

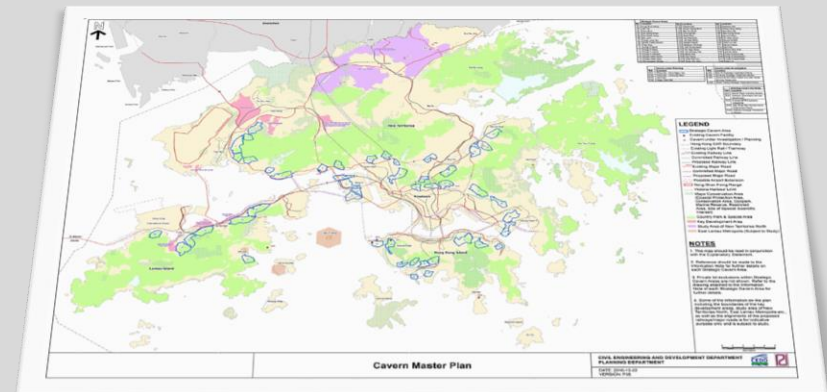
Engineering a New Future of Cavern Development in Hong Kong

Opportunities of Cavern Development and Cavern Master Plan

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Opportunities of Cavern Development



An aerial photograph of a densely populated urban area, likely Hong Kong, showing a large body of water, numerous high-rise buildings, and mountains in the background. The image is used as a background for the text.

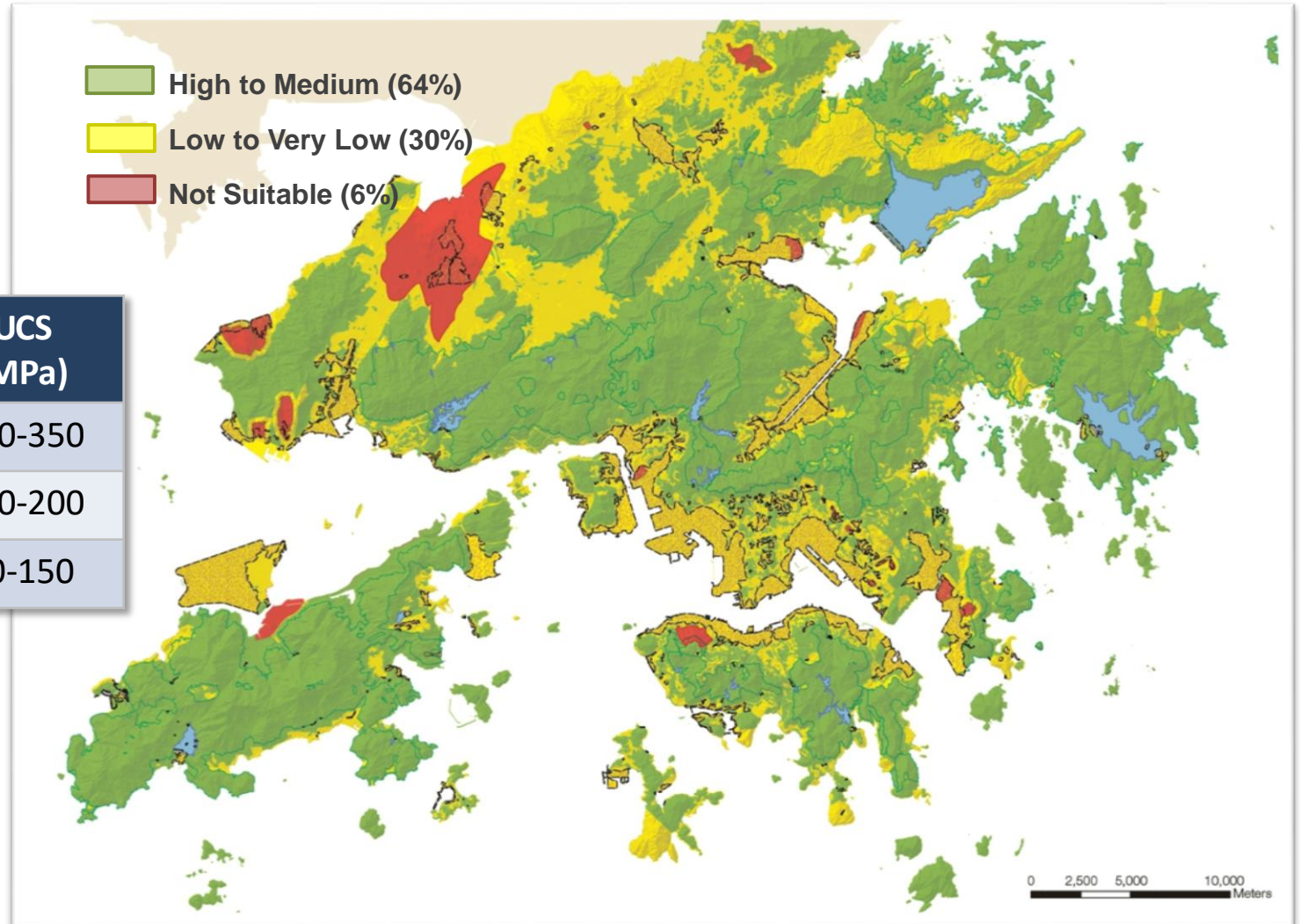
High Land Cost

Densely populated in urban area

Three Dimensional Planning Perspective



Territory-wide Cavern Suitability Map



Opportunities

- High land value and lack of land supply
- Mountains are close to urban area
- Good rock quality is common

**Cavern
development is a
sustainable source
of medium to
long-term land
supply**





Tai Koo MTR Station (1985)



Sai Wan Ho MTR Station (1985)



