

(A) NParks' Ecological Profiling Exercise

In February 2021, Minister for National Development and Minister-in-charge of Social Services Integration Mr Desmond Lee had announced that a study will be carried out to develop a more comprehensive picture of Singapore's islandwide ecosystem and ecological connectivity. To this end, the National Parks Board (NParks) kickstarted an Ecological Profiling Exercise (EPE), and developed a combination of least-resistance pathway and agent-based modelling as ecological profiling tools, to formulate conservation strategies that support our natural ecosystems. NParks has completed the islandwide terrestrial EPE as part of the Long-Term Plan Review. The findings will allow us to sensitively integrate nature in our urban landscape upfront in our land use plans, and further extend our natural capital beyond our Nature Reserves.

In tandem with the Long-Term Plan Review (LTPR) by the Urban Redevelopment Authority (URA), the findings from the EPE will guide urban planners in understanding how greenfield and brownfield sites contribute to the ecological connectivity across the island. This is in line with our overall approach of carrying out longer term planning, while committing to land stewardship and sustainable development. This is an important part of our efforts to balance development and nature conservation in Singapore, taking a holistic and science-based approach, to better safeguard our natural assets as we transform into a City in Nature.

A science-based approach towards the stewardship of our natural capital

In planning for the longer term, the Government seeks to balance between our various land use needs, which takes into consideration our natural capital and Singaporeans' aspirations for the future, as well as our current and future development needs. NParks' EPE sought to understand the role of specific sites in providing refugia and ecological connectivity for native biodiversity, which will guide the Government upstream in carrying out longer term planning.

The terrestrial EPE was carried out through the following steps, in consultation with a 14-member scientific Advisory Panel which comprises academics and expert members from the nature community.

1. Identification of core (source) habitats

Singapore's natural habitats comprise forest fragments scattered around the island. This results in the reduction of habitats for biodiversity and the loss of ecological connectivity. Building upon our existing scientific database and research models, source habitats were identified based on habitat quality such as native species richness, ecological maturity of the forest and rarity of species and habitats. Examples of these core biodiversity habitats include the four Nature Reserves and the Southern Ridges.

2. Mapping of buffer (complementary) habitats

Complementary habitats are mapped out based on proximity around the source habitats to ensure that source habitats are buffered from edge effects as well as developments that abut these core biodiversity areas.

3. Identification of ecological corridors

For terrestrial habitats, an ecological profiling tool was developed based on a Geographic Information System (GIS) least-resistance pathway model that projects movement of six target fauna species (forest birds and mammals) between the source habitats. The movement pathway is modelled based on how easy or difficult it is to

move from one source habitat to another. The result is a projection of the connectivity routes that wildlife is likely to take to move between core habitats.

The knowledge and expertise of the scientific Advisory Panel has helped NParks to strengthen proposed recommendations on nature conservation strategies, focusing on the ecological connectivity of various sites, as well as the approach in conserving ecologically sensitive areas amidst development. The Advisory Panel is chaired by Dr Leong Chee Chiew, Commissioner of Parks & Recreation at NParks and the members are:

Chaired by Dr Leong Chee Chiew (Commissioner of Parks & Recreation, NParks)		
Academics	Subject Matter Experts	NParks
Dr Norman Lim (Terrestrial, Fauna)	Dr Shawn Lum (Terrestrial, Forests)	Dr Tan Puay Yok (Terrestrial, Forests)
Prof Koh Lian Pin (Terrestrial, Forest, Fauna)	Mr N. Sivasothi (Terrestrial, Forests & Fauna)	Dr Karenne Tun (Marine)
Dr Dan Friess (Mangroves)	Mr Lim Kim Chuah (Terrestrial, Birds)	
Dr Darren Yeo (Freshwater, Fauna)	Dr Huang Danwei (Marine)	
Dr Zeehan Jaafar (Marine)	Mr Sankar Ananthanarayanan (Terrestrial, Herptiles)	
	Mr Joseph Koh (Terrestrial, Invertebrates)	

Findings from the islandwide terrestrial EPE

NParks has completed the islandwide terrestrial EPE as part of the Long-Term Plan Review. Based on the findings from the terrestrial EPE, NParks has identified key ecological corridors between core habitats and plans to establish Nature Park Networks and Nature Corridors along these identified ecological corridors. The existing Nature Park Networks and Nature Corridors are indicated in Figure 1 below.

