lower Shing Mun Reservoir (T2) due to the appearance of new outfall structure Insubstantial Impact for other VSRs as proposed structure is more distant and not visible to residents in Lakeview Garden (R1)	Moderate Adverse Impact: trail walkers in Lower Shing Mun Reservoir (T2) and residents in Lakeview Garden (R1) due to the appearance of new outfall structure

Environmental Impacts	Intake A	Intake B	Outfall C	Outfall D
		government apartment R2 (R2)		
Cultural heritage impact	Intake A is close to the Grade II Dam and Grade II Valve House of Kowloon Byewash Reservior. However, the level of vibration will be controlled at low levels so that impact to the Dam and Valve House should be acceptable.	Intake B is close to the Grade I Dam and Grade I Valve House of Kowloon Reservior. However, the level of vibration will be controlled at low levels so that impact to the Dam and Valve House should be acceptable.	Outfall C is further away from the Graded structures of the Lower Shing Mun Reservoir (also known as Shing Mun (Jubilee) Reservior Lower Reservior) than Outfall D. However, the separation distance is already enough and no adverse impacts are expected	Compared with Outfall C, Outfall D has a shorter separation distance to the Graded structures of the Lower Shing Mun Reservoir (also known as Shing Mun (Jubilee) Reservior Lower Reservior). However, the separation distance is already enough and no adverse impacts are expected

2.6 Consideration of Alternative Construction Methods and Sequence of Work

2.6.1 The IDC consultant has also produced the Working Paper No. 3 [2] to evaluate various options of construction methods for the water transfer tunnel and both portals. The following are the construction methods proposed and preferred.

Main Tunnel

2.6.2 Drill & Blast (D&B) and TBM are the most commonly used methods for tunnelling, and are feasible excavation technologies for tunnel construction where generally competent rock conditions are encountered. Others less common technologies which do not offer any special benefits, and were therefore not considered further due to limited plant availability and the relatively low efficiency. From an overall engineering point of view, tunnelling by TBM has benefits of a shorter construction programme, minimal over-breaking, and smooth lining, and is intrinsically safer.

2.6.3 From an environmental perspective, the use of TBM is preferred over D&B as it generates less noise and vibration, and is a safer method when compared to blasting, and there is no need for overnight storage of explosives on-site. Proximity of the worksite to the Lower Shing Mun Reservoir dam has been the prime factor that ruled out the use of the D&B method which involves the use of explosives.

Tunnel Portal and TBM Starter Tunnel

2.6.4 The formation of a portal access and starter tunnel/chamber for launching of TBM will be necessary. The use of conventional mechanical sequential excavation & support will be considered. For the same environmental and safety reasons mentioned above, drill and blast is considered not suitable. The alternative to D&B is likely to be a combination of mechanical, pneumatic or hydraulic splitting or expanding grout techniques. These are safe and environmental-friendly rock breaking methods that generate much less vibration. It is considered that these alternative methods are the preferred options, providing a favourable solution to suit site conditions and constraints as for the Project. For purpose of the EIA, the uses of hydraulic breaker and rock drill have been assumed for conservative evaluation of the impacts.

Sequence of Work

2.6.5 The envisaged sequence of work is presented in Appendix B. The design of the construction sequence has been to minimise overlapping so as to reduce cumulative noise impacts in particular.

2.6.6 In brief, the preferred alignment, i.e. A-D has been adopted for further study under the IDC consultancy and is agreeable from environmental perspective in the EIA. The construction method recommended for the main tunnel will be by TBM, with mechanical excavation adopted for creation of the launching tunnel and both portals. Blasting is considered not practicable and has been ruled out for this Project. The EIA has been conducted based on these selections for the various environmental issues.

[2] Working Paper No. 3 – Evaluation of Construction Methods for the Water Transfer Tunnel under Agreement No. CE 54/2006 (WS) – Inter-reservoirs Transfer Scheme (IRTS) Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir – January 2008 by Black & Veatch Hong Kong Limited.

2.7 Interface with Planned Projects

2.7.1 Planned projects identified include: -

- PWP Item No. 155CD - West Kowloon drainage improvement - Lai Chi Kok drainage tunnel scheduled to commence in November 2008 for completion in September 2012;
- Agreement No. CE 77/2001 (GE) and 2/2006 (GE) – Slope Upgrading Works with no definite program;
- The Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) – Hong Kong Section likely to commence in 2009.

2.7.2 It is envisaged that given the physical distance separation, the LCK drainage tunnel will unlikely to affect common sensitive receivers of the IRTS. The XRL is all underground with substantial vertical separation with the IRTS tunnel and hence will not affect the similarly.

2.7.3 Although the slope upgrading works could be close to the Intake A, the works would be minor in nature and would unlikely to contribute to significant cumulative impacts on common air and noise sensitive receivers located far from the works areas.

2.8 Public Consultation

2.8.1 The Project Proponent has consulted the Development and Housing Committee (DHC) of the Sha Tin District Council in October 2005 and August 2006. At the DHC meeting held on 29 August 2006, members supported the IRTS.

2.9 Summary

2.9.1 In brief, the preferred alignment, i.e. A-D has been adopted for further study under the IDC consultancy and is agreeable from environmental perspective. The construction method recommended for the main tunnel will be by TBM, with mechanical excavation adopted for creation of the launching tunnel and both portals. Blasting is not considered practicable and has been ruled out for this Project. The EIA has been conducted based on these selections for various issues presented in the rest of chapters.

3. AIR QUALITY IMPACT

3.1 Introduction

3.1.1 This assessment has been based on the criteria and guidelines for evaluation and assessment of air quality impact stated in Annexes 4 and 12 of the EIAO-TM and covered the scope outlined in Para. 3.4.1 of the EIA Study Brief.

3.2 Relevant Legislations, Standards & Guidelines

3.2.1 Hong Kong's air quality is regulated through the Air Pollution Control Ordinance (Cap. 311) ("APCO"). The APCO specifies Air Quality Objectives ("AQOs"), which are the statutory limits for a number of pollutants and the maximum allowable number of times that these may be exceeded over specified periods – these pollutants are defined as Criteria Pollutants ("CP"). The AQOs defined for these criteria pollutants are given in the following table: -

Table 3-1 Hong Kong Air Quality Objectives

Pollutant	Concentration ($\mu g/m^3$)(1) Averaging Period				
	1 Hour(2)	8 Hours(3)	24 Hours(3)	3 Months(4)	1 Year(4)
Sulphur Dioxide, SO_2	800	-	350	-	80
Total suspended Particulate, TSP	-	-	260	-	80
Respirable Suspended Particulates, RSP(5)	-	-	180	-	55
Nitrogen Dioxide, NO_2	300	-	150	-	80
Carbon Monoxide, CO	30,000	10,000	-	-	-
Photochemical Oxidants, (as ozone (6))	240	-	-	-	-
Lead	-	-	-	1.5	-

Notes:
(1) Measured at 298 K and 101.325 kPa (one atmosphere)
(2) Not to be exceeded more than 3 times per year
(3) Not to be exceeded more than once per year
(4) Arithmetic means
(5) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10μm or less
(6) Photochemical oxidants are determined by measurement of ozone only

3.2.2 For impacts during the construction stage, fugitive dust in particular, Section 1, Annex 4 of EIAO-TM stipulates the hourly average Total Suspended Particulate ("TSP") concentration of 500 μg/m3 measured at 298 K (25°C) and 101.325 kPa (1 atmosphere) for construction dust impacts. Mitigation measures for construction sites specified in the Air Pollution Control (Construction Dust) Regulation should be followed.

3.2.3 The APCO's subsidiary regulation Air Pollution Control (Construction Dust) Regulation defines notifiable and regulatory works activities that are subject to construction dust control.

Notifiable Works:

1. Site formation;
2. Reclamation;
3. Demolition of a building;
4. Work carried out in any part of a tunnel that is within 100 m of any exit to the open air;
5. Construction of the foundation of a building;
6. Construction of the superstructure of a building; or
7. Road construction work.

Regulatory Works:

8. Renovation carried out on the outer surface of the external wall or the upper surface of the roof of a building;
9. Road opening or resurfacing work;
10. Slope stabilisation work; or
11. Any work involving any of the following activities-
    - Stockpiling of dusty materials;
    - Loading, unloading or transfer of dusty materials;
    - Transfer of dusty materials using a belt conveyor system;
    - Use of vehicles;
    - Pneumatic or power-driven drilling, cutting and polishing;
    - Debris handling;
    - Excavation or earth moving;
    - Concrete production;
    - Site clearance; or
    - Blasting.

3.2.4 Notifiable works require that advance notice of activities be given to EPD. The Regulation also requires the works contractor to ensure that both notifiable works and regulatory works will be conducted in accordance with the Schedule of the Regulation, which provides dust control and suppression measures.

3.3 Study Area and Air Sensitive Uses

Study Area

3.3.1 Clause 3.4.1.2 of the EIA Study Brief prescribed a study area to be generally defined by a distance of 500m from boundary of the Project, or other project alignments as identified in the EIA. Figure 3-1 and Figure 3-2 show the study area (500m envelope) of the two portals and identified representative ASRs falling within this area.

Air Sensitive Uses

3.3.2 Although the study area can be as wide as 500m from the work sites, the first tier of ASRs will usually be considered in planning the works in order to minimise the dust nuisances. Other ASRs further away from these first tier ones will be expected to be less affected. As the assessment area fall within the Kam Shan Country Park, sensitive areas such as the picnic areas where a number of people may be affected by the Project are also included as ASRs. As confirmed by WSD, the Tai Po Road Water Treatment Works Staff Quarters will be vacated before construction commences, hence this staff quarters is not considered as ASR although it located within the assessment area. Moreover, as confirmed by CLP, the CLP Over Head Line Training School is neither registered under Education Ordinance nor classified as an Education Institute. Hence, these two uses are not classified as ASRs under this study. The representative ASRs identified within the assessment area was tabulated in Table 3-2 below.

Table 3-2 Representative ASRs within the Assessment Area

ASRs	Location	Nature of Use	Distance between ASRs and the work site boundary (m)
Outfall end (Portal D)			
A1	Lakeview Garden	Residential	200
A2	Golden Time Villas	Residential	295
A3	Ascot Villa	Residential	290
Intake end (Portal A)			
A4	Tai Po Road Village House	Residential	170
A5	Caldecott Hill	Residential	500
A6	Po Leung Kuk Choi Kai Yau School	Educational	500
A7	Playground	Recreational	320
A8	Picnic area	Recreational	250
A9	Picnic area	Recreational	180

3.4 Background Air Quality

3.4.1 There are currently 11 general and 3 roadside air quality monitoring stations operated by EPD and one of the purposes is to provide background air quality information. The proposed IRTS water tunnel starts from the Kowloon Byewash Reservoir and ends at the Lower Shing Mun Reservoir. The two air quality monitoring stations, viz., Sha Tin and Sham Shui Po, are the nearest to the outfall and intake worksites respectively. The annual average air quality measured for the past 5 years (2002 to 2006) at the two stations are presented in Table 3-3. In consideration of the two worksites being at certain distance away from the urban areas, the lower background data at Sha Tin are considered more representative than that of Sham Shui Po, whilst the data at Sha Tin could represent an upper limit of the background air quality at the two worksites lying within country parks.

Table 3-3 5-year-averaged Background Air Quality of Shatin and Shum Shui Po Air Quality Monitoring Stations

Pollutants	Shatin, Annual average (µg/m³)	Sham Shui Po, Annual average (µg/m³)	HKAQO (µg/m³)
NO_2	45	67	80
RSP	52	55	55
TSP	69	79	80
SO_2	18	24	80

3.5 Construction Phase Impacts

Analysis of Construction Activities

3.5.1 The envisaged construction programme and activities have been presented in Appendix B.

3.5.2 The construction will begin with site clearance/ formation works at both portals. Following the site clearance/ formation works, there would likely to be a combination of mechanical, pneumatic or hydraulic splitting or expanding grout techniques employed for creation of both portals, while the tunnelling works will employ the use of Tunnel Boring Machine (TBM) starting from the outfall portal. Finally, the intake and outfall structures would be constructed together with the tunnel testing and commissioning.

Assessment Methodology

3.5.3 As the construction activities would be phased and are conducted mainly inside the tunnel, it is expected that, with implementation of dust suppression measures given in the Air Pollution Control (Construction Dust) Regulation and proposed mitigation measures mentioned in Section 3.5.9 below, no significant dust impact would be envisaged. A qualitative approach to evaluate the air quality impact induced by the construction of the Project is therefore adopted.

Identification of Potential Construction Dust Impact

3.5.4 It is expected that works at the portals could generate a small amount of dust during the construction activities mentioned above. Potential sources of dust emissions include those listed below and elaborate in the following paragraphs:

- site clearance/ formation works;
- loading, unloading and transfer of dusty materials;
- gaseous emissions from the construction vehicles and the operation of Powered Mechanical Equipment (PME);
- wind erosions from stockpiles of dusty materials; and
- transfer of dusty materials using a conveyor belt system.

3.5.5 The construction will begin with site clearance. This will be a regulatory works procedure that requires appropriate dust suppression measures under the Regulation to adequately control dust to within an acceptable level.

3.5.6 Site preparation may involve minor excavation, which is also regulatory work. Dusty material stockpiling and handling may also be possible, for which dust control measures will have to be implemented.

3.5.7 The works may also involve the use of trucks for material transport. Use of vehicles is a regulatory work procedure and the required dust control measures shall ensure dust levels are controlled to an acceptable level.

3.5.8 The conveyor belt system would be enclosed throughout the tunnel and end at the outfall portal for spoil disposal. Fugitive dust would be the potential air quality impact. However, the nearest ASR identified at Portal D is Lakeview Garden (A1) which is located at 200m away and with ~60m of vertical separation. No picnic areas are found in the vicinity of the site near the outfall portal. Hence, with the implementation of dust suppression measures in Section 3.5.9, the dust impact would be limited and no exceedance of dust level would be envisaged. The same situation also applies to the intake end, where the fugitive dust impact should be controllable.

Mitigation Measures for Fugitive Dust

3.5.9 To mitigate fugitive dust impact, all dust control measures recommended in the Air Pollution Control (Construction Dust) Regulation, where applicable, will be implemented. Relevant dust control measures include:

1. The works area for site clearance shall be sprayed with water before, during and after the operation so as to maintain the entire surface wet;
2. Restricting heights from which materials are to be dropped, as far as practicable to minimise the fugitive dust arising from unloading/ loading;
3. Immediately before leaving a construction site, all vehicles shall be washed to remove any dusty materials from the bodies and wheels. However, all spraying of materials and surfaces should avoid excessive water usage;
4. Where a vehicle leaving a construction site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials will not leak from the vehicle;
5. Erection of hoarding of not less than 2.4 m high from ground level along the site boundary, where appropriate;
6. Any stockpile of dusty materials shall be covered entirely by impervious sheeting; and/or placed in an area sheltered on the top and 4 sides;
7. All dusty materials shall be sprayed with water immediately prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet.

3.6 Potential Cumulative Impacts due to Concurrent Works

3.6.1 The sections that could lead to potential cumulative air quality impact include: -

- PWP Item No. 155CD - West Kowloon drainage improvement - Lai Chi Kok drainage tunnel scheduled from November 2008 for completion in September 2012;
- Agreement No. CE 77/2001 (GE) and 2/2006 (GE) – Slope Upgrading Works with no definite program; and
- The Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) – Hong Kong Section likely to commence in 2009.

3.6.2 However, as mentioned in Section 2.7, it is envisaged that given the physical distance separation, the LCK drainage tunnel will unlikely to affect common sensitive receivers of the IRTS. The XRL is all underground with substantial vertical separation with the proposed IRTS tunnel and the slope upgrading works would be relatively minor in nature, hence, the potential cumulative projects would unlikely to contribute significant impact to ASRs.

3.7 Environmental Monitoring and Audit Requirements

3.7.1 It is necessary to ensure proper implementation of the dust control measures as required under the Air Pollution Control (Construction Dust) Regulation. No specific construction dust monitoring is recommended, although environmental audits during the construction stage will be desirable to ensure proper implementation of air quality control measures.

3.8 Conclusion

3.8.1 Through proper implementation of dust control measures required under the Air Pollution Control (Construction Dust) Regulation by the works contractor, construction dust can be controlled at source to acceptable levels and hence no unacceptable impacts will be anticipated.

3.8.2 As the project does not require large-scale site formation or other major activities that could generate significant amount of fugitive dust, no specific construction dust monitoring is considered necessary, though on-site environmental audit is recommended to ensure proper implementation of dust control measures during the construction phase.

4. NOISE IMPACT

4.1 Introduction

4.1.1 This section has evaluated and assessed the noise impact quantitatively using standard acoustic principles and has focussed on the construction phase only. The assessment has been based on the criteria and guidelines for evaluation and assessing noise impact as stated in Annexes 5 and 13 of the EIAO-TM and covered the scope outlined in Clause 3.4.2 of the EIA Study Brief.

4.2 Relevant Legislations, Standards & Guidelines

General Construction Activities during Non-Restricted Hours

4.2.1 Noise impacts arising from general construction activities other than percussive piling during the daytime period (07:00-19:00 hours of any day not being a Sunday or general holiday) shall be assessed against the noise standards tabulated in Table 4-1 below.

Table 4-1 Noise Standards for Daytime Construction Activities

Noise Sensitive Uses	0700 to 1900 hours on any day not being a Sunday or general holiday, Leq (30 min), dB(A)
All domestic premises including temporary housing accommodation	75
Hotels and hostel	
Educational institutions including kindergarten, nurseries and all others where unaided voice communication is required	70 65 during examination

Source: EIAO-TM, Annex 5, Table 1B - Noise Standards for Daytime construction Activities

Note:

- The above noise standards apply to uses, which rely on opened windows for ventilation
- The above standards shall be viewed as the maximum permissible noise levels assessed at 1m from the external facade
- The above standards shall be met as far as possible. All practicable mitigation measures shall be exhausted and the residual impacts are minimised

General Construction Activities during Restricted Hours and Percussive Piling during Anytime

4.2.2 Noise impacts arising from general construction activities (excluding percussive piling) conducted during the restricted hours (19:00-07:00 hours on any day and anytime on Sunday or general holiday) and percussive piling during anytime are governed by the Noise Control Ordinance ("NCO").

4.2.3 For carrying out of any general construction activities involving the use of any Powered Mechanical Equipment ("PME") within restricted hours, a Construction Noise Permit (CNP) is required from the Authority under the NCO. The noise criteria and the assessment procedures for issuing a CNP are specified in Technical Memorandum on Noise from Construction Work Other Than Percussive Piling (GW-TM) under the NCO.

4.2.4 The use of Specified PME ("SPME") and/or the carrying out of Prescribed Construction Work ("PCW") within a Designated Area ("DA") under the NCO during the restricted hours are also prohibited without a CNP. The relevant technical details can be referred to Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM) under NCO.

4.2.5 Designated areas, in which the control of SPME and PCW shall apply, are established through the Noise Control (Construction Work Designated Areas) Notice made under Section 8A(1) of the NCO. According to the Designated Area defined under the NCO (with effective from 1 January 2009), **none** of the works area of this project will fall within these areas.

4.2.6 As such, the application for CNP for any general construction activities involving the use of any PME shall refer to the GW-TM only. However, the Contractor has the responsibility to check the latest status and coverage of the Designated Areas at time of construction of the project.

4.2.7 Also, percussive piling is only permitted when the Authority has granted a CNP. Technical Memorandum on Noise from Percussive Piling (PP-TM) under the NCO sets out the permitted hours of operation of percussive piling and Acceptable Noise Level ("ANL") requirements, which are dependent on the level of exceedance of the Acceptable Noise Level ("ANL"). For this Project in particular, percussive piling is **not** considered necessary.

4.2.8 Regardless of any description or assessment made in this chapter, in assessing a filed application for a CNP the Authority will be guided by the relevant Technical Memoranda. The Authority will consider all the factors affecting their decision taking contemporary situations/ conditions into account. Nothing in this Report shall pre-empt the Authority in making their decisions, and there is no guarantee that a CNP will be issued. If a CNP is to be issued, the Authority may include any conditions they consider appropriate and such conditions are to be followed while the works covered by the CNP are being carried out. Failing to do so may lead to cancellation of the permit and prosecution action under the NCO.

Ground-borne Noise

4.2.9 Noise arising from general construction works during normal working hours is governed by the EIAO-TM under the EIAO as shown in Table 4-1. The Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM) under the NCO stipulates that noise transmitted primarily through the structural elements of building, or buildings, shall be 10 dB(A) less than the relevant ANLs.

4.2.10 Based on the same principle for the ground-borne noise criteria (i.e. ANL-10 dB(A) under the IND-TM), the ground-borne construction noise levels inside domestic premises and schools relying on open window for ventilation shall be limited to 65 dB(A) and 60 dB(A) respectively when compared to the EIAO-TM.

4.2.11 For daytime during general holidays and Sundays and all days during evening 1900-2300 hrs and nighttime during 2300-0700 the other day, the ground-borne construction noise level shall be limited to 10 dB(A) below the respective ANLs for the Area Sensitivity Rating appropriate to those NSRs affected by the Project. For NSRs close to both portals (i.e. intake and outfall ends), an Area Sensitivity Ratings of "A" is adopted as NSRs in both areas are low density residential area consist of low-rise buildings and are not influenced by major road traffic or industries. A summary of these criteria is given in Table 4-2 below:

Table 4-2 Ground-borne Noise Criteria (L_{eq} 30min, dB(A))

NSR type	Ground-borne Noise Criteria (1), dB(A)		
	Daytime (0700-1900) except general holidays and Sunday	Daytime (0700-1900) during general holidays and Sundays and all days during Evening (1900-2300 hrs)	Night-time (2300 – 0700 hrs)
All domestic premises including temporary housing accommodation	65	50	35
Hotels and hostel	65	50	35
Educational institutions including kindergarten, nurseries and all others where unaided voice communication is required	60 55 (during examination)	50 45 (during examination)	35

Notes:
(1) Noise descriptor for daytime noise is Leq (30min), others are Leq (5min)

4.3 Study Area

4.3.1 Clause 3.4.2.2 (i) of the EIA Study Brief prescribed the Study Area to be those within 300m from the Project or other project alignments as identified in the EIA. Figure 4-1 and Figure 4-2 shows this study area (the 300m envelope) in details and the noise sensitive receivers ("NSRs") within the area.

4.3.2 The representative NSRs are the first tier of most affected noise sensitive uses selected for the noise assessment to facilitate works planning and the implementation of necessary mitigation measures. Other NSRs further away from these first tier NSRs are expected to be less affected by comparison.

4.4 Noise Sensitive Uses (Air-borne and Ground-borne)

4.4.1 Noise sensitive receivers (NSRs) have been identified in accordance with Annex 13 of the EIAO-TM. The NSRs have included existing, planned/ committed noise sensitive developments and relevant uses earmarked on the relevant Outline Zoning Plans, Development Permission Area Plans, Outline Development Plans, Layout Plans and other relevant published land use plans, including plans and drawings published by Lands Department.

4.4.2 For purpose of this construction noise assessment, representative NSRs close to the site have been selected within the Study Area for prediction of the levels of noise impact. Selected representative existing NSRs are tabulated in Table 4-3 below and shown in Figure 4-1 and Figure 4-2.

Table 4-3 Locations of the Existing Representative NSRs for CNIA

NSR ID.	Description	No. of Floors	Horizontal Distance from tunnel alignment (m)	Horizontal Distance from portals (m)	Nature of Use
Outfall End (Portal D)					
LG	Tower 1, Lakeview Garden	1/F – 6/F	200	200	Residential
AV	House A, Ascot Villa	G/F – 2/F	290	290	Residential
GTV	House 17, Golden Time Villas	G/F – 2/F	295	295	Residential
Intake End (Portal A)					
VH	Village House	G/F – 1/F	200	170	Residential

4.4.3 As confirmed by WSD, the Tai Po Road Water Treatment Works Staff Quarters will be vacated before the construction work commences. Moreover, as confirmed by CLP, the CLP Over Head Line Training School is neither registered under Education Ordinance nor classified as an Education Institute. Hence, these two uses are not classified as NSRs under this study and no assessment have been considered.

4.4.4 No planned/ committed noise sensitive developments and relevant uses were found within the assessment area at the time of this Study.

4.5 Analysis of Construction Activities and Sources of Noise Impact

4.5.1 It is expected that works near the two portals and inside the tunnel can roughly be divided into several work stages and are given in Table 4-4. Figure 2-6 and Figure 2-7 show the locations of these two portals. The detailed construction programme has been given in Appendix B.

4.5.2 Except for tunnelling works, which the TBM will operate round the clock, all other construction activities will only be conducted during daytime, i.e. 0700-1900 on any day not being Sundays or general holidays unless there is a need to extend the working sessions to the restricted hours defined under the NCO. In such case, the Contractor will apply for CNP for the carrying out of the works.

Table 4-4 Tentative Construction Schedule

Work Stages/ Construction Activities		Occurrence		
		Intake	Outfall	Tunnel
1	Mobilization	√	√	
2	Site Formation Works	√	√	
3	Portal/ Shaft Construction		√	
4	Setting up of Tunnelling Equipment	√	√	√
5	Tunnelling Works	√	√	√
6	Tunnel Testing and Commissioning	√	√	√
7	Construction of intake and outfall structures	√	√	

4.5.3 To facilitate an estimate of the likely level of construction noise, an inventory of project-specific PME needed has been assumed and provided by the project engineer for each portals and tunnel inside were shown in Appendix B.

4.6 Assessment Approach & Methodology

Airborne Noise

4.6.1 Reference has been made to the approach given in the Guidance Note titled "Preparation of Construction Noise Impact Assessment under the Environmental Impact Assessment Ordinance" (GN 9/2004).

4.6.2 Also, as per EIAO-TM Annex 13, the assessment of construction noise impact arising from works other than percussive piling has been based on standard acoustic principles, and the guidelines given in GW-TM issued under the NCO where appropriate. Where no sound power level ("SWL") can be found in the relevant TM, reference has been made to BS 5228 Part I or noise emission levels measured for QPME used in previous projects in Hong Kong. The approach used has been as follows: -

1. Assume a typical construction schedule as in Appendix B;
2. Assume a typical project-specific equipment inventory in Appendix B for each work stage together with the number and type of PME that are considered necessary for completing the works during the non-restricted hours;

3. Obtain from GW-TM, the Sound Power Level (SWL) for each PME assumed in the equipment inventory;
4. Adopt the worst-case plant inventory in each construction activities (i.e. a higher SWL) in case there are alternative plant inventory;
5. Select representative NSRs for the construction noise impact assessment in Table 4-3;
6. Calculate the unmitigated Predicted Noise Level ("PNL") and correct it for facade reflection to obtain the Corrected Noise Level ("CNL") at any NSRs as in Table 4-3;
7. Include screening effect for the NSRs near Outfall end (Portal D) where there are no direct line of sight to the construction activities;
8. If necessary, re-select typical project-specific silenced equipment and/ or erection of noise barrier and calculate the mitigated noise impact; and
9. Compare the mitigated CNL with the noise standards given in Table 4-1 to determine acceptability and the need for further mitigation/ EM&A.

Ground-borne Noise

4.6.3 Both TBM and a combination of mechanical, pneumatic or hydraulic splitting or expanding grout techniques will be used to excavate rock along the alignment. The interaction between the operation of equipments (hydraulic breaker and rock driller), the TBM and the rock will induce ground-borne noise. Potential ground-borne noise impacts on NSRs include the use of rock drill during the excavation at two portals, and the TBM along the tunnel alignment. The methodology for assessing the ground-borne noise impact has been used as follow.

4.6.4 The method used to predict construction ground-borne noise has been based on the U.S. Department of Transportation "High-Speed Ground Transportation Noise and Vibration Impact Assessment", 1998. The vibration level $L_{v,rms}$ at a distance R from the source is related to the vibration source level at a reference distance R_o. The conversion from vibration levels to ground-borne noise levels is determined by the following factors:

C_{dist}	Distance attenuation
$C_{damping}$	Soil damping loss across the geological media
$C_{building}$	Coupling loss into building foundation
C_{floor}	Coupling loss per floor
C_{noise}	Conversion factor from floor vibration levels to noise levels

4.6.5 The predicted ground-borne noise level L_p inside the noise sensitive room is given by the following equation.

$$L_p = L_{v,rms} + C_{dist} + C_{damping} + C_{building} + C_{floor} + C_{noise}$$

Reference Vibration Sources

4.6.6 The vibration velocities of typical construction equipments and the TBM have been referenced to the approved Kowloon Southern Link EIA (Register No.: AEIAR-083/2005), which were determined by measurements and some of these in Peak Particle Velocity (PPV). In such cases, a crest factor of 4 has been applied to establish the root mean square ("rms") level in accordance with the FTA Guidance Manual. The vibration velocities measured are shown in the following table.

Table 4-5 Reference Vibration Level based on Measurements

Construction Equipments	Construction Site	Vibration (RMS) at Reference Distance of 5.5m from source
Drilling Rig	Salisbury Road Overrun Tunnel	0.536 mm/s
Hydraulic Breaker	TST site	0.298 mm/s

Source: Appendix 7-1 of KSL EIA

4.6.7 The vibration measurements for the TBM were extracted from the in-situ measurements during the bored tunnelling of Kwai Tsing Tunnel of the West Rail project. The geology consists of mainly granite, which is similar to the geology along the tunnel alignment (*Ref: Section 3.2, Working Paper No. 3 – Evaluation of Construction Methods for the Water Transfer Tunnel*). The measurements records above are considered the most appropriate available information for the purpose of assessing TBM ground-borne noise.

Soil Damping Loss

4.6.8 The geological profiles along the tunnel alignment are mainly hard rock. No soil damping loss has been assumed.

Coupling Loss into Building Structures

4.6.9 This represents the change in the incident ground-surface vibration due to the presence of the piled building foundation. The empirical values based on the guidance set out in the Transportation Noise Reference Book are given in following table.

Table 4-6 Loss Factor for Coupling into Building Foundation

Loss factor for coupling into building foundation, dB	Octave Band Frequencies, Hz					
	16	31.5	63	125	250	500
Large building on Piles	-6	-7	-11	-13	-14	-12
Single residences	-6	-8	-8	-7	-5	-4

Coupling Loss per Floor

4.6.10 This represents the floor-to-floor vibration transmission attenuation. In multi-storey buildings, a common value for the attenuation of vibration from floor-to-floor is approximately 1dB attenuation in the upper floor regions at low frequencies and greater than 3dB attenuation at lower floors at high frequencies. Coupling loss of –1 dB reduction per floor has been assumed for a conservative assessment.

Conversion from Floor Vibration to Noise Levels

4.6.11 Conversion from floor vibration levels to indoor reverberant noise levels has been based on standard acoustic principles. The conversion factor is dependent on the surface area S of the room in m^2, the radiation efficiency, σ, the volume of the room V in m^3 and the room reverberation time RT in seconds. Analyses were carried out for residential units and school in Appendix E with results summarised in the following table.

Table 4-7 Conversion Factors from Floor Vibration Levels to Indoor Reverberant Noise Levels

NSR type	Conversion C_{noise} (dB re $1x10^{-6}$ mm/s)
Residential Unit	–27
School	–24

4.7 Unmitigated Construction Noise Impacts (Airborne)

4.7.1 Based on the construction schedule in Table 4-4 and the assumed equipment inventory in Appendix B, the predicted highest construction noise impact for the unmitigated scenario amongst each construction stage has been summarised in Table 4-8 below with detailed calculations given in Appendix C.

Table 4-8 Unmitigated Construction Noise Impact

NSR ID.	Nature of Use	Unmitigated Noise Impact, dB(A)	Noise Criteria, dB(A)	Compliance of Noise Criteria?
Outfall (Portal D)				
LG	Residential	71	75	Y
AV	Residential	67	75	Y
GTV	Residential	67	75	Y
Intake (Portal A)				
VH	Residential	75	75	Y

4.7.2 The predicted unmitigated construction noise impacts at NSRs near both the intake and outfall end comply with the noise criteria, no specific mitigation measures at the intake and outfall end is required.

4.8 Noise Mitigation Measures

4.8.1 The results show that compliance of noise criteria was predicted no specific mitigation measure was recommended. Hence, no residual impact is predicted.

4.8.2 However, it is recommended that the Contractor should also adopt good working practices in order to minimise construction noise as far as possible, e.g.:

1. The Contractor shall adopt the Code of Practice on Good Management Practice to Prevent Violation of the Noise Control Ordinance (Chapter 400) (for Construction Industry) published by EPD;
2. The Contractor shall observe and comply with the statutory and non-statutory requirements and guidelines;
3. Before commencing any work, the Contractor shall submit to the Engineer Representative for approval the method of working, equipment and noise mitigation measures intended to be used at the site;
4. The Contractor shall devise and execute working methods to minimise the noise impact on the surrounding sensitive uses, and provide experienced personnel with suitable training to ensure that those methods are implemented;
5. Noisy equipment and noisy activities should be located as far away from the NSRs as is practical;
6. Unused equipment should be turned off. PME should be kept to a minimum and the parallel use of noisy equipment / machinery should be avoided;
7. Regular maintenance of all plant and equipment; and
8. Material stockpiles and other structures should be effectively utilised as noise barriers, where practicable.

4.8.3 By combining with properly designed EM&A requirements, construction noise impact could be controlled to within acceptable levels.

4.9 Potential Cumulative Impacts due to Concurrent Works

4.9.1 The sections that could lead to potential cumulative construction noise impact include: -

- PWP Item No. 155CD - West Kowloon drainage improvement - Lai Chi Kok drainage tunnel scheduled from November 2008 for completion in September 2012;
- Agreement No. CE 77/2001 (GE) and 2/2006 (GE) – Slope Upgrading Works with no definite program; and
- The Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) – Hong Kong Section likely to commence in 2009.

4.9.2 However, as mentioned in Section 2.7, It is envisaged that given the physical distance separation, the LCK drainage tunnel will unlikely to affect common sensitive receivers of the IRTS. The XRL is all underground with substantial vertical separation with the proposed IRTS tunnel and the slope upgrading works would be relatively minor in nature, hence, the potential cumulative projects would unlikely to contribute significant impact to NSRs.

4.10 Ground-borne Noise Impact

4.10.1 Both TBM and a combination of mechanical, pneumatic or hydraulic splitting or expanding grout techniques will be used to excavate rock along the tunnel alignment. Rock excavation would take place at both portals during non-restricted hours, while the TBM would be 24-hour working for excavation of the underground tunnel. Different noise criteria for the activities have been selected as shown in Table 4-2 for comparison and check for compliance.

4.10.2 Detailed assessments have been conducted for both construction equipments (hydraulic breaker and rock driller) and TBM, the results are summarised in Table 4-9 to Table 4-11 below. Potential cumulative ground-borne noise impacts due to the overlapping of construction activities have also been assessed, the results are summarised in Table 4-10 below. The detailed assessment results were shown in Appendix E.

Table 4-9 Highest Ground-borne Noise Impact by Various Construction Equipments (Daytime except Sundays and General holidays)

NSR ID.	Nature of Use	Ground-borne Noise Impact, dB(A)			Noise Criteria during non-restricted hours, dB(A)	Compliant with Noise Criteria?
		Hydraulic Breaker	Rock Driller	TBM		
Outfall (Portal D)						
LG	Residential	24	29	23	65	Y
AV	Residential	22	27	21	65	Y
GTV	Residential	22	27	21	65	Y
Intake (Portal A)						
VH	Residential	36	41	28	65	Y

Table 4-10 Cumulative Ground-borne Noise Impact (Daytime except Sundays and General holidays)

NSR ID.	Nature of Use	Ground-borne Noise Impact, dB(A)	Noise Criteria during non-restricted hours, dB(A)	Compliant with Noise Criteria?
Outfall (Portal D)				
LG	Residential	32	65	Y
AV	Residential	30	65	Y
GTV	Residential	30	65	Y

Note: Possible cumulative ground-borne noise impact is due to concurrent activities T2 (Rock Drill) and D2 (Rock Drill) which is in Outfall Portal only (Appendix B refers)

Table 4-11 Ground-borne Noise Impact by TBM (Nighttime 2300 – 0700 the next day)

NSR ID.	Nature of Use	Ground-borne Noise Impact, dB(A)	Noise Criteria during nighttime, dB(A)	Compliant with Noise Criteria?
Outfall (Portal D)				
LG	Residential	23	35	Y
AV	Residential	21	35	Y
GTV	Residential	21	35	Y
Intake (Portal A)				
VH	Residential	28	35	Y

4.10.3 The assessment results shown in the above tables have demonstrated full compliance with the ground-borne noise criteria. Rock excavation activities at the two portals combined with tunnelling by TBM can comply with the noise criterion during the daytime period (0700 – 1900) except general holiday and Sundays. The ground-borne noise impact due to the use of TBM can also meet the most stringent criterion during the nighttime period (2300-0700) hours.

4.11 Environmental Monitoring and Audit (EM&A) Requirements

4.11.1 In order to ensure that the nearby NSRs will not be subjected to unacceptable construction noise impact, an Environmental Monitoring and Audit (EM&A) programme is recommended. Details on the noise monitoring requirements, methodology and action plans have been described in the accompanying EM&A Manual.

4.12 Evaluation of Constraints on Planned Noise Sensitive Development/ Land Uses

4.12.1 There are no planned noise sensitive developments or land uses found within the assessment area at the time of study, and hence no specific constraints have been established.

4.13 Conclusion

4.13.1 This construction noise impact assessment has been based on the best estimate of the construction sequence and machines inventory. The TBM is expected to operate 24 hours a day to maximise the resources and to complete the works under a tight time schedule. Other construction activities will cease during the restricted hours.

4.13.2 The potential noise impact that could arise from daytime construction activities of the Project has been evaluated. The assessment results show no exceedances of construction noise criteria at both the intake and outfall end were predicted in the unmitigated scenario. Hence, no residual noise impact has been predicted.

4.13.3 Potential ground-borne noise impacts during the construction phase have also been assessed. Results indicated that the noise levels predicted can satisfactorily meet the derived noise criteria for the daytime period and the statutory noise criteria during the nighttime period. No mitigation measures are considered necessary.

4.13.4 The Contractor shall, from time to time, be aware of the noise impacts on the surrounding NSRs through adequate noise monitoring during the works so that adjustments could be made to control the construction noise levels. These requirements should be triggered by an Event and Action Plan as part of the EM&A which should be incorporated into the works contract in order to make it enforceable.

5. WATER QUALITY IMPACT

5.1 Introduction

5.1.1 This section presents an assessment of the potential water quality impacts associated with the construction of the proposed Inter-Reservoir Transfer Scheme (IRTS).

5.1.2 The assessment has been based on the criteria and guidelines for evaluation and assessment of water quality impact stated in Annexes 6 and 14 of the EIAO-TM and covered the scope outlined in Para. 3.4.3 of the EIA Study Brief.

5.1.3 This Project involves the construction of a water tunnel linking the Kowloon Byewash Reservoir with the Lower Shing Mun Reservoir. Although the tunnel will be entirely underground, the portals construction on either ends will fall within the water gathering grounds of both reservoirs and hence water quality impact is a key issue.

5.1.4 The following sections will analyse the baseline situation, assess the potential impacts as well as recommend ways to avoid and control water pollution in the project areas.

5.2 Relevant Legislations, Standards & Guidelines

5.2.1 In carrying out the assessment, references have been made to the following relevant Hong Kong legislations/ guidelines governing water pollution control. Relevant ones include:

- Water Pollution Control Ordinance ("WPCO") Chapter 358 (as amended by the Water Pollution Control (Amendment) Ordinance 1990 and 1993);
- Water Pollution Control (General) Regulations (as amended by the Water Pollution Control (General) (Amendment) Regulations 1990 and 1994);
- Water Pollution Control (Sewerage) Regulation;
- Water Quality Objectives ("WQOs") for relevant Water Control Zones ("WCZs");
- EIA Ordinance and EIAO-TM (Annexes 6 and 14);
- Waterworks Ordinance;
- WSD Conditions for Working within Water Gathering Grounds;
- Practice Note for Professional Persons ProPECC PN1/94, Construction Site Drainage

5.2.2 The *Water Pollution Control Ordinance (WPCO) (Cap. 358)* enacted in 1980 is the principal legislation for protection and control of water quality in Hong Kong. Under the WPCO, Hong Kong waters are divided into 10 Water Control Zones (WCZs) and statutory Water Quality Objectives (WQOs) are specified for each WCZ. The Project belongs to the catchment of the Tolo Harbour Supplementary WCZ. As both reservoirs will virtually act as buffers for all construction runoff, direct discharge to the WCZ is not envisaged. The corresponding WQOs of the Tolo Harbour Supplementary WCZ are listed in Table 5-1.

Table 5-1 Water Quality Objectives for Tolo Harbour Supplementary WCZ

Parameters	Objectives	Sub-Zone
Aesthetic Appearance	Objectionable odours or discolouration of the water not to be present.	Whole zone
	Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances not to be present.	Whole zone
	Mineral oil or surfactants giving rise to a lasting foam not to be present.	Whole zone
	Recognisable sewage-derived debris not to be present.	Whole zone
	Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels not to be present.	Whole zone
	Substances which settle to form objectionable deposits not to be present.	Whole zone
Bacteria	The level of E.coli not to exceed 1 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Whole zone
Colour	Not to cause the colour of water to exceed 30 Hazen units.	Whole zone
Dissolved Oxygen (DO)	Not less than 4 mg/L.	Whole zone
pH	Not to cause the pH of the water to exceed the range of 6.5-8.5.	Whole zone
Temperature	Not to cause the natural daily temperature range to change by more than 2 ^{o}C.	Whole zone
Salinity	Not to cause the natural ambient salinity level to change by more than 10%.	Whole zone
Suspended Solids	Not to cause the annual median of suspended solids to exceed 20 mg/L.	Whole zone
Ammonia	Un-ionized ammoniacal nitrogen level not to exceed 0.021 mg/L, calculated as the annual average (arithmetic mean).	Whole zone
5-day Biochemical Oxygen Demand	Not to exceed 3 mg/L.	Whole zone
Chemical Oxygen Demand	Not to exceed 15 mg/L.	Whole zone
Toxic substances	Should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other.	Whole zone
	Should not cause a risk to any beneficial use of the aquatic environment.	

Source: Cap. 358AJ, Statement of Water Quality Objectives (Tolo Harbour Supplementary Water Control Zone).

5.2.3 The *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS)* issued under the WPCO defines the acceptable discharge limits to the different types of receiving waters (foul sewers, storm water

drains, inland and coastal waters) in Hong Kong.

5.2.4 The Technical Memorandum on Effluent Standards is a guide to the Authority under the Ordinance. It sets the limits that make effluents acceptable into foul sewers, storm water drains, inland and coastal waters. The limits control the physical, chemical and microbial quality of effluents. The standards apply to effluents through licences, which the Authority issues under sections 15, 16 and 20 of the Ordinance. The Authority is the Director of Environmental Protection.

5.2.5 Chapter 358AK, Part II – Section 8.2 of the WPCO specifies that Group A inland waters include all waters in water gathering grounds and within the boundaries of country parks. As the majority of the inland water bodies within the Study Area are waters in water gathering grounds and within the boundaries of Kam Shan Country Park, and are therefore classified as Group A inland waters. Effluent discharge during the construction phase shall comply with the terms and conditions of a discharge license issued by EPD under the WPCO.

5.2.6 The *Waterworks Ordinance (WWO)* is the principal legislation for protection and control of waterworks in Hong Kong. Under the WWO, the Water Authority is empowered to custody and control the waterworks and of all water therein. The Water Authority may construct, install, inspect, test, regulate, alter, repair or remove any part of the waterworks in, under or over any street or land held by the Government. The Water Authority may also restrict or suspend a supply if it is necessary or expedient to avoid damage to, or a breakdown in, the waterworks from pollution or waste or otherwise.

5.2.7 Under Chapter 102, section 30 - (1) Any person who deposits, or causes or permits to be deposited, any solid or liquid matter in such a manner or place that it may fall or be washed or carried into water forming part of the waterworks shall be guilty of an offence. (3) No act shall be an offence under this section if it is done with the permission in writing of the Water Authority.

5.3 Assessment Area

5.3.1 Paragraph 3.4.3.2 of the Study Brief specifies an assessment area for water quality impact to include all areas shown in “Appendix A” of the Study Brief.

5.3.2 As this EIA concerns the chosen tunnel alignment, the immediate affected areas within 500m of the Project are shown in Figure 5-1 and Figure 5-2 together with water sensitive receivers highlighted in blue. The assessment area has included other areas/ features such as stream courses and the associated water systems in the vicinity that could be impacted by the project.

5.4 Water Systems, Catchments and Water Sensitive Receivers

5.4.1 The Project works area comprises two sites, viz. the intake and the outfall. The intake will be located near the dam at the south western part of the Kowloon Byewash Reservoir while the outfall will be located along the Lower Shing Mun Reservoir Road at the south-eastern part of the Lower Shing Mun Reservoir. Both works areas are within the catchment and water gathering grounds of the reservoirs.

5.4.2 Downstream of the intake end worksite drains into the Kowloon Byewash Reservoir, the lowest amongst all other members of the Kowloon Group of Reservoirs. When it is full, the Kowloon Byewash Reservoir will overflow to Tsuen Wan East and Kwai Chung, which falls

within the catchment of Victoria Harbour Phase 1 Water Control Zone ("WCZ")

5.4.3 For the outfall, overflow from the Lower Shing Mun Reservoir will go into the catchments of the Tolo Harbour Supplementary Water Control Zone.

5.4.4 Although the tunnel will be entirely underground, the portals and construction sites on either end will fall within the water gathering grounds of both reservoirs. During the construction phase, surface runoff and groundwater draining from the tunnel at the intake at the Kowloon Byewash Reservoir and the outfall at the Lower Shing Mun Reservoir will be diverted towards discharge points downstream of the Kowloon Byewash Reservoir Dam and Lower Shing Mun Reservoir Dam respectively. The runoff will be desilted before discharge.

5.4.5 The location of the water table within the project boundary and its distance to the proposed tunnel alignment are shown in Figures 5-3a-e.

5.4.6 The main water sensitive receivers ("WSRs") in the vicinity of the work sites and those downstream are shown in Figure 5-1 and Figure 5-2 and listed below: -

Intake End - Kowloon Byewash Reservoir and streams

Outfall End - Lower Shing Mun Reservoir and streams

5.5 Baseline Water Quality and Water Quality Standards

5.5.1 The year-round raw water quality recorded regularly through routine water quality surveys at the Kowloon Byewash and Lower Shing Mun Reservoirs was obtained from WSD. The raw water quality of the Kowloon Byewash and Lower Shing Mun Reservoirs recorded in 2005 and 2006 are presented in Appendix F. The results indicated that the reservoir water quality was generally satisfactory.

5.5.2 As the project will not involve dredging of the reservoir and/ or disruption to the river/ stream bed, sediment quality is not of a concern in connection with construction of the Project.

5.5.3 The majority of the inland water bodies within the Study Area are waters in water gathering grounds and within the boundaries of Kam Shan Country Park, which are classified as Group A inland waters. The Standards for effluents discharged into Group A inland waters are detailed inTable 5-2.

Table 5-2 Standards for Effluents Discharged into Group A Inland Waters

Flow rate (m3/day) / Determinand	≦10	>10 and ≦100	>100 and ≦500	>500 and ≦1000	>1000 and ≦2000
pH (pH units)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Temperature (℃)	35	35	30	30	30
Colour (lovibond units) (25mm cell length)	1	1	1	1	1
Conductivity (μs/cm at 20°C)	1000	1000	1000	1000	1000
Suspended solids	10	10	5	5	5
Dissolved oxygen	≧4	≧4	≧4	≧4	≧4
BOD	10	10	5	5	5
COD	50	50	20	20	10

Oil & Grease	1	1	1	1	1
Boron	2	2	1	0.5	0.5
Barium	2	2	1	0.5	0.5
Iron	2	2	1	0.5	0.5
Arsenic	0.05	0.05	0.05	0.05	0.05
Total chromium	0.05	0.05	0.05	0.05	0.05
Mercury	0.001	0.001	0.001	0.001	0.001
Cadmium	0.001	0.001	0.001	0.001	0.001
Selenium	0.01	0.01	0.01	0.01	0.01
Copper	0.2	0.2	0.2	0.2	0.1
Lead	0.1	0.1	0.1	0.1	0.1
Manganese	0.5	0.5	0.5	0.5	0.5
Zinc	1	1	1	1	1
Other toxic metals individually	0.1	0.1	0.1	0.1	0.1
Total toxic metals	0.3	0.3	0.2	0.2	0.15
Cyanide	0.05	0.05	0.05	0.05	0.02
Phenols	0.1	0.1	0.1	0.1	0.1
Hydrogen sulphide	0.05	0.05	0.05	0.05	0.05
Sulphide	0.2	0.2	0.1	0.1	0.1
Fluoride	1	1	1	1	0.5
Sulphate	800	600	500	400	200
Chloride	800	500	500	200	200
Total reactive phosphorus	1	0.7	0.7	0.5	0.5
Ammonia nitrogen	1	1	1	1	0.5
Nitrate + nitrite nitrogen	15	15	15	10	10
E. coli (count/100 ml)	＜1	＜1	＜1	＜1	＜1

Note: (All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)

5.6 Water Quality Assessment Methodology

5.6.1 To assess the potential impacts on water quality, a comprehensive desktop study covering the following aspects was carried out to:

- Identify WSRs which may be impacted by the proposed works and the assessment criteria to be complied with;
- Identify potential sources of water quality impacts that may be generated during the construction phase;
- Assess potential impacts upon the identified WSRs during the construction phase;
- Provide actions/remedial measures that need to be implemented to reduce impacts to acceptable levels and best site management practices; and
- Evaluate residual impacts and identify the requirements for preparation of an Environmental Monitoring and Audit Manual.

5.7 Identification and Evaluation of Water Quality Impact during the Construction Phase

Construction Activities and Sequences

5.7.1 The construction will begin with site clearance/ formation works at both portals. Following the site clearance/ formation works, a combination of mechanical, pneumatic or hydraulic

splitting or expanding grout techniques would be employed for the creation of both portals, while the tunnelling works will employ the use of TBM starting from the outfall portal. Finally, the intake and outfall structures would be constructed.

Construction Site Runoff and Drainage

5.7.2 Siltation generated by different construction works can have a major impact on water quality. Runoff from the construction work areas may contain increased loads of sediments, suspended solids and contaminants. Potential sources of pollution from site drainage include:

- Runoff and erosion of exposed surfaces, accidental spillage from plant maintenance and material handling;
- Release of grouting and cement with rain wash;
- Wash water from dust suppression sprays; and
- Fuel and lubricants from maintenance of construction vehicles and mechanical equipment.

5.7.3 Non-point sediment laden runoff during the construction works for the IRTS, if uncontrolled, may carry pollutants (adsorbed onto the particle surfaces) into the Kowloon Byewash and Lower Shing Mun reservoirs. Associated effects which may arise include increased suspended solids concentrations in the receiving water bodies. Mitigation measures should be implemented to control construction site runoff and drainage from the works areas, and prevent runoff and drainage water with high levels of suspended solids from entering the Kowloon Byewash and Lower Shing Mun reservoirs.

5.7.4 With the implementation of adequate construction site drainage and provision of silt removal facilities as described in Section 5.10, adverse water quality impacts to the receiving water bodies is not anticipated.

General Construction Activities

5.7.5 On-site construction activities may cause water pollution from the following:

- Uncontrolled discharge of debris and rubbish such as packaging, construction materials and refuse; and
- Accidental spillage of liquids stored on site, such as oil, diesel and solvents etc. are likely to result in water quality impacts if they enter the adjacent watercourses or stormwater drains.

5.7.6 Good construction and site management practices should be observed, as detailed in Section 5.10, to ensure that litter, fuels and solvents doe not enter the Kowloon Byewash and Lower Shing Mun reservoirs and the local storm water drainage system.

Construction Workforce Sewage

5.7.7 Domestic sewage would be generated from the workforce during the construction phase. However, this temporary sewage can be adequately treated by interim sewage treatment facilities, such as portable chemical toilets, which could be installed within the construction site. It is unlikely that sewage generated from the site would have a significant water quality impact, provided that sewage is not discharged directly to the Kowloon Byewash and Lower Shing Mun reservoirs, local stream courses nor local storm water drainage system and chemical toilets are properly used and maintained.

Construction of Tunnel, Intake and Outfall

5.7.8 The main construction activities which have the potential to impact the water bodies at the intake and outfall of the IRTS tunnel are those which may result in the generation of silt. This is likely at the intake and outfall owing to the construction of the intake and outfall within rock.

5.7.9 Excavated spoil would be disposed of at the outfall portal. It will then be removed through road access at the outfall portal. Excavated spoil would be disposed of as construction and demolition (C&D) material to public fill reception facilities as discussed in Section 6.5. Excavated spoil would be transported within the tunnel by using a conveyor belt system that terminates at the outfall portal where the spoil would be immediately transported away by trucks or unloaded to a temporary stockpile area during the nighttime period. The conveyor belt system should be properly enclosed to prevent dispersion and dropping of material during the transportation process.

5.7.10 If not controlled properly, suspended solid run-offs and nutrient loadings may increase and enter the reservoirs due to the increase of site exposure, reducing light penetration and adversely affecting water quality in the reservoirs. However, with proper handling and disposal procedures, negative impacts from this source will be minimized.

5.7.11 For the major construction works to be carried out at the intake and outfall portals, their potential impacts on the water quality would depend on the nature of the materials excavated and the runoff that can enter the receiving water bodies. Surface run-off and effluent from the construction sites at the intake at Kowloon Byewash Reservoir and outfall at the Lower Shing Mun Reservoir would be directed towards adequately designed sand/silt removal facilities such as sand/silt traps and sediment basins to remove sand/silt particles from runoff to meet the requirements of the TM standards under the WPCO before discharging to discharge points downstream of the Kowloon Byewash Reservoir Dam and Lower Shing Mun Reservoir Dam respectively as shown in Figure 5-4 and Figure 5-5. Other pollutants, such as oil and grease, may also be present in the runoff where they may flow over the storage or maintenance areas. With the proper implementation of mitigation measures and good site practices, no significant impact to the water quality would be expected.

5.7.12 Rock will be encountered in most sections of the proposed tunnel which might require more frequent maintenance of the TBM cutter head. Recycle water will also be required for the cooling of the cutter head during boring. All discharge will be conveyed to desilting facilities for treatment prior to proper discharge.

5.7.13 Based on the available geological information, the proposed raw water tunnel will be mainly bored through hard rock (Grade II/III). With such geological conditions, a hard rock TBM will most likely be adopted for the tunnelling works. Such a TBM will have minimal water quality impacts as no chemicals or other agents will be used for cooling or lubricating the cutter head of the TBM.

5.7.14 Ground water ingress into the tunnel may be encountered during the construction which is undesirable and may cause downtimes to the project. During the progress of tunnel boring, the groundwater inflows will be carefully controlled by pre-injection grouting where necessary. The pre-injection grouting involves the grout injection works in front of the tunnel face during boring of the tunnel, for sealing a limited area around the tunnel with a grout of a suitable strength for controlling the potential groundwater inflows. The pre-injection grouting

method will be supplemented by post-injection grouting where necessary to further enhance the groundwater inflow control. With the use of pre-injection with post-injection grouting, the groundwater inflows will be limited and under control. Any intrusion of groundwater during and after execution of advance probing of the TBM is therefore insignificant to affect the water table and the effect of the tunnel project on the ground water system will therefore be minimal.

5.7.15 During tunnelling works, ground water ingress pumped out from the tunnel would have a high content of SS. The water pumped out from the tunnel may be contaminated by grouting materials that would be required for the construction of the bored tunnel (for tunnel boring and groundwater treatment). On-site treatment would be required prior to off-site discharge.

5.7.16 With implementation of mitigation measures, no significant impact to nearby WSRs is expected. Sections of tunnel alignment would be underneath Kam Shan Country Park. As volcanic rock (granite) will be encountered at the intake and outfall sites, it generally means that the presence of groundwater is minimal. Therefore adverse impacts on groundwater are not expected during the construction phase.

5.8 Project-Related Pollution Sources and Cumulative Impact Implications

5.8.1 Planned projects that could lead to potential cumulative construction water quality impact include: -

- PWP Item No. 155CD - West Kowloon drainage improvement - Lai Chi Kok drainage tunnel scheduled from November 2008 for completion in September 2012;
- Agreement No. CE 77/2001 (GE) and 2/2006 (GE) – Slope Upgrading Works with no definite program; and
- The Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) – Hong Kong Section likely to commence in 2009.

5.8.2 Given that the LCK drainage tunnel is on the downstream side of the Project, it should unlikely affect the WSRs of the IRTS. The XRL is all underground with substantial vertical separation with the proposed IRTS tunnel and the scale of the slope upgrading works would be relatively minor in nature, hence, cumulative water quality impact is not anticipated.

5.9 Water Quality Impact during the Operational Phase

5.9.1 No water quality impact is envisaged for transfer of raw water between reservoirs in the operational phase.

5.10 Water Pollution Mitigation and Management

Construction of Desilting Facilities

5.10.1 Construction for the desilting facilities at intake and outfall portals should be carried out behind a temporary cofferdam which is watertight enclosure built in the reservoirs and pumped dry to expose the bottom so that construction of intake and outfall portals could be undertaken.

5.10.2 The cofferdam is composed of steel pilings driven into the slope surface of the reservoir to form a watertight structure around the intake and outfall work sites to prevent excavated

materials from getting into the reservoirs. The cofferdams should remain on site until completion of intake and outfall portals and tunnel construction.

5.10.3 The cofferdams should be regularly inspected and maintained to ensure no spillage of waste or wastewater into the reservoirs. Indicative locations of the cofferdams are shown in Figure 2-6 and Figure 2-7 respectively.

5.10.4 During the dewatering process, appropriate desilting devices should be provided for treatment before discharge. The Contractor should ensure that the discharge water from the desilting facilities complies with the WPCO/TM-DSS requirements before discharge.

Stormwater Point and Non-point Source Pollution

5.10.5 Construction runoff will be managed as per the Practice Note for Professional Persons ProPECC PN1/94 - Construction Site Drainage and the conditions of working within Water Gathering Grounds stipulated by WSD.

5.10.6 A Drainage Management Plan should be prepared by the Contractor for approval by the Engineer for each of the works areas, detailing the facilities and measures to manage pollution arising from surface runoff from those works areas.

5.10.7 An Emergency Contingency Plan should also be prepared by the Contractor, detailing the response and procedures to contain and remove any accidental spillage along the temporary and permanent roads and at the site at short notice to prevent or minimize the quantities of contaminants from reaching the reservoirs and local streams leading to the reservoirs. The Emergency Contingency Plan should be submitted to the Engineer for approval.

5.10.8 It is envisaged that the following measures will effectively control runoff from work sites and avoid water pollution downstream as well as the water gathering grounds: -

Construction Site Runoff and Discharge

1. Surface run-off and effluent from the construction sites at the intake at Kowloon Byewash Reservoir and outfall at the Lower Shing Mun Reservoir will be directed towards adequately designed sand/silt removal facilities such as sand/silt traps and sediment basins to remove sand/silt particles from runoff to meet the requirements of the TM standards under the WPCO before discharging to discharge points downstream of the Kowloon Byewash Reservoir Dam and Lower Shing Mun Reservoir Dam respectively as shown in Figure 5-4 and Figure 5-5. The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94, which states that the retention time for silt/sand traps should be 5 minutes under maximum flow conditions. Sizes may vary depending upon the flow rate, but for a flow rate of $0.1m^3/s$ a sedimentation basin of $30m^3$ would be required and for a flow rate of $0.5m^3/s$ the basin would be $150m^3$. The detailed design of the sand/silt traps should be undertaken by the contractor prior to the commencement of construction;
2. Channels, earth bunds or sand bag barriers will be provided on-site to properly direct stormwater to the above-mentioned facilities;
3. Existing on-site silt removal facilities, channels and manholes, if any, would be maintained such that the deposited silt and grit will be removed regularly, at the onset of and after each rainstorm to ensure that these facilities are functioning properly at all

times;

4. Other manholes, if any, including any newly constructed ones will be properly covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system;

5. Open stockpiles of materials on site will be avoided within water gathering grounds as far as practicable. All surplus spoil will be removed from water gathering grounds as soon as possible Measures will be taken to prevent the washing away of construction materials, soil, silt or debris;

6. Where possible, works entailing soil excavation will be minimized during the rainy season (i.e. April to September). If excavation in soil could not be avoided in these months or at any time of year when rainstorms are likely, for the purpose of preventing soil erosion, temporary exposed slope surfaces should be covered e.g. by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Intercepting channels should be provided (e.g. along the crest/edge of excavation) to prevent storm runoff from washing across exposed soil surfaces. Arrangements should always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm;

7. Where applicable, final earthworks surfaces/ slopes will be well compacted and hydro-seeded following completion to prevent erosion;

8. Where surface runoff or construction effluent is likely to be contaminated with oil, properly designed and maintained petrol interceptor will be provided to meet the WPCO/TM-DSS requirements. Oil leakage or spillage shall be contained and cleaned up immediately. Detailed design of the petrol interceptor shall be provided by the Contractor before commencement of construction;

9. Sewage arising from the construction workers on site should be collected by temporary sanitary facilities e.g. portable chemical toilets. Portable toilets should be used coupled with tankering away services provided by a licensed collector;

10. All site discharges within Inland Waters Group A must comply with the terms and conditions of a valid discharge licence issued by EPD;

11. Vehicle wheel washing facilities should be provided, where applicable, at the site exit such that mud, debris, etc. deposited onto the vehicle wheels or body can be washed off before the vehicles are leaving the site area;

12. Section of the road between the wheel washing bay and the public road should be paved with backfill to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains;

13. Vehicle washing facilities should be drained into desilting facilities before discharge. The water should be recycled on site wherever possible. It is suggested that the wash water from the wheel wash basin is either reused for site watering or pumped to the on-site desilting facilities for treatment;

14. Desilting facilities should be checked and the deposited silt and grit should be removed regularly to ensure they are working properly at all times;

Construction of Tunnel, Intake and Outfall

15. To minimize water quality impact, recycled water should be used at the cutter face for cooling purposes. Used water should be collected and discharged to settling tank for

settlement;

16. Excess water from the settling tank would be transferred to the desilting facilities for treatment before discharge. The Contractor should ensure that the discharge water from the desilting facilities and treated spent effluent arising from tunnel boring from the desilting facilities comply with the WPCO/TM-DSS requirements before discharge;

Maintenance of Tunnel and Oufall

17. Existing on-site silt removal facilities, channels and manholes, if any, would be maintained such that the deposited silt and grit will be removed regularly, at the onset of and after each rainstorm to ensure that these facilities are functioning properly at all times;

18. Desilting facilities should be checked and the deposited silt and grit should be removed regularly to ensure they are working properly at all times;

Protection against Accidental Spillage

19. The project may occasionally involve the handling of fuel and generates chemical wastes. It must be ensured that all fuel tanks and chemical storage are sited on sealed and bunded areas, provided with locks and located outside water gathering grounds as far as practicable;

20. The storage areas will be surrounded by bunds with a capacity equal to 110% of the storage capacity of the largest tank to prevent accidentally spilled oil, fuel or chemicals from reaching the receiving waters;

21. Oil and grease removal facilities will be provided where appropriate, for example, in area near plant workshop/ maintenance areas, if any;

22. Chemical waste arising from the site should be properly stored, handled, treated and disposed of in compliance with the requirements stipulated under the Waste Disposal (Chemical Waste) (General) Regulation.

5.11 Evaluation and Quantification of Residual Impacts

5.11.1 With the implementation of recommended mitigation measures for the construction phase of the proposed Project, no unacceptable water quality impacts are anticipated.

5.11.2 The water discharge from the site is subject to control by the WPCO. The Contractor should obtain a water discharge license before commencement of construction who is obliged to comply with the standards set out in the license which specifies the maximum allowable limits for the parameters of concern in the discharge. The Contractor is also responsible to design, operate and monitor the performance of any on-site treatment system.

5.12 Environmental Monitoring and Audit Requirements

5.12.1 Monitoring of water quality should be carried out during the construction phase at the intake and outfall portals at the discharge points after the desilting facilities. It is also recommended that regular site audits be undertaken to inspect the construction activities at all works areas to ensure the recommended mitigation measures are properly implemented.

5.13 Conclusion and Recommendations

5.13.1 This assessment has identified how tunnel excavations and the construction of the intake and outfall structures may affect the water quality. While minor and short term impacts to water quality could arise directly from these construction activities and from the surface runoff, these impacts could be adequately controlled by complying with the WPCO standards through implementation of recommended mitigation measures, in particular, desilting facilities and good site management practices.

