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ABBREVIATION

ADWF	Average Dry Weather Flow
AGS	Aerobic Granular Sludge
AHM	Artificial Hard Materials
ALARP	As Low As is Reasonably Practicable
ASRs	Air Sensitive Receivers
AQOs	Air Quality Objectives
C&D	Construction and Demolition
CAP	Contaminated Assessment Plan
CAR	Contamination Assessment Report
CAS	Conventional Activated Sludge
CCTV	Closed-Circuit Television
CEDD	Civil Engineering Development Department
CSTW	Cavern Sewage Treatment Works
DO	Dissolved Oxygen
DP	Designated Project
DSD	Drainage Services Department
EIA	Environmental Impact Assessment
EIAO	Environmental Impact Assessment Ordinance
EIAO-TM	Technical Memorandum on Environmental Impact Assessment Process
EM&A	Environmental Monitoring and Audit
ES	Executive Summary
FCZs	Fish Culture Zones
FSP	Fine Suspended Particulates
GB	Green Belt
HP	High Pressure
HRs	Human Receptors
IFAS	Integrated Fixed Film Activated Sludge System
IGEM	Institution of Gas Engineers and Managers
KTN	Kai Tak Nullah
LCA	Landscape Character Area
MBBR	Moving Bed Biofilm Reactor
MLE	Modified Ludzack-Ettinger
NCO	Noise Control Ordinance
NSR	Noise Sensitive Receiver
OVT	Old and Valuable Tree
OZP	Outline Zoning Plan
PME	Powered Mechanical Equipment
ProPECC PN 1/94	Professional Persons on Construction Site Drainage
QRA	Quantitative Risk Assessment
RAP	Remediation Action Plan
RR	Remediation Report
RSP	Respirable Suspended Particulates
SS	Suspended Solids
SSSI	Sites of Special Scientific Interest
STEPS	Sha Tin Effluent Pumping Station
STSTW	Sha Tin Sewage Treatment Works
TAP	Toxic Air Pollutant
TBM	Tunnel Boring Machine
THEES	Tolo Harbour Effluent Export Scheme
TIN	Total Inorganic Nitrogen
TM-DSS	Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems
TPEPS	Tai Po Effluent Pumping Station
TPSTW	Tai Po Sewage Treatment Works
TSP	Total Suspended Particulates
USEPA	US Environmental Protection Agency
UV	Ultra Violet Light
VSRs	Visually Sensitive Receivers

1 INTRODUCTION

1.1 Project Background

1.1.1 To support the social and economic development of Hong Kong, there is a pressing need to optimise the supply of land for various uses. Rock cavern development is a sustainable and innovative approach to do so. The Policy Agenda of the 2016 Policy Address has stated that works for the relocation of the Sha Tin Sewage Treatment Works (STSTW) is to commence as soon as possible for vacating the existing STSTW site for development purpose.

1.1.2 The existing STSTW, with a design sewage treatment capacity of 340,000 m^3 per day, is the largest secondary sewage treatment works in Hong Kong serving Sha Tin and Ma On Shan. Relocating STSTW to caverns can release its existing site of about 28 hectares for other beneficial and more compatible uses. This will also enhance the living environment of the surrounding areas.

1.1.3 In November 2013, the Project Proponent, Drainage Services Department (DSD) consulted the Health and Environment Committee of the Sha Tin District Council on the findings and recommendations of the "Feasibility Study on Relocation of Sha Tin Sewage Treatment Works to Caverns", and the Committee generally supported the Government to proceed with the investigation and design of the Project.

1.1.4 In September 2014, DSD appointed AECOM Asia Co Ltd. to carry out detailed investigation, design and construction supervision of the Project under Agreement No. CE 30/2014 (DS) "Relocation of Sha Tin Sewage Treatment Works to Caverns: Caverns and Sewage Treatment Works – Investigation, Design and Construction" (the Assignment).

1.1.5 The Project is a Designated Project (DP) under the Environmental Impact Assessment Ordinance (EIAO). An application for an Environmental Impact Assessment (EIA) Study Brief under section 5(1)(a) of the EIAO was submitted on 12 May 2014 with a Project Profile (No. PP-508/2014) for the Project. An EIA Study Brief (No. ESB-273/2014) was issued on 24 June 2014. An EIA for the Project was then undertaken, as part of the Assignment, in accordance with the EIA Study Brief and the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM).

1.1.6 A series of public consultation/engagement activities have been conducted to gather comments and views from the public on the Project since 2012. Activities organised include a public forum, focus group meetings, community group meetings, roving exhibitions, site visits to Stanley Cavern Sewage Treatment Works, demonstrations of de-odourisation equipment and physical models. These covered a broad spectrum of stakeholders including local residents and representatives, members of the District Council, professional bodies, environmental groups, the media and statutory bodies. Views collected during the public engagement activities have been taken into consideration in the feasibility study and investigation phases of the Project in formulating the design and arrangement. The Project Proponent would continue to engage the stakeholders and the public to enhance mutual understanding and thereby the efficaciousness of the Project.

1.1.7 The purpose of the EIA is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project and associated works that will take place concurrently. This information will contribute to decisions by the Director of Environmental Protection on:

- The overall acceptability of any potential environmental consequences that are likely to arise as a result of the Project;
- The conditions and requirements for the detailed design, construction, operation and associated works of the Project to mitigate against potential environmental consequences wherever practicable; and

- The acceptability of residual impacts after the proposed mitigation measures are implemented.

1.2 Purpose of this Executive Summary

1.2.1 The purpose of this EIA Executive Summary (ES) is to present the summary of the findings, conclusions and recommendations in the EIA Report prepared in accordance with the requirements of the EIAO. This ES contains the following information:

- Section 2 presents purpose and nature of the Project;
- Section 3 presents the consideration of alternative options for the site location, plant layout arrangement, plant design and construction methods;
- Section 4 presents the key findings of environmental impacts;
- Section 5 describes environmental monitoring and audit for the Project; and
- Section 6 gives the conclusions.

2 PROJECT DESCRIPTION

2.1 Project Scope

2.1.1 The Project comprises the following components:

(i) Construction of caverns at Nui Po Shan for housing the Sha Tin Cavern Sewage Treatment Works (CSTW);
(ii) Construction of a secondary sewage treatment works including sludge treatment facilities inside the caverns, with a design capacity of 340,000 m^3/day at average dry weather flow (ADWF);
(iii) Construction of the main and secondary access tunnels and portals for access to the CSTW;
(iv) Construction of ancillary facilities to the caverns, including ventilation system, fire services, safety measures, communication systems, utilities, etc;
(v) Site formation and construction of ancillary facilities including a multi-storey administration building with laboratories, workshops, staff office, visitor facilities, etc, ventilation building, electrical substation, and other minor buildings and internal access road at the main portal located on A Kung Kok Street;
(vi) Site formation and construction of ancillary facilities including a ventilation building, electrical substation and internal access road at the secondary portal located on Mui Tsz Lam Road;
(vii) Construction of pipelines from the CSTW for connection to the existing emergency submarine outfall of the existing STSTW;
(viii) Construction of new effluent tunnels and pipelines for the discharge of treated effluent from the relocated STSTW to the existing Tolo Harbour Effluent Export Scheme (THEES) tunnel;
(ix) Associated slope stabilisation and natural terrain hazard mitigation and geotechnical works;
(x) Landscaping and architectural works;
(xi) Construction of a ventilation adit connecting the CSTW to a ventilation shaft located in Nui Po Shan, together with a surface access of around 500m length leading from the end of A Kung Kok Shan Road;
(xii) Construction of a temporary project specific magazine at Nui Po Shan next to the location for the Ventilation Shaft, with access from A Kung Kok Shan Road, for storage of explosives for up to a few days' use for construction of the CSTW, and decommissioning of it after the completion of blasting works;
(xiii) Operation and maintenance of the CSTW; and
(xiv) Decommissioning and demolition of the existing STSTW.

2.1.2 **Figure No. 60334056/ES/1.01** shows the location and boundary of the Project. A 3-D view to better illustrate the CSTW with typical cross sections is shown on **Figure No. 60334056/ES/1.02**. A preliminary layout plan of the proposed sewage treatment works in caverns is presented on **Figure No. 60334056/ES/1.03**.