Clementi Nature Corridor and Labrador Nature Park Network were a result of the EPE results for the southwestern region of Singapore.

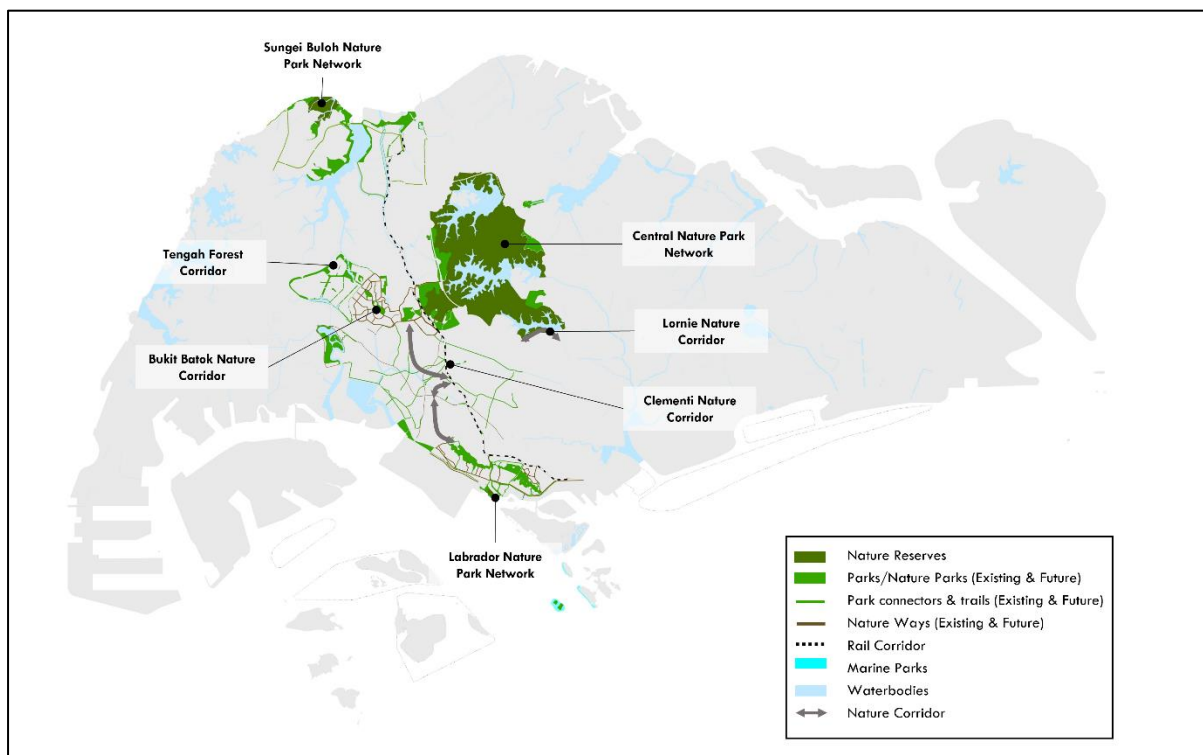


Figure 1 Map showing existing Nature Park Networks and Nature Corridors in Singapore (Credit National Parks Board)

Through the EPE, NParks has identified four new ecological corridors around northern, northwestern and northeastern Singapore at Khatib, Kranji, Lim Chu Kang and Seletar (Figure 2). With the identification of these new ecological corridors, URA will continue to work closely with NParks to ensure that key biodiversity areas, as well as ecological connectivity, will be maintained when development is needed at existing green spaces within the ecological corridors. This is done by implementing measures to support the ecological connectivity, including retaining key existing forested patches, or by incorporating Nature Parks, park connectors or Nature Ways within the development to facilitate ecological connectivity.

Details on Khatib Nature Corridor can be found in Section (B) of this Annex.

More information on the ecological corridors at Kranji, Lim Chu Kang and Seletar will be shared when ready.

