A Reliable 3D Map of Underground Utilities for Planning and Land Administration

UNWGIC 2018
Spatially Enabled Future Cities
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FINDING SPACE FOR THE FUTURE

Population density over a decade

How Singapore’s land area has grown over the years

NOTE: Population density is calculated by dividing the total population by land area as at end-June.

Sources: DEPARTMENT OF STATISTICS, GOOGLE MAPS, ONEMAP.SG, MND STRAITS TIMES GRAPHICS
To use our space more efficiently, the Government is looking to launch its Underground Master Plan in 2019. Here are some subterranean ideas that are being explored.

**Substations**
Electrical substations, which are essential for providing electricity to estates, currently occupy small tracts of land at the ground level, even though they are connected to the underground cabling network. To save space, these can be housed underground, and can still be serviced through access points with a smaller footprint.

**Bus Interchange**
The new Bidadari housing estate will be home to Singapore's first underground air-conditioned bus interchange below Housing Board flats. Slated for completion by 2019, it will sit below a carpark and a garden, and will likely cater to five bus services.

**Road and rail networks**
To enhance our living environments, future major road and rail networks, especially those that will cut through built-up areas, will be located underground. This reduces the impact of noise and dust on homes.

**Deep Tunnel Sewage System**
This is a network of tunnels that operates on gravity, and transports sewage and waste water across the island to two centralised water reclamation plants.

**Jurong Rock Caverns**
The Jurong Rock Caverns under Jurong Island is for petrochemical storage. In phase one, its five caverns are as high as nine storeys, saving approximately 60% of land.

**Ammunition facility**
The underground ammunition facility built underground in Mandai in 2008 stores ammunition and explosives. It frees up land about half the size of Pasir Ris town.

**SecureMyBike**
In Admiralty, the Land Transport Authority completed the first automated underground bicycle parking space, known as SecureMyBike. Users can leave their bikes at lockers located above ground, which then houses them in storage cells extending up to 10m underground.

**Pedestrian links**
Underground pedestrian links make it easier to connect between buildings or cross busy streets. For a more extensive underground pedestrian network, the Urban Redevelopment Authority offers an incentive scheme to co-fund the construction of selected linkages in Orchard Road and the Central Business District.

**Common Services Tunnel**
More than just space-saving measures, underground pipes are less prone to external wear and tear. The Common Services Tunnel in Marina Bay is a creative way of housing all utilities together. This frees up land with lesser maintenance disruptions on the roads.

**Waste disposal**
In housing estates, trash can be carried away to a centralised bin centre through a suction force via underground pipes, using pneumatic waste-conveyance systems. Such a waste disposal network can be seen in an HDB estate in Yishun, removing the need for refuse workers to manually collect waste from each block.

**Air-conditioning pipes**
Chilled water used for air-conditioning could be supplied centrally through an underground network of pipes, known as a district cooling system. This is already done in Marina Bay, and the authorities are looking to implement them in the Punggol Digital District.

**Reservoirs**
Water can be stored in underground reservoirs, with the national water agency PUB currently looking into an idea that can free up significant parcels of land for development. The 17 reservoirs currently occupy 3,000ha or around 5% of Singapore's total land.
Masterplan of Singapore's underground spaces ready by 2019

Ms Hwang said the URA is working towards having a more complete 3D map of the underground spaces and infrastructure here.

National Development Minister Lawrence Wong told The Straits Times that the Government has to take stock of what is underground, including pipes and power grids.

"We have to take stock and have a good database of information, and are compiling it as a central repository so we have a good basis plan," he said.
Proposed law will allow Govt to acquire specific stratum of underground space

By YVONNE LIM
INFRASTRUCTURE RESILIENCE AND SAFETY

Construction work ruptures gas pipe near Lau Pa Sat

by ROBIN CHOO


Boon Tat Street was cordoned off because of the gas leak, but gas supply to the area was not affected. Photo: Robin Choo


Cut cables disrupt fibre broadband in eastern Singapore

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Jan Lee

Fibre broadband was disrupted in the eastern part of Singapore yesterday, affecting about 10,000 customers and some might get their services back only today.

source: http://statetimesreview.com/2017/03/31/land-transport-authority-to-double-road-works-fees/

LTA double road works fees to encourage efficiency

March 31, 2017
The smart, resilient, and sustainable future city efficiently and effectively plans, manages and optimizes land use above and below the surface, and is resilient and safe.

A good spatial understanding of the underground is a key enabler for that future city.
WHAT IS THE CURRENT SPATIAL UNDERSTANDING OF UNDERGROUND UTILITIES?

Factors that affect map quality

**accuracy**
- inaccurate locations
- inaccurate geometry
- low resolution

**reliability**
- inconsistent accuracy
- inconsistent depths
- incomplete

**fitness for purpose**
- lacking 3D
- lacking semantics
- no standards

**practical usage**
- sharing limitations
- multitude of formats
- no specialized applications
The Digital Underground project
Development of a roadmap towards a reliable 3D map of underground utilities
GYROSCOPIC MAPPING CASE STUDY
HIGHLIGHTING THE POTENTIAL OF A RELIABLE 3D MAP

Seeing The Unseen: Exploring utilities underground in Singapore using augmented reality

Displayed at URA Urban Lab Exhibition and World Cities Summit 2018
LEARNING TOGETHER

Collaboration with technology providers, surveyors, and government agencies
A WHOLE ECOSYSTEM APPROACH

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Where will the roadmap lead to?

A reliable, 3D, digital map of underground utilities will contribute to a spatially enabled future city and will enable professionals to make informed decisions.

Surveyors and mappers have the capacity to produce accurate, reliable, and useful information.

Planners, land administrators and engineers have timely access to accurate, reliable, and complete information which can directly benefit their work processes.

A utility mapping ecosystem.
A UTILITY MAPPING ECOSYSTEM FOR FUTURE CITIES

Specialized technology

3D map
underground utilities
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Specialized technology

3D map
underground utilities

Skilled and qualified professionals

Committed organizations
A UTILITY MAPPING ECOSYSTEM FOR FUTURE CITIES

Specialized technology

Best practices & guidelines

Skilled and qualified professionals

Business models

Committed organizations

3D map
underground utilities

Policies & standards
A UTILITY MAPPING ECOSYSTEM FOR FUTURE CITIES

- Specialized technology
- Best practices & guidelines
- Skilled and qualified professionals
- R&D
- Business models
- Education
- Committed organizations
- Quality control & rectification strategies
- Policies & standards
- Collaboration
A smart and sustainable utility mapping ecosystem is an **agile, feedback-driven** ecosystem.
Thank you!

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