

1 Executive Summary

Objective of Study

An indicative area in Woodlands North, which has been safeguarded for part residential and road use in the Master Plan since 2003 (hereafter referred to as the “projects”), is within close proximity to Admiralty Park. Hence, the Housing and Development Board (HDB) has appointed AECOM Singapore Pte Ltd (AECOM) to carry out an Environmental Impact Study (EIS) to assess the potential impact of the projects and recommend mitigating measures.

Project Description

Close to half of the area safeguarded for residential use is occupied by the former Admiralty West Prison (AWP) and an interim road network that would be removed once Woodlands North Coast Road is completed. The rest of the area is largely composed of secondary vegetation¹.

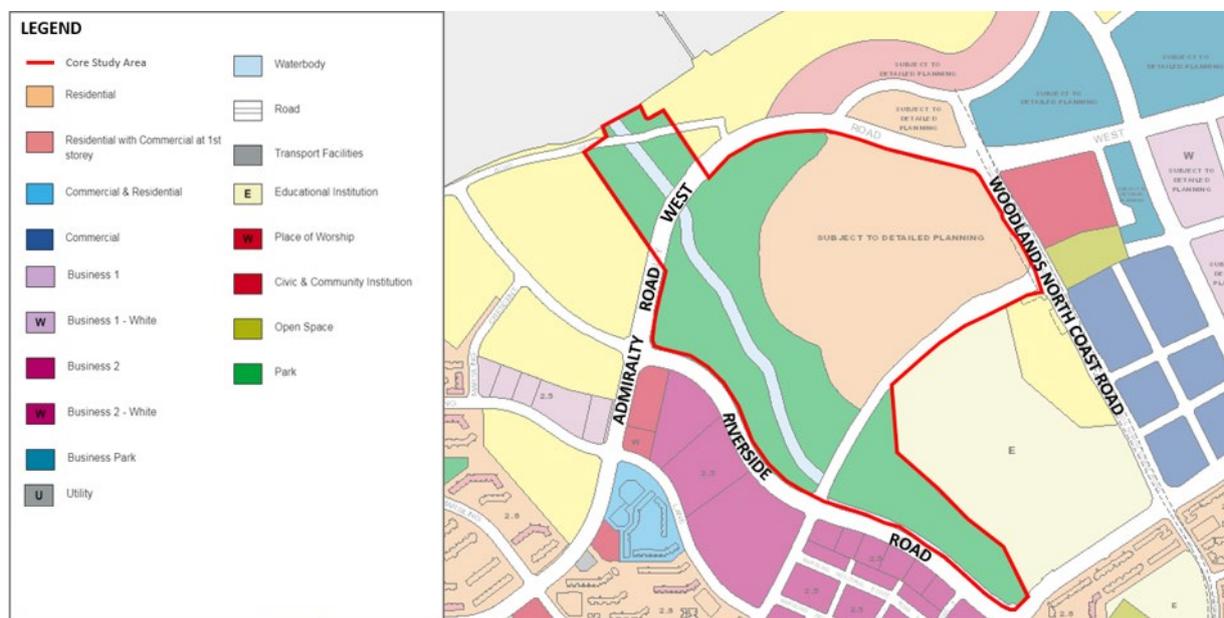


Figure 1: Planned Land Use for the Core Study Area as per URA Master Plan 2019

The proposed residential use is likely to introduce more traffic into the area, in addition to future developments in Woodlands North. Hence, to support the longer term development potential of the wider area, a road network connecting Riverside Road and the future Woodlands North Coast Road would be needed. These works are likely to entail site clearance and earthworks to achieve PUB's minimum platform levels, alongside sewer, drain, road and building construction. Full details are provided in Section 3 of the report.

¹ Secondary vegetation refers to vegetation that succeeds on the site where clearance or removal has been made by nature or mankind (Corlett, 1994)

Environmental Baseline Findings

Baseline studies were carried out between Mar 2018 to Jan 2019 and a summary of the baseline findings is provided below. The base plans shown throughout the report reflect the site condition during the subject study period. More information can be obtained from Sections 7, 8 and 9 of the report.