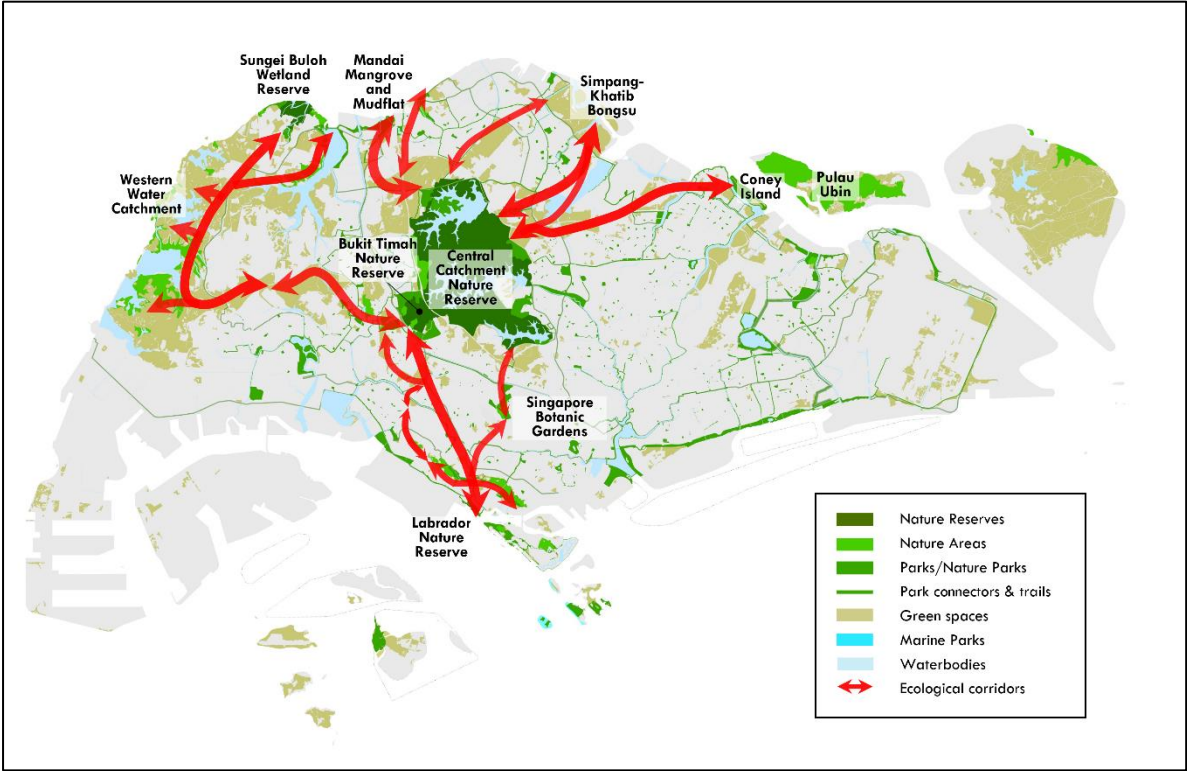


Figure 2 Map showing islandwide ecological connections, as identified through NParks' EPE (Credit National Parks Board)

Ecological connectivity in the eastern region of Singapore

Subject to the future planning for the redevelopment of Paya Lebar Air Base, another Nature Corridor in the east could be identified.

