How to make use of Underground Space to develop more land

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“to launch strategic planning and technical studies to facilitate the development of underground space and promote use of rock caverns as part of Hong Kong’s pursuit of sustainable development….”
The use of rock cavern has been identified as one of the 6 enhancing land supply options:
Background – The need!
Background - Definition

**Underground space**  地下空間:

- Large basement-type excavations formed by cut and cover methods  地下室
- Purpose-built rock caverns  岩洞
Background – Examples of basements in Hong Kong

MTR Stations

Shopping Mall

Flood storage tank at Tai Hang Tung
Background – Examples of Caverns in Hong Kong

Tai Koo MTR Stations
Background – Examples of Caverns in Hong Kong
Background – Foreign Examples

- Finland – Sewage Treatment Plant
- Norway – Water Treatment Plant
- Norway - Coliseum
  - Capacity: 5,500
Background – Foreign Examples

Norway – Water Treatment Plant

Finland – Swimming Pool
- Capacity: 1,000

Singapore – Petrol Storage Area
- 150 m3

Norway – National Registry
Background – Foreign Examples

West Island Refuse Transfer Station (1997)

The widest cavern in HK

The Coliseum in Norway (1993)

(Norway has similar geology as HK)
Natural Criteria for Developing Caverns

- Strong Granites and Volcanics
- Avoid fault zones

Hillside near the urban area
Cavern Suitability Map

Cavern Suitability Classes
- High to Medium (64%)
- Medium to low (30%)
- Not Suitable (6%)
## Selection of Potential Areas for Cavern Development

<table>
<thead>
<tr>
<th>Suitability Criteria</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Land</td>
<td>• Government land - suitable</td>
</tr>
<tr>
<td>Underground structures</td>
<td>• Away from existing tunnels and caverns</td>
</tr>
<tr>
<td>Geology</td>
<td>• Granitic and volcanic rocks – highly suitable</td>
</tr>
<tr>
<td></td>
<td>• Away from faults and poor rock mass</td>
</tr>
<tr>
<td></td>
<td>• Areas with significant geotechnical constraints – not suitable</td>
</tr>
<tr>
<td>Topography</td>
<td>• Upper elevations to allow for sufficient ground cover</td>
</tr>
<tr>
<td>Landfill Areas</td>
<td>• Not suitable</td>
</tr>
<tr>
<td>Reclamation Areas</td>
<td>• Not suitable</td>
</tr>
<tr>
<td>Country Parks</td>
<td>• Suitable but portals need to be placed outside country parks</td>
</tr>
<tr>
<td>Reservoirs</td>
<td>• Not suitable to avoid seepage</td>
</tr>
</tbody>
</table>
Stock-taking of all Government Facilities

- Government Facilities
Stock-taking of all Government Facilities

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Service Reservoir</td>
<td>183</td>
</tr>
<tr>
<td>Sports Centre</td>
<td>97</td>
</tr>
<tr>
<td>Seawater Service Reservoir</td>
<td>53</td>
</tr>
<tr>
<td>Sewage Treatment Works</td>
<td>31</td>
</tr>
<tr>
<td>Freshwater Treatment Works</td>
<td>23</td>
</tr>
<tr>
<td>Civic Centre</td>
<td>20</td>
</tr>
<tr>
<td>Refuse Transfer</td>
<td>13</td>
</tr>
<tr>
<td>Columbarium</td>
<td>8</td>
</tr>
<tr>
<td>Wholesale market</td>
<td>5</td>
</tr>
<tr>
<td>Incinerator</td>
<td>4</td>
</tr>
<tr>
<td>Mortuary</td>
<td>4</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>3</td>
</tr>
<tr>
<td>Warehouse</td>
<td>1</td>
</tr>
</tbody>
</table>

Total No.: 445

Total Area: 485 ha
Consideration of Relocation of Government Facilities into Caverns

<table>
<thead>
<tr>
<th>Environmental</th>
<th>• Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economical</td>
<td>• Nature</td>
</tr>
<tr>
<td></td>
<td>• Size</td>
</tr>
<tr>
<td></td>
<td>• Location</td>
</tr>
<tr>
<td></td>
<td>• Geological conditions</td>
</tr>
<tr>
<td></td>
<td>• Preceding case in Hong Kong / foreign countries</td>
</tr>
<tr>
<td>Social</td>
<td>• Existing Location</td>
</tr>
</tbody>
</table>
Strategic Cavern Areas

- Greater than 20 hectares in size
- Able to accommodate multiple cavern sites
- Public benefit
- Relative ease of access

Strategic Cavern Areas
Preliminary feasibility studies for transferring the following facilities into caverns had been carried out:

- Mount Davis and Kennedy Town Service Reservoir
- Shatin Sewage Treatment Plant
- Mui Wo Sewage Treatment Plant and Refuse Transfer Station
Mount Davis and Kennedy Town Service Reservoir

- 2 ha of land can be released
- Existing cavern facilities nearby successfully completed
- Future expansion can be provided for underground services
Shatin Sewage Treatment Plant

Sha Tin Sewage Treatment Works

- 28 ha of prime waterfront land can be released
- Known similar underground sewage treatment plant
- Visual and environmental impacts improved
- Future expansion can be provided for underground
Mui Wo Sewage Treatment Plant and Refuse Transfer Station

- 2.5 ha of waterfront land can be released
- Revitalize 500 m of waterfront area
- Visual and environmental impacts improved
- Future expansion can be provided for underground

Mui Wo town centre

Tentative Integrated cavern site

Not-in-my-backyard facilities including sewage treatment works, refuse transfer station, bus depot, etc.
Preliminary Findings

Merits of Developing Underground Space:

• Valuable land can be released
• Sensitive structures not occupying land in the urban areas
  ➔ create a community with harmony and improve the environment
• Facilities can be expanded underground on a need basis
• Safety consideration for dangerous good e.g. explosives, fuels, natural gas, data centre, etc.
• Energy Efficiency
Way Forward

• Public Engagement Activities being carried out:
  www.landsupply.hk

• Conduct a study “Long-term Strategy on Cavern Development” to formulate policy on cavern development for both public and private sectors, prepare cavern master plans, etc.

• Conduct a Feasibility Study on the Relocation of Shatin Sewage Treatment Works to Caverns
Video on Underground Space

http://www.youtube.com/user/hkslopesafety