

West Kowloon Drainage Improvement – Stage 2 Phase 2 Tai Hang Tung Storage Scheme

Background

Flooding incidents at Nathan Road, Mong Kok during heavy rainfalls in 1997 and 1998 have attracted much public concern. The main reason for the flooding is due to the under-capacity of the decked nullah under Nullah Road to receive the flow from two tributaries (see figure no. 1). During heavy rainstorms, stormwater overflows from the inlet of the decked nullah at the junction of Flower Market Road and Sai Yee Street. The stormwater then flows down the nearby streets and floods the section of Nathan Road between Boundary Street and Prince Edward Road.

The conventional solution to solve the flooding problem was to build two 4800 mm wide x 3500 mm deep box culverts through the heavily built-up area of Mong Kok to convey and discharge the flood water to the sea. However, it is proved infeasible due to the site constraints including lack of space, conflicts with utilities of substantial size and unacceptable disruptions to the public.

To solve this problem, an innovative solution by using a combination of stormwater storage and diversion schemes was developed – the Tai Hang Tung Storage Scheme (THTSS) and the Kai Tak Transfer Scheme (KTTS).

THTSS is designed to intercept and temporarily store the stormwater collected in the Tai Hang Tung area and the natural hillsides behind in an underground storage tank underneath the Tai Hang Tung Recreation Ground (THTRG). KTTS is designed to intercept the stormwater flow along Waterloo Road decked nullah. The intercepted water will be transferred via a 1.5 kilometers long tunnel and a 400 meters long culvert to the Kai Tak open nullah. These two schemes will

substantially reduce the surface runoff discharged into the drainage system in the downstream Mong Kok area during heavy rainstorms and the flooding problem therein will be resolved.

Project Description

THTSS comprises the following works and the details are shown on figure no. 2A.

- construction of an underground storage tank having a capacity of approximately 100,000 cubic meters underneath the THTRG, and a pumping station;
- inlet and outlet box culverts connecting the storage tank and the existing upstream and downstream drainage systems;
- an approximately 120 meters long vehicular access underpass for maintenance purposes;
- landscaping works inside and outside the THTRG; and
- reconstruction of a section of existing box culvert approximately 70 meters long along Tai Hang Tung Road near the junction with Boundary Street.

Major Design Considerations

Hydraulic Design of THTSS

THTSS is a complex and sophisticated stormwater detention scheme. Under normal conditions, the stormwater will pass through the overflow weir system and be discharged into the existing drainage system in the downstream Mong Kok and Tai Hang Tung areas. During the heavy rainstorm, the stormwater will spill over the overflow weir into the storage tank. When the water level in the downstream drains recedes, the water stored will be pumped back into the drainage system. The operation sequence of the scheme is shown on figure no. 3.

The hydraulic performance of the storage tank will hinge on the effectiveness of the overflow weir and the arrangement of inlet/outlet structures. Too early a spill into the storage tank may use up the needed storage



capacity for a later more severe rainstorm. Based on the results simulated from the mathematical hydraulic model using the “HydroWorks” software, the inlet/outlet flow behaviour of the scheme is potentially unstable and sensitive to the arrangements of overflow weir and inlet/outlet structures. The use of physical models would confirm the predictions from the mathematical models and to make the necessary improvement to the scheme. A physical model has been set up to study the hydraulic performance of the overflow weir system and inlet/outlet structures. The results of the physical models prove that the proposed overflow weir performance could perform satisfactorily and meet with the design requirements.

Performance Monitoring System

To monitor the actual performance of the storage tank in reducing peak flows downstream during heavy rainfall storms, a performance monitoring system will be installed and measured when the THTSS is in operation. The water level in the tank, the depth of water over the weir and the flow in the upstream and downstream drainage system will be measured and recorded automatically by the system. Necessary mitigation measures will be carried out in case the collected data significantly deviated from the assumed flow data.

