

11.0 ENVIRONMENTAL MONITORING AND AUDIT

11.1 Introduction

11.1.1 The development of appropriate environmental monitoring and audit (EM&A) programmes and methodologies are a vital part of the environmental management and control of the Project. This chapter provides an outline of the EM&A requirements for the Project, highlighting the environmental parameters to be monitored, timing of the monitoring work and the frequency of the monitoring and audit work. A more detailed scope of work will be provided in the EM&A Manual, prepared in accordance with Annex 21 of the TMEIA and EPD's *EM&A Guidelines for Development Projects in Hong Kong*.

11.1.2 The broad objectives of the monitoring and audit process are:

- (i) to clarify and identify sources of pollution, impact and nuisance arising from the works;
- (ii) to confirm compliance with legal and contract specifications;
- (iii) to provide an early warning system for impact prevention;
- (iv) to provide a database of environmental parameters against which to determine any short term or long term environmental impacts;
- (v) to propose timely, cost-effective and viable solutions to actual or potential environmental issues;
- (vi) to monitor performance of the mitigation measures;
- (vii) to verify the EIA predicted impacts;
- (viii) to collate information and evidence for use in public, District Board and Government consultation; and
- (ix) to audit environmental performance.

11.2 EM&A Requirements

11.2.1 In accordance with the EIA, EM&A procedures are required during the construction and operational phases of the project implementation. The EM&A requirements are divided into environmental monitoring and/or project auditing in the form of site inspection and supervision. The environmental monitoring for this Project will be conducted in two distinct stages:

- C baseline (pre-construction); and
- C construction phase impact.

11.2.2 Design phase EM&A is not required in accordance with the findings of the EIA.

- 11.2.3 Environmental monitoring and audit for dust and noise during the construction phase is recommended in order to ensure all proposed mitigation measures are implemented and effective, especially in light of the potential for residual impacts in the village areas due to sewer construction.
- 11.2.4 Obtaining a suitable and representative baseline data set will be critical to the whole monitoring and audit process because it forms the standard against which environmental impacts are assessed. Thus, baseline monitoring for dust and noise will be required prior to the start of construction.
- 11.2.5 Mitigation to avoid the pollution of the water courses in the study area have also been recommended by the EIA, as have waste management procedures and thus, monitoring in the form of regular site inspections is also required to ensure mitigation measures are being implemented and are effective.
- 11.2.6 Due to access issues during the study phase, archaeological EM&A in the form of supervision of construction activities will be required in areas presently under concrete which have been assessed as having high and medium archaeological potential, namely Wong Uk Tsuen, Ching Ka Tsuen and Luen On San Tsuen, together with supervision during construction of the Tai Lam Correctional Institution and Luen On San Tsuen pumping station sites for which access was not possible during the EIA.
- 11.2.7 In addition, audit of mitigation measures to avoid impacts on landscape and visual resources will be required during the construction period, together with supervision of the compensatory planting. Audit of the compensatory planting will also extend through the first year of the operation of the pumping stations, during the Contractor's one year maintenance period, to ensure that the establishment of the planting. The maintenance and monitoring of the planting will be responsibility of LCSD after this period.
- 11.2.8 The details of monitoring are discussed in the following sections and summarised in Table 11.1 below.

Table 11.1: Framework for Environmental Monitoring Plan

Monitoring	Period	Parameters	Monitoring Frequency
Noise	Baseline (1 occasion)	L_{eq} (30 mins)	Continuous sampling for two consecutive weeks analysed every 24 hours.
	Construction Phase	L_{eq} (30 mins) ⁽¹⁾	One set of measurements between 0700-1900 hours on normal weekdays once per week at each location undergoing construction.

Table 11.1 Cont'd....

