Agreement No. CE 43/2011 (DS)

Relocation of Sha Tin Sewage Treatment Works to Caverns – Feasibility Study

Re-confirmation of Relocation Site and Study Area for Relocated STSTW – Executive Summary

February 2013

AECOM ASIA CO. LTD.

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INTRODUCTION

1.1 Background

1.1.1 Occupying about 28 hectares of land, the existing Sha Tin Sewage Treatment Works (STSTW) is located at the mouth of Shing Mun River. It is designed to treat 340,000 m$^3$ of sewage from Sha Tin and Ma On Shan areas every day. It is the largest secondary sewage treatment works in Hong Kong.

1.1.2 To support Hong Kong’s sustainable development, the Government actively explores innovative approaches to develop new land resources. Civil Engineering and Development Department completed the study on “Enhanced Use of Underground Space in Hong Kong” (CEDD’s Study) in March 2011. The study recommended a feasibility study on the relocation of STSTW to caverns, with a view to releasing the existing site for housing and other beneficial uses, thereby improving the community and environment.

1.1.3 The relocation proposal will provide an opportunity to upgrade sewage treatment facilities and adopt advanced technology, thereby enhancing service quality. This proposal will prepare a long term planning for the aging STSTW. After relocating STSTW to caverns, the environment of the surrounding community will also be improved.

1.1.4 On 30 May 2012, AECOM Asia Co Ltd. was commissioned by Drainage Services Department (DSD) to carry out an assignment under Agreement No. CE 43/2011 (DS) “Relocation of Sha Tin Sewage Treatment Works to Caverns – Feasibility Study”. This project is expected to complete within 24 months.

1.1.5 A review has been carried out to evaluate and re-confirm with justifications whether Nui Po Shan of A Kung Kok is the best recommended relocation site for the future STSTW. This Executive Summary summarizes the major considerations in selecting the relocation site and evaluates the suitability of Nui Po Shan of A Kung Kok and other areas in Sha Tin.

1.2 Existing Sewerage System Condition

1.2.1 The existing STSTW provides sewage treatment services for Sha Tin and Ma On Shan areas. There are six upstream Sewage Pumping Stations (SPS) collecting raw sewage from their respective catchment areas, and conveying the raw sewage through pumping to the existing STSTW for treatment. The treated effluent will then go through an effluent export tunnel from Sha Tin Portal (at Nui Po Shan of A Kung Kok near Ah Kung Kok Fishermen Village) to Diamond Hill Portal (near Fung Tak Estate) for discharge to Kai Tak River in Wong Tai Sin.

1.2.2 The catchment areas, upstream and downstream sewerage facilities are shown in Figure 1-1 and 1-2:
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Figure 1-1 Existing Upstream Sewerage Collection System

Figure 1-2 Existing Downstream Sewerage Collection System
2 Description of Potential Sites and Key Considerations

2.1 Description of Potential Sites

2.1.1 Geological condition which governs the suitability of the cavern construction is one of the decisive screening criteria for shortlisting the potential sites. Reference in this aspect is therefore made to the previous CEDD’s Study. Only the sites with suitability classified as High to Medium would be shortlisted and put forward for further consideration.

2.1.2 The proximity to the existing STSTW is another important consideration during the re-confirmation of relocation site. As the STSTW is connected with a very sophisticated and complicated network of upstream and downstream sewerage systems constructed in parallel with the development of Sha Tin New Town, the current situation is like transplanting the heart or other major organs in the human body. The selected site therefore should be able to connect with all the existing sewerage systems, with the least modifications and minimum disruption to the general public particularly during the possible diversions.

2.1.3 In addition, to conserve natural habitat and avoid impact on the country park areas, the potential relocation site should avoid or minimize the encroachment onto country parks as far as practicable.

2.1.4 After considering the above criteria, 5 potential sites are identified for further evaluation namely Nui Po Shan of A Kung Kok, Shek Mun, Ma On Shan, North and South of Kau To Shan. The surrounding communities of these selected sites are listed below:

<table>
<thead>
<tr>
<th>Area</th>
<th>Surrounding Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nui Po Shan of A Kung Kok</td>
<td>Chevalier Garden, Kam Tai Court, Ah Kung Kok Fishermen Village, Tai Shui Hang Village, Mui Tsz Lam Village, etc</td>
</tr>
<tr>
<td>Shek Mun</td>
<td>Shek Mun Estate, Castello, Kwong Yuen Estate, Nam Shan Estate, Shek Kwu Lung Village, Tai Lam Liu Village, Siu Lek Yuen Tsuen, etc</td>
</tr>
<tr>
<td>Ma On Shan</td>
<td>Yan On Estate, Heng On Estate, Kam On Court, Yiu On Estate, Chevalier Garden, Tai Shui Hang Village, etc</td>
</tr>
<tr>
<td>South of Kau To Shan</td>
<td>Fo Tan &amp; Kau To Shan Residential Area, Royal Ascot, Lok Lo Ha Village etc</td>
</tr>
<tr>
<td>North of Kau To Shan</td>
<td>The Chinese University of Hong Kong, Kau To Shan Residential Area, Kau To Village, Chek Nai Ping Village, Tai Po Mei Village etc</td>
</tr>
</tbody>
</table>
2.2 Evaluation Criteria