5.13.2 With the implementation of the recommended mitigation measures and management practices, it is anticipated that the impacts upon the WSRs during the construction phase of the Project would be temporary and minimal. An environmental monitoring and audit programme in respect of water quality issues during the construction phase of the Project I is also recommended to monitor the compliance with acceptable levels of water quality indicators and to ensure the proposed mitigation measures are effectively implemented.

6. WASTE MANAGEMENT

6.1 Introduction

6.1.1 This assessment was based on the criteria and guidelines stated in Annexes 7 and 15 of the EIAO-TM for evaluating and assessing waste management implications and has covered the scope outlined in Para. 3.4.4 of the EIA Study Brief.

6.1.2 A review of the Project has suggested that the prime source of wastes generated will be largely connected with the construction phase. During the operational phase, no significant waste generation is expected.

6.2 Relevant Legislations, Standards & Guidelines

6.2.1 In carrying out the assessment, reference has been made to the following relevant Hong Kong legislations governing waste management and disposal. Directly relevant legislations include:

- The Waste Disposal Ordinance (Cap. 354) and subsidiary legislation such as the Waste Disposal (Chemical Waste) (General) Regulation that set out requirements for the storage, handling and transportation of all types of wastes.
- Dumping at Sea Ordinance (Cap. 466);
- Land (Miscellaneous Provisions) Ordinance (Cap 28).
- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499), Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM), Annexes 7 and 15;
- Public Health and Municipal Services Ordinance (Cap 132) – Public Cleansing and Prevention of Nuisance Regulation – control of disposal of general refuse.

6.2.2 Other relevant documents and guidelines that are also applicable to waste management and disposal in Hong Kong include:

- ETWB Technical Circular (Works) No. 19/2005, Environmental Management on Construction Sites;
- ETWB Technical Circular (Works) No. 31/2004 Trip-ticket System for Disposal of Construction and Demolition Materials;
- ETWB Technical Circular (Works) No. 22/2003A, Additional Measures to Improve Site Cleanliness and Control Mosquito Breeding on Construction Sites;
- ETWB Technical Circular (Works) No. 6/2002A, Enhanced Specification for Site Cleanliness and Tidiness;
- ETWB Technical Circular (Works) No. 33/2002, Management of Construction and Demolition Material Including Rock;
- Practice Note for Authorised Persons and Registered Structural Engineers 243: Construction and Demolition Waste

6.3 Analysis of Activities & Waste Generation

6.3.1 In order to assess the impacts associated with waste generation, it is necessary to determine the different categories of wastes that will be generated by the Project at various stages.

6.3.2 During the construction phase, the main types of wastes that will be generated include:

- Vegetation and C&D materials from clearance;
- C&D materials from levelling, excavation, slope works and retaining structure, portals creation;
- C&D materials from tunnelling;
- C&D materials, chemical wastes from machineries and general refuse from work force

6.4 Waste Management Hierarchy

6.4.1 The waste management strategy is based on the following key elements in descending order of priority in carrying out the assessment and in developing relevant mitigation measures: -

- Avoidance;
- Reduce;
- Reuse/ Recycle;
- Bulk Waste Reduction; and
- Disposal.

6.4.2 Opportunities for reducing waste generation have been evaluated in the course of the assessment to:

- Avoid or minimise the generation of waste where possible during the planning/ design stage;
- Adopt better site management practices in materials control and promote on-site sorting of Construction and Demolition ("C&D") materials, where practicable, during the construction stage, and;
- Explore the potential for reuse/ recycling of materials (e.g. "C&D" materials), e.g. consideration may be given to the possible use of excavated Grade II granite spoil for aggregate/ concrete production.

6.4.3 The types and quantities of residual wastes requiring disposal have been estimated together with the disposal options identified in this assessment inTable 6-1. The disposal options have considered the existing and future spare capacities of the waste disposal facilities and the environmental implications of handling, collection and disposal of waste materials.

6.5 Impact Assessment and Evaluation

Construction Wastes Types

Construction Wastes

6.5.1 Based on the design of the Project, the following types of construction wastes will be expected: -

- Site clearance waste (vegetation)
- Inert C&D wastes from tunnelling works
- Waste metal (off cuts) from in-situ concrete casting work
- Spent concrete
- Materials and equipment wrappings
- General refuse from site staff

6.5.2 It is envisaged that site clearance and tunnelling works will generate the greatest amount of wastes as presented in Table 6-1. All C&D materials generated on site will be sorted into inert (public fill) and non-inert (C&D wastes) wastes. Where possible, reuse of these materials on-site will be identified and implemented as far as practicable to minimise material volumes requiring disposal at landfill and public fill reception facilities.

6.5.3 It is envisaged that the creation of portals and re-profiling/ construction of the intake and outfall ends can absorb some inert C&D materials. However, tunnelling works will generate the largest amount of surplus materials requiring disposal at a rate of 7.5m^3 per hour based on an assumption of 0.6m per hour (100m/week) advancing rate and 12.57m^3 created per m of tunnel.

6.5.4 It is estimated that approximately 150m^3 C&D materials will be generated by TBM excavation during the hours of 19:00 to 07:00 the next day, when disposal by dump trucks is banned for noise considerations. This will happened during Month 9-17 and will last for about 9 months. Soil/rock spoil generated by TBM excavation should be removed out of water gathering grounds as soon as possible.

6.5.5 In any case, construction waste of these types should not cause any significant nuisances/ impact on the environment in their handling, storage and disposal provided that proper mitigation measures are implemented. Appropriate measures such as covering the truckload by tarpaulin sheet should be in place to minimise wind blown litter and dust during transportation.

6.5.6 The disposal trip rate is expected to be less than 2 trucks per hour on average. For disposal of inert C&D materials, the nearest outlet is at Tuen Mun Area 38. The trucks should follow local main roads to the Tai Po Road, Ching Cheung Road, Castle Peak Road, and then Tuen Mun Road towards their final destination

Chemical Waste

6.5.7 Plant and vehicle maintenance will generate a small amount of chemical wastes during the construction period. Typically they include: -

- Solid wastes (empty fuel/ lubricant drums, used oil/air filters, scrap batteries, brake clutch linings which may contain asbestos); and
- Liquid wastes (waste oils/ grease, spent solvents/ detergents, which may be halogenated, and possibly spent acid/ alkali from battery maintenance).

6.5.8 The volume of chemical waste will depend upon the total number of plant / vehicles and how much maintenance is actually required to be carried out on site.

6.5.9 However based on the proposed plant list given Appendix B, it is unlikely that the volume of chemical waste will exceed 100 litres/ month all chemical wastes are to be disposed of outside water gathering grounds as soon as possible. Given the small quantities anticipated, provided the waste is properly handled, stored and disposed of outside water gathering grounds as soon as possible, no unacceptable impact will be expected.

General Refuse

6.5.10 The construction workforce will generate a small amount of refuse such as waste papers, plastic packaging and possibly food wastes. Such refuse will generally be collected on-site and brought to the nearby refuse collection point (RCP).

6.5.11 Prior to disposal off-site, such wastes will have to be temporarily put in suitably covered storage area where it will have to be regularly cleaned and maintained to avoid attracting vermin and pests. Any refuse storage area in water gathering grounds should be located away from any watercourses as far as possible and be covered in such a way as to prevent litter from being blown out of it by wind. With proper on-site handling and storage as well as regular disposal of these wastes to the nearby refuse collection points, no adverse impacts will be envisaged.

Sewage

6.5.12 The construction work force will generate sewage on a daily basis and requires proper disposal. It is anticipated that chemical toilets shall be provided on-site for the workforce and should be located away from any watercourses as far as possible, in which case night soil will need to be collected by an approved contractor for disposal on a regular basis to avoid odour issues.

6.6 Summary of Estimated Quantities of Wastes that could be Generated

6.6.1 Based on the assessment above, the amount of wastes generated for each waste type has been estimated and presented in Table 6-1 below.

6.6.2 In general, the inert portion of C&D materials should be disposed of to public fill reception facilities while the non-inert portion should be sent to landfill for disposal. Any potential for reuse of materials on site should be explored prior to disposal. The estimated quantities of each type of inert C&D materials to be generated, reused and disposed off site are summarized in Table 6-2.

Table 6-1 Summary of Wastes Generation during the Construction Phase

Activity	Material Type	Likely time of arising	Estimated Total Amount	Disposal / Treatment Site
Site D – Portal/ Starter Tunnel Construction (Construction Period = 9 months)				
Site clearance & formation	Non-inert C&D materials	Month 1-7	100 ton	Nearest landfill, e.g. the NENT Landfill
	Inert C&D materials	Month 1-7	1,800 m^3	Nearest public fill reception facilities e.g. at Tuen Mun Area 38
Portal/ starter tunnel works	Soil/ rock and C&D materials	Month 8-9	1,900 m^3	Nearest public fill reception facilities e.g. at Tuen Mun Area 38
Site D – Outfall Structure Construction (Construction Period = 5 months)				
Scaffoldings & Superstructure works	Non-inert C&D materials	Month 19-23	50 ton	Nearest landfill, e.g. the NENT Landfill
	Inert C&D materials	Month 19-23	1,680 m^3	Nearest public fill reception facilities e.g. at Tuen Mun Area 38
Site A – Portal/ Intake Connection and Tunnel Construction (Construction Period = 5 months)				
Site clearance, access road & site formation	Non-inert C&D materials	Month 1-2, 8-10	100 ton	Nearest landfill, e.g. the NENT Landfill
	Inert C&D materials	Month 1-2, 8-10	200 m^3	Nearest public fill reception facilities e.g. at Tuen Mun Area 38
Mined Tunnel	Soil/ rock and C&D materials	Month 10-12	800 m^3	Nearest public fill reception facilities e.g. at Tuen Mun Area 38
Site A – Intake Structure Construction (Construction Period = 2 months)				
Scaffoldings & Superstructure works	Non-inert C&D materials	Month 17-18	50 ton	Nearest landfill, e.g. the NENT Landfill
	Inert C&D materials	Month 17-18	420 m^3	Nearest public fill reception facilities e.g. at Tuen Mun Area 38
Main Tunnel Excavation & Lining Construction (by TBM method) (a 3.0m ID tunnel) (Construction Period = 9 months)				
TBM Drive, Lining construction and Supporting Activities	Soil/ rock	Month 9-17	37,000m^3 or 12.57m^3 per m	Nearest public fill reception facilities e.g. at Tuen Mun Area 38
General Works				
General works	General refuse arising from works	Throughout construction	300 kg/week	Nearest RCP

Activity	Material Type	Likely time of arising	Estimated Total Amount	Disposal / Treatment Site
	Chemical waste arising from machineries	Throughout construction	100 litre/month	Chemical Waste Treatment Centre
	General refuse (generated by site staff)	Throughout construction	100 kg/week	Nearest RCP

Table 6-2 Estimated quantities of each type of inert C&D materials generated

Inert C&D material	Volume (m^3)		
	Generated	Reused on site	Disposed off site
Rock	38,400	0	38,400
Soil	5,380	150	5,230
Broken concrete	20	0	20
Total	43,800	150	43,650

6.7 Waste Management Practice during the Construction Phase

6.7.1 It is not envisaged that there will be significant impacts arising from waste generation on-site. However, given the potential for secondary environmental impacts (dust, noise, water quality and visual impacts), mitigation measures are required to ensure proper handling, storage, transportation and disposal of materials at the outset and throughout the construction phase of the project.

6.7.2 In line with Government's policy of waste minimisation, the practice of avoiding and minimising waste generation and waste recycling should be adopted as far as practicable. Recommended mitigation measures to be implemented throughout the course of the construction of the project include:

1. An on-site environmental co-ordinator employed by the Contractor should be identified at the outset of the works. The co-ordinator shall prepare a Waste Management Plan ("WMP") in accordance with the requirements set out in the ETWB TCW No. 19/2005, Waste Management on Construction Sites. The WMP shall include monthly and yearly Waste Flow Tables ("WFT") that indicate the amounts of waste generated, recycled and disposed of (including final disposal site), and which should be regularly updated;

2. The reuse/ recycling of all materials on site shall be investigated and exhausted prior to treatment/ disposal off-site;

3. Good site practices shall be adopted from the commencement of works to avoid the generation of waste, reduce cross contamination of waste and to promote waste minimisation;

4. All waste materials shall be sorted on-site into inert and non-inert C&D materials, and where the materials can be recycled or reused, they shall be further segregated. Inert material, or public fill will comprise stone, rock, concrete and soil which is suitable for land reclamation and site formation whilst non-inert materials include all other wastes generated from the construction process such as plastic packaging and vegetation

(from site clearance).

5. The Contractor shall be responsible for identifying what materials can be recycled/ reused, whether on-site or off-site. In the event of the latter, the Contractor shall make arrangements for the collection of the recyclable materials. Any remaining non-inert waste shall be collected and disposed of to the public fill reception facilities whilst any inert C&D materials shall be re-used on site as far as possible. Alternatively, if no use of the inert material can be found on-site, the materials can be delivered to public fill reception facilities after obtaining the appropriate licence;

6. In order to monitor the disposal of C&D material and solid wastes at public fill reception facilities and landfills, and control fly-tipping, a trip-ticket system shall be implemented by the Contractor, in accordance with the contract and the requirements of WBTC 31/2004 "Trip Ticket System for Disposal of Construction and Demolition Material";

7. Under the Waste Disposal (Chemical Waste) (General) Regulation, the Contractor shall register as a Chemical Waste Producer if chemical wastes such as spent lubricants and paints are generated on site. Only licensed chemical waste collectors shall be employed to collect any chemical waste generated at site. The handling, storage, transportation and disposal of chemical wastes shall be conducted in accordance with the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes and A Guide to the Chemical Waste Control Scheme both published by EPD;

8. A sufficient number of covered bins shall be provided on site for the containment of general refuse to prevent visual impacts and nuisance to the sensitive surroundings. These bins shall be cleared daily and the collected waste disposed of to the refuse transfer station. Further to the issue of ETWB TCW No. 6/2002A, Enhanced Specification for Site Cleanliness and Tidiness, the Contractor is required to maintain a clean and hygienic site throughout the project works;

9. All chemical toilets, if any, shall be regularly cleaned and the night-soil collected and transported by a licensed contractor to a Government Sewage Treatment Works facility for disposal;

10. Toolbox talks should be provided to workers about the concepts of site cleanliness and appropriate waste management procedures, including waste reduction, reuse and recycling; and

11. The Contractor shall comply with all relevant statutory requirements and guidelines and their updated versions that may be issued during the course of project construction.

6.8 Waste Management Practice during the Operational Phase

6.8.1 Insignificant amount of silt in the stilling basins at the outfall end of the IRTS tunnel would need to be removed regularly. This should not present any difficulties or insurmountable problems during the operation phase.

6.9 Environmental Monitoring and Audit Requirements

6.9.1 The assessment has concluded that proper handling, storage, collection, transportation and disposal of waste materials generated during construction of the project will not give rise to any significant impacts to nearby sensitive receivers.

6.9.2 Whilst no specific environmental monitoring requirements are considered necessary, it is recommended that during the construction phase, site inspections and supervisions of waste management procedures and auditing of the effectiveness of implemented mitigation measures should be undertaken on a regular basis (e.g. weekly as a minimum). These tasks shall be scheduled in the Waste Management Plan (WMP) to be prepared by the Contractor, and a summary of the site audits shall be presented in the monthly EM&A reports required under the EM&A Manual.

6.9.3 Given the nature of the project, there are no specific EM&A requirements for waste management considered necessary during the operational phase.

6.10 Conclusion and Recommendations

6.10.1 The potential impacts of wastes arising from the construction and operational phases of the project have been assessed. The construction activities associated with the proposed works will generate a variety of wastes including vegetation from site clearance, excavated materials, and construction wastes, chemical and municipal wastes.

6.10.2 The largest amount of waste expected would be inert C&D materials, which will be generated by tunnelling works during Month 12-17 for around 6 months. The total inert C&D materials expected for the entire project are about 43,800 m^3 and that due to tunnelling is estimated as 37,000 m^3. 43,650 m^3 of the total inert C&D materials will be disposed of at the nearest public fill reception facilities.

6.10.3 In view of the Government policy towards promotion recycling and due to the clear environmental benefits this will provide, recycling and waste reduction by site staff/ contractors (construction phase) should be encouraged whenever it is possible.

6.10.4 While an estimate has been made on the likely volumes and types of waste to be generated from the construction of the project, the Contractor should regularly update and submit the monthly Waste Flow Table ("WFT") which would provide a more accurate estimate on volumes of waste generation on-site. This WFT shall form part of the Waste Management Plan ("WMP") to be submitted as part of the EM&A requirements and in accordance with ETWB Technical Circular (Works) No. 19/2005, Waste Management on Construction Sites.

6.10.5 Provided that the waste management practices outlined are put in place, potential impacts on the environment associated with waste generated during the construction phases of the Project should be well under controlled.

7. HAZARD TO LIFE

7.1.1 The Hazard to Life assessment has to be based on the criteria and guidelines stated in Annexes 4 of the EIAO-TM for evaluating and assessing hazard and to follow the scope outlined in Para. 3.4.5 of the EIA Study Brief.

7.1.2 As indicated in the Study Brief, hazard to life can attribute to the following two sources, viz.

- Possible use of explosives for tunnelling works
- Transport, storage and use of chlorine for disinfection of water at the Shek Lei Pui Water Treatment Works ("SLPWTW")

7.1.3 The intake work site as shown in Figure 7-1 will be within the 1km consultation zone of the SLPWTW, which is a potentially hazardous installation ("PHI") defined by Co-coordinating Committee on Land Use Planning & Control relating to potentially hazardous installations ("CCPHI").

7.1.4 As outlined in Section 2.6.3, the use of explosives has been ruled out due to proximity of the tunnelling works to the Lower Shing Mun Reservoir dam. As such, explosive hazard assessment is not to be carried out.

7.1.5 Due to construction requirements, the Shek Lei Pui WTW will be temporarily taken out of service as the construction of the intake portal and TBM retrieving would require the water at the Kowloon Reception Reservoir and the Kowloon Byewash Reservoir to be temporarily drawn down, If Kowloon Reception Reservoir and Kowloon Byewash Reservoir are required to be drawn down to facilitate the construction works, both Shek Lei Pui WTW and Tai Po Road WTW are required to be shut down. The yield of Kowloon Group Reservoirs could not be fully utilized. Therefore, it is advisable for Contractor to plan the construction works taking into account of seasonal effects as far as practicable to minimize loss of yield.

7.1.6 The relatively lower capacity of water treatment at SLPWTW can easily be compensated by other water treatment works and hence would not cause unacceptable disruption to treated water supply to the area.

7.1.7 Suspension of water treatment at the SLPWTW will be accompanied by relocation of all chlorine drums before the construction works and hence remove hazard due to transport, storage and use of chlorine at SLPWTW. However, it is recommended that the inventory of chlorine should be phased out by natural consumption at SLPWTW before the construction works commence, which could eliminate the risk of chlorine drum relocation.

7.1.8 On account of the foregoing, no hazard to life assessment is considered necessary as the two hazard sources will be removed.

8. ECOLOGICAL IMPACT

8.1 Introduction

8.1.1 This section presents an assessment of the ecological impacts arising from construction and operation of the Project. Field surveys covering a period of more than 4 months (October 2007 to February 2008) have been undertaken to establish the baseline ecological conditions of the Study Area. The assessment has been based upon the criteria and guidelines for evaluating and assessing ecological impact stated in Annexes 8 and 16 of the EIAO-TM and covered the scope outlined in Section 3.4.6 of the EIA Study Brief.

8.2 Relevant Legislations, Standards & Guidelines

8.2.1 A number of international conventions and local legislation and guidelines provide the framework for the protection of species and habitats of ecological importance. Those relating to the Project are:

- Forests and Countryside Ordinance (Cap 96);
- Wild Animals Protection Ordinance (Cap 170);
- Country Parks Ordinance (Cap 208);
- Protection of Endangered Species of Animals and Plants Ordinance (Cap 586);
- Town Planning Ordinance (Cap 131);
- The Technical Memorandum on Environmental Impact Assessment Process under the Environmental Impact Assessment Ordinance (EIAO-TM); and
- Hong Kong Planning Standards and Guidelines Chapter 10 on Conservation.

8.2.2 The *Forests and Countryside Ordinance (Cap. 96)* prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on Government land. The subsidiary Forestry Regulations prohibit the picking, felling or possession of listed rare and protected plant species. The list of protected species in Hong Kong which comes under the Forestry Regulations was last amended on 11 June 1993 under the Forestry (Amendment) Regulation 1993 made under Section 3 of the Forests and Countryside Ordinance.

8.2.3 Under the *Wild Animals Protection Ordinance (Cap.170)*, designated wild animals are protected from being hunted, whilst their nests and eggs are protected from disturbance, destruction and removal. All birds and most mammals including all cetaceans are protected under this Ordinance, as well as certain reptiles, amphibians and invertebrates. The Second Schedule of the Ordinance that lists all the animals protected was last revised in June 1992.

8.2.4 The *Country Parks Ordinance (Cap. 208)* prohibiting or restricting the killing, hunting, trapping, molesting or disturbance of any form of wild life within a country park or special area, the taking of, destruction of or interference with vegetation within a country park or special area or the doing of anything therein which will interfere with the soil. It also prohibits or restricts any lighting of fires within a country park or special area and the prevention of fire hazards. The study area fall within the Kam Shan Country Park and the Lion Rock Country Park.

8.2.5 The *Protection of Endangered Species of Animals and Plants Ordinance (Cap.586)* was gazetted on 10 March 2006 and effective in December 2006 to replace the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187) which gives effect to CITES. The Ordinance aims to regulate the import, introduction from the sea, export, re-export and possession or control of certain endangered species of animals and plants and parts and derivatives of those species and to provide for incidental and connected matters.

8.2.6 The *Town Planning Ordinance (Cap. 131)* provides designation of land use zoning such as "Coastal Protection Areas", "Sites of Special Scientific Interest (SSSIs)", "Green Belt" and "Conservation Areas" to promote conservation and protect significant habitats.

8.2.7 *Annex 8 and 16 of the EIAO-TM*: Annex 8 recommends the criteria that can be used for evaluating ecological impacts. Annex 16 sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts.

8.2.8 *Hong Kong Planning Standards and Guidelines* Chapter 10 (HKPSG) comprises the available conservation measures in land-uses planning. It reviews the general principals of conservation and lists the conservation measures of natural landscapes and habitats, historical buildings, archaeological sites and other antiquities. A brief enforcement review is also included. In addition, the legislation and administrative controls for conservation, other conservation related measures and government departments involved in conservation in Hong Kong are enclosed in the appendices.

8.3 Assessment Methodologies

8.3.1 Assessment methodologies were prepared in accordance with the technical requirements set out in Annexes 8 and 16 of the EIAO-TM and Study Brief ESB-154/2006, relevant EIAO Guidance Notes (GNs) regarding Ecological Impact Assessment (EcoIA) which include GN 6/2002, GN 7/2002 and GN 10/2004. The study area of the EcoIA covered all the habitats within a 500m boundary of the works, with focus to area around the proposed intake and outfall portals (**Figure 8-1**). Terrestrial ecological surveys mainly included plantation woodland/secondary woodland and flora/ fauna species depending on these habitats, while aquatic ecological surveys covered the reservoirs, the feeding streams and aquatic wildlife.

8.3.2 Ecological surveys were conducted from September to December 2007 and January to February 2008 covering both the wet and dry seasons for more than four months.

Habitat Survey

8.3.3 Aerial photos covering the Study Area have been studied to identify the general land use/ habitat type of the study area. A preliminary habitat map was generated through translating the visualized condition in the aerial photos for the subsequent ground truthing exercise.

8.3.4 The preliminary habitat map was finalised by ground truthing which verified and confirmed the habitat types and their boundaries (**Figure 8-2** and **Figure 8-3**).

8.3.5 The finalised habitat map with suitable scale (1:1000 to 1:5000) showing the types and locations of habitats was overlaid with project alignment for further assessment.

Vegetation Survey

8.3.6 Vegetation surveys were carried out on 21, 24, 25 September 2007; 25, 29 ,31 October 2007; 2, 15, 16 November 2007; 5, 14, 17 December 2007; 3, 4, 7 January 2008 and 5, 6, 12 February 2008 by walking through habitats in the study area and recording plant species encountered by visual observation. Attention was paid to habitats of higher ecological value and to rare, protected and threatened plant species. Plant species list with plant status, form, relative abundance and location recorded was produced.

Mammal Survey

8.3.7 Mammal surveys were conducted in conjunction with herpetofauna surveys during daytime and at night time just after dusk. All sighting and sign of traits (footprints, faeces or burrows) were recorded. The secondary woodland / plantation woodland, grassland, muddy area adjacent to the streams were actively searched for mammal tracks where animals come to feed or drink. Feeding signs such as partially eaten vegetation or carcasses may provide evidence of traits of mammals. Habitat types, measurement and photographs were taken for signs of tracks to aid the identification works. Ad hoc sighting during other faunal group surveys was marked to produce a full species list. Nomenclature for mammals follows Shek (2006).

8.3.8 Mammal surveys were conducted on 25 and 31 October, 3 and 14 December 2007 and 15 January 2008 at Kam Shan Country Park and 25 and 31 October, 5 and 14 December 2007 and 11 January 2008 at Lower Shing Mun.

8.3.9 Night survey was conducted to search for nocturnal species of mammals on 31 October 2007. Hand or head torches were used to assist active searching in exposed areas of their potential habitats.

Bird Survey

8.3.10 Bird surveys were conducted by point count method at secondary woodland/ plantation woodland, grassland, stream courses and reservoirs (Figure 8-1 refers). Ten minutes were spent counting birds at each sampling point. Bird species within 30m of the sampling point were identified visually by using a pair of binoculars or by hearing their calls. Birds using the site and the adjacent area other than the sampling points for feeding, nesting and roosting was also recorded to form a complete species list. Ornithological nomenclature follows Carey *et al.* (2001).

8.3.11 Bird surveys were conducted on 25 and 31 October, 3 and 14 December 2007 and 15 January 2008 at Kam Shan Country Park and 25 and 31 October, 5 and 14 December 2007 and 11 January 2008 at Lower Shing Mun.

Herpetofauna (Amphibians and Reptiles) Survey

8.3.12 Herpetofauna surveys were conducted by active searching in conjunction with mammal survey during daytime and at night time just after dusk. Streams, reservoirs, secondary woodland / plantation woodland and grassland were actively searched for potential breeding areas of amphibians and reptiles. Microhabitats like stones, crevices, leaf litter/debris, rotten log and abandoned cardboard was also examined or uncovered to search for the eggs and tadpoles of amphibians in aquatic habitats or to reveal the presence of the amphibians and reptiles hiding under these covers. Ad hoc records during other faunal group surveys were

included in the report. Nomenclature for herpetofauna follows Karsen *et al.* (1998).

8.3.13 Herpetofauna surveys were conducted on 25 and 31 October, 3 and 14 December 2007 and 15 January 2008 at Kam Shan Country Park and 25 and 31 October, 5 and 14 December 2007 and 11 January 2008 at Lower Shing Mun.

8.3.14 Night survey was conducted on 31 October 2007 to search for nocturnal species of amphibians and reptiles in their active stage. Hand or head torches were used to assist active searching in exposed areas of their potential habitats. Auditory detection of mating calls at their breeding sites was also recorded during night survey. Species identified, number and habitat used was included in the report.

Butterflies and Dragonflies Survey

8.3.15 The surveys for butterflies and dragonflies were conducted by visual observation and photography. Survey was conducted by point counting within 15m from the sampling points for 10 minutes at secondary woodland / plantation woodland, grassland, streams and reservoirs. Butterflies and dragonflies encounter outside counting points but within the study area were also recorded to produce a complete species list. Nomenclature for butterflies follows Lo (2004), while for dragonflies follows Wilson *et al.* (2003).

8.3.16 Butterfly and dragonfly surveys were conducted on 25 and 31 October, 3 and 14 December 2007 and 15 January 2008 at Kam Shan Country Park and 25 and 31 October, 5 and 14 December 2007 and 11 January 2008 at Lower Shing Mun.

Aquatic Fauna Survey

8.3.17 Aquatic fauna survey including freshwater fishes and macro-invertebrates was carried out at stream courses and reservoirs that would potentially be impacted by the proposed development. Bank side counting of freshwater fish species with the aids of short focal length binoculars along stream bank and embankment of the reservoirs was conducted. Pot trapping and hand netting was applied at the shallow water region of the reservoirs to investigate freshwater fishes inhabit in the surface water layer. For deeper water region, angling and interviewed with the anglers were conducted to supplement the information gap from literature review. Freshwater fish survey at drainage channels within the Study Area were also conducted by bank side counting. Species observed and the estimated abundance was recorded. The riparian vegetation and the streambed environment were also recorded for species identification works. Nomenclature for freshwater fish follows Lee *et al.* (2004), other macroinvertebrates follows Dudgeon (2003).

8.3.18 Aquatic fauna surveys in small stream tributaries were conducted on 25 and 31 October, 3 and 14 December 2007. Fish surveys were carried out in Kowloon Byewash Reservoir and Kowloon Reception Reservoir on 13 November and 17 December 2007. No fish survey was conducted in the Lower Shing Mun Reservoir due to construction works were being carried out and drained down the reservoir during the survey period.

8.4 Description of Existing Ecological Baseline Conditions

Kam Shan Country Park

8.4.1 The works area including the proposed intake location and tunnel alignment are within the Kam Shan Country Park (Kam Shan CP). Kam Shan, known as Monkey Hill locally, is famous for the occurrence of macaques. Rhesus Macaque (*Macaca mulatta*) forms the largest mammals group in the park. The park also provides shelters for Palla's Squirrel (*Callosciurus erythraeus*), Intermediate Horseshoe Bat (*Rhinolophus affinis Horsfield*), East Asian Porcupines (*Hystrix brachyura*) and many other bird species, including Black Kite (*Milvus migrans*), a regional concern species. A wide range of native flora also presents in the country park, such as Rose Myrtle (*Rhodomyrtus tomentosa*), Acronychia (*Acronychia pedunculata*), Hong Kong Gordonia (*Gordonia axillaris*), Fragrant Litsea (*Litsea cubeba*), Red Machilus (*Machilus thunbergii*), Pop-gun Seed (*Bridelia tomentosa*) and Ivy Tree (*Schefflera heptaphylla*).

Lion Rock Country Park

8.4.2 A very small portion of the study area at southeast is within the Lion Rock Country Park (Lion Rock CP). Two famous fauna, Black Kite (*Milvus migrans*) and Longtailed Macaque (*Macaca fascicularis*) occur in the Lion Rock Country Park while Rhesus Macaque (*Macaca mulatta*) is the dominating species The woodland near Tai Po Road is also known as a monkey domain, where monkeys can be easily found. Various floral species can also be found in the country park. Species such as Chinese Red Pine (*Pinus massoniana*), Chinese Hackberry (*Celtis sinensis*), Incense Tree (*Aquilaria sinensis*) and Chinese New Year Flower (*Enkianthus quinqueflorus*) can be easily seen.

Habitats and Vegetation

8.4.3 Six types of habitat were identified within the study area, including secondary woodland/ plantation woodland, grassland, stream, drainage channel, reservoir and developed area/ bare ground. (**Figure 8-2** and **Figure 8-3** refer). Photographic illustrations of each type of habitat are presented in **Plates 8.1** to **8.5** in **Appendix H**.

8.4.4 The size and % coverage of each habitat type within the study area are tabulated below.

Table 8-1 Habitat types recorded within the Study Area

Habitat	Size		
	Worksite Area at Kowloon Byewash Reservoir Portal	Worksite Area at Lower Shing Mun Reservoir Portal	Study Area
Secondary Woodland / Plantation Woodland	0.03ha (11%)	-	304.61ha (81.29%)
Grassland	-	0.08ha (17%)	0.14ha (0.04%)
Stream	-	-	0.35ha / 5.3km (0.09%)
Drainage Channel	0.01ha (4%)	-	0.26ha / 0.7km (0.07%)
Reservoir	0.15ha (53%)	0.31ha (68%)	35.38ha (9.44%)
Developed Area / Bare Ground	0.09ha (32%)	0.07ha (15%)	34.00ha (9.07%)
Total Area	**0.28ha (100%)**	**0.46ha (100%)**	**374.74ha (100%)**

Note: Worksite Area refers to the area occupied for the proposed waterworks during construction period (**Figure 2-6** and **Figure 2-7**).

8.4.5 A total of 74 and 104 plant species were recorded at Kowloon Byewash Reservoir Worksite Area and Lower Shing Mun Reservoir Worksite Area respectively. Plant lists of these two

areas are presented in **Table G1a** and **Table G1b** respectively in **Appendix G**.

8.4.6 A total of 376 plant species were recorded within the study area, in which ten of them were species of conservation concern. The plant list is presented in **Table G1c** in **Appendix G**.

Worksite Area of Kowloon Byewash Reservoir Portal

8.4.7 The proposed worksite area comprises four types of habitats including secondary woodland/ plantation, drainage channel, reservoir and developed area / bare ground (**Figure 8-4**). This area will mostly cover part of the existing barbecue site while its south eastern end will encroach into the secondary woodland / plantation. The reservoir portion within the worksite area is bare rocky slope while the section of drainage channel within the worksite area is a complete concrete structure. The barbecue site within the worksite area is an open area with some tree planting for amenity function.

8.4.8 The woodland part comprises common native species such as *Acronychia pedunculata*, *Schefflera heptaphylla* and *Sterculia lanceolata*. One individual of *Artocarpus hypargyreus* was located at the north eastern corner of the worksite area. According to the proposed layout plan, this portion of woodland will be of 0.03ha in size.

Worksite Area of Lower Shing Mun Reservoir Portal

8.4.9 A vehicle access roughly divides the worksite area into two halves (**Figure 8-5**). The bigger half is the exposed soil overgrown with grasses and herbs on the drained reservoir. All the plant species are common and widespread, which include *Ageratum conyzoides, Bidens alba, Leucaena leucocephala, Stachytarpheta jamaicensis* and *Rhynchelytrum repens*. On the slope along the vehicle access, one *Pavetta hongkongensis* (it was a young individual of less than 1m in height) was found which is protected under the Forestry Regulations (Cap. 96 sub. Leg.). This species is very common in Hong Kong as well as in the study area.

8.4.10 Another half is the grassland east of the access. Common grasses such as *Microstegium ciliatum* and *Miscanthus sinensis* dominate the vegetation cover. The grassland is being disturbed which was evidenced by the presence of invasive and exotic species such as *Mikania micrantha, Bidens alba* and *Lantana camara*.

Secondary Woodland / Plantation

8.4.11 This is the dominant habitat inside the study area, which is established by the mixture of plantation and secondary woodlands. Many tree species commonly used for afforestation such as *Acacia confusa, Lophostemon confertus, Eucalyptus* spp., *Melaleuca quinquenervia* and *Schima superba* can be found in the mixed woodlands. As the areas between the Lower Shing Mun and Kowloon Byewash reservoirs are quite far away from sources of urban disturbance, secondary woodlands have been established within these plantations. These secondary woodlands are evidenced by the presence of native tree and shrub species including *Acronychia pedunculata, Alangium chinense, Aporusa dioica, Cinnamomum camphora, Cleistocalyx operculatus, Cratoxylum cochinchinense, Diospyros morrisiana, Litsea cubeba, Phyllanthus emblica, Sapium discolour*.

8.4.12 Ten species of conservation concern were recorded within the woodlands: *Aquilaria sinensis, Artocarpus hypargyreus, Castanopsis carlesii, Cibotium barometz, Enkianthus quinqueflorus, Ixonanthes reticulata, Liparis nervosa, Pavetta hongkongensis, Peristylus tentaculatus* and *Tainia hongkongensis*.

8.4.13 *Aquilaria sinensis, Cibotium barometz, Enkianthus quinqueflorus, Liparis nervosa, Pavetta hongkongensis, Peristylus tentaculatus* and *Tainia hongkongensis* are plant species under protection by either the Forestry Regulations (Cap. 96 sub. Leg.) or Protection of Endangered Species of Animals and Plants Ordinance (Cap 586). *Artocarpus hypargyreus* and *Ixonanthes reticulata* are not protected by local law but listed as Near Threatened (NT) or Vulnerable (V) respectively in Mainland China (AFCD 2003). *Castanopsis carlesii* is listed as a rare native species in Corlett's study "Hong Kong Vascular Plants: Distribution and Status" (Corlett *et al*, 2000).

8.4.14 Except *Castanopsis carlesii*, all these above species are common in Hong Kong despite having protection status in Hong Kong or Mainland China. Many localities of these species are in Country Parks with well protection and not under any particular threat (AFCD, 2003).

8.4.15 Most of these species are situated far away from the two proposed worksite areas. Only one individual of each *Artocarpus hypargyreus* and *Pavetta hongkongensis* were found within the worksite area at Kowloon Byewash Reservoir and Lower Shing Mun Reservoir respectively (**Figure 8-4** and **Figure 8-5**).

Grassland

8.4.16 One small area of grassland was identified near the proposed portal site at Lower Shing Mun reservoir. This small grassland is dominated by common grass species including *Microstegium ciliatum* and *Miscanthus sinensis*. Shrub species *Ficus hispida, Lantana camara* are common pioneer plants grown on similar habitats. The common invasive climber *Mikania* was found along the edge adjoining the road access.

Stream

8.4.17 As the study area covers the water gathering ground of the nearby reservoirs, a number of rocky streams feeding the reservoirs were identified. Vegetation found on this habitat are those common riparian species including *Adina pilulifera, Elaeocarpus chinensis, Ficus fistulosa, Glochidion zeylanicum, Ficus superba,* etc.

Drainage Channel

8.4.18 Few drainage channels were located around Shek Lei Pui Reservoir, Kowloon Byewash Reservoir and Kowloon Reception Reservoir. One of these drainage channels was found in between Kowloon Byewash reservoir and Kowloon Reception reservoir. It links up the two reservoirs and is a complete concrete structure which is free of vegetation.

Reservoir

8.4.19 The study area covers five reservoirs viz. Lower Shing Mun Reservoir, Kowloon Reservoir, Kowloon Byewash Reservoir, Kowloon Reception Reservoir and Shek Lei Pui Reservoir. The Lower Shing Mun Reservoir has been fully drained down for WSD's maintenance works while the other four reservoirs are in use during this study.

8.4.20 As these reservoirs share the same boundary with the plantation woodland / secondary woodlands, the vegetation are those along the edge of these woodlands such as *Acacia confusa, Lophostemon confertus,* and *Melaleuca quinquenervia*. Since the Lower Shing Mun Reservoir has been drained for a time period of over 2 years and the area around the proposed portal (Lower Shing Mun Reservoir portal) is of higher topographical level, the exposed bare

soil are covered with grasses and herbs during the survey period in 2007 and 2008. Many of these plants are pioneer and exotic species such as *Ageratum conyzoides, Leucaena leucocephala* and *Stachytarpheta jamaicensis*.

Developed Area / Bare Ground

8.4.21 This category of habitat includes all types of urban land uses such as pavement, buildings and bare engineering slopes. Usually these habitats are free of vegetation despite some landscape planting or weed species can be found. This habitat type in general is of negligible ecological importance.

Fauna

Mammal

Literature Review

8.4.18 Macaques are recorded as the largest group of mammals in the Kam Shan Country Park (AFCD, 2008). The two major species reported in are Rhesus Macaque (*Macaca mulatta*) and Longtailed Macaque (*Macaca fascicularis*) (AFCD, 2008). Both species are listed in the WAPO Cap. 170 and CITES while the Rhesus Macaque is also listed in China Red Data Book as vulnerable (Shek, 2006).

8.4.19 Rhesus Macaque is highly social species which live in troops of about 20-100, sometimes over 200 (Shek, 2006). Although Hong Kong is located in the range of natural distribution of the Rhesus Macaque, it is believed that the original wild stock was locally extinct by the nineteenth century (Corlett, 2004) due to the habitat destruction and over-hunting (AFCD, 2008). The existing populations are descendents of introduced individual in early 1910s and the population size was estimated as 1600 individuals in 2003 (Shek, 2006).

8.4.20 Longtailed Macaque has a restricted distribution in Hong Kong and was also found in Lion Rock Country Park, where a monkey domain is found in the woodland near Tai Po Road (AFCD, 2008). The macaques roaming wild in the region now are actually the descendants of introduced individuals in early 1950s and some individuals mixed with Rhesus Macaque to form small troops or mated with Rhesus Macaque to produce hybrid macaques (Shek, 2006). The estimated population in 2003 was about 75 individuals (Shek, 2006), however, the result of direct counting survey conducted by the AFCD showed that there were less than five individuals existed in Kam Shan Country Park (Shek, Chan and Wan, 2007).

8.4.21 Tibetan Macaque (*Macaca thibetana*) and Golden Rhesus Macaque (Complete albino form of the Rhesus Macaque) were reported as very rare in Kam Shan Country Park (Shek, 2006). It is believed that only one Tibetan Macaque left in Kam Shan (Shek, 2006).

8.4.22 There is one flying mammal recorded around the study area, the Intermediate Horseshoe Bat (*Rhinolophus affinis*). They have a wide distribution in Hong Kong, including area near Kam Shan Country Park, which was recorded during the mist net survey conducted by AFCD (Shek, 2006).

8.4.23 A direct sighting of Pallas's squirrel (*Callosciurus erythraeus*) has been recorded in the study area (Shek, 2006). It was also reported to find shelter at Kam Shan (AFCD, 2008).

8.4.24 East Asian Porcupine (*Hystrix brachyura*), Small-toothed Ferret Badger (*Melogale moschata*), Masked Palm Civet (*Paguma larvata*), Small Indian Civet (*Viverricula indica*), Leopard Cat (*Prionailurus bengalensis*), Eurasian Wild Pig (*Sus scrofa*), Red Muntjac (*Muntiacus muntjac*) and Domestic Ox (*Bos taurus*) were also recorded in Kam Shan and Lion Rock Country Park during camera trapping survey conducted by AFCD during 2002 to 2006. All the species have wide distributions in Hong Kong (Shek, 2006; Shek *et al.,* 2007).

8.4.25 The East Asian Porcupine, Small-toothed Ferret Badger, Masked Palm Civet, Small Indian Civet and Leopard Cat are protected under the WAPO (Cap.170). East Asian Porcupine also listed under IUCN Red List as vulnerable species (Baillie, 1996). The Leopard Cat is listed in CITES Appendix II (UNEP-WCMC, 2008) and the China Red Data Book (CRDB) as vulnerable species (Wang and Xie, 2004).

Survey Results

8.4.26 Two species of non-flying mammals were recorded within the study area during the survey period (Table G2). The monkey Rhesus Macaque, which is the most abundant species recorded in Kam Shan Country Park and Lion Rock Country Park, were mostly found in barbecue sites, on trees of secondary woodland / woodland plantation, retaining wall and reservoir embankment (Plate 8.6). Scat of East Asian Porcupine was recorded at the nature trail in Kam Shan Country Park passing through the secondary woodland (Plate 8.7). These two species were protected under the WAPO (Cap.170) with status of common and very common respectively (Shek, *et al.*, 2007).

Birds

Literature Review

8.4.27 Silver-eared Mesia (*Leiothrix argentauris*) and Rufous-capped Babbler (*Stachyris ruficeps*) were recorded by local bird watcher in December 2006 in the Kam Shan Country Park (http://www.hkbws.org.hk). Rufous-capped Babbler is of local concern (Fellowes *et al.,* 2002). However, both of the species are local residents of captive origin (Viney *et al.*, 2005).

8.4.28 Black Kite (*Milvus migrans*) was recorded in the Lion Rock Country Park (AFCD website, 2008). It is a common residents and winter visitor that widely distributed in Hong Kong. It is a scavenger that feeds on animal carcasses, rubbish and dead fish. Black Kite is considered of Regional Concern according to Fellowes *et al.* (2002) and was protected under Cap. 170, Cap. 586, Class 2 Protected Animals of PRC and listed in Appendix II of CITES (Zheng and Wang, 1998).

8.4.29 Previous EIA study in Butterfly Valley that partially within the southern portion of the study boundary of this Project recorded 14 and 20 species of birds during wet season (July to September 1998) and dry season survey (January to March 1999) respectively (ERM, 1999) (Table G3a). All the species are common and typical to the rural village habitat of Hong Kong. No species of conservation concern were recorded in this study.

Survey Results

8.4.30 A total of 16 species of bird were recorded during the point count survey (Table G3b). An additional of 8 species was recorded outside the sampling point but within the Study Area during September 2007 to January 2008. Bird abundance and total species recorded were highest in secondary woodland/ plantation, while lowest records were observed in stream and

grassland.

8.4.31 Thirteen species were recorded in the secondary woodland/ plantation during point count, most species recorded are common and widespread, except for Black-throated Laughingthrush, Pale-legged Leaf Warbler and Red-throated Flycatcher that are rare or very local.

8.4.32 Black Kite recorded soaring over secondary woodland/ plantation and standing in barbecue site (probably foraged on rubbish or scavenged on small animal dead body) in the Kam Shan Country Park is considered of regional concern (Fellowes *et al.,* 2002) and is Class 2 Protected Animals of PRC and listed in Appendix II of CITES (Zheng and Wang, 1998).

8.4.33 Other species of conservation interest recorded within the study area are not recorded during the point count survey. They include 3 individuals of Rufous-capped Babbler (*Stachyris ruficeps*) recorded singing in undergrowth of plantation which is considered of local concern (Fellowes *et al.*, 2002) and 3 individuals of Common Teal (*Anas crecca*) recorded during angling survey at Kowloon Reception Reservoir on 17 December 2007 considered of regional concern (Fellowes *et al.*, 2002). Rufous-capped Babbler is scarce resident of captive origin. One individual was recorded in Shing Mun in early 90s and singing males have subsequently become regularly occurred there (Carey *et al.,* 2001). It is expected that this species is gradually colonising suitable maturing woodland habitats in Hong Kong (*ibid*). Common Teal is abundant winter visitor to Deep Bay but was also recorded in small numbers in reservoirs in Hong Kong especially in the New Territories (*ibid*).

8.4.34 Bird species recorded that may utilize the reservoir include Common Kingfisher (*Alcedo atthis*), Common Teal, Yellow Wagtail (*Motacilla flava*) and Grey Wagtail (*Motacilla cinerea*). One Common Kingfisher was recorded by *ad hoc* standing on tree leaning to the Kowloon Byewash Reservoir. This species is common and widespread passage migrant and winter visitor to wetland, riverine and coastal habitats that often perches just above water level and plunges into water to catch fish (Viney *et al.,* 2005). Yellow Wagtail and Grey Wagtail were recorded in Lower Shing Mun Reservoir (with shallow water flow) and Kowloon Byewash Reservoir respectively. They are also common winter visitor and passage migrant that found mostly recorded in damp areas or near water and also in open cultivated land (*ibid*).

Herpetofauna (Amphibians and Reptiles)

Literature Review

8.4.35 Water Monitor (*Varanus salvator*) was traced in Kowloon Reservoir according to the Hong Kong Biodiversity Database and the specimen is believed to be released or escaped individuals. It is a very rare species and may be locally extinct (Karsen *et al.,* 1998). This species is considered of regional concern (Fellowes *et al.,* 2002) and is protected under the Wild Animals Protection Ordinance (WAPO) (Cap. 170), Protection of Endangered Species of Animals and Plants Ordinance (PESAPO) (Cap. 586) and listed in the China Red Data Book (CRDB) as Critically Endangered/Extinct in Wild.

8.4.36 Beale's Turtle (*Sacalia bealei*) was reported as a rare species and specimen was recorded in fast-flowing streams near the Kowloon Reservoirs (Karsen *et al.,* 1998). This species is considered of global concern (Fellowes *et a.,* 2002) and protected by the WAPO (Cap. 170), listed in the IUCN and CRDB as Endangered species.

8.4.37 Three reptiles and 2 amphibians were recorded in Butterfly Valley during July 1998 to March 1999 (ERM, 1999). These include Changeable Lizard (*Calotes versicolor*), Long-tailed Skink (*Mabuya longicaudata*), a dead Red-necked Keelback (*Rhabdophis submineatus helleri*), Asian Common Toad (*Bufo melanostictus*) and Paddy Frog (*Rana limnocharis*). All these species are common and widespread locally (Karsen *et al.,* 1998).

Survey Results

8.4.38 Three reptiles and 2 amphibians were recorded during herpetofauna survey between September 2007 and January 2008. They include Chinese Gecko (*Gekko chinensis*), Grass Lizard (*Takydromus sexlineatus ocellatus*), Red-eared Slider (*Trachemys scripta elegans*), Asian Common Toad (*Bufo melanostictus*) and Lesser Spiny Frog (*Rana exillispinosa*). All the species were recorded in the Kam Shan Country Park (Table G4a). Three Chinese Geckos and their eggs (Plate 8.8) and 18 Asian Common Toad (Plate 8.9) were observed in holes of retaining wall during night survey (Table G4b for species abundance). Both of the species are widely distributed throughout Hong Kong. The former species was frequently seen inside holes in retaining walls and catchwaters and often lays eggs (Karsen *et al.,* 1998).The Asian Common Toad requires still or slow-flowing water to breed, but can live in drier habitats like hiding beneath objects during the day (*ibid*).

8.4.39 Three Red-eared Sliders were recorded in the Kowloon Byewash Reservoir. Two of them were being stained with red paint (Plate 8.10). This species has been introduced in Hong Kong as a result of pet trade (Karsen *et al.,* 1998). It likes basking on banks of ponds and reservoirs.

8.4.40 The Grass Lizard was recorded in shrubs at daytime. It is an uncommon species with low populations in hill and mountain grassland or in mixed habitats of shrubland and grassland (*ibid*).

8.4.41 The Lesser Spiny Frog is the most common hill stream frogs in Hong Kong (*ibid*). It is considered of having potential global concern (Fellowes *et al.,* 2002). Only the tadpoles were observed in small pools of stream tributaries in the Kam Shan Country Park (Figure 8-2) (Plate 8.11). These tadpoles overwinter by hiding under leaf litter in quiet pools.

Butterflies and Dragonflies

Literature Review

8.4.42 Eight butterfly species were recorded in shrubland near the stream at Butterfly Valley during July 1998 to March 1999 (ERM, 1999). They include Gaudy Baron (*Euthalia lubentina*), Paris Peacock (*Papilio paris*), Common White (*Pieris canidia*), Common Bush Brown (*Zizeeria maha*), Common Black Jezebel (*Zizina otis*), Pale Grass Blue (*Papilio memnon*), Lesser Grass Blue (*Mycalesis horsfieldii*) and Citrus Swallowtail Butterflies (*Delias aglaja*). All species are common in Hong Kong. No rare and endangered species of butterfly and dragonfly were recorded.

Survey Results

8.4.43 A total of 27 species of butterflies were recorded during point count survey (Table G5a). Four additional species were recorded within the study area outside the sampling point (Table G5b). Only the Tree Flitter (*Hyarotis adrastus*) is uncommon but is widely distributed in woodland throughout Hong Kong, other species are either common or very common.

8.4.44 Abundance of butterfly was highest in secondary woodland/ plantation and species richness is highest in grassland. The most abundant species is the Red-base Jezebel (*Delias pasithoe*) (Table G5b), pupa and the emergence of adult from pupa were observed from the food plant *Microsolen cochinchinensis* (Plate 8.12) in Lower Shing Mun and Kam Shan Country Park during the survey period September 2007 to January 2008. This species is a forest butterfly that large numbers can be found near flowering plants in fall and winter (Lo, 2004). The other common species recorded in most of the habitats are Common Grass Yellow (*Eurema hecabe*), Common Mormon (*Papilio polytes*), Dark-brand Bush Brown (*Mycalesis mineus*), Common Sailer (*Neptis hylas*), Ceylon Blue Glassy Tiger (*Ideopsis similis*) and Blue Spotted Crow (*Euploea midamus*). No rare or endangered species of butterfly was recorded.

8.4.45 Seven species of dragonfly were recorded during point count survey (Table G6a). All species are common and abundant. The most abundant species is the Wanderling Glider (*Pantala flavescens*). It recorded in all habitats with a large number recorded in secondary woodland/ plantation near the Kowloon Byewash Reservoir (Table G6b). This species can be found all year round flying over woodland in January (Wilson *et al.,* 2003). The shallow flow streams in Lower Shing Mun Reservoir recorded 5 species of dragonflies (Figure 8-3). They include the Common Blue Skimmer (*Orthetrum glaucum*), Wandering Glider, Black Threadtail (*Prodasineura autumnalis*), Saddlebag Glider (*Tramea virginia*) and the Indigo Dropwing (*Trithemis festiva*). All these species are common in streams and drainage channels in the urban (Wilson *et al.,* 2003). No rare or endangered species of dragonfly was recorded.

Aquatic Fauna

Literature Review

8.4.46 Species recorded in the reservoirs within the study area include some edible fish Goldfish (*Carassius auratus*), Mud Carp (*Cirrhinus molitorella*), Common Carp (*Cyprinus carpio*), and Wild Carp (*Hemiculter leucisculus*); fish recorded in the wild Chinese Barb (*Puntius semifasciolatus*); aquarium fish Jewelfish (*Hemichromis stellifer*); and introduced species Nile Tilapia (*Oreochromis niloticus*) and Redbelly Tilapia (*Tilapia zillii*) (Lee *et al.,* 2004).

8.4.47 According to the territory-wide long-term monitoring survey records on major taxon groups undertaken by the Agriculture, Fisheries and Conservation Department (AFCD) of the Hong Kong SAR from 2002 to 2006, 10 fish species were recorded in the Lower Shing Mun Reservoir. These include Goldfish (*Carassius auratus*), Mud Carp (*Cirrhinus molitorella*), Hainan Culter (*Culter recurviceps*), Common Carp (*Cyprinus carpio*), Mosquito Fish (*Gambusia affinis*), Fork Tongue Goby (*Glossogobius giuris*), Wild Carp (*Hemiculter leucisculus*), Large Mouth Bass (*Micropterus salmoides*), Barcheek Goby (*Rhinogobius giurinus*) and Redbelly Tilapia (*Tilapia zillii*) (AFCD, unpublish data).

8.4.48 Species recorded in streams around Kam Shan include Predaceous Chub (*Parazacco spilurus*), Chinese Barb (*Puntius semifasciolatus*), Nile Tilapia (*Oreochromis niloticus*), Redbelly Tilapia (*Tilapia zillii*) and Barcheek Goby (*Rhinogobius giurinus*) (Lee *et al.,* 2004).

Survey Results

8.4.49 Nine species of freshwater fish and 3 macroinvertebrates were recorded during the aquatic fauna surveys. The most abundant fish species recorded in the Kowloon Byewash Reservoir is the Redbelly Tilapia (*Tilapia zillii*) followed by the Jewel Fish (*Hemichromis stellifer*). These two species were captured by pot traps and angling. The former one is an aquarium fish

that occurs in large number in a few local reservoirs (Lee *et al.,* 2004). The later one is an introduced species common in streams and rivers. The other common species recorded in reservoir is the Predaceous Chub (*Parazacco spilurus*). This species was recorded in abundant in the Kowloon Reception Reservoir and in the connected stream tributaries. This species is listed in the China Red Data Book as vulnerable species (AFCD Hong Kong Biodiversity Database website). One freshwater fish species Flat-headed Loach (*Oreochromis platycephalus*) was recorded in the water pool of Kowloon Byewash Reservoir upstream tributary at AF-7 (Figure 8-1). This species can commonly found in upper streams throughout Hong Kong (Lee *et al.,* 2004).

8.4.50 One rare species of local concern, Rose Bitterling (*Rhodeus ocellatus*), was recorded in the Kowloon Reception Reservoir (**Figure 8-2**) upstream of the Kowloon Byewash Reservoir. This species depends on the freshwater mussels by laying the eggs inside the mantle cavity of the mussels (*ibid*). The dead mussel *Anodonta woodiana* was observed at the bed of the Kowloon Reception Reservoir (**Plate 8.13, Appendix H**).

8.4.51 No freshwater fish was recorded in all drainage channels within the Study Area. These drainage channels are having shallow or no flow during dry season and very rapid flow during wet season or when the upstream reservoirs discharge the overflow downstream.

8.4.52 No freshwater fish was recorded in the stream flowing to the Lower Shing Mun Reservoir during the survey period. Only the freshwater shrimp (*Caridina cantonensis*) and Water Skater (*Ptilomera tigrina*) were recorded in the upstream of the outfall (AF-2 and AF-3 in **Figure 8-1**).

8.5 Evaluation of Sites and Species

Evaluation of Sites

8.5.1 The two sites proposed for worksite areas were evaluated in accordance with the criteria set forth in Annex 8, Table (2) of the TM-EIAO.

Table 8-2 Ecological Evaluation of Worksite Area at Kowloon Byewash Reservoir

Criteria	Worksite Area at Kowloon Byewash Reservoir
Habitat Quality	The barbecue site and the deep concrete channel are of negligible ecological value while the secondary woodland / plantation and the reservoir are considered of high and medium-low in terms of habitat quality respectively.
Naturalness	Most of the site is man made; only the very small woodland area is semi-natural.
Size	Very small, the total site area is approx. 0.28ha; the woodland inside the worksite boundary is only 0.03ha.
Diversity	Flora and fauna diversity is low.
Rarity	All of the identified habitats and species are not rare in Hong Kong. Although the tree species *Artocarpus hypargyreus* has protection status in Mainland China, it is very common in Hong Kong.

Criteria	Worksite Area at Kowloon Byewash Reservoir
Re-creatability	The existing barbecue site is easy to be re-created. The secondary woodland /plantation can be re-created in longer duration.
Fragmentation	The site is not fragmented.
Ecological linkage	The small piece of woodland is ecologically linked with the adjacent woodland but the linkage is weak as disturbance from the human activities is anticipated.
Potential value	Low
Nursery/breeding ground	No record of nursery or breeding ground of any species.
Age	The Kowloon Byewash Reservoir (including the associated structures dams and roads) is of over 70 years of age. The part of woodland within the worksite area is of about 40 years.
Abundance/ Richness of wildlife	Low wildlife richness and abundance
Overall Ecological value	Low

Table 8-3 Ecological Evaluation of Worksite Area at Lower Shing Mun Reservoir

Criteria	Worksite Area at Lower Shing Mun Reservoir
Habitat Quality	Quality of the grassland and exposed areas of the reservoir are medium-low, while the remaining artificial habitats are ranked as low.
Naturalness	Most of the site (reservoir, road access, engineering slopes) is artificial; only the grassland and the edge of the woodland are semi-natural.
Size	Very small. The total site area is approx. 0.46ha in size.
Diversity	Flora diversity is low, fanua diversity is moderate-low for butterfly and low diversity for other fauna. No fish is recorded at the Lower Shing Mun Reservoir as the the whole reservoir was drained for construction during the study period.
Rarity	All of the identified habitats and species are not rare in Hong Kong. One individual of *Pavetta hongkongensis* is found which is very common in Hong Kong. One uncommon fish the Wild Carp (*Hemiculter leucisculus*) was recorded in previous AFCD study but the reservoir was drained during the survey period.
Re-creatability	The reservoir, roadside vegetation and grassland are easy to be re-created. As only the edge of the woodland would be affected, it can be re-created by replantation.
Fragmentation	No fragmentation within the site.
Ecological linkage	The small grassland and woodland directly linked with the adjacent woodland.
Potential value	Potential value is low due to the small size of the site.
Nursery/breeding ground	Neither nursery nor breeding ground is recorded.

Criteria	Worksite Area at Lower Shing Mun Reservoir
Age	The Lower Shing Mun Reservoir (including the associated structures dams and roads) is of about 40 years old. Age of the grassland is not available.
Abundance/ Richness of wildlife	Low wildlife richness and abundance
Overall Ecological value	Low

8.5.2 Ecological evaluation of each habitat within the study area was presented in Table 8-4 to Table 8-9 below.

Table 8-4 Ecological Evaluation of Secondary Woodland / Plantation

Criteria	Description
Habitat Quality	Habitat quality is considered as high in overall.
Naturalness	Semi-natural. Plantation by afforestation exercise and secondary woodland has been established through natural colonization.
Size	Large. Totally over 300ha in size.
Diversity	Floral and faunal diversity is high.
Rarity	One rare tree species of *Castanopsis carlesii* and nine other floral species of conservation concern; a rare species of mammal Longtailed Macaque.
Re-creatability	Reforestation requires several ten years.
Fragmentation	Most of the habitat is continuous. Only at the southern end of the study area the secondary woodland / plantation in Kam Shan Country Park and Lion Rock Country Park are isolated by the Tai Po Road.
Ecological linkage	This habitat is directly linked with the remaining part pf the Kam Shan Country Park and similar habitats on Needle Hill north of the study area.
Potential value	Potential value is high
Nursery/breeding ground	Breeding and nursery ground for Rhesus Macaque and butterfly Red-base Jezebel.
Age	At least 50 years
Abundance/Richness of wildlife	High abundance of plants and animals
Overall Ecological value	High

Table 8-5 Ecological Evaluation of Grassland

Criteria	Description
Habitat Quality	Habitat quality is medium-low.
Naturalness	Semi-natural in natural. Exotic plants exist inside the habitat.
Size	Small. Approx 0.14ha.

Criteria	Description
Diversity	Flora diversity is low, moderate-low diversity for butterfly and low diversity for other fauna.
Rarity	No rare species were identified.
Re-creatability	Semi-natural grassland is easy to be re-created.
Fragmentation	No fragmentation within the grassland.
Ecological linkage	The grassland is directly linked with the adjacent secondary woodland /plantation.
Potential value	Potential value is medium.
Nursery/breeding ground	Potential nursery ground for butterfly.
Age	Not known
Abundance/Richness of wildlife	Low abundance of wildlife.
Overall Ecological value	Medium-low

Table 8-6 Ecological Evaluation of Stream

Criteria	Description
Habitat Quality	High
Naturalness	Natural
Size	Approx 5.3km in length.
Diversity	Floral diversity is medium while faunal diversity is low.
Rarity	One rare species of reptile Beale's Terrapin was recorded in fast-flowing streams near the Kowloon Reservoirs.
Re-creatability	Natural stream is difficult to be re-created.
Fragmentation	No fragmentation was observed.
Ecological linkage	These habitats ecologically linked with the surrounding woodlands, plantations and reservoirs
Potential value	Potential value is high.
Nursery/breeding ground	Streams are nursery and breeding grounds of some freshwater fish and amphibians.
Age	Not known
Abundance/ Richness of wildlife	Medium-low
Overall Ecological value	Medium-high

Table 8-7 Ecological Evaluation of Drainage Channel

Criteria	Description
Habitat Quality	Low
Naturalness	Drainage channel are man-made habitat.
Size	Approx 0.7km in length.
Diversity	Low for both flora and fauna diversity.
Rarity	Neither the habitat nor the species are rare.
Re-creatability	Drainage channel is already man-made structure.
Fragmentation	No fragmentation was observed.
Ecological linkage	These habitats ecologically linked with the surrounding woodlands, plantations and reservoirs.
Potential value	Low
Nursery/breeding ground	Not nursery / breeding grounds of any fauna.
Age	Not known
Abundance/ Richness of wildlife	Low
Overall Ecological value	Low

Table 8-8 Ecological Evaluation of Reservoir

Criteria	Description
Habitat Quality	Habitat quality is medium.
Naturalness	Reservoir is man-made habitat.
Size	Large. Totally over 35ha in size.
Diversity	Both fauna and flora diversity are low.
Rarity	A very rare Water Monitor and a rare freshwater fish Rose Bitterling were recorded in Kowloon Reservoir and Kowloon Reception Reservoir respectively. An uncommon Wild Carp (*Hemiculter leucisculus*) was recorded in the Lower Shing Mun Reservoir by AFCD previous study. The current status of the reservoir is being drained and no fish was recorded.
Re-creatability	Reservoir is re-creatable.
Fragmentation	No fragmentation was observed.
Ecological linkage	Reservoirs are ecologically linked with the feeding streams and the adjacent woodlands / plantations.
Potential value	Potential value is medium-low

Criteria	Description
Nursery/breeding ground	Breeding and nursery ground for Rose Bitterling and other freshwater fish species.
Age	Over 70 years.
Abundance/Richness of wildlife	High abundance of exotic fishes and medium to low abundance for native fish species and edible fishes. Species richness is moderate-low.
Overall Ecological value	Medium-low

Table 8-9 Ecological Evaluation of Developed Area / Bare Ground

Criteria	Description
Habitat Quality	Low
Naturalness	Artificial
Size	Approx. 34ha in size.
Diversity	Low
Rarity	No rare species were identified.
Re-creatability	Easy to be re-created.
Fragmentation	-
Ecological linkage	No ecological linkage was identified.
Potential value	Low
Nursery/breeding ground	Not nursery / breeding grounds of any fauna.
Age	-
Abundance/ Richness of wildlife	Low abundance and richness of wildlife
Overall Ecological value	Low

Evaluation of Species

8.5.3 All the species of conservation concern were evaluated in accordance with the criteria set forth in Annex 8, Table (3) of the TM-EIAO. **Table 8-10** evaluate the floral species found within the proposed worksite areas (on-site) while **Table 8-11** evaluate the floral species recorded within the study area but ouside the proposed worksite areas (offsite). **Table 8-12** evaluates the faunal species of conservation concern recorded within the study area.

