/ WORDS **LOW SHI PING**

DEALING WITH DENSITY

The Future Cities Laboratory has come up with a series of interesting possibilities for how the waterfront at Tanjong Pagar could turn out.

In 2013, it was announced that Singapore's ports, located in Tanjong Pagar, Keppel, Pulau Brani and Pasir Panjang, will be moved to Tuas by 2027. As a result, prime waterfront land will be freed up, creating a new precinct called the Greater Southern Waterfront.

"With about 1,000 hectares of land – an area three times the size of Marina Bay – up for development in the Greater Southern Waterfront after 2030, the landscape we can paint is limited only by our imagination," says the Urban Redevelopment Authority (URA), on its website.

The potential of this area caught the eye of Dietmar Leyk from the Future Cities Laboratory (FCL) at the Singapore-ETH Centre. While having a discussion with the URA in early 2016, he came up with the idea to put together a team to study the site and offer a few possible scenarios.

Three years later, in the second quarter of 2019, Leyk is ready to present the findings of his team through a book titled *High-Density Mixed-Use Cities: The Singapore Study*, centred around the Tanjong Pagar waterfront area.

"We identified the problem to be how we would be living in much higher densities in the future than today. The question therefore is how do we design density well," he explains, during an interview about the contents of the book.

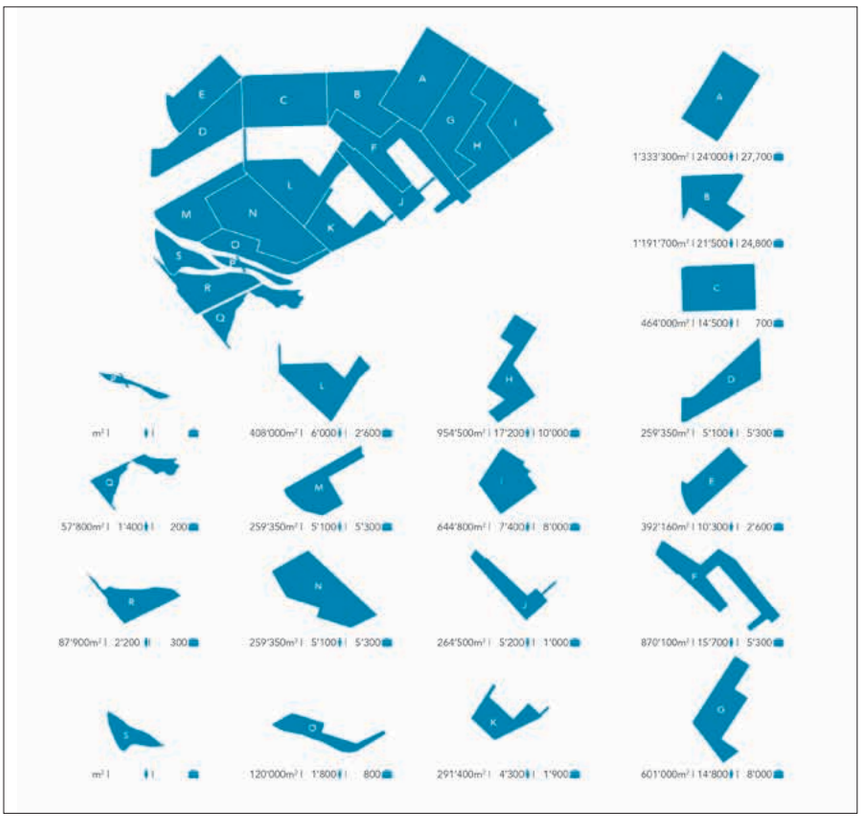
This was the task put forth to a transdisciplinary team he assembled, made up of more than 30 researchers in eight different areas – the largest he has worked with on any project. In doing so, they came up with five alternative futures for the Tanjong Pagar waterfront.

"The goal is to get across a set of ideas about a future that allows the planner and citizen a new perspective on change and on choices yet to be made.

"We see our work as being complementary to ongoing work done by the architects or planners, and hopefully by sharing our findings, some ideas, concepts and principles can be applied by the URA."