Monitoring	Period	Parameters	Monitoring Frequency
Air Quality	Baseline (1 occasion)	Total Suspended Particulates, wind speed/ direction	1 hour sampling 3 times a week for 2 consecutive weeks
	Construction Phase	Total Suspended Particulates, wind speed/ direction	1 hour TSP once per week
Water	Baseline	Survey of stream and tributaries in the study area	Once per week for two weeks before the start of the construction.
	Impact (during construction)	Survey of watercourses in area of active construction works and other areas with stock piled materials on exposed ground surface	Once per week in areas undergoing construction
Waste	Baseline	n/a	n/a
	Construction Phase	Routine supervision of construction works	As per site inspection schedule
Landscape/ Visual Resources	Baseline	Tree survey and vegetation mapping	Once immediately prior to construction
	Construction Phase	Survey of protection measures for trees and landscaping	Twice a month during construction works
	Operational Phase	Survey of establishment of planting	Once every two months for a one year period after completion of the works.
Archaeological Resources	Construction Phase	Supervision of construction works in areas of archaeological potential currently covered by hard standing. Survey of historical structures.	Subject to construction schedule.

Note (1): Should the construction schedule require works in restricted hours, monitoring in the form of 3 consecutive $L_{eq(5mins)}$ readings should be taken.

11.3 Action and Limit Levels

11.3.1 Monitoring stations will be set up at representative sensitive receivers and the results will be used to ensure compliance with determined performance criteria, based upon specific action and limit levels. The definition of these are as follows:

C the *Action Level* represents a level at which some appropriate action will be required to prevent conditions deteriorating to the extent that statutory or guide criteria are breached; and

C the *Limit Level* represents the upper limit permitted and is generally equivalent to the statutory levels specified in legislation.

11.3.2 The construction phase monitoring and relevant audit criteria for dust and noise are highlighted below. Action plans will be developed for use in the event of exceedances and are included in the EM&A Manual.

11.3.3 Action plans and audit criteria are not relevant to the water quality, waste, landscape and visual and heritage EM&A. However, the supervision methodology is highlighted below.

Noise

11.3.4 The construction noise level will be measured in terms of the A-weighted equivalent continuous sound pressure level (L_{eq}). L_{eq} measurements will be taken during 30 minutes of typical construction activity during unrestricted periods. No work during restricted periods is anticipated at this stage, however, three consecutive $L_{eq(5mins)}$ readings will be taken to monitor the noise during these periods if required.

11.3.5 Sound level metres in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications will be used for carrying out the noise monitoring, in accordance with the Technical Memorandum (TM) issued under the NCO. The noise measurements should be carried out 1m from the worst-affected external facades of the representative NSRs and not be made in the presence of fog, rain or excessive steady or gusty wind.

11.3.6 The proposed construction phase sampling frequency will be once per week and action and limit levels for work during the unrestricted period, and restricted periods for reference, are shown in Table 11.2.

Table 11.2: Action and Limit Levels for Construction Noise

Time Period	Action Level	Limit Level
Unrestricted Period Normal work days (0700 - 1900)	When one documented complaint is received	75 dB(A) reduced to 70 dB(A) for schools and 65 dB(A) during school examination periods.

Table 11.2 Cont'd....

Time Period	Action Level	Limit Level
Restricted Period 1 All days during the evening (19.00-23.00) and general holidays (including Sundays) during the daytime and evening (07.00-23.00)	When one documented complaint is received	60 dB(A) (for Area Sensitivity Ratings A)
Restricted Period 2 All days during the night-time (23.00-07.00)	When on documented complaint is received	45 dB(A) (for Area Sensitivity Ratings A)

Air Quality

- 11.3.7 Monitoring and audit of the Total Suspended Particulates (TSP) levels shall be carried out to detect any deterioration in air quality and so enable early action to be taken for impact prevention or amelioration. 1-hour TSP levels only shall be measured to indicate the impacts of construction dust on air quality using direct reading methods. Other relevant data that will need to be recorded will include the prevailing weather conditions, namely wind speed and direction and rainfall.
- 11.3.8 The sampling frequency will be once per week. Action and limit levels are shown in Table 11.3.

Table 11.3: Action and Limit Levels for Air Quality

Parameters	Action	Limit
1 Hour TSP Level ($\mu\text{g}/\text{m}^3$)	For baseline level $\leq 384 \mu\text{g}/\text{m}^3$, action level = average of baseline level plus 30% and limit level For baseline level $> 384 \mu\text{g}/\text{m}^3$, action level = limit level	500

Water Quality

- 11.3.9 Surveys are to be undertaken for watercourses which are within the influence of construction works at least once per week. The surveys should include a description of the stream course, influencing factors, photographs of the watercourse and a map showing areas of project construction works.
- 11.3.10 Any noticeable change to water quality should be recorded in the watercourse survey reports and should be investigated and remedial actions shall be undertaken to reduce impacts. Particular attention shall be paid to the Contractor's incorporation of mitigation measures.