Table 8-10 Ecological Evaluation of Floral Species within Proposed Worksite Area (On-site)

Species	Location	Protection Status / Conservation Status	Distribution	Rarity
Artocarpus	Distributed widely within	Not protected in Hong	Distributed	Common (4)

Species	Location	Protection Status / Conservation Status	Distribution	Rarity
hypargyreus	the study area; one individual situated within the worksite at Kowloon Byewash Reservoir	Kong; Listed as Near Threatened in China. (1); Listed as Vulnerable in IUCN 2008	widely in Hong Kong. (1)	
Pavetta hongkongensis	Distributed widely within the study area; one individual is found within the worksite area at Lower Shing Mun Reservoir.	Protected in Hong Kong under Forestry Regulations (1)	Distributed widely in Hong Kong. (3)	Common (4)

Reference source:
(1) Rare and Precious Plants of Hong Kong;
(2) Hong Kong Vascular Plants: Distribution and Status;
(3) Hong Kong Plant Check List 2001;
(4) Corlett's study "Hong Kong Vascular Plants: Distribution and Status".

Table 8-11 Ecological Evaluation of Floral Species outside the Proposed Worksite Areas (Offsite Habitats within the Study Area)

Species	Location	Protection Status / Conservation Status	Distribution	Rarity
Aquilaria sinensis	Distributed widely within the study area; not within the worksite areas	Listed in Protection of Endangered Species of Animals and Plants Ordinance (Cap 586); Listed as Near Threatened in China. (1); Listed as Vulnerable in IUCN 2008	Distributed widely in Hong Kong. (1)	Common (4)
Artocarpus hypargyreus	Distributed widely within the study area.	Not protected in Hong Kong; Listed as Near Threatened in China. (1); Listed as Vulnerable in IUCN 2008	Distributed widely in Hong Kong. (1)	Common (4)
Castanopsis carlesii	About 400m away from the worksite area at Lower Shing Mun Reservoir	Not protected in Hong Kong and China.	Recoded distributions include: Mt Nicholson, Wu Kau Tang, Cheung Sheung, Nei Lak Shan, Tai Mo Shan and Sunset Peak (2)	Rare (4)
Cibotium barometz	Distributed widely	Listed in Protection of	Distributed widely in	Common (4)

Species	Location	Protection Status / Conservation Status	Distribution	Rarity
	within the study area; not within the worksite areas	Endangered Species of Animals and Plants Ordinance (Cap 586); Listed as Vulnerable in China (1)	Hong Kong. (1)	
Enkianthus quinqueflorus	Distributed widely within the study area; not within the worksite areas	Protected in Hong Kong under Forestry Regulation	Distributed widely in Hong Kong. (3)	Common (4)
Ixonanthes reticulata	Distributed widely within the study area; not within the worksite areas	Not protected in Hong Kong; Listed as Vulnerable in China. (1)	Distributed widely in Hong Kong. (1)	Common (4)
Liparis nervosa	Found on some hill slopes within the study area; not within the worksite areas	Protected in Hong Kong under Forestry Regulation	Distributed widely in Hong Kong. (3)	Common (4)
Pavetta hongkongensis	Distributed widely within the study area.	Protected in Hong Kong under Forestry Regulations (1)	Distributed widely in Hong Kong. (3)	Common (4)
Peristylus tentaculatus	Found on some hill slopes within the study area; not within the worksite areas	Protected in Hong Kong under Forestry Regulation	Distributed widely in Hong Kong. (3)	Common (4)
Tainia hongkongensis	Found on some hill slopes within the study area; not within the worksite areas	Protected in Hong Kong under Forestry Regulation	Other recorded distribution: Wong Lung Hang, Repulse Bay, Ma On Shan. (3)	Common (4)

Reference source:
(1) Rare and Precious Plants of Hong Kong;
(2) Hong Kong Vascular Plants: Distribution and Status;
(3) Hong Kong Plant Check List 2001;
(4) Corlett's study "Hong Kong Vascular Plants: Distribution and Status".

Table 8-12 Ecological Evaluation of Faunal Species with Conservation Concern within the Study Area

Common Name	Scientific Name	Location	Protection Status	Distribution	Rarity
Intermediate Horseshoe Bat	*Rhinolophus affinis*	Previous records in Kam Shan Country Park	WAPO Cap. 170	Widely distributed	Common; considered of local concern
Palla's Squirrel	*Callosciurus*	Previous records	WAPO Cap.	Widely distributed	Common

Common Name	Scientific Name	Location	Protection Status	Distribution	Rarity
	erythraeus	in Kam Shan CP and Lion Rock CP	170		
Small-toothed Ferret Badger	*Melogale moschata*	Previous records in Kam Shan CP and Lion Rock CP	WAPO Cap. 170	Widely distributed in forested areas throughout Hong Kong	Common
Masked Palm Civet	*Paguma larvata*	Previous records in Kam Shan CP and Lion Rock CP	WAPO Cap. 170	Widely distributed in forested areas throughout Hong Kong	Uncommon; considered of potential regional concern
Small Indian Civet	*Viverricula indica*	Previous records in Kam Shan CP and Lion Rock CP	WAPO Cap. 170	Widely distributed in forested areas throughout Hong Kong	Common
Leopard Cat	*Prionailurus bengalensis*	Previous records in Kam Shan CP and Lion Rock CP	WAPO Cap.170; PEAPO Cap.586; CITES Appendix II; CRDB – Vulnerable	Widely distributed in forested areas throughout Hong Kong	Uncommon
Rhesus Macaque	*Macaca mulatta*	Kam Shan CP including Kowloon Reservoirs Group, secondary woodland/ plantation, barbecue site and slopes of retaining wall	WAPO Cap.170; PEAPO Cap.586; IUCN - Lower Risk/Near Threatened; CRDB – Vulnerable	Widely distributed	Common
Longtailed Macaque	*Macaca fascicularis*	Previous records in Kam Shan Country Park	WAPO Cap.170; PEAPO Cap.586; IUCN - Lower Risk/Near Threatened;	Mainly occurred in Kam Shan Country Park	Rare
East Asian Porcupine	*Hystrix brachyura*	Scat recorded at nature trail of Kam Shan CP along woodland	WAPO Cap.170; IUCN - Vulnerable	Widely distributed	Very common
Common Teal	*Anas crecca*	Kowloon Reception	WAPO Cap.170	Common winter visitor found in any wetland habitat	Locally common; considered of

Common Name	Scientific Name	Location	Protection Status	Distribution	Rarity
		Reservoir			regional concern
Black Kite	*Milvus migrans*	Soaring over secondary woodland / plantation in Kam Shan CP and Lower Shing Mun Reservoir and at barbecue site in Kam Shan CP	WAPO Cap.170	Widely distributed	Common; considered of regional concern
Rufous-capped Babbler	*Stachyris ruficeps*	Undergrowth of plantation in Kam Shan CP	WAPO Cap.170	Scarce resident	Scarce resident of captive origin; considered of local concern
Water Monitor	*Varanus salvator*	Previous records in Kowloon Reservoir	WAPO Cap.170; PEAPO Cap.586; China Red Data Book - Critically Endangered/ Extinct in Wild	Records in several localities and Kowloon Reservoir but probably released or escaped individuals.	Very rare locally, may be extinct in the wild in Hong Kong; considered of regional concern
Beale's Terrapin	*Sacalia bealei*	Previous records in fast-flowing streams near the Kowloon Reservoirs	WAPO Cap.170; IUCN – Endangered; CRDB - Endangered	A few specimens found in Tai Mo Shan, Fanling, Kowloon Reservoirs and Tai Po Kau	Rare; considered of global concern
Lesser Spiny Frog	*Rana exilispinosa*	Water pools of stream tributaries in Kam Shan Country Park	Not protected	Widely distributed in mountain streams throughout Hong Kong	Common; considered of potential global concern
Rose Bitterling	*Rhodeus ocellatus*	Kowloon Reception Reservoir	Not protected	Recorded in one stream and reservoir	Rare; considered of local concern
Predaceous Chub	*Parazacco spilurus*	Kowloon Reception Reservoir and its stream tributaries	CRDB – Vulnerable	widespread species occurring in most unpolluted hill streams in both upper and lower courses	Common
Wild Carp	*Hemiculter leucisculus*	Previous AFCD records in Lower Shing Mun	Not protected	Recorded in several local reservoirs	Uncommon

Common Name	Scientific Name	Location	Protection Status	Distribution	Rarity
		Reservoir			

8.6 Identification of Potential Impacts

Identification of Impacts during Construction Phase

8.6.1 Construction activities for the proposed waterworks project will comprise site clearance, construction of cofferdam, draining part of the reservoir and operation of a tunnel boring machine (TBM). Potential ecological impacts arising from these activities would include: habitat loss, impact on floral species of conservation concern, direct injury to wildlife, dust deposition on vegetation, site runoff and construction disturbance to wildlife.

Habitat Loss

8.6.2 Habitat loss will be a direct impact resulting from site clearance for works operation and temporary storage. Loss of different types of habitats at the two proposed worksite areas was presented in the following table.

Table 8-13 Habitat Loss at Worksite Areas

Habitat	Worksite Area at Kowloon Byewash Reservoir Portal	Worksite Area at Lower Shing Mun Reservoir Portal	Total
Secondary Woodland/ Plantation	0.03ha	-	0.03ha
Grassland	-	0.08ha	0.08ha
Stream	-	-	-
Drainage Channel	0.01ha / 26m	-	0.01ha / 26m
Reservoir	0.15ha	0.31ha	0.46ha
Developed Area/ Bare Ground	0.09ha	0.07ha	0.16ha

8.6.3 In the above table, all habitats within the boundary of Worksite Area were assumed to be affected during the construction, and therefore the sizes of the potentially affected areas are considered as the worst case scenario.

8.6.4 The loss of the small portion of secondary woodland / plantation at Kowloon Byewash Reservoir portal will cause loss of part of foraging ground especially for Rhesus Macaque. The impact will be insignificant as the Macaque has a wide range of habitat preference. The construction of intake structure in the Kowloon Byewash Reservoir will cause temporary and permanent loss of ecological function of part of the reservoir. Species mainly affected by the loss of reservoir are the aquatic life inhabit in it and the wildlife foraging in this habitat. Only one species of conservation concern Rose Bitterling may be affected by the temporary draining of part of the reservoir. Although it was not recorded in the Kowloon Byewash Reservoir during the aquatic fauna surveys, it may flow from the upstream Kowloon Reception Reservoir during the discharge of water.

8.6.5 Low species diversity and abundance were recorded at the Lower Shing Mun Reservoir during the study period. No fish species was recorded recently as the whole reservoir was drained for maintenance. Although an uncommon fish species Wild Carp *Hemiculter leucisculus* was previously recorded in this reservoir, it is not likely that the fish will recruit to the reservoir prior to the proposed construction.

8.6.6 The temporary loss of grassland habitat in the Lower Shing Mun Reservoir outfall location will cause loss of feeding ground for butterfly species. All the affected species are common and have wide distribution range.

8.6.7 Temporary loss of reservoir habitats would occur during construction phase since draining down of part of the reservoirs would be required for the construction of cofferdams (indicative locations of cofferdam refer to **Figure 5-4** and **5-5**). As both worksite areas are situated on a higher ground level at the edge of the reservoirs, both reservoirs only need to be drained down partially to expose these areas. Therefore the remaining major portion of the reservoirs will not be affected. The actual habitat loss will only be confined to the portion within the cofferdams. Aquatic fauna especially fishes inhabit in the drained portion will temporary loss their habitat. Fishes utilizing the habitat in this portion will be confined in the remaining water at the reservoir portion with normal function outside the works area. The cofferdams will be removed after completion of the works.

8.6.8 Developed area/bare ground within the worksite areas would be lost due to site clearance for works operation, temporary storage and site haul roads. These habitats will be reinstated after the completion of the works.

Impact on Floral Species of Conservation Concern

8.6.9 As described in Section 8.4.15 and **Table 8-10**, two floral species of conservation interest were identified at proposed worksite areas despite both species are common and widespread in Hong Kong. Totally two individuals of these species would be affected.

8.6.10 The affected *A. hypargyreus* at Kowloon Byewash Reservoir worksite area was found on the slope within the proposed worksite area at Kowloon Byewash Reservoir. The tree is small in size of about 190mm in trunk diameter and 6m in height. Preservation of the tree onsite is the prioritised option required by the Environment, Transport and Works Bureau Technical Circular (Works) No. 3/2006 (ETWB TCW No. 3/2006). However as the tree will be in direct conflict with the slope re-grading works for the construction of the intake structure and it has an anticipated low survival rate after transplanting, removing the tree will be the unavoidable option. Taking into account the high commonness of the tree species, only one individual involved, no significant ecological impact on this species community is anticipated.

8.6.11 The *P. hongkongensis* listed in the Forestry Regulations (Cap. 96 sub. leg.) was found on the slope along the existing vehicle access. Like *A. hypargyreus*, it is also common in Hong Kong. With reference to its existing location, it was unlikely to be affected since vegetation on the slope could be preserved during the construction period. However, under the worst case transplanting the individual would be suggested as an alternative option.

Direct Injury to Wildlife

8.6.12 Wildlife like Rhesus Macaque near the reservoir may be hurt during the operation of the construction plants, machinery and during draining of the reservoir. No direct injury of fishes will occur during the draining process of the reservoir prior to construction, as both worksite areas are situated on a higher ground level at the edge of the reservoirs, both reservoirs only need to be drained down partially to expose these areas. No pumping pipes are required in the draining process. Instead, the reservoirs will be drained down through rountine process currently operated during reservoir overflow events. Fishes will colonize to other portion of the reservoir following the water retreat outside the proposed works area.

Dust Deposition on Vegetation

8.6.13 Construction activities such as site clearance and transportation of materials may generate dust if no proper dust control measures were implemented. Dust may deposit on leaves of plants in the nearby habitats and inhibit photosynthesis, which could deteriorate the plant health.

Impacts to Water Quality

8.6.14 As the proposed worksite areas will encroach into the reservoirs, water quality may be affected by the site runoff, sediment release to the water column and chemical spillage associated with the construction works. Potential impacts to water quality include increase concentration of suspended solids and increase nutrient levels in the water column. This may eventually cause adverse impacts on aquatic ecology and water supplies of the reservoirs.

8.6.15 The water quality impact assessment of the EIA also showed that the water tunnel will not affect the water table of the existing condition. The potential effect of the proposed freshwater transfer tunnel on the water table is of negligible impact.

Disturbance to Wildlife

8.6.16 Presence of workers, moving machines and other construction activities including drilling may disturb the wildlife utilizing the reservoirs, plantation woodland and grassland within the works area in the Kam Shan Country Park and the Lower Shing Mun Reservoir. The dominant species including the Rhesus Macaque and bird species of conservation concern recorded within the works area (Black Kite) may avoid using habitats surrounding the worksite areas to get rid of the disturbing activities. The disturbance impacts due to this proposed project are expected to be low owing to the temporary nature and the existing area in Kam Shan Country Park is frequently visit by visitors and morning hikers, while construction works is being in progress in the Lower Shing Mun Reservoir, the impacts on wildlife are anticipated of low significant with good construction site practices.

8.6.17 Disturbance impacts to wildlife utilizing the adjacent habitats within the study area may include noise disturbance and silt runoff to the reservoirs. Species of conservation concern that may affect include the Rufous-capped Babbler, Black Kite, Palla's Squirrel, Rhesus macaque and Longtailed Macaque. They are all mobile species that will avoid utilizing the adjacent habitats during the construction period. The nocturnal species recorded in the Kam Shan Country Park in previous studies including the Small-toothed Ferret Badger, Masked Palm Civet, Small Indian Civet, Leopard Cat and East Asian Porcupine will also avoid hiding close to the works area during the daytime. Wildlife inhabit in the Lion Rock Country Park

within the study area will not be affected by this proposed project, as it is separated from the Kam Shan Country Park by the Tai Po Road which is having heavy traffic.

Identification of Impacts during Operational Phase

8.6.18 Only the two portal structures were proposed on surface while the whole water tunnel will be constructed underground. As these two permanent portal structures were planned on existing bare rock (i.e. at Kowloon Byewash Reservoir) or bare soil (i.e. Lower Shing Mun Reservoir), no adverse impact on ecology was anticipated during the operational phase.

Identification of Cumulative Impacts

8.6.19 As stated in Section 2.7 of this report, three planned projects may be implemented concurrently, including:

- PWP Item No. 155CD - West Kowloon drainage improvement - Lai Chi Kok drainage tunnel scheduled to commence in November 2008 for completion in September 2012;
- The Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) – Hong Kong Section likely to commence in 2009; and
- Agreement No. CE 77/2001 (GE) and 2/2006 (GE) – Slope Upgrading Works with no definite program.

8.6.20 The Lai Chi Kok Drainage Tunnel project will be located outside the EIA study area of our project, while XRL is all underground with substantial vertical separation with the IRTS tunnel. The slope upgrading works will only involve minor maintenance works on existing artificial slopes. Therefore no cumulative impacts were identified.

8.7 Evaluation of Impacts

Impacts during Construction Phase

8.7.1 Potential construction impacts identified in the study included: habitat loss, direct injury to wildlife, dust deposition on vegetation, impacts to water quality and disturbance to wildlife.

Habitat Loss

8.7.2 Although the habitat loss would be likely the potential direct impact, this impact will be temporary in nature as all the lost habitats will be reinstated after the completion of the project.

8.7.3 At worksite area at Kowloon Byewash Reservoir, although four types of habitat were included, only the secondary woodland / plantation had got a higher ecological value for its denser vegetation, semi-naturalness and support of diverse wildlife. However the affected portion of the woodland is very small in size (approx. 0.03ha) and it is directly adjoining the barbecue site where high level of human disturbance is expected. Unlike the core part of the secondary woodland / plantation, the portion within the worksite area is only the edge of the habitat which contains common species despite one individual of *Artocarpus hypargyreus* was recorded. Therefore even though the habitat type of secondary woodland / plantation within the whole study area was evaluated as high in overall, impact on the onsite habitat is

anticipated to be not significant.

8.7.4 The construction of intake structure at the Kowloon Byewash Reservoir and outfall structure at Lower Shing Mun Reservoir will cause temporary loss of part of the reservoir areas within the proposed worksite areas (approx. 0.15ha and 0.31ha respectively) during the construction period. Cofferdams would be constructed along the interface between the reservoirs and the worksite areas to separate the reservoir from construction activities. In order to build the cofferdams, the reservoirs would be required to be drained down temporarily.

8.7.5 As the cofferdam will be used to separate the reservoirs from the worksite areas, no further draining down would be required for the remaining part of the reservoirs. Therefore the minor habitat loss will not cause significant impact on the main bodies of the reservoirs which will carry out their normal function during the construction period. These cofferdams will be removed after the completion of the works. Fishes inhabit in the drained portion will follow the water flow to the remaining reservoir portion. Taking into account the small size involved, temporary nature of the impact, and the colonization of fish species to the remaining reservoir portion with normal function, the temporary impact of draining down of a small portion of the reservoir is considered negligible.

8.7.6 Taking into account the very small size of the habitats to be affected, and the temporary nature of the impact, the impact level to the habitat loss and loss of foraging ground for Rhesus macaque is considered to be moderate-low.

8.7.7 As all the habitats within the worksite area at Lower Shing Mun Reservoir were of low to medium-low ecological value, the temporary loss of the habitats was considered Low.

8.7.8 The temporary loss of feeding ground for butterfly species in the Lower Shing Mun Reservoir will have low impact on the butterflies, as the butterfly species recorded are common and very common that dominated by Riodinidae and Nymphalidae that also prefers plantation woodland habitat, the butterflies will re-colonize to the habitat once reinstate in the operation phase.

8.7.9 The temporary loss of developed area/bare ground at the two proposed worksite areas for works operation, temporary storage and site haul roads will have negligible impact for their low ecological value.

8.7.10 Summary of the impact evaluation is presented in below.

Table 8-14 Evaluation of Ecological Impact of Habitat Loss

Criteria	*Worksite Area at Kowloon Byewash Reservoir*	*Worksite Area at Lower Shing Mun Reservoir*
Habitat Quality	Most of the habitats are of medium-low to low; only the small part of the habitat edge of the secondary woodland /plantation has higher habitat quality	Overall medium-low to Low

Criteria	***Worksite Area at Kowloon Byewash Reservoir***	***Worksite Area at Lower Shing Mun Reservoir***
Species	All species are common and widespread except the potential of having Rose Bitterling flow from the upstream Kowloon Reception Reservoir. One individual of *Artocarpus hypargyreus* was found within the site. It is a common tree species in Kam Shan Country Park.	All species are common and widespread except the Wild Carp (*Hemiculter leucisculus*) of uncommon status.
Size / Abundance	The affected area is small in size; both flora and fauna abundance is low.	The affected area is small in size and both flora and fauna abundance is low especially for the aquatic fauna due to the drain down of reservoir for maintenance works.
Duration	During construction period	During construction period
Reversibility	Reversible but restoration of secondary woodland / plantation requires longer time.	Reversible.
Magnitude	Medium	Medium
Overall Impact Severity	Moderate-low	Low

Impact on Floral Species of Conservation Concern

8.7.11 As described in Section 8.4.15 and **Table 8-10**, two floral species of conservation concern were identified at proposed worksite areas. The *Artocarpus hypargyreus* found at Kowloon Byewash Reservoir worksite area is a species ranked as Near Threatened under the *List of Wild PlantsUnder State Protection* of Mainland China. However this species in contrast is quite common in Hong Kong (Corlett *et al,* 2000) and not protected locally.

8.7.12 The removal of the tree will be regulated by the requirements stipulated in the relevant technical circular ETWB TCW No. 3/2006. Although the individual is not suitable for transplanting for its low survival rate after transplanting, compensatory planting is required for its removal during the tree removal application stage in accordance with the technical circular ETWB TCW No. 3/2006. Taking into the account only one individual is affected and the species is very common in Hong Kong, no adverse impact on the species community is anticipated and the impact level is considered to be low.

8.7.13 The Pavetta hongkongensis could be either preserved onsite or transplanted. Taking into the account only one individual is affected, the affected species is common in Hong Kong and also the practical measures to be carried out, the impact level is considered to be low.

8.7.14 Summary of the impact evaluation is presented below.

Table 8-15 Evaluation of Ecological Impact on Floral Species of Conservation Concern

Criteria	*Artocarpus hypargyreus*	*Pavetta hongkongensis*
Species	- Not protected in Hong Kong; - listed as Near Threatened in Mainland China. - species is common and widespread in Hong Kong	- Protected locally under the Forestry Regulations. - species is common and widespread in Hong Kong
Size / Abundance	Young tree; one individual	Young shrub; one individual
Duration	During construction period	During construction period
Reversibility	Not reversible	Not reversible
Magnitude	Low	Low
Overall Impact Severity	Low	Low

Direct Injury to Wildlife

8.7.15 Wildlife like Rhesus Macaque may be hurt during the operation of the construction plants and machinery. Precautionary measures like avoidance of eating in the works area and feeding of wildlife could minimize the chance of attracting the wildlife to the works area. The impact on direct injury to wildlife will be of insignificant with the implementation of good site practices.

8.7.16 No direct injury of fishes may occur during the draining process of the reservoir prior to construction, as the draining process is routinely operated during reservoir overflow event and the fishes will colonize to other portion of the reservoir with water outside the works area.

Table 8-16 Evaluation of Ecological Impact on Direct Injury to Wildlife

Criteria	Rhesus Macaque	Fishes in the Reservoir
Species	- Protected under WAPO and PEAPO in Hong Kong; - listed in IUCN as Lower Risk/Near Threatened; - listed in CRDB as Vulnerable; - species is common and widely distributed in Hong Kong	- One potential rare species the Rose Bitterling of potential global concern; - Other fish species in the Kowloon Byewash Reservoir is common and widespread or exotic to Hong Kong - One uncommon species the Wild Carp (*Hemiculter leucisculus*) recorded in the Lower Shing Mun Reservoir by previous AFCD study

Criteria	Rhesus Macaque	Fishes in the Reservoir
Abundance	High abundance in Kam Shan Country Park	- No observation of Rose Bitterling was recorded in the Kowloon Byewash Reservoir but may flow from the upstream Kowloon Reception Reservoir during water discharge; - Abundance for other fish species are moderate-low to low for Kowloon Byewash Reservoir - No fish was recorded in the Lower Shing Mun Reservoir during the study period due to the drain down of reservoir for maintenance
Duration	During construction period	During construction period
Reversibility	Not reversible	Not reversible
Magnitude	The chance of direct injury to wildlife is low	The chance of direct injury to wildlife is low
Overall Impact Severity	Low	Negligible

Dust Deposition on Vegetation

8.7.17 As standard good site practices must contain dust suppression measures to control the air quality (details refer to Section 3 Air Quality), dust impact on offsite vegetation is considered not significant. Summary of the impact evaluation is presented below.

Table 8-17 Evaluation of Ecological Impact of Dust Deposition

Criteria	*Worksite Area at Kowloon Byewash Reservoir*	*Worksite Area at Lower Shing Mun Reservoir*
Habitat Quality	The habitat quality along the edge of the woodland is medium.	The habitat quality along the edge of the woodland is medium.
Species	No rare species was identified.	No rare species was identified.
Size / Abundance	The interface between the worksite area and the surrounding habitats is small.	The interface between the worksite area and the surrounding habitats is small.
Duration	During construction period	During construction period
Reversibility	Reversible	Reversible
Magnitude	Low	Low
Overall Impact Severity	Low	Low

Impact to Water Quality

8.7.18 As standard good site practices must contain site runoff control measures to maintain the water quality (details refer to Chapter 5 Water Quality) within acceptable level, no significant level of impact is thus predicted. Summary of the impact evaluation is presented in below.

Table 8-18 Evaluation of Ecological Impact of Deterioration of Water Quality

Criteria	*Worksite Area at Kowloon Byewash Reservoir*	*Worksite Area at Lower Shing Mun Reservoir*
Habitat Quality	Medium-low to low	Medium-low to low
Species	- One potential rare species the Rose Bitterling of potential global concern; other fish species are common and widespread or exotic to Hong Kong.	- One uncommon Wild Carp (*Hemiculter leucisculus*) was recorded in previous AFCD study - No aquatic fauna was recorded during the study period as it is being drained for construction.
Size / Abundance	- Size of the site is small and no observation of Rose Bitterling was recorded in the Kowloon Byewash Reservoir but may flow from the upstream Kowloon Reception Reservoir during water discharge; - Abundance for other fish species are moderate-low to low	Size of the site is small
Duration	During construction period	During construction period
Reversibility	Reversible	Reversible
Magnitude	Low	Low
Overall Impact Severity	Low	Low

Disturbance to Wildlife

8.7.19 The disturbance impacts due to this proposed project are expected to be low owing to the temporary nature and the existing area in Kam Shan Country Park is frequently visit by visitors and morning hikers, while construction works is being in progress in the Lower Shing Mun Reservoir, the impacts on wildlife are anticipated of low significant with good construction site practices.

8.7.20 The disturbance impacts to wildlife utilizing the adjacent habitats will be temporary and of moderate-low significance due to a large area of suitable habitats presence in connection to the affected area. There will be no impact on the Lion Rock Country Park for the long separation distance from the works area.

8.7.21 Summary of the impact evaluation is presented in the table below.

Table 8-19 Evaluation of Ecological Impact of Disturbance to Wildlife

Criteria	*Kam Shan Country Park*	*Lower Shing Mun Area*
Habitat Quality	High for secondary woodland / plantation and medium-low for Kowloon Reservoirs Group	High for secondary woodland / plantation and medium-low to low for other habitats
Species	Species of conservation concern that may affect by noise and other construction disturbances: Rhesus Macaque, Longtailed Macaque, Palla's Squirrel, Small-toothed Ferret Badger, Masked Palm Civet, Small Indian Civet, Leopard Cat and East Asian Porcupine Black Kite and Rufous-capped Babbler	No rare species is identified, common bird species will be disturbed by the construction activities
Size / Abundance	Small area adjacent to the works site will be affected and the species abundance is low	Small area adjacent to the works site will be affected and the species abundance is low
Duration	During construction period	During construction period
Reversibility	Reversible	Reversible
Magnitude	Low	Low
Overall Impact Severity	Moderate-low	Low

8.8 Recommendations on Ecological Impact Mitigation Measures

Mitigation Measures for Habitat Loss

8.8.1 Although the impact of habitat loss is considered not significant for both sites around the two portals, mitigation measures were recommended to further minimise adverse effect.

8.8.2 During detailed design, vegetation clearance should be minimised as far as possible. Clearance of certain areas of habitat may be required for the implementation of the project. Restoration of same type of habitat (i.e. woodland and grassland) in ratio not less than 1:1 in terms of area should be conducted to avoid residual impact and allow re-colonization of bird and butterfly species utilizing the habitats.

8.8.3 The actual size of habitat loss will be subject to the detailed design. If the worst case scenario is adopted, all the habitats within the works boundary are assumed to be affected. **Table 8-20** shows the quantities of affected and compensated areas and **Figure 8-6** and **8-7** indicate proposed area for habitat reinstatement.

Table 8-20 Habitat Loss and Proposed Mitigation at Worksite Areas

Habitat	Habitat Loss at Worksite Area at Kowloon Byewash Reservoir Portal	Habitat Loss at Worksite Area at Lower Shing Mun Reservoir Portal	Ecological Mitigation Measure	Compensated Area

Habitat	Habitat Loss at Worksite Area at Kowloon Byewash Reservoir Portal	Habitat Loss at Worksite Area at Lower Shing Mun Reservoir Portal	Ecological Mitigation Measure	Compensated Area
Secondary Woodland/ Plantation	0.03ha	-	Habitat Restoration in ratio at least 1:1	0.03ha
Grassland	-	0.08ha	Habitat Restoration in ratio at least 1:1 *	0.08ha
Drainage Channel	0.01ha / 26m	-	None **	N/A
Reservoir	0.15ha	0.31ha	None **	N/A
Developed Area/ Bare Ground	0.09ha	0.07ha	None **	N/A

* No active planting work is proposed as the grassland habitat will be reinstated through natural colonisation after the completion of the project.

** No active restoration is proposed as these habitats will be reinstated readily after the completion of the project.

8.8.4 In addition, clear definition of works boundary should be provided to prevent disturbance and damage to the adjacent habitats and wildlife.

8.8.5 The reservoirs will be restored once the removal of cofferdam and associated structure on-site, and water will be refilled to the two reservoirs to restore the ecological function by natural rainfall in the wet season.

8.8.6 With the recommended mitigation measures, the impact severity is anticipated to be insignificant.

Mitigation Measures for Impact on Floral Species of Conservation Concern

8.8.7 Avoidance should be the first prioritised option for the impact on the subject plants. Though the two species are common in nature, preservation of them should be considered and this avoidance measure is likely practical for *Pavetta hongkongensis* as it is not situated on area proposed for permanent structures. Nevertheless if this option becomes impossible due to engineering, safety or other site constraints, transplanting the affected plants instead of felling should be implemented to minimise the impact.

8.8.8 The removal of the tree will be regulated by the requirements stipulated in the relevant technical circular ETWB TCW No. 3/2006. Although the individual is not suitable for transplanting for its low survival rate after transplanting, compensatory planting is required for its removal during the tree removal application stage in accordance with the technical circular ETWB TCW No. 3/2006. Taking into the account only one individual is affected and the species is very common in Hong Kong, no adverse impact on the species community is anticipated and the impact level is considered to be low.

8.8.9 As described in Section 8.6.10, preservation of the *Artocarpus hypargyreus* may not be feasible as it will be in direct conflict with the constructions. Although the individual is not

suitable for transplanting for its low survival rate after transplanting, compensatory planting is required for its removal during the tree removal application stage in accordance with the technical circular ETWB TCW No. 3/2006. The compensatory planting plan regulated by the ETWB TCW No. 3/2006 will be reviewed and approved by the control authority AFCD before implementation

8.8.10 The impact severity of either unmitigated or mitigated condition is anticipated to be insignificant as only one individual of each species was involved.

Mitigation Measures for Direct Injury to Wildlife

8.8.11 Although the potential of direct injury to wildlife is predicted to be low, precautionary measures are recommended as below:

- Workers should avoid eating or leave food in the works area and feeding of wildlife, this could minimize the chance of attracting the wildlife especially the Rhesus Macaque to the works area to cause direct injury.
- If any fauna species are injured by accident, the species should be reported and handed to the Agricultural, Fisheries and Conservation Department.
- Fishes observed remaining at the proposed works area during the drain down process should be translocated to the portion of the reservoir outside the cofferdam.

8.8.12 The impact on direct injury to wildlife will be of insignificant with the implementation of good site practices.

Mitigation Measures for Dust Deposition on Vegetation

8.8.13 Standard good site practices for dust suppression as suggested in Chapter 3 were considered adequate to control the dust level. No additional measure is required.

Mitigation Measures for Impacts to Water Quality

8.8.14 Standard good site practices for site runoff control as suggested in Section 5.10 were considered adequate to maintain the water quality in acceptable level. No additional measure is required.

Mitigation Measures for Disturbance to Wildlife

8.8.15 Precautionary measures to minimize disturbances arising from the construction activities to wildlife are recommended as follows:

- Workers shall not disturb birds and other wildlife
- Litter shall not be burned on-site but shall be removed off-site
- Machinery not in use should be switched off to minimize the noise nuisance
- No fishing is allowed in the reservoir without permission
- Feeding prohibition

8.8.16 The implementation of precautionary measures and the provision of cofferdam to separate the works area from the remaining portion of the reservoir, the disturbance impacts to wildlife and fishes can be maintained in an acceptable level.

8.8.17 A summary of the recommended mitigation measures is presented below.

Table 8-21 Summary of Recommended Mitigation Measures

Impacts	Recommended Mitigation Measures
Habitat Loss of: - Secondary Woodland / Plantation - Grassland - Reservoir	- Restoration of secondary woodland / plantation at Worksite Area at Kowloon Byewash Reservoir by planting (species should be made reference to the Tree Survey for this project) to compensate the temporary loss of the same kind. The compensation ratio in terms of area should not be less than 1:1. - Restoration of grassland at Worksite Area at Lower Shing Mun Reservoir by natural colonisation to compensate the same kind. The compensation ratio in terms of area should not be less than 1:1. Although active planting is not necessary for this type of habitat, suitable planting soil should be provided for natural colonisation. - Apart from the Intake and outfall structures, the ecological function of the reservoir will be restored after the removal of cofferdam and associated structures and refill of the reservoir in the wet season by natural rainfall.
Impact on Floral Species of conservation Concern	- Preservation by onsite protection should be considered as prioritised option. - Mitigation through either transplanting the affected plants or compensatory planting if onsite preservation is not feasible.
Direct Injury to Wildlife	- Workers should avoid eating and leave food in works area and avoid feeding the wildlife. - Fishes observed remaining at the proposed works area during the drain down process should be translocated to the portion of the reservoir outside the cofferdam.
Dust Deposition on Vegetation	- Standard good site practices for dust suppression should be strictly implemented.
Impacts to Water Quality	- Standard good site practices for dust suppression and avoidance of chemical spillage should be strictly implemented.
Disturbance to Wildlife	- Workers shall not disturb birds and other wildlife -Litter shall not be burned on-site but shall be removed off-site -Machinery not in use should be switched off to minimize the noise nuisance -No fishing is allowed in the reservoir without permission

8.8.18 In addition to the mitigation measures for the identified impacts, a potential enhancement measure of providing roosting surface for bats inside the proposed water tunnel was considered in the tunnel design stage. However, this option was found impractical due to the engineering constraint that the water tunnel will be of full-bore flow at its capacity.

8.9 Environmental Monitoring and Audit Requirements

8.9.1 The implementation of the ecological mitigation measures stated in Section 8.8 should be checked as part of the environmental monitoring and audit procedures during the construction period as presented in the separate Environmental Monitoring and Audit Manual. No other ecology-specific measures are considered necessary.

8.10 Conclusions

8.10.1 An Ecological Impact Assessment (EcoIA) has been conducted for the proposed IRTS Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir. Ecological surveys were carried out in September 2007 to February 2008 which covered both wet and dry seasons.

8.10.2 Six types of habitats were identified within the study area, including reservoir, secondary woodland / plantation, grassland, stream, drainage channel and developed area / bare ground. The habitats inside the boundaries of the proposed worksite areas were not of high ecological value.

8.10.3 The dominant faunal species recorded in Kam Shan Country Park is the *Rhesus Macaque*, several mammal species of conservation concern were also recorded during previous studies. These faunal species mainly inhabits in secondary woodland/ plantation. The fish species recorded in the Lower Shing Mun area are all common and widespread except the Wild Carp recorded by AFCD in previous study of uncommon status. Although floral and faunal species of conservation concern were identified, no adverse impact on the subject taxa groups was anticipated. Good site practices and avoidance of eating in works area and feeding wild fauna could avoid attracting these animals to the works area. The impacts could be further minimised by implementation of water quality control measures and reinstatement of habitats after construction.

8.10.4 As the entire water tunnel will be constructed underground, the scale of surface construction works is limited in nature. The ecological impact with the implementation of recommended mitigation measures should be within acceptable level.

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9. LANDSCAPE AND VISUAL IMPACT

9.1 Introduction

9.1.1 This section sets out to assess the potential landscape and visual impact of the proposed water tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir under the West Kowloon Drainage Improvement – Lai Chi Kok Transfer Scheme - Inter-reservoirs Transfer Scheme (IRTS). The project partly falls within the Kam Shan Country Park and is therefore regarded as a Designated Project ("DP") under the Environmental Impact Assessment (EIAO) Ordinance, Cap. 499.

9.1.2 The aim of this section of the report is to focus on the major intake and outlet structures at both ends of the proposed water tunnel between Kowloon Byewash Reservoir (Southern Portal) and Lower Shing Mun Reservoir (Northern Portal). This session also identifies the condition of existing landscape resources (LRs) and landscape character areas (LCAs), and the visual amenity and visually sensitive receivers (VSRs). The assessment identifies potential landscape and visual impacts that would occur during the construction and operation phases of the proposed above ground structure, recommends landscape mitigation measures to alleviate the impacts; and identifies residual effects apparent after mitigation. The report concludes by making specific recommendations for reducing the visual impacts caused by the proposed intake and outlet structures of the water tunnel.

9.2 Environmental Legislation, Standards and Legislation

9.2.1 The following legislation, standards and guidelines are applicable to the evaluation of landscape and visual impacts associated with the construction and operation of the project:

- Environmental Impact Assessment Ordinance (Cap.499.S.16) and the Technical Memorandum on EIA process (EIAO-TM), particularly Annexes 3, 10, 11, 18, 20 and 21;
- EIAO Guidance Note 8/2002;
- Hong Kong Planning Standards and Guidelines;
- Forests and Countryside Ordinance (Cap 96) and its subsidiary legislations;
- Waterworks Ordinance (Cap 102);
- Country Parks Ordinance (Cap 208);
- Land Drainage Ordinance (Cap 446);
- Animals and Plants (Protection of Endangered Species) Ordinance (Cap 187);
- ETWBTC No. 29/93 – Control of Visual Impact of Slopes;
- ETWBTC No. 12/2000 - Improvement to the Appearance of Slopes in connection with WBTC 23/93;
- ETWBTC No. 7/2002 – Tree Planting in Public Works;
- ETWBTC No. 3/2006 –Tree Preservation;
- Land Administration Office Instruction (LAOI) Section D-12 – Tree Preservation;
- GEO publication (1999) – Use of Vegetation as Surface Protection on Slopes;

- GEO 1/2000 – Technical Guidelines on Landscape Treatment and Bio-engineering of Man-made Slopes and Retaining Walls;
- Outline Zoning Plan - Shatin (Plan No. S/ST/23)
- Outline Zoning Plan - Cheung Sha Wan (Plan No. S/K5/30)

9.3 Landscape and Visual Impact Assessment Methodology

9.3.1 Landscape and visual impacts have been assessed separately for the construction and operational phases. The assessment of landscape impacts has involved the following procedures.

1. *Identification of the baseline landscape resources/ character areas found within the study area* - This is achieved by site visit and desktop study of topographical maps, information databases and photographs.
2. *Assessment of the degree of sensitivity to change of the landscape resources/ character areas* - This is influenced by a number of factors including whether the resources/ character areas is common or rare, whether it is considered to be of local, regional, national or global importance, whether there are any statutory or regulatory limitations/ requirements relating to the resources, the quality of the resources, the maturity of the resource, and the ability of the resource to accommodate change.

9.3.2 The sensitivity of each landscape resource/ character area is classified as follows:

High: Important landscape resource/ character area of particularly distinctive character or high importance, sensitive to relatively small changes.

Medium: Landscape resource/ character area of moderately valued landscape characteristics reasonably tolerant to change.

Low: Landscape resource/ character area, the nature of which is largely tolerant to change.

3. *Identification of potential sources of landscape impacts.* These are the various elements of the construction works and operation procedures that would generate landscape impacts.
4. *Identification of the magnitude of landscape impacts.* The magnitude of the impact (or magnitude of change) depends on a number of factors including:
   - the physical extent of the impact,
   - compatibility of the project with the surrounding landscape,
   - duration of impacts i.e. whether it is temporary (short, medium or long term), under construction and operation phases, and
   - reversibility of change

9.3.3 The magnitude of landscape impacts is classified as follows:

Large: The landscape resource or character area would suffer a major change

Intermediate: The landscape resources or character area would suffer a moderate change

Small: The landscape resources or character area would suffer slight or barely perceptible change

Negligible: The landscape resources or character area would suffer no discernible change

5. *Identification of potential landscape mitigation measure* - Mitigation measures may take the form of

   - Adopting alternative design or revisions to the basic engineering the architectural design to prevent and/or minimize adverse impacts,
   - Remedial measures such as colour and textual treatment of physical, engineering and building features,
   - Compensatory measures such as the implementation of landscape design measures (e.g. tree planting, creation of new open space etc.) to compensate for unavoidable adverse impacts and to attempt potentially beneficial long term impacts.

   A programme for the mitigation measures is provided. The agencies responsible for the funding implementation, management and maintenance of the mitigation measures are identified.

6. *Predicted significance of landscape impacts before and after the implementation of the mitigation measures* - By synthesizing the magnitude of the various impacts and the sensitivity of the various landscape resources it is possible to categorize impacts in a logical, well-reasoned and consistent fashion. Table 9-1 shows the rationale for dividing the degree of significance into four thresholds, namely insubstantial, slight, moderate, and substantial, depending on the combination of a negligible-small-intermediate-large magnitude of impact and a low-medium-high degree of sensitivity of landscape resources.

Table 9-1 Relationship between Landscape Resources/ Character Area Sensitivity and Impact Magnitude in Defining Impact Significance

MAGNITUDE OF IMPACT (CHANGE)	**Large**	Slight / Moderate	Moderate/ Substantial	Substantial
	Intermediate	Slight / Moderate	Moderate	Moderate / Substantial
	Small	Insubstantial / Slight	Slight / Moderate	Slight / Moderate
	Negligible	Insubstantial	Insubstantial	Insubstantial
		Low	**Medium**	**High**
		Receptor Sensitivity (of Landscape Resources/ Character Area)		

7. *Prediction of Acceptability of Impacts* - An overall assessment of the acceptability, or otherwise, of the landscape impacts according to the five criteria set out in Annex 10 of the EIAO TM.

9.3.4 The assessment of visual impacts involves the followings:

1. *Identification of Zones of Visual Influence (ZVIs) during the construction and operation phase of the Project.* This is achieved by site visit and desktop study of topographic maps and photographs, and preparation of cross-section to determine visibility of the project from various locations.
2. *Identification of Visual Sensitive Receivers (VSRs) within the Zone of Visual Influence (ZVIs) at construction and operation stages.* These are the people who would reside within, work within, play within, or travel through, the ZVIs.
3. *Assessment of the degree of sensitivity to change of the VSRs.* Factors considered include:
   - the type of VSRs, which is classified according to whether the person is at home, at work, at school, at construction and operation stages. These who view the impact from their homes are considered to be highly sensitive as the attractiveness or otherwise of the outlook from their home will have a substantial effect on their perception of the quality and acceptability of their home environment and their general quality of life. Those who view the impact from their workplace of and at school are considered to be only moderately sensitive as the attractiveness or otherwise of the outlook will have a less important, although still material, effect on their perception of their quality of life. The degree to which this applies depends on whether the workplace is industrial, retail or commercial. Those who view the impact whilst taking part in an outdoor leisure activity may display varying sensitivity depending on the type of leisure activity. Those who view the impact whilst travelling on a public thoroughfare will also display varying sensitivity depending on the speed of travel.
   - Other factors which are considered (as required in the EIAO GN 8/2002) include the value and quality of existing views, the availability and amenity of alternative views, the duration or frequency of view, and the degree of visibility.

9.3.5 The sensitivity of VSRs is classified as follows:

High: The VSR is highly sensitive to any change in their viewing experience.

Medium: The VSR is moderately sensitivity to any change in their viewing experience.

Low: The VSR is only slightly sensitive to any change in their viewing experience.

4. *Identification of relative numbers of VSRs* - this is expressed in term of whether there are very few, few, many or very many VSRs in any one category of VSR
5. *Identification of potential sources of visual impacts* - these are the various elements of the construction works and operation procedures that would generate visual impacts.
6. *Assessment of the potential magnitude of visual impacts*. Factors considered include
   - the compatibility with the surrounding landscape,
   - the duration of the impact,

- the reversibility of the impact,
- the scale of the impact and distance of the source of impact from the viewer, and
- the blockage of view

9.3.6 The magnitude of visual impacts is classified as follows:

Large: The VSRs would suffer a major change in their viewing experience

Intermediate: The VSRs would suffer a moderate change in their viewing experience

Small: The VSRs would suffer a small change in their viewing experience

Negligible: The VSRs would suffer no discernible change in their viewing experience

7. *Identification of potential visual mitigation measures* - These may take the form of adopting alternative designs or revisions to the basic engineering and architectural design to prevent and/or minimize adverse impacts, remedial measures such as colour and textural treatment of building features, and tree planting to screen the roads and associated structures. A programme for the mitigation measures is provided. The agencies responsible for the implementation, management and maintenance of the mitigation measures are identified and their approval-in-principle has been sought.
8. *Prediction of the significance of visual impacts before and after the implementation of the mitigation measures* - by synthesizing the magnitude of the various visual impacts and the sensitivity of the VSRs, and the numbers of VSRs that are affected, it is possible to categorize the degree of significance of the impacts in a logical well-reasoned and consistent fashion. The degree of significance are divided into four thresholds, namely, insubstantial, slight, moderate and substantial, depending on the combination of a negligible-small-intermediate-large magnitude of impact and a low-medium-high degree of sensitivity of VSRs.

9.3.7 The significance of visual impacts is categorized as follows:

Substantial: Adverse / beneficial impact where the proposal would cause significant deterioration or improvement in existing visual quality

Moderate: Adverse / beneficial impact where the proposal would cause noticeable deterioration or improvement in existing visual quality

Slight: Adverse / beneficial impact where the proposal would cause barely perceptible deterioration or improvement in existing visual quality

Insubstantial: No discernible change in the existing visual quality

9. *Prediction of acceptability of impacts* - an overall assessment of the acceptability, or otherwise, of the impacts according to the five criteria set out in Annex 10 of the EIAO-TM.

9.3.8 It is assumed that funding, implementation, management and maintenance of the mitigation proposals can be satisfactorily resolved according to the principles in WBTC 3/2006. All mitigation proposals in this report are practical and achievable within the known parameters of funding, implementation, management and maintenance. The suggested agents for the

funding and implementation (and subsequent management and maintenance, if applicable) are indicated in Table 9-6. Approval-in-principle to the implementation, management and maintenance of the proposed mitigation measures is being sought form the appropriate authorities.

9.4 Project Description

9.4.1 As a part of the overall flood control strategy for West Kowloon, the proposed water tunnel will connect Kowloon Byewash Reservoir and Lower Shing Mun Reservoir with approximately 2.8km in length and 3m in diameter. The tunnel starts at Kowloon Byewash Reservoir (Southern Portal) with the level +108.0mPD, and ends at Lower Shing Mun Reservoir (Northern Portal) with the level +82.0mPD. No access shafts along the tunnel alignment would be necessary. The intake structure with an isolation system is proposed to be constructed at the Southwest corner of Kowloon Byewash Reservoir as "Intake A"; where an outfall structure will be constructed at the Southeast corner of Lower Shing Mun Reservoir in associated with an energy dissipater as "Outfall D" selected from different alignment options in Section 2 as the preferred option of this Report.

Southern Portal

9.4.2 The construction of the intake structure requires excavation of the existing ground profile from approximately +120.0mPD to +108.0mPD where the tunnel opening is located with a portal wall above. A circular weir with the radius of 10m and the weir level at +115.0mPD will be situated surrounding the tunnel opening.

Northern Portal

9.4.3 The construction of the outfall structure requires excavation of existing ground profile to the future ground level of +82.0mPD. An energy dissipater will be constructed in associated with the outfall structure with RC wing wall at both sides. The gabions steps will be situated 8m in front of the tunnel opening with the height of 4m. The size of the outfall structure will be 20m in length and 12m in width.

9.5 Review of Planning and Development Control Framework

9.5.1 The proposed water tunnel has been reviewed against a number of relevant Outline Zoning Plans of Kowloon and New Territories: Plan No. S/K5/30 for Southern Portal and Plan No. S/ST/23 for Northern Portal. The impact on the planning and development control framework is identified and evaluated.

Southern Portal

9.5.2 The landscape-related land use zonings present in the Study Area surrounding the Southern Portal and relevant to the LVIA are as follows:

- Green Belt (GB) – the planning function of GB is to limit the encroachment of urban development into the countryside.
- Residential Group C (R(C)4) – the planning function of R(C)4 is to allow low-to-medium density residential developments.
- Government, Institution or Community (G/IC) – the planning function of (G/IC) is to provide land for uses directly related to or in support of the work of the Government,

organizations providing social services to meet the community needs.

Northern Portal

9.5.3 The landscape-related land use zonings present in the Study Area surrounding the Northern Portal and relevant to the LVIA are as follows:

- Green Belt (GB) – the planning function of GB is to limit the encroachment of urban development into the countryside.
- Residential Group B (R(B)) – the planning function of R(B) is to allow medium density residential developments.
- Government, Institution or Community (G/IC) – the planning function of (G/IC) is to provide land for uses directly related to or in support of the work of the Government, organizations providing social services to meet the community needs.

9.5.4 No part of the proposed water tunnel will be constructed through any of the above landscape zonings, therefore the Project is considered not to be in conflict with the landscape zonings in the area. Therefore the proposals will fit within the future landscape planning framework as represented by the OZPs and so no amendment to the published land use plans is required.

9.6 Landscape and Visual Baseline Study

Landscape Resources (LR)

9.6.1 The baseline landscape resources that would be affected during the construction phase and operation phase, together with their sensitivity to change, are described below. The locations of baseline landscape resources are mapped in Figure 9-1a and 9-1b.

LR1 – Mixed Woodland

9.6.2 This LR refers to the continuous secondary forests and fragmented plantation forests covering hillsides and slopes around Kowloon Byewash Reservoir and Lower Shing Mun Reservoir. These provide contribute to the quality of the mountain setting and form a green backdrop to views for trail walkers at both the reservoir areas, and for the residents at Caldecott Road and Sha Tin Heights. Since all works for the connecting tunnel will be undertaken using a tunnel boring machine (TBM) the affected woodland areas are mainly concentrated at the South and North Portals where the construction of the above ground structures is required. Regarding the conditions of existing trees near the affected areas, tree surveys have been conducted for both portals of the Proposed Water Tunnel and the results of the survey are presented below.

Existing Trees - Southern Portal

9.6.3 The main concentration of trees is located on the back slope to the north of the proposed intake structure. The site contains some 262 trees as described in the preliminary tree survey schedule in Appendix I (KBR) prepared by Mott MacDonald Hong Kong Limited. Some of the trees are non-native plantation species which were planted as part of the greening of the slopes in the past. The typical plantation species include *Acacia confusa* and *Eucalyptus robusta*; and the main native species include *Celtis sinensis*, *Schefflera heptaphylla*, *Sterculia lanceolata*, *Artocarpus hypargyreus*, *Aporusa dioica*, *Antirhea chinensis* and *Acronychia pedunculata* etc. Despite their origins, these trees contribute to the landscape and visual amenity of the site and the local area. Generally the trees have an average form, fair condition and good amenity value. None of the surveyed trees were categorized as a 'Significant Tree'

with a Diameter Breast Height (DBH) of over 1m.

Existing Trees - Northern Portal

9.6.4 The main concentration of trees is located on the slope to the south on the back slope above the proposed outfall structure. The site contains some 203 trees as described in the preliminary tree survey schedule in Appendix I (LSMR). Similarly a number of the tree species are non-native being planted as part of greening of the reservoir access road and slopes. The typical plantation species include *Acacia confusa* and *Schima superba* while the main native species include *Ixonanthes reticulata*, *Schefflera heptaphylla*, *Diospyros morrisiana*, *Schima superba*, *Garcinia oblongifolia* and *Mallotus paniculatus*. Again these trees contribute to the landscape and visual amenity of the site and the local area. Generally the trees have an average form, fair condition and good amenity value. None of the surveyed trees were categorized as 'Significant Tree' with a DBH of over 1m.

9.6.5 No rare or protected tree species (based on Forests and Countryside Ordinance, Cap. 96) or Champion Trees (identified in the book 'Champion Trees in Urban Hong Kong') were found in both portal areas.

9.6.6 As this LR is one of the key resources of the area with a high landscape value, and trees are relatively mature and of a generally fair condition; and despite there being a combination of native and exotic plantation species, the sensitivity to change for LR1 is High.

LR2 – Modified Water Course

9.6.7 The Study Area covers two main reservoir systems in Hong Kong, i.e. Kowloon Byewash Reservoir as a part of Kowloon Reservoir Group and the Lower Shing Mun Reservoir. In other words, they include both upstream of the original natural stream course connected to artificially modified catchwater features, reservoirs and dams. The assessment of the sensitivity of this resource is a balance between its artificially modified form flooding the original valley landscapes and the value of the resource as part of a scenic landscape which has been modified by man. Therefore the sensitivity of LR2 to change is Low.

LR3 – Developed Areas

9.6.8 These landscape resources include the existing residential groups comprising of medium-rise residential buildings. These are mainly located at the northern and southern edge of the Study Area. Apart from residential groups, there are a number of government institutional buildings including the staff quarters and WSD maintenance areas situated the southern edge of the Study Area. In addition to the institutional buildings, an Over Head Line Training School with access road located at the northern part. These landscape resources also include part of Tai Po Road – Shatin Heights and Tai Po Road – Piper's Hill at the northern and southern edges respectively. Man-made slopes within the Study Area are also recognised as developed areas, which are mainly located adjacent to the maintenance access road of Lower Shing Mun Reservoir. Since the developed areas as a landscape resource are tolerant to change, the sensitivity of this LR is Low.

<u>Landscape Character Area (LCA)</u>

9.6.9 The following landscape character areas are identified and described below, and their locations are mapped in Figure 9-2.

LCA1 – Kowloon Reservoir Group LCA

9.6.10 This LCA refers to the entire system of Kowloon Reservoir Group including the Shek Lei Pui Reservoir, Kowloon Reservoir, Kowloon Reception Reservoir, Kowloon Byewash Reservoir, the upstream catchwater course linked to the reservoir group and the hillside enclosing the reservoir group. This LCA is formed by the steep wooded hill sides which enclose the valleys containing the reservoir system. The water body with is bare rock strewn shores and man-made features such as the dam structures and access roads form an important part of the landscape character. The enclosing hillside and upstream courses connected to catchwater form a remnant of the natural valley landscape character. The existing vegetation which encloses this area is formed from secondary forests and plantation trees on the hillsides. Based on the overall quality of this LCA and considering its importance to the landscape and visual amenity of the Kam Shan Country Park as well as for the Cheung Sha Wan urban fringe residential groups, its sensitivity to change would be High.

LCA2 – Lower Shing Mun Reservoir LCA

9.6.11 This is characterized by the Lower Shing Mun Reservoir, the catchwater linked to the reservoir and the enclosing wooded hillsides. This LCA shares the same landscape attributes as those described for LCA1 above. The LCA is bisected by the boundary of the Kam Shan Country Park. This LCA is formed from a combination of the man made or modified landscape associated with the reservoir and the remnant natural landscapes of the connecting valleys and upstream water courses. The water body and the related features, such as dams and access roads also contribute to the overall character. The main vegetation includes secondary forest and plantation trees on the surrounding hillsides. The sensitivity to change of this LCA is regarded as Medium due to its combination of natural and artificial landscape elements.

LCA3 – Sha Tin Height Urban Fringe LCA

9.6.12 This LCA is characterized by low to medium-rise residential development. These are a residual landscape type characteristic of the transition from urban to rural, the urban fringe type development. Two minor peaks located to the north and south with the levels of about +160mPD are identified with low to medium-rise residential blocks. A valley is located between two minor peaks with a level of +120mPD. The hillside is generally clothed with dense secondary forest with more composition of shrubs when it comes to higher altitude.

9.6.13 The dense vegetation which extends from the Green Belt areas provide the setting for the residential development and contribute to its integration within the existing landscape context. As a consequence the residential development is relatively inconspicuous within the overall landscape of the Study Area. The sensitivity to change of LCA3 is regarded as Medium.

LCA4 – Cheung Sha Wan Urban Fringe LCA

9.6.14 This LCA forms part of the urban fringe or transition from the urban Cheung Sha Wan area to the Kam Shan Country Park. This area is characterised by mainly medium-rise residential development, LCA4 also includes vegetation cover of valley which also shows some characters of settled valley landscape. Since this LCA is developed with quite a number of medium-rise residential buildings with other architectural structures such as high tension electricity pylons and a number of institutional buildings including water treatment plant,

primary and secondary schools, the sensitivity of this LCA is regarded as Low.

Landscape Sensitivity to Change

9.6.15 The landscape resources (LR) and landscape character areas (LCA) that would be potentially affected during the construction phase and operation phase, together with their sensitivity to change, are summarised in Table 9-2.

Table 9-2 List of Landscape Resources / Landscape Character Areas and their Sensitivity to Change

IID. No.	Landscape Resource / Landscape Character Area	Sensitivity to Change (Low, Medium, High)
	Landscape Resource	
LR1	Mixed Woodland	High
LR2	Modified Water Course	Low
LR3	Developed Areas	Low
	Landscape Character Area	
LCA1	Kowloon Reservoir Group LCA	High
LCA2	Lower Shing Mun Reservoir LCA	Medium
LCA3	Sha Tin Height Urban Fringe LCA	Medium
LCA4	Cheung Sha Wan Urban Fringe LCA	Low

Figure 9-3a-d illustrate the photographic record of the site context and identified LRs / LCAs.

Existing Visual Context

Visual Envelope

9.6.16 As the Project includes two portals of the proposed water tunnel, where underground tunnel alignment is not observable, visual envelope, the area from which the proposed intake structures will be seen, is divided into two parts, i.e. the area around the Southern Portal and that of the Northern Portal. Figure 9-3a-b illustrate the photographic record of site context at both Southern and Northern Portal.

Southern Portal

9.6.17 The visual envelope for the Southern Portal is shaped by the upland landscape which surrounds it including the ridge line of the Eagle's Nest and associated foothills to the east. Views from the north are contained by the existing undulating topography and it's covering of dense vegetation along both sides of the Kowloon Byewash Reservoir. The top of the main dam structure is evident in these views. The visual envelope to the west is also contained by the densely vegetated hillside behind the proposed intake structure. To the south, the visual envelope is shaped by the existing landform extending across the valley to the residential development adjacent to Caldecott Road. Views from this direction feature a partial view of the dam structure framed by the hillsides. Views of the whole dam structure are only available from Cheung Yuen Road (portion of the dam for the Kowloon Byewash Reservoir), the footpath on the ridge of surrounding hillside including Eagle's Nest and the abandoned WSD staff quarters; whilst for the majority of views points, the views of the proposed

structure will be partial.

9.6.18 When viewed from close proximity the site context is dominated by existing dam structure and the water body of Kowloon Byewash Reservoir, situated next to the proposed intake structure (refer to Figure Figure 9-3a – Photographic Record of the Site Context). The following views provide an indication of the character of the site and its surroundings:

9.6.19 Views to the northwest (viewpoint 1) from the existing Kowloon Byewash Reservoir dam show the roadway on top of the dam structure connecting to Cheung Yuen Road. The proposed location of the intake is located on the rocky shore to the north (right) of the dam structure. The view shows a panorama extending north east to the end of the reservoir. The image shows the screening effect of the landform and mature vegetation at the edge of the reservoir. Although the summit of Golden Hill is visible in this view it does demonstrate the screening effect of the intervening landscape features for views beyond the edge of the reservoir.

9.6.20 The view to the northeast (viewpoint 2) from the existing Kowloon Byewash Reservoir dam show a more detailed view of the proposed location for the Intake structure. The site is one formed from a combination of rock outcrops and a sandy rock strewn beach area which is exposed when the reservoir is low. Again the screening effect of the vegetation at the edge of the reservoir is apparent in this view.

9.6.21 Views to the southwest (viewpoint 3) from the existing Kowloon Byewash Reservoir dam shown the area to the south of the dam structure. Visible at the end of the dam on the hillside is the 2-storey high former WSD staff quarters. The view from this location is characterized by the landscape of the natural valley although the valley floor is dominated by the structures associated with the reservoir. The view shows the steep sides of the valley clothed by mature woodland. As with the other view points views towards the dam and the proposed site are largely enclosed by the landform and vegetation which form the valley sides.

9.6.22 The view to the west and southeast (viewpoint 4) from the dam form a continuation of viewpoint 2 and shows the south eastern shore of the reservoir with its steep terrain and dense vegetative covering. The eastern shore of the reservoir with its steep wooded sides and the summit of the Eagle's Nest appearing above are clearly visible. The 2-storey high former WSD staff quarter is visible together with the elevated dam structure as a part of Cheung Yuen Road. This view also demonstrates that despite viewing length and angle the natural topography and vegetation still serve to enclose views.

Northern Portal

9.6.23 The visual envelope for the proposed outfall structure is shaped by the natural elevated topography including the summit and ridges of Needle Hill, Sha Tin Heights and Golden Hill and contained at a lower level by the wooded valley sides and the form of the existing dam structure. Views to the east and south are contained by the natural landform and mature vegetation along the shores of the reservoir. The visual envelope to the east and south extends to ridgeline of Sha Tin Heights and extends to the summit of Golden Hill. The view to the west is mainly blocked by the ridge of Golden Hill. The view to the north is bounded by the existing dam structure of Lower Shing Mun Reservoir and the ridge of Needle Hill. Views of the whole outfall structure will be available from the top of the dam. Whereas partial views will be available from other locations such as the slopes of Needle Hill.

9.6.24 The visual envelope to the north (viewpoint 1) is contained by a combination of the landform and vegetation of the valley sides and the wooded hillside of Sha Tin Height in the background. It should be noted that the reservoir is currently drained to facilitate the proposed works hence the extensive visibility of rock and gravel surfaces. A shotcrete slope is visible mid-way up the wooded slope to the north of the proposed structure. The peak of Needle Hill (the landform on the horizon on the left hand side of the picture) is the farthest observable feature from this location.

9.6.25 Views to the southwest (viewpoint 2) from the maintenance track on the north eastern side of the valley are enclosed by the vegetated landform on the slopes above the reservoir. The cut slope in the central portion of the picture shows the extensive modification of the existing landform which was undertaken in the past to accommodate the reservoir and its associated structures. Above the cut slope the landscape is one characterized by the secondary woodland.

9.6.26 Views to the east (viewpoint 3) taken from the same location of viewpoint 1 show the reservoir maintenance access road lined by extensive tree and shrub planting. This vegetation coupled with the steep landform serve to contain the visual envelope extending east from the reservoir. The extension of the valley leading to Sha Tin Heights is partially screened by the vegetation lining the lower valley side and valley floor.