Flotation of Storage Tank

The storage tank is approximately 130 meters wide, 130 meters long and 10 meters deep in dimensions. As the ground water table at the THTRG is high, the storage tank will be subjected to a large upthrust force due to flotation. Different measures to prevent flotation of the storage tank were considered. In view of the time, cost and site constraints, the use of an anchor pile system has been adopted to guard against the flotation.

The site investigation indicates that the rock head beneath the THTRG deepens rapidly towards the north west corner of the recreation ground. To provide a practical piling system to such geological conditions, minipiles

with their toe socketed into rock are used for the shallow rock head whereas the steel H-piles acting as friction pile are adopted for the deep rock head.

Traffic Impact Assessment

It is estimated that about 185,000 cubic meters of excavated material will be removed off-site and about 40,000 cubic meters of concrete will need to be imported to the site during construction of the storage tank. A comprehensive traffic impact assessment was conducted during the design stage to identify the impact from the construction works to the existing traffic system there. After consultation with Hong Kong Police Force and Transport Department, measures to minimize the impacts to the public were formulated and incorporated as part of the Contract’s requirements. These include restricting routings for transportation of construction material, use of particular ingress and egress points on site.

Landscaping Design

THTRG is a green grass field with many well-grown trees around the perimeters. In fact, it is one of the popular sport fields used by nearby residents, students and other social organizations. To make the scheme visually compatible with the surroundings and preserve as many existing trees as possible, the storage tank is built underground and located below existing game pitches. A compensatory planting plan (see figure no. 2B) has been designed to compensate the affected vegetation and trees. The open nullah adjacent to the THTRG will also be replaced by a box culvert and the concerned area will then be backfilled and soft landscaped to provide greener environment.

Interfaces with the Public

There are a number of schools and residential blocks in the vicinity. The interfaces with the public must be properly considered and addressed in the design stage in



order to have a smooth implementation of the THTSS.

During the design stage, presentations/consultations were made to the District Council members, school principals, soccer association, rugby association and the former Provisional Urban Council about the proposed scheme and the related temporary traffic arrangement. This would allow the designer to identify public concerns in advance and make the necessary provisions in his design. It is also a good channel for the public to understand the scheme more.

Programme and Progress

The Contract at a cost of HK\$285 million commenced in January 2001 for completion in 2004. With a view to minimizing disruption to users of the THTRG, the storage tank will be constructed in two stages (see figure no. 4). In the first stage, the existing soccer pitch no. 3 will be closed for the construction of the first half of the tank. Upon completion of this part of the tank and the reinstatement of soccer pitch no. 3 for use by the public, the rugby pitch will be closed for the construction of the second half of the tank. All of the existing facilities at the THTRG will be reinstated properly upon completion. According to the implementation programme, each stage of works will last for about one and half years. Currently, the first stage of work is underway and the progress is satisfactory (see photograph 1).

With the completion of the THTSS and KTTS together with the relevant drainage works under the West Kowloon Drainage Improvement project, it is anticipated that the flooding problem at Nathan Road, Mong Kok will be resolved before the rainy season of 2004.