2.1.3 Following detailed population projection and flow assessment of the broad Sha Tin area, the design treatment capacity and effluent standards of the relocated STSTW have been set as follows, which would be the same as those of the existing STSTW:

Design Treatment Capacity	340,000m^3/day (ADWF)

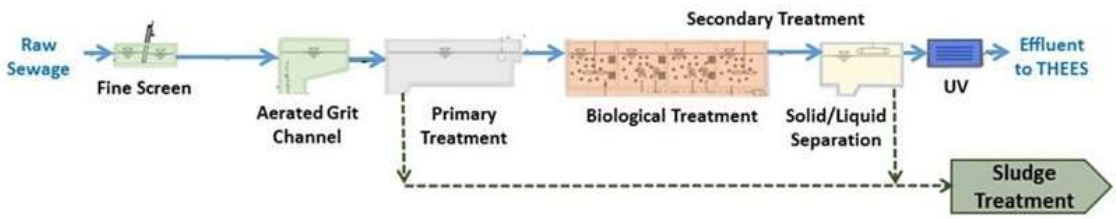
Determinand:	**Percentile Standard**	**Upper Limit**
Suspended Solids (mg/L)	30*	60
Biochemical Oxygen Demand (5 days, 20°C) (mg/L)	20*	40
Total Nitrogen (mg/L)	20#	35
Ammonia Nitrogen (mg/L)	5#	10

E. coli (count/100 mL)	1,000^	15,000*

Notes: * at 95-percentile
annual average
^ monthly geometric mean

2.1.4 In order to meet the required discharge quality standard, biological treatment will have to be provided. The sewage treatment process to be adopted for the CSTW will generally comprise the following components, but the detailed sequencing and configuration may vary from process to process (e.g. batch reactor processes may combine several functions in a single tank): (1) preliminary treatment including fine screening and grit removal; (2) primary treatment; (3) biological treatment; (4) solid/liquid separation; and (5) Ultra Violet Light (UV) disinfection. **Diagram 2.01** below presents a schematic flow diagram of the treatment process:

Diagram 2.01 Sewage Treatment Process Schematic Flow Diagram.



2.1.5 Sewage arriving at the inlet of the sewage treatment works will enter the preliminary treatment process, including mechanical bar screens and a grit removal system to remove large solid debris, sand and grit materials. Preliminarily treated effluent may then be directed to the primary treatment process where the suspended solids (SS) are settled out and removed as primary sludge. The primary effluent will then be conveyed to the biological treatment where micro-organisms will assimilate and remove pollutants in the sewage. Finally the secondary effluent will be disinfected by UV before discharge to the THEES tunnel.

2.1.6 A small portion of treated effluent, not exceeding 1,500 m^3/day (0.4% of the design capacity of the CSTW), would be reused for non-potable uses including use in the laboratory, polymer solution preparation, irrigation and toilet flushing inside the CSTW. Before reuse, this treated effluent will undergo a polishing step based on membrane filtration and/or reverse osmosis to meet the required necessary design standard.

2.1.7 A temporary project specific explosive magazine, which consist of above ground single-storey structures, is proposed to be built on Nui Po Shan next to the location of the Ventilation Shaft. The magazine will be accessed from A Kung Kok Shan Road and used for short-term – in the order of a few days – storage of explosives that will be used for construction of the CSTW. The explosive magazine will be decommissioned after the completion of construction of caverns for the Project.

2.1.8 Under the context of EIA Study Brief No. ESB-273/2014, the “Project”, as described above, is referring to the “Sha Tin Cavern Sewage Treatment Works” (CSTW). Any environmental impacts that may arise from future developments on the site of the existing STSTW after its decommissioning are outside and independent from the present EIA.

2.2 Need of the Project

There is a need to optimise the supply of land by sustainable and innovative approaches to support the social and economic development of Hong Kong. Relocating STSTW to caverns can release its present site for other beneficial uses.

2.3 Benefits of the Project

2.3.1 Upon relocation of the STSTW to caverns, 28 ha of land in Sha Tin with sea frontage can be released for re-development to meet the needs of the society.

2.3.2 The living environment of the surrounding area would be improved. The common potential impacts of a sewage treatment works, particularly odour and visual impacts, can be very effectively controlled and minimised. Odour management of the STSTW would be greatly enhanced since the caverns would serve as very effective natural barriers.

2.3.3 Advanced technologies can be adopted for the new sewage treatment facilities to enhance operation process performance, resilience and reliability, as well as operation efficiency.

2.3.4 Subject to subsequent planning, the released STSTW site will provide opportunities for developing a green and vibrant waterfront living environment with ample open space, a continuous promenade and recreational facilities such as amenity areas, cycle tracks and other leisure purposes could be created.

2.3.5 The development opportunities of the surrounding area adjacent to the existing STSTW site would be enhanced after completion of the Project and the accessibility of the area would be improved by improving transport infrastructure at the area.

2.3.6 The project location is rich in granite. Excavation of caverns will produce a large amount of hard granitic rocks, which are valuable natural resources for construction use. Rocks produced under this Project would become a local source to support the construction industry.

2.4 Project Programme

The Project construction works are anticipated to commence in 2018 with completion of the Project by 2028.

2.5 Summary of Designated Projects

2.5.1 The Project components that constitute a DP under the EIAO are listed as follows:

- DP1 – Sewage treatment works with an installed capacity of more than 15,000 m^3 per day under Item F.1 in Schedule 2 Part I;
- DP2 – Sewage treatment works under Item F.2 in Schedule 2 Part I---
  - With an installed capacity of more than 5,000 m^3 per day; and
  - A boundary of which is less than 200m from the nearest boundary of an existing or planned residential area, educational institution and health care institution.
- DP3 – An activity for the reuse of treated sewage effluent from a treatment plant under Item F.4 in Schedule 2 Part I;
- DP4 – Underground rock caverns under Item Q.2 in Schedule 2 Part I;
- DP5 – An explosives depot in a stand-alone, purpose built building under Item K.10 in Schedule 2 Part I; and
- DP6 – Decommissioning of an explosives depot under Item 11 in Schedule 2 Part II.

2.6 Concurrent Projects

2.6.1 Nine concurrent projects in the vicinity of the Project site are identified and their cumulative impacts have been assessed. Amongst the identified concurrent projects, it is found that the following two concurrent projects will have cumulative impacts on this Project. It should be noted that the status of these concurrent projects is based on the available information at the time of submission of this Report and the implementation of individual projects would be subject to further development and subsequent actions of the respective project proponents.

(a) Proposed works for Upstream Sewerage Facilities for the Relocation of Sha Tin Sewage Treatment Works – this is a DSD project and include construction of a new pumping station and modification of existing pumping stations as well as sewerage works in order to convey sewage to the CSTW for treatment. All works are expected to start at 2021 for completion in 2026.

(b) Tolo Harbour Sewerage of Unsewered Areas, Stage II - This project covers the provision of sewerage to a number of unsewered areas in Sha Tin. Works are on-going and expected to be completed by 2020.

3 CONSIDERATION OF ALTERNATIVE OPTIONS

The design of the Project has undergone a detailed evaluation of different arrangement to arrive at the optimum planning, engineering and environmental solutions which fit together in a coherent manner. The following sections summarise the evaluation criteria and the consideration of various alternative options.

3.1 Consideration of Alternative Site Locations

Consideration of Alternative Sites

3.1.1 When conducting the review of the proposed relocation site, five areas adjacent to the existing STSTW were identified and evaluated. These five areas are: Nui Po Shan at A Kung Kok, Shek Mun, Ma On Shan, Kau To Shan South and Kau To Shan North.

3.1.2 The review confirmed that Nui Po Shan is the preferred site for the relocation of the STSTW. To sum up, the Nui Po Shan site has the following merits and is more favorable than the others:

- The geology of this area, belonging to hard granite with no obvious weak zones and faults, is most suitable for construction of large caverns;
- This area is located in the proximity of the existing STSTW and THEES effluent export tunnel which conveys the treated effluent from the STSTW to Kai Tak Nullah (KTN) (Kai Tak River after completion of re-construction and upgrading works) in Wong Tai Sin for discharge. As such, relocating the STSTW to this area will minimise the disturbance to the whole Sha Tin District, reducing the extent of construction works due to modification of upstream sewerage and shortening the construction period;
- No private land resumption is needed; and
- This area is close to Ma On Shan Road. With appropriate measures, the traffic impact due to the relocation of the STSTW is the minimum.

3.1.3 Although the direct environmental impacts related to all five areas are similar, suitable geology and close to existing high-speed road in Nui Po Shan Sites will shorten the construction period and haul route that will also have less indirect environmental impacts than other options.

3.1.4 Furthermore, the position and orientation of the CSTW will avoid encroaching into the boundaries of Ma On Shan Country Park and Mui Tsz Lam and Mau Ping Priority Sites for Enhanced Conservation.

