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1. Executive Summary

AECOM Singapore Pte Ltd (AECOM) was appointed by the Housing & Development Board (HDB) to carry out an Environmental Baseline Study (EBS) for Miltonia Close (hereinafter referred to as “Study Area”). The Study Area is adjacent to Yishun Avenue 1, and has been safeguarded as “Residential”, “Park” and “Educational Institution” based on the gazetted Master Plan 2019 (see Figure 1-1). The existing Study Area is characterised by waste woodland vegetation, and its vicinity is predominantly residential developments and/or meant for recreational use. The EBS aimed to provide information on the existing diversity and distribution of flora and fauna and characterise the hydrological conditions within the Study Area, which in turn serves to guide detailed planning for this site.

This report provides the baseline results on the biodiversity, hydrology and water quality studies.



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

Biodiversity

The flora baseline survey helped to identify and map the various vegetation types, while the fauna study set out to determine the current faunal diversity and distribution of the site. Both surveys also served to identify species of conservation significance present in the area (refer to Table 1-1 and Table 1-2 for the technical definitions of the conservation status used to derive the conservation significance of the species recorded). These baseline surveys revealed that the Study Area is characterised largely by disturbed vegetation which are widespread and common in other forested areas of Singapore. Because of this, most of the fauna species recorded here are adapted to disturbed habitats and can also be commonly found in other areas of Singapore. The Study Area does not support a particularly high native species richness in a local context and is not considered an ecologically significant site in Singapore. However, there are findings that show that the abandoned-land forest, swampy scrubland, and a bamboo cluster in the young secondary forest are important for both flora and fauna.

Table 1-1: Definition of Each National Conservation Status for Flora (Davison et al., 2008; Chong et al., 2009).

National conservation status	Definition
Vulnerable	More than 250, but fewer than 1,000 mature individuals
Endangered	Fewer than 250 mature individuals
Critically Endangered	Fewer than 50 mature individuals or more than 50, but fewer than 250 mature individuals
Presumed Extinct	Not recorded within the last 30 years

Table 1-2: Definition of Each National and Global Conservation Status for Fauna (Davison et al., 2008; Soh et al., 2019; Jain et al., 2018; IUCN, 2012).

Conservation status	Definition
National	
Vulnerable	More than 250 individuals in total, but fewer than 1,000 mature individuals
Endangered	Fewer than 250 mature individuals
Critically Endangered	Fewer than 250 individuals in total or fewer than 50 mature individuals
Presumed Nationally Extinct	Not recorded within the last 50 years
Global	
Vulnerable	Faces a high risk of extinction in the wild
Endangered	Faces a very high risk of extinction in the wild
Critically Endangered	Faces an extremely high risk of extinction in the wild
Extinct in the Wild	Only survives through cultivation, captivity or as a naturalized population(s) outside its natural range
Extinct	Globally extinct, including those in captivity or through cultivation

The abandoned-land forest and edges of the swampy scrubland supports several flora species of conservation significance, including the nationally critically endangered *Bintangaur laut* (*Calophyllum inophyllum*) and vulnerable *Buas buas* (*Premna serratifolia*) (see Figure 1-2). These coastal species are nationally threatened and are more often found in coastal habitats on the offshore islands of Singapore, such as St. John's Island and Pulau Tekukor. Hence, there is value in exploring ways to conserve coastal-associated species so that they can continue to persist on the mainland, so as to help the native stocks remain genetically diverse. The abandoned-land forest also hosts several large stranglers and trees (see Figure 1-3).

Bamboo bats (*Tylonycteris* spp.) were found during roost emergence surveys at the bamboo cluster in the northern part of the Study Area (see Figure 1-4). This genus of bats may include the nationally critically endangered lesser bamboo bat (*T. fulvida*), which may also be found in other forested areas in Singapore. More details can be found in Section 7 of the report.



Figure 1-2: Vegetation Distribution and Distribution of Flora Species of Conservation Significance in the Study Area



Figure 1-3: Distribution of Large Plant Specimens in the Study Area



Figure 1-4: Distribution of Fauna Species of Conservation Significance in the Study Area



Figure 1-5: Existing Waterbodies in the Study Area

Hydrology and Water Quality

The hydrology and water quality baseline study aimed to identify waterbodies present in the Study Area including their location, water flow conditions and bank characteristics; while the water quality surveys determined the quality of water in these surface water bodies. Based on topographic survey data and site analysis, water catchment areas within the vicinity of the Study Area mainly contribute water to the identified Natural Stream and drains. There is also an abandoned fishpond connecting to the swampy area and slowly discharging to the west of Natural Stream. This fishpond has almost stagnant water during both dry and wet weather. Two concrete roadside drains (Drain 1 and Drain 2) run along the south boundary of the Study Area and collect storm runoff from south of the Study Area (see Figure 1-5). More details can be obtained in Section 8 of the report.

From the results of the hydrological and water quality assessment, it can be inferred that the Natural Stream which was generally perennial (fed from stormwater) with eutrophication conditions, may pose stress to the aquatic life in the Study Area. However, this Natural Stream, which runs through the swampy scrubland, still supports several stream-dependent faunal species, some of which are nationally threatened, such as the critically endangered red-tailed pipe snake (*Cylindrophis ruffus*) and endangered buffy fish owl (*Ketupa ketupu*). The straw-headed bulbul (*Pycnonotus zeylanicus*), which is a globally critically endangered and locally endangered species that was frequently encountered in the targeted field surveys, is also known to be associated to riparian habitats (see Figure 1-4).

Proposed Core Biodiversity Area

Based on the key findings, the proposed core biodiversity area in the Study Area is marked out. This includes the riparian habitats that flank both sides of the stream as they form an integral component of aquatic environments that provide numerous ecological services, such as the provision of food sources and habitats for fauna such as the red-tailed pipe snake (*C. ruffus*) (Kupfer et al., 2003), as well as the maintenance of water quality via the infiltration of surface runoff. The buffer zone is at least 30 m in width to ensure bank stability (Buffler et al., 2005; Jontos, 2004). To preserve the microclimate of the bamboo cluster to minimise disturbance to the bamboo bats, a 30-m buffer of vegetation has also been recommended around bamboo cluster BB_01A.

While flora specimens and flora of conservation significance can be found throughout the abandoned-land forest, it may be unrealistic to retain the abandoned-land forest in its entirety as it comprises a third of the Study Area. Therefore, the portion of this forest patch closest to the stream with a 15-m buffer should be prioritised as the proposed core biodiversity area. This allows for some large trees, stranglers, and individuals of threatened coastal species to be conserved, including the two aforementioned species. The largest strangler on site—a *Ficus microcarpa* with a spread of up to 50 m—will also be retained. A contiguous conservation zone may be achieved by connecting the stream, abandoned-land forest, and northern bamboo cluster habitats, which may preserve a higher habitat quality compared to retaining fragmented forest patches (de Paula et al., 2016). The key findings and the proposed core biodiversity area of this Study Area is shown in Figure 1-6.



Figure 1-6: Proposed Core Biodiversity Area (highlighted in red)

2. Scope of Services

2.1 Scope of Work

The key objective of the Environmental Baseline Study for Miltonia Close is to provide information on the diversity, density and distribution of flora and fauna and characterise the hydrologic conditions within the Study Area which has been largely safeguarded for future "Residential" land use based on the gazetted Master Plan 2019. The study findings will help the Authorities to evaluate whether further measures need to be studied in order to mitigate the potential impacts of the future development on the flora, fauna and hydrologic components of the site.

This study aims to identify the existing environmental baseline conditions of the site in terms of flora, fauna and hydrology through:

- Identify and map out the vegetation distribution and important floristic communities in the Study Area, including species of conservation interest and threatened/rare species of plants;
- Investigate the terrestrial and aquatic habitats in the Study Area and document the distributions of existing fauna (birds, mammals, herpetofauna, butterflies, odonates, bats, fish, crustaceans, and molluscs), particularly those of conservation significance;
- Evaluate and identify areas to prioritise for conservation of biodiversity;
- Reviewing data provided by the Client to understand the topographic and hydrographic characteristics of the Study Area;
- Site reconnaissance survey for a better understanding of the Study Area's topography, hydrology, land cover and existing waterbodies with their properties (i.e. locations, water flow conditions and bank characteristics);
- Identification and mapping of the location, alignment of all streams, ponds and swampy areas within the Study Area;
- Identification of sampling locations for in-situ and ex-situ water quality analysis of existing waterbodies located within the Study Area;
- Determining the baseline surface and subsurface hydrological conditions; and
- Determining the stormwater sources feeding major natural stream if any and suggest the stormwater flow rate.

The Final Report presents the Study Area location, its historical, existing and future land uses, the approach adopted to carry out the study, baseline study results and conclusions.

2.2 Study Limitations

This document was prepared by AECOM in accordance with generally accepted engineering and scientific practice in effect at the time of the study. The study was based on reviews of publicly available publications and literature, as well as information collected on-site.

For the biodiversity study, not all species present at the site could be captured via fauna field surveys due to the rapid nature of this study, as well as the activity patterns, weather conditions, seasonal variations and other factors. The study period coincided only with the end of the bird migratory season (September to February), when birds leave their northern breeding grounds to reach southern overwintering haunts via the East Asian-Australasian Flyway. As such, migratory bird species may be under-represented in the field assessment.

Due to the above, the statements, conclusions, and opinions contained in this report are approximations of the existing environmental conditions within the Study Area, based on available literature, expert observations and opinion at the time of reporting. Site variations, habitat conditions, technology, and economic conditions may change in the future; however, this report was prepared to accurately address the Environmental Baseline Study objectives for the given submittal timeframe.

3. Duration and Schedule of the Study

This environmental baseline studies include biodiversity, hydrology and wate quality baseline surveys carried out from December 2019 to July 2020. The details and submission deadlines for each deliverable is listed as follows:

- **Inception Report** was submitted to HDB on 17th January 2020;
- **Progress Survey Report** was submitted to HDB on 28th February 2020;
- **Interim Report** was submitted to HDB on 20th April 2020;
- **Draft Final Report** was submitted to HDB on 18th August 2020; *and*
- **Final Report** was submitted to HDB on 26th February 2021.

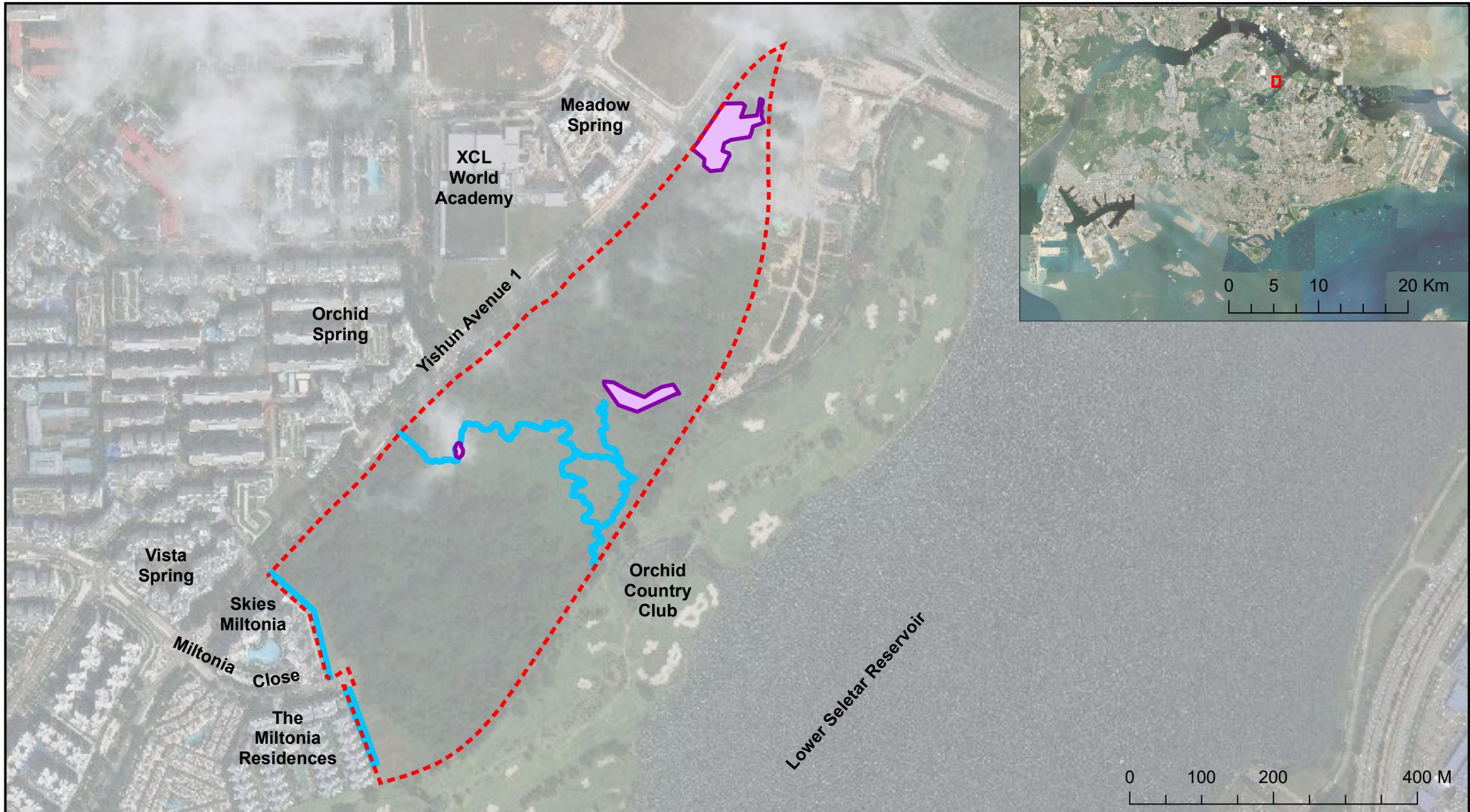
4. General Description

4.1 Location of Study Area

The proposed Study Area for this EBS is estimated to be approximately 27 hectares (ha). It is bounded by Yishun Avenue 1 to the north and east and Miltonia Close to the west.

The Study Area is a vegetated site with undulating relief and situated in the northern region of Singapore. The Study Area's vicinity is predominantly residential developments and recreational use. The residential establishments such as Vista Spring, Orchid Spring and Meadow Spring are located to the west and north of Study Area. Private properties, such as Skies Miltonia and The Miltonia Residences are situated along Miltonia Close Road to the west of Study Area. Towards the south of Study Area, the golf course of Orchid Country Club is located along the southeast boundary of Study Area. Lower Seletar Reservoir is distanced approximately 300 m from study boundary.

Figure 4-1 below shows the extent of the Study Area and its location in Singapore.



Legend

- Study Area
- Farm
- Waterbody



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(MILTONIA)**

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Figure Title :
LOCATION OF THE STUDY AREA

Figure No. : 4 - 1	Rev. 01	Sheet 1 of 1
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CAD File Name : NA

Note: Source of basemap - Google Earth Map

4.2 Historical Land Use

Corlett (1991) reported that preceding British colonization in 1819, the interior of Singapore was covered by primary lowland dipterocarp rainforest while mangrove forests lined the coasts, as well as streams and rivers. The earliest maps of Singapore were produced mainly for navigational purposes and did not detail the existing vegetation, but given that the Study Area lies close to the primeval mangrove forest along the river within the Seletar district and contains a tributary of Sungei Seletar, it was likely characterised by mangrove and freshwater swamp forest. According to O'Dempsey & Chew (2011), early immigrants to Singapore in the 1800s largely depended on agriculture as their livelihoods, so by the early 1840s, the Sungei Seletar district had been converted into gambier and pepper cultivations. The McCallum map of Singapore in 1885 shows that this Study Area avoided this conversion and remained a forested patch (Figure 4-2). Despite this, its proximity to the plantations and ease of human access meant that this area was not completely undisturbed and was likely degraded from charcoal production and timber harvested for the construction of fishing poles and fishing platforms (kelongs), materials that were typically taken from mangrove trees (O'Dempsey & Chew, 2011).

In 1911, the Crown lands on the north and south banks of Sungei Seletar were proposed by Lim Nee Soon, the major landholder and community leader in Seletar district of the time, to be converted into farms to cope with the food shortage faced by Singapore's growing population (O'Dempsey et al., 2014). This proposition was accepted and the area was cleared to make way for vegetable farms. While it is unclear whether or not current Study Area was part of the Crown lands, the next interpretable map of Sungei Seletar in 1938 shows that the site was characterized by rubber, coconut and pineapple plantations, with areas of miscellaneous cultivation (Figure 4-3). There were also buildings along roads that ran through the Study Area. Sungei Sopok flowed through the centre of the Study Area towards Sungei Seletar. Mangroves were present on both sides of Sungei Sopok (Figure 4-3). In 1958, the Study Area was mainly covered in rubber plantations. Sungei Sopok and the mangroves persisted, albeit altered with impounding reservoirs and ponds (Figure 4-4). By 1982, only coconut plantations remained, with some minor cultivation at the northern tip of the Study Area. Sungei Sopok and the mangroves were further impounded with a couple of internal roads being introduced to make the Study Area more accessible (Figure 4-5). Sungei Seletar was dammed to form Lower Seletar Reservoir in 1986. This would have resulted in the loss of the mangroves along Sungei Sopok and Sungei Seletar. The earliest satellite imagery available on Google Earth is in 2008 and it shows that the area was covered in spontaneous vegetation, i.e., vegetation that occurs naturally and is neither manicured nor managed by humans, with an open grassland in the centre – much like it is today (Figure 4-6).

4.3 Existing Land Use

Currently, the Study Area is an existing forest with dense vegetation. It is surrounded by roads, residential developments, golf course of Orchid Country Club and small plantation area. Dense vegetation was observed along the footpath beside Yishun Avenue 1 (refer to Photo 1 of Figure 4-7).

There is an ongoing drainage construction at north boundary of Study Area as shown in Photo 2 of Figure 4-7. The completion of the ongoing construction is estimated to be on 1st Quarter of year 2021. The stormwater runoff from residential areas was envisioned to be discharged into a concrete drain eventually (refer to Photo 2 of Figure 4-7). The downstream of this drain connects to a natural stream forming a swampy area in the forest which is located in the centre of Study Area. The water from the natural stream flows to a pond in the Orchid Country Club through three culvert structures (refer to Photo 6 of Figure 4-7) and eventually to the Lower Seletar Reservoir. One concrete drain was found along Skies Miltonia (refer to Photo 3) which does not connect to another concrete drain in Photo 4. It should be noted that there are two existing farming areas inside the Study Area (Figure 4-7).

4.4 Future Land Use

As shown in the gazetted Master Plan 2019 (Figure 4-8), majority of the Study Area has been proposed to be developed for residential use, supported by ancillary uses such as educational institution and park at the centre of the Study Area. The existing road at Miltonia Close will be extended into the Study Area to provide accessibility to the proposed residential parcels.



Figure 4-2: Sungei Seletar District in 1885, with the Approximate Location of Study Area Demarcated in Red (National Archives of Singapore, 2020).

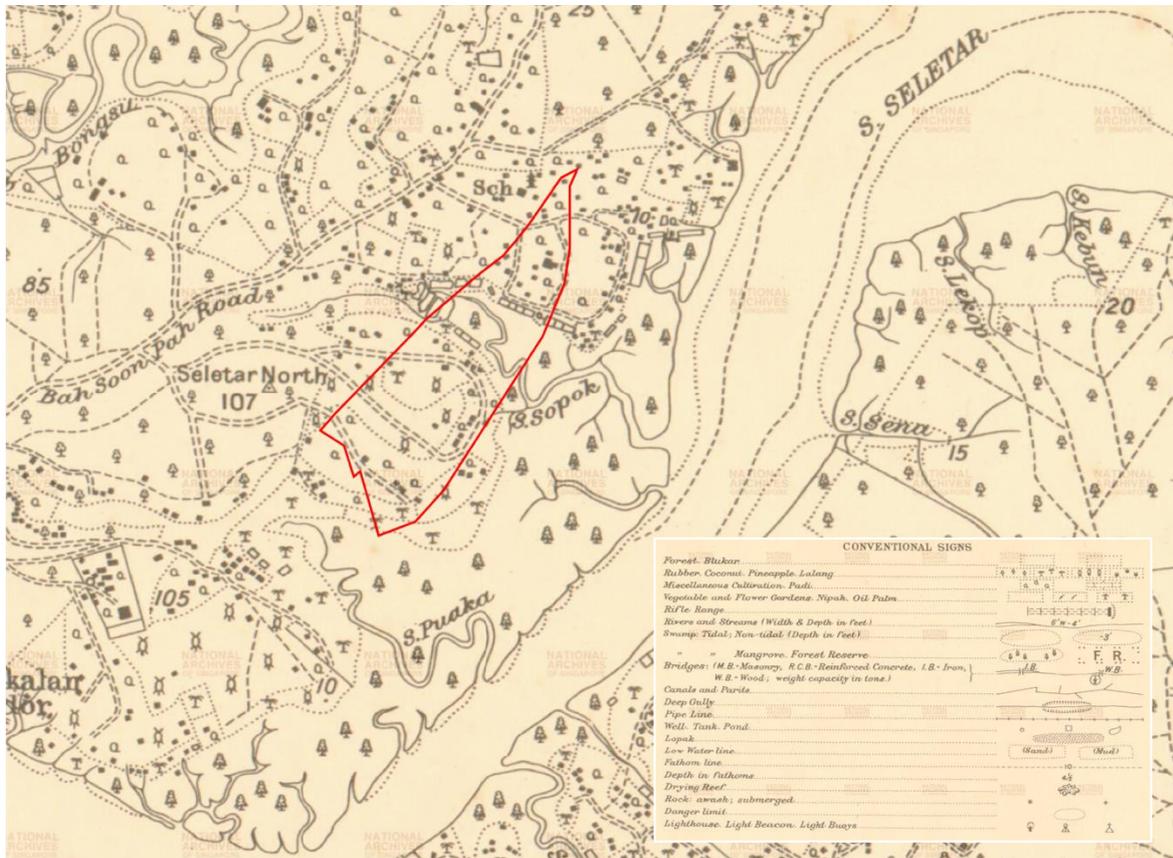


Figure 4-3: Sungei Seletar District circa 1938, with the Approximate Location of Study Area Demarcated in Red (National Archives of Singapore, 2020).



Figure 4-4: Sungei Seletar District circa 1958, with the Approximate Location of Study Area Demarcated in Red (National Archives of Singapore, 2020).

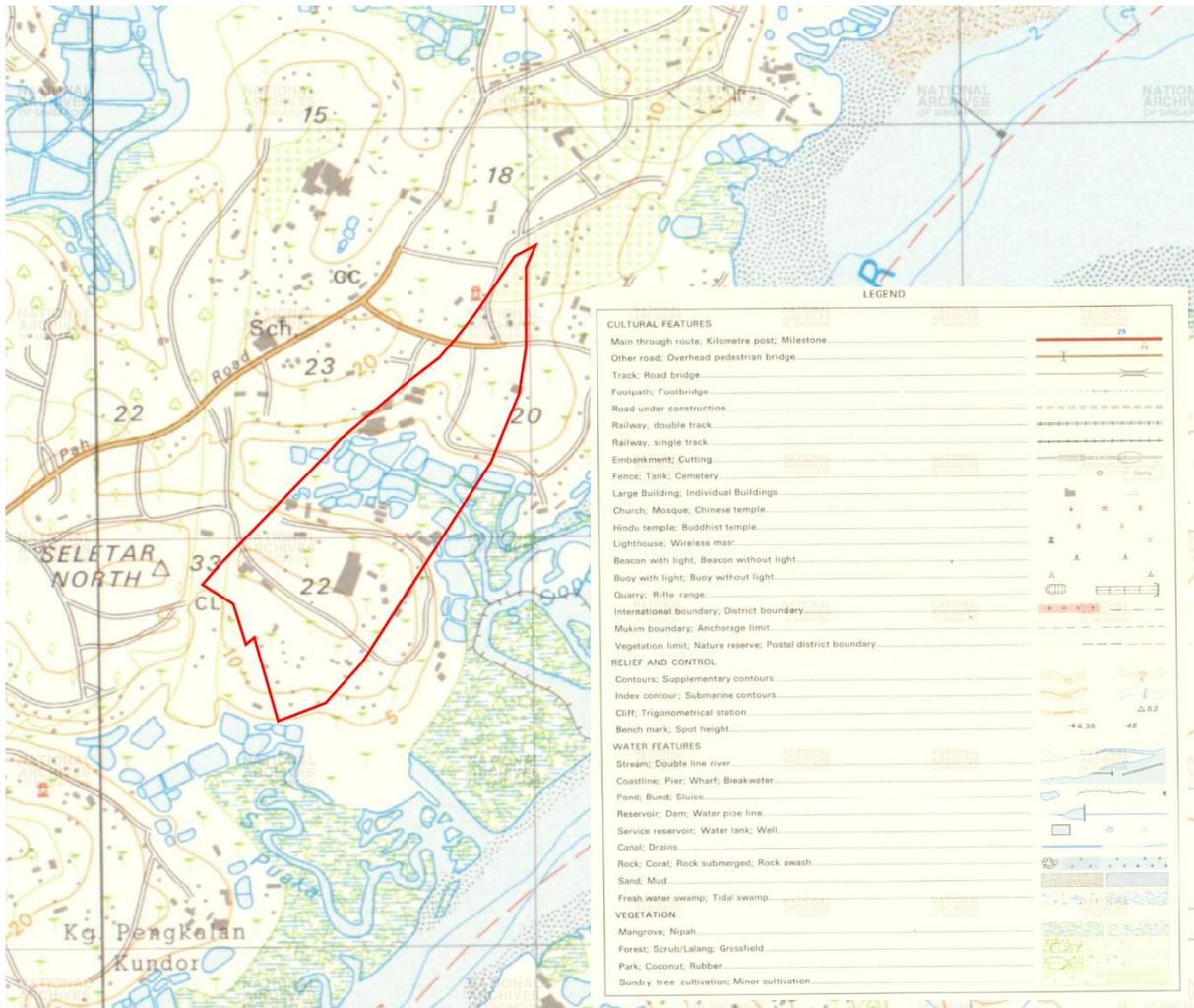


Figure 4-5: Sungei Seletar District circa 1982, with the Approximate Location of Study Area Demarcated in Red (National Archives of Singapore, 2020).



Figure 4-6: Satellite images of the Study Area (A) In 2008; and (B) In 2019 (Google Earth, 2020).



- Legend**
- Study Area
 - Farm
 - Waterbody



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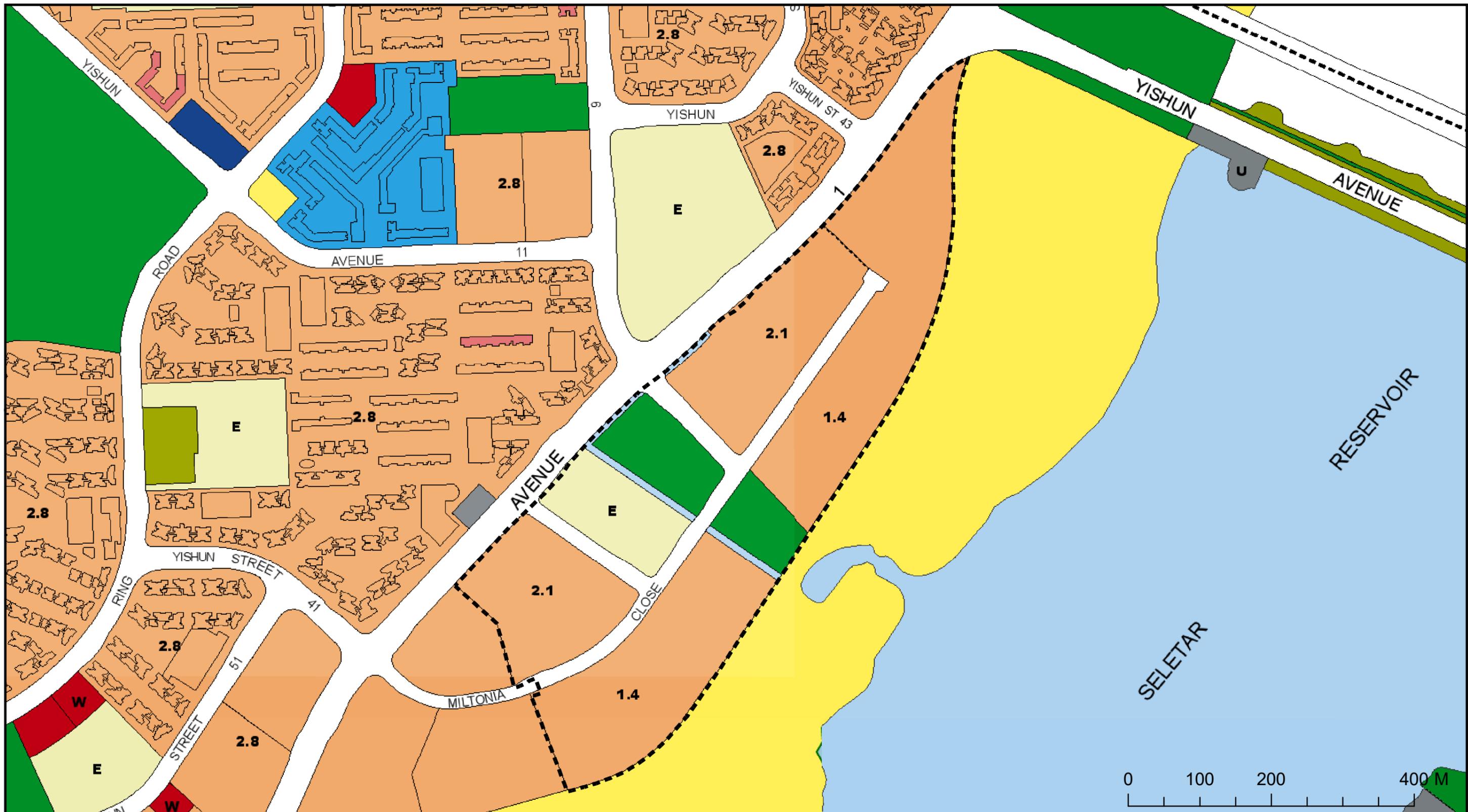
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Figure Title :
**EXISTING VEGETATION AND WATERBODIES
WITHIN THE STUDY AREA**

Figure No. : 4 - 7	Rev. 01	Sheet 1 of 1
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CAD File Name : NA

Note: Source of basemap - Google Earth Map



Legend

- Study Area
- Educational Institution
- Place of Worship
- Civic & Community Institution
- Open Space
- Residential
- Residential with Commercial at 1st storey
- Commercial & Residential
- Commercial
- Transport Facilities
- Waterbody
- Park
- Beach Area

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Figure Title : **LAND USE OF STUDY AREA AND ITS SURROUNDING**

Figure No. : 4 - 8	Rev. 02	Sheet 1 of 1
CAD File Name :		A3

Note: Source of basemap - URA's Master Plan Map 2019

5. Environmental Legislation, Policies, Plans, Standards and Criteria

A review of applicable environmental legislation, plans, standards and criteria to this baseline study was carried out and listed in the following sections. Where local Singapore legislation was not located, reference has been made to international guidelines and best practices as appropriate. All the following sections analysing the environmental baseline conditions are compared with the legislative references.

Environmental Parameter	Applicable Legislation	Key Points
General	Biodiversity Impact Assessment (BIA) Guidelines (NParks, 2020)	<p>This document is published by NParks to provide a framework guiding biodiversity baseline study in Singapore. It recommends methods for conducting baseline survey.</p> <p>Section 2 of this BIA Guidelines detailed the baseline study methods recommended for vegetation mapping, habitat mapping, hydrology (including waterbody mapping, water conditions, water quantity and water quality)</p>
Hydrology and Water Quality	Environmental Protection and Management (Trade Effluent) Regulations, 2008	<p>Regulates the discharge water quality of trade effluent.</p> <p>Any discharge into a watercourse must comply with the regulatory standards established in these regulations.</p>
	Standard Statistical Classification of Surface Freshwater Quality for the Maintenance of Aquatic Life, New York and Geneva UNECE (1994)	Provides standards for water quality assessment relating to aquatic life for surface waterbodies.
	Water Quality Requirements WHO (n.d.)	Provides standards for water quality assessment relating to aquatic life for surface waterbodies.
	Water Quality Criteria and Standards for Freshwater and Marine Aquaculture, Mitigating Impact from Aquaculture in the Philippines (PHILMINAQ),	Provides standards for water quality assessment relating to aquatic life for surface waterbodies.
	Water Quality Standards Handbook USEPA (2017)	Provides standards for water quality assessment relating to aquatic life for surface waterbodies.
	Recreational Water Quality Criteria, USEPA (2012)	Provides criteria for water quality assessment relating to human recreational activities.
	Australian & New Zealand Guidelines for Freshwater and Marine Water Quality (2000)	Provides standards for water quality assessment relating to aquatic life for surface waterbodies.
	Canadian Water Quality Guidelines for the Protection of Aquatic Life (2007)	Provides standards for water quality assessment relating to aquatic life for surface waterbodies.
	National Water Quality Standards for Malaysia (DOE)	Provides standards for water quality assessment relating to aquatic life for surface waterbodies
Biodiversity	National Biodiversity Strategy and Action Plan (NBSAP), 2009	This document provides a framework to guide biodiversity conservation efforts in Singapore. It intends to establish both policy frameworks and specific measures to ensure better planning and co-ordination in the

		sustainable use, management and conservation of biodiversity. A holistic approach has been adopted where the input of various public sector agencies and nature groups have been taken into consideration in the preparation of the document.
	Wildlife Act, Chapter 351	<ul style="list-style-type: none"> • A person must not intentionally kill, trap, take or keep any wildlife in any place unless the person has the Director-General's written approval to do so. • A person who has the Director-General's written approval mentioned in subsection (1) must comply with the conditions of the approval.
	Parks and Trees Act, 2006	<ul style="list-style-type: none"> • An Act to provide for the planting, maintenance and conservation of trees and plants within national parks, nature reserves, tree conservation areas, heritage road green buffers and other specified areas, and for matters connected therewith. • No tree with a girth exceeding one meter (when measured 1-m from the ground) should be cut or damaged without the prior approval of the relevant authorities; and • No tree or plant will be cut or damaged if located within the heritage road green buffer.
	Parks and Trees Act (Parks and Trees Regulations), 2006	Prohibitions and regulations on trees and animals within national park, nature reserve or public park.
	Parks and Trees (Heritage Road Green Buffers) Order, 2006	Lists the areas designated as heritage road green buffers.
	Parks and Trees (Preservation of Trees) Order, 1998	Lists the designated tree conservation areas No cutting or damaging of tree having girth of more than one metre.
	The Singapore Red Data Book (SRDB)	Lists the endangered plants and animals in Singapore Published by Singapore's Nature Society Provides the scientific name, common name, status, description, habitat, distribution, threats, scientific interest and potential value, as well as conservation measures for each plant and animal listed.
	The International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species	Provides taxonomic, conservation status and distribution information on plants, fungi and animals that have been globally evaluated.
	The Hong Kong Environmental Impact Assessment Ordinance - Technical Memorandum (HK EIAO TM)*	Sets out the principles, procedures, guidelines, requirements and criteria for deciding whether the Project is environmentally acceptable.

6. Study Approach

The Environmental Baseline Study includes the following stages:

- **Understanding the Baseline Environment** in terms of flora, fauna and hydrology; and
- **Reporting** findings

Figure 6-1 below provides the detailed approach applied for this study.

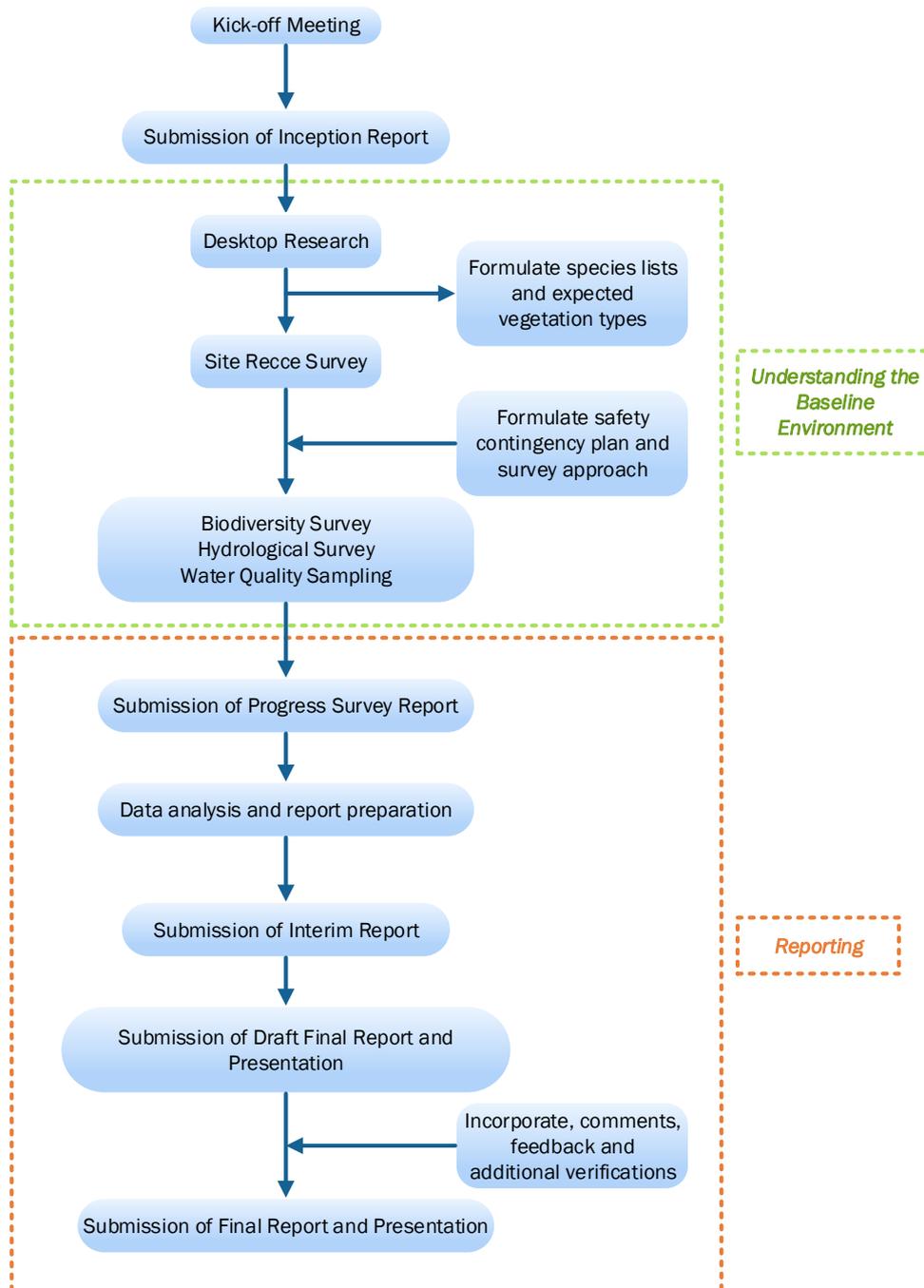


Figure 6-1: Detailed Approach for the EBS

7. Biodiversity Baseline Environment

This section includes the assessment of biodiversity baseline conditions within the Study Area with the study objectives as outlined in Section 2.1.

7.1 Methodology

7.1.1 Taxonomy and Nomenclature

The nomenclature and taxonomy in this study reference the following:

Table 7-1: Reference Used for Nomenclature and Taxonomy.

Taxon	References
Plants	Chong KY, Tan HT & Corlett RT (2009) A checklist of the total vascular plant flora of Singapore: native, naturalised and cultivated species. Raffles Museum of Biodiversity Research, Singapore.
Odonates	Soh M, Ng M & Ngiam RWJ (2019) New Singapore record of a dragonfly, <i>Indothemis carnatica</i> , with an updated Singapore Odonata checklist. Singapore Biodiversity Records, 2019: 10-17.
Butterflies	Khew SK (2015) A field guide to the butterflies of Singapore (2 nd edition). Ink Communications Pte. Ltd., Singapore.
Molluscs	Tan SK, Chan SY & Clements GR (2012) A guide to snails and other non-marine molluscs of Singapore. Science Centre, Singapore. 176 pp.
Fish	Ho JKI, Ramchunder SJ, Memory A, Theng M, Tianjiao L, Clews E, Yixiong C, Hui TH & Yeo DCJ (2016) A guide to the freshwater fauna for Nee Soon Swam Forest. Tropical Marine Science Institute, National University of Singapore. Kottelat M (2013) The fishes of the inland waters of Southeast Asia: a catalogue and core bibliography of the fishes known to occur in freshwaters, mangroves and estuaries. Raffles Bulletin of Zoology, 27: 1- 663. Suzuki T, Shibukawa K, Senou H, Chen I-S (2015) [issued 2016] Redescription of <i>Rhinogobius similis</i> Gill 1859 (Gobiidae: Gobionellinae), the type species of the genus <i>Rhinogobius</i> Gill 1859, with designation of the neotype. Ichthyological Research, 63: 227–238.
Amphibians	Baker N & Lim KKP (2012) Wild animals of Singapore: a photographic guide to mammals, reptiles, amphibians and freshwater fishes (2nd edition). Draco Pub and Distribution, Singapore.
Reptiles	Baker N & Lim KKP (2012) Wild animals of Singapore: a photographic guide to mammals, reptiles, amphibians and freshwater fishes (2nd edition). Draco Pub and Distribution, Singapore.
Birds	Gill F & Donsker D (2020) IOC World Bird List (v 10.1).
Mammals	Baker N & Lim KKP (2012) Wild animals of Singapore: A photographic guide to mammals, reptiles, amphibians and freshwater fishes (2 nd edition). Draco Pub and Distribution, Singapore.

7.1.2 Species of Conservation Significance

Threatened species of flora—i.e., listed in Chong et al. (2009) as nationally vulnerable, endangered, critically endangered, or presumed extinct (which indicates a rediscovery) (Table 7-2)—were assessed to determine whether

they are of conservation significance. While the national conservation status of threatened species is true of wild populations that originate in an area without direct or indirect human intervention, some populations may be relics that persist from past cultivation or escapees from present-day cultivation that do not belong to native genetic stock. The assessment of whether a threatened species is of conservation significance is based on, but not limited to, information on the following: (1) land use history, (2) presence of large parent tree(s), (3) commercial availability, (4) data from previous environmental impact assessments, (5) reforestation efforts, (6) natural range, and (7) importance for associated fauna. If the origin of a threatened species population is disputable or difficult to determine, we will corroborate findings from field surveys of fauna and/or adopt the more conservative approach by considering them of conservation significance. In carrying out such assessments, we are then able to prioritise conservation needs and focus resources in conserving them.

Rare species of fauna are often elusive, and/or seasonal in activity, resulting in low detectability. It is important to account for these species that may occur at the Study Areas in the impact assessment even if they were not recorded during field surveys, during which they may be undetected. Both national and global conservation statuses were considered to provide a holistic view of the conservation value of the Study Areas (Table 7-3). The national conservation status references the Singapore Red Data Book (SRDB; Davison et al., 2008) and other more updated local checklists, where available, such as Soh et al. (2019) for odonates and Jain et al. (2018) for butterflies. The global conservation status references the Red List of Threatened Species by the International Union for Conservation of Nature (IUCN, 2012). Species that are globally threatened but not native to Singapore were not considered as species of conservation significance.

Table 7-2: Definition of Each National Conservation Status for Flora (Davison et al., 2008; Chong et al., 2009).

National conservation status	Definition
Vulnerable	More than 250, but fewer than 1,000 mature individuals
Endangered	Fewer than 250 mature individuals
Critically Endangered	Fewer than 50 mature individuals or more than 50, but fewer than 250 mature individuals
Presumed Extinct	Not recorded within the last 30 years

Table 7-3: Definition of Each National and Global Conservation Status for Fauna (Davison et al., 2008; Soh et al., 2019; Jain et al., 2018; IUCN, 2012).

Conservation status	Definition
National	
Vulnerable	More than 250 individuals in total, but fewer than 1,000 mature individuals
Endangered	Fewer than 250 mature individuals
Critically Endangered	Fewer than 250 individuals in total or fewer than 50 mature individuals
Presumed Nationally Extinct	Not recorded within the last 50 years
Global	
Vulnerable	Faces a high risk of extinction in the wild
Endangered	Faces a very high risk of extinction in the wild
Critically Endangered	Faces an extremely high risk of extinction in the wild
Extinct in the Wild	Only survives through cultivation, captivity or as a naturalized population(s) outside its natural range
Extinct	Globally extinct, including those in captivity or through cultivation

7.1.3 Desktop Assessment

The historical and present-day land use of the Study Area were reviewed. Information on land use history was primarily gathered using from old maps in the online collection of the National Archives of Singapore (NAS) as well as historical maps on the OneMap Portal (Section 4.2). A list of faunal species that may potentially exist in the Study Area (“species of probable occurrence”) was generated. This list considers fauna species previously documented within and around a 2-km radius of the Study Area and are expected to occur based on the types of habitats present. It was completed by reviewing online databases, existing literature, technical reports and consulting specialists. Past and present floristic species composition as well as vegetation types were also examined.

7.1.4 Floristic Field Assessment

The field assessment for flora consists of (1) floristic surveys, (2) vegetation mapping and (3) vegetation plots. All field surveys were carried out between 10th March and 4th April 2020.

All plants observed in the Study Area during floristic surveys were identified to species whenever possible. A checklist of all the plant species recorded from the present floristic surveys was compiled. For plants that could not be immediately identified with certainty in the field, photographs and/or voucher specimens were taken. They were then identified using identification keys, taxonomic descriptions, online plant photo databases, with the help of taxonomic experts, and/or by matching the pressed and dried collected specimens with existing specimens in the Singapore Botanic Gardens’ Herbarium (SING). For very tall unidentifiable trees with leaves that were too high in the canopy to photograph, dried leaves matching these trees were collected from the forest floor and used to aid in species identification.

7.1.4.1.1 Plant Species of Conservation Significance

Geographic locations of plants of conservation significance (as defined in Section 7.1.3) were marked using a Global Positioning System (GPS) receiver (Garmin GPSMap® 64s), which records locations with accuracy of ± 4 m. Where there are clusters of plants of conservation significance—i.e., more than one individual occurring within 5 m or less of another individual—the geographic location of the approximated center of the area was marked using the GPS receiver.

7.1.4.1.2 Large Plant Specimens

The GPS receiver was also used to record locations of all trees of ≥ 3 m girth, as well as bamboo clusters, palm clusters, and strangling *Ficus* species of ≥ 3 m spread. The individuals were identified to species, whenever possible. Girth (for trees) and spread (for bamboo clusters, palm clusters, and strangling *Ficus* species) were measured and estimated, respectively. Specimen height was also estimated and recorded.

7.1.4.1.3 Other Plant Specimens of Value

Geographic locations of other plants that are of value but do not meet the minimum size requirement, as detailed above, were also recorded using the GPS receiver. Examples of such include bamboo clusters of < 3 m spread that may be important refugia for rare bamboo bats, amongst others, as well as exotic trees of < 3 m girth with active nests.

7.1.4.1.4 Vegetation Mapping

A preliminary vegetation map was first prepared based on visual interpretations of satellite images from Google Earth 7.1.2.2041 (Google Inc. 2013). Preliminary classification of the vegetation types—for example, forests, grasslands, or managed vegetation—was determined using visual features, such as textures and colours, observed in the satellite images. Adjustments were then made to the preliminary maps according to actual observations during ground truthing. Ground truthing was conducted throughout the survey area with the aid of a GPS receiver. Photographs of the vegetated areas were also taken. The boundaries of each vegetation type were tracked on the GPS receiver and mapped out on Google Earth 7.1.2.2041. The classification of the various vegetation types reference Yee et al. (2016).

7.1.4.1.5 Vegetation Plots

Twenty vegetation plots measuring 10 × 10 m were set up and sampled in the Study Area. The number of plots in each site was determined based on the sampling density of one plot for every 1.25 ha and the locations randomly generated in the statistical programming environment R version 3.4.3 (R Development Core Team, 2016).

Actual plot locations have to be adjusted on-site based on accessibility and suitability, i.e., not covered in dense vegetation and/or tree falls that would render the site inaccessible. We identified to species and measured the girth of all woody tree and shrub specimens as well as palms of ≥ 0.05 m girth. For *Ficus* stranglers and palm clusters, we estimated the size of spread and also measured the circumference of each woody aerial root or stem, respectively, of ≥ 0.05 m girth. All other plant species observed in the plots were also recorded.

7.1.5 Floristic Data Analyses

7.1.5.1 Community Data Analyses

All statistical analyses for this study were carried out in the statistical programming environment R version 3.4.3 (R Development Core Team, 2016). Community data analyses were conducted using the “vegan” package 2.5-6 (Oksanen et al., 2019) and “iNEXT” package 2.0.20 (Heish et al., 2019).