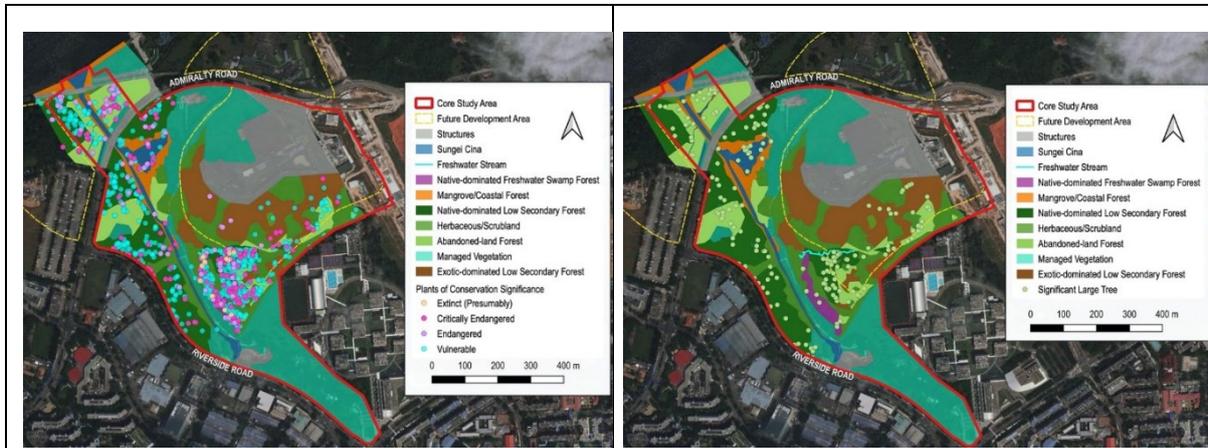


Figure 2: Vegetation Distribution and Distribution of Flora Species of Conservation Significance in the Core Study Area



Figure 3: Distribution of Large Trees in the Core Study Area

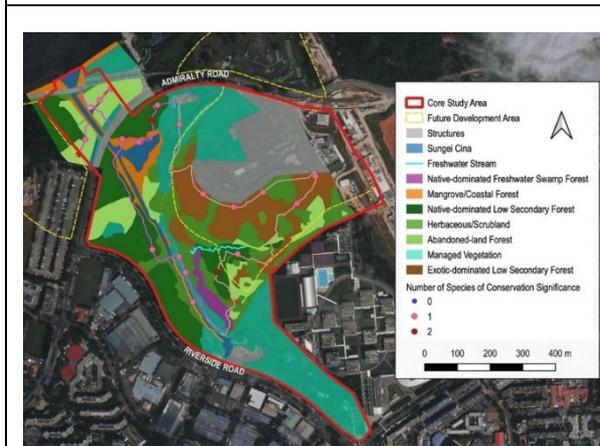


Figure 4: Distribution of Fauna Species of Conservation Significance in the Core Study Area

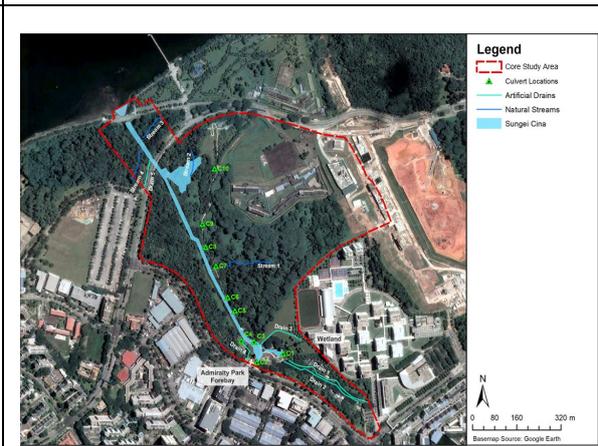


Figure 5: Existing Waterbodies and Culverts in the Core Study Area

- **Vegetation distribution** (see Figure 2) - Almost half of the core study area is composed of urban structures and managed vegetation (45.3%), followed by native dominated low secondary forest (19%), herbaceous/scrubland vegetation (15.6%), exotic-dominated secondary forest (13.2%), abandoned land forest (11.3%), mangrove/coastal forest (4.3%), native-dominated freshwater swamp forest (1.5%) and waterbodies. The mangrove/coastal forest located within Admiralty Park and the native-dominated freshwater swamp forest found near/at the southwestern corner of the proposed residential use are assessed to be of high ecological value².

² The ecological value of habitat types is evaluated based on 5 broad categories, the “Quality”, “Resilience” and “Use” of habitat and how far the habitat supports the “Resilience” of species of “Conservation Value” (refer to Table 27).