9.6.27 Views to the east (viewpoint 4) taken from the southeastern shore of the reservoir show the farmed view towards the residential development of Lake View Garden at Sha Tin Height. As with many of the other views the landform and its covering of vegetation at the sides of the valley and along the shores of the reservoir serve to contain the visual envelope and screen many of the views towards the proposed development site.

9.6.28 Views to the northwest (viewpoint 5) taken from the same location as viewpoint 4 are partially blocked by the vegetated slopes to the east and west of the valley however these views and hence the visual envelope extends north to the summit of Needle Hill and the extensive foothills to the south.

Zone of Visual Influence (ZVI)

9.6.29 The primary ZVI for the Project during the construction phase are illustrated in Figure 9-4a-b with annotated locations of Visual Sensitive Receivers.

Visual Sensitive Receivers (VSRs)

9.6.30 Table 9-3 lists the key VSRs found within the ZVIs. For ease of reference, each VSR is given an identity number, which is used in all relevant tables and figures in this report.

Table 9-3 Key VSRs Identified within the ZVIs

ID. No.	Key Visual Sensitive Receivers (VSRs)	Type of VSRs	Number of Individuals (Large/ Intermediate/ Few/ Very Few)	Quality of Existing View (Good/ Fair/ Poor)	Availability of Alternative Views (Yes/No)	Degree of Visibility (Full/Partial/ Glimpse)	Frequency of View (Very Frequent/ Frequent/ Occasional/ Rare	Sensitivity to Change (Low, Medium, High)
R1	Residents of Lakeview Garden	Residential	Large	Good	Yes	Partial	Occasional	High
R2*	Residents of No. 8 Caldecott Road Government Apartment	Residential	Large	Good	Yes	Partial	Occasional	High
T1	Visitors in Kam Shan Country Park	Traveller	Intermediate	Good	Yes	Full	Occasional	High
T2	Trail Walkers in Lower Shing Mun Reservoir	Traveller	Few	Good	Yes	Full	Occasional	High

*No access for viewing from R2 was allowed; assessment is therefore made by assumption

9.7 Landscape Impact Assessment

Sources of Landscape Impacts

Construction Phase

9.7.1 Sources of impacts in the construction phase would include:

- Construction of intake and outfall structure;
- Temporary loss of vegetative cover including trees at both the site of the intake and the outfall;
- Construction of temporary site access to the works areas at southern portal;
- Associated slope works around the intake and outfall structure;
- Construction of temporary cofferdam;
- Temporary site office, parking area, material storage, workshop, de-silting facilities, site cabins and heavy machinery;
- Temporary road diversion at northern portal;
- Temporary diversion of culverts at northern portal; and
- Construction site traffic.

Operational phase

9.7.2 Sources of impacts in the operational phase would include:

- The appearance of the intake and outfall structures, and
- Partial refill of Lower Shing Mun Reservoir with stormwater diverted from Kowloon Byewash Reservoir. (Existing drought reservoir is due to concurrent WSD's maintenance work)

Nature and Magnitude of Impacts of Unmitigated Landscape Impact during the Construction and Operational Phases

9.7.3 The magnitude of the impacts, before implementation of mitigation measures, on the landscape resources and character areas that would occur in the construction and the operation phase are described and tabulated in Table 9-4. All impacts are adverse unless otherwise stated.

Table 9-4 Significant Landscape Impacts of the Proposed Works during Construction and Operation Phase

ID. No.	Landscape Resources / Landscape Character Areas	Source of Impact	Description of Impacts	Magnitude of Change	
				Construction	Operation
LR1	Mixed Woodland (Approx. area: 319ha)	Construction of intake and outfall structure Associated slope works Construction of temporary cofferdam Construction of temporary site access at Southern Portal	***Southern Portal*** • About 212m^2 of woodland (0.006% of total area of LR1) within Kam Shan Country Park would be temporarily affected by the construction of site access • About 2366.11m^2 of woodland (0.07% of total area of LR1) within Kam Shan Country Park would be temporarily affected by construction activities • About 19 trees would be affected by permanent works ***Northern Portal*** • About 4561.17m^2 of government land (0.14% of total area of LR1) would be temporarily affected at Northern Portal • About 42 trees would be affected by permanent works.	Small	Small
LR2	Modified Water Course	Construction of intake and outfall structure with associated slope works Construction of temporary cofferdam Temporary diversion of culverts at northern portal	***Southern Portal*** • Reform of sloping ground inside Reservoirs ***Northern Portal*** • Reform of sloping ground inside Reservoirs • Culvert would be temporarily diverted	Intermediate	Small
LR3	Developed Areas	Nil	N. A.	Negligible	Negligible
LCA1	Kowloon Reservoir Group LCA	Construction of intake structure Associated slope works Construction of temporary site access Construction of temporary cofferdam	• About 2366.11m^2 of government land within Kam Shan Country Park would be temporarily affected by construction activities • About 212m^2 of government land within Kam Shan Country Park would be temporarily affected by the construction of site access at southern portal • About 19 nos. of existing trees would be affected by the permanent works	Small	Small
LCA2	Lower Shing Mun	Construction of outfall structure	• About 4561.17m^2 of government land would be	Small	Small

ID. No.	Landscape Resources / Landscape Character Areas	Source of Impact	Description of Impacts	Magnitude of Change	
				Construction	Operation
	Reservoir LCA	Associated slope works Construction of temporary cofferdam Temporary diversion of culverts	temporarily affected • About 42 nos. of existing trees would be affected by the permanent works • Refill of currently dry reservoir with diverted stormwater from Kowloon Byewash Reservoir during operation		
LCA3	Sha Tin Height Urban Fringe LCA	Nil	N. A.	Negligible	Negligible
LCA4	Cheung Sha Wan Urban Fringe LCA	Nil	N. A.	Negligible	Negligible

9.8 Visual Impact Assessment

Visual Impacts during Construction Phase

9.8.1 The visual impacts on existing views during construction will be generated by the removal of existing vegetation, the associated slope works, and the activity generally associated with construction works such as machinery, temporary buildings and hoarding.

Visual Impacts during Operational Phase

9.8.2 The visual impacts on existing views during operation will be generated by the appearance of the intake and outfall structures.

9.8.3 As it is impossible to accurately portray the appearance of the Project during construction, visual changes are illustrated in Figure 9-5a-j by comparing the existing views to those immediately after construction and assuming no mitigation measures in place.

9.8.4 The magnitude of the impacts, assuming no mitigation measures on the VSRs that would occur in the construction and operation phase are described and tabulated in Table 9-5. All impacts are adverse unless otherwise stated.

Table 9-5 Significant Visual Impacts of the Proposed Works during Construction and Operation Phase

ID. No.	Key Visual Sensitive Receivers (VSRs)	Blockage of View (Open / Partial / Glimpse / Blocked)	Viewing Distance (M)	Scale of Development (Large / Medium / Small)	Compatibility (Good / Fair / Poor)	Reversibility of Change (Yes / No)	Magnitude of Change (Large / Intermediate / Small / Negligible)	
							Construction	Operation
R1	Residents of Lakeview Garden	Glimpse	200	Medium	Fair	No	Small	Small
R2	Residents of No. 8 Caldecott Road Government Apartment	Glimpse	600	Medium	Fair	No	Small	Small
T1	Visitors in Kam Shan Country Park	Glimpse	20	Medium	Fair	No	Large	Intermediate
T2	Trail Walkers in Lower Shing Mun Reservoir	Glimpse	20	Medium	Fair	No	Large	Intermediate

9.9 Landscape and Visual Mitigation Measures

Introduction

9.9.1 The rationale behind landscape mitigation measures is described in Section 9.3.2 to 9.3.3 including the feasibility of mitigation measures in respect to funding, implementation phasing and their management and maintenance.

Landscape Mitigation Measures

9.9.2 The proposed landscape mitigation measures for the construction phase of the Project are listed in Table 9-6, together with an indication of Funding, Implementation and Maintenance and relevant Authorities. Generally, all landscape mitigation measures are to be implemented as early as possible and they are illustrated in Figure 9-6a-b.

9.9.3 The areas to receive LMM3 – Compensatory Tree Planting (Heavy Standard Trees) are as follows:

- Southern Portal: 31 trees (Heavy Standard); and
- Northern Portal: 82 trees (Heavy Standard).

9.9.4 The proposed species to be used for the compensatory tree planting comprise of a woodland mix including both native tree species and some pioneer tree species including the following species: *Celtis sinensis*, *Cinnamomum camphora*, *Bauhinia blakeana*, *Cinnamomum burmanni*, *Ficus microcarpa*, *Ficus variegata* var. *chlorocarpa.*

Tree Preservation

9.9.5 The tree survey schedules in Appendix I contain detailed information about the trees around both southern and northern portals.

9.9.6 For trees not covered under ETWB No. 29/2004; i.e. all trees in the Study Area, the following order of priority was adopted for tree felling considerations:

1. Retain the trees at their existing locations;
2. If (1) is not possible, transplant the affected trees to other permanent locations near the site, unless the trees affected are of low conservation and amenity value, or have low survival rates or a low chance of recovering normal form after transplanting;
3. If both (1) and (2) are not possible, transplant the trees affected to a permanent, local, offsite location. Only trees with high conservation value or high amenity value, including rare and precious species and 'transplantable' trees are considered for this option.
4. Felling of trees to be considered as a last resort under the following circumstances:
   - There is no other practical alternatives; or
   - The tree(s) has unrecoverable health problems and is in poor condition; or
   - Other justifications are provided by the project proponent.

9.9.7 The preliminary treatment of the existing trees on site is listed in Appendix I Tree Survey Schedule with relevant statistics.

Measures for Preservation and Protection of Trees

9.9.8 During construction progress, the Contractor are requested to carefully preserve retained trees and submit a Tree Preservation and Protection Plan to the ET for review and Engineering for approval before commencing of any works on site.

9.9.9 During the construction phase of the project it is important that the existing trees including all of the preserved and transplanted trees, be protected from the construction activity. As part of the tree protection measures a protection zone known as the 'Cordon Area' will be established around the existing trees or tree groups taking the canopies of the outermost trees as a guide to its extent. This Cordon Area is designed to prevent unauthorized access to the trees and to protect the soil and roots therein from disturbance. It will be protected by chain link fencing to prevent unauthorized access. The footings for the fencing should not infringe upon the proposed Cordon Area. It will be closed to all construction activity apart from the proposed tree preservation works and prevent potentially detrimental activities such as the storage of materials including fuel, the movement of construction vehicles, and the refuelling and washing of equipment occurring within the area of the tree canopy. The fencing shall be erected prior to the commencement of the construction phase operations and remain in place until their completion.

9.9.10 The retained trees, particularly the root systems, are potentially sensitive to runoff and contamination from adjacent construction activity. Therefore measures will be implemented to protect the trees including:

- Prevention of runoff from adjacent construction activities entering the root zone of the retained trees. Contamination through the soil of the preserved root area shall be strictly prohibited through the use of a protective rim along the base of the fence at the edge of the cordon area. This protective rim will be constructed from a waterproof membrane weighted down with sand bags.
- Prevention of chemical and mechanical damage to the trunk, branches and foliage, and the soil bed of trees immediately adjacent to the construction works through the erection of a bamboo scaffolding and transparent polythene sheeting during the proposed construction activities. This will prevent damage to the trees while maintaining solar radiation access and gaseous exchange needed for continued photosynthesis and respiration.
- Pollution control will also be addressed at the source particularly in respect to the piling machines and their associated equipment.

9.9.11 Other considerations for the protection of the existing trees include the following measures:

- The root collar of each tree shall be marked prior to the commencement of works to ensure that the finished soil level after the completion of the works will be the same as the marked collar level. The finished soil level below the retained trees will be same as the existing level.
- Excessive water shall be drained away from the tree protection zones to prevent damage to tree roots by asphyxiation.
- Where possible measures will be taken to ensure that plumes of exhaust fumes, smoke and heated air generated by construction vehicles, machines and equipment will not drift into the Cordon Area.

- Measures will be undertaken to ensure that lifting equipment with cable, pulley gears and haulage will not sail above the Cordon Area.
- Watering of existing vegetation particularly during periods of excavation.
- The rectification and repair of damaged vegetation following the construction phase to its' original condition prior to the commencement of the works or replacement using specimens of the similar or comparable species, size and form where appropriate to the design intention of the area affected.

9.9.12 The Contractor should erect, secure and maintain in good condition temporary protective fencing to protect the preserved trees before commencement of any works within the site. The Contractor should submit method statements including proposed design details of the temporary protective fencing to the ET for review and to the Engineer for approval.

9.9.13 The Contractor should follow all requirements listed in the General Specification for Civil Engineering Works: Section 26 – Preservation and Protection of Trees.

9.9.14 Where advanced tree works including surgery or pruning may be necessary for the enhancement of tree health as well as appearance, the Contractor should provide detailed proposals and method statements to the ET for review and to the Engineer for approval before commencement of any tree surgery or tree pruning works. Pruning should be conducted in accordance with good arboriculture and horticultural practices.

9.9.15 A competent member of the site supervisory staff should be assigned by the Contractor to oversee and supervise tree works related to horticultural operations and preservation of trees within the site, including but without limitation to, planting, transplanting, tree surgery work, pruning and disease or pest control affecting trees on site.

9.9.16 A number of trees were found to be in direct conflict with the works due to their position on the proposed works area for slope regarding works at both portals and permanent access road at southern portal. Trees suitable for transplant within the areas were identified based on the following criteria:

1. **Health** – healthy, free of disease, infestation and undamaged.
2. **Species** – rare species deserve higher rating of retaining. No rare species was found in the Project Area. Native trees reserve higher ecological value than exotic tree species by supporting local ecosystem, which native trees deserve higher rating in transplanting priority. Therefore, good specimen of native trees are good candidates for transplanting.
3. **Size** – large trees, 500mm girth or larger (at breast height), which require specialized method to transplant, and have relatively lower survival rate than juvenile trees
4. **Form** – Trees of poor form (e.g. serious leaning, forked or multi-stem trees) increase difficulty in transplantation.
5. **Location** – Trees situated in positions that are difficult to transplant from due to their direct conflict with the proposed structures or slope regarding works makes careful excavation or protection of their roots impossible. Trees may also located at slopes which are not suitable for transplanting due to the nature of their distorted root orientation.

Compensatory Tree Planting (LMM3)

9.9.17 Where trees cannot be retained or transplanted and have to be felled, compensatory tree planting (LMM3) is proposed as shown in Figure Figure 9-6a-b. In addition, existing retained and new slopes or open space should be planted with suitable tree planting mix for greening and screening views as mitigation purposes. Based on the current available information, the approximate numbers of trees to be felled and compensated are summarized below.

Portal	Felled Trees	Compensatory Planting	Replanting Ratio
Southern Portal	19	31	1: 1.93
Northern Portal	42	82	1: 1.95
Total	61	113	

Note: The results will be subject to the finalisation of the Tree Survey Report

Old & Valuable Trees (OVT) / Trees for Religious Rituals

9.9.18 No OVT or trees for religious rituals have been identified.

Landscape Plan

9.9.19 As the landscape design for the scheme is at a preliminary stage the details of the landscape mitigation measures have sought to establish the conceptual approach to the design and establish the number and location of the proposed tree planting. The Landscape Plan includes the location, size, number and species of plantings, the implementation programme, and the maintenance and management schedules. The Landscape Plan should be read in conjunction with the Ecology Impact Assessment chapter (See Section 8). The landscape Plan shall be certified by the ET Leader and verified by the IEC to confirm that it conforms with the recommendations set out in the approved EIA Report before submission to the relevant authorities.

Table 9-6 Proposed Construction Phase Landscape and Visual Mitigation Measures

Mitigation Measure	Landscape and Visual Mitigation Measures	Funding Agency	Implementation Agency	Maintenance Agency
LMM1	Topsoil, where identified, should be stripped and stored for re-use in the construction of the soft landscape works, where practical.	WSD	WSD	N/A
LMM2	Existing Trees to be retained on site should be carefully protected during the construction phase.	WSD	WSD	WSD / AFCD
LMM3	Compensatory tree planting should be provided to compensate for felled trees.	WSD	WSD	WSD / AFCD
LMM4	Erection of decorative screen hoarding compatible with surrounding setting.	WSD	WSD	N/A
LMM5	Locations of the site office, storage or workshops should be carefully adjusted to areas out of tree protection zones.	WSD	WSD	N/A

Mitigation Measure	Landscape and Visual Mitigation Measures	Funding Agency	Implementation Agency	Maintenance Agency
LMM6	Selection of portals to areas enclosed by existing topography or vegetation.	WSD	WSD	N/A
LMM7	Appearance of the water intake and outfall structures will be of optimal size and colour that fuses with the surrounding environment	WSD	WSD	WSD
LMM8	Reinstatement of disturbed vegetation at both portal areas	WSD	WSD	AFCD

9.10 Residual Environmental Impact

Residual Landscape Impacts

9.10.1 The residual landscape impacts are defined and assessed with reference to Sections 9.3.2 to 9.3.4. Figure 9-6a-b illustrate the proposed landscape mitigation measures that would be incorporated into the Project to mitigate landscape impacts. Residual landscape impacts on landscape resources and landscape character areas are summarized in Table 9-7.

9.10.2 The primary impact would be on the mixed woodland due to the direct conflict between existing trees and the proposed works. Some 19 trees in total would be affected due to the construction of temporary site access at southern portal, associated slope works and construction of intake structure. 31 new trees would be compensated within study area for the loss of greenery from the proposed work. The detail compensatory plan is provided as Figure 9-6a-b. No Champion Trees or Registered Old and Valuable Trees, rare or endangered species were found near both portal areas. The detailed tree preservation, transplanting and felling including the compensatory planting proposals shall be submitted to relevant government departments for approval in accordance with ETWB TCW no. 3/2006. The overall residual impacts on the existing woodland will become insubstantial with the implementation of the recommended mitigation measures.

Residual Visual Impacts

Construction Phase

9.10.3 The residual visual impacts in the Construction Phase are listed in Table 9-8. After implementation of mitigation measures, some adverse residual visual impacts still exist and are shown in Table 9-8.

9.10.4 Moderate adverse impacts would be posed to the VSRs adjacent or close to the works area, i.e. R1 and R2 would receive moderate impacts. VSRs, T1 and T2, are occasionally with close distance to the works area. Therefore, the impacts would be moderate adverse.

Operation Phase

9.10.5 Residual visual impacts in the Operation Phase are listed in Table 9-8. In the Operation Phase, day 1 after implementation of proposed mitigation measures, residual visual impacts of some VSRs are slight, i.e. R1 and R2. When it comes to 10 years after the implementation of proposed mitigation measures, residual visual impacts on R1 and R2 would become insubstantial. For VSRs T1 and T2, due to the permanent existence of the intake and outfall structure in reservoir area, the residual visual impacts would be slight with the reinstatement of woodland.

Table 9-7 Summary of Landscape Impact

ID No.	Landscape Resource / Landscape Character	Sensitivity to Change (Low, Medium, High)		Magnitude of Change (Negligible, Small, Intermediate, Large)		Impact Significance before Mitigation (Insubstantial, Slight, Moderate, Substantial)		Recommended Mitigation Measures	Impact Significance Day 1 after Mitigation		Impact Significance 10 years after Mitigation
									(Insubstantial, Slight, Moderate, Substantial)		
		Con	Oper	Con	Oper	Con	Oper		Con	Oper	Oper
LR1	Mixed Woodland	High	High	Small	Small	Moderate adverse	Moderate adverse	LMM1 to LMM8	Slight adverse	Slight adverse	Insubstantial
LR2	Modified Water Course	Low	Low	Intermediate	Small	Moderate adverse	Slight adverse	LMM4, LMM7	Slight adverse	Insubstantial	Insubstantial
LR3	Developed Areas	Low	Low	Negligible	Negligible	Insubstantial	Insubstantial	Not required	Insubstantial	Insubstantial	Insubstantial
LCA1	Kowloon Reservoir Group LCA	High	High	Small	Small	Moderate adverse	Moderate adverse	LMM1 to LMM8	Slight adverse	Slight adverse	Insubstantial
LCA2	Lower Shing Mun Reservoir LCA	Medium	Medium	Small	Small	Moderate adverse	Moderate adverse		Slight adverse	Slight adverse	Insubstantial
LCA3	Sha Tin Height Urban Fringe LCA	Medium	Medium	Negligible	Negligible	Insubstantial	Insubstantial	Not required	Insubstantial	Insubstantial	Insubstantial
LCA4	Cheung Sha Wan Urban Fringe LCA	Low	Low	Negligible	Negligible	Insubstantial	Insubstantial	Not required	Insubstantial	Insubstantial	Insubstantial

Key: Con = construction phase

Oper = Operational phase

Table 9-8 Summary of Visual Impact

Id No.	Key Visual Sensitive Receiver (VSR)	Receptor Sensitivity (Low, Medium, High)	Magnitude of Impact (Negligible, Small, Intermediate, Large)		Impact Significance without Mitigation Measures (Insubstantial, Slight, Moderate, Substantial)		Recommended Mitigation Measures	Residual Impact Significance with Mitigations (Insubstantial, Slight, Moderate, Substantial)		
			Construction	Operation	Construction	Operation		Construction	Day 1 Operation	10 year after operation
R1	Residents of Lakeview Garden	High	Small to negligible	Small to negligible	Moderate adverse	Slight adverse	LMM1-LMM8	Moderate adverse	Slight adverse	Insubstantial
R2	Residents of No. 8 Caldecott Road Government Apartment	High	Small to negligible	Small to negligible	Moderate adverse	Slight adverse		Moderate adverse	Slight adverse	Insubstantial
T1	Visitors in Kam Shan Country Park	High	Intermediate	Small to negligible	Moderate adverse	Slight adverse		Moderate adverse	Slight adverse	Insubstantial
T2	Trail Walkers in Lower Shing Mun Reservoir	High	Intermediate	Small to negligible	Moderate adverse	Slight adverse		Moderate adverse	Slight adverse	Insubstantial

9.11 Environmental Monitoring and Audit Requirement

9.11.1 This section defines the Environmental Monitoring and Audit (EM&A) requirements that have been recommended to ensure that the proposed landscape and visual mitigation measures are effectively implemented. An implementation schedule for Landscape and Visual Mitigation Measure is provided as Table 9-9.

9.11.2 Regarding the necessary felling of trees within the project area, tree felling application will be submitted for approval by the relevant government departments prior to the commencement of works and tree debris to be removed immediately after felling. Compensatory planting is encouraged to be carried out as soon as possible in order to speed up restoration of greening of environment.

9.11.3 Monitoring and audit should be taken place throughout the construction and operation phases of the Project to ensure and the progress of implementing landscape and visual mitigation measures.

9.11.4 A landscape auditor (as a member of ET) shall be employed to review contractor's submissions and proposals and to monitor and audit the contractor's landscape works in particular to ensure the existing trees retained on-site are being well preserved, tree transplanting and felling operations are being undertaken in accordance with the requirements. Procedures and specifications as stipulated in the contract and the approvals granted by concerned authorities, and all the newly planted vegetations are being maintained properly during the establishment period.

9.11.5 Please also refer to the EM & A Manual for the details of monitoring and audit.

Table 9-9 Landscape and Visual Mitigation Measures Implementation Schedule

Id No.	Landscape and Visual Mitigation Measures	Location	Funding	Implementation/ Maintenance Agent	Relevant Standard or Requirement	Implementation Stage *			Timing of Implementation	Objectives of the Recommended Measure and Main Concern to address
						D	C	O		
LMM1	Topsoil, where identified, should be stripped and stored for re-use in the construction of the soft landscape works, where practical	Site	WSD	Contractor	TM-EIA Annex 18		√		Throughout construction phase	To provide a viable growing medium suited to the existing conditions and reduce the need for the importation of top soil
LMM2	Existing Trees to be retained on site should be carefully protected during construction	Site	WSD	Contractor	TM-EIA Annex 18, ETWB TCW No. 2/2004 & WBTC No.3/2006		√		Throughout construction phase	To ensure the success of the tree preservation proposal
LMM3	Compensatory tree planting should be provided to compensate for felled trees	Site	WSD	Contractor	TM-EIA Annex 18, ETWB TCW No. 2/2004 & WBTC No.3/2006		√		Throughout design and construction phase	The planting proposal seeks to compensate for the predicted tree loss resulting form the construction, visually integrate the proposals within its existing landscape framework and provide an improved visual amenity
LMM4	Erection of decorative screen hoarding compatible with surrounding setting	Site	WSD	Contractor	TM-EIA Annex 18 and BD		√		Throughout construction phase	To integrate the construction site with the existing environment
LMM5	Locations of the site office, storage or	Site	WSD	Contractor	TM-EIA Annex 18 and BD	√			Throughout design phase	To avoid unnecessary felling of trees

Id No.	Landscape and Visual Mitigation Measures	Location	Funding	Implementation/ Maintenance Agent	Relevant Standard or Requirement	Implementation Stage *			Timing of Implementation	Objectives of the Recommended Measure and Main Concern to address
						D	C	O		
	workshops should be carefully adjusted to areas out of tree protection zones.									
LMM6	Selection of intake and outfall portals to areas enclosed by existing topography or vegetation	Site	WSD	Contractor	TM-EIA Annex 18 and BD	√			Throughout design phase	To preserve the existing topography and as many as trees as possible
LMM7	Appearance of the water intake and outfall structures	Site	WSD	Contractor	TM-EIA Annex 18 and BD	√			Throughout design phase	To reduce the apparent visual mass of water intake and outfall structures
LMM8	Reinstatement of disturbed vegetation at both portal areas	Site	WSD	Contractor	TM-EIA Annex 18			√	After the completion of construction works	To mitigate disturbance to vegetation arising from the proposed construction

* Implementation Stage: D = Design Stage; C = Construction Stage; O = Operation Stage

9.12 Conclusion

9.12.1 This section summaries the landscape and visual impact assessment result for the Project and highlights the potential residual impacts after fully establishment of recommended landscape mitigation measures. Given the utilization of tunnelling method with no provision of vent and access shaft along the inter-reservoirs transfer alignment, the source of impact is limited to the construction of the water intake and outfall portals which is located at the reservoir embankment of Kowloon Byewash Reservoir (Southern Portal) and Lower Shing Mun Reservoir (Northern Portal).

9.12.2 Landscape mitigation measures are recommended and discussed in section 9.9 of this report to alleviate the potential and visual impacts to ensure the implementation of the Project will fit into the existing landscape and visual context. These measures include the selection of portal location which enclosed by existing topography or vegetation to minimize the visual intrusion of engineering structure, maximizing the retention of existing trees in existing location or through transplantation ,as far as technical feasible, through responsive site planning for construction works, site access, offices, material storage, hoarding and temporary work areas, compensation to the loss of existing trees through new woodland planting to enhance the ecological value of the local context and reinstate the disturbed areas to its original as far as possible to maintain existing reservoir side amenity.

No Impact on Planning and Development Control Framework

9.12.3 No part of the proposed water tunnel will be constructed through any of the landscape zonings discussed in section 9.5 regarding to the use of tunnelling method, therefore the Project will fit within the future landscape planning framework as represented by the OZPs and so no amendment to the published land use plans is required.

Landscape Impacts

Preservation of Existing Trees

9.12.4 Majority of trees would be preserved on the sloping areas surrounding the reservoir, only some 19 out of total 262 surveyed trees at southern portal and would be affected by the construction of Southern Portal and 42 out of total 203 surveyed trees at northern portal would required to be felled. These affected trees are majority non-native plantation species composed of medium to small size of DBH. These trees are directly in conflict with the works and not feasible to be transplanted due to their growing condition on steep slope with dense plantation at where difficult for preparation of a viable root ball for transplantation and lowered survival rate after transplanting

9.12.5 The tree loss will be compensated through planting of new woodland trees with a replanting ratio of minimum 1:1 at reinstated areas adjacent to the portal.

Preservation of Landscape Resources

9.12.6 Given the proposed works are limited to the embankment of the reservoirs, adjacent road and sloping area, the predicted impact on landscape resources, including LR1 Mixed Woodland and LR2 Modified Watercourse will receive moderate and slight adverse impact respectively due to the modification of existing artificial topography and loss of existing trees. These impacts will be further mitigated to insubstantial through responsive site planning, restoration

of disturbed area and fully establishment of compensatory planting formed part of landscape mitigation measures to ensure no net loss of landscape resources

Maintain Landscape Character

9.12.7 In summary the predicted impact on landscape character areas, limited to LCA1 Kowloon Reservoir Group and LCA2 Lower Shing Mun Reservoir LCAs, will receive moderate adverse impact due to introduction of portal structures in their landscape context, the alternation of existing topography with man-made structure and loss of existing trees, however the magnitude of change to their landscape context is comparative small due to the scale and nature of the Project. Impact on other landscape character areas within the study area including LCA3 Sha Tin Height Urban Fringe and LCA4 Cheung Sha Wan Urban Fringe will be negligible due to no activities are carried out in these areas. Impact on LCAs will be further mitigated to insubstantial through responsive site planning, restoration of disturbed areas, fully establishment of compensatory planting formed part of landscape mitigation measures to successfully integrate the portal structures into existing reservoir setting and countryside landscape character.

Visual Impacts

9.12.8 Given the scale and nature of the Project which do not form a major component in the existing countryside visual context, VSRs, including residents of Lakeview Garden and No. 8 Caldecott Road Government Apartment located in a distance at least 200m away from the portal sites and trail walkers along reservoir side adjacent to the portals, will experience a moderate adverse impact during construction phase and slight adverse impact during operation phase. This different of impact is largely due to the intrusion of permanent portal structures during operation phase leading to a relatively smaller change of visual amenity when compared with the mobility of tunnel boring machine and increase of construction traffic during construction. This visual impact will be further alleviate through responsive alignment and portal locations, site planning and site management, preservation of trees, to slight adverse residual impact during construction. Upon to fully establishment of compensatory planting and restoration of disturbed areas, these portals will appear as an insubstantial component in views looking from the above VSRs and that the Project can be successfully integrated within the existing landscape and visual context.

Conclusion on Significant of Residual Impact

9.12.9 Although the tunnel alignment will have no impact on both landscape and visual context, there is slight adverse residual effect locally to the areas adjacent to the portals, mainly due to tree loss and the appearance of permanent intake and outfall structures upon to the fully establishment of landscape mitigation measures. In accordance with Annex 10, Paragraph 1.1(c) of the EIAO TM, the landscape and visual impacts of the proposed works would be ‘acceptable with mitigation’ that is to say ‘there would be some adverse effects, but these can be eliminated, reduced or offset to a large extent by specific measures’.

10. CULTURAL HERITAGE IMPACT

10.1 Introduction

10.1.1 The project will consist of the construction of a 2.8 kilometre long tunnel, including intake and outfall structures at the Kowloon Byewash and Lower Shing Mun Reservoirs, respectively. The Cultural Heritage Impact Assessment (CHIA) was conducted within the 300 metres boundary from the proposed works at the outfall / intake works and tunnel alignment.

10.2 Relevant Legislation and Guidelines

10.2.1 Legislation, standards, guidelines and criteria relevant to the consideration of Cultural Heritage Impacts under this study include the following:

- Antiquities and Monuments Ordinance
- Environmental Impact Assessment Ordinance
- Hong Kong Planning Standards and Guidelines
- Technical Memorandum on Environmental Impact Assessment Process.
- Criteria for Cultural Heritage Impact Assessment
- Development Bureau Technical Circular (Works) No. 11/2007

Antiquities and Monuments Ordinance

10.2.2 The Antiquities and Monuments Ordinance (the Ordinance) provides the statutory framework to provide for the preservation of objects of historical, archaeological and palaeontological interest. The Ordinance contains the statutory procedures for the Declaration of Monuments. The proposed monument can be any place, building, site or structure, which is considered to be of public interest by reason of its historical, archaeological or palaeontological significance.

10.2.3 Under Section 6 and subject to sub-section (4) of the Ordinance, the following acts are prohibited in relation to certain monuments, except under permit:

- To excavate, carry on building works, plant or fell trees or deposit earth or refuse on or in a proposed monument or monument;
- To demolish, remove, obstruct, deface or interfere with a proposed monument or monument.

10.2.4 The discovery of an Antiquity, as defined in the Ordinance must be reported to the Antiquities Authority (the Authority), or a designated person. The Ordinance also provides that, the ownership of every relic discovered in Hong Kong after the commencement of this Ordinance shall vest in the Government from the moment of discovery. The Authority on behalf of the Government may disclaim ownership of the relic.

10.2.5 No archaeological excavation may be carried out by any person, other than the Authority and the designated person, without a licence issued by the Authority. A licence will only be issued if the Authority is satisfied that the applicant has sufficient scientific training or experience to enable him to carry out the excavation and search satisfactorily, is able to conduct, or arrange for, a proper scientific study of any antiquities discovered as a result of the excavation and search and has sufficient staff and financial support.

Environmental Impact Assessment Ordinance

10.2.6 The Environmental Impact Assessment Ordinance (EIAO) was implemented on 1 April 1998. Its purpose is to avoid, minimise and control the adverse impact on the environment of designated projects, through the application of the EIA process and the Environmental Permit (EP) system.

Hong Kong Planning Standards and Guidelines

10.2.7 Chapter 10 of the HKPSG details the principles of conservation of natural landscape and habitats, historical buildings and archaeological sites. It also addresses the issue of enforcement. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong, and Government departments involved in conservation.

Technical Memorandum on Environmental Impact Assessment Process

10.2.8 The general criteria and guidelines for evaluating and assessing impacts to Cultural Heritage are listed in Annexes 10 and 19 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM). The guidelines state that preservation in totality and measures for the integration of sites of cultural heritage into the proposed project will be a beneficial impact. It also states that destruction of a site of cultural heritage must only be undertaken as a last resort.

Guidelines for Cultural Heritage Impact Assessment

10.2.9 This document, as issued by the Antiquities and Monuments Office, outlines the specific technical requirement for conducting terrestrial archaeological and built heritage impact assessments. It includes the parameters and scope for the Baseline Study, specifically desk-based research, field survey and the reporting requirements. As well, the prerequisite conditions for conducting impact assessment and mitigation measures are presented in detail.

Development Bureau Technical Circular (Works) No. 11/2007: Heritage Impact Assessment Mechanism for Capital Works Projects

10.2.10 The circular deals with certain categories of capital works projects and the requirements for conducting HIA if required by the AMO. The paper states that if “Heritage Sites” are located within or in the vicinity of the project boundary, the works agent must submit this information to AMO and the AMO will decide if an HIA should be conducted for the project. The works agent is also responsible for submitting a proposed Study Brief to the AMO on the scope of the HIA.

10.3 Assessment Area

10.3.1 The preferred alignment and intake/ outfall locations for the project can be seen in Figure 2-5.

10.4 Methodology

Baseline Study

10.4.1 A desk-based study was undertaken to assess the potential for built heritage resources to be present. The following sources were consulted; the AMO published and unpublished papers and studies; publications on relevant historical, anthropological and other cultural studies; unpublished archival, papers, records; collections and libraries of tertiary institutions; historical documents which can be found in Public Records Office, Lands Registry, District Lands Office, Museum of History; cartographic and pictorial documentation.

10.4.2 In addition to the desk-based review, in cases where the sources of information proved to be inadequate or where the project area had not been adequately studied before, field survey was conducted to assemble the necessary data.

Study Area

10.4.3 The general Study Area for the Cultural Heritage Impact Assessment (CHIA) will be 300 metres from the proposed works at the outfall and intake works areas.

Resources to be Covered by the Cultural Heritage Impact Assessment

10.4.4 As stated in the project brief the CHIA will identify all Sites of Cultural Heritage within the project Study Area. A Site of Cultural Heritage is defined as "an Antiquity or Monument, whether being a place, building, site or structure or a relic, as defined in the Antiquities or Monuments Ordinance (Cap. 53) and any place, building, site or structure or a relic identified by the Antiquities and Monuments Office to be of archaeological, historical or palaeontological significance"

10.4.5 The resources shall include, but will not be limited to the following;

- All pre 1950 structures, which include any built feature (apart from graves and historical land use features, which are dealt with separately), such as domestic structures, ancestral halls, temples, shrines, monasteries and nunneries, village gates, wells, schools, historic walls, bridges and stone tablets;
- Any post 1950 structure deemed to possess features containing architectural or cultural merit;
- All Proposed and Declared Monuments and Graded Historical Buildings as issued by the AMO
- All pre-war clan graves;
- Cultural landscape features, such as fung shui woods and ponds, historical tracks and pathways, stone walls and terraces, ponds and other agricultural features;

Impact Assessment and Mitigation Recommendations

10.4.6 Prediction and Identification of both direct and indirect impacts that may affect the built

heritage resources within the project Area will be undertaken with special attention paid to the built heritage resources identified in the project Study Brief. Preservation in-situ will always be the first priority for sites of Cultural Heritage. If preservation in totality is not possible, mitigation will be proposed to minimise the degree of adverse impact to the greatest possible extent. As well, any disturbance to sites of Cultural Heritage that may cause physical damage should be avoided wherever possible through alteration of design, construction method or protective measures as appropriate.

10.5 Identified Sites of Cultural Heritage within Study Area

The Kowloon Byewash Reservoir

10.5.1 There are two Graded Historical Structures in the vicinity of the proposed Intake Structure A, these are the Dam itself and also the valve house (both are Grade II). A map showing the locations of the dam and valve house can be found in Figure Figure 10-1 and a description of both structures in the catalogue in Appendix J. The dam was built between 1929 and 1931. The function of the dam was to receive surplus water from Kowloon Reception Reservoir and Kowloon Reservoir (AMO File).

The Lower Shing Mun Reservoir

10.5.2 The Shing Mun Reservoir Scheme was constructed as part of the Plover Cove Water Scheme. It was designed to act as a transfer and storage reservoir and works were completed in 1965 (AMO File). One Grade I Structure was identified i.e. the Lower Shing Mun Reservoir Dam (on AMO's list of graded historic buildings it is named as the Shing Mun Reservior (Jubilee) Lower Reservoir Pineapple Pass Dam). A map showing the locations of the structure can be found in Figure 10-2 and a description of the structure in the catalogue in Appendix J.

The Shek Lei Pui Reservoir

10.5.3 The reservoir was one of the early projects for expanding water supply in the New Territories and it was completed in 1925. It was expanded in 1929 to provide extra water as a result of a drought. During the Second World War, the reservoir was protected by anti-aircraft guns. There are three resources associated with this dam in the project study area; The Northeast Dam which is a Grade II structure on which construction began in 1923 was completed in 1925, it is located in the Kam Shan Country Park in Shatin District. The dam is constructed of cut stone. The Southwest Dam, completed in 1925 is also a Grade II structure and constructed of cut stone. Finally, there is the valve house of the Northeast Dam is a Grade II structure. It is square in shape and constructed of cut stone and completed in 1925. A description of each structure is presented in the catalogue in Appendix J while the map showing these structures can be found in Figure 10-3.

The Kowloon Reservoir

10.5.4 Construction of this reservoir took place between 1902 and 1910 (as part of the Kowloon Waterworks Gravitation Scheme) and it was the first reservoir in the Kowloon Peninsula. It began supplying water in 1906 to Kowloon. There is Grade I dam situated at Golden Hill Road in the Kam Shan Country Park in Shatin District. It is a large dam of cut stone and concrete and curved in shape. A description of each structure is presented in the catalogue in Appendix J while the map showing these structures can be found in Figure 10-3.

10.5.5 There are no other sites of Cultural Heritage in the project Study Area.

10.6 Impact Assessment

Prediction of Impacts

10.6.1 The method of construction for the portals at the intake and outfall structures will be a combination of mechanical, pneumatic or hydraulic splitting or expanding grout techniques. The tunnel excavation will be conducted by tunnel boring machine (or by conventional excavation methods in areas unsuitable for use of the TBM). There will be no blasting involved in the construction phase of the project and as stated in section 2.6.4 the methods to be used will create much lower levels of vibration than D&B. Impacts on historic structures are particularly sensitive to vibration therefore is considered unlikely during the construction phase.

10.6.2 The identified Sites of Cultural Heritage within the project Study Area are all parts of functioning dams and are not sensitive to changes in the surrounding environment. The project will include a Landscape and Visual Impact Assessment to ensure that the proposed works do not adversely impact on the environmental setting of the area and no additional visual impact assessment will be required from a cultural heritage standpoint.

Evaluation of Impacts

10.6.3 The following table will present the impacts associated with the construction phase of the project. No impacts have been identified during the constructional and operational phase of the project. The assessment presented in this section is based upon the works areas as currently designed. If any additional or alternate works areas are proposed in future, supplemental assessment will be undertaken.

Table 10-1 Anticipated Impacts associated with Construction of the Project

Resource	Minimum Distance from Works Area	Impact Assessment
Kowloon Byewash Reservior Dam (Grade II) *IRTS-01* Figure 10-1	30 m	The Dam is located in close proximity to the proposed works at Intake A, but no blasting is proposed for the proposed construction works. No adverse impacts are expected.
Kowloon Byewash Reservoir Valve House (Grade II) *IRTS-02* Figure 10-1	45 m	The Valve House is located in close proximity to the proposed works at Intake A, but no blasting is proposed for the proposed construction works. No adverse impacts are expected.
Lower Shing Mun Reservoir Dam* (Shing Mun Reservoir (Jubilee) Lower Reservoir Pineapple Pass Dam) (Grade I) *IRTS-03* Figure 10-2	200 m	All of the identified structures are located at a sufficient distance from the proposed works area at Outfall D and no adverse impacts are expected.

Resource	Minimum Distance from Works Area	Impact Assessment
Shek Lei Pui Northeast Dam (Grade II) IRTS-04 Figure 10-3	69 m	No blasting is proposed for the proposed construction works. No adverse impacts are expected.
Shek Lei Pui Northeast Dam Valve House (Grade II) *IRTS-05* Figure 10-3	78 m	No blasting is proposed for the proposed construction works. No adverse impacts are expected.
Shek Lei Pui Southwest Dam (Grade II) *IRTS-06* Figure 10-3	159 m	No blasting is proposed for the proposed construction works. No adverse impacts are expected.
Kowloon Reservoir Dam (Grade I) IRTS-07 Figure 10-3	257 m	All of the identified structures are located at a sufficient distance from the proposed works area along the alignment and no adverse impacts are expected.

Note: * The dam is referred to as **Lower Shing Mun Reservoir Dam** within WSD while it is named as **Shing Mun Reservoir (Jubilee) Lower Reservoir Pineapple Pass Dam** on AMO's list of graded historic buildings

10.7 Mitigation Recommendations

10.7.1 The following table presents the required mitigation for the identified sites of Cultural Heritage for which adverse impacts have been identified.

Table 10-2 Mitigation Recommendations for Sites of Cultural Heritage adversely impacted by the proposed construction works at Intake A

Resource	Map Reference	Mitigation Recommendation
Kowloon Byewash Reservoir Dam (Grade II) IRTS-01	Figure 10-1	Although no adverse impacts are expected, conducting a condition survey prior to the construction phase of the project as a precautionary mitigation measure is recommended. The survey shall check the state of the dam / valve house and provide the most up-to-date information of the condition of these structures; and advise any other additional protective measures are required during the construction period. The report should be submitted to AMO for review prior to the construction phase.
Kowloon Byewash Reservoir Valve House (Grade II) IRTS-02	Figure 10-1	
Lower Shing Mun Reservoir Dam* (Shing Mun Reservoir (Jubilee) Lower Reservoir Pineapple Pass Dam) (Grade I) I RTS-03	Figure 10-2	No mitigation will be required for the identified structures.
Shek Lei Pui Northeast Dam (Grade II)	Figure 10-3	Although no adverse impacts are expected, conducting a condition survey prior to the

Resource	Map Reference	Mitigation Recommendation
IRTS-04		construction phase of the project as a precautionary mitigation measure is recommended. The survey shall check the state of the dam and provide the most up-to-date information of the condition of the structure; and advise any other additional protective measures are required during the construction period. The report should be submitted to AMO for review prior to the construction phase.
Shek Lei Pui Northeast Dam Valve House (Grade II) IRTS-05	Figure 10-3	Although no adverse impacts are expected, conducting a condition survey prior to the construction phase of the project as a precautionary mitigation measure is recommended. The survey shall check the state of the valve house and provide the most up-to-date information of the condition of the structure; and advise any other additional protective measures are required during the construction period. The report should be submitted to AMO for review prior to the construction phase.
Shek Lei Pui Southwest Dam (Grade II) IRTS-06	Figure 10-3	Although no adverse impacts are expected, conducting a condition survey prior to the construction phase of the project as a precautionary mitigation measure is recommended. The survey shall check the state of the dam and provide the most up-to-date information of the condition of the structure; and advise any other additional protective measures are required during the construction period. The report should be submitted to AMO for review prior to the construction phase.
Kowloon Reservoir Dam (Grade I) IRTS-07	Figure 10-3	No mitigation will be required for the identified structures.

Note: * The dam is referred to as **Lower Shing Mun Reservoir Dam** within WSD while it is named as **Shing Mun Reservoir (Jubilee) Lower Reservoir Pineapple Pass Dam** on AMO's list of graded historic buildings

Requirements of the Condition Survey

10.7.2 The condition survey must be carried out by an approved qualified building surveyor who is a member of the Hong Kong Institution of Surveyors in the Building Surveying division or equivalent and an approved qualified engineer who is a member of the Hong Kong Institution of Engineers in the Civil or Structural Division or equivalent. The condition survey should also make reference (if appropriate) to the Practice Notes No. 289 issued by the Buildings Department of the Hong Kong SAR Government.

10.7.3 The condition survey report must be submitted to the Engineer and the Antiquities and Monuments Office (AMO) for review before the commencement of works and must contain the following:

- An appraisal of the state of the existing historic building and structures including location and condition of all signs of defect (including suitably referenced and catalogued photographs);
- An appraisal of their various types of construction, including foundations;
- Recommendations of monitoring measures to be taken and locations of proposed monitoring points (if required);
- Recommendations for reading frequency of the monitoring equipment (if required); and
- Recommendations of the necessity to conduct a separate assessment report.

10.7.4 A separate assessment report may be produced based on findings of this condition survey report to recommend the following:

- Setting of a safe limit for vibration levels for each historic structure (if required)
- The likely effect that the contractors method of working would have on the existing historic buildings and structures (including the structural stability of the structure);
- Recommendations of any other protective measures to be taken during the construction and/ or operational phases (if required).

10.7.5 If required, monitoring measures and protective measures must be implemented by the contractor and can include, but are not limited to; fixing approved tell tales and tilting markers to monitoring points to the structures and buildings and monitoring them on the schedule recommended in the condition survey report. It should be noted that that for the installation of monitoring measures disturbances to identified historic items should be kept to an absolute minimum and that after removal of such measures, the affected area should be restored to match the original condition. The results of the monitoring must be submitted to the engineer (in an agreed format) within two days of each monitoring undertaken. If the monitoring measurements exceed the safe limits for any of the monitored structures, the Contractor shall take immediate corrective action as necessary, to bring vibration levels within compliance. The monitoring results should be submitted to AMO only if there is significant effect on the historic items.

10.8 Conclusions

10.8.1 The Cultural Heritage Impact Assessment for the project has identified that there are sensitive historical structures in the vicinity of the proposed works and that mitigation in the form of vibration monitoring may be required during the construction period. Although no adverse impacts on the historical structures are anticipated, conducting a condition survey prior to the construction phase as a precautionary mitigation measure is recommended and the survey report shall be submitted to AMO for review prior to the commencement of the construction phase.

10.9 REFERENCES

AMO Files

AM94-0568 Shek Lei Pui Reservoir Northeast Dam (01)

AM94-0568 Shek Lei Pui Reservoir Southwest Dam (02)

AM94-0568 Shek Lei Pui Reservoir Northeast Dam Valve House (03)

AM94-0572(03) Shing Mun (Jubilee) Reservoir Lower Reservoir Pineapple Pass Dam

AM94-0567 Kowloon Reservoir Dam (01)

AM94-0570 (01) Kowloon Byewash Reservoir Dam

AM94-0570 (02) Kowloon Byewash Reservoir Valve House

Water Supplies Department 1996 "Hong Kong's Water" Hong Kong Government Information Services department

11. IMPLEMENTATION SCHEDULE OF MITIGATION MEASURES

11.1 Introduction

11.1.1 The implementation schedules for the recommended mitigation measures for each environmental aspect covered in this EIA are given in the following tables.

Table 11-1 Air Quality Impact – Implementation Schedule of Recommended Mitigation Measures

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location / Timing of implementation of Measures	What requirements or standards for the measures to achieve?
Construction Phase						
S.3.5.9	S.3.2.2	All the dust control measures as recommended in the Air Pollution Control (Construction Dust) Regulation, where applicable, should be implemented. Typical dust control measures include:	Air Quality (fugitive dust) Control during Construction Phase	Contractors	At all construction areas of the site during the entire construction period	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
S.3.5.9	S.3.2.2	▪ The works area for site clearance shall be sprayed with water before, during and after the operation so as to maintain the entire surface wet	Air Quality (fugitive dust) Control during Construction Phase	Contractors	Ditto	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
S.3.5.9	S.3.2.2	▪ Restricting heights from which materials are to be dropped, as far as practicable to minimise the fugitive dust arising from unloading/ loading	Air Quality (fugitive dust) Control during Construction Phase	Contractors	Ditto	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
S.3.5.9	S.3.2.2	▪ Immediately before leaving a construction site, all vehicles shall be washed to remove any dusty materials from the bodies and wheels. However, all spraying of materials and surfaces should avoid excessive water usage	Air Quality (fugitive dust) Control during Construction Phase	Contractors	Ditto	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
S.3.5.9	S.3.2.2	▪ Where a vehicle leaving a construction site is carrying a load of dusty materials, the load shall be covered entirely by clean impervious sheeting to ensure that the dusty materials will not leak from the vehicle	Air Quality (fugitive dust) Control during Construction Phase	Contractors	Ditto	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
S.3.5.9	S.3.2.2	▪ Erection of hoarding of not less than 2.4 m high from ground level along the site boundary, where appropriate	Air Quality (fugitive dust) Control during Construction Phase	Contractors	Ditto	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
S.3.5.9	S.3.2.2	▪ Any stockpile of dusty materials shall be covered entirely by impervious sheeting; and/or placed in an area sheltered on the top and 4 sides	Air Quality (fugitive dust) Control during Construction Phase	Contractors	Ditto	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
S.3.5.9	S.3.2.2	▪ All dusty materials shall be sprayed with water immediately prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet	Air Quality (fugitive dust) Control during Construction Phase	Contractors	Ditto	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
Operational Phase						
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 11-2 Noise Impact – Implementation Schedule of Recommended Mitigation Measures

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location / Timing of implementation of Measures	What requirements or standards for the measures to achieve?
Construction Phase						
S.4.8.2	S.4.8.1	▪ The Contractor shall adopt the Code of Practice on Good Management Practice to Prevent Violation of the Noise Control Ordinance (Chapter 400) (for Construction Industry) published by EPD	Noise control during construction	Contractors	At all construction areas of the site during the entire construction period	Annex 5 of EIAO-TM
S.4.8.2	S.4.8.1	▪ The Contractor shall observe and comply with the statutory and non-statutory requirements and guidelines	Noise control during construction	Contractors	Ditto	Annex 5 of EIAO-TM
S.4.8.2	S.4.8.1	▪ Before commencing any work, the Contractor shall submit to the Engineer Representative for approval the method of working, equipment and noise mitigation measures intended to be used at the site	Noise control during construction	Contractors	Ditto	Annex 5 of EIAO-TM
S.4.8.2	S.4.8.1	▪ The Contractor shall devise and execute working methods to minimise the noise impact on the surrounding sensitive uses, and provide experienced personnel with suitable training to ensure that those methods are implemented	Noise control during construction	Contractors	Ditto	Annex 5 of EIAO-TM
S.4.8.2	S.4.8.1	▪ Noisy equipment and noisy activities should be located as far away from the NSRs as is practical	Noise control during construction	Contractors	Ditto	Annex 5 of EIAO-TM
S.4.8.2	S.4.8.1	▪ Unused equipment should be turned off. PME should be kept to a minimum and the parallel use of noisy equipment / machinery should be avoided	Noise control during construction	Contractors	Ditto	Annex 5 of EIAO-TM
S.4.8.2	S.4.8.1	▪ Regular maintenance of all plant and equipment	Noise control during construction	Contractors	Ditto	Annex 5 of EIAO-TM
S.4.8.2	S.4.8.1	▪ Material stockpiles and other structures should be effectively utilised as noise barriers, where practicable	Noise control during construction	Contractors	Ditto	Annex 5 of EIAO-TM
Operational Phase						
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 11-3 Water Quality Impact – Implementation Schedule of Recommended Mitigation Measures

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location / Timing of implementation of Measures	What requirements or standards for the measures to achieve?
Construction Phase						
S.5.10.1 -5.10.2	S.5.8.2 -5.8.3	Construction for the desilting facilities at intake and outfall portals should be carried out behind a temporary cofferdam which is watertight enclosure built in the reservoirs and pumped dry to expose the bottom.	Point Pollution Control	Contractors	Before construction of intake and outfall portals and remain on site until completion of intake and outfall portals and tunnel construction	Water Pollution Control Ordinance
S.5.10.3	S.5.8.4	The cofferdams should be regularly inspected and maintained to ensure no spillage of waste or wastewater into the reservoirs.	Point Pollution Control	Contractors	Before construction of intake and outfall portals and remain on site until completion of intake and outfall portals and tunnel construction	Water Pollution Control Ordinance
S. 5.10.4	S. 5.8.5	Construction of desilting facilities within works areas capable of controlling discharge of SS to comply with WPCO/TM-DSS	Point and Non-point Pollution Control	Contractors	At all construction areas of the site during the entire construction period	Water Pollution Control Ordinance
S.5.10.5	S.5.8.6	Construction runoff will be managed as per the Practice Note for Professional Persons ProPECC PN1/94 - Construction Site Drainage and the conditions of working within Water Gathering Grounds stipulated by WSD	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance Water Gathering Ground control by WSD
S.5.10.6	S. 5.8.7	A Drainage Management Plan should be prepared by the Contractor for approval by the Engineer for each of the works areas, detailing the facilities and measures to manage pollution arising from surface runoff from those works areas	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance Water Gathering Ground control by WSD
S. 5.10.7	S. 5.8.8	An Emergency Contingency Plan should also be prepared by the Contractor, detailing the response and procedures to contain and remove any accidental spillage along the temporary and permanent roads and at the site at short notice to prevent or minimize the quantities of contaminants from reaching the reservoirs and local streams leading to the reservoirs. The Emergency Contingency Plan should be submitted to the Engineer for approval	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance Water Gathering Ground control by WSD
S. 5.10.8	S. 5.8.9	▪ Surface run-off and effluent from the construction sites at the intake at Kowloon Byewash Reservoir and outfall at the Lower Shing Mun Reservoir will be directed towards	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location / Timing of implementation of Measures	What requirements or standards for the measures to achieve?
		adequately designed sand/silt removal facilities such as sand/silt traps and sediment basins to remove sand/silt particles from runoff to meet the requirements of the TM standards under the WPCO before discharging to discharge points downstream of the Kowloon Byewash Reservoir Dam and Lower Shing Mun Reservoir Dam respectively. The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94, which states that the retention time for silt/sand traps should be 5 minutes under maximum flow conditions. Sizes may vary depending upon the flow rate, but for a flow rate of 0.1m3/s a sedimentation basin of 30m^3 would be required and for a flow rate of 0.5m^3/s the basin would be 150m^3. The detailed design of the sand/silt traps should be undertaken by the contractor prior to the commencement of construction				
S. 5.10.8	S. 5.8.9	▪ Channels, earth bunds or sand bag barriers will be provided on-site to properly direct stormwater to the above-mentioned facilities	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Existing on-site silt removal facilities, channels and manholes, if any, will be maintained and the deposited silt and grit will be removed regularly, at the onset of and after each rainstorm to ensure that these facilities are functioning properly at all times	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Other manholes, if any, including any newly constructed ones will be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Open stockpiles of materials on site will be avoided within water gathering grounds as far as practicable. All surplus spoil will be removed from water gathering grounds as soon as possible Measures will be taken to prevent the washing away of construction materials, soil, silt or debris	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Where possible, works entailing soil excavation will be minimized during the rainy season (i.e. April to September). If excavation in soil could not be avoided in these months or at any time of year when rainstorms are likely, for the purpose of preventing soil erosion, temporary exposed slope surfaces should be covered e.g. by tarpaulin, and	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location / Timing of implementation of Measures	What requirements or standards for the measures to achieve?
		temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Intercepting channels should be provided (e.g. along the crest/edge of excavation) to prevent storm runoff from washing across exposed soil surfaces. Arrangements should always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm				
S. 5.10.8	S. 5.8.9	▪ Where applicable, final earthworks surfaces/ slopes will be well compacted and hydro-seeded following completion to prevent erosion	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Where surface runoff or construction effluent is likely to be contaminated with oil, properly designed and maintained petrol interceptor will be provided to meet the WPCO/TM-DSS requirements. Oil leakage or spillage shall be contained and cleaned up immediately. Detailed design of the petrol interceptor shall be provided by the Contractor before commencement of construction	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Sewage arising from the construction workers on site should be collected by temporary sanitary facilities e.g. portable chemical toilets. Portable toilets should be used coupled with tankering away services provided by a licensed collector	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ All site discharges within Inland Waters Group A must comply with the terms and conditions of a valid discharge licence issued by EPD	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Vehicle wheel washing facilities should be provided, where applicable, at the site exit such that mud, debris, etc. deposited onto the vehicle wheels or body can be washed off before the vehicles are leaving the site area	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Section of the road between the wheel washing bay and the public road should be paved with backfill to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Vehicle washing facilities should be drained into desilting facilities before discharge. The water should be recycled on site wherever possible. It is suggested that the wash water from the wheel wash basin is either reused for site watering	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location / Timing of implementation of Measures	What requirements or standards for the measures to achieve?
		or pumped to the on-site desilting facilities for treatment				
S. 5.10.8	S. 5.8.9	• Desilting facilities should be checked and the deposited silt and grit should be removed regularly to ensure they are working properly at all times	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	• To minimize water quality impact, recycled water should be used at the cutter face for cooling purposes. Used water should be collected and discharged to settling tank for settlement	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	• Excess water from the settling tank would be transferred to the desilting facilities for treatment before discharge. The Contractor should ensure that the discharge water from the desilting facilities and treated spent effluent arising from tunnel boring from the desilting facilities comply with the WPCO/TM-DSS requirements before discharge	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Existing on-site silt removal facilities, channels and manholes, if any, would be maintained such that the deposited silt and grit will be removed regularly, at the onset of and after each rainstorm to ensure that these facilities are functioning properly at all times;	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ Desilting facilities should be checked and the deposited silt and grit should be removed regularly to ensure they are working properly at all times;	Stormwater and Non-point Source Pollution Control	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ The project may occasionally involve the handling of fuel and generates chemical wastes. It must be ensured that all fuel tanks and chemical storage are sited on sealed and bunded areas, provided with locks and located outside water gathering grounds as far as practicable	Protection Against Accidental Spillage	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	▪ The storage areas will be surrounded by bunds with a capacity equal to 110% of the storage capacity of the largest tank to prevent accidentally spilled oil, fuel or chemicals from reaching the receiving waters	Protection Against Accidental Spillage	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	• Oil and grease removal facilities will be provided where appropriate, for example, in area near plant workshop/ maintenance areas, if any	Protection Against Accidental Spillage	Contractors	Ditto	Water Pollution Control Ordinance
S. 5.10.8	S. 5.8.9	• Chemical waste arising from the site should be properly stored, handled, treated and disposed of in compliance with the requirements stipulated under the Waste Disposal	Protection Against Accidental Spillage	Contractors	Ditto	Waste Disposal (Chemical Waste) (General) Regulation

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location / Timing of implementation of Measures	What requirements or standards for the measures to achieve?
		(Chemical Waste) (General) Regulation				
Operational Phase						
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 11-4 Waste Management Implication – Implementation Schedule of Recommended Mitigation Measures

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location/ Timing of implementation of Measures	What requirements or standards for the measures to achieve?
Construction Phase						
S.6.7.1	S. 6.2.2	Given the potential for secondary environmental impacts (dust, noise, water quality and visual impacts), mitigation measures are required to ensure proper handling, storage, transportation and disposal of materials at the outset and throughout the construction phase of the project:	Waste management during construction	Contractors	At all construction areas of the site during the entire construction period	Waste Disposal Ordinance
S.6.7.2	S. 6.2.5	▪ An on-site environmental co-ordinator employed by the Contractor should be identified at the outset of the works. The co-ordinator shall prepare a Waste Management Plan ("WMP") in accordance with the requirements set out in the ETWB TCW No. 19/2005, Waste Management on Construction Sites. The WMP shall include monthly and yearly Waste Flow Tables ("WFT") that indicate the amounts of waste generated, recycled and disposed of (including final disposal site), and which should be regularly updated	Waste management during construction	Contractors	Ditto	ETWB TCW No. 19/2005, Waste Management on Construction Sites
S.6.7.2	S. 6.2.5	▪ The reuse/ recycling of all materials on site shall be investigated and exhausted prior to treatment/ disposal off-site	Waste management during construction	Contractors	Ditto	Waste Disposal Ordinance
S.6.7.2	S. 6.2.5	▪ Good site practices shall be adopted from the commencement of works to avoid the generation of waste, reduce cross contamination of waste and to promote waste minimisation	Waste management during construction	Contractors	Ditto	Waste Disposal Ordinance
S.6.7.2	S. 6.2.5	▪ All waste materials shall be sorted on-site into inert and non-inert C&D materials, and where the materials can be recycled or reused, they shall be further segregated. Inert material, or public fill will comprise stone, rock, concrete and soil which is suitable for land reclamation and site formation whilst non-inert materials include all other wastes generated from the construction process such as plastic packaging and vegetation (from site clearance)	Waste management during construction	Contractors	Ditto	Waste Disposal Ordinance
S.6.7.2	S. 6.2.5	▪ The Contractor shall be responsible for identifying what materials can be recycled/ reused, whether on-site or off-site. In the event of the latter, the Contractor shall make arrangements for the collection of the recyclable materials. Any remaining non-inert waste shall be collected and	Waste management during construction	Contractors	Ditto	Waste Disposal Ordinance

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location/ Timing of implementation of Measures	What requirements or standards for the measures to achieve?
		disposed of to the public fill reception facilities whilst any inert C&D materials shall be re-used on site as far as possible. Alternatively, if no use of the inert material can be found on-site, the materials can be delivered to public fill reception facilities after obtaining the appropriate licence				
S.6.7.2	S. 6.2.5	▪ In order to monitor the disposal of C&D material and solid wastes at public fill reception facilities and landfills, and control fly-tipping, a trip-ticket system shall be implemented by the Contractor, in accordance with the contract and the requirements of WBTC 31/2004 "Trip Ticket System for Disposal of Construction and Demolition Material"	Waste management during construction	Contractors	Ditto	WBTC 31/2004 "Trip Ticket System for Disposal of Construction and Demolition Material"
S.6.7.2	S. 6.2.5	▪ Under the Waste Disposal (Chemical Waste) (General) Regulation, the Contractor shall register as a Chemical Waste Producer if chemical wastes such as spent lubricants and paints are generated on site. Only licensed chemical waste collectors shall be employed to collect any chemical waste generated at site. The handling, storage, transportation and disposal of chemical wastes shall be conducted in accordance with the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes and A Guide to the Chemical Waste Control Scheme both published by EPD	Waste management during construction	Contractors	Ditto	Waste Disposal (Chemical Waste) (General) Regulation
S.6.7.2	S. 6.2.5	▪ A sufficient number of covered bins shall be provided on site for the containment of general refuse to prevent visual impacts and nuisance to the sensitive surroundings. These bins shall be cleared daily and the collected waste disposed of to the refuse transfer station. Further to the issue of ETWB TCW No. 6/2002A, Enhanced Specification for Site Cleanliness and Tidiness, the Contractor is required to maintain a clean and hygienic site throughout the project works	Waste management during construction	Contractors	Ditto	Waste Disposal Ordinance
S.6.7.2	S. 6.2.5	▪ All chemical toilets, if any, shall be regularly cleaned and the night-soil collected and transported by a licensed contractor to a Government Sewage Treatment Works facility for disposal	Waste management during construction	Contractors	Ditto	Waste Disposal Ordinance
S.6.7.2	S. 6.2.5	▪ Toolbox talks should be provided to workers about the concepts of site cleanliness and appropriate waste management procedures, including waste reduction, reuse and recycling	Waste management during construction	Contractors	Ditto	Waste Disposal Ordinance

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location/ Timing of implementation of Measures	What requirements or standards for the measures to achieve?
S.6.7.2	S. 6.2.5	▪ The Contractor shall comply with all relevant statutory requirements and guidelines and their updated versions that may be issued during the course of project construction	Waste management during construction	Contractors	Ditto	Waste Disposal Ordinance
Operational Phase						
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 11-5 Ecological Impact – Implementation Schedule of Recommended Mitigation Measures

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location/ Timing of implementation of Measures	What requirements or standards for the measures to achieve?
Construction Phase						
S 8.8	N/A	Minimise the habitat loss of secondary woodland / plantation and grassland as far as possible.	Reduce habitat and vegetation loss	Contractors	At all construction areas of the site during the entire construction period	Annex 16 of EIAO-TM
S 8.8	N/A	Disturbed secondary woodland / plantation and grassland should be reinstated after the completion of works	Reinstate disturbed habitats	Contractors	Worksite areas at the two portals / after completion of construction works	Annex 16 of EIAO-TM
S 8.8	N/A	Provide clear definition of site boundary	Prevent impact on offsite habitats	Contractors	At all construction areas of the site during the entire construction period	Annex 16 of EIAO-TM
S 8.8	N/A	Protect the protected plant *Pavetta hongkongensis* on its existing location; Transplant the *Pavetta hongkongensis* to other suitable location if onsite protection is not feasible.	Preserve the protected plant species	Contractors	On the vegetated slope along the existing vehicle access at worksite area at Lower Shing Mun Reservoir / Construction period	Annex 16 of EIAO-TM
S 8.8	N/A	Carry out compensatory planting if the individual of *Artocarpus hypargyreus* cannot be retained onsite	Mitigate the tree removal	Contractors	worksite area at Kwoloon Byewash Reservoir / Construction Period	ETWB TCW No. 3/2006
S 8.8	N/A	Workers should avoid eating and leave food in works area and avoid feeding the wildlife; Fishes observed remaining at the proposed works area during the draining down process should be translocated to the portion of the reservoir outside the cofferdam.	Avoidance of injury to wildlife	Contractors	At all construction areas of the site during the entire construction period	Annex 16 of EIAO-TM
S 8.8	N/A	Implement standard good site practices for dust suppression	Avoid dust deposition on vegetation	Contractors	At all construction areas of the site during the entire construction period	EIAO -TM, Air Pollution Control (Construction Dust) Regulation
S 8.8	N/A	Implement standard good site practices for water quality control	Avoid site runoff to nearby habitats	Contractors	At all construction areas of the site during the entire construction period	Water Pollution Control Ordinance
S 8.8	N/A	Workers shall not disturb birds and other wildlife; Litter shall not be burned on-site but shall be removed off-site; Machinery not in use should be switched off to minimize the noise	Avoid disturbance to wildlife	Contractors	At all construction areas of the site during the entire construction period	Annex 16 of EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location/ Timing of implementation of Measures	What requirements or standards for the measures to achieve?
		nuisance; No fishing is allowed in the reservoir without permission.				
Operational Phase						
S 8.8	N/A	Compensate the habitat loss (grassland and woodland) by restoration of same type of habitats to be lost. The compensatory ratio should not be less than 1:1 in terms of area.	Mitigate the temporary habitat loss	Contractors	Woodland at worksite area at Kowloon Byewash Reservoir and Grassland at worksite area at Lower Shing Mun Reservoir / Operational period	Annex 16 of EIAO-TM

Table 11-6 Landscape & Visual Impact – Implementation Schedule of Recommended Mitigation Measures

Id No.	Landscape and Visual Mitigation Measures	Location	Funding	Implementation/ Maintenance Agent	Relevant Standard or Requirement	Implementation Stage*			Timing of Implementation	Objectives of the Recommended Measure and Main Concern to address
						D	C	O		
LMM1	Topsoil, where identified, should be stripped and stored for re-use in the construction of the soft landscape works, where practical	Site	WSD	Contractor	TM-EIA Annex 18		√		Throughout construction phase	To provide a viable growing medium suited to the existing conditions and reduce the need for the importation of top soil
LMM2	Existing Trees to be retained on site should be carefully protected during construction	Site	WSD	Contractor	TM-EIA Annex 18, ETWB TCW No. 2/2004 & ETWB TCW No. 3/2006		√		Throughout construction phase	To ensure the success of the tree preservation proposal
LMM3	Compensatory tree planting should be provided to compensate for felled trees	Site	WSD	Contractor	TM-EIA Annex 18, ETWB TCW No. 2/2004 & ETWB TCW No. 3/2006		√		Throughout design and construction phase	The planting proposal seeks to compensate for the predicted tree loss resulting form the construction, visually integrate the proposals within its existing landscape framework and provide an improved visual amenity
LMM4	Erection of decorative screen hoarding compatible with surrounding setting	Site	WSD	Contractor	TM-EIA Annex 18 and BD		√		Throughout construction phase	To integrate the construction site with the existing environment
LMM5	Locations of the site office, storage or workshops should be carefully adjusted to areas out of tree protection zones.	Site	WSD	Contractor	TM-EIA Annex 18 and BD	√			Throughout design phase	To avoid unnecessary felling of trees
LMM6	Selection of intake and outfall portals to areas enclosed by existing topography or vegetation	Site	WSD	Contractor	TM-EIA Annex 18 and BD	√			Throughout design phase	To preserve the existing topography and as many as trees as possible

Id No.	Landscape and Visual Mitigation Measures	Location	Funding	Implementation/ Maintenance Agent	Relevant Standard or Requirement	Implementation Stage*			Timing of Implementation	Objectives of the Recommended Measure and Main Concern to address
						D	C	O		
LMM7	Appearance of the water intake and outfall structures	Site	WSD	Contractor	TM-EIA Annex 18 and BD	√			Throughout design phase	To reduce the apparent visual mass of water intake and outfall structures
LMM8	Reinstatement of disturbed vegetation at both portal areas	Site	WSD	Contractor	TM-EIA Annex 18			√	After the completion of construction works	To mitigate disturbance to vegetation arising from the proposed construction

Table 11-7 Cultural Heritage – Implementation Schedule of Recommended Mitigation Measures

EIA Ref.	EM&A Ref.	Recommended Environmental Protection Measures/ Mitigation Measures	Objectives of the recommended measures & main concerns to address	Who to implement the measures?	Location/ Timing of implementation of Measures	What requirements or standards for the measures to achieve?
Construction Phase						
S 10.7	S8.1.2	Condition Survey for the identified historic items and monitoring of vibration levels if required.	Prevention of structural damage to the identified historic items	Contractors	Condition survey to be undertaken prior to the construction phase and vibration monitoring to be undertaken during the construction phase if required.	None
Operational Phase						
N/A	N/A	None	None	None	None	None

12. SUMMARY OF FINDINGS, CONCLUSION & RECOMMENDATIONS

12.1 Introduction

12.1.1 This project, which the EIA concerns, is about the construction and operation of an Inter-Reservoirs Transfer Scheme ("IRTS") – Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir. The Project falls within the Kam Shan Country Parks is therefore a designated project under Item Q.1 of Part I, Schedule 2 of the EIA Ordinance.