PIECE BY PIECE

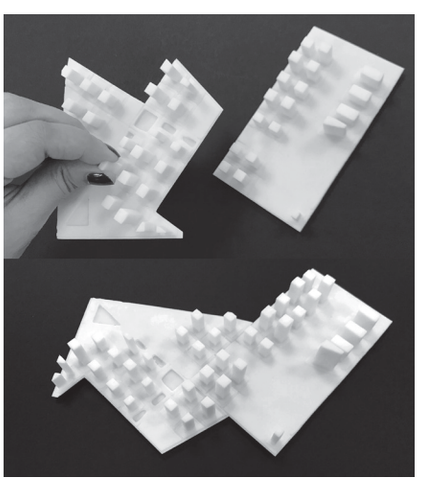
Bearing in mind the uncertainty around how the demography and economy of Singapore will develop over the next 40 years, Leyk offers a process that helps to cope with the unknown that includes the use of key strategies for the design



of dense and adaptable urban space and architecture.

"We take an interest in the factors and causal relations that influence urban transformation processes. We delve deeper into these relations and make them more transparent by dividing the area into manageable precincts (pictured above and below), and taking into consideration density, inhabitants and workers.

"Procedural master-planning and parametric modelling is applied for rapid testing and evaluation of master-planning parameters to explore different urban configurations of densities."



"Rapid decision-making in the process is supported by visualising large sets of options based on descriptive and measurable parameters. Through this process, planners are better able to react to unforeseen requirements in the future development of the project."

Unsurprisingly, the project was not without its challenges. Because the parameters were not fixed, it was difficult to create solutions without compromising on quality and identity.

"It is always a discussion we have when we are working with flexible structures. They look like they have no identity and character but in fact, we are trying to keep a distinct character while being flexible," points out Leyk.

Harnessing new digital technologies to come up with the scenarios was also something that presented its own set of challenges. In creating a highly diverse spatial output, it was important the team implemented a certain "randomness" in the urban space to ensure that not everything looks the same

"In this case, we use a certain 'randomness' to define spaces that are special for the inhabitants, as a way to create a rich diversity."

ABOUT DIETMAR LEYK

Dietmar Leyk was born in Germany and is a registered architect. He collaborates with multi-national companies, and teaches and researches at renowned universities like ETH Zurich, the Berlage Institute Rotterdam, and FCL at the Singapore-ETH Centre.

Leyk has more than 25 years of experience in the fields of architecture, urban design strategies, urbanisation, high-density mixed-use cities, knowledge space architecture, campus architecture and large-scale urban projects.

He has been responsible for numerous sizable interdisciplinary projects in research, development and design. Design, development and implementation, developing global standards and research projects in urban and real estate developments count among his extensive experience.

Leyk is also co-founder of SPACECOUNCIL, which accomplishes international design and research projects in all scales.

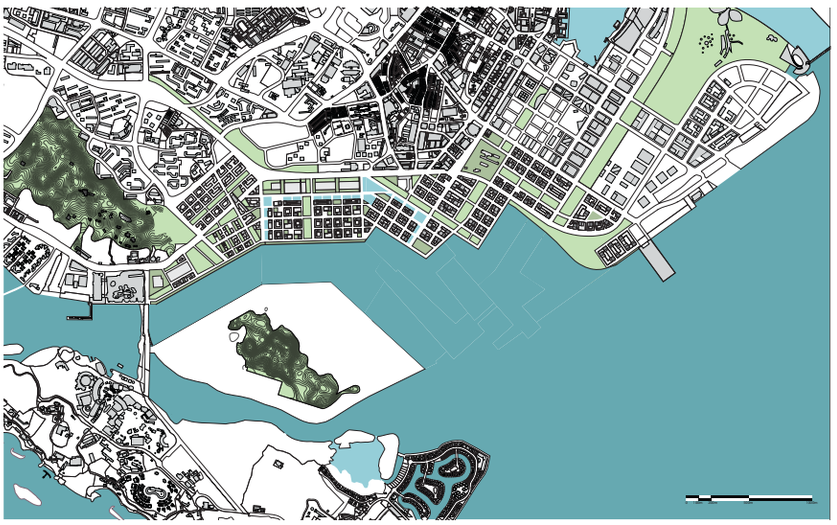
ALTERNATIVE FUTURES

The project models five different possible scenarios from which ideas can be adopted.