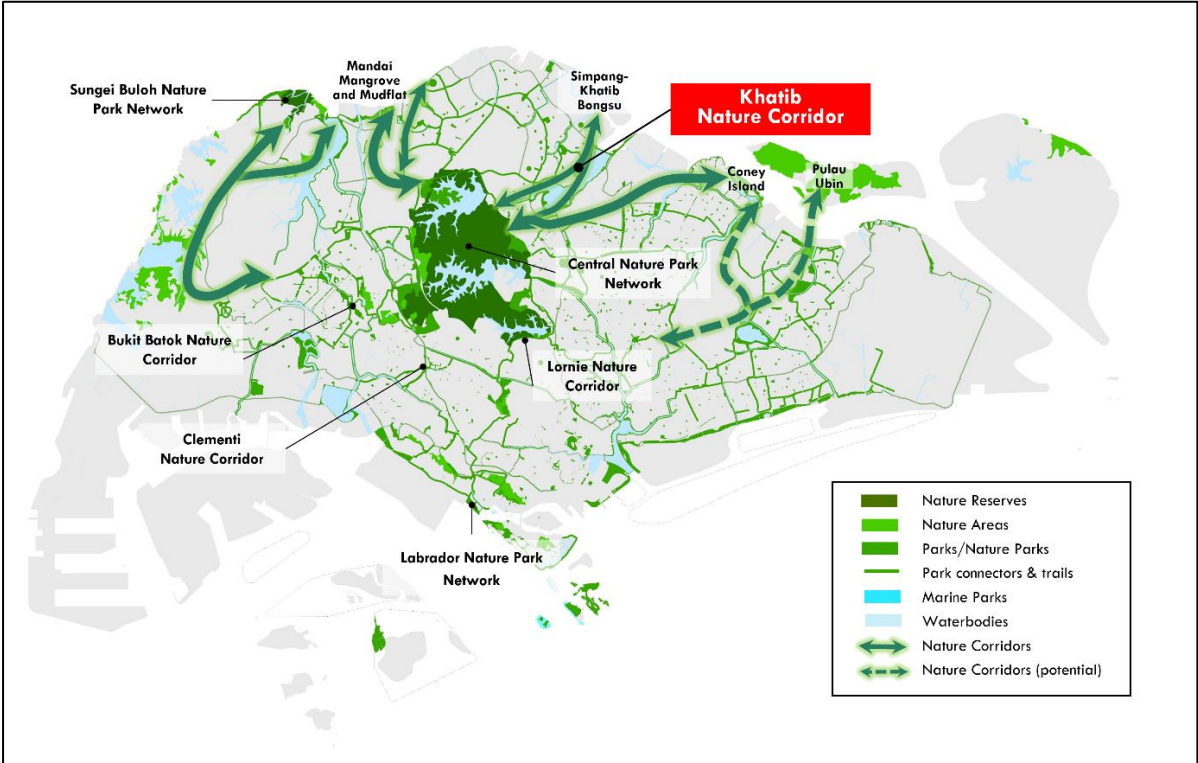


Figure 3 Map showing the upcoming and potential Nature Corridors in Singapore, with the existing Nature Park Networks and Nature Corridors (Credit National Parks Board)

EPE for the Coastal and Marine Environment

NParks has also completed an EPE for the coastal and marine environment. Similar to the terrestrial exercise, the study identified and assessed core habitats based on factors such as species diversity and habitat quality and condition. Examples of some of these core habitats include coastal forests, mangroves, intertidal flats and coral reefs. Subsequently, agent-based models and genetic data for four representative marine organisms – mangrove propagules, seagrass fragments, sea star larvae, and coral larvae – were used to map out the connectivity between these coastal and marine habitats enabled by hydrodynamic currents.