3.2 Consideration of Alternative Plant Layout Arrangement

Consideration of Supporting Facilities Locations

3.2.1 There are two options in locating the supporting facilities: (1) at both Main Portal and Area 73, or (2) at the Portals only. Option 1 was the original arrangement proposed in the Feasibility Study Stage to limit the extent of site formation works at the portal area. However, this option will take up a considerable area of Area 73 reducing the versatility of the site. Furthermore, the connectivity with the CSTW and operation effectiveness is affected. Considering the demerits of Option 1, Option 2 was developed and aimed to relocate the facilities in Area 73 under Option 1 to the Main Portal as well. The extent of site formation works in Option 2 will increase. In return, connectivity among the facilities, buildings and the sewage treatment works is much improved. The portal area will be flexibly utilised by

integration of the sewage treatment works ancillary facilities with the THEES Tunnel Portal. Area 73 will not need to be reserved for any permanent facility of the CSTW.

Consideration of Ventilation Shaft Locations

3.2.2 Different options have also been considered in determining the location of the ventilation shaft. The Feasibility Study Stage has originally proposed the ventilation shaft to be located at the south-west corner of the CSTW. The outlet of the ventilation shaft will be at an uphill area at approximately 240mPD and is far from all major residential developments and villages, the closest one being more than 700m away on plan. On the other hand, to allow construction of the ventilation shaft, an access road approximately 1,200m in length leading from the upper end of A Kung Kok Shan Road will need to be laid. The ventilation shaft location was then revised in subsequent design development, and lies approximately 500m to the south-west of the original location. It is also very remote from all major residential developments and villages, the closest one being more than 1,000m away. The outlet of the ventilation shaft will be in an uphill area at approximately 180mPD. At this location, the access road leading from the top end of A Kung Kok Shan Road can be much shortened to about 500m in length, which will generate less soft spoil and require less tree felling. Odour impact assessment indicates that residual odour impacts from both options are minimal and are in full compliance with the EIAO-TM requirements. In view of the shorter access road consequently less volume of construction works for the shaft and tree felling, the revised location is therefore considered preferable.

Consideration of Alternative Emergency Outfall Options

3.2.3 Under normal operation, treated effluent from the relocated STSTW will be conveyed by the THEES effluent tunnel for ultimate discharge into Victoria Harbour. In other or emergency situations, same as for the existing STSTW, an emergency outfall is needed for bypass of treated or partially treated effluent to Tolo Harbour. Various options of an emergency outfall for the relocated STSTW have been considered, namely (1) continued utilization of the existing emergency submarine outfall, (2) construction of a new emergency submarine outfall and (3) construction of a new seawall outfall. After evaluation, Option (1) should have the best water quality performance during the operation stage because its location will have the best effluent dispersion effect during emergency bypass. The connection pipes to the existing outfall would be constructed by trenchless method so that no disturbance to marine or riverbed sediments would be induced. This option makes the most use of the existing facilities and involves the least amount of works and will incur the least environmental impact in terms of marine ecology and water quality during construction. Hence, Option (1) is the most favourable.

3.3 Consideration of Alternative Plant Design

Consideration of Alternative Treatment Level

3.3.1 The treatment level of a sewage treatment work is dependent on its environmental settings and the mode of discharge. The aim is to achieve satisfactory water quality meeting relevant stipulations. The level of treatment of a sewage treatment work will determine the effluent quality, and the mode of discharge will affect the subsequent processes including dilution, dispersion and diminution of any residual pollutants. Hence for a given environmental setting, the treatment level and the mode of discharge are closely related – a lower treatment level will require a better mode of discharge, e.g. a longer submarine outfall, and vice versa.

3.3.2 The treatment level of the existing STSTW is secondary plus disinfection, and is able to fulfil the relevant water quality requirements. For the relocated STSTW, maintaining the treatment level the same as that of the existing STSTW will result in a water quality at least not inferior to the present situation. Raising the treatment level to tertiary treatment will give higher quality effluent but at the same time will incur significantly higher construction

and operation costs. On the other hand, a lower treatment level will result in a lower water quality in the receiving waters.

3.3.3 The whole Sha Tin District adopts seawater flushing. Switching the use of seawater to treated effluent will require a higher level of treatment than secondary to meet flushing water standard, with much higher construction and operation costs, as well as operation power consumption owing to the additional treatment processes. The benefits, nonetheless, are not apparent as such a switching will not give rise to conservation of freshwater resources.

3.3.4 In light of the adequacy of the current treatment level in meeting water quality requirements, it is both environmentally and economically acceptable to maintain the current level of secondary treatment plus disinfection for the CSTW.

Consideration of Alternative Treatment Processes

3.3.5 In order to meet the required discharge quality standard, biological treatment will have to be provided. The sewage treatment process employed in the existing STSTW is the Modified Ludzack-Ettinger (MLE) process, a relatively conventional activated sludge technology based solely on suspended growth, which has a lot of operation experience locally. This Conventional Activated Sludge (CAS) is one of the options for the sewage treatment process for the CSTW.

3.3.6 There are other technologies available that, by making use of attached growth or granular forms of activated sludge, will reduce the required hydraulic retention time and thus give an overall more compact process than CAS. For the purpose of discussion here these will be called Compact-type technologies. They include the Moving Bed Biofilm Reactor (MBBR); Integrated Fixed Film Activated Sludge System (IFAS); the Aerobic Granular Sludge (AGS), etc.

3.3.7 Both CAS and the Compact-type technologies will provide secondary biological treatment capable of achieving the required effluent standards when coupled with UV disinfection. In terms of environmental impact there is no significant difference in the nature of impacts between the two options. On the other hand, owing to higher tankage volume, CAS will involve a considerably larger volume of excavation works and higher construction period during which environmental impacts will be generated. Hence Compact-type technologies are the preferred option.

Consideration of Alternative Sludge Treatment Process

3.3.8 Sludge from the future CSTW will be conveyed to the Sludge Treatment Facility in Tuen Mun for incineration, similar to the arrangement for the existing STSTW. Prior to conveyance to the Sludge Treatment Facility, a number of alternative handling options are considered:

- Dewatering with prior anaerobic digestion, with digesters located inside the caverns
- Dewatering with prior anaerobic digestion, with digesters located outside the caverns
- Direct Dewatering without digestion

3.3.9 Anaerobic digestion would reduce the volume of the sludge to be disposed of to the Sludge Incineration Facility, and allow the recovery of heat and energy from the biogas generated for utilization in the sewage treatment works. Yet as biogas is inflammable, its generation inside caverns is as a matter of principle not acceptable under the prevailing fire safety policy. Open-top design (i.e. the top of the digester protrudes above the hill surface) is not viable for the Project owing to the CSTW being located deep under the steep topography of Nui Po Shan.

3.3.10 The available space at the cavern portal area is very limited and is not sufficient to accommodate any sludge digestion facilities in addition to the other necessary supporting facilities of the CSTW. Extensive site formation including substantial setting back of the existing green belt area would be required if space sufficient for the sludge digestion facilities is to be made available. This, however, would cause significant adverse environmental impact in terms of tree felling, significantly increased geotechnical and slope stabilisation works, additional excavated materials to be disposed as well as noise and air emission due to the additional excavation works.

3.3.11 In view of the issues arising from the inclusion of anaerobic digestion at the relocated STSTW, either inside or outside the caverns, direct dewatering option is the most feasible option for this Project.

Consideration of Alternatives to Minimise Emergency Discharges

3.3.12 In the relocated STSTW, sufficient standby units will be provided for all major treatment units and Electrical and Mechanical (E&M) equipment to cater for equipment breakdown and maintenance needs, which in turn will minimize the risk of inadequately treated effluent or emergency discharge. Dual power supply from two separate electrical sub-stations will be arranged in order to further minimise any possible disruption to operation due to suspension of power supply. Furthermore, commissioning of the relocated STSTW is planned to be carried out in stages. A portion of the total flow will first diverted to the relocated plant to enable the treatment process to be tested, refined and adjusted to the required performance before the remaining sewage is diverted to the relocated STSTW.

3.4 Consideration of Alternative Construction Methods and Sequence of Works

Construction Methods for Tunnels and Caverns

3.4.1 The main construction activities of the Project are excavation of tunnels and caverns. Based on the geological profile, it is envisaged that excavation will be mostly carried out in good quality granitic rock mass. They are typically excavated by either drill-and-blast or by Tunnel Boring Machine (TBM) methods. Other forms of excavation such as mechanical and chemical splitting are not cost effective except for either small volume of excavation or at locations where blasting would pose too great nuisance or be hazardous. The environmental impacts due to drill-and-blast and TBM are similar as the construction of caverns is basically carried out underground. However, TBM has certain limitations such as technical impracticality and thus non-availability beyond a certain size, difficulties in coping with changes in cavern levels and geometry along the treatment process trains, the need of a considerable launching space, etc., which render it not the most effective solution for this Project. For the construction of access tunnels and process caverns, drill-and-blast method would also suit the nature and scale better that TBM. On the other hand, for laying of pipes using trenchless method, TBM of smaller size is considered as an appropriate method.