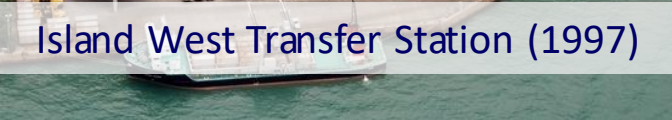
Stanley Sewage Treatment Works (1995)



Island West Transfer Station (1997)



Kau Shat Wan Explosives Depot (1997)



Island West Transfer Station (1997)



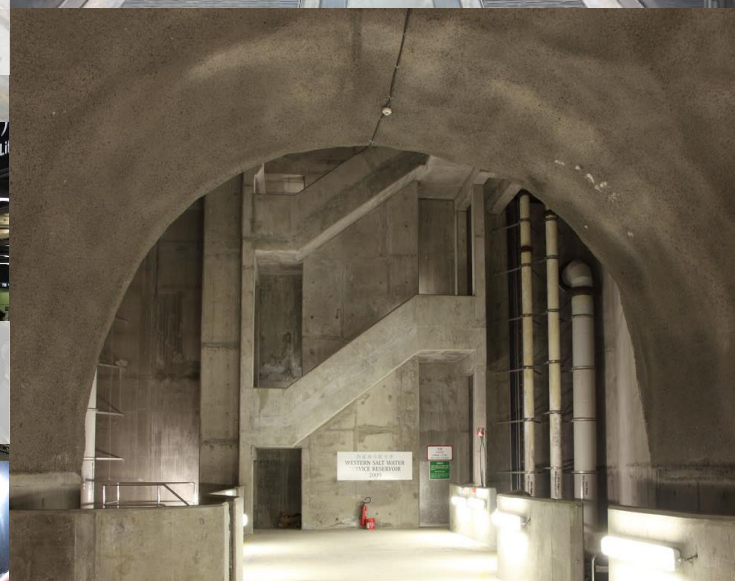
Admiralty MTR Station (2016)



Hong Kong University MTR Station (2014)



West Island Line Explosives Magazine (2010)



Western Salt Water Service Reservoirs (2009)

“NIMBY” only?

Other Opportunities !!!



Refuse Transfer Station



Swimming Hall, Finland



Sport Stadium, Norway



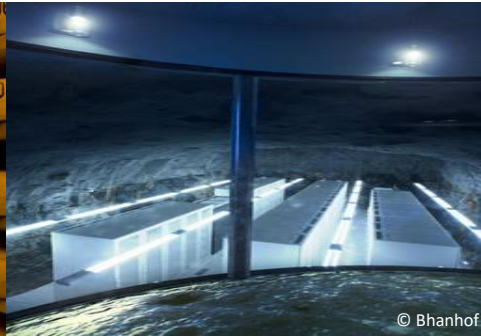
Archives, Norway



Sewage Treatment Works



Food Storage, France



Data Centre, Sweden



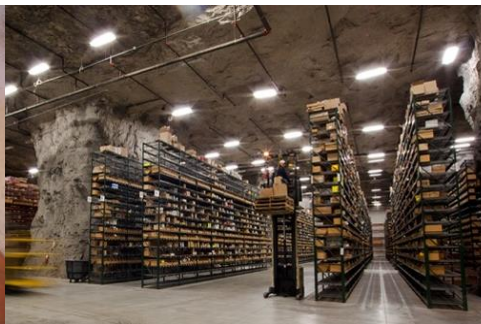
Quarrying, Switzerland



Service Reservoir



Restaurant, Switzerland



Warehousing/Logistics, USA



Vehicle Parking, Finland



House NIMBY facilities to resolve incompatible land use issue



Provide stable environments

Benefits of rock caverns



Facilitate tight security control

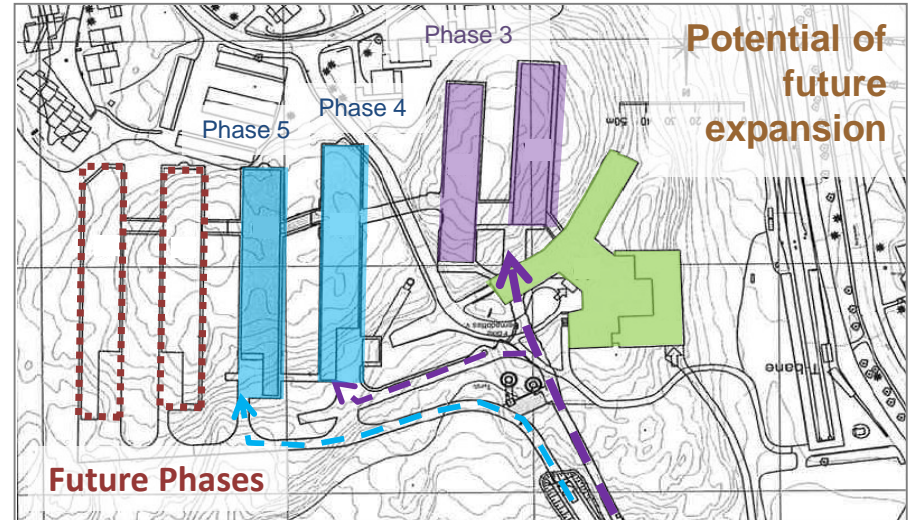
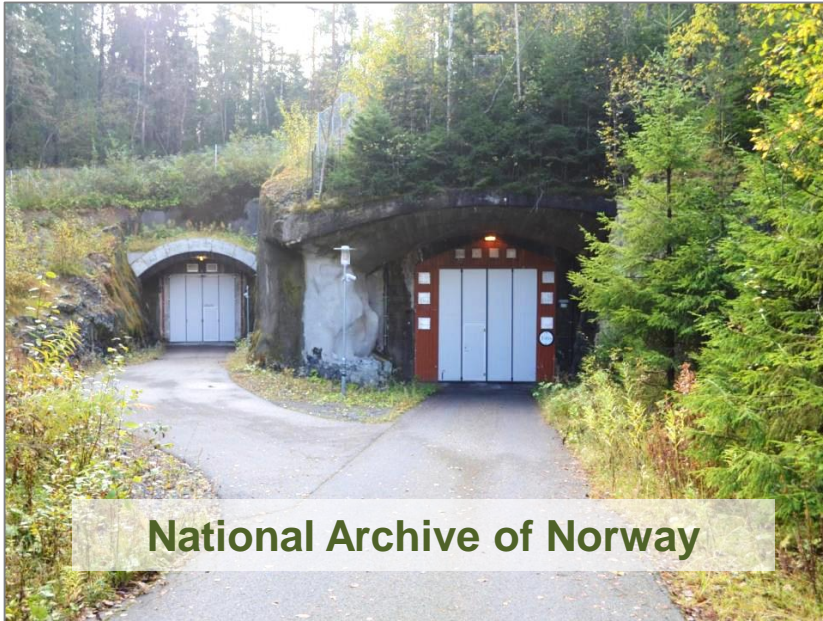


