HOUSING & DEVELOPMENT BOARD

PUB SINGAPORE'S NATIONAL WATER AGENCY

**MEDIA FACTSHEET**

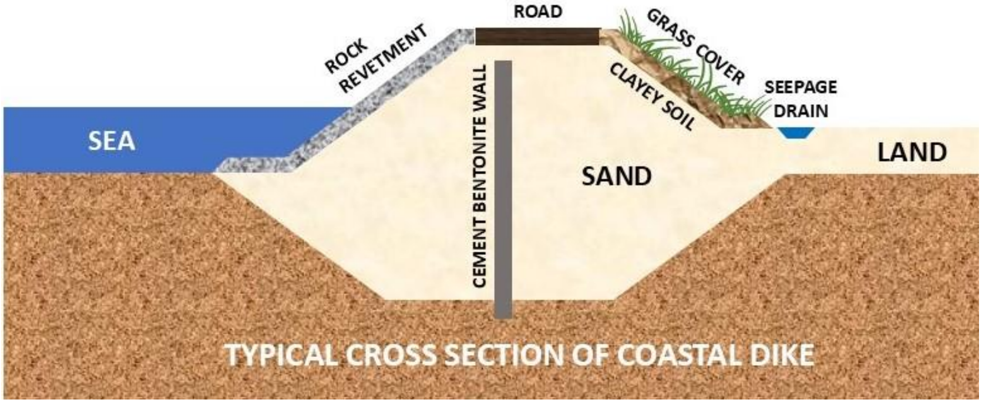
# Constructing Singapore's first Polder

The Housing & Development Board (HDB) has worked closely with national water agency PUB and other agencies to construct Singapore's first polder, adding about 800 hectares of land at Pulau Tekong while also protecting the area from rising sea levels. A first-of-its-kind development in Singapore, the completion of the main construction works for Singapore's first polder marks a significant engineering milestone for Singapore, where a variety of design and construction solutions were implemented to make it a reality.

## Constructing a Robust Coastal Dike with Nature-Based Solutions

2 The 10-kilometre coastal dike is a structure which stands up to six metres above mean sea level. Framing the perimeter of the polder, the coastal dike forms a sturdy buffer to keep seawater out of the polder.

3 The coastal dike is constructed with a variety of materials and structures to ensure its robustness, and to prevent erosion of its sand core:



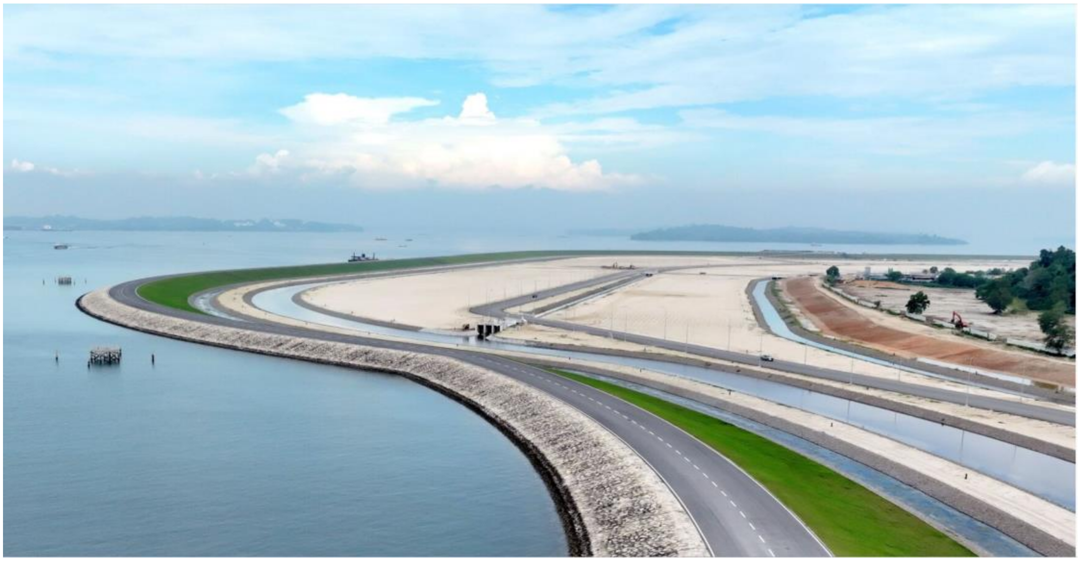

*A cement bentonite wall in the coastal dike minimises seawater seepage. This image is an artist impression and not drawn to scale. (Credit: HDB)*

A) <u>Cement bentonite inner wall to minimise seawater seepage</u>

Within the coastal dike is a cement bentonite wall, which forms a barrier to keep any seepage of seawater through the coastal dike to a minimum. Any seawater seepage is collected in a seepage drain and pumped out of the polder. This prevents seawater from entering the freshwater drainage network on the polder and helps to maintain the salinity levels in the stormwater collection pond.