A species accumulation curve (SAC) was plotted using data on floristic diversity from the vegetation plots. Species richness was plotted against sample coverage, as opposed to survey effort, to estimate sample completeness/survey adequacy, i.e., how extensively we have sampled the species in the community. According to Chao and Jost (2012), sample coverage refers to “the proportion of the total number of individuals in a community that belong to the species represented in the sample.” The curve was extrapolated to provide an estimation of species richness and sample coverage if the sample size was doubled.

As some species will always remain undetected after sampling all the vegetation plots, total species richness had to be estimated via extrapolation. The total number of species was approximated using four estimators—namely Chao estimator (Chao, 1987; Chiu et al., 2014), first and second order Jackknife estimators (Smith & van Belle, 1984), and the Bootstrap estimator (Smith & van Belle, 1984)—by estimating the number of undetected species and adding them to the observed species richness (Palmer 1990; Colwell & Coddington, 1994).

To visualize the differences among vegetation types based on species composition, non-metric multidimensional scaling (NMDS) ordination was used. The Bray–Curtis dissimilarity index was used to quantify dissimilarities between the observed communities. Permutational Multivariate Analysis of Variance (PERMANOVA) via bootstrapping with 999 permutations then tested for statistical significance. This was performed using the ‘adonis’ function in the “vegan” package 2.5-6 (Oksanen et al., 2019). The plots were nested within the respective vegetation types. The ordination was also tested to ensure that the assumption of homogeneity of multivariate dispersion holds true.

7.1.5.2 Forest Regeneration

The trees were broadly categorized into two main girth-size classes: ≥ 0.5 m and < 0.5 m. They were first ranked by abundance and examined to see which species made up the larger and smaller trees, respectively. The ten most abundant species present in the vegetation plots were then ranked according to their size-class distribution and examined.

7.1.5.3 Aboveground Biomass Estimation

The “BIOMASS” package 2.1.1 (Réjou-Méchain et al., 2017) was used to estimate aboveground biomass (AGB) and their associated uncertainties in the forest for all live trees of ≥ 0.05 m girth. Each woody aerial root of ≥ 0.05 m girth for large *Ficus* stranglers was also taken into account in the estimation. The pantropical model in Chave et al. (2014) was used to estimate the AGB. Species taxonomy was cross-checked and matched with the Angiosperm Phylogeny Group III (APG III) database. Wood density values were estimated based on the global wood density database (Chave et al., 2009; Zanne et al., 2009). These estimates were attributed to the individuals at species, genus, or family level. Tree heights were predicted using the regional Guiana Shield Feldpausch Height-Diameter (H-D) model, where the “South-Eastern Asia” region were selected (Feldpausch et al., 2012). To account for AGB uncertainty, allometric model error, tree height error, wood density error, and diameter measurement error were included in the propagation step for AGB estimation.

7.1.6 Faunistic Field Assessment

7.1.6.1.1 Targeted Field Surveys

Targeted field surveys were conducted for the following taxa: odonates (dragonflies and damselflies), butterflies, molluscs, decapod crustaceans, fish, herpetofauna (amphibians and reptiles), birds, non-volant mammals and bats.

Visual encounter surveys (VES) were conducted along two terrestrial survey routes that total to 3.24 km. The terrestrial routes, particularly in the north-east of the Study Area, were directed to avoid the farming areas. The centre of the Study Area is comprised of tall grass or dense and low vegetation, making it unfeasible to place a terrestrial route through it due to low visibility and difficulty of access (Figure 7-1).

To examine the distribution of species richness across the Study Area, points at 100-m intervals were placed along terrestrial survey routes and fauna encountered during the terrestrial surveys were recorded to the nearest point. In total, there were 32 terrestrial points within the Study Area (Figure 7-2). During surveys, at least two surveyors walked along the designated route at approximately 1 km/h to survey for targeted fauna (odonates, butterflies, molluscs, herpetofauna, birds and non-volant mammals). Locations of all faunal sightings were recorded using a handheld GPS receiver (Garmin GPSMap® 64s). The surveys were conducted twice for each taxon, and in a reverse direction during the second session to allow detection of fauna with variable activity patterns.

For the aquatic surveys, a combination of diurnal five-minute point counts, nocturnal VES, tray netting and minnow trapping was conducted. The point counts were conducted at sampling points spaced at an interval of 50 m to search for targeted fauna (odonates, molluscs, decapod crustaceans, fish and herpetofauna) (Figure 7-3). The surveys were conducted twice for each taxon.



Figure 7-1: Vegetation in the Centre of the Study Area. (Taken at 1.419929015, 103.851907, facing northwest.)



Legend

- Terrestrial Sampling Point
- Terrestrial Routes
 - T1
 - T2
- Study Area
- Vegetation
 - Waste woodland
 - Scrubland and herbaceous vegetation
 - Scrubland and herbaceous vegetation (swamp)
 - Others - farm
 - Others - construction site
 - Managed vegetation
 - Young secondary forest
 - Abandoned-land forest

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Figure Title : TERRESTRIAL SURVEY ROUTES AND POINTS

Figure No. : 7-2	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map



Legend

- Aquatic Sampling Points
- Aquatic Routes
- A1
- A2
- Canal
- Study Area
- Vegetation**
- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Qualified Person Endorsement :
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Project Title :
**ENVIRONMENTAL BASELINE STUDY
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Figure Title :
AQUATIC SURVEY ROUTES AND POINTS

Figure No. : 7-3	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

All fauna encountered were identified to species, or the next lowest taxonomic level possible. Whenever a species was sighted, the number of individuals observed was documented. Important natural history notes were also collected, such as foraging and reproductive behaviour. Notable fauna that were encountered outside of their targeted survey period were documented as incidental records. A summary of the survey methods for each targeted taxon is described in Table 7-4 and further described in this section.

Table 7-4: Survey timings and methods for each taxon.

Taxon	Survey timing (h)	Survey method
Odonates	0900–1600	Diurnal visual encounter surveys along the terrestrial routes and diurnal point count surveys at the aquatic sampling points
Butterflies	0900–1600	Diurnal visual encounter surveys along the terrestrial routes
Molluscs	0900–1600, 2000–0000	Diurnal point count surveys at the aquatic sampling points; spotlighting along the aquatic routes; diurnal and nocturnal visual encounter surveys along the terrestrial routes
Decapod crustaceans	0900–1600, 2000–0000	Diurnal point count surveys with tray netting at the aquatic sampling points; spotlighting along the aquatic routes
Fish	0900–1600, 2000–0000	Diurnal point count surveys with tray netting at the aquatic sampling points; spotlighting along the aquatic routes; minnow trapping at strategic locations along the aquatic routes
Herpetofauna	0700–1600, 2000–0000	Diurnal and nocturnal visual and auditory encounter surveys along the terrestrial routes; diurnal and nocturnal visual and auditory encounter surveys with spotlighting along the aquatic routes
Birds	0700–1000, 2000–0000	Diurnal and nocturnal visual and auditory encounter surveys along the terrestrial routes
Non-volant mammals	0700–1000, 2000–0000	Diurnal and nocturnal visual and auditory encounter surveys along the terrestrial routes
Bats	2000–0000	Acoustic recording along the terrestrial routes (Note: bat trapping has been suspended in view of the ongoing Covid-19 situation)

Odonates (dragonflies and damselflies) – A combination of visual encounter surveys along terrestrial sampling route and five-minute point counts at each aquatic sampling point were carried out between 0900h and 1600h. Owing to the difficulties in sampling and identification, aquatic larvae and exuviae were not surveyed. Adults were identified by sight (with the aid of binoculars where necessary) in flight or while perched. Specimens were also photographed or caught with insect nets if required for species identification. Individuals collected were released immediately after they have been identified.

Butterflies – Visual encounter surveys were carried out for adult butterflies, caterpillars, pupae, eggs, and host plants along terrestrial sampling routes between 0900h and 1600h. Butterflies were identified by sight (with the aid of binoculars where necessary), photographed, or captured using insect nets. Captured individuals were released immediately after identification.

Molluscs – Both aquatic and terrestrial molluscs were surveyed. For aquatic molluscs, diurnal five-minute point count surveys were conducted between 0900h and 1600h at the aquatic sampling points, and nocturnal visual encounter surveys were conducted at the water bodies between 2000h and 0000h. Terrestrial mollusc surveys consisted of diurnal surveys (0900h and 1600h), as well as nocturnal surveys (2000h–0000h) along terrestrial routes. All molluscs were identified by sight and photography.

Decapod crustaceans – A combination of five-minute point counts and tray netting were conducted at each aquatic sampling point. Point counts and tray netting were employed for diurnal (0900h–1600h) surveys. All trapped

crustaceans were released *in-situ* after identification. Nocturnal (2000h–0000h) VES at the water bodies was carried out with the help of flashlights.

Fishes – A combination of five-minute point counts, tray netting and minnow trapping were conducted at each aquatic sampling point (Figure 7-4). Point counts and tray netting were employed for diurnal (0900h–1600h) surveys. All trapped crustaceans were released *in situ* after identification. Nocturnal (2000h–0000h) VES at the water bodies was carried out with the help of flashlights. Eight minnow traps baited with halal-certified meat (e.g., sausage, liver) were deployed during the diurnal surveys and retrieved the following day (Figure 7-5). All trapped fishes were released *in situ* after identification.



Figure 7-4: Fish Sampling Using (A) Tray Netting and (B) Minnow Trapping.



Legend

- Minnow Trap
- Aquatic Routes A1
- Aquatic Routes A2
- Canal
- Study Area
- Vegetation**
- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Figure Title : **LOCATIONS OF MINNOW TRAPS**

Figure No. : 7-5	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

Herpetofauna (reptiles and amphibians) – Diurnal (0700h–1600h) and nocturnal (2000h–0000h) surveys were performed along both terrestrial sampling routes and at aquatic sampling points. Visual encounter surveys were conducted along terrestrial sampling routes, while five-minute point counts were conducted along aquatic sampling points. As herpetofauna occupy a wide range of habitat types, both surveys involved searching for individuals on the ground, below rocks, logs, leaf litter and debris, in the water, and on vegetation. For nocturnal spotlighting surveys, torches were used to elicit eyeshine. For species that are capable of quick retreats and escapes, the individuals were captured by hand, or using hooks, tongs, or dip nets for identification. Vocalising geckos and frogs were also located or identified by call recognition, whenever possible.

Birds – Surveys comprised diurnal (0700h–1000h) and nocturnal (2000h–0000h) visual encounter surveys performed along terrestrial sampling routes. All birds were identified by sight (with the aid of binoculars and cameras where necessary) and/or through call recognition. Nocturnal birds (e.g., owls and nightjars) were detected using torches to elicit eyeshine and through call recognition.

Non-volant mammals – Surveys comprised diurnal (0700h–1000h) and nocturnal (2000h–0000h) visual encounter surveys performed along terrestrial sampling routes. Mammals were surveyed on the ground and on vegetation, and in burrows and tree holes. In addition, tracks and scats were also recorded as they can aid in species identification. All mammals were identified by sight (with the aid of binoculars and cameras where necessary). Squirrels were also identified through call recognition. Nocturnal mammals were detected using torches to elicit eye shine, which aids in detection at night. In addition to visual surveys, camera trapping was also conducted (Section 7.1.6.1.2).

Bats – Owing to the difficulty in finding roost sites and the inability to visually identify bats to species when they are flying at night, bat sampling typically involves live-trapping and acoustic sampling. However, in view of the Covid-19 situation, live-trapping has been suspended. Acoustic detectors were used to detect ultrasonic echolocation calls produced by microchiropteran bats to navigate and locate prey (Schnitzler et al., 2003). The calls are unique to each species and can be used to identify bats (Fenton and Bell, 1981). However, species such as bamboo bats (*Tylonycteris* spp.) whose acoustic frequencies overlap (Kingston et al., 2009) cannot be distinguished by their calls. A handheld detector, the Echo Meter Touch 2 Pro (Wildlife Acoustics, Inc.), connected to a mobile device, was therefore, used during nocturnal surveys along terrestrial sampling routes. The detector converts the ultrasonic calls to low frequency signals below 20 kHz, a range that is audible to the human ear, which are then streamed on a spectrogram of the Echo Meter Touch app. All bat calls are automatically recorded on the device.

7.1.6.1.2 Camera Trapping

Camera traps are commonly used to survey mammals, particularly medium- to large-sized ones, as they are relatively easy to identify on photographs or videos (Figure 7-6). It is a useful as a non-invasive (i.e., no animal handling) and not labour-intensive (after deployment) method that provides a 24-hour sampling regime over months, thus often allowing for the detection of uncommon species (Rovero et al., 2010).

A total of four camera traps (Browning Strike Force HD Pro X, BTC-5HDPX) were deployed for 30 nights each. They were distributed equally across the Study Areas, with approximately one camera trap per 6–7 ha (Figure 7-6). Each camera trap was kept at least 20 m away from terrestrial sampling routes, where possible, to maximise coverage of areas not visible from terrestrial sampling routes. They were deployed at approximately 20–80 cm above ground (Figure 7-7). They operated 24 h a day and were programmed to record 10-s footage per motion trigger with a 10-s quiet period following each trigger.



Legend

- Study Area
- Camera Trap
- Vegetation**
- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Figure Title :
LOCATIONS OF CAMERA TRAPS

Figure No. : 7-6	Rev. 05	Sheet 1 of 1
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Note: Source of basemap - Google Earth Map



Figure 7-7: Camera Trap Setup.

7.2 Baseline Results

7.2.1 Habitat and Vegetation Types

The Study Area is occupied by two main habitat types – terrestrial and freshwater. Terrestrial habitat covers most of the site and is primarily forested and scrubland. The centre of the Study Area contains a permanent narrow freshwater stream that runs from the west to the east, and is Sungei Sopok which is a tributary to the larger Sungei Seletar. The mouth of the freshwater stream is connected to a pond which catches incoming water from the canal beside Yishun Avenue 1 (Photo 1 of Figure 7-8), which flows into a steep and narrow stream (Photo 2 of Figure 7-8). On the other end, a larger pond intersects the stream (Photo 3 of Figure 7-8) before it flows through a concrete drain (Photo 4 of Figure 7-8) into Orchid Country Club and Lower Seletar Reservoir.



Figure 7-8: Streams in the Study Area.

There is a total of six distinct vegetation types in the Study Area (excluding the farming areas and PUB construction site for drain improvement works). Abandoned-land forest takes up the largest area, followed by young secondary forest, and scrubland and herbaceous vegetation (swampy and non-swampy) (Table 7-5). Some small areas of the Study Area are covered by managed vegetation, waste woodland, and unauthorised farming areas (to be removed prior to commencement of works). A part of the Study Area has also been recently cleared for construction.

The distribution of these vegetation types can be broadly described as such – abandoned-land forest in the south, scrubland and herbaceous vegetation (swampy) in the middle and young secondary forest in the north. A few small patches of cleared forest are occupied by farming areas and a construction site. Other areas with open canopy are scrubland largely found along the edges of the forested area east of the Study Area. The swampy area in the middle of the Study Area was not accessible during floristic surveys as it was densely covered by spontaneous vegetation. The boundary of this habitat was outlined using visual information gathered from satellite images (Google Inc., 2013). Also, the construction site on the western side of the Study Area appears to be recently cleared as this is not reflected in the Google satellite images. As access into the construction site was not permitted, the width of the construction area was also estimated when generating the map (Figure 7-9).

Table 7-5: Absolute (ha) and Relative (%) Sizes, Number of Vegetation Plots, and Species Richness of Each Vegetation Type.

Vegetation type	ha	%	Plots	Species richness		
				Total*	Native	Exotic and cryptogenic
Abandoned-land forest	9.1	34.1	12	87	45	42
Young secondary forest	7.7	28.7	3	30	20	10
Scrubland and herbaceous vegetation	3.7	13.7	2	26	13	13
Scrubland and herbaceous vegetation (swamp)	3.5	13.2	3	13	5	8
Waste woodland	0.9	3.5	0	–	–	–
Others – farms	0.6	2.4	N.A.	–	–	–
Others – construction site	0.6	2.3	N.A.	–	–	–
Managed vegetation	0.6	2.1	N.A.	–	–	–
Total	26.7	100.0	20	–	–	–

Note: *refers to the total number of species recorded across all plots in each vegetation type



Legend

- Vegetation plot
- Study Area
- Stream
- Waste woodland
- Scrubland and herbaceous vegetation
- Others - farm
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Figure Title :
VEGETATION DISTRIBUTION AND LOCATIONS OF VEGETATION PLOTS

Figure No. : 7-9	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

7.2.1.1.1 Abandoned-land Forest

Abandoned-land forest is largely concentrated in the southern half, interspersed by a few small patches of scrubland and herbaceous vegetation with open canopy (Figure 7-10). As most of the areas with open canopy are small and lie within the larger forested landscape, they were not indicated on the vegetation distribution map. Plant species that constitute the abandoned-land forest type are mainly exotic fruit trees and crop plants cultivated in the past. Some fruit plant species commonly encountered in this forest include durian (*Durio zibethinus*), oil palm (*Elaeis guineensis*) and longan (*Dimocarpus longan*) (Figure 7-11). Many of these trees have persisted from past cultivation and hence act as seed sources in the forest. If left undisturbed, it is likely that the propagules would continue to grow as the forest persists.

Even though the forest is dominated by exotic fruit and crop plants, there are several large *Ficus* stranglers growing in it (Figure 7-22). They spread from approximately 3 to 50 m. Findings from present floristic surveys show that 17 of the 21 strangling figs are growing within the 9.1-ha abandoned-land forest, which averages to about one strangler per 0.5 ha of forest.

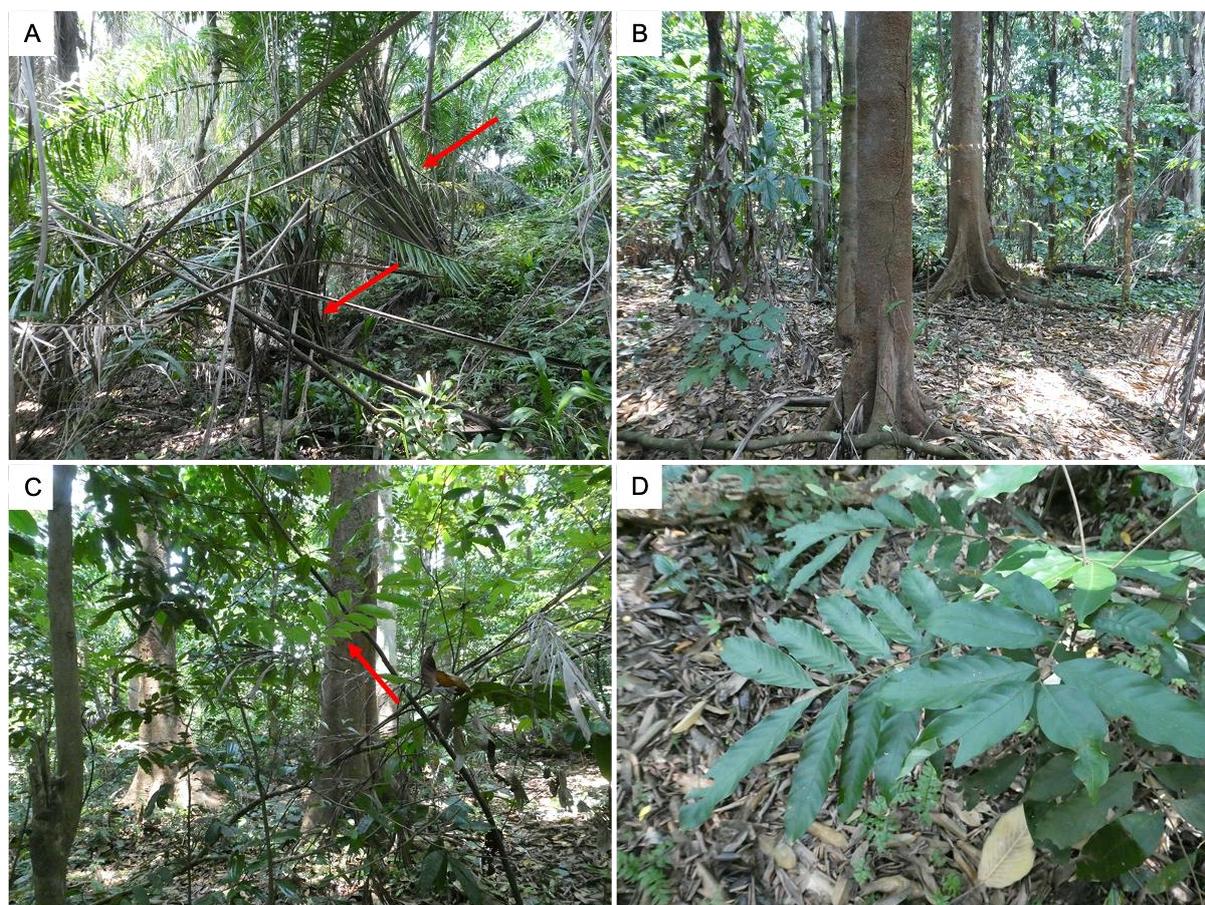


Figure 7-10: Fruit Trees and Crop Plants in the Abandoned-Land Forest in the Study Area. (A) Oil Palms *Elaeis Guineensis*; (B) Durian Trees *Durio Zibethinus*; (C) Longan *Dimocarpus Longan*; (D) Close-up of A Longan Plant.

7.2.1.1.2 Young Secondary Forest

Young secondary forest is concentrated in the northern half of the site (Figure 7-9). Unlike a typical native-dominated low secondary forest described by Yee et al. (2016), this forest is dominated by native shrub species, such as *Dillenia suffruticosa*, *Piper sarmentosum*, and *Bridelia tomentosa*. This patch of forest is interspersed with areas that have relatively open canopy, occupied by trees with mostly less than 10 m height. Some of these trees are common native species, such as *Cinnamomum iners*, *Cyrtophyllum fragrans*, and *Caryota mitis*, while others are exotic tree species, such as *Acacia auriculiformis* and *Elaeis guineensis*.



Figure 7-11: Young Secondary Forests with Relatively Open Canopy and Short *Caryota Mitis* Palms (Red Arrows) and the Common Native Shrub *Dillenia Suffruticosa*.

7.2.1.1.3 Scrubland and Herbaceous Vegetation (Swampy and Non-Swampy)

Scrubland and herbaceous vegetation (swampy and non-swampy) are characterised by short vegetation with uniform stratum and/or open canopy. Most of the swampy habitat is in the middle of the Study Area, flanked by forested areas on the northern and southern sides; the abandoned-land forest to its south and the young secondary forest to its north. The only freshwater stream in the Study Area occurs within the swampy scrubland and is characterised by a similar vegetation type i.e., largely occupied by exotic herb species often associated with wet areas/habitats. This area has low floristic diversity, of which most species are associated with wet areas. These species are *Mikania micrantha*, *Acrostichum aureum*, *Ludwigia octovalvis*, *Panicum repens* (Figure 7-12). There is a likelihood that this was previously a coastal area, but has since been taken over by the spontaneous growth of shrub species that can adapt to the swampy/inundated conditions.

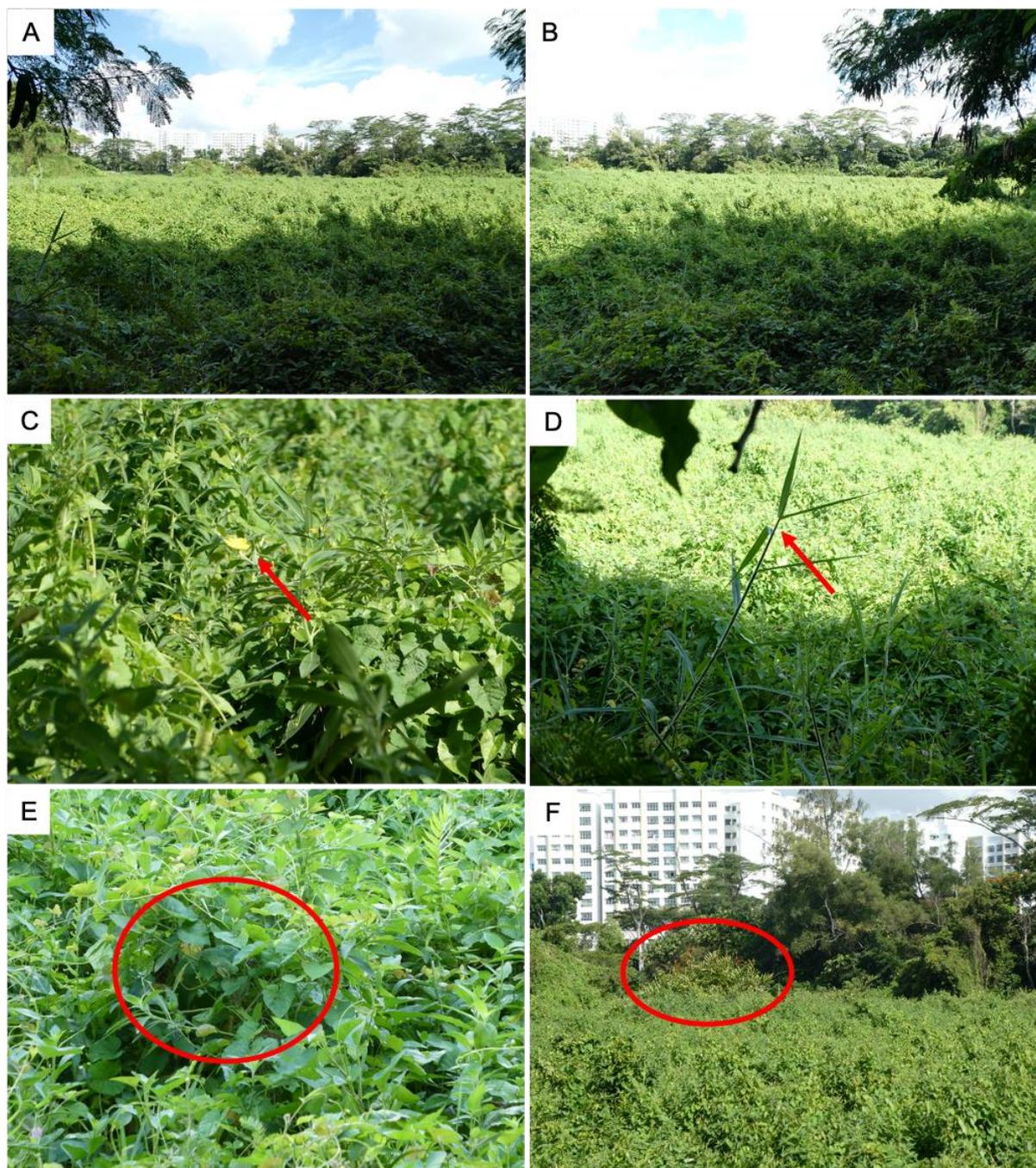


Figure 7-12: Scrubland and Herbaceous Vegetation (Swampy) in the Middle of the Study Area. (A–B) Overall View of the Swampy Habitat; (C) *Ludwigia Octovalvis*; (D) *Panicum Repens*; (E) *Mikania Micrantha*; (F) *Acrostichum Aureum*.

Other areas covered by scrubland and herbaceous vegetation (non-swampy) are mostly found in the east, along the edges of the forest next to the golf course in the adjacent Orchid Country Club (Figure 7-9). While the terrestrial area was relatively dry during the floristic surveys, several coastal associated plant species have been found growing there. Some of these are threatened native species (Section 7.2.1.1.3). Besides those, there are also other coastal-associated common native species, such as *Derris trifoliata* and *Casuarina equisetifolia*. Some areas along this stretch of scrubland next to the golf course were observed to have a relatively high concentration of coastal-associated species growing together (Figure 7-13). These areas with coastal-associated plant species were found along the edges of/within close proximity to the central swampy habitat (Figure 7-20). We hypothesise that these coastal plants could be persisting from a coastal forest that probably existed before there were disturbances arising from human developments in the adjacent spaces (Section 7.1.4.1.1). Preliminary findings suggest that the coastal plant specimens belong to the native genetic stock.



Figure 7-13: Coastal-associated Plants Growing in Proximity to Each Other – *Calophyllum Inophyllum* (red circle), *Derris Trifoliata* (red arrow), and *Premna Serratifolia* (white arrow).

7.2.1.1.4 Waste Woodland

Waste woodland is dominated by a single exotic tree species, *Falcataria moluccana* (Figure 7-14). This is a fast-growing species known to be able to quickly establish itself in disturbed vegetation. Such wasteland often regenerates in areas that have been highly disturbed. The ability of species to establish themselves there depends on available seed sources from the surroundings during clearance and succession (Yee et al., 2016). Owing to the degraded and/or disturbed nature of the surrounding forest, it is not surprising to find that the small patch of waste woodland is located within larger young secondary forest landscape.



Figure 7-14: Waste Woodland Dominated by *Falcataria Moluccana* Trees.

7.2.1.1.5 Managed Vegetation

Managed vegetation found in the area, excluding the farming areas that are regularly maintained by humans, is mostly turf that lies between the Study Area and the residential areas in the south (Figure 7-15).



Figure 7-15: Managed Turf between the Forested (Left) and Residential (Right) Areas South of the Study Area.

7.2.1.1.6 Others (Farming Areas and Construction Site)

Small parts of the forested area have been cleared for small-scale farming practices (Figure 7-16 A). Two such farming areas were found and inspected during present floristic surveys. They appear to be regularly maintained and are used to grow a large variety of food crops. Adjacent to Yishun Avenue 1, a construction site was also observed (Figure 7-16 B). The construction area is used by PUB for drain improvement works (Figure 7-16 C–D).



Figure 7-16: Other Non-Forested Areas in the Study Area. (A) Farming Area; (B–D) PUB Construction Site for Drain Improvement Works.

7.2.2 Floristic Baseline Results

7.2.2.1 Overall

A total of 169 plant species and two species groups (i.e., plants that could not be identified to species with certainty) belonging to 66 families were recorded at the Study Area. The two species groups are (1) *Lygodium cf. circinnatum* and (2) *Salacca sp.*

Only one specimen of *Lygodium cf. circinnatum* was documented. Unlike *Lygodium flexuosum* and *Lygodium longifolium* that have serrated pinnae margins, the specimen has entire pinnae margins. No sori were present on the fronds on the day of observation; without more observable characters, the species identity could not be confirmed. The specimen, however, could be a nationally vulnerable fern. This was included in species tabulation in Table 7-6 and Appendix B. One specimen of *Salacca sp.* was also encountered at the border of one of the farming areas. Its species identity could not be verified, though it is likely planted. This is listed as “Cryptogenic” in Table 7-6 below.

Of these, 77 (45.0%) are native, 76 (44.4%) exotic, and 18 (10.5%) cryptogenic (Table 7-6). The number of native threatened species adds up to 28, which is approximately 16.4% of total species count. This figure reflects only those from native wild populations. Some threatened species are cultivated locally and/or are relics from past cultivation and hence may not be of conservation significance. This is discussed in greater detail in the following section.

Table 7-6: Number and Percentage of Species Belonging to Each Status Category. (Note That the Figures in Each Category under the ‘Native’ Section Reflect That Of Native Wild Populations.)

Origin	Status	Number of species	Percentage of species (%)
Native		77	45.0
	Common	49	28.7

Origin	Status	Number of species	Percentage of species (%)
	Vulnerable	13	7.6
	Endangered	3	1.8
	Critically Endangered	11	6.4
	Extinct	1	0.6
Exotic		76	44.4
	Cultivated Only	14	8.2
	Casual	22	12.9
	Naturalised	35	20.5
	Not assessed	5	2.9
Cryptogenic		18	10.5
Total		171	100.0

7.2.2.2 Plant Species of Conservation Significance

A total of 28 species are locally threatened but of these, only 16 are considered of conservation significance. Table 7-7 summarises the number of species of conservation significance in this study. The list of species of conservation significance as well as the locations of specimens belonging to these species are in Appendix B.

The twelve species, though recorded as nationally threatened, are not considered of conservation significance in this study because they are most likely escapees from present-day cultivation and/or relics that had persisted from past cultivation. These species are (1) *Aphanamixis polystachya*, (2) *Archidendron jiringa*, (3) *Baccaurea motleyana*, (4) *Bouea oppositifolia*, (5) *Epipremnum pinnatum*, (6) *Gnetum gnemon* var. *gnemon*, (7) *Mangifera odorata*, (8) *Nephelium lappaceum*, (9) *Sterculia cordata*, (10) *Sterculia parviflora*, (11) *Syzygium myrtifolium*, and (12) *Syzygium polyanthum* (Table 7-7; Appendix B).

Of the 16 species considered of conservation significance, nine are not cultivated locally, which implies that they belong to the local native genetic stock. They are (1) *Agelaea macrophylla*, (2) *Alsophila latebrosa*, (3) *Amphineuron opulentum*, (4) *Cayratia trifolia*, (5) *Lygodium* cf. *circinnatum*, (6) *Connarus semidecandrus*, (7) *Limacia scandens*, (8) *Oxyceros longiflorus*, and (9) *Premna serratifolia*.

The other seven species considered of conservation significance, though also cultivated locally, are namely (1) *Ardisia elliptica*, (2) *Calophyllum inophyllum*, (3) *Centotheca lappacea*, (4) *Clerodendrum villosum*, (5) *Hoya diversifolia*, (6) *Litsea firma*, and (7) *Planchonella obovata*.

Table 7-7: Number of Plant Species of Conservation Significance.

	VU	EN	CR	EX
Non-cultivated threatened species	6	1	2	0
Cultivated threatened species	3	1	3	0
Total number of species of conservation significance	9	2	5	0

Note: VU – Vulnerable; EN – Endangered; CR – Critically Endangered; EX – Presumed Extinct

Calophyllum inophyllum, listed as critically endangered in Chong et al. (2009), is a native coastal species. Currently, the only known area in Singapore where mature individuals of this species still persist is the natural coastal forest southwest of St. John's Island, where a population was found to be widespread (Hung et al., 2017b). This species is also commonly planted in local streetscapes; we postulate that propagules from cultivated stocks have spread into some secondary forests in Singapore. However, according to the field findings from present floristic surveys, there is some evidence that part of this Study Area used to be a coastal area, but has since become swampy/permanently-inundated and taken over by spontaneous vegetation (Section 7.2.1.1.3). This corroborates historical land use information discussed in Section 4.2 that the Study Area was close to primeval coastal/mangrove forest. We hypothesise that *Calophyllum inophyllum* specimens found in the Study Area could be remnants of the original native population there before human disturbance. The individuals could still be persisting in spite of the

surrounding human developments, such as the construction of the adjacent golf course in Orchid Country Club. Therefore, there is value in exploring ways to conserve them (Figure 7-17).



Figure 7-17: Nationally Critically Endangered *Calophyllum Inophyllum* Aaplings Found along the Edge of the Swampy Area.

Besides *Calophyllum inophyllum*, *Hoya diversifolia* (Figure 7-18 A–B), *Premna serratifolia* (Figure 7-18 C–D), and *Ardisia elliptica* are also coastal native species, listed as nationally critically endangered, vulnerable, and endangered, respectively. *Alsophila latebrosa* (Figure 7-18 E–F), while not a coastal species, has often been observed to grow near streams and in areas with wet/poor-draining soils. This species is nationally vulnerable. Specimens of these species were mostly found along the edges of the swampy area within the Study Area (Figure 7-20). With natural coastal habitats becoming increasingly rare as forests are cleared to make way for development, coastal plant species face the threat of local extinction. Most of the remaining natural undisturbed coastal habitats in Singapore are found on the offshore islands, such as St. John's Island and Pulau Tekukor (Hung et al., 2017a; 2017b).

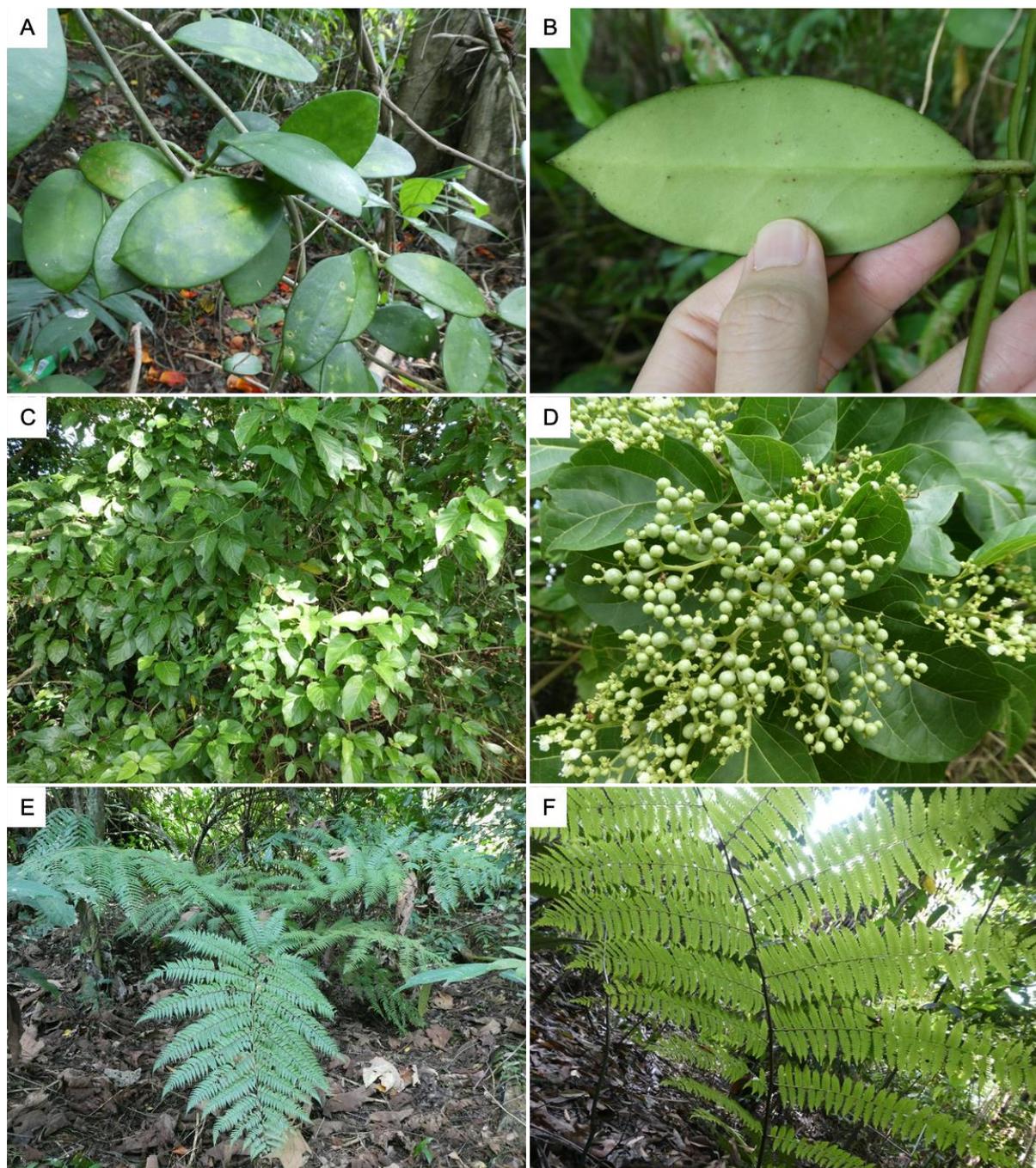


Figure 7-18: Native Threatened Plant Species Associated with Coastal and/or Wet Areas. (A) Critically Endangered Climber *Hoya Diversifolia*; (B) Close-up of a Leaf underside of *Hoya Diversifolia*; (C) Vulnerable Climber *Premna Serratifolia*; (D) Close-up of A Fertile *Premna Serratifolia* Specimen with Fruits and Flowers; (E) Vulnerable Tree Fern *Alsophila Latebrosa*; (F) Frond underside of *Alsophila Latebrosa*.

Other non-coastal native threatened species were also found in the Study Area (Figure 7-20). Specimens belonging to these species were found largely in the southern half of the Study Area. Two specimens of *Agelaea macrophylla* and *Amphineuron opulentum* per species were encountered, while only one of *Connarus semidecandrus* and *Litsea firma* were encountered during the present floristic surveys (Appendix B) (Figure 7-19).

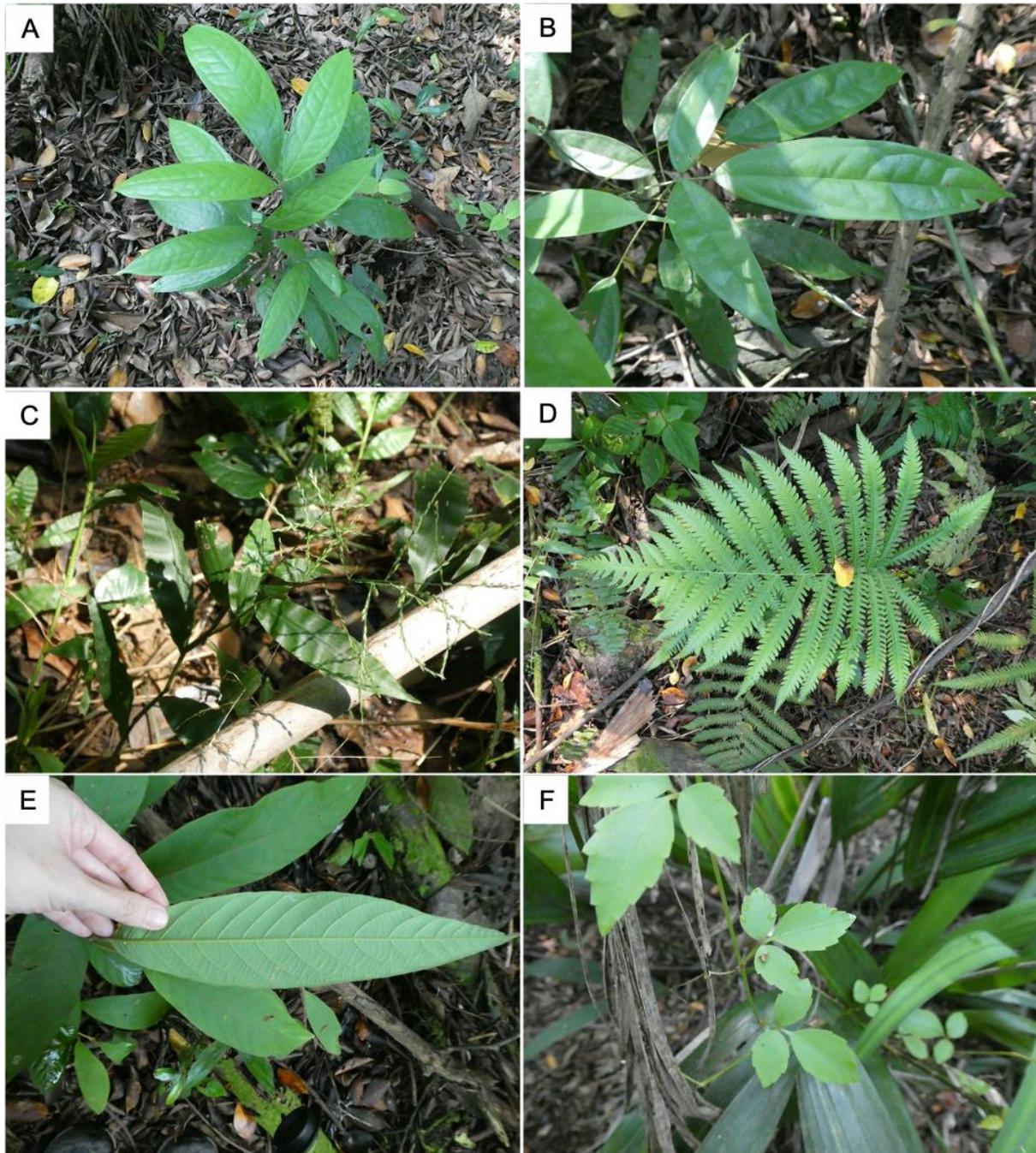


Figure 7-19: Other Nationally Threatened Plant Species. (A) Critically Endangered Climber *Agelaea Macrophylla*; (B) Critically Endangered Climber *Connarus Semidecandrus*; (C) Critically Endangered Grass *Centotheca Lappacea* with Flowering Spikes; (D) Endangered Fern *Amphineuron Opulentum*; (E) Vulnerable Tree Species *Litsea Firma*; (F) Vulnerable Climber *Cayratia Trifolia*.



Legend

Coastal Species
 ▲ Critically Endangered
 ▲ Endangered
 ▲ Vulnerable

Other plant species
 ● Critically Endangered
 ● Endangered
 ● Vulnerable

Stream
 Study Area

Vegetation
 Waste woodland
 Scrubland and herbaceous vegetation
 Scrubland and herbaceous vegetation (swamp)
 Others - farm
 Others - construction site
 Managed vegetation
 Young secondary forest
 Abandoned-land forest

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Qualified Person Endorsement :
NA

HDB Endorsement : NA

Consultant :
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AT YISHUN NEIGHBOURHOOD 5
(MILTONIA)**

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Figure Title :
DISTRIBUTION OF PLANT SPECIMENS OF
CONSERVATION SIGNIFICANCE

Figure No. : 7-20	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

7.2.2.3 Large Plant Specimens

A total of 43 large specimens were encountered, mostly in the southern half of the Study Area (Table 7-8; Figure 7-21; Appendix C). Of these, 21 individuals are large strangling figs of 10–30 m median spread. The largest strangler was the native common *Ficus microcarpa* with a spread of up to 50 m. Other large specimens include 16 trees of 3–5 m girth and six bamboo clusters of 3–10 m spread (Figure 7-22).

Table 7-8: Number of Large Specimens belonging to Each Species.

	Species	No. of specimens
Strangler	<i>Ficus benjamina</i>	1
	<i>Ficus caulocarpa</i>	1
	<i>Ficus microcarpa</i>	19
Tree	<i>Alstonia angustiloba</i>	1
	<i>Durio zibethinus</i>	2
	<i>Falcataria moluccana</i>	8
	<i>Ficus variegata</i>	1
	<i>Mangifera odorata</i>	1
	<i>Michelia alba</i>	1
	<i>Pterocarpus indicus</i>	1
	<i>Spathodea campanulata</i>	1
Bamboo	<i>Bambusa heterostachya</i>	3
	<i>Bambusa vulgaris</i>	3
Total		43



Legend

Large Specimens

- ◆ Tree
- ◆ Strangler
- ◆ Bamboo

Vegetation

- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

Stream

- Stream

Study Area

- Study Area

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Figure Title :
DISTRIBUTION OF LARGE PLANT SPECIMENS

Figure No. : 7-21	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map



Figure 7-22: Some of the Large Plant Specimens Encountered in the Study Area. (A) *Ficus Microcarpa*; (B) *Ficus Benjamina*; (C) *Bambusa Vulgaris*; (D) *Durio Zibethinus*.

7.2.2.4 Other Plant Specimens of Value

Seven other plant specimens of value were recorded in the Study Area (Figure 7-23; Appendix D). Three specimens are *Falcataria moluccana* trees, which are exotic and naturalised, but were observed to each have a raptor nest on it (Figure 7-24). As all three, except one, raptor nests were seen from a distance, it was challenging to estimate tree girth. Locations of these trees were also taken from the position of the observer, which was approximately 50–100 m away from the two nests. These points were then adjusted post-hoc to indicate the approximate locations of the nests on the map (Figure 7-23). It is not known as to whether these nests are actively used by raptors, but raptors are known to nest all year round in Singapore, and these existing nests may be reused given that nest building is comparatively costly (Yong, 2011; Jimenez-Franco et al., 2014). Observations of raptors include a brahmyn kite (*Haliastur indus*) was seen soaring near one of the nests and a changeable hawk-eagle (*Nisaetus cirrhatus*) heard vocalising during floristic surveys. Other observations include a pair of white-bellied sea eagles (*Haliaeetus leucogaster*) during a targeted faunistic survey, and on a separate occasion one individual perched next to a raptor nest.



Legend

Other Specimens of Value

- Raptor nest
- Tree
- Bamboo

Vegetation

- Stream
- Study Area
- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Figure Title :
DISTRIBUTION OF OTHER PLANT SPECIMENS OF VALUE

Figure No. : 7-23	Rev. 05	Sheet 1 of 1
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Note: Source of basemap - Google Earth Map



Figure 7-24: Three Distinct Raptor Nests Seen on *Falcataria Moluccana* Trees at a Distance (Left) and the Corresponding Close-up Photographs of the Nests (Right).

The remaining four other specimens of value are two bamboo clusters of 2 m spread, a *Terminalia catappa* tree of 2.5 m girth, and a durian (*Durio zibethinus*) tree of 2.2 m girth.

The bamboo clusters could be a potential roost site for rare bamboo bats (*Tylonycteris* spp.).

The two other trees appear to have good health with little or no structural defects (Figure 7-25).



Figure 7-25: Other Specimens of Value (A) *Terminalia Catappa*; (B) *Durio Zibethinus*.