Consideration of Alternative Temporary Explosive Magazine Arrangements

3.4.2 The scenario of not having an on-site temporary magazine has been considered. Under such a situation, explosives availability at the works fronts will be dependent totally upon explosives delivery by the Mines Division of Civil Engineering and Development Department (CEDD), which normally is limited to once per day and in any case would be subjected to resources limitations of the Mines Division. For a project with multiple large-scale caverns like the CSTW, this will pose a serious constraint on the construction programme and unnecessarily prolong the construction period, with a significant delay in realizing the environmental benefits of the relocation Project. This scenario is therefore undesirable in environmental aspects. The option of shared use of other existing magazine sites with other contracts have also been considered. However, there are actually very few such magazines, and all of them are subject to different constraints or uncertainties which make this option infeasible. A much more environmentally sound and technically viable

alternative is the provision of a temporary on-site explosives magazine. The future CSTW complex will comprise a vertical ventilation shaft opening to a remote uphill area on Nui Po Shan. Construction of the shaft will necessitate the installation of an access road from the upper end of A Kung Kok Shan Road. Adjacent to the location of the ventilation shaft opening is a small flat area. This is considered a very suitable site for the temporary explosives magazine, as it is remote from most population and the community.

3.4.3 To ensure the security during storage of explosives, security fences complete with overhang covered in barbed wire will be installed around the store. Security guards will be on duty 24 hours and only registered authorised persons will be allowed to enter the compound. Furthermore, a Closed-circuited Television (CCTV) system will be installed to provide 24 hours surveillance and video recording.

Construction Methods for THEES Connection Works

3.4.4 The current arrangement of discharging STSTW treated effluent to KTN through the THEES tunnel would be maintained after the relocation. To convey the treated effluent of the future CSTW to the tunnel, two options have been considered:

- Option 1: the connection point will be outside the THEES tunnel at its Sha Tin portal. A short section of tunnel will be constructed between the CSTW and the THEES tunnel inlet chamber.

- Option 2: the connection point will be at a point along the THEES tunnel several hundred metres downstream of its Sha Tin portal.

3.4.5 Both Options will inevitably require temporary suspension of the THEES tunnel at certain times for constructing the connection, during which treated effluent in the THEES will be temporarily bypassed into Tolo Harbour. For Option 1, the connection works involve modifications to the existing inlet chamber to the THEES tunnel; while for Option 2, the connection will involve breaking into the existing THEES tunnel for a T-junction and making good the tunnel lining afterwards. Both the number of times and duration of temporary suspension will be less for Option 1 than Option 2. Option 1 is therefore the preferred alternative. Furthermore, it is assessed that the connection works of Option 1 can be split into a number of steps for synchronized implementation with THEES maintenance, thereby avoiding the need for additional temporary suspension of the THEES.

4 KEY FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

4.1 Approach to the EIA

4.1.1 The EIA process provides a means of identifying, assessing and reporting the environmental impacts associated with the construction and operation of the Project based on the engineering design information available at this stage. It is an iterative process that has been followed in parallel with the design process to identify the potential environmental effects of various design options, and develop alternatives as well as mitigation measures to be incorporated into the design, construction and operation of the Project. Feedbacks and advices obtained from various public engagement activities have been considered and incorporated into the design and EIA process where appropriate. The Project Proponent has also come up with measures that can avoid some potential environmental impacts, while others are minimized or mitigated to acceptable levels.

4.1.2 The findings of this EIA study have determined the likely nature and extent of the following environmental impacts predicted to arise from the construction and operation of the Project:

- Air Quality Impact;
- Noise Impact;
- Water Quality Impact;
- Land Contamination;
- Hazard to Life;
- Ecology Impact (Terrestrial and Marine);
- Fisheries Impact;
- Landscape and Visual Impacts;
- Cultural Heritage Impact;
- Waste Management Implications; and
- Health Impact.

4.2 Air Quality Impact

Assessment Scope and Key Criteria

4.2.1 Potential air quality impacts associated with the construction and operational phases of the project have been assessed in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.1 and Appendix B of the EIA Study Brief, as well as Annex 4 and Annex 12 of the EIAO-TM. The assessment area for construction dust impact assessment is within 500m from the boundary of the Project site. Regarding operational odour impact by CSTW, potentially affected air sensitive receivers (ASRs) are generally identified within 500m study boundary from the ventilation shaft, portal facilities and CSTW. In light that odour is a key concern of the local community, ASRs outside the 500m study boundary are also identified to investigate the impact in a longer range.

Construction Phase

4.2.2 Potential air quality impacts from the construction works (including construction of CSTW and demolition of existing STSTW) of the Project would mainly be related to construction dust from excavation, materials handling, spoil removal and wind erosion. Quantitative fugitive dust assessments have been conducted, taking into account the cumulative impact caused by nearby concurrent sources within 500m from the boundary of the Project site. With the implementation of mitigation measures specified in the Air Pollution Control (Construction Dust) Regulation together with the recommended dust suppression measures including watering 8 times a day on active works areas, exposed areas and unpaved haul roads, using dust collector with 99% removal efficiency for rock crusher and adopting good site practices, and Environmental Monitoring and Audit (EM&A) programme, the predicted dust impact at ASRs (locations of ASRs refer to **Figure No. 60334056/ES/4.01**) would comply with the hourly, daily and annual particulate criteria stipulated in the Air Quality Objectives (AQOs) and EIAO-TM. The predicted cumulative 1-hour average Total Suspended Particulates (TSP), daily and annual average Respirable

Suspended Particulates (RSP), daily and annual average Fine Suspended Particulates (FSP) are summarised in **Table 4.1** and **Table 4.2** below.

Table 4.1 Summary of predicted construction dust levels (in µg/m³) at representative air sensitive receivers during construction of relocated STSTW

	TSP	RSP		FSP	
	Max. 1-hour	**24-hour (10th highest)**	**Annual**	**24-hour (10th highest)**	**Annual**
Concentrations at ASR (Unmitigated)	248 – 14,458	75 - 443	38 - 55	55 - 118	26 - 34
Concentrations at ASR (Mitigated)	132 - 471	72 - 100	37 - 41	53 - 60	26 - 29
Criteria	500	100	50	75	35

Table 4.2 Summary of predicted construction dust levels (in µg/m³) at representative air sensitive receivers during demolition of existing STSTW

	TSP	RSP		FSP	
	Max. 1-hour	**24-hour (10th highest)**	**Annual**	**24-hour (10th highest)**	**Annual**
Concentrations at ASR (Unmitigated)	228 – 4,567	74 – 221	37 - 45	55 – 68	26 – 29
Concentrations at ASR (Mitigated)	132 - 491	72 - 85	37 - 41	53 - 59	26 - 29
Criteria	500	100	50	75	35

Operational Phase

4.2.3 Potential air quality impacts during operational phase would come from odour emission from the ventilation shaft of the CSTW (locations of ASRs refer to **Figure No. 60334056/ES/4.02**). Cavern is an effective natural barrier and the sewage treatment facilities which would pose odour emission would be enclosed. Odour emitted from these enclosed sewage treatment facilities would all be treated in the deodourizing units with odour removal efficiency of 80 – 97% before venting to the ambient via the ventilation shaft which is located at a remote area on Nui Po Shan. In addition, negative pressure would be applied inside caverns preventing the odour leakage through the access tunnels. Odour management of the sludge transportation would also be enhanced.

4.2.4 With the implementation of odour control measures, the odour impact assessment results show that the predicted odour concentration at all ASRs located in the vicinity of CSTW would comply with the odour criterion (5 odour units based on an averaging time of 5 seconds) stipulated in the EIAO-TM. The Project is considered to have considerable improvement on the air quality condition at the Study Area as comparing with the situation with the operation of existing STSTW.

4.3 Noise Impact

Assessment Scope and Key Criteria

4.3.1 Potential noise impacts associated with the construction and operational phases of the project have been assessed in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.2 and Appendix C of the EIA Study Brief, as well as Annex 5 and Annex 13 of the EIAO-TM. The study area for noise impact assessment is defined by a distance of 300m from the site boundary of the Project.