12.1.2 An application for an EIA study brief under section 5(1) of the EIAO was submitted by the Water Supplies Department on 29 September 2006 with a Project Profile.

12.1.3 An EIA Study Brief was issued by EPD to the project proponent – Water Supplies Department for the carrying out of the EIA.

12.1.4 In fact, the alignment adopted for the IRTS differs from the original one outlined in the project profile due to various design constraints, benefits and environmental considerations.

12.1.5 The environmental implications of this Project have been addressed and presented in the foregoing sections and summarised in the sections below.

12.2 Air Quality Impact

12.2.1 A review of the site environs and the construction of the Project have suggested that the main sources of air pollution during the construction phase will mainly be fugitive dust emissions which are expected to be controllable.

12.2.2 Through proper implementation of dust control measures as required under the Air Pollution Control (Construction Dust) Regulation, construction dust can be controlled at source to acceptable levels and hence no unacceptable impacts are anticipated.

12.2.3 During the operational phase, the project itself is not a source of air pollution.

12.2.4 As the project does not require large-scale site formation or other major activities that could generate significant amount of fugitive dust, no specific construction dust monitoring is considered necessary, though on-site environmental audit is recommended to ensure proper implementation of dust control measures during the construction phase.

12.3 Construction Noise Impact

12.3.1 The construction noise impact assessment has been based on a best estimate of the construction sequence and machines inventory. TBM is expected to operate 24 hours a day to maximise the resources and to complete the works under a tight schedule, while other construction activities at both portals will cease during the restricted hours unless the contractor can obtain a construction noise permit ("CNP") from the Authority to extent the works into the restricted hours.

12.3.2 The potential noise impact that could arise from daytime construction activities of the Project has been evaluated. The assessment results show no exceedances of construction noise criteria at both the intake and outfall end were predicted in the unmitigated scenario. Hence, no residual noise impact has been predicted.

12.3.3 Potential ground-borne noise impacts during the construction phase have also been assessed. Results indicated that the noise levels predicted can satisfactorily meet the derived noise criteria for the daytime and nighttime period. No mitigation measures are considered necessary.

12.3.4 The Contractor shall, from time to time, be aware of the noise impacts on the surrounding NSRs through adequate noise monitoring during the works so that adjustments could be made to control the construction noise levels. These requirements should be triggered by an Event and Action Plan as part of the EM&A which should be incorporated into the works contract in order to make it enforceable.

12.3.5 As part of the EM&A, baseline monitoring is necessary given an existing tranquil environment in the vicinity of the work site and the local noise sensitive uses on either ends of the IRTS and the envisaged 24-hour tunnelling works.

12.3.6 Impact monitoring will be carried out at monitoring stations defined in the EM&A Manual at a weekly basis to cover working session including the following: -

a) 1 no. of L_{eq} (30 min) noise measurements between 0700-1900 hours on any normal weekdays

b) 3 nos. of consecutive L_{eq} (5 min) noise measurements between 0700-1900 hours on general holidays or Sundays (if work is undertaken)

c) 3 nos. of consecutive L_{eq} (5 min) noise measurements between 1900-2300 hours (if evening activities are undertaken)

d) 3 nos. of consecutive L_{eq} (5 min) noise measurements between 2300-0700 hours next day (if there are nighttime activities).

12.4 Water Quality Impact

12.4.1 This Project involves the construction of a water tunnel linking both the Kowloon Byewash and Lower Shing Mun Reservoirs. Although the tunnel will be entirely underground, the portals and construction sites on either side will fall within the water gathering grounds of both reservoirs, which are water sensitive receivers. Water quality impact will be a key concern during the construction phase.

12.4.2 Surface run-off and effluent from the construction sites will be directed towards adequately designed sand/silt removal facilities such as sand/silt traps and sediment basins to remove sand/silt particles from runoff to meet the requirements of the TM standards under the WPCO before discharging.

12.4.3 It is envisaged that the best practicable pollution control measures recommended for the construction phases should be effective to control the potential water quality impacts resulting from stormwater runoff into receiving waters, usually water sensitive receivers.

12.4.4 With the implementation of the recommended mitigation measures and management practices, it is anticipated that the impacts upon the WSRs during the construction phase of the

Project would be temporary and minimal. An EM&A programme in respect of water quality issues during the construction phase of the Project would be carried out to monitor compliance with acceptable levels of water quality indicators and to ensure the proposed mitigation measures are effective and implemented.

12.5 Waste Management

12.5.1 The potential impacts of wastes arising from the construction and operational phases of the project have been assessed. The construction activities associated with the proposed works will generate a variety of wastes including vegetation from site clearance, excavated materials, and construction wastes, chemical and municipal wastes.

12.5.2 The largest amount of waste expected would be inert C&D materials, which will be generated by tunnelling works during Month 12-17 for around 6 months. The total inert C&D materials expected for the entire project are about 43,800 m^3 and that due to tunnelling is estimated as 37,000 m^3. 43,650 m^3 of the total inert C&D materials will be disposed of at the nearest public fill reception facilities.

12.5.3 In view of the Government policy towards promotion recycling and due to the clear environmental benefits this will provide, recycling and waste reduction by site staff/ contractors (construction phase) should be encouraged whenever it is possible.

12.5.4 While an estimate has been made on the likely volumes and types of waste to be generated from the construction of the project, the Contractor should regularly update and submit the monthly Waste Flow Table ("WFT") which would provide a more accurate estimate on volumes of waste generation on-site. This WFT shall form part of the Waste Management Plan ("WMP") to be submitted as part of the EM&A requirements and in accordance with ETWB Technical Circular (Works) No. 19/2005, Waste Management on Construction Sites.

12.5.5 Provided that the waste management practices outlined are put in place, potential impacts on the environment associated with waste generated during the construction phases of the Project should be well under controlled.

12.6 Hazard to Life

12.6.1 The Project work site will potentially be affected by two major sources of hazards, viz.: -

- Possible use of explosives for tunnelling works
- Transport, storage and use of chlorine for disinfection of water at the Shek Lei Pui Water Treatment Works ("SLPWTW") – a PHI defined by the CCPHI

12.6.2 As outlined in Section 2.6.3, the use of explosives has been ruled out due to proximity of the tunnelling works to the Lower Shing Mun Reservoir dam.

12.6.3 Due to construction requirements, the Shek Lei Pui WTW will be temporarily taken out of service as the construction of the intake portal and TBM retrieving would require the water at the Kowloon Reception Reservoir and the Kowloon Byewash Reservoir to be temporarily drawn down.

12.6.4 Suspension of water treatment at the SLPWTW will be accompanied by relocation of all chlorine drums and hence remove hazard due to transport, storage and use of chlorine at

SLPWTW.

12.6.5 Because of the above, no hazard to life assessment is considered necessary as the two hazard sources will be removed.

12.7 Ecological Impact

12.7.1 An Ecological Impact Assessment (EcoIA) has been conducted for the proposed IRTS Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir. Ecological surveys were carried out in September 2007 to February 2008 which covered both wet and dry seasons.

12.7.2 Six types of habitats were identified within the study area, including reservoir, secondary woodland / plantation, grassland, stream, drainage channel and developed area / bare ground. The habitats inside the boundaries of the proposed worksite areas were not of high ecological value.

12.7.3 The dominant faunal species recorded in Kam Shan Country Park is the *Rhesus Macaque*, several mammal species of conservation concern were also recorded during previous studies. These faunal species mainly inhabits in secondary woodland/ plantation. The fish species recorded in the Lower Shing Mun area are all common and widespread except the Wild Carp recorded by AFCD in previous study of uncommon status. Although floral and faunal species of conservation concern were identified, no adverse impact on the subject taxa groups was anticipated. Good site practices and avoidance of eating in works area and feeding wild fauna could avoid attracting these animals to the works area. The impacts could be further minimised by implementation of water quality control measures and reinstatement of habitats after construction.

12.7.4 As whole water tunnel will be constructed underground, the scale of surface construction works is limited in nature. The ecological impact with the implementation of recommended mitigation measures should be within acceptable level.

12.8 Landscape and Visual Impact

Landscape Impact

12.8.1 The landscape impacts on the landscape resources and landscape character areas of LR1 Mixed Woodland, LR2 Modified Water Course, LCA1 Kowloon Reservoir Group and LCA2 Lower Shing Mun Reservoir are predicted to be moderate to slight adverse due to modification of existing artificial topography and loss of existing trees. The incorporation of landscape mitigation measures through responsive site planning, retention of vegetations by compensatory planting of trees and planting of shrubs would lessen the landscape impacts to acceptable level.

12.8.2 Since there will be no construction activity outside the works area, the landscape impacts on the landscape resources and landscape character areas of LR3 Developed Area, LCA3 Sha Tin Height Urban Fringe, LCA4 Cheung Sha Wan Urban Fringe are predicted to be insubstantial.

Visual Impact

12.8.3 The unmitigated visual impact of the Project on all identified Visual Sensitive Receivers (VSRs), R1 Residents at Lakeview Garden, R2 Residents of No. 8 Caldecott Road Former Government Apartment, T1 Visitors in Kam Shan Country Park and T2 Trail Walkers in Lower Shing Mun Reservoir are predicted to be moderate adverse due to the appearance of new water intake or outfall structures together with the loss of surrounding vegetations. Through the mitigation measures by enhancing the appearance of the structures, compensatory planting of trees as well as restoration of shrubs at the works areas, it is expected to reduce the visual impacts after mitigation to slight adverse impacts.

12.8.4 Overall, the proposed water tunnel portals with water intake and outfall structures in the Project is considered to be acceptable with the implementation of mitigation measures recommended in the EIA.

12.9 Cultural Heritage Impact

12.9.1 The Cultural Heritage Impact Assessment for the project has identified that there are sensitive historical structures in the vicinity of the proposed works and that mitigation in the form of vibration monitoring may be required during the construction phase at Intake A. Although no adverse impacts on the historical structures are anticipated, conducting a condition survey prior to the construction phase as a precautionary mitigation measure is recommended and the survey report shall be submitted to AMO for review prior to the commencement of the construction phase.

12.10 Conclusions

12.10.1 This EIA has provided information on the nature and extent of environmental impacts arising from the construction and operation of the project and has revealed no insurmountable environmental issues.

Appendices

Appendix A
Study Brief

Environmental Impact Assessment Ordinance (Cap. 499)
Section 5(7)

Environmental Impact Assessment Study Brief No. ESB-154/2006

Project Title: West Kowloon Drainage Improvement – Lai Chi Kok Transfer Scheme Inter-Reservoirs Transfer Scheme (IRTS) – Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir

(hereinafter known as the "Project")

Name of Applicant :
Water Supplies Department
(hereinafter known as the "Applicant")

1. BACKGROUND

1.1 An application (No. ESB-154/2006) for an Environmental Impact Assessment (EIA) study brief under section 5(1) of the Environmental Impact Assessment Ordinance (EIAO) was submitted by the Applicant on 29 September 2006 with a project profile (No. PP-298/2006) (the Project Profile).

1.2 The Project is to construct a fresh water transfer tunnel of approximately 2.8 km long with 3 m inside diameter between Kowloon Byewash Reservoirs and Lower Shing Mun Reservoir. The Project is to alleviate recurrent flooding in Sham Shui Po, Cheung Sha Wan and Lai Chi Kok and forms part of the overall flood control strategy for West Kowloon. The project will reduce the quantity of the overflow from the Kowloon Group of Reservoirs into the Lai Chi Kok Transfer Scheme by transferring water from Kowloon Byewash Reservoirs into Lower Shing Mun Reservoir via the new water tunnel. The Project will substantially reduce the scope of Lai Chi Kok Transfer Scheme and make better use of water collected by Kowloon Group of Reservoirs[1] which otherwise overflows into the Butterfly Valley and discharge into the sea during rainstorm. The water transfer tunnel will be located beneath the Kam Shan Country Park and will cross over the High Island Water Tunnel as shown in Appendix I of the project profile, reproduced here as Appendix A and described below :-

(a) construction of a fresh water transfer tunnel, approximately 2.8km long with 3m diameter;
(b) construction of an intake structure at Kowloon Bywash Reservoir; and
(c) construction of an outfall structure at Lower Shing Mun Reservoir.

1.3 The Project partly falls within Kam Shan Country Park. It is therefore a designated project under Item Q.1 of Part I, Schedule 2 of the EIAO which specifies: "*All projects including new access roads, railways, sewers, sewage treatment facilities, earthworks, dredging works and other building works partly or wholly in an existing or gazetted proposed country park or special area, a conservation area, an existing or gazetted proposed marine park or marine reserve, a site of cultural heritage, and a*

[1] Kowloon Group of Reservoirs are Kowloon Reservoir, Shek Lei Pui Reservoir, Kowloon Reception Reservoir and Kowloon Byewash Reservoir.

site of special scientific interest". In accordance with section 5(1)(a) of the EIAO, a person who is planning a designated project shall apply to the Director of Environmental Protection (the Director) for an EIA study brief to proceed with an EIA study for the project.

1.4 Pursuant to section 5(7)(a) of the EIAO, the Director issues this EIA study brief to the Applicant to carry out an EIA study.

1.5 The purpose of this EIA study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project and related activities that take place concurrently. This information will contribute to decisions by the Director on :

(i) the overall acceptability of any adverse environmental consequences that are likely to arise as a result of the Project;

(ii) the conditions and requirements for the detailed design, construction and operation of the Project to mitigate against adverse environmental consequences wherever practicable; and

(iii) the acceptability of residual impacts after the proposed mitigation measures are implemented.

2. OBJECTIVES OF THE EIA STUDY

2.1 The objectives of the EIA study are as follows :

(i) to describe the Project and associated works together with the requirements for carrying out the Project;

(ii) to identify and describe the elements of the community and environment likely to be affected by the Project and/or likely to cause adverse impacts to the Project, including both the natural and man-made environment;

(iii) to provide information on the consideration of alternatives to avoid and minimise the potential adverse environmental impacts on the sensitive uses that may be subject to the adverse environmental impacts of the proposed developments and associated works; to compare the environmental benefits and dis-benefits of each of the different options; to provide reasons for selecting the preferred option(s) and to describe the part of environmental factors played in the selection of the preferred option(s);

(iv) to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;

(v) to identify and quantify any potential losses or damages and other potential impacts on flora, fauna and natural habitats and to propose measures to mitigated these impacts;

(vi) to identify any potential landscape and visual impacts and to propose measures to mitigate these impacts;

(vii) to identify and assess any adverse impacts on historical buildings/structures and archaeological sites and to propose measures to mitigate these impacts;

(viii) to propose the provision of infrastructure or mitigation measures so as to

minimise pollution, environmental disturbance and nuisance during construction and operation of the Project;

(ix) to investigate the feasibility, practicability, effectiveness and implications of the proposed mitigation measures;

(x) to identify, predict and evaluate the residual environmental impacts (i.e. after practicable mitigation) and the cumulative effects expected to arise during the construction and operation phases of the Project in relation to the sensitive receivers and potential affected uses;

(xi) to identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the Project which are necessary to mitigate these environmental impacts and cumulative effects and reduce them to acceptable levels;

(xii) to investigate the extent of the secondary environmental impacts that may arise from the proposed mitigation measures and to identify constraints associated with the mitigation measures recommended in the EIA study, as well as the provision of any necessary modification; and

(xiii) to design and specify the environmental monitoring and audit requirements to ensure the effective implementation of the recommended environmental protection and pollution control measures.

3. DETAILED REQUIREMENTS OF THE EIA STUDY

3.1 The Purpose

The purpose of this study brief is to scope the key issues of the EIA study and to specify the environmental issues that are required to be reviewed and assessed in the EIA report. The Applicant has to demonstrate in the EIA report that the criteria in the relevant sections of the Technical Memorandum on the Environmental Impact Assessment Process of the Environmental Impact Assessment Ordinance (hereinafter referred to as "the TM") are fully complied with.

3.2 The Scope

The scope of this EIA study shall cover the project proposed in the Project Profile and the works mentioned in Section 1.2 above. The EIA study shall address the likely key issues described below, together with any other key issues identified during the course of the EIA study :

(i) potential air quality impact from the construction of the Project, taking into account the cumulative impact from the existing and planned sources of pollution in the vicinity of the Project, on the sensitive receivers within the study area as detailed in Section 3.4.1, in particular the Tai Po Road Water Staff Quarters which is located about 140m from the proposed intake structure at Kowloon Byewash Reservoir;

(ii) potential noise impact from the construction of the Project, taking into account the cumulative impact from other concurrent projects in the vicinity of the project, on the sensitive receivers within the study area as detailed in Section 3.4.2, in particular the Tai Po Road Water Staff Quarters;

(iii) potential water quality impact from the construction of the Project on the relevant water system(s), e.g. the water gather grounds and the reservoirs;

(iv) potential impacts of various types of waste arising from the construction of the Project;

(v) potential hazard to life on construction workers and other sensitive receivers to be identified, given Shek Lei Pui Water Treatment Works (SLP WTW) is a Potentially Hazardous Installations (PHI) due to the use of liquid chlorine on site, and the possible use of explosives for blasting;

(vi) potential ecological impact from the construction and operation of the Project, including its management and maintenance, on the Kam Shan and Lion Rock Country Parks, sites of ecological importance and wildlife groups or habitats/species of conservation importance;

(vii) potential landscape and visual impacts from the construction and operation of the Project, e.g. on the landscape and visual resources of the Kam Shan and Lion Rock Country Parks;

(viii) potential cultural and heritage impacts on graded buildings/structures including the Grade II Dam and Valve House of the Kowloon Byewash Reservoir, the Grade II Dam (Northeast) and Valve House of the Shek Lei Pui Reservoir; and

(ix) cumulative environmental impacts of the Project, through interaction or in combination with other existing, committed and planned developments in the vicinity of the Project including and that those impacts may have a bearing on the environmental acceptability of the Project.

3.3 Consideration of Alternatives

3.3.1 Need for the Project

The Applicant shall study and review the need for the Project and provide information to justify the need. The Applicant shall explain clearly the purpose and objectives of the Project and describe the scenarios with and without the Project.

3.3.2 Consideration of Different Alignment Options

In addition to the proposed alignment set out in the Project Profile, the Applicant shall consider other feasible alternative options for the proposed project, provide justification for the selected alignment, including description of the environmental factors considered in the alignment selection process and attempts made to avoid ecological sensitive areas and the historical buildings/structures.

3.3.3 Consideration of Alternative Construction Methods and Sequences of Works

Taking into consideration the combined effect with respect to the severity and duration of the construction impacts to the affected sensitive receivers, the EIA study shall explore alternative construction methods and sequences of works for the Project,

in particular to avoid the use of explosives, with a view to avoiding prolonged adverse environmental impacts to the maximum practicable extent. A comparison of the environmental benefits and dis-benefits of applying different construction methods and sequences of works shall be made.

3.3.4 Selection of Preferred Scenario

Taking into consideration of the findings in sub-sections 3.3.2 and 3.3.3 above, the Applicant shall recommend with full justifications the adoption of the preferred scenario that will avoid or minimise adverse environmental effects arising from the Project, and adequately describe the part that environmental factors played in arriving at the final selection.

3.4 Technical Requirements

The Applicant shall conduct the EIA study to address all environmental aspects of the activities as described in Sections 3.2 and 3.3 above. The EIA study shall include the following technical requirements on specific impacts.

3.4.1 Air Quality Impact

3.4.1.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing air quality impact as stated in Annexes 4 and 12 of the TM, respectively.

3.4.1.2 The study area for air quality impact assessment shall be defined by a distance of 500 metres from site boundary of the Project shown in Appendix A or other project alignments as identified in the EIA, which shall be extended to include major emission sources that may have a bearing on the environmental acceptability of the Project. The assessment shall include the existing, planned and committed sensitive receivers within the study area. Such assessment shall be based on the best available information at the time of the assessment.

3.4.1.3 When carrying out quantitative assessment, the Applicant shall assess the air pollutant concentrations with reference to the relevant sections of the guidelines in Appendices B-1 to B-3 attached to this study brief, or other methodology as agreed by the Director.

3.4.1.4 The air quality impact assessment shall include the following:

(i) Background and Analysis of Activities

(a) Provide background information relating to air quality issues relevant to the Project, e.g. description of the types of activities of the Project that may affect air quality during construction stage.

(b) Give an account, where appropriate, of the consideration/measures that had been taken into consideration in the planning of the Project to abate the air pollution impact. That is, the Applicant shall consider alternative construction methods/phasing programmes to minimize the constructional air quality impact.

(c) Present background air quality levels in the assessment area for the purpose

of evaluating cumulative constructional air quality impacts.

(ii) Identification of Air Sensitive Receivers (ASRs) and Examination of Emission / Dispersion Characteristics

(a) Identify and describe existing and planned/committed ASRs that would likely be affected by the Project, including those earmarked on the relevant Outline Zoning Plans, Development Permission Area Plans, Outline Development Plans and Layout Plans. The Applicant shall select the assessment points of the identified ASRs that represent the worst impact point of these ASRs. A map showing the location and description such as name of buildings, their uses and height of the selected assessment points shall be given. The separation distances of these ASRs from the nearest emission sources shall also be given.

(b) Provide a list of air pollutant emission sources, including any nearby emission sources which are likely to have impact related to the Project based on the analysis of constructional activities in Sub-section 3.4.1.4(i) above. Examples of construction stage emission sources include stockpiling, blasting, concrete batching and vehicular movements on unpaved haul roads on site, etc. Confirmation of validity of the assumptions and magnitude of the activities (e.g. volume of construction material handled, etc.) shall be obtained from the relevant government departments/authorities and documented.

(iii) Construction Phase Air Quality Impact

(a) The Applicant shall follow the requirements stipulated under the Air Pollution Control (Construction Dust) Regulation to ensure that construction dust which may arise as a result of the works are controlled within the relevant standards as stipulated in Section 1 of Annex 4 of the TM. A monitoring and audit programme for the construction phase shall be devised to verify the effectiveness of the control measures proposed so as to ensure proper construction dust control.

(b) If the Applicant anticipates that the Project will give rise to significant construction dust impacts likely to exceed recommended limits in the TM at the ASRs despite the incorporation of the dust control measures proposed in accordance with Sub-section 3.4.1.4(iii)(a) above, a quantitative assessment shall be carried out to evaluate the construction dust impact at the identified ASRs. The Applicant shall follow the methodology set out in Sub-section 3.4.1.4(iv) below when carrying out the quantitative assessment.

(iv) Quantitative Assessment Methodology

(a) The Applicant shall apply the general principles enunciated in the modelling guidelines in Appendices B-1 to B-3 while making allowance for the specific characteristics of the Project. This specific methodology must be documented in such level of details (preferably with tables and diagrams) to allow the readers of the assessment report to grasp how the model is set up to simulate the situation at hand without referring to the model input files. Details of the calculation of the emission rates of air pollutants for

input to the modelling shall be presented in the report. The Applicant must ensure consistency between the text description and the model files at every stage of submission. In case of doubt, prior agreement between the Applicant and the Director on the specific modelling details should be sought.

(b) The Applicant shall identify the key/representative air pollutant parameters (types of pollutants and the averaging time concentration) to be evaluated and provide explanation for choosing these parameters for the assessment of the impact of the Project.

(c) The Applicant shall calculate the cumulative air quality impact at the identified ASRs and compare these results against the criteria set out in Section 1 of Annex 4 in the TM. The predicted air quality impacts (both unmitigated and mitigated) shall be presented in the form of summary table and pollution contours, to be evaluated against the relevant air quality standards and on any effect they may have on the land use implications. Plans of a suitable scale should be used to present pollution contour to allow buffer distance requirements to be determined properly.

(v) Mitigation Measures for Non-compliance

The Applicant shall propose remedies and mitigating measures where the predicted air quality impact exceeds the criteria set in Section 1 of Annex 4 in the TM. These measures and any constraints on future land use planning shall be agreed with the relevant government departments/authorities and documented. The Applicant shall demonstrate quantitatively that the residual impacts after incorporation of the proposed mitigating measures will comply with the criteria stipulated in Section 1 of Annex 4 in the TM.

(vi) Submission of Model Files

All input and output file(s) of the model run(s) shall be submitted to the Director in electronic format.

3.4.2 Noise Impact

3.4.2.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing noise impact as stated in Annexes 5 and 13 of the TM, respectively.

3.4.2.2 The noise impact assessment shall include the following :

(i) Determination of Assessment Area

The study area for the noise impact assessment shall include all areas within 300m from site boundary of the Project shown in Appendix A or other project alignments as identified in the EIA. Subject to the agreement of the Director, the assessment area could be reduced accordingly if the first layer of noise sensitive receivers (NSRs), closer than 300m from the outer project limit, provides acoustic shielding to those receivers at further distance behind. Subject to the agreement from the Director, the assessment area shall be expanded to include NSRs at larger distance that would be affected by the

construction of the Project.

(ii) Provision of Background Information and Existing Noise Levels

The Applicant shall provide background information relevant to the Project, e.g. relevant previous or current studies. Unless required for determining the planning standards, e.g. those for planning of fixed noise sources, no existing noise levels are particularly required.

(iii) Identification of Noise Sensitive Receivers

(a) The Applicant shall refer to Annex 13 of the TM when identifying the NSRs. The NSRs shall include all existing NSRs and all planned/committed noise sensitive developments and uses earmarked on the relevant Outline Zoning Plans, Development Permission Area Plans, Outline Development Plans and Layout Plans.

(b) The Applicant shall select assessment points to represent all identified NSRs for carrying out quantitative noise assessment described below. The assessment points shall be agreed with the Director prior to the quantitative noise assessment. A map showing the location and description such as name of building, use, and floors of each and every selected assessment point shall be given.

(iv) Provision of an Emission Inventory of the Noise Sources

The Applicant shall provide an inventory of noise sources including construction equipment for construction noise assessment. Confirmation of the validity of the inventory shall be obtained from the relevant government departments/authorities and documented.

(v) Construction Noise Assessment

(a) The Applicant shall carry out assessment of noise impact from construction (excluding percussive piling) of the Project during day time, i.e. 7 a.m. to 7 p.m., on weekdays other than general holidays in accordance with the methodology stipulated in paragraphs 5.3 and 5.4 of Annex 13 of the TM. The criteria in Table 1B of Annex 5 of the TM shall be adopted in the assessment.

(b) For ground-borne noise impacts, the criteria and assessment methodology shall be agreed with the Director (with reference to Section 4.4.2(c) of the TM). Site measurements at appropriate locations may be required in order to obtain the empirical input parameters required in the ground-borne noise model.

(c) To minimise the construction noise impact, alternative construction methods to replace percussive piling shall be proposed as far as practicable. In case blasting works will be involved, it should be carried out, as far as practicable, outside the sensitive hours of 7 p.m. to 7 a.m. on Monday to Saturday and any time on a general holiday,

including Sunday. For blasting that must be carried out during the above-mentioned sensitive hours, the noise impact in associated with the removal of debris and rocks should be fully assessed and adequate mitigation measures should be recommended to reduce the noise impact as appropriate.

(d) For tunnelling, noise impact (including air-borne noise and ground-borne noise) associated with the operation of powered mechanical equipment, in particular, tunnel boring machines or equivalent, shall be assessed. If the equipment, such as a tunnel boring machine and associated facilities, is used, the methodology/model for assessing ground-borne noise impact from these equipments/facilities shall be agreed with the Director prior to obtaining the empirical parameters required in the ground-borne noise model. Cumulative impacts with other projects shall be covered if appropriate.

(e) If the unmitigated construction noise levels are found exceeding the relevant criteria, the Applicant shall propose practicable direct mitigation measures (including movable barriers, enclosures, quieter alternative methods, re-scheduling and restricting hours of operation of noisy task) to minimise the impact. If the mitigated noise levels still exceed the relevant criteria, the duration of the noise exceedance shall be given.

(f) In case the Applicant would like to evaluate whether construction works in restricted hours as defined under the Noise Control Ordinance (NCO) are feasible or not in the context of programming construction works, reference should be made to the relevant technical memoranda issued under the NCO. Regardless of the results of the construction noise impact assessment for restricted hours, the Noise Control Authority will process the Construction Noise Permit (CNP) application, if necessary, based on the NCO, the relevant technical memoranda issued under the NCO, and the contemporary conditions/situations. This aspect should be explicitly stated in the noise chapter and the conclusions and recommendations chapter in the EIA report.

(vi) Assessment of Side Effects and Constraints

The Applicant shall identify, assess and propose means to minimise any side effects and to resolve any potential constraints due to the inclusion of any recommended direct technical remedies.

(vii) Evaluation of Constraints on Planned Noise Sensitive Development/Landuses

For planned noise sensitive uses which will still be affected even with all practicable direct technical remedies in place, the Applicant shall propose, evaluate and confirm the practicality of additional measures within the planned noise sensitive uses and shall make recommendations on how these noise sensitive uses will be designed for the information of relevant parties.

The Applicant shall take into account agreed environmental requirements /

constraints identified by the study to assess the development potential of concerned sites which shall be made known to the relevant parties.

3.4.3 Water Quality Impact

3.4.3.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing water pollution as stated in Annexes 6 and 14 of the TM respectively.

3.4.3.2 The assessment area for the purpose of this water quality impact assessment shall cover the project area(s) as shown in Appendix A or other project alignments as identified in the EIA, plus any stream courses and the associated water system in the vicinity that may be affected by the project.

3.4.3.3 The Applicant shall identify and analyse physical, chemical and biological disruptions of marine, estuarine, fresh water or ground water system(s) arising from construction of the Project.

3.4.3.4 The Applicant shall include the following in the water quality impact assessment:

General

(i) Collection and review of background information on the existing water system(s) and their respective catchments which might be affected by the Project;

(ii) Characterization of water and sediment quality based on existing information or appropriate site survey/tests as appropriate;

(iii) Identification and analysis of relevant existing and planned future activities and beneficial uses related to the water system(s) and identification of all water sensitive receivers within the assessment area;

(iv) Identification of pertinent water and sediment quality objectives, criteria and standards for the water system(s) and all of the sensitive receivers identified in (iii) above;

(v) Identification of any alteration of any water courses, natural streams/ponds, wetland, change of shoreline or bathymetry, change of flow regimes, change of ground water levels, change of catchment types or areas;

(vi) Identification, analysis and quantification of existing and future water and sediment pollution sources, including point and non-point discharges to surface water runoff, and analysis of the provision and adequacy of future facilities to reduce such pollution. An emission inventory on the quantities and characteristics of these existing and future pollution sources in the assessment area shall also be provided. Field investigation and laboratory tests, as appropriate, shall be conducted to fill in any relevant information gaps;

(vii) Identification of the location of the water table within the project boundary and its distance to the proposed tunnel alignment;

Impact Prediction

(viii) Prediction and quantification of impacts on the water system(s) and the

sensitive receivers due to those alterations and changes identified in (v) above and the pollution sources identified in (vi) above. Possible impacts include changes in hydrology, flow regime, sediment erosion or deposition, water and sediment quality and the effects on the aquatic organism due to such changes. The prediction shall include possible different construction stages or sequences;

(ix) Prediction of potential water quality impact on the water systems and sensitive receivers if the tunnel alignment fall within the phreatic zone, which is right under the water table and are permanently saturated with groundwater, during the stage of tunnel construction;

(x) Cumulative impacts due to other projects, activities or pollution sources within a boundary around the assessment area, subject to the agreement of the Director shall also be predicted and quantified;

Waste Water and Non-point Sources Pollution

(xi) proposal for upgrading or providing any effective infrastructure, water pollution prevention and mitigation measures to be implemented during the construction stage so as to reduce the water and sediment quality impacts to within standards. Requirements to be incorporated in the project contract document shall also be proposed;

(xii) Best management practices to reduce storm water and non-point source pollution shall be investigated and proposed as appropriate; and

(xiii) evaluation and quantification of residual impacts on the water system(s) and the sensitive receivers with regard to the appropriate water and sediment quality objectives, criteria, standards or guidelines.

Protection of Water Gathering Ground

(xiv) Specification of an emergency contingency plan for the construction phase of the project to contain and remove all accidental spillage along roads at short notice so as to prevent/minimize the quantities of contaminants from reaching water gathering grounds.

3.4.4 Waste Management Implications

3.4.4.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing waste management implications as stated in Annexes 7 and 15 of the TM respectively.

3.4.4.2 The assessment of waste management implications shall cover the following:

(i) Analysis of Activities and Waste Generation

The Applicant shall identify the quantity, quality and timing of the waste arising as a result of the construction activities of the Project, based on the sequence and duration of these activities. The Applicant shall adopt design, general layout, construction methods and programme to minimize the

generation of public fill/inert C&DM and maximize the use of public fill/inert C&DM for other construction works.

(ii) Proposal for Waste Management

(a) Prior to considering the disposal options for various types of wastes, opportunities for reducing waste generation, on-site or off-site re-use and recycling shall be fully evaluated. Measures that can be taken in the planning and design stages e.g. by modifying the design approach and in the construction stage for maximizing waste reduction shall be separately considered.

(b) After considering all the opportunities for reducing waste generation and maximizing re-use, the types and quantities of the wastes required to be disposed of as a consequence shall be estimated and the disposal options for each type of waste shall be described in detail. The disposal options recommended for each type of wastes shall take into account the result of the assessment in item (c) below. The EIA report shall also state clearly the transportation routings and the frequency of the trucks / vessels involved, any barging point or conveyor system to be used, the stockpiling areas and the agreed disposal outlets for the wastes identified; and

(c) The impact caused by handling (including stockpiling, labelling, packaging & storage), collection, transportation and disposal of wastes shall be addressed in detail and appropriate mitigation measures shall be proposed. This assessment shall cover the following areas :

- potential hazard;
- air and odour emissions;
- noise;
- wastewater discharge; and
- public transport.

3.4.5 Hazard To Life

3.4.5.1 The Applicant shall follow the criteria for evaluating hazard to life as stated in Annex 4 of the TM.

Explosives

3.4.5.2 The Applicant shall investigate alternative construction method to avoid the use of explosives. If there is use of explosives for the construction activities and the storage or blasting location is in close proximity to populated areas and/or Potentially Hazardous Installation sites (i.e. Shek Lei Pui Water Treatment Works (SLP WTW)), the Applicant shall carry out hazard assessment as follows:

(i) Identify hazardous scenarios associated with the transport, storage and use of explosives and then determine a set of relevant scenarios to be included in a Quantitative Risk Assessment (QRA);
(ii) Execute a QRA of the set of hazardous scenarios determined in (i), expressing population risks in both individual and societal terms;
(iii) Compare individual and societal risks with the criteria for evaluating hazard to

life stipulated in Annex 4 of the TM; and

(iv) Identify and assess practicable and cost-effective risk mitigation measures.

The methodology of hazard assessment shall be agreed and approved by the Director.

Chlorine

3.4.5.3 The Applicant shall investigate methods to avoid and/or minimize chlorine risks during construction. The Applicant shall carry out hazard assessment to evaluate the risk to construction workers of the Project due to the transport, storage and use of chlorine associated with the operations at SLP WTW. The hazard assessment shall include the following:

(i) Identify hazardous scenarios associated with the transport, storage and use of chlorine at SLP WTW and determine a set of relevant scenarios to be included in a QRA;

(ii) Execute a QRA of the set of hazardous scenarios determined in (i), expressing population risks in both individual and societal terms;

(iii) Compare individual and societal risks with the criteria for evaluating hazard to life stipulated in Annex 4 of the TM; and

(iv) Identify and assess practicable and cost-effective risk mitigation measures.

The methodology of hazard assessment shall be agreed and approved by the Director.

3.4.6 Ecological Impact (Terrestrial and Aquatic)

3.4.6.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing ecological impact as stated in Annexes 8 and 16 of the TM, respectively.

3.4.6.2 The assessment area for the purpose of this ecological impact assessment shall include all areas within 500 m distance from site boundary of the Project shown in Appendix A or other project alignments as identified in the EIA, or the area likely to be impacted by the project.

3.4.6.3 In the ecological impact assessment, the Applicant shall examine the flora, fauna and other components of the ecological habitats within the assessment area. The aim shall be to protect, maintain or rehabilitate the natural environment. In particular, the proposed project shall avoid impacts on recognised sites of conservation importance and wildlife groups or habitats/species of conservation importance. The assessment shall identify and quantify as far as possible the potential ecological impacts on the natural environment and the associated wildlife groups and habitats/species arising from the Project during the construction and operation phases including its management and maintenance. Assessment of the potential ecological impacts associated with the Project including haul roads and works areas shall also be included. The potential impact of draining down of the Kowloon Byewash Reservoir and Lower Shing Mun Reservoir during the construction and operation phases should be addressed.

3.4.6.4 The assessment shall include the following :

(a) review the findings of relevant studies/surveys and collate the available information regarding the ecological characters of the assessment area;

(b) evaluate the information collected and identify any information gap relating

to the assessment of potential ecological impacts to the terrestrial and aquatic environment;

(c) carry out necessary ecological field surveys (the during of which shall be at least 4 months to cover both wet and dry seasons) and investigations to verify the information collected, fill the information gaps identified and fulfill the objectives of the EIA study;

(d) establish the general ecological profile of the assessment area based on data of relevant previous studies/surveys and results of the ecological field surveys, and describe the characteristics of each habitat found. Major information to be provided shall include :

(i) description of the physical environment including recognised sites or habitats of conservation importance;

(ii) habitat maps of suitable scale (1:1000 to 1:5000) showing the types and locations of habitats/species in the assessment area with special attention to those with conservation importance including monkeys, water monitor *(Varanus salvator)*, Beale's turtle *(Sacalia bealei)*, bats and any other habitats/species identified as having special conservation importance by this EIA study;

(iii) ecological characteristics of each habitat type such as size, vegetation type, species present, dominant species found, species diversity and abundance, community structure, seasonal patterns, ecological value, inter-dependence of the habitats and species, and presence of any features of ecological importance;

(iv) representative colour photos of each habitat type and any important ecological features identified;

(v) species found that are rare, endangered and/or listed under local legislation, international conventions for conservation of wildlife/habitats or red data books;

(e) investigate and describe the existing wildlife uses of various habitats with special attention to those wildlife groups and habitats identified as having conservation importance by this EIA study;

(f) describe all recognized sites of conservation importance in the proposed development site and its vicinity including Kam Shan Country Park and Lion Rock Country Park and assess whether these sites will be affected by the proposed development or not;

(g) provide information and assess the potential effect of the proposed fresh water transfer tunnel on the water table;

(h) provide cross-sectional diagrams of the Project for reference.

(g) using suitable methodology, identify and quantify as far as possible any direct, indirect, on-site, primary, secondary and cumulative ecological impacts such as destruction of habitats, reduction of species

abundance/diversity, loss of feeding grounds, reduction of ecological carrying capacity and habitat fragmentation;

(h) evaluate the significance and acceptability of the ecological impacts identified using the criteria in Annex 8 of the TM;

(i) recommend possible alternatives (such as modifications of layout and design) and practicable mitigation measures to avoid, minimize and/or compensate for the adverse ecological impacts identified;

(j) evaluate the feasibility and effectiveness of the recommended mitigation measures and define the scope, type, location, implementation arrangement, subsequent management and maintenance of such measures;

(k) determine and quantify as far as possible the residual ecological impacts after implementation of the proposed mitigation measures;

(l) evaluate the severity and acceptability of the residual ecological impacts using the criteria in Annex 8 of the TM; and

(m) review the need for and recommend any ecological monitoring programme required.

3.4.7 Landscape and Visual Impacts

3.4.7.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing landscape and visual impacts for any above ground structures and work areas as stated in Annexes 10 and 18 of the TM, respectively. Landscape and visual impacts during both construction and operation stages within the study area shall be assessed.

3.4.7.2 The study area for the landscape impact assessment shall include all areas within a 500m distance from the works limit of the above ground elements of the Project shown in Appendix A or other project alignments as identified in the EIA, while the assessment area for the visual impact assessment shall be defined by the visual envelope of the Project. The defined visual envelope must be shown on a plan in the EIA report.

3.4.7.3 The Applicant shall review relevant outline development plans, outline zoning plans, layout plans, other published land use plans, planning briefs and studies which may identify areas of high landscape value, and recommend open space and amenity designations. Any guidelines on landscape strategies, landscape framework, urban design concept, building height profiles, designated view corridors, open space network and landscape links that may affect the appreciation of the project should also be reviewed. The aim is to gain an insight to the future outlook of the area affected so as to assess whether the Project can fit into surrounding setting. Any conflict with the published land use plan(s) should be highlighted and appropriate follow-up action should be recommended.

3.4.7.4 The Applicant shall describe, appraise, analyse and evaluate the existing landscape resource and character of the assessment area. For judging the significance of landscape and visual impacts, reference should be made to Guidance Note No. 8/2002 “Preparation of Landscape and Visual Impact Assessment under the

Environmental Impact Assessment Ordinance". Annotated oblique aerial photographs and plans of suitable scale showing the baseline landscape character areas and landscape resources and mapping of impact assessment shall be extensively used to present the findings of the impact assessment. Descriptive text shall provide a concise and reasoned judgment from a landscape and visual point of view. The assessment shall particularly focused on the sensitivity of the landscape framework and its ability to accommodate change. The Applicant shall identify the degree of compatibility of the Project with the existing and planned landscape settings. The landscape impact assessment shall quantify the potential landscape impacts as far as possible, so as to illustrate the significance of such impacts arising from the Project. Clear mapping of the landscape impact is required. A tree survey shall be carried out and the impacts on existing trees shall be addressed. Cumulative landscape and visual impacts of the Project with other existing, committed and planned developments in the study area shall be assessed.

3.4.7.5 The Applicant shall assess the visual impacts of the Project. Clear illustrations including mapping of visual impact are required. The assessment shall include the following:

(i) identification and plotting of visual envelope of the Project within the assessment area;

(ii) identification of the key groups of sensitive receivers including park visitors within the visual envelope with regard to views from the ground level and elevated vantage points;

(iii) description of the visual compatibility of the Project with the surrounding and the existing and planned setting, and its obstruction and interference with the key views of the adjacent areas; and

(iv) description of the severity of visual impacts in terms of nature, distance and number of sensitive receivers.

3.4.7.6 Annotated illustration materials such as coloured perspective drawings, plans and section / elevation diagrams, oblique aerial photographs, photographs taken at vantage points and computer-generated photomontage shall be adopted to fully illustrate the landscape and visual impacts of the Project. In particular, the landscape and visual impacts of the Project with and without mitigation measures shall also be properly illustrated in existing and planned setting by computer-generated photomontage so as to demonstrate the effectiveness of the proposed mitigation measures. All computer graphics shall be compatible with Microstation DGN file format or as agreed with the Director. The Applicant shall record the technical details such as system set-up, software, data files and function in preparing the illustration, which may need to be submitted for verification of the accuracy of the illustrations.

3.4.8 Impacts on Cultural Heritage

3.4.8.1 The Applicant shall follow the criteria and guidelines for evaluating and assessing the cultural heritage impacts as stated in Annex 10 and 19 of the TM, respectively.

3.4.8.2 The Applicant shall conduct a cultural heritage impact assessment (CHIA) to identify known and unknown heritage items within the assessment area (as described in

sections 1.2 and 3.2) that may be affected by the Project and its associated works to assess the direct and indirect impacts on the heritage items. The information of all the identified archaeological sites and historic buildings and structures including their ownerships, historical background, 1:1000 scale location plans, photographs and the like shall be provided. A plan showing the location of both the proposed works and all identified cultural heritage resources shall be included. The Applicant shall consider referring to the relevant sections of the Criteria of Cultural Heritage Impact Assessment in Appendix C for this CHIA.

3.4.8.3 Any potential physical disturbance caused by works during construction and operation of the project to the built heritage (The Grade II Dam and Valve House of the Kowloon Byewash Reservoir, the Grade II Dam (Northeast) and Valve House of the Shek Lei Pui Reservoir), other identified archaeological sites and historic buildings and structures shall be identified and avoided, if applicable. Direct and indirect impacts (including visual impact, impacts due to demolition and vibration associated with the construction activities of the Project) on all identified archaeological sites, historic buildings and structures shall be assessed. Appropriate presentation methods, such as perspective drawings, plans and section /elevation diagrammes, photo retouching and photomontage, shall be used of the visual impact assessment an the recommended mitigation measures.

3.4.8.4 The applicant shall assess the extent to which those cultural heritage resources that might be affected and recommend possible alternatives, (such as other feasible tunnel alignment options, modification of design and construction method, and so forth). Practicable monitoring and mitigation measures including identification of implementation agents and periods to avoid or minimize the impacts on each of the affected cultural heritage resources shall be recommended, if applicable.

3.4.9 Summary of Environmental Outcomes

The EIA report shall contain a summary of the key environmental outcomes arising from the EIA study, including the population and environmentally sensitive areas protected, environmentally friendly designs recommended, key environmental problems avoided, compensation areas included and the environmental benefits of environmental protection measures recommended.

4. ENVIRONMENTAL MONITORING & AUDIT (EM&A) REQUIREMENTS

4.1 The Applicant shall identify in the EIA study whether there is any need for EM&A activities during construction and operation phases of the Project and, if affirmative, to define the scope of EM&A requirements for the Project in the EIA study.

4.2 Subject to the confirmation of the EIA study findings, the Applicant shall comply with the requirements as stipulated in Annex 21 of the TM.

4.3 The Applicant shall prepare a project implementation schedule, in the form of a checklist containing all the EIA study recommendations and mitigation measures with reference to the implementation programme.

5. DURATION OF VALIDITY

5.1 This EIA study brief is valid for 36 months counting from the date of its issuance. If

the EIA study does not commence within this period, the Applicant shall apply to the Director for a fresh EIA study brief before commencement of the EIA study. The Applicant shall advise the Director the date of commencement of the EIA study

6. REPORT REQUIREMENTS

6.1 In preparing the EIA report, the Applicant shall refer to Annex 11 of the TM for the contents of an EIA report. The Applicant shall also refer to Annex 20 of the TM, which stipulates the guidelines for the review of an EIA report.

6.2 The Applicant shall supply the Director with the following number of copies of the EIA report and the executive summary:

(i) 40 copies of the EIA report in English and 20 copies of the executive summary (each bilingual in both English and Chinese) as required under section 6(2) of the EIAO to be supplied at the time of application for approval of the EIA report.

(ii) when necessary, addendum to the EIA report and the executive summary submitted in (i) above as required under section 7(1) of the EIAO, to be supplied upon advice by the Director for public inspection.

(iii) 20 copies of the EIA report in English and 50 copies of the executive summary (each bilingual in both English and Chinese) with or without Addendum as required under section 7(5) of the EIAO, to be supplied upon advice by the Director for consultation with the Advisory Council on the Environment.

6.3 In addition, to facilitate public inspection of the EIA report via the EIAO Internet Website, the Applicant shall provide electronic copies of both the EIA report and the Executive Summary Report prepared in HyperText Markup Language (HTML) (version 4.0 or later) and in Portable Document Format (PDF version 5.0 or later) [for English documents], unless otherwise agreed by the Director. For the HTML version, a content page capable of providing hyperlink to each section and sub-section of the EIA report and the Executive Summary Report shall be included in the beginning of the document. Hyperlinks to all figures, drawings and tables in the EIA report and executive summary shall be provided in the main text from where respective references are made. All graphs in the report shall be in interlaced GIF format unless otherwise agreed by the Director.

6.5 The electronic copies of the EIA report and the executive summary shall be submitted to the Director at the time of application for approval of the EIA report.

6.6 When the EIA report and the executive summary are made available for public inspection under s.7(1) of the EIAO, the content of the electronic copies of the EIA report and the executive summary must be the same as the hard copies and the Director shall be provided with the most updated electronic copies.

6.7 To facilitate public involvement in the EIA process, the applicant shall produce 3-dimensional electronic visualisations of the major findings and elements of the EIA report, including baseline environmental information, the environmental situations with and without the project, key mitigated and unmitigated environmental impacts, and key recommended environmental mitigation measures so that the public can

understand the project and the associated environmental issues. The visualisations shall be based on the report and released to the public. The visualisations shall be submitted in CD-ROM or other suitable means agreed with the Director in commonly readable formats. Unless otherwise advised or agreed by the Director, the number of copies of CD-ROM required shall be the same as that for EIA reports under clause 6.2 above.

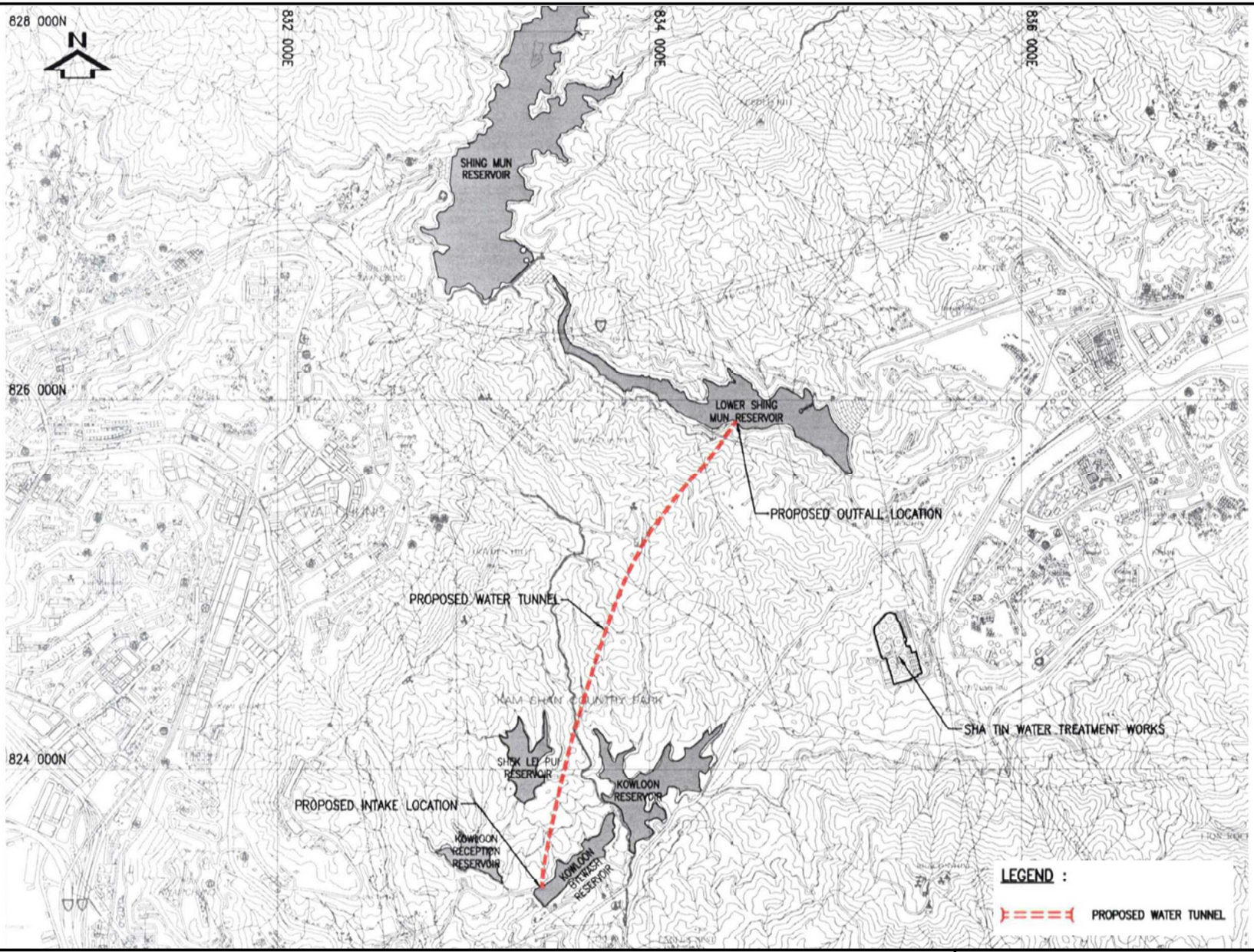
7. OTHER PROCEDURAL REQUIREMENTS

7.1 During the EIA study, if there is any change in the name of Applicant (as representing his or her organisation) for this EIA study brief, the Applicant mentioned in this study brief must notify the Director immediately.

7.2 If there is any key change in the scope of the Project mentioned in Section 1.2 of this EIA study brief and in Project Profile (No. PP-298/2006), the Applicant must seek confirmation from the Director in writing on whether or not the scope of issues covered by this EIA study brief can still cover the key changes, and the additional issues, if any, that the EIA study must also cover to address these key changes. If the changes to the Project fundamentally alter the key scope of the EIA study brief, the Applicant shall apply to the Director for a fresh EIA study brief .