7.2.2.5 Community Data Results

Majority of the plant species present in the Study Area was captured via vegetation plot sampling alone. Sample coverage was 88.5% (Figure 7-26), i.e., this proportion of the total number of species in the community belong to those represented in the vegetation plots (Chao & Jost, 2012). Upon extrapolation, i.e., sample sizes were theoretically doubled using the statistical programme, sample coverage increases to 95.0% and species richness increases to 125.82 (the 95% confidence interval is between 109.41 and 142.22). This implies that even with increased survey effort (vegetation plot sampling), a small proportion of plant species in the community, i.e., around 5%, will remain undetected in the vegetation plots.

Hence, to account for undetected species in the plots, species estimators were used to predict the total number of species in the species pool of the Study Area (Table 7-9). Four commonly-used species estimators—namely, Chao, first and second order Jackknife, and Bootstrap—estimated species richness to be between 115.14 and 159.36 (Table 7-9). This was performed using the 'specpool' function in the vegan 2.5-6 package (R Development Core Team, 2016).

Using the 'ChaoRichness' function in the iNEXT 2.0.20 package (R Development Core Team, 2016), total species richness was approximated to be 147.302 ± 20.722 (standard error). The 95% confidence interval is between 120.363 and 206.689.

Table 7-9: Approximate Total Number of Species (\pm the Standard Error) Estimated Using Data from Twenty 10 x 10 m Vegetation Plots, Using Four Commonly-Used Species Estimators.

Estimator	Chao	Jackknife 1	Jackknife 2	Bootstrap
Predicted number of species	144.97 \pm 19.80	136.95 \pm 12.29	159.36	115.14 \pm 6.34

In this study, the recorded total species richness is 171 (Table 7-7). This figure exceeds the number of species predicted using all four estimators, including the two more conservative estimates, i.e., Chao and Jackknife2 (Table 7-9). This could be attributed to the fact that species undetected or absent in the vegetation plots were encountered during general floristic surveys. The recorded species richness, however, falls within the 95% confidence interval for total species richness estimated using the Chao estimator.

The proportion of the number of observed species (171) out of the (higher bound) predicted total number of species (207, to the nearest integer) is 82.6%. This is relatively higher compared to studies in other secondary forests in Singapore by Neo et al. (2012; 2013; 2014). The authors sampled five (Neo et al., 2012), ten (Neo et al., 2013) and five (Neo et al., 2014) 20 x 20 m vegetation plots, which represented only 53%, 54%, and 63%, respectively, of the total number of species present in the respective project sites.

Therefore, comparatively, the combined survey efforts of general floristic surveys and vegetation plot sampling in this present study were adequate in documenting floristic composition of the plant community in the Study Area.

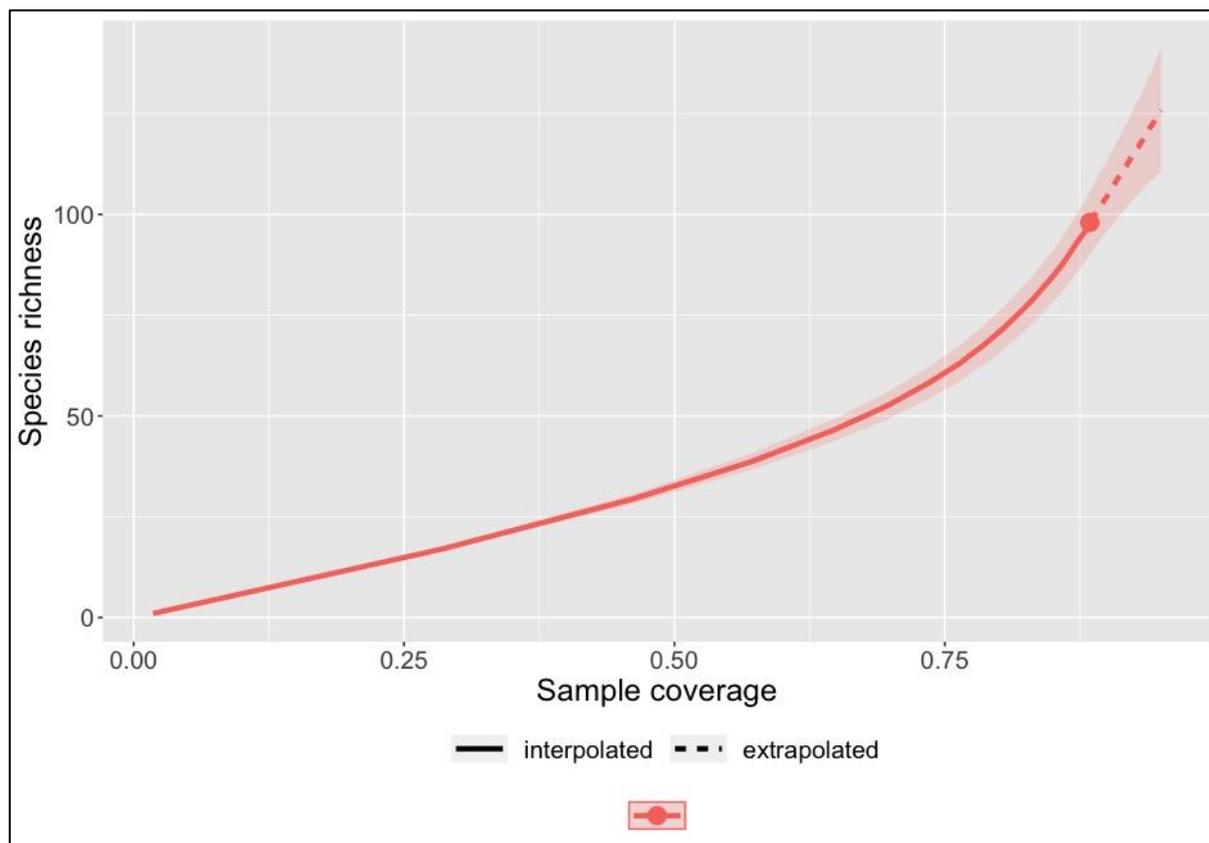


Figure 7-26: Coverage-Based Sampling Curve Using Data from Twenty 10 × 10 m Vegetation Plots.

The NMDS ordination shows that vegetation plots representing abandoned-land forest, young secondary forest, and scrubland and herbaceous vegetation are floristically similar. That of scrubland and herbaceous vegetation (swampy) is the most distinct among the four vegetation types, as indicated by the non-overlapping polygons. Results of the PERMANOVA using Bray–Curtis distance as a measure of dissimilarity indicates that floristic community of scrubland and herbaceous vegetation (swampy) is statistically different from the others (pseudo- $F = 4.0483$; p -value = 0.001) (Table 7-10).

Scrubland and herbaceous vegetation (swampy) are the most species-poor compared to other spontaneous vegetation types (Table 7-5). Within the floristic assemblage of this vegetation type, most (8 out of 13; 61.5%) are exotic species. Even fewer native plant species were recorded from this vegetation type, and no plant species of conservation significance were found there. Most species are capable of adapting to wet conditions (Section 7.2.1.1.3). Although, floristically, the area hosts only a few species, the habitat is still important for some fauna, especially aquatic fauna such as odonates and herpetofauna, some of which could only be found exclusively in the swampy habitats (Section 7.1.6.1.1). Some rare native species recorded there are the nationally critically endangered red-tailed pipe snake (*Cylindrophis ruffus*), and fauna dependent on the habitat for food, such as the buffy fish owl (*Ketupa ketupu*) and smooth-coated otter (*Lutrogale perspicillata*). Given that different parts in Singapore have been safeguarded or used for development, there is value in considering how natural swampy habitats like this may be conserved.

The other three vegetation types have similar floristic composition. In particular, part of the plant composition of scrubland and herbaceous vegetation overlaps with that of abandoned-land forest (Figure 7-27). This could be because most of the open scrubland patches are adjacent to the forested areas. Some of the propagules may be dispersing from the forested areas to the adjacent scrublands. Considering that majority of the spontaneous vegetation presently found in Singapore are secondary forests (Yee et al., 2011), these patches in the Study Area have some conservation value. If left undisturbed, the forest would slowly regenerate as seedling dispersals and recruitment take place, among many other ecological processes. The forest also serves as important refugia for forest-dependent animal species within the larger urban-dominated landscape in Singapore (Corlett, 1997), in addition to other ecosystem functions and services it provides.

Table 7-10: Results of Permutational Multivariate Analysis of Variance (PERMANOVA) comparing Floristic Composition among Habitat Types.

Terms	df	pseudo-F	R ²	p-value
Habitat	3	4.0482	0.43151	0.001
Residuals	16	–	0.56849	–

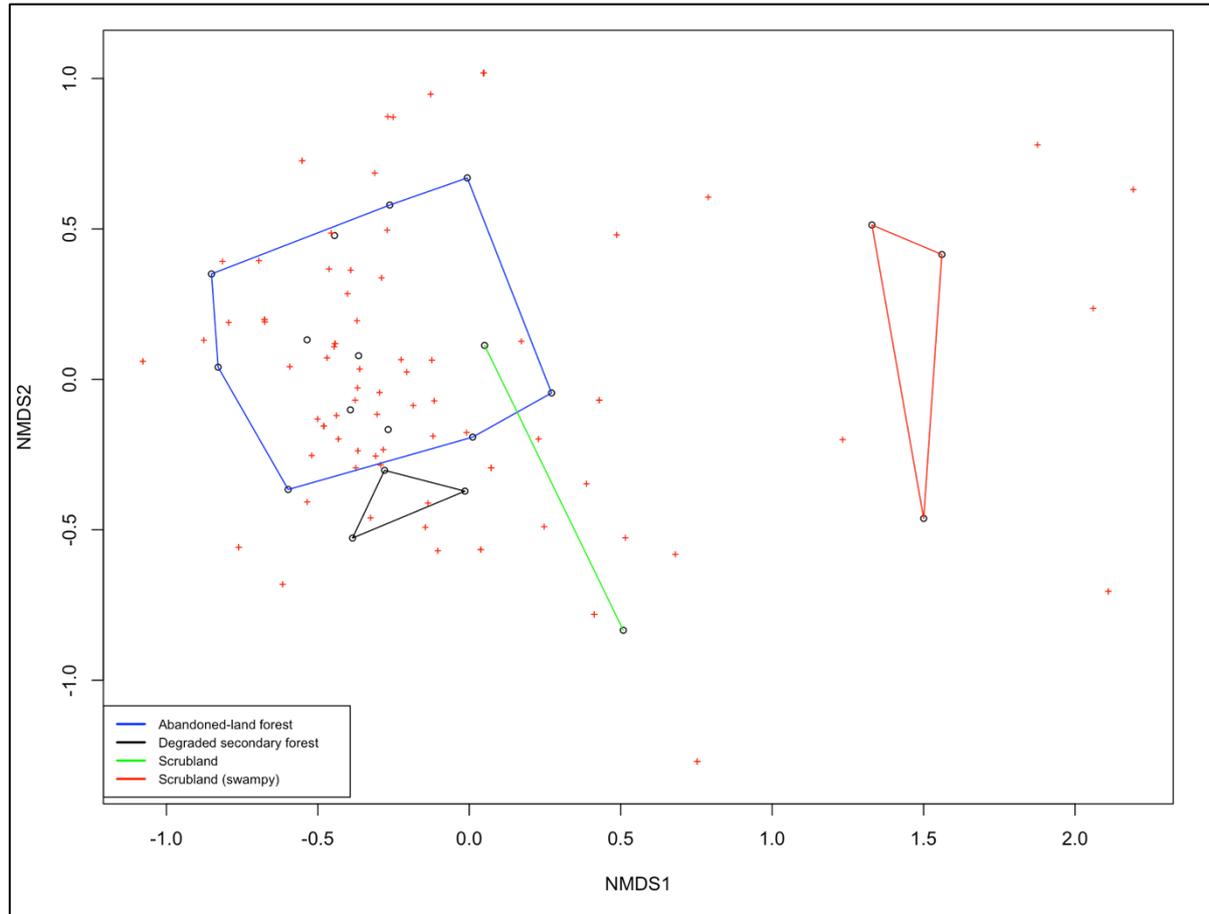


Figure 7-27: NMDS Ordination of the 20 Vegetation Plots (open circles) Based on Species Composition. Red Crosses Represent the Plant Species Found in the Plots. (Stress value = 0.16, k = 2.)

7.2.2.6 Forest Regeneration

In this analysis, the girth of specimens with multiple stems was taken to be that of its largest stem. In view of this, large strangling figs were excluded in the count analysis as a single strangler has several woody aerial roots of ≥ 0.5 m girth; it would be imprecise to record the girth (spread) of a large strangler that lies partially within a vegetation plot as that of the thickest woody aerial root. Given the large spread of most of the stranglers found in the Study Area, it is more appropriate to document count and spread of stranglers recorded during general floristic surveys, as opposed to vegetation plot sampling. This is discussed in Section 7.2.2.3 and recorded in Appendix C.

Within the vegetation plots, there were 31 specimens of ≥ 0.5 m girth belonging to 14 species (excluding strangling fig species) (Figure 7-28) and 750 specimens of ≤ 0.4 m girth belonging to 43 species (Figure 7-30). The top five and ten most abundant species in these two broad girth-size classes— ≥ 0.5 m girth and ≤ 0.4 m girth, respectively—are listed in descending order in Table 7-11. Only the top five most abundant species in the larger girth-size class were listed as nine out of the 14 species only had one specimen each (Figure 7-28). Both girth-size classes were further divided; trends in diameter frequency distribution for all 14 species (for ≥ 0.5 m girth-size class) and the top ten most abundant species (for ≤ 0.4 m girth-size class) are shown in Figure 7-29 and Figure 7-31, respectively.

Table 7-11: The Top Five and Ten Most Abundant Species Ranked in Descending Order for Specimens of ≥ 0.5 m and ≤ 0.4 m Girth, Respectively.

S/N	Trees of ≥ 0.5 m girth	Trees of ≤ 0.4 m girth
1.	<i>Cinnamomum iners</i>	<i>Cinnamomum iners</i>
2.	<i>Elaeis guineensis</i>	<i>Adenanthera pavonina</i>
3.	<i>Nephelium lappaceum</i>	<i>Syzygium polyanthum</i>
4.	<i>Spathodea campanulata</i>	<i>Dillenia suffruticosa</i>
5.	<i>Acacia auriculiformis</i>	<i>Nephelium lappaceum</i>
6.	–	<i>Caryota mitis</i>
7.	–	<i>Gnetum gnemon</i> var. <i>gnemon</i>
8.	–	<i>Syzygium grande</i>
9.	–	<i>Clausena excavata</i>
10.	–	<i>Syzygium lineatum</i>

Most of the very large trees—i.e., 1.5 m girth or larger—belong to, in descending order, *Elaeis guineensis*, *Spathodea campanulata*, and *Nephelium lappaceum* (Figure 7-29). *Nephelium lappaceum*, commonly known as Rambutan, is listed as nationally critically endangered (Chong et al., 2009), but it is likely to have persisted from past cultivation. *Elaeis guineensis*, commonly known as oil palm, is also a crop plant species. On the other hand, *Spathodea campanulata* was cultivated in the past as an ornamental plant. Nevertheless, all three species that have very large specimens present in the Study Area can be considered as crop plants. This result corroborates vegetation distribution findings that majority of this forest belong to the abandoned-land forest sub-type (Section 7.2.1); forests that have regenerated from land previously used for plantations or orchards, but were abandoned, are expected to have mature trees still largely intact (Yee et al., 2016).

Cinnamomum iners, though ranked as the species with the highest number of large specimens (Table 7-11), has mostly trees in the lower range within the large girth-size class, i.e. 0.5–0.9 m (Figure 7-29). Albeit having relatively smaller trees than the other species, *Cinnamomum iners* appears to display the highest recruitment of seedlings and saplings. It is the only species with stem counts exceeding 100. Up to 163 specimens belonging to this species were encountered, majority (98.2%) of which have ≤ 0.2 m girth (Figure 7-31). This is a common native species. Only one out of the ten most abundant species in the ≤ 0.4 m girth-size class is exotic, i.e., the naturalised *Adenanthera pavonina*. All other nine species are native, though a few are/were cultivated locally, such as *Syzygium polyanthum* and *Gnetum gnemon* var. *gnemon*. All ten species generally exhibit a typical reverse-J distribution pattern, indicating a high recruitment of small trees.

The presence of large *Cinnamomum iners* and *Nephelium lappaceum* trees could act as potential seed sources in the forest, thus explaining the higher number of seedlings of these species found in the understory. The absence of large trees within the vegetation plots for the other species with high seedling recruitment does not imply that they are not present in the Study Area; rather, they may have been opportunistically missed out with random plot sampling. A second possible explanation for the high seedling recruitment for other species which did not record any large trees in the vegetation plots could be attributed to the proximity of the Study Area to larger forest patches, such as the Khatib Bongsu Nature Park to its north, which provides a nearby seed source for the arrival of propagules.

Having a high occurrence of native seedlings in the understory positively suggests that should they successfully outcompete the exotic seedlings when there are forest canopy openings, e.g., from natural tree falls, the forest may slowly regenerate into a native secondary forest over time if left undisturbed.

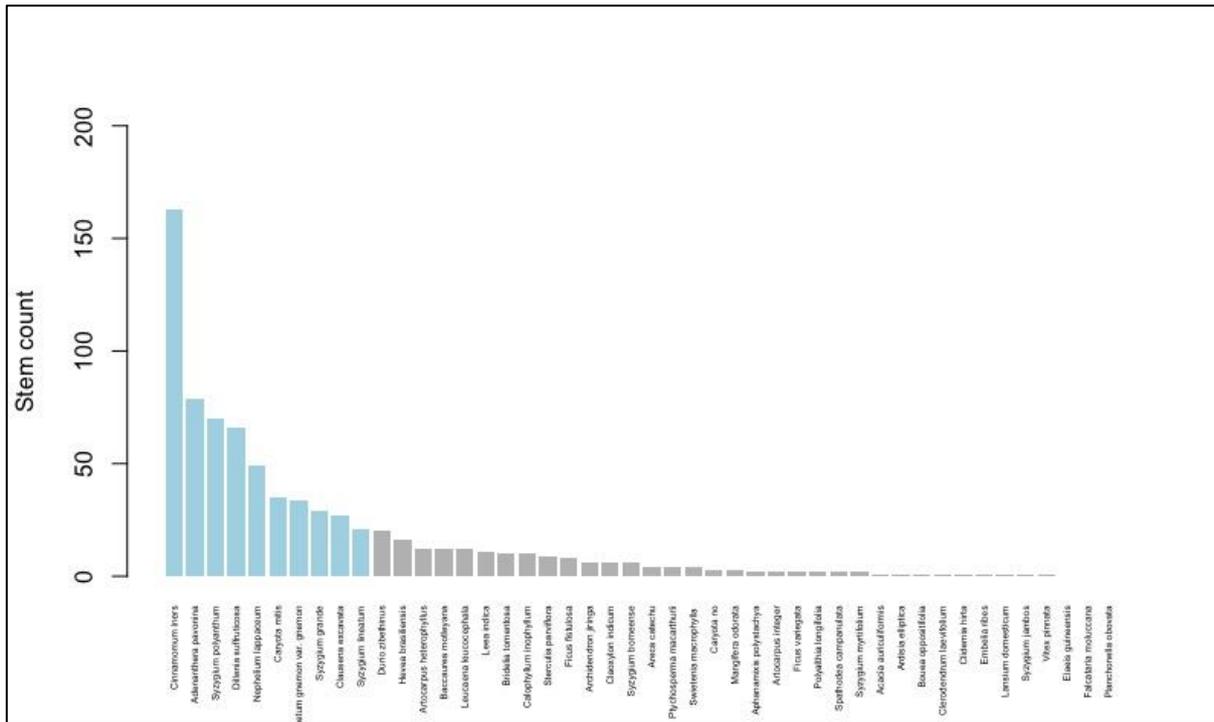


Figure 7-30: Number of Specimens with ≤ 0.4 m Girth for Each Species across all Vegetation Plots. (Bars in light blue belong to the ten most abundant species.)

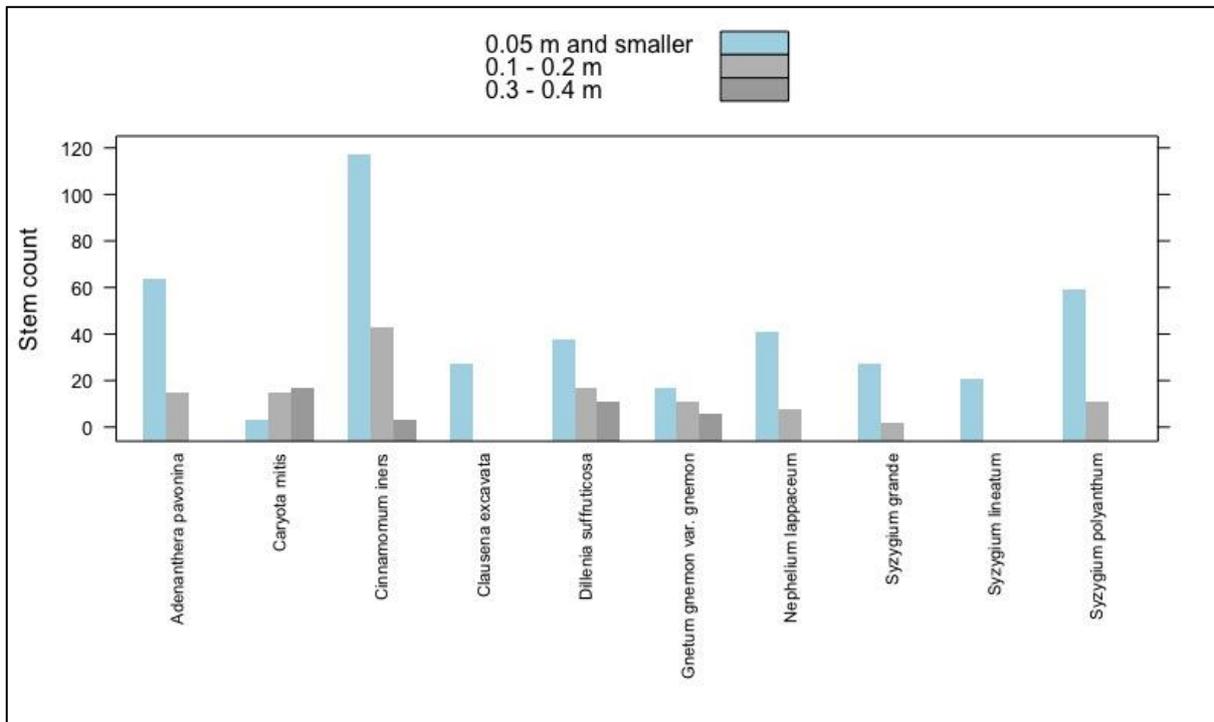


Figure 7-31: Girth-Size Class Distribution of the Ten Most Abundant Species with Trees of ≤ 0.4 m Girth.

7.2.3 Faunistic Baseline Results

7.2.3.1 Desktop Assessment Results

Based on the desktop assessment, 431 species of probable occurrence were identified for the Study Area. These comprise mainly birds (160 species) and butterflies (149 species) (Table 7-12; Appendix E). A total of 38 species

are of conservation significance, dominated by birds (19 species) and butterflies (13 species) (Table 7-14). The list of fauna species of conservation is shown in Appendix F.

Table 7-12: Number of Species of Probable Occurrence for Each Taxon Based on Desktop Assessment.

Taxon	Total number of extant species in Singapore	Total number of probable species (number of species of conservation significance)
Odonates	133	38 (0)
Dragonflies	83	33 (0)
Damselflies	50	5 (0)
Butterflies	341	149 (13)
Molluscs	≥ 84	Insufficient data
Freshwater decapod crustaceans	≥ 26	2 (0)
Freshwater fish	≥ 111	20 (0)
Herpetofauna	172	41 (3)
Amphibians	33	13 (0)
Reptiles	139	28 (3)
Birds	442	160 (19)
Mammals	75	21 (3)
Non-volant mammals	45	12 (1)
Bats	30	9 (2)
Total	> 1,384	431 (38)

7.2.3.2 Field Assessment Results

In the targeted field surveys, the field assessment recorded a total of 142 species, including three genus-level and one family-level identifications. (Table 7-14; Appendix E). An additional 10 species were observed incidentally, and one was observed from point counts and camera trapping each, bringing the total number of observed species to 153. This confirms 35.49% of the 431 species of probable occurrence on site.

The majority of the species observed on site are able to thrive in degraded habitat conditions, which explains why the highest numbers of species (23 to 38 species) were found along the edge of the Study Area in managed and scrubland habitat (T1_17 to T2_10; Figure 7-32). Some of the most common urban species in the Study Area include birds such as the red-breasted parakeet (*Psittacula alexandri*), dragonflies such as the common scarlet (*Crocothemis servilia*), and butterflies such as the painted jezebel (*Delias hyparete metarete*). High species richness was also observed in the young secondary forest (T1_01 and T1_02), contributed mainly by birds (Figure 7-32). Uncommon bird species that were only observed in the young secondary forest include the blue-winged pitta (*Pitta moluccensis*), a migrant bird. More aquatic species were found close to the canal in A1 compared to near the golf course in A2 (Figure 7-32). This was because more dragonflies were observed in A1 while only one species, the common parasol (*Neurothemis fluctuans*), was observed along A2. The same number of damselfly species were observed in A1 and A2.

The field assessment, together with point counts, camera trapping, and incidental observations, recorded 11 species of local and/or global conservation significance, comprising one reptile, one non-volant mammal, one bat,

one butterfly, and seven birds. (Appendix E). The locations of species of conservation significance are shown in Figure 7-33.

Species richness estimates based on Chao et al. (2012) were calculated for all recorded species from VES and they show a relatively complete sampling coverage for all taxa surveyed; the total sampling effort for all targeted terrestrial fauna achieved a 94.20% sample coverage while the sampling effort for all targeted aquatic fauna achieved a 74.14% sample coverage (Table 7-13). The sampling coverage for damselflies, molluscs, and bats are not included because there were none or too few observed species to produce an accurate sampling coverage. The total true species richness is estimated to be between 169 to 210 species, suggesting that the field assessment has documented most of the fauna species on site in this baseline study (Table 7-13).

Table 7-13: Total Number of Faunal Species Recorded, Sampling Coverage, and Estimated True Fauna Species Richness.

Terrestrial faunal group	Recorded	n	Estimated true species richness	Sampling coverage (%)
Terrestrial sampling routes				
Amphibians	9	18	9.94 ± 1.78	95.41
Bats	5	18	5.94 ± 2.09	94.74
Birds	60	30	67.73 ± 5.86	96.86
Butterflies	28	26	41.85 ± 10.78	85.30
Molluscs	9	25	11.88 ± 4.31	96.49
Non-volant mammals	6	19	10.26 ± 6.832	87.42
Odonates	9	16	11.11 ± 3.2	90.82
Reptiles	6	13	8.77 ± 4.10	85.43
Aquatic Sampling Points				
Amphibians	2	2	2.25 ± 0.75	88.89
Decapod crustaceans	0	0	-	-
Freshwater fish	5	4	7.25 ± 3.35	77.50
Molluscs	1	1	-	-
Odonates	8	4	9.13 ± 1.80	88.00
Reptiles	2	1	-	-
Camera trapping				
Mammals	6	96	6.99 ± 2.20	98.80

Note: The number of sampling units (n) refers to the number of terrestrial points for terrestrial sampling routes, aquatic sampling points, and trap nights for camera trapping with species records. Values for estimated true species richness represent ± standard error. Incidental records are excluded.

Table 7-14: Number of Recorded Species for Each Taxon.

Taxon	Total number of recorded species (number of species of conservation significance)	Total number of recorded species not on probable list
Odonates	14 (0)	0

Dragonflies	10 (0)	1
Damselflies	4 (0)	0
Butterflies	32 (1)	0
Molluscs	10 (0)	-
Decapod crustaceans	0 (0)	0
Fish	6 (0)	0
Herpetofauna	17 (1)	0
Amphibians	9 (0)	0
Reptiles	8 (1)	0
Birds	63 (7)	0
Mammals	11 (2)	0
Non-volant Mammals	7 (1)	0
Bats	5 (1)	0
Total	142 (11)	1



Legend

Species Richness (Aquatic Routes)

- 1 (White diamond)
- 7 (Light blue diamond)
- 9 (Blue diamond)
- 11 (Dark blue diamond)

Aquatic Routes

- A1 (Blue line)
- A2 (Dark blue line)

Species Richness (Terrestrial Routes)

- 1-8 (Yellow circle)
- 9-15 (Orange circle)
- 16-23 (Red-orange circle)
- 24-30 (Red circle)
- 31-38 (Dark red circle)

Terrestrial Routes

- T1 (Orange line)
- T2 (Red line)

Vegetation

- Waste woodland (Light green)
- Scrubland and herbaceous vegetation (Yellow-green)
- Scrubland and herbaceous vegetation (swamp) (Light yellow)
- Others - farm (Light blue)
- Others - construction site (Light purple)
- Managed vegetation (Light green)
- Young secondary forest (Dark green)
- Abandoned-land forest (Light green)

Canal (Grey line)

Stream (Blue line)

Study Area (Red outline)

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Figure Title : **TOTAL FAUNAL SPECIES RICHNESS DISTRIBUTION ALONG TERRESTRIAL AND AQUATIC ROUTES**

Figure No. : 7-32

Rev. 05

Sheet 1 of 1

CAD File Name : NA

A3

Note: Source of basemap - Google Earth Map



Legend

Fauna of conservation significance

- Bat
- Bird
- Non-volant mammal
- Reptile

Aquatic Routes

- A1
- A2

Terrestrial Routes

- T1
- T2

Canal

- Canal
- Stream

Study Area

- Study Area

Vegetation

- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
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AT YISHUN NEIGHBOURHOOD 5
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Figure Title :
LOCATIONS OF FAUNA OF CONSERVATION SIGNIFICANCE

Figure No. : 7-33	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

7.2.3.2.1 Odonates

Thirty-eight odonate species were determined to be of probable occurrence in the Study Area (Table 7-12; Appendix E). The Study Area is expected to support a moderate number of odonate species because of the presence of a large swamp habitat and permanent freshwater stream that runs through its centre. This assemblage of probable species was identified by their locally widespread and relatively common distribution and tolerance for disturbed and open habitats, since the Study Area is largely comprised of herbaceous vegetation and scrubland as well as degraded forest patches. Thirteen of these probable species were observed within the site, confirming the presence of 34.21% of all odonates of probable occurrence in the site (Table 7-14; Appendix E). An additional species not of probable occurrence, the dingy duskhawker (*Gynacantha subinterrupta*), was observed during the field assessment (Figure 7-34). This brings the total number of observed odonates to 10 dragonflies and four damselflies, of which none are of conservation significance. The dingy duskhawker (*G. subinterrupta*) is not determined to be a species of probable occurrence because it typically inhabits forested areas and is uncommon in Singapore. This individual may have therefore originated from the larger forested patch along the nearby Seletar Reservoir.

Given the low number of odonates observed on site, few odonate species are similarly observed at any one location. However, more species were observed in certain areas of the Study Area, namely the freshwater swamp where four dragonflies were observed at each sampling point (A1_01 and A1_02) as well as the managed vegetation and scrubland that lines its southwestern boundary (T2_03 to T2_05 and T2_07 to T2_11) where two to three odonate species were observed at every sampling point (Figure 7-35). The common bluetail (*Ischnura senegalensis*) seemed to be the most commonly encountered damselfly, while the common scarlet (*Crocothemis servilia*), common parasol (*Neurothemis fluctuans*), and dancing dropwing (*Trithemis pallidinervis*) were the most common dragonfly observations and were also abundant as 10 or more individuals of each species were occasionally observed at one spot (Appendix H). While the common scarlet (*C. servilia*) and common parasol (*N. fluctuans*) are very common and widespread, the dancing dropwing (*T. pallidinervis*) is widespread but uncommon. Its abundance in the Study Area may be attributed to its propensity for open and grassy areas close to coastal habitats, which the current Study Area is characterised by.

The sampling effort for odonates observed along the terrestrial routes achieved 90.82% of the sample coverage and the true species richness is estimated to be between eight to 15 species (Table 7-13; Figure 7-36). The sampling effort for odonates observed along aquatic routes achieved a similar sample coverage of 88.00% and the estimated true species richness is between eight to 11 species. This suggests that the field assessment has managed to document most of the odonates on site.



Figure 7-34: An Incidental Observation of the Dingy Duskhawker (*Gynacantha Subinterrupta*) within the Study Area.



Legend

<p>Odonate Species Richness (Aquatic Routes)</p> <ul style="list-style-type: none"> ◇ 1 ◇ 3 ◇ 5 ◇ 6 <p>Aquatic Routes</p> <ul style="list-style-type: none"> A1 A2 	<p>Odonate Species Richness (Terrestrial Routes)</p> <ul style="list-style-type: none"> ● 0 ● 1 ● 2 ● 3 <p>Terrestrial Routes</p> <ul style="list-style-type: none"> T1 T2 	<p>Canal</p> <p>Stream</p> <p>Study Area</p> <p>Vegetation</p> <ul style="list-style-type: none"> Waste woodland Scrubland and herbaceous vegetation Scrubland and herbaceous vegetation (swamp) Others - farm Others - construction site Managed vegetation Young secondary forest Abandoned-land forest
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Figure Title : **ODONATE SPECIES RICHNESS DISTRIBUTION ALONG TERRESTRIAL AND AQUATIC ROUTES**

Figure No. : 7-35	Rev. 05	Sheet 1 of 1
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Note: Source of basemap - Google Earth Map

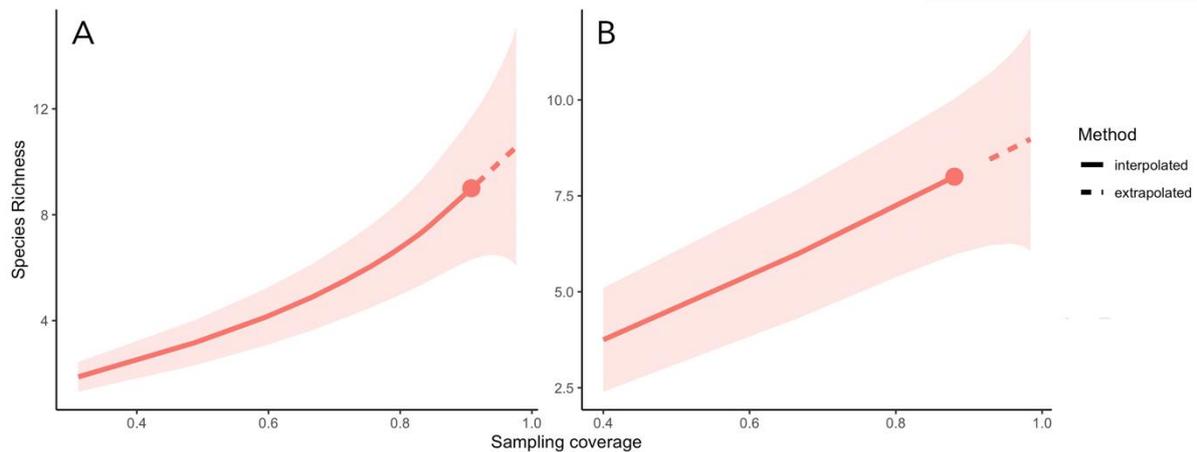


Figure 7-36: Coverage-based Rarefaction Curves for Odonates along the (A) Terrestrial Routes and (B) Aquatic Routes.

7.2.3.2.2 Butterflies

Based on the presence of suitable habitat conditions, 149 species were deemed of probable occurrence within the Study Area, including 13 locally conservation significant species (Table 7-13; Appendix E). Most of these species were included because they are common and because of their locally widespread distribution. This includes seven of the conservation significant butterflies, which are considered moderately common in Singapore.

A total of 32 species, all of probable occurrence, were recorded in the field assessment, confirming the presence of 21.48% of all butterflies of probable occurrence in the site (Appendix E). One species—the forest hopper (*Astictopterus jama jama*)—is of conservation significance (Table 7-13; Figure 7-37). Although it is listed as nationally Extinct in the Singapore Red Data Book (Davison et al., 2008), Jain et al. (2018) states that it has been rediscovered from extinction. Its accorded status in the Singapore Red Data Book is likely a result of confusion in field identification, and thus may not be of true conservation significance. The locations of the observations of the forest hopper (*A. jama jama*) is shown in Figure 7-38.

The butterflies on-site appeared to have a greater association with open habitats, as the highest butterfly species richness (six to seven species) was found along the canal and within the swampy scrubland (T1_12, T1_13) as well as along the study boundary at managed vegetation and scrubland (T1_16, T1_17, T2_02 to T2_04, T2_07, T2_08; Figure 7-38). On the other hand, zero to one species was observed along most of the young secondary forest (Figure 7-38). The most common species found repeatedly throughout the site were the painted jezebel (*Delias hyparete metarete*) and grass yellow species (*Eurema* spp.), which are sun-loving and can be found in a variety of habitats, from the forested areas of nature reserves to urban areas such as parks and gardens.

The sampling effort for butterflies achieved 85.30% of the sample coverage and the true estimate species is between 32 to 52 species, suggesting that the field assessment has managed to document many of the butterflies on site in this baseline study (Table 7-13; Figure 7-39)



Figure 7-37: Forest Hopper (*Astictopterus Jama Jama*) Recorded during Field Surveys.



Legend

Butterfly Species Richness (Terrestrial Routes)

- 0
- 1 - 3
- 4 - 5
- 6 - 7

Terrestrial Routes

- T1
- T2

Forest hopper

Canal

Stream

Study Area

Vegetation

- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Figure Title : BUTTERFLY SPECIES RICHNESS DISTRIBUTION ALONG TERRESTRIAL ROUTES, AS WELL AS LOCATIONS OF SPECIES OF CONSERVATION SIGNIFICANCE

Figure No. : 7-38, Rev. 05, Sheet 1 of 1

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Note: Source of basemap - Google Earth Map

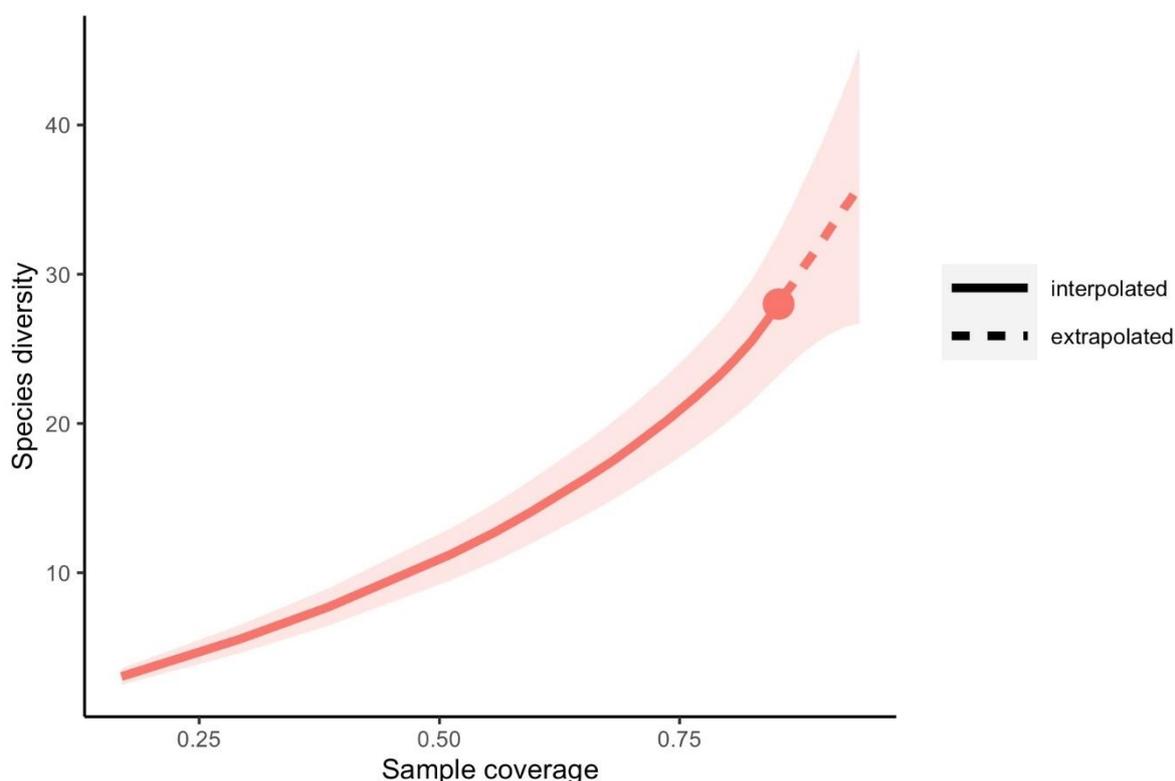


Figure 7-39: Coverage-Based Rarefaction Curve for Butterflies.

7.2.3.2.3 Molluscs

As there is insufficient literature on the distribution of non-marine snails in Singapore, a probable species list was not generated in this study.

Ten species of molluscs were recorded, comprising three native species, three non-native species, three indeterminate species and one family-level identification (Lymnaeidae) (Table 7-14; Appendix E). With the exception of *Physastra sumatrana* which was observed only within the stream, all of these snails were observed terrestrially. Due to inadequate literature, all observed molluscs have not been assessed on their conservation status. However, these molluscs are shown to be relatively common and widespread, and some are even highly invasive, such as the giant African land snail (*Achatina fulica*) (Tan & Tan, 2003) *P. sumatrana*, although listed to be of indeterminate origin in Tan et al. (2012), is also potentially an introduced invasive species (Ng et al., 2015). Lim et al. (2018) and Tan et al. (2015) reported that all three observed native molluscs are common and can be found in urban areas or parks and gardens, suggesting that they may be of low conservation value. Figure 7-40 depicts some of the molluscs observed in the Study Area during the field assessment.

The highest concentration of molluscs was found within the young secondary forest and swampy scrubland (T1_02, T1_06, T1_07, T1_13). The giant African land snail (*A. fulica*), luminescent land snail (*Quantula striata*), and *Sarika resplendens* were the most pervasive, occurring throughout the entire Study Area (Figure 7-41). *P. sumatrana* was only observed on the surface of the stream in the swampy scrubland (A1_01, A1_02), but they were highly abundant and were too excessive in numbers to count (Figure 7-41). This may be attributed to their highly invasive nature that has been elaborated on by Ng et al. (2015).

The sampling effort for molluscs achieved 95.31% of the sample coverage, suggesting that the field assessment has documented the majority of molluscs on site (Table 7-13; Figure 7-42). The true species richness is estimated to be between ten to 22 species.



Figure 7-40: Some of the Molluscs Observed. (A) *Quantula Striata* (B) *Sarika Resplendens* (C) *Parmarion Martensi* (D) *Bradybaena Similaris* (E) *Achatina Fulica* (F) *Laevicaulis Alte*.

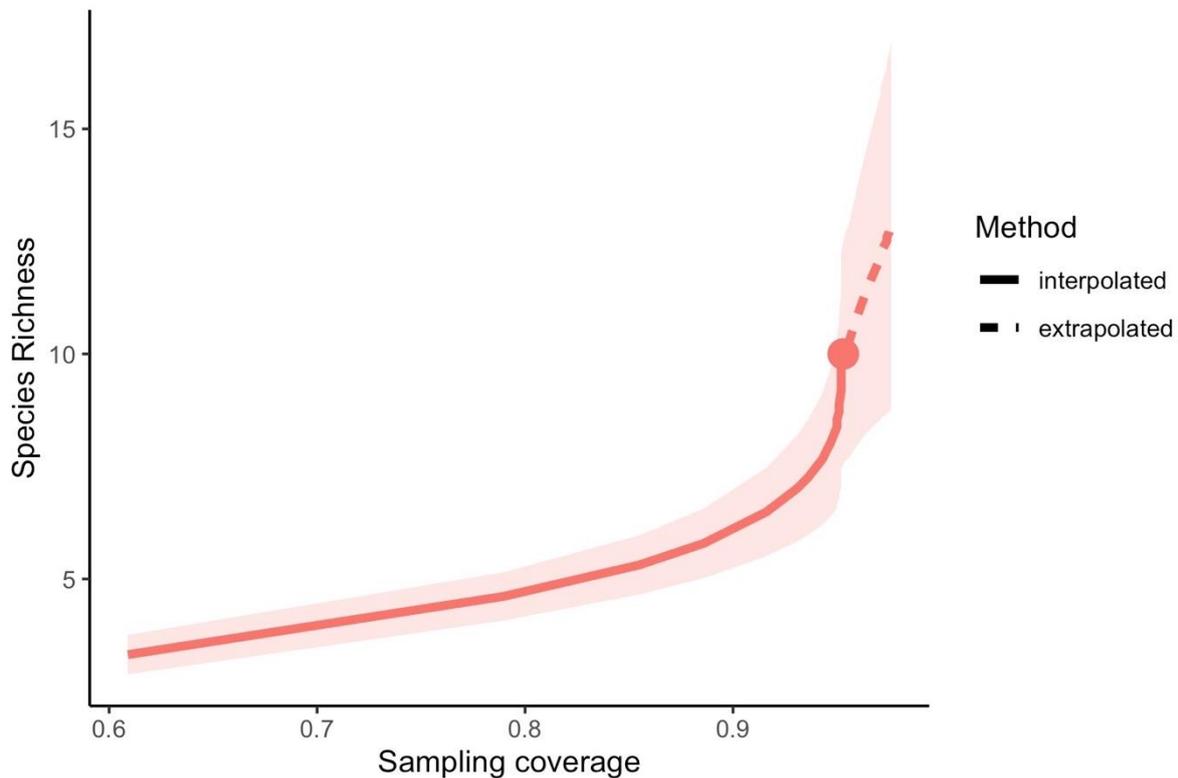


Figure 7-42: Coverage-Based Rarefaction Curve for Molluscs.

7.2.3.2.4 Decapod Crustaceans

Only two decapod crustacean species were of probable occurrence based on the presence of suitable habitats (Table 7-12; Appendix E). Majority of the species found in Singapore are predominantly aquatic and require fast-flowing oxygenated waters. As a result of their stenotopic requirements for elevated streams, they are generally found in isolated waterways with very restricted distribution. Additionally, some require a marine/estuarine phase for their larval stage and the lack of connectivity to marine habitats would preclude their presence at the Study Area.

No decapod crustaceans were detected through the field assessment (Table 7-14).

7.2.3.2.5 Fish

The desktop assessment identified 20 species of probable occurrence (Table 7-12; Appendix E). The species of probable occurrence consist mainly of common and introduced species that are relatively tolerant to disturbances such as the whitespot (*Aplocheilichthys armatus*) and species from the family Poeciliidae – guppy (*Poecilia reticulata*), common molly (*Poecilia sphenops*) and mosquitofish (*Gambusia affinis*). These species can reside in a range of environments ranging from poorly oxygenated freshwaters to hypersaline waters, and from pockets of water to ditches and vegetated canals (Ng et al., 2018).

A total of six species were recorded (Table 7-14), half of which were introduced species. The presence of introduced species such as the guppy (*P. reticulata*), carp (*Cyprinus carpio*), and Indochinese spotted barb (*Barbodes rhombeus*) is likely the result of deliberate introduction on-site or off-site due to the aquarium trade and mosquito control purposes (Ho et al., 2016; Lim, 1995).

The three native species recorded, namely the oriental climbing perch (*Anabas testudineus*), common snakehead (*Channa striata*) and threespot gouramy (*Trichopodus trichopterus*), are all common and widely distributed in Singapore. The presence of the common snakehead suggests it is the main piscine predator in the Study Area. Although the threespot gouramy is considered native to Singapore, various artificial colour varieties are widely sold in the aquarium trade (Low & Lim, 2012). Of notable interest is their ability to breathe air using a specialised auxiliary respiratory organ, making them highly tolerant of hypoxic conditions.

Fish were observed at all aquatic sampling points, but only incidentally at the point closest to the outlet of the stream (A2_01). Guppies (*P. reticulata*) were the most common and were found on both ends of the stream (A1 and A2), suggestive of their prolificity. Both ends of the stream support a similar community of fish, but the oriental climbing perch (*A. testudineus*) was observed several times only along A1. This may have simply been due to the depth and low water transparency of the pond along A2, which made it difficult to observe fish that were not close to the surface.

The sampling effort for freshwater fish achieved 77.50% of the sample coverage, suggesting that the field assessment has managed to document the majority of freshwater fish on site (estimated true species richness is estimated to be between five to 11 species) in this baseline study. The coverage-based rarefaction curve for freshwater fish was not included in the report because the fish species recorded in the Study Area was too low.



Legend

Fish Species Richness (Aquatic Routes)

- ◊ 0
- ◊ 1
- ◊ 3
- ◊ 4

Aquatic Routes

- A1
- A2

Vegetation

- Canal
- Stream
- Study Area
- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Figure Title : **FRESHWATER FISH SPECIES RICHNESS DISTRIBUTION ALONG AQUATIC ROUTES**

Figure No. : 7-43	Rev. 05	Sheet 1 of 1
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Note: Source of basemap - Google Earth Map

7.2.3.2.6 Herpetofauna

Forty-one species comprising 13 amphibians and 28 reptiles (three turtles, 10 lizards and 15 snakes) were identified to be of probable occurrence (Table 7-12; Appendix E). Widespread and common amphibians and reptiles constitute most of the species of probable occurrence within the site. For instance, amphibians that are expected to be in the Study Area are mainly species that can thrive and breed in disturbed habitats with temporary pools of poor water quality (Bickford et al., 2010; Baker & Lim, 2012). Nevertheless, forest-dependent species such as the Malayan giant frog (*Limnonectes blythii*) are also expected to occur within the site, as the presence of a freshwater stream serves as an important breeding ground for these species.