Construction Phase

4.3.2 Construction airborne noise is expected from the use of Powered Mechanical Equipment (PME) during various construction activities, such as excavation, concreting, compaction works, demolition activities, material handling activities etc, at all land-based works areas including the existing and relocated STSTW, improvement measures at A Kung Kok Street, alternative accessed to and from the relocated STSTW and temporary explosives magazine site at A Kung Kok Shan. Noise impact arising from construction activities of the Project is assessed. The predicted maximum unmitigated construction airborne noise levels at the representative Noise Sensitive Receivers (NSRs) (locations refer to **Figure No. 60334056/ES/4.03**) in the vicinity of the Project work sites would be 70 – 89 dB(A). With the implementation of all practicable mitigation measures including adoption of quiet PME, use of movable noise barrier/acoustic mat, and limitation of the number of on-time operating PMEs within 120m of the Neighbourhood Advice-Action Council Harmony Manor during construction of the access road to temporary magazine site, the predicted maximum construction airborne noise levels at the representative NSRs in the vicinity of the Project work sites would comply with the EIAO-TM criteria of 75 dB(A) for residential NSRs and 70 dB(A) for educational NSRs during normal teaching hours (65 dB(A) during examination period) except occasional exceedance of noise criterion for examination period by 1 dB(A) at S.K.H. Ma On Shan Holy Spirit Primary School during examination period in January and June 2021, January and June in 2022, and January 2023. As this NSR is located in close vicinity of the construction work areas, all practical mitigation measures have been exhausted. With reference to the latest examination schedule of this school, the affected period would be limited to 3 days in each affected examination month. In addition, the affected educational NSR has been noise insulated with air conditioners. It is therefore considered that the residual noise impact is in short term period and could be significantly reduced by keeping the windows closed during the affected examination periods. To further reduce the noise impact, it is recommended that the Contractor should closely liaise with the schools to avoid scheduling the noisy construction works during examination period as far as practicable.

4.3.3 During the actual construction period, as much as practically possible, measures should be done to reduce the construction noise, and on-going liaison with all concerned parties and site monitoring should also be conducted during the course of the construction period. A construction noise EM&A programme is recommended to check the compliance of the noise criteria during normal daytime working hours.

4.3.4 Ground-borne construction noise impacts pertinent to the use of hydraulic breaker, hand-held breaker, drill rig and TBM would comply with criteria of EIAO-TM. The predicted maximum construction ground-borne noise levels associated with the PME use at open works areas at the representative NSRs (locations of NSRs refer to **Figure No. 60334056/ES/4.04**) in the vicinity of the work sites would be 40 – 53 dB(A), hence comply with the EIAO-TM criterion. No adverse ground-borne construction noise impacts is predicted and therefore no noise mitigation measure and noise monitoring are proposed.

4.3.5 For the temporary modification works at the merging point of Ma On Shan Road and temporary access haul road, the provision of 220m length of noise barrier of a height at 10mPD on the temporary access haul road to replace the existing 150m length of noise barrier at 9.2mPD to 10mPD height on Ma On Sha Road would pose negligible difference in the overall traffic noise level at the sensitive facades in the vicinity. Once the construction work is completed, the noise barrier on the concerned road section of Ma On Shan Road would be re-installed according to the existing configuration.

Operational Phase

4.3.6 The noise impact associated with the operation of the Project has been assessed. The predicted fixed plant noise levels at the representative NSRs (locations of NSRs refer to **Figure No. 60334056/ES/4.03**) would comply with the criteria based on the plant design information provided by the Engineer at the time of the assessment. If there is any change in engineering design information during detailed design stage or fitting-out stage, the fixed source noise design should be reviewed by the Engineer/Contractor to ensure that both the Noise Control Ordinance (NCO) and EIAO-TM criteria at the NSRs can be met in the future. Prior to the operational phase of the Project, a commissioning test for the equipment in ventilation buildings, the ventilation shaft, ventilation fan for chiller plant room and cooling tower at the administration building would be conducted to ensure compliance with the relevant allowable maximum sound power levels.

4.4 Water Quality Impact

Assessment Scope and Key Criteria

4.4.1 The Study area for water quality impact assessment covered the Victoria Harbour Water Control Zone (WCZ) and Tolo Harbour and Channel WCZ as designated under Water Pollution Control Ordinance (WPCO), including inland water bodies within 500m from the site boundary. Key assessment criteria include Annexes 6 and 14 of the EIAO-TM, Water Quality Objectives (WQO) for Victoria Harbour WCZ and Tolo Harbour and Channel WCZ, Hong Kong Planning Standards and Guidelines, Water Supplies Department (WSD) target seawater quality objectives, Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS), Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94), Section 3.4.3 and Appendix D of the EIA Study Brief.

Representative Sensitive Receivers

4.4.2 In Victoria Harbour WCZ, major Water Sensitive Receivers (WSRs) identified are WSD flushing water intakes, cooling water intakes, typhoon shelters and potential water sports area at Kai Tak. In Tolo Harbour and Channel WCZ, major WSRs identified are marine water including flushing water intakes, cooling water intake, bathing beach, typhoon shelter, corals, mangroves, Fish Culture Zones (FCZs), Sites of Special Scientific Interest (SSSI) and nursery area for commercial fisheries resources; inland water bodies within 500m from the site boundary including Shing Mun River, Ma Tai Stream, and streams along Mui Tsz Lam Road and in Nui Po Shan, water gathering grounds as well as secondary contact recreation subzone for water recreational uses.

Construction Phase

Land-based Construction

4.4.3 Minor water quality impact would be associated with land-based construction. Impacts may result from surface runoff, accidental spillage, sewage from on-site construction workers and groundwater infiltration. Impacts could be controlled to comply with the WPCO standards by implementing the recommended mitigation measures.

THEES Connection Works

4.4.4 Both the Tai Po Sewage Treatment Works (TPSTW) and existing STSTW are secondary treatment plants with disinfection process. Under normal operation of the THEES, the Tai Po Effluent Pumping Station (TPEPS) would pump the secondarily treated and disinfected effluent from TPSTW via a rising main and a submarine pipeline to the Sha Tin Effluent Pumping Station (STEPS). The STEPS would receive the secondarily treated and disinfected effluent from both TPSTW and STSTW for combined discharge to the KTN in the Victoria Harbour WCZ via the THEES effluent tunnel.

4.4.5 In order to maintain the current arrangement in discharging effluent to KTN through THEES tunnel, the provision of a dry construction zone within the THEES tunnel to allow connection from the CSTW would be essential for the Project. During the connection works, the THEES Tunnel needs to be temporarily suspended from its normal operation with effluent bypass into the Tolo Harbour.

4.4.6 To minimize water quality impact to Tolo Harbour, the necessary THEES connection works required for this Project will be split into a number of steps for sequential and synchronized implementation with THEES maintenance, thereby avoiding the need for additional temporary suspension of the THEES. Each suspension will not be longer than 4 weeks and will be outside the algae blooming season (January to May), and the frequency will be no more than once per year during the construction phase of the Project. Therefore, no additional water quality effect on the Tolo Harbour waters would result from the proposed THEES connection works. No cumulative or residual impact would be expected during the construction phase of the Project with the recommended mitigation measures properly implemented.

Operational Phase

4.4.7 The CSTW effluent together with the TPSTW effluent will be discharged to the Victoria Harbour via the THEES during normal operation. Compared with the existing STSTW, the CSTW has the same design flow capacity and effluent standard. Hence, this Project will not induce any change to the flow and loading of THEES effluent to the Victoria Harbour.

4.4.8 Maintenance of the THEES tunnel is required to ensure proper functioning and integrity of the tunnel. During the inspection or maintenance of the THEES tunnel, temporary suspension of the normal THEES operation with effluent bypass into the Tolo Harbour is unavoidable in order to provide a safe and dry zone within the THEES tunnel. It should be noted that such temporary effluent bypass during THEES maintenance is part and parcel of the existing THEES regardless of whether the Project is implemented or not.

4.4.9 Mathematical modelling was undertaken under this EIA to study the water quality impact arising from a 4-week THEES maintenance discharge. The model results indicated that even for such a discharge in the algae blooming season (January to May) under the ultimate development scenario, the increase in pollution level in Tolo Harbour would still be transient and reversible.

4.4.10 With the design capacity, effluent standards and effluent discharge points being the same as those of the existing STSTW, this Project will not change the flow, load and discharge point of the THEES effluent to Victoria Harbour and Tolo Harbour.