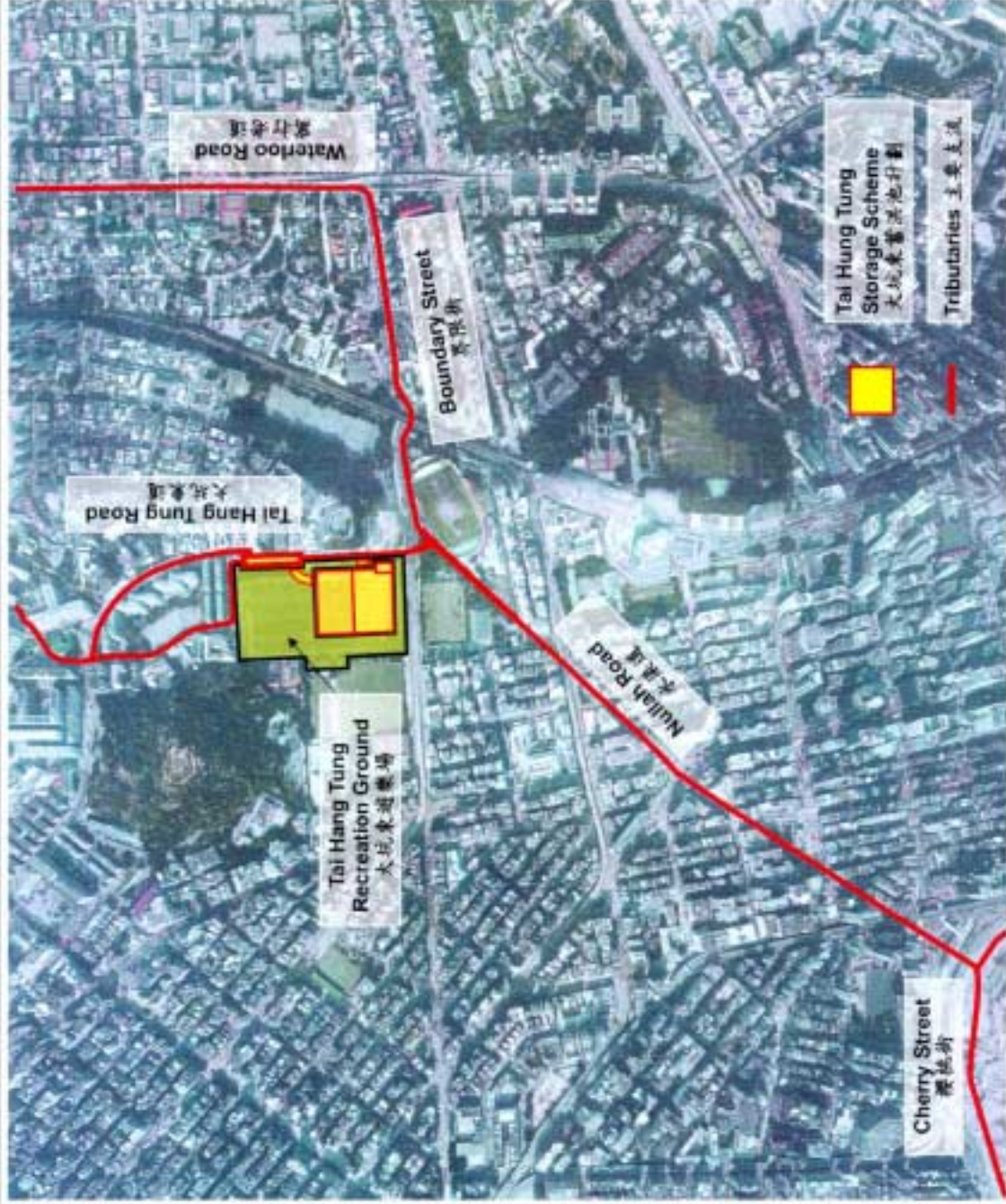


Figure 1 : LOCATION OF