Create space to free up surface land, serve as a land supply option

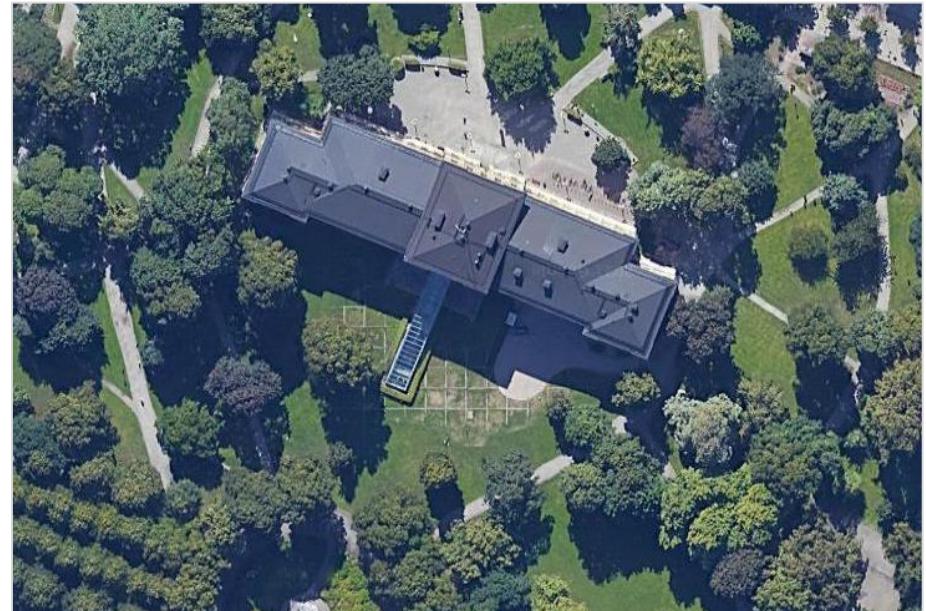
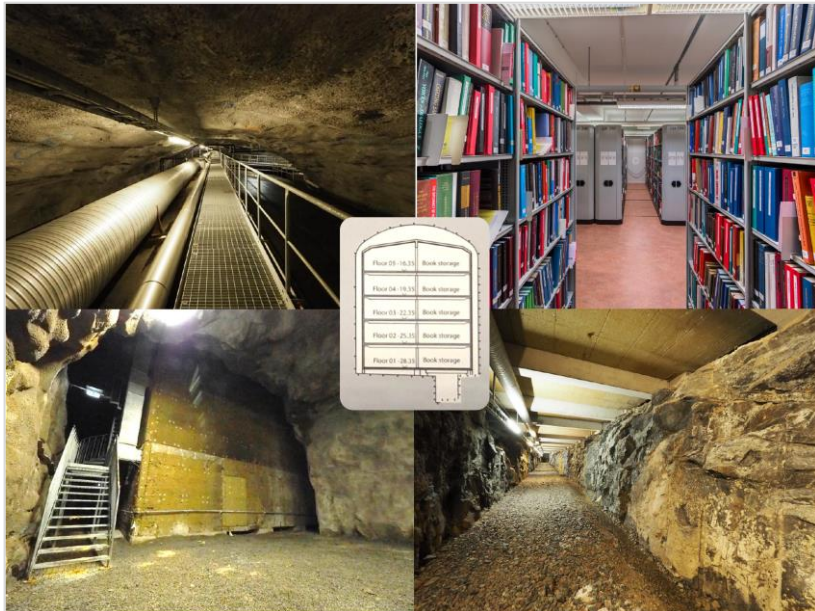
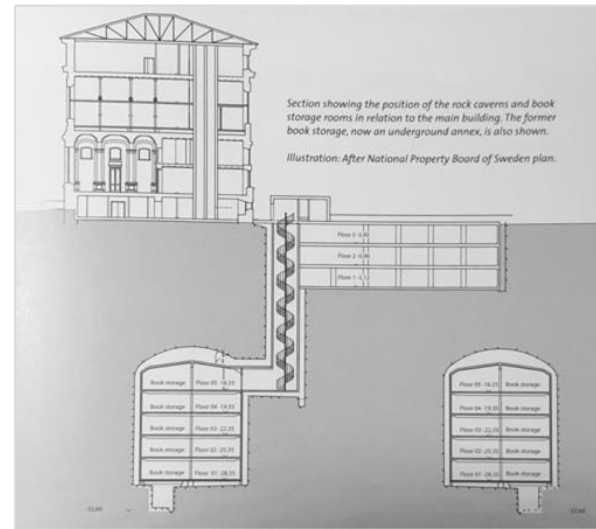