Waste

- 11.3.11 Supervision of the construction works should be undertaken during site inspections to ensure that waste material is being properly stockpiled and handled. Any malpractice should be reported and remedial measure recommended.

Landscape and Visual

- 11.3.12 The landscape and visual mitigation proposals comprise a combination of preventive measures to protect the existing landscape resources, including careful alignment of underground pipes to avoid mature trees and woodland, as well as sensitive building design with new tree and shrub planting to the perimeter of pumping stations. To ensure these impact mitigation measures are carried out satisfactorily, EM&A during the construction and operational phases are proposed.
- 11.3.13 Baseline monitoring for the landscape will comprise a vegetation survey of the entire selected route option undertaken on an 'area' basis. Representative vegetation types will be identified along with typical species composition. An assessment of landscape character will be made against which future change can be monitored. The landscape resources and elements of particular concern are to be noted. Reference to the habitat maps included in the EIA shall be made.
- 11.3.14 Trees identified for protection or transplanting shall be identified at the outset of the construction contract and all approved protection measures such as hoarding and fencing shall be in place prior to any excavation or site formation works. The tree felling, transplanting, protection and new planting works shall be carried out by an approved landscape contractor. Regular twice monthly site inspections for the duration of the contract shall be made to ensure that all protection measures are well maintained, there is no damage to retained trees and the new planting complies with the design of the landscape mitigation measures.
- 11.3.15 Upon completion of the works, audit of the maintenance and establishment works to all planted areas shall be undertaken for a 12 month period during the Contractor's one year maintenance period, with LCSD taking over responsibility for the maintenance after this period. Inspections of the works shall be undertaken once every two months during the establishment period to ensure the intended mitigation of landscape and visual impacts is achieved. That is, the trees and shrubs planted around pumping stations create the desired screen and, where required, the regrassing of pipe alignments provides a fully vegetated cover to match the original site conditions.

Heritage

- 11.3.16 In accordance with the findings of the EIA, EM&A during the construction phase to monitor the effects on adjacent historical buildings and during excavation activities in areas of high and medium archaeological potential as detailed in the section below.
- 11.3.17 A programme of monitoring is recommended for the observation of the engineering works when they come in close proximity, i.e. 0 to 3 metres, of the highlighted historic buildings, see

Section 9.6.8. The main aim of the programme is prevention of any possible damage through on-site liaison with the Contractor, Engineer's Representative and Environmental Specialist before and during the engineering works. A heritage consultant will be required to be present on-site to ensure that no structural damage is incurred or that any historical or cultural features of the buildings are altered, through:

- non-contact effects of the engineering works, such as vibration from pneumatic drills which could cause damage, such as foundation or wall cracks and loosening of tiles or fixtures; and
- contact between the historic structures and equipment and materials associated with the engineering works;

11.3.18 The monitoring programme will entail observation of the historic structures by a heritage consultant during the engineering works that are carried out within the area defined above. In the event that any damage to the historic structure is observed by the heritage consultant, works must cease until the degree and nature of the damage is assessed and measures are recommended for remedy and prevention of any further damage. These measures must be agreed upon and implemented before work is allowed to resume.

11.3.19 In addition to the above, in accordance with the requirements of the Antiquities and Monuments Office, a programme of monitoring is recommended to systematically observe the excavations associated with the sewerage works. This programme will require archaeologists to be present on site when strata with archaeological potential are penetrated in areas considered to have medium and high archaeological potential which are currently under concrete. The strata of interest are those below the present road surface and pavement down to decomposing rock or rock head. The timing and duration of archaeological monitoring and the number of archaeologists required will be dependent on the scheduling of the engineering works and, thus, liaison will be required between the archaeologists, the Contractor, the Engineer's Representative and the Environmental Specialist.