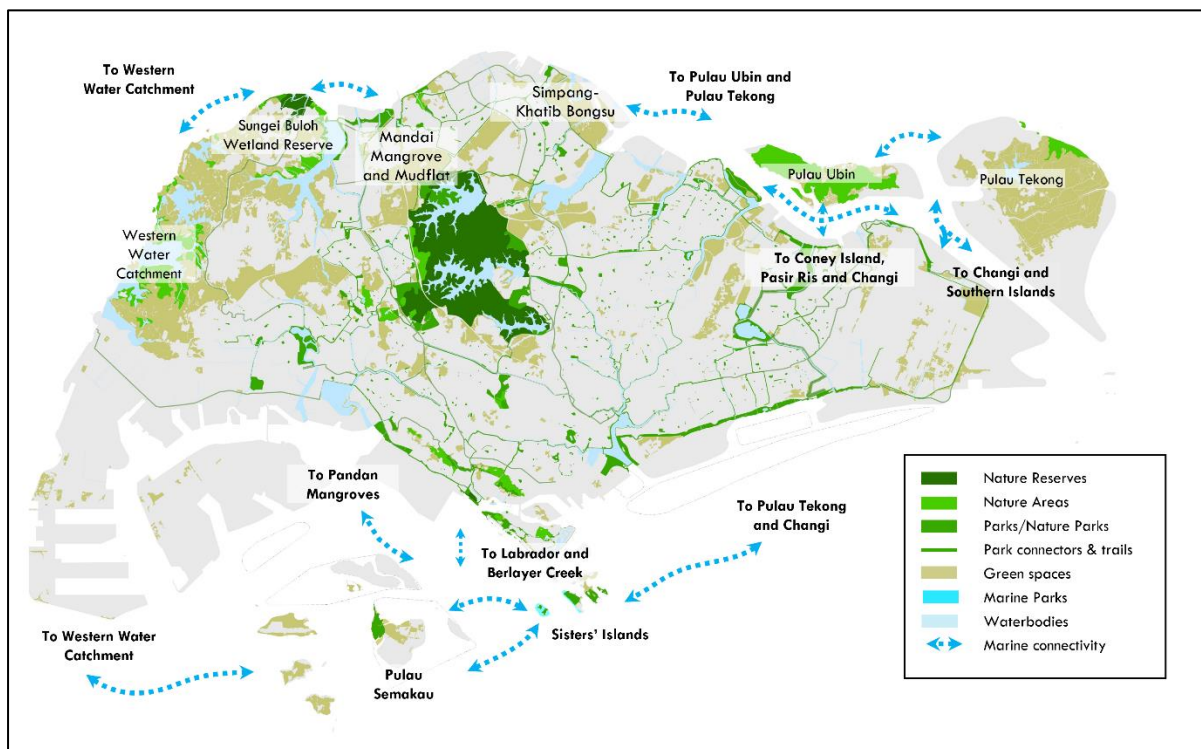


Figure 4 Map showing marine ecological connectivity identified through NParks' EPE for coastal and marine habitats (Credit National Parks Board)

Results from agent-based modelling showed that Singapore's marine ecosystems are generally self-sustaining. Based on the findings, NParks will work with agencies to study how developments can be done sensitively, taking into consideration the various coastal and marine habitats. We will also explore how habitat enhancement and restoration can be applied to enhance the resilience of our coastal and marine habitats. NParks will also continue to restore habitat quality at key connectivity sites such as Sisters' Islands Marine Park, through habitat restoration programmes with the community (e.g. 'Plant-a-Coral, Seed-a-Reef Programme).

To future-proof our coastal and marine habitats against climate change, NParks is leading the \$25 million Marine Climate Change Science research programme to advance the core sciences of marine climate change, and to develop evidence-based solutions to address the challenges faced by our coastal and marine environment arising from climate change. We will also continue working with agencies to implement nature-based solutions to integrate coastal and marine habitats like mangroves with coastal protection measures. One example is the coastal enhancement at Kranji Coastal Nature Park. This will ensure the continued survival of these habitats, which are faced with the threat of rising sea levels.

Ecological profiling is a continuous and iterative process

Ecological profiling will guide urban planners in the overall approach in carrying out longer term planning, while committing to land stewardship and sustainable development.

By extending our natural capital beyond our Nature Reserves and our island-wide recreational network, we aim to enhance ecological and recreational connectivity throughout the island as we grow our City in Nature.

(B) Khatib Nature Corridor

The National Parks Board (NParks) will be establishing a new Khatib Nature Corridor. It was conceptualised by taking into account the ecological profile of the area, with inputs from a scientific Advisory Panel, as part of NParks' islandwide EPE. Comprising forested sites at Springleaf, Tagore, Miltonia Close and along Lower Seletar Reservoir, as well as the existing Springleaf Nature Park, the new Nature Corridor allows ecological connectivity to be maintained and enhanced between the Central Catchment Nature Reserve and the Khatib Bongsu Nature Park. In addition, three new parks will be safeguarded along Khatib Nature Corridor to serve as buffer and stepping-stone habitats.