Generate rock materials for construction

Integration with the environment



Concealed facilities





Lecture hall



Concrete batching



Hagerbach Testing Gallery
(Testing gallery under Geopark Sardona)



Fire testing chamber



Material testing lab



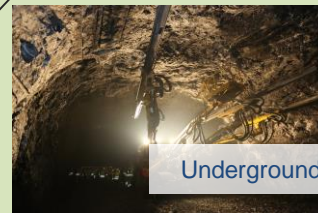
Schollberg underground quarry



Brunig Indoor



Geopark Sardona



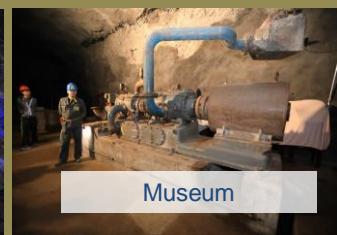
Underground



Quarrying



Exhibition



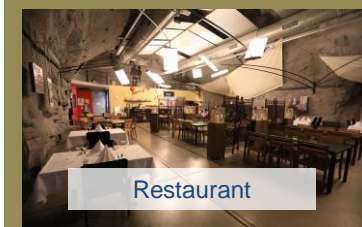
Museum



Shooting centre



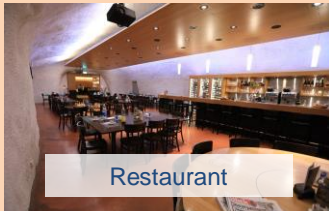
Storage/warehouse



Restaurant



Fire testing tunnel



Restaurant



Maintenance Depot



Berwerk Gonzen
(Museum under Geopark Sardona)

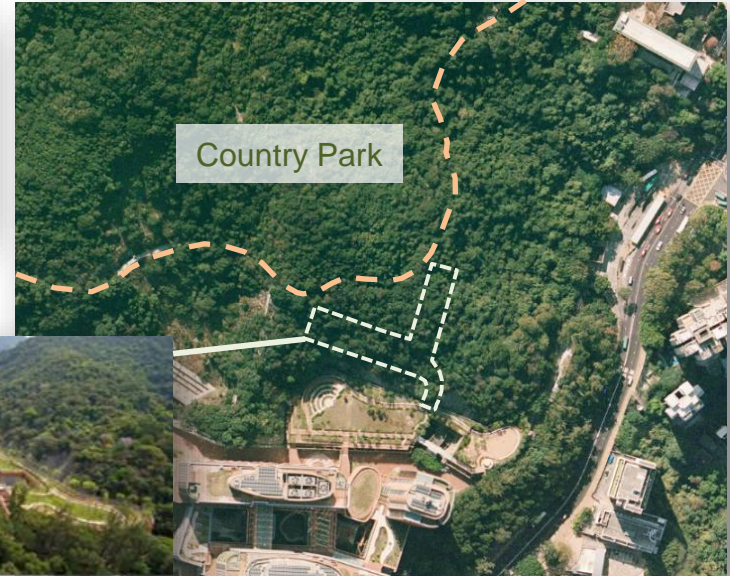


Island West Transfer Station

You even don't notice it!



Stanley Sewage Treatment Works



Western Salt Water Service Reservoirs

Cavern Master Plan and other enabling measures





Strategic Cavern Areas

Possibilities

Land Uses with Potential for Cavern Development (Ch.12 of HKPSG)

Commercial Uses

- Food/Wine storage
- Food and beverage
- Retail

Industrial Uses

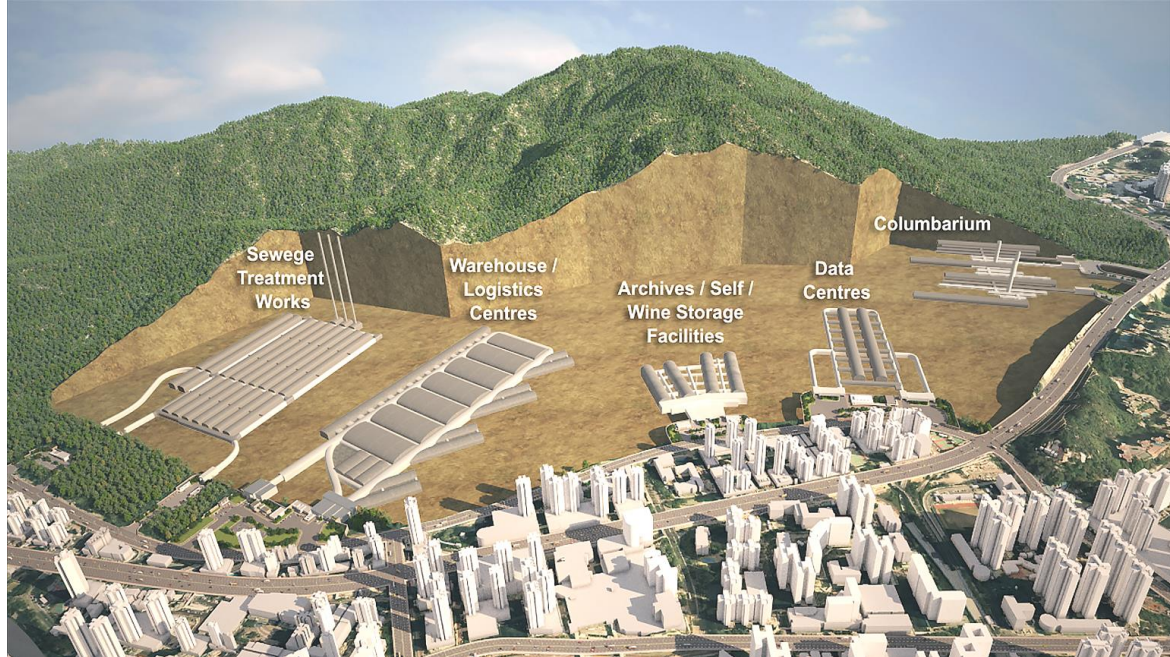
- Industry
- LPG bulk storage
- Oil bulk storage
- Storage/Warehousing
- Data centre
- Research/Testing laboratories
- Container storage