--- END OF EIA STUDY BRIEF ---

November 2006
Environmental Assessment Division,
Environmental Protection Department



Project Title - West Kowloon Drasinage Improvement - Lai Chi Kok Transfer Scheme
Inter-Reservoir Transfer Scheme
Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir

Appendix A - Location Plan (Plan originated from Appendix I of Project Profile no. PP-298/2006))

EIA Study Brief
Application No.:
ESB-154/2006

Appendix B
Construction Program, Envisaged Activities and Inventory of PME

Agreement No. CE 55/2006 (EP) Inter-reservoirs Transfer Scheme (IRTS) Water Tunnel between Kowloon Byewash Reservoir and Lower Shung Mun Reservoir EIA

Working Programme of Construction Stage

Master Construction Programe

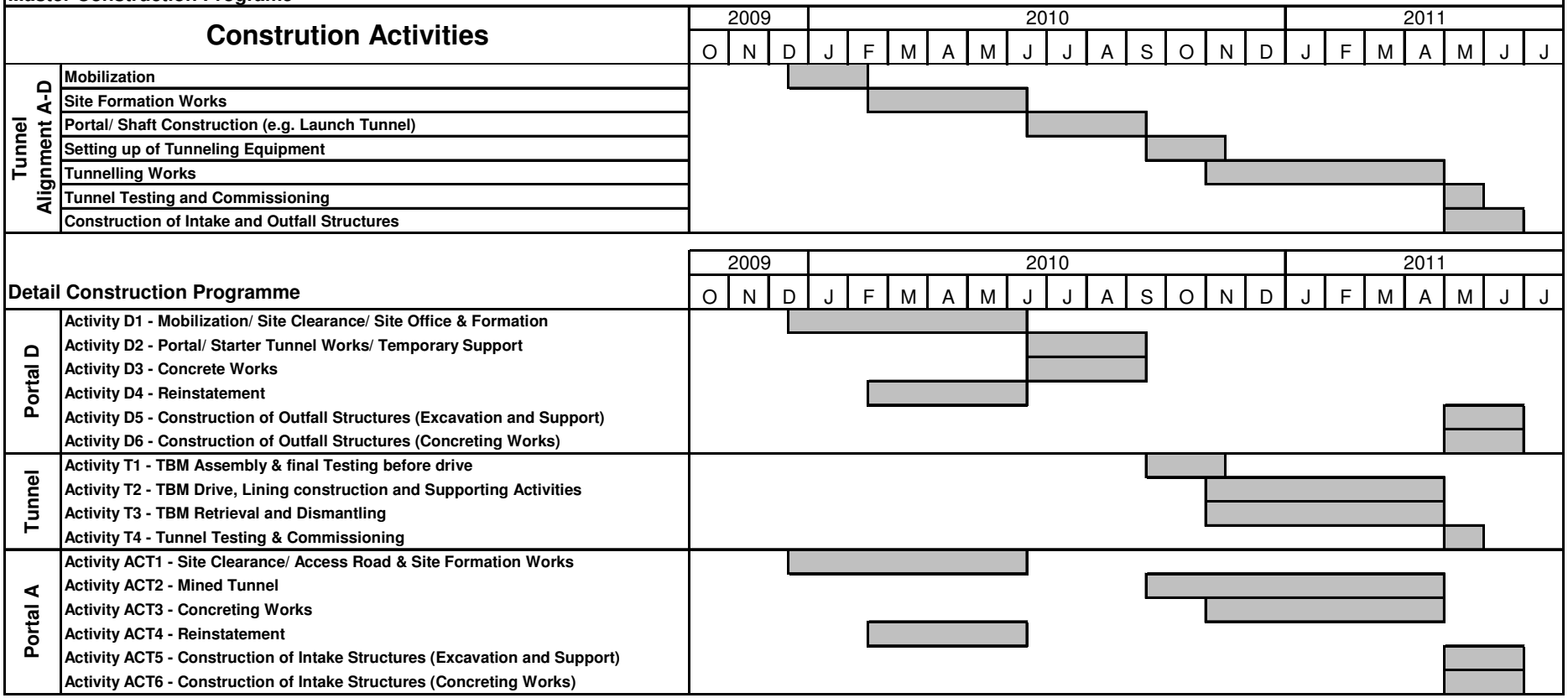


Table B1 - Envisaged Construction Activities and Inventory of Powered Mechanical Equipment for Portal and TBM Tunnel Works

Main Construction Activity		Typical Construction Stages and Remarks		PME Used			
		Sub-ID No.	Description	Description	ID code and number/ BS 5228	SWL	No.
Site D - Portal / Starter Tunnel Construction							
D1	Mobilization / Site Clearance / Site Office & Formation	1	Initial possession of land; clearance; exposing utilities:				
			- saw then break road slab;	Saw, concrete (petrol)	CNP 203	115	1
				then			
				Breaker, hand-held, mass ≥20kg and ≤35kg	CNP 025	111	1
			- excavate	Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Dump truck	CNP 067	117	1
				Air Compressor	CNP 002	102	1
				Breaker, hand-held, mass ≥20kg and ≤35kg	CNP 025	111	1
				Or			
				Hydraulic breaker (excavator mounted)	*CNP 028*	122	1
		2	Construction of temporary cofferdam across portion of existing reservoir; support suspended utilities (if any) & site platform (drill-in or drive piled wall; fill and compaction)	Piling; DTH pipe pile rig *(same as CNP 182 when toeing-in)*	-	123	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Breaker, excavator mounted (hydraulic)	CNP 028	122	1
				Generator, mobile (standard)	CNP 101	108	1
				Or			
				Drive shet piles (vibratory), and	-	*112*	*1*
				Piling; drop hammer on sheet piles	-	*114*	*1*
				Dump truck	CNP 067	117	1
				Power rammer (petrol)	CNP 169	108	1
				Compactor, vibratory	CNP 050	105	1
		3	Setting-up of site office / workshop / storage containers	Truck (lorry)	CNP 141	112	2
				Crane, mobile	CNP 048	112	1
		4	Temporary diversion of existing culvert	Truck (lorry)	CNP 141	112	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
		5	Temporary diversion of existing access road	Dump truck	CNP 067	117	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Compactor, vibratory	CNP 050	105	1
D2	Portal / Starter Tunnel Works / Temporary Support		Bulk excavation and support / strutting (where necessary):				
			- In soft ground:	Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Dump truck	CNP 067	117	1
				Water pump, submersible	CNP 283	85	1
			- In rock:	Rock drill, crawler mounted (hydraulic)	CNP 182	123	1
				Or			
				Drill, percussive, hand-held	*CNP 064*	*103*	*1*
				Grout mixer and pump	C.6/13	108	1
				Air Compressor	CNP 002	102	1
				then			
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Crane, mobile	CNP 048	112	1
				Dump truck	CNP 067	117	1
				Water pump, submersible	CNP 283	85	1
			Ventilation (concurrent with excavation and support)	Ventilation fan	CNP 241	108	1

D3	Concreting Works		Reinforcement, shuttering and concreting	Bar bender and cutter (electric)	CNP 021	90	1
				Generator (standard)	CNP 101	108	1
				Saw, circular, wood	CNP 201	108	1
				Concrete pump / shotcrete vehicle	CNP 047	109	1
				Concrete lorry mixer	CNP 044	109	1
				Poker, vibrator, hand-held	CNP 170	113	1
				Water pump, submersible	CNP 283	85	1
D4	Reinstatement	1	Extraction of temporary cofferdam piles	Pile extractor	C.4/22	125	1
		2	Fill and compaction	Dump truck	CNP 067	117	1
				Power rammer (petrol)	CNP 169	108	1
				Compactor, vibratory	CNP 050	105	1
		3	Concreting road slab *(or asphalt paver)*	Breaker, hand-held, mass ≥20kg and ≤35kg	CNP 025	111	1
				Concrete lorry mixer	CNP 044	109	1
				Poker, vibrator, hand-held	CNP 170	113	1
				Or Asphalt paver	*CNP 004*	*109*	*1*
		4	Landscaping	Dump truck	CNP 067	117	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
		5	Removal of site office / workshop / storage containers	Truck (lorry)	CNP 141	112	2
				Crane, mobile	CNP 048	112	1
D5	Excavation and Support		Bulk excavation and support / strutting (where necessary)	Rock drill, crawler mounted (hydraulic)	CNP 182	123	1
				Air Compressor	CNP 002	102	1
				Grout mixer and pump	C.6/13	108	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Dump truck	CNP 067	117	1
				Water pump, submersible	CNP 283	85	1
D6	Concreting Works		Reinforcement, shuttering and concreting	Bar bender and cutter (electric)	CNP 021	90	1
				Generator (standard)	CNP 101	108	1
				Saw, circular, wood	CNP 201	108	1
				Concrete pump / shotcrete vehicle	CNP 047	109	1
				Concrete lorry mixer	CNP 044	109	1
				Poker, vibrator, hand-held	CNP 170	113	1
				Water pump, submersible	CNP 283	85	1

Site A - Portal / Intake Connection Tunnel Construction							
ACT1	Site Clearance / Access Road & Site Formation Works		Initial possession of land; clearance	Dump truck	CNP 067	117	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Breaker, excavator mounted (hydraulic)	CNP 028	122	1
				Generator, mobile (standard)	CNP 101	108	1
				Air Compressor	CNP 002	102	1
				Winch	CNP 201	110	1
ACT2	Mined Tunnel	1	Setting up of tunnelling equipment	Truck (lorry)	CNP 141	112	2
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Winch	CNP 201	110	1
		2	Ventilation (concurrent with excavation and support)	Ventilation fan	CNP 241	108	1
		3	Excavation and support	Rock drill, crawler mounted (hydraulic)	CNP 182	123	1
				Air Compressor	CNP 002	102	1
				Grout mixer and pump	C.6/13	108	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Dump truck	CNP 067	117	1
				Water pump, submersible	CNP 283	85	1
ACT3	Concreting Works		Reinforcement, shuttering and concreting	Bar bender and cutter (electric)	CNP 021	90	1
				Generator (standard)	CNP 101	108	1
				Saw, circular, wood	CNP 201	108	1
				Concrete pump / shotcrete vehicle	CNP 047	109	1
				Concrete lorry mixer	CNP 044	109	1
				Poker, vibrator, hand-held	CNP 170	113	1
				Water pump, submersible	CNP 283	85	1
ACT4	Reinstatement	1	Fill and compaction	Dump truck	CNP 067	117	1
				Power rammer (petrol)	CNP 169	108	1
				Compactor, vibratory	CNP 050	105	1
		2	Landscaping	Dump truck	CNP 067	117	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
ACT5	Excavation and Support		Bulk excavation and support / strutting (where necessary)	Rock drill, crawler mounted (hydraulic)	CNP 182	123	1
				Air Compressor	CNP 002	102	1
				Grout mixer and pump	C.6/13	108	1
				Excavator/Loader, wheeled/tracked (backhoe)	CNP 081	112	1
				Dump truck	CNP 067	117	1
				Water pump, submersible	CNP 283	85	1
ACT6	Concreting Works		Reinforcement, shuttering and concreting	Bar bender and cutter (electric)	CNP 021	90	1
				Generator (standard)	CNP 101	108	1
				Saw, circular, wood	CNP 201	108	1
				Concrete pump / shotcrete vehicle	CNP 047	109	1
				Concrete lorry mixer	CNP 044	109	1
				Poker, vibrator, hand-held	CNP 170	113	1
				Water pump, submersible	CNP 283	85	1

Main Tunnel Excavation & Lining Construction (by TBM method) *(assume a 3.0m ID tunnel)*							
T1	TBM Assembly & Final Testing before		At Site D	Truck (lorry) Crane, mobile	CNP 141 CNP 048	112 112	2 1
T2	TBM Drive, Lining construction and Supporting Activities	1	General	Generator (standard)	CNP 101	108	1
		2	Ventilation (concurrent with drive and lining works)	Ventilation fan	CNP 241	108	1
		3	Drive up-gradient from Site D to Site A *(say 120m / week)*	TBM Conveyor belt system (throughout the tunnel at at Portal Site D for spoil disposal)	- CNP 041	88 90	1 1
			and spoil removal *(operation may be subject to restrictions depending hours)*	Truck (lorry) Excavator/Loader, wheeled/tracked (backhoe)	CNP 141 CNP 081	112 112	1 1
		4	Temporary excavation and support	Rock drill (hydraulic) Water pump, submersible	CNP 044 CNP 283	123 85	1 1
		5	Permanent tunnel lining *(it is envisaged to use cast in-situ concrete lining - fully lined tunnel)*	Bar bender and cutter (electric) Generator (standard) Saw, circular, wood Concrete pump / shotcrete vehicle Concrete lorry mixer Poker, vibrator, hand-held Water pump, submersible	CNP 021 CNP 101 CNP 201 CNP 047 CNP 044 CNP 170 CNP 283	90 108 108 109 109 113 85	1 1 1 1 1 1 1
T3	TBM Retrieval and Dismantling (*)			Truck (lorry) Crane, mobile	CNP 141 CNP 048	112 112	1 1
T4	Tunnel Testing & Commissioning						

Notes: *Preliminary list subject to review as study progresses.*

24-hour working is assumed for excavation of the underground tunnel as a normal practice for optimizing the works programme and use of resources.

The following items are *not included* in the above table:
- slope remedial works and natural terrain hazard mitigation works (if any);
- desilting / treatment of wastewater.

(*) Option 1 - TBM retracted through the bored tunnel (back to Site D), or
Option 2 - TBM retrieved through shaft or C&C portal at Site A

Non-explosive rock excavation methods assumed *(likely to be a combination of mechanical, pneumatic or hydraulic splitting or expanding grout techniques).*

Nominal runoff diversion and control to be implemented.

Works areas to be reinstated upon completion of the works.

SWL - Sound Power Level (dB(A)).

Appendix C
Unmitigated Construction Noise Impact (Air-borne)

Table C-1 Plant Inventory and the SWL at Intake End (Portal A)

PME	TM or other reference	No. of PME	SWL, dB(A)/ unit	Total SWL, dB(A)
Activity ACT1 - Site Clearance/ Access Road & Site Formation				
Dump truck	CNP 067	1	117	117
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Breaker, excavator mounted (hydraulic)	CNP 028	1	122	122
Generator, standard	CNP 101	1	108	108
Air compressor, air flow > 10m3/min and <= 30m3/min	CNP 002	1	102	102
Winch (pneumatic)	CNP 261	1	110	110
			Total	**124**
			Max. of Activity ACT1	**124**
Activity ACT2 - Mined Tunnel				
Activity ACT2_1 - Setting up of tunnelling equipment				
Lorry	CNP 141	2	112	115
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Winch (pneumatic)	CNP 261	1	110	110
			Total	**118**
Activity ACT2_2 - Ventilation				
Ventilation fan	CNP 241	1	108	108
			Total	**108**
Activity ACT2_3 - Excavation and support				
Rock drill, crawler mounted (hydraulic)	CNP 182	1	123	123
Air compressor, air flow > 10m3/min and <= 30m3/min	CNP 002	1	102	102
Grout mixer and pump (34kW)	BS 5228 Table C.6/13	1	108	108
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Dump truck	CNP 067	1	117	117
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**124**
			Max. of Activity ACT2	**124**
Activity ACT3 - Concreting Works				
Bar bender and cutter (electric)	CNP 021	1	90	90
Generator, standard	CNP 101	1	108	108
Saw, circular, wood	CNP 201	1	108	108
Concrete pump, stationary/ lorry mounted	CNP 047	1	109	109
Concrete lorry mixer	CNP 044	1	109	109
Poker, vibratory, hand-held	CNP 170	1	113	113
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**117**
			Max. of Activity ACT3	**117**
Activity ACT4 - Reinstatement				
Activity ACT4_1 - Fill and compaction				
Dump truck	CNP 067	1	117	117
Power rammer (petrol)	CNP 169	1	108	108
Compactor, vibratory	CNP 050	1	105	105
			Total	**118**
Activity ACT4_2 - Landscaping				
Dump truck	CNP 067	1	117	117
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
			Total	**118**
			Max. of Activity ACT4	**118**
Activity ACT5 - Excavation and Support				
Rock drill, crawler mounted (hydraulic)	CNP 182	1	123	123
Air compressor, air flow > 10m3/min and <= 30m3/min	CNP 002	1	102	102
Grout mixer and pump (34kW)	BS 5228 Table C.6/13	1	108	108
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Dump truck	CNP 067	1	117	117
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**124**
			Max. of Activity ACT5	**124**
Activity ACT6 - Concreting Works				
Bar bender and cutter (electric)	CNP 021	1	90	90
Generator, standard	CNP 101	1	108	108
Saw, circular, wood	CNP 201	1	108	108
Concrete pump, stationary/ lorry mounted	CNP 047	1	109	109
Concrete lorry mixer	CNP 044	1	109	109
Poker, vibratory, hand-held	CNP 170	1	113	113
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**117**
			Max. of Activity ACT6	**117**

Table C-2 Unmitigated Noise Impact at Intake End (Portal A)

Intake

Main Construction Activity	01/02/10 - 15/02/10	16/02/10 - 28/02/10	01/03/10 - 15/03/10	16/03/10 - 31/03/10	01/04/10 - 15/04/10	16/04/10 - 30/04/10	01/05/10 - 15/05/10	16/05/10 - 31/05/10	01/06/10 - 15/06/10	16/06/10 - 30/06/10	01/07/10 - 15/07/10	16/07/10 - 31/07/10	01/08/10 - 15/08/10	16/08/10 - 31/08/10	01/09/10 - 15/09/10	16/09/10 - 30/09/10	01/10/10 - 15/10/10	16/10/10 - 31/10/10	01/11/10 - 15/11/10	16/11/10 - 30/11/10	01/12/10 - 15/12/10	16/12/10 - 31/12/10	01/01/11 - 15/01/11	16/01/11 - 31/01/11	01/02/11 - 15/02/11	16/02/11 - 28/02/11	01/03/11 - 15/03/11
	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	1	1	2	2	3
Activity ACT1 - Site Clearance/ Access Road & Site Formation Works	Y	Y	Y																								
Activity ACT2 - Mined Tunnel																			Y	Y	Y	Y	Y				
Activity ACT3 - Concreting Works																											
Activity ACT4 - Reinstatement																											
Activity ACT5 - Excavation and Support of Intake Structure																Y	Y	Y									
Activity ACT6 - Concreting Works of Intake Structure																											
Activity T1 - TBM Assembly & final Testing before drive																											
Activity T2 - TBM Drive, Lining construction and Supporting Activities																										Y	Y
Activity T3 - TBM Retrieval and Dismantling																											
Activity T4 - Tunnel Testing & Commissioning																											

Sound Power Level, dB(A)	01/02/10 - 15/02/10	16/02/10 - 28/02/10	01/03/10 - 15/03/10	16/03/10 - 31/03/10	01/04/10 - 15/04/10	16/04/10 - 30/04/10	01/05/10 - 15/05/10	16/05/10 - 31/05/10	01/06/10 - 15/06/10	16/06/10 - 30/06/10	01/07/10 - 15/07/10	16/07/10 - 31/07/10	01/08/10 - 15/08/10	16/08/10 - 31/08/10	01/09/10 - 15/09/10	16/09/10 - 30/09/10	01/10/10 - 15/10/10	16/10/10 - 31/10/10	01/11/10 - 15/11/10	16/11/10 - 30/11/10	01/12/10 - 15/12/10	16/12/10 - 31/12/10	01/01/11 - 15/01/11	16/01/11 - 31/01/11	01/02/11 - 15/02/11	16/02/11 - 28/02/11	01/03/11 - 15/03/11
Activity ACT1 - Site Clearance/ Access Road & Site Formation Works	123.8	123.8	123.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity ACT2 - Mined Tunnel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124.4	124.4	124.4	124.4	124.4	0.0	0.0	0.0	0.0
Activity ACT3 - Concreting Works	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity ACT4 - Reinstatement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity ACT5 - Excavation and Support of Intake Structure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124.4	124.4	124.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity ACT6 - Concreting Works of Intake Structure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T1 - TBM Assembly & final Testing before drive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T2 - TBM Drive, Lining construction and Supporting Activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	123.0	123.0
Activity T3 - TBM Retrieval and Dismantling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T4 - Tunnel Testing & Commissioning	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total SWL	123.8	123.8	123.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124.4	124.4	124.4	124.4	124.4	124.4	124.4	124.4	0.0	0.0	123.0	123.0

Unmitigated

Predicted Noise Level, dB(A)					01/02/10 - 15/02/10	16/02/10 - 28/02/10	01/03/10 - 15/03/10	16/03/10 - 31/03/10	01/04/10 - 15/04/10	16/04/10 - 30/04/10	01/05/10 - 15/05/10	16/05/10 - 31/05/10	01/06/10 - 15/06/10	16/06/10 - 30/06/10	01/07/10 - 15/07/10	16/07/10 - 31/07/10	01/08/10 - 15/08/10	16/08/10 - 31/08/10	01/09/10 - 15/09/10	16/09/10 - 30/09/10	01/10/10 - 15/10/10	16/10/10 - 31/10/10	01/11/10 - 15/11/10	16/11/10 - 30/11/10	01/12/10 - 15/12/10	16/12/10 - 31/12/10	01/01/11 - 15/01/11	16/01/11 - 31/01/11	01/02/11 - 15/02/11	16/02/11 - 28/02/11	01/03/11 - 15/03/11
					123.8	123.8	123.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124.4	124.4	124.4	124.4	124.4	124.4	124.4	124.4	0.0	0.0	123.0	123.0
NSR	Slant Distance from Source to Receiver (m)	Distance Attenuation (dB(A))	Façade Effect (dB(A))	Screening Effect (dB(A))																									
VH	172	-52.7	3	0	74.1	74.1	74.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	0.0	0.0	73.3	73.3

Intake

Main Construction Activity	16/03/11 - 31/03/11	01/04/11 - 15/04/11	16/04/11 - 30/04/11	01/05/11 - 15/05/11	16/05/11 - 31/05/11	01/06/11 - 15/06/11	16/06/11 - 30/06/11	01/07/11 - 15/07/11	16/07/11 - 31/07/11	01/08/11 - 15/08/11	16/08/11 - 31/08/11	01/09/11 - 15/09/11	16/09/11 - 30/09/11	01/10/11 - 15/10/11	16/10/11 - 31/10/11	01/11/11 - 15/11/11	16/11/11 - 30/11/11	01/12/11 - 15/12/11	16/12/11 - 31/12/11	01/01/12 - 15/01/12	16/01/12 - 30/01/12	01/02/12 - 15/02/12	16/02/12 - 28/02/12
	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	1	1	2	2
Activity ACT1 - Site Clearance/ Access Road & Site Formation Works																							
Activity ACT2 - Mined Tunnel																							
Activity ACT3 - Concreting Works						Y	Y				Y	Y											
Activity ACT4 - Reinstatement																		Y	Y	Y	Y	Y	Y
Activity ACT5 - Excavation and Support of Intake Structure																							
Activity ACT6 - Concreting Works of Intake Structure						Y	Y	Y	Y														
Activity T1 - TBM Assembly & final Testing before drive																							
Activity T2 - TBM Drive, Lining construction and Supporting Activities	Y	Y	Y	Y	Y																		
Activity T3 - TBM Retrieval and Dismantling																							
Activity T4 - Tunnel Testing & Commissioning																							

Sound Power Level, dB(A)	16/03/11 - 31/03/11	01/04/11 - 15/04/11	16/04/11 - 30/04/11	01/05/11 - 15/05/11	16/05/11 - 31/05/11	01/06/11 - 15/06/11	16/06/11 - 30/06/11	01/07/11 - 15/07/11	16/07/11 - 31/07/11	01/08/11 - 15/08/11	16/08/11 - 31/08/11	01/09/11 - 15/09/11	16/09/11 - 30/09/11	01/10/11 - 15/10/11	16/10/11 - 31/10/11	01/11/11 - 15/11/11	16/11/11 - 30/11/11	01/12/11 - 15/12/11	16/12/11 - 31/12/11	01/01/12 - 15/01/12	16/01/12 - 30/01/12	01/02/12 - 15/02/12	16/02/12 - 28/02/12
Activity ACT1 - Site Clearance/ Access Road & Site Formation Works	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity ACT2 - Mined Tunnel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity ACT3 - Concreting Works	0.0	0.0	0.0	0.0	0.0	116.9	116.9	0.0	0.0	0.0	116.9	116.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity ACT4 - Reinstatement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.2	118.2	118.2	118.2	118.2	118.2
Activity ACT5 - Excavation and Support of Intake Structure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity ACT6 - Concreting Works of Intake Structure	0.0	0.0	0.0	0.0	0.0	116.9	116.9	116.9	116.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T1 - TBM Assembly & final Testing before drive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T2 - TBM Drive, Lining construction and Supporting Activities	123.0	123.0	123.0	123.0	123.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T3 - TBM Retrieval and Dismantling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T4 - Tunnel Testing & Commissioning	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total SWL	**123.0**	**123.0**	**123.0**	**123.0**	**123.0**	**119.9**	**119.9**	**116.9**	**116.9**	**0.0**	**116.9**	**116.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**118.2**	**118.2**	**118.2**	**118.2**	**118.2**	**118.2**

Unmitigated

Predicted Noise Level, dB(A)					16/03/11 - 31/03/11	01/04/11 - 15/04/11	16/04/11 - 30/04/11	01/05/11 - 15/05/11	16/05/11 - 31/05/11	01/06/11 - 15/06/11	16/06/11 - 30/06/11	01/07/11 - 15/07/11	16/07/11 - 31/07/11	01/08/11 - 15/08/11	16/08/11 - 31/08/11	01/09/11 - 15/09/11	16/09/11 - 30/09/11	01/10/11 - 15/10/11	16/10/11 - 31/10/11	01/11/11 - 15/11/11	16/11/11 - 30/11/11	01/12/11 - 15/12/11	16/12/11 - 31/12/11	01/01/12 - 15/01/12	16/01/12 - 30/01/12	01/02/12 - 15/02/12	16/02/12 - 28/02/12	
					123.0	**123.0**	**123.0**	**123.0**	**123.0**	**119.9**	**119.9**	**116.9**	**116.9**	**0.0**	**116.9**	**116.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**118.2**	**118.2**	**118.2**	**118.2**	**118.2**	**118.2**	
NSR	Slant Distance from Source to Receiver (m)	Distance Attenuation (dB(A))	Façade Effect (dB(A))	Screening Effect (dB(A))																							Maximum
VH	172	-52.7	3	0	73.3	73.3	73.3	73.3	73.3	70.2	70.2	67.2	67.2	0.0	67.2	67.2	0.0	0.0	0.0	0.0	0.0	68.5	68.5	68.5	68.5	68.5	68.5	74.7

Table C-3 Plant Inventory and SWL at Outfall End (Portal D)

PME	TM or other reference	No. of PME	SWL, dB(A)/ unit	Total SWL, dB(A)
Activity D1 - Mobilization/ Site Clearance/ Site Office & Formation				
Activity D1_1 - Initial possession of land; clearance; exposing utilities				
Saw/groover, concrete (petrol)	CNP 203	1	115	115
Breaker, hand-held, mass >= 20kg and <= 35kg	CNP 025	1	111	111
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Dump truck	CNP 067	1	117	117
Air compressor, air flow > 10m3/min and <= 30m3/min	CNP 002	1	102	102
Breaker, excavator mounted (hydraulic)	CNP 028	1	122	122
			Total	**124**
Activity D1_2 - Construction of temporary cofferdam across portion of existing reservoir; support suspended utilities (if any) & site platform (drill-in or drive piled wall; fill and compaction)				
Rock drill, crawler mounted (hydraulic)	CNP 182	1	123	123
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Breaker, excavator mounted (hydraulic)	CNP 028	1	122	122
Generator, standard	CNP 101	1	108	108
Dump truck	CNP 067	1	117	117
Power rammer (petrol)	CNP 169	1	108	108
Compactor, vibratory	CNP 050	1	105	105
			Total	**126**
Activity D1_3 - Setting-up of site office/ workshop/ storage containers				
Lorry	CNP 141	2	112	115
Crane, mobile/ barge mounted (diesel)	CNP 048	1	112	112
			Total	**117**
Activity D1_4 - Temporary diversion of existing culvert				
Lorry	CNP 141	1	112	112
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
			Total	**115**
Activity D1_5 - Temporary diversion of existing access road				
Dump truck	CNP 067	1	117	117
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Compactor, vibratory	CNP 050	1	105	105
			Total	**118**
			Max. of Activity D1	**126**
Activity D2 - Portal/ Starter Tunnel Works/ Temporary Support				
Rock drill, crawler mounted (hydraulic)	CNP 182	1	123	123
Grout mixer and pump (34kW)	BS 5228 Table C.6/13	1	108	108
Air compressor, air flow > 10m3/min and <= 30m3/min	CNP 002	1	102	102
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Crane, mobile/ barge mounted (diesel)	CNP 048	1	112	112
Dump truck	CNP 067	1	117	117
Water pump, submersible (electric)	CNP 283	1	85	85
Ventilation fan	CNP 241	1	108	108
			Total	**125**
			Max. of Activity D2	**125**
Activity D3 - Concrete Works				
Bar bender and cutter (electric)	CNP 021	1	90	90
Generator, standard	CNP 101	1	108	108
Saw, circular, wood	CNP 201	1	108	108
Concrete pump, stationary/ lorry mounted	CNP 047	1	109	109
Concrete lorry mixer	CNP 044	1	109	109
Poker, vibratory, hand-held	CNP 170	1	113	113
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**117**
			Max. of Activity D3	**117**

Table C-4 Plant Inventory and SWL at Outfall end (Portal D)

PME	TM or other reference	No. of PME	SWL, dB(A)/ unit	Total SWL, dB(A)
Activity D4 - Reinstatement				
Activity D4_1 - Extraction of temporary cofferdam piles				
Electric vibratory extractor	BS 5228 Table C.4/22	1	125	125
			Total	**125**
Activity D4_2 - Fill and compaction				
Dump truck	CNP 067	1	117	117
Power rammer (petrol)	CNP 169	1	108	108
Compactor, vibratory	CNP 050	1	105	105
			Total	**118**
Activity D4_3 - Concreting road slab				
Breaker, hand-held, mass >= 20kg and <= 35kg	CNP 025	1	111	111
Concrete lorry mixer	CNP 044	1	109	109
Poker, vibratory, hand-held	CNP 170	1	113	113
			Total	**116**
Activity D4_4 - Landscaping				
Dump truck	CNP 067	1	117	117
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
			Total	**118**
Activity D4_5 - Removing of site office/ workshop/ storage containers				
Lorry	CNP 141	2	112	115
Crane, mobile/ barge mounted (diesel)	CNP 048	1	112	112
			Total	**117**
			Max. of Activity D4	**125**
Activity D5 - Excavation and Support				
Rock drill, crawler mounted (hydraulic)	CNP 182	1	123	123
Air compressor, air flow > 10m3/min and <= 30m3/min	CNP 002	1	102	102
Grout mixer and pump (34kW)	BS 5228 Table C.6/13	1	108	108
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
Dump truck	CNP 067	1	117	117
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**124**
			Max. of Activity D5	**124**
Activity D6 - Concreting Works				
Bar bender and cutter (electric)	CNP 021	1	90	90
Generator, standard	CNP 101	1	108	108
Saw, circular, wood	CNP 201	1	108	108
Concrete pump, stationary/ lorry mounted	CNP 047	1	109	109
Concrete lorry mixer	CNP 044	1	109	109
Poker, vibratory, hand-held	CNP 170	1	113	113
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**117**
			Max. of Activity D6	**117**

Table C-5 Plant Inventory and SWL along Tunnel by TBM

PME	TM or other reference	No. of PME	SWL, dB(A)	Total SWL, dB(A)
Activity T1 - TBM Assembly & final Testing before drive				
Lorry	CNP 141	2	112	115
Crane, mobile/ barge mounted (diesel)	CNP 048	1	112	112
			Total	**117**
			Max. of Activity T1	**117**
Activity T2 - TBM Drive, Lining construction and Supporting Activities				
Activity T2_1 - General				
Generator, standard	CNP 101	1	108	108
			Total	**108**
Activity T2_2 - Ventilation				
Ventilation fan	CNP 241	1	108	108
			Total	**108**
Activity T2_3 - Drive up-gradient from Site D to Site A and soil removal				
TBM	CNP 281	1	88	88
Conveyor belt	CNP 041	1	90	90
Lorry	CNP 141	1	112	112
Excavator/ loader, wheeled/ tracked	CNP 081	1	112	112
			Total	**115**
Activity T2_4 - Temporary excavation and support				
Rock drill, crawler mounted (hydraulic)	CNP 182	1	123	123
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**123**
Activity T2_5 - Permanent tunnel lining				
Bar bender and cutter (electric)	CNP 021	1	90	90
Generator, standard	CNP 101	1	108	108
Saw, circular, wood	CNP 201	1	108	108
Concrete pump, stationary/ lorry mounted	CNP 047	1	109	109
Concrete lorry mixer	CNP 044	1	109	109
Poker, vibratory, hand-held	CNP 170	1	113	113
Water pump, submersible (electric)	CNP 283	1	85	85
			Total	**117**
			Max. of Activity T2	**123**
Activity T3 - TBM Retrieval and Dismantling				
Lorry	CNP 141	1	112	112
Crane, mobile/ barge mounted (diesel)	CNP 048	1	112	112
			Total	**115**
			Max. of Activity T3	**115**

Table C-6 Unmitigated Noise Impact at Outfall end (Portal D)

Outfall

Main Construction Activity	01/02/10 - 15/02/10	16/02/10 - 28/02/10	01/03/10 - 15/03/10	16/03/10 - 31/03/10	01/04/10 - 15/04/10	16/04/10 - 30/04/10	01/05/10 - 15/05/10	16/05/10 - 31/05/10	01/06/10 - 15/06/10	16/06/10 - 30/06/10	01/07/10 - 15/07/10	16/07/10 - 31/07/10	01/08/10 - 15/08/10	16/08/10 - 31/08/10	01/09/10 - 15/09/10	16/09/10 - 30/09/10	01/10/10 - 15/10/10	16/10/10 - 31/10/10	01/11/10 - 15/11/10	16/11/10 - 30/11/10	01/12/10 - 15/12/10	16/12/10 - 31/12/10	01/01/11 - 15/01/11	16/01/11 - 31/01/11	01/02/11 - 15/02/11
Activity D1 - Mobilization/ Site Clearance/ Site Office & Formation	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y											
Activity D2 - Portal/ Starter Tunnel Works/ Temporary Support															Y	Y	Y	Y							
Activity D3 - Concrete Works																									
Activity D4 - Reinstatement																									
Activity D5 - Excavation and Support of Outfall Structure																									
Activity D6 - Concreting Works of Outfall Structure																									
Activity T1 - TBM Assembly & final Testing before drive											Y	Y	Y	Y	Y	Y	Y								
Activity T2 - TBM Drive, Lining construction and Supporting Activities																		Y	Y	Y	Y	Y	Y	Y	Y
Activity T3 - TBM Retrieval and Dismantling																									
Activity T4 - Tunnel Testing & Commissioning																									

Sound Power Level, dB(A)	01/02/10 - 15/02/10	16/02/10 - 28/02/10	01/03/10 - 15/03/10	16/03/10 - 31/03/10	01/04/10 - 15/04/10	16/04/10 - 30/04/10	01/05/10 - 15/05/10	16/05/10 - 31/05/10	01/06/10 - 15/06/10	16/06/10 - 30/06/10	01/07/10 - 15/07/10	16/07/10 - 31/07/10	01/08/10 - 15/08/10	16/08/10 - 31/08/10	01/09/10 - 15/09/10	16/09/10 - 30/09/10	01/10/10 - 15/10/10	16/10/10 - 31/10/10	01/11/10 - 15/11/10	16/11/10 - 30/11/10	01/12/10 - 15/12/10	16/12/10 - 31/12/10	01/01/11 - 15/01/11	16/01/11 - 31/01/11	01/02/11 - 15/02/11
Activity D1 - Mobilization/ Site Clearance/ Site Office & Formation	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	126.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D2 - Portal/ Starter Tunnel Works/ Temporary Support	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124.7	124.7	124.7	124.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D3 - Concrete Works	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D4 - Reinstatement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D5 - Excavation and Support of Outfall Structure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D6 - Concreting Works of Outfall Structure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T1 - TBM Assembly & final Testing before drive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	116.8	116.8	116.8	116.8	116.8	116.8	116.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T2 - TBM Drive, Lining construction and Supporting Activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	123.0	123.0	123.0	123.0	123.0	123.0	123.0	123.0
Activity T3 - TBM Retrieval and Dismantling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T4 - Tunnel Testing & Commissioning	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total SWL	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.9**	**126.9**	**126.9**	**126.9**	**125.4**	**125.4**	**125.4**	**126.9**	**123.0**	**123.0**	**123.0**	**123.0**	**123.0**	**123.0**	**123.0**

Predicted Noise Level, dB(A)					01/02/10 - 15/02/10	16/02/10 - 28/02/10	01/03/10 - 15/03/10	16/03/10 - 31/03/10	01/04/10 - 15/04/10	16/04/10 - 30/04/10	01/05/10 - 15/05/10	16/05/10 - 31/05/10	01/06/10 - 15/06/10	16/06/10 - 30/06/10	01/07/10 - 15/07/10	16/07/10 - 31/07/10	01/08/10 - 15/08/10	16/08/10 - 31/08/10	01/09/10 - 15/09/10	16/09/10 - 30/09/10	01/10/10 - 15/10/10	16/10/10 - 31/10/10	01/11/10 - 15/11/10	16/11/10 - 30/11/10	01/12/10 - 15/12/10	16/12/10 - 31/12/10	01/01/11 - 15/01/11	16/01/11 - 31/01/11	01/02/11 - 15/02/11
					126.4	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.4**	**126.9**	**126.9**	**126.9**	**126.9**	**125.4**	**125.4**	**125.4**	**126.9**	**123.0**	**123.0**	**123.0**	**123.0**	**123.0**	**123.0**	**123.0**
NSR	**Slant Distance from Source to Receiver (m)**	**Distance Attenuation (dB(A))**	**Façade Effect (dB(A))**	**Screening Effect (dB(A))**																									
LG	211	-54.5	3	-5	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	69.9	70.4	70.4	70.4	70.4	68.9	68.9	68.9	70.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5
AV	299	-57.5		-5	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	67.4	67.4	67.4	67.4	65.8	65.8	65.8	67.4	63.5	63.5	63.5	63.5	63.5	63.5	63.5
GTV	300	-57.6		-5	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	67.3	67.3	67.3	67.3	65.8	65.8	65.8	67.4	63.4	63.4	63.4	63.4	63.4	63.4	63.4

Outfall

Main Construction Activity	16/02/11 - 28/02/11	01/03/11 - 15/03/11	16/03/11 - 31/03/11	01/04/11 - 15/04/11	16/04/11 - 30/04/11	01/05/11 - 15/05/11	16/05/11 - 31/05/11	01/06/11 - 15/06/11	16/06/11 - 30/06/11	01/07/11 - 15/07/11	16/07/11 - 31/07/11	01/08/11 - 15/08/11	16/08/11 - 31/08/11	01/09/11 - 15/09/11	16/09/11 - 30/09/11	01/10/11 - 15/10/11	16/10/11 - 31/10/11	01/11/11 - 15/11/11	16/11/11 - 30/11/11	01/12/11 - 15/12/11	16/12/11 - 31/12/11	01/01/12 - 15/01/12	16/01/12 - 30/01/12	01/02/12 - 15/02/12	16/02/12 - 28/02/12
Activity D1 - Mobilization/ Site Clearance/ Site Office & Formation																									
Activity D2 - Portal/ Starter Tunnel Works/ Temporary Support																									
Activity D3 - Concrete Works													Y	Y	Y	Y									
Activity D4 - Reinstatement																					Y	Y	Y	Y	Y
Activity D5 - Excavation and Support of Outfall Structure															Y	Y									
Activity D6 - Concreting Works of Outfall Structure																	Y	Y	Y	Y					
Activity T1 - TBM Assembly & final Testing before drive																									
Activity T2 - TBM Drive, Lining construction and Supporting Activities																									
Activity T3 - TBM Retrieval and Dismantling								Y	Y	Y	Y	Y													
Activity T4 - Tunnel Testing & Commissioning																									

Sound Power Level, dB(A)	16/02/11 - 28/02/11	01/03/11 - 15/03/11	16/03/11 - 31/03/11	01/04/11 - 15/04/11	16/04/11 - 30/04/11	01/05/11 - 15/05/11	16/05/11 - 31/05/11	01/06/11 - 15/06/11	16/06/11 - 30/06/11	01/07/11 - 15/07/11	16/07/11 - 31/07/11	01/08/11 - 15/08/11	16/08/11 - 31/08/11	01/09/11 - 15/09/11	16/09/11 - 30/09/11	01/10/11 - 15/10/11	16/10/11 - 31/10/11	01/11/11 - 15/11/11	16/11/11 - 30/11/11	01/12/11 - 15/12/11	16/12/11 - 31/12/11	01/01/12 - 15/01/12	16/01/12 - 30/01/12	01/02/12 - 15/02/12	16/02/12 - 28/02/12
Activity D1 - Mobilization/ Site Clearance/ Site Office & Formation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D2 - Portal/ Starter Tunnel Works/ Temporary Support	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D3 - Concrete Works	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	116.9	116.9	116.9	116.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D4 - Reinstatement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	125.0	125.0	125.0	125.0	125.0
Activity D5 - Excavation and Support of Outfall Structure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124.4	124.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity D6 - Concreting Works of Outfall Structure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	116.9	116.9	116.9	116.9	0.0	0.0	0.0	0.0	0.0
Activity T1 - TBM Assembly & final Testing before drive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T2 - TBM Drive, Lining construction and Supporting Activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T3 - TBM Retrieval and Dismantling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.0	115.0	115.0	115.0	115.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Activity T4 - Tunnel Testing & Commissioning	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total SWL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.0	115.0	115.0	115.0	115.0	116.9	116.9	125.1	125.1	116.9	116.9	116.9	116.9	125.0	125.0	125.0	125.0	125.0

Predicted Noise Level, dB(A)	16/02/11 - 28/02/11	01/03/11 - 15/03/11	16/03/11 - 31/03/11	01/04/11 - 15/04/11	16/04/11 - 30/04/11	01/05/11 - 15/05/11	16/05/11 - 31/05/11	01/06/11 - 15/06/11	16/06/11 - 30/06/11	01/07/11 - 15/07/11	16/07/11 - 31/07/11	01/08/11 - 15/08/11	16/08/11 - 31/08/11	01/09/11 - 15/09/11	16/09/11 - 30/09/11	01/10/11 - 15/10/11	16/10/11 - 31/10/11	01/11/11 - 15/11/11	16/11/11 - 30/11/11	01/12/11 - 15/12/11	16/12/11 - 31/12/11	01/01/12 - 15/01/12	16/01/12 - 30/01/12	01/02/12 - 15/02/12	16/02/12 - 28/02/12	
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.0	115.0	115.0	115.0	115.0	116.9	116.9	125.1	125.1	116.9	116.9	116.9	116.9	125.0	125.0	125.0	125.0	125.0	
NSR	Slant Distance from Source to Receiver (m)	Distance Attenuation (dB(A))	Façade Effect (dB(A))	Screening Effect (dB(A))																						Maximum
LG	211	-54.5	3	-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.5	58.5	58.5	58.5	58.5	60.4	60.4	68.6	68.6	60.4	60.4	60.4	60.4	68.5	68.5	68.5	68.5	68.5	70.5
AV	299	-57.5		-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.5	55.5	55.5	55.5	55.5	57.3	57.3	65.6	65.6	57.3	57.3	57.3	57.3	65.5	65.5	65.5	65.5	65.5	67.4
GTV	300	-57.6		-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.5	55.5	55.5	55.5	55.5	57.3	57.3	65.5	65.5	57.3	57.3	57.3	57.3	65.4	65.4	65.4	65.4	65.4	67.4

Appendix D
(Not Used)

Appendix E
Ground-borne Noise Impact

Table E-1 Ground-borne Noise Impact Summary Sheet

Prepared by: CWK
Checked by: FN
Approved by: AFK
Date: 29 Sept 2008

TBM Noise Calculation

NSR No.	Location	ASR	Type	Description	Noise Criteria (24 Hours)/dB(A) Daytime 0700-1900	Evening 1900-2300	Night-time 2300-0700	Distance Vertical (m)	Horizontal (m)	Slant (m)	Predicted Ground-borne Noise from TBM, dB(A)
LG	Outfall	A[1]	Residential	Tower 1, Lakeview Garden	65	50	35	68	200	211	23
AV		A[1]	Residential	House A, Ascot Villa	65	50	35	73	290	299	21
GTV		A[1]	Residential	House 17, Golden Time Villas	65	50	35	57	295	300	21
VH	Intake	A[1]	Residential	Village House [2]	65	50	35	24	200	201	28

Hydraulic Breaker and Rock Drill Noise Calculation

NSR No.	Location	ASR	Type	Description	Noise Criteria dB(A) Daytime 0700-1900	Evening 1900-2300	Night-time 2300-0700	Distance Vertical (m)	Horizontal (m)	Slant (m)	Ground-borne Noise from Hydraulic Breaker, dB(A)
LG	Outfall	A[1]	Residential	Tower 1, Lakeview Garden	65	N/A [4]	N/A [4]	68	200	211	24
AV		A[1]	Residential	House A, Ascot Villa	65	N/A [4]	N/A [4]	73	290	299	22
GTV		A[1]	Residential	House 17, Golden Time Villas	65	N/A [4]	N/A [4]	57	295	300	22
VH	Intake	A[1]	Residential	Village House [2]	65	N/A [4]	N/A [4]	24	170	172	36

NSR No.	Location	ASR	Type	Description	Noise Criteria dB(A) Daytime 0700-1900	Evening 1900-2300	Night-time 2300-0700	Ground-borne Noise from Hydraulic Breaker, dB(A)	Correction to Rock Drill Noise, dB(A) [5]	Ground-borne Noise from Rock Drill, dB(A)
LG	Outfall	A[1]	Residential	Tower 1, Lakeview Garden	65	N/A [4]	N/A [4]	24	5	29
AV		A[1]	Residential	House A, Ascot Villa	65	N/A [4]	N/A [4]	22	5	27
GTV		A[1]	Residential	House 17, Golden Time Villas	65	N/A [4]	N/A [4]	22	5	27
VH	Intake	A[1]	Residential	Village House [2]	65	N/A [4]	N/A [4]	36	5	41

Note(s):
1) For the areas at Outfall and Intake being 'Low density residential area' and not affected by Influencing factor, hence ASR is classified as 'A'
2) Assume the buildings on spread footing and no coupling loss from bedrock to pile
3) No sensitive uses during these periods
4) No rock drilling works during these periods
5) Correction to Rock Drill Noise = +20 log (Vibration, rms, of Drilling Rig / Vibration, rms, of Hydraulic Breaker) = +20 log (0.536/0.298) =+5.1 dB(A)

Table E-2 Conversion Factors from Floor Vibration Levels to Indoor Reverberant Noise Levels

	Data		Correction (dB(A))			SPL-VL
Uses	H(m)	RT(s)	-10 log H	+10 log RT	Constant	dB(A)
Residential	2.8	0.5	-4.5	-3.0	-20	-27
Classroom	2.8	1.0	-4.5	0.0	-20	-24

(1) $SWL = VL + 10\log S + 10\log\sigma - 34$

(2) $SWL = SPL + 10\log(V/RT) - 14$

$\Rightarrow SPL - VL = -10 \log H + 10 \log RT - 20 \quad \{\sigma = 1; H = V/S\}$

where

SWL:	Sound Power Level	(dB(A))
VL:	Vibration Level	(dB(V))
SPL:	Sound Pressure Level	(dB(A))
S:	Surface Area	(m)
σ:	Radiation Efficiency	
V:	Volume	(m^3)
RT:	Reverberation Time	(s)
H:	Height	(m)

Note(s):

1) Reference please refer to 'Noise and Vibration Control Engineering, 1992'
2) Reference please refer to 'Woods Practical Guide to Noise Control, 1972'

Table E-3 Coupling Loss Calculation from Bedrock to Piles

Reference: "*Sound Transmission through Buildings using Statistical Energy Analysis*", 1996

1. In Statistical Energy Analysis (SEA), the dynamic variable is energy E.
Energy attenuation is related to coupling loss factor η_{12} between two subsystems 1 and 2, and the total loss factor η_2 of subsystem 2:

Coupling Loss in dB $$= 10 Log[\frac{E_2}{E_1}] = 10 Log[\frac{\eta_{12}}{\eta_2}]$$

2. Coupling loss factor (CLF) from one structure to another is given by Equation (4.32) in the Reference mentioned above:

$$\eta_{12} = \frac{1}{\pi(\sqrt{3}\pi)^{0.5}}[\frac{h_1 c_{L1}}{f}]^{0.5}(\frac{L_{12}}{S_1})\tau_{12}$$

where
h_1 = Bedrock thickness in m;
c_{L1} = Longitudinal wave speed in rock in m/s;
f = Frequency in Hz;
L_{12} = Structural joint length of piles to bedrock in m;
S_1 = Impact surface area in m^2;
τ_{12} = Transmission loss coefficient.

3. Approximation to total loss factor of concrete or similar is given by:

$$\eta_2 = f^{-0.5} + 0.015$$

	NSR ID.		
Input Para.:	LG	AV	GTV
h_1 (m)	68	73	57
c_{L1} (m/s)	3500	3500	3500
L_{12} (m)	5	5	5
ℓ, (m)	33	27	25
S_1, ($\pi r \ell$), (m^2)	156	127	118
τ_{12}	1/3	1/3	1/3

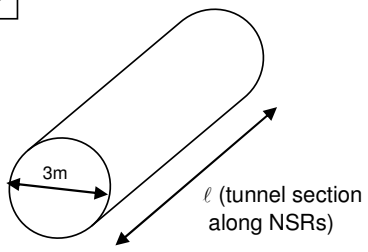


Fig.: Section of Tunnel alignment

LG

Frequency (Hz)	h_1 (m)	c_{L1} (m/s)	L_{12} (m)	S_1 (m^2)	τ_{12}	η_{12}	η_2	Coupling loss (dB)
16	68.0	3500.0	5.0	155.5	0.3333	0.17837	0.26500	-2
31.5	68.0	3500.0	5.0	155.5	0.3333	0.12712	0.19317	-2
63	68.0	3500.0	5.0	155.5	0.3333	0.08989	0.14099	-2
125	68.0	3500.0	5.0	155.5	0.3333	0.06381	0.10444	-2
250	68.0	3500.0	5.0	155.5	0.3333	0.04512	0.07825	-2
500	68.0	3500.0	5.0	155.5	0.3333	0.03191	0.05972	-3

AV

Frequency (Hz)	h_1 (m)	c_{L1} (m/s)	L_{12} (m)	S_1 (m^2)	τ_{12}	η_{12}	η_2	Coupling loss (dB)
16	73.4	3500.0	5.0	127.2	0.3333	0.22650	0.26500	-1
31.5	73.4	3500.0	5.0	127.2	0.3333	0.16142	0.19317	-1
63	73.4	3500.0	5.0	127.2	0.3333	0.11414	0.14099	-1
125	73.4	3500.0	5.0	127.2	0.3333	0.08103	0.10444	-1
250	73.4	3500.0	5.0	127.2	0.3333	0.05730	0.07825	-1
500	73.4	3500.0	5.0	127.2	0.3333	0.04052	0.05972	-2

GTV

Frequency (Hz)	h_1 (m)	c_{L1} (m/s)	L_{12} (m)	S_1 (m^2)	τ_{12}	η_{12}	η_2	Coupling loss (dB)
16	56.5	3500.0	5.0	117.8	0.3333	0.21462	0.26500	-1
31.5	56.5	3500.0	5.0	117.8	0.3333	0.15296	0.19317	-1
63	56.5	3500.0	5.0	117.8	0.3333	0.10816	0.14099	-1
125	56.5	3500.0	5.0	117.8	0.3333	0.07678	0.10444	-1
250	56.5	3500.0	5.0	117.8	0.3333	0.05429	0.07825	-2
500	56.5	3500.0	5.0	117.8	0.3333	0.03839	0.05972	-2

Table E-4 Sample Calculation of Ground-borne Noise Impact (TBM), Lakeview Garden

NSR ID.:	LG	1/F, Tower 1, Lakeview Garden	
Location:	Outfall	NSR distance:	211 m

Items	Description		
a)	PPV at 5.5 m (DB320 Kwai Tsing Tunnel)	=	2.5 mm/s
b)	Conversion the Velocity from PPV to RMS	=	0.637 mm/s
c)	Vibration Velocity (ref. 10^-9 m/s)	= =	20 log (V/Vref) 116 dB
d)	Distance Attenuation r= 211 m	= =	-20 log (r/ro) -32 dB
e)	Soil Damping Loss (Assume zero as through the Rock)	=	0 dB
f)	Building Coupling Loss (1) (at 63Hz to 250Hz)	=	-11 dB
g)	Coupling Loss from Bedrock to Pile	=	-2 dB
h)	Floor to floor attenuation (1)	=	-1 dB
i)	Conversion from Vibration to Noise (2)	=	-27 dB
j)	Conversion to A-weighted Noise	=	-20 dB
k)	Predicted Noise Level (Ground-borne) (c+d+e+f+g+h+i+j)	=	23 dB(A)

Note(s):
1) Please refer to the Section 4 of EIA Report
2) Please refer to the attached calculation using standard acoustic principles

Table E-5 Sample Calculation of Ground-borne Noise Impact (TBM), Ascot Villa

NSR ID.:	AV	G/F, House A, Ascot Villa		
Location:	Outfall	NSR distance:	299 m	

Items	Description		
a)	PPV at 5.5 m (DB320 Kwai Tsing Tunnel)	=	2.5 mm/s
b)	Conversion the Velocity from PPV to RMS	=	0.637 mm/s
c)	Vibration Velocity (ref. 10^-9 m/s)	=	20 log (V/Vref)
		=	116 dB
d)	Distance Attenuation	=	-20 log (r/ro)
	r= 299 m	=	-35 dB
e)	Soil Damping Loss (Assume zero as through the Rock)	=	0 dB
f)	Building Coupling Loss (1) (at 63Hz to 250Hz)	=	-11 dB
g)	Coupling Loss from Bedrock to Pile	=	-1 dB
h)	Floor to floor attenuation (1)	=	-1 dB
i)	Conversion from Vibration to Noise (2)	=	-27 dB
j)	Conversion to A-weighted Noise	=	-20 dB
k)	Predicted Noise Level (Ground-borne) (c+d+e+f+g+h+i+j)	=	21 dB(A)

Note(s):
1) Please refer to the Section 4 of EIA Report
2) Please refer to the attached calculation using standard acoustic principles

Table E-6 Sample Calculation of Ground-borne Noise Impact (TBM), Golden Time Villas

NSR ID.:	GTV	G/F, House 17, Golden Time Villas	
Location:	Outfall	NSR distance:	300 m

Items	Description		
a)	PPV at 5.5 m (DB320 Kwai Tsing Tunnel)	=	2.5 mm/s
b)	Conversion the Velocity from PPV to RMS	=	0.637 mm/s
c)	Vibration Velocity (ref. 10^-9 m/s)	=	20 log (V/Vref)
		=	116 dB
d)	Distance Attenuation	=	-20 log (r/ro)
	r= 300 m	=	-35 dB
e)	Soil Damping Loss (Assume zero as through the Rock)	=	0 dB
f)	Building Coupling Loss (1) (at 63Hz to 250Hz)	=	-11 dB
g)	Coupling Loss from Bedrock to Pile	=	-1 dB
h)	Floor to floor attenuation (1)	=	-1 dB
i)	Conversion from Vibration to Noise (2)	=	-27 dB
j)	Conversion to A-weighted Noise	=	-20 dB
k)	Predicted Noise Level (Ground-borne) (c+d+e+f+g+h+i+j)	=	21 dB(A)

Note(s):
1) Please refer to the Section 4 of EIA Report
2) Please refer to the attached calculation using standard acoustic principles

Table E-7 Sample Calculation of Ground-borne Noise Impact (TBM), Village House

NSR ID.:	VH	Village House	
Location:	Intake	NSR distance:	201 m

Items	Description		
a)	PPV at 5.5 m (DB320 Kwai Tsing Tunnel)	=	2.5 mm/s
b)	Conversion the Velocity from PPV to RMS	=	0.637 mm/s
c)	Vibration Velocity (ref. 10^-9 m/s)	= =	20 log (V/Vref) 116 dB
d)	Distance Attenuation r= 201 m	= =	-20 log (r/ro) -31 dB
e)	Soil Damping Loss (Assume zero as through the Rock)	=	0 dB
f)	Building Coupling Loss (1) (at 63Hz to 250Hz)	=	-8 dB
g)	Coupling Loss from Bedrock to Pile	=	0 dB
h)	Floor to floor attenuation (1)	=	-1 dB
i)	Conversion from Vibration to Noise (2)	=	-27 dB
j)	Conversion to A-weighted Noise	=	-20 dB
k)	Predicted Noise Level (Ground-borne) (c+d+e+f+g+h+i+j)	=	28 dB(A)

Note(s):
1) Please refer to the Section 4 of EIA Report
2) Please refer to the attached calculation using standard acoustic principles

Table E-8 Sample Calculation of Ground-borne Noise Impact (Construction Equipment), Lakeview Garden

NSR ID.: LG 1/F, Tower 1, Lakeview Garden
Location: Outfall NSR distance: 211 m

Items	Description			Octave Band Frequency, Hz					
				16	31.5	63	125	250	500
a)	Source Vibratory Velocity (Based on site measurement with an excavator-mounted breaker operating at distance Ro=5.5m)	mm/s	=	0.05886	0.06816	0.06195	0.05033	0.06225	0.12091
b)	Vibration Velocity (ref. 10^-6 m/s)	20 log (V/Vref) dB	=	95	97	96	94	96	102
c)	Distance Attenuation r= 211 m	-20 log (r/ro) dB	=	-32	-32	-32	-32	-32	-32
d)	Soil Damping Loss (Assume zero as through the Rock)	dB	=	0	0	0	0	0	0
e)	Building Coupling Loss [1]	dB	=	-6	-7	-11	-13	-14	-12
e')	Coupling Loss from bedrock to piles	dB	=	-2	-2	-2	-2	-2	-3
f)	Floor to floor attenuation [1]	dB	=	-1	-1	-1	-1	-1	-1
g)	Conversion from Vibration to Noise [2]	dB	=	-27	-27	-27	-27	-27	-27
h)	Conversion to A-weighted Noise	dB	=	-56.7	-39.4	-26.2	-16.1	-8.6	-3.2
i)	Predicted Noise Level (Ground-borne) (b+c+d+e+f+g+h+i)	dB(A)	=	-29	-12	-3	3	11	24
									24 dB(A)

Note(s):
1) Please refer to the Section 4 of EIA Report
2) Please refer to the attached calculation using standard acoustic principles

Table E-9 Sample Calculation of Ground-borne Noise Impact (Construction Equipment), Ascot Villa

NSR ID.: AV G/F, House A, Ascot Villa
Location: Outfall NSR distance: 299 m

Items	Description			Octave Band Frequency, Hz					
				16	31.5	63	125	250	500
a)	Source Vibratory Velocity (Based on site measurement with an excavator-mounted breaker operating at distance Ro=5.5m)	mm/s	=	0.05886	0.06816	0.06195	0.05033	0.06225	0.12091
b)	Vibration Velocity (ref. 10^-6 m/s)	20 log (V/Vref) dB	=	95	97	96	94	96	102
c)	Distance Attenuation r= 299 m	-20 log (r/ro) dB	=	-35	-35	-35	-35	-35	-35
d)	Soil Damping Loss (Assume zero as through the Rock)	dB	=	0	0	0	0	0	0
e)	Building Coupling Loss [1]	dB	=	-6	-7	-11	-13	-14	-12
e')	Coupling Loss from bedrock to piles	dB	=	-1	-1	-1	-1	-1	-2
f)	Floor to floor attenuation [1]	dB	=	-1	-1	-1	-1	-1	-1
g)	Conversion from Vibration to Noise [2]	dB	=	-27	-27	-27	-27	-27	-27
h)	Conversion to A-weighted Noise	dB	=	-56.7	-39.4	-26.2	-16.1	-8.6	-3.2
i)	Predicted Noise Level (Ground-borne) (b+c+d+e+f+g+h+i)	dB(A)	=	-31	-14	-5	1	9	22
									22 dB(A)

Note(s):
1) Please refer to the Section 4 of EIA Report
2) Please refer to the attached calculation using standard acoustic principles

Table E-10 Sample Calculation of Ground-borne Noise Impact (Construction Equipment), Golden Time Villas

NSR ID.: GTV G/F, House 17, Golden Time Villas
Location: Outfall NSR distance: 300 m

Items	Description			Octave Band Frequency, Hz					
				16	31.5	63	125	250	500
a)	Source Vibratory Velocity (Based on site measurement with an excavator-mounted breaker operating at distance Ro=5.5m)	mm/s	=	0.05886	0.06816	0.06195	0.05033	0.06225	0.12091
b)	Vibration Velocity (ref. 10^-6 m/s)	20 log (V/Vref) dB	=	95	97	96	94	96	102
c)	Distance Attenuation r= 300 m	-20 log (r/ro) dB	=	-35	-35	-35	-35	-35	-35
d)	Soil Damping Loss (Assume zero as through the Rock)	dB	=	0	0	0	0	0	0
e)	Building Coupling Loss [1]	dB	=	-6	-7	-11	-13	-14	-12
e')	Coupling Loss from bedrock to piles	dB	=	-1	-1	-1	-1	-2	-2
f)	Floor to floor attenuation [1]	dB	=	-1	-1	-1	-1	-1	-1
g)	Conversion from Vibration to Noise [2]	dB	=	-27	-27	-27	-27	-27	-27
h)	Conversion to A-weighted Noise	dB	=	-56.7	-39.4	-26.2	-16.1	-8.6	-3.2
i)	Predicted Noise Level (Ground-borne) (b+c+d+e+f+g+h+i)	dB(A)	=	-31	-14	-6	0	8	21
									22 dB(A)

Note(s):
1) Please refer to the Section 4 of EIA Report
2) Please refer to the attached calculation using standard acoustic principles

Table E-11 Sample Calculation of Ground-borne Noise Impact (Construction Equipment), Village House

NSR ID.: VH Village House
Location: Intake NSR distance: 172 m

Items	Description			Octave Band Frequency, Hz					
				16	31.5	63	125	250	500
a)	Source Vibratory Velocity (Based on site measurement with an excavator-mounted breaker operating at distance Ro=5.5m)	mm/s	=	0.05886	0.06816	0.06195	0.05033	0.06225	0.12091
b)	Vibration Velocity (ref. 10^-6 m/s)	20 log (V/Vref) dB	=	95	97	96	94	96	102
c)	Distance Attenuation r= 172 m	-20 log (r/ro) dB	=	-30	-30	-30	-30	-30	-30
d)	Soil Damping Loss (Assume zero as through the Rock)	dB	=	0	0	0	0	0	0
e)	Building Coupling Loss [1]	dB	=	-6	-8	-8	-7	-5	-4
e')	Coupling Loss from bedrock to piles	dB	=	0	0	0	0	0	0
f)	Floor to floor attenuation [1]	dB	=	-1	-1	-1	-1	-1	-1
g)	Conversion from Vibration to Noise [2]	dB	=	-27	-27	-27	-27	-27	-27
h)	Conversion to A-weighted Noise	dB	=	-56.7	-39.4	-26.2	-16.1	-8.6	-3.2
i)	Predicted Noise Level (Ground-borne) (b+c+d+e+f+g+h+i)	dB(A)	=	-26	-9	3	13	24	36
									36 dB(A)

Note(s):
1) Please refer to the Section 4 of EIA Report
2) Please refer to the attached calculation using standard acoustic principles

Appendix F
Baseline Raw Water Quality at Kowloon Byewash and Lower Shing Mun Reservoirs

Water Supplies Department

OFFICE OF THE WATER AUTHORITY
WATER SCIENCE DIVISION
File Ref: WS/S/P11
Date of Issue : 29/10/2007

Water Quality Statistics

1/4/2005 - 31/3/2007

Report No. RM3-0710291057
Source: Raw Water
Sampling Point(s): RV-00011-RW-001 Kowloon Byewash Reservoir, Draw-off Tower Surface
RV-00011-RW-006 Kowloon Byewash Reservoir, Draw-off Tower mid depth
RV-00011-RW-007 Kowloon Byewash Reservoir, Draw-off Tower bottom

Parameters	Unit	Raw Water											
		RV-00011-RW-001				RV-00011-RW-006				RV-00011-RW-007			
		Test No.	Max	Min	Ave	Test No.	Max	Min	Ave	Test No.	Max	Min	Ave
Temperature	deg. C	24	30.7	16.9	24.4	24	27.1	16.1	21.7	24	26.3	15.9	19.9
pH value at 25 deg. C	-	24	7.5	6.5	7.1	24	7.4	6.6	7.0	24	7.3	6.6	7.0
Colour	Hazen	24	15	< 3	4	*	-	-	-	*	-	-	-
Turbidity	NTU	24	7.3	0.6	2.7	24	8.8	1.0	3.9	24	120	1.0	16
Conductivity at 25 deg. C	uS/cm	24	48	35	40	*	-	-	-	*	-	-	-
Ammoniacal Nitrogen	mg/L	24	0.06	< 0.02	0.03	24	0.04	< 0.02	< 0.02	24	0.65	< 0.02	0.09
Nitrate Nitrogen	mg/L	24	0.24	0.15	0.19	*	-	-	-	*	-	-	-
Total Kjeldahl Nitrogen	mg N/L	4	0.2	< 0.1	0.1	*	-	-	-	*	-	-	-
Total Alkalinity (CaCO3)	mg/L	24	11	5	7	*	-	-	-	*	-	-	-
Total Hardness (CaCO3)	mg/L	24	16	4.0	7.6	*	-	-	-	*	-	-	-
Fluorides (F)	mg/L	24	0.24	0.12	0.15	*	-	-	-	*	-	-	-
Chlorides (Cl)	mg/L	24	5.9	3.7	4.5	*	-	-	-	*	-	-	-
Phosphates (Ortho)	mg/L	24	0.07	< 0.02	0.03	24	0.05	< 0.02	0.02	24	0.06	< 0.02	0.03
Phosphate (O+AH)	mg/L	24	0.13	0.01	0.04	*	-	-	-	*	-	-	-
Iron (Fe)	mg/L	24	0.09	< 0.01	0.04	1	-	-	0.07	1	-	-	1.8
Manganese (Mn)	mg/L	24	0.09	0.01	0.02	24	0.11	0.01	0.03	24	2.4	0.01	0.41
Silica (SiO2)	mg/L	24	17	4.8	9.9	*	-	-	-	*	-	-	-
Oil and Grease	mg/L	24	1	< 1	< 1	*	-	-	-	*	-	-	-
Cyanide	mg/L	2	< 0.01	< 0.01	< 0.01	*	-	-	-	*	-	-	-
Chlorophyll - a	ug/L	24	5	1	3	24	7	< 1	3	24	17	1	4
Dissolved Oxygen	mg/L	24	9.1	4.1	7.4	24	9.2	3.5	6.8	24	9.2	1.1	5.7

Chemical results expressed in mg/L

Remarks :

Note: Results in this report apply only to the samples as received and tested.
This test report shall not be reproduced except in full, without the written approval of the laboratory.

RM3-STAT-DIRECT-ALL.V1.1

CHENG Ching Man
Ch/RM(3)

Water Supplies Department

OFFICE OF THE WATER AUTHORITY
WATER SCIENCE DIVISION
File Ref: WS/S/P11
Date of Issue : 29/10/2007

Water Quality Statistics

1/4/2005 - 31/3/2007

Report No. RM3-0710291100
Source: Raw Water
Sampling Point(s): RV-00022-RW-001 Lower Shing Mun Reservoir, Drawoff Tower Surface
RV-00022-RW-002 Lower Shing Mun Reservoir, Depth 1 (79.50mPD) 11M
RV-00022-RW-003 Lower Shing Mun Reservoir, Depth 2 (70.36mPD) 21M
RV-00022-RW-004 Lower Shing Mun Reservoir, Depth 3 (45.97mPD) 45M
RV-00022-RW-006 Lower Shing Mun Reservoir, Draw-off Tower bottom

Parameters	Unit	Raw Water																			
		RV-00022-RW-001				RV-00022-RW-002				RV-00022-RW-003				RV-00022-RW-004				RV-00022-RW-006			
		Test No.	Max	Min	Ave	Test No.	Max	Min	Ave	Test No.	Max	Min	Ave	Test No.	Max	Min	Ave	Test No.	Max	Min	Ave
Temperature	deg. C	19	33.5	15.6	25.7	5	29.9	25.2	26.8	11	33.0	21.4	26.7	12	28.2	17.7	23.8	18	29.6	17.2	24.6
pH value at 25 deg. C	-	19	8.0	6.4	7.2	5	7.4	6.6	7.0	11	7.3	6.4	6.9	13	7.4	6.6	7.0	19	7.3	6.6	7.0
Colour	Hazen	19	60	< 3	9	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Turbidity	NTU	19	55	3.0	16	5	38	2.8	13	11	32	3.5	11	13	220	8.8	55	19	800	4.8	200
Conductivity at 25 deg. C	uS/cm	19	185	33	61	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Ammoniacal Nitrogen	mg/L	19	1.8	< 0.02	0.25	5	0.04	< 0.02	< 0.02	11	0.05	< 0.02	< 0.02	13	1.9	< 0.02	0.33	19	2.6	< 0.02	0.31
Nitrate Nitrogen	mg/L	19	0.78	0.08	0.22	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Total Kjeldahl Nitrogen	mg N/L	3	2.1	< 0.1	0.8	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Total Alkalinity (CaCO3)	mg/L	19	65	4	17	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Total Hardness (CaCO3)	mg/L	19	59	5.9	16	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Fluorides (F)	mg/L	19	2.15	0.16	0.51	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Chlorides (Cl)	mg/L	19	6.9	3.2	4.2	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Phosphates (Ortho)	mg/L	19	0.23	< 0.02	0.04	5	0.08	< 0.02	0.04	11	0.07	< 0.02	0.03	13	0.27	< 0.02	0.06	19	0.32	< 0.02	0.05
Phosphate (O+AH)	mg/L	19	0.35	0.02	0.07	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Iron (Fe)	mg/L	19	1.9	0.03	0.37	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Manganese (Mn)	mg/L	19	3.1	0.01	0.52	5	0.02	0.01	0.02	11	0.05	0.01	0.02	13	3.5	0.03	0.80	19	4.0	0.02	0.94
Silica (SiO2)	mg/L	19	15	6.0	10	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Oil and Grease	mg/L	19	1	< 1	< 1	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Cyanide	mg/L	2	< 0.01	< 0.01	< 0.01	*	-	-	-	*	-	-	-	*	-	-	-	*	-	-	-
Chlorophyll - a	ug/L	19	21	1	7	5	9	1	4	11	6	< 1	3	13	10	2	5	19	46	< 1	11
Dissolved Oxygen	mg/L	19	10.0	3.9	7.3	5	9.2	6.9	7.7	11	9.2	5.5	7.1	13	9.1	2.2	6.4	19	9.0	2.2	6.1

Chemical results expressed in mg/L

Remarks :

CHENG Ching Man
Ch/RM(3)

Note: Results in this report apply only to the samples as received and tested.
This test report shall not be reproduced except in full, without the written approval of the laboratory.