Similarly, many reptiles of probable occurrence are able to tolerate relatively degraded habitats and can be found in urban areas, such as the reticulated python (*Malayopython reticulatus*), changeable lizard (*Calotes versicolor*), and the spiny-tailed house gecko (*Hemidactylus frenatus*). Besides common species, certain rarer and locally conservation significant reptiles are also expected to occur within the Study Area, including the critically endangered red-tailed pipe snake (*Cylindrophis ruffus*) and the puff-faced water snake (*Homalopsis buccata*). This is because the freshwater stream in the Study Area is connected to Lower Seletar Reservoir, the outlet for Nee Soon Swamp Forest (NSSF). NSSF is characterised by a swamp habitat with shaded acidic streams of waters around pH 5 (Ng & Lim 1992), and while the stark difference in the aquatic environments between NSSF and the warmer and more open waters of Lower Seletar Reservoir and Yishun keep their aquatic communities distinct, there is still a possibility of species movement between the two sites. This makes good swimmers typically associated to the freshwater swamp of NSSF such as the red-tailed pipe snake (*C. ruffus*) and puff-faced water snake (*H. buccata*) probable species in the Study Area.

The field assessment recorded 17 species comprising nine amphibians and eight reptiles (two turtles, four lizards and two snakes), confirming the presence of 41.46% of all herpetofauna of probable occurrence (Table 7-14; Figure 7-45; Appendix E). This includes the first record in history of a red-tailed pipe snake carcass (*C. ruffus*) in the Study Area. Figure 7-44 shows the carcass that was observed. This is an extremely rare finding, because there have only been three reported local records of the red-tailed pipe snake (*C. ruffus*) after 1929 – Singapore Science Centre (Lim and Lee, 1989), a roadkill at Choa Chu Kang Road (Lim, 1993), and another roadkill on Island Club Country Road (Lim et al., 1995). There are no known hotspots for this species. However, the red-tailed pipe snake is assumed to be an inhabitant of the Study Area because it was found in the freshwater stream surrounded by a swamp (A1_02, Figure 7-45), which is a habitat it is known to prefer (Kupfer et al., 2003).

Herpetofauna of the Study Area appeared to prefer open habitats, as the highest concentration of both amphibians and reptiles were observed along the boundary of the Study Area at the edge of managed vegetation and scrubland (T2_01 to T2_13). A few species were found in young secondary forest (T1_01 to T1_03), but none of them are forest specialists and they were also observed in other habitats of the site. Amphibians found along the aquatic route (A1_01 and A1_02), namely the dark-sided chorus frog (*Microhyla heymonsi*) and greenhouse frog (*Eleutherodactylus planirostris*), were commonly observed throughout the Study Area along the terrestrial transects. More importantly, the aquatic observations of the reptilian fauna (A1_01) were distinct from those found terrestrially. Both aquatic observations are species with conservation status, including the aforementioned red-tailed pipe snake (*C. ruffus*) and the globally vulnerable Chinese softshell turtle (*Pelodiscus sinensis*). However, the Chinese softshell turtle (*P. sinensis*) is non-native and the individual observed on site was most likely released, therefore it is not a species of conservation significance.

The sampling effort for herpetofauna along the terrestrial routes achieved 91.68% of the sample coverage, suggesting that the field assessment managed to document the majority of herpetofauna terrestrially on site (Figure 7-46). The true species richness is estimated to be 17 to 31 reptiles and amphibians. On the other hand, the sampling effort for herpetofauna along the aquatic routes achieved only 64.00% of the sample coverage in this baseline study (estimated true species numbers between three to 10 species).



Figure 7-44: Carcass of a Red-tailed Pipe Snake (*Cylindrophis ruffus*) Recorded during Field Surveys.



Legend

Herpetofauna Species Richness (Aquatic Routes)

- 0 (White diamond)
- 2 (Blue diamond)
- 3 (Dark blue diamond)

Aquatic Routes

- A1 (Blue line)
- A2 (Dark blue line)

Red-tailed pipe snake (Pink circle)

Herpetofauna Species Richness (Terrestrial Routes)

- 0 (Yellow circle)
- 1-3 (Orange circle)
- 4-5 (Red circle)
- 6-7 (Dark red circle)

Terrestrial Routes

- T1 (Orange line)
- T2 (Red line)

Vegetation

- Waste woodland (Light green)
- Scrubland and herbaceous vegetation (Yellow-green)
- Scrubland and herbaceous vegetation (swamp) (Light yellow)
- Others - farm (Light blue)
- Others - construction site (Brown)
- Managed vegetation (Light purple)
- Young secondary forest (Dark green)
- Abandoned-land forest (Light green)

Canal (Grey line)

Stream (Blue line)

Study Area (Red outline)

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Figure Title : **HERPETOFAUNA SPECIES RICHNESS DISTRIBUTION ALONG TERRESTRIAL AND AQUATIC ROUTES, AND LOCATIONS OF HERPETOFAUNA BELONGING TO SPECIES OF CONSERVATION SIGNIFICANCE**

Figure No. : 7-45

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Sheet 1 of 1

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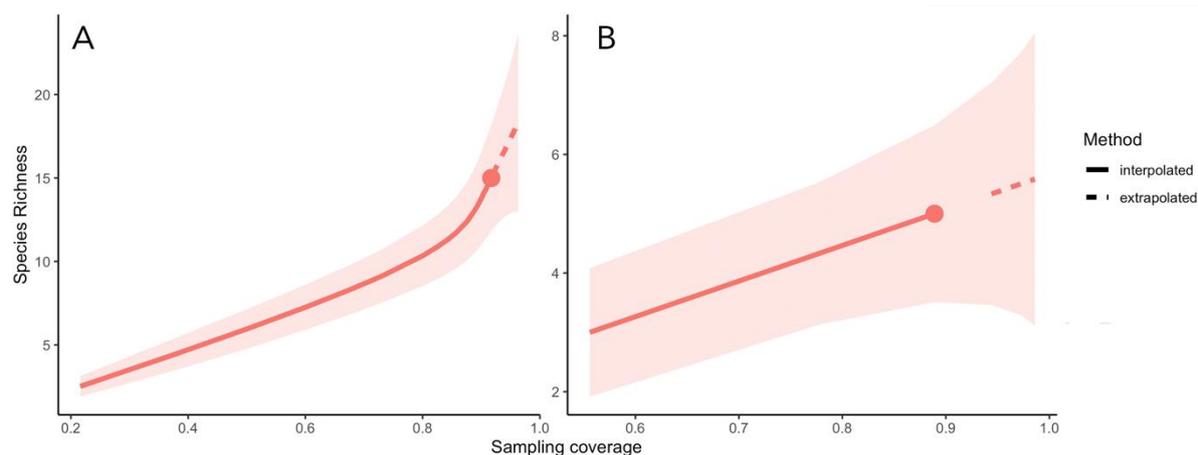


Figure 7-46: Coverage-Based Rarefaction Curve for herpetofauna along the (A) Terrestrial Routes and (B) Aquatic Routes.

7.2.3.2.7 Birds

The desktop assessment identified 160 bird species of probable occurrence, of which 62 are migrants, 82 are native residents and 16 are introduced (Table 7-12; Appendix E). The bird richness is attributed to the wide range of habitats including wetlands, scrubland and herbaceous vegetation, abandoned-land forest, waste woodland and managed vegetation, that support a diversity of bird species.

The field assessment recorded 63 species, of which 12 are migrants, 43 are native residents, eight are introduced. This confirms the presence of 39.38% of all birds of probable occurrence. Out of them, 11 were migratory species. The moderately low number of migrant birds observed may be attributed to the field assessment period (6 Feb 2020 to 17 Feb 2020), which coincided with the end of the migratory season (Sep to Feb).

Of the 20 probable conservation significant species, eight were recorded (Table 7-14; Table 7-15; Appendix E). The locally endangered changeable hawk-eagle (*Nisaetus cirrhatus*; Figure 7-47 A) has been increasing in numbers over the years (Lim & Yong, 2013), and builds nests on tall trees such as *Falcataria moluccana*, which is abundant within and around the Study Area. The locally endangered red-wattled lapwing (*Vanellus indicus*; Figure 7-47 B) was recorded near the open area covered with scrubland and herbaceous vegetation. This species has become more widespread in recent years (Yong et al. 2016).

The oriental magpie-robin (*Copsychus saularis*; Figure 7-47 C) and blue-crowned hanging parrot (*Loriculus galgulus*; Figure 7-47 D), although listed as endangered in the Singapore Red Data Book (Davison et al., 2018), have increased in range and abundance and can now easily be seen in urban parks and gardens (Lim & Yong, 2013). The long-tailed parakeet (*Psittacula longicauda*; Figure 7-47 E) is globally vulnerable and its population is threatened mainly by pet bird trade (BirdLife International, 2018). It is currently protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) as an Appendix II species, meaning its international trade is controlled. Locally, this bird is relatively common, but faces competition from the introduced red-breasted parakeet (*Psittacula alexandri*) as they both nest in tree holes (Collar et al., 2020).

The straw-headed bulbul (*Pycnonotus zeylanicus*; Figure 7-47 F) is globally critically endangered as a result of rampant poaching for the songbird trade. In Singapore, although it is listed as endangered in the Singapore Red Data Book (Davison et al., 2008), the population is showing an increasing trend (Lim & Yong, 2013). Singapore is now a global stronghold for this species. All habitats in Singapore that support the species play a critical role in its global conservation. The locally vulnerable red-legged crane (*Rallina fasciata*; Figure 7-47 G) can be found in many forested areas around Singapore, although the loss of habitat has contributed to its decline over the years (Lim & Yong, 2013). The buffy fish owl (*Ketupa ketupu*; Figure 7-47 H) is a predator of mainly fish and frogs, therefore it is usually found near reservoirs or rivers. Although listed as locally critically endangered, recent sightings at various localities in Singapore suggest that its distribution is expanding (OwYong, 2016). The locations of records of these species within the Study Area are shown in Figure 7-48.

The highest bird species richness (26-28) was recorded at the boundary of the Study Area in managed vegetation and scrubland habitat (T2_04, T2_06), because many of these birds typically inhabit edge or open habitats (Figure 7-49). This is also in part because the open habitats provide a better visibility which allows a higher number of

observations to be made compared to forested areas. While fewer species were observed within the forested patches, certain species were only observed there. For example, the uncommon blue-winged pitta (*Pitta moluccensis*), a winter visitor, was encountered once within the young secondary forest (T1_02), suggesting that the Study Area may serve as a wintering ground for migratory birds (Figure 7-49). This is an important consideration because certain birds, particularly those that inhabit better quality (forested) habitats, may exhibit high site fidelity and will consequently experience adverse impacts from habitat loss of its wintering ground (Schlossberg, 2009; King & Hutchinson, 2001; Warkentin & Hernandez, 1996).

The sampling effort for birds achieved 96.86% of the sample coverage, suggesting that the field assessment managed to document most of the birds on site. The true species richness is estimated to be between 63 and 73 bird species (Table 7-13; Figure 7-50).

Table 7-15: List of Bird Species of Conservation Significance Recorded.

Species	Common Name	Local Status (Davison et al., 2008)	Global Status (IUCN Red List)
<i>Nisaetus cirrhatus</i>	Changeable hawk-eagle	Endangered	Least Concern
<i>Vanellus indicus</i>	Red-wattled lapwing	Endangered	Least Concern
<i>Copsychus saularis</i>	Oriental magpie-robin	Endangered	Least Concern
<i>Loriculus galgulus</i>	Blue-crowned hanging parrot	Endangered	Least Concern
<i>Psittacula longicauda</i>	Long-tailed parakeet	Not Assessed	Vulnerable
<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	Endangered	Critically Endangered
<i>Rallina fasciata</i>	Red-legged crake	Vulnerable	Least Concern
<i>Ketupa ketupu</i>	Buffy fish owl	Critically Endangered	Least Concern



Figure 7-47: Recorded Bird Species of Conservation Significance. (A) Changeable Hawk-eagle (*Nisaetus Cirrhatus*); (B) Red-Wattled Lapwing (*Vanellus Indicus*); (C) Oriental Magpie-Robin (*Copsychus Sauraris*); (D) Blue-Crowned Hanging Parrot (*Loriculus Galgulus*); (E) Long-Tailed Parakeet (*Psittacula Longicauda*); (F) Straw-Headed Bulbul (*Pycnonotus Zeylanicus*); (G) Red-Legged Crake (*Rallina Fasciata*); (H) Buffy Fish Owl (*Ketupa Ketupu*).



Legend

Global Conservation Status

- Critically Endangered
- Vulnerable

Local Conservation Status

- Critically Endangered
- Endangered
- Vulnerable

Terrestrial Routes

- T1
- T2

Vegetation

- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

Other Features

- Canal
- Stream

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Consultant : **AECOM**

Project Title : **ENVIRONMENTAL BASELINE STUDY AT YISHUN NEIGHBOURHOOD 5 (MILTONIA)**

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Figure Title : **LOCATIONS OF BIRD SPECIES OF CONSERVATION SIGNIFICANCE**

Figure No. : **7-48**

Rev. **05** Sheet **1 of 1**

CAD File Name : NA

A3

Note: Source of basemap - Google Earth Map



Legend

Bird Species Richness (Terrestrial Routes)

- 0
- 1 - 10
- 11 - 20
- 21 - 28

Terrestrial Routes

- T1
- T2

Vegetation

- Canal
- Stream
- Study Area
- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Figure Title : BIRD SPECIES RICHNESS DISTRIBUTION ALONG TERRESTRIAL ROUTES

Figure No. : 7-49, Rev. 05, Sheet 1 of 1

CAD File Name : NA, A3

Note: Source of basemap - Google Earth Map

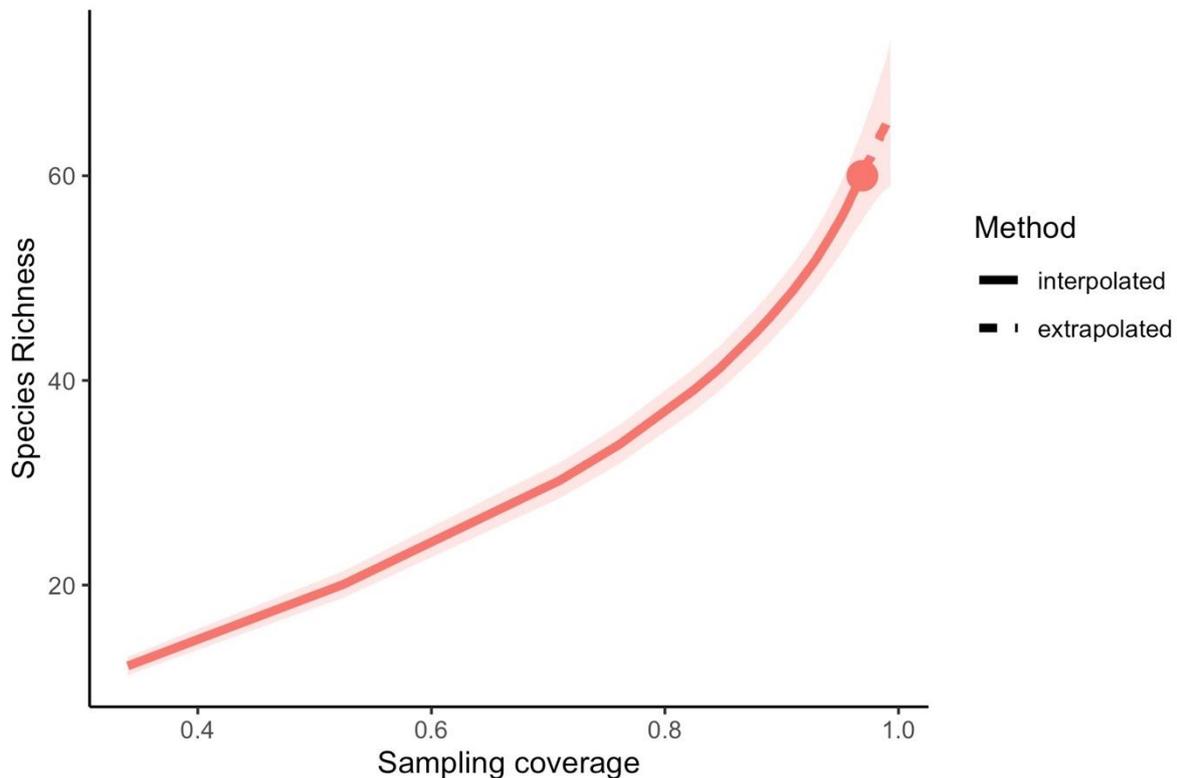


Figure 7-50: Coverage-Based Rarefaction Curve for Birds.

7.2.3.2.8 Non-volant Mammals

Twelve of the 30 non-volant mammals were deemed of probable occurrence (Table 7-12; Appendix E). With the exception of the wild pig (*Sus scrofa*), which could possibly travel over to the Study Area from the larger forested region northwest to it, these mammals are able to survive in small wooded or scrubland habitats. Amongst them is the smooth-coated otter (*Lutrogale perspicillata*), which is conservation significant and locally critically endangered. The freshwater stream and presence of relatively large fish such as the oriental climbing perch (*A. testudineus*) and common snakehead (*C. striata*) provide a good habitat and food source for this animal. Furthermore, a family of otters have been known to frequent the adjoining Lower Seletar Reservoir. A sole encounter with the smooth-coated otter (*L. perspicillata*) was recorded by a camera trap (CT_04) situated on the northern section of the site within the young secondary forest (Figure 7-6). This individual was observed a distance away from the nearest aquatic habitat it is typically associated with, but CT_04, which was pointed towards the Northeast, showed footage of it running in that direction, suggesting that it may have come from the stream at the centre of the site.

The field assessment documented six other species, which confirms the presence of 58.33% of all mammals of probable occurrence (Table 7-14; Appendix E). Besides the smooth-coated otter (*L. perspicillata*), only three were native – the plantain squirrel (*C. notatus*), common treeshrew (*Tupaia glis*), and Malaysian wood rat (*Rattus tiomanicus*). The six observed species are widespread and common generalists that are able to inhabit degraded and urban habitats.

Low mammalian species richness was observed throughout the site. These sightings were primarily of the feral dog (*C. lupus familiaris*) and plantain squirrel (*Callosciurus notatus*). The common treeshrew (*Tupaia glis*) was only encountered once during targeted transect surveys at the edge of the young secondary forest along Yishun Avenue 1 (T1_05), where the highest number of species of mammals was also recorded (four species) (Figure 7-51).

The sampling effort for non-volant mammals achieved 87.42% of the sample coverage, suggesting that the field assessment has documented most of the mammals on site. The true species richness is estimated to be between six and 19 species (Table 7-13; Figure 7-52).



Legend

Mammal Species Richness (Terrestrial Routes)

- 0
- 1
- 2
- 4

Terrestrial Routes

- T1
- T2

Vegetation

- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

Canal

Stream

Study Area

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Figure Title : **MAMMAL SPECIES RICHNESS DISTRIBUTION ALONG TERRESTRIAL ROUTES**

Figure No. : 7-51	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

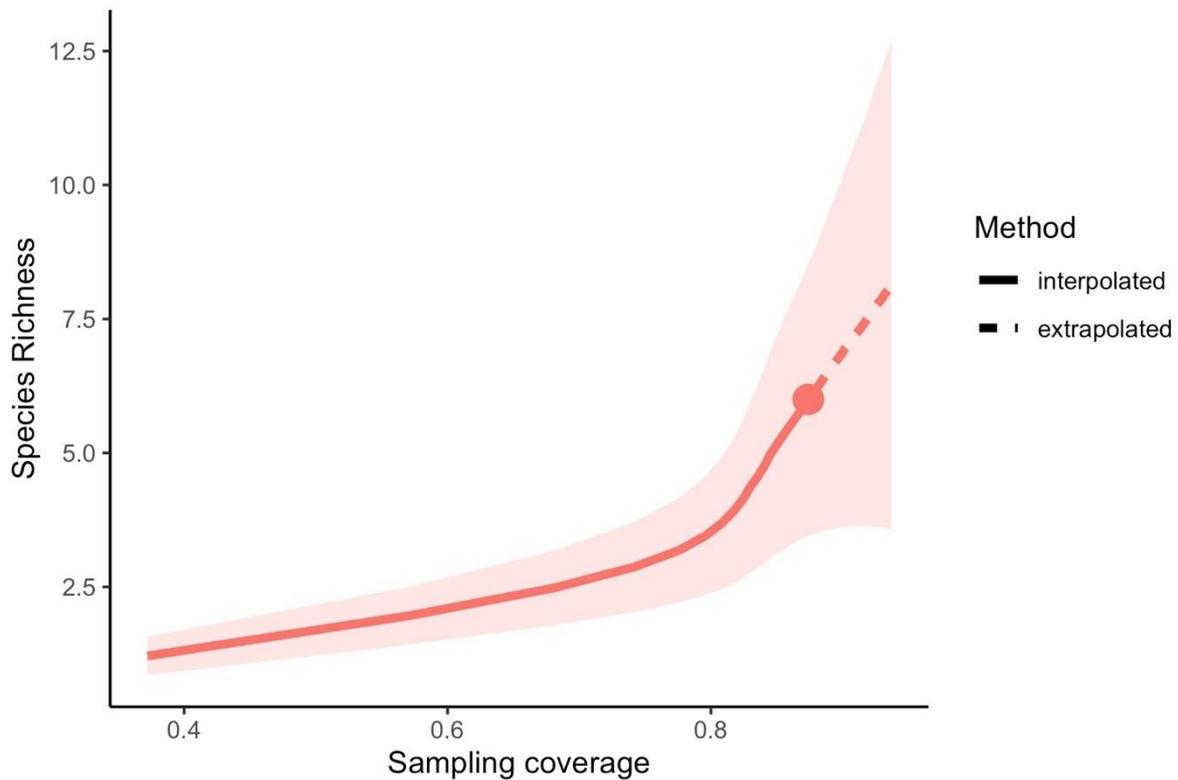


Figure 7-52: Coverage-Based Rarefaction Curve for Mammals.

Four camera traps were deployed for 29 trap nights each. Unfortunately, two camera traps (CT03 and CT04) were faulty and only produced 22 and 28 trap nights of footage, bringing the collective number of trap nights to 108 (Appendix G). Six mammals were recorded and yielded 267 independent detections over 108 trap nights. Of these species, only the smooth-coated otter (*L. perspicillata*) that was recorded at CT_04 was not recorded during the targeted field surveys, and it is also the only conservation-significant mammal. The number of species recorded at each camera trap ranged between two and six (Figure 7-53).

The most commonly recorded animal was the feral dog (*Canis lupus familiaris*) (n=144), because at the point of the field assessment, a pack of at least seven feral dogs had taken residence at the Study Area and were constantly encountered during surveys. They were recorded in all camera traps. On the same note, CT04, situated in the young secondary forest patch on the northern section of the Study Area, had a far higher detection rate both for all fauna and only mammals (5.36 and 4.36 respectively) because of the much higher independent detection of feral dogs (*C. lupus familiaris*) at that area.

The sampling effort for camera traps achieved 98.80% of the sample coverage, suggesting that camera trapping was adequate to capture most of the mammal species potentially detectable by camera trapping (Table 7-16; Figure 7-54). The true mammal species richness based on the estimators for the area is between five to nine species, which is close to the mammal species detected of six, suggesting sampling completeness (Table 7-17; Figure 7-54).



Legend

Mammal Species Richness (Camera Traps)

- 2
- 3
- 4
- 5

Canal

Stream

Study Area

Vegetation

- Waste woodland
- Scrubland and herbaceous vegetation
- Scrubland and herbaceous vegetation (swamp)
- Others - farm
- Others - construction site
- Managed vegetation
- Young secondary forest
- Abandoned-land forest

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Figure Title : MAMMAL SPECIES RICHNESS DISTRIBUTION AT CAMERA TRAPS

Figure No. : 7-53

Rev. 05

Sheet 1 of 1

CAD File Name : NA

A3

Note: Source of basemap - Google Earth Map

Table 7-16: Number of Independent Detections of Each Species Recorded by Camera Traps.

Species	Common name	No. of independent detections (n)
<i>Canis lupus familiaris</i>	Feral dog	144
<i>Callosciurus notatus</i>	Plantain squirrel	59
<i>Tupaia glis</i>	Common treeshrew	43
<i>Rattus tiomanicus</i>	Malaysian wood rat	19
<i>Lutrogale perspicillata</i>	Smooth-coated otter	1
<i>Felis catus</i>	Feral cat	1
		267

Table 7-17: Species Richness and Detection Rate Merges of Fauna and Mammals for Each Camera Trap.

Camera trap no.	No. of trap-nights	Detection rate of fauna	Detection rate of mammals	No. of fauna species recorded	No. of mammal species recorded
CT_01	29	1.93	1.931	2	2
CT_02	29	2.93	1.72	8	4
CT_03	22	1.68	1.68	3	3
CT_04	28	5.36	4.36	10	6

Note: Detection rate = number of independent detections captured at the same camera trap, over the number of independent nights; the detections were standardised to 60 min

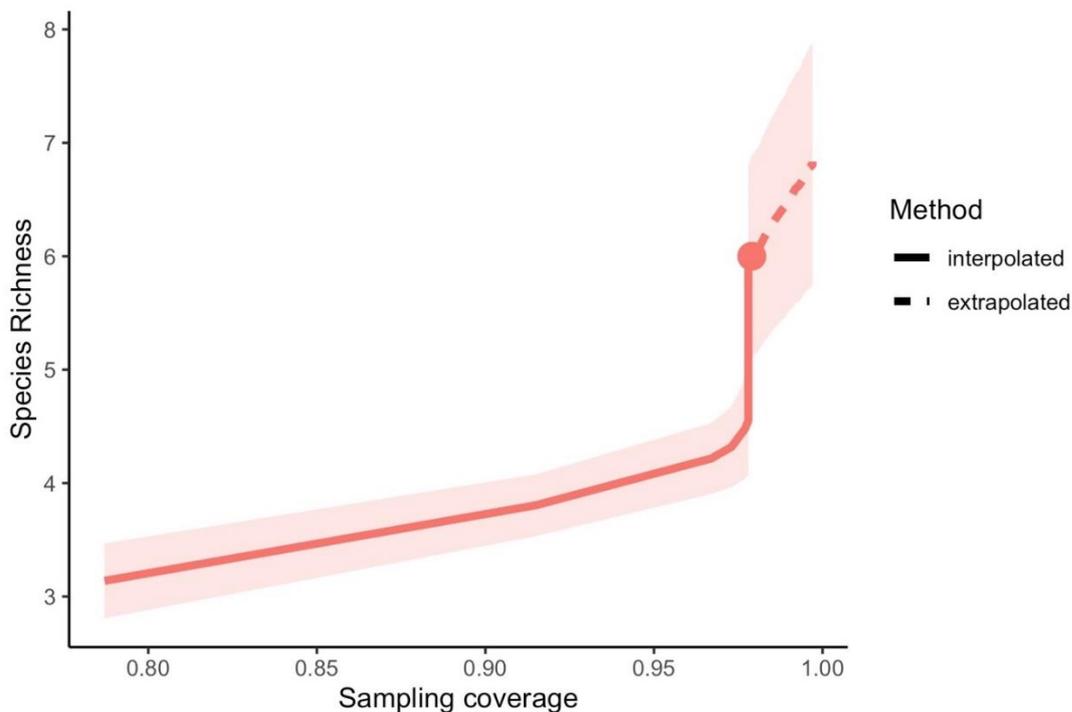


Figure 7-54: Coverage-Based Rarefaction Curve for Mammal Camera Trapping

7.2.3.2.9 Bats

Nine bats were deemed of probable occurrence within the Study Area, including two locally conservation significant species – the black-bearded tomb bat (*Taphozous melanopogon*) and the critically endangered lesser bamboo bat (*Tylonycteris fulvida*) (Table 7-12; Appendix E). While rare, the black-bearded tomb bat (*T. melanopogon*) is widespread and can inhabit degraded habitats to the extent of inhabiting buildings; a roost was found in the basement of a building along Orchard Road (Davidson et al., 2008). On the other hand, the lesser bamboo bat (*T. fulvida*) is an expected species because of the presence of bamboo (*Bambusa vulgaris*, *Bambusa heterostachya*) on site, which it relies on for roosts (Figure 7-55). Bamboo bats (*Tylonycteris* spp.) have been observed in various locations throughout Singapore during our previous faunistic surveys, including sites that have a habitat condition similar to this Study Area. The only other bamboo bat species in Singapore, the greater bamboo bat (*T. malayana*), is comparatively common according to Pottie et al. (2005). However, while the acoustic frequencies and morphometrics between the two bamboo bats are slightly different, there is an overlap (Kingston et al., 2009; Francis, 2008). This makes differentiating the calls and morphometrics of the two species difficult (Lee B, pers. comm.), and suggests that the lesser bamboo bat (*T. fulvida*) may be misclassified and could be more common than what is stated in existing literature on the microchiroptera of Singapore.

The field assessment recorded six bat species. Five of these species were recorded during targeted field surveys. This confirms 66.66% of all bats of probable occurrence within the Study Area. Only the lesser dog-faced fruit bat (*Cynopterus brachyotis*) was identified visually during the targeted field surveys, while the other four are insectivorous bats that were identified acoustically from sonograms. During roost emergence surveys at all seven bamboo clusters found in the Study Area, bamboo bats (*Tylonycteris* spp.) were recorded acoustically on the bat detector and also observed flying around bamboo cluster BB_01A.

Bats were observed throughout the Study Area, but fewer were detected at the edge of the golf course (T2_04 to T2_09) and the young secondary forest (T1_02, T1_03, T1_06 to T1_08). The highest number of bat species (three to four species) were observed close to roads along Yishun Avenue 1 (T1_04, T1_11, T1_12, T2_14) and Miltonia Close (T2_01) (Figure 7-55). This could be due to the open canopy offering a higher density of insects and not restricting the flight movement of bats compared to wooded areas of the site (Koike, 1998; Basset et al., 2002), but given that the highest species richness was also observed within abandoned-land forest (T1_16) and bat species richness differed by only a few species across sampling points, the locations of the highest species richness could be more likely attributed to chance encounters and that bat species richness is relatively even throughout the Study Area (Figure 7-55).

The sampling effort for bats achieved 94.74% of the sample coverage, and the true species richness is estimated to be four to eight species, suggesting that the field assessment has documented most of the bats on site (Table 7-13).



Legend

Bat Species Richness (Terrestrial Routes)

- 0 (Yellow circle)
- 1 (Orange circle)
- 2 (Red circle)
- 4 (Dark red circle)

Terrestrial Routes

- T1 (Orange line)
- T2 (Yellow line)

Bamboo bat

- (Pink circle)

Vegetation

- Waste woodland (Light green)
- Scrubland and herbaceous vegetation (Yellow)
- Scrubland and herbaceous vegetation (swamp) (Light yellow)
- Others - farm (Light blue)
- Others - construction site (Brown)
- Managed vegetation (Light purple)
- Young secondary forest (Dark green)
- Abandoned-land forest (Light green)

Other Features

- Canal (Grey line)
- Stream (Blue line)
- Study Area (Red outline)

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Figure Title : **BAT SPECIES RICHNESS DISTRIBUTION ALONG TERRESTRIAL ROUTES AND LOCATIONS OF BAMBOO BATS**

Figure No. : 7-55	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

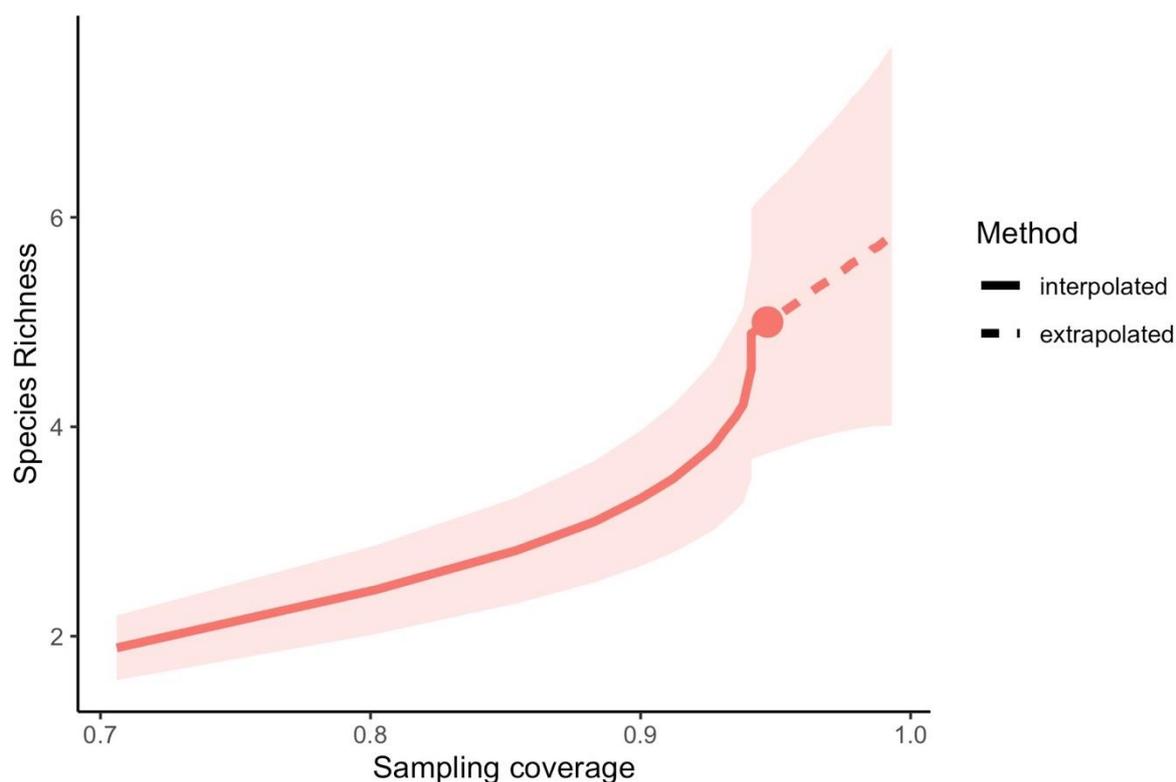


Figure 7-56: Coverage-based Rarefaction Curve for Bats.

7.3 Summary of Key Findings

The Study Area is characterised largely by disturbed vegetation which are widespread and common in other forested areas of Singapore. Because of this, most of the fauna species recorded here are adapted to disturbed habitats and can also be commonly found in other areas of Singapore. The Study Area does not support a particularly high native species richness in a local context, and is not considered an ecologically significant site in Singapore. However, there are findings that show that the abandoned-land forest, swampy scrubland, and a bamboo cluster (BB_01A) in the young secondary forest are important for both flora and fauna.

The abandoned-land forest and edges of the swampy scrubland supports several flora species of conservation significance, including the nationally critically endangered *Bintangaur laut* (*Calophyllum inophyllum*) and vulnerable *Buas buas* (*Premna serratifolia*). These coastal species are nationally threatened and are more often found in coastal habitats on the offshore islands of Singapore, such as St. John's Island and Pulau Tekukor. Hence, there is value in exploring ways to conserve coastal-associated species so that they continue to persist on the mainland, so as to help the native stocks remain genetically-diverse. This in turn could increase the resistance and ability of species to adapt in face of changing climatic conditions (Reusch et al., 2005; Leger & Espeland, 2010). In the long run, they could contribute to important ecosystem functions and services that may benefit humans (e.g., Li et al., 2010 and Samah et al., 2014). The abandoned-land forest also hosts several large stranglers and trees.

Bamboo bats (*Tylonycteris* spp.) were found during roost emergence surveys at bamboo cluster BB_01A (Figure 7-55). This genus of bats may include the nationally critically endangered lesser bamboo bat (*T. fulvida*), which may also be found in other forested areas in Singapore. Therefore, this bamboo cluster should be considered a specimen of importance.

The stream, which runs through the swampy scrubland, supports several stream-dependent faunal species, some of which are nationally threatened, such as the critically endangered red-tailed pipe snake (*Cylindrophis ruffus*) and endangered buffy fish owl (*Ketupa ketupu*). The straw-headed bulbul (*Pycnonotus zeylanicus*), which is a globally critically endangered and locally endangered species that was frequently encountered in the targeted field surveys, is also known to be associated to riparian habitats.

Based on the key findings, the proposed core biodiversity area in the Study Area is marked out in Figure 7-57. This includes the riparian habitats that flank both sides of the stream as they form an integral component of aquatic environments that provide numerous ecological services, such as the provision of food sources and habitats for fauna such as the red-tailed pipe snake (*C. ruffus*) (Kupfer et al., 2003), as well as the maintenance of water quality via the infiltration of surface runoff. The buffer zone is at least 30 m in width to ensure bank stability (Buffler et al., 2005; Jontos, 2004). To preserve the microclimate of the bamboo cluster to minimise disturbance to the bamboo bats, a 30-m buffer of vegetation has also been delineated around bamboo cluster BB_01A.

While flora specimens and flora of conservation significance can be found throughout the abandoned-land forest, it may be unrealistic to retain the abandoned-land forest in its entirety as it comprises a third of the Study Area. Therefore, the portion of this forest patch closest to the stream with a 15-m buffer should be prioritised as the proposed core biodiversity area. This allows for some large trees, stranglers, and individuals of threatened coastal species to be conserved, including the two aforementioned species. The largest strangler on site—a *Ficus microcarpa* with a spread of up to 50 m—will also be retained. A contiguous conservation zone may be achieved by connecting the stream, abandoned-land forest, and bamboo cluster (BB_01A) habitats, which may preserve a higher habitat quality compared to retaining fragmented forest patches (de Paula et al., 2016).



Legend

Conservation Zone	Stream
Flora conservation zone	Study Area
Bamboo bat conservation zone	Vegetation
Stream conservation zone	Waste woodland
Proposed Core Biodiversity Area	Scrubland and herbaceous vegetation
Coastal Species	Scrubland and herbaceous vegetation (swamp)
▲ Critically Endangered	Others - farm
▲ Endangered	Others - construction site
▲ Vulnerable	Managed vegetation
Specimens of Value	Young secondary forest
▲ Bamboo	Abandoned-land forest
◆ Tree	
◆ Strangler	
◆ Raptor nest	

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Figure Title : **PROPOSED CORE BIODIVERSITY AREA IN THE STUDY AREA**

Figure No. : 7-57	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

8. Hydrology and Water Quality Baseline Environment

This section includes the assessment of stream characteristics and surface water quality within the Study Area (Figure 8-1). Results from the site surveys are presented to establish the baseline conditions. As outlined in the Inception Report, the section below details the completed hydrological mapping of the Study Area and the results from water quality sampling of two (2) dry weather and one (1) wet weather event.

This report presents findings from the field surveys undertaken on the following dates:

- 27th of December 2019 (site reconnaissance);
- 8th of January 2020 (site reconnaissance);
- 11th of February 2020 (dry weather sampling);
- 11th of February 2020 (wet weather sampling); and
- 25th of March 2020 (dry weather sampling).

8.1 Study Objectives

The key objective of the hydrology and water quality baseline study was to identify waterbodies present in the Study Area which includes their location, water flow conditions and bank characteristics. Baseline water quality of existing waterbodies in the Study Area was also examined.

This scope of work of the baseline study consists of:

- Reviewing data provided by the Client to understand the topographic and hydrographic characteristics of the Study Area;
- Site reconnaissance survey for a better understanding of the Study Area's topography, hydrology, land cover and existing waterbodies with their properties (i.e. locations, water flow conditions and bank characteristics);
- Identification and mapping of the location, alignment of all streams, ponds and swampy areas within the Study Area;
- Identification of sampling locations for in-situ and ex-situ water quality analysis of existing waterbodies located within the Study Area;
- Determining the baseline surface and subsurface hydrological conditions; and
- Determining the stormwater sources feeding major natural stream if any and suggest the stormwater flow rate.

8.2 Methodology

8.2.1 Desktop Research

Desktop research aided in determining the location of existing waterbodies within the Study Area. Using the topographic survey data, ArcGIS was applied to develop an elevation map for the Study Area to support the findings of the hydrological survey. With the aid of these maps, the catchment area (i.e. the source of water flow to existing streams or drains) was identified and analysed to further support the environmental baseline study. The information, retrieved during the desktop assessment, comprised of publicly available data from government and technical agencies, existing publicly-available data (e.g. rainfall data, online satellite images), as well as published books, relevant articles, and other online sources.



- Legend**
-  Study Area
 -  Farm
 -  Waterbody



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Figure Title :
**STUDY AREA FOR THE HYDROLOGY
AND SURFACE WATER QUALITY
BASELINE STUDY**

Figure No. : 8 - 1	Rev. 01	Sheet 1 of 1
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8.2.2 Hydrological Survey

The hydrological survey was conducted by casual exploration methods to determine:

- The streams/drains, ponds and swampy areas location and outline;
- The streams/drains, ponds and swampy areas width;
- The water flow conditions (static/flowing), and;
- The bank characteristics (natural/artificial).

GIS technique was used to develop elevation and slope map for the site to support hydrological survey with the topographic data provided by Client. The slope, topography as well as existing structures (e.g. drains, stream and inlet/outlet) within the Study Area were analysed to delineate existing sub-catchment of the Study Area.

Soil investigation is not part of this study and may be carried out independently by HDB at a later stage after this study hence groundwater flow and level cannot be ascertained at this stage.

8.2.3 Water Quality Survey

As mentioned in the section above, waterbodies present in the Study Area were identified during site surveys. Suitable locations were selected within the identified waterbodies for collection of water samples in order to assess the baseline in-situ and ex-situ water quality of existing waterbodies within the Study Area. The baseline conditions of the surface water quality at the Study Area were then be established.

Water samples were collected at seven (7) water quality stations along the Natural Stream and the Drain 1 as detailed in Figure 8-3 and Table 8-1. Stations WQ1 and WQ2 were selected to capture the water quality of upstream concrete drain and swampy area of Natural Stream, respectively. Stations WQ3 and WQ4 were selected to capture the water quality of downstream and discharge outlet of Natural Stream. Station WQ6 was selected to determine the upstream water quality in the pond area of another tributary of the Natural Stream. Station WQ5 was selected to study the runoff quality in the stormwater drain (Drain 1), which can also represent runoff water quality in Drain 2. One station, WQ7, which is at the pond immediately after the concrete drain before reaching the swampy area of Natural Stream, was sampled for in-situ parameters to provide additional water quality information along Natural Stream just after mixing with swampy water. Except for station WQ7, all the other water quality stations were sampled for both in-situ and ex-situ analysis.

Apart from WQ5, two dry weather (normal conditions) and one wet weather (after a storm event) samples were collected from each water quality station. Only wet weather samples were collected at WQ5, as dry weather sampling was not viable due to low flow. Dry-weather conditions are defined as after a continuous 48-hour period of no-rain, and wet-weather conditions are defined as a rainfall event having more than 10mm of rainfall, with samples to be collected within 3 hours after the rain stops. It should be noted that WQ7 was only sampled for in-situ parameters as WQ1 and WQ2 are enough to represent the stream water quality conditions.

In-situ water quality parameters were measured using a calibrated multi-parameter digital sensor (YSI ProDSS, Figure 8-2) with USEPA approved testing methods for water quality parameters and included:

- pH;
- Temperature;
- Dissolved Oxygen (DO);
- Total Dissolved Solids (TDS); and
- Salinity/Conductivity.

The ex-situ parameters analysed by Marchwood Laboratory Services Pte Ltd (MLS) are listed below:

- Turbidity;
- Total Nitrogen;
- Total Phosphorus;
- Ammoniacal Nitrogen (AN);
- Nitrate (NO₃);
- Orthophosphates;
- Total Suspended Solids (TSS);

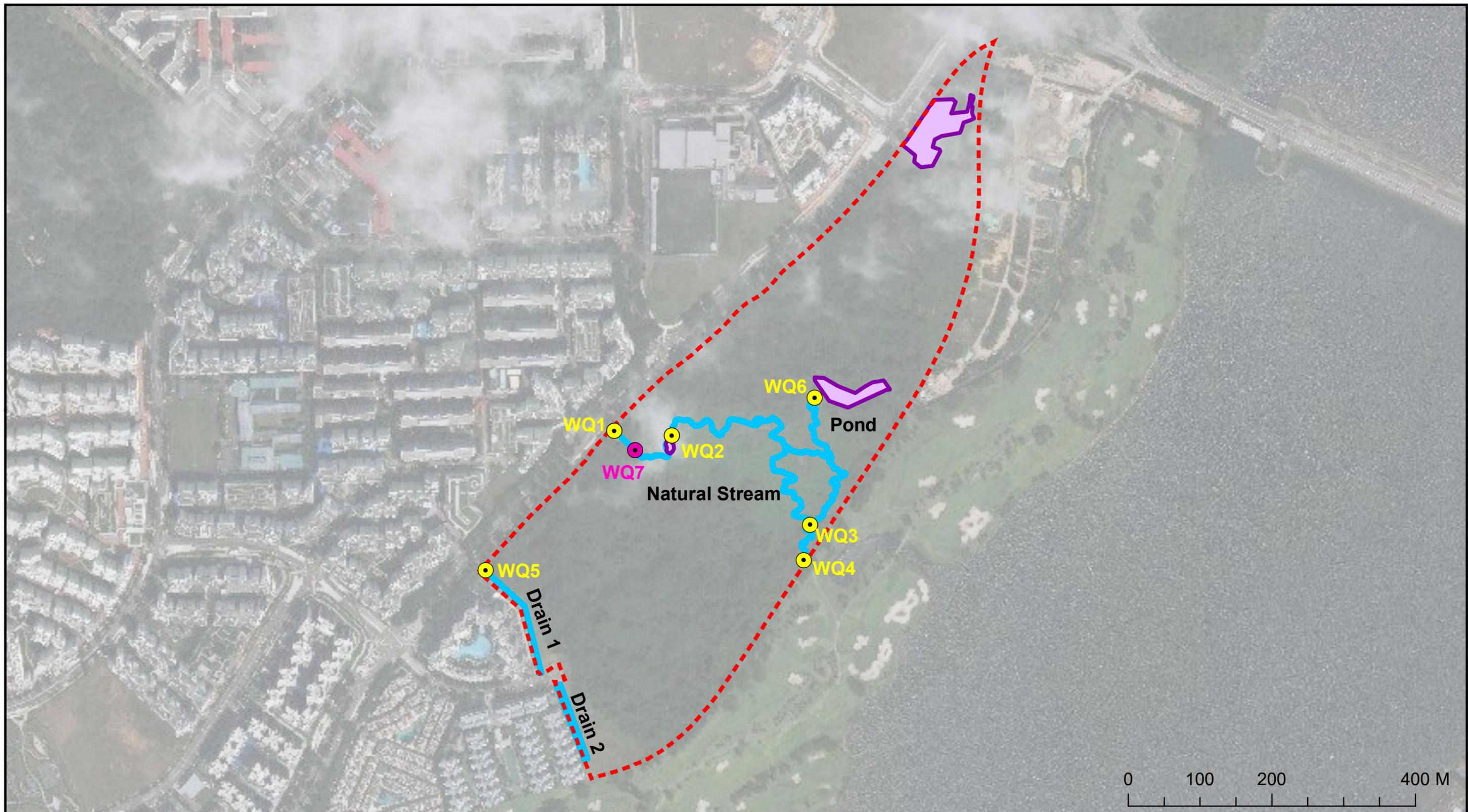
- Biological Oxygen Demand (BOD₅);
- Total Organic Carbon (TOC);
- Enterococcus; and
- Lead.



Figure 8-2: Example of In-situ Water Quality Measurement.

Table 8-1: Rationale for the Selection of the Water Quality Sampling Locations.