4.4.11 In order to further minimize water quality impact, it is recommended under this Project to schedule the THEES maintenance outside the algae blooming season (January to May). Water quality modelling indicates that the pollution elevation in Tolo Harbour and the associated recovery period would be significantly reduced and alleviated as compared to the case of inside the algae blooming season (January to May). An event and action plan and a water quality monitoring programme (presented in the standalone EM&A Manual) is proposed for the THEES maintenance events during both construction and operational phases to minimize water quality impacts.

4.4.12 A contingency plan has also been formulated to minimize the impact of emergency discharges and facilitate subsequent management of the situation. An event and action plan and a water quality monitoring programme (as presented in the standalone EM&A Manual) is also proposed for the emergency discharge events during operational phase to minimize the water quality impacts. No cumulative or residual impact is expected during the operational phase of the Project with the recommended mitigation measures properly implemented.

4.5 Land Contamination

4.5.1 The land contamination assessment is conducted in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.4 and Appendix F of the EIA Study Brief, as well as Annex 19 of the EIAO-TM.

4.5.2 Based on the site appraisal, within the Project boundary, the existing STSTW and the temporary works area on Area 73, currently part of a Vehicle Detention Centre, are considered to be areas with potential land contamination concerns.

4.5.3 A sampling and testing programme, targeting the existing STSTW and the temporary works area on Area 73, has been proposed. Since the sites will continue to be in use until the full commissioning of the relocated STSTW, the proposed Site Investigation works and any necessary remediation action are recommended to be carried out after decommissioning of the existing STSTW and when the Area 73 temporary works area is vacated, but prior to re-development.

4.5.4 In addition, two sites (the David Camp and proposed A Kung Kok Shan Road surface magazine site) within the Project boundary are inaccessible or yet to be constructed. Further site walkover is recommended within the sites when access to the camp site is available and before the decommissioning of the surface magazine site to confirm the presence of any land contamination. If land contamination were present, detailed land contamination assessment and remediation would be required prior to the re-development.

4.5.5 Further site walkover, assessment and remediation (if necessary), including the submission of Supplementary Contamination Assessment Plan (CAP(s)), Contamination Assessment Report/ Remediation Action Plan (CAR(s)/RAP(s)) and Remediation Report (RR(s)) would follow Environmental Protection Department's prevailing guidelines and recommendation in the EIA Study.

4.5.6 With the implementation of further site walkover, land contamination assessment and, if required, remediation works for the Project Site, any soil/groundwater contamination would be identified and properly treated prior to re-development. Land contamination impacts are therefore considered surmountable to future occupants.

4.6 Hazard to Life

4.6.1 The hazard to life assessment is conducted in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.5 and Appendix G of the EIA Study Brief, as well as Annex 4 of the EIAO-TM.

Storage, Transport and Use of Explosives

4.6.2 As discussed in Section 3.4.1 of this ES, to ensure the timely completion of the Project, Drill-and-Blasting method for rock excavation is proposed. As further discussed in Section 3.4.2 of this ES, in view of the large quantity of rock to be excavated, the provision of a temporary magazine would provide a more reliable explosive supply, allow flexible blasting time and multiple faces under different excavation sequence and give maximum tunnel production rates. A Quantitative Risk Assessment (QRA) for the storage, transport and use of explosives relates to the construction stage of the Project has been carried out. Since no explosives will be handled during the operational stage, no QRA would be conducted for the operational stage.

4.6.3 A robust site selection process has been undertaken for the proposed temporary magazine. A surface-type magazine is proposed to be constructed at the location next to the proposed ventilation shaft with access from the end of A Kung Kok Shan Road. The criteria of the EIAO-TM for Individual Risk will be met. The assessment results show that the Societal Risk lies within the "As Low As Reasonably Practicable (ALARP)" region in respect of the criteria stipulated in Annex 4 of the EIAO-TM. All practicable mitigation measures have

been identified, including the use of cast boosters and reduction of explosives quantities to be transported in each trip. The cost effectiveness of each justifiable mitigation measure has been assessed. The results show compliance with the ALARP principles and Risk Guidelines (EIAO-TM Annex 4) provided recommendations are implemented.

High Pressure (HP) Underground Town Gas Transmission Pipelines

4.6.4 The transport route of explosives is close to an HP underground town gas transmission pipeline. A QRA has therefore been conducted to assess the increased societal risk arising from the incremental population during both construction and operational phases of the Project. The individual risk complies with both the Hong Kong Risk Guidelines and the Institution of Gas Engineers and Managers (IGEM) Risk Guidelines. The societal risk lies in the lower "ALARP" region of the Hong Kong Risk Guidelines for both construction stage and operational stage scenarios. Compared to the "without Project" scenarios for both construction and operational stages, it is found that the ALARP is due to the background population instead of the population induced by the Project.

4.7 Ecological Impact (Terrestrial and Marine)

4.7.1 The Ecological Impact Assessment is conducted in accordance with the relevant requirements as specified in Section 3.4.6 and Appendix H of the EIA study brief, as well as Annexes 8 and 16 of the EIAO-TM.

4.7.2 Literature review and ecological field surveys have been conducted. Terrestrial habitats identified within the assessment area include woodland, fung shui wood, plantation, shrubland, cultivated land, developed area, and stream. (Refer to **Figure No. 60334056/ES/4.05** and **Figure No. 60334056/ES/4.06**) Marine habitats within the assessment area include subtidal hard substrata, soft bottom habitats, and intertidal habitats. The ecological values of the identified habitats are rated between low and moderate to high. No sites of conservation importance will be directly affected.

4.7.3 Direct impacts arising from the proposed land-based works include permanent loss and temporary loss of some woodland, plantation, and shrubland, as well as minor habitat fragmentation of woodland and plantation in Nui Po Shan. Given the relatively low to moderate ecological values of the habitats and the small area affected, impacts are anticipated to be generally minor in nature. The permanent loss of woodland (0.65 ha) will be mitigated by compensatory planting (approximately 0.92 ha) of native species, while all temporarily affected works area will be reinstated. A Woodland Compensation Plan should be prepared to form the basis (e.g. implementation details, management requirement, and monitoring requirements) and submitted for approval from EPD at least three months before commencement of compensatory woodland planting. All temporarily affected works area will be reinstated. Avoidance measures would be implemented to preserve a natural stream in vicinity of the proposed access road on Nui Po Shan (e.g. provision of an elevated section at the stream crossing).

4.7.4 Some plant species of conservation importance were recorded within the Project boundary. To minimise impacts, a Detailed Vegetation Survey should be conducted prior to the commencement of construction works to identify potentially affected plant species. All identified species would be labelled and fenced off on site for better preservation or, in case of unavoidable loss, for transplantation according to the Protection and Transplantation Proposal.

4.7.5 There would be no disturbance to marine or riverbed sediments under the Project and hence loss of marine habitat is avoided. According to the water quality impact assessment, no unacceptable ecological impact is anticipated on marine ecological resources. Nevertheless, an event and action plan and a water quality monitoring programme should be implemented during construction and operation phases to verify whether or not impact predictions are representative, and to ensure that it would not result in unacceptable impacts. During operation phase, monitoring of the treated effluent quality from the CSTW

should be carried out to ensure that the effluent quality would comply with the design standards.

4.7.6 Construction site runoff and other disturbance impacts resulting from the proposed aboveground works may potentially result in indirect impact on the streams, wildlife, and some fauna species of conservation importance. Standard mitigation measures such as good site practice, control of glare / lighting, minimisation of groundwater infiltration, and water quality impact control measures are proposed.

4.7.7 Excavation in rock would have relatively minor potential impacts on groundwater as compared to excavation in soft ground. The rock itself is a natural barrier with very low permeability which can prevent potential groundwater drawdown in any soil and aquifer layers above the rock stratum. Thus it would not adversely affect the groundwater level within the soil layer as well as the water level of the adjacent streams. Since the majority of the CSTW is situated in very competent rock stratum in Nui Po Shan, the impact on groundwater would be minor. Nonetheless, precautionary measures would be taken in cavern design and construction to minimize the potential impacts from the change in groundwater level. Preventive measures such as pre-grouting and post-grouting, which have been successfully applied in other tunnel projects in Hong Kong, would be conducted to minimize any impact from the cavern construction activities to the adjacent groundwater table. Surface water level or groundwater level near the caverns will be closely monitored during the construction stage to ensure that the surrounding groundwater level will not be adversely affected due to the cavern construction activities and presence of the caverns. Post-construction monitoring of groundwater for 1 year will also be carried out after completion of excavation works.

4.7.8 With the proper implementation of mitigation measures, no adverse residual ecological impacts are expected from the Project. The implementation of mitigation measures would be subject to regular audit as part of the EM&A programme.

