CATALOGUE OF HONG KONG TUNNELS (Up to February 2019)

Mainland East Division
Geotechnical Engineering Office
Civil Engineering and Development Department

FOREWORD

This document contains a catalogue of existing tunnels and tunnels currently under construction in Hong Kong. It is based on a literature review of published information as well as information obtained from various government departments, the MTR Corporation, the former Kowloon Canton Railway Corporation, the Airport Authority Hong Kong, Hongkong Electric Company Limited, CLP Power Hong Kong Limited, and The Hong Kong and China Gas Company Limited. This catalogue is a live document that will be updated from time to time as further information becomes available.

The main purpose of the catalogue is to disseminate available information on tunnels/caverns. A few significant cable duct and gas pipe crossings constructed using tunnelling methods such as horizontal directional drilling and pipe jacking have also been included. It is hoped that this catalogue and, in particular, the associated references, will prove to be a useful source of information for civil and geotechnical engineers when planning, investigating, designing and constructing new tunnel projects.

Staff from the Mainland East Division of this Office compiled the catalogue. Apart from other GEO colleagues, the project clients and the works agents, members of the Hong Kong Institution of Engineers Geotechnical Division Working Group on Cavern and Tunnel Engineering and other individuals have also provided useful information. All contributions are gratefully acknowledged.

The user of this catalogue is entirely responsible for verifying the accuracy and relevance of the information presented. If any information in this catalogue is found to be inaccurate or out-of-date, please contact the Chief Geotechnical Engineer/Mainland East of the Geotechnical Engineering Office, Civil Engineering and Development Department, 101 Princess Margaret Road, Ho Man Tin, Kowloon, Hong Kong.

Sammy P Y Cheung
Chief Geotechnical Engineer/Mainland East

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Table 1 : Road Tunnels						
Route 1 – First Lion Rock Tunnel (dual 2-lane road, carrying 3 water mains)	1967	1.4 km	9.0 m span max. x 9.2 m high internally horseshoe shaped	Drill & blast, with a five-drill jumbo, steel girder roof supports near the Kowloon Portal, concrete lining	Granite, with a maximum overburden of 258 m, fault breccias (fractured rocks, mylonites and gouge) up to 6 m wide (possibly associated with the injection of the Maryknoll ring dyke), minor water inflow, air temperature in tunnel 61-78 degrees F	Payne (1962), Davis (1963), Payne (1963), Phillips (1990)
Route 1 – Cross Harbour Tunnel (dual 2-lane, the first immersed tube tunnel in HK)	1972	1.9 km (twin tubes)	Twin circular section of approx.10.5 m dia. connected with transverse steel diaphragms	Immersed tube (steel tube with reinforced concrete lining)	Tunnel section under the sea supported by a screed of crushed stone on the seabed and protected by a backfilled blanket of coarse stone	Asian Building & Construction (1976), Pratt (1987), Yang et al (2006)
Route 1 – Second Lion Rock Tunnel (dual 2-lane road, carrying 2 water mains)	1978	1.4 km	9.0 m span max. x 9.5 m high internally horseshoe shaped	Drill & blast, concrete lining	Similar to first Lion Rock Tunnel	Phillips (1990)
Route 1 – Aberdeen Tunnel (dual 2-lane)	1982	1.9 km (twin tubes)	10.0 m span x 11.0 m high horseshoe shaped	Drill & blast (*pilot tunnel constructed)* , lining 0.61 m thick min.	1.55 km weathered to fresh granite; 250 m volcanic rock including 50 m weathered quartz monzonite; groundwater problems near the ground surface at portal area	Chappell & Tonge (1975; 1976), Twist & Tonge (1979), Cochrane (1984)
Route 5 – Kai Tak Tunnel (dual 2-lane)	1982	1.25 km	27.7 m x 14.6 m reinforced concrete box sections	Cut & cover	Reclaimed land, with old seawall, groundwater level similar to tide level in the harbour	Tunnels & Tunnelling (1972)
Route 2 – Eastern Harbour Crossing Tunnel (the only cross-harbour tunnel with road and rail, dual 2-lane road, 2 MTR tracks) (first concrete immersed tube tunnel in HK)	1989	2.25 km (1.86 km of immersed tube tunnel (15 nos of segments) and 0.39 km of cut & cover approach tunnels)	35.45 m x 9.75 m high box sections	Immersed tube (concrete)	Tunnel sections on alluvial deposits or sand fill within a dredged trench in the seabed	Matson (1987), Taylor (1990), Yang et al (2006)

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Route 7 – Tseung Kwan O Tunnel (formerly known as Junk Bay Tunnel, dual 2-lane)	1990	0.9 km (twin tunnels)	10.85 m span x 7.59 m high horseshoe shaped twin tube	700 m drill & blast, 200 m cut & cover	Strong to very strong volcanic tuff with close to widely spaced joint, water head to tunnel 30-60 m	Matson (1984), Matson & Robinson (1984)
Route 9 – Shing Mun Tunnel (dual 2-lane)	1990	2.6 km (twin tunnels)	10 m span x 7.8 m high oval shaped	Drill & blast	Grades I-V fine- to coarse-grained granite	Highways Department (1987), Bergfors & Coates (1990), Larkin (1990), Torpey & Larkin (1990), Torpey & Hawley (1991)
Route 2 – Tate's Cairn Tunnel (dual 2-lane, the longest twin tube road tunnel in HK)	1991	4 km tunnel (0.54 km & 0.38 km north & south ventilation adits respectively) (twin tunnels)	11 m span x 8.5 m high horseshoe shaped twin tube tunnel	Drill & blast	Medium- to coarse-grained granite, intrusive feldspar porphyries with faults, generally none to minor water inflow, cumulative flow at portals of about 480 l/min.	Martin (1989), World Tunnelling (1989), Matson & Porter (1990), McFeat-Smith et al (1999)
Airport Authority Hong Kong Vehicular Tunnels	1996	0.7 km for east tunnel and 0.7 km for west tunnel	Rectangular triple tube tunnel (two tubes for vehicles, one for utilities), overall dimensions 25-26 m wide x 8 m high	Cut & cover, cast in situ reinforced concrete, tunnel crown at approximately 2.5 m below ground level.	Reclaimed land comprising mainly fill of granitic origin, some areas in rockfill, groundwater at about 5 m below ground level	
Route 3 – Cheung Tsing Tunnel (formerly known as Cheung Ching Tunnel, the first dual 3-lane highway tunnel in HK)	1997	1.6 km (twin tunnels)	17 m span x 10 m high horseshoe shaped twin tube tunnel and rectangular cut & cover end sections	1.5 km twin tube tunnel by drill & blast (*first time full-face blasting for a 3-lane road tunnel in HK*), with two end sections of cut & cover reinforced concrete tunnel at both portals	Approx. 300 m of grade II volcanics near the west portal, medium- to fine-grained grades I-IV granite for the remaining bore, with no or minor water inflow	Tunnels & Tunnelling (1994), Wong (1994), McFeat-Smith (1996), McFeat-Smith et al (1999)
Route 3 – Western Harbour Crossing Tunnel (dual 3-lane)	1997	1.95 km comprising 1.34 km immersed tube tunnel (12 nos of segments) and 0.61 km cut & cover approach tunnels	33.4 m x 8.02 m high box sections	Immersed tube (concrete)	Tunnel sections on alluvial deposits or sand fill within a dredged trench in the seabed	Silva et al (1998), Yang et al (2006)

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Route 3 Country Park Section – Tai Lam Tunnel (dual 3-lane)	1998	3.8 km tunnel (0.9 km ventilation adits) (twin tunnels)	15.2 m span x 10.4 m high twin tube tunnel, 14.1 m span x 9.9 m high adits	Drill & blast, computer-controlled drilling jumbos used for the first time in HK (Central Diaphragm Wall Method for soft ground excavation at north portal), only limited groundwater control carried out	Grades I-IV fine-grained granite (50m grade V granite at north portal), encountered 20m faults (Ho Pui Reservoir Fault and Sham Tseng Fault) with highest water inflow of 400 l/min.	Endicott et al (2000), Sjostrom (2004), GEO (2007)
Discovery Bay Tunnel (privately developed and operated)	2000	0.6 km	14 m span x 10 m high	Drill & blast	Granite	
Ma On Shan Underpass (Trunk Road T7 Project)	2004	0.2 km (twin tunnels)	12 m/16 m span x 10 m high	Drill & blast	Weak, altered and metamorphosed mudstone/siltstone, grades 1-III granite, natural stream courses above tunnel	Yang et al (2003), Ho & Li (2006)
Route 8 – Eagle's Nest Tunnel (dual 3-lane)	2007	2.1 km (twin tunnels)	17 m/19 m span x 11m high	Drill & blast	Grades I-V granite, rhoyolite dykes	Green et al (2006), Leung et al (2006), Lo & Cheuk (2006)
Route 8 – Sha Tin Heights Tunnel (dual 3-lane)	2007	0.9 km (twin tunnels)	17 m widened to 19 m x 11 m high horseshoe-shaped tunnel	Drill & blast	Granite, with occasional basalt dykes	Murfitt & Siu (2006a & b), Murfitt et al (2006a & b), GEO (2007)
Route 8 – Nam Wan Tunnel (dual 3-lane)	2007	1.25 km (twin tunnels)	16 m span x 10 m high	Drill & blast	Grades I-V granite, grades I-IV rhyolite	
Central-Wan Chai Bypass and Island Eastern Corridor Link	2018	3.7 km (single tunnel)	45 m span x 14 m high	Mined tunnel and cut & cover tunnel with pipe piles wall and diaphragm wall	Mainly granite, groundwater level similar to tide level in the harbour	
Hong Kong-Zhuhai-Macao Bridge (HZMB) - Hong Kong Link Road	2018	1.2 km (twin tunnels)	20 m span x 10 m high (16 m span x 10 m high)	Sub-horizontal pipe piles, Cut & cover and non-blasting method (e.g. mechanical excavation)	Fine to medium-grained granite.	Quanke et al (2011), Olsen et al (2011)