Survey Locations	Rationale
WQ1	To capture water quality from the concrete drain before it discharges to Natural Stream
WQ2	To capture water quality in the swampy area, which is the midstream of Natural Stream
WQ3	To capture water quality near downstream of Natural Stream before reaching the discharge outlet
WQ4	To capture water quality at the discharge outlet of Natural Stream before reaching Orchid Country Club
WQ5	To capture water quality at a stormwater drain (Drain 1) that collects runoff from southwest of the project site
WQ6	To capture water quality of an earth pond which located downstream of a farm and another upstream tributary of the Natural Stream
WQ7	To capture in-situ water quality in a pond right after the concrete drain section where water starts to mix with water in the swampy area of Natural Stream



Legend

- Water Quality Sampling Location
 - In-Situ and Ex-Situ
 - In-Situ Only
- Study Area
- Farm
- Waterbody



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Figure Title :
WATER QUALITY SAMPLING LOCATIONS

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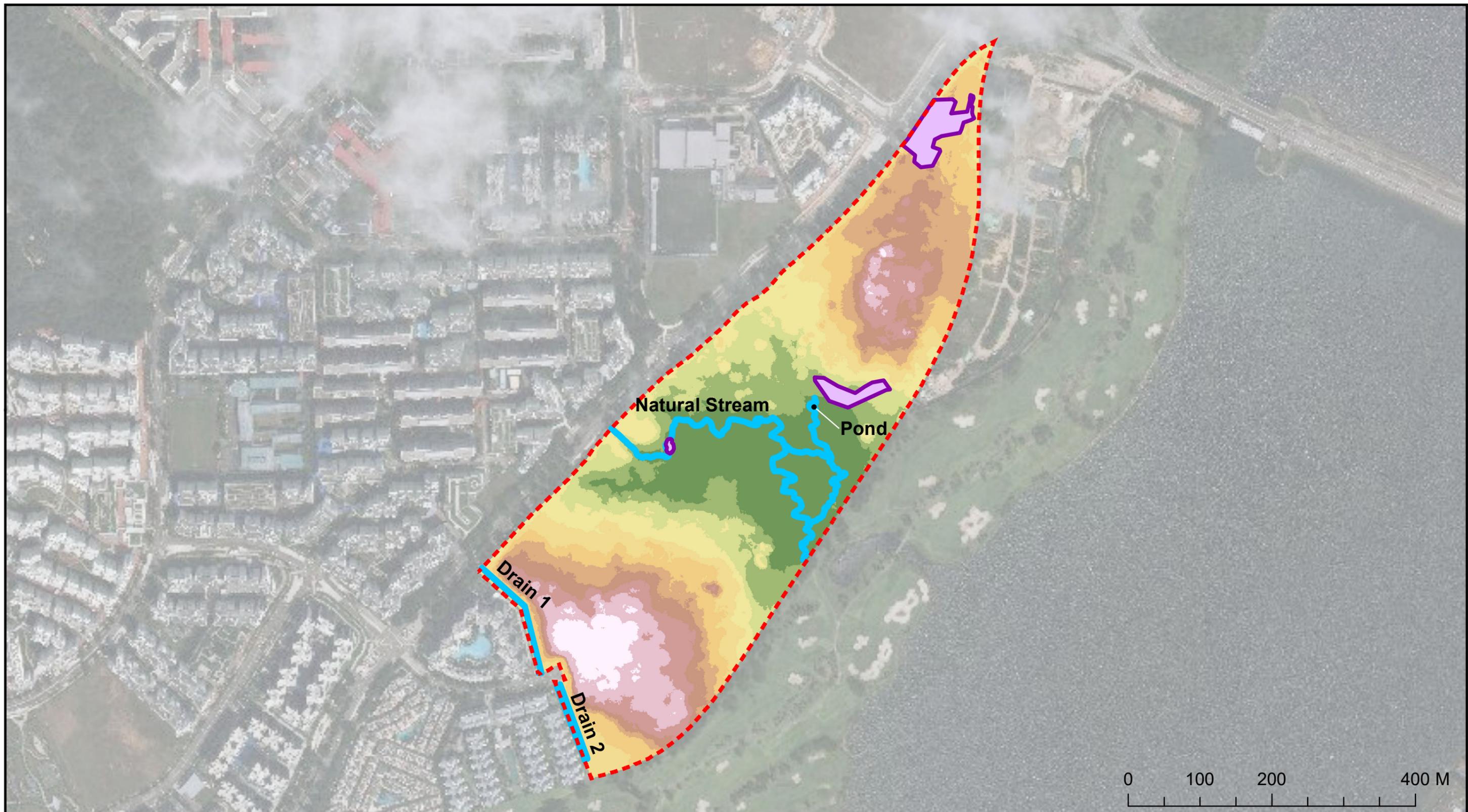
Note: Source of basemap - Google Earth Map

8.3 Baseline Monitoring Results

8.3.1 Hydrological Conditions in the Study Area

During site reconnaissance, one natural stream (Natural Stream), two concrete drains (Drain 1 and Drain 2) and one pond was observed, with the Natural Stream flowing from west to east across the centre of the Study Area, Drain 1 flowing from southeast to northwest and Drain 2 flowing to the opposite direction along the southwest study boundary, as well as the pond located at downstream of the farm discharging water to Natural Stream (Figure 8-1). Natural Stream has concrete drain at the upstream, followed by swampy area at the midstream and earth drain at the downstream before reaching the concrete culvert structure at the outlet. By comparing with historical land use which was shown in Figure 4-3, the Natural Stream should be the Sungei Sopok that was a tributary of Sungei Seletar. The Pond located at the upstream of the swampy area slowly discharges water into Natural Stream.

The topographic survey data of this Study Area was received from Client on 9th January 2020. Elevation map overlaid with surface waterbodies (Figure 8-4) was generated with the topographic survey data using ArcGIS. As shown in Figure 8-4 and Figure 8-5, Study Area can be described as a hilly, with moderate rising slopes from centre towards north, west and south of the Study Area. The low-lying area is the swampy area of Natural Stream. Catchment delineation was carried out to develop the catchment map within the Study Area as shown in Figure 8-6. The Study Area was divided into four (4) catchment areas (i.e. northeastern, central, southwestern and southern catchment areas). As shown in Figure 8-6, in northeastern catchment, water flows to the underground roadside drains along the boundary of the Study Area. Natural Stream collects water from central catchment, while Drains 1 and 2 collect water from southwestern and southern catchments, respectively.



Legend

- Study Area
- Farm
- Waterbody

Elevation (mRL)

	< 104		112 - 114
	104 - 106		114 - 116
	106 - 108		116 - 118
	108 - 110		118 - 120
	110 - 112		120 - 122
			> 122

Rev.	Date	By	Description	Chk'd	App'd
01	AUG 2021	LAL	Final Report	NHT	JAG
-	FEB 2021	LAL	Final Report	NHT	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : **AECOM**

Project Title : **ENVIRONMENTAL BASELINE STUDY AT YISHUN NEIGHBOURHOOD 5 (MILTONIA)**

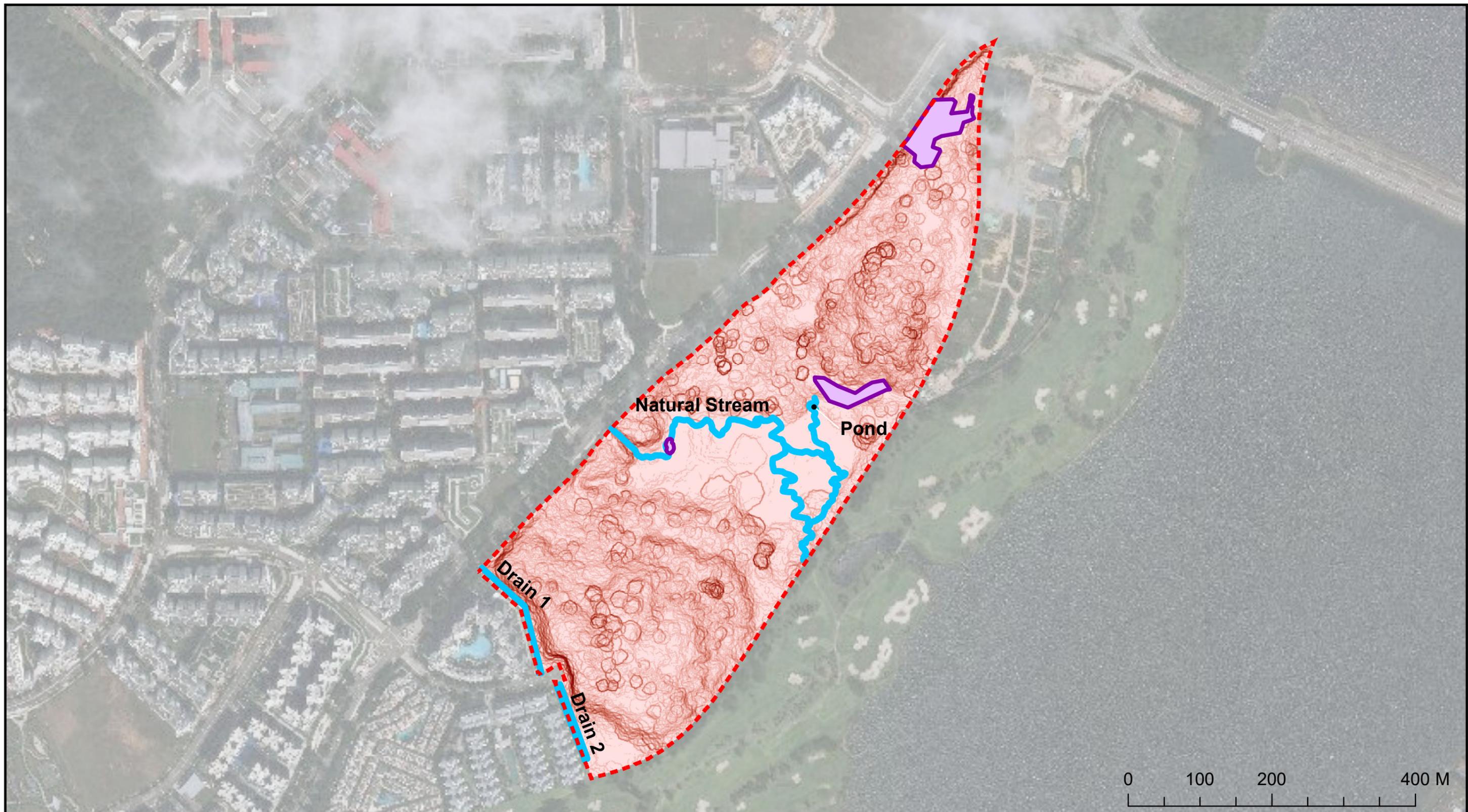
Designed LAL	Checked NHT	Approved JAG
Drawn LAL	Date AUG 2021	

HOUSING & DEVELOPMENT BOARD

Figure Title : **ELEVATION AND DRAINAGE MAP OF THE STUDY AREA (DEVELOPED BASED ON TOPOGRAPHY DATA RECEIVED FROM HDB)**

Figure No. : 8 - 4	Rev. 01	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map



Legend

- Study Area
- Farm
- Waterbody

Slope (%)

	<5
	5-25
	25-45
	45-65
	65-85
	85-105
	105-125
	125-145
	145-165
	>165

Rev.	Date	By	Description	Chk'd	App'd
01	AUG 2021	LAL	Final Report	NHT	JAG
-	FEB 2021	LAL	Final Report	NHT	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : **AECOM**

Project Title : **ENVIRONMENTAL BASELINE STUDY AT YISHUN NEIGHBOURHOOD 5 (MILTONIA)**

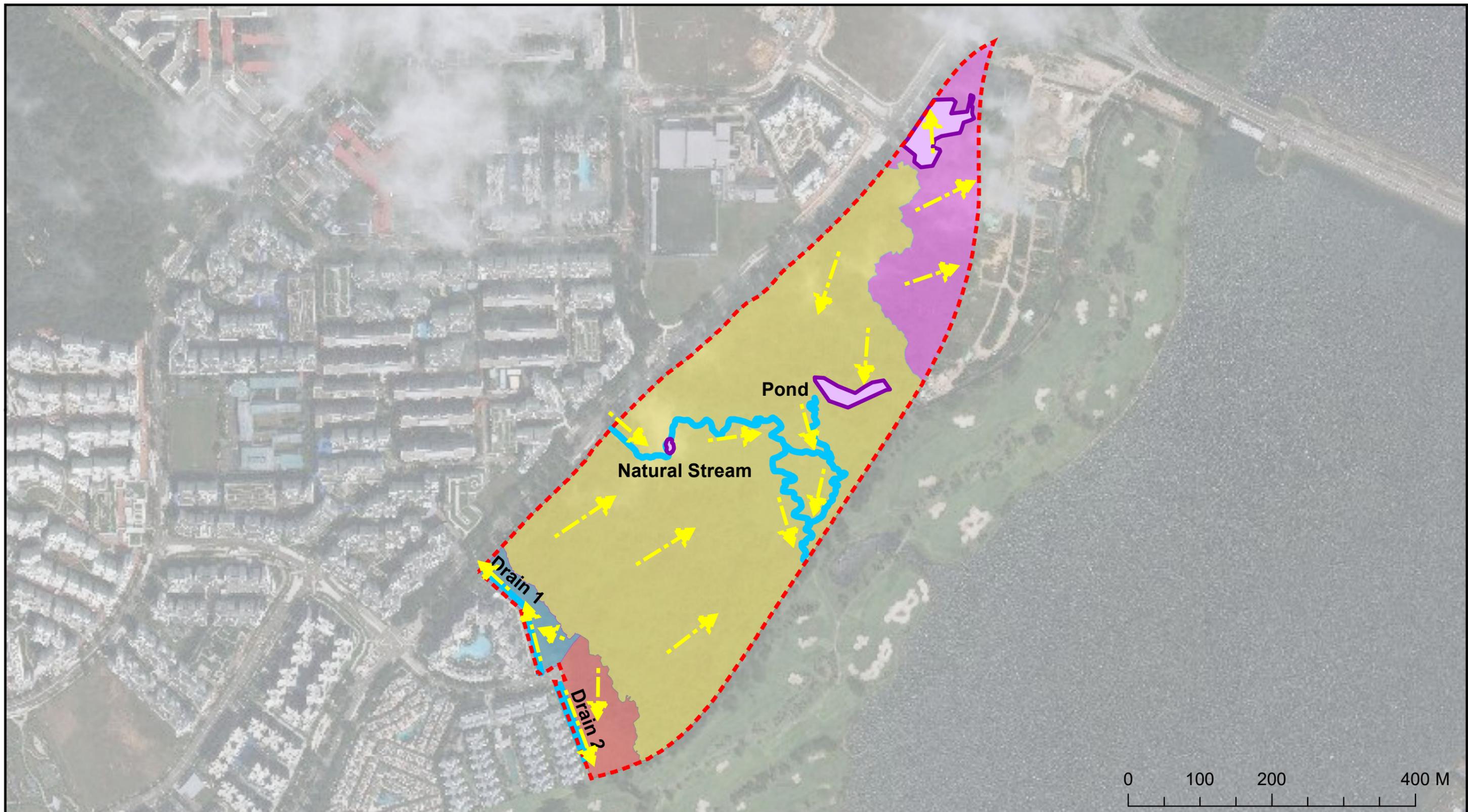
Designed LAL	Checked NHT	Approved JAG
Drawn LAL	Date AUG 2021	

HOUSING & DEVELOPMENT BOARD

Figure Title : **SLOPE MAP OF THE STUDY AREA (DEVELOPED BASED ON TOPOGRAPHY DATA RECEIVED FROM HDB)**

Figure No. : 8 - 5	Rev. 01	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map



Legend

- Study Area
- Farm
- Waterbody
- Flow Direction

Catchment

- 1
- 2
- 3
- 4

N
↑

Rev.	Date	By	Description	Chk'd	App'd
05	OCT 2021	LAL	Final Report	NHT	JAG
01	AUG 2021	LAL	Final Report	NHT	JAG
-	FEB 2021	LAL	Final Report	NHT	JAG

Qualified Person Endorsement :
NA

HDB Endorsement : NA

Consultant : **AECOM**

Project Title :
**ENVIRONMENTAL BASELINE STUDY
AT YISHUN NEIGHBOURHOOD 5
(MILTONIA)**

Designed LAL	Checked NHT	Approved JAG
Drawn LAL	Date OCT 2021	

HOUSING & DEVELOPMENT BOARD

Figure Title :
**CATCHMENT MAP OF THE STUDY AREA
(DEVELOPED BASED ON TOPOGRAPHY
DATA RECEIVED FROM HDB)**

Figure No. : 8 - 6	Rev. 05	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

Table 8-2 below provides details regarding the observed bank features and water flow conditions of the main waterbodies during dry and wet weather. Field observations suggest that the natural waterbodies are surrounded by dense vegetation. The identified stream and drains carry the runoff in the Study Area. Natural Stream has perennial flow with low water flow (i.e. almost stagnant at Midstream and slow flow at Upstream and Outlet with estimated flow velocity less than 0.6 m/s) observed during dry weather and faster flowing water with estimated flow velocity up to 2 m/s along the whole stream during wet weather. Along Natural Stream, Station WQ7 has almost stagnant water during dry weather. The abandoned Fish Pond at downstream of an existing vegetation farm has almost stagnant water during both dry and wet weather, connecting to the swampy area of Natural Stream. Drains 1 and 2 are concrete roadside drains along the southwest boundary of the Study Area. Drains 1 and 2 have ephemeral flow with slightly higher flow velocity observed during wet weather. As Drains 1 and 2 are similar, only Drain 1 was surveyed in detail. All the waterbodies within the Study Area do not have obvious smell.

Table 8-2: Description of Water Quality Sampling Points within the Study Area

Waterbodies	Bank Characteristics	Water Flow Conditions	Photos	
Natural Stream	<p>Upstream of Natural Stream is a closed culvert followed by a concrete drain with artificial banks.</p> <p>The midstream is a swampy area with dense vegetation.</p> <p>The downstream is earth stream with dense vegetation.</p> <p>Estimated stream length was 860m.</p>	<ul style="list-style-type: none"> • Originates outside of the Study Area with upstream is urbanize area • Perennial flow <p>During dry weather condition:</p> <ul style="list-style-type: none"> • <u>Upstream</u>: slow water flow observed (estimated at 0.6 m/s) • Approximately 2 - 5 cm depth and an approximate width of 200 - 300 cm, at time of survey • <u>Midstream</u>: slow dry weather flow (almost stagnant) in the swampy area • Approximately 10 - 20 cm depth and width of 50-60cm at time of survey • <u>Downstream</u>: slow dry weather flow (almost stagnant) • Approximately 10 - 15 cm depth and an approximate width of 40 - 50 cm, at time of survey • <u>Outlet</u>: slow dry weather flow (estimated at 0.05 m/s) • Approximately 5-10 cm depth and width of 200 – 600 cm at time of survey 	WQ1 (upstream)	
			During Dry Weather	During Wet Weather
				
			WQ2 (midstream)	
During Dry Weather	During Wet Weather			
				

Waterbodies	Bank Characteristics	Water Flow Conditions	Photos	
		<ul style="list-style-type: none"> Water is clear and no smell <p>During wet weather condition:</p> <ul style="list-style-type: none"> <u>Upstream</u>: fast water flow draining from outside catchment was observed (estimated at around 2 m/s) Approximately 10 - 15 cm depth and an approximate width of 200 - 300 cm, at time of survey <u>Midstream</u>: fast flow in the swampy area (estimated at around 0.15 m/s) Approximately 20 - 30 cm depth expanding to the whole swampy area at time of survey <u>Downstream</u>: fast flow (estimated at around 0.26 m/s) Approximately 15 – 20 cm depth and an approximate width of 40 - 50 cm, at time of survey <u>Outlet</u>: fast flow (estimated at around 1.1 m/s) Approximately 20 - 30 cm depth and width of 600 – 700 cm at time of survey Water is clear and no smell 	WQ3 (downstream)	
			During Dry Weather	During Wet Weather
				
			WQ4 (outlet)	
			During Dry Weather	During Wet Weather
				

Waterbodies	Bank Characteristics	Water Flow Conditions	Photos	
			WQ7 (upstream)	
			During Dry Weather 	During Wet Weather 
Drain 1	Concrete roadside drain along the southwest boundary of the Study Area	<ul style="list-style-type: none"> • Originates from forest area in south of the Study Area and surrounding residential area • Ephemeral flow during wet weather condition only During dry weather condition: <ul style="list-style-type: none"> • Almost no flow During wet weather condition: <ul style="list-style-type: none"> • Water flow observed • Approximately 3 – 5 cm water depth • Water is clear and has no smell 	WQ5	
			During Dry Weather 	During Wet Weather 

Waterbodies	Bank Characteristics	Water Flow Conditions	Photos	
<p>Pond</p>	<p>Abandoned fish pond with earth bank covered by dense vegetation</p>	<ul style="list-style-type: none"> • Originates from Study Area <p>During dry weather</p> <ul style="list-style-type: none"> • Water is almost stagnant <p>During wet weather</p> <ul style="list-style-type: none"> • Water is almost stagnant with slightly increased water level compared to dry days 	<p>WQ6</p>	
			<p>During Dry Weather</p> 	<p>During Wet Weather</p> 

8.3.2 Water Quality Conditions in the Study Area

The water quality data were assessed based on relevant guideline and criteria as described in the section below.

8.3.2.1 Relevant Guidelines and Criteria for Water Quality

The baseline water quality of the waterbodies located within the Study Area was analysed against the NEA Trade Effluent Discharge limits for controlled watercourses (NEA,2008). This comparison could be used to determine whether the existing baseline water quality of the waterbodies within the Study Area complies with NEA limits or already exceeds these limits. To assess whether the water quality along the identified streams is suitable for aquatic life, certain parameters were compared to the international water quality criteria for aquatic life including United Nations Economic Commission for Europe (1994), World Health Organization (n.d.), United States Environmental Protection Agency (2017), Australian & New Zealand (ANZECC, 2000), Canada (2007), Philippines (PHILMINAQ, n.d.), and Malaysia (DOE, n.d.), which provides guidelines for the protection of aquatic life.

The relevant limits and guidelines for water quality parameters are summarised in Table 8-3; however, where no guidelines exist, the monitored results were considered as the baseline. Most of the parameters listed below were requirements of this study. For parameters listed below which do not have local criteria, international criteria were referred. Basic in-situ test parameters of water to identify water sources (e.g. fresh water/sea water intrusion etc.) were helpful in providing a better understanding of the water body even though it does not have a local or international criteria. The types of water sources were eventually identified based on the values obtained and with reference to appropriate publications/known values.

Table 8-3: Referenced Guidelines and Criteria.

Parameter	NEA Trade Effluent Discharge Limits ¹	Water Quality Criteria for Aquatic Life from other countries ²
pH	6 – 9	6.5 – 9
Temperature (°C)	45	-
Dissolved Oxygen, DO (mg/L)	-	> 4.0
Total Dissolved Solids, TDS (mg/L)	1000	1000
Salinity (ppt)	-	-
Conductivity (µS/cm)	-	-
Turbidity (NTU)	-	50
Total Nitrogen, TN (mg/L)	-	Eutrophic limit: 1.5
Total Phosphorous, TP (mg/L)	-	Eutrophic limit: 0.075
Ammonia, NH ₄ -N (mg/L)	-	1
Nitrate, NO ₃ -N (mg/L)	4.52 (equivalent to 20 as NO ₃)	10 (equivalent to 44 as NO ₃)
Orthophosphate, PO ₄ (mg/L)	2	< 0.1
Total Suspended Solids, TSS (mg/L)	30	50
Biological Oxygen Demand, BOD ₅ (mg/L) ³	20	< 3
Total Organic Carbon (TOC)	-	-
<i>Enterococcus</i> (cfu/100mL)	-	130 ⁴
Lead, Pb (µg/L)	100	Acute LOEL ⁵ : 82 Chronic LOEL: 3.2

Note:

1. Limits for discharge into a controlled watercourse
2. The sources includes Australian and New Zealand Environment and Conservation Council (ANZECC, 2000), Canadian Council of Ministers of the Environment (2007), Department of Environment of Malaysia (DOE, n.d.), United Nations Economic Commission for Europe (UNECE, 1994), World Health Organization (WHO, n.d.), United States Environmental Protection Agency (USEPA, 2017), United States Environmental Protection Agency (USEPA, 2012), and Mitigating Impact from Aquaculture in the Philippines (PHILMINAQ, n.d.).

Parameter	NEA Trade Effluent Discharge Limits ¹	Water Quality Criteria for Aquatic Life from other countries ²
3.	BOD5 is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material per litre of sample during 5 days of incubation at 20 °C.	
4.	Recreational Water Quality Criteria from USEPA requires that the Enterococcus count should be less than or equal to 130 counts per 100 millilitres of water	
5.	LOEL – Lowest Observed Effect Level	

8.3.2.2 Water Quality Baseline Results

Six (6) water quality stations (WQ1, 2, 3, 4, 6 and 7) were sampled for two (2) dry weather events and one (1) wet weather event, whereas station WQ5 was sampled only during wet weather event, as shown in Table 8-4 below. A total of nineteen (19) samples have been collected.

The in-situ and ex-situ water quality results are presented in Table 8-5 below. As described in Section 8.2.3, WQ5 was only sampled during wet weather due to its ephemeral flow condition. WQ7 provides in-situ water quality information in addition to the in-situ and ex-situ information collected from the other 4 sampling stations (i.e. WQ1 to 4) along the Natural Stream.

Table 8-4: Water Quality Monitoring Schedule.

Sampling Event Water Quality Assessment Location		Dry Weather		Wet Weather
		11 th Feb 2020	25 th Mar 2020	11 th Feb 2020
Natural Stream	WQ1	√	√	√
	WQ2	√	√	√
	WQ3	√	√	√
	WQ4	√	√	√
	WQ7*	√	√	√
Drain 1	WQ5	-	-	√
Pond	WQ6	√	√	√

Notes:

√ indicates that the station has been sampled

- indicates that sampling not required

* indicates that only the in-situ data was collected

Table 8-5: Surface Water Quality Results (NA-Not Available; Red Values-exceed limits/criteria).

Parameter	Dry						Wet							Average	NEA Allowable Limits ¹	Water Quality Criteria for Aquatic Life from other countries ²
	WQ1	WQ2	WQ3	WQ4	WQ6	WQ7	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7			
Temperature (°C)	28.4	27.7	26.4	26.5	26.7	28.0	27.9	27.9	26.9	27.2	29.4	27.6	27.8	27.6	45	NA
pH	7.24	7.12	6.53	6.55	5.71	7.64	7.77	7.75	6.77	6.95	8.80	5.87	7.91	7.12	6 – 9	6.5 – 9
Salinity (PSU)	0.13	0.20	0.18	0.18	0.15	0.21	0.040	0.040	0.120	0.090	0.070	0.100	0.030	0.118	NA	NA
Conductivity (µS/cm)	206.14	300.41	282.73	284.85	223.50	314.48	101.68	84.88	265.50	209.90	154.06	223.74	81.60	210.27	NA	NA
Total Dissolved Solids, TDS (mg/L)	126	186	179	180	141	194	63	52	166	131	92	138	50	131	1000	1000
DO (mg/L)	6.78	0.77	1.42	1.15	1.29	3.57	7.44	7.15	1.57	2.45	7.90	5.75	7.38	4.20	NA	>4
Turbidity (NTU)	1.4	3.5	1.9	12.0	9.9	NA	15.0	18.0	6.7	8.8	13.0	16.0	NA ³	8.9	NA	50
Total Suspended Solids, TSS (mg/L)	3.0	8.0	1.7	13.8	2.8	NA	6.0	13.0	4.0	2.0	2.0	7.0	NA ³	6.1	30	50
Total Nitrogen, TN (mg/L)	1.60	3.43	0.51	0.62	0.50	NA	1.48	1.21	0.86	0.74	1.17	0.81	NA ³	1.22	NA	Eutrophic limit: 1.5
Nitrate as NO ₃ -N (mg/L)	0.72	0.53	0.01	0.06	0.20	NA	0.75	0.64	0.12	0.18	0.14	0.21	NA ³	0.30	NA	10
Ammonia as NH ₄ -N (mg/L)	0.37	2.01	0.10	0.21	0.05	NA	0.21	0.12	0.34	0.22	0.03	0.07	NA ³	0.36	NA	1
Total Phosphorous, TP (mg/L)	0.062	0.123	0.065	0.071	0.034	NA	0.089	0.049	0.081	0.240	0.088	0.031	NA ³	0.081	NA	Eutrophic limit: 0.075
Orthophosphate as PO ₄ (mg/L)	0.086	0.160	0.103	0.104	0.038	NA	0.130	0.100	0.150	0.120	0.190	0.050	NA	0.117	5	<0.1

Parameter	Dry						Wet							Average	NEA Allowable Limits ¹	Water Quality Criteria for Aquatic Life from other countries ²
	WQ1	WQ2	WQ3	WQ4	WQ6	WQ7	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7			
Biochemical Oxygen Demand, BOD ₅ (mg/L)	1.34	1.70	<1	1.40	<1	NA	2.19	2.35	1.24	1.28	1.56	1.58	NA	1.54	50	<3
Total Organic Carbon, TOC (mg/L)	3.41	4.71	4.76	4.78	2.16	NA	4.04	3.91	5.87	5.29	11.1	3.06	NA	5.28	NA	NA
Enterococcus (cfu/100ml)	0	965	1055	1005	330	NA	10	12000	10000	11000	12000	17000	NA	5615	NA	130 ⁴
Lead, Pb (µg/L)	<0.5	<0.5	<0.5	<0.5	0.6	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA	0.6	100	Acute LOEL ⁵ : 82 Chronic LOEL ⁵ : 3.2

Note:

- Limits for discharge into a controlled watercourse
- The sources includes Australian and New Zealand Environment and Conservation Council (ANZECC, 2000), Canadian Council of Ministers of the Environment (2007), Department of Environment of Malaysia (DOE, n.d.), United Nations Economic Commission for Europe (UNECE, 1994), World Health Organization (WHO, n.d.), United States Environmental Protection Agency (USEPA, 2017), United States Environmental Protection Agency (USEPA, 2012), and Mitigating Impact from Aquaculture in the Philippines (PHILMINAQ, n.d.).
- NA – Not Available. As mentioned in Section 8.3.3, only in-situ measurement was carried out at WQ7.
- Recreational Water Quality Criteria from USEPA requires that the Enterococcus count should be less than or equal to 130 counts per 100 millilitres of water
- LOEL – Lowest Observed Effect Level

The Natural Stream has perennial shallow flow and supports aquatic life, while the concrete Drain 1 has ephemeral flow and unlikely supports any aquatic life. Hence, water quality of all stations were compared against criteria for aquatic life, while WQ5 was compared against NEA guidelines. As Drains 1 and 2 are similar, only Drain 1 was surveyed in detail.

Generally, the existing baseline surface water quality (i.e. Temperature, TSS, BOD₅, PO₄ and Pb) at all water quality stations met the NEA guidelines as shown in Table 8-3. The current baseline as observed in this situation can be used to refer to the baseline water quality during development phases. For pH, most stations met the NEA guidelines, with the exception of WQ6 which is located at the abandoned Fish Farm within swampy area.

As shown in Figure 8-7, water temperature across all water quality stations during both dry and wet conditions ranged from 26.4 °C – 29.4 °C, which is below the NEA limit of 45°C.

Besides the NEA criteria for trade effluent regulations, in cases of water bodies in a natural ecosystem, a baseline water quality should be compared to international water quality standards for aquatic water bodies in order to assess its appropriateness to support aquatic life. The pH of the streams within the Study Area did not vary significantly, ranging from 5.71 to 8.80, with an average of 7.12. WQ6, located at the abandoned fish farm, has slightly lower pH compared to other stations. Although pH range of NEA guideline is 6 to 9, our baseline pH data were consistent with a previous study, which showed pH generally ranged from 4 to 9 in Singapore drain/streams (Blakely, 2014). This may due to the stagnant water condition with accumulated humic acid decomposed from forest debris. Generally, pH did not vary a lot during dry and wet weather days.

The conductivity of water is strongly dependent on the number of ions available to participate in the conduction process. This parameter positively correlated to salinity which measures the amount of salts dissolved in water and TDS (i.e. a measurement of the amount of all dissolved solids). The salinity, conductivity and TDS of the waterbodies found within the study were low (i.e. less than 0.21 PSU, 314.48 µS/cm and 194 mg/L, respectively), which confirmed prevalence of freshwater, given that seawater generally has salinity of around 35 PSU (Pawlowicz, 2013), conductivity of around 3.31×10^6 µS/m (Tyler, 2017) and TDS of around 35,000 mg/L (USEPA, n.d.)

Decomposition of organic matter from forest vegetation is inevitable in natural streams surrounded by vegetation which could in turn possibly result in the depletion of DO in the water. This is indicated by the low DO measurements found at Natural Stream during dry weather, ranging from 0.77 to 6.78 mg/L. Except for WQ1, all the stations (i.e. WQ2, WQ3, WQ4 and WQ7) along Natural Stream had DO lower than 4 mg/L due to lower flow rate or even stagnant conditions. According to water quality criteria for aquatic life, DO below 4 mg/L may lead to stressful conditions for aquatic life. However, previous studies (Blakely, 2014) have shown that DO lower than 4 mg/L was normal in natural streams of Singapore, which is consistent with our study. This could be an indication that freshwater aquatic life may have adapted to low DO below 4 mg/L. During wet weather, DO increased at all the stations due to the aeration effects brought by the heavy storm.

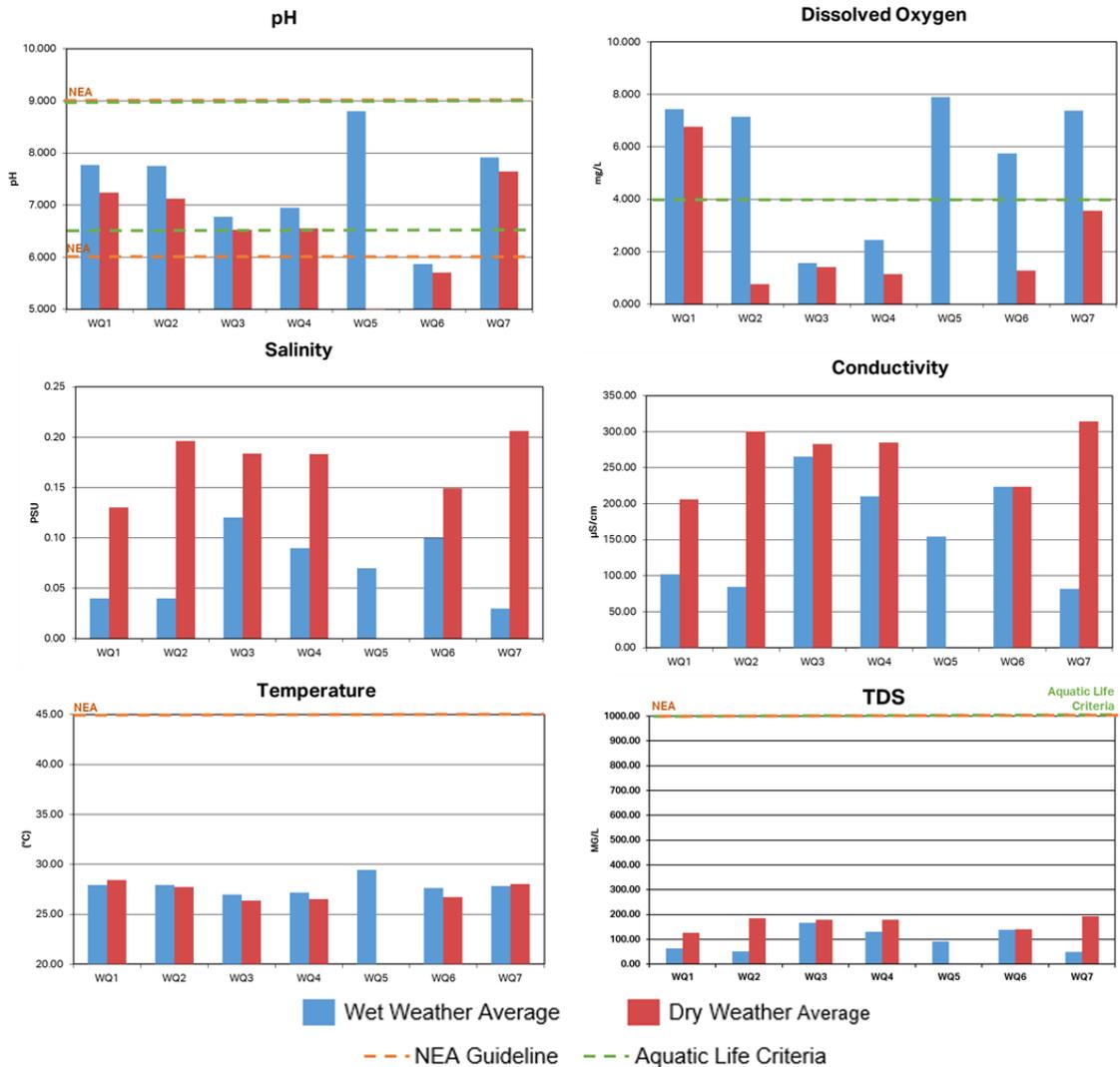


Figure 8-7: Average Monitoring Results of in-situ Parameters for Wet and Dry Weather Conditions.

As shown in Figure 8-8, the turbidity of dry day samples in the Natural Stream and Pond (i.e. WQ1 to WQ6) was below 15 Nephelometric Turbidity Units (NTU), which indicates that the waterbodies may be clear enough to support aquatic life. During wet weather, the turbidity of WQ1, WQ2, WQ3 and WQ6) was slightly higher than their dry weather counterparts, which could be due to resuspended sediment from the stream bed when the water is disturbed, or soil is flushed from the surrounding forest during a storm event. The turbidity of WQ4 was slightly lower during wet weather due to the stormwater dilution effects. Similarly, Total Suspended Solids (TSS) concentration was below 14 mg/L within the NEA limits (i.e. 30 mg/L), indicating clear water conditions in all the waterbodies.

Total Nitrogen (TN) had an average concentration of 1.22 mg/L, ranging from 0.50 mg/L to 3.43 mg/L. USEPA Nutrient Criteria Guidance suggests that eutrophic limit of TN in rivers or streams is 1.5 mg/L. During dry days, only WQ1 and WQ2 had TN above 1.5 mg/L, indicating eutrophication may exist in the upstream and swampy area of Natural Stream. As WQ1 is located at the beginning of concrete drain, which receives water from surrounding urban residential area, it suggests that the relatively high TN content at WQ1 and WQ2 might come from human activities upstream. This is consistent with site observation which showed greenish water colour with algae growing (refer to photos of WQ 1 and WQ2 in Table 8-2). During wet days, the storm diluted the TN concentration at upstream portion of the Natural Stream and increased TN concentration at WQ3, WQ4 and WQ6, which are located in the pond and downstream of Natural Stream. During the site survey, it is observed that some farming activities were being carried out in the vicinity of the swampy area and fertilizer might be used during farming activities. This indicates that the additional source for the increased TN at mid- and downstream of Natural Stream during wet days might come from farming activities.

NO₃-N (Nitrate) had an average concentration of 0.30 mg/L, ranging from below 0.01 mg/L to 0.75 mg/L. NH₄-N (Ammonia) had an average concentration of 0.36 mg/L, ranging from 0.03 mg/L to 2.01 mg/L. With a measurement of 2.01 mg/L of NH₄-N, WQ2 has exceeded the water quality criteria for aquatic life. This indicates eutrophication at the swampy area of Natural Stream.

Total Phosphorus (TP) had an average concentration of 0.081 mg/L, ranging from 0.031 mg/L to 0.240 mg/L, without significant variation within the Study Area. The average concentration of PO₄ (Orthophosphate) was 0.117 mg/L, ranging from 0.038 mg/L to 0.190 mg/L. Compared with water quality criteria for aquatic life, TP at WQ1, WQ3, WQ4 and WQ5 exceeded the eutrophication limit (i.e. 0.075 mg/L) temporarily during wet days, while PO₄ exceeded the limit (i.e. 0.1 mg/L) along the whole Natural Stream (i.e. WQ1 to WQ4). Phosphorus data show high eutrophication potential in Natural Stream again, which is consistent with the site observation of greenish waterbodies with algae (refer to photos in Table 8-2). The source of phosphorus may come from both upstream residential area (e.g. fertilizer from tree plantation, food wastes, etc.) as well as the fertilizer from farming activities within the Study Area.

Biochemical Oxygen Demand (BOD₅) at all water quality stations were below 3 mg/L and met the NEA guidelines, implying a low concentration of organics within the streams and good quality of water. This can also be deduced from the low Total Organic Carbon (TOC) concentration, which was lower than 12 mg/L at sampling locations. Both TOC and BOD₅ slightly increased during the storm event. This suggests that TOC flushed from the surrounding environment mainly consists of organic compounds that are easily digested by microorganisms.

Enterococcus counts, which indicates possible human or animal faecal pollution in the streams, ranged from 0 to 17,000 cfu/100ml with an average value of 5615 cfu/100ml in the waterbodies in the Study Area. The USEPA Recreational Water Quality Guidelines requires enterococcus to be below 130 cfu/100ml. However, it should be noted that all waterbodies are not expected to hold any recreational activities that involve direct human contact. Among the sampling stations, WQ1 which was located at upstream of the Natural Stream had the lowest enterococcus counts (below 10 cfu/100ml) during both dry and wet days, indicating the enterococcus contaminant source did not come from the upstream urban area. However, all the other sampling stations (i.e. WQ2 to WQ6) had sharply increased enterococcus after a heavy storm event. This indicates that the contaminant source mainly originates from the forest/swampy area in the Study Area, showing human/animal faecal intervention somewhere between WQ1 and WQ2.

Lead (Pb) was always below detection limit (i.e. 0.5 µg/L), except for WQ6 during dry weather. This indicates low Pb pollution and less impact from modern anthropogenic activities within this Study Area. Although farming activities were observed in the Study Area, it is unlikely to contribute heavy metals into the Study Area.

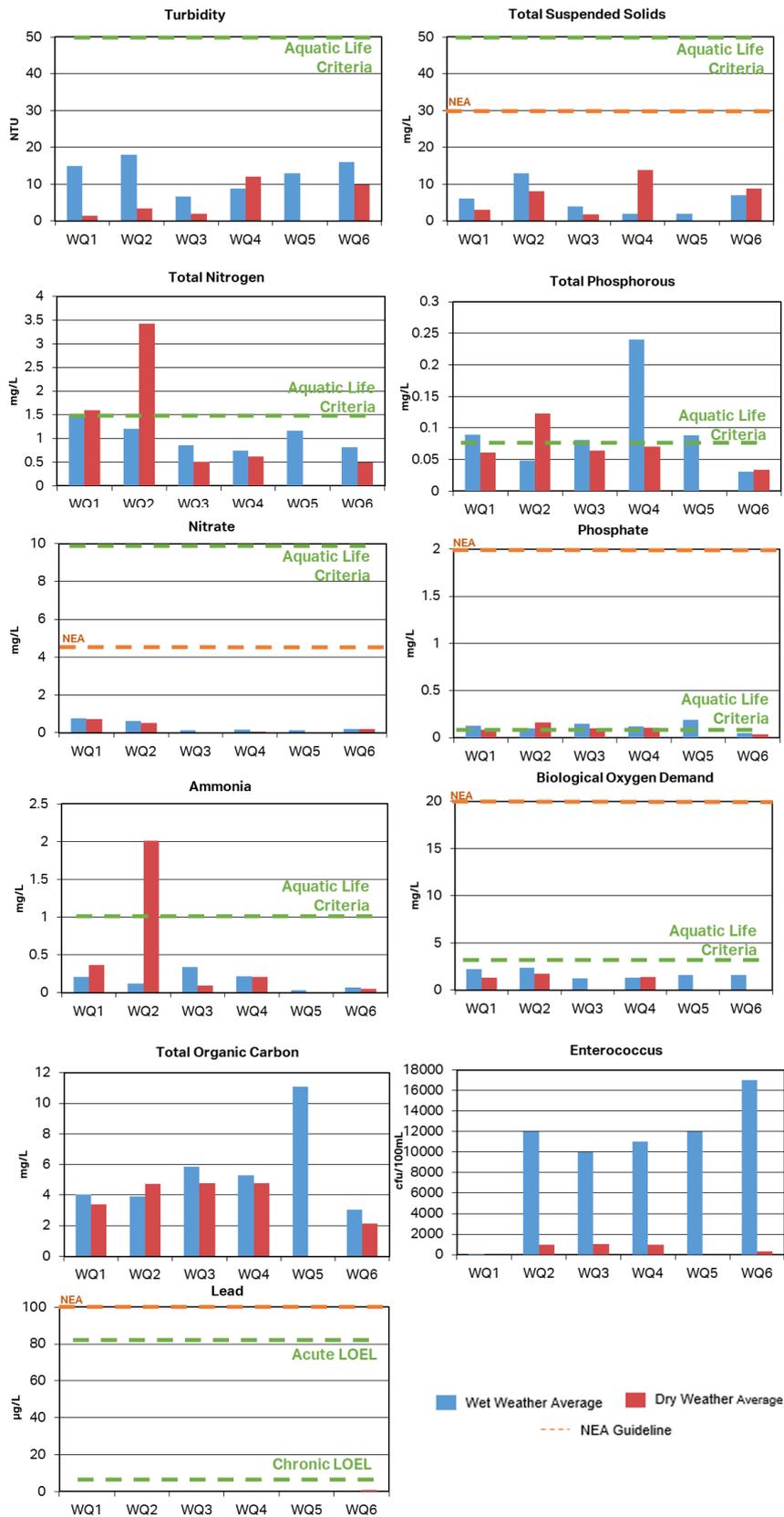


Figure 8-8: Average Monitoring Results of ex-situ parameters for Wet and Dry Weather Conditions.

8.4 Summary of Key Findings

Based on the baseline studies, below are the key findings.

While the hydrology and water quality baseline study aimed to identify waterbodies present in the Study Area and their location, water flow conditions and bank characteristics, the water quality surveys determined the quality of water in these surface waterbodies.

Based on topographic survey data and site survey, water catchment areas within the vicinity of the Study Area mainly contribute water to the identified Natural Stream, Drain 1 and Drain 2. The Natural Stream flows perennially across the Study Area from west to east, being a concrete drain upstream, swampy area at midstream and earth stream at downstream before concluding at the concrete culvert discharge outlet. It collects surface runoff from the upstream urban area to the west of the Study Area as well as from the sub-catchment within the Study Area. Drain 1 and Drain 2 are concrete roadside drains with ephemeral flow running along the south boundary of the Study Area and collecting storm runoff from south of the Study Area. There is also an abandoned fish pond connecting to the swampy area and slowly discharging to the west of Natural Stream. In order to assess the water quality in the Study Area, at upstream, midstream and downstream levels, five (5) water quality sampling stations were surveyed along the Natural Stream, one (1) station at Drain 1 and one (1) at the Pond, making a total of seven (7) sampling locations in the area.

Water samples were tested for parameters including temperature, pH, salinity, conductivity, DO, turbidity, TSS, TDS, BOD₅, TOC, TN, NO₃-N, NH₄-N, TP, PO₄, enterococcus and lead. Between dry and wet conditions, there were fluctuations, as sudden storm events potentially affected these parameters due to flushing, dilution, and/or aeration effects that these storms bring.

Results were compared with both NEA discharge guidelines in Singapore and criteria for aquatic life from other countries. According to NEA discharge guidelines, temperature, TSS, BOD₅, PO₄ and Pb could meet the discharge limits at all sampling locations. Temperature did not vary much across all the sampling stations or between dry and wet days. Although pH in the natural streams was slightly lower than the NEA guidelines, it was consistent with a previous study which showed pH generally ranged from 4 to 9 in Singapore drain/streams. Given that the area is far from the influence of the sea, the salinity, conductivity and TDS of the water confirmed the prevalence of freshwater. DO was lower than 4 mg/L (i.e. water quality criteria for aquatic life) due to the decomposition of organic matter from forest vegetation. However, previous studies have also shown DO below 4 mg/L among Singapore nature streams, indicating that freshwater aquatic life may have adapted to such low DO environments in Singapore. Low turbidity, TSS, and Pb indicated clear water and low contamination from modern anthropogenic activities. Nutrients (i.e. TN, NH₄-N, TP and PO₄) were slightly high in Natural Stream, indicating that eutrophication has occurred in Natural Stream and this is consistent with greenish water with algae observed during site survey. Elevated enterococcus counts were observed at parts of the Natural Stream. For instance, low enterococcus counts were recorded at WQ1, while there was a sudden increase after WQ2 along the Natural Stream. This could be due to slow dry weather flow at midstream and the flushing of faecal contaminants from surrounding forest and swampy area in the Study Area.

From the results of the hydrological and water quality assessment, it can be inferred that the natural stream was generally perennial (fed from stormwater) with eutrophication conditions. This may pose stress to the aquatic life in the Study Area.

9. Conclusion

This report provides the baseline results on the biodiversity, hydrology and water quality studies which were carried out from December 2019 to July 2020. The baseline findings are summarized as below.

The Study Area is characterised largely by disturbed vegetation which are widespread and common in other forested areas of Singapore. Because of this, most of the fauna species recorded here are adapted to disturbed habitats and can also be commonly found in other areas of Singapore. The Study Area does not support a particularly high native species richness in a local context and is not considered an ecologically significant site in Singapore. However, there are findings that show that the abandoned-land forest, swampy scrubland, and a bamboo cluster (BB_01A) in the young secondary forest are important for both flora and fauna.