TAI HANG TUNG STORAGE SCHEME

圖一：大坑東蓄洪池計劃位置圖

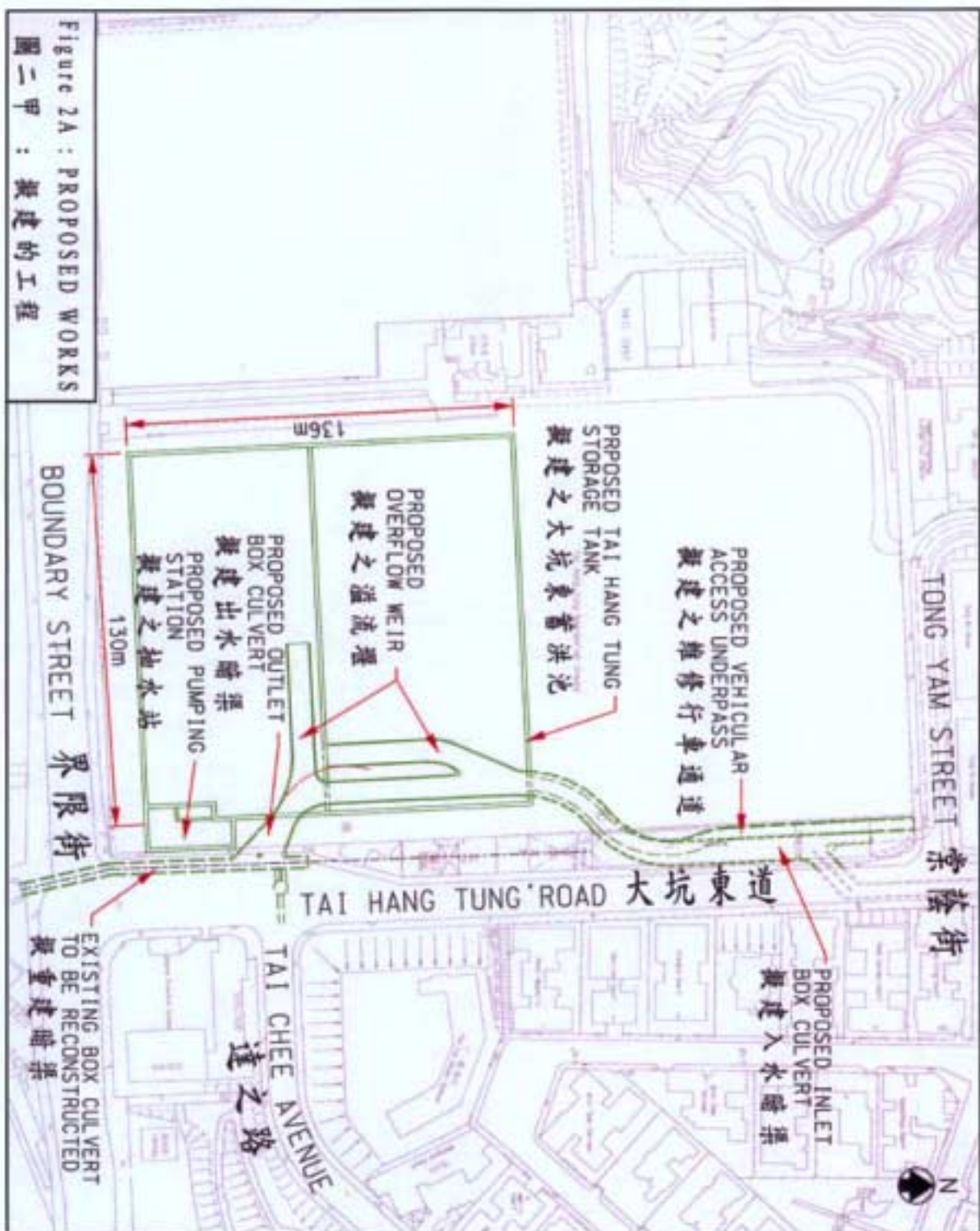
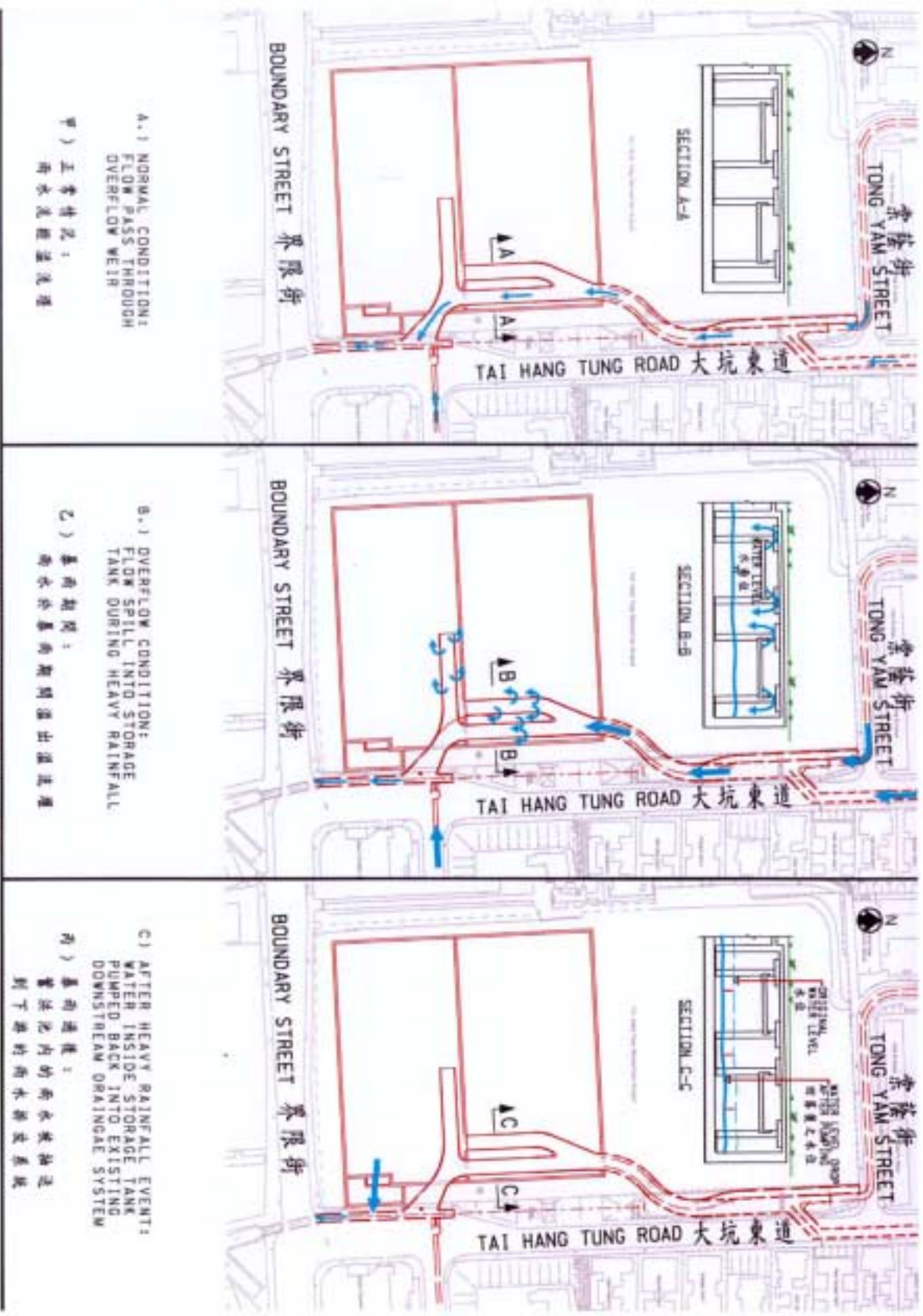