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Tuen Mun - Chek Lap Kok Link	Construction in progress*	5.7 km	12.4 m - 15.6 m dia.	TBM tunnelling, cut & cover	Subsea tunnel through marine clay, alluvium, CDG and M/SDG	
Liantang / Heung Yuen Wai Cross-boundary Check Point and Associated Connecting Roads in Hong Kong	Tunnelling works substantially completed*	2 twin tunnels namely Lung Shan and Cheung Shan tunnels with total length of about 5.6 km	14 m & 17 m dia.	EPB TBM (14 m dia.) and drill & blast (17 m dia.)	Volcanic rock, groundwater table at various depths	
Central Kowloon Route	Construction in progress*	3.9 km (twin tunnels)	15 m span	Drill & blast, cut & cover,	Granitic rock, groundwater table at various depths	
Tseung Kwan O – Lam Tin Tunnel	Construction in progress*	2.6 km	Twin 25 m wide elliptical	Drill & blast	Volcanic rock, granitic rock, marine clay, alluvium	Tsang et al (2010), Tam et al (2012)
Kai Tak Development - Trunk Road T2	Construction in progress *	2.1 km (twin tunnels)	13.2 m dia.	Slurry TBM, cut & cover	Alluvium, C/HDG and M/SDG	

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Table 2 : Railway Tunnels (including associated underground facilities) – MTRC (including ex-KCRC) Tunnels						
KCR Beacon Hill Tunnel (First) (single lane tunnel of standard gauge)	1910	2.2 km	5.2 m int. width x 5.8 m high above rail level horseshoe shaped	Drill & blast, using gelatine and electric fuse firing, brick lining (portals and lining 30 m from the face at either end were built of granite in ashlar work), up to 427 m below ground surface	Granite, quartz felsite, felsite and diorite, water inflow up to 2,700 l/min.	Eves (1908, 1911)
Modified Initial System Tunnels MTRC Contract 103: Cross-Harbour Tunnel	1980	1.4 km	Immersed tube	Immersed tube	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Yang et al (2006)
Modified Initial System Tunnels MTRC Contract 106: Central & Admiralty	1980	0.8 km	-	Cut & cover stations using diaphragm walling	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980)
Modified Initial System Tunnels MTRC Contract 107: Mong Kok to Yau Ma Tei & Prince Edward to Mong Kok	1980	0.8 km	4.9-5.0 m ID SGI & PCC, 11.6 m crossover chambers	Bored tunnels under compressed air with precast concrete segmental lining	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 108: Yau Ma Tei to Jordan & Jordon to TST	1980	1.2 km	4.9-5.0 m ID SGI & PCC, 11.6 m crossover chambers	– bored tunnels – bored tunnels under compressed air with precast concrete segmental and in situ lining	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Endicott (1980), Haswell et al (1980), McIntosh et al (1980)

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Modified Initial System Tunnels MTRC Contract 109: Central to Admiralty and connections to Immersed tube at each side of harbour	1980	1.0 km	4.9-5.0 m ID SGI & PCC, 11.6 m crossover chambers	– cut & cover – bored tunnels – bored tunnels under compressed air with precast concrete segmental and in situ lining	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 101: Prince Edward to Yau Ma Tei	1980	1.4 km	4.9-5.0 m ID SGI & PCC, 11.6 m crossover chambers	Cut & cover stations using: secant piling, sheet piling, packed-in-place piling	Fill, marine deposits, alluvium, grades I-V granite, with corestones	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 102: Jordon & TST	1980	0.6 km	-	Cut & cover stations using packed-in-place piles	Fill, marine deposits, alluvium, grades I-V granite, with corestones	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 201: Lok Fu to Wong Tai Sin an Wong Tai Sin to Diamond Hill	1980	1.5 km	4.9-5.0 m ID SGI & PCC, 11.6 m crossover chambers	Bored tunnels in free and compressed air with precast concrete lining. Station by cut & cover using soldier piles	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels Contract 202: Prince Edward to Shek Kip Mei	1980	0.7 km	4.9-5.0 m ID SGI & PCC, 11.6 m crossover chambers	Cut & cover tunnels plus bored tunnels with precast and in situ concrete lining. Station by cut & cover using soldier piles	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 203: Shek Kip Mei to Kowloon Tong and Kowloon Tong to Lok Fu	1980	1.7 km	4.9-5.0 m ID SGI & PCC, 11.6 m crossover chambers	Bored tunnel with in situ concrete lining	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 205: Kowloon Tong	1980	0.3 km	Station box	Station by cut & cover using diaphragm walling and soldier piles	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)

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Modified Initial System Tunnels MTRC Contract 206: Choi Hung	1980	0.4 km	Station box	Station by cut & cover using king piles	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 207: Diamond Hill	1980	0.3 km	Station box	Station by cut & cover using king piles	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 208: Choi Hung to Kowloon Bay	1980	0.7 km	4.9-5.0 m ID SGI & PCC, 11.6 m crossover chambers	Bored tunnels with SGI and in situ lining	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
Modified Initial System Tunnels MTRC Contract 209: Diamond Hill to Choi Hung	1980	0.7 km	4.9-5.9 m ID SGI and in situ	Cut & cover tunnel with sheet piles	Fill, marine deposits, alluvium, grades I-V granite, with corestone	Haswell & Umney (1978), Edwards et al (1980), Endicott (1980), Haswell et al (1980), McIntosh et al (1980)
KCR Beacon Hill Tunnel (Second) (30-40m to the side of the first KCR Beacon Hill Tunnel)	1981	2.3 km	11.1 m span x 9.0 m high horseshoe shaped	Drill & blast, pilot method adopted (two side pilot tunnels of 3 m x 4 m were excavated, and fitted with steel arches and reinforced concrete walls up to 300-500 mm thick which later became part of the lining)Messer Method used to place steel ribs (being jacked forward in stages in soft ground at the faces before excavation), rock bolts used extensively	As above,with fractured zones and water inflow in places	Parrott (1980)

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Tsuen Wan Extension Tunnels MTRC Contract 301: Prince Edward to Cheung Sha Wan	1982	1.7 km	5.1-6.4 m ID SGI & PCC, 11.6 m crossover chambers	Tunnels: bored under compressed air with SGI and precast concrete segments hand-excavated within open shield, cut & cover. Underground stations using cut & cover via: pack-in-piling, diaphragm walling, sheet piling, secant piling	Fill, marine deposits, alluvium, grades I-V granite, with corestones	Cater et al (1984) MTRC as-built drawings
Tsuen Wan Extension Tunnels MTRC Contract 302: Cheung Sha Wan to Mei Foo	1982	2.1 km	5.1-6.4 m ID SGI & PCC, 11.6 m crossover chambers	Tunnels: bored under compressed air with SGI and precast concrete segments hand-excavated within open shield, cut & cover. Underground stations using cut & cover via: pack-in-piling, diaphragm walling, sheet piling, secant piling	Fill, marine deposits, alluvium, grades I-V granite, with corestones	Cater et al (1984) MTRC as-built drawings
Tsuen Wan Extension Tunnels MTRC Contract 303: Mei Foo to Lai King	1982	1.4 km	5.1-6.4 m ID SGI & PCC, 11.6 m crossover chambers	Tunnels: bored under compressed air with SGI and precast concrete segments hand-excavated within open shield, cut & cover. Underground stations using cut & cover via: pack-in-piling, diaphragm walling, sheet piling, secant piling	Fill, marine deposits, alluvium, grades I-V granite, with corestones	Cater et al (1984) MTRC as-built drawings
Tsuen Wan Extension Tunnels MTRC Contract 305: Kwai Hing to Tsuen Wan	1982	1.6 km	5.1-6.4 m ID SGI & PCC, 11.6 m crossover chambers	Tunnels: bored under compressed air with SGI and precast concrete segments hand-excavated within open shield, cut & cover. Underground stations using cut & cover via: pack-in-piling, diaphragm walling, sheet piling, secant piling	Fill, marine deposits, alluvium, grades I-V granite, with corestones	Cater et al (1984) MTRC as-built drawings