2.2.1 Below are the criteria assessed in this re-confirmation of the proposed relocation site:

(i) Geology;
(ii) Impact on existing sewerage system;
(iii) Land status;
(iv) Impact on surrounding environment; and
(v) Impact on nearby traffic network.
3 Evaluation Criteria and Assessment

3.1 Geology

Geological condition is very important as far as large-scale cavern construction is concerned. Construction cost (including structural support, mitigation measures and life-long maintenance), risk and period of cavern construction will depend very much on geological condition. Evaluation of the geological condition of different sites is listed below:

Kau To Shan North and South Areas:
Kau To Shan North and South are found to have very complex geological condition. The geology consists of granite and tuff. They have been faulted and fractured, and contact metamorphism between granite and tuff possibly influences the site geology and formed a relatively complex geological setting. Together a number of faults are identified, and this makes these sites less suitable for large-scale cavern construction.

Ma On Shan Area:
The geological condition at Ma On Shan is very complex. There are various rock types such as tuff and granite. The contact metamorphism between granite and tuff possibly influenced the site geology and formed a relatively complex geological setting with weak zones identified. All these suggested that Ma On Shan is the least suitable for cavern construction.

Shek Mun Area:
Shek Mun is also located within high strength granite. Preliminarily, there are fault and weak zone identified. However, it is still suitable for construction of caverns with smaller size.

Nui Po Shan of A Kung Kok Area:
Geological condition at Nui Po Shan of A Kung Kok is not complex and located predominantly within medium grained high strength granite, and no faults or weak zones are shown on the geological map. All these make the best ground condition for large-scale cavern construction out of all proposed sites.
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Figure 3-1 Geological Map of Potential Sites

Figure 3-2 Legend of Geological Map

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Legend

Superficial Geology
- Bauxite
- Dolomieu
- Collophane
- Bauxite
- Interbedded deposits
- Marine mud
- Marine sand
- Fill, sanitary fill
- Metamorphite
- Tuff, lavas, and tuff
- Contact metamorphism

Solid Geology
- Finely crystalline marble
- Fine- to coarse-grained quartz sandstone
- Siltsone
- Laminated siltsone and mudstone
- Felsic porphyry: rhyolite to tuffaceous rhyolite
- Porphyry: fine- to coarse-grained granite
- Ipswich porphyry: rhyolite to tuffaceous rhyolite
- Ipswich porphyry: fine- to coarse-grained granite
- Ipswich porphyry: tuffaceous sandstone and tuff
- Ipswich tuff
- Ipswich breccia
- Ipswich tuffaceous sandstone
- Ipswich tuffaceous sandstone

Structure
- Breccia (Dip)
- Breccia (Strike)
- Flow banding (Dip)
- Flow banding (Strike)
- Fault (Dip)
- Fault (Strike)
- Inclined contact (Dip)
- Inclined contact (Strike)
- Joint (Dip)
- Joint (Strike)

Aluvial Terrace
- Marine sand

Remarks: Colours may vary between the electronic and paper versions (Geology Map). Please refer to the legend for geological units.
3.2 Impact on Existing Sewerage System

3.2.1 The STSTW is not an isolated facility. It is connected with a complicated network of upstream and downstream sewerage systems, and the extent of sewers and ancillary facilities that need to be reconstructed for connection to the relocated STSTW, will affect the existing roads and footpaths which will cause unavoidable disturbance to the public. So selecting a site that is located in the proximity of the existing STSTW will minimize the disturbance to the whole Sha Tin District. The Sewerage Influence Diagrams for each Areas are presented in Figure 3.3-3.7 below. A comparison is tabulated below:

<table>
<thead>
<tr>
<th></th>
<th>North of Kau To Shan Area</th>
<th>South of Kau To Shan Area</th>
<th>Ma On Shan Area</th>
<th>Nui Po Shan of A Kung Kok Area</th>
<th>Shek Mun Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Distance from existing STSTW</strong></td>
<td>Approx 1.8km</td>
<td>Approx 1.4km</td>
<td>Approx 1.2km</td>
<td>Approx 0.9km</td>
<td>Approx 1.5km</td>
</tr>
<tr>
<td><strong>2. Downstream pumping distance to effluent tunnel</strong></td>
<td>Approx 3.5km</td>
<td>Approx 2.8km</td>
<td>Approx 1.3km</td>
<td>Close to effluent tunnel</td>
<td>Approx 2.7km</td>
</tr>
<tr>
<td><strong>3. Distance to Seafront (for Emergency Outfall)</strong></td>
<td>Approx 2.1km</td>
<td>Approx 2.0km</td>
<td>Approx 0.7km</td>
<td>Approx 0.6km</td>
<td>Approx 2.9km</td>
</tr>
</tbody>
</table>

![Figure 3-3 North of Kau To Shan Area - Sewerage Influence Diagram](image-url)
North of Kau To Shan Area
Ma On Shan Area
South of Kau To Shan Area
Nui Po Shan of A Kung Kok Area (Proposed Relocation Site)
Shek Mun Area

South of Kau To Shan Area
Distance from Existing STSTW: approx 1.4km
Downstream Pumping Distance to Effluent Tunnel: approx 2.8km
Distance to Seafront (for Submarine Outfall): approx 2.0km

Figure 3-4 South of Kau To Shan Area - Sewerage Influence Diagram

Ma On Shan Area
North of Kau To Shan Area
South of Kau To Shan Area
Nui Po Shan of A Kung Kok Area (Proposed Relocation Site)
Shek Mun Area

Ma On Shan Area
Distance from Existing STSTW: approx 1.2km
Downstream Pumping Distance to Effluent Tunnel: approx 1.3km
Distance to Seafront (for Submarine Outfall): approx 0.7km

Figure 3-5 Ma On Shan Area - Sewerage Influence Diagram
3.2.2 Based on the above table, Nui Po Shan of A Kung Kok Area has the least impact on the existing sewerage system, followed by Ma On Shan Area.
3.3 **Land Status**

3.3.1 Kau To Shan North and South have large numbers of private lots/allocated land with building developments, so the works areas during cavern construction may affect private land ownership. Therefore choosing other potential sites which are located within Government land can avoid any possible disturbance to the public and impacts to the implementation programme and costs due to issues arising from encroaching onto private/allocated land.

3.4 **Impact on Surrounding Environment**

3.4.1 The environmental impact arising from the relocation of STSTW will be assessed in both construction and operation stages include air quality/odour, noise, ecology, cultural heritage and water quality. Preliminary assessment revealed that the environmental impacts (during both construction and operation stages) to sensitive receivers near all potential sites are anticipated to be manageable as long as proper mitigation measures are implemented.

3.5 **Impact on Nearby Traffic Network**

3.5.1 Currently, the number of trucks for disposal of sludge from the existing STSTW is about 20 numbers per day. It is expected that the number of sludge trucks will remain in similar order and therefore the traffic impact during the operation stage is expected to be minimal only. So this assessment will be focused on the impact to nearby traffic network during the construction stage.

3.5.2 For Kau To Shan South and North as well as Shek Mun Areas, they are not located near the high speed roads. It will be very difficult to divert the construction traffic and will have great impact to the nearby traffic network. Ma On Shan and Nui Po Shan of A Kung Kok Areas are both located near high speed roads, the construction vehicles can be diverted to the high speed roads directly, thereby increasing the efficiency during the construction stage.

3.5.3 With appropriate mitigation measures in place, the traffic impact due to the relocation of STSTW to caverns at Nui Po Shan of A Kung Kok Area can also be minimized.
4 Conclusion

4.1.1 After the review, it is confirmed that Nui Po Shan of A Kung Kok Area is the best site for the relocation of the STSTW. The methodology and result of the review have been examined by an independent expert panel composed of three professors from the Hong Kong University of Science and Technology. To conclude, Nui Po Shan of A Kung Kok Area has the following favorable conditions:

(i) The geology of this area, belonging to hard granite with no obvious weak zones and faults, is most suitable for construction of large caverns;
(ii) The selected site is located in the proximity of the existing STSTW and effluent tunnel. As such, relocating the STSTW to this area will minimize the effect on the upstream sewerage and the downstream disposal network, thereby minimizing the disturbance to the whole Sha Tin District, reducing the construction and operation costs and shortening the construction period;
(iii) As majority of the area belongs to government land, the relocation project does not involve large extent of private land resumption;
(iv) With appropriate measures, the surrounding environment impact due to the relocation of the STSTW could be minimized; and
(v) With appropriate measures, the traffic impact due to the relocation of the STSTW could be minimized.