CASE STUDY
TUNNELS & GROUND ENGINEERING

ATKINS

Contract No. DC/2007/16 Lai Chi Kok Transfer Scheme - Design and Construction

PROJECT DESCRIPTION

The Lai Chi Kok Transfer Scheme (LCKTS) forms an integral part of the overall flood control strategy for West Kowloon to intercept the surface runoff at six locations from the hinterland north of Lai Chi Kok and provide a drainage tunnel discharge directly into Victoria Harbour near Stonecutters Island.

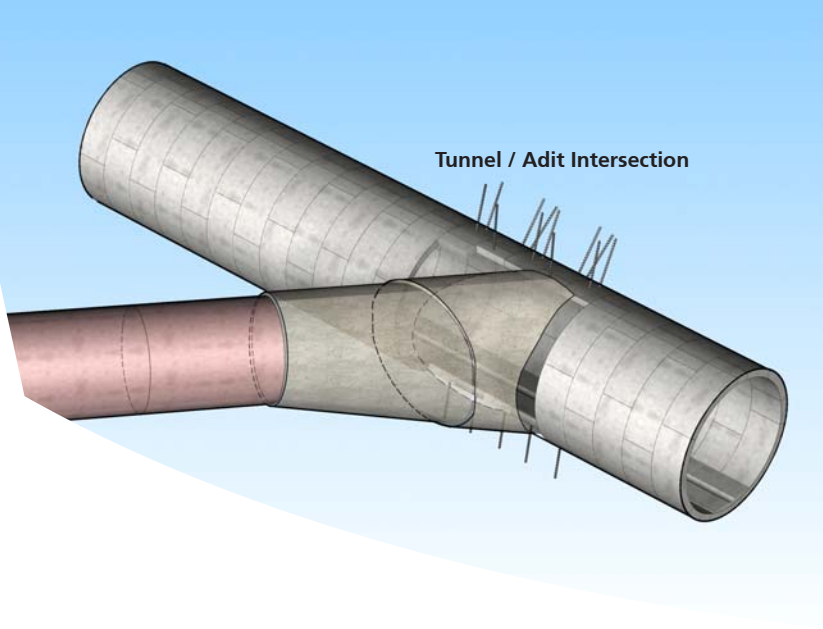
The key project features encompass 6 drop shaft intakes arranged on the Lai Chi Kok hillside to intercept storm water runoff and direct water into the Branch Tunnel. The Branch Tunnel discharges into the Stilling Basin structure which is constructed below Butterfly Valley Road at the former Wai Man Tsuen. The Main Tunnel comprises an inverted siphon with inlet Shaft M1 and outlet Shaft M2 adjacent to Victoria Harbour.

Atkins is commissioned by Leighton-John Halland Joint Venture to undertake the detailed design of all civil and structural works, and also traffic and environmental consultation services.

MAIN TUNNEL

The length of the Main Tunnel is approximately 1.14km with 4.9m internal diameter. The tunnel with precast segmental lining is constructed by slurry-type TBM in a general southerly direction within bedrock, mixed ground and soil from Shaft M1 towards Shaft M2 at a level of approximately -40mPD. The tunnel alignment passes through a heavily built up area.