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Tsuen Wan Extension Tunnels MTRC Contract 307 & 308: Tsuen Wan and Tsuen Wan Depot	1982	0.3 km	5.1-6.4 m ID SGI & PCC, 11.6 m crossover chambers	Tunnels: bored under compressed air with SGI and precast concrete segments hand-excavated within open shield, cut & cover. Underground stations using cut & cover via: pack-in-piling, diaphragm walling, sheet piling, secant piling	Fill, marine deposits, alluvium, grades I-V granite, with corestones	Cater et al (1984) MTRC as-built drawings
Island Line Tunnels Contract 401: Sheung Wan	1986	0.04 km		Cut & cover using diaphragm walling	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Contract 402: Sheung Wan & overrun tunnels	1986	0.8 km	5.3-8.9 m ID SGI & PCC	Tunnels: bored tunnel using compressed air Station: diaphragm walling	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Contract 403: Sheung Wan to Admiralty	1986	1.3 km	5.3-7.6 m ID SGI & PCC	Tunnels: bored tunnel using compressed air using segmental lining Station: diaphragm walling	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Contract 404: Admiralty to Causeway Bay	1986	2 km	5.1-7.6 m ID SGI & PCC	Tunnels: bored tunnel using compressed air using segmental lining Station: diaphragm walling	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)

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Island Line Tunnels Contract 405: Causeway Bay to Tin Hau	1986	2 km	5.3-7.6 m ID SGI & PCC	Tunnels: bored tunnel using compressed air using segmental and cast in situ lining Station: diaphragm and caisson walling	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Contract 406: Tin Hau to North Point	1986	1.3 km	5.1-7.6 m ID in situ	Tunnels: bored tunnel and cast in situ lining Station: bored tunnel	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Contract 407: North Point to Tai Koo	1986	1.8 km	5.1-7.6 m ID in situ	Tunnels: bored tunnel and cast in situ lining Station: cut & cover & bored	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Contract 408: Tai Koo to Sai Wan Ho	1986	0.9 km	5.1-7.6 m ID in situ	Tunnels: bored tunnel and cast in situ lining Station: bored cavern	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Contract 409: Sai Wan Ho to Shau Kei Wan	1986	0.5 km	5.1-7.6 m ID in situ	Cut & cover using bored piles and hand-dug caissons	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)

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Island Line Tunnels Contract 410: Shau Kei Wan to Heng Fa Chuen	1986	0.8 km	5.1-7.6 m ID in situ	Tunnels: bored tunnel and cast in situ lining	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Contract 414: Sai Wan Ho to Shau Kei Wan	1986	1.0 km	5.1-7.6 m ID in situ	Tunnels: bored tunnel and cast in situ lining Station: diaphragm walling	Fill, marine deposits, alluvium, grades I-IV granite, with corestones, below old jetties and seawalls, near to many old buildings on timber piles (in one contract it was necessary to remove lower ends of piles)	Caiden et al (1986), Thorley et al (1986), Sharp at al (1986), GEO (2007)
Island Line Tunnels Eastern Harbour Crossing & Approach Tunnels (Contracts C1, C2 & C3)	1989	3.6 km	5.1-7.6 m ID arch rail / road immersed tube	Drill & blast, immersed tube		Yang et al (2006)
Island Line Tunnels Queensway Tunnel (Admiralty to Pacific Place)	1990	53 m	8.3 m dia. horseshoe shaped	Drill & blast section from south sides and north side of Queensway via shafts sunk on footpath. Ribs and laggings main form of support together with shotcreteing and spot bolting		
Island Line Tunnels Quarry Bay Improvement Works	1997	Not available		Robbins vertical raise-borer and hand-excavation for passenger adits and staircases and chemical expansion grouts	Grades I-II granite	Law & Keller (1999)

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Lantau and Airport Railway Tunnels Contract No. 508: Lai King Tunnels	1998	0.9 km	5.4 m int. width horseshoe shaped, 10-12 m wide x 6 m high box structure, 12.4 m wide x 7.7 m high	Drill & blast, cast in situ lining, cut & cover	Grades I-IV granite, rhyolite, tuff	Hardingham et al (1998), Morris et al (1992)
Lantau and Airport Railway Tunnels Contract No. 512: Tsing Yi Tunnels	1998	1.66 km	Horseshoe	Drill & blast, shotcrete with rockbolts and steel arches and cast in situ lining	Grades I-IV volcanic rock with granodiorite dyke	Züblin (2007)
Lantau and Airport Railway Tunnels Contract No. 514: East Lantau Tunnels	1998	1.0 km	Horseshoe	Drill & blast, shotcrete with rockbolts and steel arches and cast in situ lining	Grades I-IV granite, rhyolite, tuff	
Lantau and Airport Railway Tunnels Contract No. 501A: Central Subway	1998	265 m	90 m^2 box section	Pedestrian cut & cover tunnels	Reclaimed land	Atkins (2007), Bayliss (1998)
Lantau and Airport Railway Tunnels Contract No. 502: Immersed Tube	1998	1.3 km	125 m x 12 m x 8 m	Twin bore immersed tube		Yang et al (2006)
Lantau and Airport Railway Tunnels Contract No. 503B & 504: Cut & cover sections	1998	500 m; 950 m		4 cellular cut & cover cast in situ box tunnel	Reclaimed land	
Quarry Bay Congestion Relief Tunnels	2001	Two 2.2 km twin running tunnels, two 0.3 km platform tunnels, cross-over cavern and 70 m deep shafts	6.2 m dia. running tunnels, 10 m span platform tunnels, 20 m span crossover cavern at Fortress Hill	Two hard rock Robbins TBMs, drill & blast for platform, crossover and niches and hand-excavation for passenger adits and turnout chamber. Shotcrete and rock bolts, chemical expansion grouts and non-explosive method (Sunburst, which involves use of small cartridges containing explosives and gas) for splitting the rock at vibration-sensitive areas	Grades I-III granite	Tam (1998), Cooper et al (2001), Tam (2001), Yang et al (2005), GEO (2007)

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Tseung Kwan O Extension – Black Hill Tunnels	2002	8.0 km	6.3 m dia.	Drill & blast, shotcrete, steel ribs to support weak zones, unreinforced cast in situ lining 250 mm thick min., small sections of cut & cover (four single lane tunnels, from Yau Tong to Tiu Keng Leng)	Granite, some volcanic tuff, maximum depth of 180 m below ground level	Tunnels & Tunnelling International (1999; 2002)
Tseung Kwan O Extension – Pak Shing Kok Tunnels	2002	6.4 km	6.3 m dia. Tunnels, 23 m span x 10 m high cavern	Drill & blast, shotcrete, steel ribs, rockbolts, unreinforced cast in situ lining 250 mm thick min.	Strong volcanic tuff, highly fractured, low rock cover at fault zone, with highest water head above tunnel of 30 m	Tunnels & Tunnelling International (1999), Lo et al (2001a), GEO (2007)
Tseung Kwan O Extension – Lam Tin to Eastern Harbour Crossing Tunnels	2002	1.2 km	6.3 m dia.	Drill & blast, Cut & cover for approach tunnels	Granite, Fill, marine clay, alluvium grades III-V tuff, 30 m from seawall in marine clay	Ho et al (2001), Pan et al (2001), Hill et al (2002), Wightman & Cheung (2002)
West Rail Tunnels (ex-KCRC) Tai Lam Tunnel (single tube, twin/triple track tunnel with centre partition wall)	2003	(a) 5.5 km; (b) 0.36 km	(a) 14-19 m wide x 9-11 m high horseshoe shaped; (b) 14.5 m x 8.8 m twin cell box	Drill & blast, dowels and sprayed concrete temporary support, probing ahead when approaching the faults and pre-grouting, permanent unreinforced concrete lining predominantly 300-500 mm thick, with waterproofing membrane, incorporating drainage measures to collect and drain groundwater. Crushers together with a conveyor belt, which advanced with the blast face was used for mucking out – first of its kind in the world to have such a long (up to 3.5 km) conveyor belt system. Cut & cover at portals	Volcanic tuff, intrusive granite, granodiorite, dacite, basalt dyke, rhyolite dyke, two major fault zones 1-8 m wide (Ho Pui Reservoir Fault and Sham Tseng Fault) with water inflow from probe holes of 240-400 l/min. at fault zone	Lo et al (2001b), Gould et al (2002), GEO (2007)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
West Rail Tunnels (ex-KCRC) Kwai Tsing Tunnels (Tsing Tsuen Tunnel)	2003	3.6 km	8.75 m dia. twin tube tunnel	1.8 km EPB TBM (first use of open & closed compressed air mode EPB TBM in HK), 120 m cut & cover	Residual soils, marine deposits, alluvium and reclamation fill	
West Rail Tunnels (ex-KCRC) (Ha Kwai Chung Tunnel)	2003	1.7 km	13 m wide x 9 m high	1.7 km drill & blast, up to 180 m below ground surface	Loose marine sands/soft marine clays, granular alluvial deposits, granodiorite, granite with intrusions of rhyolite, basalt and quartz monzonite	Stenning et al (2001)
Disneyland Resort Line (Tai Yam Teng Tunnels)	2004	(a) 0.12 km; (b) 0.75 km	(a) 6.6 m x 6.1 m box section; (b) 6.1 m span x 6 m high horseshoe shaped	(a) Cut & cover; (b) Drill & blast	Grades I-III porphyritic rhyolite, grades I-IV granite, grades I-IV volcanic tuff	Salisbury et al (2006)
West Rail Tunnels (ex-KCRC) Tsim Sha Tsui Extension Tunnels (ex-KCRC), Signal Hill Tunnel (pedestrian subway)	2005	1 km	12 m wide x 9.5 m high	Cut & cover with pipe pile wall supported by struts, working less than 0.5 m above Cross Harbour Tunnel, tunnel runs parallel to and just 10 m from Victoria Harbour at 18 m deep at the closet location.	Fill, marine deposits, alluvial deposits, grades I-V granite	Ng et al (2004)
West Rail Tunnels (ex-KCRC) Signal Hill Tunnel (pedestrian subway)	2005	945 m	8.8 m wide x 6-8.5 m high horseshoe shaped	843 m cut & cover and 102 m drill & blast	Fill, marine deposits, alluvial deposits, grades I-V granite	Ng et al (2004)
West Rail Tunnels (ex-KCRC) Lok Ma Chau Spurline Tunnels (ex-KCRC)	2007	(a) 3.2 km; (b) 2 km	(a) 8.75 m dia. twin tube tunnel; (b) 20 m wide x 10 m high	(a) Mixshield EPB TBM; (b) Cut & cover, (Ground freezing used for the construction of 5 m span cross passages below Long Valley)	Superficial deposits, grades I-V tuff, Fill, alluvial deposits, grade V tuff, with groundwater at 2-3 m below ground level	Storry et al (2006a), Storry et al (2006b), Martin, O. et al (2005a, b).