4.8 Fisheries Impact

4.8.1 Potential impacts on fisheries have been assessed in accordance with Section 3.4.7 and Appendix I of the EIA study brief as well as Annex 9 and Annex 17 of the EIAO-TM.

4.8.2 No important spawning or nursery grounds were identified in the immediate vicinity of the existing STSTW, while the nearest important nursery area for commercial fisheries resources is located in Three Fathoms Cove in Tolo Channel (approximately 6.5 km from the existing STSTW). The nearest FCZs (Yim Tin Tsai FCZ and Yim Tin Tsai (East) FCZ) are located approximately 4.5 km away from the existing STSTW. The importance of capture fisheries resources in the vicinity of the existing STSTW was identified as low in terms of both production weight and value. Fish fry production was low in the immediate vicinity of the existing STSTW in Tolo Harbour.

4.8.3 The Project will only involve land-based construction works. There will be no disturbance to marine or riverbed sediments. Under the Project design, any Project effluent bypass to the Tolo Harbour will be discharged separately through the existing emergency outfalls of the TPSTW and STSTW. Construction of the connection pipes to existing emergency outfall of STSTW was proposed to be by trenchless method underneath Shing Mun River. This construction method would not cause disturbance to the marine sediment and hence no impact to or loss of fishing ground is anticipated.

4.8.4 During the construction phase, THEES connection works required for this Project will be arranged to be synchronized with the THEES maintenance, such that no additional water quality impact, and hence fisheries impact from changes of water quality, will be induced by the proposed THEES connection works.

4.8.5 Despite not being specifically induced by this Project, the scenario of THEES maintenance or bypass under extreme emergency situations during the operation phase of the Project

as mentioned in Sections 4.4.6 and 4.4.10 have been considered. Indirect fisheries impacts due to deterioration of water quality are expected during these abnormal operation periods. Changes in water quality (e.g. SS, dissolved oxygen (DO), total inorganic nitrogen (TIN), chlorophyll-a) at Yim Tin Tsai FCZ, Yim Tin Tsai (East) FCZ, potential subzone of Yim Tin Tsai FCZ, Yung Shue Au FCZ, Lo Fu Wat FCZ and the nursery area for commercial fisheries resources at Three Fathoms Cove are expected during these scenarios. However, no significant changes in water quality parameters are predicted as the pollution elevation associated with the discharge would be reversible and hence no unacceptable water quality impacts are expected. With the implementation of mitigation measures for water quality, no unacceptable fisheries impacts are expected.

4.9 Landscape and Visual Impacts

4.9.1 A landscape and visual impact assessment has been carried out in accordance with Section 3.4.8 and Appendix J of the EIA study brief, and Annexes 10 and 18 of the EIAO-TM.

4.9.2 The Project will inevitably result in changes to the existing landscape in the vicinity of the portal areas, the ventilation shaft outlet and the access road leading to it, during construction and operation phases. Associated landscape and visual impacts have been minimized through careful consideration of alternatives, minimization of works areas, incorporation of aesthetic external designs and landscape treatments of proposed aboveground structures.

4.9.3 The Project is generally located within Green Belt (GB) Zones of the Approved Sha Tin Outline Zoning Plan (OZP) No. S/ST/32 (11.12.2015) and, for a small part, on the Approved Ma On Shan OZP No. S/MOS/22 (15.1.2016). It is recommended that both the Sha Tin OZP and Ma On Shan OZP shall be amended to incorporate the latest changes arising from the Project.

4.9.4 Based on a broad brush estimate, approximately 828 existing trees in the three landscape resources (i.e. Amenity Planting Area in the existing STSTW, Roadside Planting Areas along Ma On Shan Road and Woodland on Slopes of Nui Po Shan) will be affected by the proposed works. The affected trees shall be considered for transplanting in accordance with Development Bureau Technical Circular (Works) No. 7/2015 - Tree Preservation and the latest Guidelines on Tree Preservation. Many of the affected trees are of semi-mature to mature size. None of these are Registered Old and Valuable Trees (OVTs). Under the proposed scheme for the Project, opportunities for tree compensation within the Project boundary has been fully explored and incorporated in the proposed mitigation measures as much as practicable. Approximately 330 nos. of heavy standard trees and 10,000 nos. of tree whips can be compensated for the loss of existing trees due to the Project. Tree Preservation and Removal Proposals including compensation planting scheme shall be submitted in accordance with the above mentioned technical circular.

4.9.5 Under the Project, there would be temporary loss of 59,900m^2 of existing vegetation on Slopes of Nui Po Shan. With the proposed compensation and reinstatement woodland mix planting proposals (approximately 34,700 m^2), there would be a net permanent loss of 25,200m^2 of vegetation in Woodland on Slopes of Nui Po Shan.

4.9.6 With the implementation of proposed mitigation measures, it is predicted that there would be substantial to slight residual impact on the above listed landscape resources in Section 4.9.4 during construction, and moderate to insubstantial impact on day 1 of operation. The residual impact on these landscape resources would be further reduced to slight to insubstantial when the proposed compensatory planting, buffer planting and woodland mix planting become mature in year 10 of operation.

4.9.7 It is predicted that there would be substantial to slight residual impact on four landscape character areas (i.e. Sha Tin Waterfront Industrial Landscape Character Area (LCA), Ma On Shan Transportation Corridor LCA, A Kung Kok and Tai Shui Hang Miscellaneous

Urban Fringe LCA and A Kung Kok Settled Valley LCA) during construction, and moderate to insubstantial impact on day 1 of operation. The residual impact on these landscape character areas would be further reduced to slight to insubstantial when the proposed compensatory planting, buffer planting and woodland mix planting become mature in year 10 of operation.

4.9.8 Regarding visual impact, it is predicted that there would be moderate residual impact on residential Visually Sensitive Receivers (VSRs) in Chevalier Garden (R-01) and Kam Tai Court (R-12) (locations of VSRs refer to **Figure No. 60334056/ES/4.07**). The residual impact on these VSRs would remain moderate on day 1 of operation and would be reduced to slight when the proposed tree planting becomes mature in year 10 of operation. (Photomontages refer to **Figure No. 60334056/ES/4.08** and **Figure No. 60334056/ES/4.09**.) There would be slight to insubstantial residual impact on other VSRs within the visual envelope during the construction and operation of the Project.

4.9.9 As a whole, the residual landscape and visual impacts of the proposed Project is considered acceptable with the proposed mitigation measures implemented during construction and operation phases.

4.10 Cultural Heritage Impact

4.10.1 The Cultural Heritage Impact Assessment is conducted in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.9 and Appendix K of the EIA Study Brief, as well as Annexes 10 and 19 of the EIAO-TM. The assessment area includes areas within a distance of 50m from the site boundary of the Project.

4.10.2 It has assessed current condition and potential impact on cultural heritage resources within the study area. As no terrestrial and marine archaeological potential is identified, it is considered that there is no impact on archaeology and mitigation measures are not required.

4.10.3 Two built heritage resources in Tai Shui Hang (both are Grade 3 historic buildings) as well as the Pak Kong-Mui Tsz Lam Trackway (Site of Archaeological Interest) are identified outside the 50m study area from the site boundary of the Project. Thus, no potential direct or indirect impact to these cultural heritage resources is anticipated, and therefore no mitigation measures are required.

4.11 Waste Management Implications

4.11.1 The wastes impact assessment is conducted in accordance with the criteria and guidelines as stated in the requirements given in Section 3.4.4 and Appendix E of the EIA Study Brief, as well as Annex 7 and Annex 15 of the EIAO-TM.

Construction Phase

4.11.2 Construction and Demolition (C&D) materials will be generated from excavation of rock caverns (at the CSTW site and the potential explosive magazine site), tunnels, adits, ventilation/shafts buildings, site formation works and the demolition of the existing STSTW. These C&D materials comprise both inert and non-inert components, such as soil, Artificial Hard Materials (AHM), rocks, wood and metals. Based on the latest layout, the volume of surplus C&D materials is estimated to be approximately 6,000,000 m^3 of inert material and 124,000 m^3 of non-inert material (i.e. C&D waste). About 3,740,000 m^3 of total excavated materials is rock, which would be generated from the cavern constructions. An estimated volume of 595,000 m^3 is soft materials while 1,669,000 m^3 would be AHM (i.e. concrete).