Playing with the elements of population density and land use, Leyk and his team generated a quintet of scenarios, made up of a collection of precincts, that could arise from the Tanjong Pagar waterfront.

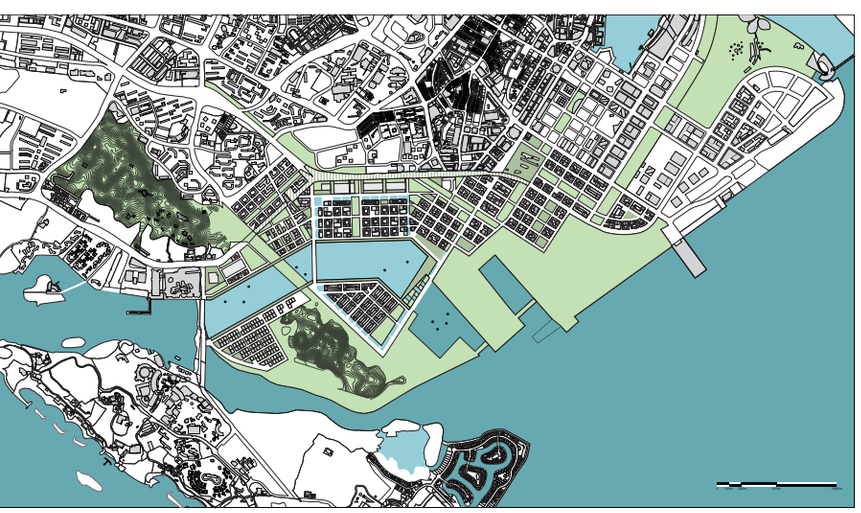
All five relate to historic morphology and narratives, which were then developed according to specific aims and objectives, such as having fresh water basins and being efficient for autonomous vehicles.

Each describes a different way to connect the existing central business district with the new area via the "high park" – the existing Keppel Viaduct – that is proposed to be greened with landscaping.



▲ CITY EDGE SCENARIO

- This scenario can also be described as minimal impact.
- New settlements create a southern edge to the existing northern built developments north of Keppel.
- Areas of the harbour (especially those built today on piles that are considered too weak for future development) are demolished and become open water. Pulau Brani and Sentosa are not impacted in this scenario.

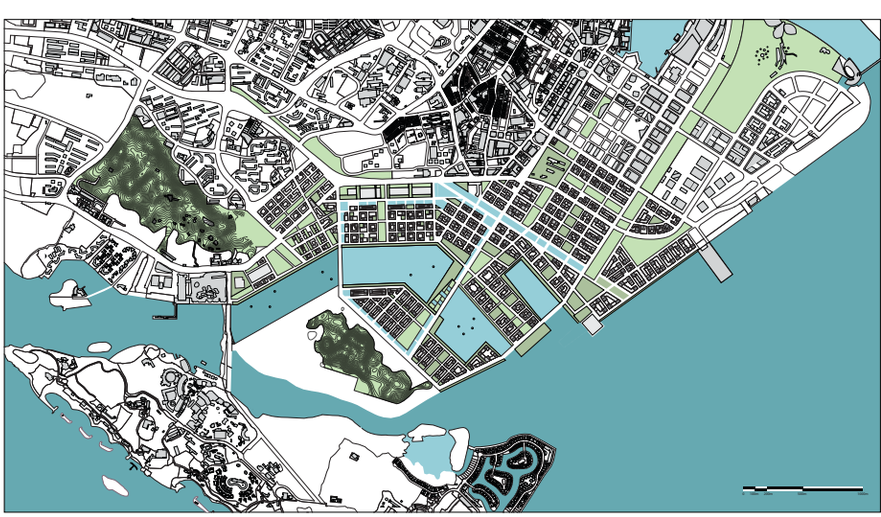


◀ GREEN BELT SCENARIO

- The entire site acts as a green belt between Pulau Brani and Sentosa. This is similar to having a second Gardens by the Bay.
- Two large fresh water basins are located in the centre of the new district.
- This scenario acts as a system where flood water can occupy the land inside the green belt in a controlled way. It comes with with a distinct ability to have hydrological, morphological and biological dynamics.
- There is a large number of green bridges.