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
West Rail Tunnels (ex-KCRC) Queensway Subway	2007	0.35 km	7.15 m span widened to 17 m span x 11 m high (in rock)	Drill & blast, probing ahead and pre-grouting for groundwater control as required (generally single-stage grouting with micro-fine cement); shotcrete, lattice girders, pre-support canopy and face reinforcement as temporary support for weak zones (mined in free air). Permanent cast in situ concrete or shotcrete lining	Grades II-V granite, groundwater at about 10 m above tunnel crown level	Desaintpaul & Askew (2006)
Kowloon Southern Link (ex-KCRC) KDC 200 (Jordon Road via Canton Road to Salisbury Road)	2008	1.2 km	8 m dia. twin tube	Mixshield slurry TBM	Superficial deposits, grades I-V granite with groundwater at about +2.5 mPD	Lee et al (2008), Wong et al (2008), Frew et al (2009), Tam & Howley (2009), Taylor (2009)
Kowloon Southern Link (ex-KCRC) KDB 300 (Jordon Road to Yau Ma Tei ventilation building)	2008	0.85 km	12.8 m wide x 8.5 m high reinforced concrete box, excavation to approx. -15 mPD	Cut & cover	Fill, marine deposits, alluvium and decomposed granite	Lee et al (2008), Wong et al (2008), Frew et al (2009), Tam & Howley (2009), Taylor (2009)
Kowloon Southern Link (ex-KCRC) KDB 400 (Yau Ma Tei ventilation building to Nam Cheong overrun tunnel)	2008	1.06 km	12.8 m wide x 8.5 m high reinforced concrete box, excavation to approx. -15 mPD	Cut & cover	Fill, marine deposits, alluvium and decomposed granite	Lee et al (2008), Wong et al (2008), Frew et al (2009), Tam & Howley (2009), Taylor (2009)
West Island Line	2014	3.3 km, plus 3 stations (2 caverns and passenger/ ventilation adits networking)	6.5 m span (tunnels); 5.5 m - 8 m span (adits); and 22 m span (caverns)	Drill & blast, cut & cover station, Mined tunnelling with pre-support canopy, steel ribs and lattice girders and ground freezing	Fill, marine deposits, alluvium, colluvium, Granite and Tuffs, corestones; water inflows in places through fracture zones	Ground Engineering (2011), New Civil Engineering International (2011), Bolton (2011a), Bolton (2011c), Polycarpe et al (2012), Tsang et al (2012), Baribault et al (2012), Hamill et al (2013), Shimizu et al (2014)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
South Island Line (East)	2016	4.9 km tunnel	12 m - 19 m span, 6.5 m - 12 m span (tunnels) and 22 m span (cavern)	Drill & blast; cut & cover station, underpinning with temporary rock pillars; mined tunnelling with pre-support canopy, steel ribs and lattice girders	Granite and volcanic tuff with localized Monzonite. The alignment intersects a number of fault zones	Tam (2012a), Bolton (2011a), Steele & Mackay (2013), Steele et al (2013)
Kwun Tong Line Extension	2016	2.6 km	5.2 m - 14.2 m span (tunnels) and 20.2 m (cavern)	Drill & blast, cut & cover and mined tunnelling	Granitic rock, groundwater table at various depths	
Express Rail Link: Guangzhou-Shenzhen-Hong Kong	2018	26.0 km (Hong Kong section)	8.7 m - 9 m dia. twin tunnels and 30 m cut and cover section	Drill & blast, cut & cover, slurry TBM and EPB TBM tunnelling	Soft ground, mixed ground and hard rock with different weathering grades; fault zone encountered; groundwater table at various depths.	Bolton (2011a), Bolton (2011b), Chan & Li (2012), So et al (2013a), So et al (2013b), Koungelis & Lyall (2013), Leung et al 2013), Pollak et al (2013)
Shatin To Central Link	Construction in progress*	17 km (Tai Wai to Hung Hom section – 11 km, Cross Harbour section – 6 km)	6-7 m span for Tai Wai to Hung Hom, and 7-8 m span for Cross Harbour	Drill & blast, cut & cover, TBM and mined tunnelling. Cross Harbour tunnel to be immersed tube	Fill, marine deposits, alluvium and grades II-V granite.	Bolton (2011a), Bolton (2011d)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Table 3 :Water Supply Tunnels						
Pok Fu Lam Tunnel	1877	0.08 km	1.5 m dia.			
Tai Tam Tunnel (Tai Tam to Wong Nai Chung)	1887	2.2 km	1.5 m dia.	Drill & blast (dynamite), unlined	Granite	Surveyor General (1884; 1885), Davis (1963)
Shing Mun Tunnels (North Conduit and South Conduct, Shing Mun to Shek Lei Pui)	1926	2.0 km	2.74 m dia.	Drill & blast, concrete lined or unlined	Granite	Davis (1963), Woodward (1935)
Tai Tam Tuk East Tunnel	1934	0.03 km	4.3 m dia.			
Mount Parker Lower Catchwater Tunnel	1934	0.17 km	2.7 m dia.			
Tai Po Road WTW Raw Water Inlet Pipe Tunnel	1956	0.11 km	2.34 m dia.	Drill & blast		
Tai Lam Chung Tunnels (Tai Lam Chung to Chai Wan Kok to Tsing Lung Tau)	1957-1974	24.45 km	1.75-5.35 m dia.	Drill & blast, up to 350 m approx. below ground surface	Granite, granodiorite	Davis (1963)
Tai Po Road S/R Outlet Pipe Tunnel	1958	0.26 km	2.34 m dia.	Drill & blast		
Tunnel for Shek Pik Trunk Main	1962	0.12 km	2.7 m dia.			
Shek Pik Scheme Water Tunnels Tunnel A	1963	483 m	2.4 m dia.	Drill & blast, concrete lined or unlined	Granite, rhyolites	Davis (1963)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Shek Pik Scheme Water Tunnels Tunnel B	1963	1.24 km	3.7 m dia.	Drill & blast, concrete lined or unlined	Granite, rhyolites	Davis (1963)
Shek Pik Scheme Water Tunnels Tunnel C	1963	1.59 km	3.7 m & 5.3 m dia.; 3.8 m & 5.3 m dia.	Drill & blast, concrete lined or unlined	Granite, rhyolites	Davis (1963)
Shek Pik Scheme Water Tunnels Tunnel D	1963	1.85 km	1.5 m dia.	Drill & blast, concrete lined or unlined	Granite, rhyolites	Davis (1963)
Shek Pik Scheme Water Tunnels Supply Tunnel (1)	1963	7.64 km	5.2 m dia.	Drill & blast, concrete lined or unlined	Granite, rhyolites	Davis (1963)
Shek Pik Scheme Water Tunnels Supply Tunnel (2)	1963	1.45 km	1.5 m dia.	Drill & blast, concrete lined or unlined	Granite, rhyolites	Davis (1963)
Shek Pik Scheme Water Tunnels Diversion Tunnel	1963	559 m	1.5 m dia.	Drill & blast, concrete lined or unlined	Granite, rhyolites	Davis (1963)
Tung Chung Tunnel	1963	7.2 km	4.0-4.6 m dia.	Drill & blast, concrete lined or unlined		
Plover Clove Stage I Tunnels (Tai Po to Pai Tau Hang)	1965-1971	20.2 km main tunnel, plus branch and access tunnels	1.75-6.7 m dia.	Drill & blast, concrete lined or unlined	Granite, fine-grained rhyolitic tuff	Davis (1963), Garrod (1966)
Plover Clove Stage II Tunnels	1967	18.2 km main tunnel, plus branch and access tunnels	2.59-9.14 m dia.	Drill & blast, (first reported use of NATM in HK), concrete lined or unlined	Fine-grained rhyolitic tuff, with severe weathering in some areas	Davis (1963), Ford & Elliot (1965)
Aberdeen East Catchwater Tunnel	1969	0.12 km	1.98 m dia.	Drill & blast, concrete lined		
High Island Water Tunnels	1976	40 km, plus 10 shafts	2.29-4.27 m dia.	Drill & blast, sprayed concrete or steel rib temporary support, unlined, sprayed or cast in situ concrete permanent lining, up to 500 m below ground surface	Granite, rhyolites	Tunnels & Tunnelling (1971), Don et al (1973), Vail et at (1976)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Sai Kung Tunnel	1982	0.85 km	2.5-2.8 m dia.			
Tai Po Tau to Shatin Aqueduct Tunnel	1983	2.25 km tunnel (in 3 sections)	2.7-3.3 m dia.	Drill & blast, sprayed concrete or steel rib, and rock bolts as temporary support, steel, sprayed or cast in situ concrete permanent lining or unlined		
Top Hill to Lamb Hill, Ma Mei Ha to Nam Chung Tunnel	1983	5.3 km	3.3 m dia.	Drill & blast, concrete lined or unlined		
Kornhill Tunnel	1983	0.19 km	3.0 m dia.			
Tsing Tam/Yau Kom Tau Tunnel	1985	5.2 km	2.5-3.45 m dia.	Drill & blast, concrete lined or unlined		
Western Aqueduct Tunnels (Increase of Water Supply from China, Stage I Muk Wu/Au Tau/Tai Lam Chung Aqueduct)	1986	13.8 km	2.6-3.4 m dia.	Drill & blast, concrete lined, steel lined or unlined	Granites, granodiorites, sedimentary rock, coarse ash tuffs, generally none to moderate water inflows, high inflow in shear zone in volcanic rocks and at fractured zones or open joints connecting the tunnels with a local reservoir	McFeat-Smith (1982), McFeat-Smith et al (1999)
Ngau Tam Mei Aqueduct Tunnel	1986	0.39 km	2.6 m dia.	Drill & blast, steel lined		