RM3-STAT-DIRECT-ALL.V1.1

Appendix G
Ecological Survey Results

Table G-1a Status and Relative Abundance of Plant Species Recorded within Worksite Area at the Kowloon Byewash Reservoir (21 September 2007; 25 October 2007; 2 November 2007; 5 December 2007; 3 January 2008; 5 February 2008)

Scientist Name	Native to HK	Habit [1]	Status [2]	Secondary Woodland / Plantation [3] [4]
Achyranthes aspera	Y	H	-	+
Acronychia pedunculata	Y	T	-	+++
Adiantum flabellulatum	Y	H	-	+
Alangium chinense	Y	T	-	+
Alocasia odora	Y	H	-	++
Antidesma ghaesembilla	Y	T	-	+
Antirhea chinensis	Y	T	-	+
Aporusa dioica	Y	T	-	++
Archidendron lucidum	Y	T	-	+
Ardisia crenata	Y	S	-	+
Artocarpus hypargyreus	Y	T	(c) (f)VU	+
Bauhinia variegata	Y	T	-	+
Bidens alba	N	H	-	++
Bridelia tomentosa	Y	S	-	+
Cansjera rheedii	Y	C	-	+
Carallia brachiata	Y	T	-	++
Celtis sinensis	Y	T	-	++
Cratoxylum cochinchinense	Y	T	-	++
Cynodon dactylon	Y	H	-	++
Dalbergia benthamii	Y	C	-	+
Dalbergia millettii	Y	C	-	+
Daphniphyllum calycinum	Y	T	-	+
Desmodium tortuosum	N	H	-	+
Desmos chinensis	Y	S	-	++
Dianella ensifolia	Y	H	-	++
Dimocarpus longan	N	T	-	+
Embelia ribes	Y	C	-	+
Eucalyptus robusta	N	T	-	+
Eurya nitida	Y	S	-	+
Ficus hirta	Y	S	-	++
Ficus hispida	Y	S	-	++
Ficus variolosa	Y	S	-	+
Garcinia oblongifolia	Y	T	-	++
Gardenia jasminoides	Y	S	-	+
Glochidion hirsutum	Y	S	-	+
Gnetum luofuense	Y	C	-	+++
Gordonia axillaris	Y	T	-	+
Hypserpa nitida	Y	C	-	+
Ilex asprella	Y	S	-	++
Ilex memecylifolia	Y	T	-	+
Ipomoea cairica	N	C	-	++
Lantana camara	N	S	-	++
Lasianthus chinensis	Y	S	-	+
Liriope spicata	Y	H	-	++
Litchi chinensis	N	T	-	+

Scientist Name	Native to HK	Habit [1]	Status [2]	Secondary Woodland / Plantation [3] [4]
Litsea rotundifolia	Y	S	-	++
Lonicera macrantha	Y	C	-	+
Lophatherum gracile	Y	H	-	++
Lygodium flexuosum	Y	C	-	+
Machilus chekiangensis	Y	T	-	+
Malvaviscus arboreus	N	S	-	+
Microcos paniculata	Y	S	-	++
Mikania micrantha	N	C	-	++
Millettia dielsiana	Y	C	-	+
Miscanthus floridulus	Y	H	-	+
Neyraudia reynaudiana	Y	H	-	+
Ormosia semicastrata	Y	T	-	+
Paederia scandens	Y	C	-	++
Pandanus tectorius	Y	S	-	+
Phyllanthus cochinchinensis	Y	S	-	++
Psychotria asiatica	Y	S	-	+++
Rhus succedanea	Y	S	-	++
Rourea microphylla	Y	C	-	+
Sageretia thea	Y	S	-	++
Schefflera heptaphylla	Y	T	-	+++
Schizostachyum dumetorum	Y	S	-	++
Smilax glabra	Y	C	-	+
Stachytarpheta jamaicensis	N	S	-	+
Sterculia lanceolata	Y	T	-	+++
Strychnos angustiflora	Y	C	-	++
Synedrella nodiflora	N	H	-	+
Tetracera asiatica	Y	C	-	+
Trema tomentosa	Y	S	-	+
Tylophora ovata	Y	C	-	+

(1) Habit: T=Tree; S=Shrub / Bamboo; H=Herb; C=Climber.

(2) Status: (a) listed species in Forestry Regulation (Cap.96 sub. Leg.);

(b) listed species in Protection of Endangered Species of Animals and Plants Ordinance (Cap 586);

(c) listed species in AFCD's Rare and Precious Plants of Hong Kong;

(d) rare species listed in Corlett's study Hong Kong Vascular Plants: Distribution and Status;

(e) listed in China Red Data Book: (e)EX: Extinct; (e)EW: Extinct in the wild; (e)CR: Critically Endangered; (e)EN: Endangered; (e)VU: Vulnerable; (e)NT: Near Threatened; (e)LC: Least Concern;

(f) listed in IUCN 2008: (f)EX: Extinct; (f)EW: Extinct in the wild; (f)CR: Critically Endangered; (f)EN: Endangered; (f)VU: Vulnerable; (f)NT: Near Threatened; (f)LC: Least Concern.

(3) Abundance: +++=abundant; ++=fairly abundant; +=low abundance

(4) As the drainage channel within the site is a concrete structure while developed area / bare ground is of negligible ecological value, weed species growing on cracks of these two habitats were thus excluded from the list.

Table G-1b Status and Relative Abundance of Plant Species Recorded within Worksite Area at the Lower Shing Mun Reservoir (24 September 2007; 29 October 2007; 15 November 2007; 14 December 2007; 4 January 2008; 6 February 2008)

Scientist Name	Native to HK	Habit [1]	Status [2]	Grassland [3]	Reservoir [3] [4]
Acacia confusa	N	T	-		+++
Acronychia pedunculata	Y	T	-		++
Ageratum conyzoides	N	H	-		+++
Alangium chinense	Y	T	-		++
Aporusa dioica	Y	T	-		++
Bidens alba	N	H	-	++	+++
Brachiaria mutica	N	H	-	+	++
Breynia fruticosa	Y	S	-	+	++
Byttneria aspera	Y	C	-	+	
Centella asiatica	Y	H	-	+	+
Conyza bonariensis	N	H	-	+	+
Crotalaria pallida	N	H	-		+
Cyclea hypoglauca	Y	C	-		+
Cyclosorus acuminatus	Y	H	-	+	+
Cynodon dactylon	Y	H	-	+	++
Cyperus rotundus	Y	H	-		+
Cyrtococcum accrescens	Y	H	-		++
Dendrotrophe frutescens	Y	C	-		+
Desmos chinensis	Y	S	-		+
Dianella ensifolia	Y	H	-		++
Dicranopteris pedata	Y	H	-		++
Digitaria longiflora	Y	H	-	+	++
Eclipta prostrata	Y	H	-		+
Elephantopus tomentosus	Y	H	-		+
Eleusine indica	Y	H	-	+	++
Embelia ribes	Y	C	-		++
Emilia sonchifolia	Y	H	-	+	+
Eriocaulon sexangulare	Y	H	-		+
Ficus hirta	Y	S	-		+
Ficus hispida	Y	T	-	+	+
Ficus variegata	Y	T	-	+	
Glochidion wrightii	Y	S	-		+
Glochidion zeylanicum	Y	T	-		+
Gnetum luofuense	Y	C	-	+	++
Hedyotis acutangula	Y	H	-		++
Hedyotis auricularia	Y	H	-		+
Hedyotis hedyotidea	Y	S	-		+
Hypericum japonicum	Y	H	-		+
Ilex asprella	Y	S	-		++
Ipomoea cairica	N	C	-	+	++
Ipomoea triloba	Y	H	-		+
Lantana camara	N	S	-	+	+
Leucaena leucocephala	N	T	-		++

Scientist Name	Native to HK	Habit [1]	Status [2]	Grassland [3]	Reservoir [3] [4]
Ligustrum sinense	Y	S	-	+	+
Liriope spicata	Y	H	-		+
Litsea glutinosa	Y	T	-		+
Litsea cubeba	Y	T	-	+	++
Litsea rotundifolia	Y	S	-		++
Lophatherum gracile	Y	H	-		+
Ludwigia octovalvis	Y	H	-		+
Lygodium japonicum	Y	C	-	+	+
Macaranga tanarius	Y	T	-	+	++
Maesa perlarius	Y	S	-	++	++
Mallotus paniculatus	Y	T	-	++	+++
Melastoma candidum	Y	S	-		++
Melastoma sanguineum	Y	S	-		++
Melia azedarach	N	T	-	+	+
Melicope pteleifolia	Y	S	-		+
Microcos paniculata	Y	S	-		+
Microstegium ciliatum	Y	H	-	+++	+
Mikania micrantha	N	C	-	++	+++
Mimosa pudica	N	H	-	+	+
Miscanthus sinensis	Y	H	-	+++	+
Mussaenda pubescens	Y	S	-	+	+
Neyraudia reynaudiana	Y	H	-	+	++
Paederia scandens	Y	C	-		++
Panicum brevifolium	Y	H	-		++
Panicum maximum	N	H	-	++	+++
Panicum repens	Y	H	-		+
Paspalum conjugatum	N	H	-		++
Paspalum orbiculare	Y	H	-		++
Pavetta hongkongensis	Y	S	(a)		+
Pennisetum polystachyon	N	H	-		++
Phyllanthus emblica	Y	T	-		+
Polygonum hydropiper	Y	H	-		+
Polygonum perfoliatum	Y	H	-		+
Psychotria asiatica	Y	S	-		++
Psychotria serpens	Y	C	-		+
Pteris semipinnata	Y	H	-		++
Pueraria lobata	Y	C	-		+
Rhus hypoleuca	Y	S	-		++
Rhus succedanea	Y	T	-		+
Rhynchelytrum repens	N	H	-	+	++
Rhynchospora rubra	Y	H	-		+
Rubus leucanthus	Y	C	-	+	+
Rubus reflexus	Y	C	-	++	++
Sageretia thea	Y	S	-		++
Sapium discolor	Y	T	-		++
Sarcandra glabra	Y	S	-	+	+
Schefflera heptaphylla	Y	T	-	+	+++
Schima superba	Y	T	-		+
Scoparia dulcis	N	H	-		++
Setaria glauca	Y	H	-		+

Scientist Name	Native to HK	Habit (1)	Status (2)	Grassland (3)	Reservoir (3) (4)
Smilax china	Y	C	-		+
Solanum nigrum	Y	H	-		++
Sphenomeris chinensis	Y	H	-		+
Stachytarpheta jamaicensis	N	S	-		+++
Stephania longa	Y	C	-	+	+
Synedrella nodiflora	N	H	-		+
Tetracera asiatica	Y	C	-		+
Trema tomentosa	Y	S	-	+	+
Tylophora ovata	Y	C	-		+
Urena lobata	Y	H	-		+
Zanthoxylum avicennae	Y	T	-		+

(1) Habit: T=Tree; S=Shrub / Bamboo; H=Herb; C=Climber.

(2) Status: (a) listed species in Forestry Regulation (Cap.96 sub. Leg.);

(b) listed species in Protection of Endangered Species of Animals and Plants Ordinance (Cap 586);

(c) listed species in AFCD's Rare and Precious Plants of Hong Kong;

(d) rare species listed in Corlett's study Hong Kong Vascular Plants: Distribution and Status;

(e) listed in China Red Data Book: (e)EX: Extinct; (e)EW: Extinct in the wild; (e)CR: Critically Endangered; (e)EN: Endangered; (e)VU: Vulnerable; (e)NT: Near Threatened; (e)LC: Least Concern;

(f) listed in IUCN 2008: (f)EX: Extinct; (f)EW: Extinct in the wild; (f)CR: Critically Endangered; (f)EN: Endangered; (f)VU: Vulnerable; (f)NT: Near Threatened; (f)LC: Least Concern.

(3) Abundance: +++=abundant; ++=fairly abundant; +=low abundance

(4) Species were recorded on slopes and exposed areas of the reservoir.

Table G-1c Status and Relative Abundance of Plant Species Recorded within the Study Area (21, 24, 25 September 2007; 25, 29, 31 October 2007; 2, 15, 16 November 2007; 5, 14, 17 December 2007; 3, 4, 7 January 2008; 5, 6, 12 February 2008)

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Acacia confusa	N	T	-		+++		+++
Acacia mangium	N	T	-		+		
Achyranthes aspera	Y	H	-		+		
Acronychia pedunculata	Y	T	-		+++		+++
Actinidia latifolia	Y	S	-		+		
Adenosma glutinosum	Y	H	-		+		
Adiantum flabellulatum	Y	H	-		++		
Adina pilulifera	Y	T	-		+++	+++	
Ageratum conyzoides	N	H	-			+	+++
Ageratum houstonianum	N	H	-			+	+
Alangium chinense	Y	T	-		++	+	++
Albizia corniculata	Y	S	-		+		
Albizia lebbeck	N	T	-		+		
Alchornea trewioides	Y	S	-		++		
Allamanda cathartica	N	S	-		+		
Alleizettella leucocarpa	Y	S	-		+		
Alocasia odora	Y	H	-		+		
Alpinia hainanensis	Y	H	-		+		
Alpinia oblongifolia	Y	H	-		+		
Alpinia stachyodes	Y	H	-		+		
Alysicarpus vaginalis	Y	H	-		+		
Alyxia sinensis	T	C	-		+		
Amaranthus viridis	Y	H	-		+		
Ampelopsis cantoniensis	Y	C	-		+		
Antidesma ghaesembilla	Y	T	-		+		
Antidesma japonicum	Y	T	-		+		
Antidesma venosum	Y	T	-		+		
Antirhea chinensis	Y	S	-		+++	+	++
Apluda mutica	Y	H	-		+		
Aporusa dioica	Y	T	-		+++	+++	+++
Aquilaria sinensis	Y	T	(c), (e)VU, (f)VU		+++	+	+
Archidendron clypearia	Y	T	-		++	+	+
Archidendron lucidum	Y	T	-		++		+
Ardisia crenata	Y	S	-		++		
Ardisia lindleyana	Y	S	-		+		
Ardisia quinquegona	Y	S	-		+		
Artemisia capillaries	Y	H	-				+
Artocarpus hypargyreus	Y	T	(c), (f)VU		+++		++
Artocarpus macrocarpon	N	T	-		+		

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Arundinaria hindsii	Y	S	-		++	+	+
Asparagus cochinchinensis	Y	H	-		+		+
Aster baccharoides	Y	H	-		+		
Baeckea frutescens	Y	T	-		+++		
Bauhinia championii	Y	C	-		+		
Bauhinia purpurea	N	T	-		+		
Bauhinia variegata	Y	T	-		+		
Berchemia floribunda	Y	C	-		++		
Bidens alba	N	H	-	++	+		+++
Bischofia javanica	Y	T	-		+		
Blechnum orientale	Y	H	-		+		+
Blumea megacephala	Y	C	-		+		+
Bothriochloa bladhii	Y	H	-		+		
Bougainvillea spectabilis	N	S	-		+		
Brachiaria mutica	N	H	-	+	+		++
Breynia fruticosa	Y	S	-	+	+++	+	++
Bridelia tomentosa	Y	T	-		++		+
Byttneria aspera	Y	C	-	+	+	+	+
Caesalpinia crista	Y	C	-		++	++	+
Caesalpinia vernalis	Y	C	-		+	+	
Cajanus scarabaeoides	Y	C	-		+		
Callicarpa nudiflora	Y	S	-		+	+	
Campsis grandiflora	N	C	-		+		
Canarium album	N	T	-		+		
Cansjera rheedii	Y	C	-		+		
Canthium dicoccum	Y	T	-		++		
Carallia brachiata	Y	T	-		++	++	++
Cassytha filiformis	Y	C	-		+	+	+
Castanopsis carlesii	Y	T	(d)		+		
Castanopsis fabri	Y	T	-		+		
Castanopsis fissa	Y	T	-		++		
Casuarina equisetifolia	N	T	-		+		+
Celtis sinensis	Y	T	-		++		+
Centella asiatica	Y	H	-	+	+	+	+
Centotheca lappacea	Y	H	-		+	+	+
Choerospondias axillaris	Y	T	-		+		
Chrysopogon aciculatus	Y	H	-		+		
Cibotium barometz	Y	H	(b) (c)		+++	++	+
Cinnamomum camphora	Y	T	-		++		+
Cinnamomum parthenoxylon	Y	T	-		+		
Citrus maxima	N	T	-		+		
Citrus reticulata	N	T	-		+		
Cleistocalyx operculatus	Y	T	-		++	+++	+++
Clematis meyeniana	Y	C	-		++	+	+
Clerodendrum chinense	Y	S	-		+		
Clerodendrum fortunatum	Y	S	-		+		+
Cocculus orbiculatus	Y	C	-		+	+	+

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Codonacanthus pauciflorus	Y	H	-		+		
Coix lacryma-jobi	Y	H	-		+		
Conyza bonariensis	N	H	-	+	+		+
Cordia dichotoma	Y	T	-		+		
Cordyline fruticosa	N	S	-		+		
Crateva unilocularis	N	T	-		+		
Cratoxylum cochinchinense	Y	T	-		+++	++	+++
Crotalaria pallida	N	H	-				+
Cyclea hypoglauca	Y	C	-		+	+	+
Cyclosorus acuminatus	Y	H	-	+	+	+	+
Cyclosorus interruptus	Y	H	-		+	+	+
Cynodon dactylon	Y	H	-	+	+		+
Cyperus rotundus	Y	H	-		+	+	+
Cyrtococcum accrescens	Y	H	-		++	+	++
Daemonorops margaritae	Y	C	-		+		
Dalbergia benthamii	Y	C	-		++	++	+
Dalbergia hancei	Y	C	-		++	++	++
Dalbergia millettii	Y	C	-		+	+	+
Daphniphyllum calycinum	Y	T	-		+		
Delonix regia	N	T	-		+		
Dendranthema indicum	Y	H	-		+		
Dendrotrophe frutescens	Y	C	-		++	+	++
Desmodium heterocarpon	Y	S	-		+		
Desmodium tortuosum	N	H	-		+		+
Desmos chinensis	Y	S	-		+++	++	++
Dianella ensifolia	Y	H	-		+++	+	+
Dichrocephala integrifolia	Y	H	-		+		
Dicranopteris pedata	Y	H	-		++	++	++
Digitaria longiflora	Y	H	-	+	+		
Dimocarpus longan	N	T	-		+		
Dioscorea benthamii	Y	C	-		+		
Diospyros eriantha	Y	S	-		++		
Diospyros morrisiana	Y	T	-		+++	+	+
Diospyros vaccinioides	Y	S	-		++	+	
Diploclisia glaucescens	Y	C	-		+	+	
Diplospora dubia	Y	S	-		++	++	
Dracaena marginata	N	S	-		+		
Dracaena reflexa	N	S	-		+		
Drosera spathulata	Y	H	-		+	+	
Duranta erecta	N	S	-		+		
Eclipta prostrate	Y	H	-				+
Elaeocarpus chinensis	Y	T	-		++		
Elephantopus scaber	Y	H	-		+		
Elephantopus tomentosus	Y	H	-		+		+
Eleusine indica	Y	H	-	+	+		+
Eleutherococcus trifoliatus	Y	S	-		++	++	++
Embelia laeta	Y	C	-		++	+	+

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Embelia ribes	Y	C	-		+++	++	++
Emilia sonchifolia	Y	H	-	+	+		+
Enkianthus quinqueflorus	Y	S	(a)		++		
Eragrostis tenella	Y	H	-		+++	++	+
Eriobotrya japonica	N	T	-		+		
Eriocaulon sexangulare	Y	H	-				+
Erythrina variegata	N	T	-		+		
Eucalyptus robusta	N	T	-		+		
Eucalyptus torelliana	N	T	-		+		
Euphorbia hirta	N	H	-		+		
Euphorbia prostrata	N	H	-		+		
Euphorbia thymifolia	Y	H	-		+		
Eurya macartneyi	Y	S	-		++	+	
Eurya nitida	Y	S	-		++	++	++
Ficus fistulosa	Y	T	-		++	+++	+
Ficus hirta	Y	S	-		+++	++	+
Ficus hispida	Y	T	-	+	++	++	+
Ficus microcarpa	Y	T	-		+		
Ficus religiosa	N	T	-		+		
Ficus superba	Y	T	-		+		++
Ficus variegata	Y	T	-	+	++		+
Ficus variolosa	Y	S	-		++		
Ficus virens	Y	T	-		+		
Gahnia tristis	Y	H	-		+		
Garcinia oblongifolia	Y	T	-		++	+	+
Gardenia jasminoides	Y	S	-		++		
Glochidion eriocarpum	Y	S	-		+++	++	++
Glochidion hirsutum	Y	S	-		+		
Glochidion lanceolarium	Y	T	-		+		
Glochidion wrightii	Y	S	-		++	+	++
Glochidion zeylanicum	Y	T	-		+	+	+
Gnetum luofuense	Y	C	-		+++	+++	+++
Gordonia axillaris	Y	T	-		+++		+++
Graphistemma pictum	Y	C	-		+		
Gymnema sylvestre	Y	C	-		+		
Hedyotis acutangula	Y	H	-		++		+
Hedyotis auricularia	Y	H	-		+		+
Hedyotis corymbosa	Y	H	-		+	+	+
Hedyotis hedyotidea	Y	S	-		+		
Helicteres angustifolia	Y	S	-		+++		
Heterosmilax japonica	Y	S	-		+		
Hippeastrum vittatum	N	H	-		+		
Homalium cochinchinensis	Y	T	-		++		
Hymenocallis littoralis	N	H	-		+		
Hypericum japonicum	Y	H	-		+	+	+
Hypserpa nitida	Y	C	-		+		
Ilex asprella	Y	S	-		+++	+	++

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Ilex graciliflora	Y	T	-		+		
Ilex memecylifolia	Y	T	-		++		+
Ilex pubescens	Y	S	-		+++	+	+
Ilex rotunda	Y	T	-		+		
Indocalamus sinicus	Y	S	-		+		
Ipomoea batatas	N	H	-		+		
Ipomoea cairica	N	C	-	+	+		+
Ipomoea triloba	Y	H	-				+
Itea chinensis	Y	T	-		+++		
Ixonanthes reticulata	Y	T	(c), (e)VU		+++		
Ixora chinensis	Y	S	-		+		
Lagerstroemia speciosa	N	T	-		+		
Lantana camara	N	S	-	+	+		+
Lasianthus chinensis	Y	S	-		+		
Lepidosperma chinense	Y	H	-		++		
Leucaena leucocephala	N	T	-		+		+
Ligustrum sinense	Y	S	-	+	++		+
Lindera aggregata	Y	S	-		+		
Lindernia crustacean	Y	H	-		+		
Lindsaea orbiculata	Y	H	-		++		
Liparis nervosa	Y	H	(a) (b)		+	+	+
Liriope spicata	Y	H	-		+++	++	
Litchi chinensis	N	T	-		+		
Lithocarpus corneus	Y	T	-		+		
Litsea cubeba	Y	T	-	+	+++	+	++
Litsea glutinosa	Y	T	-		+++	+	+++
Litsea rotundifolia	Y	S	-		+++	+++	+++
Livistona chinensis	N	T	-		+		
Lonicera confusa	Y	C	-		+		
Lonicera macrantha	Y	C	-		+		
Lophatherum gracile	Y	H	-		+		+
Lophostemon confertus	N	T	-		++		++
Ludwigia octovalvis	Y	H	-		+		+
Ludwigia perennis	Y	H	-				+
Lygodium japonicum	Y	C	-	+	+		+
Lygodium scandens	Y	C	-		+		+
Macaranga tanarius	Y	T	-	+	+		+
Machilus chekiangensis	Y	T	-		++		
Machilus velutina	Y	T	-		+		
Maesa japonica	Y	S	-		++		+
Maesa perlarius	Y	S	-	++	+++		++
Mallotus paniculatus	Y	T	-	++	+++		+++
Malvastrum coromandelianum	Y	S	-		+		
Malvaviscus arboreus	N	S	-		+		
Mangifera indica	N	T	-		+		
Manihot esculenta	N	S	-		+		

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Melaleuca quinquenervia	N	T	-		++		++
Melastoma candidum	Y	S	-		+++		++
Melastoma dodecandrum	Y	S	-		++		+
Melastoma sanguineum	Y	S	-		+++		++
Melia azedarach	N	T	-	+	+		+
Melicope pteleifolia	Y	S	-		++		+
Melodinus suaveolens	Y	C	-		++		++
Merremia umbellate	Y	C	-		+		
Michelia alba	N	T	-		+		
Microcos paniculata	Y	S	-		++		++
Microstegium ciliatum	Y	H	-	+++			+
Mikania micrantha	N	C	-	++	+	++	+
Millettia dielsiana	Y	C	-		++	+	+
Millettia nitida	Y	S	-		+		
Millettia speciosa	Y	C	-		+		
Mimosa pudica	N	H	-	+	+	+	+
Miscanthus floridulus	Y	H	-		+	+	+
Miscanthus sinensis	Y	H	-	+++	+		+
Morinda parvifolia	Y	C	-		+		+
Morinda umbellata	Y	C	-		+++	+	
Murraya paniculata	N	T	-		+		+
Musa x paradisiaca	N	H	-		+		
Mussaenda pubescens	Y	S	-	+	+++	+	+
Myrica rubra	Y	T	-		++		
Myrsine seguinii	Y	S	-		+		
Neyraudia reynaudiana	Y	H	-	+	+	+	++
Ormosia emarginata	Y	T	-		+		
Ormosia semicastrata	Y	T	-		+		
Osmanthus fragrans	N	S	-		+		
Osmunda japonica	Y	H	-		+		
Oxalis corniculata	Y	H	-		+		
Pachira macrocarpa	N	T	-		+		
Paederia scandens	Y	C	-		+	+	+
Palhinhaea cernua	Y	H	-		+	+	+
Pandanus tectorius	Y	S	-		+	+	+
Panicum brevifolium	Y	H	-		++		+
Panicum maximum	N	H	-	++	+	+	++
Panicum repens	Y	H	-		+		+
Paraixeris denticulata	Y	H	-		+		
Paspalum conjugatum	N	H	-				+
Paspalum orbiculare	Y	H	-		+		+
Pavetta hongkongensis	Y	S	(a)		+++	+	+
Pennisetum polystachyon	N	H	-				+
Pennisetum purpureum	N	H	-			+	+
Pentasachme caudatum	Y	H	-			++	
Peristylus tentaculatus	Y	H	(a) (b)		+	+	
Phoenix hanceana	Y	T	-		+		

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Phyllanthus cochinchinensis	Y	S	-		++	+	
Phyllanthus emblica	Y	T	-		+++		+
Phyllodium pulchellum	Y	S	-		+		
Pilea microphylla	N	H	-		+		
Pinus elliottii	N	T	-		+		
Pinus massoniana	Y	T	-		++		
Podocarpus macrophyllus	Y	T	-		+		
Pogonatherum crinitum	Y	H	-		+		
Polygonum chinense	Y	H	-			++	+
Polygonum hydropiper	Y	H	-			+	+
Polygonum perfoliatum	Y	H	-				+
Pothos chinensis	Y	H	-		+		
Pouzolzia zeylanica	Y	H	-		+		
Pronephrium simplex	Y	H	-		++		
Psidium guajava	N	T	-		+		
Psychotria asiatica	Y	S	-		+++	+++	+++
Psychotria serpens	Y	C	-		+	+	+
Pteridium aquilinum	Y	H	-		+		
Pteris ensiformis	Y	H	-		++	++	++
Pteris semipinnata	Y	H	-		++	++	++
Pteris vittata	Y	H	-		+		
Pueraria lobata	Y	C	-		+		+
Pyrrosia adnascens	Y	H	-		+		
Reevesia thyrsoidea	Y	T	-		++		
Rhaphiolepis indica	Y	S	-		++		
Rhodomyrtus tomentosa	Y	S	-		+++		+++
Rhus hypoleuca	Y	S	-		++		+
Rhus succedanea	Y	T	-		++		+
Rhynchelytrum repens	N	H	-	+	+		+
Rhynchospora rubra	Y	H	-				+
Rosa laevigata	Y	C	-		+		
Rourea microphylla	Y	C	-		++	+	+
Rubus leucanthus	Y	C	-	+	++		
Rubus reflexus	Y	C	-	++	++		+
Sabia limoniacea	Y	C	-		+	+	+
Sageretia thea	Y	S	-		++	+	+
Sansevieria trifasciata	N	H	-		+		
Sapindus saponaria	Y	T	-		+		
Sapium discolour	Y	T	-		+++		+
Sarcandra glabra	Y	S	-	+	+++		+
Saurauia tristyla	Y	T	-		++	+++	+
Schefflera heptaphylla	Y	T	-	+	+++	+++	+++
Schima superba	Y	T	-		+++	+++	+++
Schizostachyum dumetorum	Y	S	-		++	+	+
Scleria ciliaris	Y	H	-		+		
Scolopia saeva	Y	S	-		+		
Scoparia dulcis	N	H	-		+		+

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Scutellaria indica	Y	H	-		+		
Selaginella biformis	Y	H	-		+		
Senecio scandens	Y	H	-		+		
Setaria glauca	Y	H	-				+
Setaria palmifolia	Y	H	-		+		
Severinia buxifolia	Y	S	-		++		+
Sida rhombifolia	Y	S	-		+		
Sinosideroxylon wightianum	Y	T	-		+		
Smilax china	Y	C	-		+		
Smilax glabra	Y	C	-		+		
Smilax lanceifolia	Y	C	-		+		
Solanum nigrum	Y	H	-		+		
Solanum torvum	N	S	-		+		
Solena amplexicaulis	Y	C	-		+		
Spathodea campanulata	N	T	-		+		
Sphaerocaryum malaccense	Y	H	-		+	+	+
Sphenomeris chinensis	Y	H	-		+		+
Sporobolus fertilis	Y	H	-		+		
Stachytarpheta jamaicensis	N	S	-		+		++
Stauntonia obovata	Y	C	-		+		
Stephania longa	Y	C	-	+	+		+
Sterculia lanceolata	Y	T	-		+++	+++	+++
Strophanthus divaricatus	Y	C	-		+++	+	+
Strychnos angustiflora	Y	C	-		+++	++	+++
Strychnos cathayensis	Y	C	-		+		
Styrax suberifolius	Y	T	-		++		
Synedrella nodiflora	N	H	-		+		
Syzygium jambos	N	T	-		+		
Tadehagi triquetrum	Y	S	-		++		
Tainia hongkongensis	Y	H	(a) (b)		+	+	
Tarenna attenuata	Y	S	-		+		
Telosma cordata	N	C	-		+		
Ternstroemia gymnanthera	Y	T	-		+		
Tetracera asiatica	Y	C	-		++	+	+
Tetradium glabrifolium	Y	T	-		+		+
Thevetia peruviana	N	T	-		+		
Thysanolaena agrostis	Y	H	-		+		
Toddalia asiatica	Y	S	-		+		+
Trema tomentosa	Y	S	-	+	+		+
Tylophora ovata	Y	C	-		++		+
Uraria crinita	Y	S	-		+		
Urena lobata	Y	H	-		+	+	+
Utricularia caerulea	Y	H	-		+	+	
Uvaria macrophylla	Y	C	-		+++		++
Ventilago leiocarpa	Y	C	-		+		
Vernonia cinerea	Y	H	-		+		
Viburnum sempervirens	Y	S	-		+		

Scientist Name	Native to HK	Habit (1)	Status (2)	Grass-land (3)	Secondary Woodland / Plantation (3)	Stream / Drainage Channel (3)	Reservoir (3)
Viola diffusa	Y	H	-		+		
Vitex negundo	Y	S	-		+		
Vitex quinata	Y	T	-		+		
Wedelia trilobata	N	H	-			+	+
Wikstroemia indica	Y	S	-		++		
Wikstroemia nutans	Y	S	-		++		
Zanthoxylum avicennae	Y	T	-		++	++	++
Zanthoxylum nitidum	Y	C	-		++	+	+
Zanthoxylum scandens	Y	C	-		+		

(1) Habit: T=Tree; S=Shrub / Bamboo; H=Herb; C=Climber.

(2) Status: (a) listed species in Forestry Regulation (Cap.96 sub. Leg.);

(b) listed species in Protection of Endangered Species of Animals and Plants Ordinance (Cap 586);

(c) listed species in AFCD's Rare and Precious Plants of Hong Kong;

(d) rare species listed in Corlett's study Hong Kong Vascular Plants: Distribution and Status;

(e) listed in China Red Data Book: (e)EX: Extinct; (e)EW: Extinct in the wild; (e)CR: Critically Endangered; (e)EN: Endangered; (e)VU: Vulnerable; (e)NT: Near Threatened; (e)LC: Least Concern;

(f) listed in IUCN 2008: (f)EX: Extinct; (f)EW: Extinct in the wild; (f)CR: Critically Endangered; (f)EN: Endangered; (f)VU: Vulnerable; (f)NT: Near Threatened; (f)LC: Least Concern.

(3) Abundance: +++=abundant; ++=fairly abundant; +=low abundance

(4) Species were recorded on slopes and exposed areas of the reservoir

Table G-2 Status of Mammals Recorded within the Study Area (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	Status^	Distribution*	Protection*
Rhesus Macaque	*Macaca mulatta*	Common	Widely distributed	Cap.170; Cap.586; IUCN - Lower Risk/Near Threatened; CRDB - Vulnerable
East Asian Porcupine	*Hystrix brachyura*	Very Common	Widely distributed	Cap.170; IUCN - Vulnerable

Note:

^Status follows Shek, C.T., Chan, C.S.M. and Wan, Y.F. (2007). Camera Trap Survey of Hong Kong Terrestrial Mammals in 2002-2006. Hong Kong Biodiversity Newsletter 15:1-11. Agriculture, Fisheries and Conservation Department, HKSAR.

*Distribution and Protection follows Shek, C.T. (2006). A Field Guide to the Terrestrial Mammals of Hong Kong. Agriculture, Fisheries and Conservation Department HKSAR, Friends of the Country Parks, Cosmos Books Ltd., Hong Kong.

(Cap.170 - Wild Animals Protection Ordinance; Cap. 586 - Protection of Endangered Species of Animals and Plants Ordinance; CRDB - China Red Data Book)

Table G-3a Bird Species Recorded within Butterfly Valley (abstracted from ERM, 1999)

Common Name	Scientific Name	Wet Season	Dry Season	Conservation Status / Level of Concern
Cattle Egret	*Bubulcus ibis*	√		Local Concern
Black Kite	*Milvus migrans*	√		Regional Concern
Spotted Dove	*Streptopelia chinensis*	√	√	
Grey Wagtail	*Motacilla alba*	√		
Crested Bulbul	*Pycnonotus jocosus*	√	√	
Chinese Bulbul	*Pycnonotus sinensis*	√	√	
Violet Whilsting Thrush	*Myiophoneus caeruleus*	√		
Yellow-bellied Warbler	*Phylloscopus inornatus*	√	√	
Long-tailed Tailor Bird	*Orthotomus sutorius*	√		
Hawamei	*Garrulax canorus*	√		
Grest Tit	*Parus major*	√	√	
Japanese White Eye	*Zosterops japonica*	√	√	
Flower Pecker spp	*Diaeum spp.*	√		
Large-billed Crow	*Corvus macrohynchus*	√		
Common Tailor Bird	*Orthotomus sutorius*		√	
Tree Sparrow	*Passer montanus*		√	
Black-faced Laughingthrush	*Garrulax perspicillatus*		√	
Blue magpie	*Urocissa erythrorhy*		√	
Magpie	*Pica pica*		√	
Greater Coucal	*Centropus sinensis*		√	Listed as Vulnerable in China Red Data Book
Grey-backed Thrush	*Turdus hortulorum*		√	
Fork-tailed Sunbird	*Aethopyga christinae*		√	
Buzzard	*Buteo buteo*		√	
Rufous-backed Shrike	*Lanius schach*		√	

Table G-3b Status and Abundance of Bird Species Recorded within the Point Count Location (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	WL	GL	S	R	DA	Principal Status^	Conservation Status / Level of Concern	Commonness and Distribution*
Black Kite	*Milvus migrans*	5					W, R	Regional Concern	CW
Spotted Dove	*Streptopelia chinensis*	20					R		CW
Yellow Wagtail	*Motacilla flava*				1		M,W		CL
White Wagtail	*Motacilla alba*				10	2	W, R		CW
Red-whiskered Bulbul	*Pycnonotus jocosus*	29				6	R		CW
Chinese Bulbul	*Pycnonotus sinensis*	23					R		CW
Long-tailed Shrike	*Lanius schach*				1		R		CW
Oriental Magpie Robin	*Copsychus saularis*	1				1	R		CW
Black-throated Laughingthrush	*Garrulax chinensis*	3					R		R
Hwamei	*Garrulax canorus*	4					R		CL
Yellow-bellid Prinia	*Prinia flaviventris*	1					R		CW
Pale-legged Leaf Warbler	*Phylloscopus tenellipes*	11					AM		R
Red-throated Flycatcher	*Ficedula albicilla*	2					AM, W		R
Great Tit	*Parus major*	2					R		CW
Japanese White-eye	*Zosterops japonica*	2					R, ?W		CW
Large-billed Crow	*Corvus macrohynchus*	3	1				R		CW
Total Birds		**106**	**1**	**0**	**12**	**9**			
Total Species		**13**	**1**	**0**	**3**	**3**			

^ Principal Status: R - Resident; W - Winter visitor; Su - Summer; M - Migrant; AM - Autumn migrant; P - Present all year, exact compostion unknown; ?W - Increased number in winter.

Principal status follows: Carey, G.J., Chalmers, M.L., Diskin, D.A., Kennerley, P.R., Leader, P.J., Leven, M.R., Lewthwaite, R.W., Melville, D.S., Turnbull, M., and Yound, L.(2001): The Avifauna of Hong Kong. Hong Kong Bird Watching Society, Hong Kong.

* Commonness and Distribution: CW - Common and widespread; CL - Local but not uncommon; R - Very local or rare

Habitats: WL - Secondary Woodland / Plantation; GL - Grassland; S - Stream / Drainage Channel; R - Reservoir; DA - Develped Area / Bare Ground

Table G-3c Bird Species Recorded in Each Location within the Study Area (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	Location	Principal Status^	Conservation Status / Level of Concern	Commonness and Distribution*
Common Kingfisher	*Alcedo atthis*	KBR	AM,P		CW
Common Teal	*Anas crecca*	KRR	W	Regional Concern	CL
Oriental Magpie Robin	*Copsychus saularis*	KSCP, KS-1	R		CW
Large-billed Crow	*Corvus macrohynchus*	LSM-2, LSM-6, KS-2, KS-5, KBR	R		CW
Black Drongo	*Dicrurus macrocercus*	KBR	M,Su		CW
Red-throated Flycatcher	*Ficedula albicilla*	KS-1	AM,W		R
Hwamei	*Garrulax canorus*	LSM-2, LSM-3, KS-3, KBR	R		CL
Black-throated Laughingthrush	*Garrulax chinensis*	KS-3	R		R
Masked Laughingthrush	*Garrulax perspicillatus*	KSCP	R		CW
Long-tailed Shrike	*Lanius schach*	LSM-4, LSMR	R		CW
Black Kite	*Milvus migrans*	LSM-2, KS-2, KS-4, KS-5, KSCP, KBR	W,R	Regional Concern	CW
White Wagtail	*Motacilla alba*	LSM-1, LSM-4, LSM-5, KBR	W,R		CW
Grey Wagtail	*Motacilla cinerea*	KBR	W		CW
Yellow Wagtail	*Motacilla flava*	LSM-4	M,W		CL
Asian Brown Flycatcher	*Muscicapa dauurica*	KBR	M,W		CL
Common Tailorbird	*Orthotomus sutorius*	KBR	R		CW
Great Tit	*Parus major*	KS-1	R		CW
Pale-legged Leaf Warbler	*Phylloscopus tenellipes*	LSM-2, LSM-3, LSM-7, KS-4, LSMR	AM		R
Yellow-bellid Prinia	*Prinia flaviventris*	KS-4	R		CW
Red-whiskered Bulbul	*Pycnonotus jocosus*	KS-1, KS-2, KS-5, LSM-3, LSM-6, LSMR, KBR, KSCP	R		CW
Chinese Bulbul	*Pycnonotus sinensis*	LSM-4, LSM-7, KS-1, KS-2, KS-4, LSMR, KBR, KSCP	R		CW

Common Name	Scientific Name	Location	Principal Status^	Conservation Status / Level of Concern	Commonness and Distribution*
Rufous-capped Babbler	*Stachyris ruficeps*	KSCP	R	Local Concern	Scarce resident of captive origin
Spotted Dove	*Streptopelia chinensis*	KS-1, KS-2, KS-5, LSM-3, KBR, KSCP, LRCP	R		CW
Japanese White-eye	*Zosterops japonica*	KS-2, KSCP, LSMR	R,?W		CW

^ Principal Status: R - Resident; W - Winter visitor; Su - Summer; M - Migrant; AM - Autumn migrant; P - Present all year, exact composition unknown; ?W - Increased number in winter.

Principal status follows: Carey, G.J., Chalmers, M.L., Diskin, D.A., Kennerley, P.R., Leader, P.J., Leven, M.R., Lewthwaite, R.W., Melville, D.S., Turnbull, M., and Young, L.(2001): The Avifauna of Hong Kong. Hong Kong Bird Watching Society, Hong Kong.

* Commonness and Distribution: CW - Common and widespread; CL - Local but not uncommon; R - Very local or rare

Location: LSMR - Lower Shing Mun Reservoir; KSCP - Kam Shan Country Park; KBR - Kowloon Byewash Reservoir; KRR - Kowloon Reception Reservoir; LRCP - Lion Rock Country Park.

Table G-4a Herpetofauna Recorded within the Study Area (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	Location	Conservation Status/ Level of Concern	Commonness and Distribution*
Chinese Gecko	*Gekko chinensis*	Kam Shan Country Park		VC
Grass Lizard	*Takydromus sexlineatus ocellatus*	Kam Shan Country Park		UC
Red-eared Slider	*Trachemys scripta elegans*	Kowloon Byewash Reservoir		Introduced species well established in several reservoirs
Asian Common Toad	*Bufo melanostictus*	Kam Shan Country Park		A
Lesser Spiny Frog	*Rana exillispinosa*	KS-5, Kam Shan Country Park	Potential Global Concern	C

* Commonness and Distribution: A - Abundant; VC - Very Common; C - Common; UC - Uncommon (Karsen et al., 1998)

Table G-4b Status and Abundance of Herpetofauna Recorded within the Study Area (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	WL	GL	S	R	DA	Conservation Status/ Level of Concern	Commonness and Distribution*
Chinese Gecko	*Gekko chinensis*					3		VC
Grass Lizard	*Takydromus sexlineatus ocellatus*					1		UC
Red-eared Slider	*Trachemys scripta elegans*				3			Introduced species well established in several reservoirs
Asian Common Toad	*Bufo melanostictus*					18		A
Lesser Spiny Frog	*Rana exillispinosa*			27			Potential Global Concern	C
Total Herpetofauna		**0**	**0**	**27**	**3**	**22**		
Total Species		**0**	**0**	**1**	**1**	**3**		

* Commonness and Distribution: A - Abundant; VC - Very Common; C - Common; UC - Uncommon (Karsen et al., 1998)

Habitats: WL - Secondary Woodland / Plantation; GL - Grassland; S - Stream / Drainage Channel; R - Reservoir; DA - Developed Area / Bare Ground

Table G-5a Abundance and Commonness of Butterfly Species Recorded within the Point Count Location (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	WL	GL	S	R	DA	Commonness and Distribution*	Conservation Status / Level of Concern
Hesperiidae								
Tree Flitter	*Hyarotis adrastus*		1				UC	--
Papilionidae								
Common Mormon	*Papilio polytes*	11	5	1	2		VC	--
Great Mormon	*Papilio memnon*	1	3	1			VC	--
Paris Peacock	*Papilo paris*	5	1				VC	--
Pieridae								
Red-base Jezebel	*Delias pasithoe*	99	14	23	18	8	VC	--
Indian Cabbage White	*Pieris canidia*	1		2	1	1	VC	--
Common Grass Yellow	*Eurema hecabe*	10	6	13	11	2	VC	--
Lycaenidae								
Slate Flash	*Rapala manea*					1	C	--
Common Hedge Blue	*Acytolepis puspa*					4	C	--
Riodinidae								
Punchinello	*Zemeros flegyas*		1				C	--
Plum Judy	*Abisara echerius*		2	3	1		VC	--
Banded Tree Brown	*Lethe confusa*		1				VC	--
Dark Brand Bush Brown	*Mycalesis mineus*	1	4	12			VC	--
Common Five-ring	*Ypthima baldus*		2				VC	--
Straight Five-ring	*Ypthima lisandra*	1			1		C	--
Amathusiidae								
Large Faun	*Faunis eumeus*	1					C	--
Nymphalidae								
Rustic	*Cupha erymanthis*	2	2	4			VC	--
Great Eggfly	*Hypolimnas bolina*	1	3		1		VC	

Common Name	Scientific Name	WL	GL	S	R	DA	Commonness and Distribution*	Conservation Status / Level of Concern
Common Sailer	*Neptis hylas*	6	2	1	1		VC	--
Southern Sullied Sailer	*Neptis clinia*		2				C	--
Staff Sergeant	*Athyma selenophora*	1	1				C	--
Common Mapwing	*Cyrestis thyodamas*			1			C	--
Danaidae								
Glassy Tiger	*Parantica aglea*		2	5			VC	--
Ceylon Blue Glassy Tiger	*Ideopsis similis*	5		6	12		VC	--
Common Tiger	*Danaus genutia*		2		12		VC	--
Blue Spotted Crow	*Euploea midamus*	2	2	4	6		VC	--
Common Indian Crow	*Euploea core*				1		VC	--
Total Butterflies		**43**	**33**	**41**	**29**	**4**		
Total Species		**11**	**13**	**8**	**7**	**3**		

Habitats: WL - Secondary Woodland / Plantation; GL - Grassland; S - Stream / Drainage Channel; R - Reservoir; DA - Developed Area / Bare Ground

* Commonness and Distribution: UC - Uncommon; C - Common; VC - Very Common (Young and Yiu, 2002)

Table G-5b Butterfly Species Recorded in each Location within the Study Area (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	Location	Commonness and Distribution*	Conservation Status / Level of Concern
Hesperiidae				
Tree Flitter	*Hyarotis adrastus*	LSM-2	UC	--
Formosan Swift	*Borbo cinnara*	KSCP	C	--
Papilionidae				
Common Mime	*Chilasa clytia*	KBR	C	--
Common Mormon	*Papilio polytes*	KS-1, KS-2, KS-4, LSM-2, LSM-3, LSM-4, LSM-6	VC	--
Great Mormon	*Papilio memnon*	LSM-2, LSM-6, LSM-7	VC	--
Paris Peacock	*Papilo paris*	KS-1, KS-4, LSM-2, LSM-6, LSM-7, KSCP	VC	--
Pieridae				
Red-base Jezebel	*Delias pasithoe*	KS-1, KS-2, KS-3, KS-4, KS-5, LSM-1, LSM-2, LSM-3, LSM-4, LSM-5, LSM-6, LSM-7, KBR	VC	--
Indian Cabbage White	*Pieris canidia*	LSM-1, LSM-3, LSM-4, LSM-5, LSM-6, KBR	VC	--
Common Grass Yellow	*Eurema hecabe*	KS-1, KS-3, KS-4, KS-5, LSM-1, LSM-2, LSM-3, LSM-4 LSM-5, LSM-6, LSM-7	VC	--
Lycaenidae				
Slate Flash	*Rapala manea*	LSM-1	C	--
Pale Grass Blue	*Zizeeria maha*	KBR	C^	
Common Hedge Blue	*Acytolepis puspa*	LSM-1	C	--
Riodinidae				
Punchinello	*Zemeros flegyas*	LSM-2	C	--
Plum Judy	*Abisara echerius*	LSM-2, LSM-3, LSM-5, LSM-6, KSCP, LSMR	VC	--
Banded Tree Brown	*Lethe confusa*	LSM-2	VC	--
Bamboo Tree Brown	*Lethe europa*	KSCP	C	--
Dark-brand Bush Brown	*Mycalesis mineus*	LSM-2, LSM-6, LSM-7, KS-5	VC	--
Common Five-ring	*Ypthima baldus*	LSM-2	VC	--
Straight Five-ring	*Ypthima lisandra*	KS-1, KS-4, KSCP, LSMR	C	--
Amathusiidae				
Large Faun	*Faunis eumeus*	KS-2, KSCP	C	--
Nymphalidae				
Rustic	*Cupha erymanthis*	LSM-2, LSM-6	VC	--

Common Name	Scientific Name	Location	Commonness and Distribution*	Conservation Status / Level of Concern
Great Eggfly	*Hypolimnas bolina*	LSM-2, LSM-5, LSM-6	VC	--
Common Sailer	*Neptis hylas*	LSM-2, LSM-3, LSM-6, KS-2, KS-4	VC	--
Southern Sullied Sailer	*Neptis clinia*	LSM-2	C	--
Staff Sergeant	*Athyma selenophora*	LSM-2, KS-1	C	--
Common Mapwing	*Cyrestis thyodamas*	LSM-6, LSMR	C	--
Danaidae				
Glassy Tiger	*Parantica aglea*	LSM-2, LSM-6	VC	--
Ceylon Blue Glassy Tiger	*Ideopsis similis*	LSM-3, LSM-4, LSM-5, LSM-6, KS-2, KS-3, KS-5	VC	--
Common Tiger	*Danaus genutia*	LSM-2, LSM-3, LSM-4, LSM-5	VC	--
Blue Spotted Crow	*Euploea midamus*	LSM-2, LSM-3, LSM-4, LSM-5, LSM-6, KBR	VC	--
Common Indian Crow	*Euploea core*	LSM-5, LSMR	VC	--

* Commonness and Distribution: UC - Uncommon; C - Common; VC - Very Common (Young and Yiu, 2002)

^ Status follows AFCD Hong Kong Biodiversity Database:
<http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/search.asp>

Location: LSMR - Lower Shing Mun Reservoir; KSCP - Kam Shan Country Park; KBR - Kowloon Byewash Reservoir; KRR - Kowloon Reception Reservoir; LRCP - Lion Rock Country Park.

Table G6a Abundance and Commonness of Dragonfly Species Recorded within the Point Count Location (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	WL	GL	S	R	DA	Commonness and Distribution*
Crimson Darter	*Crocothemis servilla servilla*					5	A
Common Blue Skimmer	*Orthetrum glaucum*	1		6	2		A
Wandering Glider	*Pantala flavescens*	32	8	2	8	8	A
Black Threadtail	*Prodasineura autumnalis*			1			A
Saddlebag Glider	*Tramea virginia*			2			C
Crimson Dropwing	*Trithemis aurora*				8		A
Indigo Dropwing	*Trithemis festiva*			5			A
Total Dragonflies		**33**	**8**	**16**	**18**	**13**	
Total species		**2**	**1**	**5**	**3**	**2**	

* Commonness and Distribution: A - Abundent; C - Common (Wilson, 2003)

Habitats: WL - Secondary Woodland / Plantation; GL - Grassland; S - Stream / Drainage Channel; R - Reservoir; DA - Developed Area / Bare Ground

Table G6b Dragonfly Species Recorded in each Location within the Study Area (25, 31 October 2007; 3, 5, 14 December 2007; 11, 15 January 2008)

Common Name	Scientific Name	Location	Commonness and Distribution*
Crimson Darter	*Crocothemis servilla servilla*	LSM-1	A
Common Blue Skimmer	*Orthetrum glaucum*	LSM-4, LSM-5, KS-1, KBR, KSCP	A
Wandering Glider	*Pantala flavescens*	LSM-1, LSM-2, LSM-3, LSM-4, LSM-5, LSM-7, KS-4, KS-5, KBR, LSCP	A
Black Threadtail	*Prodasineura autumnalis*	LSM-5	A
Saddlebag Glider	*Tramea virginia*	LSM-5	C
Crimson Dropwing	*Trithemis aurora*	LSM-4	A
Indigo Dropwing	*Trithemis festiva*	LSM-5, LSM-6	A

* Commonness and Distribution: A - Abundent; C - Common (Wilson et al., 2003)

Location: LSMR - Lower Shing Mun Reservoir; KSCP - Kam Shan Country Park; KBR - Kowloon Byewash Reservoir; KRR - Kowloon Reception Reservoir; LRCP - Lion Rock Country Park.

Table G7a Status and Abundance of Aquatic Fauna Recorded within the Survey Point (Stream tributaries: 25, 31 October and 3, 14 December 2007; Reservoirs: 13 November and 17 December 2007)

Common Name	Scientific Name	S	R	Conservation Status / Level of Concern	Commonness and Distribution*
Freshwater Shrimp	*Caridina cantonensis*	5			C^
Water Skater	*Ptilomera tigrina*	3			C^
Mosquito Fish	*Gambusia affinis*		23		C*
Jewel Fish	*Hemichromis stellifer*		129		Aquarium fish occurs in large number in a few local reservoirs*
Nile Tilapia	*Oreochromis niloticus*		1		C*
Flat-headed Loach	*Oreonectes platycephalus*	15			C*
Predaceous Chub	*Parazacco spilurus*		37	Listed as Vulnerable in China Red Data Book	C*
Chinese Half-striped	*Puntius semifasciolatus*		2		C*
Rose Bitterling	*Rhodeus ocellatus*		2	Local Concern	R*
Tilapia Joka	*Tilapia joka*		4		Introduced species*
Redbelly Tilapia	*Tilapia zillii*		140		C*
Total Aquatic Fauna		**23**	**338**		
Total species		**3**	**8**		

Commonness and Distribution: C - Common; R - Rare (*Lee et al., 2004; ^Dudgeon, 2003)

Habitats: S - Stream / Drainage Channel; R - Reservoir

Table G7b Aquatic Fauna Recorded in each Location within the Study Area (Stream tributaries: 25, 31 October and 3, 14 December 2007; Reservoirs: 13 November and 17 December 2007)

Common Name	Scientific Name	Location	Conservation Status / Level of Concern	Commonness and Distribution
Freshwater Shrimp	*Caridina cantonensis*	AF-3, AF-7		C^
Water Skater	*Ptilomera tigrina*	AF-2		C^
Freshwater Mussel	*Anodonta woodiana*	AF-6		--
Mosquito fish	*Gambusia affinis*	AF-6, AF-8, AF-9		C*
Jewel fish	*Hemichromis stellifer*	AF-4, AF-5, AF-6, AF-8, AF-9		Aquarium fish occurs in large number in a few local reservoirs*
Nile Tilapia	*Oreochromis niloticus*	AF-5		C*
Flat-headed Loach	*Oreonectes platycephalus*	AF-7		C*
Predaceous Chub	*Parazacco spilurus*	AF-6, AF-8, AF-9	Listed as Vulnerable in China Red Data Book	C*
Chinese Half-striped	*Puntius semifasciolatus*	AF-8		C*
Rose Bitterling	*Rhodeus ocellatus*	AF-6	Local Concern	R*
Tilapia Joka	*Tilapia joka*	AF-4, AF-5		Introduced species*
Redbelly tilapia	*Tilapia zillii*	AF-5, AF-6, AF-8		C*

Commonness and Distribution: C - Common; R - Rare (*Lee et al., 2004; ^Dudgeon, 2003)

Location: AF-1 to AF-9 = Aquatic Fauna survery locations within the Study Area, shown in Figure 8.1.