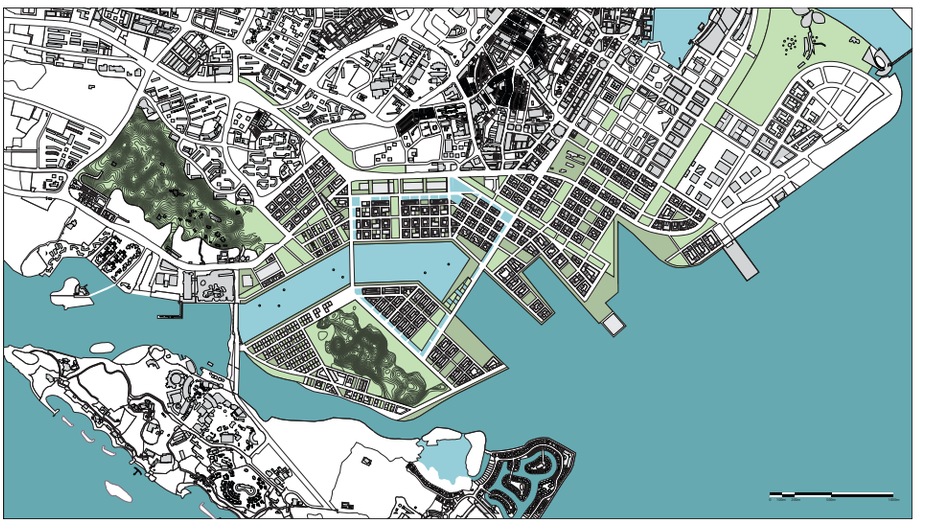
▶ VENICE SCENARIO

- The mainland and Pulau Brani are connected by two freshwater reservoirs and several green bridges.
- Dams are built to create the reservoirs.
- Canals are carved out and mixed-use architecture are built along them, like in Venice. The canal system is pedestrianised by bridges.
- Industrial buildings in Keppel Distripark are preserved to retain a connection to the site's past.
- Southern Pulau Brani and Sentosa are not impacted in this scenario.



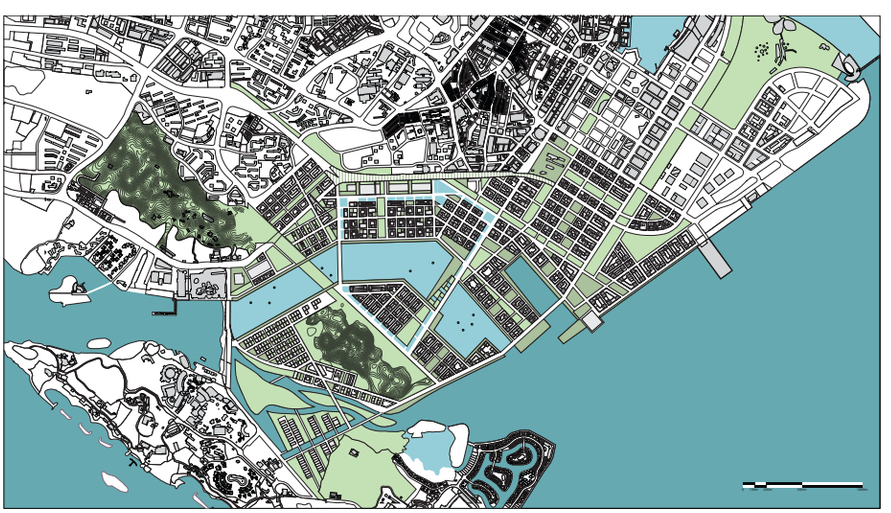
ABOUT THE SITE

AREA OF SITE ⁄ 600 HECTARES (INCLUDING WATER AREA)
LAND AREA ⁄ 300 HECTARES
NUMBER OF INHABITANTS ⁄ 160,000
NUMBER OF WORKERS ⁄ 100,000



▲ STATUS QUO SCENARIO

- New settlements occupy all the existing harbour area, including the area built today on piles on the mainland and Pulau Brani.
- Two large fresh water basins are located in the centre of the new district.
- Sentosa is not impacted in this scenario.