Government/Institution/Community and Other Specified Uses

- Archives
- Civic centre
- Columbarium/Mausoleum/Mortuary
- Cultural/Performance venue
- Explosives depot/magazine
- Incinerator
- Indoor games/Sports hall
- Indoor swimming pool/complex
- Maintenance depot
- Recreational complex
- Refuse transfer facility
- Service reservoir
- Sewage/Water treatment plant
- Slaughterhouse
- Transport connections & networks
- Underground quarrying
- Vehicle parking
- Vehicle (including bus) depot
- Wholesale market

Public Utilities

- Power station
- Public utility installation



Strategic Cavern Area - Video



Relocation Plan for Suitable Government Facilities



Sewage treatment works



Refuse transfer stations



Vehicle depot



Water treatment works



Service reservoirs



Warehouse

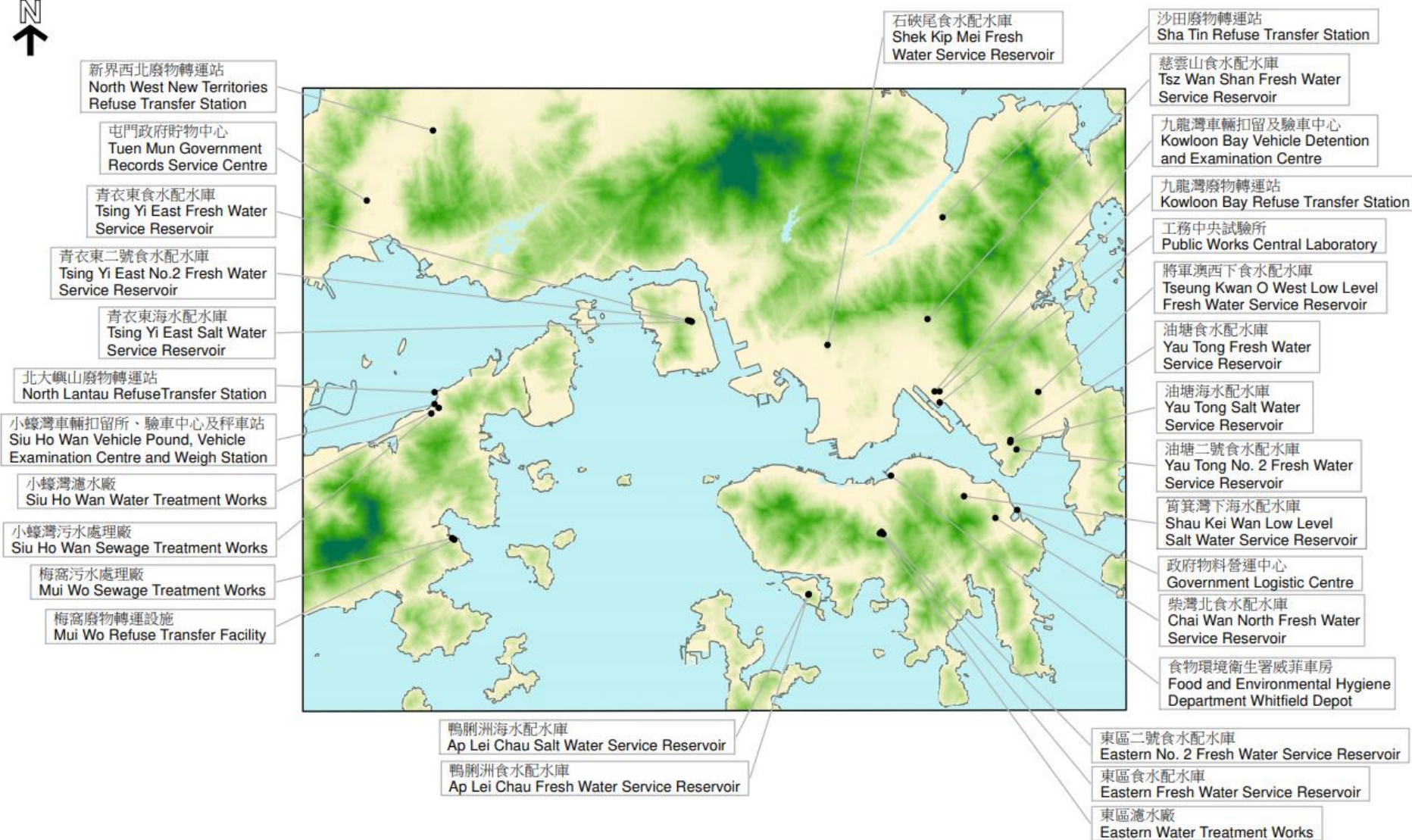


Archive

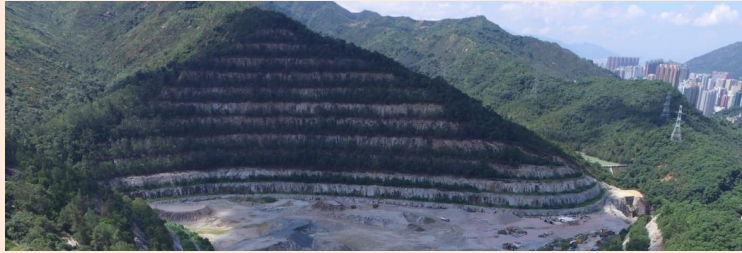


Material testing laboratory

Relocation Plan for Suitable Government Facilities



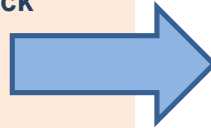
Benefits of Underground Quarrying-cum-Cavern Development