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Plover Cove Reservoir Harbour Island Raw Water Pumping Station Intake Tunnel	1987	0.775 km intake tunnel, 30 m and 70 m deep shafts	2.75-3.2 m dia.	Drill & blast	Coarse ash tuff, rhyolites, sandstones, siltstones, quartzite	McMeekan & Yue (1987)
Tolo Harbour Aqueduct Scheme Plover Cove Sai O to Pak Kong Water Tunnel	1988	5.4 km	2.7-3.0 m dia.	Drill & blast, sprayed or cast in situ concrete with mesh reinforcement and rock bolts as temporary and permanent support, concrete lined, steel lined or unlined, up to 370 m below ground surface	Similar to above	McMeekan & Yue (1987)
Ngau Tam Mei/Tai Po Tau Aqueduct	1988	6.1 km	2.5-3.1 m dia.	Drill & blast, concrete lined, steel lined or unlined		
Pak Kong/Ho Chung, Ho Chung/Tseung Kwan O Tunnel	1989	6 km	2.0 m dia.	Drill & blast, steel lined	Granites, volcanics, generally none to minor water inflow, very high initial inflows (3,600 l/min) at granite/volcanic interface reducing to 50%	McFeat-Smith (1998), McFeat-Smith et al (1999)
Tai Po Tau No 4 Raw Water Pumping Station Tunnels	1992	0.3 km (4 sections), 2 shafts	3.6-6.0 m dia.	160 m of existing 3.6 m dia. tunnel enlarged to up to 6 m dia., concrete lined		
Siu Ho Wan to Silvermine Bay Aqueduct Tunnel	1996	7 km	2.7-3.56 m dia.	Open TBM, concrete lined, steel lined or unlined	Granite with rhyolite dyke swarm, several zones of initially high water inflows at open joints, with cumulative outflow of 2,400 l/min reducing with time	McFeat Smith et al (1999)
Western Aqueduct Supply Tunnel to Siu Ho Wan Treatment Works	1996	0.2 km	3 m dia.	Drill & blast, concrete lined or steel lined	Under the dam at Tai Lam Chung Reservoir	