*The seepage drain on the landward side of the coastal dike (Credit: HDB)*

B) <u>Nature-based solutions to absorb wave-impact and mitigate erosion</u>



*Natural materials are used on both sides of the coastal dike. (Credit: HDB)*

The seaward side of the coastal dike is covered with a layer of natural rockwhich is effective in absorbing wave-impact to ensure the coastal dike remains robust, and also cost-effective for both construction and maintenance. Additionally, the naturalistic look of the rock enables the polder's coastline to blend in more sensitively with its natural surroundings.

*The natural rock layer covering the seaward side of the coastal dike's wall sensitively integrates the polder's coastline with its natural surroundings. (Credit: HDB)*

Meanwhile, the landward side of the coastal dike slope has been designed with a verdant covering. This helps to reduce ambient heat and beautify the landscape. The selected Bermuda grass (*Cyndon Dactylon*) has a deep-reaching root system which allows it to hold the soil firmly together. This mitigates the erosion of the coastal dike during rain, or in the unlikely event of water from large waves flowing over the top of the coastal dike and into the polder land. The Bermuda grass is also a hardy plant which grows well in Singapore's hot tropical climate and can tolerate a saline environment.

*Bermuda grass (left) covers the landward side of the coastal dike (right) to mitigate erosion, while beautifying the landscape. (Credit: HDB)*

**Building and Automating the Polder's Water Management System**

5 Apart from the coastal dike, the viability of the polder also depends on its water management system, as any seawater seepage and stormwater runoff are unable to flow out naturally due to the polder land lying below mean sea level. The polder's water management system comprises:

A) <u>Outlet structures to channel water out of the polder</u>

Outlet structures, which run through the coastal dike serve to channel excess water collected within the polder out to sea, are important features of the polder's water management system.

*Multiple outlet structures run through the coastal dike and help channel excess water from the polder out into the sea. (Credit: HDB)*

As these outlet structures had to be built on-location, they required a dry environment to construct. However, this posed a challenge as the structures had to lie below mean sea level, and had to be constructed first before the corresponding segment of the coastal dike could be built. To overcome this, temporary water-retaining structures known as cofferdams were constructed to keep the construction areas of these outlet structures sufficiently dry, before the coastal dike was constructed over the completed outlet structures.

*Cofferdams installed to keep construction areas dry. (Credit: HDB)*

The polder's cofferdams were made primarily of steel sheet piles which were driven up to 26 metres (about the height of an eight-storey HDB block) deep into the ground to ensure they were strong enough to keep seawater out of the construction area. Temporary pumps were also deployed to pump stormwater out of the area, until the Drainage Pumping Station was ready for operation. After the outlet structures and coastal dike were completed and able to keep the seawater out of the polder, the cofferdams were removed.

B) Enabling automated monitoring of the polder drainage system

The drainage system on the polder is monitored and operated by PUB through the fully automated Supervisory Control and Data Acquisition (SCADA) system at the Operation Control Centre located within the Drainage Pumping Station. The system is directly connected to PUB's Joint Operations Centre to allow for remote monitoring. PUB has also installed more than 170 CCTVS and over 260 sensors to monitor the dike as well as the water quality and water level within the drainage network.

**Repurposing excess soil as infill material to reduce sand use**

6 Over 10 million cubic metres of clayey soil, enough to fill about 4,000 Olympic-sized swimming pools, was dredged from the construction of the polder's stormwater collection pond. This presented HDB the opportunity to further reduce the use of sand by repurposing some of the clayey soil as infilling material for the polder land.

7 Due to the high water content of the soil, improvement works to strengthen the soil had to be carried out first, to ensure minimal land settlement. For example, after infilling an area with a layer of clayey soil, Prefabricated Vertical Drains (PVDs) were inserted at regular intervals into the soil to create drainage paths. The soil was then overlaid with a layer of sand to compress it and force the water in the soil to drain upwards through the PVDs. The process transformed the soft soil into sturdy usable land, ready for development.

*PVDs were inserted to drain water out of the clayey soil. (Credits: HDB)*