Suitable underground quarry sites



Excavated rock



Valuable Cavern Space



Warehouse



Data Centre

Diversified long-term uses



Surplus rocks from local construction sites



Rock processing



Concrete batching



Rock products



Concrete products

Underground Quarrying-cum-Cavern Development

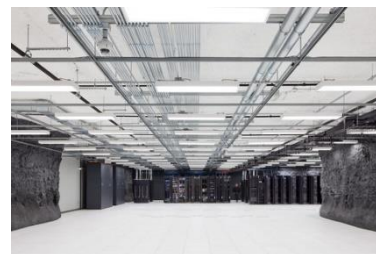
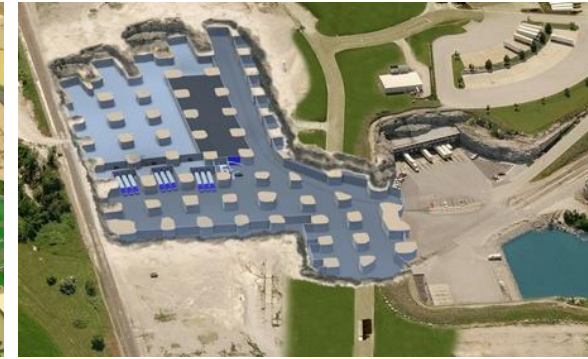
Schollberg, Switzerland



SubTropolis, USA



Springfield, USA



- Financially viable
- Private sector participation
- Sustainable land supply
- Versatile use of space