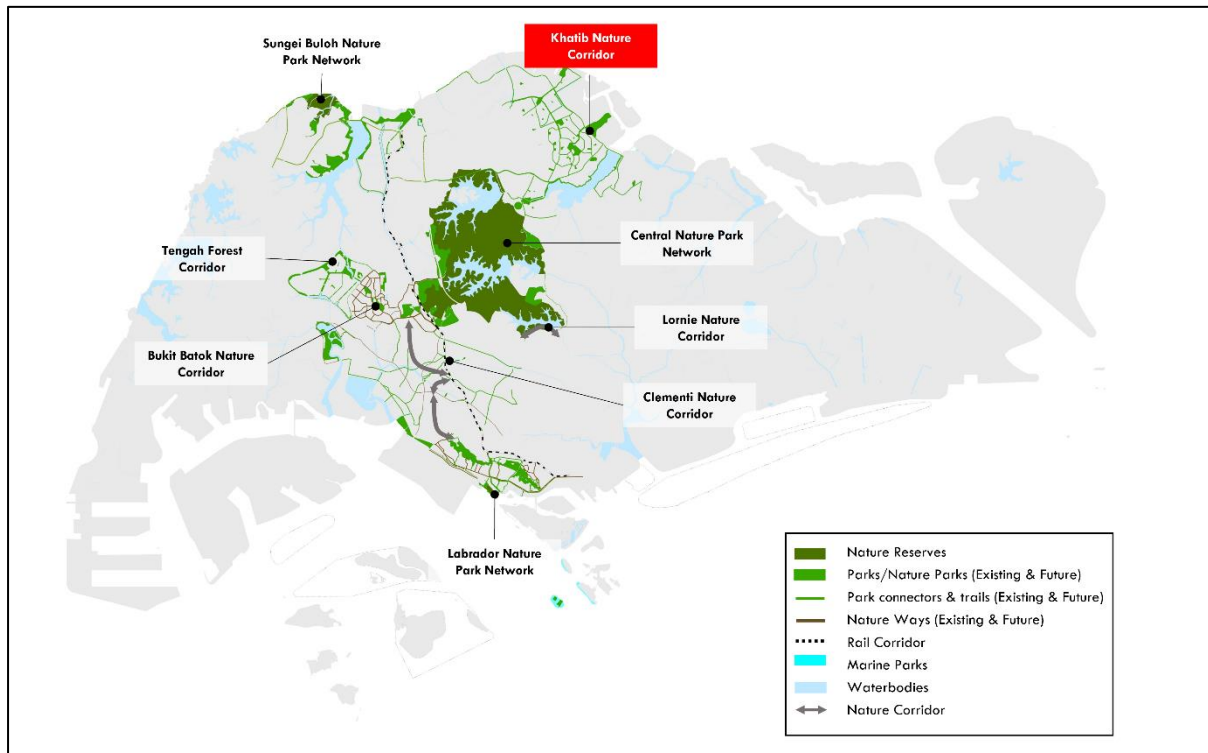


Figure 5 Map showing location of new Khatib Nature Corridor, together with existing Nature Park Networks and Nature Corridors (Credit National Parks Board)

EPE results for northern Singapore: Simpang-Khatib Bongsu, Miltonia Close and Springleaf



EPE results for northern Singapore had identified important source habitats of native biodiversity in the Central Catchment Nature Reserve and Khatib Bongsu Nature Park with ecological corridors between these two source habitats running along Lower Seletar Reservoir.


Two upcoming residential and mixed-use developments – at Springleaf and Miltonia Close – lie within the identified ecological corridor. In view of this, NParks has worked with the URA and the Housing & Development Board (HDB) to safeguard sizeable portions of land in Springleaf and Miltonia Close as Nature Parks, to serve as buffer and stepping-stone habitats respectively, for wildlife to move between the Central Catchment Nature Reserve and Khatib Bongsu Nature Park. The development strategies adopted for the Springleaf area are featured as part of URA's LTPR exhibition.

Establishing new green spaces within Khatib Nature Corridor

Within the Khatib Nature Corridor, NParks will be enhancing greenery to strengthen ecological connectivity and resilience, through the safeguarding of three new parks and Nature Parks, two of which lie within the Springleaf and Miltonia Close development sites. In addition to the previously announced Khatib Bongsu Nature Park and Canberra Park, the three new parks are - (i) Nee Soon Nature Park, (ii) Miltonia Nature Park and (iii) Extension of Lower Seletar Reservoir Park. In total, there will be more than 90 hectares of new green spaces.

More details on the new parks can be found in the table below.

<p>(i) Nee Soon Nature Park (10-15ha)</p>	 <p><i>Artist impression of Nee Soon Nature Park (Credit National Parks Board)</i></p> <ul style="list-style-type: none">- Contains rare freshwater swamp forest habitat- Extension of the Nee Soon Swamp Forest in the Central Catchment Nature Reserve, which is Singapore's last remaining primary freshwater swamp forest- Directly buffers the Central Catchment Nature Reserve- To be completed in tandem with mixed-use developments
<p>(ii) Miltonia Nature Park (6.4ha)</p>	 <p><i>Artist impression of Miltonia Nature Park (Credit National Parks Board)</i></p>

	<ul style="list-style-type: none"> - NParks worked with HDB to set aside this as a stepping-stone habitat between the Central Catchment Nature Reserve and Khatib Bongsu Nature Park, within the future residential Miltonia estate - Will retain a natural stream and riparian habitat, as well as part of the abandoned-land forest - Supports conservation of significant native coastal flora such as the Penaga Laut (<i>Calophyllum inophyllum</i>) and fauna species such as the Red-tailed Pipe Snake and Buffy Fish Owl - To be completed in tandem with HDB developments
<p>(iii) Extension of Lower Seletar Reservoir Park (16.5ha)</p>	 <p><i>Artist impression of Extension of Lower Seletar Reservoir Park (Credit National Parks Board)</i></p> <ul style="list-style-type: none"> - Along northern bank of Lower Seletar Reservoir - Enhances waterfront connectivity between Central Catchment Nature Reserve and Khatib Bongsu Nature Park - Habitat restoration along the waterfront will be further studied when Orchid Country Club is returned to the State after 2030 - To be completed in tandem with redevelopment of Orchid Country Club