4.11.3 Soft inert C&D materials from the above construction works will be sorted and reused as filling material as much as possible. The surplus will be transported to Tuen Mun Area 38 Fill Bank for reuse by other projects. Hard inert C&D material includes Grade III granitic rock and Grade I & II granitic rock. The Grade III granitic rock and AHM will be re-used on

site as much as possible and the surplus will be transported to Tuen Mun Area 38 Fill Bank for reuse by other projects. The Grade I & II rock will be transported to Lam Tei Quarry for recycling as useful aggregates for construction use by other projects. Non-inert waste will be recycled as far as possible before disposed to landfill. Opportunities in minimisation of generation and maximisation of reuse would be continually investigated during the detailed design and construction phases. With the implementation of the recommended good site practices and mitigation measures for the handling, transportation and disposal of the identified waste arising, adverse environmental impacts is not anticipated.

4.11.4 Other waste materials, including general refuse and chemical waste, will also be generated throughout construction. Provided that these identified wastes will be handled, transported and disposed of using the recommended methods and that good site practices would be followed, adverse environmental impacts are not expected.

Operational Phase

4.11.5 The main waste types to be generated during the operation phase would be grit and screenings, and sewage sludge. The collection, transportation and disposal practices of the grit and screenings would follow the existing arrangements currently in operation at the existing STSTW. The dewatered sludge would be disposed of to the proposed Sludge Treatment Facilities. Provided proper handling procedures and disposal method are adopted, adverse environmental impacts are not expected during the operation phase.

4.12 Health Impact

4.12.1 Potential health impact in relation to Toxic Air Pollutants (TAPs) emissions associated with activities during the operation of the CSTW have been assessed in accordance with the requirements given in Section 3.4.10 of EIA Study Brief.

4.12.2 Literature review was conducted to identify the sewage treatment related TAPs of potential concern for further assessment, and determine the acceptable toxicity values for non-carcinogenic and carcinogenic risks assessment.

4.12.3 The risk arising from exposure to TAPs associated with the emissions of the relocated STSTW is evaluated. The non-carcinogenic and carcinogenic health impact of the TAPs imposed to the impacted human receptors (HRs) were assessed and compared with international guideline levels. The assessment findings revealed that the levels of TAPs at HRs would be extremely small when compared to the derived reference levels. The highest incremental cancer risk arising from the operation of CSTW is predicted to be 7.1 E-08 which is far below the guidance level of 1E-06 adopted by United States Environmental Protection Agency (USEPA) and it is considered that the Project would not present an unacceptable risk and no further analysis is necessary. For the criteria of air pollutants, while it is not possible to rule out the additional potential health effects from the operation of CSTW with complete certainty, the impact on health from extremely small additional air pollutants is likely to be very small and unlikely to be quantifiable.

4.12.4 A minor portion of treated effluent would be reused but would be limited to non-potable uses inside the plant and therefore the general public is not expected to be exposed to the treated effluent. Thus, there is no health risk to the general public caused from the reuse of treated effluent.

5 ENVIRONMENTAL MONITORING AND AUDIT (EM&A)

5.1.1 An EM&A programme has been prepared for air quality, noise, water quality, land contamination, ecology (terrestrial and marine), fisheries, landscape and visual, and waste management during construction phase. A summary of the EM&A requirements by each of the environmental parameters is presented in **Table 5.1** below.

Table 5.1 Summary of EM&A Requirements

	Prior to Construction	Construction Phase	Operational Phase
Air Quality Impact	✓	✓	✓
Noise Impact	✓	✓	✓
Water Quality Impact	✓	✓	✓
Land Contamination	×	✓	×
Hazard to Life	×	✓	×
Ecology (Terrestrial and Marine) Impact	✓	✓	×
Fisheries	×	×	×
Landscape and Visual Impacts	✓	✓	×
Cultural Heritage	×	×	×
Waste Management Implication	×	✓	×
Health Impact	×	×	×

Air Quality Impact

5.1.2 EM&A for potential dust impacts would be conducted during the construction phase of the Project so as to check compliance with legislative requirements. Baseline and impact monitoring of 1-hour average TSP at representative locations are recommended.

5.1.3 No adverse impact would be generated during the operational phase of this Project. However, odour monitoring is proposed to be conducted at the deodorizing units in the first three years upon commissioning of CSTW to determine whether the deodorizing units can meet the odour removal performance requirement. An Odour Complaint Registration System is also proposed in the EM&A programme to ascertain whether the ASRs experience odour nuisance as a result of emissions from CSTW.

Noise Impact

5.1.4 An EM&A programme has been proposed to be established according to the expected occurrence of noisy activities during construction phase. All the recommended mitigation measures for daytime normal working activities would be incorporated into the EM&A programme for implementation during construction.

5.1.5 No adverse impact would be generated during the operational phase of this Project. Prior to the operational phase of the Project, a commissioning test for the ventilation buildings, the ventilation shaft, ventilation fan for chiller plant room at administration building and cooling tower at the administration building would be conducted to ensure compliance with the relevant allowable maximum sound power levels.

Water Quality Impact

5.1.6 A baseline monitoring programme at Tolo Harbour is proposed prior to the commencement of the Project construction works to establish the baseline water quality conditions. An

event and action plan and a water quality monitoring programme for the THEES maintenance events are proposed during the construction phase of the Project. Regular site inspections during the construction phase is also recommended to be undertaken to inspect the construction activities and works areas in order to ensure the recommended mitigation measures are properly implemented.

5.1.7 A water quality monitoring programme at KTN is proposed after commissioning of this Project to verify if there is any adverse water quality impact from the Project. An event and action plan and water quality monitoring programme for the THEES maintenance or emergency discharge events are also proposed for the operational phase of the Project.

Land Contamination

5.1.8 Remediation works, if necessary, would be carried out during construction phase but prior to commencement of any construction works. All the mitigation measures as recommended in the EIA Study, EM&A Manual and future RAP(s) would be implemented during the remediation works. Regular site inspection during the construction phase have been proposed to ensure the recommended mitigation measures are properly implemented.

5.1.9 As any contaminated soil / groundwater would be identified and properly treated prior to re-development, land contamination during the operational phase is not expected. As such, EM&A during operational phase is considered not necessary.

Hazard to Life

5.1.10 Blasting activities regarding storage, transport and use of explosives should be supervised and audited by competent site staff to ensure strict compliance with the blasting permit conditions.

Ecological Impact (Terrestrial and Marine)

5.1.11 Implementation of the recommended mitigation measures during construction phase would be regularly audited.

5.1.12 No adverse ecological impact during operational phase is anticipated as the level of disturbance would be comparable to the existing condition. EM&A during operational phase is considered not necessary.

Fisheries Impact

5.1.13 No unacceptable residual fisheries impact is expected from the Project. No monitoring program specific for fisheries is required. However, an event and action plan and a water quality monitoring programme is proposed for the THEES maintenance events during the construction and operational phases of the Project. Regular site inspections during the construction phase is also recommended to be undertaken to inspect the construction activities and works areas in order to ensure the recommended mitigation measures are properly implemented.

Landscape and Visual Impacts

5.1.14 The EM&A for the implementation of recommended mitigation measures during construction phase would be regularly conducted.

5.1.15 No significant adverse impact during operational phase is anticipated after implementation of the mitigation measures. Therefore, the EM&A works related to landscape and visual impacts for the operational phase are considered not necessary.

Cultural Heritage

5.1.16 No cultural heritage resources are located within the 50m study area from the site boundary of the Project and no direct or indirect impact to these cultural heritage resources is anticipated. On this basis, EM&A programme is considered not necessary.

Waste Management Implications

5.1.17 There are stringent regulations, legislations requirements and contract requirements on the handling, storage, and disposal of construction waste. Regular site inspections during the construction phase is proposed to be undertaken to inspect the construction activities and works areas in order to ensure the recommended mitigation measures are properly implemented.

5.1.18 Adverse environmental impacts generated from handling, storage and disposal of waste are not expected from the operation of the Project with the implementation of good waste management practices. Therefore, waste monitoring and audit programme for the operation phase of the Project would not be required.

Health Impact

5.1.19 Since no adverse health impact is expected from the Project, EM&A programme for health impact is not required.

6 CONCLUSION

6.1.1 The EIA provides information on the nature and extent of the environmental impacts likely to arise from the construction and operation of the CSTW and decommissioning of existing STSTW. The EIA has, where appropriate, identified mitigation measures to ensure compliance with environmental legislations and standards.

6.1.2 Overall, the EIA concluded that the Project would comply with the requirements of the EIAO and EIAO-TM with the implementation of the proposed mitigation measures during the construction and operational phases of the CSTW and decommissioning of existing STSTW. The schedule of implementation of the proposed mitigation measures has been provided in the EIA Report. An EM&A programme has also been recommended to check the effectiveness of the proposed mitigation measures.