11.3.20 Monitoring will entail observation of the stratigraphy and contents of the excavations as they are removed. The archaeologists will observe the excavation of deposits with archaeological potential and scan the material as it is removed. These procedures will not interfere with the progress of the works. The survey procedure will be implemented for approximately 20-25 % of the area of the excavations.

11.3.21 Supervision units will be randomly spaced within the areas of archaeological interest. Areas of interest will be clearly identified before excavation works begin and archaeologists will liaise with the Contractor involved to arrange scheduling.

11.3.22 In the event that archaeological material is found during the excavation, the archaeologists will require time to retrieve as much data as possible. The retrieval methodology is designed to achieve this aim while at the same time minimising delay in the engineering programme.

11.3.23 If original soil deposits are exposed, which could potentially contain archaeological material, soil samples will be taken and the excavations will proceed. If archaeological material is

found, time will be required to map, record and remove it before excavation can continue.

11.3.24 The period of cessation of works would depend on the material concerned, although every effort will be made to minimise the interruption to the programme. In order to increase efficiency and minimise delay, it is recommended that a set of Guidelines be prepared in conjunction with the AMO before the project begins. Monitoring of this type is new to Hong Kong archaeology but is regularly carried out in Europe and the Americas and many methods can be adopted and adapted for use locally. However, the range of potential finds and local circumstances are particular to Hong Kong. Thus, a set of draft set of guidelines for this work has been developed and are included in Appendix I. The guidelines will need to be reviewed and finalised by the ES in conjunction with the archaeologist, following liaison with the AMO, at the start of the monitoring period.

11.4 EM&A Responsibilities

11.4.1 The noise and dust baseline and impact environmental monitoring and water quality and waste supervision should be carried out by an independent Environmental Specialist (ES), who will be employed by the Contractor but is not in any way an associated company of the Contractor. The responsibilities of the ES will include field measurements, sampling, analysis of monitoring results, reporting and auditing. The ES will be required to be approved by the Environmental Protection Department (EPD). The ES shall be competent and have relevant environmental monitoring and audit experience.

11.4.2 The ES will require suitably qualified support staff (the Environmental Team, (ET)) to carrying out the EM&A programme. Both the ES and members of the ET shall be independent and shall not be in any way connected to the Contractor's company. Due to the specialist nature of some of the EM&A works required for this project, the ET should comprise professionals proficient to undertake the tasks involved. Thus, the ET should include personnel experienced in noise, dust and supervision of water quality and waste management.

11.4.3 Accordingly, a Landscape Architect with a minimum of 1-2 years on-site experience will be required on the ET to monitor and audit the landscaping installation works and landscape protection measures.

11.4.4 In respect of the archaeological supervision, these works should be undertaken by a suitably qualified archaeologist, who will form part of the environmental team (ET) under the supervision of the ES. The qualified archaeologist should possess professional qualifications, such as an academic degree in archaeology, relevant experience in field archaeology at a supervision level and be familiar with the archaeology of Hong Kong and/or South China. The qualified archaeologist will also be required to obtain a licence from the AMO prior to undertaking the supervision works. The responsibilities of the specialist will be to oversee the construction activities, notify the Contractor, the AMO, the EPD and the ER of any findings and develop appropriate mitigation measures.

11.4.5 In addition, an Independent Checker (Environmental) (IC(E)), shall also be employed by the Contractor but shall not be in any way associated with either the Contractor nor the ES and his team. The IC(E) shall advise the Engineer's Representative on environmental issues

related to the project. The role of the checker shall be independent from the management of the construction works and shall be empowered to audit the environmental performance during construction.

11.5 Reporting

- 11.5.1 Deliverables in the form of the baseline survey report and regular and summary EM&A Reports should be prepared in accordance with the requirements of Annex 21 of the TMEIA. It is recommended that EM&A Reports are issued monthly during the construction phase and bi-monthly during the operational phase in respect of the tree planting audit. Further details on the contents of these reports is provided in the EM&A Manual.

11.6 Implementation Schedules

- 11.6.1 The recommended mitigation measures specified in this EIA report have been summarised in the Environmental Mitigation Implementation Schedules provided in Appendix H for air quality, noise, water quality, waste, ecology, heritage and landscape and visual.