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Tai Po to Butterfly Valley Fresh Water Tunnel (Tai Po Treatment Works Raw and Treated Water Aqueducts)	2001	14 km raw water tunnel, treated water tunnel and short tunnels, 2 shafts, 2x107 m (pipe jacking), 1.2 km raw water tunnel, 1.2 km treated water tunnel	2.7-4.9 m dia 3.1 m dia. 2.7 m dia 3.8 m dia.	Two hard rock TBMs (greatest depth below ground surface in HK – up to 600 m), steel ribs and laggings as temporary support where weak/fractured rock was encountered, difficulties installing permanent lining due to very high water pressures, two pipe jacked mini-tunnels, two drill & blast drives water main tunnel by pipe jacking; raw water tunnel – steel rigs and lagging, drill & blast treated water tunnel – 2 TBMs and drill & blast	Granodiorite, fine ash tuff, tuff-breccia, tuffite, granite, seven major faults and over 20 minor faults, low to moderate inflows in granite, extremely high inflows in volcanics up to 14,940 l/min, water temperature 34-36 ^{o}C, high radon levels	McFeat-Smith (1998), World Tunnelling (1999), Arnold (1999), Sjostrom (2004)
Butterfly Valley Primary Service Reservoir	2001	Outlet: 295 m Inlet: 210 m	5.67-9.3m	Mechanical excavation, drill and blast	Granite	
Tan Kwai Tseun Tunnel	2002	0.18 km	2.8 m high x 4.8 m wide			
Ma Wan Water Main	2003	1.36 km	0.82 m dia. drillhole, 0.45 m dia. water pipe within 0.61 m dia. steel casing coated with fusion- bonded epoxy coating, with HDPE duct inside	Horizontal directional drilling (HDD) (first use of horizontal directional drilling in hard rock in HK), use of pilot drillholes of 0.33 m and 0.7 m diameter, enlarging to 0.82 m in diameter, 76 m below sea level, 38 m rock cover except in fault zones	Granite, volcanic tuff	Tam (2000), Loneragan & Lukas (2003)
Gloucester Road Water Main	2003	0.019 km	1.0 m dia. with 1.4 m dia. steel sleeve	Open shield pipe jacking with manual excavation	Fill with cobbles and boulders, seawall blocks, marine and alluvial deposits, groundwater about 2.6 m below ground level	Swann et al (2003)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Underground Service Reservoir behind The University of Hong Kong Proposed Centennial Campus	2009	0.2 km	8 m to 15 m	Sub-horizontal pipe piles (for the first 20 m access tunnel) and NATM (for the rock caverns)	The caverns were built in metasandstone and granite. Metasandstone: RQD 30-70%; UCS 20 to 65 MPa; locally damp condition and minor inflow were observed Granite: RQD 75-80%; UCS above 20 MPa; the rock was dry	Mackay et al(2009)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Table 4 : Drainage and Sewage Tunnels						
Seymour Road/Robinson Road Drainage Tunnel (private)	1975	80 m	1.5 m wide x 2.0 m high horseshoe shaped tunnel			
Tseung Kwan O Sewer Tunnel	1986	1.82 km	2.4 m dia.	Drill & blast, shotcrete, dowels, steel sets with laggings, concrete permanent lining	Lapilli tuff, rhyolite, fault, shear zones	
Fanling South Trunk Sewer Tunnel	1989	0.37 km	1.35 m ID (6-14 m below ground level)	Pipe jacked (3 m long 125 mm thick precast reinforced concrete pipes) slurry shield TBM (cutters with tungsten carbide bits), electro-magnetic flowmeter for slurry (first sewer tunnel constructed using pipe jacked slurry shield TBM in HK)	Alluvial deposits, grades III-V volcanics with boulders, groundwater up to 7 m above tunnel soffit level	McFeat-Smith & Woods (1990), McFeat-Smith & Herath (1994)
NWNT Sewerage Tunnel	1992	9.1 km, (3.1 km 1.8 m dia. marine outfall pipeline)	3.0 m dia.	Drill & blast, two-boom jumbo, concrete lining (longest tunnel in HK at the time)	Granite, no to minor water inflow	Construction & Contract News (1992), McFeat-Smith et al (1999)
East Kowloon Sewer Tunnel	1993	0.1 km	1.95 m ID (9-11 m below ground)	Pipe jacked slurry shield TBM, with man access to tunnel face through machine chamber for removal of boulders	Fill with boulders, alluvial deposits, groundwater 3 m below ground level	McFeat-Smith (1994), McFeat-Smith & Herath (1994)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Hong Kong University of Science & Technology Sewerage Tunnel	1993	1.5 km		Drill & blast	Volcanic rocks, generally none to minor water inflows, but with high inflow (2,800 l/min) at fracture zones, reducing to 50% in one month and by 80% ultimately	McFeat-Smith et al (1999)
Stanley Sewerage Treatment Cavern	1994	130 m	17 m wide x 17 m high	Drill & blast	Massive granite with widely spaced joints and 10 m wide fault zone	Oswell et al (1993), Chan & Ng (2006)
Stanley, Tai Tam & Redhill Sewage Tunnel	1994	0.75 km	1.9 m x 2.1 m high horseshoe shaped	Drill & blast		
Tolo Harbour Effluent Export Scheme Tunnel	1996	7.5 km, 18 m deep shaft at Diamond Hill	3.56 m dia. (2.5 m ID)	Double shield hard rock TBM (first hard rock TBM drive by HKSAR Government), water proof lining inside precast concrete segmental lining, tunnel crosses about 12 m below Tate's Cairn Tunnel and about 4 m above water supply tunnel from High Island Reservoir, steel lining provided to the latter tunnel	Fine- to coarse-grained granite occasionally intersected by porphyritic rhyolite (100-200 m grades III-V rock), syenite and dolerite dykes, granodiorite, with no to minor water inflow and occasional initial high inflow at fractured zones or open joints cumulating to 2,400 l/min	Morris et al (1992), McFeat-Smith (1998), McFeat-Smith et al (1999)
Island West (Mount Davis, SG (1963)) Refuse Transfer Station	1997	(a) 66 m; (b)160 m	(a) 28 m wide x 12 m high (tripping hall); (b)12.5 m wide x 7 m high (compactor hall)	Drill & blast	Volcanic tuff of generally, good rock quality with a few fracture zones	Chan & Ng (2006)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Central, Western and Wanchai West Trunk Sewer Tunnels	2000	5.0 km	1.05-1.8 m dia. (up to 18 m deep)	Pipe jacked slurry shield TBM, free air/compressed air hand shield	Mixed ground in reclaimed area (fill, marine deposits and alluvium, with boulders and armour rock), groundwater about 2-4 m below ground level	Mok (2002)
HATS Stage 1 Tunnels (Strategic Sewage Disposal Scheme)	2001	4.8 km	3.2 m dia.	Tunnel AB: open hard rock TBM	Volcanic tuff, granite, fault	McFeat-Smith et al (1999), Chui & Tai (2001), Grandori et al (2001), McLearie et al (2001), Pakianathan et al (2002), Tai & Ho, (2002), Pakianathan et al (2004), Sjostrom (2004), GEO (2007), Maxwell & Kite (2012)
HATS Stage 1 Tunnels (Strategic Sewage Disposal Scheme)	2001	5.3 km	4.23 m dia.	Tunnel C: open hard rock TBM	Volcanic tuff, granite, rhyolite, fault	McFeat-Smith et al (1999), Chui & Tai (2001), Grandori et al (2001), McLearie et al (2001), Pakianathan et al (2002), Tai & Ho, (2002), Pakianathan et al (2004), Sjostrom (2004), GEO (2007), Maxwell & Kite (2012)
HATS Stage 1 Tunnels (Strategic Sewage Disposal Scheme)	2001	3.6 km	3.4 m dia.	Tunnel D: open hard rock TBM	Granite	McFeat-Smith et al (1999), Chui & Tai (2001), Grandori et al (2001), McLearie et al (2001), Pakianathan et al (2002), Tai & Ho, (2002), Pakianathan et al (2004), Sjostrom (2004), GEO (2007), Maxwell & Kite (2012)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
HATS Stage 1 Tunnels (Strategic Sewage Disposal Scheme)	2001	5.5 km	4.3 m dia.	Tunnel E: open hard rock TBM	Granite	McFeat-Smith et al (1999), Chui & Tai (2001), Grandori et al (2001), McLearie et al (2001), Pakianathan et al (2002), Tai & Ho, (2002), Pakianathan et al (2004), Sjostrom (2004), GEO (2007), Maxwell & Kite (2012)
HATS Stage 1 Tunnels (Strategic Sewage Disposal Scheme)	2001	3.6 km	3.35 m dia.	Tunnel F: open hard rock TBM	Granite, rhyolite dykes, faults	McFeat-Smith et al (1999), Chui & Tai (2001), Grandori et al (2001), McLearie et al (2001), Pakianathan et al (2002), Tai & Ho, (2002), Pakianathan et al (2004), Sjostrom (2004), GEO (2007), Maxwell & Kite (2012)
HATS Stage 1 Tunnels (Strategic Sewage Disposal Scheme)	2001	0.8 km	3.0 m dia.	Tunnel G: drill & blast	Granite	McFeat-Smith et al (1999), Chui & Tai (2001), Grandori et al (2001), McLearie et al (2001), Pakianathan et al (2002), Tai & Ho, (2002), Pakianathan et al (2004), Sjostrom (2004), GEO (2007), Maxwell & Kite (2012)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
HATS Stage 1 Tunnels (Strategic Sewage Disposal Scheme)	2001	1.7 km	5.64 m dia., (finished diameter ranging from 1.2 m to 5.0 m)	Outfall tunnel: open hard rock TBM Pre-grouting using OPC, some UFC and MFC in-situ concrete lining for tunnels A, B, C, F & G, precast (75-145 m below sea level, unprecedented in HK) ground freezing used around the eye of a 1.8 m dia. pipe jacked tunnel between two shafts at Kwun Tong (*75-145 m below sea level, unprecedented in HK*)	Granite, (Predominantly hard volcanic tuff or granite, with fault zones and zones of deep weathering at isolated locations; water inflow through rock joints and other discontinuities under pressure of up to 15 bars)	McFeat-Smith et al (1999), Chui & Tai (2001), Grandori et al (2001), McLearie et al (2001), Pakianathan et al (2002), Tai & Ho, (2002), Pakianathan et al (2004), Sjostrom (2004), GEO (2007), Maxwell & Kite (2012)
West Kowloon Drainage Improvement Stage 2 Phase 2 – Kai Tak Transfer Scheme Tunnel	2004	1.5 km tunnel, 6 shafts (up to 9.5 m dia.), 450 m long 4.8 m x 2.5 m box culvert	4.4 m ID	5.17 m dia. mixshield slurry TBM (610 mm x 356 mm single cutters, 4 twin cutters for rock and 50 soft ground scraps), precast concrete segmental lining, two-part EPDM and hydrophilic strip inset gasket, up to 30 m below ground surface (first use of large diameter slurry TBM in HK). The TBM was turned 90 degrees through a shaft. A 90 m tunnel section was constructed using NATM	Fill, alluvial deposits (some with peat), grades II-V granite with corestones, a section with a highly weathered fault and a basalt dyke, very shallow cover (<0.75 tunnel dia.) at a location approaching a shaft, maximum hydrostatic head of 140kPa at crown level, compressed air "bubble" behind top of cutterhead for TBM maintenance	Salisbury & Hake (2004), Chu & Wong (2009)
Wan Chai East and North Point Trunk Sewer Tunnels	2005	3.8 km	0.6-1.8 m ID. (0.78-2.15 m outer dia.), 27 temporary shafts	Four pipe jacked slurry shield TBMs with rock cutters, precast reinforced concrete pipes, 3.9-18 m below ground level, compressed air chamber for replacement of cutters (404 m long S-curve section is the first time achieved in HK)	Fill with cobbles and boulders, old seawalls, disused piles, marine and alluvial deposits, grades II-V granite with corestones, groundwater about 2-4 m below ground level	Mok (2006), Wang et al (2006), Wong (2006)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Stormwater Drain by the Hong Kong Airport Authority	2006	42.9 m	1.75 m dia. concrete pipe	Pile jacking	Fill material comprising coarse gravel, cobbles and boulders; the measured groundwater level is about 5.5 m below ground level	
Harbour Area Treatment Scheme Stage 2A - Upgrading of the Stonecutters Island Sewage Treatment Works and the Preliminary Treatment Works - Interconnection Tunnel	2012	0.251 km	4.0 m dia. tunnel	TBM	The interconnection tunnel is underlying soil stratum of alluvium, marine deposit and fill and is embedded in alluvium and completely decomposed granite soil, where marine deposite and alluvium were encountered from CH. 0 to CH. 220 and CDG from CH. 221 to CH. 236. GWL varied from +1.07mPD to +2.69mPD, mainly related to the tidal effect.	Endicott & Tattersall (2010), Tam (2011), Tai et al (2011), Cunningham et al (2012b), Leung et al (2012), Tsang et al (2012a), Tsang et al (2012b), Liu et al (2012), Cheung et al (2012), Chan et al (2012b), Garshol et al (2012a), Kwan et al (2012), Mui et al (2012a), Seit et al (2012), Tang et al (2012), Garshol et al (2014)
Lai Chi Kok Transfer Scheme	2012	1.2 km main tunnel plus 2.5 km branch tunnel and 270 m of connecting adits, total of 3.97 km	4.9 m dia.	Slurry TBM with permanent tunnel lining for tunnels, drill & blast for adits	Grades I-III granite at branch tunnel and grades I-IV granite at main tunnel; groundwater varies from 1 to 2 m below ground level along the main tunnel and 0.5 to 35 m below ground along the branch tunnel	Ip et al (2009), Endicott et al (2012), Wong, E.K.L. (2012), Kan et al (2013