Network of recreational connectivity and green spaces

A network of park connectors, Nature Ways, and trails through Lower Seletar Reservoir and the surrounding Khatib areas will be curated to connect the various green spaces in the northern part of Singapore, with over 20km of new trails being added.

Khatib Nature Corridor will also be connected to three recreational routes – the Round-Island Route, Coast-to-Coast Northern Trail, and the Central Corridor, which connect to other parts of Singapore. The upcoming Canberra Park (4.8 ha) will also offer an additional new space for nature-based recreation in the vicinity.

Overall, Khatib Nature Corridor will include a recreational green network comprising 150 ha of nature parks and parks, and 80km of curated trails for residents to access a variety of natural habitats in northern Singapore. These are part of NParks' efforts to curate several islandwide routes across Singapore comprising park connectors and trails, which will provide more opportunities for Singaporeans to enjoy the green spaces in our City in Nature.

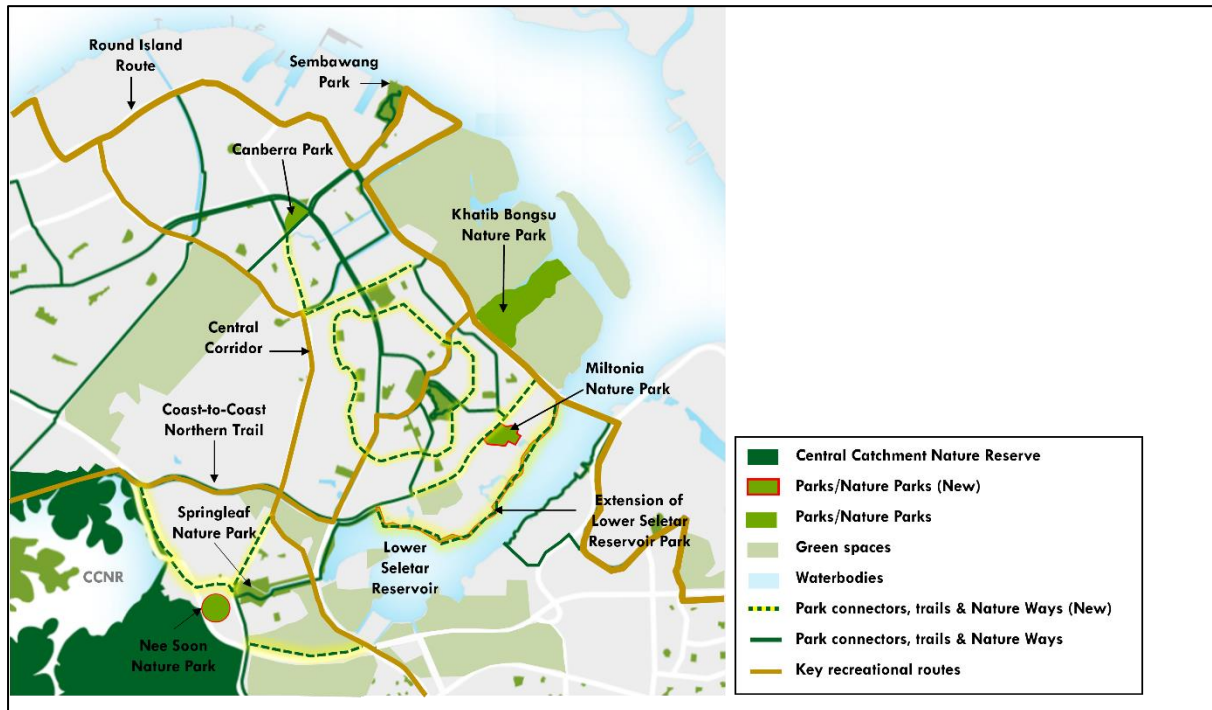


Figure 6 Map showing the recreational offerings within Khatib Nature Corridor (Credit National Parks Board)