Slurry Machine for the Main and Branch Tunnel



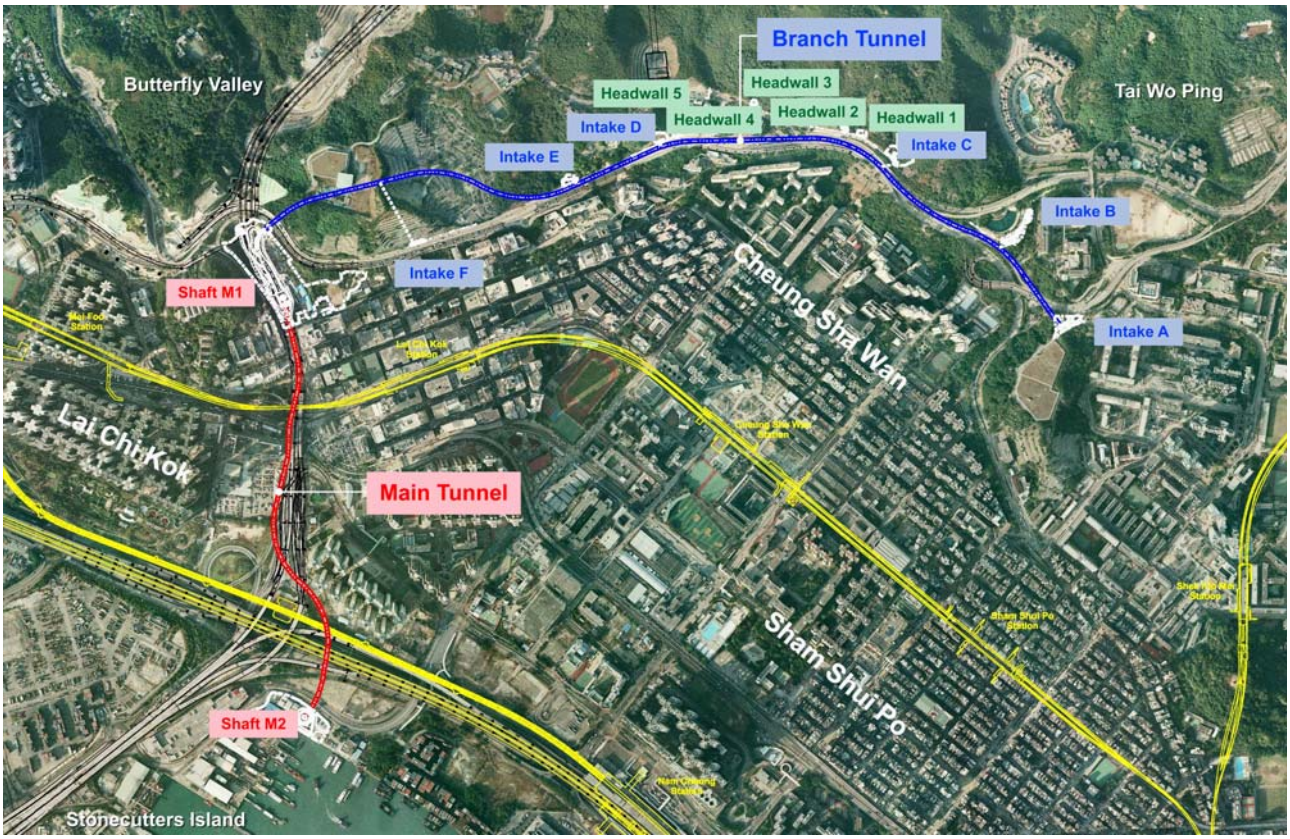
Tunnel / Adit Intersection

BRANCH TUNNEL

The 2.5km Branch Tunnel is constructed by using a 5.7-m-dia slurry-type TBM through hard rock and precast segments are adopted to be the permanent tunnel lining. The ground level along the tunnel alignment varies between +12mPD and +100mPD, and much of the overlying terrain supports a trunk road with adjacent steep cuttings or fill slopes on either side.

INTAKES AND ADITS

There are a total of six intake structures (A to F). Intakes A to E with a dropshaft and adit are located close to the Branch Tunnel alignment whereas Intake F is located adjacent to Ching Cheung Road requiring an approximately 170m long adit which passes under the Butterfly Valley Fresh Water Reservoir on the hill top. The intake drop shaft diameters vary from 2.5m to 3.7m and the deepest shaft is approximately 60m below the ground level. These structures are constructed via drill-&-blast excavation methods and designed to have a cast in situ concrete lining.



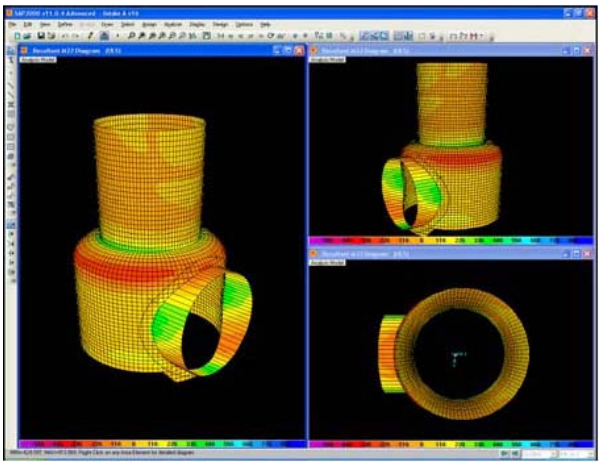
Scheme Layout of LCKTS

Branch Tunnel Chamber
Constructed in Softground

INLET SHAFT M1 AND OUTLET SHAFT M2

Both Shaft M1 and Shaft M2 are circular and have internal diameters of 10m, and connect to the Main Tunnel. Shaft M1 is partly in soil and partly in rock, while Shaft M2 is entirely in soil. Shaft M1 is supported by an in situ reinforced concrete lining. A 1.5-m –think and 45-m-deep diaphragm wall with six panels will be adopted as the permanent support structure for Shaft M2. Particular design problems to overcome:

- location in an urban area and construction under sensitive existing structures including the MTR Tsuen Wan, West Rail, Tung Chung Line, and Airport Express Line Tunnels, Lai Chi Kok Viaduct, Ngong Shuen Chau Viaduct and Western Kowloon Expressway;
- TBM tunnel for the construction of the Main Tunnel driven in highly / completely decomposed granite with water pressure over 4.5 bars;
- design of a 10m diameter diaphragm wall with a depth of 45m below existing ground surface for outfall Shaft M2 construction;
- design of a 60m x 60m x 11m deep, temporary earth lateral support for the construction of reinforced outfall structure adjacent to Victoria Harbour;
- design TBM breakthrough soft-eye in diaphragm wall at 45m below ground near the waterfront. Extremely high earth and water pressure were considered for the structural design at the TBM / Shaft interface.



Branch Tunnel Chamber Constructed in Softground

Excavation of Drop Shaft A for TBM Retrieval