The abandoned-land forest and edges of the swampy scrubland supports several flora species of conservation significance, including the nationally critically endangered *Bintangaur laut* (*Calophyllum inophyllum*) and vulnerable *Buas buas* (*Premna serratifolia*). These coastal species are nationally threatened and are more often found in coastal habitats on the offshore islands of Singapore, such as St. John's Island and Pulau Tekukor. Hence, there is value in exploring ways to conserve coastal-associated species so that they continue to persist on the mainland, so as to help the native stocks remain genetically-diverse. This in turn could increase the resistance and ability of species to adapt in face of changing climatic conditions (Reusch et al., 2005; Leger & Espeland, 2010). In the long run, they could contribute to important ecosystem functions and services that may benefit humans (e.g., Li et al., 2010 and Samah et al., 2014). The abandoned-land forest also hosts several large stranglers and trees.

Bamboo bats (*Tylonycteris* spp.) were found during roost emergence surveys at bamboo cluster BB_01A (Figure 7-55). This genus of bats may include the nationally critically endangered lesser bamboo bat (*T. fulvida*), which may also be found in other forested areas in Singapore. Therefore, this bamboo cluster should be considered a specimen of importance.

The hydrology and water quality baseline study aimed to identify waterbodies present in the Study Area and their location, water flow conditions and bank characteristics, the water quality surveys determined the quality of water in these surface water bodies. Based on topographic survey data and site analysis, water catchment areas within the vicinity of the Study Area mainly contribute water to the identified Natural Stream and drains. The Natural Stream covered flows perennially across the Study Area from west to east, being a concrete drain upstream, swampy area at midstream and natural stream at downstream before concluding at the concrete culvert discharge outlet. It collects surface runoff from the upstream urban area to the west of the Study Area as well as from the sub-catchment within the Study Area. Natural Stream has perennial flow with low water flow (i.e. almost stagnant at Midstream and slightly faster at Upstream and Outlet) observed during dry weather and fast flowing water along the whole stream during wet weather. The Drain 1 and Drain 2 are concrete roadside drains with ephemeral flow running along the south boundary of the Study Area and collecting storm runoff from south of the Study Area. These drains have higher flow velocity observed during wet weather and almost dry during no rain period. There is also an abandoned fishpond connecting to the swampy area and slowly discharging to the west of Natural Stream. This fishpond has almost stagnant water during both dry and wet conditions.

In order to assess the water quality in the Study Area, at upstream, midstream and downstream levels, five (5) water quality sampling stations were surveyed along the Natural Stream, one (1) station at the Drain 1 and one (1) at the Pond, making a total of seven (7) sampling locations in the area. Water samples were tested for parameters including temperature, pH, salinity, conductivity, DO, turbidity, TSS, TDS, BOD₅, TOC, TN, NO₃-N, NH₄-N, TP, PO₄, enterococcus and lead. Between dry and wet conditions, there were fluctuations, as sudden storm events potentially affected these parameters due to flushing, dilution, and/or aeration effects that these storms bring. From the results of the hydrological and water quality assessment, it can be inferred that the Natural Stream was generally perennial (fed from stormwater) with eutrophication conditions. This may pose stress to the aquatic life in the Study Area. However, this Natural Stream, which runs through the swampy scrubland, still supports several stream-dependent faunal species, some of which are nationally threatened, such as the critically endangered red-tailed pipe snake (*Cylindrophis ruffus*) and endangered buffy fish owl (*Ketupa ketupu*). The straw-headed bulbul (*Pycnonotus zeylanicus*), which is a globally critically endangered and locally endangered species that was frequently encountered in the targeted field surveys, is also known to be associated to riparian habitats.

Based on the key findings, the proposed core biodiversity area in the Study Area is marked out. This includes the riparian habitats that flank both sides of the stream as they form an integral component of aquatic environments that provide numerous ecological services, such as the provision of food sources and habitats for fauna such as

the red-tailed pipe snake (*C. ruffus*) (Kupfer et al., 2003), as well as the maintenance of water quality via the infiltration of surface runoff. The buffer zone is at least 30 m in width to ensure bank stability (Buffler et al., 2005; Jontos, 2004). To preserve the microclimate of the bamboo cluster to minimise disturbance to the bamboo bats, a 30-m buffer of vegetation has also been delineated around bamboo cluster BB_01A.

While flora specimens and flora of conservation significance can be found throughout the abandoned-land forest, it may be unrealistic to retain the abandoned-land forest in its entirety as it comprises a third of the Study Area. Therefore, the portion of this forest patch closest to the stream with a 15-m buffer should be prioritised as the proposed core biodiversity area. This allows for some large trees, stranglers, and individuals of threatened coastal species to be conserved, including the two aforementioned species. The largest strangler on site—a *Ficus microcarpa* with a spread of up to 50 m—will also be retained. A contiguous conservation zone can be achieved by connecting the stream, abandoned-land forest, and bamboo cluster (BB_01A) habitats, which may preserve a higher habitat quality compared to retaining fragmented forest patches (de Paula et al., 2016).

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Appendix A

List of Plant Species

A (Plant species list)

Site	Species	Family	Origin	Status	Habit
Yishun N5	<i>Acacia auriculiformis</i>	Fabaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Acalypha wilkesiana</i>	Euphorbiaceae	Exotic	Not assessed	Shrub
Yishun N5	<i>Acrostichum aureum</i>	Pteridaceae	Native	Common	Herb
Yishun N5	<i>Adenanthera pavonina</i>	Fabaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Adiantum latifolium</i>	Adiantaceae	Exotic	Naturalised	Herb
Yishun N5	<i>Agelaea macrophylla</i>	Connaraceae	Native	Critically Endangered	Climber
Yishun N5	<i>Alocasia macrorrhizos</i>	Araceae	Exotic	Naturalised	Herb
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree
Yishun N5	<i>Amphineuron opulentum</i>	Thelypteridaceae	Native	Endangered	Climber
Yishun N5	<i>Archidendron jiringa</i>	Fabaceae	Native	Vulnerable	Tree
Yishun N5	<i>Artocarpus heterophyllus</i>	Moraceae	Exotic	Casual	Tree
Yishun N5	<i>Artocarpus integer</i>	Moraceae	Exotic	Casual	Tree
Yishun N5	<i>Asplenium longissimum</i>	Aspleniaceae	Native	Common	Epiphyte
Yishun N5	<i>Asplenium nidus</i>	Aspleniaceae	Native	Common	Epiphyte
Yishun N5	<i>Asystasia gangetica</i> ssp. <i>micrantha</i>	Acanthaceae	Exotic	Naturalised	Herb
Yishun N5	<i>Axonopus compressus</i>	Poaceae	Exotic	Naturalised	Herb
Yishun N5	<i>Baccaurea motleyana</i>	Phyllanthaceae	Native	Critically Endangered	Tree
Yishun N5	<i>Bambusa heterostachya</i>	Poaceae	Exotic	Casual	Shrub
Yishun N5	<i>Bambusa vulgaris</i>	Poaceae	Exotic	Casual	Shrub
Yishun N5	<i>Bridelia tomentosa</i>	Phyllanthaceae	Native	Common	Tree
Yishun N5	<i>Calophyllum inophyllum</i>	Calophyllaceae	Native	Critically Endangered	Tree
Yishun N5	<i>Caryota mitis</i>	Arecaceae	Native	Common	Tree
Yishun N5	<i>Casuarina equisetifolia</i>	Casuarinaceae	Native	Common	Tree
Yishun N5	<i>Cayratia trifolia</i>	Vitaceae	Native	Vulnerable	Climber
Yishun N5	<i>Cecropia pachystachya</i>	Urticaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Centotheca lappacea</i>	Poaceae	Native	Critically Endangered	Herb
Yishun N5	<i>Centrosema molle</i>	Fabaceae	Exotic	Naturalised	Climber
Yishun N5	<i>Cheilocostus speciosus</i>	Costaceae	Native	Common	Herb
Yishun N5	<i>Chromolaena odorata</i>	Asteraceae	Exotic	Naturalised	Herb
Yishun N5	<i>Cinnamomum iners</i>	Lauraceae	Native	Common	Tree
Yishun N5	<i>Cissus hastata</i>	Vitaceae	Cryptogenic	-	Climber
Yishun N5	<i>Claoxylon indicum</i>	Euphorbiaceae	Native	Common	Tree
Yishun N5	<i>Clausena excavata</i>	Rutaceae	Native	Common	Shrub
Yishun N5	<i>Clerodendrum laevifolium</i>	Lamiaceae	Native	Common	Shrub
Yishun N5	<i>Clidemia hirta</i>	Melastomataceae	Exotic	Naturalised	Shrub
Yishun N5	<i>Coccinia grandis</i>	Cucurbitaceae	Exotic	Naturalised	Climber
Yishun N5	<i>Cocos nucifera</i>	Arecaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Connarus semidecandrus</i>	Connaraceae	Native	Critically Endangered	Climber
Yishun N5	<i>Cordyline fruticosa</i>	Asparagaceae	Exotic	Casual	Shrub
Yishun N5	<i>Davallia denticulata</i>	Davalliaceae	Native	Common	Epiphyte
Yishun N5	<i>Derris trifoliata</i>	Fabaceae	Native	Common	Climber
Yishun N5	<i>Desmodium heterophyllum</i>	Fabaceae	Cryptogenic	-	Herb
Yishun N5	<i>Desmodium triflorum</i>	Fabaceae	Cryptogenic	-	Herb
Yishun N5	<i>Dieffenbachia seguine</i> var. <i>seguine</i>	Araceae	Exotic	Casual	Herb
Yishun N5	<i>Dillenia suffruticosa</i>	Dilleniaceae	Native	Common	Shrub
Yishun N5	<i>Dimocarpus longan</i>	Sapindaceae	Exotic	Casual	Tree
Yishun N5	<i>Dimocarpus longan</i> ssp. <i>malesianus</i>	Sapindaceae	Exotic	Casual	Tree
Yishun N5	<i>Dracaena fragrans</i>	Asparagaceae	Exotic	Casual	Shrub
Yishun N5	<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Tree

A (Plant species list)

Yishun N5	<i>Eclipta prostrata</i>	Asteraceae	Exotic	Naturalised	Herb
Yishun N5	<i>Elaeis guineensis</i>	Arecaceae	Exotic	Cultivated Only	Tree
Yishun N5	<i>Embelia ribes</i>	Myrsinaceae	Native	Common	Climber
Yishun N5	<i>Emilia sonchifolia</i>	Asteraceae	Cryptogenic	-	Herb
Yishun N5	<i>Epipremnum amplissimum</i>	Araceae	Exotic	Cultivated Only	Herb
Yishun N5	<i>Epipremnum pinnatum</i>	Araceae	Native	Critically Endangered	Climber
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	Strangler
Yishun N5	<i>Ficus fistulosa</i>	Moraceae	Native	Common	Tree
Yishun N5	<i>Ficus heteropleura</i>	Moraceae	Native	Common	Climber
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler
Yishun N5	<i>Ficus variegata</i>	Moraceae	Native	Common	Tree
Yishun N5	<i>Gnetum gnemon</i> var. <i>gnemon</i>	Gnetaceae	Native	Critically Endangered	Tree
Yishun N5	<i>Gynochthodes umbellata</i>	Rubiaceae	Native	Common	Climber
Yishun N5	<i>Hedyotis auricularia</i>	Rubiaceae	Native	Common	Herb
Yishun N5	<i>Heliconia psittacorum</i>	Heliconiaceae	Exotic	Casual	Herb
Yishun N5	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Epiphyte
Yishun N5	<i>Imperata cylindrica</i>	Poaceae	Cryptogenic	-	Herb
Yishun N5	<i>Ipomoea cairica</i>	Convolvulaceae	Exotic	Naturalised	Climber
Yishun N5	<i>Ischaemum muticum</i>	Poaceae	Native	Common	Herb
Yishun N5	<i>Kyllinga nemoralis</i>	Cyperaceae	Cryptogenic	-	Herb
Yishun N5	<i>Leea indica</i>	Vitaceae	Native	Common	Shrub
Yishun N5	<i>Legazpia polygonoides</i>	Linderniaceae	Cryptogenic	-	Herb
Yishun N5	<i>Leucaena leucocephala</i>	Fabaceae	Exotic	Naturalised	Shrub
Yishun N5	<i>Limacia scandens</i>	Menispermaceae	Native	Vulnerable	Climber
Yishun N5	<i>Lindernia crustacea</i>	Linderniaceae	Cryptogenic	-	Herb
Yishun N5	<i>Litsea firma</i>	Lauraceae	Native	Vulnerable	Tree
Yishun N5	<i>Ludwigia octovalvis</i>	Onagraceae	Cryptogenic	-	Herb
Yishun N5	<i>Lygodium flexuosum</i>	Schizaeaceae	Native	Common	Climber
Yishun N5	<i>Macaranga gigantea</i>	Euphorbiaceae	Native	Common	Tree
Yishun N5	<i>Mallotus paniculatus</i>	Euphorbiaceae	Native	Common	Tree
Yishun N5	<i>Mangifera odorata</i>	Anacardiaceae	Native	Vulnerable	Tree
Yishun N5	<i>Manihot carthagenensis</i> ssp. <i>glaziovii</i>	Euphorbiaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Manihot esculenta</i>	Euphorbiaceae	Exotic	Naturalised	Herb
Yishun N5	<i>Manilkara zapota</i>	Sapotaceae	Exotic	Cultivated Only	Tree
Yishun N5	<i>Megathyrsus maximus</i>	Poaceae	Exotic	Naturalised	Herb
Yishun N5	<i>Melastoma malabathricum</i>	Melastomataceae	Native	Common	Shrub
Yishun N5	<i>Melothria pendula</i>	Cucurbitaceae	Exotic	Not assessed	Climber
Yishun N5	<i>Mikania micrantha</i>	Asteraceae	Exotic	Naturalised	Climber
Yishun N5	<i>Mimosa pudica</i>	Fabaceae	Exotic	Naturalised	Shrub
Yishun N5	<i>Muntingia calabura</i>	Malvaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Nephelium lappaceum</i>	Sapindaceae	Native	Critically Endangered	Tree
Yishun N5	<i>Nephrolepis biserrata</i>	Oleandraceae	Cryptogenic	-	Herb
Yishun N5	<i>Ottochloa nodosa</i>	Poaceae	Native	Common	Herb
Yishun N5	<i>Oxyceros longiflorus</i>	Rubiaceae	Native	Vulnerable	Climber
Yishun N5	<i>Paederia foetida</i>	Rubiaceae	Native	Common	Climber
Yishun N5	<i>Pandanus amaryllifolius</i>	Pandanaceae	Exotic	Casual	Herb
Yishun N5	<i>Panicum repens</i>	Poaceae	Native	Common	Herb
Yishun N5	<i>Passiflora suberosa</i>	Passifloraceae	Exotic	Naturalised	Climber

A (Plant species list)					
Yishun N5	<i>Persicaria chinensis</i> var. <i>chinensis</i>	Polygonaceae	Exotic	Naturalised	Herb
Yishun N5	<i>Piper sarmentosum</i>	Piperaceae	Native	Common	Climber
Yishun N5	<i>Polyalthia longifolia</i>	Annonaceae	Exotic	Cultivated Only	Tree
Yishun N5	<i>Premna serratifolia</i>	Lamiaceae	Native	Vulnerable	Climber
Yishun N5	<i>Ruellia repens</i>	Acanthaceae	Cryptogenic	-	Herb
Yishun N5	<i>Sauropus androgynus</i>	Phyllanthaceae	Native	Common	Herb
Yishun N5	<i>Spathodea campanulata</i>	Bignoniaceae	Exotic	Naturalised	Tree
Yishun N5	<i>Stenochlaena palustris</i>	Blechnaceae	Native	Common	Climber
Yishun N5	<i>Syngonium podophyllum</i>	Araceae	Exotic	Naturalised	Climber
Yishun N5	<i>Syzygium borneense</i>	Myrtaceae	Native	Common	Tree
Yishun N5	<i>Syzygium grande</i>	Myrtaceae	Native	Common	Tree
Yishun N5	<i>Syzygium lineatum</i>	Myrtaceae	Native	Common	Tree
Yishun N5	<i>Syzygium myrtifolium</i>	Myrtaceae	Native	Extinct	Shrub
Yishun N5	<i>Syzygium polyanthum</i>	Myrtaceae	Native	Vulnerable	Tree
Yishun N5	<i>Syzygium zeylanicum</i>	Myrtaceae	Native	Common	Shrub
Yishun N5	<i>Telosma cordata</i>	Apocynaceae	Exotic	Cultivated Only	Climber
Yishun N5	<i>Terminalia catappa</i>	Combretaceae	Native	Common	Tree
Yishun N5	<i>Tetracera indica</i>	Dilleniaceae	Native	Common	Climber
Yishun N5	<i>Theobroma cacao</i>	Malvaceae	Exotic	Cultivated Only	Tree
Yishun N5	<i>Thunbergia fragrans</i>	Acanthaceae	Exotic	Naturalised	Climber
Yishun N5	<i>Tinospora crispa</i>	Menispermaceae	Exotic	Casual	Climber
Yishun N5	<i>Uncaria gambir</i>	Rubiaceae	Exotic	Naturalised	Climber
Yishun N5	<i>Vitex pinnata</i>	Lamiaceae	Native	Common	Tree
Yishun N5	<i>Youngia japonica</i>	Asteraceae	Exotic	Naturalised	Herb

Appendix B

List and Locations of
Plant Specimens of
Conservation
Significance

B1 (CS species list)

Site	Species	Family	Origin	Status	Habit
Yishun N5	<i>Agelaea macrophylla</i>	Connaraceae	Native	Critically Endangered	Climber
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree
Yishun N5	<i>Amphineuron opulentum</i>	Thelypteridaceae	Native	Endangered	Climber
Yishun N5	<i>Calophyllum inophyllum</i>	Calophyllaceae	Native	Critically Endangered	Tree
Yishun N5	<i>Cayratia trifolia</i>	Vitaceae	Native	Vulnerable	Climber
Yishun N5	<i>Centotheca lappacea</i>	Poaceae	Native	Critically Endangered	Herb
Yishun N5	<i>Connarus semidecandrus</i>	Connaraceae	Native	Critically Endangered	Climber
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Epiphyte
Yishun N5	<i>Limacia scandens</i>	Menispermaceae	Native	Vulnerable	Climber
Yishun N5	<i>Litsea firma</i>	Lauraceae	Native	Vulnerable	Tree
Yishun N5	<i>Oxyceros longiflorus</i>	Rubiaceae	Native	Vulnerable	Climber
Yishun N5	<i>Premna serratifolia</i>	Lamiaceae	Native	Vulnerable	Climber

B2 (CS species list)

Site	Species	Family	Origin	Status	Habit	Northing	Easting
Yishun N5	<i>Agelaea macrophylla</i>	Connaraceae	Native	Critically Endangered	Climber	44650.09324	29850.61401
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44642.56697	29790.2973
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44641.57537	29794.52616
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44638.81347	29801.53717
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44647.22016	29849.05603
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44649.53716	29850.83658
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44638.48013	29853.39623
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44623.88264	29863.52332
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44624.77239	29856.84618
Yishun N5	<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Vulnerable	Tree	44626.64482	29895.01711
Yishun N5	<i>Amphineuron opulentum</i>	Thelypteridaceae	Native	Endangered	Climber	44660.81597	29747.22968
Yishun N5	<i>Calophyllum inophyllum</i>	Calophyllacaceae	Native	Critically Endangered	Tree	44662.91686	29742.88953
Yishun N5	<i>Calophyllum inophyllum</i>	Calophyllacaceae	Native	Critically Endangered	Tree	44679.39241	30124.04233
Yishun N5	<i>Cayratia trifolia</i>	Vitaceae	Native	Vulnerable	Climber	44646.44165	29855.39931
Yishun N5	<i>Cayratia trifolia</i>	Vitaceae	Native	Vulnerable	Climber	44632.17775	29861.96526
Yishun N5	<i>Centothea lappacea</i>	Poaceae	Native	Critically Endangered	Herb	44566.93729	29717.07192
Yishun N5	<i>Centothea lappacea</i>	Poaceae	Native	Critically Endangered	Herb	44835.30395	30171.22607
Yishun N5	<i>Connarus semidecandrus</i>	Connaraceae	Native	Critically Endangered	Climber	44630.8524	29862.85556
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Climber	44853.88731	30225.53322
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Climber	44850.89801	30223.64139
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Climber	44851.67226	30224.42038
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Climber	44859.74467	30197.93437
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Climber	44854.98994	30184.13502
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Climber	44885.28724	30102.45125
Yishun N5	<i>Hoya diversifolia</i>	Apocynaceae	Native	Critically Endangered	Climber	44889.70825	30102.67379
Yishun N5	<i>Litsea firma</i>	Lauraceae	Native	Vulnerable	Tree	44650.63952	29762.25329
Yishun N5	<i>Oxyceros longiflorus</i>	Rubiaceae	Native	Vulnerable	Climber	44399.52474	29787.51685
Yishun N5	<i>Oxyceros longiflorus</i>	Rubiaceae	Native	Vulnerable	Climber	44431.48236	29868.30999
Yishun N5	<i>Oxyceros longiflorus</i>	Rubiaceae	Native	Vulnerable	Climber	44424.52202	29886.33832
Yishun N5	<i>Oxyceros longiflorus</i>	Rubiaceae	Native	Vulnerable	Climber	44440.11134	29904.25519
Yishun N5	<i>Premna serratifolia</i>	Lamiaceae	Native	Vulnerable	Climber	44692.88719	30136.72877
Yishun N5	<i>Premna serratifolia</i>	Lamiaceae	Native	Vulnerable	Climber	44710.58037	30146.0766

Appendix C

List of Large Plant
Specimens

C (Large specimens)

Site	Species	Family	Origin	Status	Habit	Girth/ spread (m)	Height (m)	Northing	Easting
Yishun N5	<i>Alstonia angustiloba</i>	Apocynaceae	Native	Common	Tree	4.6	25	44593.47213	29674.44938
Yishun N5	<i>Bambusa heterostachya</i>	Poaceae	Exotic	Casual	Shrub	3	4	44674.63482	29726.53047
Yishun N5	<i>Bambusa heterostachya</i>	Poaceae	Exotic	Casual	Shrub	3	6	44965.01236	30008.30315
Yishun N5	<i>Bambusa heterostachya</i>	Poaceae	Exotic	Casual	Shrub	5	7	44406.16106	29826.91192
Yishun N5	<i>Bambusa vulgaris</i>	Poaceae	Exotic	Casual	Shrub	10	10	44478.37101	29929.18288
Yishun N5	<i>Bambusa vulgaris</i>	Poaceae	Exotic	Casual	Shrub	5	7	44870.68983	30119.47805
Yishun N5	<i>Bambusa vulgaris</i>	Poaceae	Exotic	Casual	Shrub	6	8	44871.3571	30114.13634
Yishun N5	<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Tree	3	25	44639.25842	29817.00585
Yishun N5	<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Tree	3	20	44539.40284	29940.75613
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	3	15	44607.19147	29997.17739
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	5	15	44597.79353	30003.40946
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	4.5	25	44580.98117	30046.92224
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	5	25	44423.40952	29840.93379
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	5	25	44428.38642	29829.36005
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	4	15	44425.17955	29816.89608
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	4	25	44447.07126	29812.55578
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	4	25	44529.67019	29810.44078
Yishun N5	<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	Strangler	3	15	44421.86165	29834.03409
Yishun N5	<i>Ficus caulocarpa</i>	Moraceae	Native	Common	Strangler	20	20	44517.73281	29837.1494
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	30	25	44654.17997	29753.79557
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	20	30	44643.01161	29744.44766
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	15	25	44644.11469	29774.27217
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	15	25	44631.50977	29768.37413
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	50	25	44638.59104	29838.59525
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	25	25	44650.09326	29853.84129
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	25	25	44608.6272	29882.88712
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	10	20	44644.44944	29919.27723
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	20	25	44650.97438	29936.19258
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	8	20	44649.42659	29941.64558
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	30	25	44491.96641	29756.46753
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	25	25	44521.6062	29732.98606
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	10	25	44556.32519	29733.43097
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	30	25	44583.52749	29712.73167
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	10	20	44865.60242	30215.62871
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	15	18	44900.65663	30211.06571
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	26	22	44553.45211	29747.89812
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	-	-	44560.08309	29876.43291
Yishun N5	<i>Ficus microcarpa</i>	Moraceae	Native	Common	Strangler	-	-	44689.45527	29802.98352
Yishun N5	<i>Ficus variegata</i>	Moraceae	Exotic	Naturalised	Tree	3.2	18	44599.99691	29653.41636
Yishun N5	<i>Mangifera odorata</i>	Anacardiaceae	Native	Vulnerable	Tree	3	18	44483.78416	29981.26451
Yishun N5	<i>Michelia alba</i>	Magnoliaceae	Exotic	Not assessed	Tree	3.5	18	44901.98352	30209.61898
Yishun N5	<i>Pterocarpus indicus</i>	Fabaceae	Exotic	Casual	Tree	4	15	44471.62266	29780.83921
Yishun N5	<i>Spathodea campanulata</i>	Bignoniaceae	Exotic	Naturalised	Tree	4	20	44445.31029	29818.67651

Appendix D

List of Other Plant
Specimens of Value

D (Other plant specimens of value)

Site	Species	Family	Origin	Status	Habit	Girth/ spread (m)	Height (m)	Northing	Easting
Yishun N5	<i>Bambusa vulgaris</i>	Poaceae	Exotic	Casual	Shrub	2	6	44697.30516	29731.53817
Yishun N5	<i>Bambusa heterostachya</i>	Poaceae	Exotic	Casual	Shrub	2	5	44921.22027	30079.86002
Yishun N5	<i>Terminalia cattapa</i>	Combretaceae	Native	Common	Tree	2.5	15	44436.34847	29903.92136
Yishun N5	<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Tree	2.2	20	44857.52941	30185.24785
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	-	-	44953.84421	30025.77505
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	-	-	45045.50812	30097.77596
Yishun N5	<i>Falcataria moluccana</i>	Fabaceae	Exotic	Naturalised	Tree	4	25	44529.67019	29810.44078

Appendix E

Fauna Species of
Probable Occurrence
and Recorded Species

Odonates								
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Soh et al., 2019)	Distribution/Rarity	Probable	Recorded?
1	Aeshnidae	Emperor	<i>Anax guttatus</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
2	Coenagrionidae	Variable Wisp	<i>Agriocnemis femina</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
3	Coenagrionidae	Variable Sprite	<i>Agriocnemis rubescens</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
4	Coenagrionidae	Ornate Coraltail	<i>Ceriagrion cerinorubellum</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
5	Coenagrionidae	Common Bluetail	<i>Ischnura senegalensis</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
6	Coenagrionidae	Blue Sprite	<i>Pseudagrion microcephalum</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
7	Gomphidae	Common Flangetail	<i>Ictinogomphus decoratus</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
8	Libellulidae	Trumpet Tail	<i>Acisoma panorpoides</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
9	Libellulidae	Blue Adjutant	<i>Aethriamanta aethra</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
10	Libellulidae	Scarlet Adjutant	<i>Aethriamanta brevipennis</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
11	Libellulidae	Pond Adjutant	<i>Aethriamanta gracilis</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
12	Libellulidae	Grenadier	<i>Agrionoptera insgnis</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
13	Libellulidae	Blue Dasher	<i>Brachydiplax chalybea</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
14	Libellulidae	Common Amberwing	<i>Brachythemis contaminata</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
15	Libellulidae	Sultan	<i>Camacinia gigantea</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
16	Libellulidae	Common Scarlet	<i>Crocothemis servilia</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
17	Libellulidae	Black-tipped Percher	<i>Diplacodes nebulosa</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
18	Libellulidae	Blue Percher	<i>Diplacodes trivialis</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
19	Libellulidae	Scarlet Grenadier	<i>Lathrecista asiatica</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
20	Libellulidae	Scarlet Pygmy	<i>Nannophya pygmaea</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
21	Libellulidae	Common Parasol	<i>Neurothemis fluctuans</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
22	Libellulidae	Variable Sentinel	<i>Orchithemis pulcherrima</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
23	Libellulidae	Spine-tufted Skimmer	<i>Orthetrum chrysis</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
24	Libellulidae	Slender Blue Skimmer	<i>Orthetrum luzonicum</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
25	Libellulidae	Variiegated Green Skimmer	<i>Orthetrum sabina</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
26	Libellulidae	Scarlet Skimmer	<i>Orthetrum testaceum</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
27	Libellulidae	Common Chaser	<i>Potamarcha congener</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
28	Libellulidae	Banded Skimmer	<i>Pseudothemis jorina</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
29	Libellulidae	Common Redbolt	<i>Rhodothemis rufa</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
30	Libellulidae	Bronze Flutterer	<i>Rhyothemis obsolescens</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
31	Libellulidae	Yellow-barred Flutterer	<i>Rhyothemis phyllis</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
32	Libellulidae	Sapphire Flutterer	<i>Rhyothemis triangularis</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	No
33	Libellulidae	White-barred Duskhawk	<i>Tholymis tillarga</i>	Least Concern	Least Concern	Widespread and Common	Yes	Yes
34	Libellulidae	Saddlebag Glider	<i>Tramea transmarina</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
35	Libellulidae	Crimson Dropwing	<i>Trithemis aurora</i>	Least Concern	Least Concern	Widespread and Common	Yes	No

Odonates

No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Soh et al., 2019)	Distribution/Rarity	Probable	Recorded?
36	Libellulidae	Dancing Dropwing	<i>Trithemis pallidinervis</i>	Least Concern	Least Concern	Widespread but Uncommon	Yes	Yes
37	Libellulidae	Scarlet Basker	<i>Urothemis signata insignata</i>	Not Assessed	Least Concern	Widespread and Common	Yes	No
38	Libellulidae	Slender Duskdarter	<i>Zyxomma petiolatum</i>	Least Concern	Least Concern	Widespread and Common	Yes	No
39	Aeshnidae	Dingy Duskhawker	<i>Gynacantha subinterrupta</i>	Least Concern	Least Concern	Widespread but Uncommon	No	Yes

Butterflies								
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008; Jain et al, 2018)	Abundance/ Rarity	Probable	Recorded?
1	Hesperiidae	Bush Hopper	<i>Ampittia dioscorides camertes</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
2	Hesperiidae	Chocolate Demon	<i>Ancistroides nigrita maura</i>	Not Assessed	Not Assessed	Common	Yes	No
3	Hesperiidae	Forest Hopper	<i>Astictopterus jama jama</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	Yes
4	Hesperiidae	Brown Awl	<i>Badamia exclamatonis</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
5	Hesperiidae	Bamboo Paintbrush Swift	<i>Baoris farri farri</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
6	Hesperiidae	Paintbrush Swift	<i>Baoris ocea</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
7	Hesperiidae	Formosan Swift	<i>Borbo cinnara</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
8	Hesperiidae	Orange Awlet	<i>Burara harisa consobrina</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
9	Hesperiidae	Full Stop Swift	<i>Caltoris cormasa</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
10	Hesperiidae	Malayan Swift	<i>Caltoris malaya</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	No
11	Hesperiidae	Plain Palm Dart	<i>Cephenes acalle niasicus</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	No
12	Hesperiidae	Yellow Palm Dart	<i>Cephenes trichopepla</i>	Not Assessed	Not assessed	Common	Yes	Yes
13	Hesperiidae	White Tipped Skipper	<i>Erionota hiraca apicalis</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
14	Hesperiidae	Banana Skipper	<i>Erionota thrax thrax</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
15	Hesperiidae	Torus Skipper	<i>Erionota torus</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
16	Hesperiidae	Common Awl	<i>Hasora badra badra</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
17	Hesperiidae	Common Banded Awl	<i>Hasora chromus chromus</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
18	Hesperiidae	Plain Banded Awl	<i>Hasora vitta vitta</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
19	Hesperiidae	Coconut Skipper	<i>Hidari irava</i>	Not Assessed	Not Assessed	Common	Yes	No
20	Hesperiidae	Chestnut Bob	<i>Iambrix salsala salsala</i>	Not Assessed	Not Assessed	Common	Yes	Yes
21	Hesperiidae	Common Redeye	<i>Matapa aria</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
22	Hesperiidae	Banded Demon	<i>Notocrypta paralysos varians</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
23	Hesperiidae	Common Dartlet	<i>Oriens gola pseudolus</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
24	Hesperiidae	Bengal Swift	<i>Pelopidas agna agna</i>	Not Assessed	Endangered	Moderately common	Yes	No
25	Hesperiidae	Great Swift	<i>Pelopidas assamensis</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
26	Hesperiidae	Conjoined Swift	<i>Pelopidas conjunctus conjunctus</i>	Not Assessed	Not assessed	Moderately rare	Yes	No
27	Hesperiidae	Small Branded Swift	<i>Pelopidas mathias mathias</i>	Not Assessed	Not Assessed	Common	Yes	Yes
28	Hesperiidae	Chequered Lancer	<i>Plastingia naga</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
29	Hesperiidae	Contiguous Swift	<i>Polytremis lubricans lubricans</i>	Not Assessed	Not Assessed	Common	Yes	Yes
30	Hesperiidae	Lesser Dart	<i>Potanthus omaha omaha</i>	Not Assessed	Not Assessed	Common	Yes	Yes
31	Hesperiidae	Large Dart	<i>Potanthus serina</i>	Not Assessed	Not assessed	Moderately common	Yes	No
32	Hesperiidae	Detached Dart	<i>Potanthus trachala tyleri</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	No
33	Hesperiidae	Palm Bob	<i>Suastus gremius gremius</i>	Not Assessed	Not Assessed	Common	Yes	No
34	Hesperiidae	Yellow Grass Dart	<i>Taractrocera archias quinta</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
35	Hesperiidae	Pale Palm Dart	<i>Telicota augias augias</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
36	Hesperiidae	Besta Palm Dart	<i>Telicota besta bina</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
37	Hesperiidae	Common Palm Dart	<i>Telicota colon stinga</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately common	Yes	No
38	Hesperiidae	Linna Palm Dart	<i>Telicota linna</i>	Not Assessed	Not assessed	Moderately rare	Yes	No
39	Hesperiidae	Grass Demon	<i>Udaspes folus</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
40	Hesperiidae	Hoary Palmer	<i>Unkana ambasa batara</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
41	Lycaenidae	Common Hedge Blue	<i>Acytolepis pusa lambi</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
42	Lycaenidae	Lesser Darkwing	<i>Allotinus unicolor unicolor</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
43	Lycaenidae	Ciliate Blue	<i>Anthene emolus goberus</i>	Not Assessed	Not Assessed	Common	Yes	No
44	Lycaenidae	Pointed Ciliate Blue	<i>Anthene lycaenina miya</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
45	Lycaenidae	N/A	<i>Arhopala amphimuta amphimuta</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately common	Yes	No
46	Lycaenidae	Centaur Oakblue	<i>Arhopala centaurus nakula</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
47	Lycaenidae	N/A	<i>Arhopala major major</i>	Not Assessed	Data Deficient	Common	Yes	No
48	Lycaenidae	Silver Forget-Me-Not	<i>Catochrysops panormus exiguus</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
49	Lycaenidae	Forget-Me-Not	<i>Catochrysops strabo strabo</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
50	Lycaenidae	Ancyra Blue	<i>Catopyrops ancyra</i>	Not Assessed	Vulnerable	Moderately rare	Yes	No

Butterflies								
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008; Jain et al, 2018)	Abundance/ Rarity	Probable	Recorded?
51	Lycaenidae	Cycad Blue	<i>Chilades pandava pandava</i>	Not Assessed	Not Assessed	Common	Yes	No
52	Lycaenidae	Malayan Sunbeam	<i>Curetis santana malayica</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
53	Lycaenidae	Sumatran Sunbeam	<i>Curetis saronis sumatrana</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
54	Lycaenidae	Gram Blue	<i>Euchrysops cnejus cnejus</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
55	Lycaenidae	Plain Plushblue	<i>Flos apidanus saturatus</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
56	Lycaenidae	Common Tit	<i>Hypolycaena erylus teatus</i>	Not Assessed	Not Assessed	Common	Yes	No
57	Lycaenidae	Dark Tit	<i>Hypolycaena thecloides thecloide</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
58	Lycaenidae	Pointed Line Blue	<i>Ionolyce helicon merguiana</i>	Not Assessed	Not Assessed	Common	Yes	No
59	Lycaenidae	Scarce Silverstreak	<i>Iraota rochana boswelliana</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
60	Lycaenidae	Metallic Caerulean	<i>Jamides alecto ageladas</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	No
61	Lycaenidae	Dark Caerulean	<i>Jamides bochus nabonassar</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
62	Lycaenidae	Common Caerulean	<i>Jamides celeno aelianus</i>	Not Assessed	Not Assessed	Common	Yes	No
63	Lycaenidae	Pea Blue	<i>Lampides boeticus</i>	Not Assessed	Not Assessed	Common	Yes	Yes
64	Lycaenidae	Malayan	<i>Megisba malaya sikkima</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
65	Lycaenidae	Bigg's Brownwing	<i>Miletus biggsii biggsii</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
66	Lycaenidae	Blue Brownwing/Great Brownie	<i>Miletus symethus petronius</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
67	Lycaenidae	Rounded Sixline Blue	<i>Nacaduba berenice icena</i>	Not Assessed	Not Assessed	Common	Yes	No
68	Lycaenidae	Opaque Sixline Blue	<i>Nacaduba beroe neon</i>	Not Assessed	Not Assessed	Common	Yes	No
69	Lycaenidae	Two Spotted Line Blue	<i>Nacaduba biocellata</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
70	Lycaenidae	Transparent Sixline Blue	<i>Nacaduba kurava nemana</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately common	Yes	No
71	Lycaenidae	Dingy Line Blue	<i>Petrelaea dana</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
72	Lycaenidae	Sumatran Gem	<i>Poritia sumatrae sumatrae</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
73	Lycaenidae	Tailless Line Blue	<i>Prosotas dubiosa lumpura</i>	Not Assessed	Not Assessed	Common	Yes	No
74	Lycaenidae	Common Line Blue	<i>Prosotas nora superdates</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
75	Lycaenidae	Scarlet Flash	<i>Rapala dieneces dieneces</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
76	Lycaenidae	Common Red Flash	<i>Rapala iarbus iarbus</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
77	Lycaenidae	Slate Flash	<i>Rapala manea chozeba</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
78	Lycaenidae	Copper Flash	<i>Rapala pheretima sequeira</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
79	Lycaenidae	Suffused Flash	<i>Rapala suffusa barthema</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
80	Lycaenidae	Indigo Flash	<i>Rapala varuna orseis</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
81	Lycaenidae	Apefly	<i>Spalgis epius epius</i>	Not Assessed	Not Assessed	Moderately common	Yes	Yes
82	Lycaenidae	Long Banded Silverline	<i>Spindasis lohita senama</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
83	Lycaenidae	Club Silverline	<i>Spindasis syama terana</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
84	Lycaenidae	Acacia Blue	<i>Surendra vivarna amisena</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
85	Lycaenidae	Peacock Royal	<i>Tajuria cippus maxentius</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
86	Lycaenidae	N/A	<i>Tajuria dominus dominus</i>	Not Assessed	Not Assessed	Very rare	Yes	No
87	Lycaenidae	Felder's Royal	<i>Tajuria mantra mantra</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
88	Lycaenidae	Pitcher Blue	<i>Virachola kessuma deliochus</i>	Not Assessed	Not Assessed	Rare	Yes	No
89	Lycaenidae	Fluffy Tit	<i>Zeltus amasa maximinianus</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
90	Lycaenidae	Pale Grass Blue	<i>Zizeeria maha serica</i>	Not Assessed	Not Assessed	Common	Yes	No
91	Lycaenidae	Lesser Grass Blue	<i>Zizina otis lampa</i>	Not Assessed	Not Assessed	Common	Yes	Yes
92	Lycaenidae	Pygmy Grass Blue	<i>Zizula hylax pygmaea</i>	Not Assessed	Not Assessed	Common	Yes	Yes
93	Nymphalidae (Brush Foots)	Tawny Coster	<i>Acraea terpsicore</i>	Not Assessed	Not assessed	Common	Yes	Yes
94	Nymphalidae (Brush Foots)	Palm King	<i>Amathusia phidippus phidippus</i>	Not Assessed	Not Assessed	Moderately rare	Yes	Yes
95	Nymphalidae (Brush Foots)	Colour Sergeant	<i>Athyma nefte subrata</i>	Not Assessed	Not Assessed	Common	Yes	No
96	Nymphalidae (Brush Foots)	Common Yeoman	<i>Cirrochroa tyche rotundata</i>	Not Assessed	Not assessed	Rare	Yes	No
97	Nymphalidae (Brush Foots)	Plain Tiger	<i>Danaus chrysippus chrysippus</i>	Not Assessed	Not Assessed	Common	Yes	No
98	Nymphalidae (Brush Foots)	Common Tiger	<i>Danaus genutia genutia</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
99	Nymphalidae (Brush Foots)	Black Veined Tiger	<i>Danaus melanippus hegesippus</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
100	Nymphalidae (Brush Foots)	Autumn Leaf	<i>Doleschallia bisaltide bisaltide</i>	Not Assessed	Not assessed	Common	Yes	No

Butterflies								
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008; Jain et al, 2018)	Abundance/ Rarity	Probable	Recorded?
101	Nymphalidae (Brush Foots)	Common Palmfly	<i>Elymnias hypermnestra agina</i>	Not Assessed	Not Assessed	Common	Yes	Yes
102	Nymphalidae (Brush Foots)	Tawny Palmfly	<i>Elymnias panthera panthera</i>	Not Assessed	Not Assessed	Moderately common	Yes	Yes
103	Nymphalidae (Brush Foots)	Baron	<i>Euthalia aconthea gurma</i>	Not Assessed	Not Assessed	Common	Yes	Yes
104	Nymphalidae (Brush Foots)	Green Baron	<i>Euthalia adonia pinwilli</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
105	Nymphalidae (Brush Foots)	Malay Baron	<i>Euthalia monina monina</i>	Not Assessed	Not Assessed	Common	Yes	No
106	Nymphalidae (Brush Foots)	Malayan Eggfly	<i>Hypolimnas anomala anomala</i>	Not Assessed	Not Assessed	Common	Yes	No
107	Nymphalidae (Brush Foots)	Great Eggfly	<i>Hypolimnas bolina bolina</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
108	Nymphalidae (Brush Foots)	Jacintha Eggfly	<i>Hypolimnas bolina jacintha</i>	Not Assessed	Not Assessed	Common	Yes	No
109	Nymphalidae (Brush Foots)	Blue Glassy Tiger	<i>Ideopsis vulgaris macrina</i>	Not Assessed	Not Assessed	Common	Yes	No
110	Nymphalidae (Brush Foots)	Peacock Pansy	<i>Junonia almana javana</i>	Least Concern	Not Assessed	Common	Yes	Yes
111	Nymphalidae (Brush Foots)	Grey Pansy	<i>Junonia atlites atlites</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
112	Nymphalidae (Brush Foots)	Chocolate Pansy	<i>Junonia hedonia ida</i>	Not Assessed	Not Assessed	Common	Yes	Yes
113	Nymphalidae (Brush Foots)	Blue Pansy	<i>Junonia orithya wallacei</i>	Not Assessed	Not Assessed	Common	Yes	No
114	Nymphalidae (Brush Foots)	Bamboo Tree Brown	<i>Lethe europa malaya</i>	Not Assessed	Not Assessed	Moderately rare	Yes	No
115	Nymphalidae (Brush Foots)	Common Evening Brown	<i>Melanitis leda leda</i>	Not Assessed	Not Assessed	Moderately rare	Yes	Yes
116	Nymphalidae (Brush Foots)	Commander	<i>Moduza procris milonia</i>	Not Assessed	Not Assessed	Moderately common	Yes	Yes
117	Nymphalidae (Brush Foots)	Dark Brand Bush Brown	<i>Mycalesis mineus macromalayana</i>	Not Assessed	Not Assessed	Common	Yes	No
118	Nymphalidae (Brush Foots)	Burmese Bush Brown	<i>Mycalesis perseoides perseoides</i>	Not Assessed	Data Deficient	Common	Yes	Yes
119	Nymphalidae (Brush Foots)	Dingy Bush Brown	<i>Mycalesis perseus cepheus</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
120	Nymphalidae (Brush Foots)	Long Brand Bush Brown	<i>Mycalesis visala phamis</i>	Not Assessed	Not Assessed	Moderately common	Yes	Yes
121	Nymphalidae (Brush Foots)	Common Sailor	<i>Neptis hylas papaja</i>	Not Assessed	Not Assessed	Moderately common	Yes	Yes
122	Nymphalidae (Brush Foots)	Dark Grass Brown	<i>Orsotriaena medus cinerea</i>	Not Assessed	Not Assessed	Common	Yes	No
123	Nymphalidae (Brush Foots)	Dark Glassy Tiger	<i>Parantica agleooides agleooides</i>	Not Assessed	Not Assessed	Common	Yes	No
124	Nymphalidae (Brush Foots)	Short Banded Sailor	<i>Phaedyma columella singa</i>	Not Assessed	Not Assessed	Common	Yes	Yes
125	Nymphalidae (Brush Foots)	Leopard	<i>Phalanta phalantha phalantha</i>	Not Assessed	Not Assessed	Common	Yes	No
126	Nymphalidae (Brush Foots)	Plain Nawab	<i>Polyura hebe plautus</i>	Not Assessed	Not Assessed	Common	Yes	No
127	Nymphalidae (Brush Foots)	Horsfield's Baron	<i>Tanaecia iapis puseda</i>	Not Assessed	Not Assessed	Common	Yes	No
128	Nymphalidae (Brush Foots)	Common Five-Ring	<i>Ypthima baldus newboldi</i>	Not Assessed	Not Assessed	Common	Yes	No
129	Nymphalidae (Brush Foots)	Malayan Five-Ring	<i>Ypthima horsfieldii humei</i>	Not Assessed	Not Assessed	Common	Yes	No
130	Nymphalidae (Brush Foots)	Common Four-Ring	<i>Ypthima huebneri</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
131	Nymphalidae (Brush Foots)	Common Three-Ring	<i>Ypthima pandocus corticaria</i>	Not Assessed	Not Assessed	Common	Yes	No
132	Papilionidae (Swallowtails & Birdwings)	Common Mime	<i>Chilasa clytia clytia</i>	Not Assessed	Not Assessed	Common	Yes	No
133	Papilionidae (Swallowtails & Birdwings)	Tailed Jay	<i>Graphium agamemnon agamemnon</i>	Not Assessed	Not Assessed	Common	Yes	No
134	Papilionidae (Swallowtails & Birdwings)	Lesser Jay (Blue Jay)	<i>Graphium evemon eventus</i>	Not Assessed	Not Assessed	Common	Yes	No
135	Papilionidae (Swallowtails & Birdwings)	Common Bluebottle	<i>Graphium sarpedon luctatius</i>	Not Assessed	Not Assessed	Common	Yes	No
136	Papilionidae (Swallowtails & Birdwings)	Common Rose	<i>Pachiopta aristolochiae asteris</i>	Not Assessed	Vulnerable	Moderately common	Yes	No
137	Papilionidae (Swallowtails & Birdwings)	Lime Butterfly	<i>Papilio demoleus malayanus</i>	Not Assessed	Not Assessed	Common	Yes	No
138	Papilionidae (Swallowtails & Birdwings)	Common Mormon	<i>Papilio polytes romulus</i>	Not Assessed	Not Assessed	Common	Yes	Yes
139	Papilionidae (Swallowtails & Birdwings)	Common Birdwing	<i>Troides helena cerberus</i>	Not Assessed: CITES protected (Appendix II)	Vulnerable	Moderately common	Yes	No
140	Pieridae (Whites & Sulphurs)	Striped Albatross	<i>Appias libythea olferna</i>	Not Assessed	Not Assessed	Common	Yes	Yes
141	Pieridae (Whites & Sulphurs)	Lemon Emigrant	<i>Catopsilia pomona pomona</i>	Not Assessed	Not Assessed	Common	Yes	No
142	Pieridae (Whites & Sulphurs)	Mottled Emigrant	<i>Catopsilia pyranthe pyranthe</i>	Not Assessed	Not Assessed	Common	Yes	No
143	Pieridae (Whites & Sulphurs)	Orange Emigrant	<i>Catopsilia scylla cornelia</i>	Not Assessed	Not Assessed	Common	Yes	Yes
144	Pieridae (Whites & Sulphurs)	Painted Jezebel	<i>Delias hyparete metarete</i>	Not Assessed	Not Assessed	Common	Yes	Yes
145	Pieridae (Whites & Sulphurs)	Anderson's Grass Yellow	<i>Eurema andersonii andersonii</i>	Not Assessed	Not Assessed	Moderately common	Yes	Yes
146	Pieridae (Whites & Sulphurs)	Three Spot Grass Yellow	<i>Eurema blanda snelleni</i>	Not Assessed	Not Assessed	Common	Yes	Yes
147	Pieridae (Whites & Sulphurs)	Common Grass Yellow	<i>Eurema hecabe contubernalis</i>	Not Assessed	Not Assessed	Common	Yes	Yes
148	Pieridae (Whites & Sulphurs)	Chocolate Grass Yellow	<i>Eurema sari sodalis</i>	Not Assessed	Not Assessed	Moderately common	Yes	No
149	Pieridae (Whites & Sulphurs)	Psyche	<i>Leptosia nina malayana</i>	Not Assessed	Not Assessed	Common	Yes	No
-	Hesperiidae	-	<i>Baoris sp.</i>	-	-	-	-	Yes