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Tsuen Wan Drainage Tunnel	2013	5.1 km plus 80 m connecting adit	6.5 m dia.	TBM for main tunnel and mechanical excavation for adits. Precast segmental lining by Design & Build contractor (URS/Scott Wilson)	Mainly granodiorite and coarse ash crystal tuff	Ciamei & Grandori (2011), Perlo et al (2012)
Hong Kong West Drainage Tunnel	2013	10.5 km plus 7.9 km of adits, total of 18.4 km	Tunnel 6.25 m & 7.25 m dia., adits in horse-shoe shape with max. 2.5 m & 3.75 m width	TBM for tunnel, drill & blast for adits	Mainly through granite/volcanic bedrock of HK Island with rock cover genrally more than 100 m for main tunnel and more than 50 m for adits ; groundwater expected at intersections with major faults.	Tam (2012b), Evans et al (2012),
Harbour Area Treatment Scheme Stage 2A (Conveyance System) – Aberdeen to Ap Lei Chau	2014	Tunnels: Q 1.32 km	Twin circular 0.6 m dia. pipes	Two horizontal directional drill holes	Predominantly volcanic fine vitric tuff, with quartz monzonite intrusion associated with the major Aberdeen fault; groundwater similar to tide level in the harbour	Endicott & Tattersall (2010), Tam (2011), Tai et al (2011), Cunningham et al (2012a), Cunningham et al (2012b), Endicott, et al (2012), Tattersall et al (2012), Garshol et al (2012), Chan et al (2012), Mui et al (2012a), Mui et al (2012b), Indelicato, A. (2012)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Harbour Area Treatment Scheme Stage 2A – Construction of Sewage Conveyance System from Aberdeen to Sai Ying Pun	2014	Tunnels: M 3.7 km, N 1.2 km, P 2.6 km	To accommodate oval pipes from 1 m x 1.9 m to 1.26 m x 2.16 m	Drill & blast	Mainly granite and tuff, groundwater level at various depths	Endicott & Tattersall (2010), Tam (2011), Tai et al (2011), Cunningham et al (2012a), Cunningham et al (2012b), Endicott, et al (2012), Tattersall et al (2012), Garshol et al (2012), Chan et al (2012), Mui et al (2012a), Mui et al (2012b), Indelicato, A. (2012)
Harbour Area Treatment Scheme Stage 2A – Construction of Sewage Conveyance System from North Point to Stonecutters Island	2014	Tunnels: J 3.2 km, K 4.3 km, L 4.6 km	Excavated dia. from 3.9 m to 5.5 m to accommodate oval pipes from 1 m x 2 m to 2 m x 3.6 m and circular 3 m dia. Pipe	Drill & blast	Mainly granite, groundwater level similar to tide level in the harbour	Endicott & Tattersall (2010), Tam (2011), Tai et al (2011), Cunningham et al (2012a), Cunningham et al (2012b), Endicott, et al (2012), Tattersall et al (2012), Garshol et al (2012), Chan et al (2012), Mui et al (2012a), Mui et al (2012b), Indelicato, A. (2012)
Harbour Area Treatment Scheme Stage 2A - Upgrading of the Stonecutters Island Sewage Treatment Works and the Preliminary Treatment Works – Effluent Tunnel	2016	0.88 km	8.5 m dia. tunnel	Drill & blast	The site is underlain by reclamation fill which overlies beach sand and marine sand of Hang Hau Formation. Saprolite of completely decomposed medium- to coarse-grained granite is present above the bedrock. The underlying bedrock generally comprises strong to moderately strong, slightly to moderately decomposed medium- to coarse-grained granite. The invert level of Effluent Tunnel varies from 92.8 m to 94.5 m below ground, which has a minimum 30 m thick bedrock cover. GWL varied from +0.33 mPD to + 2.46 mPD and +1.23 mPD to +5.03 mPD at Riser Shaft and Drop Shaft respectively.	Endicott & Tattersall (2010), Tam (2011), Tai et al (2011), Cunningham et al (2012b), Leung et al (2012), Liu et al (2012), Cheung et al (2012), Chan et al (2012b), Garshol et al (2012a), Kwan et al (2012), Mui et al (2012a), Seit et al (2012), Tang et al (2012), Garshol et al (2014)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Relocation of Sha Tin Sewerage Treatment Works to Caverns - Investigation, Design and Construction	Construction in progress*	1.342 km (including main/secondary access tunnels and ventilation adit) & the main cavern	Main access tunnel - 26 m span; secondary access tunnel - 14 m span; main cavern - 32 m span	Drill & blast (except a small section of soft/mixed ground tunnel by mechanical excavation)	Mainly Grade III/II granite	

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Table 5 : Cable and Other Tunnels						
Disused Tunnels (94 such tunnels known as of January 2006, 62, 21 & 11 in Hong Kong Island, Kowloon & New Territories & outlying islands respectively)	Air raid protection tunnels built during the Second World War, other tunnels built before or during the Japanese occupation of Hong Kong	Various	Various, sufficient for man-entry	Generally hand dug with minimal support. (Bunkers at Shouson Hill leased to a company as wine cellars, one network at Lei Yue Mun being used as part of the Hong Kong Museum of Coastal Defence, one network at Sai Ying Pun being used by the Hongkong Electric Co. Ltd for routing electric cables)	Various	GEO (2015)
Mining tunnels at: Lin Ma Hang, Needle Hill, Lin Fa Shan, Ma On Shan, West Brother Island, ShaLo Wan Mines	1915-1981	0.9 km, 3.4 km, 2.3 km, 23.5 km, extensive, 0.3 km	2.3-2.4 m dia.	Hand excavation picks and chisels) and drill & blast	Various, at West Brother Island the mine workings had reached 90 m below sea level by 1964, with serious water inflow problems encountered (West Brother Island was flattened in the mid-1990's for a navigation facility for the Chek Lap Kok Airport)	Davis (1963), Roberts & Strange (1991), Strange & Woods (1991), Williams (1991), Woods & Langford (1991)
Hongkong Bank Seawater Tunnel (private tunnel built within Government land under a short term tenancy)	1985	0.37 km	7.0 m dia.	Drill & blast, probing ahead and pre-grouting (fan grouting and localised fissured grouting), rock bolts and shotcrete, 0.5 m cast in situ concrete lining after completion of tunnel excavation	Tunnel up to 75 m below ground, minimum rock cover of 10 m, mainly grade II granite with weak seams encountered, water inflow up to 540 l/min., drawdown up to 25 m at 100 m west of tunnel alignment, resulting in large settlements (up to 100 mm) and building damage	Cowland & Thorley (1985), Archer & Knight 1986), Troughton et al (1991), GEO (2007)
Crossings for seawater cooling pipes at Harcourt Road and Queensway (private)	1988	27 m (Harcourt Road crossing)	6 m wide x 2.5 m high	Horizontal mini-piles to form tunnel wall structure, pre-grouting (tube-à-manchette) prior to excavation	Reclaimed land, grade V granite	Owen & Tam (1989)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
HEC Wah Fu to Bowen Road Cable Tunnel	1988	3.1 km	4.4 m wide x 3.7 m high horseshoe shaped tunnel	Drill & blast, cast in situ permanent concrete lining	Mainly volcanic tuff	McFeat Smith et al (1999), HEC (2007)
HEC Nam Fung Road to Parker (Chaiwan Road) Cable Tunnel	1993	5.7 km	4.8 m dia.	Open hard rock TBM, with 32 single disc cutters of 483 mm in dia. and facilities for probing ahead (the first hard rock TBM drive in HK), some sections were widened by drill & blast	Fine- to medium-grained granite with 17 m wide fault zone, 120 m of weathered quartz monzonite at portal, high initial water inflows (up to 2,400 l/min.) at fracture zones or open joints	McFeat Smith et al (1985), McFeat Smith (1992), McFeat Smith (1994), McFeat-Smith (1998), McFeat-Smith et al (1999), HEC (2007)
The Hong Kong and China Gas Co. Ltd Braemar Hill Tunnel	1994	2.6 km	3.35 m dia. man-accessible tunnel housing a 600 mm gas pipe	Open hard rock TBM (subsequently used for SSDS tunnel between Kwun Tong and Chai Wan)	Granite, significant fracture zone trending from Tai Hang to Tai Tam Tuk, up to 80 m wide and roughly vertical, none to minor water inflow	McFeat-Smith et al (1999)
The Hong Kong and China Gas Co. Ltd Pipe Crossing Underneath Seawall at Ta Pang Po, North Lantau	1995	0.45 km	2 x 500 mm dia. holes housing two 300 mm dia. steel gas pipes	HDD	Up to 15 m below sea level, marine deposits	
Kau Shat Wan Tunnel and Audits (Mines Division Lantau Island Explosives Magazine)	1997	1.42 km (comprising 1.15 km long main access tunnel and 10 nos 27 m long audits to the caverns), 20 m (caverns)	6.5 m span (arch roof of max. height of 5.5 m with a rectangular base of 4.0 m high), 13 m wide x 6.8 m high	Drill & blast, unlined with rock bolts and shotcrete support	Medium-grained granite intruded by feldsparphyric rhyolite dykes (grade I/II) and approx. 200 m of grade IV/V rock at portals supported by reinforced concrete lining, generally high water inflow at several sheared zones or basalt dykes, covered by shotcrete	Chan & Ng (2006)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
Tunnels for Glory Hole Construction for Rehabilitation of Anderson Road Quarries	1998	0.1 km and 0.08 km long tunnels, 3 shafts	5.5 m and 4.6 m span x 5.5 m high (enlarged to 12.5 m high) tunnels, 76-89 m deep 2.75 m dia. Shafts	Drill & blast for tunnels, dowels and shotcrete, steel ribs for the first 20 m of one tunnel, raise boring techniques with the use of TBM for shaft construction	Grades I-II granite, shear zone encountered and grades I-II volcanic at the top 11 m of one of the shafts, no water inflow	Lam et al (2003)
HEC Tin Wan to Wah Fu Tunnel	1999	0.8 km tunnel, 14 m deep shaft	4.0 m wide and 3.7 m high horseshoe shaped tunnel	Drill & blast, sprayed concrete permanent lining, up to 180 m below a rock mount	Volcanic tuff, generally none to minor water inflows	
CLP Lantau to Ma Wan Cable Crossing	2002	0.85 km	584 mm dia. drill hole	HDD	96 m below sea level, 40 m rock cover except in fault zones	Tam (2000), Hui et al (2002), Loneragan & Lukas (2003)
CLP Sham Tseng to Ma Wan Cable Crossing	2002	1.3 km	584 mm dia. drill hole	HDD	96 m below sea level, 40 m rock cover except in fault zones	Tam (2000), Hui et al (2002), Loneragan & Lukas (2003)
The Hong Kong and China Gas Co. Ltd Pipe Crossing at Tai Lam Marine Police Base near Tai Lam Offtake/ Pigging Station	2002	0.17 km	550 mm dia. backreamed hole housing a 400 mm dia. PE gas pipe	HDD	Various. Granite encountered in some sections and soft clay at other sections	
HEC Ap Lei Chau Cable Tunnels (for Ap Lei Chau Industrial Estate Zone Substation)	2003	0.42 km (twin tunnels)	1.8 m dia.	Slurry TBM, precast concrete segmental lining, up to 100 m below mountain	Grades I-III tuff	
HEC Cyberport to Wah Fu Cable Tunnel	2003	0.83 km	4.0 m wide x 3.7 m high horseshoe shaped tunnel, 8 m wide x 6.15 m high joint bays	Drill & blast, plain or fibre reinforced sprayed concrete lining, rock dowels	Fine ash vitric tuff, eutaxite	