Figure 2A : PROPOSED WORKS
圖二甲：擬建的工程



Figure 2B : LANDSCAPE LAYOUT PLAN

圖二乙 園林佈置圖



A.) NORMAL CONDITION:
FLOW PASS THROUGH
OVERFLOW WEIR

甲) 正常情況：
雨水流經溢流堰

B.) OVERFLOW CONDITION:
FLOW SPILL INTO STORAGE
TANK DURING HEAVY RAINFALL

乙) 暴雨期間：
雨水於暴雨期間溢出現流堰

C.) AFTER HEAVY RAINFALL EVENT:
WATER INSIDE STORAGE TANK
PUMPED BACK INTO EXISTING
DOWNSTREAM DRAINAGE SYSTEM

丙) 暴雨過後：
蓄洪池內的雨水被抽送
到下游的雨水排水系統

Figure 3 : SCHEMATIC OPERATION DIAGRAM
圖三：操作流程示意圖

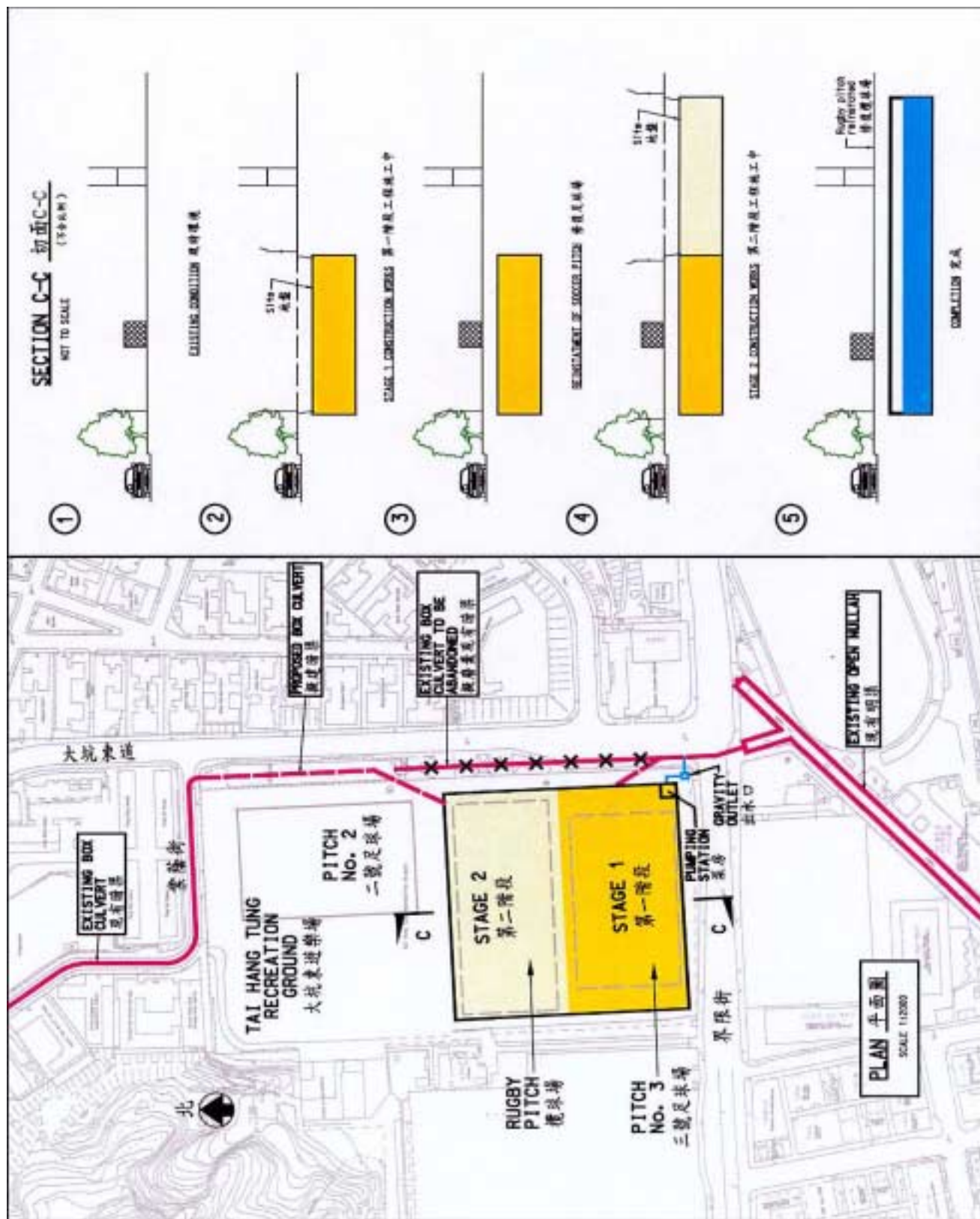


Figure 4 : TAI HANG TUNG STORAGE SCHEME - CONSTRUCTION SEQUENCE

圖四：大坑東蓄洪池計劃 - 施工程序



Photograph 1 : OVERVIEW OF CONSTRUCTION SITE
相片一 : 地盤施工情況