▲ SENTOSA LINK SCENARIO

- The entire site is connected by a generous urban landscape of water bodies, forests and gardens. Higher densities will be found closer to the central business district, with it decreasing as you move away and towards the sea.
- Three freshwater basins, promenades and canals are fully developed.
- Two botanical islands, acting as subtropical parks, connect Pulau Brani with Sentosa.
- An eco-bridge connects Mount Faber and Pulau Brani. The bridge is dedicated to animals and pedestrians.
- A dam system (dyke) is constructed, where building and landscape elements merge. This system located along the water edges provides this part of the coast from the rising sea level in the future.
- Sentosa receives a residential cluster closely connected to nature and sports.
- This scenario can be described as the maximum scenario, since it uses the maximum parameters of 160,000 inhabitants, 100,000 workers and land use.
- This is optimised for autonomous vehicles. The yellow MRT line is extended from the mainland to Sentosa.

Envelope Study: View from Keppel Viaduct towards the sea.

A TRANSDISCIPLINARY APPROACH

The scenarios for the Tanjong Pagar Waterfront were the outcome of a collaboration between more than 30 researchers across eight research teams to create sustainable and liveable high-density cities.

TEAM 1 THE GRAND PROJET

RESEARCH OBJECTIVE: Explore the characteristics, mechanisms and implications of existing large urban projects as agents of development and redevelopment in contemporary cities

Analyse the Tanjong Pagar Waterfront site to understand potential design and implementation processes for the large-scale project to ensure its social acceptance, economic success, as well as long-term sustainability and liveability. The team brings to the table urban design concepts that meet the requirements of high-density, mixed-use and transit-connectivity.

TEAM 2 DENSE AND GREEN BUILDING TYPOLOGIES

RESEARCH OBJECTIVE: Study the urban, architectural, environmental, social, and economic benefits of dense and green building typologies in high-density urban contexts

Explore means to integrate green spaces in buildings, and therefore introducing public space, sky terraces, sky bridges, vertical parks, roof gardens and other green components into residential, civic and commercial buildings and how these buildings need to be integrated in the environment. It considers how these green elements can contribute towards the urban, architectural, environmental, social, and economic benefits for the site and its users.

TEAM 3 CYBER CIVIL INFRASTRUCTURE

RESEARCH OBJECTIVE: Improve knowledge of the performance of civil infrastructure to better predict performance when weighing decisions such as extension, improvement, repair and replacement

Explore the possibility of reinforcing and/or reusing the existing port infrastructure such as the platform and supporting pillar structures, instead of tearing them down and replacing them with new structures of a similar nature. This would result in substantial materials and cost saving in the redevelopment of the site.

TEAM 4 MULTI-SCALE ENERGY SYSTEMS FOR LOW-CARBON CITIES

RESEARCH OBJECTIVE: Leverage synergies between urban development, urban design and energy systems for the efficient and sustainable supply of energy in cities

Provide a multi-scale (from building to district scale) and holistic approach to energy systems design that is integrated with the urban system and suited to the urban form of the site. The goal is to improve energy efficiency, increase adoption of renewable/low-carbon energy sources, while improving occupant well-being. The City Energy Analyst toolbox is employed for energy modelling and analysis.