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
CLP Kwai Chung Cable Tunnel	2005	1.1 km	3.8 m dia.	Drill & blast	Grades I-III granite, average depth of 35 m	Hui et al (2002), Chan et al (2009)
CLP Tuen Mun Cable Tunnel	2005	0.28 km	3.3 m dia.	Air plenum shield	Rock fill, marine deposits, grade V volcanic	
CLP Pui O Beach, Chi Ma Wan, Cable Crossing	2005	Not available	Twin 600 mm dia. boreholes with 7 x 163 mm ID ducts in borehole A, 3 x 163 mm ID ducts and 3 x 127 mm ducts in borehole B	HDD	Marine sediments, marine deposits, highly fractured grades III-V granite, grade II granite with closely spaced joints, maximum depth at -40mPD	
CLP Tze Wan Shan Cable Tunnel	2005	0.65 km	3.3 m dia.	Air plenum shield	Colluvium with boulders, grade V granite	Hui et al (2002), Chan et al (2009)
HEC Headland Road to Chung Hom Kok Road Cable Duct Crossings	2005	0.27 km	4 x 350 mm dia., with 4 nos of. 315 mm dia. cable ducts	HDD, 330 m in radius	Mainly grades II-III tuff	
CLP Chi Ma Wan Cable Tunnel	2006	3.2 km	3.2 m dia.	Open face hard rock TBM 13.5 m long 4.75 dia., drill & blast and steel segmental rings to form joint bays and dismantling chamber at Pui O portal	Grades I-II granite, feldsparphyric rhyolite, 4-9 m thick debris flow deposits at portals	Hui et al (2002), Chan et al (2009)
HEC Pak Kok Tsui Cable Tunnel	2006	0.13 km	2.5 m wide x 3.2 m high horseshoe shaped tunnel	Drill & split (both mechanical splitter and chemical expanders were used), manual excavation for soft ground, sprayed concrete lining	50% of tunnel length in grade II fine- to medium-grained granite and 50% in grade V granite	

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
The Hong Kong and China Gas Co. Ltd Pipe Crossing Underneath Fanling Highway	2006	0.04 km	450 mm dia. casing housing a 400 mm dia. PE gas pipe	Pipe ramming. Open-ended steel casing pushed horizontally from a launch pit to a receiving pit by a pneumatic hammer. Soil inside casing removed and gas pipe inserted into casing	Generally clay with some cobbles	
CLP Cable Tunnel at KCRC Hung Hom Freight Yard	2006	0.32 km	3 m dia.	EPB TBM and cut & cover	Reclamation fill, marine deposits, grades I-V granite, with groundwater 2-3 m below ground surface, encountered rubble mound beneath an old seawall (for the reclamation in 1963-1967)	Wong & Wong (2012)
The Hong Kong and China Gas Co. Ltd Pipe Crossing Underneath Tai Wan Stream, Sai Kung	2006	0.03 km	1.1 m dia. concrete sleeve pipe housing a 750 mm dia. steel gas pipe	Pipe jacking	Mainly boulders	
Jordan Valley Pedestrian Tunnel	2006	100 m	5 m wide x 3.5 m high	Drill & blast	Grades I & II granite, occasional grade III	
HEC Lamma Power Station to Yung Shue Wan South Cable Tunnel	2006	0.22 km	2.5 m wide x 3.2 m high horseshoe shaped tunnels	Drill & split (both mechanical splitter and chemical expanders were used), mini-jumbo used, plain sprayed concrete lining	Grade II fine- to medium-grained granite	
CLP Cable Duct at West Kowloon Highway	2008	0.2 km	1.95 m dia.	TBM with precast concrete segmental lining	Reclaimed land in fill and marine deposits	Lam (2008)

Project Title	Year of Completion	Length Details	Cross Section Details	Method of Construction	Geology and Groundwater	References
CLP Cable Tunnel, Yeung Uk Road, Tsuen Wan	2008	65 m	Twin section with 1.6 m & 1.2 m diameters	TBM	Fill, groundwater at about 3.5 mPD.	
HEC Bowen Road to Kennedy Road Cable Tunnel and Cable Duct Crossings	2008	0.23 km tunnel and 0.11 km cable ducts, 2 shafts	2.5 m wide x 2.8 m high horseshoe shaped tunnel with 14nos. of 300 mm dia. cable ducts	Drill & split for tunnel, HDD for cable ducts	Mainly grades II-III volcanic tuff, part of the tunnel is in colluvium	
CLP Castle Peak Cable Tunnel	2009	4.5 km	4.5 m dia.	TBM, precast concrete segmental lining being considered	Grades I-II porphyritic fine- to medium-grained granite, Tuen Mun Formation comprising andesite, tuffs and sedimentary rocks such as sandstone near the Tuen Mun shaft	Chan et al (2009)
Ocean Park Funicular Tunnel	2009	1.3 km	6 m dia.	Drill & blast	Eutaxitic fine ash vitric tuff	Pan et al (2011)
Landslide Preventive Works at Po Shan Road, Mid-levels	2009	Twin tunnels 0.18 km and 0.26 km long	3.5 m dia.	Retractable TBM, cast in situ concrete lining	Mainly grade II coarse to fine ash crystal tuff	Ho et al (2008), Solomon et al (2008), Lo et al (2009), Chau et al (2011), AECOM (2010), Lo et al (2010), Lo et al (2011) & Chau et al (2011)
Contract 3801 Automated People Mover (APM) and Baggage Handling System (BHS) Tunnels on Existing Airport Island	Construction in progress*	0.45 km	6 m to 7 m span x 13 m high for APM Tunnel ; 8 m span x 12 m high for BHS Tunnel	Cut & cover tunnel; jacked box tunnel under the portion of the Airport Express Line	Sand fill, rockfill, marine deposits, alluvium	
Re-provisioning of Victoria Public Mortuary: Cavern Enchancement Works and Natural Terrain Hazard Mitigation Works	Detailed design completed*	0.33 km	5.5 m	Drill & blast (former MTRCL WIL Project's temporary underground magazine)	Granitic rock, groundwater level at various depths	

*Remark: Readers could visit the respective project websites for the anticipated completion dates of the on-going projects.

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