Logistics/Warehouse

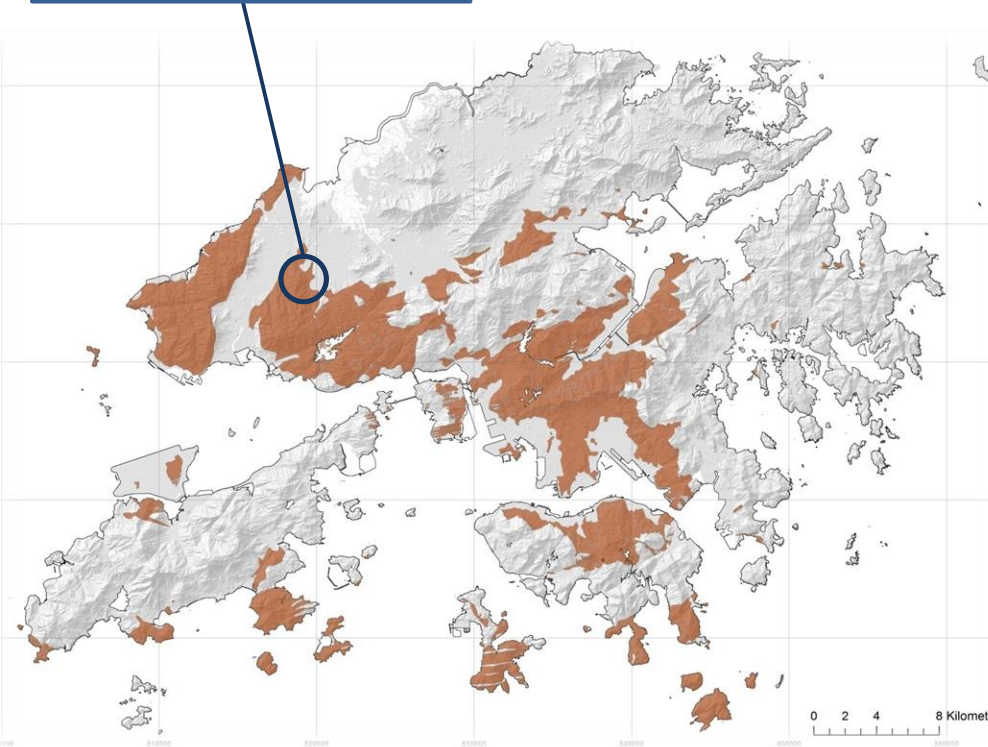
Manufacturing

Data Centre

Potential Underground Quarrying Sites

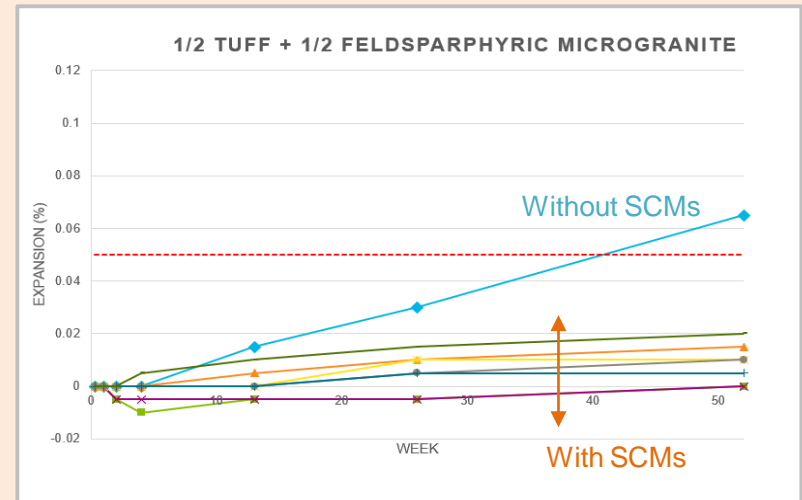
Lam Tei

- Granitic rock
- Technically feasible
- Long-term land use compatible

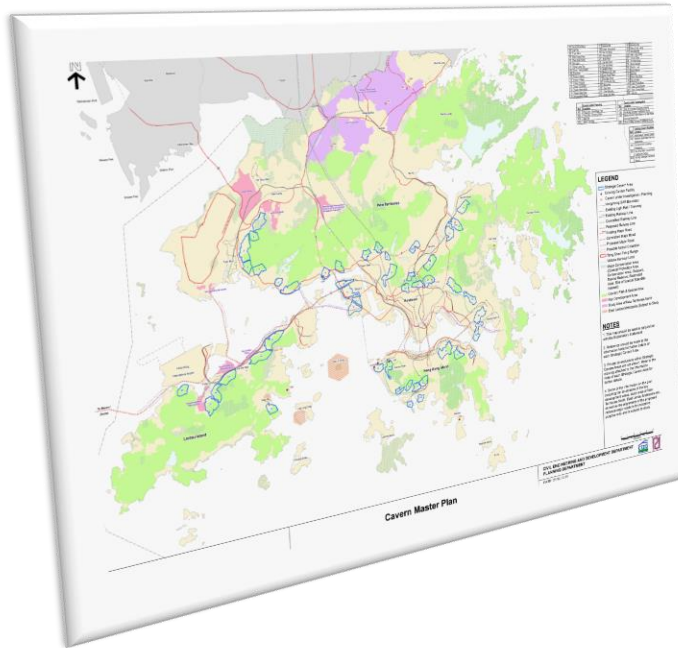


Other potential site

- Volcanic rock
- Rhyolite dyke rock/Micro-granite
- Alkali-Silica Reactive (ASR) Aggregate
- A series of tests proved the effectiveness of Supplementary Cementitious Materials (SCMs) in suppressing the ASR effect
- SCMs: Pulverized Fly Ash (PFA) & Ground Granulated Blastfurnace Slag (GGBS)



Pilot Planning and Engineering Study



Select strategic cavern areas

Identify suitable land uses

Conduct technical assessments

Prepare for zoning amendment for caverns

Reference design for high potential facilities

Data Centre

Cloud computing

Energy saving

Security



Green Mountain Data Centre, Norway



Cavern Technologies, USA



Tencent Data Centre, Guizhou



Lefdal Mine Data Centre, Norway



Container type

Reference design for high potential facilities

Logistic warehouse



Springfield, Illinois, USA

Columbarium



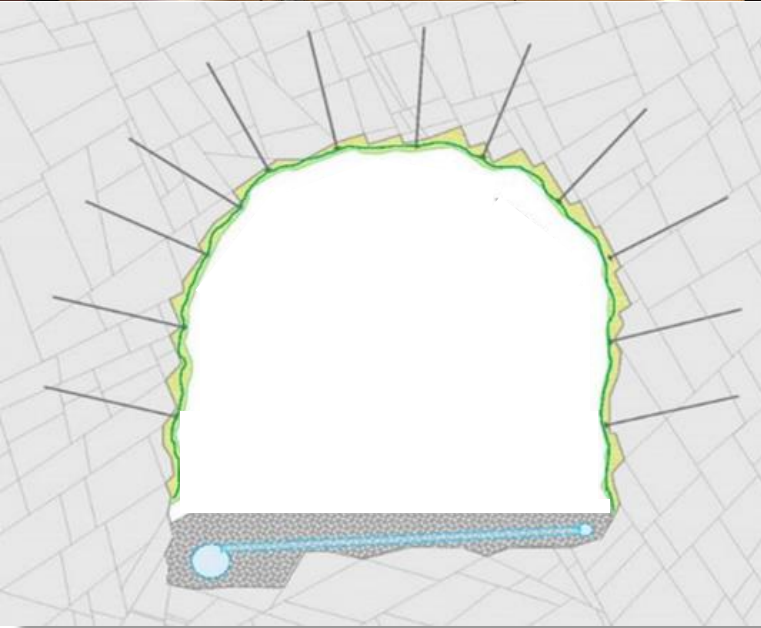
Jerusalem, Israel



Meritex, Kansas, USA

Rock reinforcement approach

Thin sprayed concrete + rock bolting

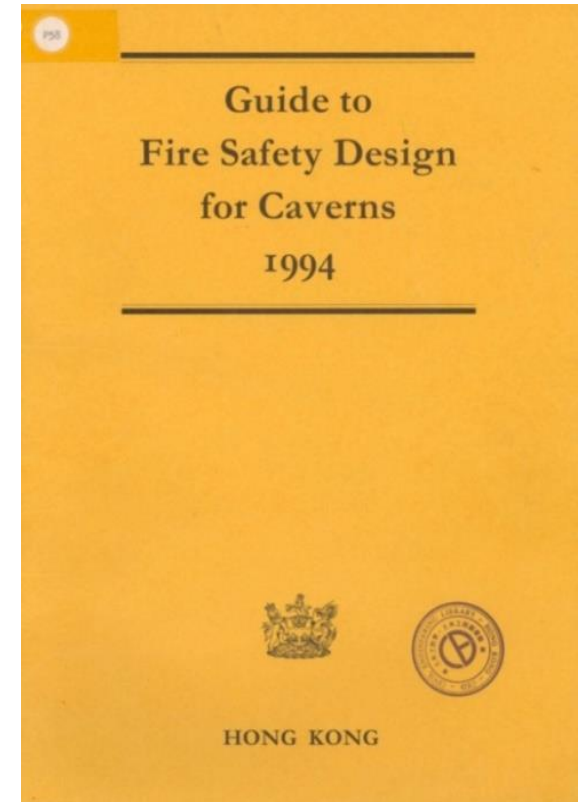


Guide to Fire Safety Design for Caverns 1994

- The Cavern Guide was issued in 1994, which was published more than **25 years ago**
- For **public utilities** such as sewage treatment works, refuse transfer stations and water reservoirs only
- Characterized with **low population**, low fire load and occupancy not involving sleeping risk