TEAM 5 ECOSYSTEM SERVICES IN URBAN LANDSCAPES

RESEARCH OBJECTIVE: Understand how we can better design urban green spaces to provide ecosystem services to users of the space

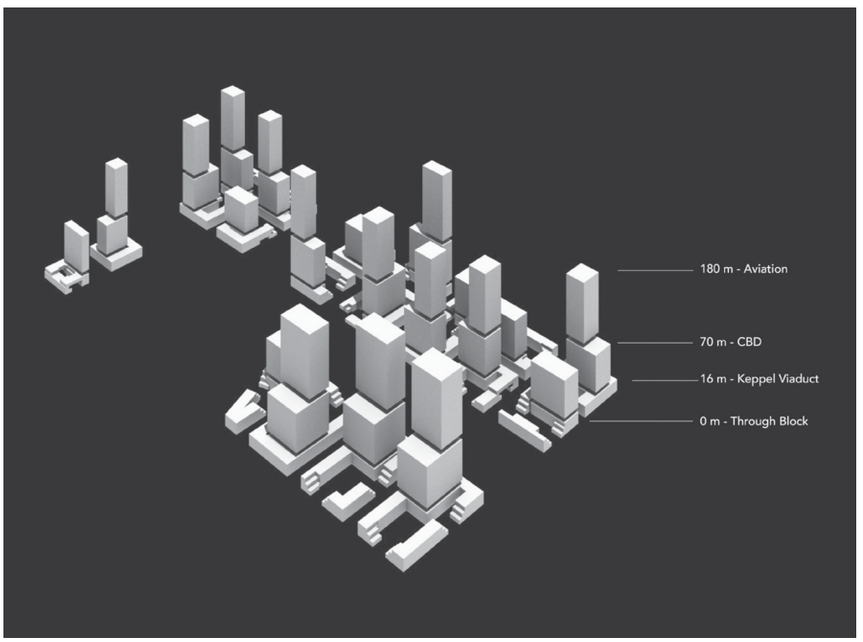
Explore ways to retain and/or introduce green spaces and natural water bodies in the site, so that they can provide ecosystem services (such as providing shade, cooling the air, providing recreational spaces) to users. This also includes the exploration of connecting the site to existing green spaces in the vicinity, such as the adjacent Mount Faber Park, a valuable neighbouring ecosystem, which provides links to the wider network of green spaces in Singapore. Enabling connectivity to the Southern Ridges park network may help to bring biodiversity into the site. The patch of secondary rainforest present on Pulau Brani represents the only significant ecological resource within the study area, and could be protected as a natural site.

TEAM 6 BIG DATA INFORMED URBAN DESIGN AND GOVERNANCE

RESEARCH OBJECTIVE: Inform urban design and governance through big data analytics, complexity science, cognitive design computing and citizen design science

Strengthen the capacity for rapid decision-making in the planning for increasingly dynamic cities and sites by visualising large sets of options including descriptive and measurable parameters from the site scale (street network and block sizes) to the building scale.

In the project, procedural master-planning and parametric modelling are applied for rapid testing and evaluation of master-planning parameters to explore different configurations and layouts. Further, it develops methods and tools based on user evidence to support designers in making urban public spaces that are well-used and appreciated.



TEAM 7 ENGAGING MOBILITY

RESEARCH OBJECTIVE: Understand current and future urban mobility challenges through travel behaviour research, big data informed simulation, so as to better design and evaluate alternative solutions

The team integrates new big data streams from public transport smart cards, mobile phones, and behavioural information from travel surveys, combined with new insights from research into an extended MATSim (Multi-Agent Transport Simulation) model for the site to analyse, simulate and design for the future mobility (including autonomous vehicles) needs of users of the site. It also offers solutions at the intersection of urban design and transport planning, such as street networks, and cycling and pedestrian infrastructure to support active modes of transport, and the connectivity of the spaces within the site for walking and cycling.

TEAM 8 COGNITION, PERCEPTION AND BEHAVIOUR IN URBAN ENVIRONMENTS.

RESEARCH OBJECTIVE: Understand and model wayfinding behaviour in complex, multi-level environments using a combination of real-world observations and virtual reality experiments

The team uses spatial analysis methods (like space syntax) to predict wayfinding performance based on different design options for the site. It uses virtual reality as a platform to generate and assess different design options for block typologies. Using this evidence-based approach, the project produces scientifically-grounded guidelines for the design of indoors public space that are more responsive to the needs of both stakeholders and users, and thus, result in better human traffic flow and well-being, and better integration with adjoining neighbourhoods.