

Water Supply to South East Kowloon Development

Introduction

South East Kowloon Development (SEKD) is a major development within the urban area of Hong Kong covering the former Kai Tak Airport together with area reclaimed from Kai Tak Airport Approach Channel, Kwun Tong Typhoon Shelter and Kowloon Bay. The total area covered by the development is about 460 hectares and will be developed in phases to accommodate a total population of about 250,000 upon full development by 2016. The initial phase of the SEKD will be concentrated mainly in the north apron of the former airport with the first intake of population scheduled for late 2005.

According to the planned developments and population buildup for SEKD, the ultimate projected fresh and salt water daily demands will be 123,000 cubic meters and 32,000 cubic meters respectively. The existing fresh and salt water supply systems in the Kowloon metropolitan area do not have spare capacity to cater for the additional water demand from SEKD. It is therefore necessary to construct additional water supply facilities to meet the demand from SEKD.

Scope of Works

The following works are required to facilitate water supply to SEKD:-

- construction of Diamond Hill No. 2 fresh water service reservoir, at Diamond Hill, with a storage capacity of 76,500 cubic metres;
- uprate the existing Tai Wan salt water pumping station, at Hung Hom, with additional pumping capacity of 40,000 cubic metres per day;
- laying of about 3.4 kilometres of fresh water trunk mains of 1,000 millimetres diameter from Wang Tau Hom to the proposed Diamond Hill No. 2 fresh water service reservoir (Photo 1);



Photo 1: Mainlaying of 1,000 mm fresh watermain along along Fu Mei Street

- laying of about 1.2 kilometres of fresh water distribution mains of 1,200 millimetres diameter from the proposed Diamond Hill No. 2 fresh water service reservoir to the northern boundary of SEKD at Prince Edward Road East; and
- laying of about 5.8 kilometres of salt water mains of 800 millimetres diameter from the existing Tai Wan salt water pumping station through SEKD to the existing Diamond Hill salt water service reservoir.

The project is divided geographically into two areas and is being constructed under the following contracts:-

- Contract No 11/WSD/01 for construction of the fresh water service reservoir and mainlaying works in Diamond Hill area at a contract sum of \$212 million; and
- Contract No 12/WSD/01 for uprating the existing salt water pumping station and mainlaying in To Kwa Wan area at a contract sum of \$115 million.

Both contracts started work in July 2002 and are scheduled for completion by mid-2005, in time for the first population intake at SEKD in late 2005.



Diamond Hill No.2 Fresh Water Service Reservoir

Measuring 127m by 74m and 10 m high, Diamond Hill No.2 Fresh Water Service Reservoir rank amongst the largest service reservoirs in the Territory. Constructed on a platform level at 74mPD with a top water level of 85mPD, the reservoir will have a capacity of 76,500 cubic metres which will be adequate to cater for a daily demand of 90,000 cubic metres anticipated by 2013. A second service reservoir at Jordan Valley is planned for construction at a future date to meet water demand beyond 2013.

The site reserved for the service reservoir in Diamond Hill is very tight, restricted by Po Kong Village Road to the east, a steep slope to the south and Tate's Cairn Tunnel Protection Zone to the north-west. The design of the floor of the service reservoir was based on rock foundation, but site investigations revealed that the southern area comprised of degraded rock. To avoid costly construction by changing the design and the risk of differential settlement of the structure, the reservoir site had to be shifted northwards by about 20 metres to ensure the foundation will be on sound rock. Unfortunately, this means encroaching into the protection zone of Tate's Cairn Tunnel. After a feasibility assessment was carried out to confirm that the tunnel structure would be not adversely affected by the service reservoir, the tunnel company gave permission for construction to proceed provided that blasting was not used during site excavation. In addition, a leakage containment membrane will be required under the floor of the reservoir to ensure any leakage will be contained and drained away from the tunnel area.

For aesthetic reasons and to reduce visual impact from the road, the reservoir will be buried and the top surface will be landscaped with grass and small trees. Some 100,000 cubic metres of material, nearly half in rock, will be excavated to form the platform at 74mPD; some of the hard rock will be processed off-site for reuse as concrete aggregates (Photo 2). With close proximity of Tate's

Carne Tunnel, schools and residential housing, it is essential that stringent supervision of the Contractor's activities be maintained to ensure that noise, dust and rock excavation method requirements of the contract would be strictly complied with.



Photo 2: Rock Excavation to form platform at 74 mPD for Diamond Hill No2 Fresh Water Service Reservoir

Upgrading existing Tai Wan Salt Water Pumping Station

The source of salt water to SEKD will be from the existing sea-front Tai Wan Salt Water Pumping Station located in Hung Hom. Two new electric pumpsets will be installed with capacity of 40,000 cubic metres per day to meet the anticipated ultimate salt water demand from SEKD. Although the new pumpsets and associated 800 mm diameter pumping main will supply solely to SEKD, it is designed to integrate with the existing pumps for strategic supply between SEKD and the adjacent Kowloon East areas. Both the new and existing pumping systems feed into the existing Diamond Hill Salt Water Service Reservoir, which will be used as balancing storage to meet peak demand draw-offs.