- **Biodiversity, Flora** (see Figure 2 and Figure 3) – Of the 475 vascular plant species (e.g. ferns and flowering plants) documented, 162 species are of conservation significance³ to varying degrees⁴. Many were planted in the past. These species are mainly concentrated near/at the southwestern corner of the proposed residential use. A total of 197 significant large trees and palms, comprising 44 species were documented. Close to 75% of them are found within Admiralty Park. The remaining 25% (53 trees of 13 species) are found in the southern part of the proposed residential use, most of which are commonly cultivated species.
- **Biodiversity, Fauna** (see Figure 4) – A total of 246 fauna species were recorded. 14 are of conservation significance to varying degrees⁵. They are made up of one odonate, two butterflies, two reptiles and nine bird species. Though the highest fauna richness was recorded in northern Admiralty Park, with 37 species, there is no clear hotspot for fauna of conservation significant species.
- **Stream Mapping** (see Figure 5) – There are 4 natural streams, 5 concrete drains, 10 culverts and Sungei Cina identified. All streams have continuous low-flow when no rain occurs on site or at surrounding areas. No flow condition was observed for certain drains during dry weather. During wet weather, high flow rate and increased water levels were observed at certain drains and along Sungei Cina. Most of the natural streams and drains flow to Sungei Cina through existing concrete culverts located at their downstream. Water flow of Sungei Cina is influenced by tides.
- **Water Quality** – Water samples were collected along the upstream, midstream and downstream of Sungei Cina to observe its in-situ and ex-situ water quality conditions. Most water quality parameters met NEA Trade Effluent Discharge limits. The concentration of ex-situ parameters did not vary significantly across the assessed locations. Comparison against relevant guidelines indicated that the water quality had a relatively high nutrient content, which suggest that water quality in Sungei Cina might affect aquatic life in Sungei Cina, in line with dissolved oxygen (DO) level findings from in-situ results.
- **Groundwater** - Based on the existing groundwater levels, the inferred groundwater flow direction is in the west-southwest towards Sungei Cina. Groundwater in areas near the Straits of Johor are expected to flow towards the sea. Saline groundwater discharge could be due to marine deposits in the soil and/or exchange with the Johor Straits.

³ The global conservation status of flora and fauna follow the International Union for Conservation of Nature (Red List) while the local conservation status of fauna mainly follows the Singapore Red Data Book, with reference to updated local checklists where available. Refer to Table 13 for the definition of various global and local conservation statuses for species. For vascular plant species, only their local conservation status is considered as it is deemed more relevant in a local and development context.

⁴ See Appendix B for the plants of conservation significance

⁵ See Appendix F for more information on the list of fauna species of conservation significance

Proposed Core Conservation Area (CCA)

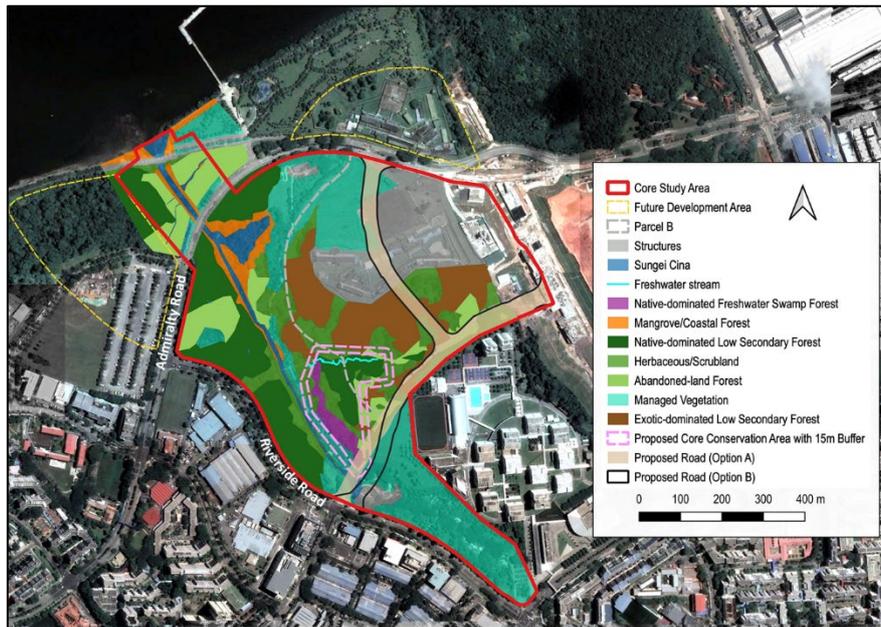


Figure 6: Proposed Core Conservation Area (dashed pink)

Based on the baseline findings, a 4.39 ha area (inclusive of 15 m buffer), as shown in Figure 6, is recommended to be retained based on the following considerations. More details are provided in Section 7.

- **Presence of rare and native vegetation types**, i.e. native-dominated freshwater swamp forest and native-dominated low secondary forest. The latter acts as a buffer to the former and is an early-successional secondary forest⁶ that has the potential to transit into a more mature forest
- **Freshwater stream feeds the native-dominated freshwater swamp forest**
- **High concentration of flora species of conservation significance and significant large trees**
- The 15m buffer protects the retained habitats from disturbances

Environmental Impact Assessment

Sections 7, 8, and 9 discuss the methodologies used for impact identification, prediction and assessment on environmental parameters including biodiversity, hydrology, water quality and groundwater, throughout the course of the projects.