Appendix H
Plates

Plate 8.1 Secondary Woodland / Plantation

Plate 8.2 Grassland

Plate 8.3 Stream / Drainage Channel

Plate 8.4 Reservoir

Plate 8.5 Developed Area / Bare Ground

Plate 8.6 Rhesus Macaque recorded in Kam Shan Country Park

Plate 8.7 Scat of East Asian Porcupine

Plate 8.8 Chinese Gecko

Plate 8.9 Asian Common Toad

Plate 8.10 Red-eared Slider stained with red paint

Plate 8.11 Tadpole of Lesser Spiny Frog

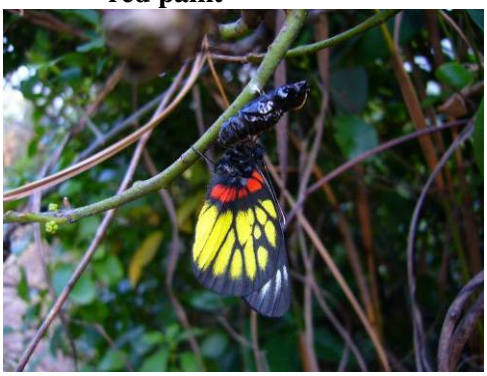


Plate 8.12 Emergence of adult Red-base Jezebel from pupa

Plate 8.13 Dead mussel *Anodonta woodiana*

Appendix I
Preliminary Tree Survey Schedule

INDICATIVE TUNNEL EXCAVATION LINES
(MAIN TUNNEL)

CHANNEL TO BE TEMPORARILY COVERED

INTAKE CONNECTION TUNNEL

KAM SHAN COUNTRY PARK
GN2685

PROPOSED LOCATION OF INTAKE
STRUCTURE AND INSOLATION SYSTEM

Picnic Site

九龍副水塘
KOWLOON BYEWASH RESERVOIR

0 5 10 15 20 25 M
1:200 SCALE BAR

LEGEND:

- WORKSITE AREA
- T55 TREES TO BE RETAINED
- T209 TREES TO BE FELLED
- T26 DEAD TREE

Rev	Date	Drawn	Description	Ch'k'd	App'd

Client

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Project

Agreement No. CE55/2006(EP)
Inter-reservoirs Transfer Scheme (IRTS)
Water Tunnel between Kowloon Byewash
Reservoir and Lower Shing Mun Reservoir
Environmental Impact Assessment
Investigation

Title

TREE RECOMMENDATION PLAN
(SOUTHERN PORTAL)

Designed			Eng.Chk.		
Drawn			Coordination		
Dwg.Chk.			Approved		

Scale 1:200@A0	Project	Status
	CAD File	
Drawing No. MTCL03A/TR01		Rev

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T002	*Acacia confusa*	台灣相思	0.75	7	5		1			1						1			1	1		1			128.78		
T004	*Celtis sinensis*	朴樹	0.79	8	9		1			1						1			1	1		1			128.07		
T005	*Acacia confusa*	台灣相思	1.07	10	6		1		1							1			1	1		1			128.79		Leaning
T006	*Acacia confusa*	台灣相思	0.82	4	8			1			1						1		1	1		1			128.43		Horizontal growth
T007	*Celtis sinensis*	朴樹	0.63	7	4		1			1						1			1	1		1			128.32		
T008	*Schefflera heptaphylla*	鴨腳木	0.44	3	4			1	1							1			1	1		1			128.43		On slope
T009	*Acacia confusa*	台灣相思	1.13	9	7		1		1							1			1	1		1			128.10		Leaning
T010	*Acacia confusa*	台灣相思	0.79	8	6		1		1							1			1	1		1			128.32		
T011	*Acacia confusa*	台灣相思	0.53	6	5		1			1						1			1	1		1			128.38		
T012	*Schefflera heptaphylla*	鴨腳木	0.38	7	5	1			1							1			1	1		1			128.27		
T013	*Celtis sinensis*	朴樹	0.75	7	5		1		1							1			1	1		1			127.84		On slope
T014	*Bridelia tomentosa*	土蜜樹	0.35	6	4		1		1							1			1	1		1			128.82		
T015	*Celtis sinensis*	朴樹	0.53	5	4		1			1						1			1	1		1			126.54		On slope
T016	*Artocarpus hypargyreus*	白桂木	0.69	6	3	1				1						1			1	1		1			128.25		
T017	*Celtis sinensis*	朴樹	0.69	6	4		1			1						1			1	1		1			128.24		
T018	*Celtis sinensis*	朴樹	0.63	8	4		1			1						1			1	1		1			127.98		
T019	*Ficus hispida*	對葉榕	0.60	8	4		1			1							1		1	1		1			127.34		
T020	*Celtis sinensis*	朴樹	0.57	6	7			1		1							1		1	1		1			127.33		
T021	*Acacia confusa*	台灣相思	1.23	8	10			1		1						1			1	1		1			127.03		Leaning on slope
T022	*Acacia confusa*	台灣相思	1.07	8	9			1		1						1			1	1		1			127.39		Leaning on slope
T023	*Acacia confusa*	台灣相思	0.60	4	5			1		1						1			1	1		1			126.65		Leaning on slope
T024	*Acacia confusa*	台灣相思	0.82	10	6	1			1						1				1	1		1			127.16		
T025	*Gordonia axillaris*	大頭茶	0.71	7	6	1			1						1				1	1		1			128.00		
T026	*Tree Cut Off (Delonix regia)*	鳳凰木	-	-	-							1													128.24		Cut off by others
T027	*Pinus elliottii*	愛氏松	0.85	10	6	1			1						1				1	1		1			125.70		
T028	*Pinus elliottii*	愛氏松	0.94	10	5	1			1						1				1	1		1			125.25		
T029	*Pinus elliottii*	愛氏松	0.88	10	5	1			1						1				1	1		1			125.17		
T030	*Celtis sinensis*	朴樹	0.75	7	4	1				1						1			1	1		1			125.59		In planter
T031	*Delonix regia*	鳳凰木	0.97	7	4	1				1						1			1	1		1			125.57		In planter
T032	*Acacia confusa*	台灣相思	1.04	7	5		1			1						1			1	1		1			125.50		In planter
T033	*Bauhinia variegata*	白花羊蹄甲	0.94	5	6	1			1						1				1	1		1			125.47		In planter
T034	*Acacia mangium*	大葉相思	0.31	4	3	1			1						1				1	1		1			125.51		In planter
T035	*Phyllanthus emblica*	油甘子	0.69	4	4	1			1						1				1	1		1			125.55		In planter
T036	*Aporusa dioica*	銀柴	0.75	6	4	1			1							1			1	1		1			125.15		
T037	*Eucalyptus robusta*	大葉桉	1.45	10	6	1			1						1				1	1		1			125.55		In planter
T038	*Eucalyptus robusta*	大葉桉	1.04	11	4	1				1						1			1	1		1			125.67		Branch dieback
T039	*Eucalyptus robusta*	大葉桉	0.91	7	2		1			1						1			1	1		1			125.89		In planter
T040	*Ficus microcarpa*	細葉榕	0.79	9	10	1			1						1				1	1		1			126.18		In planter
T041	*Acronychia pedunculata*	山油柑	0.47	6	4	1				1						1			1	1		1			125.37		
T042	*Schefflera heptaphylla*	鴨腳木	0.75	5	4	1			1						1				1	1		1			125.39		
T043	*Sapindus saponaria*	無患子	0.63	5	4	1				1						1			1	1		1			124.86		
T044	*Phyllanthus emblica*	油甘子	0.85	5	6	1			1							1			1	1		1			125.26		
T045	*Schefflera heptaphylla*	鴨腳木	1.30	11	8	1			1						1				1	1		1			125.28		
T046	*Phyllanthus emblica*	油甘子	0.63	5	5	1			1							1			1	1		1			125.88		
T047	*Citrus maxima*	柚	0.75	6	5	1			1						1				1	1		1			126.09		
T048	*Schima superba*	木荷	0.81	7	5	1			1						1				1	1		1			126.32		
T049	*Schefflera heptaphylla*	鴨腳木	0.72	6	5		1		1							1			1	1		1			124.67		
T050	*Sapindus saponaria*	無患子	0.99	9	8	1			1						1				1	1		1			124.19		
T051	*Litchi chinensis*	荔枝	0.79	5	8			1		1						1			1	1		1			126.32		Leaning on slope
T052	*Celtis sinensis*	朴樹	0.44	7	5		1			1						1			1	1		1			128.29		tree covered by *Gnetum luofuense*
T053	*Mallotus paniculatus*	白楸	0.44	6	4		1			1						1			1	1		1			126.30		
T054	*Schefflera heptaphylla*	鴨腳木	0.44	4	4		1		1							1			1	1		1			125.83		
T055	*Celtis sinensis*	朴樹	0.72	8	6	1			1						1				1	1		1			125.22		
T056	*Bridelia tomentosa*	土蜜樹	0.38	6	5			1			1						1		1	1		1			125.34		Leaning
T057	*Schefflera heptaphylla*	鴨腳木	0.47	6	7		1		1							1			1	1		1			125.28		
T058	*Celtis sinensis*	朴樹	0.57	7	6		1			1						1			1	1		1			125.35		
T059	*Bauhinia variegata*	宮粉羊蹄甲	0.91	7	8			1			1						1		1	1		1			125.13		Falling
T060	*Antirhea chinensis*	毛茶	0.38	6	4		1			1						1			1	1		1			125.70		
T061	*Aporusa dioica*	銀柴	0.35	4	5			1		1						1			1	1		1			125.22		Leaning on slope
T062	*Bridelia tomentosa*	土蜜樹	0.31	4	3			1			1						1		1	1		1			124.84		Branch dieback
T063	*Aporusa dioica*	銀柴	0.30	6	4			1		1							1		1	1		1			124.70		
T064	*Litsea rotundifolia*	豺皮樟	0.35	6	3		1			1							1		1	1		1			125.42		
T065	*Sterculia lanceolata*	假蘋婆	0.79	7	5	1			1						1				1	1		1			124.92		

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T066	*Celtis sinensis*	朴樹	1.26	8	10	1			1						1				1	1		1			125.27		
T067	*Celtis sinensis*	朴樹	0.53	7	5		1			1						1			1	1		1			125.18		On tree hole
T068	*Bauhinia variegata*	白花羊蹄甲	0.31	5	6			1		1						1			1	1		1			125.04		Basal forking. On tree hole
T069	*Celtis sinensis*	朴樹	0.72	7	6	1			1							1			1	1		1			125.01		On tree hole
T070	*Bauhinia variegata*	宮粉羊蹄甲	1.48	10	9	1			1						1				1	1		1			125.05		
T071	*Bauhinia variegata*	宮粉羊蹄甲	1.13	10	8	1			1						1				1	1		1			124.81		On slope
T072	*Dimocarpus longan*	龍眼	0.41	5	5	1			1							1			1	1				1	125.08	B, C, D	
T073	*Cratoxylum cochinchinense*	黃牛木	0.66	7	4		1			1						1			1	1		1			122.14		On slope & tree hole
T074	*Schefflera heptaphylla*	鴨腳木	0.53	8	7	1			1							1			1	1		1			121.87		
T075	*Schefflera heptaphylla*	鴨腳木	0.44	5	4		1		1							1			1	1		1			124.44		On slope
T076	*Litsea glutinosa*	潺槁	0.53	5	3		1		1							1			1	1		1			121.43		On slope & tree hole
T077	*Archidendron lucidum*	亮葉猴耳環	0.50	5	3		1			1							1		1	1		1			121.89		On slope & tree hole
T078	*Schefflera heptaphylla*	鴨腳木	0.35	4	3		1			1						1			1	1		1			122.52		Prunned
T078A	*Schefflera heptaphylla*	鴨腳木	0.31	2	1			1			1						1		1	1		1			119.72		On slope
T079	*Ficus hispida*	對葉榕	0.66	8	7	1			1							1			1	1		1			126.57		
T080	*Schefflera heptaphylla*	鴨腳木	0.63	6	4	1			1							1			1	1		1			129.13		
T080A	*Eucalyptus robusta*	大葉桉	0.57	6	3			1		1						1			1	1		1			129.13		
T081	*Eucalyptus robusta*	大葉桉	0.57	7	4			1			1						1		1	1		1			130.02		
T082	*Mangifera indica*	杧果	0.47	5	4	1			1							**1**			1	1		1			**131.22**		
T083	*Garcinia oblongifolia*	黃牙果	0.52	6	4		1		1							1			1	1		1			127.86		
T084	*Mallotus paniculatus*	白楸	0.75	8	6		1		1							1			1	1		1			127.64		
T085	*Antirhea chinensis*	毛茶	0.47	7	6		1		1							1			1	1		1			128.38		
T086	*Schefflera heptaphylla*	鴨腳木	0.47	7	5		1		1							1			1	1		1			128.13		
T088	*Eucalyptus robusta*	大葉桉	0.57	8	4		1			1						1			1	1		1			128.19		
T089	*Eucalyptus robusta*	大葉桉	0.79	8	4	1				1						1			1	1		1			128.33		
T090	*Mangifera indica*	杧果	0.53	6	4		1		1							1			1	1		1			127.08		
T091	*Eucalyptus robusta*	大葉桉	0.60	6	4		1		1							1			1	1		1			127.64		
T092	*Eurya sp.*	柃	0.31	4	3		1				1						1		1	1		1			127.52		
T093	*Antirhea chinensis*	毛茶	0.50	6	5	1			1							1			1	1		1			127.25		
T095	*Artocarpus hypargyreus*	白桂木	0.72	8	4	1				1						1			1	1		1			128.05		
T096	*Eucalyptus robusta*	大葉桉	0.94	10	4		1		1							1			1	1		1			127.75		
T097	*Aporusa dioica*	銀柴	0.38	6	4		1			1							1		1	1		1			127.00		
T098	*Sterculia lanceolata*	假蘋婆	0.44	6	5	1			1							1			1	1		1			126.81		
T099	*Eucalyptus robusta*	大葉桉	1.26	13	7	1			1						1				1	1		1			127.76		
T100	*Carallia brachiata*	竹節樹	0.44	7	4		1			1							1		1	1		1			128.21		
T101	*Acronychia pedunculata*	山油柑	0.57	8	7		1			1						1			1	1		1			128.71		
T102	*Bridelia tomentosa*	土蜜樹	0.41	4	3			1		1							1		1	1		1			126.69		
T103	*Schefflera heptaphylla*	鴨腳木	0.35	4	3			1		1						1			1	1		1			126.62		
T104	*Celtis sinensis*	朴樹	0.82	7	5		1			1						1			1	1		1			125.41		
T105	*Sterculia lanceolata*	假蘋婆	0.75	7	4		1		1							1			1	1		1			125.89		
T106	*Schefflera heptaphylla*	鴨腳木	0.31	5	3			1	1								1		1	1		1			126.59		
T107	*Eucalyptus robusta*	大葉桉	0.82	7	6	1				1						1			1	1		1			127.77		
T108	*Artocarpus hypargyreus*	白桂木	0.41	7	3	1			1							1			1	1		1			127.68		
T109	*Schefflera heptaphylla*	鴨腳木	0.31	5	3	1				1						1			1	1		1			125.77		
T110	*Mallotus paniculatus*	白楸	0.53	4	5			1			1						1		1	1		1			125.62		Leaning
T111	*Mallotus paniculatus*	白楸	0.50	3	5			1			1						1		1	1		1			125.54		
T112	*Schefflera heptaphylla*	鴨腳木	0.31	5	3			1		1							1		1	1		1			125.44		
T113	*Unidentified Tree Species*	未確認品種	0.44	6	4		1												1	1		1			125.66		Deciduous species. No leaves for identification during survey.
T114	*Acronychia pedunculata*	山油柑	0.44	5	5			1		1							1		1	1		1			124.92		
T115	*Acronychia pedunculata*	山油柑	0.63	8	7	1				1						1			1	1		1			126.37		
T116	*Schefflera heptaphylla*	鴨腳木	0.79	8	5		1			1						1			1	1		1			126.51		
T117	*Carallia brachiata*	竹節樹	0.63	12	7		1			1						1			1	1		1			127.23		
T118	*Acronychia pedunculata*	山油柑	0.76	9	7		1		1							1			1	1		1			126.78		
T119	*Artocarpus hypargyreus*	白桂木	0.60	8	4	1				1						1			1	1		1			125.88		
T120	*Artocarpus hypargyreus*	白桂木	0.41	8	5	1				1						1			1	1		1			125.97		
T121	*Acronychia pedunculata*	山油柑	0.56	6	4		1				1						1		1	1		1			126.18		Covered by climbers
T122	*Artocarpus hypargyreus*	白桂木	0.75	8	4		1		1							1			1	1		1			123.67		
T123	*Unidentified Tree Species*	未確認品種	0.53	9	4		1												1	1		1			125.07		Deciduous species. No leaves for identification during survey.
T124	*Artocarpus hypargyreus*	白桂木	0.47	5	6		1		1							1			1	1		1			123.58		
T125	*Mallotus paniculatus*	白楸	0.47	6	5		1			1						1			1	1		1			123.75		
T126	*Ficus variegata*	青果榕	2.01	13	10	1			1						1				1	1		1			124.34		Buttress roots developed.

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T127	*Celtis sinensis*	朴樹	1.85	13	9	1			1						1				1	1		1			124.35		
T128	*Sterculia lanceolata*	假蘋婆	0.66	5	4		1		1							1			1	1		1			124.89		
T129	*Aporusa dioica*	銀柴	0.47	5	4		1			1						1			1	1		1			125.26		
T130	*Celtis sinensis*	朴樹	1.70	10	10	1			1						1				1	1		1			124.52		
T131	*Sterculia lanceolata*	假蘋婆	0.53	5	5	1			1							1			1	1		1			124.39		
T132	*Artocarpus hypargyreus*	白桂木	0.30	5	4	1			1							1			1	1		1			124.08		
T133	*Schefflera heptaphylla*	鴨腳木	0.31	6	5		1		1							1			1	1		1			123.69		
T134	*Acronychia pedunculata*	山油柑	0.94	8	7	1			1							1			1	1		1			124.72		
T135	*Acronychia pedunculata*	山油柑	0.47	5	6			1			1						1		1	1		1			125.16		Leaning
T136	*Aporusa dioica*	銀柴	0.47	6	5			1		1							1		1	1		1			123.76		
T137	*Aporusa dioica*	銀柴	0.47	6	4		1			1						1			1	1		1			123.80		
T138	*Unidentified Tree Species*	未確認品種	0.75	6	5	1													1	1		1			126.38		Deciduous species. No leaves for identification during survey.
T139	*Schefflera heptaphylla*	鴨腳木	0.75	7	5		1		1							1			1	1		1			123.79		
T140	*Sterculia lanceolata*	假蘋婆	0.38	4	5		1		1							1			1	1		1			123.81		
T141	*Alangium chinense*	八角楓	0.35	5	4	1				1						1			1	1		1			124.52		
T142	*Acronychia pedunculata*	山油柑	0.60	4	5			1			1						1		1	1		1			124.28		Dieback
T143	*Mallotus paniculatus*	白楸	0.88	7	9			1	1							1			1	1		1			122.08		Leaning on slope
T144	*Aporusa dioica*	銀柴	0.47	3	4			1		1							1		1	1		1			123.52		Covered by climbers
T145	*Aporusa dioica*	銀柴	0.30	4	4		1			1						1			1	1		1			122.66		
T146	*Alangium chinense*	八角楓	0.44	4	5			1		1							1		1	1		1			119.61		Leaning
T147	*Alangium chinense*	八角楓	0.97	11	4	1				1						1			1	1		1			119.28		
T148	*Antidesma ghaesembilla*	方葉五月茶	0.47	5	4		1				1						1		1	1		1			120.32		
T149	*Sterculia lanceolata*	假蘋婆	0.47	6	5		1			1						1			1	1		1			120.76		
T150	*Ficus hispida*	對葉榕	0.85	8	7		1		1							1			1	1		1			120.60		
T151	Schefflera heptaphylla	鴨腳木	0.70	6	7		1			1						1			1	1		1			121.55		
T152	*Carallia brachiata*	竹節樹	0.38	6	3		1			1						1			1	1		1			121.55		
T153	*Sterculia lanceolata*	假蘋婆	0.57	3	4			1		1						1			1	1		1			122.08		
T154	*Ficus hispida*	對葉榕	0.60	7	4		1		1								1		1	1		1			122.44		
T155	*Schefflera heptaphylla*	鴨腳木	0.60	7	5		1			1						1			1	1		1			122.44		
T156	*Ficus hispida*	對葉榕	0.72	6	7		1		1							1			1	1		1			123.47		
T158	*Sterculia lanceolata*	假蘋婆	0.38	4	3	1			1							1			1	1		1			124.41		
T160	*Acronychia pedunculata*	山油柑	0.44	5	3		1		1							1			1	1		1			124.46		
T161	*Schefflera heptaphylla*	鴨腳木	0.44	5	5		1			1							1		1	1		1			126.16		
T162	*Sterculia lanceolata*	假蘋婆	0.82	9	7		1			1						1			1	1		1			126.83		
T163	*Mallotus paniculatus*	白楸	0.69	7	5			1			1						1		1	1		1			126.96		Trunk broken & root exposed
T164	*Sterculia lanceolata*	假蘋婆	0.66	5	6		1		1							1			1	1		1			126.04		
T165	*Schefflera heptaphylla*	鴨腳木	0.79	7	8		1		1							1			1	1		1			125.75		
T166	*Schefflera heptaphylla*	鴨腳木	0.66	8	7		1			1						1			1	1		1			125.86		
T167	*Eucalyptus robusta*	大葉桉	0.75	9	4		1			1						1			1	1		1			126.25		Covered by climbers
T168	*Pinus massoniana*	馬尾松	0.69	8	7		1				1						1		1	1		1			127.18		Branch dieback
T169	*Artocarpus hypargyreus*	白桂木	1.57	9	8		1		1							1			1	1		1			127.12		
T170	*Schefflera heptaphylla*	鴨腳木	0.82	5	7		1		1							1			1	1		1			126.40		
T172	*Rhus succedanea*	野漆	0.53	6	4		1			1						1			1	1		1			125.27		
T173	*Schefflera heptaphylla*	鴨腳木	0.79	7	6		1			1						1			1	1		1			125.59		Leaning
T174	*Schefflera heptaphylla*	鴨腳木	0.47	6	5		1		1							1			1	1		1			125.54		
T175	*Schefflera heptaphylla*	鴨腳木	0.72	8	6		1		1							1			1	1		1			123.72		
T176	*Schefflera heptaphylla*	鴨腳木	0.63	7	6		1		1							1			1	1		1			123.91		
T177	*Rhus succedanea*	野漆	0.47	7	5		1			1							1		1	1		1			123.80		Covered by climbers
T178	*Itea chinensis*	鼠刺	0.72	8	6		1			1							1		1	1		1			123.50		Upper trunk forking
T179	*Schefflera heptaphylla*	鴨腳木	0.44	5	4		1			1							1		1	1		1			122.82		
T180	*Carallia brachiata*	竹節樹	0.66	6	5		1		1							1			1	1		1			124.93		
T181	*Schefflera heptaphylla*	鴨腳木	0.66	7	5		1		1							1			1	1		1			124.25		
T182	*Schefflera heptaphylla*	鴨腳木	0.47	6	4			1			1						1		1	1		1			127.18		
T183	*Schefflera heptaphylla*	鴨腳木	0.53	7	5		1			1						1			1	1		1			123.72		
T184	*Schefflera heptaphylla*	鴨腳木	0.47	5	6			1			1						1		1	1		1			123.52		
T185	*Carallia brachiata*	竹節樹	0.44	5	5			1		1							1		1	1		1			123.52		
T186	*Schefflera heptaphylla*	鴨腳木	0.82	9	8	1			1						1				1	1		1			122.43		
T187	*Carallia brachiata*	竹節樹	0.60	9	4	1				1						1			1	1		1			122.81		
T188	*Schefflera heptaphylla*	鴨腳木	0.66	7	4		1		1							1			1	1		1			121.64		
T189	*Microcos paniculata*	布渣葉	0.41	5	4		1		1							1			1	1		1			120.76		
T190	*Schefflera heptaphylla*	鴨腳木	0.30	4	4		1			1						1			1	1		1			120.83		
T191	*Acronychia pedunculata*	山油柑	0.47	5	4			1	1							1			1	1				1	120.88	B, C, D	Leaning on slope

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T192	*Carallia brachiata*	竹節樹	0.35	6	3		1			1						1			1	1				1	121.53	B, C, D	
T193	*Sterculia lanceolata*	假蘋婆	0.57	6	3			1		1						1			1	1				1	121.23	B, C, D	
T194	*Acronychia pedunculata*	山油柑	0.35	4	3		1			1						1			1	1				1	121.23	B, C, D	
T195	*Acronychia pedunculata*	山油柑	0.51	4	5			1	1							1			1	1				1	122.21	B, C, D	Leaning
T196	*Aporusa dioica*	銀柴	0.35	4	4		1			1						1			1	1				1	123.87	B, C, D	Covered by climbers
T198	*Acronychia pedunculata*	山油柑	0.66	6	5		1			1						1			1	1				1	125.33	B, C, D	Covered by climbers
T199	*Aporusa dioica*	銀柴	0.44	5	4		1			1						1			1	1				1	124.30	B, C, D	
T200	*Artocarpus hypargyreus*	白桂木	0.60	6	5	1			1							1			1	1				1	123.61	B, C, D	
T201	*Rhus succedanea*	野漆	0.47	7	3		1			1						1			1	1				1	123.77	B, C, D	
T202	*Rhus succedanea*	野漆	0.75	5	3		1			1						1			1	1				1	123.48	B, C, D	Covered by climbers
T203	*Schefflera heptaphylla*	鴨腳木	0.53	4	3			1		1							1		1	1				1	123.98	B, C, D	Leaning on slope
T203A	*Bridelia tomentosa*	土蜜樹	0.38	3	3			1		1							1		1	1		1			123.50		Leaning on slope
T204	*Cratoxylum cochinchinense*	黃牛木	0.38	4	4		1			1						1			1	1				1	119.80	B, C, D	Dieback
T206	*Sterculia lanceolata*	假蘋婆	0.69	3	5			1			1						1		1	1				1	117.57	B, C, D	Leaning on slope. Tree trunck inter-crossed with T207
T207	*Aporusa dioica*	銀柴	0.44	5	4			1			1						1		1	1				1	116.55	B, C, D	Tree trunck inter-crossed with T206
T208	*Reevesia thyrsoidea*	梭羅樹	0.47	7	4		1			1						1			1	1		1			117.76		
T209	*Ficus hispida*	對葉榕	0.53	5	6		1		1							1			1	1		1			119.06		Leaning on slope
T210	*Acronychia pedunculata*	山油柑	0.31	4	4		1		1							1			1	1		1			117.86		
T211	*Schefflera heptaphylla*	鴨腳木	0.41	5	6			1		1							1		1	1		1			122.27		
T212	*Schefflera heptaphylla*	鴨腳木	0.44	7	4		1			1							1		1	1		1			123.15		
T213	*Schefflera heptaphylla*	鴨腳木	0.47	5	4		1			1							1		1	1		1			122.70		
T214	*Schefflera heptaphylla*	鴨腳木	0.50	7	4		1		1							1			1	1		1			121.97		
T215	*Carallia brachiata*	竹節樹	0.66	6	5		1			1							1		1	1		1			123.78		
T216	*Schefflera heptaphylla*	鴨腳木	0.44	6	5			1		1							1		1	1		1			123.78		Leaning
T217	*Schefflera heptaphylla*	鴨腳木	0.47	6	4		1		1							1			1	1		1			123.00		Covered by climbers
T218	*Schefflera heptaphylla*	鴨腳木	0.69	6	5		1		1							1			1	1		1			121.76		Leaning on slope
T219	*Schefflera heptaphylla*	鴨腳木	0.72	6	4		1		1							1			1	1		1			121.72		
T220	*Ormosia semicastrata*	軟莢紅豆	0.67	6	4		1			1						1			1	1		1			119.91		Multi-trunked
T221	*Ormosia semicastrata*	軟莢紅豆	0.40	6	4			1			1						1		1	1		1			118.00		
T222	*Schefflera heptaphylla*	鴨腳木	0.41	5	3		1		1							1			1	1		1			121.70		
T223	*Bridelia tomentosa*	土蜜樹	0.47	6	4		1			1						1			1	1		1			130.12		
T224	*Eucalyptus robusta*	大葉桉	0.50	6	5			1		1							1		1	1		1			130.07		Leaning
T225	*Eucalyptus robusta*	大葉桉	0.44	5	4			1			1						1		1	1		1			129.77		Leaning
T226	*Sterculia lanceolata*	假蘋婆	0.41	5	5		1		1							1			1	1		1			129.96		
T227	*Rhus succedanea*	野漆	0.47	6	3		1			1						1			1	1		1			131.10		
T228	*Eucalyptus robusta*	大葉桉	0.50	4	3		1			1						1			1	1		1			132.14		
T229	*Acronychia pedunculata*	山油柑	0.44	4	5			1		1							1		1	1		1			128.56		
T230	*Carallia brachiata*	竹節樹	0.44	5	3	1				1						1			1	1		1			129.85		
T231	*Antirhea chinensis*	毛茶	0.38	4	5		1				1						1		1	1		1			131.12		
T232	*Acronychia pedunculata*	山油柑	0.69	5	4			1		1							1		1	1		1			128.71		
T233	*Diospyros morrisiana*	羅浮柿	0.30	5	3			1		1							1		1	1		1			128.43		
T234	*Garcinia oblongifolia*	黃牙果	0.38	5	3		1		1							1			1	1		1			128.05		
T237	*Acronychia pedunculata*	山油柑	0.30	6	4		1				1					1			1	1		1			127.69		
T238	*Litesea rotundifolia*	豺皮樟	0.50	5	4			1		1							1		1	1		1			128.78		
T239	*Celtis sinensis*	朴樹	0.38	4	5		1			1							1		1	1				1	125.05	B, C, D	
T240	*Mallotus paniculatus*	白楸	0.66	5	7	1			1							1			1	1		1			125.81		
T241	*Ficus hispida*	對葉榕	0.69	5	4		1		1							1			1	1				1	125.05	B, C, D	
T242	*Schefflera heptaphylla*	鴨腳木	0.38	4	4		1			1						1			1	1		1			121.92		
T243	*Rhus succedanea*	野漆	0.57	7	6		1			1						1			1	1		1			122.72		
T244	*Celtis sinensis*	朴樹	1.54	11	10	1			1						1				1	1		1			121.92		
T246	*Cratoxylum cochinchinense*	黃牛木	0.36	3	2			1			1						1		1	1				1	123.23	B, C, D	Wilting
T247	*Bauhinia variegata*	宮粉羊蹄甲	0.35	4	4		1		1							1			1	1		1			122.65		On slope
T248	*Schefflera heptaphylla*	鴨腳木	0.47	4	4		1			1							1		1	1		1			120.57		On slope
T249	*Schefflera heptaphylla*	鴨腳木	0.44	5	4		1			1						1			1	1		1			119.27		On slope
T250	*Schefflera heptaphylla*	鴨腳木	0.38	4	4		1			1						1			1	1		1			118.89		On slope
T251	*Schefflera heptaphylla*	鴨腳木	0.47	4	3		1			1						1			1	1		1			118.48		
T252	*Schefflera heptaphylla*	鴨腳木	0.47	5	4		1			1							1		1	1		1			116.92		On slope
T253	*Celtis sinensis*	朴樹	0.85	6	4			1		1							1		1	1		1			117.48		Leaning on slope
T254	*Schefflera heptaphylla*	鴨腳木	0.57	4	3			1		1							1		1	1		1			116.90		On slope
T255	*Schefflera heptaphylla*	鴨腳木	0.47	4	4			1		1							1		1	1		1			119.47		On slope, leaning
T256	*Schefflera heptaphylla*	鴨腳木	0.47	4	4			1		1							1		1	1		1			119.67		On slope, leaning
T257	*Bauhinia variegata*	宮粉羊蹄甲	0.88	6	8		1			1						1			1	1		1			123.73		On slope

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T258	*Mallotus paniculatus*	白楸	0.35	4	4			1		1						1			1	1		1			128.48		Leaning
T259	*Schefflera heptaphylla*	鴨腳木	0.38	4	3	1			1							1			1	1		1			128.47		
T260	*Aporusa dioica*	銀柴	0.48	5	4	1			1							1			1	1		1			129.13		
T261	*Aporusa dioica*	銀柴	0.38	5	4			1			1						1		1	1		1			129.27		
T262	*Celtis sinensis*	朴樹	0.94	7	6		1		1							1			1	1		1			129.00		
T263	*Celtis sinensis*	朴樹	0.82	7	5		1			1						1			1	1		1			128.34		
T264	*Aporusa dioica*	銀柴	0.41	5	3		1		1							1			1	1		1			129.90		
T265	*Aporusa dioica*	銀柴	0.41	4	3		1		1							1			1	1		1			129.70		
T266	*Schefflera heptaphylla*	鴨腳木	0.60	5	4		1			1						1			1	1		1			127.45		
T267	*Mallotus paniculatus*	白楸	0.31	5	3			1		1						1			1	1		1			127.50		Trunk very close to T266
T268	*Litchi chinensis*	荔枝	0.63	5	4		1				1					1			1	1		1			126.50		Tree trunk twisted with *Gnetum luofuense*
T269	*Antirhea chinensis*	毛茶	0.41	5	3		1			1						1			1	1		1			125.69		
T270	*Artocarpus hypargyreus*	白桂木	0.47	5	3	1				1						1			1	1		1			125.70		
T271	*Acronychia pedunculata*	山油柑	0.38	4	3		1		1							1			1	1		1			121.19		On shotcrete
Summary Statistics						**66**	**137**	**58**	**107**	**125**	**26**	**1**	**0**	**0**	**26**	**169**	**63**	**0**	**261**	**261**	**0**	**242**	**0**	**19**			**261**
						25%	52%	22%	41%	48%	10%	0%	0%	0%	10%	65%	24%	0%	100%	100%	0%	93%	0%	7%			(plus 1 tree cut off)
						Good	**Aver**	**Poor**	**Good**	**Fair**	**Poor**	**Dead**	**A**	**B**	**C**	**D**	**E**	**Yes**	**No**	**Slope**	**Flat**	**Retain**	**Trans**	**Fell**			**Total**

The preliminary tree survey results would be subject to further change before the finalisation during tree felling application stage

Note: Trunk girth measured using the AFCD's Nature Conservation Practice for multitrunk trees

Legend

Tree Condition / Health

G Good
F Fair
P Poor
D Dead

Tree Form

G Good
F Fair
P Poor

Survival After Transplanting

Y Yes
N No

Amenity Value

A with cultural significance or high functional signficance or high visual impact ,or mature and good health, good condition and good form.
B with cultural significance or high functional signficance or high visual impact, or mature and poor health, poor condition and poor form.
C Common species and goood health, good condition and good form.
D Common species and average health, average condition and average form.
E Common species and little or no functional or visual value and poor health, poor condition and poor form.

Remarks

Trees with high conservation values such as rare or protected species or of Old and Valuable tree values or will be recorded in the remarks of the Tree Survey Schedule

Tree Girth

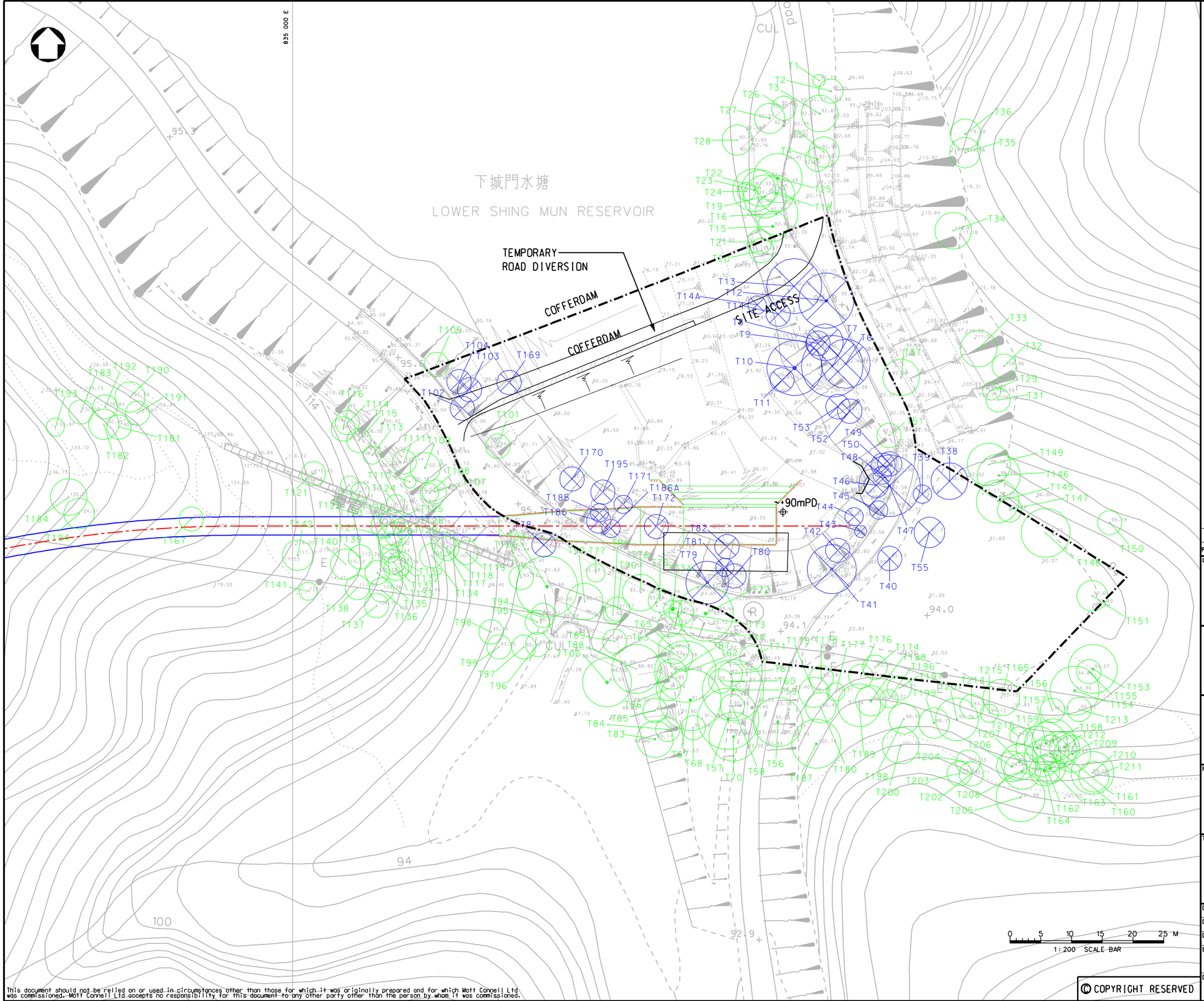
* Girth of a tree refers to its trunk circumference at breast height (i.e. measured at 1.3m above ground level)
** Girth of a tree refers to its trunk cirumference at breast height (i.e. trees with multitrunk branching were all measured seperately at 1.3m above ground level). The collective girth was then calculated using the methodollogy set out in Nature Conservation Practice Note No. 02/2003, Measurement of Diameter at Breast Height (DBH).

Top of Soil Level at the base of the Tree

It should be noted that this figure provides the existing soil level

Justification for Tree Felling

A Existing dead tree to be felled
B Recommend to fell as the existing tree is in conflict with the proposed slope regrading works
C Recommend to fell as the existing tree has an anticipated low survival rate if transplanted.
D Recommend to fell as the existing tree has leaning form and broken or damaged branches and trunk.



LEGEND:

- WORKSITE AREA
- T55 — TREES TO BE RETAINED
- T10 — TREES TO BE FELLED

Rev	Date	Drawn	Description	Ch'k'd	App'd

Client

THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION
WATER SUPPLIES DEPARTMENT

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Project

Agreement No. CE55/2006(EP)
Inter-reservoirs Transfer Scheme (IRTS)
Water Tunnel between Kowloon Byewash Reservoir and Lower Shing Mun Reservoir
Environmental Impact Assessment Investigation

Title

TREE RECOMMENDATION PLAN (NORTERN PORTAL)

Designed			Eng.Chk.		
Drawn			Coordination		
Dwg.Chk.			Approved		

Scale 1:200@A0	Project	Status
	CAD File	
Drawing No. MTCL03A/TR02		Rev

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T001	*Acacia confusa*	台灣相思	0.47	3	2			1			1						1		1	1		1			92.75		Topped
T002	*Acacia confusa*	台灣相思	0.72	7	4		1			1						1			1	1		1			92.85		
T003	*Acacia confusa*	台灣相思	0.85	7	6	1				1						1			1	1		1			92.69		Physically injured by vehicle; pruned
T004	*Acacia confusa*	台灣相思	0.75	7	4			1			1						1		1	1		1			92.19		One of two main branches being decayed
T005	*Acacia confusa*	台灣相思	0.53	6	5		1			1						1			1	1		1			92.58		Branch dieback
T006	*Acacia confusa*	台灣相思	0.85	9	8		1		1							1			1	1				1	92.44	B, C	
T007	*Acacia confusa*	台灣相思	1.26	8	10		1			1						1			1	1				1	92.45	B, C	
T008	*Acacia confusa*	台灣相思	0.75	7	6		1		1							1			1	1				1	92.36	B, C	Root adjoining a u-chanel
T009	*Mallotus paniculatus*	白楸	0.30	7	4		1				1						1		1	1				1	92.25	B, C	Branch dieback
T010	*Acacia confusa*	台灣相思	1.32	10	9			1		1							1		1	1				1	92.40	B, C	Branch dieback
T011	*Aporusa dioica*	銀柴	0.30	5	4			1		1							1		1	1				1	88.96	B, C	multi-trunked
T012	*Acacia confusa*	台灣相思	1.23	9	9		1			1						1			1	1				1	92.49	B, C	Root adjoining pavement
T013	*Acacia confusa*	台灣相思	0.95	8	9		1			1						1			1	1				1	92.52	B, C	Multi-trunk
T014	*Schefflera heptaphylla*	鴨腳木	0.31	4	4		1			1						1			1	1				1	90.94	B, C	
T014A	*Casuarina equisetifolia*	木麻黃	0.41	6	3		1			1						1			1	1				1	90.94	B, C	On steep slope
T015	*Acacia confusa*	台灣相思	1.07	9	5		1			1						1			1	1		1			92.69		Branch dieback
T016	*Acacia confusa*	台灣相思	0.88	8	7		1			1						1			1	1		1			92.71		Branch dieback
T018	*Acacia confusa*	台灣相思	0.82	7	6		1			1							1		1	1		1			92.59		Leaning trunk
T019	*Acacia confusa*	台灣相思	0.94	8	7		1			1							1		1	1		1			92.05		
T020	*Acacia confusa*	台灣相思	0.44	6	4		1			1							1		1	1		1			91.87		Branch dieback
T021	*Acacia confusa*	台灣相思	0.53	6	4		1			1						1			1	1		1			92.02		Branch dieback
T022	*Acacia confusa*	台灣相思	0.57	8	6		1			1						1			1	1		1			92.33		
T023	*Acacia confusa*	台灣相思	0.72	8	7		1		1							1			1	1		1			92.52		
T024	*Alangium chinense*	八角楓	0.30	4	3			1			1						1		1	1		1			91.27		
T025	*Acacia confusa*	台灣相思	0.87	9	8			1		1							1		1	1		1			92.75		Decay; weak joint between two main forking trunks
T026	*Acacia confusa*	台灣相思	0.47	7	4			1			1						1		1	1		1			92.44		
T027	*Acacia confusa*	台灣相思	0.75	6	5			1			1						1		1	1		1			92.37		Leaning trunk
T028	*Mallotus paniculatus*	白楸	0.50	5	5			1			1						1		1	1		1			90.70		
T029	*Litsea glutinosa*	潺槁	0.38	4	3			1		1							1		1	1		1			106.59		On Shotcrete
T031	*Mallotus paniculatus*	白楸	0.44	5	4		1			1							1		1	1		1			105.94		On Shotcrete
T032	*Alangium chinense*	八角楓	0.38	5	4			1		1							1		1	1		1			109.96		Inter-crossed with another leaning tree
T033	*Acacia confusa*	台灣相思	0.97	7	6		1		1							1			1	1		1			111.15		leaning on slope
T034	*Ixonanthes reticulata*	黏木	0.91	7	6	1			1						1				1	1		1			116.87		On slope
T035	*Ixonanthes reticulata*	黏木	0.69	6	5	1			1						1				1	1		1			119.98		
T036	*Ixonanthes reticulata*	黏木	0.69	7	5	1			1							1			1	1		1			119.69		Twisted with climbers
T037	*Acacia confusa*	台灣相思	0.72	8	6		1			1						1			1	1		1			92.64		
T038	*Melia azedarach*	楝	0.57	7	6		1			1						1			1	1				1	92.67	B, C	Branch dieback
T039	*Litsea cubeba*	山鴉樹	0.38	4	3		1			1						1			1	1				1	92.69	B, C	Branch dieback
T040	*Ficus hispida*	對葉榕	0.63	4	4	1			1							1			1	1				1	93.13	B, C	
T041	*Acacia confusa*	台灣相思	1.23	8	8			1			1						1		1	1				1	93.16	B, C	
T042	*Schefflera heptaphylla*	鴨腳木	0.52	4	4	1			1							1			1	1				1	92.02	B, C	
T043	*Acronychia pedunculata*	山油柑	0.35	4	2		1			1						1			1	1				1	92.51	B, C, D	Physical damage
T044	*Alangium chinense*	八角楓	0.41	5	3			1			1						1		1	1				1	91.25	B, C, D	Physical damage; branch dieback
T045	*Ficus hispida*	對葉榕	0.41	4	3		1				1						1		1	1				1	92.64	B, C, D	Physical damage; branch dieback
T046	*Bridelia tomentosa*	土蜜樹	0.38	4	4		1			1							1		1	1				1	92.37	B, C	
T047	*Acacia confusa*	台灣相思	1.98	15	10		1			1						1			1	1				1	92.66	B, C	
T048	*Mallotus paniculatus*	白楸	0.38	4	3			1		1							1		1	1				1	91.54	B, C, D	Leaning Trunk
T049	*Alangium chinense*	八角楓	0.41	6	4		1			1							1		1	1				1	92.08	B, C	
T050	*Sterculia lanceolata*	假蘋婆	0.50	6	4		1		1							1			1	1				1	91.53	B, C	
T051	*Mallotus paniculatus*	白楸	0.50	6	4	1			1							1			1	1		1			92.52		
T052	*Acacia confusa*	台灣相思	0.41	6	4			1		1							1		1	1				1	91.18	B, C, D	Leaning trunk
T053	*Acacia confusa*	台灣相思	0.44	9	4	1				1						1			1	1				1	90.16	B, C	
T055	*Ficus hispida*	對葉榕	0.66	7	5			1		1							1		1	1				1	91.37	B, C	Covered by climbers
T056	*Acacia confusa*	台灣相思	1.26	12	8	1				1						1			1	1		1			93.25		Bark decay
T057	*Acacia confusa*	台灣相思	1.13	15	10		1		1						1				1	1		1			92.31		Leaning
T058	*Mallotus paniculatus*	白楸	0.41	6	4	1			1							1			1	1		1			92.16		
T059	*Acacia confusa*	台灣相思	1.13	15	10			1	1							1			1	1		1			92.12		Leaning trunk
T060	*Machilus* sp.	潤楠	0.41	6	4	1			1						1				1	1		1			92.05		
T061	*Ficus hispida*	對葉榕	0.53	6	4	1				1						1			1	1		1			92.13		
T062	*Acacia confusa*	台灣相思	0.72	10	5		1			1						1			1	1		1			91.98		
T063	*Mallotus paniculatus*	白楸	0.35	8	2		1				1						1		1	1		1			91.98		
T065	*Mangifera indica*	杧果	0.44	6	5	1			1							1			1	1		1			92.14		
T067	*Acacia confusa*	台灣相思	1.47	15	10		1			1						1			1	1		1			91.82		

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T068	*Mallotus paniculatus*	白楸	0.44	6	4	1			1							1			1	1		1			91.59		
T070	*Acacia confusa*	台灣相思	1.13	15	8	1			1						1				1	1		1			92.54		
T071	*Macaranga tanarius*	血桐	0.41	6	4		1		1							1			1	1		1			93.53		
T072	*Acacia confusa*	台灣相思	1.57	10	9	1			1						1				1	1		1			93.91		
T073	*Schefflera heptaphylla*	鴨腳木	0.38	5	4	1			1						1				1	1		1			92.62		
T073A	*Rhus succedanea*	野漆	0.41	6	3			1		1						1			1	1		1			92.23		
T074	*Schefflera heptaphylla*	鴨腳木	0.53	7	4			1		1						1			1	1		1			92.23		
T075	*Acacia confusa*	台灣相思	0.44	8	4	1			1						1				1	1		1			93.66		
T076	*Schefflera heptaphylla*	鴨腳木	0.53	6	6	1			1						1				1	1		1			93.26		
T077	*Schefflera heptaphylla*	鴨腳木	0.35	4	3	1			1							1			1	1		1			93.44		
T078	*Schefflera heptaphylla*	鴨腳木	0.87	7	4		1			1						1			1	1				1	94.23	B, C	
T079	*Acacia confusa*	台灣相思	1.36	12	7		1			1						1			1	1				1	93.76	B, C	
T080	*Alangium chinense*	八角楓	0.44	7	4		1			1							1		1	1				1	93.24	B, C	
T081	*Phyllanthus emblica*	油甘子	0.31	5	3			1			1						1		1	1				1	91.92	B, C	Damaged by a neighboring falling tree
T082	*Sapium discolor*	山烏桕	0.38	5	4			1		1						1			1	1				1	89.21	B, C	Inbalanced tree form
T083	*Acacia confusa*	台灣相思	0.88	8	6		1			1						1			1	1		1			89.17		Inbalanced tree form
T084	*Alangium chinense*	八角楓	0.63	9	4		1			1							1		1	1		1			90.55		
T085	*Acacia confusa*	台灣相思	0.63	10	4		1			1						1			1	1		1			89.94		
T086	*Unidentified Tree Species*	未確認品種	0.44	6	4		1												1	1		1			91.76		Deciduous tree. No leaves for identification during survey.
T087	*Schefflera heptaphylla*	鴨腳木	0.35	6	5		1		1							1			1	1		1			91.85		
T088	*Acacia confusa*	台灣相思	0.66	15	8		1			1						1			1	1		1			88.82		
T089	*Ilex rotunda*	鐵冬青	0.50	7	4		1			1						1			1	1		1			88.12		
T090	*Sapium discolor*	山烏桕	0.41	6	4		1		1							1			1	1		1			91.17		
T091	*Sterculia lanceolata*	假蘋婆	0.41	4	3	1			1						1				1	1		1			90.47		
T092	*Mallotus paniculatus*	白楸	0.66	10	6		1			1						1			1	1		1			90.57		
T093	*Cinnamomum parthenoxylon*	黃樟	1.50	15	10	1			1						1				1	1		1			90.84		Multi-trunked
T094	*Aporusa dioica*	銀柴	0.41	6	4			1		1							1		1	1		1			89.82		Leaning trunk
T095	*Aporusa dioica*	銀柴	0.44	7	4		1			1						1			1	1		1			89.81		
T096	*Garcinia oblongifolia*	黃牙果	0.41	6	4			1		1							1		1	1		1			89.31		Cover by *Gnetum luofuense*
T097	*Microcos paniculata*	布渣葉	0.41	6	4		1		1							1			1	1		1			90.33		
T098	*Rhus succedanea*	野漆	0.47	7	4		1				1					1			1	1		1			95.15		Cover by *Gnetum luofuense*
T099	*Aporusa dioica*	銀柴	0.47	6	4			1			1						1		1	1		1			93.85		
T100	*Cleistocalyx operculatus*	水翁	1.45	14	8	1			1						1				1	1		1			87.54		
T101	*Litsea glutinosa*	潺槁	0.50	4	4	1			1							1			1	1		1			94.54		
T102	*Acacia confusa*	台灣相思	0.57	5	4	1			1							1			1	1				1	95.11	B, C	
T103	*Schefflera heptaphylla*	鴨腳木	0.50	4	4	1			1							1			1	1				1	93.97	B, C	
T104	*Carallia brachiata*	竹節樹	0.41	6	4	1				1						1			1	1				1	94.19	B, C	
T105	*Acacia confusa*	台灣相思	0.53	5	4	1			1							1			1	1		1			95.24		
T106	*Acronychia pedunculata*	山油柑	0.44	7	4		1		1							1			1	1		1			93.18		
T107	*Schefflera heptaphylla*	鴨腳木	0.60	6	4		1		1							1			1	1		1			102.76		On shotcrete
T108	*Alangium chinense*	八角楓	0.38	5	3		1			1							1		1	1		1			103.52		On shotcrete
T109	*Aporusa dioica*	銀柴	0.72	6	5		1		1								1		1	1		1			102.85		On shotcrete
T110	*Schefflera heptaphylla*	鴨腳木	0.41	4	2		1		1							1			1	1		1			105.37		On shotcrete
T111	*Schefflera heptaphylla*	鴨腳木	0.47	5	4		1		1							1			1	1		1			105.14		On shotcrete
T113	*Rhus succedanea*	野漆	0.41	5	3		1				1						1		1	1		1			108.46		
T114	*Aporusa dioica*	銀柴	0.50	6	4	1			1							1			1	1		1			110.37		On shotcrete
T115	*Schefflera heptaphylla*	鴨腳木	0.89	6	4	1			1						1				1	1		1			109.81		
T116	*Aporusa dioica*	銀柴	0.38	5	4		1		1							1			1	1		1			111.06		
T117	*Schefflera heptaphylla*	鴨腳木	0.35	4	4		1		1							1			1	1		1			103.64		
T118	*Sapium discolor*	山烏桕	0.38	4	4		1				1						1		1	1		1			103.40		
T119	*Alangium chinense*	八角楓	0.53	6	4		1			1						1			1	1		1			101.13		Leaning
T121	*Acronychia pedunculata*	山油柑	0.35	4	4		1		1							1			1	1		1			115.45		
T122	*Rhus succedanea*	野漆	0.38	4	3			1			1						1		1	1		1			112.44		Cover by *Gnetum luofuense*
T123	*Sapium discolor*	山烏桕	0.41	4	3			1			1						1		1	1		1			111.26		Cover by *Gnetum luofuense*
T124	*Itea chinensis*	鼠刺	0.35	4	3			1			1						1		1	1		1			107.01		
T125	*Diospyros morrisiana*	羅浮柿	0.38	5	4	1			1							1			1	1		1			107.83		
T126	*Acronychia pedunculata*	山油柑	0.35	4	4		1		1							1			1	1		1			109.38		Leaning trunk
T127	*Garcinia oblongifolia*	黃牙果	0.44	5	4	1				1						1			1	1		1			108.77		
T128	*Garcinia oblongifolia*	黃牙果	0.44	5	4		1			1						1			1	1		1			107.87		
T129	*Acronychia pedunculata*	山油柑	0.38	5	4			1		1							1		1	1		1			108.82		Leaning trunk
T130	*Artocarpus hypargyreus*	白桂木	0.38	6	3		1		1							1			1	1		1			108.64		
T131	*Diospyros morrisiana*	羅浮柿	0.50	5	4		**1**			**1**							**1**		1	1		1			108.47		

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T132	*Schefflera heptaphylla*	鴨腳木	0.38	4	4			1		1							1		1	1		1			107.79		
T134	*Schefflera heptaphylla*	鴨腳木	0.63	7	4		1			1						1			1	1		1			108.17		
T135	*Garcinia oblongifolia*	黃牙果	0.54	7	4		1		1							1			1	1		1			104.19		
T136	*Acronychia pedunculata*	山油柑	0.35	6	4		1			1						1			1	1		1			109.72		
T137	*Garcinia oblongifolia*	黃牙果	0.60	7	4		1			1						1			1	1		1			108.75		
T138	*Litsea cubeba*	山蒼樹	0.47	6	4		1		1							1			1	1		1			111.85		
T139	*Garcinia oblongifolia*	黃牙果	0.60	6	4	1			1							1			1	1		1			112.26		
T140	*Diospyros morrisiana*	羅浮柿	0.53	7	5		1		1							1			1	1		1			113.62		
T141	*Diospyros morrisiana*	羅浮柿	0.41	4	3		1			1						1			1	1		1			116.71		Topped
T142	*Ixonanthes reticulata*	黏木	1.41	8	5	1			1						1				1	1		1			117.37		
T145	*Macaranga tanarius*	血桐	0.35	6	4		1		1							1			1	1		1			92.41		
T146	*Ficus variegata*	青果榕	0.97	8	7	1			1						1				1	1		1			96.98		On slope
T147	*Macaranga tanarius*	血桐	0.35	6	4		1		1							1			1	1		1			92.46		
T148	*Mallotus paniculatus*	白楸	0.67	10	8		1		1							1			1	1		1			92.23		
T149	*Mallotus paniculatus*	白楸	0.69	5	7			1		1						1			1	1		1			98.28		Leaning on slope
T150	*Schima superba*	木荷	0.69	7	4		1		1							1			1	1		1			95.19		
T151	*Ficus hispida*	對葉榕	0.66	5	5			1		1							1		1	1		1			92.61		Leaning
T153	*Schima superba*	木荷	1.79	11	8	1			1						1				1	1		1			94.57		
T154	*Mallotus paniculatus*	白楸	0.53	9	4			1		1							1		1	1		1			94.46		
T155	*Schima superba*	木荷	0.88	7	4	1			1						1				1	1		1			94.85		
T156	*Acronychia pedunculata*	山油柑	0.35	5	4		1		1							1			1	1		1			94.35		
T157	*Schima superba*	木荷	1.07	11	7	1			1						1				1	1		1			96.74		
T158	*Schima superba*	木荷	1.23	11	7	1			1						1				1	1		1			96.75		
T159	*Schima superba*	木荷	1.03	11	7		**1**		**1**							**1**			1	1		1			96.75		
T160	*Schima superba*	木荷	0.79	10	6		1		1							1			1	1		1			97.24		
T161	*Schima superba*	木荷	0.82	10	6	1			1						1				1	1		1			97.24		
T162	*Schima superba*	木荷	0.69	10	6		1		1							1			1	1		1			77.31		
T163	*Schima superba*	木荷	1.32	14	5	1			1						1				1	1		1			98.32		
T164	*Schima superba*	木荷	1.54	13	5	1			1						1				1	1		1			98.35		
T165	*Ficus hispida*	對葉榕	0.60	5	6		1			1						1			1	1		1			93.75		
T167	*Unidentified Tree Species*	未確認品種	0.41	7	3		1			1							1		1	1		1			126.06		Deciduous species. No leaves for identification during survey.
T169	*Acacia confusa*	台灣相思	1.05	6	4		1		1							1			1	1				1	90.32	B, C	Root adjoining concrete access
T170	*Acacia confusa*	台灣相思	0.53	6	4		1		1							1			1	1				1	92.90	B, C	Root adjoining concrete access
T171	*Mallotus paniculatus*	白楸	0.38	6	3		1		1							1			1	1				1	89.82	B, C	
T172	*Rhus hypoleuca*	白背漆	0.41	4	4	1				1						1			1	1				1	90.22	B, C	
T174	*Ficus* sp.	榕屬	0.79	6	4		1				1						1		1	1		1			93.47		The individual is of poor health. No leaves for further identification.
T176	*Schefflera heptaphylla*	鴨腳木	0.30	5	4			1	1								1		1	1		1			94.96		
T177	*Aporusa dioica*	銀柴	0.44	4	3		1			1						1			1	1		1			95.31		
T178	*Acronychia pedunculata*	山油柑	0.38	6	4		1		1							1			1	1		1			92.18		
T179	*Sterculia lanceolata*	假蘋婆	0.47	6	5		1		1							1			1	1		1			95.79		
T180	*Garcinia oblongifolia*	黃牙果	0.50	6	5	1			1							1			1	1		1			96.49		
T181	*Garcinia oblongifolia*	黃牙果	0.58	6	4	1				1						1			1	1		1			130.44		
T182	*Schefflera heptaphylla*	鴨腳木	0.41	5	5	1			1							1			1	1		1			130.45		
T183	*Acronychia pedunculata*	山油柑	0.41	4	4	1			1							1			1	1		1			132.02		
T184	*Ixonanthes reticulata*	黏木	1.04	7	6	1			1							1			1	1		1			135.01		
T185	*Rhus* sp.	漆屬	0.38	5	3		1				1						1		1	1				1	93.06	B,C	Infected by parasitic plants
T186	*Rhus* sp.	漆屬	0.35	6	4		1				1						1		1	1				1	93.08	B,C	Infected by parasitic plants
T186A	*Mallotus paniculatus*	白楸	0.31	4	3		1		1							1			1	1				1	94.00	B, C	Infected by parasitic plants
T187	*Schima superba*	木荷	1.55	12	8	1			1						1				1	1		1			102.16		
T188	*Diospyros morrisiana*	羅浮柿	1.04	8	5		1		1							1			1	1		1			96.80		
T189	*Mallotus paniculatus*	白楸	0.53	8	7			1			1						1		1	1		1			97.66		Leaning
T190	*Canthium dicoccum*	魚骨木	0.60	5	5	1			1							1			1	1		1			127.24		
T191	*Aporusa dioica*	銀柴	0.53	4	4	1			1							1			1	1		1			127.87		
T192	*Garcinia oblongifolia*	黃牙果	0.63	5	4	1			1							1			1	1		1			129.84		
T193	*Cratoxylum cochinchinense*	黃牛木	0.50	4	3	1			1							1			1	1		1			133.97		
T194	*Canthium dicoccum*	魚骨木	0.38	5	5	1			1						1				1	1		1			134.31		
T195	*Acronychia pedunculata*	山油柑	0.42	4	4	1			1							1			1	1				1	90.12	B, C	
T196	*Rhus succedanea*	野漆	0.41	4	3			1			1						1		1	1		1			97.01		Leader trunk broken
T197	*Alangium chinense*	八角楓	0.41	6	4		1			1							1		1	1		1			95.21		
T198	*Diospyros morrisiana*	羅浮柿	0.41	5	5	1				1						1			1	1		1			98.93		
T199	*Schefflera heptaphylla*	鴨腳木	0.82	7	5		1			1						1			1	1		1			98.21		
T200	*Acronychia pedunculata*	山油柑	0.85	5	6			1			1						1		1	1		1			101.26		

Tree No.	Botanical Name	Chinese Name	Survey Size (M)			Form			Existing Tree Condition				Amenity Value					Transplant		Location		Proposed Treatment			Soil Level at Base of Tree	Justification	Remarks
			Girth	Height	Spread	Good	Aver	Poor	Good	Fair	Poor	Dead	A	B	C	D	E	Yes	No	Slope	Flat	Retain	Trans	Fell			
T201	*Diospyros morrisiana*	羅浮柿	0.79	9	3		1			1							1		1	1		1			95.76		
T202	*Aporusa dioica*	銀柴	0.55	5	4			1		1							1		1	1		1			102.11		
T203	*Diospyros morrisiana*	羅浮柿	0.47	5	4			1		1							1		1	1		1			103.14		
T204	*Aporusa dioica*	銀柴	0.66	5	4			1		1							1		1	1		1			101.33		Seriously leaning on slope
T205	*Acacia confusa*	台灣相思	0.75	10	8			1		1							1		1	1		1			101.99		Branch dieback
T206	*Schima superba*	木荷	0.97	10	5	1			1						1				1	1		1			98.89		
T207	*Schima superba*	木荷	0.97	8	6		1		1							1			1	1		1			98.22		Upper trunk leaning
T208	*Schima superba*	木荷	1.04	14	6	1			1						1				1	1		1			99.27		
T209	*Schima superba*	木荷	1.20	11	6		1		1							1			1	1		1			97.47		
T210	*Acronychia pedunculata*	山油柑	0.60	8	5		1		1							1			1	1		1			99.26		
T211	*Diospyros morrisiana*	羅浮柿	0.38	7	3			1		1							1		1	1		1			99.36		
T212	*Schima superba*	木荷	1.16	8	5	1			1						1				1	1		1			96.82		
T213	*Melicope pteleifolia*	三椏苦	0.31	6	4		1		1							1			1	1		1			95.85		
T214	*Archidendron lucidum*	亮葉猴耳環	0.44	4	4		1		1							1			1	1		1			93.55		
T215	*Sterculia lanceolata*	假蘋婆	0.35	4	3	1			1							1			1	1		1			94.12		
T216	*Sterculia lanceolata*	假蘋婆	0.30	5	3	1			1							1			1	1		1			94.53		
																											203
Summary Statistics						**61**	**101**	**41**	**97**	**80**	**25**	**0**	**0**	**0**	**27**	**117**	**58**	**0**	**203**	**203**	**0**	**161**	**0**	**42**			
						30%	50%	20%	48%	39%	12%	0%	0%	0%	13%	58%	29%	0%	100%	100%	0%	79%	0%	21%			(plus dead trees)
						Good	**Aver**	**Poor**	**Good**	**Fair**	**Poor**	**Dead**	**A**	**B**	**C**	**D**	**E**	**Yes**	**No**	**Slope**	**Flat**	**Retain**	**Trans**	**Fell**			**Total**

The preliminary tree survey results would be subject to further change before the finalisation during tree felling application stage

Note: Trunk girth measured using the AFCD's Nature Conservation Practice for multitrunk trees

Legend

Tree Condition / Health

G Good
F Fair
P Poor
D Dead

Tree Form

G Good
F Fair
P Poor

Survival After Transplanting

Y Yes
N No

Amenity Value

A with cultural significance or high functional signficance or high visual impact ,or mature and good health, good condition and good form.
B with cultural significance or high functional signficance or high visual impact, or mature and poor health, poor condition and poor form.
C Common species and goood health, good condition and good form.
D Common species and average health, average condition and average form.
E Common species and little or no functional or visual value and poor health, poor condition and poor form.

Remarks

Trees with high conservation values such as rare or protected species or of Old and Valuable tree values or will be recorded in the remarks of the Tree Survey Schedule

Tree Girth

* Girth of a tree refers to its trunk circumference at breast height (i.e. measured at 1.3m above ground level)
** Girth of a tree refers to its trunk cirumference at breast height (i.e. trees with multitrunk branching were all measured seperately at 1.3m above ground level). The collective girth was then calculated using the methodollogy set out in Nature Conservation Practice Note No. 02/2003, Measurement of Diameter at Breast Height (DBH).

Top of Soil Level at the base of the Tree

It should be noted that this figure provides the existing soil level and that where these trees are to be retained in-situ the soil level will be maintained at the base of the tree and not cover the root collar.

Justification for Tree Felling

A Existing dead tree to be felled
B Recommend to fell as the existing tree is in conflict with the proposed site formation works
C Recommend to fell as the existing tree has an anticipated low survival rate if transplanted.
D Recommend to fell as the existing tree has leaning form and broken or damaged branches and trunk.

Appendix J
Catalogue

Table J1 Dam

Project: Inter reservoir Transfer Scheme **Title: Dam**	**Location: Kowloon Byewash Reservoir** **Map Ref: Figure 10-1**	**Ref # IRTS-01**
Originally Recorded: 03.03.08	Updated On: N/A	
Original Usage: Dam	Current Usage: Dam	
Orientation: The dam runs from the southeast to the northwest	Address: N/A	
Construction Date: 1931	Ownership: HKSAR Government	
Setting: Reservoir	Historical Associations: None	
Condition: Good	Degree of Modification: Low	
Architectural Significance: Moderate	Cultural Significance: Moderate	
Description: Stone arched dam with single lane road across the top with concrete balustrade.		
Inscriptions: None		
Additional Notes: Grade II Historic Structure		

Table J2 Valve House

Project: Inter reservoir Transfer Scheme **Title: Valve House**	**Location: Kowloon Byewash Reservoir** **Map Ref: Figure 10-1**	**Ref # IRTS-02**
Originally Recorded: 03.03.08	Updated On: N/A	
Original Usage: Valve House	Current Usage: Valve House	
Orientation: the valve house faces southwesterly	Address: N/A	
Construction Date: 1931	Ownership: HKSAR Government	
Setting: Reservoir	Historical Associations: None	
Condition: Good	Degree of Modification: Low	
Architectural Significance: Moderate	Cultural Significance: Moderate	
Description: Rectangular stone and concrete structure. Windows have been sealed up. Flat roof with concrete moulding around edges.		
Inscriptions: 1929 HKWW 1931 on lintel above the entrance door		
Additional Notes: Grade II Historic Structure		

Table J3 Pineapple Pass Dam

Project: Inter reservoir Transfer Scheme **Title: Pineapple Pass Dam**	**Location: Lower Shing Mun Reservoir** **Map Ref: Figure 10-2**	**Ref # IRTS-03**
Originally Recorded: 03.03.08	Updated On: N/A	
Original Usage: Dam	Current Usage: Dam	
Orientation: The dam runs from the southeast to the northwest	Address: N/A	
Construction Date: 1965	Ownership: HKSAR Government	
Setting: Reservoir	Historical Associations: None	
Condition: Good	Degree of Modification: Low	
Architectural Significance: Moderate	Cultural Significance: Moderate	
Description: Vegetation covered dam wall with single lane road across the top.		
Inscriptions: None		
Additional Notes: Grade I Historic Structure		

Table J4 Northeast Dam

Project: Inter reservoir Transfer Scheme **Title: Northeast Dam**	**Location: Shek Lei Pui Reservoir** **Map Ref: Figure 10-3**	**Ref # IRTS-04**
Originally Recorded: 19.07.08	Updated On: N/A	
Original Usage: Dam	Current Usage: Dam	
Orientation: The dam runs from south to north	Address: N/A	
Construction Date: 1925	Ownership: HKSAR Government	
Setting: Reservoir	Historical Associations: None	
Condition: Good	Degree of Modification: Low	
Architectural Significance: Moderate	Cultural Significance: Moderate	
Description: Cut stone curved surface. No walkway across dam.		
Inscriptions: None		
Additional Notes: Grade II Historic Structure		

Table J5 Northeast Dam Valve House

Project: Inter reservoir Transfer Scheme **Title: Northeast Dam Valve House**	**Location: Shek Lei Pui Reservoir** **Map Ref: Figure 10-3**	**Ref # IRTS-05**
Originally Recorded: 19.07.08	Updated On: N/A	
Original Usage: Valve House	Current Usage: Dam	
Orientation: the valve house faces easterly	Address: N/A	
Construction Date: 1925	Ownership: HKSAR Government	
Setting: Reservoir	Historical Associations: None	
Condition: Good	Degree of Modification: Low	
Architectural Significance: Moderate	Cultural Significance: Moderate	
Description: Concrete square structure, sealed up. Exterior has concrete moulded to resemble stone work. Flat roof.		
Inscriptions: None		
Additional Notes: Grade II Historic Structure		

Table J6 Southwest Dam

Project: Inter reservoir Transfer Scheme **Title: Southwest Dam**	**Location: Shek Lei Pui Reservoir** **Map Ref: Figure 10-1**	**Ref # IRTS-06**
Originally Recorded: 19.07.08	Updated On: N/A	
Original Usage: Dam	Current Usage: Dam	
Orientation: The dam runs from the southeast to the northwest	Address: N/A	
Construction Date: 1925	Ownership: HKSAR Government	
Setting: Reservoir	Historical Associations: None	
Condition: Good	Degree of Modification: Low	
Architectural Significance: Moderate	Cultural Significance: Moderate	
Description: Very high cut stone and concrete structure with walkway on the top surface across the dam. Metal railings		
Inscriptions: None		
Additional Notes: Grade II Historic Structure		

Table J7 Dam

Project: Inter reservoir Transfer Scheme **Title: Dam**	**Location: Kowloon Reservoir** **Map Ref: Figure 10-1**	**Ref # IRTS-07**
Originally Recorded: 19.07.08	Updated On: N/A	
Original Usage: Dam	Current Usage: Dam	
Orientation: The dam runs from the southeast to the northwest	Address: N/A	
Construction Date: 1910	Ownership: HKSAR Government	
Setting: Reservoir	Historical Associations: None	
Condition: Good	Degree of Modification: Low	
Architectural Significance: Moderate	Cultural Significance: Moderate	
Description: Long curved cut stone dam structure with road and metal railing on the top.		
Inscriptions: None		
Additional Notes: Grade I Historic Structure