Butterflies								
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008; Jain et al, 2018)	Abundance/ Rarity	Probable	Recorded?
-	Nymphalidae (Brush Foots)	-	<i>Hypolimnas bolina</i>	-	-	-	-	Yes

 Species of conservation significance

Molluscs							
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Native Status	Recorded?
1	Achatinidae	Giant African Land Snail	<i>Achatina fulica</i>	Not Assessed	Not Assessed	Non-native	Yes
2	Ariophantidae	Yellow-shelled Semi-slug	<i>Parmarion martensi</i>	Not Assessed	Not Assessed	Native	Yes
3	Bradybaenidae	Asian Tramp Snail	<i>Bradybaena similaris</i>	Not Assessed	Not Assessed	Non-native	Yes
4	Dyakiidae	Luminescent Land Snail	<i>Quantula striata</i>	Not Assessed	Not Assessed	Native	Yes
5	Helicarionidae	Fragile Arion Helix	<i>Helicarion perfragilis</i>	Not Assessed	Not Assessed	Native	Yes
6	Subulinidae	-	<i>Subulina octona</i>	Not Assessed	Not Assessed	Non-native	Yes
7	Veronicellidae	Tropical Leatherleaf	<i>Laevicaulis alte</i>	Not Assessed	Not Assessed	Non-native	Yes
8	Ariophantidae	-	<i>Sarika resplendens</i>	Not Assessed	Not Assessed	Native	Yes
9	Physidae	European Physa	<i>Physa acuta</i>	Not Assessed	Not Assessed	Non-native	Yes
-	Lymnaeidae	-	Lymnaeidae	-	-	-	Yes

Decapod crustaceans								
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Native Status	Probable	Recorded?
1	Gecarcinucidae	Maculate Freshwater Crab	<i>Parathelphusa maculata</i>	Least Concern	Not Assessed	Native	Yes	No
2	Palaemonidae	Riceland Shrimp	<i>Macrobrachium lanchesteri</i>	Least Concern	Not Assessed	Non-native	Yes	No

Freshwater fish								
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Native Status	Probable	Recorded?
1	Anabantidae	Oriental Climbing Perch	<i>Anabas testudineus</i>	Least Concern	Not Assessed	Native	Yes	Yes
2	Aplocheilidae	Whitespot	<i>Aplocheilus armatus</i>	Least Concern	Not Assessed	Non-native	Yes	No
3	Channidae	Common Snakehead/Aruan	<i>Channa striata</i>	Least Concern	Not Assessed	Native	Yes	Yes
4	Clariidae	Common Walking Catfish	<i>Clarias cf. batrachus</i>	Not Assessed	Not Assessed	Native	Yes	No
5	Cyprinidae	Indochinese Spotted Barb	<i>Barbodes rhombeus</i>	Least Concern	Not Assessed	Non-native	Yes	Yes
6	Cyprinidae	Pearl Danio	<i>Brachydanio albolineata</i>	Least Concern	Not Assessed	Non-native	Yes	No
7	Cyprinidae	Carp	<i>Cyprinus carpio</i>	Vulnerable	Not Assessed	Non-native	Yes	Yes
8	Cyprinidae	Red-tailed Rasbora	<i>Rasbora borapetensis</i>	Least Concern	Not Assessed	Non-native	Yes	No
9	Cyprinidae	Scissorstail Rasbora	<i>Rasbora trilineata</i>	Least Concern	Not Assessed	Non-native	Yes	No
10	Eleotrididae	Marbled Gudgeon	<i>Oxyeleotris marmorata</i>	Least Concern	Not Assessed	Non-native	Yes	No
11	Gobionellidae	Lesser Bumblebee Goby	<i>Brachygobius sabanus</i>	Data Deficient	Not Assessed	Non-native	Yes	No
12	Osphronemidae	Siamese Fighting-fish	<i>Betta splendens</i>	Vulnerable	Not Assessed	Non-native	Yes	No
13	Osphronemidae	Snakeskin Gouramy	<i>Trichopodus pectoralis</i>	Least Concern	Not Assessed	Non-native	Yes	No
14	Osphronemidae	Threespot Gouramy	<i>Trichopodus trichopterus</i>	Least Concern	Not Assessed	Native	Yes	Yes
15	Osphronemidae	Croaking Gouramy	<i>Trichopsis vittata</i>	Least Concern	Not Assessed	Native	Yes	No
16	Poeciliidae	Mosquitofish	<i>Gambusia affinis</i>	Least Concern	Not Assessed	Non-native	Yes	No
17	Poeciliidae	Guppy	<i>Poecilia reticulata</i>	Not Assessed	Not Assessed	Non-native	Yes	Yes
18	Poeciliidae	Common Molly	<i>Poecilia sphenops</i>	Least Concern	Not Assessed	Non-native	Yes	No
19	Synbranchidae	Asian Swamp-eel	<i>Monopterus javanensis</i>	Least Concern	Not Assessed	Native	Yes	No
20	Zenarchopteridae	Sunda Pygmy Halfbeak	<i>Dermogenys collettei</i>	Not Assessed	Not Assessed	Native	Yes	No

Herpetofauna									
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Distribution/Rarity	Native Status	Probable	Recorded?
1	Agamidae	Green Crested Lizard	<i>Bronchocela cristatella</i>	Not Assessed	Not Assessed	Widespread but Uncommon	Native	Yes	No
2	Agamidae	Changeable Lizard	<i>Calotes versicolor</i>	Not Assessed	Not Assessed	Widespread and Common	Non-native	Yes	Yes
3	Agamidae	Sumatran Flying Dragon	<i>Draco sumatranus</i>	Not Assessed	Not Assessed	Widespread and Common	Native	Yes	No
4	Bufonidae	Asian Toad	<i>Duttaphrynus melanostictus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
5	Colubridae (Ahaetuliinae)	Oriental Whip Snake	<i>Ahaetulla prasina</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
6	Colubridae (Ahaetuliinae)	Paradise Gliding Snake	<i>Chrysopelea paradisi</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
7	Colubridae (Ahaetuliinae)	Striped Bronzeback	<i>Dendrelaphis caudolineatus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
8	Colubridae (Ahaetuliinae)	Painted Bronzeback	<i>Dendrelaphis pictus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
9	Colubridae (Calamariinae)	Dwarf Reed Snake	<i>Pseudorabdion longiceps</i>	Least Concern	Endangered	Widespread but Rare	Native	Yes	No
10	Colubridae (Colubrinae)	House Wolf Snake	<i>Lycodon capucinus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
11	Colubridae (Colubrinae)	Striped Kukri Snake	<i>Oligodon octolineatus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
12	Colubridae (Natricinae)	Striped Keelback	<i>Xenochrophis vittatus</i>	Least Concern	Not Assessed	Widespread and Common	Non-native	Yes	No
13	Cylindrophidae	Red-tailed Pipe Snake	<i>Cylindrophis ruffus</i>	Least Concern	Critically Endangered	Widespread but Rare	Native	Yes	Yes
14	Dicroglossidae	Crab-eating Frog	<i>Fejervarya cancrivora</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
15	Dicroglossidae	Field Frog	<i>Fejervarya limnocharis</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
16	Dicroglossidae	Malayan Giant Frog	<i>Limnonectes blythii</i>	Near Threatened	Not Assessed	Widespread and Common	Native	Yes	Yes
17	Elapidae	Equatorial Spitting Cobra	<i>Naja sumatrana</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
18	Eleutherodactylidae	Greenhouse Frog	<i>Eleutherodactylus planirostris</i>	Least Concern	Not Assessed	Widespread and Common	Non-native	Yes	Yes
19	Emydidae	Red-eared Slider	<i>Trachemys scripta</i>	Least Concern	Not Assessed	Widespread and Common	Non-native	Yes	Yes
20	Gekkonidae	Four-clawed Gecko	<i>Gehyra mutilata</i>	Not Assessed	Not Assessed	Widespread and Common	Native	Yes	No
21	Gekkonidae	Spotted House Gecko	<i>Gekko monarchus</i>	Not Assessed	Not Assessed	Widespread and Common	Native	Yes	Yes
22	Gekkonidae	Spiny-tailed House Gecko	<i>Hemidactylus frenatus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
23	Gekkonidae	Flat-tailed Gecko	<i>Hemidactylus platyurus</i>	Not Assessed	Not Assessed	Widespread and Common	Native	Yes	No
24	Geomydidae	Giant Asian Pond Turtle	<i>Heosemys grandis</i>	Vulnerable; CITES protected	Not Assessed	N/A	Non-native	Yes	No
25	Homalopsidae	Rainbow Water Snake	<i>Enhydrys enhydrys</i>	Least Concern	Not Assessed	Restricted and Uncommon	Non-native	Yes	No
26	Homalopsidae	Puff-faced Water Snake	<i>Homalopsis buccata</i>	Least Concern	Vulnerable	Widespread but Uncommon	Native	Yes	No
27	Microhylidae	Banded Bull Frog	<i>Kaloula pulchra</i>	Least Concern	Not Assessed	Widespread and Common	Non-native	Yes	Yes
28	Microhylidae	Painted Chorus Frog	<i>Microhyla butleri</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
29	Microhylidae	East Asian Ornate Chorus Frog	<i>Microhyla fissipes</i>	Least Concern	Not Assessed	Restricted and Rare	Non-native	Yes	Yes
30	Microhylidae	Dark-sided Chorus Frog	<i>Microhyla heymonsi</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
31	Pythonidae	Reticulated Python	<i>Malayopython reticulatus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
32	Ranidae	Green Paddy Frog	<i>Hylarana erythraea</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
33	Ranidae	American Bullfrog	<i>Lithobates catesbeianus</i>	Least Concern	Not Assessed	Widespread and Common	Non-native	Yes	No
34	Ranidae	Guenther's Frog	<i>Sylvirana guentheri</i>	Least Concern	Not Assessed	Widespread but Uncommon	Non-native	Yes	No
35	Rhacophoridae	Four-lined Tree Frog	<i>Polypedates leucomystax</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
36	Scincidae	Many-lined Sun Skink	<i>Eutropis multifasciata</i>	Not Assessed	Not Assessed	Widespread and Common	Native	Yes	No
37	Scincidae	Garden Supple Skink	<i>Lygosoma bowringii</i>	Not Assessed	Not Assessed	Widespread and Common	Native	Yes	No
38	Trionychidae	Chinese Softshell Turtle	<i>Pelodiscus sinensis</i>	Vulnerable	Not Assessed	Widespread and Common	Non-native	Yes	Yes
39	Typhlopidae	Brahminy Blind Snake	<i>Indotyphlops braminus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
40	Varanidae	Malayan Water Monitor	<i>Varanus salvator</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
41	Xenopeltidae	Iridescent Earth Snake	<i>Xenopeltis unicolor</i>	Least Concern	Not Assessed	Widespread but Uncommon	Native	Yes	No

Species of conservation significance

Birds									
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Abundance/Rarity	Native Status	Probable	Recorded?
1	Acanthizidae	Golden-bellied Gerygone	<i>Gerygone sulphurea</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
2	Accipitridae	Japanese Sparrowhawk	<i>Accipiter gularis</i>	Least Concern	Not Assessed	Common	Migrant	Yes	No
3	Accipitridae	Chinese Sparrowhawk	<i>Accipiter soloensis</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
4	Accipitridae	Crested Goshawk	<i>Accipiter trivirgatus</i>	Least Concern	Critically Endangered	Uncommon	Native	Yes	No
5	Accipitridae	Jerdon's Baza	<i>Aviceda jerdoni</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
6	Accipitridae	Black Baza	<i>Aviceda leuphotes</i>	Least Concern	Not Assessed	Common	Migrant	Yes	No
7	Accipitridae	Common Buzzard	<i>Buteo buteo</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
8	Accipitridae	Eastern Buzzard	<i>Buteo japonicus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
9	Accipitridae	Grey-headed Fish Eagle	<i>Haliaeetus ichthyaeus</i>	Near Threatened	Critically Endangered	Uncommon	Native	Yes	No
10	Accipitridae	White-bellied Sea Eagle	<i>Haliaeetus leucogaster</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	Yes
11	Accipitridae	Brahminy Kite	<i>Haliastur indus</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
12	Accipitridae	Blyth's Hawk-Eagle	<i>Nisaetus alboniger</i>	Least Concern	Not Assessed	Very rare	Migrant	Yes	No
13	Accipitridae	Changeable Hawk-Eagle	<i>Nisaetus cirrhatus</i>	Least Concern	Endangered	Uncommon	Native	Yes	Yes
14	Accipitridae	Crested Honey-buzzard	<i>Pernis ptilorhynchus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
15	Accipitridae	Crested Serpent Eagle	<i>Spiornis cheela</i>	Least Concern	Critically Endangered	Rare	Native	Yes	No
16	Acrocephalidae	Black-browed Reed Warbler	<i>Acrocephalus bistrigiceps</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
17	Acrocephalidae	Oriental Reed Warbler	<i>Acrocephalus orientalis</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
18	Aegithinidae	Common Iora	<i>Aegithina tiphia</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
19	Alcedinidae	Common Kingfisher	<i>Alcedo atthis</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
20	Alcedinidae	Blue-eared Kingfisher	<i>Alcedo meninting</i>	Least Concern	Critically Endangered	Rare	Native	Yes	No
21	Alcedinidae	Oriental Dwarf Kingfisher	<i>Ceyx erithaca</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
22	Alcedinidae	Ruddy Kingfisher	<i>Halcyon coromanda</i>	Least Concern	Critically Endangered	Rare	Migrant	Yes	No
23	Alcedinidae	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
24	Alcedinidae	Stork-billed Kingfisher	<i>Pelargopsis capensis</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	Yes
25	Alcedinidae	Collared Kingfisher	<i>Todiramphus chloris</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
26	Apodidae	Edible-nest Swiftlet	<i>Aerodramus fuciphagus</i>	Least Concern	Not Assessed	Common	Native	Yes	No
27	Apodidae	Germain's Swiftlet	<i>Aerodramus germani</i>	Least Concern	Not Assessed	Common	Native	Yes	No
28	Apodidae	Black-nest Swiftlet	<i>Aerodramus maximus</i>	Least Concern	Not Assessed	Common	Native	Yes	No
29	Ardeidae	Chinese Pond Heron	<i>Ardeola bacchus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
30	Ardeidae	Javan Pond Heron	<i>Ardeola speciosa</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
31	Ardeidae	Eastern Cattle Egret	<i>Bubulcus coromandus</i>	Least Concern	Not Assessed	Common	Non-native	Yes	No
32	Ardeidae	Striated Heron	<i>Butorides striata</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
33	Ardeidae	Little Egret	<i>Egretta garzetta</i>	Least Concern	Not Assessed	Common	Migrant	Yes	No
34	Ardeidae	Malayan Night Heron	<i>Gorsachius melanolophus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
35	Ardeidae	Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
36	Ardeidae	von Schrenck's Bittern	<i>Ixobrychus eurhythmus</i>	Least Concern	Not Assessed	Rare	Migrant	Yes	No
37	Ardeidae	Black Bittern	<i>Ixobrychus flavicollis</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
38	Ardeidae	Yellow Bittern	<i>Ixobrychus sinensis</i>	Least Concern	Not Assessed	Common	Migrant	Yes	Yes
39	Ardeidae	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Least Concern	Critically Endangered	Uncommon	Migrant	Yes	No

Birds									
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Abundance/Rarity	Native Status	Probable	Recorded?
40	Bucerotidae	Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	Least Concern	Critically Endangered	Common	Native	Yes	No
41	Cacatuidae	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	Least Concern	Not Assessed	N/A	Non-native	Yes	No
42	Cacatuidae	Tanimbar Corella	<i>Cacatua goffiniana</i>	Near Threatened	Not Assessed	Uncommon	Non-native	Yes	No
43	Cacatuidae	Yellow-crested Cockatoo	<i>Cacatua sulphurea</i>	Critically Endangered	Not Assessed	Uncommon	Non-native	Yes	No
44	Campephagidae	Pied triller	<i>Lalage nigra</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	Yes
45	Campephagidae	Ashy Minivet	<i>Pericrocotus divaricatus</i>	Least Concern	Not Assessed	Common	Migrant	Yes	Yes
46	Caprimulgidae	Savanna Nightjar	<i>Caprimulgus affinis</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	Yes
47	Caprimulgidae	Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
48	Charadriidae	Red-wattled Lapwing	<i>Vanellus indicus</i>	Least Concern	Endangered	Uncommon	Native	Yes	Yes
49	Cisticolidae	Zitting Cisticola	<i>Cisticola juncidis</i>	Least Concern	Not Assessed	Common	Native	Yes	No
50	Cisticolidae	Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
51	Cisticolidae	Ashy Tailorbird	<i>Orthotomus ruficeps</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
52	Cisticolidae	Rufous-tailed Tailorbird	<i>Orthotomus sericeus</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	Yes
53	Cisticolidae	Common Tailorbird	<i>Orthotomus sutorius</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
54	Cisticolidae	Yellow-bellied Prinia	<i>Prinia flaviventris</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	Yes
55	Columbidae	Common Emerald Dove	<i>Chalcophaps indica</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
56	Columbidae	Rock Dove	<i>Columba livia</i>	Least Concern	Not Assessed	Common	Non-native	Yes	No
57	Columbidae	Pied Imperial Pigeon	<i>Ducula bicolor</i>	Least Concern	Not Assessed	Rare	Migrant	Yes	No
58	Columbidae	Zebra Dove	<i>Geopelia striata</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
59	Columbidae	Jambu Fruit Dove	<i>Ptilinopus jambu</i>	Near Threatened	Not Assessed	Uncommon	Native	Yes	No
60	Columbidae	Spotted Dove	<i>Spilopelia chinensis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
61	Columbidae	Pink-necked green pigeon	<i>Treeron vernans</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
62	Coraciidae	Oriental Dollarbird	<i>Eurystomus orientalis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
63	Corvidae	Large-billed Crow	<i>Corvus macrorhynchos</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
64	Corvidae	House Crow	<i>Corvus splendens</i>	Least Concern	Not Assessed	Common	Non-native	Yes	Yes
65	Cuculidae	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
66	Cuculidae	Rusty-breasted Cuckoo	<i>Cacomantis sepulcralis</i>	Least Concern	Vulnerable	Uncommon	Native	Yes	No
67	Cuculidae	Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
68	Cuculidae	Lesser Coucal	<i>Centropus bengalensis</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
69	Cuculidae	Greater Coucal	<i>Centropus sinensis</i>	Least Concern	Not Assessed	Rare	Native	Yes	No
70	Cuculidae	Little Bronze-Cuckoo	<i>Chrysococcyx minutillus</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
71	Cuculidae	Chestnut-winged Cuckoo	<i>Clamator coromandus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
72	Cuculidae	Indian Cuckoo	<i>Cuculus micropterus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
73	Cuculidae	Oriental Cuckoo	<i>Cuculus optatus</i>	Least Concern	Not Assessed	Rare	Migrant	Yes	No
74	Cuculidae	Asian Koel	<i>Eudynamis scolopaceus</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
75	Cuculidae	Malaysian Hawk-Cuckoo	<i>Hierococcyx fugax</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
76	Cuculidae	Hodgson's Hawk Cuckoo	<i>Hierococcyx nasicolor</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
77	Cuculidae	Large Hawk-Cuckoo	<i>Hierococcyx sparveriioides</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
78	Dicaeidae	Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes

Birds									
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Abundance/Rarity	Native Status	Probable	Recorded?
79	Dicruridae	Crow-billed Drongo	<i>Dicrurus annectans</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
80	Dicruridae	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	Least Concern	Not Assessed	Common	Native	Yes	No
81	Estrildidae	Chestnut Munia	<i>Lonchura atricapilla</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
82	Estrildidae	White-headed Munia	<i>Lonchura maja</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
83	Estrildidae	Scaly-breasted munia	<i>Lonchura punctulata</i>	Least Concern	Not Assessed	Common	Native	Yes	No
84	Falconidae	Peregrine Falcon	<i>Falco peregrinus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
85	Hemiprocnidae	Grey-rumped Treeswift	<i>Hemiprocne longipennis</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
86	Hirundinidae	Red-rumped Swallow	<i>Cecropis daurica</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
87	Hirundinidae	Barn swallow	<i>Hirundo rustica</i>	Least Concern	Not Assessed	Common	Migrant	Yes	Yes
88	Hirundinidae	Pacific swallow	<i>Hirundo tahitica</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
89	Laniidae	Brown Shrike	<i>Lanius cristatus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	Yes
90	Laniidae	Long-tailed Shrike	<i>Lanius schach</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
91	Laniidae	Tiger Shrike	<i>Lanius tigrinus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
92	Leiotherichidae	White-crested Laughingthrush	<i>Garrulax leucolophus</i>	Least Concern	Not Assessed	Common	Non-native	Yes	No
93	Locustellidae	Pallas's Grasshopper Warbler	<i>Locustella certhiola</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
94	Locustellidae	Lanceolated Warbler	<i>Locustella lanceolata</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
95	Megalaimidae	Coppersmith barbet	<i>Psilopogon haemacephalus</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
96	Megalaimidae	Lineated Barbet	<i>Psilopogon lineatus</i>	Least Concern	Not Assessed	Uncommon	Non-native	Yes	Yes
97	Meropidae	Blue-tailed bee-eater	<i>Merops philippinus</i>	Least Concern	Not Assessed	Common	Migrant	Yes	Yes
98	Meropidae	Blue-throated Bee-eater	<i>Merops viridis</i>	Least Concern	Not Assessed	Common	Native	Yes	No
99	Monarchidae	Blyth's Paradise Flycatcher	<i>Terpsiphone affinis</i>	Least Concern	Not Assessed	Common	Migrant	Yes	No
100	Monarchidae	Japanese Paradise Flycatcher	<i>Terpsiphone atrocaudata</i>	Near Threatened	Not Assessed	Rare	Migrant	Yes	No
101	Monarchidae	Amur Paradise Flycatcher	<i>Terpsiphone incei</i>	Least Concern	Not Assessed	Common	Migrant	Yes	No
102	Monarchidae	Indian Paradise Flycatcher	<i>Terpsiphone paradisi</i>	Least Concern	Not Assessed	Very rare	Migrant	Yes	No
103	Motacillidae	Paddyfield Pipit	<i>Anthus rufulus</i>	Least Concern	Not Assessed	Common	Native	Yes	No
104	Motacillidae	Forest Wagtail	<i>Dendronanthus indicus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
105	Motacillidae	Grey Wagtail	<i>Motacilla cinerea</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
106	Muscicapidae	Oriental Magpie-Robin	<i>Copsychus saularis</i>	Least Concern	Endangered	Uncommon	Native	Yes	Yes
107	Muscicapidae	Mugimaki Flycatcher	<i>Ficedula mugimaki</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
108	Muscicapidae	Yellow-rumped Flycatcher	<i>Ficedula zanthopygia</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	Yes
109	Muscicapidae	Siberian Blue Robin	<i>Larvivora cyane</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
110	Muscicapidae	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	Least Concern	Not Assessed	Common	Migrant	Yes	Yes
111	Muscicapidae	Dark-Sided Flycatcher	<i>Muscicapa sibirica</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
112	Nectariniidae	Crimson Sunbird	<i>Aethopyga siparaja</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
113	Nectariniidae	Brown-throated Sunbird	<i>Antheptes malacensis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
114	Nectariniidae	Olive-backed Sunbird	<i>Cinnyris jugularis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
115	Oriolidae	Black-naped Oriole	<i>Oriolus chinensis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
116	Passeridae	Eurasian Tree Sparrow	<i>Passer montanus</i>	Least Concern	Not Assessed	Common	Non-native	Yes	Yes
117	Phasianidae	Red Junglefowl	<i>Gallus gallus</i>	Least Concern	Endangered	Common	Native	Yes	No

Birds									
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Abundance/Rarity	Native Status	Probable	Recorded?
118	Phasianidae	Domestic Chicken	<i>Gallus gallus domesticus</i>	Not Assessed	Not Assessed	Common	Non-native	Yes	No
119	Phylloscopidae	Arctic Warbler	<i>Phylloscopus borealis</i>	Least Concern	Not Assessed	Common	Migrant	Yes	Yes
120	Phylloscopidae	Eastern Crowned Warbler	<i>Phylloscopus coronatus</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
121	Phylloscopidae	Dusky Warbler	<i>Phylloscopus fuscatus</i>	Least Concern	Not Assessed	Very rare	Migrant	Yes	No
122	Picidae	Banded Woodpecker	<i>Chrysophlegma miniaceum</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
123	Picidae	Common Flameback	<i>Dinopium javanense</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
124	Picidae	Rufous Woodpecker	<i>Micropternus brachyurus</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	Yes
125	Picidae	Laced Woodpecker	<i>Picus vittatus</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	Yes
126	Picidae	Sunda Pygmy Woodpecker	<i>Yungipicus moluccensis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
127	Pittidae	Blue-winged Pitta	<i>Pitta moluccensis</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	Yes
128	Pittidae	Hooded Pitta	<i>Pitta sordida</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
129	Ploceidae	Baya Weaver	<i>Ploceus philippinus</i>	Least Concern	Not Assessed	Common	Native	Yes	No
130	Psittaculidae	Blue-crowned Hanging-parrot	<i>Loriculus galgulus</i>	Least Concern	Endangered	Common	Native	Yes	Yes
131	Psittaculidae	Red-breasted Parakeet	<i>Psittacula alexandri</i>	Near Threatened	Not Assessed	Common	Non-native	Yes	Yes
132	Psittaculidae	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Least Concern	Not Assessed	Uncommon	Non-native	Yes	No
133	Psittaculidae	Long-tailed Parakeet	<i>Psittacula longicauda</i>	Vulnerable	Not Assessed	Uncommon	Native	Yes	Yes
134	Psittaculidae	Blue-rumped Parrot	<i>Psittinus cyanurus</i>	Near Threatened	Critically Endangered	Uncommon	Native	Yes	No
135	Psittaculidae	Coconut Lorikeet	<i>Trichoglossus haematodus</i>	Least Concern	Not Assessed	Uncommon	Non-native	Yes	Yes
136	Pycnonotidae	Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	Least Concern	Not Assessed	Common	Non-native	Yes	No
137	Pycnonotidae	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
138	Pycnonotidae	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Least Concern	Not Assessed	Uncommon	Non-native	Yes	Yes
139	Pycnonotidae	Olive-winged Bulbul	<i>Pycnonotus plumosus</i>	Least Concern	Not Assessed	Common	Native	Yes	No
140	Pycnonotidae	Straw-headed Bulbul	<i>Pycnonotus zeylanicus</i>	Critically Endangered	Endangered	Uncommon	Native	Yes	Yes
141	Rallidae	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Least Concern	Not Assessed	Common	Migrant	Yes	Yes
142	Rallidae	Watercock	<i>Gallicrex cinerea</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
143	Rallidae	Slaty-breasted Rail	<i>Gallirallus striatus</i>	Least Concern	Not Assessed	Common	Native	Yes	No
144	Rallidae	Ruddy-breasted Crake	<i>Porzana fusca</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
145	Rallidae	Red-legged Crake	<i>Rallina fasciata</i>	Least Concern	Vulnerable	Uncommon	Migrant	Yes	Yes
146	Rhipiduridae	Malaysian Pied Fantail	<i>Rhipidura javanica</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
147	Scolopacidae	Common Sandpiper	<i>Actitis hypoleucos</i>	Least Concern	Not Assessed	Common	Migrant	Yes	No
148	Scolopacidae	Common Snipe	<i>Gallinago gallinago</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
149	Scolopacidae	Pin-tailed Snipe	<i>Gallinago stenura</i>	Least Concern	Not Assessed	Uncommon	Migrant	Yes	No
150	Scolopacidae	Greater Painted-snipe	<i>Rostratula benghalensis</i>	Least Concern	Critically Endangered	Rare	Native	Yes	No
151	Strigidae	Buffy Fish Owl	<i>Ketupa ketupu</i>	Least Concern	Critically Endangered	Uncommon	Native	Yes	Yes
152	Strigidae	Sunda Scops Owl	<i>Otus lempiji</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
153	Strigidae	Spotted Wood Owl	<i>Strix seloputo</i>	Least Concern	Critically Endangered	Uncommon	Native	Yes	No
154	Sturnidae	Javan Myna	<i>Acridotheres javanicus</i>	Least Concern	Not Assessed	Common	Non-native	Yes	Yes
155	Sturnidae	Common Myna	<i>Acridotheres tristis</i>	Least Concern	Not Assessed	Common	Native	Yes	No
156	Sturnidae	Daurian Starling	<i>Agropsar sturninus</i>	Least Concern	Not Assessed	Common	Migrant	Yes	No

Birds									
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Abundance/Rarity	Native Status	Probable	Recorded?
157	Sturnidae	Asian Glossy Starling	<i>Aplonis panayensis</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
158	Sturnidae	Common Hill Myna	<i>Gracula religiosa</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
159	Tytonidae	Eastern Barn Owl	<i>Tyto javanica</i>	Least Concern	Not Assessed	Uncommon	Native	Yes	No
160	Zosteropidae	Swinhoe's White-eye	<i>Zosterops simplex</i>	Least Concern	Not Assessed	Common	Native	Yes	Yes
-	Apodidae	-	<i>Aerodramus</i> sp.	-	-	-	-	-	Yes
-	Cacatuidae	-	<i>Cacatua</i> sp.	-	-	-	-	-	Yes

 Species of conservation significance

Non-volant mammals									
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Distribution/Rarity	Native Status	Probable	Recorded?
1	Canidae	Feral Dog	<i>Canis lupus familiaris</i>	Not Assessed	Not Assessed	N/A	Non-native	Yes	Yes
2	Felidae	Feral Cat	<i>Felis catus</i>	Not Assessed	Not Assessed	N/A	Non-native	Yes	Yes
3	Muridae	House Mouse	<i>Mus castaneus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
4	Muridae	Brown Rat	<i>Rattus norvegicus</i>	Least Concern	Not Assessed	Widespread and Common	Non-native	Yes	Yes
5	Muridae	Oriental House Rat	<i>Rattus tanezumi</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
6	Muridae	Malaysian Wood Rat	<i>Rattus tiomanicus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
7	Mustelidae	Smooth-coated Otter	<i>Lutrogale perspicillata</i>	Vulnerable	Critically Endangered	Widespread but Rare	Native	Yes	Yes
8	Sciuridae	Plantain Squirrel	<i>Callosciurus notatus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
9	Soricidae	House Shrew	<i>Suncus murinus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
10	Suidae	Wild Pig	<i>Sus scrofa</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
11	Tupaiaidae	Common Treeshrew	<i>Tupaia glis</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
12	Viverridae	Common Palm Civet	<i>Paradoxurus musangus</i>	Least Concern	Not Assessed	Widespread but Uncommon	Native	Yes	No

 Species of conservation significance

Bats									
No.	Family	Common Name	Scientific Name	Global Status (IUCN/CITES)	Local Status (Davison et al., 2008)	Distribution/Rarity	Native Status	Probable	Recorded?
1	Emballonuridae	Pouch-bearing Bat	<i>Saccolaimus saccolaimus</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
2	Emballonuridae	Black-bearded Tomb Bat	<i>Taphozous melanopogon</i>	Least Concern	Endangered	Widespread but Rare	Native	Yes	No
-	Emballonuridae	-	-	-	-	-	Native	-	Yes
3	Pteropodidae	Lesser Dog-faced Fruit Bat	<i>Cynopterus brachyotis</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
4	Vespertilionidae	Grey Large-footed Myotis	<i>Myotis 'adversus'</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
5	Vespertilionidae	Whiskered Myotis	<i>Myotis muricola</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
6	Vespertilionidae	Javan Pipistrelle	<i>Pipistrellus javanicus</i>	Least Concern	Not Assessed	Widespread but Uncommon	Native	Yes	No
7	Vespertilionidae	Asiatic Lesser Yellow House Bat	<i>Scotophilus kuhlii</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	Yes
8	Vespertilionidae	Lesser Bamboo Bat	<i>Tylonycteris fulvida</i>	Least Concern	Critically Endangered	Restricted and Rare	Native	Yes	No
9	Vespertilionidae	Greater Bamboo Bat	<i>Tylonycteris malayana</i>	Least Concern	Not Assessed	Widespread and Common	Native	Yes	No
-	Vespertilionidae	Bamboo Bat	<i>Tylonycteris sp.</i>	Least Concern	-	-	Native	-	Yes

Species of conservation significance

Appendix F

List of Fauna Species
of Conservation
Significance

Fauna species of conservation significance

No.	Taxon	Family	Common Name	Scientific Name	Global status (IUCN/CITES)	Local status (Davison et al., 2008; Jain et al., 2018)	Distribution/Rarity	Native Status	Probable?	Recorded?
1	Butterfly	Hesperiidae	Forest Hopper	<i>Astictopterus jama jama</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	Yes	Yes
2	Butterfly	Hesperiidae	Formosan Swift	<i>Borbo cinnara</i>	Not Assessed	Endangered	Moderately common	Yes	No	No
3	Butterfly	Hesperiidae	Malayan Swift	<i>Caloris malaya</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	No	No
4	Butterfly	Hesperiidae	Plain Palm Dart	<i>Cephenes acalle miasicus</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	No	No
5	Butterfly	Hesperiidae	Bengal Swift	<i>Pelopidas agna agna</i>	Not Assessed	Endangered	Moderately common	Yes	No	No
6	Butterfly	Hesperiidae	Detached Dart	<i>Potanthus trachala tyleri</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	No	No
7	Butterfly	Hesperiidae	Common Palm Dart	<i>Telicoia colon stinga</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately common	Yes	No	No
8	Butterfly	Lycaenidae	N/A	<i>Arhopala amphimuta amphimuta</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately common	Yes	No	No
9	Butterfly	Lycaenidae	Ancyra Blue	<i>Catopyrops ancyra</i>	Not Assessed	Vulnerable	Moderately rare	Yes	No	No
10	Butterfly	Lycaenidae	Metallic Caerulean	<i>Jamides alecto ageladas</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately rare	Yes	No	No
11	Butterfly	Lycaenidae	Transparent Sixline Blue	<i>Nacaduba kurava nemana</i>	Not Assessed	Nationally Extinct (Rediscovered)	Moderately common	Yes	No	No
12	Butterfly	Papilionidae (Swallowtails & Birdwings)	Common Rose	<i>Pachlopta aristolochiae asteris</i>	Not Assessed	Vulnerable	Moderately common	Yes	No	No
13	Butterfly	Papilionidae (Swallowtails & Birdwings)	Common Birdwing	<i>Troides helena cerberus</i>	Not Assessed, CITES protected (Appendix II)	Vulnerable	Moderately common	Yes	No	No
14	Reptile	Colubridae (Calamariinae)	Dwarf Reed Snake	<i>Pseudorabdion longiceps</i>	Least Concern	Endangered	Widespread but Rare	Native	Yes	No
15	Reptile	Cylindrophidae	Red-tailed Pipe Snake	<i>Cylindrophis ruffus</i>	Least Concern	Critically Endangered	Widespread but Rare	Native	Yes	Yes
16	Reptile	Homalopsidae	Puff-faced Water Snake	<i>Homalopsis buccata</i>	Least Concern	Vulnerable	Widespread but Uncommon	Native	Yes	No
17	Bird	Accipitridae	Crested Goshawk	<i>Accipiter trivirgatus</i>	Least Concern	Critically Endangered	Uncommon	Native	Yes	No
18	Bird	Accipitridae	Grey-headed Fish Eagle	<i>Haliaeetus ichthyaeus</i>	Near Threatened	Critically Endangered	Uncommon	Native	Yes	No
19	Bird	Accipitridae	Changeable Hawk-Eagle	<i>Nisaetus cirrhatus</i>	Least Concern	Endangered	Uncommon	Native	Yes	Yes
20	Bird	Accipitridae	Crested Serpent Eagle	<i>Spilornis cheela</i>	Least Concern	Critically Endangered	Rare	Native	Yes	No
21	Bird	Alcedinidae	Blue-eared Kingfisher	<i>Alcedo meninting</i>	Least Concern	Critically Endangered	Rare	Native	Yes	No
22	Bird	Alcedinidae	Ruddy Kingfisher	<i>Halcyon coromanda</i>	Least Concern	Critically Endangered	Rare	Migrant	Yes	No
23	Bird	Ardeidae	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Least Concern	Critically Endangered	Uncommon	Migrant	Yes	No
24	Bird	Bucerotidae	Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	Least Concern	Critically Endangered	Common	Native	Yes	No
25	Bird	Charadriidae	Red-wattled Lapwing	<i>Vanellus indicus</i>	Least Concern	Endangered	Uncommon	Native	Yes	Yes
26	Bird	Cuculidae	Rusty-breasted Cuckoo	<i>Cacomantis sepulchralis</i>	Least Concern	Vulnerable	Uncommon	Native	Yes	No
27	Bird	Muscicapidae	Oriental Magpie-Robin	<i>Copsychus saularis</i>	Least Concern	Endangered	Uncommon	Native	Yes	Yes
28	Bird	Phasianidae	Red Junglefowl	<i>Gallus gallus</i>	Least Concern	Endangered	Common	Native	Yes	No
29	Bird	Psittaculidae	Blue-crowned Hanging-parrot	<i>Loriculus galgulus</i>	Least Concern	Endangered	Common	Native	Yes	Yes
30	Bird	Psittaculidae	Blue-rumped Parrot	<i>Psittinus cyanurus</i>	Near Threatened	Critically Endangered	Uncommon	Native	Yes	No
31	Bird	Pycnonotidae	Straw-headed Bulbul	<i>Pycnonotus zeylanicus</i>	Critically Endangered	Endangered	Uncommon	Native	Yes	Yes
32	Bird	Rallidae	Red-legged Crane	<i>Rallina fasciata</i>	Least Concern	Vulnerable	Uncommon	Migrant	Yes	Yes
33	Bird	Scolopacidae	Greater Painted-snipe	<i>Rostratula benghalensis</i>	Least Concern	Critically Endangered	Rare	Native	Yes	No
34	Bird	Strigidae	Butfly Fish Owl	<i>Ketupa ketupu</i>	Least Concern	Critically Endangered	Uncommon	Native	Yes	Yes
35	Bird	Strigidae	Spotted Wood Owl	<i>Syrix seloputo</i>	Least Concern	Critically Endangered	Uncommon	Native	Yes	No
36	Mammal	Mustelidae	Smooth-coated Otter	<i>Lutrogale perspicillata</i>	Vulnerable	Critically Endangered	Widespread but Rare	Native	Yes	Yes
37	Mammal	Emballonuridae	Black-bearded Tomb Bat	<i>Taphozous melanopogon</i>	Least Concern	Endangered	Widespread but Rare	Native	Yes	No
38	Mammal	Vespertilionidae	Lesser Bamboo Bat	<i>Tylonycteris fulvida</i>	Least Concern	Critically Endangered	Restricted and Rare	Native	Yes	No
-	Mammal	Vespertilionidae	Bamboo Bat	<i>Tylonycteris sp.</i>	-	-	-	Native	Yes	Yes

Appendix G

Camera Trap Data

Camera trap data

Station	Sampling_date	Date	Time	DateTimeOriginal	File	Scientific_name	Taxon	Abundance	Remarks
CT01	18/2/20	5/2/20	2:32:32 PM	5/2/20 14:32	IMG_0014.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	5/2/20	2:50:46 PM	5/2/20 14:50	IMG_0015.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	5/2/20	2:51:16 PM	5/2/20 14:51	IMG_0016.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	5/2/20	2:53:50 PM	5/2/20 14:53	IMG_0017.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	6/2/20	2:31:58 PM	6/2/20 14:31	IMG_0019.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	6/2/20	2:32:52 PM	6/2/20 14:32	IMG_0020.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	6/2/20	2:44:00 PM	6/2/20 14:44	IMG_0021.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	6/2/20	2:45:30 PM	6/2/20 14:45	IMG_0022.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	6/2/20	2:45:52 PM	6/2/20 14:45	IMG_0023.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	7/2/20	10:12:20 AM	7/2/20 10:12	IMG_0029.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	7/2/20	10:12:42 AM	7/2/20 10:12	IMG_0030.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	8/2/20	2:15:20 PM	8/2/20 14:15	IMG_0037.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	8/2/20	3:19:06 PM	8/2/20 15:19	IMG_0039.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	8/2/20	4:39:34 PM	8/2/20 16:39	IMG_0040.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	8/2/20	4:42:56 PM	8/2/20 16:42	IMG_0041.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	8/2/20	5:02:10 PM	8/2/20 17:02	IMG_0042.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	8/2/20	5:23:14 PM	8/2/20 17:23	IMG_0043.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	10/2/20	3:11:42 PM	10/2/20 15:11	IMG_0060.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	10/2/20	4:09:54 PM	10/2/20 16:09	IMG_0061.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	11/2/20	6:25:44 PM	11/2/20 18:25	IMG_0063.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	11/2/20	6:26:08 PM	11/2/20 18:26	IMG_0064.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	15/2/20	1:43:44 PM	15/2/20 13:43	IMG_0073.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	15/2/20	6:22:20 PM	15/2/20 18:22	IMG_0075.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	15/2/20	6:25:56 PM	15/2/20 18:25	IMG_0076.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	15/2/20	6:26:32 PM	15/2/20 18:26	IMG_0077.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	15/2/20	6:27:08 PM	15/2/20 18:27	IMG_0078.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	15/2/20	6:29:56 PM	15/2/20 18:29	IMG_0079.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	15/2/20	6:31:04 PM	15/2/20 18:31	IMG_0080.AVI	Callosciurus notatus	Mammal	1	

Camera trap data									
CT01	18/2/20	15/2/20	6:31:36 PM	15/2/20 18:31	IMG_0081.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	3:06:58 PM	19/2/20 15:06	IMG_0002.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	3:44:58 PM	19/2/20 15:44	IMG_0003.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	4:10:00 PM	19/2/20 16:10	IMG_0004.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	5:21:14 PM	19/2/20 17:21	IMG_0005.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	5:21:36 PM	19/2/20 17:21	IMG_0006.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	5:23:38 PM	19/2/20 17:23	IMG_0008.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	6:20:22 PM	19/2/20 18:20	IMG_0009.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	6:33:28 PM	19/2/20 18:33	IMG_0010.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	6:34:18 PM	19/2/20 18:34	IMG_0011.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	6:34:50 PM	19/2/20 18:34	IMG_0012.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	6:35:16 PM	19/2/20 18:35	IMG_0013.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	6:35:38 PM	19/2/20 18:35	IMG_0014.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	19/2/20	7:09:36 PM	19/2/20 19:09	IMG_0016.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	8:34:40 AM	20/2/20 8:34	IMG_0017.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	8:35:04 AM	20/2/20 8:35	IMG_0018.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	8:35:34 AM	20/2/20 8:35	IMG_0019.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	8:36:40 AM	20/2/20 8:36	IMG_0020.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	6:43:06 PM	20/2/20 18:43	IMG_0022.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	6:43:28 PM	20/2/20 18:43	IMG_0023.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	6:44:02 PM	20/2/20 18:44	IMG_0024.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	6:45:20 PM	20/2/20 18:45	IMG_0025.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	20/2/20	7:07:32 PM	20/2/20 19:07	IMG_0026.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	21/2/20	11:06:22 AM	21/2/20 11:06	IMG_0027.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	22/2/20	9:26:36 AM	22/2/20 9:26	IMG_0030.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	22/2/20	9:27:54 AM	22/2/20 9:27	IMG_0031.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	22/2/20	5:05:58 PM	22/2/20 17:05	IMG_0034.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	22/2/20	5:22:56 PM	22/2/20 17:22	IMG_0035.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	23/2/20	2:35:14 PM	23/2/20 14:35	IMG_0037.AVI	Callosciurus notatus	Mammal	1	

Camera trap data									
CT01	5/3/20	25/2/20	10:02:40 AM	25/2/20 10:02	IMG_0038.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	25/2/20	3:01:36 PM	25/2/20 15:01	IMG_0040.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	25/2/20	5:05:28 PM	25/2/20 17:05	IMG_0041.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	25/2/20	5:23:52 PM	25/2/20 17:23	IMG_0042.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	25/2/20	5:24:18 PM	25/2/20 17:24	IMG_0043.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	28/2/20	3:51:40 PM	28/2/20 15:51	IMG_0045.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	28/2/20	3:52:18 PM	28/2/20 15:52	IMG_0046.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	28/2/20	3:52:40 PM	28/2/20 15:52	IMG_0047.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	28/2/20	3:53:36 PM	28/2/20 15:53	IMG_0048.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	28/2/20	3:55:18 PM	28/2/20 15:55	IMG_0050.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	28/2/20	4:38:40 PM	28/2/20 16:38	IMG_0051.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	28/2/20	4:40:04 PM	28/2/20 16:40	IMG_0053.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	28/2/20	7:18:26 PM	28/2/20 19:18	IMG_0054.AVI	Callosciurus notatus	Mammal	2	
CT01	5/3/20	29/2/20	9:12:10 AM	29/2/20 9:12	IMG_0055.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	2:22:50 PM	29/2/20 14:22	IMG_0057.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	2:23:12 PM	29/2/20 14:23	IMG_0058.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	2:27:22 PM	29/2/20 14:27	IMG_0059.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	2:28:32 PM	29/2/20 14:28	IMG_0060.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	2:29:52 PM	29/2/20 14:29	IMG_0061.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	3:15:48 PM	29/2/20 15:15	IMG_0062.AVI	Callosciurus notatus	Mammal	1	
CT02	18/2/20	5/2/20	1:28:00 PM	5/2/20 13:28	IMG_0018.AVI	Callosciurus notatus	Mammal	1	
CT02	18/2/20	6/2/20	12:45:10 PM	6/2/20 12:45	IMG_0030.AVI	Callosciurus notatus	Mammal	1	
CT02	18/2/20	7/2/20	7:01:52 PM	7/2/20 19:01	IMG_0040.AVI	Callosciurus notatus	Mammal	1	
CT02	18/2/20	6/2/20	12:36:10 AM	6/2/20 0:36	IMG_0023.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	6/2/20	10:57:02 AM	6/2/20 10:57	IMG_0029.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	6/2/20	10:12:18 PM	6/2/20 22:12	IMG_0032.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	6/2/20	10:12:40 PM	6/2/20 22:12	IMG_0033.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	6/2/20	10:33:30 PM	6/2/20 22:33	IMG_0034.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	7/2/20	7:18:28 AM	7/2/20 7:18	IMG_0035.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT02	18/2/20	7/2/20	7:18:48 AM	7/2/20 7:18	IMG_0036.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	7/2/20	7:19:14 AM	7/2/20 7:19	IMG_0037.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	8/2/20	2:14:46 AM	8/2/20 2:14	IMG_0045.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	9/2/20	7:37:34 AM	9/2/20 7:37	IMG_0053.AVI	Canis lupus familiaris	Mammal	4	
CT02	18/2/20	9/2/20	12:55:24 PM	9/2/20 12:55	IMG_0055.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	10/2/20	7:54:34 PM	10/2/20 19:54	IMG_0061.AVI	Canis lupus familiaris	Mammal	2	
CT02	18/2/20	10/2/20	7:55:14 PM	10/2/20 19:55	IMG_0062.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	10/2/20	7:55:52 PM	10/2/20 19:55	IMG_0063.AVI	Canis lupus familiaris	Mammal	3	
CT02	18/2/20	11/2/20	11:06:14 AM	11/2/20 11:06	IMG_0068.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	12/2/20	9:36:48 AM	12/2/20 9:36	IMG_0071.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	12/2/20	9:38:10 AM	12/2/20 9:38	IMG_0072.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	15/2/20	2:12:42 PM	15/2/20 14:12	IMG_0093.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	15/2/20	2:13:08 PM	15/2/20 14:13	IMG_0094.AVI	Canis lupus familiaris	Mammal	1	
CT02	18/2/20	9/2/20	3:29:48 AM	9/2/20 3:29	IMG_0051.AVI	Rattus tiomanicus	Mammal	1	
CT02	18/2/20	16/2/20	8:43:42 PM	16/2/20 20:43	IMG_0101.AVI	Rattus tiomanicus	Mammal	2	
CT02	18/2/20	5/2/20	12:53:36 PM	5/2/20 12:53	IMG_0017.AVI	Tupaia glis	Mammal	1	
CT02	18/2/20	6/2/20	6:38:14 PM	6/2/20 18:38	IMG_0031.AVI	Tupaia glis	Mammal	1	
CT02	18/2/20	8/2/20	7:31:36 AM	8/2/20 7:31	IMG_0048.AVI	Tupaia glis	Mammal	1	
CT02	18/2/20	9/2/20	5:46:32 PM	9/2/20 17:46	IMG_0057.AVI	Tupaia glis	Mammal	1	
CT02	18/2/20	11/2/20	7:14:32 AM	11/2/20 7:14	IMG_0064.AVI	Tupaia glis	Mammal	1	
CT02	18/2/20	11/2/20	7:42:18 AM	11/2/20 7:42	IMG_0065.AVI	Tupaia glis	Mammal	1	
CT02	18/2/20	11/2/20	8:03:18 AM	11/2/20 8:03	IMG_0066.AVI	Tupaia glis	Mammal	1	
CT02	18/2/20	13/2/20	12:06:52 PM	13/2/20 12:06	IMG_0075.AVI	Tupaia glis	Mammal	1	
CT02	18/2/20	13/2/20	1:27:36 PM	13/2/20 13:27	IMG_0077.AVI	Tupaia glis	Mammal	1	
CT03	18/2/20	5/2/20	1:55:38 PM	5/2/20 13:55	IMG_0011.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	5/2/20	5:10:30 PM	5/2/20 17:10	IMG_0017.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	5/2/20	6:37:58 PM	5/2/20 18:37	IMG_0018.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	9/2/20	11:03:42 AM	9/2/20 11:03	IMG_0034.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	13/2/20	2:36:38 PM	13/2/20 14:36	IMG_0049.AVI	Callosciurus notatus	Mammal	1	