**There is a need to update
the Guide to Fire Safety
Design for Caverns**



Multi-disciplinary collaboration

Cavern studies and projects prior to CMP



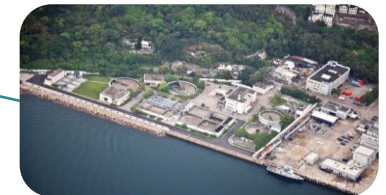
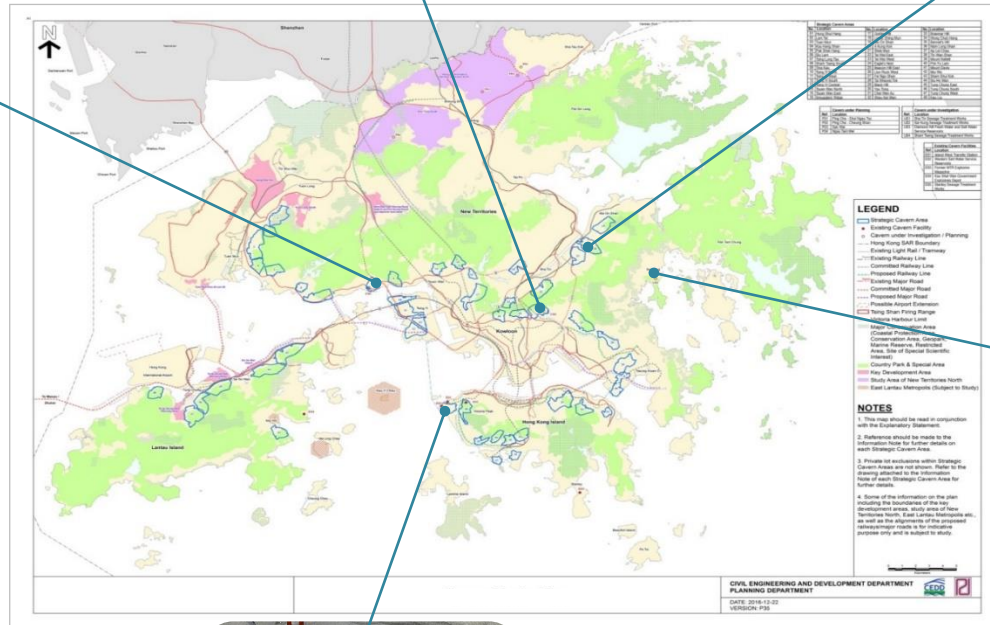
Relocation of Diamond Hill SRs



Relocation of Sha Tin Sewage Treatment Works



Relocation of Sham Tseng Sewage Treatment Works



Relocation of Sai Kung Sewage Treatment Works



Re-provision of Victoria Public Mortuary

Ongoing cavern development studies and projects



Lam Tei Underground Quarry
(Upcoming IDC Study)



Relocation of Tsuen Wan No. 2 SR
(Feasibility Study)



Relocation of Diamond Hill SRs
(IDC Study)



Revitalization of Lin Ma Hang Lead Caves
(IDC Study)



Relocation of Sha Tin Sewage Treatment Works
(Construction)



Relocation of Tan Kwai Tsuen SRs
(Feasibility Study)



Relocation of Tuen Mun WTW
(Upcoming Feasibility Study)



Relocation of Tsing Yi SRs
(Upcoming Feasibility Study)



Technical study of underground quarrying-cum-cavern development
(Feasibility Study)



Pilot P&E Study for SCVAs
(Feasibility Study)



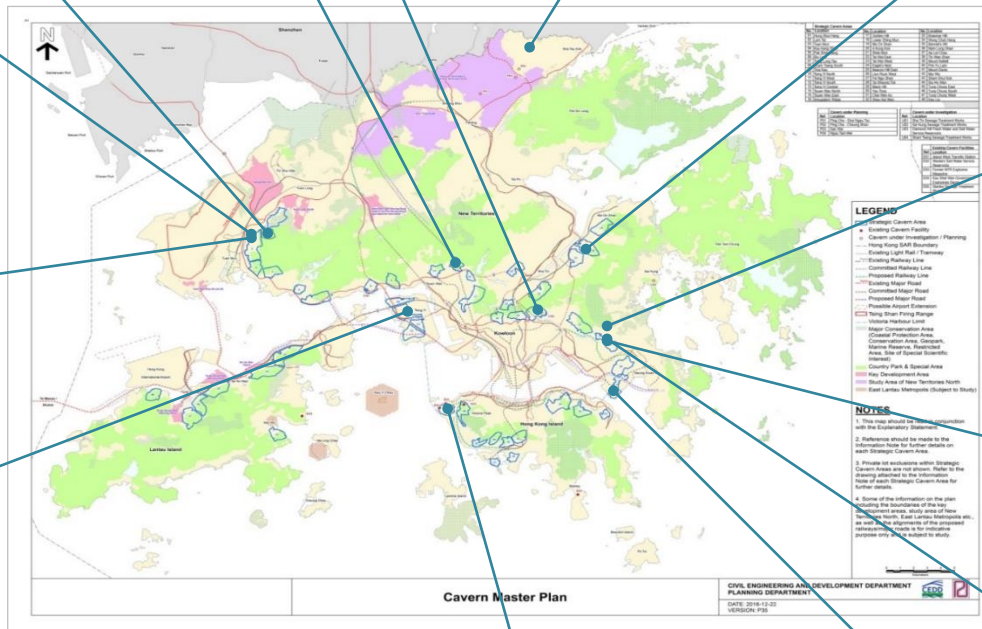
Re-provision of Victoria Public Mortuary
(Detailed Design)



Relocation of Yau Tong SRs
(Feasibility Study)



Refuse Transfer Station
(Investigation Study)



Relocation of Public Works Central Laboratory
(Upcoming IDC Study)



New Archive Centre
(Upcoming IDC Study)