Recommended Mitigation Measures & Environmental Monitoring and Management Plan (EMMP)

Table 1 summarises the key mitigation measures that have been developed for adoption, to minimise the adverse impacts throughout the course of the projects. More details are in Sections 7, 8 and 9.

⁶ Forest that developed on land cleared before the 1950s, dominated by native plant species

Table 1: Recommended Key Mitigation Measures

Environmental Parameter	Recommended Key Mitigation Measures and Best Management Practices	
	During Pre-Construction Phase	During Construction & Operational Phase
Flora and Fauna	<ul style="list-style-type: none"> Retain habitats as much as possible, especially the CCA with a 15-m buffer. Enhance landscape connectivity. Implement bird-friendly building design. Raise awareness on human-wildlife conflicts. Minimise unnecessary works by revising contractors' method statements. Establish Tree Protection Zones; Transplant/harvest species of conservation significance Execute tree-felling works outside of bird breeding and nesting season, if possible. 	<ul style="list-style-type: none"> Provide soil erosion control measures; Ensure slope stabilisation and grading works will not impact the CCA. Execute fauna response and rescue protocol when fauna is found on site. Raise awareness on biodiversity and minimise human-wildlife conflicts by conducting toolbox briefings to workers. Conduct regular inspections on contractors' compliance to reduce fauna mortality and negative impacts to surrounding habitats. Reduce insecticide use.
Hydrology and Water Quality	<p>For proposed residential development</p> <ul style="list-style-type: none"> Conduct detailed hydrological and erosion control study on stormwater to be diverted from future development to CCA. Design for stormwater peak flow to be lower/or equal to existing peak flow of current condition. Divert stormwater run-off from existing drain and future development to freshwater stream. Create green areas to buffer against the edge effects of the future development. <p>For proposed road development</p> <ul style="list-style-type: none"> Avoid the CCA as much as possible. Avoid introducing road structures such as columns or supporting structures directly on the man-made freshwater pond and Sungei Cina as much as possible. 	<ul style="list-style-type: none"> Dry out the man-made freshwater pond at Admiralty Park forebay and install silt curtains before road construction; Divert flow to Sungei Cina while ensuring no erosion along its banks. Implement settling pond to limit discharge of suspended solids into waterbodies; Monitor and treat effluent before released into waterbodies. Undertake precautionary management controls measures (e.g. regular inspections, housekeeping). Install portable toilets and collect sanitary effluents weekly for disposal. Develop protocols for proper handling, transfer and storage of chemical substances to prevent chemical spillage; Conduct periodical leak detection tests. Periodically dispose stored solid and toxic waste by licensed waste management contractors.
Groundwater	<ul style="list-style-type: none"> Install piezometers to monitor changes in groundwater level. Monitor salinity near the eastern and western margins of the Sungei Cina mangrove. Schedule developments in phases to minimise volume of dewatering at any one time. Use recharge wells as necessary during excavation works to limit groundwater drawdown and baseflow reduction on Sungei Cina. 	

With the implementation of the mitigation measures, the resultant impact significance is assessed to be minor for most of the environmental parameters, as shown in Table 2.

Table 2: Summary of Impact Evaluation and Residual Impact Significance for all Environmental Parameters

Environmental Parameter	Sensitive Receptors	Unmitigated Impact Significance	Mitigated Impact Significance
Flora and Fauna	Proposed CCA Due to residential development	Major <i>(including CCA)</i>	Minor <i>(excluding CCA)</i>
	Due to road development - Option A ⁷ - Option B ⁸	Major Minor	Major Minor
	Sungei Cina Mangroves (within Admiralty Park)	Minor	Minor
Hydrology and Water Quality	Proposed CCA Due to residential development	Minor – Major	Minor
	Due to road development - Option A - Option B		
	Sungei Cina	Negligible - Major	Negligible - Minor
	Sungei Cina Mangroves (within Admiralty Park)	Negligible - Minor	Negligible - Minor
	Aquatic life	Negligible - Major	Negligible - Minor
Groundwater	Proposed CCA	Major	Minor
	Sungei Cina	Minor	Minor
	Sungei Cina Mangroves (within Admiralty Park)	Negligible - Minor	Negligible - Minor

EMMP has also been developed to be implemented during the construction phase of the projects to ensure that residual impacts are minimised, the effectiveness of mitigation measures are justified and contingency plans are prepared/implemented, as needed. The EMMP is described in Section 10 of the report.

⁷ See Figure 6 for more details

⁸ See Figure 6 for more details