Camera trap data									
CT03	18/2/20	13/2/20	3:04:46 PM	13/2/20 15:04	IMG_0050.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	15/2/20	4:51:46 PM	15/2/20 16:51	IMG_0053.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	15/2/20	4:52:12 PM	15/2/20 16:52	IMG_0054.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	15/2/20	4:53:58 PM	15/2/20 16:53	IMG_0055.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	15/2/20	4:56:16 PM	15/2/20 16:56	IMG_0056.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	17/2/20	1:31:30 PM	17/2/20 13:31	IMG_0066.AVI	Callosciurus notatus	Mammal	1	
CT03	18/2/20	5/2/20	4:11:12 PM	5/2/20 16:11	IMG_0012.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	5/2/20	4:22:58 PM	5/2/20 16:22	IMG_0013.AVI	Canis lupus familiaris	Mammal	2	
CT03	18/2/20	5/2/20	4:23:40 PM	5/2/20 16:23	IMG_0014.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	5/2/20	4:49:50 PM	5/2/20 16:49	IMG_0015.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	6/2/20	11:01:50 AM	6/2/20 11:01	IMG_0021.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	6/2/20	11:02:14 AM	6/2/20 11:02	IMG_0022.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	6/2/20	3:14:28 PM	6/2/20 15:14	IMG_0023.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	6/2/20	3:16:34 PM	6/2/20 15:16	IMG_0024.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	6/2/20	3:17:16 PM	6/2/20 15:17	IMG_0025.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	6/2/20	3:17:46 PM	6/2/20 15:17	IMG_0026.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	7/2/20	9:11:06 AM	7/2/20 9:11	IMG_0027.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	8/2/20	10:46:56 AM	8/2/20 10:46	IMG_0030.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	8/2/20	11:34:04 AM	8/2/20 11:34	IMG_0031.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	8/2/20	5:25:12 PM	8/2/20 17:25	IMG_0032.AVI	Canis lupus familiaris	Mammal	2	
CT03	18/2/20	8/2/20	5:25:34 PM	8/2/20 17:25	IMG_0033.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	10/2/20	11:34:42 AM	10/2/20 11:34	IMG_0036.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	10/2/20	11:38:56 AM	10/2/20 11:38	IMG_0037.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	10/2/20	11:40:50 AM	10/2/20 11:40	IMG_0038.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	10/2/20	11:41:30 AM	10/2/20 11:41	IMG_0039.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	10/2/20	11:44:36 AM	10/2/20 11:44	IMG_0040.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	10/2/20	11:45:28 AM	10/2/20 11:45	IMG_0041.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	11/2/20	4:56:50 PM	11/2/20 16:56	IMG_0042.AVI	Canis lupus familiaris	Mammal	2	
CT03	18/2/20	13/2/20	9:48:18 AM	13/2/20 9:48	IMG_0047.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT03	18/2/20	13/2/20	9:49:28 AM	13/2/20 9:49	IMG_0048.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	13/2/20	7:08:02 PM	13/2/20 19:08	IMG_0051.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	14/2/20	2:28:42 AM	14/2/20 2:28	IMG_0052.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	16/2/20	7:34:50 AM	16/2/20 7:34	IMG_0057.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	16/2/20	8:16:02 AM	16/2/20 8:16	IMG_0058.AVI	Canis lupus familiaris	Mammal	3	
CT03	18/2/20	16/2/20	8:16:24 AM	16/2/20 8:16	IMG_0059.AVI	Canis lupus familiaris	Mammal	2	
CT03	18/2/20	17/2/20	11:44:32 AM	17/2/20 11:44	IMG_0064.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	17/2/20	11:45:30 AM	17/2/20 11:45	IMG_0065.AVI	Canis lupus familiaris	Mammal	1	
CT03	18/2/20	8/2/20	4:33:12 AM	8/2/20 4:33	IMG_0028.AVI	Rattus tiomanicus	Mammal	1	
CT03	18/2/20	8/2/20	4:34:52 AM	8/2/20 4:34	IMG_0029.AVI	Rattus tiomanicus	Mammal	1	
CT04	18/2/20	6/2/20	12:40:26 PM	6/2/20 12:40	IMG_0037.AVI	Callosciurus notatus	Mammal	1	
CT04	18/2/20	7/2/20	2:54:38 PM	7/2/20 14:54	IMG_0059.AVI	Callosciurus notatus	Mammal	1	
CT04	18/2/20	13/2/20	12:26:22 PM	13/2/20 12:26	IMG_0123.AVI	Callosciurus notatus	Mammal	1	
CT04	18/2/20	15/2/20	8:41:50 AM	15/2/20 8:41	IMG_0138.AVI	Callosciurus notatus	Mammal	1	
CT04	18/2/20	5/2/20	1:33:10 PM	5/2/20 13:33	IMG_0018.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	5/2/20	2:22:48 PM	5/2/20 14:22	IMG_0019.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	5/2/20	5:00:18 PM	5/2/20 17:00	IMG_0020.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	5/2/20	5:13:54 PM	5/2/20 17:13	IMG_0021.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	5/2/20	5:14:14 PM	5/2/20 17:14	IMG_0022.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	5/2/20	5:14:36 PM	5/2/20 17:14	IMG_0023.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	5/2/20	6:00:04 PM	5/2/20 18:00	IMG_0024.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	5/2/20	6:45:06 PM	5/2/20 18:45	IMG_0026.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	6/2/20	1:14:04 PM	6/2/20 13:14	IMG_0039.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	6/2/20	5:45:42 PM	6/2/20 17:45	IMG_0040.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	6/2/20	5:46:32 PM	6/2/20 17:46	IMG_0041.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	6/2/20	5:47:36 PM	6/2/20 17:47	IMG_0042.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	6/2/20	5:53:04 PM	6/2/20 17:53	IMG_0043.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	6/2/20	5:53:48 PM	6/2/20 17:53	IMG_0044.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	6/2/20	6:54:20 PM	6/2/20 18:54	IMG_0046.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT04	18/2/20	6/2/20	6:56:42 PM	6/2/20 18:56	IMG_0047.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	6/2/20	7:04:34 PM	6/2/20 19:04	IMG_0048.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	7/2/20	8:13:24 AM	7/2/20 8:13	IMG_0053.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	7/2/20	8:14:08 AM	7/2/20 8:14	IMG_0054.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	7/2/20	8:14:44 AM	7/2/20 8:14	IMG_0055.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	7/2/20	2:59:08 PM	7/2/20 14:59	IMG_0060.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	7/2/20	6:18:44 PM	7/2/20 18:18	IMG_0061.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:36:40 AM	8/2/20 4:36	IMG_0063.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:37:04 AM	8/2/20 4:37	IMG_0064.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:37:28 AM	8/2/20 4:37	IMG_0065.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:37:58 AM	8/2/20 4:37	IMG_0066.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:46:44 AM	8/2/20 4:46	IMG_0067.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:47:12 AM	8/2/20 4:47	IMG_0068.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:47:58 AM	8/2/20 4:47	IMG_0069.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:48:22 AM	8/2/20 4:48	IMG_0070.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:48:46 AM	8/2/20 4:48	IMG_0071.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:51:40 AM	8/2/20 4:51	IMG_0072.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	4:52:02 AM	8/2/20 4:52	IMG_0073.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	10:57:28 AM	8/2/20 10:57	IMG_0078.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	11:22:40 AM	8/2/20 11:22	IMG_0079.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	5:16:08 PM	8/2/20 17:16	IMG_0081.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	5:49:14 PM	8/2/20 17:49	IMG_0082.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	5:51:44 PM	8/2/20 17:51	IMG_0083.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	6:07:42 PM	8/2/20 18:07	IMG_0084.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	6:09:54 PM	8/2/20 18:09	IMG_0085.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	6:24:04 PM	8/2/20 18:24	IMG_0086.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	8/2/20	6:26:34 PM	8/2/20 18:26	IMG_0087.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	9/2/20	7:48:06 AM	9/2/20 7:48	IMG_0091.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	9/2/20	9:26:32 AM	9/2/20 9:26	IMG_0094.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT04	18/2/20	9/2/20	9:26:52 AM	9/2/20 9:26	IMG_0095.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	9/2/20	9:27:24 AM	9/2/20 9:27	IMG_0096.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	9/2/20	7:49:22 PM	9/2/20 19:49	IMG_0100.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	10/2/20	8:12:32 AM	10/2/20 8:12	IMG_0103.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	10/2/20	8:22:52 AM	10/2/20 8:22	IMG_0104.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	10/2/20	8:31:48 AM	10/2/20 8:31	IMG_0105.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	10/2/20	10:02:12 AM	10/2/20 10:02	IMG_0106.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	11/2/20	5:19:26 PM	11/2/20 17:19	IMG_0108.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	13/2/20	9:28:50 AM	13/2/20 9:28	IMG_0122.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	13/2/20	6:01:48 PM	13/2/20 18:01	IMG_0125.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	14/2/20	2:13:24 PM	14/2/20 14:13	IMG_0131.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	14/2/20	2:13:46 PM	14/2/20 14:13	IMG_0132.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	14/2/20	6:23:30 PM	14/2/20 18:23	IMG_0133.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	14/2/20	6:24:20 PM	14/2/20 18:24	IMG_0134.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	14/2/20	6:43:48 PM	14/2/20 18:43	IMG_0135.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	15/2/20	11:48:50 AM	15/2/20 11:48	IMG_0140.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	15/2/20	1:22:06 PM	15/2/20 13:22	IMG_0141.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	15/2/20	1:23:14 PM	15/2/20 13:23	IMG_0142.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	15/2/20	4:39:50 PM	15/2/20 16:39	IMG_0144.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	16/2/20	11:08:04 AM	16/2/20 11:08	IMG_0148.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	16/2/20	11:10:22 AM	16/2/20 11:10	IMG_0149.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	16/2/20	12:07:36 PM	16/2/20 12:07	IMG_0151.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	16/2/20	12:08:38 PM	16/2/20 12:08	IMG_0152.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	16/2/20	1:48:42 PM	16/2/20 13:48	IMG_0154.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	16/2/20	1:49:56 PM	16/2/20 13:49	IMG_0155.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	16/2/20	1:50:20 PM	16/2/20 13:50	IMG_0156.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	11:50:18 AM	17/2/20 11:50	IMG_0160.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	12:02:08 PM	17/2/20 12:02	IMG_0161.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	1:27:24 PM	17/2/20 13:27	IMG_0163.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT04	18/2/20	17/2/20	1:29:08 PM	17/2/20 13:29	IMG_0164.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	1:34:14 PM	17/2/20 13:34	IMG_0165.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	1:36:48 PM	17/2/20 13:36	IMG_0166.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	1:41:30 PM	17/2/20 13:41	IMG_0168.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	3:36:34 PM	17/2/20 15:36	IMG_0169.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	3:36:54 PM	17/2/20 15:36	IMG_0170.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	3:37:18 PM	17/2/20 15:37	IMG_0171.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	17/2/20	5:16:04 PM	17/2/20 17:16	IMG_0173.AVI	Canis lupus familiaris	Mammal	1	
CT04	18/2/20	12/2/20	11:36:38 AM	12/2/20 11:36	IMG_0112.AVI	Lutrogale perspicillata	Mammal	1	
CT04	18/2/20	5/2/20	11:55:26 PM	5/2/20 23:55	IMG_0028.AVI	Rattus tiomanicus	Mammal	1	
CT04	18/2/20	8/2/20	4:14:50 AM	8/2/20 4:14	IMG_0062.AVI	Rattus tiomanicus	Mammal	1	
CT04	18/2/20	12/2/20	12:20:16 AM	12/2/20 0:20	IMG_0110.AVI	Rattus tiomanicus	Mammal	1	
CT04	18/2/20	13/2/20	11:48:32 PM	13/2/20 23:48	IMG_0126.AVI	Rattus tiomanicus	Mammal	1	
CT04	18/2/20	8/2/20	5:09:38 PM	8/2/20 17:09	IMG_0080.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	13/2/20	12:47:52 PM	13/2/20 12:47	IMG_0124.AVI	Callosciurus notatus	Mammal	1	
CT04	18/2/20	15/2/20	2:57:32 PM	15/2/20 14:57	IMG_0143.AVI	Callosciurus notatus	Mammal	1	
CT04	18/2/20	17/2/20	1:03:02 PM	17/2/20 13:03	IMG_0162.AVI	Callosciurus notatus	Mammal	1	
CT04	18/2/20	5/2/20	6:37:02 PM	5/2/20 18:37	IMG_0025.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	5/2/20	6:54:46 PM	5/2/20 18:54	IMG_0027.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	6/2/20	11:44:22 AM	6/2/20 11:44	IMG_0035.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	6/2/20	11:45:10 AM	6/2/20 11:45	IMG_0036.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	7/2/20	7:34:12 AM	7/2/20 7:34	IMG_0051.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	7/2/20	8:23:10 AM	7/2/20 8:23	IMG_0057.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	7/2/20	10:35:04 AM	7/2/20 10:35	IMG_0058.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	8/2/20	9:38:06 AM	8/2/20 9:38	IMG_0077.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	9/2/20	1:51:26 PM	9/2/20 13:51	IMG_0098.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	9/2/20	6:36:24 PM	9/2/20 18:36	IMG_0099.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	10/2/20	7:22:58 PM	10/2/20 19:22	IMG_0107.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	11/2/20	7:02:02 PM	11/2/20 19:02	IMG_0109.AVI	Tupaia glis	Mammal	1	

Camera trap data									
CT04	18/2/20	12/2/20	8:56:24 AM	12/2/20 8:56	IMG_0111.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	12/2/20	5:59:50 PM	12/2/20 17:59	IMG_0113.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	12/2/20	6:50:40 PM	12/2/20 18:50	IMG_0115.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	14/2/20	8:05:30 AM	14/2/20 8:05	IMG_0127.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	14/2/20	8:05:52 AM	14/2/20 8:05	IMG_0128.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	15/2/20	10:13:16 AM	15/2/20 10:13	IMG_0139.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	16/2/20	1:14:02 PM	16/2/20 13:14	IMG_0153.AVI	Tupaia glis	Mammal	1	
CT04	18/2/20	17/2/20	5:08:48 PM	17/2/20 17:08	IMG_0172.AVI	Tupaia glis	Mammal	1	
CT01	5/3/20	29/2/20	3:39:30 PM	29/2/20 15:39	IMG_0063.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	3:58:16 PM	29/2/20 15:58	IMG_0064.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	4:06:32 PM	29/2/20 16:06	IMG_0065.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	29/2/20	4:07:24 PM	29/2/20 16:07	IMG_0066.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	1/3/20	2:17:46 PM	1/3/20 14:17	IMG_0069.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	2/3/20	1:04:48 PM	2/3/20 13:04	IMG_0070.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	2/3/20	1:13:54 PM	2/3/20 13:13	IMG_0071.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	2/3/20	1:14:30 PM	2/3/20 13:14	IMG_0072.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	2/3/20	1:29:08 PM	2/3/20 13:29	IMG_0073.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	2/3/20	3:27:18 PM	2/3/20 15:27	IMG_0074.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	3/3/20	12:06:18 PM	3/3/20 12:06	IMG_0075.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	3/3/20	12:08:36 PM	3/3/20 12:08	IMG_0076.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	3/3/20	1:28:44 PM	3/3/20 13:28	IMG_0077.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	3/3/20	2:29:08 PM	3/3/20 14:29	IMG_0078.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	3/3/20	2:52:56 PM	3/3/20 14:52	IMG_0079.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	3/3/20	3:03:28 PM	3/3/20 15:03	IMG_0081.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	3/3/20	6:32:56 PM	3/3/20 18:32	IMG_0082.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	4/3/20	10:15:46 AM	4/3/20 10:15	IMG_0083.AVI	Callosciurus notatus	Mammal	1	
CT01	5/3/20	4/3/20	1:28:20 PM	4/3/20 13:28	IMG_0084.AVI	Callosciurus notatus	Mammal	1	
CT01	18/2/20	6/2/20	7:39:10 AM	6/2/20 7:39	IMG_0018.AVI	Canis lupus familiaris	Mammal	2	
CT01	18/2/20	6/2/20	6:34:14 PM	6/2/20 18:34	IMG_0024.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT01	18/2/20	6/2/20	6:45:46 PM	6/2/20 18:45	IMG_0025.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	6/2/20	6:52:56 PM	6/2/20 18:52	IMG_0026.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	6/2/20	6:53:20 PM	6/2/20 18:53	IMG_0027.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	6/2/20	7:05:08 PM	6/2/20 19:05	IMG_0028.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	7/2/20	6:34:48 PM	7/2/20 18:34	IMG_0031.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	7/2/20	6:35:24 PM	7/2/20 18:35	IMG_0032.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	7/2/20	8:11:42 PM	7/2/20 20:11	IMG_0033.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	8/2/20	2:27:12 AM	8/2/20 2:27	IMG_0034.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	8/2/20	2:27:34 AM	8/2/20 2:27	IMG_0035.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	8/2/20	7:36:46 AM	8/2/20 7:36	IMG_0036.AVI	Canis lupus familiaris	Mammal	2	
CT01	18/2/20	8/2/20	6:04:52 PM	8/2/20 18:04	IMG_0044.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	8/2/20	6:36:08 PM	8/2/20 18:36	IMG_0045.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	8/2/20	6:36:32 PM	8/2/20 18:36	IMG_0046.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	8/2/20	7:08:26 PM	8/2/20 19:08	IMG_0048.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	8/2/20	7:30:12 PM	8/2/20 19:30	IMG_0049.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	9/2/20	7:53:28 AM	9/2/20 7:53	IMG_0050.AVI	Canis lupus familiaris	Mammal	2	
CT01	18/2/20	9/2/20	7:53:50 AM	9/2/20 7:53	IMG_0051.AVI	Canis lupus familiaris	Mammal	2	
CT01	18/2/20	9/2/20	7:54:42 AM	9/2/20 7:54	IMG_0052.AVI	Canis lupus familiaris	Mammal	2	
CT01	18/2/20	9/2/20	7:56:18 AM	9/2/20 7:56	IMG_0053.AVI	Canis lupus familiaris	Mammal	2	
CT01	18/2/20	9/2/20	11:21:32 AM	9/2/20 11:21	IMG_0054.AVI	Canis lupus familiaris	Mammal	3	
CT01	18/2/20	9/2/20	11:22:24 AM	9/2/20 11:22	IMG_0055.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	9/2/20	12:04:46 PM	9/2/20 12:04	IMG_0056.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	9/2/20	12:05:06 PM	9/2/20 12:05	IMG_0057.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	9/2/20	12:06:00 PM	9/2/20 12:06	IMG_0058.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	9/2/20	8:10:54 PM	9/2/20 20:10	IMG_0059.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	12/2/20	9:33:16 AM	12/2/20 9:33	IMG_0065.AVI	Canis lupus familiaris	Mammal	2	
CT01	18/2/20	14/2/20	7:35:40 AM	14/2/20 7:35	IMG_0067.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	14/2/20	7:36:00 AM	14/2/20 7:36	IMG_0068.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	14/2/20	8:47:38 AM	14/2/20 8:47	IMG_0069.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT01	18/2/20	14/2/20	9:01:08 AM	14/2/20 9:01	IMG_0070.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	14/2/20	9:01:54 AM	14/2/20 9:01	IMG_0071.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	14/2/20	7:31:36 PM	14/2/20 19:31	IMG_0072.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	15/2/20	2:38:54 PM	15/2/20 14:38	IMG_0074.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	15/2/20	8:21:34 PM	15/2/20 20:21	IMG_0082.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	16/2/20	12:26:04 PM	16/2/20 12:26	IMG_0083.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	17/2/20	8:15:06 AM	17/2/20 8:15	IMG_0084.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	17/2/20	8:25:56 AM	17/2/20 8:25	IMG_0085.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	17/2/20	12:22:58 PM	17/2/20 12:22	IMG_0086.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	17/2/20	6:15:30 PM	17/2/20 18:15	IMG_0087.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	17/2/20	6:32:18 PM	17/2/20 18:32	IMG_0088.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	17/2/20	6:32:40 PM	17/2/20 18:32	IMG_0089.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	18/2/20	4:32:24 AM	18/2/20 4:32	IMG_0090.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	18/2/20	6:37:36 AM	18/2/20 6:37	IMG_0091.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	18/2/20	7:47:30 AM	18/2/20 7:47	IMG_0092.AVI	Canis lupus familiaris	Mammal	1	
CT01	18/2/20	18/2/20	7:47:56 AM	18/2/20 7:47	IMG_0093.AVI	Canis lupus familiaris	Mammal	1	
CT01	5/3/20	22/2/20	8:04:00 AM	22/2/20 8:04	IMG_0028.AVI	Canis lupus familiaris	Mammal	2	
CT01	5/3/20	22/2/20	8:05:14 AM	22/2/20 8:05	IMG_0029.AVI	Canis lupus familiaris	Mammal	3	
CT02	5/3/20	1/3/20	4:34:58 PM	1/3/20 16:34	IMG_0071.AVI	Callosciurus notatus	Mammal	1	
CT02	5/3/20	1/3/20	4:35:22 PM	1/3/20 16:35	IMG_0072.AVI	Callosciurus notatus	Mammal	1	
CT02	5/3/20	22/2/20	11:16:38 AM	22/2/20 11:16	IMG_0034.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	22/2/20	11:24:02 AM	22/2/20 11:24	IMG_0035.AVI	Canis lupus familiaris	Mammal	2	
CT02	5/3/20	22/2/20	11:26:18 AM	22/2/20 11:26	IMG_0036.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	22/2/20	11:32:16 AM	22/2/20 11:32	IMG_0037.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	22/2/20	11:35:14 AM	22/2/20 11:35	IMG_0038.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	22/2/20	6:44:44 PM	22/2/20 18:44	IMG_0039.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	22/2/20	6:46:58 PM	22/2/20 18:46	IMG_0040.AVI	Canis lupus familiaris	Mammal	2	
CT02	5/3/20	22/2/20	6:47:20 PM	22/2/20 18:47	IMG_0041.AVI	Canis lupus familiaris	Mammal	2	
CT02	5/3/20	23/2/20	12:24:30 PM	23/2/20 12:24	IMG_0043.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT02	5/3/20	23/2/20	12:26:34 PM	23/2/20 12:26	IMG_0044.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	26/2/20	7:38:30 AM	26/2/20 7:38	IMG_0046.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	26/2/20	7:40:02 AM	26/2/20 7:40	IMG_0047.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	26/2/20	11:58:38 AM	26/2/20 11:58	IMG_0049.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	27/2/20	7:41:30 PM	27/2/20 19:41	IMG_0051.AVI	Canis lupus familiaris	Mammal	2	
CT02	5/3/20	27/2/20	7:44:12 PM	27/2/20 19:44	IMG_0052.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	28/2/20	7:28:06 AM	28/2/20 7:28	IMG_0053.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	1/3/20	4:58:36 PM	1/3/20 16:58	IMG_0073.AVI	Canis lupus familiaris	Mammal	2	
CT02	5/3/20	2/3/20	8:22:34 PM	2/3/20 20:22	IMG_0079.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	3/3/20	3:34:58 PM	3/3/20 15:34	IMG_0082.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	3/3/20	3:37:20 PM	3/3/20 15:37	IMG_0083.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	3/3/20	3:39:16 PM	3/3/20 15:39	IMG_0084.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	3/3/20	3:41:40 PM	3/3/20 15:41	IMG_0085.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	3/3/20	3:42:22 PM	3/3/20 15:42	IMG_0086.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	3/3/20	3:44:30 PM	3/3/20 15:44	IMG_0087.AVI	Canis lupus familiaris	Mammal	2	
CT02	5/3/20	3/3/20	7:41:16 PM	3/3/20 19:41	IMG_0090.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	3/3/20	7:42:44 PM	3/3/20 19:42	IMG_0091.AVI	Canis lupus familiaris	Mammal	1	
CT02	5/3/20	18/2/20	8:47:36 PM	18/2/20 20:47	IMG_0015.AVI	Rattus tiomanicus	Mammal	2	
CT02	5/3/20	25/2/20	4:00:44 AM	25/2/20 4:00	IMG_0045.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	28/2/20	11:19:58 PM	28/2/20 23:19	IMG_0057.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	28/2/20	11:20:18 PM	28/2/20 23:20	IMG_0058.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	29/2/20	2:47:36 AM	29/2/20 2:47	IMG_0059.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	29/2/20	9:56:12 PM	29/2/20 21:56	IMG_0064.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	1/3/20	1:14:40 AM	1/3/20 1:14	IMG_0065.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	1/3/20	4:54:52 AM	1/3/20 4:54	IMG_0066.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	1/3/20	11:02:54 PM	1/3/20 23:02	IMG_0075.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	2/3/20	5:33:08 AM	2/3/20 5:33	IMG_0076.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	2/3/20	11:34:54 PM	2/3/20 23:34	IMG_0080.AVI	Rattus tiomanicus	Mammal	1	
CT02	5/3/20	19/2/20	7:07:40 AM	19/2/20 7:07	IMG_0024.AVI	Tupaia glis	Mammal	1	

Camera trap data									
CT02	5/3/20	22/2/20	8:01:40 AM	22/2/20 8:01	IMG_0031.AVI	Tupaia glis	Mammal	1	
CT02	5/3/20	26/2/20	11:48:28 AM	26/2/20 11:48	IMG_0048.AVI	Tupaia glis	Mammal	1	
CT02	5/3/20	28/2/20	10:26:40 AM	28/2/20 10:26	IMG_0054.AVI	Tupaia glis	Mammal	1	
CT02	5/3/20	1/3/20	7:18:00 AM	1/3/20 7:18	IMG_0067.AVI	Tupaia glis	Mammal	1	
CT02	5/3/20	1/3/20	7:30:08 AM	1/3/20 7:30	IMG_0068.AVI	Tupaia glis	Mammal	1	
CT02	5/3/20	1/3/20	7:31:28 AM	1/3/20 7:31	IMG_0069.AVI	Tupaia glis	Mammal	1	
CT02	5/3/20	1/3/20	11:25:14 AM	1/3/20 11:25	IMG_0070.AVI	Tupaia glis	Mammal	2	
CT02	5/3/20	2/3/20	7:29:30 AM	2/3/20 7:29	IMG_0077.AVI	Tupaia glis	Mammal	1	
CT02	5/3/20	2/3/20	7:33:10 AM	2/3/20 7:33	IMG_0078.AVI	Tupaia glis	Mammal	1	
CT03	5/3/20	21/2/20	8:05:20 AM	21/2/20 8:05	IMG_0015.AVI	Callosciurus notatus	Mammal	1	
CT03	5/3/20	23/2/20	5:23:40 PM	23/2/20 17:23	IMG_0021.AVI	Callosciurus notatus	Mammal	1	
CT03	5/3/20	26/2/20	4:51:18 PM	26/2/20 16:51	IMG_0024.AVI	Callosciurus notatus	Mammal	1	
CT03	5/3/20	18/2/20	5:12:20 PM	18/2/20 17:12	IMG_0002.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	19/2/20	3:38:18 PM	19/2/20 15:38	IMG_0006.AVI	Canis lupus familiaris	Mammal	7	
CT03	5/3/20	20/2/20	12:16:32 PM	20/2/20 12:16	IMG_0011.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	20/2/20	6:53:40 PM	20/2/20 18:53	IMG_0013.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	20/2/20	7:21:30 PM	20/2/20 19:21	IMG_0014.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	21/2/20	2:49:30 PM	21/2/20 14:49	IMG_0016.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	22/2/20	2:59:48 PM	22/2/20 14:59	IMG_0017.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	22/2/20	3:17:22 PM	22/2/20 15:17	IMG_0018.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	22/2/20	6:41:56 PM	22/2/20 18:41	IMG_0019.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	23/2/20	9:27:24 AM	23/2/20 9:27	IMG_0020.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	27/2/20	10:07:12 AM	27/2/20 10:07	IMG_0025.AVI	Canis lupus familiaris	Mammal	3	
CT03	5/3/20	27/2/20	10:07:34 AM	27/2/20 10:07	IMG_0026.AVI	Canis lupus familiaris	Mammal	2	
CT03	5/3/20	27/2/20	6:33:08 PM	27/2/20 18:33	IMG_0027.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	27/2/20	6:33:32 PM	27/2/20 18:33	IMG_0028.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	27/2/20	6:33:54 PM	27/2/20 18:33	IMG_0029.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	27/2/20	6:39:36 PM	27/2/20 18:39	IMG_0030.AVI	Canis lupus familiaris	Mammal	2	
CT03	5/3/20	27/2/20	6:41:12 PM	27/2/20 18:41	IMG_0031.AVI	Canis lupus familiaris	Mammal	2	

Camera trap data									
CT03	5/3/20	28/2/20	12:21:28 PM	28/2/20 12:21	IMG_0032.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	28/2/20	1:44:34 PM	28/2/20 13:44	IMG_0033.AVI	Canis lupus familiaris	Mammal	1	
CT03	5/3/20	19/2/20	12:22:40 PM	19/2/20 12:22	IMG_0004.AVI	Callosciurus notatus	Mammal	1	
CT03	5/3/20	19/2/20	12:23:48 PM	19/2/20 12:23	IMG_0005.AVI	Callosciurus notatus	Mammal	1	
CT04	5/3/20	19/2/20	4:06:22 PM	19/2/20 16:06	IMG_0017.AVI	Callosciurus notatus	Mammal	1	
CT04	5/3/20	1/3/20	7:30:00 PM	1/3/20 19:30	IMG_0177.AVI	Callosciurus notatus	Mammal	1	
CT04	5/3/20	3/3/20	10:53:28 AM	3/3/20 10:53	IMG_0200.AVI	Callosciurus notatus	Mammal	1	
CT04	5/3/20	3/3/20	10:54:18 AM	3/3/20 10:54	IMG_0201.AVI	Callosciurus notatus	Mammal	1	
CT04	5/3/20	18/2/20	4:57:52 PM	18/2/20 16:57	IMG_0008.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	18/2/20	5:29:14 PM	18/2/20 17:29	IMG_0009.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	18/2/20	5:48:14 PM	18/2/20 17:48	IMG_0010.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	12:45:40 PM	19/2/20 12:45	IMG_0013.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	12:57:16 PM	19/2/20 12:57	IMG_0014.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	1:52:46 PM	19/2/20 13:52	IMG_0015.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	4:13:04 PM	19/2/20 16:13	IMG_0018.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	4:13:36 PM	19/2/20 16:13	IMG_0019.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	19/2/20	4:17:22 PM	19/2/20 16:17	IMG_0020.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	4:28:46 PM	19/2/20 16:28	IMG_0021.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	4:29:22 PM	19/2/20 16:29	IMG_0022.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	19/2/20	4:29:44 PM	19/2/20 16:29	IMG_0023.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	4:30:06 PM	19/2/20 16:30	IMG_0024.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	4:31:08 PM	19/2/20 16:31	IMG_0025.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	6:02:22 PM	19/2/20 18:02	IMG_0027.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	6:30:18 PM	19/2/20 18:30	IMG_0028.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	19/2/20	6:30:40 PM	19/2/20 18:30	IMG_0029.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	6:37:02 PM	19/2/20 18:37	IMG_0030.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	6:39:04 PM	19/2/20 18:39	IMG_0031.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	6:43:58 PM	19/2/20 18:43	IMG_0032.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	19/2/20	7:23:46 PM	19/2/20 19:23	IMG_0033.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT04	5/3/20	19/2/20	7:39:52 PM	19/2/20 19:39	IMG_0034.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	22/2/20	7:50:22 AM	22/2/20 7:50	IMG_0049.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	22/2/20	8:35:14 AM	22/2/20 8:35	IMG_0050.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	22/2/20	12:45:18 PM	22/2/20 12:45	IMG_0051.AVI	Canis lupus familiaris	Mammal	3	
CT04	5/3/20	22/2/20	1:50:36 PM	22/2/20 13:50	IMG_0052.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	22/2/20	2:41:26 PM	22/2/20 14:41	IMG_0053.AVI	Canis lupus familiaris	Mammal	3	
CT04	5/3/20	24/2/20	11:39:04 AM	24/2/20 11:39	IMG_0061.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	11:53:12 AM	24/2/20 11:53	IMG_0062.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	1:25:04 PM	24/2/20 13:25	IMG_0063.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	24/2/20	1:29:06 PM	24/2/20 13:29	IMG_0064.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	1:29:26 PM	24/2/20 13:29	IMG_0065.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	24/2/20	1:30:00 PM	24/2/20 13:30	IMG_0066.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	1:30:20 PM	24/2/20 13:30	IMG_0067.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	1:30:44 PM	24/2/20 13:30	IMG_0068.AVI	Canis lupus familiaris	Mammal	4	
CT04	5/3/20	24/2/20	2:13:50 PM	24/2/20 14:13	IMG_0069.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	2:59:56 PM	24/2/20 14:59	IMG_0070.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	3:17:38 PM	24/2/20 15:17	IMG_0071.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	24/2/20	3:18:04 PM	24/2/20 15:18	IMG_0072.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	24/2/20	8:23:16 PM	24/2/20 20:23	IMG_0075.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	9:49:10 PM	24/2/20 21:49	IMG_0076.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	9:49:30 PM	24/2/20 21:49	IMG_0077.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	9:49:52 PM	24/2/20 21:49	IMG_0078.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	9:50:24 PM	24/2/20 21:50	IMG_0079.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	9:51:48 PM	24/2/20 21:51	IMG_0080.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	10:30:46 PM	24/2/20 22:30	IMG_0081.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	24/2/20	10:31:18 PM	24/2/20 22:31	IMG_0082.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	25/2/20	8:03:54 AM	25/2/20 8:03	IMG_0087.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	25/2/20	11:18:42 AM	25/2/20 11:18	IMG_0091.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	25/2/20	11:19:22 AM	25/2/20 11:19	IMG_0092.AVI	Canis lupus familiaris	Mammal	2	

Camera trap data									
CT04	5/3/20	25/2/20	11:25:58 AM	25/2/20 11:25	IMG_0093.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	25/2/20	12:12:36 PM	25/2/20 12:12	IMG_0094.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	25/2/20	12:13:02 PM	25/2/20 12:13	IMG_0095.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	25/2/20	12:13:26 PM	25/2/20 12:13	IMG_0096.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	25/2/20	2:14:36 PM	25/2/20 14:14	IMG_0097.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	25/2/20	2:15:50 PM	25/2/20 14:15	IMG_0098.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	25/2/20	10:53:44 PM	25/2/20 22:53	IMG_0099.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	10:44:26 AM	26/2/20 10:44	IMG_0100.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	10:50:56 AM	26/2/20 10:50	IMG_0101.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	11:52:32 AM	26/2/20 11:52	IMG_0102.AVI	Canis lupus familiaris	Mammal	3	
CT04	5/3/20	26/2/20	11:53:14 AM	26/2/20 11:53	IMG_0103.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	26/2/20	1:48:48 PM	26/2/20 13:48	IMG_0104.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	26/2/20	1:49:30 PM	26/2/20 13:49	IMG_0105.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	2:00:34 PM	26/2/20 14:00	IMG_0106.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	2:01:50 PM	26/2/20 14:01	IMG_0108.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	26/2/20	2:50:20 PM	26/2/20 14:50	IMG_0109.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	2:56:18 PM	26/2/20 14:56	IMG_0110.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	2:56:54 PM	26/2/20 14:56	IMG_0111.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	2:59:24 PM	26/2/20 14:59	IMG_0112.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	3:23:00 PM	26/2/20 15:23	IMG_0113.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	26/2/20	3:23:40 PM	26/2/20 15:23	IMG_0114.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	5:17:16 PM	26/2/20 17:17	IMG_0115.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	26/2/20	5:19:26 PM	26/2/20 17:19	IMG_0116.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	26/2/20	5:23:28 PM	26/2/20 17:23	IMG_0117.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	7:23:22 AM	27/2/20 7:23	IMG_0120.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	2:05:32 PM	27/2/20 14:05	IMG_0124.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	2:09:26 PM	27/2/20 14:09	IMG_0125.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	4:20:36 PM	27/2/20 16:20	IMG_0126.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	4:24:22 PM	27/2/20 16:24	IMG_0127.AVI	Canis lupus familiaris	Mammal	1	

Camera trap data									
CT04	5/3/20	27/2/20	7:37:42 PM	27/2/20 19:37	IMG_0128.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	9:21:58 PM	27/2/20 21:21	IMG_0129.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	9:50:38 PM	27/2/20 21:50	IMG_0131.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	27/2/20	9:54:56 PM	27/2/20 21:54	IMG_0132.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	10:57:06 PM	27/2/20 22:57	IMG_0133.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	10:58:18 PM	27/2/20 22:58	IMG_0134.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	27/2/20	10:59:54 PM	27/2/20 22:59	IMG_0135.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	28/2/20	8:09:52 AM	28/2/20 8:09	IMG_0136.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	28/2/20	8:10:12 AM	28/2/20 8:10	IMG_0137.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	28/2/20	1:11:46 PM	28/2/20 13:11	IMG_0138.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	28/2/20	2:13:40 PM	28/2/20 14:13	IMG_0139.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	28/2/20	2:17:36 PM	28/2/20 14:17	IMG_0140.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	28/2/20	2:17:58 PM	28/2/20 14:17	IMG_0141.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	28/2/20	2:18:24 PM	28/2/20 14:18	IMG_0142.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	29/2/20	8:01:06 AM	29/2/20 8:01	IMG_0147.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	29/2/20	12:43:18 PM	29/2/20 12:43	IMG_0151.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	29/2/20	12:45:20 PM	29/2/20 12:45	IMG_0152.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	29/2/20	3:50:04 PM	29/2/20 15:50	IMG_0154.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	29/2/20	4:43:46 PM	29/2/20 16:43	IMG_0155.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	29/2/20	7:18:58 PM	29/2/20 19:18	IMG_0156.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	29/2/20	7:32:22 PM	29/2/20 19:32	IMG_0158.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	29/2/20	7:32:56 PM	29/2/20 19:32	IMG_0159.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	29/2/20	7:33:30 PM	29/2/20 19:33	IMG_0160.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	1/3/20	12:43:06 AM	1/3/20 0:43	IMG_0162.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	1/3/20	4:30:34 AM	1/3/20 4:30	IMG_0163.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	1/3/20	8:31:20 AM	1/3/20 8:31	IMG_0166.AVI	Canis lupus familiaris	Mammal	4	
CT04	5/3/20	1/3/20	8:32:48 AM	1/3/20 8:32	IMG_0167.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	1/3/20	8:45:54 AM	1/3/20 8:45	IMG_0168.AVI	Canis lupus familiaris	Mammal	3	
CT04	5/3/20	1/3/20	8:46:16 AM	1/3/20 8:46	IMG_0169.AVI	Canis lupus familiaris	Mammal	2	

Camera trap data									
CT04	5/3/20	1/3/20	11:59:20 AM	1/3/20 11:59	IMG_0170.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	1/3/20	7:03:20 PM	1/3/20 19:03	IMG_0176.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	2/3/20	11:23:00 AM	2/3/20 11:23	IMG_0182.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	2/3/20	11:24:10 AM	2/3/20 11:24	IMG_0183.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	2/3/20	12:43:14 PM	2/3/20 12:43	IMG_0185.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	2/3/20	1:41:40 PM	2/3/20 13:41	IMG_0186.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	2/3/20	1:42:02 PM	2/3/20 13:42	IMG_0187.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	2/3/20	2:03:52 PM	2/3/20 14:03	IMG_0188.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	2/3/20	2:04:14 PM	2/3/20 14:04	IMG_0189.AVI	Canis lupus familiaris	Mammal	5	
CT04	5/3/20	2/3/20	2:06:10 PM	2/3/20 14:06	IMG_0190.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	2/3/20	2:39:18 PM	2/3/20 14:39	IMG_0191.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	2/3/20	6:45:00 PM	2/3/20 18:45	IMG_0192.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	2/3/20	6:46:04 PM	2/3/20 18:46	IMG_0193.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	2/3/20	7:11:02 PM	2/3/20 19:11	IMG_0194.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	3/3/20	8:57:24 AM	3/3/20 8:57	IMG_0198.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	3/3/20	4:30:54 PM	3/3/20 16:30	IMG_0203.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	3/3/20	5:40:44 PM	3/3/20 17:40	IMG_0204.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	3/3/20	5:50:04 PM	3/3/20 17:50	IMG_0205.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	3/3/20	6:15:48 PM	3/3/20 18:15	IMG_0206.AVI	Canis lupus familiaris	Mammal	1	
CT04	5/3/20	4/3/20	12:24:26 AM	4/3/20 0:24	IMG_0208.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	4/3/20	12:25:48 AM	4/3/20 0:25	IMG_0209.AVI	Canis lupus familiaris	Mammal	2	
CT04	5/3/20	29/2/20	1:56:04 AM	29/2/20 1:56	IMG_0144.AVI	Felis catus	Mammal	1	
CT04	5/3/20	18/2/20	9:44:58 PM	18/2/20 21:44	IMG_0011.AVI	Rattus tiomanicus	Mammal	1	
CT04	5/3/20	22/2/20	9:21:22 PM	22/2/20 21:21	IMG_0055.AVI	Rattus tiomanicus	Mammal	1	
CT04	5/3/20	26/2/20	11:32:08 PM	26/2/20 23:32	IMG_0119.AVI	Rattus tiomanicus	Mammal	1	
CT04	5/3/20	29/2/20	3:59:04 AM	29/2/20 3:59	IMG_0145.AVI	Rattus tiomanicus	Mammal	1	
CT04	5/3/20	27/2/20	8:58:52 AM	27/2/20 8:58	IMG_0121.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	29/2/20	8:50:58 AM	29/2/20 8:50	IMG_0148.AVI	Callosciurus notatus	Mammal	1	
CT04	5/3/20	1/3/20	6:19:46 PM	1/3/20 18:19	IMG_0171.AVI	Tupaia glis	Mammal	1	

Camera trap data									
CT04	5/3/20	20/2/20	6:03:22 PM	20/2/20 18:03	IMG_0044.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	24/2/20	6:58:54 PM	24/2/20 18:58	IMG_0074.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	19/2/20	5:11:32 PM	19/2/20 17:11	IMG_0026.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	20/2/20	2:25:26 PM	20/2/20 14:25	IMG_0043.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	20/2/20	7:19:28 PM	20/2/20 19:19	IMG_0045.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	20/2/20	7:25:08 PM	20/2/20 19:25	IMG_0046.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	26/2/20	7:20:50 PM	26/2/20 19:20	IMG_0118.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	28/2/20	7:24:50 PM	28/2/20 19:24	IMG_0143.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	1/3/20	6:46:12 PM	1/3/20 18:46	IMG_0173.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	1/3/20	6:59:58 PM	1/3/20 18:59	IMG_0175.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	2/3/20	7:45:00 AM	2/3/20 7:45	IMG_0178.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	2/3/20	7:45:28 AM	2/3/20 7:45	IMG_0179.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	2/3/20	8:58:42 AM	2/3/20 8:58	IMG_0180.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	2/3/20	8:59:10 AM	2/3/20 8:59	IMG_0181.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	4/3/20	7:37:08 AM	4/3/20 7:37	IMG_0211.AVI	Tupaia glis	Mammal	1	
CT04	5/3/20	4/3/20	7:42:00 AM	4/3/20 7:42	IMG_0212.AVI	Tupaia glis	Mammal	1	

Appendix H

Baseline Water Quality
Monitoring Report

R200690

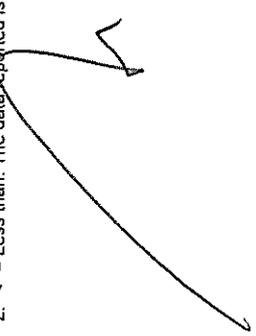
RESULTS

Test Parameter	Unit	Test Method	Sampling Date: 10/02/2020							Detection Limit
			WQ1	WQ2	WQ4	WQ6	WQ1R			
Turbidity	NTU	APHA 2130B	1.5	3.6	14	10	15	-		
Biochemical Oxygen Demand (BOD)	mg/L	APHA 5210B	<2	2.11	<2	<2	2.19	2		
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	1.62	4.07	0.79	0.69	1.48	0.01		
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.055	0.173	0.072	0.033	0.089	0.01		
Nitrate as NO ₃ -N	mg/L	APHA 4500-NO ₃ (I)	0.78	0.40	0.056	0.40	0.75	0.015		
Ammonia as NH ₄ -N	mg/L	APHA 4500-NH ₃ (H)	0.41	3.15	0.29	0.014	0.21	0.01		
Phosphate as PO ₄	mg/L	APHA 4500-P (G)	0.12	0.26	0.15	0.049	0.13	0.025		
Total Suspended Solids, TSS	mg/L	APHA 2540D	<10	14.0	22.0	<10	<10	10		
Total Organic Carbon, TOC	mg/L	APHA 5310B	3.51	4.73	4.59	2.06	4.04	1		
Enterococcus	cfu/100ml	APHA 9230C	<1	1,600	10	<1	10	1		
Lead as Pb	µg/L	APHA 3120B	<5	<5	<5	<5	<5	5		

Test Parameter	Unit	Test Method	Sampling Date: 10/02/2020						Detection Limit
			WQ2R	WQ3R	WQ4R	WQ5R	WQ6R		
Turbidity	NTU	APHA 2130B	18	6.7	8.8	13	16	-	
Biochemical Oxygen Demand (BOD)	mg/L	APHA 5210B	2.35	<2	<2	<2	<2	2	
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	1.21	0.86	0.74	1.17	0.81	0.01	
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.049	0.081	0.24	0.088	0.031	0.01	
Nitrate as NO ₃ -N	mg/L	APHA 4500-NO ₃ (I)	0.64	0.12	0.18	0.14	0.21	0.015	
Ammonia as NH ₄ -N	mg/L	APHA 4500-NH ₃ (H)	0.12	0.34	0.22	0.031	0.066	0.01	
Phosphate as PO ₄	mg/L	APHA 4500-P (G)	0.10	0.15	0.12	0.19	0.050	0.025	
Total Suspended Solids, TSS	mg/L	APHA 2540D	13.0	<10	<10	<10	<10	10	
Total Organic Carbon, TOC	mg/L	APHA 5310B	3.91	5.87	5.29	11.1	3.06	1	
Enterococcus	cfu/100ml	APHA 9230C	12,000	10,000	11,000	12,000	17,000	1	
Lead as Pb	µg/L	APHA 3120B	<5	<5	<5	<5	<5	5	

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 23rd Edition, 2017)
2. "<" = Less than. The data reported is less than Detection Limit of the test.



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RESULTS

Test Parameter	Unit	Test Method	Sampling Date: 25/03/2020										LOR				
			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5										
			WQ1	WQ2	WQ3	WQ4	WQ6										
Turbidity	NTU	APHA 2130B	1.3	3.3	1.6	10	9.9										0.1
Total Suspended Solids as TSS	mg/L	APHA 2540D	<1	2.00	1.40	5.50	8.50										1
Biochemical Oxygen Demand, BOD	mg/L	APHA 5210B	1.51	1.29	<1	<1	<1										1
Total Organic Carbon, TOC	mg/L	APHA 5310B	3.31	4.69	4.50	4.97	2.25										1
Total Nitrogen as TN	mg/L	APHA 4500-P (J)	1.57	2.78	0.34	0.45	0.31										0.01
Ammonia as NH ₄ -N	mg/L	APHA 4500-NH ₃ (H)	0.32	0.87	0.039	0.13	0.090										0.01
Nitrate as NO ₃ -N	mg/L	APHA 4500-NO ₃ (I)	0.66	0.65	<0.005	<0.005	0.0085										0.005
Total Phosphorus as TP	mg/L	APHA 4500-P (J)	0.068	0.076	0.061	0.069	0.035										0.01
Orthophosphates as PO ₄ -P	mg/L	APHA 4500-P (G)	0.051	0.059	0.055	0.057	0.026										0.005
Enterococcus	cfu/100mL	APHA 9230C	<1	330	1,500	2,000	330										1
Lead as Pb	µg/L	APHA 3125B	<0.5	<0.5	<0.5	<0.5	2.35										0.5

Note:

1. APHA is a standard method for Determination of Water and Waste Water (APHA 23rd Edition, 2017)
2. "<" = Less than. The data reported is less than Detection Limit of the test.