To make room for the new pumps, the existing electrochlorination system inside the pumping station will be relocated to a new Electrochlorination House outside the pumping station. Due to site constraints, it was necessary to locate the Electrochlorination House close to the existing stone seawall and to avoid excessive loading on

the seawall, the Electrochlorination House will be supported on piles founded on bedrock down to 50 metres below ground level (Photo 3).



Photo 3: Drilling of piles for the Electrochlorination House near the seawall of the existing Tai Wan Salt Water Pumping Station

Mainlaying Works

Laying watermains in urban areas is never an easy task, especially in built-up areas, such as Wong Tai Sin and Kowloon City. More and more utilities such as watermains, sewer pipes, stormwater pipes, gas mains and electric cables have been installed over the years to meet the needs of development and population increases. During the detailed design stage, careful study of utility record plans, extensive site investigations involving trial pits, utility mapping techniques and traffic impact assessments were carried out to determine the feasibility of the watermain alignments. To reduce impact to the local residents and disruption to traffic, the mainlaying works incorporated the following requirements:-

- Replacement of old fresh and salt watermains having the same alignment as the proposed watermains will be carried out in conjunction with the project and, where possible, laid in common trench at the same time to reduce the need for future road openings in the same area. About 4.6 kilometres of replacement watermains ranging in size from 150 to 600 millimetre have been included in the contracts.

- Co-ordination of the power cable laying project China Light and Power Company with the watermain laying works in the same area to reduce the number of road openings.
- Co-ordination of road improvement or resurfacing works by Highways Department with the mainlaying works in the same area so that road works will proceed soon after completion of the mainlaying works.
- Maintain close liaison with the Working Group set up to monitor the status and progress of the contracts. Maintain good public relations with the Area Committees by informing them in advance of the mainlaying works in their respective areas.
- Laying of watermains near schools will be programmed during school holidays to reduce noise, dust and traffic impacts, specially during school examinations.
- At busy road junctions, trenchless techniques such as pipejacking or tunneling will be used, instead of the conventional open-cut method, to reduce disruption to traffic and inconvenience to the public. The only excavation required on the surface will be the jacking and receiving pits.

Trenchless Technology

Trenchless technology includes several methods utilized for laying underground utility systems. Some typical trenchless techniques include microtunneling, horizontal directional drilling and pipe jacking. Some of the benefits of using trenchless techniques over open-cut excavation for laying watermains are:-

- Minimal disturbance to the surface and other structures.
- Reduce traffic disruptions and diversions, especially in built-up urban areas.
- Reduce construction noise and dust.
- Reduce inconvenience to pedestrians.

Trenchless techniques have been identified for mainlaying at the following busy road locations:-

- **Prince Edward Road East crossing**

The Contractor has proposed to install the fresh and salt water mains by pipe jacking under Prince Edward Road East. The approximate length of road crossing is 90 metres. The jack sleeves for installing the 1200mm diameter fresh watermain will be 1430mm diameter x 20mm thick steel pipes, while 1200mm diameter precast concrete pipes will be used for installing the 800mm diameter salt watermain. The size of the jacking pit required is 7 metre wide by 15 metre long and the receiving pit is 6 metre wide by 4.5 metre long. Excavation will be carried out using a Tunnel Boring Machine (TBM) which is placed inside the jack sleeves (Photo 4).



Photo 4: A Tunnel Boring Machine in a jacking pit

- **Lung Cheung Road crossing**

Approximately 70m of pipe jacking will be required to install the 1200mm diameter fresh water trunk main under this busy road.

- **To Kwa Wan Road crossing at junction with Sheung Heung Road and Kwei Chow Street**

The road crossing is approximately 60m long, but due to congestion of other utilities at this location, the only option to lay the new 800mm diameter

salt watermain is to pipe jack under the existing utilities. Using open-cut method to lay the watermain at a depth of 4.5m below road level would be difficult, time consuming and disruptive to traffic and the public.

- **Tsz Wan Shan Road crossing at junction with Po Kong Village Road**

The Contractor has proposed to install the 1000mm diameter fresh and 800mm diameter salt water mains by tunnel method. The tunnel, measuring 78m long, 2.5m wide by 1.5m high and supported by steel frames at 600mm intervals, will be manually excavated. A tunnel access pit measuring 3m by 2m will be formed to start the tunnel excavation process and will exit at the other end to an open trench measuring 8m long for installing the pipe sections. The pipes will be lowered down the open trench and pulled on rollers through the tunnel to the access pit (Photo 5).



Photo 5: Manual tunnel excavation for installing the 1,000 mm fresh watermain and 800 mm salt watermain under Tsz Wan Shan Road at its junction with Po Kong Village Road

